

Moose Management Report

of survey-inventory activities
1 July 2007–30 June 2009

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



©2011 Ken Marsh.

**Funded through
Federal Aid in Wildlife Restoration
Grants W-33-6 and W-33-7, Project 1.0
2010 Set**

STATE OF ALASKA
Sean Parnell, Governor

DEPARTMENT OF FISH AND GAME
Cora Campbell, Commissioner

DIVISION OF WILDLIFE CONSERVATION
Corey Rossi, Director

For a hard copy of this report please direct requests to our publications specialist:

Publications Specialist
ADF&G, Wildlife Conservation
P.O. Box 115526
Juneau, AK 99811-5526
(907) 465-4176
dfg.dwc.publications@alaska.gov

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

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

- ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK 99811-5526
- U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203
- Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, Washington DC 20240.

The department's ADA Coordinator can be reached via phone at the following numbers: (VOICE) 907-465-6077; (Statewide Telecommunication Device for the Deaf) 1-800-478-3648; (Juneau TDD) 907-465-3646; (FAX) 907-465-6078.

For information on alternative formats and questions on this publication, please contact the following: Publications Specialist, ADF&G/Division of Wildlife Conservation, P.O. Box 115526, Juneau, AK 99811-5526, or call 907-465-4176.

Cover Photo: A bull moose, fatigued from the rut, calls out from its bed in Chugach State Park in mid-October. Moose gather in the Chugach Mountains foothills near Anchorage each fall in large numbers. Bulls are frequently seen sparring as their harems of cows look on. © 2011 Ken Marsh.

**Moose
Management Report**
of survey-inventory activities
1 July 2007–30 June 2009

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

Funded through
Federal Aid in Wildlife Restoration
Grants W-33-6 and W-33-7, Project 1.0
2010 Set

Any information taken from this report should be cited with credit given to authors and the Alaska Department of Fish and Game. Authors are identified at the end of each unit section.

If this report is used in its entirety, please reference as: Alaska Department of Fish and Game. 2010. Moose management report of survey-inventory activities 1 July 2007–30 June 2009. P. Harper, editor. Juneau, Alaska.

Please note that this report was released as a complete set in 2011, but is part of the 2010 set of species management reports. We encourage referencing this report as a 2010 report to maintain understanding of when reports were written and ease of locating this particular set of reports.

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

TABLE OF CONTENTS

Unit Map	i
Units 1A and 2 – Southeast mainland and adjacent islands draining into Behm and Portland canals and Prince of Wales Island and adjacent islands	1
Unit 1B – Southeast Alaska mainland from Cape Fanshaw to Lemesurier Point.....	9
Unit 1C – Southeast Alaska mainland from Cape Fanshaw to Eldred Rock	26
Unit 1D – Southeast Alaska mainland north of Eldred Rock, excluding Sullivan Island and the drainages of Berners Bay	53
Unit 3 – Islands of Petersburg, Kake and Wrangell areas.....	64
Unit 5 – Cape Fairweather to Icy Bay, eastern Gulf of Alaska coast	77
Unit 6 – Prince William Sound and north Gulf of Alaska coast.....	93
Unit 7 – Eastern Kenai Peninsula	110
Unit 9 – Alaska Peninsula.....	116
Unit 11 – Chitina Valley and eastern half of the Copper River Basin.....	124
Unit 12 – Upper Tanana and White River drainages	133
Unit 13 – Nelchina and Upper Susitna River.....	150
Unit 14A – Matanuska Valley	165
Unit 14B – Western Talkeetna Mountains (Willow to Talkeetna)	181
Unit 14C – Anchorage area.....	190
Unit 15 – Western Kenai Peninsula	208
Unit 16A – West side of Susitna River.....	225
Unit 16B – West side of Cook Inlet.....	235
Unit 17 – Northern Bristol Bay	248
Unit 18 – Yukon-Kuskokwim Delta	271
Unit 19 – All of the drainages into the Kuskokwim River upstream from Lower Kalskag.....	286
Unit 20A – Tanana Flats, Central Alaska Range	320
Unit 20B – Drainages into the north bank of the Tanana River between Delta Creek and Manley Hot Springs	345
Units 20C, 20F and 25C – Drainages into south bank of the Tanana River west of the Nenana River, west bank of the Nenana River, and the south bank of the Yukon River.....	366

Unit 20D – Central Tanana Valley near Delta Junction	380
Unit 20E – Charley, Fortymile, and Ladue River drainages.....	410
Units 21A and 21E – Innoko, Nowitna, and Yukon River drainages	429
Unit 21B – Lower Nowitna River and Yukon River between Melozitna and Tozitna Rivers.....	446
Unit 21C – Melozitna River above Grayling Creek and Dulbi River above Cottonwood Creek	466
Unit 21D – Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough ..	477
Unit 22 – Seward Peninsula and adjacent mainland	522
Unit 23 – Western Brooks Range and Kotzebue Sound	551
Unit 24 – Koyukuk River drainage above the Dulbi River.....	572
Units 25A, 25B, and 25D – Upper Yukon River Valley	611
Unit 26A – Western North Slope.....	643
Units 26B and 26C – North Slope of the Brooks Range and Arctic Coastal Plain east of Itkillik River .	666

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 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNITS: 1A (5300 mi²) and 2 (3600 mi²)

GEOGRAPHIC DESCRIPTION: That portion of Unit 1 lying south of Lemesurier Point, including all drainages into Behm Canal and excluding all drainages into Ernest Sound. Unit 2: Prince of Wales Island and adjacent islands south of Sumner Strait and west of Kashevarof Passage.

BACKGROUND

The status and state management of moose in these units has been relatively unchanged for the past few management periods, about 6 years. The introduction of a federally managed subsistence hunt in 2003 changed harvest and effort between those hunting under the state permit and qualified federal subsistence hunters. When the federal permit information is available we include the additional harvest with this report.

Most of the Unit 1A moose population is localized in the Unuk River drainage on the mainland and moose numbers appear stable. Heavy timber along 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 recent snowfalls. Good habitat is limited and moose densities are low. The harvest is variable, 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 on 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.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- Maintain a Unit 1A post-hunting population of 50 moose, and an annual state harvest of at least 2 bulls.
- Provide maximum moose hunting opportunity.
- Provide opportunities for nonconsumptive users by maintaining a healthy moose population.

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 five 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.

After more than two decades of no moose observations along the mainland Chickamin River, the Alaska Fish and Game sport fish tagging crew observed fresh moose tracks and pellets from at least one adult moose during summer 2010. This area once held a small moose population during the 1970s and we will watch to see if more signs of moose are observed in the near future.

A recent decline in hunter observations of moose in Unit 2 suggests very little recent 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, widely scattered and no reproduction has ever been documented.

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 Unuk 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 moose sightings outside the Unuk River drainage during this report period but reports are scattered and infrequent.

MORTALITY

Harvest

Season and bag limit

Resident and nonresident hunters

Unit 1A

15 Sep–15 Oct

One bull by registration permit only

(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 10-year mean harvest is 2 bulls. During the past 2 years 2 moose were harvested each year under state registration permit (Table 1). Hunters who receive federal registration

permits do not report to us. We are aware of some moose harvest using Federal registration permits and when available the federal registration harvest information is included in this report.

During 2007 hunters reported 2 bulls taken under state registration permit and no additional harvest was reported from the federal permit. During 2008, 2 bulls were taken by state permit and 1 bull harvested under the federal permit (Table 1).

Permit Hunts. During fall 2007, 33 individuals obtained Unit 1A state moose registration permits and 17 hunted. During the 2008 season 20 hunters registered and 15 of them reported hunting (Table 1). In 2007, hunters reported 95 days hunted and in 2008 hunters reported 97 days hunted.

Hunter Residency and Success. Unit 1A moose hunters continue to be primarily from Ketchikan, Metlakatla, and more recently Prince of Wales Island. All successful hunters during the past 10 years were residents of 1 of these 3 local communities. On average 12% of the hunters who spend time afield are successful (Table 2).

Harvest Chronology. Under the state registration permit most Unit 1A moose were harvested during the late portion of the season (Table 3). Typically there are moose harvested during the early Federal season but we were unable to obtain that information for this report.

Transport Methods. Most hunters use boats to access the Unuk River. Occasionally hunter access this area by airplane but then most use a boat to travel upstream to hunt (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 growth, distribution and expansion of this small semi-isolated moose herd.

CONCLUSIONS AND RECOMMENDATIONS

Access to this hunt area is difficult and consequently attracts only a few hunters. Historically most moose hunters are from Ketchikan. 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.

PREPARED BY:

Boyd Porter
Wildlife Biologist III

SUBMITTED BY:

Neil Barten
Management Coordinator

Please cite any information taken from this section, and reference as:

Porter, B. 2010. Unit 1A moose management report. Pages 1–8 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 1A moose harvest data by permit hunt for regulatory years 1999 through 2008.

Hunt	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Harvest						Total harvest
						Males	(%)	Females	(%)	Unk	(%)	
RM022	1999	34	14	19	1	1	(100)	0	(0)	0	(0)	1
	2000	51	24	26	1	1	(100)	0	(0)	0	(0)	1
	2001	25	0	22	3	3	(100)	0	(0)	0	(0)	3
	2002	21	0	19	2	2	(100)	0	(0)	0	(0)	2
	2003	10	0	8	2 ^a	2	(100)	0	(0)	0	(0)	2 ^a
	2004	24	0	21	3 ^b	3	(100)	0	(0)	0	(0)	3 ^b
	2005	41	24	24	3 ^c	3	(100)	0	(0)	0	(0)	3 ^c
	2006	16	0	14	2 ^c	2	(100)	0	(0)	0	(0)	2 ^c
	2007	33	16	15	2	2	(100)	0	(0)	0	(0)	2
	2008	20	5	13	2 ^c	2	(100)	0	(0)	0	(0)	2 ^c
Average		28	8	18	2	2	(100)	0	(0)	0	(0)	2

^aThree additional bulls harvested under federal regulations

^b Two additional bulls harvested under federal regulations

^c One additional bull harvested under federal regulations

Table 2. Unit 1A moose hunter residency and success for regulatory years 1999 through 2008.

Year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Total	(%)	Local ^a resident	Nonlocal resident	Nonresident	Total	(%)	
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 ^a	(20)	8	0	0	8	(80)	10
2004	2	1	0	3 ^b	(12)	21	0	0	21	(88)	24
2005	3	0	0	3 ^c	(7)	36	2	0	38	(93)	41
2006	2	0	0	2 ^c	(20)	8	0	0	8	(80)	10
2007	2	0	0	2	(12)	15	0	0	15	(88)	17
2008	2	0	0	2 ^c	(13)	13	0	0	13	(87)	15
Average	2	0	0	2	(12)	18	1	0	19	(89)	21

^aThree additional bulls harvested under federal regulations

^bTwo additional bulls harvested under federal regulations

^cOne additional bull harvested under federal regulations

Table 3. Unit 1A moose harvest chronology for regulatory years 1999 through 2008.

<i>Year</i>	15–21 Sept	(%)	22–28 Sept	(%)	29 Sept–5 Oct	(%)	6–15 Oct	(%)	n
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 ^a
2004	1	(33)	0	(0)	1	(33)	1	(33)	3 ^b
2005	1	(33)	0	(0)	1	(33)	1	(33)	3 ^c
2006	0	(0)	1	(50)	0	(0)	1	(50)	2 ^c
2007	0	(0)	0	(0)	0	(0)	2	(100)	2
2008	0	(0)	0	(0)	2	(100)	0	0	2 ^c
<i>Average</i>	1	(36)	0	(14)	<1	(23)	1	(27)	2

^aThree additional bulls harvested under federal regulations

^bTwo additional bulls harvested under federal regulations

^cOne additional bull harvested during early federal season

Table 4. Unit 1A moose harvest percent by transport method for regulatory years 1999 through 2008.

Year	Harvest percent by transport method										n
	Airplane	(%)	Boat	(%)	Highway vehicle	(%)	Off-road vehicle	(%)	Unk	(%)	
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)	3	(100)	0	(0)	0	(0)	0	(0)	3
2006	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
2007	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
2008	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
Average	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 1B (3000 mi²)

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, Farragut 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.

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). From 1983 to 1995 most winters were 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 of the moose hunting season in that portion of Unit 1B south of the LeConte Bay and Glacier in 1994. In 1995 antler restrictions were implemented in the drainages of the Stikine River and as a result now apply to moose hunting throughout Unit 1B.

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 had long existed that the antler restrictions developed for the *gigas* subspecies of moose found elsewhere in Alaska were, were overly restrictive when applied to the smaller *andersonii* 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. At the time the registration moose hunt (RM038) was managed under a selective harvest strategy that allowed the taking of only those bulls that met the spike-fork-3-brow tine or 50-inches antler criteria. Data collected from bulls harvested during the any-bull drawing permit hunts were later used to evaluate the age structure and antler characteristics of that segment of the bull population protected under the existing antler restrictions. Information gathered via the any-bull drawing hunts proved useful for evaluating the effectiveness of the existing antler restrictions, and was used to persuade the Board of Game to liberalize the RM038 moose antler regulations beginning with the 2009 season.

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 suspicion that hunters may be intentionally modifying antlers.

Prior to 2006, state law contained a positive customary and traditional use finding for moose in Stikine River drainages 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 beyond 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.

On October 6, 2006 we issued an emergency order closing the RM038 Stikine River moose hunting season early because the reported harvest of bull moose in these drainages had reached 31 animals. This was the highest moose harvest on the river since 1990. The problem of high harvest was exacerbated by a growing number of hunters who were not complying with the existing antler regulations. This resulted in an unacceptably high harvest of bull moose that the existing regulations were intended to protect.

Historical Harvest Patterns

Annual harvest of Stikine River moose from the 1950s through the 1970s averaged about 27 moose. During the 1980s the average rose to 39 but fell to 18 during the 1990s. 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 rose steadily through the decades from 5 during the 1950s to 21 during in the 1990s. 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 13 moose annually from 2000 to 2006.

Historical Harvest Locations

The vast majority of moose harvested in the subunit are taken either from 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

	<u>Plan Objective</u>	<u>2007</u>	<u>2008</u>
Post-hunt numbers	300	N/A	N/A
Annual hunter kill	30	20	16
Number of hunters	250	147	171
Hunter-days of effort	1,750	1,234	1,398
Hunter success	12%	14%	9%

Thomas Bay

	<u>Plan Objective</u>	<u>2007</u>	<u>2008</u>
Post-hunt numbers	200	N/A	N/A
Annual hunter kill	20	10	10
Number of hunters	160	67	72
Hunter-days of effort	675	505	440
Hunter success	12%	15%	14%

METHODS

We flew late winter population surveys along the Stikine River valley. All successful hunters must present the antlers attached to the skull plate, and the lower front teeth to ADF&G representatives to verify compliance with antler restrictions. We also checked hunters and harvested moose in the field during the Stikine River and Thomas Bay hunts. Since 1997 in Unit 1B we have asked hunters 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. Hunters took 57 bulls in 1988, and the kill dropped each succeeding year to a low of three in 1994 (taken under a federal permit; the state season was closed by emergency order in 1994). 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). 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 1995. 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 a high likelihood of replicate sightings exists, and so it should be interpreted with caution. In 2007 a total of 212 RM038 hunters reported observing a total of 1,172 moose in Unit 1B, including 393 bulls, 568 cows, and 211 calves, for a bull-to-cow ratio of 69:100, and a calf-to-cow ratio of 37:100. In 2008, 240 RM038 hunters reported observing a total of 1175 moose, including 444 bulls, 549 cows, and 182 calves, for a bull-to-cow ratio of 81:100, and a calf-to-cow ratio of 33:100.

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

<u>Season and Bag Limit</u>	<u>Resident and nonresident hunters</u>
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 of 2008, based on age and antler data collected during the any-bull moose drawing permit hunts implemented in 2004, the Board of Game liberalized the moose antler restrictions for the entire RM038 hunt area. As a result,

beginning with the 2009 season, a legal bull must possess spike-forked antlers or 50-inch antlers or antlers with 3 or more brow tines on at least one side, or 2 or more brow tines on both sides. In a related action, the board eliminated the DM033 and DM035 any-bull drawing hunts until such time that the impact of the new liberalized antler restrictions on the moose herd could be evaluated.

Hunter Harvest. In 2007 the unit-wide harvest for both registration and drawing permit hunts was 30 moose, including 5 illegals. In 2008 the unit-wide harvest was 26 moose, including 1 illegal. In 2007, 147 hunters harvested 20 moose on the Stikine portion of Unit 1B. In 2008, 171 hunters harvested 16 moose in the Stikine River drainage (Table 2). In 2007, 67 hunters harvested 10 moose in the general vicinity of Thomas Bay, including 2 from Farragut Bay (Table 3). In 2008, 72 hunters harvested 10 moose in the Thomas Bay vicinity, including 2 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 2007, a total of 7 any-bull drawing permits (DM035) were issued for the area north of LeConte Bay and glacier. All 7 permittees hunted and 6 were successful. A total of 5 any-bull drawing permits (DM033) were issued for the area south of LeConte Bay and glacier. All 5 permittees hunted and 4 were successful. In 2008, 5 drawing permits each were issued for DM033 and 7 permits were issued for DM035. All of those who received DM033 permits hunted and were successful. All 7 of the DM035 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 2007, local residents of Wrangell and Petersburg represented 95% of successful hunters on the Stikine River, with non-local hunters representing 5%. In 2008, local residents of Wrangell and Petersburg represented 94% of successful hunters on the Stikine River, with non-local hunters representing 6% (Table 5). The overall success rate for Stikine River moose hunters was 14% in 2007 and 9% in 2008.

Petersburg residents continued to dominate the Thomas Bay and Farragut Bay moose hunts (Table 6). In 2007, local residents of Petersburg and Wrangell represented 80% of successful hunters in the vicinity of Thomas Bay and Farragut Bay, with non-local hunters representing 20%. In 2008, 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 15% and 14%, respectively, in 2007 and 2008.

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 2007, the largest percentage of the annual harvest in the Thomas Bay Area occurred during the fourth week of the season, followed by the second and third weeks. The largest percentage of the annual harvest on the Stikine River occurred during the first, second and third weeks of the season, respectively. In 2008 the largest percentage of the annual harvest at Thomas Bay occurred during the first, third and fourth weeks of the season, each with an equal percentage of the harvest. The largest percentage of the annual harvest on the Stikine occurred during the first and second 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 6 Unit 1B WAA's and 1 Unit 1C WAA. In both 2007 and 2008 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 1 Stikine hunter and 2 Thomas Bay hunters who reported using airplanes in 2007, 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 within 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 years 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 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.

Enhancement

Pre-commercial thinning of second-growth stands has been estimated to extend the habitat value of clearcuts for 20–30 years. In March 1997 ADF&G enhanced moose habitat on state land at Thomas Bay by thinning 4 second-growth units totaling 380 acres. The project was completed in October 1998. Anecdotal reports from hunters and observations by staff over the past 10 years indicate that moose use increased in these thinned units.

CONCLUSIONS AND RECOMMENDATIONS

During this report period, the only Stikine management objective met was that of hunter success in 2007. In 2007 the success rate of 14% exceeded the management objective of 12%. The 9% success rate in 2008 was below the management objective. Although the total number of hunters declined 5% from the previous report period, actual days of effort increased by nearly 6%. The harvest of 20 moose on the Stikine River in 2007 and 16 moose in 2008 were both well below

the management objective of 30 moose. We believe the Stikine moose population was at low levels during the late 1990s and early 2000s, 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 has been declining in recent years and that trend continued during the current report period. This trend will likely continue as the Thomas Bay moose population declines in response to habitat changes. Hunter-days of effort continued a decreasing trend in 2007 and 2008 reflecting similar declines in the number of hunters. The success rate of 15% in 2007, and 14% in 2008, each exceeded the management objective, and were bolstered in part by the high success rate enjoyed by DM035 any-bull 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 resulting in low recruitment, and possibly causing moose to disperse to other areas. With the recent low level of harvest 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. The only way to prevent further decline of moose habitat will be to institute additional habitat manipulation procedures.

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 4 animals taken by any-bull permit holders, the harvest of 20 bulls, including 16 antler-restricted bulls in 2007 was below 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 since 1960. The relatively sudden appearance of moose in high numbers on the US-side of the international boundary implies that there may be considerable trans-boundary movement of moose between US and Canada. During this report period, however, the number of moose observed during aerial surveys of the Stikine River valley declined from the all time high of 199 in 2006, to 146 in 2007 and 65 in 2008.

Variation in winter weather conditions can have a profound influence on recruitment and overwinter survival of moose. Much of Unit 1B experienced record snowfall during winter 2006–2007, followed by well above average snowfall in 2007–2008 and 2008–2009. Winter-related reductions in the recruitment of young, reduced overwinter survival of moose, and perhaps, trans-boundary moose movement likely left fewer bulls available for harvest during the report period.

For genetic or environmental reasons moose in this subunit do not develop antler configurations that correlate well with age; therefore, some modification of the existing antler restriction was justified. Unit 1B moose 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

facilitated the removal of some surplus bulls, while providing information on the age structure and antler characteristics of that segment of the bull population otherwise protected under the then existing antler restrictions. Based on this information, in 2008 the Board of Game liberalized the moose antler restrictions for the RM038 hunt area and eliminated the any-bull drawing hunts until such time that the impact of the new liberalized antler restrictions on the moose herd could be evaluated.

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 revised bag limit of one bull with spike/fork or 50" antlers or 3 or more brow tines on one antler, or 2 brow tines on both antlers.

LITERATURE CITED

Craighead, F. L., E. L. Young, and R. Boertje. 1984. Stikine River moose study, wildlife evaluation of Stikine-Iskut dams. Final Report. Alaska Department of Fish and Game. Juneau. 72pp.

PREPARED BY:

Richard E. Lowell
Wildlife Biologist III

SUBMITTED BY:

Neil Barten
Regional Management Coordinator

Please cite any information taken from this section, and reference as:

Lowell R. E. 2011. Unit 1B moose management report. Pages 9–25 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, Alaska.

Table 1. Unit 1B Stikine area aerial moose surveys, regulatory years 1995 through 2009.

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
2008						
1/29	54	11	(17)	0	65	30
2009						
2/18	82	21	(20)	39	142	53

^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 1997 through 2008.

Year	Hunter harvest reported						Total
	M	(%)	F	(%)	Illegal	Unk	
1997	17	(100)	0	(0)	0	0	17
1998 ^a	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 ^b	19	(100)	0	(0)	2	0	21
2006 ^{b, c}	32	(100)	0	(0)	3	0	35
2007 ^b	17	(100)	0	(0)	3	0	20
2008 ^b	15	(100)	0	(0)	1	0	16

^a Includes 1 DLP.

^b Includes RM038 and DM033 harvest.

^c State season closed by emergency order on October 6.

Table 3. Unit 1B (Thomas and Farragut bays) moose harvest by permit hunts, regulatory years 1997 through 2008.

Year	Hunter harvest reported						Total
	M	(%)	F	(%)	Illegal	Unk.	
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 ^a	12	(100)	0	(0)	1	0	13
2006 ^a	13	(100)	0	(0)	0	0	13
2007 ^a	8	(100)	0	(0)	2	0	10
2008 ^{ab}	10	(100)	0	(0)	0	0	10

^a Includes RM038 and DM033 harvest

^b Includes one moose harvested at Port Houghton in Unit 1C.

Table 4. Unit 1B moose harvest data by drawing hunt number, regulatory years 2005 through 2008.

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
	2007	5	0	80	20	4	(100)	0	(0)	0	0	4
	2008	5	0	100	0	5	(100)	0	(0)	0	0	5
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
	2007	7	0	86	14	6	(0)	0	(0)	0	0	6
	2008	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
	2007	12	0	83	17	10	(100)	0	(0)	0	0	10
	2008	12	0	100	0	12	(100)	0	(0)	0	0	12

Table 5. Unit 1B (Stikine) moose hunter residency and success by permit hunt, regulatory years 1997 through 2008.

Year	Successful						Unsuccessful						Total hunters
	Local ^a resident	Nonlocal resident	Non- resident	Unk.	Total	(%)	Local ^a resident	Nonlocal resident	Non- resident	Unk.	Total	(%)	
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
2007	19	1	0	0	20	(14)	114	13	0	0	127	(86)	147
2008	15	1	0	0	16	(9)	143	11	1	0	155	(91)	171

^a Residents of Petersburg and Wrangell.

Table 6. Unit 1B (Thomas and Farragut bays) moose hunter residency and success by permit hunt, regulatory years 1997 through 2008.

Year	Successful					Unsuccessful					
	Local ^a resident	Nonlocal resident	Non- resident	Total	(%)	Local ^a resident	Nonlocal resident	Non- resident	Total	(%)	Total hunters
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 ^d	13	0	0	13	(12)	90	7	0	97	(88)	110
2006 ^d	12	1	0	13	(15)	65	6	0	71	(85)	84
2007 ^d	8	2	0	10	(15)	52	5	0	57	(85)	67
2008 ^d	10	0	0	10	(14)	57	5	0	62	(86)	72

^a Residents of Petersburg and Wrangell.

^b Includes 2 illegal kills.

^c Includes illegal kill.

^d Includes RM038 and DM035 harvest

Table 7. Unit 1B moose harvest chronology, regulatory years 1997 through 2008.

Area	Year	15–21 Sept.	22–28 Sept.	29 Sept.–5 Oct.	6–15 Oct.
Thomas Bay					
	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
	2007	1	3	2	4
	2008	3	1	3	3
Stikine					
	1999	6	3	4	7
	2000	3	1	5	5
	2001 ^a	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 ^b	21	3	9	2
	2007	8	6	4	2
	2008	6	5	3	2

^a Excludes one unknown

^b State season closed emergency order on October 6.

Table 8. Unit 1B successful moose hunter transport methods by area, regulatory years 1999 through 2008.

Area	Year	Airplane	Boat	Highway vehicle	3- or 4- wheeler	Horse	Other	Total
Thomas Bay	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
	2007	2	8	0	0	0	0	10
	2008	0	10	0	0	0	0	10
Stikine	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
	2007	1	19	0	0	0	0	20
	2008	0	16	0	0	0	0	16

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 1C (7600 mi²)

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.

Moose are seen regularly in the Port Houghton area. These moose probably moved across the Fanshaw Peninsula from the Farragut Bay/Thomas Bay population to the south. Although geographically within Unit 1C, moose in this area have been managed since 1995 as part of the in Unit 1B registration hunt (see below).

Berners Bay: This moose population did not occur naturally, but rather was introduced in the form of translocated calves. Fifteen calves from Southcentral Alaska were released in Berners Bay in 1958, and a supplemental release of six 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 (Paul 2009). The first limited open season was held in 1963, when 4 bulls were killed. Since that time, the annual harvest has ranged from 5–23 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 post hunt population at no more than 90 moose observed during aerial surveys, to assure the herd does not exceed a level the habitat can support.

Chilkat Range: Moose were first documented in western Unit 1C in 1962 on the Bartlett River. In 1963 moose were observed in the Chilkat Mountain range; these animals probably originated from the Chilkat Valley population near Haines. In 1965 moose were sighted for the first time along the Endicott River and St. James Bay areas. Moose probably followed the Endicott River to Adams Inlet shortly thereafter, because they were common in Adams Inlet by the 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 the 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, ADF&G biologists had increasing concerns about habitat over-utilization. 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. We conducted further studies including additional habitat evaluation, and radiocollaring and monitoring of female moose. Data from these studies and examinations of harvested female moose are directing management 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 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 post hunting 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

We conducted aerial surveys during both years of the report period at Berners Bay and the Gustavus Forelands, but not along the Chilkat Mountains or in the Taku River drainage. We used 2 registration permit hunts (RM046 and RM049) and 5 drawing permit hunts (DM041, DM042, DM043, DM044, and DM045) 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 drawing permit areas listed as DM044 and DM045 to disperse the moose hunting pressure away from the few easily accessible areas hunters were targeting. No hunts were held for Berners Bay moose during the report period. Both bull (DM041) and cow (DM042) drawing hunts remain in regulation and will be used when the population reaches a level that can support harvest. We managed remainder of Unit 1C (excluding Gustavus and the area south of Pt. Hobart) under the RM046 registration permit hunt for bull moose. Gustavus was managed under the RM049 registration permit hunt, and three drawing 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 held in 2008. These data included: rump fat measurements and collection of the reproductive tract. Other data collected from the permit hunt reports included the hunt length, hunter residency, hunt and kill 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 relating to moose browse availability and utilization, sightability during aerial surveys, and population parameters such as survival, pregnancy, and twinning were collected. 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

Berners Bay: Aerial surveys conducted in Berners Bay in 2007 and 2008 enumerated 59 and 33 moose, respectively (Table 1). The lower number of moose seen during 2008 is due to poor survey conditions and reduced moose sightability. These survey numbers are below our management objective of 80–90 moose counted post hunt. The Berners Bay moose population is depressed likely because of 3 successive years of severe winter weather in 2006–2007, 2007–2008, and 2008–2009. Additional moose sightability surveys associated with a road project baseline study were conducted in Berners Bay during the report period. These surveys observed a range of 34–62 total moose (White and Barten 2009).

Chilkat Range: We have no direct data on the status of the Chilkat Range moose population as no surveys have been conducted for many years due to limited snow cover and dense forest canopy. However, based on harvest records and anecdotal information from hunters, we believe the number of moose in the Chilkat Range to be stable in the Endicott River and St. James Bay areas, and increasing near Homeshore and Pt. Couverdon.

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 by the department in the Taku River was in the winter of regulatory year 2000, when 37 moose were counted (Table 1). In response to proposed mine development on the Canadian portion of the Taku River a consulting group conducted an aerial moose survey in March 2007 along a proposed barge transportation route from the U.S./Canadian Border to the mouth of the Taku River at Taku Inlet. It found a total of 21 moose including 4 bulls, 9 cows and 8 calves (A. MacLeod, unpublished data). 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.

Gustavus Forelands: Aerial surveys conducted at Gustavus during 2007 and 2008 counted 254 and 273 moose respectively. These are both well below our highest count of 404 moose during 2003, and an indication that our harvest strategy to decrease the number of moose at Gustavus appears to be working (Table 1). Additional moose sightability surveys associated with research projects were conducted at Gustavus during the report period. These surveys resulted in population estimates ranging between 274 and 342 moose (K. White, Unpublished data).

Population Composition

We were able to conduct composition surveys of the Berners Bay moose population in 2007 and the Gustavus population in 2008. Composition surveys are not always possible due to various factors including weather, snow cover, and antler loss. In many years snow conditions do not warrant surveys until 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 and 3).

Berners Bay: In 2007, we conducted one aerial survey that allowed us to gather reliable composition data for this population. We observed ratios of 23 bulls:100 cows, and 11 calves:100 cows. The bull:100 cow ratio is lower than our objective of 25, but still considered healthy. The low number of calf moose detected is related to overall reduction of moose in the Berners Bay system. Lower calf production and survival (White and Barten 2009) are contributing factors in the Berners Bay moose population decline.

No moose were harvested in Berners Bay during the report period so we did not obtain age data.

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 3.6 years, similar to the previous report period. However, during the report period only 4 of 30 bull moose taken were yearlings (13%), a sharp drop from 22% and 27% during the previous 2 report periods. Reasons for the lack of younger bulls in the harvest are not understood. 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 cannot easily locate them. It will be important to monitor this population through age at harvest to see if the present age structure is an anomaly or a trend.

Gustavus Forelands: Herd composition surveys were flown in both years of the report period. These surveys are intended to provide herd demographic data rather than a total moose count. In 2008, 107 moose were observed with a bull:cow ratio of 20 bulls:100 cows, and a calf:cow ratio of 7 calves:100 cows. In 2009, 98 moose were observed with a bull:cow ratio of 13 bulls:100 cows, and a calf: cow ratio of 6 calves:100 cows. The number of calves observed 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 bull:cow ratio continues to decline and remains below the management objective of 25 bulls:100 cows. We hope a 2008 Alaska Board of Game proposal to implement an antler restriction bull moose hunt on the Gustavus Forelands will stabilize the bull:cow ratio, and ultimately result in higher bull numbers.

The mean bull moose age at harvest was 4.3 and 3.4 years, both higher than any of the previous 8 years (table 3). This higher age structure was caused by fewer yearlings in the harvest. During the report period only 7 yearling bulls were taken, the lowest number of yearlings recorded. 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.

An antlerless moose hunt was held in Gustavus in 2008. During this hunt 10 cow moose were taken. The mean age of cow moose harvested was 5.4 years (Table 3). The 2008 mean age is nearly identical to the mean age of cow moose (5.0 years) harvested since the antlerless hunt was implemented in 2002.

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, by examining lower jaws 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 2.4 years during 2007, and 2.6 years during 2008 (Table 3). During the report period 42% of the 33 bulls taken were yearling animals. This harvest of young bulls indicates a population with good recruitment. Unlike previous report periods, during this period several older bulls were taken on the Taku River. Seven of the 33 bulls taken (21%) were 3.5 years or older.

MORTALITY

Harvest

Season and bag limits

Unit 1(C), Berners Bay
Drainages:

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:

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

1 antlerless moose by drawing
permit only; up to 100 permits
may be issued

Remainder of Unit 1(C)
1 bull by registration permit only

Resident and nonresident hunters

15 Sep–15 Oct
(General hunt only)

15 Sep–15 Oct
(General hunt only)

15 Sep–15 Oct
(General hunt only)

15 Nov–30 Nov
(General hunt only)

15 Sep–15 Oct
(General hunt only)

Game Board Actions and Emergency Orders. At the 2008 Alaska Board of Game meeting the Gustavus bull moose hunt was changed from an any bull hunt to a antler restricted (spike/fork, 3 brow tine, or 50 inch antlers) bull moose hunt. In 2007, we closed the season by emergency order

after the harvest reached the guideline harvest level (GHL) of 30 bull moose; the season was open for 8 days. In 2008, we closed the season by emergency order after the harvest reached the 15 bull moose GHL; the season was open for less than 1 day.

Hunter Harvest.

Berners Bay: No moose were harvested in Berners Bay during the report period. Historical harvest data can be found in Table 4.

Chilkat Range: The mean annual harvest during this report period was 15 moose, a decrease from 23 during the previous report period. Twelve moose were taken in 2007, and 18 in 2008. This compares with an annual average take of 17 during 1999–2006 (Table 4).

Gustavus: During this report period, the any bull hunt at Gustavus was being managed under a guideline harvest of 30 bulls in 2007, and 15 bulls in 2008. The antlerless moose drawing permit allowance was 15 in 2008; an antlerless hunt was not held in 2007. In 2007, 29 bulls were taken in 7 days and the hunt was closed by emergency order. In 2008, we closed the hunt by emergency order at noon on the opening day (Sept. 15) after 15 bulls had been taken. In 2008 we issued 15 antlerless permits, and 10 cow moose were harvested (Table 4).

Taku River: The annual harvest of moose during this report period averaged 16 moose, with 16 taken in 2007 and 17 in 2008. The mean harvest for the report period is the same as the mean annual harvest of 16 moose during 1999–2006 (Table 4).

Permit Hunts. In Unit 1C, moose hunts are managed under 2 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 3 drawing permits (DM043, DM044 and DM045) to manage the antlerless hunt, and a single registration permit (RM049) to manage the bull moose hunt. The remaining areas of Unit 1C (e.g., Chilkat Peninsula and Taku River) are managed under an any bull registration permit (RM046).

No moose were harvested in Berners Bay during the report period. Historical permit and harvest data can be found in Table 5.

Under the Unit 1C bull moose registration permit (RM046) a total of 358 permits were issued in 2007, followed by 363 in 2008. Although we cannot 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 (42%) hunted the Taku River, while (58%) hunted the Chilkat Peninsula.

For RM049 at Gustavus, 214 permits were issued in 2007, and 159 in 2008. Gustavus attracted the most hunters, with 163 in 2007, and 134 in 2008 (Table 5). As in most hunts, not all the permittees actually participated in a hunt. Combining both years of the report period, approximately 80% of the permittees hunted. Overall, during the report period, the Gustavus bull moose hunt accounted for 42% of the bull moose hunting activity in Unit 1C.

A small number of antlerless moose permits were made available for the Gustavus forelands in 2008. A total of 15 permits, allocated evenly between DM043, DM044 and DM045 were offered. Eleven hunters (73% of permit holders) participated in the hunts.

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 97 of 118 harvested moose, other Alaska residents took 20, and nonresidents took 1 moose. Southeast moose hunting areas are not readily accessible via highway vehicles, and residents from elsewhere in Alaska have better moose hunting opportunities closer to home. Nonresidents eager to take moose focus on areas with larger moose populations and a better chance of getting a trophy animal. When offered, antlerless moose hunts draw prospective hunters from across the region, and to a lesser degree, from the remainder of and outside the state. Seventeen percent of hunters pursuing bull moose in Unit 1C were successful during the report period. Gustavus moose hunters had a success rate of 15% successful for bull moose, and 91% for the antlerless draw hunt. Nineteen percent of the Taku River hunters were successful, and Chilkat Range hunters had a success rate of 13%.

Harvest Chronology. Similar to recent years, the 2007 and 2008 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 eight days of hunting during 2007, and less than one full day in 2008. 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 is December 1-December 10. 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.

Berners Bay: Historically, all successful Berners Bay 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 air boaters who then take them into Berners for their hunt.

Chilkat Range: Hunters on the Chilkat Peninsula used boats, ORVs, airplanes and highway vehicles for transportation to hunting areas. During the report period boats and ORVs were used by 42% and 35% of the hunters respectively (Table 7). Generally, most airplane access (19%) to this area is in the upper Endicott River, and most boat access takes place at St. James Bay, Howard Bay, and Point Couverdon/Swanson Harbor area. 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. One successful moose hunter reported using a highway vehicle for transportation. The vehicle is likely being used on logging roads in the Homeshore/Couverdon area.

Gustavus Forelands: Successful Gustavus Forelands hunters use a variety of access methods. During the report period an average of 68% used highway vehicles, 14% used a boat, 11% walked, 5% used airplanes, and 2% used all-terrain vehicles 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.

Taku: Almost all (100% and 94%, respectively) successful Taku River moose hunters used boats to access the area in 2007 and 2008 (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. Occasionally, an airplane is used to access the area. In 2008, 1 successful hunter reported using an airplane for transportation.

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 radio-collared cow moose in each of these populations. Although we did not have bull moose or calves radio-collared, it is likely mortality for both of these segments of these populations was even greater than that experienced by cows. Bulls tend to go into winter in poor body condition due to rutting behavior, and calves are more susceptible to predation, and starvation. During this report period survival estimates for radio-collared female moose improved in both Berners Bay and Gustavus. The 2007 Berners Bay survival estimate of 81% (White and Barten 2009) represents a relatively low annual survival. In addition, annual calf survival in Berners Bay is estimated at 17% (White and Barten 2009) during the report period. We believe severe winter weather and resulting snow depths in Berners Bay are the likely cause of adult moose mortality. The combination of low calf survival and adult mortality in Berners Bay will impact this herds’ ability to grow, prolonging the need to keep moose hunting seasons closed. One positive note is that the percentage of collared female moose that are pregnant in Berners Bay increased substantially between 2007 and 2008; from 84% in 2007 to 92% in 2008 (White and Barten 2009). The survival estimates for radio-collared female moose in Gustavus remained the same (89%) during both years of the report period. These estimates are a slight increase from 2006. Gustavus pregnancy percentages dipped to 78% in 2007 but increased to 87% in 2008 (K. White, unpublished data). While improved pregnancy is encouraging, the calf survival estimate for Gustavus in 2008 (7%) (K. White, unpublished data) creates concern for managers. Predation by bears and wolves has always been a factor in the 1C moose populations and undoubtedly plays a role in calf survival in both Berners Bay and Gustavus. During the report period, research data indicate that predation on Gustavus area 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 continues. 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

Berners Bay: The 2007 bull:cow ratio is only slightly below the management objective of 25:100. Aerial survey data failed to count 80–90 moose as listed in the Berners Bay management objectives. The winter of 2006–2007 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 relatively high mortality rates on collared cows. It is likely the mortality of bulls and calves exceeded this level. During the report period several positive indices collected through research efforts (pregnancy rates and decreasing mortality, and increased body condition) suggest the Berners Bay herd has the potential to grow. Current moose research in Berners Bay will end in 2009. Data collected during the project and continued monitoring will direct future management of the herd.

Chilkat Range: There are no established management objectives for the Chilkat Range moose population. As with the Taku River moose population, the Chilkat Range moose numbers and composition are not attainable 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 similar to 1999–2002, but less than 2003–2006. With the decreasing opportunity in Gustavus, this population is fast becoming the most utilized area in Unit 1C. Hunters have figured out that ATV's and other vehicles 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 thickly 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.

Taku: The harvest management objective of at least 10 bull moose was met during the report period. 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 representation of yearling bulls in the harvest 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. There is some speculation that moose move up the river drainage during fall to winter in areas with less snow. The high proportion of yearling bulls in the harvest suggests young males are dispersing to the Alaska portion of the river. In discussions, Canadian biologists 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 effect on this herd, and suggests a significant portion of the breeding in the Taku drainage occurs on the Canadian side of the border. Attempts need to be made in future years to acquire survey data in the upper Taku River by working with Canadian biologists.

Gustavus Forelands: The bull:cow management objective of 25 bulls:100 cows was not met during the report period. The bull to cow ratio continues to decline, and is likely due to several factors such as overall moose mortality, and low calf survival and recruitment. Ongoing moose research 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. Given the reduction of moose numbers at Gustavus through antlerless hunts, hard winters, and predation, we are content at this time to restrict harvest to bulls only, as antlerless hunts are no longer needed to limit the size of this moose population. Though there is variability between years in the report period, there are some indices suggesting the overall Gustavus moose herd health is improving. Estimated survival for adult female moose remained stable during the report period; body condition improved; and pregnancy rates and the number of calves produced increased. Even with the positive indications listed above, increased predation and lowering recruitment are reasons for concern about the future trajectory of this population. The new selective harvest strategy (spike/fork, 3 brow tine, or 50 inch antler spread) should change the current bull moose hunt in Gustavus from a derby style hunt to one where hunters will be able to hunt longer and enjoy the hunt rather than worrying about their safety, or feeling like they have to harvest the first bull they see due to short hunting seasons.

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 on other populations.

LITERATURE CITED

- Paul, T. W. 2009. Game transplants in Alaska. Technical bulletin No. 4, second edition. Alaska Department of Fish and Game. Juneau, Alaska. 150 pp.
- Swarth, H. S. 1922. Birds and Mammals of the Stikine River Region of Northern British Columbia and Southeastern Alaska. Vol. 24 No. 2. University of California.
- White, K. and Barten, N. 2009. Moose Assessment and Monitoring along the Juneau Access Road Corridor, Southeast, Alaska. Alaska Department of Fish and Game. Wildlife Research Annual Progress Report. 9pp.

PREPARED BY:

Ryan Scott
Area Management Biologist

SUBMITTED BY:

Neil Barten
Management Coordinator

Please cite any information taken from this section, and reference as:

Scott, R. 2010. Unit 1C moose management report. Pages 26–52 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project. 1.0. Juneau, Alaska.

Table 1. Unit 1C aerial moose survey data, regulatory years 1995 through 2008.

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
<u>Berners Bay 1999–2008</u>										
1999	14	11	13	70	108	2.4	---	---	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
2007	10	44	5	0	59	3.0	23	11	8	20
2008	3	22	3	5	33	3.3	---	---	9	10
<u>Chilkat Range 1995–2008</u>										
1995					<u>No survey</u>					
1996	---	---	---	20	20	---	---	---	---	
1997					<u>No survey</u>					
1998	6	15	16	35	72	1.1	---	---	22	65
1999					<u>No survey</u>					
2000	---	6	6	113	125	1.7	---	---	---	74
2001- 2008					<u>No survey</u>					
<u>Taku River 1995–2008</u>										
1995– 1997					<u>No survey</u>					
1998	---	1	1	3	5	---	---	---	---	---
1999					<u>No survey</u>					
2000	---	5	7	25	37	2.1	---	---	19	18
2001- 2008					<u>No survey</u>					

Table 1 Continued

Gustavus Forelands 1998–2008

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
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
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	---
2007	20	203	31	0	254	3.0	---	---	12	85
2008	5	31	32	205	273	3.7	---	---	12	74

Table 2. Unit 1C moose age at harvest, Berners Bay, regulatory years 1999 through 2008.

	Age								Class								Total kill	% aged	Mean age
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			
	<u>Males</u>																		
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
2007	HUNT CLOSED																		
2008	HUNT CLOSED																		
	<u>Females</u>																		
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	HUNT CLOSED																		
2004	HUNT CLOSED																		
2005	HUNT CLOSED																		
2006	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100	2.5
2007	HUNT CLOSED																		
2008	HUNT CLOSED																		

Table 3. Unit 1C moose age at harvest, excluding Berners Bay, regulatory years 1999 through 2008¹.

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
<u>Chilkat Range</u>																			
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
2007	0	2	2	1	5	1	0	0	0	0	0	0	0	0	0	0	12	92	3.6
2008	0	2	4	4	4	2	0	1	0	0	0	0	0	0	0	0	18	94	3.7
<u>Gustavus Forelands</u>																			
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
2007	0	2	4	8	5	4	3	1	1	0	0	0	0	0	0	0	29	97	4.3
2008	0	5	3	1	3	1	1	1	0	0	0	0	0	0	0	0	15	100	3.4

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
<u>Taku River</u>																			
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
2007	0	8	5	1	0	0	0	1	0	0	0	0	0	0	0	0	16	94	2.4
2008	0	6	6	3	1	1	0	0	0	0	0	0	0	0	0	0	17	100	2.6

42

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
<u>Gustavus Forelands (Antlerless Harvest)</u>																			
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
2007	HUNT CLOSED																		
2008	0	0	2	3	0	1	0	3	0	0	1	0	0	0	0	0	10	100	5.4

Table 4. Unit 1C moose historical harvests, number of hunters, and percent success, regulatory years 1999 through 2008.

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% success ^b
<u>Berners Bay</u>						
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
2007			HUNT CLOSED			
2008			HUNT CLOSED			
<u>Chilkat Range</u>						
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
2007	12	1	0	13	116	11
2008	18	0	0	18	121	15

Table 4 continues next page

Table 4. continued.

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% Success ^b
<u>Gustavus Forelands</u>						
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
2007	29	0	0	29	163	18
2008	15	0	0	15	124	12
<u>Taku River</u>						
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
2007	16	0	0	16	87	18
2008	17	0	0	17	83	20
<u>Gustavus Forelands (Antlerless Harvest)</u>						
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
2007	HUNT CLOSED					
2008	0	10	0	10	11	91

^a Illegal take^b Includes only legally harvested bull moose

Table 5. Unit 1C moose hunter effort and success, regulatory years 1999 through 2008.

Year	Permits issued ¹	Successful hunters			Unsuccessful hunters			Total hunters		
		Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days
<u>Berners Bay-DM041 and DM042</u>										
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
2007					HUNT CLOSED					
2008					HUNT CLOSED					
<u>Chilkat Range</u>										
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
2007	358	13	41	3.2	103	452	4.4	116	493	4.3
2008	363	18	81	4.5	103	366	3.6	121	447	3.7
<u>Gustavus Forelands</u>										
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
2007	214	29	83	2.9	134	445	3.3	163	528	3.2
2008	159	15	15	1.0	109	109	1.0	134	124	1.0

Table 5 continues on the next page

Table 5. continued.

Year	Permits issued	<u>Successful hunters</u>			<u>Unsuccessful hunters</u>			<u>Total hunters</u>		
		Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days
<u>Taku River</u>										
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
2007	---	16	38	2.4	71	285	4.0	87	323	3.7
2008	---	17	53	3.1	66	277	4.2	83	330	4.0
<u>Gustavus Forelands (Antlerless Harvest)—DM043, DM044, DM045</u>										
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
2007	HUNT CLOSED									
2008	15	10	15	1.5	1	5	5.0	11	20	1.8

^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 6. Unit 1C annual moose kill by community of residence, regulatory years 1999 through 2008.

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non- resident
<u>Berners Bay</u>									
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
2007	HUNT CLOSED								
2008	HUNT CLOSED								
<u>Chilkat Range</u>									
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
2007	13	1	6	3	0	0	0	3	0
2008	18	2	11	3	0	0	0	2	0
<u>Gustavus Forelands</u>									
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
2007	29	18	10	0	0	0	0	0	1
2008	15	8	6	1	0	0	0	0	0

^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
<u>Taku River</u>									
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
2007	16	0	13	2	0	0	0	1	0
2008	17	0	13	1	0	0	0	3	0
<u>Gustavus Forelands (Cow Harvest)</u>									
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
2007					HUNT CLOSED				
2008	10	0	9	1	0	0	0	0	0

Table 7. Unit 1C successful moose hunters transport methods, regulatory years 1999 through 2008.

Year	<u>Airplane</u>		<u>Boat</u>		<u>3 or 4 wheeler</u>		<u>Hwy vehicle</u>		<u>Foot</u>	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
<u>Berners Bay</u>										
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	---
2007	HUNT CLOSED									
2008	HUNT CLOSED									
<u>Chilkat Range</u>										
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	---
2007	2	(15)	5	(39)	6	(46)	0	---	0	---
2008	4	(22)	8	(44)	5	(28)	1	(6)	0	---
<u>Gustavus Forelands</u>										
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)
2007	2	(7)	5	(17)	0	---	18	(62)	4	(7)
2008	0	---	1	(7)	1	(7)	12	(80)	1	(7)

Table 7. continued .

Year	<u>Airplane</u>		<u>Boat</u>		<u>3 or 4 wheeler</u>		<u>Hwy vehicle</u>		<u>Foot</u>	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
<u>Taku River</u>										
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	---
2007	0	---	16	(100)	0	---	0	---	0	---
2008	1	(6)	16	(94)	0	---	0	---	0	---
<u>Gustavus Forelands (Cow Harvest)</u>										
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)
2007					HUNT CLOSED					
2008	0	---	0	---	1	(10)	9	(90)	0	---

Table 8. Unit 1C moose hunters commercial services use, regulatory years 1999 through 2008.

Year	Unit residents		Other AK residents		Non-residents		Total use		Transport	Non-guided services	Other services
	No	Yes	No	Yes	No	Yes	No	Yes			
<u>Berners Bay</u>											
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
2007	HUNT CLOSED										
2008	HUNT CLOSED										
<u>Chilkat Range</u>											
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
2007	82	8	22	2	1	1	105	11	11	0	0
2008	83	1	34	0	3	0	120	1	1	0	0
<u>Gustavus Forelands</u>											
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	15	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
2007	147	2	9	1	4	0	160	3	1	1	1
2008	116	0	6	1	1	0	123	1	1	0	0

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											
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
2007	78	2	6	0	1	0	85	2	2	0	0
2008	75	2	5	1	0	0	80	3	2	1	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
2007	HUNT CLOSED										
2008	6	2	3	0	0	0	9	2	1	1	0

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 1D (2,854 mi²)

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 mi² of summer range and 110–120 mi² of winter range, including 80 mi² of preferred winter range. Small areas of moose habitat are also located in the Chilkoot, Katzeihin, and Warm Pass valleys, and along the western shore of Lynn Canal (ADFG 1990a).

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. Sustain a harvest of 20–25 moose annually

METHODS

Chilkat River Valley aerial surveys were conducted in both 2007 and 2008 (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 2007 and 2008. In 2007 we counted 211 moose and in 2008 we counted 210 moose. 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 2007 survey were adequate enough to classify animals (211 total) seen as bulls, cows or calves. We classified 23 (11 %) of the moose seen on this survey as calves, substantially lower than the 2005 and 2006 surveys (Table 1), of 19 and 16% respectively. The bull:cow ratio was determined to be 30:100 and the calf:cow ratio was 16:100. Survey conditions in 2008 did not allow us to collect a reliable herd composition due to antler drop, and we were

only able to classify 70 of the 210 animals as bulls, cows or calves. We classified 23 (11%) of the moose seen as calves, while the bull:cow and calf:cow ratios were not meaningful as we had 140 moose observed that we were not able to classify. The high bull:cow ratio during 2006 may have been a function of survey timing as most of the bulls apparently still retained their antlers, whereas 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 24% below the 10-year mean count of 30 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 and 2006 (Table 1).

Mean age at harvest was 3.8 years during this report period, an increase from the mean age of 3.0 during the last report period. The harvest age structure shift is due to a high proportion of yearling bulls taken in 2005–2006 (20) compared to this report period (12).

MORTALITY

Harvest

<u>Season and bag limit</u>	<u>Resident hunters</u>	<u>Nonresident hunters</u>
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 250 permits may be issued.	15 Sep–7 Oct (Subsistence hunt only)	No open season.

Game Board Actions and Emergency Orders: During the fall 2008 BOG meeting, the Board voted to “Take No Action” on a proposal to eliminate points for the tier II hunt in Unit 1D, and allow Haines residents to harvest one moose every two years. Tier II scoring is a statewide function and was not addressed at the Southeast board meeting. During the winter 2008 BOG meeting the Board repealed the broken antler restriction for Unit 1D. This regulation was passed in fall 2006 and made 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 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. Unit 1D moose hunters were dissatisfied with this additional restriction and a proposal (#64) was submitted to the BOG by the Upper Lynn Canal Advisory Board to repeal the regulation. The department supported repeal as antler modification was not considered to be a problem in this hunt.

Hunter Harvest: During this report period, the mean annual harvest was 26 moose, a slight increase from 23 reported during the last report period. In 2007, 22 bull moose were taken, and in 2008, 30 bull moose were harvested. The 2008 harvest is the highest harvest during the past

10 years. The reason for this additional harvest is likely the increased season length (approved by the BOG in fall 2006), which provided an extra week of hunting opportunity (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 2007 and 2008. Although the Alaska Board of Game authorizes 250 permits, the department first issued all 250 in 2009. The number of permits applicants increased in 2007 and 2008 to 287 and 297 applications respectively, up from 256 in RY2006. We do not know why the number of applicants is increasing.

Hunter Residency and Success: During the report period local residents were the primary Unit 1D moose hunters even though all Alaskans were eligible to apply for this or any other Tier II hunt. Residents of Haines and Klukwan (Table 4) took 50 of the 52 moose harvested during the report period. Hunter success was 12% and 16% in 2007 and 2008, respectively. Success rates are similar to the previous decade (Table 5). Successful hunters took an average of 4.7 days in 2007 and 6.8 days in 2008 to harvest a bull moose (Table 3). Total hunter days were 1,534 in 2007 and 1,568 in 2008 (Table 3), with more effort reflecting the lengthened season.

Harvest Chronology: During each year of the report period, the Unit 1D moose season remained open for the entire 3 weeks of the season. Hunters took 50% and 57% of the total harvest in the first week of the season in 2007 and 2008, respectively. This is partly due to the high level of participation during the early part of the season, but also reflects the quick harvest of bulls that have obviously legal antler formations. Six of the 9 spike/fork bulls (27% of the total harvest) were taken during this period in 2007. Three of four sublegal moose were taken during this time with 1 bull having only 2 brow tines and 2 illegal bulls having broken antlers. In 2008 2 bulls with spike/fork antlers and 10 bulls with 3 brow tines (33% of the total harvest) were taken in the first week.

Transport Methods: Most Unit 1D moose hunters use boats or highway vehicles (Table 6). During the 2007 and 2008 hunting seasons, 64% and 53% of successful hunters used boats, respectively. Many of the remaining successful hunters used highway vehicles (13% in 2007 and 37% in 2008) (Table 6). In 2007 23% of hunters used off road vehicles to harvest moose, the highest percentage reported in the last 10 years.

Commercial Services: No unit resident or non-unit resident hunters reported using commercial services during the report period (Table 7). Although hunters indicated they used commercial services in other report periods, hunters reporting use of commercial services may have been reporting incorrectly (e.g., listing commercial airline to Haines as a transporter). Virtually all hunters reside within or 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:

Local residents continue to have interest in harvesting moose for cultural education and traditional funeral ceremonies. One bull moose was taken in both 2007 and 2008 for cultural education and another bull was harvested in 2008 for a potlatch ceremony. These types of harvests are important for passing traditional subsistence knowledge from generation to

generation. If 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 predate on moose calves and 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 1998–2008 (range 7–18) (Scott 2009a), 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 five wolves per year over the last ten years (range 0–12) (Scott 2009b). During this report period 0 and 6 wolves were taken in 2007 and 2008, 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 2007 and 2008 (11% both years) is lower than the 10-year average of 16% calves. In some years deep snow may contribute to calf mortality and may have been the case during the heavy snow winters during this report period. Deteriorating range conditions may also play a role in low calf production and survival (Hundertmark et al. 1983), and this is something that is being examined more closely through browse vegetation surveys.

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, 1 moose each year. When possible 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. Moose seem to respond similarly to deer when snow depth increases by selecting coniferous forest habitats where snow

accumulates to a lesser degree than open habitats. These habitats may also play an important role in predator avoidance.

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 and 2008 department staff conducted moose browse surveys 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 heavy snowfall in 2007–2008, 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. Current browse surveys are 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 1990b). 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 2007 (22) and exceeded in 2008 (30). We also met the objective of a 12% hunter success rate in 2007 (12%) and 2008 (16%).

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 early 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, the actively trapping populace likely maintains a check on this source of predation.

McCarthy (ADF&G 1990a) 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 conifer growth for moose to use for winter shelter.

Aerial surveys conducted the last few years suggest that moose numbers in Unit 1D have remained relatively stable over the past 20 years. During this report period, the harvest of yearling and 2.5 year age classes were well represented (52%), which suggests that calf survival and recruitment of young bulls into the harvestable age classes has been good the past 2 years. The present regulatory structure supports a moose population concomitant with habitat capabilities. Predation, deep snows, and possible habitat constraints point to the need for regular surveys to better understand the status and trend of the population.

LITERATURE CITED

- ADF&G. 1990a. Moose. Annual Report of Survey-Inventory Activities, 1 July 1988–30 June 1989. Federal Aid in Wildlife Restoration. Vol. XX, Part VIII. Project W-23-2, Study 1.0. Juneau. 428 pp.
- ADF&G. 1990b. Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94. Division of Wildlife Conservation, Southeast Regional Office. Douglas, Alaska. 103pp.
- ADNR. 2002. Haines State Forest Management Plan. Alaska Department of Natural Resources, Division of Mining, Land & Water, Resource Assessment & Development Section. Division of Forestry. Anchorage, Alaska. 212pp.
- Hessing, P. 2004. Unit 1D Moose Management Report. Pages 45-57 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- Hundertmark, K.J., W.L. Eberhardt and R.E. Ball. 1983. Winter habitat utilization by moose and mountain goats in the Chilkat valley. Alaska Department of Fish and Game. Final report for the Haines-Klukwan Cooperative Resource Study. Juneau, Alaska. 44pp.
- Scott, R. 2009a. Unit 1 Brown Bear Management Report. Pages 1-18 *in* P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2006–30 June 2008. Alaska Department of Fish and Game. Juneau, Alaska.
- Scott, R. 2009b. Unit 1D Wolf Management Report. Pages 24-30 *in* P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2005–30 June 2008. Alaska Department of Fish and Game. Project 14.0. Juneau, Alaska.

PREPARED BY:

Anthony P. Crupi
Wildlife Biologist II

SUBMITTED BY:

Neil L. Barten
Regional Management Coordinator

Please cite any information taken from this section, and reference as:

Crupi, A.P. 2010. Unit 1D moose management report. Pages 53-63 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 1D (Chilkat Valley) moose aerial survey data, regulatory years 1998 through 2008¹.

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
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	---	---	16	40
2001	38	153	30	---	221	5.2	25	20	14	42
2002	No Survey									
2003	29	103	26	---	158	4.4	28	25	16	36
2004	23	45	52	119	239	4.4	---	---	22	54
2005	46	118	39	---	203	5.0	39	33	19	41
2006	49	106	31	2	188	4.4	46	29	16	43
2007	43	144	23	1	211	4.3	30	16	11	49
2008	25	22	23	140	210	5.7	---	---	11	37

¹Missing 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 1999 through 2008.

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
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
2007	0	6	8	4	1	0	2	0	0	0	1	0	0	0	0	0	22	100	3.2
2008	0	6	7	2	1	8	2	1	1	1	0	0	0	1	0	0	30	100	4.5

¹Does not include 1 unsalvaged illegal harvest.

Table 3. Unit 1D moose hunter effort and success, regulatory years 1999 through 2008.

Year	Permits Issued	Successful hunters			Unsuccessful hunters			Total hunters		
		# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days
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
2007	220	22	104	4.7	156	1430	9.2	178	1534	8.6
2008	220	30	203	6.8	155	1365	8.8	185	1568	8.5

Table 4. Unit 1D annual moose kill by community of residence, regulatory years 1999 through 2008.

Regulatory year	Total kill	Haines	Skagway	Juneau	Sitka	Other Alaska	Non-resident
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
2007	22	20	0	1	1	0	0
2008	30	30	0	0	0	0	0

¹Includes 1 illegally harvested bull.

²Does not include 1 unsalvaged illegal harvest.

Table 5. Unit 1D historical moose harvests, number of hunters, and percent success, regulatory years 1999 through 2008.

Regulatory year	NR males	NR females	NR unknown	Total kill	NR hunters	Percent success
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
2007	22	0	0	22	178	12
2008	30	0	0	30	185	16

¹Does not include 1 unsalvaged illegal harvest.

Table 6. Unit 1D transport methods used by successful moose hunters, regulatory years 1999 through 2008.

Year	<u>Airplane</u>		<u>Boat</u>		<u>ORV</u>		<u>Highway vehicle</u>		<u>Other</u>	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
1999	2	(10)	15	(71)	0	---	4	(19)	0	---
2000	0	---	12	(67)	2	(11)	4	(22)	0	---
2001	1	(6)	14	(82)	0	---	2	(12)	0	---
2002	2	(9)	12	(55)	2	(9)	5	(23)	1	(5)
2003	1	(5)	13	(62)	1	(5)	3	(14)	3	(14)
2004	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)
2007	0	---	14	(64)	5	(23)	3	(14)	0	---
2008	0	---	16	(53)	2	(7)	11	(37)	1	(3)

Table 7. Unit 1D commercial services used by moose hunters, regulatory years 1999 through 2008¹.

Year	<u>Unit residents</u>		<u>Other AK residents</u>		<u>Total use</u>		Other services
	No	Yes	No	Yes	No	Yes	
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
2007	174	0	4	0	178	0	0
2008	178	0	7	0	185	0	0

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

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 3 (3000 mi²)

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 and moose now occur on all major islands in the unit.

HABITAT DESCRIPTION

Recent increases in moose distribution and abundance in Unit 3 are likely linked to timber harvest. 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.

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 as existing clearcuts advance in age and browse availability decreases. 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 that are likely to be controversial.

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 canopy closure again results in loss of understory vegetation.

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. The present season dates of 15 September–15 October have been in effect since 1995.

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 those antler restrictions, which were developed for the *gigas* subspecies of moose found elsewhere in Alaska, are overly restrictive when applied to the smaller *andersonii* 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 and Unit 3. The registration moose hunt (RM038) in effect during this report period allows the taking of only those bulls that meet the spike/fork, 50-inch antlers or 3 brow tines on at least one side criteria.

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 a growing suspicion that hunters may be intentionally modifying antlers.

In the Petersburg Management Area (Units 1B & 3) 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.

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. In recent years Kupreanof has surpassed all other Unit 3 islands as the Unit's leading moose producer.

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 than other factors. We cannot estimate how long Unit 3 habitat will support a viable moose population. The desire to rebuild Sitka black-tailed deer populations on the Unit 3 islands compounds the complexity of establishing moose management goals because habitat alterations like clearcut logging that benefit moose are detrimental to deer. 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 are based on 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. We increased the objectives to match the apparent capacity of the herd to sustain a larger harvest and effort.

<u>Unit 3:</u>	<u>Plan Objective</u>	<u>2007</u>	<u>2008</u>
Post hunt numbers	400	N/A	N/A
Annual hunter kill	40	33	34
Number of hunters	470	481	472
Hunter-days of effort	2300	2799	1977
Hunter success	10%	7%	7%

METHODS

We opportunistically checked hunters and harvested moose in the field. Hunters were also required to bring antlers of harvested moose to ADF&G to verify compliance with antler restrictions, and to submit the lower jaw of harvested moose for aging purposes. Since 1997 we have asked hunters to report 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 that relies on atypical habitat and whose permanence is unknown. With no definitive information on the current population or habitat-carrying capacity, population objectives are only speculative. Consequently, with the exception of the experimental any-bull drawing permit hunts, we have supported only hunts with self-limiting regulations (such as limiting the harvest to only bulls possessing specific antler configurations). We believe such hunts enable the population to thrive as permitted by the carrying capacity of the habitat while providing hunting opportunity. However, for genetic or environmental reasons moose in this unit do not develop antler configurations that correlate well with age. Unit 3 moose rarely achieve 50-inch antler spreads, and in some areas 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 both facilitated the removal of some surplus bulls and provided information on the age structure and antler characteristics of that segment of the bull population otherwise protected under the existing antler restrictions. The data collected led to Board of Game changes to the RM038 antler restrictions for future seasons

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 moose numbers.

POPULATION STATUS AND TREND

Population Size and Composition

The Unit 3 moose population is the most enigmatic in Southeast Alaska. No aerial surveys have ever been conducted in Unit 3 because dense forest cover and the lack of any winter concentration areas make them impractical. Harvest data and anecdotal information collected by ADF&G wildlife biologists over a period of many years continue to suggest a low to moderate

population that is expanding. 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.

Likewise, definitive sex and age ratios, calf-to-cow ratios, and other population characteristics are unknown. We infer the moose population composition from observations reported by hunters on registration hunt report cards. Because this data is anecdotal and not systematic, there is a high likelihood of replicate sightings and we interpret it with caution. In 2007 a total of 477 RM038 moose hunters reported observing 1,003 moose in Unit 3, including 323 bulls, 439 cows, and 241 calves, for a bull-to-cow ratio of 74:100 and a calf-to-cow ratio of 55:100. In 2008, 470 RM038 moose hunters reported observing 1,300 moose, including 448 bulls, 533 cows, and 319 calves, for a bull-to-cow ratio of 84:100 and a calf-to-cow ratio of 60:100.

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. They 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 increasing in both distribution and abundance and now occupy most of the larger Unit 3 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 2008, based in part on age and antler data collected during the any-bull moose drawing permit hunts implemented in 2004, the Board of Game liberalized the moose antler restrictions for the RM038 hunt area. As a result, beginning with the 2009 season, a legal bull must possess spike-forked antlers or 50-inch antlers or antlers with 3 or more brow tine at least one side, or 2 or more brow tines on both sides. In a related action, the board eliminated the DE047 and DM048 any-bull drawing hunts until such time that the impact of the revised antler restrictions on the RM038 moose herd could be evaluated.

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

Hunter Harvest.

In 2007, 481 hunters harvested 33 moose in Unit 3 (Table 1). Even with the addition of 7 bulls taken under any-bull drawing permits, the harvest of 33 moose in 2007 was the lowest unitwide harvest since 2002 when 26 bulls were taken. In 2008, 472 permittees harvested 34 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 2007, a total of 5 any-bull permits (DM047) were issued for Mitkof Island; 3 of the 5 permittees were successful. A total of 5 any-bull permits (DM048) were issued for Kupreanof Island in 2007; 4 of those hunters were successful. In 2008, 5 any-bull permits were issued for Mitkof, only 3 permittees hunted and 1 was successful. Five any-bull permits were issued for Kupreanof in 2008, all permittees hunted, and 2 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 7% each in 2007 and 2008, both of which were equal to the 10-year average. In 2007, the 7 moose taken by nonlocal residents was the second highest total on record for this residency group. Just 3 and 4 nonresident hunters participated in the Unit 3 moose hunt in 2007 and 2008, respectively, and only 1 was successful.

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 2007 most of the annual harvest occurred during the fourth and second weeks of the season, respectively. In 2008 most of the annual harvest occurred during the third and fourth weeks of the season (Table 4).

Harvest in particular Wildlife Analysis Areas (WAAs). During the report period hunters reported harvesting moose in 8 Unit 3 WAAs. In 2007 the largest percentage of the annual harvest occurred in WAA # 5132 on northwest Kupreanof Island, followed by WAA # 2007 on Mitkof Island and WAA # 5130 on western Kupreanof each with an equal percentage of the harvest. In 2008 the largest percentage of the harvest also occurred in WAA # 5132, followed by WAA # 2007.

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 remains unknown.

CONCLUSIONS AND RECOMMENDATIONS

The Unit 3 moose population 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. Both biologists and hunters are concerned over the eventual loss of habitat and resulting decline in food availability for moose and deer. Any attempted remedies involving habitat manipulation need to be undertaken with the involvement of the U.S. Forest Service which manages nearly all Unit 3 habitat.

The annual hunter kill was below the management objective of 40 moose during both 2007 and 2008. The number of hunters was slightly above the management objective of 470 hunters during both 2007 and 2008. The hunter days of effort was well above and well below the management objective of 2300 days in 2007 and 2008, respectively. The success rates of 7% each in 2007 and 2008 were down from the previous report period, and below the management objective of 10% annually. The low success rates during the report period was likely attributable to population declines and/or low recruitment rates associated with record snowfall during winter of 2006–2007, followed by well above average snowfall during winter of 2007–2008. Although moose density varies from island to island, the Unit 3 moose population appears to be expanding. Since 2000 the moose harvest from the Unit 3 islands has regularly exceeded that of the Unit 1B mainland, and this was the case during the report period.

In fall of 2008 the Board of Game liberalized the moose antler restrictions for the RM038 hunt area, based in part on age and antler data collected during the any-bull moose drawing permit hunts implemented in 2005. Beginning with the 2009 season, a legal bull must possess spike-forked antlers or 50-inch antlers or antlers with 3 or more brow tine at least one side, or 2 or more brow tines on both sides. In a related action, the board eliminated the any-bull drawing hunts until such time that the impact of the new liberalized antler restrictions on the moose herd could be evaluated. We recommend that the RM038 hunt area, including 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 revised bag limit of 1 bull with spike-forked antlers or 50-inch antlers or antlers with 3 or more brow tine at least one side, or 2 or more brow tines on both sides.

LITERATURE CITED

ADF&G. 1990. Strategic plan for management of moose in Region I, Southeast Alaska 1990–1994. ADF&G/DWC. Juneau, Alaska. 120 pp.

PREPARED BY:

Richard E. Lowell
Wildlife Biologist III

SUBMITTED BY:

Neil Barten
Management Coordinator

Please cite any information taken from this section, and reference as:

Lowell, R. E. 2010. Unit 3 moose management report. Pages 64–76 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 3 moose harvest, regulatory years 1999 through 2008.

Year	Hunter harvest reported							
	M	(%)	F	(%)	Unk.	Total	Illegal	Total
1999 ^a	24	(100)	0	(0)	0	24	2	26
2000	30	(100)	0	(0)	0	30	1	31
2001 ^a	24	(100)	0	(0)	0	24	1	25
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
2007 ^c	32	(100)	0	(0)	0	32	1	33
2008 ^c	28	(100)	0	(0)	0	28	6	34

^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 2008.

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
	2007	5	0	60	40	3	(100)	0	(0)	0	0	3
	2008	5	40	20	40	1	(100)	0	(0)	0	0	1
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
	2007	5	0	80	20	4	(100)	0	(0)	0	0	4
	2008	5	0	40	60	2	(100)	0	(0)	0	0	2
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
	2007	10	0	70	30	7	(100)	0	(0)	0	0	7
	2008	10	20	30	50	3	(100)	0	(0)	0	0	3

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

Table 3. Unit 3 moose hunter residency and success, regulatory years 1999 through 2008.

Year	<u>Successful</u>					<u>Unsuccessful</u>					Total hunters
	Local ^a resident	Nonlocal resident	Non- resident	Total	(%)	Local ^a resident	Nonlocal resident	Non- resident	Total	(%)	
1999	26	0	0	26	(5)	430	34	2	466	(95)	492
2000	27	4	0	31	(6)	435	33	5	473	(94)	504
2001	22	3	0	25	(5)	402	31	1	434	(95)	459
2002	25	1	0	26	(6)	398	31	0	429	(94)	455
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
2007	26	7	0	33	(7)	397	48	3	448	(93)	481
2008	29	4	1	34	(7)	367	68	3	438	(93)	472

^a Residents of Kake, Petersburg, and Wrangell

Table 4. Unit 3 moose harvest chronology in, regulatory years 1999 through 2008.

Year	15–21 Sep	22–28 Sep	29 Sep–5 Oct	6–15 Oct	Total
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
2007	6	7	6	14	33
2008 ^a	4	2	14	13	34

^aNumbers do not equal total due to one unknown

Table 5. Unit 3 successful moose hunter transport methods, regulatory years 1999 through 2008.

Year	Airplane	Boat	Highway vehicle	3/4 wheeler	Horse	Unknown	Total
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
2007	3	8	20	2	0	0	33
2008	0	10	21	3	0	0	34

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 5 (5800 mi²)
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. A moose population study conducted on the Yakutat Forelands during 2000-2002 by the USFS and ADF&G indicated that cow moose were in good condition, with high pregnancy and twinning rate, indicative of healthy moose with good habitat. Predation appears to be a significant major limiting factor 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 the summer of 1986, resulting in a dramatic decline of moose in this area. We presume moose emigrated to adjacent areas to escape the high water levels that displaced them from low lying habitats. The increased water level was also found to have flooded and killed willow shrubs which are a main source of browse for moose. Following retreat of the Hubbard Glacier and subsidence of the waters of Russell Fiord in fall 1986, moose slowly recolonized this area over the next 7 years. Based on 1994 aerial survey counts, the Board of Game (BOG) reopened moose hunting in this area, beginning with the 1995 season. However, the Hubbard Glacier blocked off Russell Fiord again when it advanced in

2002. The water level rose approximately 65 feet, again drowning much of the moose habitat in this area. The moose season has been closed since due to low moose numbers.

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 compared to 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, a block of 9 nonfederal townships lie 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.

Beginning in 2007 the department worked with the USFS to reduce the joint state and federal moose hunt guideline harvest levels on the Yakuat Forelands to accommodate lower than optimal bull:cow ratios. In 2007 the guideline harvest level was reduced from 30 to 20 for that portion of Unit 5A west of the Dangerous River. In 2008 the guideline was raised to 25 bulls. Biologists will continue to monitor the moose population bull:cow ratios through aerial surveys, and recommend adjusting the guideline harvest levels as needed.

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 1990). They are compared with current population estimates and use levels (these estimates include data from both state and federal hunts).

	Current report period (RY 2007– RY 2008)	Plan objective
Unit 5A Yakutat Forelands		
Post-hunt moose numbers (estimated)	600–800	1000
Annual hunter kill (average)	42	70
Number of hunters (annual average)	195	250
Hunter-days of effort (annual average)	589	1025
Hunter success (annual average)	22%	28%

Unit 5A Nunatak Bench

Post-hunt moose numbers (estimated)	18	50
Annual hunter kill (average)	0	5
Number of hunters (annual average)	0	10
Hunter-days of effort (annual average)	0	60
Hunter success (annual average)	0%	50%

Unit 5B Malaspina Forelands

Post-hunt moose numbers (estimated)	200	250
Annual hunter kill (average)	10	25
Number of hunters (annual average)	33	50
Hunter-days of effort (annual average)	168	200
Hunter success (annual average)	29%	50%

METHODS

We conducted aerial surveys on the Yakutat Forelands of Unit 5A during both years of the report period, and surveyed Nunatak Bench and Unit 5B during 2007 (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 hunts and one joint state/federal registration permit hunt 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 permit reports, 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 deliver a completed hunt report to the department no later than 15 days after the hunt closes. We ask hunters to voluntarily provide a photograph of harvest bull moose antlers for age and antler development comparisons.

RESULTS AND DISCUSSION**POPULATION STATUS AND TREND***Population Size*

Portions of the Yakutat and the Malaspina forelands consist of dense 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 annual comprehensive moose surveys in the Yakutat area. Variable snow coverage, strong drainage winds, inclement weather, and the availability of survey aircraft in Yakutat all affect when and where we conduct surveys. Consequently survey frequency and coverage can vary considerably year to year (Table 1). The Yakutat Forelands in Unit 5A are generally surveyed annually, although in some years we attempt only to acquire a sample of moose for composition analysis. We try to survey Nunatak Bench each year because the population has declined dramatically due to recent flooding of prime habitat by rising water levels of Russell Fiord. In Unit 5B, our survey schedule is less consistent because the lower hunting pressure means less need to monitor this population annually.

Inconsistent early snowfall often means aerial surveys occur after antler drop, resulting in unreliable composition data. When composition data is not available, survey reports note total number of moose and numbers of adults and calves (Table 1).

Unit 5(A) Yakutat Forelands: During the first year of this report period, we counted 685 moose on the forelands; by far the highest count in the past 10 years (Table 1) and more than any count since the late 1960s. Considering we see approximately 70% of all moose during surveys conducted in good conditions, there may be nearly 1,000 moose on the forelands based on the 2006 survey. Weather and good snow conditions and the adoption of a more thorough systematic survey design are likely the main reasons for this higher count. The 2006 survey is the most reliable data staff has been able to collect recently to assess the Unit 5A moose population. The new method, developed in conjunction with our regular Yakutat survey pilot, involves flying transects one-quarter mile apart across the entire forelands. This assures we thoroughly cover all habitats on the forelands except the dense coniferous forests where sightability is low. During 2008 we limited our survey to a subset of the population to achieve herd composition. Given the varying survey intensities over the years displayed in Table 1, the best way to compare populations over time is to use the number of moose observed per hour of flight time.

Unit 5(A) Nunatak Bench: Aerial surveys of the Nunatak Bench area were completed only during 2007. That year we counted 17 moose of which 7 were calves. This moose herd continues to suffer the effects of habitat depletion from the 2002 flooding.

Unit 5(B) Malaspina Forelands: The only survey of Unit 5B in this report period was in 2007; 82 moose were observed. Although 82 moose is lower than the long-term average (1995–2006) of 105 moose, the difference is likely a factor of survey conditions and timing. The survey was conducted in late winter with good snow cover on the ground, but all snow had been blown off the vegetation. Consequently moose had good cover. The sunny weather and moderate winds during the survey created challenging conditions for detecting moose due to glare and aircraft instability.

Population Composition

Unit 5A, Yakutat Forelands: During this report period the 2007 aerial survey did not provide us with herd composition data because it came after antler drop began and bull moose could not

always be detected. Thus, survey data lists cows, calves, bulls, and adult moose of unknown sex (Table 1). Several bull moose we counted had only one antler, and others undoubtedly had lost both antlers. The minimal bull:cow ratio was 15:100, with a minimum calf:cow ratio of 13:100. Percent calves was 11%.

In addition to sex composition data, age structure of harvested bull moose provides valuable population information. During the past decade, the mean age at harvest of Unit 5A Yakutat Forelands moose has ranged from a low of 3.2 years in 1999 to a high of 4.4 years in 2002 (Table 2). Mean age at harvest during this report period was 3.2 years. The number of yearling and 2-year-old bulls was 26 and 16 during 2007 and 2008 respectively. The number of 3- and 4-year-old bulls increased substantially over the previous report period to 18 and 16 bulls, respectively. Overall harvest in 2007 was higher than the last several years largely because it was bolstered by an increase in 3–4 year old bulls. This suggests a high survival and good recruitment of this age cohort. In looking back at the previous 2 years, this theory is supported as the 2.5 and 1.5 age classes are well represented in 2006 and 2005 respectively, and are likely due to moderate to high levels of calf production and survival. The 2008 harvest returned to a level closer to the decadal mean and the proportion of young bulls was also more in line with that average (Table 2). The presence of young bulls in the harvest provides some confidence that these age classes are well represented in the population. We hope it also indicates calf survival is high enough to provide continued harvest of bull moose at a level similar to recent years.

Nunatak Bench: At Nunatak Bench, the 2007 survey did not provide reliable composition data (Table 1) and lack of harvest means no age distribution information was gathered.

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 1999. The mean age of 3.3 during the report period is within the age structure range of the last 10 years. The number of yearling bulls harvested in both years of the current report period (2 and 4, respectively) is higher than any of the past 5 years. Typically, the presence of young bulls in the harvest occurs when the total harvest is higher than the 10-year average. Both RY 2007 (10) and RY 2008 (9) harvests are higher than the 10-year average of 6.2 moose.

MORTALITY

Harvest

Season and bag limits

Unit 5A, except Nunatak Bench

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 25 bulls have been taken from that area

Unit 5A, Nunatak Bench

Resident and nonresident hunters

15 Oct–15 Nov

15 Nov–15 Feb

1 moose by registration permit
only; up to 5 moose may be
taken

Unit 5B
1 bull by registration permit
only
may be taken

15 Sep–15 Dec

Game Board Actions and Emergency Orders. There were no Board of Game actions concerning Unit 5 moose hunting during the report period. We issued Emergency Orders in both 2007 and 2008 to close the Unit 5A moose hunting season west of the Dangerous River when guideline harvest levels were reached.

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 during the previous two report periods (35 moose/year) is substantially lower than that recorded during 1997–2002 (Table 3). The average harvest for this report period increased to 42 moose/year. The reasons for the decline in 2003–2004 and 2005–2006 are unknown. Based on aerial survey data 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 if the proportion of bulls in the herd has changed. A decline in bull:cow ratio seems the most likely explanation for the decline in harvest. So, although moose numbers appear relatively stable, the bull:cow ratios in our surveys are likely lower than optimal (Table 1).

No registration permits were issued for the Nunatak Bench portion of Unit 5 (RM059). No moose were harvested at Nunatak Bench during the report period. This area has been closed to moose hunting since 2006 due to low numbers of moose observed during aerial surveys. (Table 1).

The harvest in Unit 5B also increased during this report period. In 2007, 10 moose were taken; and in 2008, 9 moose were taken. Total harvest for the report period (19 moose) is similar to harvests in the 1990s. The number of hunters increased significantly in Unit 5B in this report period compared to the previous period (Table 5), and the number of days spent by hunters in the unit was also much higher than the previous report period. Access to Unit 5B is often limited by weather and once on the ground hunters tend to remain close to the beach. This suggests hunters may not be using much of the available moose habitat and the overall harvest may be less than it could be.

Permit Hunts. Permits issued for the Yakutat Forelands hunt (RM061) in 2007 and 2008 totaled 196 and 182 respectively. The number of permittees who actually hunted in 2007 and 2008 was nearly the same as the previous report period with 151 and 139 hunters respectively (Table 5).

The number of permits issued for the Unit 5B hunt (RM062) in 2007–2008 increased to a number similar to the average for the period 1997–2004 (Table 5). The number of hunters and total days hunting were the highest for any report period since 1997–1998 (Table 5).

Staff from the Department of Public Safety/Alaska Wildlife Troopers and both ADF&G fisheries divisions continued to assist with issuing permits and monitoring these permit hunts. Enforcement personnel from the USFS also helped monitor the Unit 5A hunt during the report period. We used reminder cards and certified letters 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 because most easily accessible land is under federal management, harvest by Yakutat residents predominates. Yakutat hunters took 55 of 83 bulls (66%) harvested in 5A during the report period (Table 4). The majority of moose taken by local hunters were taken during the first 2 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 24 moose (29%) during the report period. Nonresidents took only 4 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 1999 the overall success of Unit 5A hunters has ranged from 22% to 37% (Table 3). Hunter success was 32% in 2007 and 25% in 2008.

The Malaspina Forelands hunt is less dominated by local residents because it is less convenient to hunt, and poor weather often deters local hunters from short excursions to this area. During this report period Unit 5 residents took 47% of the Unit 5B moose harvest, nonresidents took 32%, and other Alaska residents took the remaining 21% of the harvest (Table 4).

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, whereas the state season opens a week later on 15 October. However, up to 22 October only federally qualified subsistence hunters can hunt on federal land in Unit 5A.

In Unit 5B, the majority of moose (12) were taken in September. Of these moose, 8 were taken after 21 September. The remaining moose taken during the report period were taken in October. The Unit 5B season remains open until 31 December but fall and early winter weather conditions make access to the unit difficult.

Transport Methods. Transport methods used in the Yakutat Forelands were similar to the previous report period (Table 6). The use of aircraft increased slightly, from 17% during 2005–2006 to 22% in 2007–2008. The use of boats was 31%, the same as the previous report period, while 3- and 4-wheeler use continued to increase to 33%. Highway vehicles made up most of the remainder transportation access, with 11% of the hunters using this method. Three and 4-wheelers, and other forms of ORVs are probably underrepresented because some hunters reporting highway vehicles or “other” likely used off-road vehicles as well. Many unsuccessful hunters also use these machines for access. Virtually every fish camp has 1 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. They 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 nonlocal hunter transportation, relatively few Yakutat residents use them. Most locals hunt with the aid of riverboats, off road vehicles (ORV), 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 where there are no roads.

Commercial Services. Commercial services were used by 29% 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. Nonresidents used a registered guide in many cases, especially in Unit 5B. Commercial services were used by a higher percentage of Unit 5B hunters (71%) than Unit 5A hunters (20%). This is undoubtedly because the Malaspina Forelands are more difficult to access.

Other Mortality

As noted in the 2008 management report, the winter of 2006–2007 was the most severe on record in many parts of Southeast Alaska, including Yakutat. The winters of 2007–2008 and 2008–2009 were only slightly better than the extreme winter of 2006–2007. Winter mortality from consecutive hard winters has been detected in other northern Southeast moose populations and Unit 5 moose have likely experienced above average winter mortality as well.

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 (based on the 2006 surveys) are near management objectives and traditionally have supported a higher moose harvest. The high number of yearling and 2-year-old bulls in the harvest during the report period suggests that recruitment was good during those years. We hope 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. The lower guideline harvest west of the Dangerous River should be kept in place until we see improved bull:cow ratios in that area.

LITERATURE CITED

- ADF&G. 1990. Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94. Division of Wildlife Conservation. Juneau, Alaska. 120 pp.
- Smith, C.A., Franzman, A.W. 1979. Productivity and Physiology of Yakutat Forelands Moose. ADF&G, Division of Game. Final Report Federal Aid in Wildlife Restoration Projects W-17-10 and W-17-11, Job 1.25R. Juneau, Alaska. 18 pp.

PREPARED BY:

Ryan Scott
Area Management Biologist

SUBMITTED BY:

Neil Barten
Management Coordinator

Please cite any information taken from this section, and reference as:

Scott, R. 2010. Unit 5 moose management report. Pages 77–92 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 5 aerial survey data, regulatory years 1999 through 2008¹.

Year	MM	FF	Calves	Unk	Total	Count time (hrs)	MM Per 100 FF	Calves per 100 FF	Percent calves in herd	Moose per hour
<u>5A Yakutat Forelands</u>										
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
2007	79	70	74	462	685	9.0	15	13	11	76
2008	47	266	44	0	360	5.0	18	17	12	72
<u>5A Nunatak Bench</u>										
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
2007	NA	6	7	4	17	.5	---	---	41	34
2008						No survey				
<u>5B Malaspina Forelands</u>										
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
2007	NA	13	13	56	82	3.7	NA	NA	16	22
2008						No survey				

¹Due 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 1999 through 2008.

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
<u>Yakutat Forelands</u>																			
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
2007	0	14	12	14	4	1	0	0	1	0	0	0	0	0	1	0	48	98	3.1
2008	0	9	7	10	6	2	1	0	0	0	0	0	0	0	0	0	35	100	3.2
<u>5A Nunatak Bench</u>																			
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- 2008	No Harvest																		
<u>5B Malaspina Forelands</u>																			
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
2007	0	2	1	3	2	1	0	0	0	0	0	0	0	0	0	0	10	90	3.4
2008	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	0	9	100	3.1

Table 3. Unit 5 historical harvests, hunters, and success, regulatory years 1999 through 2008.

Year	Nr MM	Nr FF	Nr unk.	Total kill	Nr hunters	Percent success
<u>5A Yakutat Forelands</u>						
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
2007	48	0	0	48	151	32
2008	35	0	0	35	139	25
<u>5A Nunatak Bench</u>						
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					
2007	---					
2008	---					
<u>5B Malaspina Forelands</u>						
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
2007	10	0	0	10	35	29
2008	9	0	0	9	31	29

Includes moose harvested under federal ceremonial permit

Table 4. Unit 5 annual moose kill by community of residence, regulatory years 1999 through 2008.

Year	Total kill	Yakutat	Juneau	Ketchikan	Sitka	Pelican	Hoonah	Petersburg	Haines	Wrangell	Other AK	Non-resident
<u>5A Yakutat Forelands</u>												
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
2007	48	33	10	0	0	0	0	0	0	0	2	3
2008	35	22	6	0	0	0	0	0	0	0	6	1
<u>5A Nunatak Bench</u>												
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											
2007	---											
2008	---											
<u>5B Malaspina Forelands</u>												
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
2007	10	5	0	0	1	0	0	0	0	0	1	3
2008	9	4	0	1	0	0	0	0	0	0	1	3

Table 5. Unit 5 hunter effort and success, regulatory years 1999 through 2008¹.

		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
<u>5A Yakutat Forelands</u>										
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
2007	196	48	148	3.1	103	454	4.4	151	602	4.0
2008	182	35	110	3.1	104	465	4.5	139	575	4.1
<u>5A Nunatak Bench</u>										
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									
2007	---									
2008	---									
<u>5B Malaspina Forelands</u>										
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
2007	54	10	34	3.4	25	140	5.6	35	175	5.0
2008	44	9	23	2.6	22	138	6.3	31	161	5.2

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 1999 through 2008¹.

Year	<u>Airplane</u>		<u>Boat</u>		<u>3 or 4 wheeler</u>		<u>ORV</u>		<u>Highway vehicle</u>		<u>Foot</u>	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
<u>5A Yakutat Forelands</u>												
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	---
2007	11	(23)	17	(35)	12	(25)	2	(4)	6	(13)	0	---
2008	7	(20)	9	(26)	15	(43)	0	---	3	(8)	1	(3)
<u>5A Nunatak Bench</u>												
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											
2007	---											
2008	---											
<u>5B Malaspina Forelands</u>												
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	---
2007	4	(40)	2	(20)	4	(40)	0	---	0	---	0	---
2008	4	(44)	2	(23)	3	(33)	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 1999 through 2008¹.

Year	Unit residents		Other AK residents		Nonresidents		Total use		Transport	Registered guide	Other Services
	No	Yes	No	Yes	No	Yes	No	Yes			
5A Yakutat Forelands											
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
2007	95	2	16	25	3	9	114	36	36	1	2
2008	100	1	17	20	1	0	118	21	21	0	0
5A Nunatak Bench											
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										
2007	---										
2008	---										
5B Malaspina Forelands											
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
2007	9	2	1	4	1	18	11	24	23	9	7
2008	8	5	0	7	0	11	8	23	23	6	12

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

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: Unit 6 (10,140 mi²)

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 Unit 6C. This small population grew rapidly and expanded eastward into Unit 6B by the early 1960s. Eastward expansion continued into Unit 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 1,600 in 1988 (Griese 1990), then declined to about 1,200 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 Unit 6C began with 25 bulls harvested in 1960. Harvest began in Unit 6B during 1965 and Unit 6A during 1971. Moose in Unit 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 4,800 moose during 1965–2008 in Units 6A, 6B and 6C. In contrast, total kill of the endemic moose population in Unit 6D during the same period was approximately 75 moose. The harvest quota for cow moose in Unit 6C was moved into federal subsistence hunting during FY00, as was 75% of the bull harvest quota during FY02. This increased rural harvest priority for Cordova residents from an average 75% under state regulations to more than 90% under combined state and federal regulations.

Population objectives were relatively conservative in the 1970s and early 1980s, because of concerns about mortality during severe winters. Objectives were established at 0.9–1.2 moose/mi² 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 Unit 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 Unit 6A east is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 30:100. Our objectives for Units 6A west and 6B are to maintain populations of 300–350 moose and minimum bull:cow ratios of 15:100 in each unit. In Unit 6C, our objective for this report period was to increase the population to 400 moose by 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 Unit, except for Unit 6A, which was divided into eastern and western portions. The eastern portion was all drainages into the Gulf of Alaska between Cape Suckling and the head of Icy Bay. The western portion was all drainages into the Gulf between Cape Suckling and Palm Point.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We conducted five modified Gasaway surveys and two composition counts in Unit 6 (Table 1) during the reporting period. Gasaway surveys were flown in January and February, after most bulls had cast antlers. We flew composition counts in Units 6A west and 6C in November while most bulls still retained antlers (Table 1).

Population Size

Survey results indicated moose populations were declining in Units 6A and 6C, and increasing in Unit 6B. The Unit 6C population was deliberately reduced toward the management objective.

The post-hunt moose population in Unit 6 during the reporting period was approximately 1,120 moose, including 230 in Unit 6A east, 245 in Unit 6A west, 242 in Unit 6B, 353 in Unit 6C, and 40 in Unit 6D.

Population Composition

Bull:cow ratios were obtained for Units 6A West, 6B, and 6C during the reporting period (Table 1), although they are minimum estimates because of some early antler cast. Bull:cow ratio was low in Unit 6C because of heavy harvest to reduce population size. The proportion of calves in February 2008 was lower than normal in Unit 6A west. We flew five twinning surveys: one 29 May–19 June 2008, and four 26 May–1 June 2009 in Unit 6C. Best results were obtained during overcast mornings when moose were actively feeding. Surveys indicated a twinning rate of 58–65% for cows with calves at heel.

MORTALITY

Harvest

Season and Bag Limit. The bag limit in Unit 6A east for all hunters was one bull moose 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 one side. Resident hunters were restricted to spike-fork or 50-inch antlers (SF/50).

In Unit 6A west, the season for all hunters was 1 September–30 November, with a bag limit of one moose. Resident harvest quota was up to 20 bulls by registration permit, and nonresident quota was up to five bulls by drawing permit.

The season in Unit 6B was 1 September–30 November for resident hunters only with a bag limit of one moose. We authorized a harvest of 28 bulls by registration permit. Unit 6B is a controlled use area. No motorized vehicles were allowed for transportation 15 August–4 September, with the exception of highway vehicles on the maintained surface of the Copper River Highway. Therefore the first four days of the season were open to non-motorized hunting only. Similar to the “no same-day airborne” regulation, moose could not be taken until after 3 a.m. following the day on which a motorized vehicle was used for transportation off the highway after 4 September. This required motorized hunters to camp out before harvesting a moose, which slowed harvest, extended the season and allowed more hunters to participate. All airboats were required to display an Alaska Department of Fish and Game identification number.

In Unit 6C, the state season was 1 September–31 October, open to resident hunters only to provide rural preference for Cordova residents. Bag limits were one bull moose by drawing permit with the quota varying by year (Table 3). Of the 199 moose permits issued during the reporting period, 31 were state drawing permits, of which the majority was issued to Cordova residents. The remaining quota was allocated to federal subsistence permits, which required Cordova residency to be eligible (Table 1). This provided a 92% rural priority for Cordova residents during the reporting period. The subsistence hunt, which extends to 31 December, was administered by the U.S. Forest Service, Cordova Ranger District.

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

Reported moose harvest for Unit 6 was 183 in RY07 and 132 in RY08, while composition of the harvest in Unit 6 was 75% and 83% bulls, respectively (Table 2).

Board of Game Actions and Emergency Orders. We issued emergency orders to close the registration permit hunts for bull moose in Unit 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, Unit 6A west had one registration and one drawing permit hunt, Unit 6B had one registration hunt, and Unit 6C had one state drawing hunt. Also in Unit 6C, there were one federal subsistence hunt (both antlerless and bulls) and one potlatch bull permit each year (Table 3).

Hunter Residency and Success. Local residents comprised 80% or more of successful moose hunters in Unit 6 during reporting period (Table 4). This was an increase over past years because most of the increased quota in Unit 6C has gone to federal subsistence users (Cordova residents only). Resident-only seasons and difficult access on the Copper and Bering River deltas discouraged nonlocal hunters from participating in hunts in Units 6A west and 6B. This has been the pattern for the last five years.

Harvest Chronology. Most of the Unit 6 harvest over the past two years occurred during September (Table 5). Federal subsistence harvest has been increasing toward the end of the subsistence season in December. This has resulted in many breeding groups being harassed daily or weekly by airboats or snowmachines for four months of the year, including the post-rut period when bulls in poor condition should be allowed to forage on core winter habitat.

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 five 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. Post-hunt wolf population size was generally six or fewer in two small packs, which had relatively little impact

on the moose population. Therefore, moose in Unit 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 Units, 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 one week, to reduce brown bear predation. Options to reduce wolf predation are limited. Trapper access into Units 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 (31 May) to allow spring bear hunters the opportunity to take wolves in Units 6A and 6B.

Change the Unit 6C population objective from 400 moose to a range of 400–500.

LITERATURE CITED

- Burris O. E., and D. E. McKnight. 1973. Game transplants in Alaska. Technical Bulletin 4. Alaska Department of Fish and Game. Juneau, Alaska.
- Carnes, J. C. 2004. Ecology of wolves on the Copper and Bering River Deltas, Alaska [Ph.D. dissertation]. University of Idaho. Moscow, Idaho.
- Gasaway W. C., S. D. DuBois, D. J. Reed and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Institute of Arctic Biology. Fairbanks, Alaska.
- Griese, H. J. 1990. Unit 6 moose survey/inventory progress report. Pages 46–63 in S. O. Morgan, editor. Annual report of survey/inventory activities. Part VII. Volume XX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Project W–23–2, Study 1.0. Juneau, Alaska. 428pp.
- MacCracken J. G. 1992. Ecology of moose on the Copper River Delta, Alaska [dissertation]. University of Idaho. Moscow, Idaho.
- _____, V. Van Ballenberghe, and J. M. Peek. 1997. Habitat relationships of moose on the Copper River Delta in coastal South Central Alaska. Wildlife Monographs. 136.

Nowlin, R. A. 1995. Unit 6 moose. Pages 45–65 in M. V. Hicks, editor. Survey/inventory management report. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Study 1.0, Grants W–23–5, W–24–1. Juneau, Alaska.

_____. 1998. Unit 6 moose. Survey/inventory management report. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Study 1.0. Grants W–24–4 and W–24–5. Juneau, Alaska.

Rausch R. 1977. Alaska wildlife management plans, Southcentral Alaska. Alaska Department of Fish and Game.

Stephenson, T. R., K. J. Hundertmark, C.C. Schwartz, and V. VanBallenberghe. 1998. Predicting body fat and body mass in moose with ultrasonography. Canadian Journal of Zoology 76:717–722.

PREPARED BY:

David W. Crowley
Wildlife Biologist III

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Crowley, D. 2010. Unit 6 moose management report. Pages 93–109 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 6, moose estimated population composition and size, 2000–2009.

Unit	Regulatory Year	Survey date (m/d/y)	Bulls: 100 cows	Calves (%)	Adults	Population size	90% C.I.	Total moose observed
6A East	2000–01 ^a		-	13	136	-	-	189
	2001–02		-	15	265	285	220–360	218
	2007–08	29 Jan 08		7	213	230	212–247	203
6A West	2005–06	04 Dec 05	18	15	143	275	238–311	206
	2005–06 ^a	31 Jan 06	-	10	163	-	-	187
	2006–07	31 Jan 08	-	7	215	276	249–301	232
	2008–09 ^a	17 Nov 09	20	11	150	-	-	174
	2008–09	14 Feb 09	-	3	238	245	212–279	194
6B	2000–01 ^a	02 Feb 01	-	11	159	-	-	178
	2001–02	21 Feb 02	-	13	144	198	176–219	168
	2003–04 ^a	25 Nov 03	57	6	111	-	-	124
	2005–06 ^a	02 Dec 05	45	15	103	-	-	129
	2007–08	18 Jan 07		9	179	242	225–258	195
6C	2001–02	06 Feb 02	-	20	272	341	318–365	326
	2003–04 ^a	13 Nov 03	63	6	114	-	-	146
	2005–06 ^a	01 Dec 05	30	18	163	-	-	240
	2005–06	2 Feb 06	-	10	425	488	423–533	409
	2006–07	18 Jan 07	-	20	273	560	453–667	361
	2007–08 ^a	30 Nov 07	15	11	99	-	-	129
	2007–08	14 Jan 08	-	15	273	430	389–471	361
	2008–09	14 Feb 09	-	19	286	353	304–403	269

^a Composition count

Table 2. Unit 6, moose harvest and accidental death, 2004–2009.

Unit	Regulatory year	Hunter harvest									
		Reported					Estimated			Accidental death	Total
		M	(%)	F	(%)	Total ^a	Unreported	Illegal	Total		
6A East	2004–05	26	(100)	0	(0)	26	0	1	1	0	27
	2005–06	12	(100)	0	(0)	12	0	1	1	0	13
	2006–07	21	(100)	0	(0)	21	0	1	1	0	22
	2007–08	24	(100)	0	(0)	24	0	1	1	0	25
	2008–09	14	(100)	0	(0)	14	0	1	1	0	15
6A West	2004–05	15	(88)	2	(12)	17	0	1	1	0	18
	2005–06	25	(86)	4	(14)	29	0	1	1	0	30
	2006–07	12	(100)	0	(0)	12	0	1	1	0	13
	2007–08	15	(100)	0	(0)	15	0	1	1	0	16
	2008–09	14	(100)	0	(0)	14	0	1	1	0	15
6A TOTAL	2004–05	41	(95)	2	(5)	43	0	2	2	0	45
	2005–06	37	(90)	4	(10)	41	0	2	2	0	43
	2006–07	33	(100)	0	(0)	33	0	2	2	0	35
	2007–08	39	(100)	0	(0)	39	0	2	2	0	41
	2008–09	28	(100)	0	(0)	28	0	2	2	0	30

Table 2, continued.

Unit	Regulatory year	Hunter harvest								Accidental death	Total
		Reported					Estimated				
		M	(%)	F	(%)	Total ^a	Unreported	Illegal	Total		
6B	2004–05	30	(100)	0	(0)	30	0	1	1	0	31
	2005–06	20	(100)	0	(0)	20	0	1	1	0	21
	2006–07	25	(100)	0	(0)	25	0	1	1	0	26
	2007–08	27	(100)	0	(0)	27	0	1	1	0	28
	2008–09	26	(100)	0	(0)	26	0	1	1	0	27
6C	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
	2007–08	68	(60)	45	(40)	113	0	3	3	0	116
	2008–09	49	(69)	22	(31)	71	1	1	2	0	73
6D	2004–05	3	(100)	0	(0)	3	0	1	1	0	4
	2005–06	2	(100)	0	(0)	2	0	1	1	0	3
	2006–07	7	(100)	0	(0)	7	0	1	1	0	8
	2007–08	4	(100)	0	(0)	4	0	1	1	0	5
	2008–09	7	(100)	0	(0)	7	0	1	1	0	8
Unit 6 TOTAL	2004–05	109	(94)	7	(6)	116	0	4	4	3	123
	2005–06	94	(92)	8	(8)	102	0	5	5	1	108
	2006–07	97	(72)	38	(28)	135	0	5	5	0	140
	2007–08	138	(75)	45	(25)	183	0	7	7	0	190
	2008–09	110	(83)	22	(17)	132	1	5	6	0	138

^aTotals may include moose of unknown sex for Federal subsistence hunts.

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

Unit/ hunt number	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6A/RM160 ^a	2004–05	Bull	62	69	47	53	10	(100)	0	(0)	10
	2005–06	Bull	72	47	39	61	23	(100)	0	(0)	23
	2006–07	Bull	61	69	47	53	10	(100)	0	(0)	10
	2007–08	Bull	48	60	37	63	12	(100)	0	(0)	12
	2008–09	Bull	47	60	37	63	12	(100)	0	(0)	12
6A/DM160 ^b	2004–05	Bull	5	0	40	100	5	(100)	0	(0)	5
	2005–06	Bull	5	60	50	100	2	(100)	0	(0)	2
	2006–07	Bull	5	60	0	100	2	(100)	0	(0)	2
	2007–08	Bull	5	20	25	75	3	(100)	0	(0)	3
	2008–09	Bull	5	40	33	0	2	(100)	0	(0)	2
6A/DM162	2004–05	Antlerless	5	40	33	67	0	(0)	2	(100)	2
	2005–06	Antlerless	5	20	0	100	0	()	4	(100)	4
	2006–07	No Hunt									
	2007–08	No Hunt									
	2008–09	No Hunt									
6B/RM164	2004–05	Bull	166	28	75	25	30	(100)	0	(0)	30
	2005–06	Bull	159	27	77	17	20	(100)	0	(0)	20
	2006–07	Bull	192	35	80	20	25	(100)	0	(0)	25
	2007–08	Bull	159	27	77	23	27	(100)	0	(0)	27
	2008–09	Bull	183	28	80	20	26	(100)	0	(0)	26

Table 3, continued.

Unit/ hunt number	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6C/DM167	2004–05	Bull	9	11	0	100	8	(100)	0	(0)	8
	2005–06	Bull	9	0	0	100	9	(100)	0	(0)	9
	2006–07	Bull	9	0	0	100	9	(100)	0	(0)	9
	2007–08	Bull	18	2	6	72	13	(100)	0	(0)	13
	2008–09	Bull	13	0	8	92	12	(100)	0	(0)	12
6C/ Federal subsistence ^b	2004–05	Both	33	0	3	97	27	(84)	5	(16)	32
	2005–06	Both	32	3	3	97	26	(87)	4	(13)	30
	2006–07	Both	66	0	2	95	23	(38)	38	(62)	61
	2007–08	Both	105	0	3	97	55	(55)	45	(45)	100
	2008–09	Both	63	0	3	92	36	(62)	22	(38)	58

^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.

Unit	Regulatory year	Successful					Unsuccessful					Total hunters
		Local ^a resident	Nonlocal resident	Non-resident	Total	(%)	Local resident	Nonlocal resident	Non-resident	Total	(%)	
6A East	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
	2007–08	1	1	21	24	(49)	3	2	19	25	(51)	49
	2008–09	0	0	14	14	(40)	1	1	19	21	(60)	35
6A West	2004–05	12	0	5	17	(10)	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
	2007–08	12	0	3	15	(65)	6	1	1	8	(35)	23
	2008–09	10	2	2	14	(74)	3	1	1	5	(26)	19
6A TOTAL	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
	2007–08	13	1	24	39	(54)	9	3	20	33	(46)	72
	2008–09	10	2	16	28	(52)	4	2	20	26	(48)	54
6B ^a	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
	2007–08	25	2	0	27	(23)	77	12	0	89	(77)	116
	2008–09	23	3	0	26	(20)	93	13	0	106	(80)	132

Table 4, continued.

Unit	Regulatory year	Successful					Unsuccessful					Total hunters
		Local ^a resident	Nonlocal resident	Non-resident	Total	(%)	Local resident	Nonlocal resident	Non-resident	Total	(%)	
6C ^a	2004–05	39	1	--	40	(10)	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
	2007–08	109	2		111	(90)	12	0		12	(10)	123
	2008–09	67	3		70	(91)	6	1		7	(9)	77
6D	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
	2007–08	3	0	1	4	(12)	27	3	0	30	(88)	34
	2008–09	5	0	2	7	(22)	23	2	0	25	(78)	32
Unit 6 TOTAL	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
	2007–08	150	5	25	181	(52)	125	18	20	164	(48)	345
	2008–09	105	8	18	131	(44)	126	18	20	164	(56)	295

^a Resident hunters only.

Table 5. Unit 6, moose harvest percent by time period, 2000–2005.

Unit	Regulatory year	Harvest periods							n ^a
		August	September		October		November	December	
		20–31	1–15	16–30	1–15	16–31	1–30	1–31	
6A East	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
	2007–08	0	21	13	38	29	0	0	24
	2008–09	0	29	36	21	14	0	0	14
6A West	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
	2007–08	0	33	25	42	0	0	0	12
	2008–09	0	14	57	29	0	0	0	14
6A TOTAL	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
	2007–08	0	25	17	39	19	0	0	36
	2008–09	0	21	46	25	7	0	0	28

Table 5, continued.

Unit	Regulatory year	Harvest periods							n ^a
		August	September		October		November	December	
		20–31	1–15	16–30	1–15	16–31	1–30	1–31	
6B	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
	2007–08	0	89	11	0	0	0	0	27
	2008–09	0	69	31	0	0	0	0	26
6C	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
	2007–08	0	38	22	12	10	9	10	111
	2008–09	0	39	19	17	13	6	7	70
6D	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
	2007–08	0	75	25	0	0	0	0	4
	2008–09	0	43	43	14	0	0	0	7
Unit 6 TOTAL	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
	2007–08	0	44	19	15	10	6	6	178
	2008–09	0	41	28	15	8	3	4	131

^a Totals may include harvest of unknown date of kill for Federal subsistence hunters.

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	2004–05	85	8	4	4	0	26
	2005–06	58	25	8	0	8	12
	2006–07	65	10	15	10	0	21
	2007–08	79	4	8	4	4	24
	2008–09	64	0	0	36	0	14
6A West	2004–05	59	41	0	0	0	17
	2005–06	21	79	0	0	0	29
	2006–07	55	45	0	0	0	12
	2007–08	20	80	0	0	0	15
	2008–09	7	93	0	0	0	14
6A TOTAL	2004–05	74	21	2	2	0	43
	2005–06	32	63	2	0	2	41
	2006–07	61	23	10	6	0	33
	2007–08	56	33	5	3	3	39
	2008–09	36	46	0	18	0	28

Table 6, continued.

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	n ^a
6B	2004–05	8	67	8	0	17	30
	2005–06	6	63	6	0	25	20
	2006–07	10	52	0	5	33	25
	2007–08	8	63	4	0	25	27
	2008–09	0	65	0	0	35	26
6C	2004–05	0	39	0	0	61	40
	2005–06	0	58	5	3	34	39
	2006–07	0	47	0	6	47	70
	2007–08	0	54	5	16	25	112
	2008–09	0	52	3	21	24	70
6D	2004–05	0	0	0	0	100	3
	2005–06	0	50	0	0	50	3
	2006–07	0	0	17	0	83	6
	2007–08	25	0	50	0	25	4
	2008–09	0	17	0	17	67	7
Unit 6 TOTAL	2004–05	32	37	3	1	27	116
	2005–06	15	61	4	1	19	101
	2006–07	17	40	3	6	35	135
	2007–08	15	49	6	10	20	182
	2008–09	8	51	2	16	23	131

^a Totals may include harvest of using unknown transportation.

**WILDLIFE
MANAGEMENT REPORT**

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

MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

Game Management Unit: 7 (3,520 mi²)

Geographic Description: Eastern Kenai Peninsula

BACKGROUND

Federal public lands cover approximately 78% of Unit 7, for which 50% is 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.

MANAGEMENT DIRECTION

Management Objective

To maintain a healthy population of moose with a minimum bull: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 eight count areas in December 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 (SF/50). 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 2004 through 2008 in Unit 7 was 30 moose (Table 2).

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). Due to low counts, no permits were issued for DM522 in 2008.

Board of Game Action and Emergency Orders. There were no Board of Game (BOG) actions for Unit 7 moose during the reporting period.

Hunter Residency and Success. About half of the general season hunters were residents of Unit 7 (Table 4). The success rate averaged 9% over the past 5 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 25 moose per year during the past five seasons 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

Moose densities in Unit 7 are chronically low. Despite hunting seasons never starting before 20 August for at least the past 70 years, the Federal Subsistence Board granted residents of Cooper Landing a moose season that starts on 10 August in Unit 7 and Subunit 15A. Through Federal Subsistence regulations, residents of Cooper Landing can also hunt a postrut season (20 October–10 November) in Subunit 15B, when bulls are in poor condition after the rut. ADF&G was opposed to these federal regulations, but the Regional Advisory Council and the Federal Subsistence Board did not grant deference to conservation concerns raised by ADF&G. A federal subsistence season in Unit 7 of 10 August–20 September is being considered for residents of Hope and Sunrise. Future management reports will report the results and possible impacts of these Federal hunts.

PREPARED BY:

Thomas McDonough
Wildlife Biologist II

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

McDonough, T. 2010. Unit 7 moose management report. Pages 110–115 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 7 moose aerial composition counts and estimated population size, 2004–09.

Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
2004–05			No Surveys Conducted			700–1000
2005–06	23	11	8	422	465	700–1000
2006–07			No Surveys Conducted			700–1000
2007–08			No Surveys Conducted			700–1000
2008–09			No Surveys Conducted			700–1000

Table 2. Unit 7, reported general season moose harvest and accidental death, 2004–2008.

Regulatory Year	Reported Hunter Harvest				Accidental death			Total Reported Mortality
	Bull	Cow	Unknown	Total	Road	Train	Total	
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
2007–08	18	0	0	18	19		19	37
2008–09	31	0	1	32	23		23	55

Table 3. Unit 7, harvest for drawing permit hunts, 2004–2008.

Hunt Nr	Regulatory Year	Permits Issued	Permittees that hunted	Percent success	Harvest			
					Bulls	Cows	Unknown	Total
DM522 ^a	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
	2007–08	25	22	23	5	0	0	5
	2008–09	0						

^a Includes area within Units 15A and 7.

Table 4. Unit 7, residency and success of moose hunters for the general season, 2004–2008.

Regulatory Year	Successful				Unsuccessful				Total Hunters
	Local ^a Resident	Nonlocal Resident	Non-Resident	Total ^b (%)	Local ^a Resident	Nonlocal Resident	Non-Resident	Total ^b	
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
2007–08	8	9	1	18 (6)	128	144	15	287	305
2008–09	15	15	2	32 (11)	116	145	7	268	300

^a Local = residents of Unit 7.

^b Includes unspecified residency.

Table 5. Unit 7, moose general season harvest chronology (percent of harvest), 2004–2008.

Regulatory Year	Harvest Periods						Unknown	Harvest
	August		September					
	20–25	26–31	1–5	6–10	11–15	16–20		
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
2007–08	11	17	17	17	11	17	11	18
2008–09	22	9	9	9	19	28	3	32

Table 6. Unit 7, general season transport methods for successful moose hunters (percent of harvest), 2004–2008.

Regulatory Year	Percent of Harvest							Harvest
	3/4 wheel- ATV	Airplane	Boat	Highway Vehicle	Horse/ Dog team	ORV	Unknown	
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
2007–08	0	22	11	39	28	0	0	18
2008–09	3	6	9	50	28	0	3	32

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 9 (33,600 mi²)

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/mi²) or high (1.5–2.5 moose/mi²) densities, 2) increase low-density populations (where habitat conditions are not limiting) to 0.5 moose/mi², 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, and 9D.

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-mi² 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 400 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.

Lack of snow cover and aircraft availability prevented surveys of population trend count areas in the fall of 2007 and 2008, however age and sex composition data was collected in Units 9C and 9B during the fall of 2007 and in Unit 9C during the fall of 2008 by subsampling each of the established trend survey areas and pooling the data.

Bull:cow ratios in Unit 9B were generally lower than ratios reported during the 80s and 90s, but were above the management objective in 2007 (Table 1). The calf:cow ratio in Unit 9 was extremely low in 2007, but not unprecedented, as calf ratios in the unit have been known to fluctuate significantly (25-year average = 21.5 calves:100 cows, Table 1). Anecdotal observations made by guides and Lake Clark National Park staff suggest that moose numbers have declined in the northern portion of Unit 9B (Lake Clark National Park and Preserve), but additional survey data are needed to document the trend.

The bull:cow ratio is above the management objective in Unit 9C and appears to be increasing following several years of improved recruitment (Table 2). Surveys conducted in 2007 and 2008 incorporated a variation in sampling technique compared to prior years, which may account for some change in the ratio estimate. However, a large number of yearling bulls were also observed, which altered the ratio, and also suggests that the increase is the result of improved moose calf

recruitment. The calf:cow ratio was lower in 2008 than it had been in 2005 and 2007, but still within the normal range of ratios observed in Unit 9C over the past 25 years.

Surveys in Unit 9E were not conducted during this survey period due to increasing tension between user groups in Units 9B and 9C. 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 appeared stable the last time surveys were possible. Harvests in most of Unit 9E were not high enough to have a negative influence on population size or 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, with a bag limit of 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. Unit 9B residents 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 was 1–15 September throughout the Unit, but the resident winter season dates were different between the Naknek River drainage and the remainder of 9C. Within the Naknek drainage the state hunting season was open 1–31 December, while the remainder of 9C was open 15 December–15 January. The resident bag limit was one bull. 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–31 January with a bag limit of 1 bull. Only antlered bulls could be harvested during the 1 December–31 January hunt.

Unit 9D was open only to residents 15 December–20 January with a bag limit of 1 bull under state regulations. Federal subsistence permits were also issued in Unit 9D for a federal hunt with the same season and bag limit. However, of the federal season was scheduled to close once 10 bulls had been harvested from both the state and federal hunts combined.

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 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 ranged between 107 and 179 moose annually since 2000 (Table 4), with an annual average of 154. Household surveys of several communities 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 1990s 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 = 50% from 2000 to 2008, range = 41–57%) than either residents of Unit 9 (average = 27% from 2000 to 2008, range = 19–33%) or other Alaska residents (average = 28% from 2000 to 2008, range = 19–35%) because virtually all of them flew out to hunt, and many employed guides.

Harvest Chronology. Since 2000, the majority of the reported moose harvest has occurred in September (Table 6), with an average of 88% of the harvest occurring in that month. Reported harvest levels during the winter season have remained low and ranged from 7 to 16% of the total harvest. However, the total winter harvests exceed reported values according to many sources.

Transportation Methods. No major change in transportation type has occurred during the reporting period. 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.

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. The recent decline in moose harvests has been associated with a decrease in the number of people hunting moose in Unit 9 and was not the result of changes in the moose population. The reduced hunting effort is primarily attributed to the increasing cost of hunting moose in Unit 9 combined with recent downturns in the national economy and changes in caribou populations that greatly reduced the possibility of simultaneously hunting caribou.

The average annual harvest reported since 2000 (154 moose, primarily bulls) was within sustainable limits. An unknown number of unreported moose are taken each year, many of which are cows. Fortunately, these illegal practices primarily occur in specific geographic areas and are not pervasive enough to impact the overall Unit 9 moose population.

Tension between user groups 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. The same proposals are frequently accompanied by proposals to expand opportunity for the remaining user groups to levels that would be detrimental to moose populations in easily accessible areas. If these changes are instituted, moose hunting would essentially be eliminated in much of Unit 9 because the difficult access would limit the hunting opportunity for the remaining hunters. Moose would be exploited in easily accessible areas, eventually reducing harvest rates for the remaining hunters. At the suggestion of the Board of Game, a working group of various stakeholders was formed to address user group tensions in the area. The Unit 9 Moose Working Group plans to meet in 2010.

Brown bear predation on neonate moose and illegal harvests in select areas are the major factors limiting the moose population in Unit 9. However, altering bear:moose ratios would require substantial reduction in bear densities to achieve a measurable improvement in moose calf survival. The drastic reduction in bear numbers required to improve moose calf survival 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.

PREPARED BY:

Lem Butler
Wildlife Biologist III

SUBMITTED BY:

Tony Kavalok
Acting Management Coordinator

Please cite any information taken from this section, and reference as:

BUTLER, L. G. 2010. Unit 9 moose management report. Pages 116-123 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau.

TABLE 1 Moose composition counts in Unit 9B, 2003–2007

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
2005	23	5.5	19	13	158	182	20
2007	40	4	2	2	103	106	27

TABLE 2 Moose composition counts in Unit 9C, 2005–2008

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
2005	34	9	19	12	440	504	36
2007	40	8	20	13	236	270	34
2008	46	4	13	8	166	181	

TABLE 3 Moose composition counts in Unit 9E, 2002–2005

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
2002 ^a	74	27	20	11	87	97	47
2003 ^a	46	10	10	6	131	140	18
2005 ^a	25	5	22	15	81	95	19

^a Includes some surveys by FWS.

TABLE 4 Annual moose harvest in Unit 9, 2001–2008

Year	Reported				Estimated	
	Male	Female	Unknown	Total	Unreported	Total
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
2007	147	0	0	147	100	247
2008	107	0	0	107	100	207

TABLE 5 Moose hunter residency and success in Unit 9, 2001–2009

Year	Successful					Unsuccessful				
	Local resident	Nonlocal resident	Nonresident	Unk.	Total	Local resident	Nonlocal resident	Nonresident	Unk.	Total
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
2007	31	31	81	4	147	95	75	85	2	257
2008	33	18	53	2	106	99	78	77	3	257

TABLE 6 Reported moose harvest chronology (percent) in Unit 9, 2001–2008

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
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
2007	1	3	19	44	19	6	5	3	0
2008	0	11	15	43	14	2	12	2	1

TABLE 7 Successful moose hunter transport methods (percent) in Unit 9, 2001–2008

Year	Airplane	Boat	3- or 4- wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unspecified
2001	59	24	6	7	0	2	2	2
2002	65	28	3	0	1	2	0	1
2003	57	21	7	10	1	2	1	2
2004	59	25	4	3	3	2	0	4
2005	61	26	8	2	0	3	0	1
2006	61	23	5	8	0	1	0	2
2007	67	14	9	4	3	1	1	2
2008	57	21	7	10	2	2	0	1

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 11 (12,784 mi²)

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 bottomed out in 2001 (19 moose per hour) because of severe winters and increased wolf predation, and have been increasing slightly since.

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 with a bag limit of 1 bull. Total Unit 11 moose harvests have averaged 47 bulls per year since.

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 the park boundaries, rather than the preserve, 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 other 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. The population has been relatively stable since the early 1990s, with a slight improvement in recent years. Because of a lack of snow, fall counts were not completed in 2002 or 2005. The surveys in 2004, 2007, and 2009 were dropped 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. In the past year, however, much of the private Native corporation lands in Unit 11 have been converted to full fire suppression. The checkerboard pattern of private lands in the unit may encourage fire suppression on adjacent lands as well.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

In 2008, 164 moose (0.6 moose/mi^2) were observed in Count Area (CA) 11 (212 mi^2 ; the western slopes of Mount Drum). This is the highest count since 1990, when 209 moose (0.7 moose/mi^2) were observed, and appreciably higher than the count of 93 (0.3 moose/mi^2) obtained in 2001. Even though moose numbers have improved somewhat during this reporting period, the overall moose population remains at a low density throughout Unit 11. To help monitor moose in northern Unit 11 where hunter access is good, a new count area (CA 11-02) was recently established between Boulder Creek and Drop Creek by the NPS.

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 $0.1\text{--}0.4 \text{ moose/mi}^2$ and resulted in an extrapolated unitwide population estimate of approximately 2,500 moose (within Unit 11 approximately $5,800 \text{ mi}^2$ are considered 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 3,300 moose (Bill Route, NPS, personal

communication). The most recent census conducted by NPS biologists, in fall 2007, resulted in a moose density estimate of 0.5 moose/mi² over a 3,170 mi² area of Unit 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 2,900 moose.

Population Composition

The bull:cow ratio in CA11, between the Sanford and Nadina rivers was 73:100 in 2008 (Table 1). In this area, bull:cow ratios had been between 92 and 115 bulls:100 cows since 2003. The bull:cow ratio in CA 11-02, between Boulder Creek and Drop Creek was 41:100 in 2008 (Mason Reid, NPS, personal communication). The lower bull:cow ratio in this area reflects better hunter access. These bull:cow ratios exceed the current management goal of maintaining no less than 30 total bulls:100 cows, and 15 adult bulls:100 cows.

The 2008 calf:cow ratio in CA 11 of 17:100 is well below the 2006 count of 48:100, but typical of the 9–25 calves:100 cows usually observed. The unusually high ratio observed in 2006 could be explained by movement, increased production and/or survival in this area. Reid reported calf:cow ratios in 2007 during the NPS census of 19:100, a figure more in line with values usually observed in CA11 (Mason Reid, NPS personal communication).

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 post-rutting concentrations normally occur in upland habitats to elevations as high as 4,000 feet. Migrations to lower elevations begin with snowfall, but usually are not complete until late November or 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. During the March 2009 meeting the Board of Game opened Unit 11 to a community harvest hunt for moose by the eight Ahtna communities of Chitina, Kluti kaah, Tazlina, Gakona, Gulkana, Chistochina, Mentasta and Cantwell. The season dates are 10 August – 20 September and the bag limit is 1 bull. Community hunters can take up to 15 ‘any’ bulls, and an unlimited number of bulls meeting the state general hunt antler restrictions. For purposes of this hunt, an ‘any’ bull is one that does not meet the state general hunt antler restrictions.

Hunter Harvest. The combined federal and state harvest for the 2008–09 season was 53 bull moose (Table 2). The reported moose harvest averaged 48 (range = 40–56) a year for the 5-year period between 2004 and 2008. With the 2008 harvest within the 5-year range, no trends are evident.

Hunter Residency and Success. Local rural residents accounted for 12% (n=3) of the total moose taken in Unit 11 during 2008, nonlocal Alaska residents took 40% (n=10), and nonresidents took 48% (n=12; Table 3). 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 and open only to local residents, the federal hunt is more appealing than the state hunt. The bag limit is 1 bull and the hunt area includes both the preserve and hard-park. In 2008, 181 local resident hunters reported taking 28 bulls in the federal hunt (Table 4); 53% of the total Unit 11 harvest.

The overall hunter success rate in 2008 was 20% for the state general hunt, no change from the 5-year average of 20% between 2004 and 2008. Success rates for federal subsistence hunters have been lower, averaging 15% (range = 11–18; Table 4). Successful state hunters averaged 6.4 (range = 5.8–6.9) days in the field to kill a moose during this reporting period, while unsuccessful hunters averaged 7.1 (range = 6.9–7.6) 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, especially during the last week, in Unit 11 (Table 5). Bull moose are more vulnerable then. Their movements increase at the onset of rut in mid September, they respond better to hunters' calls, and the timing 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 can be used for hunter transportation in the preserve, but not in the hard-park. Except for federal subsistence hunting, all off-road vehicle use on federal lands in Unit 11 is restricted to existing trails by permit only. Since federal subsistence hunters do not need a permit to use 3-or 4-wheelers or ORVs on NPS lands in Unit 11, 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

Wolves and brown bears are abundant in Unit 11, but predation rates on moose 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 generally 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

There is no evidence to suggest this moose population has productivity limitations. Given the consistent low density of moose, browse removal is minimal across the unit. Even within the small clear-cuts on the lower Chitina River from the mid 1990s, browse utilization rates on the relatively early succession willow appear very low.

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 that era, a natural fire mosaic with substantial amounts of early succession browse, rapidly declined after the 1960s. In 1981, the Wilson Camp Fire started on the slopes of Mt. Drum and covered 13,000 acres (20 mi²). Not a single substantial fire occurred in Unit 11 for another 27 years. In 2009, the Chakina fire near McCarthy burned 52,000 acres (81 mi²). This fire should produce forage for moose within a few years. Other recent fires have received initial fire suppression due to changes in land management policies, such as the Kotsina River fire in 2009, or have had unfavorable burning conditions. 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 Native corporation lands. The willow regrowth in some of these cuts has been substantial. However, most of it remains underutilized by moose, as 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, and NPS regulations prohibit wildlife population and habitat manipulation.

Unit 11 is covered by the Copper River Fire Management Plan which was designed to bring natural wildfire back onto the landscape. Given recent changes in land management policies, large tracts of private Native corporation land, even though remote, are now listed under the full protection category. This will have substantial impacts on fire management throughout Unit 11. In addition to full fire suppression on private corporation lands, NPS will now be expected to suppress fires on any adjacent lands, if there is any chance the fire could spread to corporation land. Even though fire has been absent from much of Unit 11 for over 60 years, the possibility of habitat enhancement from wildfire in vast portions of the unit is very low.

CONCLUSIONS AND RECOMMENDATIONS

An increase in the number of moose counted, the moose per hour figures, and the moose per mi² figures lead to the conclusion that moose numbers in the western portion of Unit 11 may have increased slightly between 2001 and 2008. Recent winters have been mild and snow depths have been average. Predation remains the limiting factor for moose in Unit 11. Given the relatively high numbers of brown bears and wolves in Unit 11, the moose population is expected to remain

at a relative low density for an extended period of time. Annual fluctuations may occur when predation rates respond to changing winter severity. The Chakina fire should provide substantial new early succession browse near McCarthy in the next 3–10 years. Without a reciprocal decline in predation, the response in the moose population is expected to be minimal.

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. While the number of hunters has increased since 2000 for all hunts combined, much of this was due to the establishment of the NPS federal subsistence moose 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 1 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 allowing the population to fluctuate as dictated by available habitat and predation rates should be re-evaluated. We need to explore available options to enhance the moose population consistent with NPS regulations and other land management policies in Unit 11. I recommend reviewing the control and enforcement of moose harvest in Unit 11. Having separate federal and state hunts creates numerous enforcement and reporting problems, such as illegally taken moose on state or private land being reported on federal subsistence permits.

LITERATURE CITED

GASAWAY, W. C., R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey and man in interior Alaska. *Wildlife Monographs* 84.

PREPARED BY:

Robert W. Tobey
Wildlife Biologist III

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

TOBEY R. W. 2010. Unit 11 moose management report. Pages 124–132 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau.

TABLE 1 Unit 11 (CA-11) fall aerial moose composition counts, 2000–2009

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	--	--	--	--	--	--	--
2008	73	7	17	9	149	164	38	0.6
2009	No data	--	--	--	--	--	--	--

TABLE 2 Unit 11 Moose harvest ^a and accidental death, 2000–2009

Regulatory Year	M	Reported F	Total ^b	Unreported	Estimated Illegal	Total	Total
2000–01	45	0	45	5	5	10	55
2001–02	42	1	43	5	5	10	53
2002–03	51	0	51	5	5	10	61
2003–04 ^c	45	0	45	5	5	10	55
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
2007–08	47	1	48	5	5	10	58
2008–09 ^c	54	0	54	5	5	10	64

^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, 2000–2009

Regulatory Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Non- Resident	Total ^a	Local resident	Nonlocal resident	Non- resident	Total ^a
2000–01	8	5	4	22	41	42	4	88
2001–02	5	12	8	28	42	34	4	91
2002–03	8	12	8	30	54	30	8	92
2003–04	9	7	14	30	35	46	12	97
2004–05	4	10	13	27	38	34	12	84
2005–06	8	6	8	22	36	46	18	100
2006–07	6	6	8	20	30	39	4	76
2007–08	3	8	13	24	48	40	12	100
2008–09	3	10	12	25	41	52	8	101

^a Includes unspecified residency.

TABLE 4 Unit 11 Federal subsistence permit hunt, 2000–2009

Hunt	Regulatory year	Permits issued	Percent ^a did not	Number (%) unsuccessful	Number (%) successful	Bulls	Cows	Unknown	Harvest
			hunt	hunters	hunters				
RM 714	2000–01	161	16	98 (81)	23 (19)	23	0	0	23
	2001–02	183	22	114 (88)	15 (12)	14	1	0	15
	2002–03	191	27	108 (84)	21 (16)	21	0	0	21
	2003–04	245	22	141 (90)	15 (10)	15	0	0	15
	2004–05	263	30	126 (82)	27 (18)	27	0	0	27
	2005–06	231	27	123 (84)	24 (16)	24	0	0	24
	2006–07	254	30	151 (89)	18 (11)	18	0	0	18
	2007–08	283	32	159 (87)	24 (13)	24	0	0	24
	2008–09	280	32	153 (85)	28 (15)	28	0	0	28

^a Percent of all permittees returning reports.

TABLE 5 Unit 11 Moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, 2000–2009

Regulatory	Season	<i>Week of Season</i>				
Year	Dates	1st	2nd	3rd	4th	5th
2000–01	20 Aug–20 Sep	9	5	9	32	45
2001–02	20 Aug–20 Sep	7	7	7	30	48
2002–03	20 Aug–20 Sep	11	0	25	32	32
2003–04	20 Aug–20 Sep	10	10	17	38	24
2004–05	20 Aug–20 Sep	4	4	23	38	31
2005–06	20 Aug–20 Sep	9	14	18	27	27
2006–07	20 Aug–20 Sep	0	15	30	20	35
2007–08	20 Aug–20 Sep	8	13	8	29	42
2008–09	20 Aug–20 Sep	8	12	16	12	52

132

TABLE 6 Unit 11 Successful moose hunter transport methods (%) for general state harvest ticket hunt only, 2000–2009

Regulatory Year	Airplane	Horse	Boat	3- or 4- Wheeler	Snowmachine	ORV	Highway vehicle	Unknown
2000–01	59	0	0	18	0	5	14	5
2001–02	61	0	0	25	0	7	7	0
2002–03	33	3	13	27	0	7	13	3
2003–04	60	3	3	17	0	10	7	0
2004–05	56	7	0	11	0	15	11	0
2005–06	45	5	0	36	0	5	9	0
2006–07	45	10	0	30	0	0	15	0
2007–08	50	8	4	25	0	8	0	4
2008–09	56	8	4	8	0	8	12	4

**WILDLIFE
MANAGEMENT REPORT**

**Alaska Department of Fish and Game
Division of Wildlife Conservation**
(907) 465-4190 PO Box 115526
Juneau, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 12 (10,000 mi²)

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 at 0.2–0.4 moose/mi² (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/mi²).

Based on data collected during October–November aerial composition surveys and area-specific population estimation surveys from 1989 through 2008, 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 1998–2008. During the growth phase of 1994–1997, the most apparent increase occurred in northwest Unit 12 within the area affected by the 1990 Tok wildfire (155 mi²). Population estimates indicate this area supported 0.19 moose/mi² in 1989, 0.6 moose/mi² by 1994, and about 1.0 moose/mi² in 1997.

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

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

tourists driving the Alaska Highway. 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, 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 RY03 we estimated moose population size and composition in Unit 12 (excluding Wrangell–St. Elias National Park and Preserve) 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. To accomplish this we used survey data collected in fall 2003 in cooperation with U.S. Fish and Wildlife Service (FWS), Tetlin National Wildlife Refuge (Tetlin NWR) staff. ADF&G staff also conducted GSPE moose population estimation surveys during fall 2005 (2845 mi²) and 2006 (2702 mi²) on state and private lands in northwest Unit 12. Search intensity was approximately 4.0–5.0 min/mi² for these surveys.

During November 2008 we cooperated with Tetlin NWR staff to complete a unitwide GSPE survey similar to the area surveyed in 2003, including the 2702 mi² northwest Unit 12 survey area. Comparisons of the 2008 survey (search intensity of 7.0 to 8.0 min/mi²) with previous surveys (search intensity of 4.0 to 5.0 min/mi²) should be made with caution because of the differences in search intensity, which affects moose sightability (R. Boertje, ADF&G Fairbanks, unpublished data).

A sightability correction factor (SCF) specific to Unit 12 GSPE surveys does not exist (R. Boertje, ADF&G, unpublished data, Fairbanks). Therefore, based on studies conducted in Units 20A and 19D during 2003–2006 we applied an SCF of 1.25 to the Unit 12 GSPE estimate of observable moose during 2000–2006. We applied a lower SCF (1.2) to the 2008 estimate of observable moose due to the increased search intensity of that survey. Observable moose estimates used a relatively cost-efficient search and estimates modified by an SCF should be used with caution.

Data collected for the GSPE surveys were also used to determine moose population trends and sex and age composition within the survey areas and within the entire unit. During GSPE surveys, moose 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 unidentifiable moose.

No other surveys were conducted during RY07–RY08.

HARVEST

Harvest was estimated using mandatory harvest report cards. To increase the reporting rate, reminder letters were sent to hunters who did not initially report. Data 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 (DNR), Division of Forestry on a cooperative wildlife habitat logging plan for the lower Tok River drainage, to increase deciduous browse and cover for wildlife while providing nursery structure for spruce regeneration. The *Robertson River Prescribed Burn Plan* (Paragi et al., ADF&G–DNR 2002 unpublished Robertson River burn plan, Fairbanks) was completed in 2001 and may be implemented when conditions and funding allow.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In RY03 we estimated the Unit 12 observable moose population at 4000 moose ($\pm 22\%$, 90% CI). We estimated the total number of moose at 3600–6400 using an SCF of 1.25. This yielded an estimated density of 0.6–1.1 moose/mi² within the 6000 mi² of suitable moose habitat. Although unitwide population surveys were not conducted during RY04–RY07, similar density estimates in northwest Unit 12 of 1.35, 0.94, 1.07, and 1.43 moose/mi² in 2003, 2005, 2006, and 2008, respectively, suggest a stable population trend (Table 1).

The 2008 combined ADF&G and Tetlin NWR GSPE moose surveys produced an estimated 5000 ($\pm 13\%$, 90% CI) observable moose in Unit 12 excluding Wrangell–St. Elias National Park and Preserve. After applying an SCF of 1.20, the total estimated number of moose in the 6000 mi^2 of suitable moose habitat was 5160–6720 (0.9–1.1 moose/ mi^2). The highest moose densities (1.19 observable moose/ mi^2) were in northwest Unit 12, surveyed by ADF&G.

Localized moose harvest likely caused declines in moose numbers near communities in Unit 12. Poaching and legal harvest for funeral and ceremonial potlatches likely had a significant effect, because cow moose were frequently harvested. However, research has shown that predation by both wolves and bears is generally the primary factor maintaining the area moose population at low densities (0.2–1.1 moose/ mi^2 , Gasaway et al. 1992; FWS Tetlin NWR, unpublished data, Tok).

Population Composition

Bull:cow ratios in northwest Unit 12 during 2006 and 2008 were 37:100 and 46:100. This compares to only 22 bulls:100 cows found during the 2005 survey, which covered a smaller (731 mi^2) portion of the upper Tok River drainage (excluding most of the Little Tok River drainage). Conservative antler restrictions were implemented based on the 2005 results, and the ratio was higher in that area in 2008. Antler restrictions required resident hunters to harvest bulls with spike–fork antlers or ≥ 50 -inch antlers, or antlers with ≥ 4 brow tines; and nonresidents were required to harvest bulls with ≥ 50 -inch antlers or antlers with ≥ 4 brow tines. Calf:cow ratios during fall surveys in northwest Unit 12 were 35:100 and 41:100 and yearling bull:cow ratios were 11:100 and 15:100 during 2006 and 2008 respectively (Table 2).

Distribution and Movements

Moose do not occupy the large portions of Unit 12 that are composed of rock and ice at high elevation in the Alaska, Wrangell and Nutzotin mountains. Moose generally occur below 4500 feet throughout Unit 12. Based on this criterion, 6000 mi^2 (15,540 km^2) of Unit 12 is suitable moose habitat. Recent satellite imagery (The National Map LANDFIRE. 2009. LANDFIRE National Existing Vegetation Type layer. U.S. Department of Interior, Geological Survey. Available at: <http://gisdata.usgs.net/website/landfire/>) created vegetation classifications based on 2001 Landsat™ imagery. This classification system estimates 5250 mi^2 (13,597 km^2) of available winter moose habitat (deciduous woody browse ≥ 0.5 m tall) and 6572 mi^2 (17,021 km^2) of summer range (winter range plus all other vegetated types) (T. Paragi, ADF&G Fairbanks unpublished data). I continued to use the more general 6000 mi^2 of moose habitat for this report because the LANDFIRE classification system has not yet been validated.

There are both migratory and nonmigratory segments of the moose population, with moose that rut in the Tok River area moving 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 winter, to either the area burned by the 1990 Tok wildfire or the Tanana River, a straight-line distance of 90–100 miles (144–160 km; ADF&G, unpublished data, Tok).

During RY99–RY08, 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 potlatch harvest likely contribute to low numbers of resident moose in these areas.

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. Reducing harvest could become necessary if the population is depleted or has reduced productivity. The board set the Unit 12 IM population objective at 4000–6000 moose and IM harvest objective at 250–350 moose.

Since the mid 1970s, residents of communities in and adjacent to Units 12 and 20E 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 the 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 mi² (17,094 km²) 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 mi² (6993 km²) 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 mi² 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 mi² (10,490 km²) portion of southern Unit 20E to reduce predation on moose calves. The brown bear control portion of the program was eliminated in 2009.

In 2006 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 Unit 12 within 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 appeared likely to fall in the future below the management objective of 20 bulls:100 cows.

Harvest by Hunters. Reported harvest in Unit 12 was 121 bulls and 1 moose of unknown sex in RY07 and 159 bulls in RY08 (Table 4). The harvest during the previous 5 years was similar, averaging 129 bulls annually (range 118–137).

Total unitwide harvest has represented $\leq 4\%$ of the estimated prehunt population in recent years and has likely had little impact on unitwide population dynamics. During RY07–RY08 the annual out-of-season take was estimated at 25–40 moose, mostly cows. In RY07–RY08, reported potlatch moose harvest averaged 12 moose per year (40% cows). However, reporting is poor and each year a large portion of the potlatch harvest remains undocumented. Most out-of-season take occurred near communities and along the road system.

Hunter Residency and Success. The number of people who reported hunting moose in Unit 12 was 615 in RY07 and 616 in RY08 (Table 5). Hunter numbers increased from the previous 5-year average of 561 hunters (9% increase). Participation by local and nonlocal Alaska residents and nonresidents all added to this increase. In RY07 the success rate of 20% was slightly below the previous 5-year average of 23%. In RY08 the success rate increased to 26%.

During RY07–RY08, local residents accounted for an average of 50% of moose hunters, nonlocal residents averaged 36% and nonresidents 13%. The number of local resident and nonresident hunters has remained relatively constant since RY94, but the number of nonlocal resident hunters has increased. Local hunters took 50% and 33% of the reported harvested bulls in RY07 and RY08, nonlocals took 31% and 36%, and nonresidents took 19% and 31% (Table 5). Harvest by nonlocal Alaska residents increased during RY99–RY08 compared to RY93–RY98, due to increasing numbers of nonlocal Alaska resident hunters.

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–RY08 (24–28 Aug) harvest was reduced 44% ($\bar{x}$ = 12 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, but the unitwide harvest has remained within sustainable levels.

Transport Methods. During RY07–RY08, the type of transportation used most by successful hunters was 4-wheelers ($\bar{x}$ = 31%), followed by airplane ($\bar{x}$ = 17%) and boat ($\bar{x}$ = 16%), highway vehicle ($\bar{x}$ = 14%), other ORV ($\bar{x}$ = 9%), and horse ($\bar{x}$ = 10%, Table 7). During RY90–RY00, an average of 19% of successful hunters used ATVs and 24% used highway vehicles, compared to 39% and 17% respectively during RY04–RY08. This represents a 105% increase in ATV use by successful hunters and a 29% decrease in use of highway vehicles. Use of other transportation types by successful hunters remained relatively constant.

Other Mortality

Predation by wolves and grizzly bears is probably 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, Tok; FWS Tetlin NWR, unpublished data, Tok). 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 is high, suggesting grizzly bears were likely more significant predators in these areas.

HABITAT

Assessment

Wildfire suppression has allowed large areas of potentially good moose habitat to become dominated by spruce forests lacking abundant moose browse. However, browse surveys conducted periodically since the 1970s indicate that use of preferred browse species is low in most years 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. We do not believe that habitat was a major factor limiting the moose population in Unit 12 during RY07–RY08. However, the creation of medium- to large-scale habitats with early seral species may 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 early seral stages also reduce predation efficiency in a variety of ways.

Given no medium- to large-scale wildfires or changes in the population of wolves and grizzly bears in Unit 12, the moose population is likely to remain at low densities. However, it appears that concentrated public wolf trapping and bear harvest could cause local populations of moose to increase, especially in areas that have 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 wolf control efforts during RY05–RY09. Additional population data are needed to evaluate bear and wolf numbers in this area.

Enhancement

During the 1980s, more than 1800 acres of old-age, decadent willows were crushed to stimulate crown sprouting of new leaders. Data collected during browse surveys indicate that these habitat enhancement projects annually produced over 2 million pounds of additional winter moose browse for 10–15 years following the treatment. Since the 1980s in eastern Unit 12, the FWS completed several prescribed fires on approximately 10 mi² of mature spruce forest to benefit moose on Tetlin NWR.

In 1990 a wildfire burned approximately 97,000 acres of primarily black spruce muskeg in the Tetlin Hills and adjacent to Tok. Quality moose browse species now dominate much of this area. In response, the moose population increased rapidly from 0.19 moose/mi² in 1989 to 1.0 moose/mi² by 1997. Excellent moose winter browse is expected to persist for the next 10–15 years. As a result, local residents who observed the increase in moose in this area 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. However, no prescribed burns were conducted during RY07–RY08.

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 willows were 3–10 feet tall; <1% were above 10 feet and unavailable for moose. We observed use of this area during winter by 10–30 moose as well as an apparent increase in use as calving habitat.

Since 1998, we have been working in cooperation with DNR, Division of Forestry to determine suitable timber harvest sites within a proposed 1000 acre timber sale area in the Tok River valley. Logging and treatment of this area began in 2008 and will be completed over the next 5 to 10 years. 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. Twenty-to eighty-acre clearcuts are treated to encourage hardwood regeneration, with the objective of simulating natural succession. Beginning in 2008 about 1000 acres will be logged and treated during the next 5 to 10 years. Mechanical treatment projects began in spring 2010.

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 must be addressed. ADF&G has worked with local communities during village council meetings and traditional knowledge workshops to improve reporting and reduce harvest of cow moose, but limited corrective steps have been taken. Potlatches are culturally important and should be maintained; however, restrictions on harvest are recommended in portions of Unit 12 where moose densities are low. In summer 2004 we worked with local residents, the Tanana Chiefs Conference, and ADF&G, Division of Subsistence staff to design management of potlatch moose harvest that better protects the moose population while meeting the needs of community residents. In 2009 ADF&G worked with the Tetlin Village Council to develop a Tetlin Tribal Moose Management Plan to better understand how the needs of the community of Tetlin can be met within Tetlin Tribal lands. We plan to continue these efforts in the future.

CONCLUSIONS AND RECOMMENDATIONS

Population surveys in fall 2008 indicate the unitwide population is likely stable at 5160–6720 moose (average density = 0.9–1.1 moose/mi² of suitable moose habitat), which met the IM population objective. Moose numbers in portions of Unit 12, especially near roads, remained low (<0.2 moose/mi²), which primarily affected subsistence hunters and nonconsumptive users. Predation and out-of-season take in certain areas likely maintained the moose population at low density, and we believe habitat was not a major limiting factor.

During RY07–RY08 we met 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. The bull:cow ratio in the more accessible areas remained approximately 20–25:100 due to moderate harvest rates and low yearling bull recruitment. Expanding the area with moose antler restrictions in RY06 appeared to be effective at increasing bull:cow ratios, while allowing maximum hunter opportunity. By fall 2008, the bull:cow ratio in the upper Tok River drainage improved to 39 bulls:100 cows. Similar harvest restrictions may be

needed in other areas of high harvest to maintain a bull:cow ratio adequate to meet our management objectives.

During RY04–RY08 the most significant change in harvest patterns was the increase in the portion of the harvest by hunters who used 4-wheelers (39%) compared to RY90–RY00 (19%). Since RY04, harvest has averaged 134 moose (range 118–159). 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 opportunity. However, continued harvest of cows is likely unsustainable in localized areas. Additional efforts need to be made to track overall cow harvest within the unit.

Totals of 122 and 159 moose were reported harvested during RY07 and RY08, respectively, which did not meet the IM harvest objective of 250–450 moose. Recruitment of young moose into the population is 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.

We monitored population trends during RY07–RY08. Additional habitat enhancement programs were planned and will be implemented during the next 2 years. Hunting seasons and bag limits allowed maximum allowable hunting opportunity and met subsistence opportunity. Moose viewing opportunities were enjoyed by both visitors and local residents. We continue to work with local communities to manage harvest and reduce take of cow moose.

LITERATURE CITED

- BOERTJE, R. D., D. G. KELLEYHOUSE, AND R. D. HAYES. 1995. Methods for reducing natural predation on moose in Alaska and Yukon: an evaluation. Pages 505–541 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Edmonton, Canada.
- DELONG, R. A. 2006. Geospatial population estimator software user's guide. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPESoftwareUsersGuide.pdf>> Accessed 29 May 2008.
- GARDNER, C. 2000. Unit 20E moose. Pages 373–393 in M. V. Hicks, editor. Moose management report of survey and inventory activities 1 July 1997–30 June 1999. Alaska Department Fish and Game. Study 1.0. Juneau, Alaska, USA.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22. University Alaska Fairbanks, USA.
- , R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPHERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. Wildlife Monographs 84.

KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://www.wildlife.alaska.gov/index.cfm?adfg=management.main>> Accessed 30 April 2008.

VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the section on statistics and the environment of the American Statistical Association.

PREPARED BY:

Torsten W. Bentzen
Wildlife Biologist II

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

BENTZEN, T. W. 2010. Unit 12 moose. Pages 134–149 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1 Unit 12 Northwest population estimate using the geospatial population estimator, 2000–2008

Year	Area surveyed	Survey size (mi ²)	Number of sample units surveyed	Population estimate (±90% CI)	Population estimate with SCF	Moose/mi ² w/SCF
2000	Northwest Unit 12	2846	60	2575 (±23%)	3219 ^a	1.13 ^a
2001	Northwest Unit 12	2865	79	2204 (±15%)	2755 ^a	0.96 ^a
2003	Northwest Unit 12	2845	69	3064 (±35%)	3830 ^a	1.35 ^a
2005	Northwest Unit 12	2845	48	2129 (±15%)	2661 ^a	0.94 ^a
2006	Northwest Unit 12	2702	89	2317 (±18%)	2896 ^a	1.07 ^a
2008	Northwest Unit 12	2702	92	3225 (±18%)	3870 ^b	1.43 ^b

^a Sightability correction factor of 1.25 used in estimate.

^b Sightability correction factor of 1.20 used in estimate.

TABLE 2 Unit 12 aerial moose composition counts, fall 1994–2008

Calendar Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Percent calves	Calves observed	Adults observed	Moose observed
1994 ^a	38	16	39	21	87	327	414
1994 ^b	97	13	25	11	47	374	421
1995 ^b	82	12	26	12	65	461	526
1996	39	9	32	19	236	1022	1258
1997 ^a	36	11	41	23	138	458	596
1997 ^b	87	22	31	14	73	439	512
1998 ^c	65	14	34	17	48	229	277
1998 ^d	38	7	29	17	26	124	150
2000 ^{e,f}	40	9	18	11	72	558	630
2000 ^{f,g}	84	10	34	15	39	229	268
2001 ^{e,f}	40	11	27	16	106	566	672
2001 ^{f,g}	64	18	33	14	66	400	466
2002 ^{e,f}	42	12	15	13	45	305	350
2003 ^{e,f}	25	7	32	19	111	464	575
2003 ^{f,g}	89	15	33	16	89	475	564
2004 ^{f,g}	70	16	48	20	89	351	440
2005 ^{e,f}	22	11	30	18	69	315	384
2006 ^{e,f}	37	7	41	21	185	688	873
2008 ^{f,g}	62	14	24	13	81	552	633
2008 ^{e,f}	46	15	35	20	218	899	1117

^a Based on population estimation results from northwest Unit 12.

^b Cheslina, Kalukna, Nabesna, and Chisana count areas were sampled using contour survey techniques.

^c Based on population estimation results from the Chisana area, southwest Unit 12 using the "No stratification" technique."

^d Only the north face of the Alaska Range sampled using the contour survey technique.

^e Survey area includes state and private lands in northwest Unit 12. Survey conducted by Alaska Department of Fish and Game.

^f Ratios determined using weighted contributions from high and low sample areas. Actual counts of cows, calves, and bulls were not used in estimates.

^g 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 2006–2007 through 2008–2009

Regulatory year	Area	Season	Bag limit ^a
2006–2007 through 2008–2009	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 NONRESIDENT: 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. 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 NONRESIDENT: 1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side. 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 NONRESIDENT: 8–17 Sep	1 bull. Or 1 bull. 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 at the widest point 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 2008–2009

Regulatory year	Harvest by hunters							Accidental death		
	Reported				Estimated					Total
	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 ^a	5–10	25–40	3–5	3–5	164–181
2006–2007	118 (100)	0 (0)	0	118	20–30 ^a	5–10	25–40	3–5	3–5	146–163
2007–2008	121 (100)	0 (0)	1	122	20–30 ^a	5–10	25–40	3–5	3–5	150–167
2008–2009	159 (100)	0 (0)	0	159	20–30 ^a	5–10	25–40	3–5	3–5	187–204

^aThis estimate of unreported harvest includes the reported ceremonial potlatch harvest of 9, 11, 11, and 12 moose in 2005, 2006, 2007, and 2008 respectively.

TABLE 5 Unit 12 moose hunter residency and success, regulatory years 1990–1991 through 2008–2009

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 (25)	251	119	14	0	384 (76)	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
2007–2008	61	38	23	0	122 (20)	256	189	45	3	493 (80)	615
2008–2009	53	57	49	0	159 (26)	251	160	42	4	457 (74)	616

^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 2008–2009

Regulatory year	Harvest chronology by month/day (%)							Total
	8/15–8/28	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	Unknown	
1990–1991		18 (18)	41 (42)	28 (29)	4 (4)	3 (3)	4 (4)	98
1991–1992		34 (31)	45 (41)	22 (20)	4 (4)	1 (1)	4 (4)	110
1992–1993		25 (35)	31 (44)	6 (8)	4 (6)	4 (6)	1 (1)	71
1993–1994		29 (32)	40 (44)	16 (18)	4 (4)	0 (0)	2 (2)	91
1994–1995		25 (28)	26 (30)	25 (28)	3 (3)	4 (5)	5 (6)	88
1995–1996	2 (2)	33 (28)	52 (44)	17 (14)	5 (4)	6 (5)	2 (3)	118 ^a
1996–1997	1 (1)	39 (31)	44 (35)	27 (22)	7 (6)	1 (1)	4 (4)	124 ^a
1997–1998	1 (1)	30 (29)	38 (37)	19 (19)	10 (10)	1 (1)	3 (3)	102
1998–1999	2 (1)	41 (28)	65 (44)	30 (20)	5 (3)	1 (1)	5 (3)	149
1999–2000	11 (8)	37 (27)	54 (39)	23 (17)	3 (2)	2 (1)	9 (6)	139
2000–2001	4 (4)	32 (29)	48 (43)	16 (14)	6 (5)	2 (2)	4 (4)	112
2001–2002	9 (9)	0 (0)	41 (41)	34 (34)	6 (6)	4 (4)	7 (7)	101
2002–2003	13 (10)	0 (0)	64 (52)	45 (36)	0 (0)	0 (0)	2 (2)	124
2003–2004	12 (9)	2 (1)	63 (47)	40 (30)	12 (9)	2 (1)	3 (2)	134
2004–2005	7 (5)	3 (2)	68 (50)	43 (32)	10 (7)	4 (3)	0 (0)	135
2005–2006	12 (9)	0 (0)	58 (46)	43 (34)	7 (6)	7 (6)	0 (0)	127
2006–2007	15 (13)	2 (2)	60 (51)	31 (26)	4 (3)	4 (3)	2 (2)	118
2007–2008	15 (12)	0 (0)	58 (48)	36 (30)	5 (4)	3 (2)	5 (4)	122
2008–2009	16 (10)	3 (2)	82 (52)	42 (26)	12 (8)	3 (2)	1 (1)	159

^a 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 2008–2009

Regulatory year	Harvest percent by transport method								<i>n</i>
	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
2007–2008	17	8	13	30	0	10	18	3	122
2008–2009	18	11	18	32	0	8	11	3	159

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009^a

LOCATION

GAME MANAGEMENT UNIT: 13 (23,368 mi²)

GEOGRAPHIC DESCRIPTION: Nelchina and Upper Susitna River

BACKGROUND

Moose densities in Game Management Unit 13 were low during the early 1900s, but started to increase by the 1940s. Moose were abundant throughout the 1950s, and the population peaked in the mid 1960s. For the next 10 years, moose numbers declined and reached a population low by 1975. Factors contributing to the decline were severe winters, increased predation, and large human harvests of both bulls and cows.

The number of moose counted during fall surveys started to increase in 1978 and climbed at an average annual rate of 5% until 1987, when the population peaked again. Moose numbers started to decline again during the early 1990s, because of a series of severe winters and increased predation. Moose declined by an estimated 47%, reaching a low in 2001. Since implementation of active wolf management in Unit 13 in 2003, moose numbers have been increasing.

Historically, Unit 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging more than 1,200 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 three brow tines on at least one antler. Under this management regime, the bull harvest dropped 34% from the previous season. From 1981–1988, the population increased, as did the harvest, which peaked in 1988 at 1,259 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.

^a This unit report also includes data collected after the end of the reporting period at the discretion of the reporting biologist.

The moose harvest along with the population has steadily increased since then.

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 1,200–2,000 animals. Provide for a subsistence harvest of 300–600 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 5,000 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. Monitoring remains ongoing for the browse plots and new count area.

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 46% (average = 6% annually), going from 3,466 in 2001 to 5,046 in 2009 (includes an estimated 171 moose for count area 15). The moose per hour figure went up 35% between 2001 and 2009 (37 to 50 moose/hour). A moose count in CA12, a low density area in the Lake Louise flats, was conducted in 2009 and data compared to 2006. The number of moose counted was up 6% a year. Counts on low density areas near Cantwell showed similar increases. Moose appear to be increasing in poorer habitats also. The increase in moose numbers is attributed to good productivity, mild winters, and lower wolf predation due to predator management.

Population Size

Unit 13 covers nearly 24,000 mi^2 over five 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 3,600 mi^2 . Density estimates from fall 2009 counts ranged from a low of 0.5 moose/ mi^2 in subunit 13D (count area 15), to a high of 2.0 moose/ mi^2 in count area 13 within Subunit 13A. An average of 1.7 moose/ mi^2 was observed within the continuous trend count areas during 2009 (Table 2), up 70% 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 current population objective until fall trend count figures increase to the levels observed during the late 1980s.

Population Composition

Composition data collected during fall sex and age counts from 2001 through 2009 are presented in Table 1. The Unit 13 bull:cow ratio for the continuous count areas steadily increased from 23 bulls:100 cows in 2001 to 35 bulls:100 cows in 2008. The bull:cow ratio in 2009 was 34 bulls:100 cows and now exceeds management goals for the unit as a whole. The lowest bull:cow ratios are in Units 13A and 13E (Table 2). An analysis of the bull:cow ratio by age class indicates an increase of 6 yearling bulls:100 cows from 2001 to 2009 (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 Units 13A, 13D and 13E, though still fall short in the remaining subunits (Table 2).

Fall calf:cow ratios in the continuous count areas were 19:100 in 2008 and 23:100 in 2009 (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 of 11:100 observed in 2000 was the lowest annual estimate ever observed in GMU 13. Although calf:cow ratios the last four years have shown improvement, 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 Unit 13 predator management program. Bear predation on calves remains high.

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 Units 13A and 13B. The lower rates were attributed to misdiagnosis and a disproportionate number of older cows in the sample population. Research in Unit 13A since the early 1990s has addressed pregnancy and twinning rates. The radio-collared 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 two of the three years (Testa 1997). These pregnancy rates were similar to those observed during earlier research by Ballard et al. (1991), when calf recruitment was higher. The pregnancy rate for November 2007 was likewise 88% (Dale, pers. comm.).

The fall in utero twinning rate was 26% (n=43) for radio-collared cows in Unit 13A, tested by ultrasound in 1994 and 1995 (Testa and Adams 1998). The twinning rate at birth for collared cows in Unit 13A was 27% in 2009 but, based on calf observations, has averaged 20% (range = 9–35) between 1994 and 2009. 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 Unit 13A, averaging 31% (range = 11–51) between 1992 and 2009. For interior Alaska moose populations, twinning rates of $\geq 20\%$ 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 Units 13B and 13C and in the eastern Talkeetna Mountains in western Unit 13A. Subunit 13D and the Lake Louise Flats (eastern Unit 13A) continue to have the lowest densities unitwide. Historically, moose numbers in western Units 13A, 13B, and 13C have fluctuated more than the lower density areas of eastern Units 13A and 13D.

Fall rutting and post rutting 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 those 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 one bull with a spike/fork antler on one side, or four brow tines on one side, or a spread of 50 inches or more (SF/50).

A Tier II subsistence permit hunt was established in 1995, and 150 Tier II permits were issued

annually until the 2009 season when the hunt was cancelled. Tier II moose permits were limited to one per household. The Tier II hunting season during this report period was 15–31 August. Drawing hunts for residents to take any bull and for nonresidents to take a 50-inch or four brow tine bull, started in 2009. Also new in 2009, was the Ahtna community harvest hunt for 100 bulls and unlimited SF/50 bulls 10 August–20 September. A federal subsistence registration hunt has been in place in Unit 13 since 1990 for residents of Units 12, 13 and 20, with a bag limit of any bull and season dates of 1 August–20 September, within federal subsistence areas.

Board of Game Actions and Emergency Orders. 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. Tier II moose hunters were also required to salvage the heart and liver. In addition for the Tier II hunt, the use of aircraft or any off-road vehicle over 1,500 pounds were 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 of Game meeting, the aircraft and off-road vehicle use restrictions for the Tier II hunt were lifted.

The Board of Game, during the March 2009 meeting, cancelled the Tier II moose hunt. The board established drawing permit hunts for any bull, with up to 1,000 permits issued. In 2009, five hunt areas were established: two in Unit 13A, two in Unit 13B and one in Unit 13C with 160 permits issued. A drawing permit hunt for nonresidents to take a 50-inch or four brow tine bull with up to 150 permits issued was also established. In 2009, each of the five subunits were separate hunts and 10 permits were issued per subunit. The board also enacted a community harvest hunt primarily for Unit 13, but some hunting was also allowed under this permit in Unit 11 and a small portion of Unit 12 near Mentasta Pass. The bag limit was one bull per permit; however, only 100 bulls not meeting the SF/50 restrictions were allowed. An unlimited number of bulls meeting the general bag limit were allowed. Permit qualifications were determined by the eight Ahtna villages of Mentasta, Chistochina, Gakona, Gulkana, Kluti Kaah, Tazlina, Chitina and Cantwell. Ahtna Inc. issued the harvest tickets and was responsible for reporting.

Harvest

Total Harvest. The 2008 Unit 13 reported harvest was 735 moose from all hunts (Table 3). The lowest harvest in 40 years was 468 moose reported seven years earlier in 2001. Hunting pressure peaked in 1996 with 6,135 reported hunters, and then dropped 44% to a recent low of 3,462 in 2002. Pressure has steadily increased since then, with 4,278 hunters in 2008. The preliminary 2009 unit wide harvest is 863, up 17% from the 2008 take partially due to the new hunts created by the Board of Game.

General Hunt. Harvest reports from 2008 showed 616 moose taken by 3,586 hunters during the general state hunt (Table 4). This is the highest harvest in eight years, and an increase of 32% from the 2002 low of 466. The preliminary 2009 general harvest is 627.

Permit Hunts. The BLM implemented a subsistence moose hunt on federal land in 1990. Registration permits are issued to residents of Unit 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 reporting period averaged 52 bulls a year (Table 5). This is a very popular hunt for Unit 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 the unit. The fact that the federal harvest can account 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 surrounding state lands. With season dates of 1 August–20 September, federal hunters are out one month earlier than state general season hunters. While success is low early in the season, enforcement is 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 2008 was 62 bulls, and averaged 51 moose a year during this reporting period (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% and increased from 35 to 54 bulls. Of the total unit moose harvest, this subsistence harvest has gone from 3% in 1995 to approximately 8% in 2008. This hunt was eliminated before the 2009 season, because the total harvest of bulls has increased due to predator management, and the rural communities for Unit 13 requested a change in the subsistence hunt allocation procedure.

The 2009 preliminary harvest for the Ahtna community harvest hunt was 100 bulls (Table 5), with 70 of these bulls qualifying as “any bulls,” those having antler configurations or size not legal under the general hunt definition. There were 377 community harvest tickets issued with 43 people signed up as designated hunters. Hunter qualifications were set by the eight villages and based on village residency, ties to village residents or willingness to share meat with village residents.

The drawing permit hunt for any bull open to residents had a preliminary 2009 take of 64 bulls by 160 permittees (Table 5).

Nonresidents took a total of 12 SF/50 bulls with 50 permits in 2009 (Table 5).

Illegal Harvests. Unreported and illegal harvest estimates are presented in Table 3. The estimate for the illegal take is high (potentially exceeding 10% of the reported harvest) because of the spike-fork 50-inch regulation. A number of yearlings taken and reported as forks, may actually be illegal because of the difficulty distinguishing small paddles and palms from forks. Also, 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.

Hunter Residency and Success. Local residents (residents of Unit 13) accounted for 9–13% of the moose harvested under the general season, according to harvest report data (Table 4). Historically, nonresidents averaged 10% (7–12%) of the unitwide moose harvest; they took 1.4% of the total harvest in 2009.

The success rate for moose hunters in the Unit 13 general hunt has averaged 16% (range=13–18) for the last 15 years. As moose numbers declined, so did the number of hunters in GMU 13. The hunter success rate in 2008 for the Tier II subsistence permit hunt was 47%, and 10% for the

federal subsistence hunt (Table 5). Effort has remained steady in the general hunt over the last five years, averaging 7.4 (range = 7.1–7.7) days per hunter for successful hunters and 7.5 days (range = 7.2–7.8) 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 61% by 2002, when approximately 2,660 hunters spent an average of 8.0 days hunting (total of 21,169 days). In 2008, an average of 7.8 days of hunting was spent by 3,586 general season hunters (total of 27,334 days).

Harvest Chronology. Chronology data for the general hunt are presented in Table 6. The last two 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 movement's 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 Unit 13 is an important 4-wheeler and off-road vehicle (ORV) area for moose hunters. In 2008, those using either 4-wheelers or ORVs were the largest group of hunters and accounted for 75% of the total moose harvest.

Other Mortality

Brown bears are abundant in Unit 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 six 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 Unit 13 since the mid 1990s, in an attempt to substantially reduce the population and increase calf survival unitwide. Even though bear harvests have doubled under the more liberal regulations, ongoing research continues to show high neonatal losses due to bears (Dale, pers. comm.).

Wolf numbers in Unit 13 started increasing in 1990. The fall of 1999 and 2000, unitwide estimates exceeded 500 wolves (>12 wolves/1000km²) and were the highest in more than 25 years. Snow depths in 1999 and again in 2000 were considered severe. Based on unitwide wolf population and moose estimates, the fall 2000 moose:wolf ratio was estimated at about 31:1. Considering that wolves in Unit 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 take started increasing and the wolf population declined. Spring wolf estimates in 2008 and 2009 were approximately 153 and 145 wolves respectively (3.6 and 3.4 wolves/1000 km²), 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 Unit 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 more than 15 years. Record snow depths were recorded in 13E. The last two winters were classified as moderate or mild. Observations of winter mortality 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. Reduced wolf densities may increase this threshold above 30 inches. As the snowpack increases, yearlings, then adult bulls, and finally adult cows die, regardless of 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

Unit 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 Unit 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, 2003) 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 Unit 13. Because of the lack of fire-created seral plant communities, climax upland and riparian willow communities are the most important habitat types for moose in the unit.

Ongoing research continues to evaluate browse quality and use by moose in western portions of Unit 13A. All indications are that browse availability is high, and use rates are sustainable (Collins 2001). Although there is no problem with the amount of browse available, browse quality in Unit 13A is not as good as in other portions of the state. Bill Collins (pers. comm.) has found higher levels of tannins and lower nitrogen in Unit 13A browse than in nearby study areas in Denali National Park. He is currently investigating causes and implications for these findings.

The use of prescribed fires to replace wildfire as a method of improving moose habitat has had very limited application in Unit 13. The climate typically prevents the use of prescribed fire, except in the driest years. Also, scattered cabins and private land ownership 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 the 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. Land transfers in the Alphabet Hills area should be completed soon. Once ownership clears, plans call for another ignition attempt in years the fire prescription is met.

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 Unit 13C was treated in March of 2006. Another 80-acre site was treated in March 2008 in the same vicinity. Vegetation regrowth will be monitored over the next several years.

CONCLUSIONS AND RECOMMENDATIONS

Moose numbers have increased in Unit 13 since 2001. Comparison of the number of moose counted between 2001 and 2009 indicates there has been an increase in all sex and age categories of moose. Overall, moose count numbers are up approximately 46%, with the largest increases in Subunits 13A, 13B and 13C.

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: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. It is very difficult to detect changes in brown bear numbers with current population estimate techniques. Due to the extent of the moose population decline, a drop in the actual number of calves taken by bears could still result in a high mortality rate and impact on the moose population. 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 over the last two years of this reporting period meets or exceeds the overall management objective for the unit. Much of the increase 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. To take advantage of increasing bull numbers, harvest strategies have been modified to include additional any bull hunts during this reporting period.

Harvests and hunting pressure in Unit 13 increased during this reporting period; however, both harvests and hunting effort are well below the level observed in the late 1980s, when Unit 13 was one of the top moose hunting units in the state. Whether Unit 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 suggests Unit 13 moose reproductive performance figures remain average for moose statewide.

We recommend increasing moose harvests in those portions of Unit 13, where moose numbers have increased the most. Specifically, bull harvests should continue to be liberalized in Subunits 13A, 13B and 13C. Also, limited cow harvests should soon be established in Subunits 13A west, 13B and 13C. A permit system should be implemented to increase the harvest of bulls and a limited number of cows. These permit hunts should be for small specific areas, and the permit harvests limited by strict harvest objectives for each area.

LITERATURE CITED

- Ballard, W. B., T. H. Spraker, and K. P. Taylor. 1981. Causes of neonatal moose calf mortality in Southcentral Alaska. *Journal of Wildlife Management* 45(2):335–342.
- , J. S. Whitman, and C. L. Gardner. 1987. Ecology of an exploited wolf population in Southcentral Alaska. *Wildlife Monographs* 98. 54pp.
- , ———, and D. J. Reed. 1991. Population dynamics of moose in Southcentral Alaska. *Wildlife Monographs* 114:1–49.
- Collins, W. B. 2001. Interrelationship of forage and moose in Game Management Unit 13. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Research Final Report, Project W–24–4 through W–27–4, Study 1.50. Juneau, Alaska.
- Gasaway, W. C., S. D. DuBois, D. J. Reed and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. University of Alaska, Institute of Arctic Biology. Alaska Department of Fish and Game. Biological papers No. 22. Fairbanks, Alaska.
- Testa, J. W. 1997. Population dynamics of moose and predators in Game Management Unit 13. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report, Grant W–24–5, Study 1.49. Juneau, Alaska.
- and G. P. Adams. 1998. Body condition and adjustments to reproductive effort in female moose (*Alces alces*). *Journal of Mammalogy* 79(4):1345–1354.
- Ver Hoef J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.
- Copper River Basin Fire Management Plan, 2003.

PREPARED BY:

Robert W. Tobey
Wildlife Biologist

Rebecca A. Schwanke
Wildlife Biologist

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Tobey, R. W. and R. A. Schwanke. 2010. Unit 13 moose management report. Pages 150–164 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 13 fall aerial moose composition counts in continuous count areas 3, 5, 6, 10, 13, 14, 15, and 16, 2001–2009.

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)
2008	35	12	19	13	3918	4481	54	1.4 (0.5–2.0)
2009 ^b	34	9	23	15	4315	5046	50	1.7 (0.5–2.0)

^a Count areas 3 and 6 were not flown in 2002, data was estimated.

^b Count area 15 was not flown, data was estimated.

Table 2. Unit 13 fall 2009 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	27	12	16	11	1642	53	1.7
13B	36	7	29	18	2320	49	1.5
13C	42	8	22	13	520	62	1.7
13D	79	11	17	9	171	34	0.5
13E	31	10	21	14	393	41	0.9

^a13D not counted in 2009, 2008 data included.

Table 3. Unit 13 moose harvest ^a and accidental death, 2002–2010.

Regulatory year	Reported				Estimated			Accidental			Grand total
	M	F	U	Total ^b	Unreported	Illegal	Total	Road	Train ^c	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	571	0	4	575	25	25	50	50	25	75	700
2006–07	685	0	4	689	25	25	50	50	25	75	814
2007–08	644	0	4	648	25	25	50	50	25	75	773
2008–09	730	1	4	735	25	25	50	50	25	75	860
2009–10 (preliminary)	858	2	3	863	25	25	50	50	25	75	988

^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, 2002–2009.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Non-resident	Total ^b	Local ^a resident	Nonlocal resident	Non-resident	Total ^b	
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
2007–08	72	468	0	545	341	2400	10	2774	3319
2008–09	51	560	1	616	363	2592	3	2970	3586

^a Residents of Unit 13

^b Includes unspecified residency

Table 5. Unit 13 moose harvest data for permit hunts, 2004–2010.

Hunt Number	Regulatory Year	Permits ^a issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Harvest
State Tier II TM300	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
	2007–08	150	13	63	37	47	0	0	47
	2008–09	150	11	53	47	62	0	0	62
	2009–10	Hunt eliminated							
Federal Subsistence BLM FM313/314	2004–05	1062	38	91	9	49	0	1	50
	2005–06	938	39	91	9	51	0	0	51
	2006–07	1077	52	91	9	47	0	0	47
	2007–08	936	51	88	12	52	0	1	53
	2008–09	1124	47	90	10	55	1	1	57
	2009–10 (preliminary)	1096	41	90	10	61	0	0	61
State Resident Any Bull DM330-334	2009–10 (preliminary)	160	29	42	58	64	0	0	64
State Nonresident Antler Restricted DM335-339	2009–10 (preliminary)	50	34	64	36	12	0	0	12
Ahtna Community Harvest Hunt CM300	2009–10 (preliminary)	377	23	66	34	100	0	0	100

^a Harvest tickets were issued for the Ahtna hunt.

Table 6. Unit 13 moose harvest chronology percent by week for general harvest ticket hunt, 2002–2009.

Regulatory year	Season dates	Week of harvest ^a				<i>n</i>
		1 st	2 nd	3 rd	4 th	
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
2007–08	1 Sep–20 Sep	7	26	36	31	545
2008–09	1 Sep–20 Sep	9	25	36	30	616

^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, 2002–2009.

Regulatory year	Percent of Harvest									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat	Unknown	
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
2007–08	6	1	6	52	0	14	13	2	2	545
2008–09	6	1	4	56	0	19	12	1	0	610

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 14A (2,561 mi²)

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 moose population probably grew to numbers approaching 7,000 during the 1960s (Griese 1996). Moose numbers fluctuated with deep snow winters, but stabilized between 5,000 and 6,000 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 6,000 animals by the late 1990s.

Annual harvest levels in the first 12 years after statehood (1959–71) ranged from 20 to 1,300 (Griese 2000). The harvest was predominantly bulls, averaging 350 annually, but the harvest of antlerless moose was as high as 1,131 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 one side or a minimum of three brow tines on at least one side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork 50-inch” (SF/50) (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 2000–2004, the average roadkill increased to 194. Road kill

reporting since 2005 has been inconsistent and 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 has been cooperating regularly with Division of Forestry staff on proposed timber sales in an effort to enhance moose habitat in lieu of prescribed fires (Kavalok 2008).

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 non-consumptive uses.

MANAGEMENT OBJECTIVES

- Maintain a post-hunt population of 6,000–6,500 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 13–17 November 2007. 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 three brow tines), or large (>50 inch or three brow tines). In addition, a composition count of bulls, cows and calves was conducted in known areas of wintering concentration on 1 December 2007.

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

A GSPE survey was conducted 13–17 November 2007 in Unit 14A. The population was estimated at $6,613 \pm 727$ (80% CI) (Table 1). This estimate includes a sightability correction factor of 1.24. It appears that the population has been stable since 2001 ($6,564 \pm 748$) (Table 1).

Population Composition

We observed 23 bulls:100 cows in the fall of 2008 (Table 1). We observed 21 bulls:100 cows in 2003. We are currently within 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–20 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 one bull with a spike or fork antler on at least one side, or with an antler spread at least 50 inches or three or more brow tines on at least one side (SF/50).

The department issued 280 drawing permits for antlerless moose for the 20 August–25 September period in 2007 and 2008 (Table 3).

Board of Game Actions and Emergency Orders. At the spring 2007 meetings, the BOG considered proposals to change or modify moose hunting seasons in Subunits 14A, 14B, and 16A. They decided to reduce the general moose hunting seasons in Subunits 14B and 16A due to conservation concerns, and as a precondition to consideration of predator control implementation. The Subunit 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 Board of Game for Subunits 14B and 16A. This was to reduce or eliminate the possibility of general season hunters putting additional pressure on Subunit 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. At the spring 2009 meeting, the BOG added five days to the end of the general season.

Hunter Harvest. During the past 10 years, the moose harvest has fluctuated from 319 to 594 moose, depending on herd status and the number of permit hunts. The bull harvest for the past five years has remained relatively consistent, averaging 359 moose (range 269–397).

Permit Hunts. The department began issuing antlerless permits in 2001 in order to keep the moose population within objectives (Table 4). Up to 400 permits may be issued by drawing and

the unit is divided into several hunt areas. There were 280 permits issued each year during the reporting period, resulting in 153 moose harvested 2007 and 156 moose harvested in 2008.

Hunter Residency and Success. An average of 2,885 people has hunted bulls in Unit 14A each year during the last five years. Local residents of Subunit 14 consistently make up the majority of the hunter composition, harvesting 96–98% percent of all moose taken in Subunit 14A. Hunter success was 13% during four of the last five 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% 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 (1999–2009) averaged 214 (range 130–345) moose killed by highway vehicles and 18 (range 2–37) 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 RY01–RY07, 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 489 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 necessary 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 Point

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 Point MacKenzie winter population exceeds 10 moose/mi², 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.

LITERATURE CITED

- Becker E. F. and D. J. Reed. 1990. A modification of a moose population estimator. *Alces* 26:73–79.
- Collins W. B. 1996. Wildlife habitat enhancement in the spruce-hardwood forest of the Matanuska and Susitna River valleys. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Final Research Report. Project W–23–5, W–24–1, W–24–2, W–24–3. Juneau, Alaska.
- Del Frate G. G. 2004. Unit 14A moose management report. Pages 161–173 in C. Brown, editor. Moose management report of survey and inventory activities, 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Project 1.0. Juneau, Alaska.
- Griese H. J. 1996. Game Management Unit 14A moose survey and inventory progress report. Pages 117–130 in M. V. Hicks, ed. Survey and inventory management report: Moose. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grants W–24–2 and W–24–3. Study 1.0. Juneau. 510 pp.
- 2000. Game Management Unit 14A moose management report. Pages 140–154 in M. V. Hicks, ed. Federal aid in wildlife restoration management report survey and inventory activities, 1 July 1997–30 June 1999. Moose. Alaska Department of Fish and Game. Grants W–27–1 and W–27–2, Study 1.0. Juneau, Alaska.
- and M. Masteller 1998. Game Management Unit 14A moose management report. Pages 126–144 in M. V. Hicks, ed. Federal aid in wildlife restoration management report survey and inventory activities, 1 July 1995–30 June 1997. Moose. Alaska Department of Fish and Game. Grants W–24–4 and W–24–5, Study 1.0. Juneau, Alaska.
- Kavalok, T. P. 2008. Unit 14A moose management report. Pages 165–179 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005–30 June, 2007. Alaska Department of Fish & Game. Project 1.0. Juneau, Alaska.
- Schwartz C. C., K. J. Hundertmark, and T. H. Spraker. 1992. An evaluation of selective bull moose harvest on the Kenai Peninsula, Alaska. *Alces* 28:1–14.
- Ver Hoef J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

PREPARED BY:

Tim Peltier
Wildlife Biologist II

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Peltier, T. C. 2010. Unit 14A moose management report. Pages 165–180 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 14A fall aerial moose composition surveys and censuses, 1999–2009.

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose / mi ²	Estimated Population Size
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	--	--	--	--	--	--	--	--
2007–08 ^g	33	--	32	19	540	665	--	--
2008–09 ^f	23	8	42	25	1498	2158	4.1	6613 ⁺ 727

^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^g Composition count of known wintering areas

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				
2005–06	no surveys				
2006–07	no surveys				
2007–08	no surveys				
2008–09	no surveys				

^a Calves = short yearlings

Table 3. Unit 14A moose harvest^a and accidental death, 1999–2009.

Regulatory year	Reported				Estimated			Accidental deaths ^e			Grand total
	M	F	Unk	Total ^b	Unreported ^c	Illegal ^d	Total	Road	Train	Total	
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
2007–08	269	146	2	417	19	60	79	245	15	260	756
2008–09	390	157	2	549	27	60	87	345	37	382	1018

^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
	2007–08	1086	20	15	63	37	1	9	0	10
	2008–09	1180	20	15	47	53	0	8	0	8
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
	2007–08	435	10	30	29	71	0	2	0	2
	2008–09	425	10	0	40	60	0	6	0	6
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

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
DM402, 14A, Point Mackenzie										
	2006–07	2844	50	6	30	70	1	31	0	32
	2007–08	2595	40	5	18	82	0	31	0	31
	2008–09	2595	40	10	42	58	0	21	0	21
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
	2007–08	1517	20	10	33	67	0	12	0	12
	2008–09	1639	20	5	28	72	0	13	0	13
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	13	52	48	0	16	0	16
	2007–08	1853	40	15	46	54	3	16	0	19
	2008–09	1974	40	13	32	68	0	23	0	23

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
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
	2007–08	3117	60	10	45	55	1	28	0	29
	2008–09	3337	60	5	30	70	1	38	0	39
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	868	30	13	52	48	1	11	0	12
	2007–08	1195	50	10	38	62	1	27	0	28
	2008–09	1359	50	14	43	57	2	21	0	23
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

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
DM410, 14A, Knik River										
	2005–06	1992	40	8	22	78	0	29	0	29
	2006–07	1954	40	5	45	55	0	21	0	21
	2007–08	2025	30	7	39	61	0	17	0	17
	2008–09	2189	30	13	23	77	1	19	0	20
DM412, 14A, Point Mackenzie ^c										
	2007–08	300	10	0	50	50	1	4	0	5
	2008–09	221	10	0	70	30	0	3	0	3

^a DM400 divided into two hunts – DM400, DM401 – in 2005.

^b DM409 split into two hunts – DM407, DM408 – in 2004.

^c DM412 added in 2007, boundaries are the same as DM402.

Table 5. Unit 14A moose hunter residency and success^a, 1999–2009.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^b	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident ^b	Nonlocal resident	Nonres.	Unk.	Total (%)	
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
2007–08	247	10	6	3	266(10)	2208	59	50	5	2322(90)	2588
2008–09	355	22	15	1	393(13)	2599	59	33	15	2706(87)	3099

^a Does not include drawing permit hunters.^b Unit 14 residents.

Table 6. Unit 14A moose harvest chronology ^a 1999–2009.

Regulatory year	August			September					November	December		Unknown	Total
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15		
1999–00 ^b	6	57	14	32	25	44	53	--	--	36	52	13	332
2000–01 ^b	4	67	20	38	30	43	24	--	--	27	55	11	319
2001–02 ^c	10	61	28	36	43	48	46	68	--	--	--	13	353
2002–03 ^c	6	71	20	32	35	51	45	53	--	--	--	10	323
2003–04 ^c	13	87	34	57	41	67	54	50	--	--	--	14	417
2004–05 ^c	11	73	17	48	36	62	45	53	--	--	--	16	361
2005–06 ^c	9	70	21	43	50	62	57	57	--	--	--	9	378
2006–07 ^c	10	65	22	47	34	74	50	78	2	--	--	5	387
2007–08 ^d	13	65	22	26	51	83	--	--	--	--	--	5	265
2008–09 ^d	19	108	38	43	71	100	--	--	--	--	--	8	387

^a Does not include drawing permit hunts.

^b Open season = 10–17 Aug (Archery only), 20Aug–25 Sep (Gen.SF/50), 5 Dec–15 Dec (SF).

^c Open season = 10–17 Aug (Archery-only), 20 Aug–30 Sep (Gen.SF/50).

^d Open season = 10–17 Aug (Archery only), 20 Aug–20 Sep (Gen.SF/50).

Table 7. Unit 14A percent transport methods of successful moose hunters^a, 1999–2009.

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Sample size
1999–00	3	2	12	29	7	6	36	4	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	6	1	361
2005–06	7	3	10	37	0	7	34	1	1	380
2006–07	6	2	9	39	0	6	36	2	0	381
2007–08	7	2	11	40	0	4	36	0	0	254
2008–09	5	2	9	44	0	6	31	1	2	378

^a Does not include drawing permit hunts.

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 14B (2,152 mi²)

GEOGRAPHIC DESCRIPTION: Western Talkeetna Mountains

BACKGROUND

The first comprehensive moose survey in Subunit 14B, conducted in fall 1987, estimated moose numbers at 2,814 ± 248 (80% CI) (Masteller 1995). Deep snow winters in 1989–90 and 1994–95 caused high mortality reflected in the 1999 survey estimate of 1,687 ± 244 (Masteller 1995, 1998). Surveys completed in 2005 showed a further decline to 1,412 ± 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 one side or a minimum of three brow tines on at least one side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork 50-inch” (SF/50) (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 2,500–2,800 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 surveys during this reporting period due to poor survey conditions.

The harvest was monitored with harvest reports from Subunit 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

Subunit 14B was not surveyed during this reporting period. It was last surveyed in the fall of 2005. The resulting moose population estimate was $1,413 \pm 215$ (80% CI) (Table 1). Local residents have been concerned about an increase in the brown bear population in this subunit. That may have an impact on recruitment and prevent the moose population from increasing at a significant rate.

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–20 September for all resident and nonresident hunters. The bag limit was one SF/50 bull.

Board of Game Actions and Emergency Orders. During the spring 2007 meeting, the board reduced the season 10 days to address low population numbers in Subunits 14B and 16 (Peltier 2008).

Hunter Harvest. The reported harvest averaged 53 bulls during the reporting period (Table 2). This is lower than the 8-year average of 58 bulls and substantially lower than the historic highs reported in the 1980s.

Hunter Residency and Success. Local residents of Subunit 14 consistently make up the majority of the hunter composition (Table 3). The number of local hunters has been relatively consistent in the past five years ranging between 386–419 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 where the season length gets closer to the rut. Only three animals were harvested during the August archery-only season in the past 10 years (Table 4).

Transport Methods. The elimination of the winter hunt in 2001–02 virtually 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 36 in 2007–08 and 2008–09, respectively (Table 2). The number of road killed moose reported (Table 2) for this period was estimated as a minimum from the previous 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 2,500–2,800. Since the 2005 survey, the population may have increased. A survey was completed in the fall of 2009. These results show that while there has been an improvement, the unit is still well below management objectives. The average annual harvest by hunters for the last five years was 53, 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 Subunits 13E, 16A, 14A and 14B (Modafferi 1999). Therefore, management decisions for Subunit 14B should be made in conjunction with neighboring units.

LITERATURE CITED

- Griese, H. J. 1993. Unit 14B moose survey and inventory progress report. Pages 126–135 in S. M. Abbott, ed. Moose survey and inventory management report, 1 July 1989–30 June 1991. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grants W-23-3 and W-23-4, Study 1.0. Juneau, Alaska.
- Masteller, M. A. 1995. Unit 14B moose survey and inventory progress report. Pages 131–142 in M. Hicks, ed. Moose survey and inventory management report, 1 July 1991–30 June 1993. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grants W-24-1 and W-24-2. Study 1.0. Juneau, Alaska.

- . 1998. Unit 14B moose survey and inventory progress report. Pages 145–154 in M. Hicks, ed. Moose survey and inventory management report, 1 July 1995–30 June 1997. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grants W–24–4 and W–24–5, Study 1.0. Juneau, Alaska.
- Modafferi, R. D. 1999. Lower Susitna Valley moose population identity and movement study. Alaska Department of Fish and Game. Federal Aid Wildlife Restoration Research Final Report. Grant W–22–5 and W–24–3, Study 1.38. Juneau, Alaska.
- Peltier, T. C. 2006. Unit 14B moose management report. Pages 172–180 in C. Brown, editor. Moose management report of survey and inventory activities, 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Grants W–27–3 and 4, Project 1.0. Juneau, Alaska.
- Peltier, T. C. 2008. Unit 14B moose management report. Pages 180–188 in P. Harper, editor. Moose management report of survey and inventory activities, 1 July 2005–30 June 2007. Alaska Department of Fish and Game. Grants W–27–3 and 4, Project 1.0. Juneau, Alaska.
- Schwartz C.C., K. J. Hundertmark, and T. H. Spraker. 1992. An evaluation of selective bull moose harvest on the Kenai Peninsula, Alaska. *Alces* 28:1–14.
- Ver Hoef J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

PREPARED BY:

Tim C. Peltier
Wildlife Biologist II

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Peltier, T. C. 2010. Unit 14B moose management report. Pages 181–189 in P. Harper, editor. Moose management report of survey and inventory activities, 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 14B, fall aerial moose composition surveys, 1999–2009.

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)
1999–00 ^c	40.2	12.3	21.3	13.2	616	699	1.6	1,687 ± 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	--	1,413 ± 215
2006–07 ^a	--	--	--	--	--	--	--	--
2007–08 ^a	--	--	--	--	--	--	--	--
2008–09 ^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 and accidental death, 1999–2009.

Regulatory year	Reported				Estimated			Accidental deaths ^c			Grand
	M	F	Unknown	Total	Unreported ^a	Illegal ^b	Total	Road	Train	Total	Total
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	189
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
2007–08	49	0	0	49	5	20	25	20 ^e	19	39	113
2008–09	57	0	1	58	6	20	26	20 ^e	36	56	140

^a Derived by taking 10% of the total reported kill.^b Includes moose taken in defense of life or property.^c Road and train are minimum numbers. Road kills do not include unsalvageable animals.^d Estimated minimum based on the previous years as data was missing for this period.

Table 3. Unit 14B, moose hunter residency and success, 1999–2009.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^a	Nonlocal resident	Non- resident	Unknown	Total (%)	Local resident ^a	Nonlocal resident	Non- resident	Unknown	Total	
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
2007–08	43	4	2	0	49(12)	340	13	17	0	370	419
2008–09	49	2	7	0	58(13)	370	20	12	0	402	460

^a Unit 14 residents.

Table 4. Unit 14B, moose harvest chronology 1999–2009.

Regulatory year	August			September					November		December		Unknown	Total ^e
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15			
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 ^c	0	3	6	2	5	8	6	16	--	--	--	2	48	
2006–07 ^c	1	7	3	7	9	12	4	13	--	--	--	--	56	
2007–08 ^d	1	4	1	6	9	26	--	--	--	--	--	--	47	
2008–09 ^d	0	17	5	2	10	21	--	--	--	--	--	--	55	

^a Open season=10–17 Aug (Archery-only), 20 Aug–20 Sept (general 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 Sept (general SF/50), 5–15 Dec (SF-only).

^c Open season=10–17 Aug (Archery-only), 10 Aug–30 Sept (general SF/50).

^d Open season=10–17 Aug (Archery-only), 20 Aug–20 Sept (general SF/50).

^e Chronology does not include moose taken out of season or during DM416.

Table 5. Unit 14B, percent transport methods of successful moose hunters, 1999–2009.

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Airboat	Number moose harvested
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
2007–08	4	0	2	55	0	14	24	0	0	49
2008–09	9	0	11	44	2	19	6	0	0	57

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 14C (1912 mi²) 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 secondary growth replaced mature forests that had been cut or burned during the development of Anchorage and the Fort Richardson Military Reservation. Moose numbers increased considerably during the early 1950s, and by the late 1950s and early 1960s moose were abundant. The moose population has remained relatively 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 moose habitat abounds along streams and rivers, and extensive stands of subalpine willow are on south-facing slopes in most drainages. However, during the last three decades, overabundant moose have reduced the distribution and density of browse species, and overbrowsing is apparent in most of Unit 14C.

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 resulted in increased annual harvests.

MANAGEMENT DIRECTION

Management Objectives

- Maintain a population of 1,500–1,800 moose.
- Maintain a post-hunting sex ratio of no fewer than 25 bulls:100 cows.

METHODS

We conducted aerial surveys annually, except in 2007, in some hunt areas to estimate sex and age composition during fall and early winter (Table 1). Fall surveys were not flown in 2007 because there was inadequate snow cover until late December, after most bulls had shed antlers. In 2008, we were unable to fly surveys in one of fourteen sample areas in the census area due to a housing expansion on Elmendorf Air Force Base (AFB); this excluded an area of 6.9 mi² out of a total of 138.8 mi².

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 deep-snow 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 unit's moose population. During this winter, 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 unit's moose population recovered by fall 1998 above the management objective of 1800 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. In 2004, another severe winter, with high snow depths, occurred in the Anchorage area. 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. Since 2005, the moose population has been steadily increasing. However, the pattern of large population declines following severe winters and slow increases following milder winters suggests that available habitat cannot sustain moose numbers at the high end of the population objective during winters characterized by above-average snowfall.

Population Size

Surveys were conducted only once during this reporting period (2007–2009). In 2008, a census was completed for the Fort Richardson/Elmendorf/upper Ship Creek area, and a survey was

conducted in the Twentymile, Portage, and Placer River valleys (Table 1). We estimated a fall 2008 population of 1800 moose in Unit 14C.

Population Composition

During this reporting period, the bull:cow ratio was estimated in 2008 only, with a ratio of 45:100 (Table 1). The bull:cow ratio has declined slightly since the last reporting period (59:100 in 2005 and 45:100 in 2006). The overall calf:cow ratio has declined since the last reporting period, as well (30:100 in 2006 vs. 15:100 in 2008). The unit had 11 yearling bulls per 100 cows, which was slightly less than reported previously.

Distribution and Movements

Moose are year-round residents of Unit 14C, ranging from sea level to an elevation of 3500 feet. During winters with substantial snow accumulation, most moose are found 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. Road construction and urban development continue to fragment habitat throughout Anchorage and can significantly alter moose movement patterns and survival.

Mortality

Harvest

Season and Bag Limit. Moose are harvested in Unit 14C during a general season hunt period, as well as various registration and drawing permit hunts. The general season harvest occurred the day after Labor Day through 30 September, with a bag limit of 1 bull moose with spike-fork/50-inch antlers. In the Fort Richardson Management Area, the open seasons for resident and nonresident hunters were the day after Labor Day through 15 November and 15 December–15 January, with a bag limit of 1 moose by drawing permit only; however, some hunts specified bull or antlerless moose 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 2007 and 2008 in this management area.

Moose harvest on Elmendorf Air Force Base was by drawing permit only from the day after Labor Day through 30 September. We issued 25 drawing permits for these hunts both years. The bag limit was 1 moose; however, bull, antlerless, or either-sex moose were specified by permit.

Moose harvest in the Anchorage Management Area is restricted to 1 antlerless moose, by muzzleloader or shotgun with rear sights and slugs, by drawing permit only, from 1–30 November. Eight drawing permits were issued for two separate hunt areas in 2001 and 2008.

Birchwood Management Area was open to moose hunting the day after Labor Day through 30 September by drawing permit only with a bag limit of 1 bull by archery only. Fifteen bull permits were issued in 2007; however, only 5 bull permits were issued in 2008. 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 hunting and trapping are

prohibited. Much of the private land in the Birchwood Management Area is being developed into residential housing, and the area is becoming less rural and more suburban.

Moose harvest in the Eklutna Lake Management Area was the day after Labor Day through 23 October in 2007 and 28 October in 2008. The bag limit was 1 bull by registration permit and by archery only, with a quota of 4 bulls.

The open season for the Twentymile River area was 20 August—30 September in 2007 and 2008. The bag limit was 1 moose by drawing permit with 20 bull permits issued in 2007 and 2008.

Board of Game Actions and Emergency Orders.

The Board of Game reauthorized all antlerless moose hunts annually during this reporting period, except in 2009. In 2009, the Anchorage Advisory Committee failed to support the reauthorization of antlerless moose hunts in the Anchorage Management Area. Without advisory committee approval, the Board of Game had to approve an amended proposal to reinstate antlerless hunts in the Anchorage Management Area at the March 2009 board meeting.

In 2002, the Board of Game revised 5 AAC 92.230 (Feeding of game) to include moose in the list of wildlife illegal to negligently or intentionally feed or attract with human food, pet food, or garbage. Initially the fine was \$50, but it was increased to \$100 in September 2002 and to \$300 in May 2008. Moose in Anchorage have learned to eat from garbage cans when browse is scarce. This behavior is becoming more widespread across the Anchorage Bowl area. Alaska State Wildlife Troopers stationed in Anchorage and the Anchorage area biologists issued several citations for feeding moose during this reporting period.

Hunter Harvest. During 2007–08 and 2008–09, 113 and 125 moose were harvested, respectively, with a 2-year mean of 77 bulls and 36 cows (Table 2). Approximately 28% of the bulls were taken during the general season harvest.

Permit Hunts. During 2007–08, we issued 551 permits to hunt moose in Unit 14C. Of the hunters that actually hunted, 89 hunters (23%) were successful. In 2008–09, 568 permits were issued and of the hunters that actually hunted, 94 hunters (23%) were successful (Table 4).

Drawing permit hunts are very popular. In 2007, 5,668 hunters applied for 253 drawing permits (1,405 applications were for the 20 bull permits for the Placer/Twentymile hunts). In 2008, 5,845 hunters applied for 243 drawing permits (1,541 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 compared to previous years. In addition to those receiving drawing permits, 298 bow hunters in 2007 and 325 bow hunters in 2008 registered for a permit for the Eklutna Lake archery hunt. The high number of unsuccessful bow hunters in this hunt reduced the total success rate for permit hunts in Unit 14C (Table 4).

Hunter Residency and Success. Residents of Unit 14C accounted for 71% and 68% of the moose harvested in Unit 14C in 2007–08 and 2008–09, respectively (Table 3), which was a decrease

from 90% and 85% in 2005–06 and 2006–07, respectively. Nonlocal resident harvest increased to 23% and 28% of the moose harvest in Unit 14C in 2007–08 and 2008–09, respectively, which was an increase from 6% in both 2005–06 and 2006–07. Nonresidents accounted for 6% and 4% of the total harvest in Unit 14C in 2007–08 and 2008–09, 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). However, recent years have shown a continued decline in harvest for the first week, even though the number of huntable days in the first week has increased (Table 5). The day after Labor Day was 3 September in 2007 and 2 September in 2008; however, a smaller proportion of moose were harvested the first week in 2007 and 2008 (13%) than during the first week in 2003 (29%) when the day after Labor Day was September 2.

Most moose in Unit 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. Therefore, the harvest chronology of these hunts is not comparable.

Transport Methods. Approximately 75% of all successful hunters used a highway vehicle for transportation to their hunting area (Table 6). Most moose hunt areas in Unit 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 Unit 14C are not navigable by motorboats.

Other Mortality

Moose killed by vehicles and trains accounted for estimated 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 and onto the roads and railroad tracks. Historically, moose killed by motor vehicle accidents were recorded by Alaska State Trooper Dispatch and records were easily available. In 2006, this responsibility was turned over to Mat-Com Dispatch based in Wasilla, and records of moose killed by motor vehicle accidents have become increasingly incomplete and difficult to access. An average of 166 moose per year were killed in vehicle and train collisions in 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 which influence collision rates are the moose 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 necropsied. One died in winter from cyanide gas produced during the digestion of what appeared to be Mayday tree (*Prunus padus*) fruits (K. Beckmen, personal communication). 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 Unit 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 during the reporting period (“fall” includes 1 July–31 December, “spring” includes 1 January–30 June): 4 (spring 2007), 3 (fall 2007), 3 (spring 2008), 3 (fall 2008), and 4 (spring 2009). 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 unit. Increased traffic on existing roads continues to boost Anchorage road kills. Several new roads (e.g., Elmore Road 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 overwinter in the Anchorage Bowl.

CONCLUSIONS AND RECOMMENDATIONS

One of two population objectives was met during this reporting period. The fall 2008 population was estimated at 1,800 moose, at the upper limits of the population objective; however, the bull:cow ratio exceeded 25:100. The moose population has increased 12% since the last Fort Richardson/Elmendorf/Ship Creek census in fall 2006. With several new hunts, including “either-sex” and “any-bull” bag limits, hunters have been able to maintain moose numbers within population goals, 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 conflicts 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 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 numerous 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 Unit 14C. 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. During this reporting period, staff participated in planning for a number of transportation infrastructure projects. DOT&PF project engineers and environmental staff has been largely unresponsive to requests for adequate moose-crossing structures, although this relationship appears to be improving slightly. Based on research in other areas of North America and Europe (Clevenger and Waltho 2003), we recommend overpass structures for moose to be at least 14 ft in height.

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 (R. J. Sinnott, ADF&G biologist, letter to Colonel D. G. Boltz, 6 September 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. However, a solid 8-foot-high chain link and pipe rail fence was constructed from the Muldoon Exit nearly to the Hiland weigh station along the Glenn Highway, spanning a distance of approximately 10 miles. 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 Unit 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.

LITERATURE CITED

- ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES. 1995. A mitigation plan for moose-vehicle accidents on Alaska’s rural highways. Anchorage.
- CLEVENGER, A.P., AND N. WALTHO. 2003. Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. Unpublished report. Western Transportation Institute, Montana State University, Bozeman. 35 pp.
- COADY, J. W. 1974. Influence of snow on behavior of moose. *Nature Canada*. 101:417–436.
- WHITTAKER, D., M. J. MANFREDO, P. J. FIX, R. J. SINNOTT, S. MILLER, AND J. J. VASKE. 2001. Understanding beliefs and attitudes about an urban wildlife hunt near Anchorage, Alaska. *Wildlife Society Bulletin* 29:1114–1124.

PREPARED BY:

Tony Carnahan

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Carnahan, T. 2010. Unit 14C moose management report. Pages 190–207 *in* P. Harper, editor. Moose management report of survey and inventory activities, 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

TABLE 1 Unit 14C fall aerial moose composition counts and estimated population size, 2004–2009

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	2004–05	61	34	52	24	94	30	120
Portage River	2005–06	--	--	--	--	--	--	
Placer River	2006–07	--	--	--	--	--	--	150
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	30	12	25	16	192	50	192
Hillside	2004–05 ^c	28	11	40	24	99 ^d	30	120
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	140 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	--	--	--	--	--	--	155 ^e
Anchorage Bowl (except Hillside)	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	250 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	--	--	--	--	--	--	280 ^e
Fort Richardson	2004–05 ^f	--	--	--	--	--	--	
Elmendorf AFB	2005–06	59	16	31	17	395	38	435
Upper Ship Cr.	2006–07	45	14	30	17	404	26	452
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	48	11	15	9	335	25	473

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	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	120 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	--	--	--	--	--	--	135 ^e
Peters Creek ^h	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	65 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	--	--	--	--	--	--	73 ^e
Eklutna River Thunderbird Cr.	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	45 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	58	--	37	15	48	12	58
Bird Creek Indian River ^h	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	110 ^e
	2007–08 ^b	--	--	--	--	--	--	
	2008–09	--	--	--	--	--	--	124 ^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 ⁱ Knik River	2004–05	--	--	--	--	--	--	150 ^e
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	
	2007–08 ^b	--	--	--	--	--	--	165 ^e
	2008–09	--	--	--	--	--	--	
Lake George ^j	2004–05	--	--	--	--	--	--	140 ^e
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	
	2007–08 ^b	--	--	--	--	--	--	155 ^e
	2008–09	--	--	--	--	--	--	
Unit 14C	2004–05 ^f	43	22	45	24	183	28	1600
Total	2005–06	57	16	31	17	395	38	
	2006–07	45	14	30	17	404	26	
	2007–08 ^b	--	--	--	--	--	--	1800
	2008–09	45	11	19	5	574	29	

^a Estimates based on sightability correction factors (SCF) of 1.10 (2005), 1.12 (2006), and 1.41 (2008) 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 Bird/Indian count area last surveyed in 1988; ^j Lake George count area last surveyed in 1997; ⁱ Peters Creek count area and Hunter/Knik count area last surveyed in 2001.

TABLE 2 Unit 14C moose harvest and accidental death, 2004–2009

Regulatory year	Hunter harvest						Accidental death ^b			
	Reported			Estimated						
	M (%)	F (%)	Total ^a	Unreported	Illegal	Total	Road	Train	Total	Total
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
2007–08	74 (65)	39 (35)	113	10	10	20	-- ^c	-- ^c	--	290 ^d
2008–09	80 (71)	33 (29)	125	10	10	20	-- ^c	-- ^c	--	302 ^d

^a Includes those with unreported sex.^b Reported deaths only.^c Information unavailable.^d Includes estimation for accidental death from average of previous five years.

TABLE 3 Unit 14C moose hunter residency and success, general season hunts, 2004–2009

Regulatory year	Successful				Unsuccessful				Total hunters ^a
	Local resident	Nonlocal resident	Nonresident	Total ^a (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	
2004–05	72 ^b	8	3	83 (18)	353 ^b	18	13	384 (82)	467
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
2007–08	80 ^c	26	7	113 (16)	423 ^c	161	18	602 (84)	715
2008–09	85 ^c	35	5	125 (19)	371 ^c	149	8	528 (81)	653

^a Includes hunters with unspecified residency.

^b Residents of Units 14 and 7 (majority from Unit 14C). Includes all DM210 hunt area.

^c Residents of Unit 14C. Includes only Unit 14C portion of DM210.

TABLE 4 Unit 14C moose harvest data by permit hunt, 2004–2009

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	% Bulls	% Cows	Total harvest ^a
DM210, 211 Twentymile Portage Placer	2004–05 2005–06 2006–07 2007–08 2008–09	25 20 20 20 20	28 5 5 15 15	57 37 58 29 24	43 63 42 71 76	89 100 100 100 100	11 0 0 0 0	25 20 20 12 13
DM422,423 Fort Richardson (muzzleloader)	2004–05 2005–06 2006–07 2007–08 2008–09	25 25 25 25 25	12 8 8 16 12	73 48 74 67 55	27 52 26 33 45	83 70 83 71 90	17 30 17 29 10	6 12 6 7 10
DM424,425,427 Fort Richardson (archery only)	2004–05 2005–06 2006–07 2007–08 2008–09	100 100 100 100 100	13 19 17 14 13	67 60 57 66 51	33 40 43 44 49	55 56 53 50 53	45 44 47 50 47	29 32 36 38 43
DM428,429,430 Elmendorf AFB (archery only)	2004–05 2005–06 2006–07 2007–08 2008–09	20 25 25 25 25	10 24 12 12 12	50 21 45 55 45	50 79 55 45 55	67 60 58 40 58	33 40 42 60 42	9 15 12 10 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 Hunter Knik (antlerless)	2004–05	10	30	86	14	0	100	1
	2005–06	10	40	83	17	0	100	1
	2006–07	10	30	57	43	0	100	3
	2007–08	5	0	40	60	33	67	3
	2008–09	5	40	67	33	0	100	1
DM442 Ship (antlerless)	2004–05	40	30	93	7	0	100	2
	2005–06	0	--	--	--	--	--	--
	2006–07	0	--	--	--	--	--	--
	2007–08	0	--	--	--	--	--	--
	2008–09	0	--	--	--	--	--	--
DM443 Peters and Little Peters (antlerless)	2004–05	10	20	100	0	0	0	0
	2005–06	10	40	67	33	0	100	2
	2006–07	10	20	75	25	50	50	2
	2007–08	5	20	100	0	0	0	0
	2008–09	5	20	100	0	100	100	0
DM446, 447 Ship (any moose)	2005–06	40	28	66	34	70	30	10
	2006–07	50	24	61	39	80	20	15
	2007–08	50	30	66	34	75	25	12
	2008–09	50	36	69	31	60	40	10

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)	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
	2007–08	15	47	88	12	100	0	1
	2008–09	5	60	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
	2007–08	8	0	37	63	0	100	5
	2008–09	8	25	17	83	0	100	5
RM445 ^b Eklutna (archery only)	2004–05	218	58 ^c	96	4	100	0	4
	2005–06	257	32 ^d	98	2	100	0	3
	2006–07	249	31 ^e	99	1	100	0	2
	2007–08	298	37 ^f	100	0	0	0	0
	2008–09	325	36 ^g	99	1	100	0	2
Totals for all permit hunts	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
	2007–08	551	28	77	23	57	43	89
	2008–09	568	29	77	23	64	36	94

^a Includes moose with unspecified sex; ^b Registration hunt; ^c Includes 86 permittees who did not report; ^d Includes 9 permittees who did not report; ^e Includes 2 permittees who did not report; ^f Includes 5 permittees who did not report; ^g Includes 2 permittees who did not report.

TABLE 5 Unit 14C moose harvest ^a chronology, 2004–2009

Regulatory year	Percent of harvest						<i>n</i>
	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29	9/30–10/6	
2004–05 ^b	10	19	24	24	24	0	21
2005–06 ^c	4	20	24	28	20	4	25
2006–07 ^d	0	13	29	29	29	0	14
2007–08 ^e	0	13	31	25	25	6	16
2008–09 ^f	0	13	17	20	50	0	24

^a Does not include permit hunt harvests and Placer and Portage drainages (Unit 7).

^b Season 9/7–9/30

^c Season 9/6–9/30

^d Season 9/5–9/30

^e Season 9/3–9/30

^f Season 9/2–9/30

TABLE 6 Unit 14C moose harvest ^a percent by transport method, 2004–2009

Regulatory year	Percent of harvest								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown/ Other	
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
2007–08	4	10	7	3	0	1	73	2	114
2008–09	4	6	6	3	0	0	75	6	125

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

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 15A (1,314 mi²), 15B (1,121 mi²), and 15C (2,441 mi²)

GEOGRAPHIC DESCRIPTION: Western Kenai Peninsula

BACKGROUND

Subunit 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 two factors contributing to the 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 over-browsing occurred by the late 1960s. A wildfire in 1969 burned approximately 135 mi² (11 % of Subunit 15A), initially reducing moose habitat in Subunit 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 7,900 in 1971 to 3,375 by 1975. Subunit 15A represents 75% of these estimates, a decline from 5,900 to 2,500 moose. By 1982, following more favorable winters, the moose population estimate for Subunit 15A increased to 3,000.

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 3,014–3,850 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). Results from February 2001 estimated the moose population in Subunit 15A at 2,097 (95% confidence interval 1,704–2,431). A subsequent census using the same technique in February 2008 resulted in a population estimate of 1,670 (95% confidence interval 1,405–1,934).

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 5,000 acres. Consequently, less browse associated with successional forest stages have 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 & 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. Close coordination and cooperation should continue. Future efforts should focus on addressing habitat concerns, now that most of the habitat in Unit 15A is in mid-late successional stages.

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.

Subunit 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 1,000. Forests within Subunit 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 Subunit 15B is within the Kenai National Wildlife Refuge and has a “wilderness” designation, which limits all commercial activities.

Most of the hunting within Subunit 15B is by drawing permit only in Subunit 15B East, which is designated as a “trophy” area. During this reporting period (1 July 2007–30 June 2009), the quality (antler size) and quantity of moose harvested has continued to decline, as has hunter satisfaction.

From 2004–2009, fire perimeters have encompassed about 36,000 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.

Subunit 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.

With respect to as moose habitat, Subunit 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 these fires, but relative to Units 15A and 15B, Unit 15C has more potential for large areas of quality moose habitat in the near (by 2015) future.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Subunit 15A: Maintain a healthy population of moose with a post-hunting bull-to-cow ratio of at least 15:100 in Subunit 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 mi². 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.

Subunit 15 West

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

Subunit 15B East

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

Subunit 15C

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

METHODS

Subunit 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. More recently, weather conditions permitted surveys during 2003, 2005, 2006 and only limited surveys during 2008 and 2009.

A population estimate for Subunit 15A was developed from data collected with a geospatial survey (Kellie and Delong 2006) in February 2001. An additional geospatial survey was conducted in February 2008.

Subunit 15B. Composition surveys were flown in November 2009. This was the first time this area was surveyed since November 1996. Results for these flights will be presented during the next reporting period. Harvest data is provided by hunter information taken from harvest tickets.

Subunit 15C. The only fall composition surveys completed during this reporting period were conducted in November 2007. Censuses were done in 1993, 2002 and 2010. Results from the March 2010 census will be presented during the next reporting period. 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 Subunit 15A

Data from the 1991 census resulted in a Subunit 15A population estimate of 3,432 (CI: 2,921–3,943). The February 2001 estimate for moose wintering in the unit was 2,068 (95% CI: 1,704–2,431), while the February 2008 census resulted in a population estimate of 1,670 (95% CI: 1,405–1,934). This data indicated a decline of approximately 51%; however, it is believed that most of this decline occurred during the severe winters of 1998–99 and 1999–2000. Subsequent winters were relatively mild and should have been favorable for moose survival and production.

Composition surveys flown during November and December 2008 indicated a low bull:cow ratio of 11 bulls:100 cows (Table 1). However, only two count areas were surveyed in 2008 and they were areas that have historically had low bull:cow ratios. It also appears that the calf:cow ratio increased in 2008 (Table 1), but that may also be caused by the limited number of survey units flown that year. Since these are trend counts, we did not apply statistical analyses to the data, but there is an obvious decline in total moose numbers in Unit 15A.

Population Size and Composition in Subunit 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: 777–1,139). This produced a density of about 1.5 moose/mi². 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. Composition surveys were flown in three areas during November 2009. These data will be presented during the next reporting period.

Population Size and Composition in Subunit 15C

A random-stratified census (Gasaway 1986) was conducted in lowland portions of Subunit 15C (1,190 mi²) during the winter of 1992–93. The population was estimated at 2,079 moose (95% CI: 1,425–2,734). During the winter of 2001–02, a geospatial census (Ver Hoef 2001) conducted over the same area produced an estimate of 2,981 moose (95% CI: 2,508–3,454) (Table 1). A comparison between surveys showed a population increase of about 30%. Both censuses were conducted in late winter, precluding composition counts. There may have been additional moose in the mountainous portion of Subunit 15C (outside the census area), during both censuses. A geospatial census (Ver Hoef 2001) was also conducted in March 2010. Results from that census will be presented during the next reporting period.

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 of bull-to-cow and calf-to-cow ratios. 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 was above the minimum management objective of 15:100.

Composition data from the fall 2007 and 2008 surveys (Table 1) are difficult to interpret. Compared to the 2005 survey, there appears to be a dramatic decline in bull:cow (21 bulls:100 cows compared to 12 and 13 bulls:100cows) and calf:cow (27 calves:100 cows compared to 18 and 10 calves:100cows) ratios. Whether this reflects a decline throughout the unit or a result of moose redistribution following the Caribou Hills fire of 2007 is unknown. Efforts will be made (i.e., additional surveys and a census) to address this issue in subsequent years.

MORTALITY

Harvest

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

Board of Game Actions. Reauthorization of 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 Subunits 15B and 15C for federally qualified subsistence users. The additional season dates are 20 October–10 November. The SF/50 or three brow-tine restrictions still apply to this hunt.

Permit Hunts

Subunit 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 prior to 1 Dec, and a minimum count of 130 moose must be obtained before permits for this area can be issued. Survey conditions have prevented subsequent surveys, but it is highly unlikely that adequate numbers of moose reside in the area to support a hunt, given the condition of the 1996 agreement.

Subunit 15B: Subunit 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 five bulls in 2007 and two in 2008 (Table 3). During 2008, the number of permits issued for the 26 Sept–15 Oct season was reduced from 50 to 10.

Subunit 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 three bulls have been taken during this season in the last four years (Table 3).

The antlerless hunt for moose near Homer was initiated in 1995 (DM549). No permits were issued in 2001. During 2002–2009, 50 permits were issued each year. The most recent 5-year average annual harvest is 22 moose (Table 3).

Hunter Residency and Success

Subunit 15A: Hunter success ranged 10–13% during the last four years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (79–86%) of successful moose hunters.

Subunit 15B West: Hunter success ranged 13–18% during the last four years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (83–92%) of successful moose hunters.

Subunit 15C: Hunter success ranged 14–22% during the last four years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (78–87%) of successful moose hunters.

During this reporting period (1 July 2007–30 June 2009), 32% of the reported moose harvest came from Unit 15A, 10% from Unit 15B and 58% from Unit 15C.

Transport Method: Most moose hunters use highway vehicles as their primary method of transportation to access hunting areas in Subunits 15A and 15B (Table 5). The most popular method used in Subunit 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

Subunit 15A: Crippling loss by hunters and loss to predation was unknown. During the last 5 years (2004–05 thru 2008–09), a yearly average of 73 moose have been killed by motor vehicles in Unit 15A (Table 2). The majority of moose killed by vehicles are cows and calves. This data only includes moose that were hit by vehicles and died at the collision site. The number of moose that were hit, walked off, but later died from injuries sustained during the collision is unknown.

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 collisions.

Subunit 15B: Crippling loss by hunters and loss to predation was unknown. During the last five years (2004–05 thru 2008–09), a yearly average of 50 moose have been killed by motor vehicles in Unit 15A (Table 2). Similar to Unit 15A, the majority of moose killed by vehicles are cows and calves. This data only includes moose that were hit by vehicles and died at the collision site.

Subunit 15C: Crippling loss by hunters and loss to predation was unknown. During the last five years (2004–05 thru 2008–09), a yearly average of 66 moose have been killed by motor vehicles in Unit 15A (Table 2). Similar to the other units, the majority of moose killed by vehicles are cows and calves. This data only includes moose that were hit by vehicles and died at the collision site. 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 high.

HABITAT

Subunit 15A

Assessment

The last significant burn (approx. 85,000 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 7,900 acres burned in the southeastern portion of Unit 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 (USFWS) 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 re-vegetation.

From 1970–2007, fires have encompassed less than 5,000 acres in Unit 15A.

Subunit 15B

Assessment

From 1890 (when a wildfire burned most of the unit) to 2003, no significant wildfires occurred in this unit. However, from 2004–2009, fires have encompassed about 34,000 acres. Assessment of moose habitat generated by these fires is premature.

Enhancement

No significant enhancement projects have been identified for this unit.

Subunit 15C

Assessment

Reduction of beetle-killed forest stands through salvage logging has been underway for more than a decade. Post-logging site work that encourages hardwood regeneration beneficial for moose habitat (primarily scarification to expose mineral soil) 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 5,000 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, while the Caribou Hills fire (summer 2007) encompassed about 50,000 acres. The long term effects of these fires, relative to producing quality moose habitat, is unknown at this time.

CONCLUSIONS AND RECOMMENDATIONS

Subunit 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). However, composition surveys in fall 2006 and 2008 seem to indicate bull:cow ratios are

declining. As stated earlier, it is difficult to draw conclusions based on the 2006 and 2008 data because only two areas were surveyed. The areas surveyed in 2006 and 2008 have traditionally had low bull:cow ratios and these data likely do not reflect conditions throughout Unit 15A. Hopefully, we will get adequate snow cover and flying conditions in the future so we can survey all the traditional count areas in future years.

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.

Since 1999, Subunit 15A has been below Intensive Management (IM) harvest objectives every year excluding 2001. This subunit has also been below IM population objectives since at least 2001 (a census year) and has likely been below the objective since the mid-1990s (the nearest census previous to 2001 was conducted in February 1991). This information has been presented to the Board of Game (BOG) since the March 2003 meeting. During the March 2009 BOG, the board directed the department to work cooperatively with the Kenai National Wildlife Refuge to develop a plan to address the decreasing moose population and harvest in Unit 15A (to be presented at the January 2010 BOG meeting). As a result, a proposal was submitted for funding to address moose productivity, focusing on pregnancy rates, twinning rate, birthing date as it relates to primary or later estrous breeding, and calf survival to winter. The opportunity to conduct this study will depend on securing adequate funding and staff.

Schwartz and Franzmann (1991) stated that by 1989, the moose population in Subunit 15A was likely above carrying capacity in the area encompassed by the 1969 burn. Interestingly, the IM population objectives were set near the number of moose estimated during the 1991 census and the moose population in 1991 is believed to be similar to the population in 1989. In the absence of periodic (every 20–25 years) and significant (75,000 acres or more) wild fire or other habitat events, it is unlikely we can maintain a moose population of 3,000–3,500 moose (the IM population objective) in Subunit 15A. Without periodic and significant habitat alteration, a more reasonable expectation would be a moose density of 1–2 moose/mi² on a sustained basis. That would equate to a population of about 1,500–2,500 moose. Given current conditions, I cannot foresee the moose population recovering to the numbers we had during the late 1980s–mid 1990s, unless aggressive habitat management is initiated. We will continue to work with the Kenai National Wildlife refuge regarding these issues and we will likely see proposals relating to the Unit 15A moose situation during the BOG meeting in March 2011.

Subunit 15B: The permit hunts in Subunit 15B East are not producing the quality (antler size) or quantity of large bulls that they were in the recent past and I have received numerous complaints from hunters that the area is no longer producing “quality” animals. As a consequence of these data and concerns, the number of late-season permits was reduced to 10 (down from 50) for the 2008 season and no permits were issued in 2009. After conducting composition flights in November 2009, my intent is to make permits available for DM531 during the 2010 drawing permit application period.

Harvest levels are well within acceptable guidelines to maintain a minimum bull:cow ratio of 40:100. Hopefully the fires in the past decade (2004, 2005, 2007, and 2009), will produce quality

moose habitat in the future. This unit is in prime condition for additional fires, whether naturally occurring or set intentionally. ADF&G and USFWS should cooperate on selected habitat enhancement projects (mechanical manipulation and prescribed burns) to improve moose habitat in the unit.

Subunit 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, especially since the recent fires. 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.

LITERATURE CITED

- Del Frate, G. G. and T. H. Spraker. 1991. Moose vehicle interactions and an associated public awareness program on the Kenai Peninsula, Alaska. *Alces* 27:1–10.
- Gasaway, W. C., S. D. Dubois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Papers of the University of Alaska No. 22. University of Alaska Fairbanks. 108pp.
- Kellie, K. A. and R. A. DeLong. 2006. GeoSpatial Survey Operations Manual. Alaska Department of Fish and Game. Fairbanks, Alaska. 55pp.
- Kenai Peninsula Borough. Spruce Bark Beetle Mitigation [Internet]. Kenai Peninsula Borough. Accessed May 31, 2006. <http://www.borough.kenai.ak.us/sprucebeetle>.
- Schwartz, C. C., and A. W. Franzmann. 1991. Interrelationship of black bears to moose and forest succession in the northern coniferous forest. *Wildl Monogr.* 113. 58pp.
- Schwartz, C. C., K. J. Hundertmark, and E. F. Becker. 1994. Growth of moose calves conceived during the first versus second estrus. *Alces* 30:91–100.

U.S. Forest Service and Alaska Department of Natural Resources–Division of Forestry. February 2002. Forest Insect and Disease Conditions in Alaska–2002, General Technical Report R10–TP–113.

Ver Hoef, J. M. 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the section on Statistics and the Environment of the American Statistical Association. pp93–98.

PREPARED BY:

Jeff Selinger
Wildlife Biologist III

SUBMITTED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Selinger, J. 2010. Unit 15 moose management report. Pages 208–224 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 15 aerial composition counts for moose and estimated population size, 2004–08.

Unit	Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
15A	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
	2007–08 ^a			12			1400–1900
	2008–09	11	21	16	171	204	1000–2000
15B	2004–05	No Surveys Conducted					700–1000
	2005–06	No Surveys Conducted					700–1000
	2006–07	No Surveys Conducted					700–1000
	2007–08	No Surveys Conducted					700–1000
	2008–09	No Surveys Conducted					700–1000
15C	2004–05	No Surveys Conducted					2500–3500
	2005–06	21	27	18	637	780	2500–3500
	2006–07	No Surveys Conducted					2500–3500
	2007–08	12	18	14	183	212	2500–3500
	2008–09	13	10	8	492	537	2500–3500

^a Estimates from geostatistical census method, estimated population size shown = 95% CI

Table 2. Unit 15 Reported general season moose harvest and accidental death, 2004–08.

Unit	Regulatory Year	Reported Hunter Harvest				Accidental death			Total Reported Mortality
		Bull	Cow	Unk	Total	Road	Train	Total	
15A	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
	2007–08	109	0	2	111	78	0	78	189
	2008–09	112	1	0	113	101	0	101	214
15B	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
	2007–08	39	0	0	39	41	0	41	80
	2008–09	33	0	0	33	41	0	41	74
15C	2004–05	276	0	2	278	74	0	74	352
	2005–06	275	3	1	279	86	0	86	365
	2006–07	212	1	2	215	79	0	79	294
	2007–08	208	2	0	210	52	0	52	262
	2008–09	192	0	0	192	40	0	40	232

Table 3. Unit 15 harvest data for drawing permit hunts, 2004–2008.

Hunt No.		Regulatory Year	Permits Issued	Permittees that hunted	Percent Success	Harvest			
						Bulls	Cows	Unk.	Total
15A	DM524	2004–05	0						
		2005–06	0						
		2006–07	0						
		2007–08	0						
		2008–09	0						
	DM526	2004–05	0						
		2005–06	0						
		2006–07	0						
		2007–08	0						
		2008–09	0						
15B	DM530-539 (combined totals)	2004–05	100	58	28	16	0	0	16
		2005–06	100	76	21	16	0	0	16
		2006–07	100	67	13	9	0	0	9
		2007–08	100	54	9	5	0	0	5
		2008–09*	60	42	5	2	0	0	2
15C	DM549	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
		2007–08	50	44	48	1	20	0	21
		2008–09	50	40	58	0	23	0	23
	TM549	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
		2007–08	4	4	50	2	0	0	2
		2008–09	4	4	25	1	0	0	1

*The drop from 100 to 60 permits issued occurred because only 10 permits were issued for the 26 Sep-15 Oct season.

Table 4 Unit 15 residency and success of moose hunters for the general season, 2004–2008

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	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
	2007–08	91	13	7	111 (10)	798	166	25	991	1102
	2008–09	97	12	4	113 (10)	827	162	24	1020	1133
15B	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
	2007–08	36	2	1	39 (14)	213	18	4	235	274
	2008–09	29	3	1	33 (13)	198	23	1	222	255
15C	2004–05	241	27	9	278 (22)	871	110	21	1010	1288
	2005–06	241	24	13	279 (21)	905	136	26	1075	1354
	2006–07	186	18	10	215 (16)	908	155	25	1097	1312
	2007–08	164	34	10	210 (17)	884	148	25	1060	1270
	2008–09	165	21	5	192 (14)	999	128	23	1153	1345

^a Local = residents of Unit 15.^b Includes unspecified residency.

Table 5 Unit 15 general season transport methods for moose hunters (percent of harvest), 2004–2008

Unit	Regulatory Year	Percent of Harvest							Harvest
		3/4 wheel- ATV	Airplane	Boat	Highway Vehicle	Horse/ Dogteam	ORV	Unknown	
15A	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
	2007–08	14	4	11	62	1	5	3	111
	2008–09	19	2	10	61	2	3	4	113
15B	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
	2007–08	10	3	5	64	8	5	5	39
	2008–09	18	0	3	64	9	3	3	33
15C	2004–05	52	2	3	25	7	6	5	278
	2005–06	44	2	6	31	8	5	3	279
	2006–07	43	1	4	33	7	7	5	215
	2007–08	51	0	2	27	9	6	5	210
	2008–09	49	0	4	29	7	6	5	192

Table 6. Unit 15 moose general season harvest chronology (percent of harvest), 2004–08.

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	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
	2007–08	23	19	9	3	10	15	18	4	111
	2008–09	27	21	5	7	3	12	20	4	113
15B	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
	2007–08	28	21	3	5	10	18	15	0	39
	2008–09	30	21	9	3	3	6	24	3	33
15C	2004–05	0	27	10	13	12	16	21	3	278
	2005–06	1	25	16	11	10	16	16	4	279
	2006–07	0	37	10	7	10	10	20	5	215
	2007–08	1	29	11	11	11	11	19	6	210
	2008–09	1	35	14	11	8	9	19	4	192

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

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 16A (1,850 mi²)

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

BACKGROUND

Historically, the moose population in Subunit 16A has fluctuated greatly as a consequence of severe winters. Griese (1996) described significant winter die-offs of moose occurring at least once each decade beginning with the 1950s. The winter of 1989–90 caused 30–40% mortality from malnutrition, highway accidents, and predation, 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.

Subunit 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 Subunit 16A was separated from Subunit 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 five seasons (2002–2006) (Kavalok 2008).

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least one side or a minimum of three brow tines on at least one side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork 50-inch” (SF/50) (Schwartz et al. 1992) and was implemented to maximize the length of the moose hunting season while maintaining the bull:cow ratio within objectives.

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 3,500–4,000 moose, with a sex ratio of 20–25 bulls:100 cows during the rut.
- Achieve an annual harvest of 190–360 moose.

METHODS

No surveys were conducted during the reporting period due to unfavorable survey conditions. Previous surveys were conducted in 1997 and 2000, and 2005 (Del Frate 2004, Kavalok 2008). 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 harvest reports from hunters. 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 ($3,636 \pm 614$, 80% CI) and 2005 ($1,619 \pm 197$, 80% CI) (Table 1). The unit was scheduled for surveys in 2007 and 2008 but none were conducted due to poor weather conditions and lack of snow. A survey was completed in the fall of 2009.

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–20 September for all resident and nonresident hunters for both years, and 10–17 August for archery-only hunters, with a bag limit of one SF/50 bull.

Board of Game Actions and Emergency Orders. At the spring meetings in 2007, the board considered proposals to change moose hunting in Subunit 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 Sept.

Hunter Harvest. The annual harvest has declined recently, averaging 110 moose over the last five years. This is down from the previously reported 5-year average of 157 (Table 2) and below the harvest objective minimum (190). The lower harvest is likely due to lower moose densities.

Hunter Residency and Success. The number of moose hunters in Subunit 16A averaged 855 during 2004–2009, down from the average of 921 during 1999–2004 (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 12%. This is lower than the previous 8-year average of 15%.

Harvest Chronology. One moose was taken in the August archery season in 2008. None were taken during the archery season in 2007. During this reporting period, hunters generally waited till the end of the season to hunt, harvesting more than 70% of the general season moose during the last two weeks (Table 4).

Transport Methods. The elimination of the winter hunt in 2001–02 virtually 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% 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 1996 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. The Department of Natural Resources, Division of Forestry proposed additional timber sales that would have the 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 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 subunits 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.

The predator control program implemented in Subunit 16B was expanded in 2006, to include the unroaded portions of Unit 16A. This was done in an effort to get at wolf packs that existed near the boundary of subunits 16A and 16B, which were believed to be crossing the border and impacting the moose population in 16B. In 2007, a black bear control program began, which included provisions for an unlimited take of black bears, the taking of sows with cubs and the taking of cubs among others. The boundaries of the program also included a portion of 16A (Peltier 2008). It is believed that predator reductions in the unit will lead to an increase in calf recruitment and the moose population overall.

LITERATURE CITED

- Becker, E. F. and D. J. Reed. 1990. A modification of a moose population estimator. *Alces* 26:73–79.
- Del Frate, G. G. 2004. Unit 16A moose management report. Pages 224–232 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Grants W–27–3 and 4, Project 1.0. Juneau, Alaska.
- Griese, H. J. 1996. Unit 16A moose survey-inventory management report. Pages 183–191 *in* M. V. Hicks, ed. Moose survey and inventory management report, 1 July 1991–30 June 1993. Alaska Department Fish and Game, Federal Aid in Wildlife Restoration. Grants W–23–5, W–24–1 and W–24–2. Study 1.0. Juneau, Alaska USA.
- Kavalok, T.P. 2008. Unit 16A moose management report. Pages 223–232 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish & Game. Project 1.0 Juneau, Alaska.
- Schwartz, C.C., K.J. Hundertmark, and T.H. Spraker. 1992. An evaluation of selective bull-moose harvest on the Kenai Peninsula, Alaska. *Alces* 28:1–14.
- Ver Hoef, J.M. 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association, pp 93–98.

PREPARED BY:

Tim Peltier
Wildlife Biologist III

REVIEWED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Peltier, T.C. 2010. Unit 16A moose management report. Pages 225–234 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 16A fall aerial moose composition surveys and censuses, 1999–2009.

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults Observed	Moose Observed	Moose /mi ²	Population Size ^b
1999–00 ^a	--	--	--	--	--	--	--	--
2000–01 ^c	28	6	22	15	661	787	1.4	2,420 ± 528
2001–02 ^a	--	--	--	--	--	--	--	--
2002–03 ^a	--	--	--	--	--	--	--	--
2003–04 ^a	--	--	--	--	--	--	--	--
2004–05 ^a	--	--	--	--	--	--	--	--
2005–06 ^d	22	3	19	14	510	590	1.1	1,619 ± 197
2006–07 ^a	--	--	--	--	--	--	--	--
2007–08 ^a	--	--	--	--	--	--	--	--
2008–09 ^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, 1999–2009.

Regulatory year	Reported				Estimated			Accidental deaths ^c			Grand total
	M	F	Unknown	Total	Unreported ^a	Illegal ^b	Total	Road	Other	Total	
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
2007–08	85	0	0	85	6	20	26	10 ^d	0	10	121
2008–09	102	0	0	102	7	20	27	10 ^d	0	10	139

^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 years as data was missing for this period.

Table 3. Unit 16A moose hunter residency and success, 1999–2009.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^a	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident ^a	Nonlocal resident	Nonres.	Unk.	Total	
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
2007–08	5	74	6	0	85(11)	41	599	37	0	677	762
2008–09	7	84	11	0	102(12)	42	680	29	0	751	853

^a Unit 16 residents

Table 4. Unit 16A moose harvest chronology^a 1999–2009.

Regulatory year	August			September			November			December		Unknown	Total
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15		
1999–00 ^b	--	11	7	15	21	38	32	--	--	2	16	4	146
2000–01 ^b	--	6	3	5	16	37	29	--	--	7	11	4	118
2001–02 ^c	0	8	3	7	10	34	37	52	--	--	--	2	153
2002–03 ^c	0	17	2	9	11	33	34	44	--	--	--	4	154
2003–04 ^c	0	13	6	10	15	34	34	47	--	--	--	9	168
2004–05 ^c	0	8	4	9	20	35	37	21	--	--	--	5	139
2005–06 ^c	0	5	2	8	11	19	24	36	--	--	--	3	108
2006–07 ^c	0	4	5	6	14	33	24	25	--	--	--	4	115
2007–08 ^d	0	1	3	11	22	47	--	--	--	--	--	1	85
2008–09 ^d	1	13	2	7	25	52	--	--	--	--	--	2	102

^a Does not include harvest from drawing permit hunts.^b Open season = 20 Aug–25 Sept (SF/50), 1–15 Dec (SF only).^c Open season = 10–17 Aug (Archery only), 20 Aug–30 Sept (SF/50) .^d Open season = 10–17 Aug (Archery only), 20 Aug–20 Sept (SF/50).

Table 5. Unit 16A percent transport methods of successful moose hunters^a, 1999–2009.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Airboat	Total
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
2007–08	6	1	25	45	1	6	13	0	4	85
2008–09	9	0	28	32	0	12	14	0	5	102

^a Does not include harvest from drawing permit hunts.

**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 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 16B (10,405 mi²)

GEOGRAPHIC DESCRIPTION: West Side of Cook Inlet and Kalgin Island

BACKGROUND

Moose likely numbered in excess of 10,000 in Subunit 16B during the early 1980s (Griese 1996). Before the severe winter of 1989–90, there probably were 8,500–9,500 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 deep snow winters and growing predator influence (Griese 2000). Predation on neonatal moose calves by bears was thought to have influenced recruitment and contributed to the decline (Faro 1989).

Predation by wolves was not considered to be a significant factor influencing the moose population until 1992 when an increase in the wolf population was first noticed. The minimum population estimate in 1993 was 39–42 wolves. A subsequent survey in the fall of 1998 estimated a population of 120–140 wolves (Masteller 2000), and McDonough (unpublished data) estimated 150–200 wolves in the unit during the winter of 2001–02. As a result of increased wolf numbers and a decrease in the moose population, the influence of wolf predation on the moose population is believed to have increased over time. A control program to reduce wolf predation on moose began in 2004. At that time, the population was estimated at 175–180 wolves (Peltier 2006).

From 1962–74, hunting seasons were liberal in Subunit 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 beginning in 1990, to assure local residents an opportunity to meet subsistence needs.

Beginning in 1993, the bull harvest (during the general season) was restricted to moose with antlers having a spike or fork on at least one side or a minimum of three brow tines on at least one side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork 50-inch” (SF/50) (Schwartz et al 1992). It was implemented as a precautionary measure to aid in enforcement of moose regulations on the adjacent road system where that was needed. The antler restrictions were not necessary for moose population management in Unit 16B at the time, and harvest was not indicated as a cause for the moose decline in Unit 16B.

The general season was closed in both 2001 and 2002 and then again in 2006 through 2008 due to the decreased population size and poor recruitment. The permit levels for the existing Tier II hunts were increased to provide for subsistence. These Tier II hunts were divided into three areas: TM565, TM567, and 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/mi² during 1981 (Taylor 1983), but were reduced to approximately 1 moose/mi² by 1985. High moose densities severely degraded habitat and the department adopted restrictive population objectives to maintain moose densities at less than 1 moose/mi² while vegetation recovered (Faro 1990). In 1999 the Board of Game, adopted an any-moose registration hunt to reduce the population to the management objectives. The board later shortened the season by 10 days 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

Subunit 16B (excluding Kalgin Island)

- Maintain a moose population of 6,500–7,500 moose and 20–25 bulls:100 cows.
- Achieve a harvest of 310–600 moose.

Kalgin Island

- Maintain a post hunt population of 20–40 moose with at least 15 bulls:100 cows

METHODS

Because of its size, Unit 16B is divided into three zones (North, Middle, and South) for survey purposes. The North area is described as Unit 16B north of the Skwentna River. The Middle area is described as Unit 16B north of the Beluga River and Beluga Lake and south of Skwentna River. The South area is described as all of Unit 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 Unit 16B Middle and on Kalgin Island in 2007. 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 Unit 16B Middle population at $2,446 \pm 322$ (80% CI) in fall 2008 (Table 1). This point estimate suggests an increase from $1,714 \pm 343$ (80% CI) in fall 2005 (Table 1).

However, that would mean the population grew at 13%/year which seems unlikely given the low cow:calf ratios observed in those surveys and low calf survival (J. Crouse ADF&G, unpublished data). More likely, the population estimates and confidence intervals reflect the difficulty in estimating population size in Unit 16B where moose movements and sightability are problematic. The population of Unit 16B North was estimated at 917 ± 207 (80% CI) in fall 2008, similar to the estimate of 898 ± 163 (80% CI) in fall of 2003. These population estimates, low calf:cow ratios, and poor calf survival (J. Crouse ADF&G unpublished data) indicate that moose numbers have—at best—remained stable at low densities in 16B North. The most recent population estimate in Unit 16B South was 960 animals, based on a survey conducted in 2006. Thus, the Unit 16B moose population is estimated to be 3,794–4,852 moose. The moose population on Kalgin Island was estimated to be 120–140 moose in November 2007 (Table 1).

Population Composition

Composition surveys were flown in the three main survey areas for the mainland portion of Unit 16B during the fall of 2008 and on Kalgin Island during the fall of 2007. During that year the composition of moose in Unit 16B North was 58 bulls:100 cows and 12 calves:100 cows. The Unit 16B Middle composition was 54 bulls:100 cows and 21 calves:100 cows. The Unit 16B South composition was 78 bulls:100 cows and 18 calves:100 cows. In 2007 Kalgin Island was assessed in 2007 as having 26 bulls:100 cows and 67 calves:100 cows (Table 1).

MORTALITY

Harvest

Season and Bag Limit The general resident-only hunting season for TY2007 and RY2008 was closed. Tier II (TM 565, TM 567, and TM 569) hunting was open 1–20 September for residents only (SF/50), or for any bull 15 November–28 February (Table 2). There were 280 Tier II permits issued for RY07 and 331 permits issued for RY08 (Table 3). Kalgin Island was open to registration hunting (RM572) 20 August–20 September (any moose).

Board of Game Actions and Emergency Orders. The board made no changes to Unit 16B moose hunting during the reporting period. The Board of Game approved a black bear control program that allowed the taking of multiple bears, sows with cubs and cubs, along with other changes (Peltier, 2008). As a result of these actions, black bear harvest in the Unit 16 Predator Control Area has been high. Calf recruitment is being monitored in Unit 16 to determine if these actions are having a positive effect on calf recruitment.

Hunter Harvest. The harvests in 2007 and 2008 were typical for years when no resident general season hunting is allowed (Table 2). The Tier II harvest was also consistent with the previous reporting period (Table 3). The harvest on Kalgin Island averaged 18 moose during the reporting period, down from an average of 45 for the previous 8 years (Table 3).

Hunter Residency and Success. The general season was closed to nonresidents during the reporting period and closed to all hunters, excluding Tier II hunters, during 2007–2009 (Table 4).

Harvest Chronology. The general season was closed to nonresidents during the reporting period and closed to all hunters, excluding Tier II hunters, during 2007–2009 (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 suggest the population is not rebuilding from the 1999–00 winter, despite promising factors, including lower harvests, greater overwinter survival likely due in part to wolf reduction, and a large percentage of cows giving birth in the spring, with high twinning rates (J. Crouse, ADF&G, unpublished data). The potential for recovery was most likely hampered by the effects of predation by wolves and bears on mainland Unit 16B, as assessed from low calf recruitment in the fall (Table 1). 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. Studies in Unit 16B strongly suggest that bear predation has a strong influence on calf recruitment (Faro, 1989; J. Crouse ADF&G, unpublished data). Black and brown bear surveys we conducted in spring of 2007 indicated a very high density of bears in the unit (E. Becker ADF&G, unpublished data). Brown bear season and bag limits were liberalized and a black bear control program began in the fall of 2007.

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Subunit 16B was below objective levels for this reporting period. Our estimate of 3,793–4,852 moose was below the minimum objective of 6,500 and below what the habitat can support based on twinning rates and other nutritional indices. 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 Subunit 16B. Current research plans include looking at calf recruitment and calf mortality in the lower Tyonek area, as well as an ongoing project looking at calf recruitment around Skwentna. Future efforts should be directed at gaining accurate and precise estimates of wolf and bear populations. There are currently plans to do a wolf population survey in RY10 if snow cover and weather conditions allow, and a black bear population survey in the near future.

LITERATURE CITED

- Becker, E. F. and D. J. Reed. 1990. A modification of a moose population estimator. *Alces* 26:73–79.
- Del Frate, G. G. 2004. Unit 16B moose management report. Pages 233–245 in C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Grants W-27-3 and 4, Project 1.0. Juneau, Alaska.
- Faro, J. B. 1989. Game Management Unit 16 moose survey/inventory progress report. Pages 156–166 in S. O. Morgan, Ed. Annual report of survey/inventory activities, Part VIII.

- Moose. Vol. XIX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report Project W-23-1, Study 1.0. Juneau, Alaska.
- . 1990. Game Management Unit 16 moose survey/inventory progress report. Pages 165–176 *in* S. O. Morgan, ed. Annual report of survey/inventory activities, Part VIII. Moose. Vol. XX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report Project W-23-2, Study 1.0. Juneau, Alaska.
- Gasaway, W. C., S. D. DuBois, D. J. Reed and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. University of Alaska, Institute of Arctic Biology. Alaska Department of Fish and Game. Biological papers No. 22. Fairbanks, Alaska.
- Griese, H.J. 1996. Game Management Unit 16B moose management report. Pages 208–221 *in* M. V. Hicks, ed. Management report of survey/inventory activities, 1 July 1993–30 June 1995. Moose. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Grants W-24-2 and W-24-3. Study 1.0. Juneau, Alaska. 487pp.
- . 2000. Game Management Unit 16B moose management report. Pages 224–236 *in* M. V. Hicks, ed. Management report of survey/inventory activities, 1 July 1997–30 June 1999. Moose. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Grants W-27-1 and W-27-2. Study 1.0. Juneau, Alaska.
- Harkness, D. B. 1993. Game Management Unit 16 moose survey/inventory management report. Pages 182–190 *in* S. M. Abbott, ed. Survey/inventory management report, 1 July 1989–30 June 1991. Moose. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Grants W-23-3 and W-23-4. Study 1.0. Juneau, Alaska.
- Masteller, M. 2000. Game Management Unit 16 wolf management report. *In* M. V. Hicks, ed. Management report of survey/inventory activities, 1 July 1997–30 June 1999. Wolf. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Grants W-27-1 and W-27-2. Juneau, Alaska.
- Peltier, T.C. 2006. Unit 16B moose management report. Pages 225-238 *in* P. Harper, editor. Moose management report of survey/inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- Peltier, T.C. 2008. Unit 16B moose management report. Pages 233-245 *in* P. Harper, editor. Moose management report of survey/inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- Peltier, T. 2008. Unit 16 black bear management report. Pages 187–198 *in* P. Harper, editor. Black bear management report of survey/inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish & Game. 17.0 Juneau, Alaska.
- Schwartz, C.C., K.J. Hundertmark and T.H. Spraker. 1992. An evaluation of selective the bull moose harvest on the Kenai Peninsula, Alaska. *Alces* 28:1–14.

Taylor, W. P. 1983. Unit 16B, Kalgin Island, moose survey/inventory progress report. Pages 70–72 *in* J. A. Barnett, ed. Annual report of survey/inventory activities. Part II. Moose. Vol. XIII. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report Project. Grant W-22-1. Study 1.0. Juneau, Alaska.

Ver Hoef J.M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

PREPARED BY:

Tim C. Peltier
Wildlife Biologist II

REVIEWED BY:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Peltier, T.C. 2010. Unit 16B moose management report. Pages 235–247 *in* P. Harper, editor. Moose management report of survey/inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, 1999–2009.

Regulatory 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
1999–00	Middle ^a	11/22–27	28	2	9	7	587	631	1.3	3314±489 ^b
	Southern ^c	11/15–22	38	4	8	6	432	458	--	--
	Kalgin Is. ^d	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 ^c	12/16	--	--	--	--	85	98	--	--
	Kalgin Is. ^d	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 ^c	10/30–11/4	31	3	13	9	539	594	--	700–850
	Kalgin Is. ^d	10/22	--	--	--	33	64	96	4.2	110–140
2002–03 ^f	--	--	--	--	--	--	--	--	--	--
2003–04	Northern ^g	11/24–12/6	35	7	17	9	292	326	--	898±163
	Southern ^c	12/1	46	17	23	14	133	154	--	700–850
	Kalgin Is. ^d	11/25	38	25	89	39	76	125	--	179
2004–05	Southern ^c	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. ^d	1/17/06	17	3	47	29	69	97	4.2	100–120
2006–07	Kalgin Is. ^d	2/9/07	--	--	--	30	26	37	1.6	50–70
2007–08	Kalgin Is. ^d	11/19/07	26	13	67	37	77	118	5.2	120–140
2008–09	Northern ^e	10/29–30	58	16	12	7	318	340	1.9	917±207
	Middle ^e	11/15–17	54	11	21	12	600	678	1.1	2446±322
	South ^f	12/2/08	78	13	18	9	224	247	--	--

^a Gasaway et al (1986) random stratified survey.^b 80% confidence intervals.^c Trend area composition survey (2–4 min./mi²).^d Trend area composition survey (6–8 min./mi²).^e Becker survey (Becker and Reed 1990).^f No surveys completed.^g J. Ver Hoef's regression sampling method (Ver Hoef 2001) for 1/3 of area (612± 151 [80% CI]), plus 350 – 550 estimated for remained of area.

Table 2. Unit 16B moose harvest^a and accidental death, 1999–2009.

Regulatory year	Reported				Estimated			Accidental deaths ^e			Grand Total
	M	F	Unk	Total ^a	Unreported ^b	Illegal	Total	Road	Other	Total	
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
2007–08	116	10	0	126	15	25	40	0	0	0	166
2008–09	133	13	0	146	15	25	40	0	0	0	186

^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, 1999–2009.

Hunt Number ^a	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Harvest		
							Cows	Unk	Total
TM565	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
	2007–08	100	21	38	41	40	1	0	41
	2008–09	110	20	40	40	44	0	0	44
TM567	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
	2007–08	80	20	39	41	33	0	0	33
	2008–09	120	18	40	42	50	0	0	50

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	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
	2007-08	100	19	52	29	29	0	0	29
	2008-09	101	30	47	23	23	0	0	23
DM571/ RM572	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
	2007-08	131	44	38	18	14	9	0	23
	2008-09	134	10	63	27	13	0	0	13

^aTM = Tier II permit, RM = registration permit, DM = drawing permit.

Table 4. Unit 16B moose hunter^a residency and success 1999–2009.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^b	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident ^b	Nonlocal resident	Nonres.	Unk.	Total	
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	--	--	--	--	--	--	--	--	--	--	--
2007–08 ^c	--	--	--	--	--	--	--	--	--	--	--
2008–09 ^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, 1999–2009.

Regulatory year	August		September					Unknown	Total
	20–26	27–31	1–7	8–14	15–20	21–25	26–30		
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	--	--	--	--	--	--	--	--	--
2007–08 ^d	--	--	--	--	--	--	--	--	--
2008–09 ^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
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	--	--	--	--	--	--	--	--	--	--
2007–08 ^b	--	--	--	--	--	--	--	--	--	--
2008–09 ^b	--	--	--	--	--	--	--	--	--	--

^a Does not include harvest from permit hunts^b No general open season

**WILDLIFE
MANAGEMENT REPORT**

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

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 17 (18,800 mi²)

GEOGRAPHIC DESCRIPTION: Northern Bristol Bay

BACKGROUND

Moose are relatively new inhabitants in the Bristol Bay area, possibly migrating from middle Kuskokwim River drainages. Until recent years, 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 moose were not abundant in the unit and 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 were 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 likely 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 Kulukak and Togiak 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 1,100–1,750 moose.

Subunit 17B

- Manage for a population of 4,900–6,000 moose with a human use objective of 200–400 moose. Achieve and maintain a density of 1 moose/mi² on habitat considered good moose range.

Subunit 17C

- Manage for a population of 2,800–3,500 moose with a human use objective of 165–350 moose. Maintain a minimum density of 0.5 moose/mi²

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 radio-telemetry study from 1989 to 1994. In March 1998, 36 moose were radio-collared in 17A to study movements and population parameters (Aderman, et. al. 1999). Additional moose have been radio-collared 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 eight 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, 2004, and 2008, 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 portion 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. Hunters who did not report were sent reminder letters. We monitored harvest and cooperated with enforcement efforts of the Alaska Wildlife Troopers 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 a 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 2008 indicated a minimum population of 1,070 moose in 17A (Aderman, pers. com.). The present population size in 17A probably exceeds 1,200 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 2,500–3,000 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 4,900 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 1,202 (± 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 1,953 (± 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 1,210 (± 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 1,400–1,700 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 2,800 moose. In March 1999, a moose population estimation survey was completed for 17C north of the Igushik River, yielding an extrapolated estimate of 2,955 (± 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 3,670 (± 542 at 90% CI) moose, including 410 (± 96 at 90% CI) calves (11.2% of moose) (Woolington 2006). In March 2008, a moose population estimation survey was completed for 17C north of the Igushik River, yielding an extrapolated estimate of 3,235 (± 354 at 90% CI) moose, including 392 (± 72 at 90% CI) calves (12% of total moose). 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. The 2006 population estimation survey indicated a minimum calf percentage of 12.5% in western Unit 17B, and the 2008 survey indicated a minimum calf percentage of 12% 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 radio-telemetry study indicated most moose radio-collared 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 and Aderman 2008).

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 two-week registration hunt in 17A and western 17C (RM575) for RY07 was 2–15 January. The winter resident-only two-week registration hunt in 17A and western 17C (RM575) for RY08 was 5–18 January. Registration permit holders could take one 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 one bull with spike-fork (SF/50) or 50-inch or greater antler spread or with three or more brow tines on at least one side (SF/50). The general moose hunt in 17B for nonresident hunters was 5–15 September with a bag limit of one SF/50 bull with four brow tines. 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 one bull in a regulatory year. The fall nonresident-only registration moose hunt in the 17B nonresident corridor (RM587) was 5–15 September. Registration permit holders could take one SF/50 bull with four brow tines. The area open for this registration hunt was a corridor extending two 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 one 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, and beginning fall 2008 in Dillingham. 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), or when issued at Nushagak River drainage communities.

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 (2–15 January 2008; 5–18 January 2009).

Hunter Harvest. As a result of a more than four-fold increase in moose hunters afield in Unit 17 since 1983 (1983–84=293; 2005–06=1,230), reported moose harvests have almost tripled (1983–84=127; 2007–08=388). However, the most recent years have seen a decline from the peak year of RY03. The reported harvest in the past five years in 17B has ranged from 79 to 168, with an annual average harvest of 118 moose. In Unit 17C, the 5-year mean annual harvest was 220, with a range of 193 to 233 moose (Table 1).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last five 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 72 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 RY80. The reported harvest in the past five

years for the general moose season in 17B has ranged from 34 to 107, with a mean annual harvest of 63 moose (Table 4). In 17C, the 5-year mean annual harvest for the general hunt was 23 moose, with a range of 17 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 2007-08, 1,104 resident permits were issued for Unit 17 registration moose hunts, and 833 permittees reported they hunted, killing 300 moose. In fall 2007, 30 nonresidents were issued permits for registration hunt RM587, and 26 permittees reporting they hunted, killing 11 moose. In the fall and winter of 2008-09, 1,227 resident permits were issued for Unit 17 registration moose hunts, and 960 hunters reported hunting, killing 295 moose. In fall 2008, 23 nonresidents were issued permits for registration hunt RM587, and 19 permittees reported they hunted, killing seven 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 five years was 315, a continued decline from the previous reporting periods (Woolington 2008). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. Unit-wide success during the general hunt ranged from 20 to 31% during the past 5 years, with a mean annual success rate of 27%. In RY04 through RY08, nonresidents accounted for 54% of reporting hunters in the general hunt, residents of Unit 17 accounted for 11%, and other residents of Alaska made up 33% 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 five years was 832, a 9% increase from the previous reporting period (Woolington 2008). Success during the registration hunts in Unit 17 ranged from 31 to 38% during the past five years, with a mean annual hunter success rate of 34%. Residents of Unit 17 composed 86%, and other residents of Alaska made up 14% of hunters in the resident registration hunts from RY04 through RY08 (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 = 66%, Table 12). Most successful hunters in the registration hunt used boats for access (5-yr mean = 72%, 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 unit-wide, and brown bears are common. Snow depths throughout the unit were

moderate during the winters of this reporting period, and there were no reports of excessive winter mortality. Moose were apparently able to find abundant forage on winter ranges in riparian areas.

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 seven 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 mi² of optimal moose winter habitat and another 520 mi² 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. There are some areas formerly used by moose where browse species appear to have grown out of reach. 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 were 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.

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.

NON-REGULATORY 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 present 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 1,100–1,750 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 RY93. The board adjusted it again in 1997. The board and the department will need to continue managing these two 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.

LITERATURE CITED

- Aderman, A. R. 2008. Demographics and home ranges of moose at Togiak National Wildlife Refuge, southwest Alaska, 1998 - 2007. Progress Report. Togiak National Wildlife Refuge, Dillingham, Alaska.
- Aderman, A., L. Van Daele, and M. Hinkes. 1995. Estimated moose population size in the Togiak River drainage (Unit 17A) and adjacent Wood River Mountains (western unit 17C), southwest Alaska, 1995. Togiak NWR & Alaska Department of Fish and Game. Dillingham, Alaska USA.
- Aderman, A., M. Hinkes, and J. Woolington. 1999. Population identity and movements of moose in the Togiak, Kulukak, and Goodnews River drainages, southwest Alaska. March 1998–April 1999. Progress Report 99–01. Togiak NWR & Alaska Department of Fish and Game. Dillingham, Alaska USA.
- _____, _____, and _____. 2000. Population identity and movements of moose in the Togiak, Kulukak, and Goodnews River drainages, southwest Alaska. March 1998–April 2000. Progress Report 00–01. Togiak NWR & Alaska Department of Fish and Game. Dillingham, Alaska USA.
- Aderman, A. and J. Woolington. 2005. Population identity and movements of moose in the Togiak, Kulukak, and Goodnews River drainages, southwest Alaska. March 1998–April 2005. Progress Report. Togiak NWR & Alaska Department of Fish and Game. Dillingham, Alaska USA.
- Delong RA. 2006. Geospatial population estimator software user’s guide. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.
- Faro, J.B. 1973. Game Management Unit 17 moose survey-inventory progress report. Pages 117–119 in D.E. McKnight, editor. Annual report of survey-inventory activities. Part I. Moose, Deer and Elk. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Project W-17-4, Job 1, 2, & 13. Juneau, Alaska USA.
- Jemison, L. 1994. Distribution, movements, reproduction, and survival of radiocollared moose, southwest Alaska. Togiak NWR & Alaska Department of Fish and Game. Dillingham, Alaska USA.
- Kellie KA and Delong RA. 2006. Geospatial software operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.

- Taylor, K.P. 1988. Game Management Unit 17 moose survey-inventory progress report. Pages 87–89 *in* S. Morgan, editor. Annual report of survey-inventory activities. Part VIII. Moose. Vol. XVIII. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-22-6, Job 1.0. Juneau, Alaska USA.
- . 1990. Game Management Unit 17 moose survey-inventory progress report. Pages 177–185 *in* S. Morgan, editor. Annual report of survey-inventory activities. Part VIII. Moose. Vol. XX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Progress Report. Grant W-23-2, Study 1.0. Juneau, Alaska USA.
- Van Daele, L.J. 1995. Mulchatna caribou survey-inventory management report. Pages 23–36 *in* M.V. Hicks, editor. Annual report of survey-inventory activities. Caribou. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grants W-24-1 and W-24-2. Study 3.0. Juneau, Alaska USA.
- Woolington, J.D. 2002. Game Management Unit 17 moose management report. Pages 250–272 *in* C. Healy, editor. Moose management report of survey-inventory activities 1 July 1999–30 June 2001. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- Woolington, J.D. 2004. Game Management Unit 17 moose management report. Pages 246–266 *in* C. Healy, editor. Moose management report of survey-inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- Woolington, J.D. 2005. Mulchatna caribou management report.. Pages 20–37 *in* C. Brown, editor. Caribou management report of survey-inventory activities 1 July 2002–30 June 2004. Alaska Department of Fish and Game. Juneau, Alaska.
- Woolington, J.D. 2006. Game Management Unit 17 moose management report. Pages 239–261 *in* P. Harper, editor. Moose management report of survey-inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Prepared by:

James D. Woolington
Wildlife Biologist III

Submitted by:

Gino Del Frate
Management Coordinator

Please cite any information taken from this section, and reference as:

Woolington, J.D. 2010. Unit 17 moose management report. Pages 248–270 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

TABLE 1 Reported moose harvest data for all hunts in Unit 17, 1968-09 through 2008-09

Regulatory Year	Reported Harvest	Hunters afield	Success rate	Unit ^a			
				17A	17B	17C	Unk
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
2007-08	388	1142 ^b	34%	40	113	213	22
2008-09	353	1230 ^b	29%	45	79	229	0

^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 2008-09

Regulatory Year	Antler size			Largest antlers
	<30"	30–50"	>50"	
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"
2007-08	13	41	46	77"
2008-09	5	35	59	73"

TABLE 3 Unit 17 moose hunter^a residency and success, 1992-93 through 2008-09

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
2007-08	9	28	40	78 (28) ^r	23	70	108	201 (72) ^r	283
2008-09	3	23	24	51 (20) ^s	37	82	76	199 (80) ^s	250

^a Excludes hunters in permit hunts.^b Includes 8 successful and 7 unsuccessful hunters of unknown residency.^c Includes 7 successful and 8 unsuccessful hunters of unknown residency.^d Includes 1 successful and 2 unsuccessful hunters of unknown residency.^e Includes 1 unsuccessful hunter of unknown residency.^f Includes 1 unsuccessful hunter of unknown residency.^g Includes 6 successful hunters of unknown residency.^h Includes 2 successful hunters of unknown residency.ⁱ Includes 1 unsuccessful hunter of unknown residency.^j Includes 1 successful and 4 unsuccessful hunter of unknown residency.^k Includes 2 successful and 6 unsuccessful hunters of unknown residency.^l Includes 3 successful and 6 unsuccessful hunters of unknown residency.^m Includes 4 successful and 8 unsuccessful hunters of unknown residency.ⁿ Includes 5 successful and 12 unsuccessful hunters of unknown residency.^o Includes 6 successful and 2 unsuccessful hunters of unknown residency.^p Includes 3 unsuccessful hunters of unknown residency.^q Includes 2 unsuccessful hunters of unknown residency.^r Includes 1 successful and 3 unsuccessful hunter of unknown residency^s Includes 1 successful and 4 unsuccessful hunter of unknown residency.

TABLE 4 Unit 17B reported moose harvest^a and accidental death, 1992–93 through 2008-09

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
2007-08	53 (100)	0	0	53	0	0	0	0	53
2008-09	34 (100)	0	0	34	0	0	0	0	34

^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 2008-09

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
2007-08	25 (100)	0	0	25	0	0	0	0	25
2008-09	17 (100)	0	0	17	0	0	0	0	17

^a Excludes permit hunt harvest.^b No estimates of unreported/illegal harvests have been made for this unit.^d Does not include 1 bull from an unspecified portion of Unit 17.^f Does not include 3 bulls from an unspecified portion of Unit 17.^h Does not include 1 cow and 1 bull killed in motor vehicle accidents.^j Does not include 3 bulls from an unspecified portion of Unit 17.^l Does not include 1 bull from an unspecified portion of Unit 17.ⁿ Does not include 3 bulls from an unspecified portion of Unit 17.^p Does not include 1 bull from an unspecified portion of Unit 17.^c Does not include 3 bulls from an unspecified portion of Unit 17.^e Includes 1 bull killed in defense of life or property.^g Does not include 11 bulls from an unspecified portion of Unit 17.ⁱ Does not include 2 bulls from an unspecified portion of Unit 17.^k 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.^o Does not include 1 bulls 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 2008-09

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
573/575 ^c	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
	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
	2007-08 ^d	181	38	64	36	40 (100)	0	0	40
	2008-09 ^d	214	26	72	28	45 (100)	0	0	45

^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

^d Beginning 2007-08, RM575 winter hunt included western portion of Unit 17C

TABLE 7 Unit 17B reported moose harvest data by permit hunt, 1992–93 through 2008-09

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
	2007-08	953	22	62	38	60 (100)	0	0	60
	2008-09	1,037	21	69	31	45 (100)	0	0	45

^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 2008–09

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
	2007–08	953	22	60	40	188 (100)	0	0	188
	2008–09	1,037	21	69	31	212 (100)	0	0	212

^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 2008-09

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
2007-08	260	39	11	310 (36)	469	65	15	549 (64)	859
2008-09	257	38	7	302 (31)	596	70	12	678 (69)	980

^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 2008-09

Regulatory Year	Harvest periods									<i>n</i> ^b
	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.	
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
2007–08	0	0	40	56	0	0	0	0	4	78
2008–09	0	0	37	57	0	0	0	0	6	51

^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 2008–09

Regulatory Year	Harvest periods									<i>n</i> ^a
	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.	
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
2007–08	13	26	20	24	0	1	3	8	5 ^e	310
2008–09	11	22	15	25	0	1	6	13	8 ^f	302

^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.^e Includes 8 bulls taken Jan 2–15 in Unit 17A and western 17C.^f Includes 21 bulls taken Jan 5–18 in Units 17A and western 17C.

TABLE 12 Unit 17 reported moose harvest^a percent by transport method, 1992-93 through 2008-09

Regulatory Year	Percent of harvest							Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	
1992-93	64	0	29	0	2	0	1	212
1993-94	71	0	26	0	9	0	0	144
1994-95	71	0	22	0	2	0	1	161
1995-96	64	0	33	1	1	0	1	171
1996-97	68	0	29	0	2	0	1	196
1997-98	65	0	30	1	3	0	1	150
1998-99	67	0	32	0	1	1	0	169
1999-00	61	0	36	0	3	0	0	146
2000-01	75	0	23	0	0	0	0	184
2001-02	64	0	34	1	0	0	0	169
2002-03	61	0	38	1	0	0	0	120
2003-04	70	0	29	1	0	0	0	141
2004-05	75	0	23	1	0	0	0	129
2005-06	66	0	28	3	0	0	0	100
2006-07	63	0	33	0	0	0	0	76
2007-08	62	0	32	3	0	1	0	78
2008-09	63	0	35	0	0	0	0	51

^a Excludes permit hunt harvest.

TABLE 13 Unit 17 reported moose harvest by permit hunt, percent by transport method, 1992-93 through 2008-09

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
2007-08	5	0	75	2	14	1	2	1	310
2008-09	8	0	59	2	27	0	2	1	302

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 18 (42,000 mi²)

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 January and February 2008 we conducted a moose population survey in the Kuskokwim and Lowest Yukon count areas using the Geospatial Population Estimator (GSPE) method developed by Ver Hoef (2001). In the winter of 2009 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 January and February 2008, we conducted moose population censuses in the Lower Kuskokwim and Lowest Yukon count areas. (Table 1). Unless otherwise noted, the following results are reported at the 95% CI.

The moose population on the Lowest Yukon count area grew from an estimated $1341 \pm 21.0\%$ in 2005 to an estimated $2827 \pm 11.9\%$ in 2008. When we apply the Sightability Correction Factor

(SCF) (Kellie 2006) to this estimate we get $3230 \pm 21.0\%$. The density has changed from 1.1 moose/mi² in 2005 to 2.7 moose/mi² in 2008.

The moose population in the Lower Kuskokwim count area grew from an estimate of $70 \pm 32.4\%$ moose in 2004 to $515 \pm 17.5\%$ in 2008. When we apply the SCF the population estimate is $668 \pm 22.0\%$. The density of this moose population has changed from 0.1 moose/mi² in 2004 to 0.8 moose/mi² in 2008.

Population Composition

In November of 2007 we classified bulls, cows and calves in the Lower Kuskokwim count area (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 Lower Kuskokwim count area. This area also had an extremely high bull to cow ratio, probably due to the fact that it is an unhunted, rapidly growing population and that the sample size was fairly low.

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 but increasing 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 radio telemetry 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 Mountain Village where it is 1 antlered bull or 1 calf.

Federal seasons in Unit 18 were the same as State of Alaska seasons, except that there is no federal season in Unit 18 south of and including the Kanektok River drainages.

2007–2008	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit and Bag Limits		
Unit 18, Lower Kuskokwim Closed area; easterly of a line from the mouth of the Ishkowiik 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 drainage:		
1 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
1 antlered bull OR one calf	20 Dec – 10 Jan	No open season
Remainder of Unit 18		
1 antlered bull	1 Sep – 30 Sep	1 Sep – 30 Sep
OR 1 antlered bull	20 Dec – 10 Dec	No open season

2008–2009	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit and Bag Limits		
Unit 18, Lower Kuskokwim Closed area; easterly of a line from the mouth of the Ishkowiik 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 and including the Goodnews River drainage		
1 antlered bull	25 Aug – 20 Sep	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 Mountain to Mountain Village and excluding all Yukon River drainages upriver from Mountain Village (lower Yukon)		
1 antlered bull	10 Aug – 30 Sep	1 Sep – 30 Sep
OR 1 antlered bull OR one calf	20 Dec – 20 Jan	No open season
Unit 18, Remainder		
1 antlered bull	10 Aug – 30 Sep	1 Sep – 30 Sep
OR 1 antlered bull	20 Dec – 10 Jan	No open season

Board of Game Actions and Emergency Orders. At the November 2007 Board of Game (BOG) meeting in Bethel the Board extended the moose season below Mountain Village by moving the starting date in the fall to August 10 and extending the winter season to January 20. The BOG also opened the fall season on August 10 in Unit 18 remainder.

At the March 2008 meeting the BOG established a registration hunt and season in the area south of and including the Goodnews River drainage.

The BOG approved a request for an emergency season extension in the area below Mountain Village in January 2009. The department issued an emergency order (EO) on January 28, 2009 to extend the season from January 29, 2009 to February 28, 2009.

Human-Induced Harvest. During the 2007–2008 open season, 827 hunters reported a harvest of 458 moose. For the 2008–2009 season, 849 hunters reported a harvest of 465 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 99% (453 moose) of the reported harvest in 2007–2008 and 97% (429 moose) in 2008–2009. The few other moose reported harvested were either in the Kanektok River drainage (5 moose in 2007–2008 and 3 in 2008–2009) or in 2008–2009 the Goodnews drainage where 13 were harvested.

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 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 was one permit hunt for moose in Unit 18 during the reporting period. Forty hunters obtained RM620 registration permits; 5 reported that they did not hunt, 13 were successful and 23 hunted but were not successful. All hunters used boats to access the area.

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 827 hunters who participated during the 2007–2008 season, 18 were nonresidents. Of 849 hunters who participated during the 2008–2009 season, 42 were nonresidents. This is a higher number than in the past and is due to federal refuge lands becoming open to residents and nonresidents of the state in the Yukon drainage.

Based on reported harvest, the moose hunter success rates based on harvest reports were 55% for 2007–2008 and 56% for the 2008–2009 seasons. Successful hunters spent an average of 6.3 days hunting in 2007–2008 and 6.2 days in 2008–2009. Unsuccessful hunters spent an average of 9.5 days hunting in 2007–2008 and 2008–2009.

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 mi² of moose habitat exists in Unit 18. Approximately 4500 mi² of this habitat occurs along the riparian zone of the Yukon River and the remaining 3500 mi² 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 agreed upon a strategy centered on a 5-year moose hunting moratorium. The LKAC voted unanimously to submit a proposal to the Board of Game to initiate the moratorium beginning in the fall of 2004. Since that time, moose numbers have grown in the area. Anecdotal evidence suggested that the population had increased and the surveys conducted in January and February of 2008 estimated a minimum of 668 moose on the Kuskokwim drainage. In November of 2008, the LKAC made an Agenda Change Request (ACR) to the BOG to open the season on the Kuskokwim Drainage with in Unit 18 to a short 10 day season in fall of 2009. The Board approved a registration hunt for September 1 -10.

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 river 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.

LITERATURE CITED

ADERMAN, A. AND J. WOOLINGTON. 2001. Population Identity and Movements of Moose in the Togiak, Kulukak, and Goodnews River Drainages, Southwest Alaska. April 2000–April 2001 Progress Report.

GASAWAY, W.C., S.D. DUBOIS, D.J. REED AND S.J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biology Paper No. 22. University Alaska Fairbanks, Alaska.

KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.

VERHOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

PREPARED BY:

Phillip Perry
Wildlife Biologist III

SUBMITTED BY:

Peter J. Bente
Survey-Inventory Coordinator

Please cite any information taken from this section, and reference as:

PERRY, P. 2010. Unit 18 moose management report. Pages 271–285 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

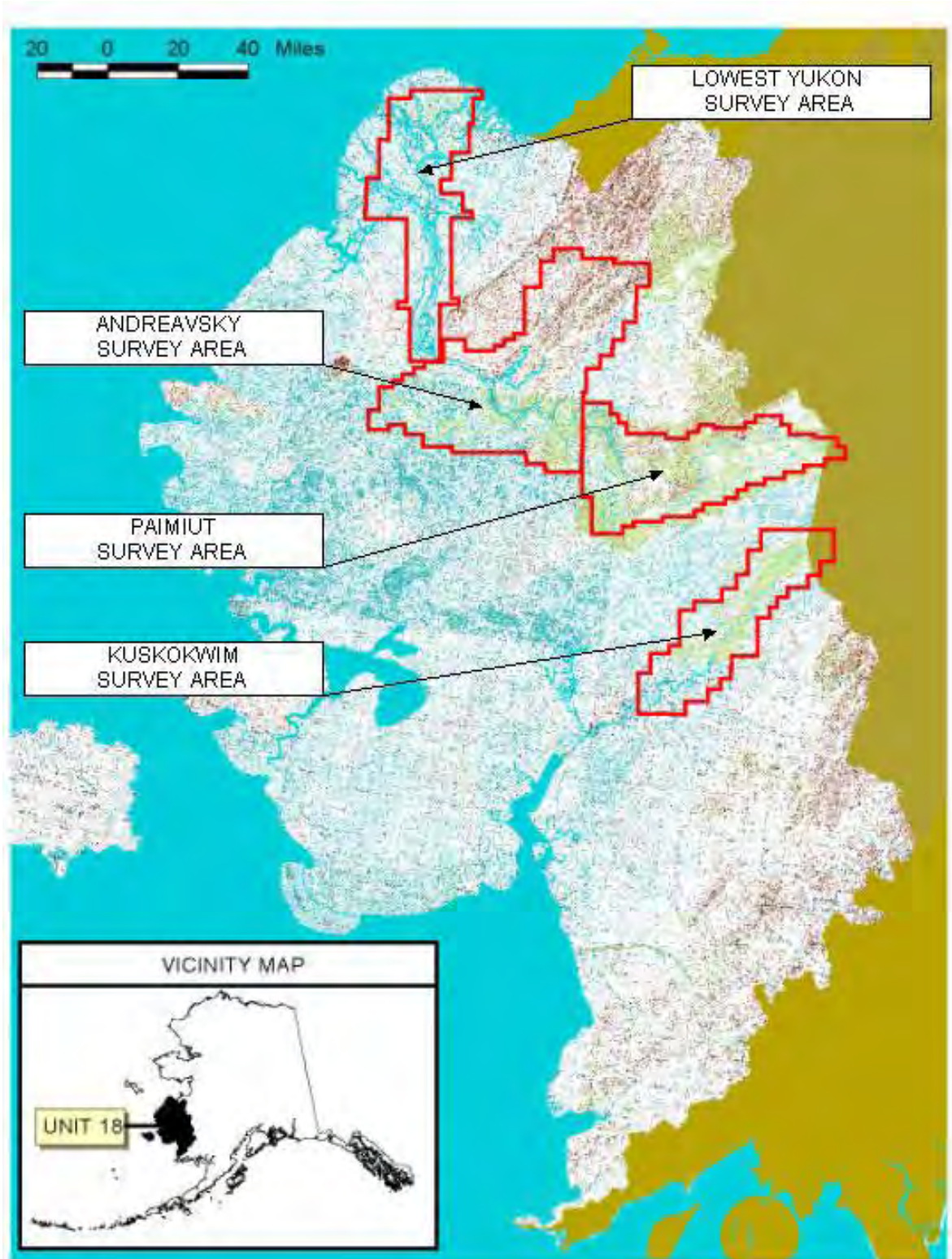


FIGURE 1 Unit 18 showing geostatistical population survey areas (Ver Hoef style survey areas).

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	< 0.1	Minimum count
	1994	1703	65	< 0.1	Minimum count
	2002	1151	674 ± 21.9%	0.7	Spatial method
	2005	1193	1341±21.0%	1.1	Spatial method
	2008	1193	2827±11.9%	2.5	Spatial method
	2008	1193	3230±21.0%	2.7	Spatial with SCF ^a
Andreafsky	1995	1393	52 ± 74.0%	< 0.1	Gasaway method
	1999	2279	524 ± 29.8%	0.2	Spatial method
	2002	1150	418 ± 22.4%	0.4	Spatial method
Paimiut	1992	1558	994 ± 19.7%	0.6	Gasaway method
	1998	1558	2024 ± 12.9%	1.3	Gasaway method
	2002	1571	2382 ± 16.1%	1.5	Spatial method
	2006	1571	3614 ± 18.1%	2.3	Spatial method
Lower Kuskokwim	1993	648	216 ± 44.6%	0.3	Gasaway method
	2000	907	86 ± 26.4%	0.1	Spatial method
	2002	907	117 ± 18.3%	0.1	Spatial method
Lower Kuskokwim Unit 18 only	2002	869	94 ± 23.0%	0.1	Spatial method
	2004	869	70 ± 32.4%	0.1	Spatial method
	2008	869	515±17.5%	0.6	Spatial method
	2008	869	668±22.0%	0.8	Spatial with SCF ^a

^a Sightability correction factor (SCF) applied to census estimate.

TABLE 2 Moose composition surveys, Unit 18, November 2007

Survey Area	Calves:100 cows	% calves as twins	Bulls:100 cows
Lower Kuskokwim(N=96)	84.4	44.4 %	115

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
2007–2008	827	458
2008–2009	849	465

TABLE 4 Fall and winter moose harvests for Unit 18, 1978–2009

Regulatory Year	Fall harvest		Winter harvest		Unknown harvest		Total Harvest (N)
	(N)	(%)	(N)	(%)	(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
2007–2008	370	81	86	19	2	1	458
2008–2009	350	78	81	18	11	4	442

**WILDLIFE
MANAGEMENT REPORT**

**Alaska Department of Fish and Game
Division of Wildlife Conservation**

(907) 465-4190 PO Box 115526
Juneau, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNITS: 19A, 19B, 19C, and 19D (36,486 mi²)

GEOGRAPHIC DESCRIPTION: All Kuskokwim River drainages upstream from Lower Kalskag

BACKGROUND

According to oral history, moose initially arrived in western Interior Alaska sometime after the turn of the twentieth century, and by 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 a major factor influencing moose abundance in Unit 19 with weather, habitat, and hunting also 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 also.

Prior to moose population density estimates such as those conducted in Unit 19A and eastern Unit 19D (Tables 1a–1d), aerial composition and trend surveys were the primary means of assessing population status and trend for several decades (Tables 2a–2c). Unfortunately, some of the 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, including controlled use areas (CUA) and management areas (MA), and other requirements to manage moose hunting and reduce conflicts between user groups, exist throughout the area. For example, the Holitna–Hoholitna CUA imposes a boat motor horsepower restriction; the upper 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

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

same means; there are meat on the bone requirements and meat care education requirements in various areas; a nonresident closed area exists within 2 miles of most major rivers in Units 19A and 19B prohibits nonresidents from hunting moose and caribou; aircraft restrictions apply in the Upper Kuskokwim CUA in Unit 19D; and moose hunting is allowed by Tier II permit only 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 complicated. These conflicts lead to the creation of the Central Kuskokwim Working Group, made up of representatives of multiple user groups, and the development the Central Kuskokwim Moose Management Plan (CKMMP), which was finalized in June 2004 and now guides moose management decisions in Units 19A and 19B. Similar public input has been accomplished in Unit 19D since 1995 largely through the McGrath 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 2009). With this understanding, we began managing to reduce predation in eastern Unit 19D (Unit 19D East); an 8513 mi² area of Unit 19D upriver of the Black and Selatna River drainages. In 2001, the Experimental Micro Management Area (EMMA), a 528-mi² area of eastern Unit 19D within an approximately 20-mi radius of McGrath, was established. This area, renamed the Bear Control Area (BCA) in 2009, encompasses the highest density of moose in Unit 19D East and was established as a treatment area to test and implement predator population manipulations and other management actions (Fig. 1).

In 1995 the Alaska Board of Game adopted a Wolf Control Implementation Plan for Unit 19D East. The board updated and/or reauthorized the plan in January 2000, March 2001, March 2003, January 2006, and May 2006. In March 2009 the plan was updated and reauthorized through June 2014.

Similarly, in Unit 19A, the Board of Game adopted a wolf predation control implementation plan in March 2004 with updates and/or reauthorizations in January 2006 and May 2006. In March 2009 the plan was updated, permitted areas for aerial wolf control were redefined (Fig. 2), and the plan was reauthorized through June 2014.

Predation control programs in Units 19A and 19D are critical for compliance with the intensive management mandates found in regulations 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 moose population and harvest objectives. As moose numbers declined, public planning efforts increased; predation 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 population indices in Unit 19C consistent with stable or increasing moose numbers.
- In Unit 19A and Unit 19D East: reduce predation on moose through predation 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 a fall posthunt bull:cow ratio of at least 30 bulls:100 cows.

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, thereby 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.

METHODS

To estimate moose population size and density in Unit 19A, we used the geospatial population estimator method (GSPE; Ver Hoef 2001, Ver Hoef 2008, Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. In Unit 19A, aerial surveys were conducted during March 2005 in approximately 7156 mi² south of and along the Kuskokwim River (South of the Kuskokwim); during March 2006 and 2010 in the western 3444 mi² of this area (19A West [Aniak]); and during March 2008 in the eastern 3874 mi² of this area (19A East [Holitna]; Fig. 3). All sample units were stratified as high or low density moose habitat in advance of the intensive surveys. A simple random sample of survey units (SUs; approximately 53%–66% high density and 33%–47% low density;) was selected from each stratum using Microsoft[®] Excel 2003 software. Additional SUs were selected to fill gaps in the randomized coverage. Sightability correction factors (SCFs) were not obtained during these surveys. Overall and strata-specific densities calculated from these surveys are extrapolated to similar areas where no population estimation surveys were conducted.

Since 2001 moose early winter numbers and densities have been estimated in 3 overlapping survey areas in Unit 19D. These areas are: 1) the 528 mi² EMMA; 2) the 1118 mi² EMMA buffer (this area is synonymous with the Upper Kuskokwim Moose Management Area [MMA]); and 3) the 5313 mi² moose survey area (MSA) (Fig. 4). With the exception of the 2003 EMMA estimate, all estimates of moose numbers in 19D are based upon GSPE techniques. The two stratum Gasaway method (Gasaway et al. 1986) was used for estimating moose numbers in the EMMA during 2003. Estimates of total numbers of moose in Unit 19D include yearly sightability correction factors (SCFs) based upon observations of radiocollared moose during surveys in 2001, 2003, and 2005–2008. Because yearly SCFs were not obtained during 2004 and 2009, an average SCF value was used for those years.

We determined bull:cow, calf:cow, and yearling bull:cow ratios using population survey data in Unit 19D and data from fall trend and composition surveys in central Unit 19A in the Holitna River drainage (Holitna Trend Count Area); in western Unit 19A in the Aniak River drainage, including the Aniak River downstream of the Buckstock River and the Kuskokwim River from Lower Kalskag to Aniak (Aniak Trend Count Area); and in Unit 19C in the Farewell area, generally from the Farewell airport east to the South Fork of the Kuskokwim River then northerly approximately 12 miles to the second moraine, then back to the Farewell airport (Farewell Trend Count Area). PA-18 aircraft were flown along randomly selected transects, ≤ 500 feet above ground level approximately 3–10 miles long at $\frac{1}{2}$ -mile intervals perpendicular to riparian moose habitats, and pilots used a Global Positioning System (GPS) to maintain the aircraft on transect. Most habitats in these areas are roughly linear and parallel to nearby rivers and 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 twinning surveys in the Holitna Trend Count Area, and in western Unit 19A in the Aniak Trend Count Area. PA-18 aircraft were flown along randomly selected transects at ≤ 500 feet above ground level, and pilots used a GPS to maintain the aircraft on transect. Cows accompanied by single calves or multiple calves were enumerated. Twinning surveys were flown in late May and twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

To determine twinning rates in Unit 19D, radiocollared cows were relocated using PA-18 and Bellanca Scout aircraft during May and early June. These cows, as well as other cows found during these flights, were enumerated and classified as being accompanied by single calves or multiple calves. The twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

We estimated annual harvest using data from mandatory harvest report cards. This included data from report cards from general season harvest tickets, and registration and Tier II permits. 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. Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY08 = 1 Jul 2008–30 Jun 2009). We also received notification of mortuary moose requests consistent with regulation 5 AAC 92.019, coordinated these hunts with enforcement personnel, and recorded harvests.

As part of a habitat assessment, we conducted browse surveys in Units 19A and 19D. We sampled 278 plants in 42 plots, counting plants, counting twigs on sampled plants, and measuring diameter of sampled twigs at the annual growth scar and any browsed points. (Paragi and Haggstrom 2006; Paragi et al. 2008; Tom Paragi, Alaska Department of Fish and Game [ADF&G] Fairbanks, unpublished data). We used helicopters to access areas in the EMMA buffer to conduct browse surveys during 30 March to 1 April 2009 (Tom Paragi, ADF&G Fairbanks, unpublished data) to gauge the extent to which nutrition may be limiting moose productivity (Boertje et al. 2007). This study area corresponded in part to earlier browse surveys in Unit 19D East (2001) and the EMMA (2003) when moose densities were lower. We also conducted snow depth surveys in Units 19A and 19D since 2008 (Paragi and Kellie 2008) and

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. From the March 2005 survey south of the Kuskokwim River, we calculated a moose density of 0.27 observable moose/mi² ($\pm 16\%$, 90% CI; Table 1a) with 17% calves.

From the March 2006 survey in 19A West (Aniak), we calculated a moose density of 0.39 observable moose/mi² ($\pm 15\%$, 90% CI) with 9% calves. In this area in March 2010, we calculated a moose density of 0.33 observable moose/mi² ($\pm 15\%$, 90% CI; Table 1a) with 23% calves. Confidence intervals overlap, and no trend is detected.

From the March 2008 survey in 19A East (Holitna), we calculated a moose population density of 0.44 observable moose/mi² ($\pm 28\%$, 90% CI; Table 1a) with 21% calves. Analysis of the March 2005 survey data south of the Kuskokwim River produced a density of 0.28 observable moose/mi² ($\pm 17\%$, 90% CI) within the 19A East (Holitna) portion. Confidence intervals overlap, and no trend is detected.

No direct moose population abundance measures were made in Unit 19B, but densities are likely at or below those found in Unit 19A.

Unit 19D. Within the EMMA and EMMA buffer, moose densities were estimated as high as 1.6 moose/mi² in 2009. This compares to an estimated density of 0.8 moose/mi² in 2001 in the EMMA buffer. Tables 1b and 1c show that the population has been increasing since the implementation of predator reductions in RY03.

In the 5313 mi² MSA, we calculated a moose population density of 0.7 moose based on the GSPE estimate of 3889 moose ($\pm 25\%$, 90% CI; Table 1d) during early winter 2008 (Table 1c). We estimate 2171 moose (0.5 moose/mi²) in the 4086 mi² portion of the MSA excluding the EMMA buffer (3889 moose in the entire MSA minus the 1718 moose in the EMMA buffer). Because habitat is similar in this area and the unsurveyed portions of 19D East, and we believe moose densities are also similar, we used this density to extrapolate to the unsurveyed portion of Unit 19D East to obtain an estimate of about 5400 moose in Unit 19D East.

Unit 19C. GSPE moose population estimation surveys are not conducted in Unit 19C. However, moose numbers in Unit 19C are likely similar to those of the late 1980s and early 1990s. 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 are equivocal because 2006 data was largely lost in an office fire, 2007 data was adversely influenced by weather, and weather prevented a survey in 2008. In 2009, 134 moose per hour were detected, similar to detection rates during the 1980s and 1990s (Table 2a).

Population Composition

Units 19A and 19B. In the November 2007 moose composition surveys in the Aniak Trend Count Area we found 122 moose, as well as ratios of 28 bulls:100 cows; 9 yearling bulls:100 cows; and 52 calves:100 cows. Calf:cow ratios this high are unusual in Interior Alaska, but this count area is adjacent to Unit 18 where similar calf:cow ratios are more common. In November 2008, we found 51 moose; as well as ratios of 42 bulls:100 cows; 6 yearling bulls:100 cows; and 23 calves:100 cows (Table 2b).

In the November 2007 moose composition surveys in the Holitna Trend Count Area we found 200 moose; as well as ratios of 35 bulls:100 cows; 21 yearling bulls:100 cows; and 45 calves:100 cows. In November 2008 we found 124 moose; as well as ratios of 34 bulls:100 cows; 12 yearling bulls:100 cows; and 27 calves:100 cows (Table 2c). Bull:cow ratios in this area appear to be recovering from the 8 bulls:100 cows found in 2005. The improvement in bull:cow ratios are consistent with a closed hunting season in this area.

We conducted spring twinning surveys in the Aniak Trend Count Area during early June 2007 and late May 2008 (Table 3a). In the Holitna Trend Count Area we conducted twinning surveys in late May in 2007 and 2008 (Table 3b). However, sample sizes were too small to be meaningful.

Unit 19C. In November 2007 we conducted a moose composition survey in the Farewell Trend Count Area but weather did not allow a complete survey. We found 104 moose (83 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 probably inflated due to these conditions. The calf:cow ratio is also suspect due to the incomplete survey.

In the November 2009 composition survey in the Farewell Trend Count Area we found 245 moose, with ratios of 53 bulls:100 cows; 23 yearling bulls:100 cows; and 25 calves:100 cows (Table 2a). Antler restrictions in Unit 19C contribute to high bull:cow ratios.

Unit 19D. Within the EMMA in 2007, the bull:cow ratio was 39:100; the yearling:cow ratio was 32:100; and the calf:cow ratio was 56 calves:100 cows. In 2008, the bull:cow ratio was 33:100; the yearling bull:cow ratio was 28:100; and the calf:cow ratio was 43 calves:100 cows. Since 2001, 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 1b). Similar composition data were obtained in the EMMA buffer (Table 1c). Moose population composition for the MSA during 2008 was 55 bulls:100 cows; 34 yearlings:100 cows; and 41 calves:100 cows (Table 1d).

Table 3c shows twinning rates for moose in Unit 19D East during spring 2001–2009. Twinning rates were generally high and ranged from 24% to 59% suggesting that the habitat is capable of

supporting higher moose populations (Boertje et al. 2007). Recently, however, lower twinning rates have been observed.

Moose Movements

Radiotelemetry locations during 2003–2005 in Units 19A and 19B showed that most moose did not move great distances from their capture locations, but those that did move considerable distances wintered to the south in Unit 17. In Unit 19C fewer moose are found in the Farewell Trend Count Area during spring bison surveys than are found during fall trend and composition surveys, suggesting that this population includes a large migratory component. In Unit 19D moose radiocollared in and around the EMMA as part of mortality research generally remained within 25–30 miles of their capture location and were essentially nonmigratory.

MORTALITY

Harvest

Seasons and Bag Limits.

Seasons and bag limits for RY07 through RY09 were:

<u>Units and Bag Limits</u>	<u>Open Seasons</u>
<i>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.</i> RESIDENT HUNTERS: 2 antlered bulls by Tier II permit TM684 NONRESIDENT HUNTERS:	Or, 10 Aug–25 Sep 20 Nov–31 Mar No open season
<i>Unit 19A, Kuskokwim River drainage downstream of and including the George River drainage and downstream of and excluding the Downey Creek drainage.</i> RESIDENT HUNTERS: 1 antlered bull by tier II permit TM680. NONRESIDENT HUNTERS:	1 Sep–20 Sep No open season
<i>Remainder of Unit 19A</i> RESIDENT AND NONRESIDENT HUNTERS:	No open season
<i>Unit 19B within the Nonresident Closed Area</i> RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side. NONRESIDENT HUNTERS:	1 Sep–20 Sep No open season
<i>Remainder of Unit 19B</i> 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

<u>Units and Bag Limits</u>	<u>Open Seasons</u>
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
<i>Unit 19C</i>	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers, or antlers with 4 or more brow tines on at least one side. Or, 1 bull by registration permit RM655.	1 Sep–20 Sep 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
<i>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</i>	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–25 Sep
NONRESIDENT HUNTERS:	No open season
<i>Unit 19D, that portion of the Takotna River drainage upstream of Takotna village</i>	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
<i>Unit 19D, that portion between and including the Cheeneetnuk and Gagaryah River drainages, excluding that portion within 2 miles of the Swift River</i>	
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
<i>Remainder of Unit 19D</i>	
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season

Alaska Board of Game Actions and Emergency Orders. As a discretionary condition of registration permit hunt RM650, the Alaska Department of Fish and Game maintained an area closed to moose hunting during RY03–RY07 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. During RY08–RY09, moose hunting in this area was allowed during 1–15 September.

The Board of Game redefined the Upper Kuskokwim CUA during the March 2008 meeting. Effective in RY09, this area was redefined as that portion of Unit 19D extending 2 miles on either side of, and including, the Kuskokwim River, upstream from the mouth of the Black River to the mouth of the Swift Fork, extending 2 miles on either side of and including the Takotna River, upstream from the mouth of the Takotna River to Takotna, and extending 2 miles on either side of and including the South Fork River, upstream from the mouth of the South Fork to Nikolai.

During the March 2010 meeting, the Board of Game made the following changes to the resident moose hunts in Unit 19D effective during the RY10 season:

- Changed the RM650 resident moose hunt area to include all of Unit 19D and extended the season throughout the area to 1–25 September.
- Allowed for a general moose hunt throughout Unit 19D, excluding the Upper Kuskokwim Controlled Use Area, 1–20 September.
- Established a season for resident hunters by registration permit, which may be announced in February, with a bag limit of any moose.

Harvest by Hunters. The overall reported harvests in Unit 19 were 263 and 277 moose in RY07 RY08, respectively (Table 4a). Moose harvest fell slightly (4%) from RY07 to RY08 in Unit 19A. In Unit 19B harvest increased by 25%, but remained low. Harvest increased by 20% in Unit 19C and by 6% in Unit 19D (Tables 4b–4e). A few moose were reported taken in Unit 19, but reported location information is missing or does not allow identification of subunit (Table 4f). 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.

Permit Hunts. The numbers of moose reported taken using Tier II permit hunt TM684 in the Lime Village MA in Unit 19A and registration permit RM655 in Unit 19C were typically low (Table 5). During RY07, 2 bulls were taken by one hunter (bag limit is 2 antlered bulls in TM684) and during RY08, 1 bull was reported taken under TM684. During RY07–RY08, a total of 18 bulls were taken under RM644 in Unit 19C.

Participation and harvest in registration permit hunt RM640 in Units 19A and 19B were high. However, harvestable surplus in Unit 19A was lower than amounts needed for reasonable subsistence opportunity, so this hunt was eliminated in RY06. It was replaced with the current general hunt with antler restrictions in Unit 19B and a Tier II permit hunt, TM680, that was established on all lands in western Unit 19A. A federal hunt for local rural resident hunters, FM019, was established for federal lands within the TM680 hunt boundaries. In RY07, 54 bulls were reported taken using TM680 permits and 16 bulls were taken using FM019 permits. In RY08, 56 bulls were reported taken using TM680 permits and 11 bulls were taken using FM019 permits (Table 5).

In Unit 19C, registration permit hunt RM655 for bulls takes place during February. Hunters cannot use aircraft and generally 10 or fewer hunters participate. During RY07 and RY08, 4 and 3 bulls, respectively, were reported taken (Table 5).

In Unit 19D during RY04–RY08, an annual average of 254 hunters took an average of 77 bulls using the RM650 permit (Table 5). During RY07, 86 moose were reported taken and during RY08, 103 moose were reported taken. The RY08 harvest is the highest reported harvest using this permit.

Hunter Residency and Success. Hunter residency and success during RY04–RY08 were subdivided by local and nonlocal resident hunters and nonresident hunters (Tables 6a–6e). Hunter success in Unit 19 improved from 23% in RY05 and 25% in RY06 to 33% in RY07 and 34% in RY08 (Table 6a).

Hunter success in Unit 19A improved from 17% and 15% in RY05 and RY06, to 24% and 25% in RY07 and RY08 (Table 6b). During RY05 and RY06, hunters complained of low water levels and persistent warm weather. Increased hunter success in RY07 and RY08 was probably due to improved weather-related hunt conditions.

In Unit 19B, the number of hunters declined from 151 hunters who reported hunting during RY04 to 87 in RY07 and 90 in RY08. Antler restrictions and a much smaller caribou herd likely explain much of this decline. Success rates in Unit 19B were 23% in RY07 and 28% in RY08 (Table 6c).

In Unit 19C, success rates improved from 34% in RY05 and 32% in RY06 to 42% in RY07 and 43% in RY08 (Table 6d).

Success rates for resident hunters also improved in Unit 19D, increasing from 37% in RY05 and 33% in RY06 to 44% in RY07 and 42% in RY08 (Table 6e). Some of this increase is likely due to opening a portion of the RM650 hunt area that was closed beginning in RY07, as well as an increase in moose numbers in the central Unit 19D.

In Units 19A and 19D, residency restrictions eliminated or reduced nonresident hunting. During RY07 and RY08, no nonresidents reported taking moose in Unit 19A and only 5 nonresidents reported taking moose in each of these years in Unit 19D.

Nonresidents still take a substantial portion of the harvest in Units 19B and 19C. In Unit 19B, 58% of the combined take during RY07 and RY08 was taken by nonresidents (Table 6c). In Unit 19C, 43% of the combined take during RY07 and RY08 was taken by nonresidents (Table 6d).

Transport Methods. In Units 19B and 19C, hunters primarily used aircraft, while in Units 19A and 19D, boats were the most common method of transport. (Tables 7a–7e). These methods have always been dominant and remained so throughout RY07–RY08.

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 and 4–8 moose were likely taken each year during RY03–RY05, but these data were lost during the December 2006 fire. During January–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. During RY07, 3 bulls, 2 cows, and 5 unsuccessful hunts were reported. During RY08, 15 bulls, 4 cows, and 2 unsuccessful hunts were reported for mortuary ceremonies in Unit 19.

Other known mortality during RY07–RY08 included a moose caught in willows on a cut bank near McGrath, 2 calves hit by cars in McGrath, and a moose found with 2 broken front legs in Kalskag that was killed and salvaged. This list is incomplete, but illustrates the variety of accidental deaths that occur.

Keech (2009) found that the primary cause of moose calf mortality was predation by black bears, grizzly bears, and wolves. Deep snow also contributed to calf mortality.

HABITAT

Assessment

Paper birch, balsam poplar, quaking aspen, red osier dogwood, and 5 willow species were recorded, similar to most areas in Interior Alaska. Moose removed an estimated 41% (95% confidence limit: 33%–47%) of the current annual growth (biomass, mean plant basis) by later winter 2008–2009. This was a relatively high removal rate for Interior Alaska (Paragi et al. 2008; Tom Paragi, ADF&G, unpublished data) and significantly greater ($z > 6.2$, $P < 0.0005$) than removal rates estimated in 2001 (15.9%) or 2003 (17.0%). Moose removed 42% of browse biomass on riparian willow bars (95% CL: 32%–52%; $n = 99$ plants on 15 plots), which was not different ($z = 0.67$, $P > 0.5$) from a removal rate of 38% in non-riparian habitat (30%–44%; $n = 179$ plants on 27 plots).

Snow depth can restrict moose movement when it reaches about 28 inches and make movement very difficult at about 35 inches (Coady 1974). Preliminary analysis of snow depths from the April 2008 survey and historic data suggests that Unit 19 experiences snow depths of this magnitude more frequently than other 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. Snow depth measured in McGrath was 24 inches in April 2008 and 39 inches in April 2009 (Fig. 5).

High twinning rates indicate favorable nutritional status, indicating that habitat was adequate to support an increasing moose population (Boertje et al. 2007). Twinning rates observed in Unit 19A (Tables 3a and 3b) include too few observations to make any assessment of habitat quality there. In Unit 19D, twinning rates may be declining as the 2009 observed twinning rate of uncollared cows was 26%, the lowest observed since we began collecting these data in 2001

(Table 3c). This in combination with the high browse removal rate recorded during 2009 browse surveys indicates that habitat quality may be beginning to decline in Unit 19D East.

Enhancement

We continued cooperating 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 occurred regularly over large areas of diverse vegetation types in Unit 19, particularly during summers 2002 and 2005, when a total of 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 two large events occurred recently, in 2002 and to a lesser extent, in 2009. These events produced ice-scouring that helped rejuvenate some willow stands but the quality and availability of the moose habitat along the rivers is not believed to be as high as during the previous decade. With the exception of EMMA buffer, the available browse is generally underutilized, particularly in Unit 19A.

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/mi². Our recent moose density estimates of 0.33 observable moose/mi² in western Unit 19A (Aniak) during March 2010 and 0.44 observable moose/mi² in eastern Unit 19A (Holitna) during March 2008 were below this objective. Even if we apply a sightability correction factor of 1.3, the estimated density would be 0.4–0.6 moose/mi². The combined moose harvests in Units 19A and 19B of 100 in RY07 and 102 in RY08 (Tables 6b and 6c) are below the intensive management harvest objective.

We could not detect a change in moose numbers in the 19A West (Aniak) or 19A East (Holitna) areas (Table 1a). A density estimate of 0.28 moose/mi² ±17% (90% CI) was calculated for the 19A East (Holitna) area from a subanalysis of the South of the Kuskokwim survey of March 2005 and was compared to the March 2008 estimate of 0.44 moose/mi² ±28% (90% CI). While the midpoint of the 2008 estimate was higher than in 2005, confidence intervals overlap. Further, these estimates are of observable moose and variations in sightability complicate interpretation of these data.

We met our objective of 20–30 bulls:100 cows in Unit 19A. In November 2007 we found 28 bulls:100 cows in the Aniak Trend Count Area and 35 bulls:100 cows in the Holitna Trend Count Area. In November 2008 we found 42 bulls:100 cows in the Aniak Trend Count Area and 34 bulls:100 cows in the Holitna Trend Count area.

In November 2007, we exceeded our fall calf composition objective of 30–40 calves:100 cows in Unit 19A. In November 2007 we found 52:100 cows in the Aniak Trend Count Area and 45 calves:100 cows in the Holitna River drainage, exceeding our objective in both locations. Calf:cow ratios above 30–40 calves:100 cows are not common in Interior Alaska, but are not

unusual in adjacent Unit 18. In November 2008, we failed to reach this objective as we found 23 calves:100 cows in the Aniak area and 27 calves:100 cows in the Holitna River drainage.

Our objective for no fewer than 20% calves in late winter surveys was achieved in March 2008 in the 19A West (Holitna) survey area where we estimated 21% calves. It was also achieved in March 2010 in the 19A East (Aniak) survey area where we estimated 23% calves.

No composition data has been collected in Unit 19B since 2005 and no calf:cow ratio is available. Therefore, we are unable to directly determine whether we have achieved our composition objectives in Unit 19B. However, we expect that the moose population in Unit 19B is similar to Unit 19A West (Aniak) where we achieved most of our composition objectives.

The objective in Unit 19C to maintain a fall posthunt bull:cow ratio of at least 30 bulls:100 cows was probably achieved. During RY07, composition surveys were compromised by weather and in RY08 the survey was not completed. However, during a November 2009 survey, we found a bull:cow ratio of 53 bulls:100 cows.

Taking into account the moose population growth within the EMMA buffer, we estimate the population in Unit 19D East to be 5400 moose, which is below our objective of 6000–8000. Reported harvest of 114 and 121 moose in Unit 19D during RY07 and RY08 (Tables 4e, 6e, and 7e) 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.

The Board of Game is on record stating that the local need for moose in Unit 19D is 130–150. The hunt that best provides for this harvest is the RM650 registration permit hunt. The harvest from this hunt was 86 in RY07 and 103 in RY08.

The MMA has a population objective of 2500 moose, or a density of about 2.2 moose/mi², and a harvest objective of a minimum of 100 moose. The midpoint of the fall 2008 population estimate for this area is was 1718 moose, and the RY08 harvest was about 75 moose, both of which were below these objectives.

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 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 19A East (Holitna), the eastern two thirds of Unit 21E (not included in this report), and the MSA in Unit 19D, with an emphasis on the EMMA buffer. If the opportunity presents itself to conduct a survey in 19A West (Aniak), we will take advantage of it, but this will not be part of the normal cycle. To preserve 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 surveys throughout the McGrath area. However, spring twinning surveys in the Aniak Trend Count Area should be reconsidered because sample size is generally low.

Unit 19 twinning rates are generally above 25% and suggests higher moose densities and harvests could be supported by the existing moose habitat. However, as the moose population has increased, especially in the EMMA, browse removal rates have increased as well and we anticipate lower twinning rates to follow. We recommend using 2-year average twinning rates to adjust harvest, guide predation management, and assess our population and harvest objectives.

Radiocollars on moose in Unit 19A are no longer functioning. We recommend ending radiotelemetry flights during the next reporting period.

Snow and other weather conditions do not allow for regular GSPE moose surveys during November in Southwestern Alaska, so we conduct Unit 19A GSPE surveys during late winter. Sightability has not been measured during February and March but is thought to be lower than during November. A sightability study is proceeding in Unit 21E and we recommend using SCFs from that study to adjust our late winter population estimates when needed.

We recommend continued support for information and education programs, license vendors, and delivery of materials. We also recommend working closely with advisory committees to develop hunting regulations as moose populations respond to predation management.

LITERATURE CITED

- BOERTJE, R. D., K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ALDERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management* 73:314–327.
- COADY, J. W. 1974. Influence of snow on behavior of moose. *Naturaliste Canadien* 101:417–436.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. *Institute of Arctic Biology*. No. 22.
- KEECH, M. A. 2009. Response of moose and their predators to wolf reduction and short-term bear removal in a portion of Unit 19D East. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Annual Research Performance Report. Grant W-33-7. Project 1.62. Juneau, Alaska, USA. <<http://www.wildlife.alaska.gov/index.cfm?adfg=pubs.reports>> Accessed 4 May 2010.
- , T. A. BOUDREAU, AND P. VALKENBURG. 2002. Factors limiting moose at low density in Unit 19D-East, and response of moose to wolf control and increased bear harvest. Alaska Department of Fish and Game. Federal Aid Wildlife Restoration. Research Performance Report. Grant W-27-5. Project 1.58. Juneau, Alaska, USA.

<http://www.wildlife.alaska.gov/pubs/techpubs/research_pdfs/19dmoose.pdf> Accessed 19 May 2008.

KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 14 May 2010.

PARAGI, T. F., AND D. A. HAGGSTROM. 2006. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Annual Research Performance Report, 1 July 2005 to 30 June 2006. Project 5.10. Juneau, Alaska, USA.

———, AND K. A. KELLIE. 2008. Habitat evaluation techniques for moose management in Interior Alaska. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Annual Research Performance Report, 1 July 2007 to 30 June 2008. Project 5.20. Juneau, Alaska, USA. <http://www.wildlife.alaska.gov/pubs/techpubs/research_pdfs/hab_5.20_08.pdf>. Accessed 14 May 2010.

———, CT. SEATON, AND KA KELLIE 2008. Identifying and evaluating techniques for wildlife habitat management in interior Alaska: Moose range assessment. Alaska Department of Fish and Game, Research Final Technical Report. Project 5.10. Juneau, Alaska. 76 p. <http://www.wildlife.alaska.gov/pubs/techpubs/research_pdfs/hab-mgt08final.pdf>. Accessed 14 May 2010.

VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

VER HOEF, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13.

PREPARED BY:

Roger J. Seavoy
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

SEAVOY, R. J. 2010. Units 19A, 19B, 19C, and 19D moose. Pages 286–319 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

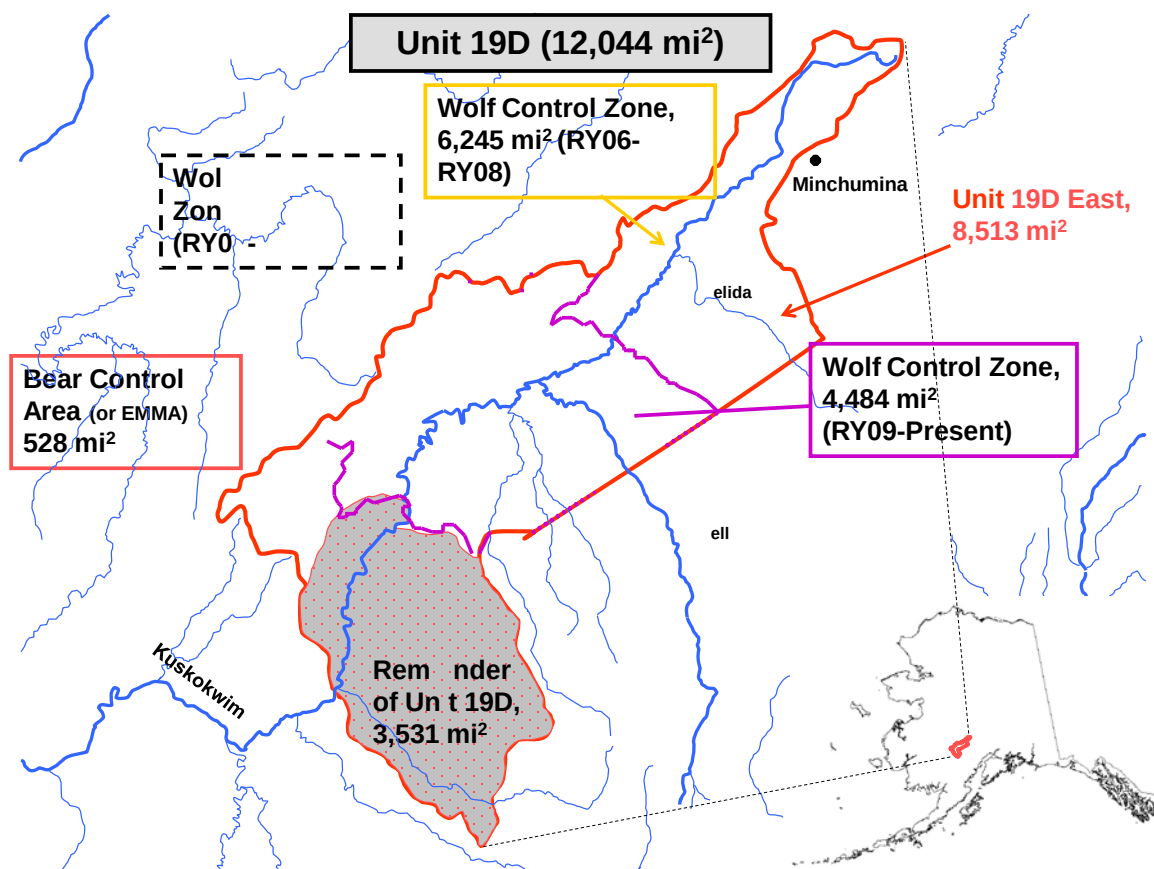


FIGURE 1 Predation control areas in Unit 19D showing the Bear Control area (also known as the EMMA) and wolf control areas in place between RY03 and RY09.

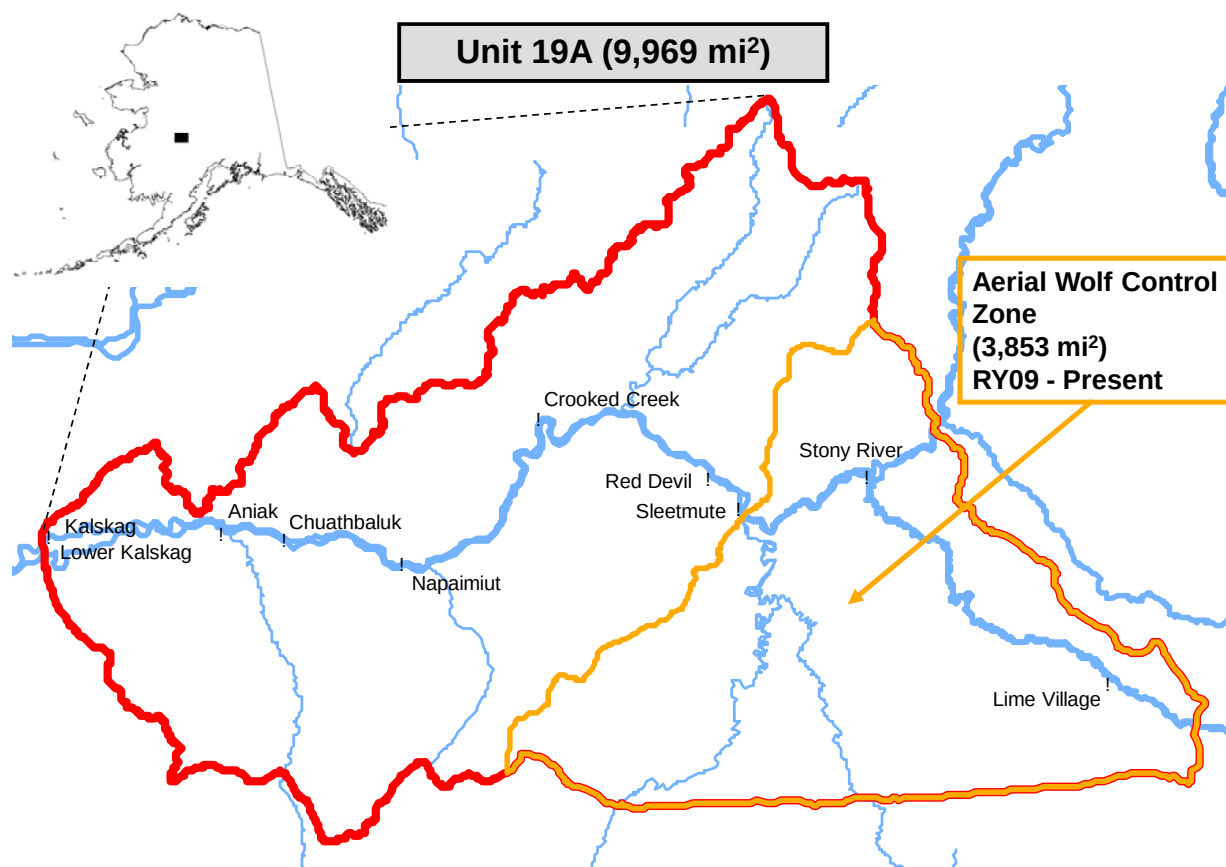


FIGURE 2 Unit 19A aerial wolf control area permitted throughout Unit 19A during RY04–RY08. Beginning in RY09, aerial wolf control was limited to those drainages upriver of Sleetmute.

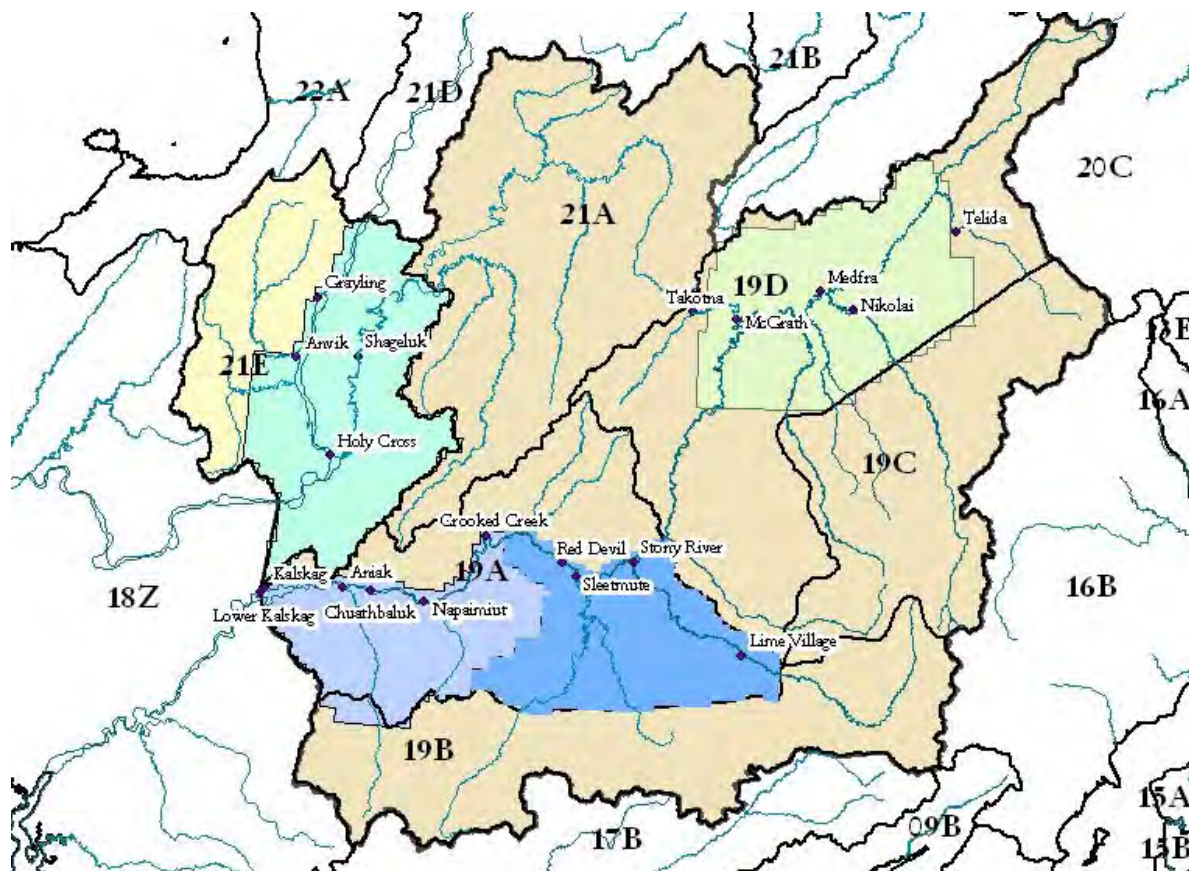


FIGURE 3 Unit 19 and 21A and 21E showing the 3 scheduled moose survey areas Unit 19D East Moose Survey Area, 19A East (Holitna), and Unit 21E Moose Survey Area as well as the 19A West (Aniak) moose survey area which is surveyed opportunistically. The area South of the Kuskokwim includes both the 19A East (Holitna) and 19A West (Aniak) survey areas.

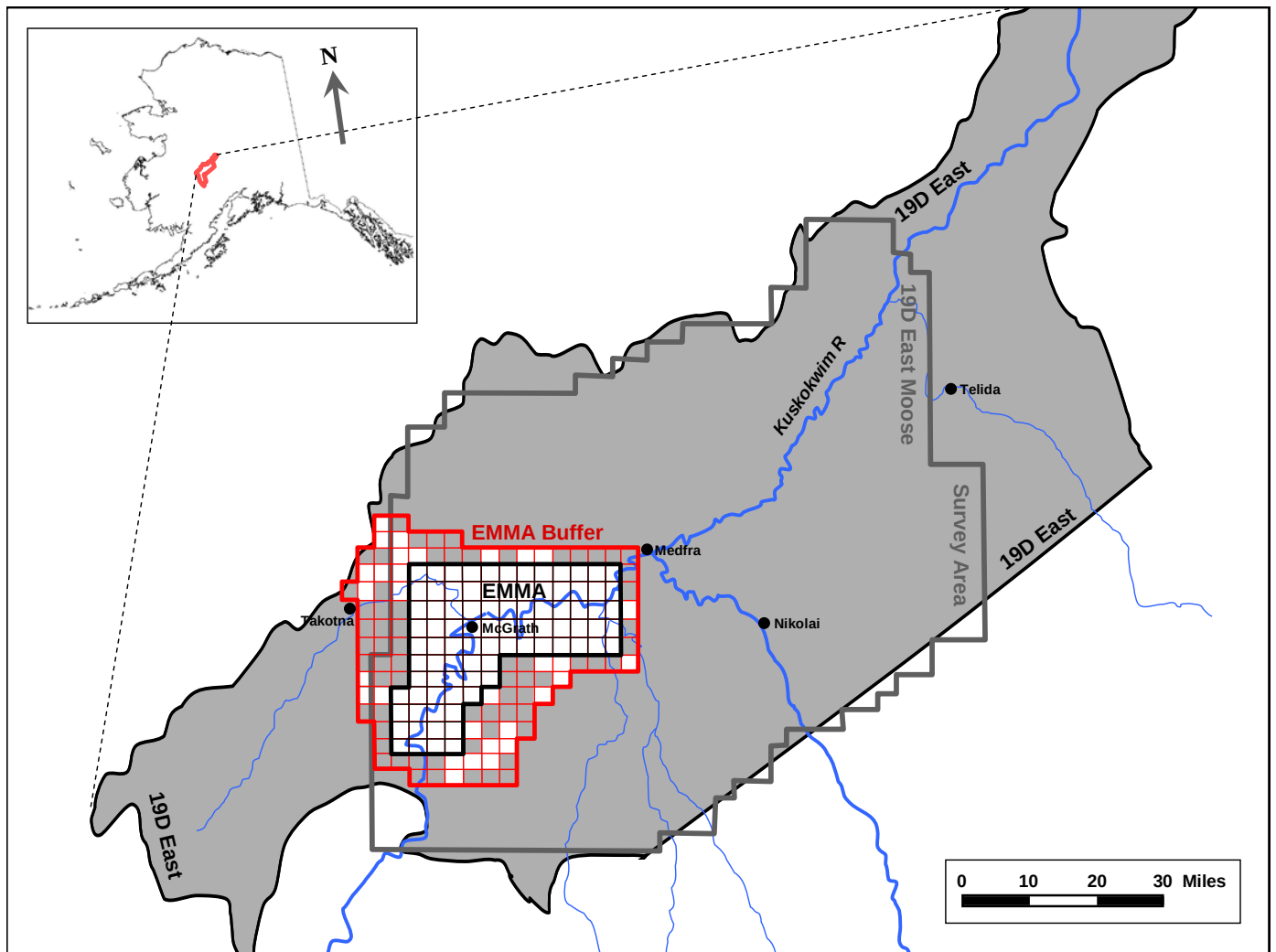


FIGURE 4 Unit 19D East showing the 3 Unit 19D moose survey areas (Unit 19D East Moose Survey Area, EMMA in black, and the EMMA buffer in red) that have been counted since 2001. The size of each of these survey areas is: EMMA, 528 mi²; EMMA buffer, 1118 mi²; and MSA, 5313 mi². Sample units depicted in white represent those units which were sampled during the 2007 survey. The EMMA buffer boundaries coincide with the Upper Kuskokwim Villages MMA.

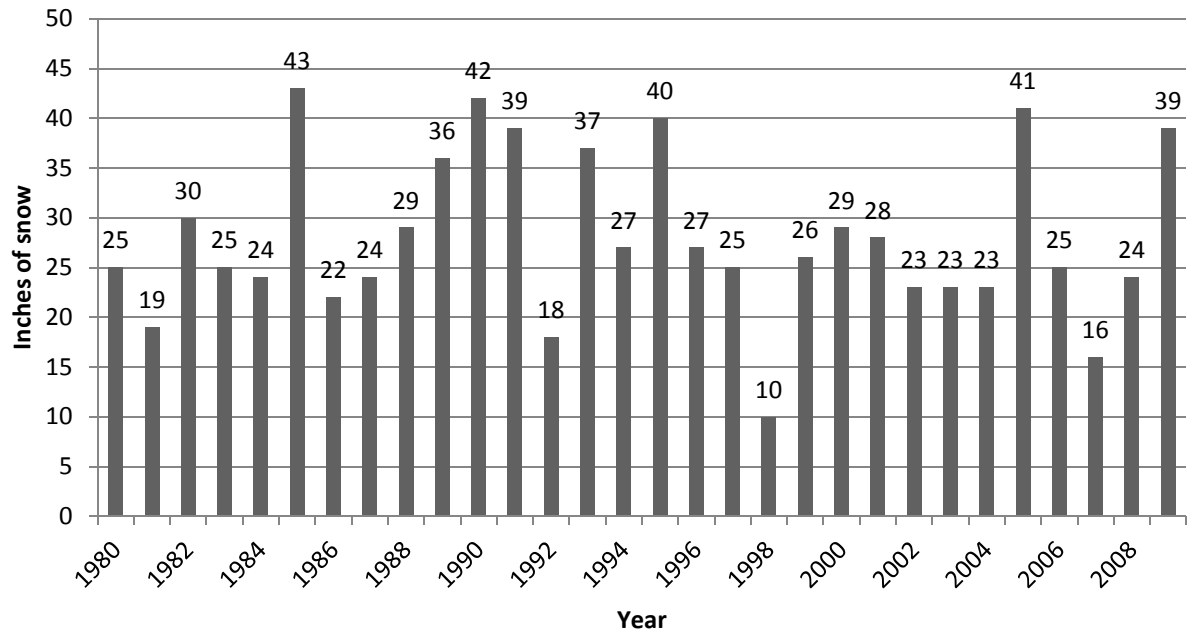


FIGURE 5 Snow depth in inches in McGrath reported on 1 April from 1980 through 2009

TABLE 1A Summary of geospatial population estimates (GSPE)^a for moose in Unit 19A, 2005–2010

Location and survey year	Survey area (mi ²)	Strata size (mi ²)		Area searched (mi ²)		Total search area (mi ²)	No. of moose estimated by strata and density (moose/mi ²)		Total estimate @ 90% CI	Average density moose/mi ²	No. of sample units counted
		Low	High	Low	High		Low	High			
<i>Unit 19A</i>											
<u>South of Kuskokwim</u>											
February 2005	7156	5709	1446	306	719	1025	623 (0.11)	1330 (0.92)	1953±16%	0.27	161
<u>19A West (Aniak)</u>											
March 2006	3444	2404	1040	192	408	600	NA ^b	NA ^b	1329±15%	0.39	94
March 2010	3444	2404	1040	441	498	939	466 (0.19)	663 (0.64)	1130±15%	0.33	147
<u>19A East (Holitna)</u>											
March 2008	3874	2833	1041	223	255	478	339 (0.12)	1364 (1.31)	1703±28%	0.44	75

^a Population estimates are of observable moose and do not include a sightability correction factor.

^b Data not available due to office fire Dec 2006.

TABLE 1B Unit 19D, aerial moose fall composition counts and estimated population size within the EMMA, 2001–2009

Calendar year	Moose observed	Estimated population (90% CI) ^a	SCF (n _{observed} , n _{available})	Estimated population w/SCF	Bulls:100 cows ^b	Yearlings: 100 cows ^{bc}	Calves: 100 cows ^b	Moose/mi ² w/SCF ^d
2001	440	440 (±0%)	1.19 (32,38)	525 (±12%)	18	16	34	1.0
2002								
2003	237	424 (±19%)	1.35 (21,28)	573 ^a (±24%)	18	10	56	1.1
2004	531	531 (±0%)	1.27	674 (±15%)	13	12	63	1.3
2005	479	479 (±0%)	1.30 (38,49)	621 (±13%)	18	18	51	1.2
2006	591	591 (±0%)	1.17 (42,49)	692 (±10%)	25	28	58	1.3
2007	662	662 (±0%)	1.33 (31,41)	883 (±15%)	39	32	56	1.7
2008	296	599 (±17%)	1.27 (16,20)	758 (±25%)	33	28	43	1.4
2009	331	654 (±14%)	1.27	830 (±21%)	31	14	44	1.6

^a All sample units were sampled during 2001 and 2004–2007, estimates/counts of observable moose have no variance or CIs.

^b Ratios based on estimates rather than counts of sex and age classes.

^c Yearlings:100 cows = Yearling bulls:100 cows × 2.

^d Based on an estimated 528 mi² of moose habitat in the EMMA.

TABLE 1C Unit 19D, aerial moose fall composition counts and estimated population size within the EMMA buffer, 2001–2009.

Calendar year	Moose observed	Estimated population (90% CI)	SCF (n_{observed} , $n_{\text{available}}$)	Estimated population w/SCF	Bulls:100 cows ^a	Yearlings: 100 cows ^{ab}	Calves: 100 cows ^a	Moose/mi ² w/SCF ^c
2001	455	727 ($\pm 12\%$)	1.19 (32,38)	868 ($\pm 17\%$)	21	16	36	0.8
2002								
2003								
2004	578	940 ($\pm 11\%$)	1.27	1192 ($\pm 19\%$)	18	16	66	1.1
2005								
2006	762	1117 ($\pm 9\%$)	1.17 (42,49)	1308 ($\pm 13\%$)	30	24	55	1.2
2007	844	1290 ($\pm 10\%$)	1.33 (31,41)	1720 ($\pm 20\%$)	36	30	53	1.5
2008	678	1356 ($\pm 9\%$)	1.27 (16,20)	1718 ($\pm 20\%$)	40	28	44	1.5
2009	711	1435 ($\pm 9\%$)	1.27	1820 ($\pm 18\%$)	40	22	38	1.6

^a Ratios based on estimates rather than counts of sex and age classes.^b Yearlings:100 cows = Yearling bulls:100 cows $\times$ 2.^c Based on an estimated 1,118 mi² of moose habitat in the EMMA buffer.

TABLE 1D 19D aerial moose fall composition counts and estimated population size within the Moose Survey Area (MSA), 2001–2009

Calendar year	Moose observed	Estimated population (90% CI)	SCF (n_{observed} , $n_{\text{available}}$)	Estimated population w/SCF	Bulls:100 cows ^a	Yearlings: 100 cows ^{ab}	Calves: 100 cows ^a	Moose/mi ² w/SCF ^c
2001	743	2148 ($\pm 26\%$)	1.19 (32,38)	2564 ($\pm 28\%$)	34	14	25	0.5
2004	764	2163 ($\pm 19\%$)	1.27	2744 ($\pm 24\%$)	31	24	54	0.5
2008	982	3071 ($\pm 16\%$)	1.27 (16,20)	3889 ($\pm 25\%$)	55	34	41	0.7

^a Ratios based on estimates rather than counts of sex and age classes.^b Yearlings:100 cows = Yearling bulls:100 cows $\times$ 2.^c Based on an estimated 5,313 mi² of moose habitat in the 19D East MSA.

TABLE 2A Unit 19C Farewell Burn Trend Count Area 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	Total 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 ^e	42 ^e	68	26	25	78	104	83
2008–2009 ^b								
2009–2010	53	23	25	34	14	211	245	134

^a Calves plus adults do not add to match the 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 2B Unit 19A Aniak Trend Count Area fall aerial moose composition counts, regulatory years 1987–1988 through 2008–2009

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total Moose	Moose/hr
2004–2005	20	6	23	66	16	344	410	18
2005–2006 ^a								
2006–2007 ^a								
2007–2008	28	9	52	35	29	87	122	41
2008–2009	42	6	23	7	14	44	51	26
2009–2010 ^a								

^a No survey.

TABLE 2C Unit 19A Holitna Trend Count Area fall aerial moose composition counts, regulatory years 1987–1988 through 2009–2010

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total 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 ^a	163
1990–1991	26	10	52	139	29	336	475	162
1991–1992 ^b								
1992–1993	31	15	63	172	32	360	542 ^a	169
1993–1994 ^b								
1994–1995	14	2	42	209	27	568	778 ^a	251
1995–1996 ^b								
1996–1997	22	10	50	146	29	355	502 ^a	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 ^b								
2006–2007 ^b								
2007–2008	35	21	45	50	25	150	200	65
2008–2009	34	12	27	21	18	103	124	35
2009–2010	51	6	36	25	19	104	129	20

^a Calves plus adults do not add to total which probably includes unknown moose, but records were lost in office fire.

^b No survey.

TABLE 3A Unit 19A moose aerial twinning surveys in the Aniak Trend Count Area, 2005–2009

Year	Total moose	Cows w/1 calf	Cows w/twins	Twinning % ^a	Dates
2005 ^b					
2006 ^b					
2007	11	2	0	0	6 Jun
2008	20	0	3	100	28 May
2009 ^b					

^a Percent of cows with calves that had twins.^b No survey.

TABLE 3B Unit 19A moose aerial twinning surveys in the Holitna Trend Count Area, 2005–2009

Year	Total moose	Cows w/1 calf	Cows w/twins	Twinning % ^a	Dates
2005 ^b					
2006 ^b					
2007	71	4	7	64	30–31 May
2008	47	1	3	75	30–31 May
2009 ^b					

^a Percent of cows with calves that had twins.^b No survey.

TABLE 3C Twinning rates for moose in Unit 19D East, 2000–2001 through 2008–2009

Year	Observed rate of twinning for radiocollared cows >2 yr old (n)	Observed rate of twinning for uncollared cows (n)
2001	25% (16)	
2002	59% (22)	39% (46)
2003	24% (25)	36% (39)
2004	32% (31)	39% (31)
2005	44% (45)	50% (40)
2006	40% (60)	35% (29)
2007	52% (56)	50% (30)
2008	55% (51)	
2009	33% (43)	26% (87)

TABLE 4A Unit 19 reported moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Reported harvest			
	M (%)	F (%)	Unk	Total
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	263 (100)	0 (0)	0	263
2008–2009	276 (>99)	0 (0)	1	277

TABLE 4B Unit 19A moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Moose harvest				Hunt type			
	M	F	Unk	Total	General	TM684	RM640	TM680 (FM019) ^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	80	0	0	80	8 ^b	2	n/a	54 (16)
2008–2009	77	0	0	77	9 ^b	1	n/a	56 (11)

^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 4C Unit 19B moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Moose harvest				Hunt type	
	M	F	Unk	Total	General	RM640
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	20	0	0	20	20	n/a
2008–2009	25	0	0	25	25	n/a

TABLE 4D Unit 19C moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Moose harvest				Hunt type		
	M	F	Unk	Total	General	RM655	RM640 ^a
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	44	0	0	44	40	4	--
2008–2009	53	0	0	53	50	3	--

^a Incorrect permit for this hunt area.

TABLE 4E Unit 19D moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Moose harvest				Hunt type	
	M	F	Unk	Total	General	RM650
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	114	0	0	114	28	86
2008–2009	120	0	1	121	18	103

TABLE 4F Moose harvest from Unit 19 where specific harvest location was not reported, regulatory years 2004–2005 through 2008–2009

Regulatory year	Moose harvest				Hunt type		
	M	F	Unk	Total	General	RM640	RM650
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		
2008–2009	1	0	0	1	1		

TABLE 5 Permit hunt results from Unit 19A Lime Village MA Tier II (TM684), Units 19A and 19B RM640, Unit 19A TM680 and FM019^a, Unit 19C (RM655) and Unit 19D (RM650), regulatory years 2004–2005 through 2008–2009

Unit/Hunt no.	Regulatory year	Successful hunters	Unsuccessful hunters	Did not hunt	Total reports
Unit 19A, TM684 ^b	2004–2005	0	3	3	6
	2005–2006	3	6	3	12
	2006–2007	1	7	6	14
	2007–2008	2 ^c	6	6	13
	2008–2009	1	8	5	14
Units 19A and 19B, RM640	2004–2005	121	634	191	946
	2005–2006	173	688	162	1023
Unit 19A, TM680 (and FM019) ^d	2006–2007	26 (6)	143 (36)	28 (unk)	197 (unk)
	2007–2008	54 (16)	141 (45)	32 (unk)	227 (unk)
	2008–2009	56 (11)	141 (57)	33 (unk)	230 (unk)
Unit 19C, RM655	2004–2005	3	5	2	10
	2005–2006	2	0	5	7
	2006–2007	0	0	3	3
	2007–2008	4	2	2	8
	2008–2009	3	2	5	10
Unit 19D, RM650	2004–2005	60	109	70	239
	2005–2006	72	114	51	237
	2006–2007	62	112	74	248
	2007–2008	86	98	69	253
	2008–2009	103	114	74	291

^a Includes data not available in Winfonet.

^b Successful hunters for TM684 is the number of moose taken. Total reports and Did Not Hunt are based on individual hunters reporting. The bag limit is 2 antlered bulls.

^c One hunter took 2 bulls.

^d Number in parentheses is from FM019 reports.

TABLE 6A Unit 19 moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters ^b
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	134	91	36	2	263 (33)	260	200	78	4	542 (67)	805
2008–2009	154	72	44	7	277 (34)	262	208	69	6	545 (66)	822

^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 6B Unit 19A moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	45	35	0	0	80 (24)	138	103	5 ^b	1	247 (76)	327
2008–2009	51	22	0	4	77 (25)	159	69	5 ^b	0	233 (75)	310

^a Local residents reside in Unit 19A.^b Incorrect permit for this hunt area.

TABLE 6C Unit 19B moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	7	11	0	20 (23)	11	22	34	0	67 (77)	87
2008–2009	1	7	15	2	25 (28)	1	32	30	2	65 (72)	90

^a Local residents reside in Units 19A or 19B.

TABLE 6D Unit 19C moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	23	18	0	44 (42)	2	35	23	2	62 (58)	106
2008–2009	3	26	24	0	53 (43)	4	39	27	1	71 (57)	124

^a Local residents reside in Units 19C or 19D.

TABLE 6E Unit 19D moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	80	27	5	2	114 (44)	101	34	11	0	146 (56)	260
2008–2009	87	28	5	1	121 (42)	105	52	7	3	167 (58)	288

^a Local residents reside in Unit 19D.TABLE 7A Unit 19^a moose harvest percent by transport method, regulatory years 2004–2005 through 2008–2009

Regulatory year	Harvest percent by transport method ^b									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	<i>n</i>
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	19	<1	71	5	2	0	1	2	0	263
2008–2009	23	<1	66	5	2	<1	2	2	0	277

^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 7B Unit 19A moose harvest percent by transport method, regulatory years 2004–2005 through 2008–2009

Regulatory year	Harvest percent by transport method ^a									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	<i>n</i>
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	91	4	1	0	1	3	0	80
2008–2009	0	0	95	5	0	0	0	0	0	77

^a Successful hunters only.

TABLE 7C Unit 19B moose harvest percent by transport method, regulatory years 2004–2005 through 2008–2009

Regulatory year	Harvest percent by transport method ^a									<i>n</i>
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	
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	60	0	35	0	0	0	0	5	0	20
2008–2009	76	0	12	4	8	0	0	0	0	25

^a Successful hunters only.

TABLE 7D Unit 19C moose harvest percent by transport method, regulatory years 2004–2005 through 2008–2009

Regulatory year	Harvest percent by transport method ^a									<i>n</i>
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	
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	66	5	0	18	9	0	2	0	0	44
2008–2009	74	4	0	9	6	0	0	8	0	53

^a Successful hunters only.

TABLE 7E Unit 19D moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method ^a									<i>n</i>
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	
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	6	0	90	2	0	0	<1	<1	0	114
2008–2009	4	0	88	2	0	<1	4	<1	0	121

^a Successful hunters only.

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 20A (6796 mi²; ~5040 mi² of moose habitat)

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 mi² 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/mi². 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.

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,

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

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 (Young and Boertje 2008). Evidence of an increasing, high-density, nutritionally-stressed moose population led to liberal antlerless hunts by registration permit across the entire unit during 2004–2007 (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 (1996–2000 and 2004–2009), limited drawing permit hunts for “any bull” moose (2006–2009) concurrent with the antler restricted general season hunt, and registration hunts for antlerless moose (2004–2009) with seasons extending up to 7 months in portions of the unit.

Approximately one-third of Unit 20A is military land, including 1003 mi² used by the U.S. Army at Fort Wainwright, 893 mi² by the U.S. Army at Fort Greely, and 17 mi² 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

2007 Population Estimation Survey

Surveys were not conducted in 2007 due to poor survey conditions (i.e., low snow accumulation through November and early December).

2008 Population Estimation Survey

We surveyed 158 (99 high density and 59 low density; 917 mi²) of 987 survey units (SU; 5747 mi²) during 24 October–2 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 (70 high density and 30 low density) was selected from each stratum using Microsoft® Excel 2003 software. An additional 49 SUs (26 high density and 23 low density) were selected to intensively survey (approximately 50% of the SUs) within the 2001 Survey Line and Fish Creek burns and another 9 SUs (3 high density and 6 low density) were selected to fill gaps in the randomized coverage.

The GSPE method does not employ a sightability correction factor (SCF), thus does not correct for moose not seen during the survey. Rather, the GSPE method employs greater search intensity, 8–10 min/mi² versus 4–6 min/mi² (Gasaway et al. 1986), resulting in a higher level of sightability. Search time per SU in SUs with 100% moose habitat averaged 7.8 min/mi² ($n = 121$ SUs). Preliminary work with the sightability of radiocollared 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 1.21 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 excellent (47%; $n = 74$) and good (39%; $n = 62$) with the remainder reported as fair (6%; $n = 9$) or unclassified (8%; $n = 13$).

2009 Population Estimation Survey

We used the GSPE method and surveyed 116 SUs (80 high density and 36 low density; 676 mi²) of 987 SUs (5747 mi²) during 18 November–25 November. A simple random sample of 100 SUs (70 high density and 30 low density) was selected from each stratum using Microsoft® Excel 2003 software. An additional 3 SUs (3 high density) were selected to intensively survey (i.e., a total of 10 contiguous SUs) the Gold King area and another 13 SUs (7 high density and 6 low density) were selected to fill gaps in the randomized coverage.

Search time per SU with 100% moose habitat averaged 7.91 min/mi² ($n = 77$ SUs). 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 excellent (34%; $n = 39$) and good (60%; $n = 70$) with the remainder reported as fair (6%; $n = 7$).

Twinning Surveys

Twinning rate surveys were expanded in 2006 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 in late May during or within a few days of the median calving date (Boertje et al. 2007) to minimize potential biases resulting from 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.

2008 Twinning Surveys. Surveys were flown mornings–early afternoons (08:00–12:55) and afternoons–evenings (14:10–19:35). 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 eastern Unit 20A ($n = 41$). Total flight time (including ferry time) was 19.6 hours (\$3822.00) and total survey time was 15.2 hours. We observed 806 moose ≥ 1 year (53 moose/hour); 164 (20%) parturient moose; and 11 parturient moose/hour. Mean (Northcentral, Western and Eastern Tanana Flats/Foothills) observed twinning rate was 15.0% (25/164; Table 1). No black bears or wolves were observed.

Northcentral Tanana Flats — Surveys were conducted on 23 May east of Crooked Creek, east of the Tanana River and north of approximately N64 7.00'. Total flight time was 5.8 hours (\$1131) and actual survey time was 5.4 hours. We observed 379 moose ≥ 1 year old (70 moose/hour); 63 (17%) parturient moose; and 12 parturient moose/hour. The observed twinning rate was 10% (6/63; Table 1).

Western Tanana Flats — Surveys were conducted on 27 May west of Tatlanika Creek, east of the George Parks Highway and north of the Rex Trail. Total flight time was 7.4 hours (\$1443) and actual survey time was 4.9 hours. As in 2006 and 2007, moose observations were noticeably higher in the 2001 Fish Creek Burn. As in 2007, we observed noticeably fewer moose in the 2006 Parks Highway burn. We observed 183 moose ≥ 1 year old (37 moose/hour); 60 (33%) parturient moose; and 12 parturient moose/hour. The observed twinning rate was 23% (14/60; Table 1).

Eastern Tanana Flats/Foothills — Surveys were conducted on 26 May east of Delta Creek and west of the Delta River. Total flight time was 6.4 hours (\$1248) and actual survey time was 4.8 hours. As in 2007, most moose were observed in the northern portion of the survey unit (i.e., within the Karla Lake fire perimeter). We observed 244 moose ≥ 1 year old (51 moose/hour); 41 (17%) parturient moose; and 9 parturient moose/hour. The observed twinning rate was 12% (5/41; Table 1).

2009 Twinning Surveys. Surveys were flown mornings/afternoons (08:37–14:00) and afternoons/evenings (14:50–10:25). 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 eastern ($n = 36$) Unit 20A. Total flight time (including ferry time) was 25.5 hours (\$4836) and total survey time was 18.95 hours. We observed 819 moose ≥ 1 year old (46 moose/hour); 154 (19%) parturient moose; and 8 parturient moose/hour. Mean (Northcentral, Western and Eastern Tanana Flats) observed twinning rate was 10% (15/154; Table 1). We observed 9 black bear units (5 single bears, and 2 different females accompanied by 3 yearlings in the Northcentral

Tanana Flats; 2 single bears in the Western Tanana Flats) and 1 female grizzly bear with 2 cubs in the Western Tanana Flats.

Northcentral Tanana Flats — Surveys were conducted on 23–24 May east of Crooked Creek, east of the Tanana River and north of approximately N64 8.00'. Estimated flight time was 7.5 hours (\$1424) and actual survey time was 5.37 hours. We observed 341 moose ≥ 1 year old or 64 moose/hour; 60 (18%) parturient moose; and 11 parturient moose/hour. The observed twinning rate was 8% (5/60; Table 1).

Western Tanana Flats — Surveys were conducted on 27–28 May west of Tatlanika Creek, east of the George Parks Highway and north of the Rex Trail. Estimated flight time was 10.4 hours (\$1970) and actual survey time was 8.2 hours. We observed 240 moose (≥ 1 year old) or 29 moose/hour; 58 (24%) parturient moose; and 7 parturient moose/hour. The observed twinning rate was 10% (6/58; Table 1).

Eastern Tanana Flats/Foothills — Surveys were conducted on 30 May east of Delta Creek and west of the Delta River. Estimated flight time was 7.6 hours (\$1442) and actual survey time was 5.38 hours. As in 2008, most moose were observed in the northern portion of the survey area (i.e., within the Karla Lake fire perimeter). We observed 238 moose ≥ 1 year old or 44 moose/hour; 36 (15%) parturient moose; and 7 parturient moose/hour. The observed twinning rate was 11% (4/36; Table 1).

Antler Development Studies 2006–2009. Because of the poor nutritional plane documented for moose in Unit 20A, anecdotal information regarding retarded antler development, and the adoption of antler restrictions in 2002, we initiated a study to measure the relationship between antler width and age, and a study to characterize antler development of known-age radiocollared moose. The purpose of the antler width and age study was to determine how many years, on average, it takes for a bull moose to attain 50-inches in antler width; useful information regarding the efficacy of antler restrictions. During 2006–2009, as part of the specimen requirement for “any bull” moose drawing permits, we required that successful hunters present, to ADF&G personnel, antlers for measuring and teeth (i.e., lower front incisors) for aging in order to regress antler width/age data. We collected antler width data and teeth for aging from 69 bulls in 2006, 106 in 2007, 154 in 2008, and 174 in 2009.

The purpose of the antler development study was to measure the occurrence of underdeveloped antlers of known-age (i.e., captured and radiocollared at 10 months of age), 15-month-old (i.e., antlers ≤ 6 inches in length that likely would not be seen), and 27-month-old (i.e., < 30 -inch antler spread and lacking antlers with distinct brow/main palm separation) bull moose that likely would be misclassified (i.e., yearlings as females; 2-year-olds as yearlings) during November surveys. We classified antler characteristics of six 15-month-old and fourteen 27-month-old bulls on 27 August 2007, five 15-month-old and seventeen 27-month-olds on 22–23 August 2008, and zero 15-month-old and twelve 27-month-olds on 17 and 19 August 2009.

I intend to present this antler study data at the 2011 North American Moose Conference and Workshop, and submit the manuscript to the journal *Alces* at that time.

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., RY07 = 1 Jul 2007–30 Jun 2008).

We estimated total take by humans (excluding mortality by motor vehicles and trains) as reported hunter harvest times 1.35 (Boertje et al. 2009), which includes all other types of reported (e.g., defense of life and property, dispatched, potlatch, stickdance) and unreported (e.g., illegal, snaring, other, and wounding loss) types of take by humans. We estimated accidental mortality by motor vehicles and trains from Alaska Department of Public Safety and Alaska Railroad Corporation records.

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 2.5–3.1 moose/mi² during RY05–RY09 (Table 2). These are the highest reported moose densities in Alaska for any comparably-sized area, although a smaller 1890-mi² area in southern Unit 20D which includes agricultural lands and recent large burns had 4.6 moose/mi² in 2006 (DuBois 2008).

The Unit 20A moose population increased between 1999 and 2003, peaking at 15,000–20,000 moose (Young 2008). Lower population estimates in 2004, 2005, 2006, 2008, and 2009 (Table 2) 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. The cow segment of the population, our most precise estimate, declined from an estimated (with SCF = 1.21) 11,019 cows in 2003 to 9652 cows in 2009 (i.e., an average annual finite growth rate of 0.96 (SE=0.021) during that period).

Population Composition

Bull:cow ratios steadily increased between 2000 and 2005 and remained high through 2008 (Table 2). Mean bull:cow ratios of 36:100 (range 32–38) during 2003–2008 met the unitwide management objective of ≥30 bulls:100 cows. We deliberately increased bull harvest in RY08 and RY09 by issuing additional “any bull” drawing permits (750 in RY08 and 1000 in RY09) to reduce bull:cow ratios to the management objective of 30:100. This reduction was consistent

with our intensive management (IM) strategy to manage for elevated yield and to reduce moose densities in order to protect the moose population's health and habitat.

We also met our objective of ≥ 20 bulls:100 cows in the Tanana Flats, western foothills/mountains, and eastern foothills/mountains of Unit 20A. Unlike 2001, when bull:cow ratios were much higher in the eastern foothills/mountains (40:100) than the Tanana Flats (26:100) and western foothills/mountains (22:100), bull:cow ratios were more 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), 2006 (Tanana Flats 33:100, western foothills/mountains 35:100, and eastern foothills/mountains 43:100) and 2008 (Tanana Flats 39:100, western foothills/mountains 33:100, and eastern foothills/mountains 38:100). This result likely occurred because of 1) higher harvests of bulls in the eastern foothills due to increased access and hunting pressure, 2) lower harvests of bulls in the Tanana Flats and western foothills/mountains because of antler restrictions, and 3) improved harvest distribution of bulls across subareas via issuance of "any bull" drawing permits. In addition, higher harvests of antlerless moose 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 RY07–RY08 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; 2008: FTMA = 31:100; western Tanana Flats = 39:100).

Yearling recruitment (i.e., yearlings:100 cows) was relatively strong during 2003–2009, averaging 21:100 (range = 18–25:100; Table 2). Estimated percent yearlings in the population was 11%–15% during 2003–2009. Moose populations with >10% yearlings during fall, particularly in areas where mortality factors such as deep snow or predation are of minimal importance, 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 2003–2009 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 2007–2009 of known-age radiocollared moose revealed that 22% (11 of 51) 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. Using brow/main palm separation, antler spread, antler length, and body

size, collectively, all 27-month old bulls ($n = 43$) 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 2008 and 2009 ($\bar{x} = 12\%$; Table 1). Twinning rates were lowest in the northcentral Tanana Flats ($\bar{x} = 9\%$) followed by the eastern Tanana Flats/foothills ($\bar{x} = 12\%$) and the western Tanana Flats ($\bar{x} = 17\%$). 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).

Antler Development

Preliminary results suggest that, on average, it takes ≥ 6 years for a bull moose in Unit 20A to attain an antler spread of 50 inches.

Preliminary results indicate that 22% (11 of 51) of the known-age 15-month-old bull moose had antlers ≤ 6 inches in length and probably would be misclassified as females during November surveys. Twenty-three percent (10 of 43) of the 27-month-old known-age bulls probably would have been misclassified as yearlings using only brow/main palm separation as the criterion. However, using brow/main palm separation, antler spread, antler length, and body size collectively resulted in all 27-month-old bulls being classified correctly.

Distribution and Movements

Moose distribution varies widely across Unit 20A. Boertje et al. (2009) reported that a 2598-mi² 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-mi² 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 RY07 were as follows:

<u>Unit and Bag Limits</u>	Resident Open Season (Subsistence and <u>General Hunts</u>)	Nonresident Open <u>Season</u>
Unit 20A, the Ferry Trail Management Area, Wood River Controlled Use Area, Healy–Lignite Management Area, and the Yanert Controlled Use Area.		
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 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 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 Sep–25 Sep
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; or		
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

<u>Unit and Bag Limits</u>	Resident Open Season (Subsistence and <u>General Hunts</u>)	Nonresident Open <u>Season</u>
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;	25 Aug–28 Feb (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 RY08 were as follows:

<u>Unit and Bag Limits</u>	Resident Open Season (Subsistence and <u>General Hunts</u>)	Nonresident Open <u>Season</u>
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	

<u>Unit and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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)	
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, adopted a drawing permit hunt for “any bull” moose, and authorized up to 500 permits be issued. In 2008, the board authorized the department to issue up to 1000 “any bull” permits.

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 WRCUA. The antlerless hunts were suspended in RY99 because of an agreement with local advisory committees that cows would be hunted only 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, in the Unit 20A portion of the Nenana Controlled Use Area (NCUA; i.e., the western Tanana Flats), and a calf hunt by drawing permit (up to 300 permits) during 1–25 September; recipients of antlerless and calf hunt permits were 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. In 2008, the board adopted language making it unlawful to take a calf or a cow accompanied by a calf in antlerless hunts.

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 RY08.

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 2009 — The board took the following actions for moose in Unit 20A:

- Restricted the season dates for antlerless moose from 25 August–28 February to 10 January–28 February; and
- Authorized a new drawing permit hunt with up to 500 permits for antlerless moose during 25 August–31 October.

Alaska Board of Game Actions, March 2010 — The board took the following actions for moose in Unit 20A:

- Authorized up to 1000 permits be issued for the drawing permit hunts for antlerless moose.

Harvest by Hunters. Overall reported harvests of 962 and 821 moose in RY07 and RY08 (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 during the general season in RY06 (408 bulls) and RY07 (384 bulls) 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, and during RY07, 500 drawing permits were issued and 96 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 and 497 in RY07, supports this assertion (Tables 4 and 5).

Permit Hunts — Permit hunt harvest increased from 127 to 175 antlerless moose during RY02–RY03 because of two factors: 1) a regulation change that prohibited recipients of drawing and registration permits for antlerless moose from taking an antlered bull moose in Unit 20A, and 2) the addition of a limited registration hunt (30 permits) in the western Tanana Flats. After

antlerless hunts were liberalized in RY04, permit hunt harvest jumped to 599, 687, 644, and 469 moose during RY04–RY07 (Table 5). There was nearly a 10-fold increase in the number of antlerless permits issued during RY04–RY07 ($\bar{x}$ = 4501) compared to RY02–RY03 ($\bar{x}$ = 509). In RY08, we reduced the antlerless harvest quota substantially to 200 moose, which resulted in a commensurate decrease in the number of permits issued (n = 1852) and antlerless moose harvested (n = 197).

Beginning in RY06, we issued drawing permits (DM766, DM768–DM774) for “any moose” specific to 7 different hunt areas to more effectively manage bull:cow ratios and harvest distribution of bull moose across the unit. Our intent during RY07–RY08 was to reduce bull:cow ratios differentially across the 7 different hunt areas to achieve our unitwide management objective of 30 bulls:100 cows. We increased the number of permits each year during RY06–RY08 and harvest increased commensurately (Table 5).

Hunter Residency and Success. Success rates for general season hunts 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–RY07, but jumped to 30% in RY08. Nonresidents had higher success rates than residents. During RY07–RY08, the average success rate was 50% for nonresident hunters compared to 23% for resident hunters. This can likely be explained by the greater use of guides by nonresident hunters. During RY07–RY08, 24% (107/452) of nonresident hunters reported using a registered guide compared to <1% (4/1925) 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 = 2361 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 = 2057 hunters). This trend continued through RY07 (1585 general season hunters; 1888 antlerless moose hunters) and RY08 (1469 general season hunters; 644 antlerless moose hunters).

Harvest Chronology. Moose harvest in Unit 20A has traditionally been well distributed throughout the season and no deviations were apparent during RY07–RY08 (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 from their use in recent years were apparent during RY07–RY08 (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 RY07–RY08 (Table 3). This may be the result of a lack of deep snow (long-term mean annual snowfall for Fairbanks = 68 inches) during winters 2007–2008 (55.6 inches) and 2008–2009 (71.5 inches).

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 that the population still exceeds the habitat capability and is 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 burn) occurred on the western Tanana Flats in 2006, but the extent to which moose are using that burn is not known. In 2009, there were 2 additional large wildfires: the 125,000-acre Wood River burn (includes re-burn of 18,500 acres of the 2001 Survey Line burn) in the central Tanana Flats; and the 101,000 acre Rex Creek burn (includes re-burn of 40,000 acres of the 2001 Fish Creek burn) in the southwestern mountains/western Tanana Flats. 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). Currently, research is being conducted to assess the effect of these large burns on moose body condition, reproductive performance, distribution and movements, and browse availability and removal.

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.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates indicated the Unit 20A moose population remained above the upper limit of the population objective through 2008. 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 RY07 the department continued to recommend liberal antlerless moose hunts (i.e., 600 antlerless moose) to reduce moose density and maintain high harvests. However, because a population estimate was not conducted in 2007 and the 2008 estimate was only slightly above the upper limit of the IM population objective, the department recommended more conservative antlerless hunts (i.e., 200 antlerless moose) aimed at population stability. 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 burns, 2006 Parks Highway burn).

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 nutritional 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/or increasing bull:cow ratios during 2001–2008 indicated that unitwide antler restrictions initiated in RY02 were effective (Young and Boertje 2008) and harvest rates of bulls were below maximum sustainable levels. During RY07–RY08, I recommended retaining unitwide antler restrictions for both resident and nonresident hunters in conjunction with 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 RY07 or RY08. 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.

LITERATURE CITED

- BISHOP, R. H., AND R. A. RAUSCH. 1974. Moose population fluctuations in Alaska, 1950–1972. *Naturaliste Canadien* 101:559–593.
- BOERTJE, R. D., M. A. KEECH, D. D. YOUNG, K. A. KELLIE, C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- , K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ADERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- , P. VALKENBURG, AND M. MCNAY. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. *Journal of Wildlife Management* 60:474–489.
- DALE, B. W. 1998. Unit 20A moose. Pages 275–287 in M. V. Hicks, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- DUBOIS, S. D. 2008. Unit 20D moose. Pages 377–408 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, Alaska, USA.

- GASAWAY, W. C., S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22, University of Alaska Fairbanks, Alaska, USA.
- , R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPHERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. Wildlife Monographs 84.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 9 Sep 2008.
- MCNAY, M. E. 1993. Units 20B and 25C moose. Pages 244–266 *in* S. M. Abbott, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.
- YOUNG, D. D. 2008. Unit 20A moose. Pages 325–347 *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, Alaska, USA.
- YOUNG, D. D., AND R. D. BOERTJE. 2004. Initial use of moose calf hunts to increase yield, Alaska. *Alces* 40:1–6.
- , AND R. D. BOERTJE. 2008. Recovery of low bull:cow ratios of moose in Interior Alaska. *Alces* 44:65–71.
- , R. D. BOERTJE, C. T. SEATON, AND K. A. KELLIE. 2006. Intensive management of moose at high-density: impediments, achievements, and recommendations. *Alces* 42:41–48.

PREPARED BY:

Donald D. Young
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

YOUNG, D. D. 2010. Unit 20A moose. Pages 320–344 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1 Unit 20A moose twinning rates from transect surveys, 2002–2009

Calendar Year	Date	Cows			% Twins ^a	Mean ^b
		w/Single calf	w/Twins	Total		
2002 ^c	24–25 May	52	6	58	10	
2003 ^c	27–28 May	53	5	58	9	
2004 ^c	23 May	57	3	60	5	
2005 ^c	23 May	49	5	54	9	
2006 ^c	23 May	49	6	55	11	
2006 ^d	24 May	32	6	38	16	14
2006 ^e	25 May	30	6	36	17	
2007 ^c	25 May	58	2	60	3	
2007 ^d	28 May	28	9	37	24	13
2007 ^e	2 Jun	36	4	40	10	
2008 ^c	23 May	57	6	63	10	
2008 ^d	27 May	46	14	60	23	15
2008 ^e	26 May	36	5	41	12	
2009 ^c	23–24 May	55	5	60	8	
2009 ^d	27–28 May	52	6	58	10	10
2009 ^e	30 May	32	4	36	11	

^a Percentage of cows with calves that had twins.^b Mean of percent twins for central, western, and eastern Tanana Flats.^c Central Tanana Flats.^d Western Tanana Flats.^e Eastern Tanana Flats.

TABLE 2 Unit 20A aerial moose fall composition counts and estimated population size, 1999–2009

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 = 1.21 ^c	Moose/mi ² w/SCF = 1.21 ^d
1999	23	13	33	21	760	965	11,205 (±14%)	13,558	2.7
2000	23	10	33	21	1089	1377	10,557 (±18%)	12,774	2.5
2001	26	18	26	17	737	887	11,511 (±15%)	13,928	2.8
2002 ^e									
2003	32	22	28	18	1212	1483	14,684 (±13%)	17,768	3.5
2004	35	21	36	21	1512	1922	13,566 (±15%)	16,415	3.3
2005	38	18	30	19	1370	1684	13,348 (±15%)	16,151	3.2
2006	36	22	34	20	1232	1536	12,773 (±16%)	15,455	3.1
2007 ^e									
2008	37	25	35	20	1335	1672	10,361 (±11%)	12,537	2.5
2009	32	18	30	19	1411	1740	12,956 (±12%)	15,677	3.1

^a Yearlings:100 cows = Yearling bulls:100 cows × 2.^b Geospatial population estimator (GSPE) method.^c Sightability correction factor (Boertje et al. 2009).^d Based on an estimated 5040 mi² of moose habitat in Unit 20A.^e Surveys were not conducted due to lack of snow.

TABLE 3 Estimate of Unit 20A moose harvest^a and accidental death, regulatory years 2001–2002 through 2008–2009

Regulatory year	Human Take					Accidental death			Grand Total
	Reported Hunter Harvest				Estimated Total ^b	Reported			
	M	F	Unk	Total		Road ^c	Train ^d	Total	
2001–2002	541	70		615	830	3	4	7	837
2002–2003	363	115	1	479	647	7	6	13	660
2003–2004	347	159	0	506	683	0	6	6	689
2004–2005	431	557	0	988	1334	0	11	11	1345
2005–2006	497	634	0	1131	1527	0	6	6	1533
2006–2007	558	493	0	1051	1419	2	8	10	1429
2007–2008	538	417	7	962	1299	0	8	8	1307
2008–2009	642	171	8	821	1108	1	11	12	1120

^a Includes general and permit hunt harvest.

^b Reported total harvest times 1.35 (Boertje et al. 2009); includes all other types of reported (e.g., DLP, dispatched, potlatch, stickdance) and unreported (e.g., illegal, snaring, other, and wounding loss), except train and roadkill.

^c Documented kills; actual number killed by vehicles is certainly greater.

^d 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 2001–2002 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2007–2008	176	90	116	2	384 (24)	694	374	132	1	1201 (76)	1585
2008–2009	197	113	136	5	451 (30)	596	304	116	22	1038 (70)	1489

^a Excludes hunters in permit hunts.^b Residents of Unit 20.

TABLE 5 Unit 20A moose harvest data by permit hunt, regulatory years 2004–2005 through 2008–2009

Permit hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Male (%)	Female (%)	Unk	Harvest
Totals for antlerless permit hunts	2004–2005	5430	3069 (57)	1766 (75)	595 (25)	37 (6)	553 (94)	5	595
	2005–2006	5114	2397 (47)	2038 (75)	679 (25)	47 (7)	629 (93)	3	679
	2006–2007	3737	1680 (45)	1498 (73)	559 (27)	66 (12)	484 (88)	9	559
RM764 & RM768	2007–2008	3721	1833 (49)	1419 (75)	469 (25)	44 (9)	421 (91)	4	469
	2008–2009	1852	1208 (65)	447 (69)	197 (31)	24 (12)	171 (88)	2	197
Totals for antlered permit hunts DM766 & DM768–DM772	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
	2007–2008	576	240 42	223 66	113 34	113 100	0 0	0	113
	2008–2009	825	413 50	242 59	170 41	170 100	0 0	0	170
Totals for all permit hunts	2004–2005	5430	3069 (57)	1766 (75)	595 (25)	37 (6)	553 (94)	5	595
	2005–2006	5189	2437 (47)	2065 (75)	687 (25)	55 (8)	629 (92)	3	687
	2006–2007	4112	1844 (45)	1624 (72)	644 (28)	151 (24)	484 (76)	9	644
	2007–2008	4297	2073 (48)	1642 (74)	582 (26)	157 (27)	421 (73)	4	582
	2008–2009	2677	1621 (61)	689 (65)	367 (35)	194 (53)	171 (47)	2	367

TABLE 6 Unit 20A moose harvest^a chronology percent by month/day, regulatory years 2001–2002 through 2008–2009

Regulatory year	Harvest chronology percent by month/day					Unk/Other	<i>n</i>
	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25		
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
2007–2008	18	11	23	26	20	2	384
2008–2009	14	15	20	25	23	3	454

^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									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
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	25	0	11	3	4	0	395
2006–2007	38	7	13	28	0	7	2	4	1	408
2007–2008	33	5	15	25	1	12	2	5	2	382
2008–2009	37	5	15	30	0	6	2	4	1	454

^a Excludes permit hunt harvest.

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 20B (9196 mi²)

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 for bulls only 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, 2003–2006, and 2008 indicated that the moose population increased from an estimated 9800 (about 1.1 moose/mi²) in 1990 to 18,000 (about 2.0 moose/mi²) in 2008.

Demand for moose hunting opportunities in Unit 20B is high. 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] within the FMA by muzzleloader, and 4 in central 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 mi² 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 mi², of which an area of about 50 mi² 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: 1) western Unit 20B (2942 mi²), including the Minto Flats, Tatalina Creek drainage, Tolovana River drainage, and areas west; 2) eastern Unit 20B (2425 mi²) including the Little Salcha and Salcha River drainages; and 3) central Unit 20B (3829 mi²), the remainder.

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).

In addition to our management objective, Alaska Administrative Code 92.108 identifies the Unit 20B moose population as important for providing high levels of harvest for human consumptive use, and established Intensive Management population and harvest objectives of 12,000–15,000 and 600–1,500 moose, respectively.

METHODS

POPULATION STATUS AND TREND

Adequate snow conditions did not develop in 2007, but a unitwide population estimate survey was completed during 11–22 November 2008. We surveyed 166 (113 high-density and 53 low-density; 938mi²) of 1628 survey units (SUs; 9196 mi²) in Unit 20B, which included a complete census of the FMA. We used the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008; 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 ($n = 100$) was selected from each stratum using Microsoft[®] Office Excel for Windows 98[®] software. Additional SUs ($n = 15$) were selected to fill holes in the coverage and all of the SUs with at least 50% of their area within the FMA were selected ($n = 51$).

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/mi² vs. 4–6 min/mi² (Gasaway et al. 1986), resulting in a higher level of sightability. Preliminary sightability studies suggest an SCF of 1.16 to 1.25 using the GSPE method (Boertje et al. 2009). We applied an SCF of 1.21 to GSPE estimates in Unit 20B to estimate total moose numbers. We applied the same 90% CI percentages from the uncorrected estimate (i.e. $\pm 19\%$) to get the confidence interval on the sightability-corrected population estimate.

Survey observers subjectively rated survey conditions using a scale that Gasaway et al. (1986) created with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence). During the 2008 survey, conditions for each SU were reported as good (55%), excellent (23%), fair (16%), and unclassified (6%), respectively.

Twinning Rate Surveys

Twinning rates were estimated from surveys conducted in traditional twinning survey trend count areas on Minto Flats and surveys initiated in central Unit 20B in 2006. Surveys consisted of parallel transects flown at approximately ½-mile intervals at ≤ 500 feet above ground level in PA-18 or Bellanca 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.

2008 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 24 May between the Tolovana River and 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. Survey flight time was 5.3 hours.

Central Unit 20B. A Bellanca Scout aircraft was used to search Goldstream Creek from Dunbar to Fox, Luck Dome, and the lowlands within 10 miles of the Tanana River from Nenana to the Little Salcha River 29–31 May. Survey flight time was 9.75 hours.

2009 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 25 May between the Tolovana River and Swanneck Slough to the west and Dunbar Trail to the east beginning at 65°02.7' N and ending at Nenana. Weather, turbulence, and airsickness were not factors.

Central Unit 20B. Piper Super Cub aircraft were used to search Goldstream Creek from Dunbar to Fox, Luck Dome, and the lowlands within 10 miles of the Tanana River from Nenana to the Little Salcha River on 28 and 29 May. Survey flight time was about 8 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., RY08 = 1 Jul 2008 through 30 Jun 2009).

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 Alaska Department of Public Safety and Alaska Department of Fish and Game (ADF&G) records and added an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population $\times 0.005361$ (estimated mortality rate caused by snares based on a radiocollared sample of moose in Unit 20A).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Moose numbers have almost doubled in Unit 20B since the early 1990s. In 1990 the population was estimated at 9800 moose (1.1 moose/mi²; McNay 1993). By 2001, the population was estimated at 12,313 moose (1.3 moose/mi²; Table 1). Population estimate increased to >16,080 moose (>1.7 moose/mi²) in 2003. The population then appeared to stabilize between 2004 and 2006. In 2008, the population estimate increased again to 17,806 (1.9 moose/mi²) moose, with the lower end of the 90% confidence interval just above the Intensive Management population objective of 15,000 moose. Relatively high measures of productivity and recruitment, as well as low snow winters and high predator (black bear, brown bear, and wolf) harvests in Unit 20B between 2000 and 2008, are consistent with population growth.

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/mi²) to 7436 moose (1.9 moose/mi²) between 2001 and 2008. In western Unit 20B moose numbers increased from 4562 (1.6 moose/mi²) to 6618 (2.2 moose/mi²) between 2001 and 2008, while in the MFMA estimates of moose numbers increased from 2252 (2.4 moose/mi²) to 4136 (4.3 moose/mi²) between 2001 and 2004, then declined to around 2984 in 2008 (3.1 moose/mi²). Gasaway et al. (1992) reported that areas of Interior Alaska and the Yukon have densities of 0.1–1.1 moose/mi² where predators are lightly harvested. Higher densities occurred where wolf and/or bear populations were below food-limited levels. Central Unit 20B and the MFMA in western Unit 20B have had relatively intensive wolf trapping efforts compared with most of Interior Alaska, black bear harvest is also relatively high in roadside areas of Unit 20B and grizzly bears are rare relative to more remote areas of Alaska. This increased predator harvest may have contributed to the increased moose densities in Unit 20B, although we lack formal wolf and bear population estimates for this area.

Annual estimates of moose densities in the MFMA during 2003–2008 were highly variable (Table 1). This 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 communication; 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 $\geq 30:100$, 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 Salcha River had bull:cow ratios of 44:100 (1990) and the MFMA had 49:100 (1989) and 47:100 (1994). In contrast, the more intensively harvested Chena River had 28:100 (1990), and the most intensively harvested FMA had 9–14:100 (1989–1994).

The 2008 survey indicated posthunting bull:cow ratios of ≥ 28 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 estimated at 30:100 in the MFMA in 2008, almost double the average for the previous two estimates. I hypothesize that changes in moose distributions in this relatively small survey area (see earlier discussion) may be a factor in the highly variable sex ratios as well as the population estimates.

Calf:Cow Ratios. Calf:cow ratios were high during 2001–2008 (Table 1). In general, calf:cow ratios tended to be higher in central and western Unit 20B, where predation is likely lower, and lower in eastern Unit 20B, where predation is likely higher (Young 2006).

Twinning Rates

Twinning rates in the MFMA appeared to decline between 1997 and 2001 (Table 2). Higher twinning 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, 2002–2009). Although we have only 4 years of data, twinning rates ($\bar{x}$ = 9%, range = 3–18) for 2005–2008 in central Unit 20B were lower 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

Season and Bag Limit. Seasons and bag limits in Unit 20B in RY07 and RY08 were:

<u>Unit and Bag Limits</u>	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

<u>Unit and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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
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

<u>Unit and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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 mi² to 318 mi² 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 that they had authorized beginning in RY02 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 FMA from taking an antlered bull in this management area, redefined the FMA boundaries; and in the MFMA, changed the Tier II hunt to registration hunts RM775 (fall) and RM785 (winter) and lengthened the fall general season within the MFMA to 11–25 September.

At the spring 2006 meeting, the board authorized the department to issue up to 300 drawing permits for antlerless moose in central Unit 20B.

At the spring 2008 meeting, 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. Per an agreement with the affected advisory committees in Unit 20B, ADF&G agreed to cut the number of drawing permits in half. Much of the reasoning was based on lack of survey data from RY07.

Harvest by Hunters.

General Season — The reported harvests of 528 bulls in RY07 and 648 bulls in RY08 ($\bar{x}$ = 588) were higher than the average reported harvest of 494 bulls during the previous 4 years (Table 3).

The majority of harvest during RY07–RY08 was in central Unit 20B, followed by western Unit 20B and then eastern Unit 20B (Table 3). This differs from RY05–RY06 when more moose were reported taken from eastern Unit 20B than western Unit 20B, but sample sizes were small. Harvest density in central Unit 20B (83 moose/1000 mi²) was 2.4 times that reported in eastern Unit 20B (35 moose/1000 mi²) and 2.2 times that reported for western Unit 20B (37 moose/1000 mi²). As mentioned above for calf:cow ratios, this is probably a function of higher moose densities due to lower predator densities in central Unit 20B compared to 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 RY98–RY06. 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 was reported for RY04 (Young 2006), and observed in RY05–RY08 (Table 3). This may be a function of lower moose densities resulting from increased antlerless harvests, but the census of the FMA we completed in 2008 indicated no change in density from 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 during RY02–RY08 (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 typically lower in Unit 20B than elsewhere in Unit 20. For example, between RY01 and RY08, 18–23% ($\bar{x}$ = 20%) of the hunters in Unit 20B were successful (Table 3), whereas annual success rates in Units 20A and 20C typically exceed 35% (Young 2000). The average success rate of 21% during RY07–RY08 increased from the average (19%) reported during RY03–RY06. During RY03–RY06, success rates were similar in central ($\bar{x}$ = 18%), eastern ($\bar{x}$ = 23%), 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 RY07–RY08, central Unit 20B had the lowest success rates ($\bar{x}$ = 21%), followed by western ($\bar{x}$ = 25%) 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 RY07–RY08 harvests were highest during the 1–5 September ($\bar{x}$ = 32%) and 11–15 September ($\bar{x}$ = 32%) periods, followed by the 6–10 September ($\bar{x}$ = 24%) period.

Transport Methods. Three- or 4-wheelers and highway vehicles were the primary methods of transportation used by successful hunters (Table 6). Methods of transportation used by successful hunters were relatively consistent during RY01–RY08.

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 roads in the FMA averaged 76 animals during RY07–RY08 compared to 93 animals during RY02–RY06. This is an indication that the increased antlerless hunts in the FMA may be helping to reduce roadkill. An additional 56 and 67 moose were reported killed on roads in the remainder of Unit 20B during RY07 and RY08. Generally, few moose are reported killed by trains in Unit 20B (Young 2006) and this trend continued during RY07 and RY08 with an average of 9 (range 6–12) reported killed.

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, the board lengthened the MFMA general season by 5 days and ADF&G increased the number of permits issued in hunts RM775 and RM785 beginning in RY04 in order to increase harvest to limit moose population growth. Browse utilization surveys (Paragi et al. 2008) conducted in spring 2007 indicated that moose utilization of preferred browse species in central Unit 20B was also moderately high. This supported our recommendation to limit population growth through conservative antlerless harvests in portions of central Unit 20B.

ADF&G has conducted moose habitat enhancement projects in portions of the Fairbanks area. These efforts included 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 RY07–RY08 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

The unitwide population estimate conducted in 2008 suggests that the Intensive Management population objective of 12,000–15,000 moose has been exceeded. Reported harvests reached the Intensive Management objective's lower limit of 600 moose in RY05–RY08. At the spring 2010 Alaska Board of Game meeting I recommended 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 consistently met 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, central, and western Unit 20B), but sometimes not in the relatively small MFMA (12 bulls:100 cows in 2005). Lower bull:cow ratios in the MFMA (900 mi²) and FMA (300 mi²) are of less biological concern than in larger areas because these areas are small in relation to the annual home range of moose. If insufficient bulls are available for breeding, cows in estrus 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 we have recommended that antlerless hunts occur not only in the MFMA and FMA, but also in most of central Unit 20B. I recommend continued 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 or the MFMA every 2–3 years (4–6 year cycle for each) to evaluate the effectiveness of increased antlerless harvests to reduce moose numbers/densities and moose–vehicle collisions.

LITERATURE CITED

- BOERTJE, R. D., M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- DALE, B. W. 1998. Unit 20B moose. Pages 288–299 in M. V. Hicks, editor. *Moose management report of survey and inventory activities*. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska.

- GASAWAY, W. C., R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPHERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Wildlife Monographs* 84.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. *Biological Paper* 22. University of Alaska Fairbanks.
- , R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 8 Sep 2008.
- MCNAY, M. E. 1993. Units 20B and 25C moose. Pages 244–266 *in* S. M. Abbott, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska.
- PARAGI, T. F., C. T. SEATON, and K. A. KELLIE. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: moose range assessment. Alaska Department of Fish and Game, Division of Wildlife Conservation. Final Research Technical Report. Grants W-33-4, 5, 6 & 7. Project 5.10. Juneau, Alaska.
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.
- . 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13.
- YOUNG, D. D. 2000. Unit 20A moose. Pages 300–318 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities 1 July 1997–30 June 1999. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska.
- . 2002. Unit 20B moose. Pages 345–363 *in* C. Healy, editor. Moose management report of survey and inventory activities 1 July 1999–30 June 2001. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- . 2004. Unit 20B moose. Pages 362–382 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- . 2006. Unit 20B moose. Pages 344–362 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

PREPARED BY:

C. Tom Seaton
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

SEATON, C. T. 2010. Unit 20B moose. Pages 345–365 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009 Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

TABLE 1 Unit 20B aerial moose fall composition counts and estimated population size, 2001–2008

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 (□□□ %)	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
Unit 20B	2008	28	20	36	24	1177	1558	14,838 (±16%)	17,806	1.9
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
East ^d	2008	31	13	26	20	106	132	3126 (±31%)	3751	1.5
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
Central ^e	2008	26	24	36	26	627	852	6197 (±20%)	7436	1.9
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
West ^f	2008	27	22	44	23	444	574	5515 (±19%)	6618	2.2
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
MFMA ^h	2008	30	23	37	18	309	375	2487 (±20%)	2984	3.1
FMA ^{i,j}	2001	12	13	39	29	70	99	461 (±34%)	553	1.7
FMA ^{i,k}	2008	25	26	56	31	288	417	417 ^l	500	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-mi² count area.^e A 3829-mi² count area.^f A 2942-mi² count area.^g Minto Flats Management Area within western Unit 20B.^h A 951-mi² count area.ⁱ Fairbanks Management Area.^j A 318-mi² count area.^k A 293-mi² count area.^l Census, all units surveyed.

TABLE 2 Results of twinning rate surveys for moose in Unit 20B (Minto Flats Management Area and central Unit 20B), 1997–2008

Year	Date	Cows		Total	% Twins ^a
		w/Single calf	w/Twins		
1997 ^b	22 May	17	9	26	35
1998 ^b	31 May	18	5	23	22
1999 ^b	27–29 May	59	4	63	6
2000 ^b	30–31 May	74	10	84	12
2001 ^b	31 May	58	5	63	8
2002 ^b	29 May	38	10	48	21
2003 ^b	29 May	40	10	50	20
2004 ^b	25 May	61	21	82	26
2005 ^b	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
2008 ^b	24 May	60	20	80	25
2008 ^c	29–31 May	55	7	62	11
2009 ^b	25 May	46	16	62	26
2009 ^c	28–29 May	50	1	51	2

^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 2008–2009

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total	
<u>Unit 20B East (UCUs 600, 601, 602, 603, 604, 605, 684)</u>												
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
2007–2008	60	14	8	4	86	24	222	24	22	2	270	356
2008–2009	65	13	6	4	88	26	206	20	12	10	248	336
<u>Unit 20B Central (UCUs 207, 208, 209, 211, 212, 213, 301, 401, 402, 403, 404, 405, 406, 484, 485, 486, 487, 501, 583, 584)</u>												
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
2007–2008	216	31	33	0	280	18	1072	118	63	14	1267	1547
2008–2009	276	45	20	19	360	23	1005	100	44	62	1211	1571
<u>Unit 20B West (UCUs 101, 201, 202, 203, 204, 205, 206, 210)</u>												
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
2007–2008	67	20	8	1	96	23	247	62	12	1	322	418
2008–2009	91	23	6	1	121	28	216	78	12	8	314	435
<u>FMA^c general archery hunt^d (UCUs 0212, 0213, 0300, 0301, 0401, 0402, 0403, 0501; archery only)</u>												
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							

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total	
2007–2008	21	2	0	0	23							
2008–2009	26	1	0	0	27							
<u>MFMA^e general hunt (UCUs 0201, 0205, 0210; Nonresident hunters and antlerless harvest censored)</u>												
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
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
2007–2008	43	8	0	0	51	28	108	25	0	0	133	184
2008–2009	45	11	0	0	56	30	102	26	0	0	128	184
<u>Unit 20B remainder general hunt (Includes FMA general archery hunt, but excludes MFMA)</u>												
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
2007–2008	350	67	54	1	472	18	1772	241	118	19	2150	2622
2008–2009	440	93	33	24	590	22	1653	221	81	90	2045	2635
<u>All general hunts</u>												
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
2007–2008	394	75	57	2	528	19	1879	265	119	19	2282	2810
2008–2009	486	104	33	25	648	23	1755	247	82	91	2175	2823

^a Excludes drawing, registration and Tier II permit hunt harvest.

^b Residents of Unit 20.

^c Fairbanks Management Area, due to the nature of the harvest reporting system, unsuccessful bowhunters cannot be extracted from the data, thus unsuccessful archers are not available for the FMA archery-only hunts.

^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 2008–2009

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
	2007–2008	151	28 (19)	81 (66)	42 (34)	6 (14)	36 (86)	0	42
	2008–2009	75	14 (19)	47 (77)	14 (23)	0 (0)	14 (100)	0	14
DM789	2004–2005	10	3 (30)	7 (100)	0 (0)	0 (0)	0 (0)	0	0
	2005–2006	10	1 (10)	6 (67)	3 (33)	0 (0)	3 (100)	0	3
	2006–2007	10	2 (20)	7 (88)	1 (13)	0 (0)	1 (100)	0	1
	2007–2008	10	4 (40)	4 (67)	2 (33)	0 (0)	2 (100)	0	2
	2008–2009	10	1 (10)	8 (89)	1 (11)	0 (0)	1 (100)	0	1
DM776	2006–2007	60	5 (8)	26 (47)	29 (53)	5 (17)	24 (83)	0	29
	2007–2008	60	14 (23)	32 (70)	14 (30)	0 (0)	14 (100)	0	14
	2008–2009	30	6 (20)	11 (46)	13 (54)	0 (0)	13 (100)	0	13
DM777	2006–2007	40	10 (25)	13 (43)	17 (57)	1 (6)	16 (94)	0	17
	2007–2008	40	5 (13)	15 (43)	20 (57)	0 (0)	20 (100)	0	20
	2008–2009	20	0 (0)	8 (40)	12 (60)	0 (0)	12 (100)	0	12
DM778	2006–2007	40	5 (13)	14 (40)	21 (60)	1 (5)	20 (95)	0	21
	2007–2008	40	8 (20)	21 (66)	11 (34)	0 (0)	11 (100)	0	11
	2008–2009	20	3 (15)	11 (65)	6 (35)	0 (0)	6 (100)	0	6
DM779	2006–2007	60	7 (12)	19 (36)	34 (64)	0 (0)	34 (100)	0	34
	2007–2008	60	6 (10)	16 (30)	38 (70)	2 (5)	36 (95)	0	38
	2008–2009	30	5 (17)	8 (32)	17 (68)	0 (0)	17 (100)	0	17
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

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Harvest
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
	2007–2008	100	9 (9)	28 (31)	63 (69)	39 (62)	24 (38)	0	63
	2008–2009	120	11 (9)	23 (21)	84 (77)	56 (67)	28 (33)	0	84
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
	2007–2008	97	23 (24)	30 (41)	44 (59)	7 (16)	37 (84)	0	44
	2008–2009	91	15 (16)	20 (26)	56 (74)	13 (23)	43 (77)	0	56
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 for all permit hunts	2001–2002	175	31 (18)	59 (41)	85 (59)	33 (39)	52 (61)	0	85
	2002–2003	432	62 (14)	230 (62)	140 (38)	84 (60)	56 (40)	0	140
	2003–2004	480	68 (14)	299 (73)	113 (27)	62 (55)	51 (45)	0	113
	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
	2007–2008	558	97 (17)	227 (49)	234 (51)	54 (23)	180 (77)	0	234
	2008–2009	396	55 (14)	136 (40)	203 (60)	69 (34)	134 (66)	0	203

TABLE 5 Unit 20B moose harvest^a chronology percent by month/day, regulatory years 2001–2002 through 2008–2009

Regulatory year	Harvest chronology percent by month/day					Unk/Other	<i>n</i>
	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
2007–2008	27	24	36	8	2	4	528
2008–2009	37	25	29	5	2	3	648

^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 2008–2009

Regulatory year	Harvest percent by transport method									<i>n</i>
	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
2007–2008	3	1	17	35	0	4	33	3	2	528
2008–2009	3	0	17	37	0	6	33	2	2	648

^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 2008–2009

Regulatory year	Harvest by hunters							Accidental death					
	Reported				Estimated			Road ^b					
	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
2007–2008	581	183	5	769	136	93 ^g	229	73	56	129	12	141	1139
2008–2009	718	135	4	857	152	112 ^g	264	79	67	146	6	152	1273

^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 $\times$ 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNITS: 20C (11,902 mi²), 20F (6267 mi²), and 25C (5149 mi²)

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 in these units. Bull moose harvest is low relative to population size as indicated by the high proportion of large bulls in the harvest. Generally, if harvest rates of bulls were not sustainable, large bulls would be rare in the harvest. Thus, harvest is a minor factor affecting population dynamics relative to predation.

These units contain tracts of mature black spruce that are poor quality moose habitat. However, based on aerial observations, it appears that many riparian areas, subalpine hills, and burns have habitat capable of sustaining moose at densities higher than they are currently.

Trends in moose populations have been difficult to identify, but densities probably fluctuate within 0.1 and 1.1 moose/mi², and more likely 0.2–0.7 moose/mi², based on Alaska and Yukon

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

studies in large areas ($>800\text{ mi}^2$) 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 remainder of these units. Within DNPP radiocollared moose have been monitored for movement, behavior, survival, and reproduction (Franzmann and Schwartz 1997). Also, composition surveys and population estimates have been conducted by DNPP biologists since 1970.

Moose in these units are an important source of food, trophies, and recreation for many residents and nonresidents. Nonconsumptive uses are particularly important 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 $\geq 30:100$ in areas with aerial surveys and $\geq 20\%$ large bulls in the harvest in areas without aerial surveys.

METHODS

No aerial moose surveys were completed in Units 20C and 20F during this reporting period (RY07–RY08). The most recent 20C survey is a composition survey completed during November 2006 in the western portion of 20C from the Kantishna river east to the Teklanika river and from the Tanana River south to the Bear Paw Trail (Seaton 2008). 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.

A geospatial estimator (GSPE) moose survey (Ver Hoef 2001, Ver Hoef 2008, Kellie and DeLong 2006) was conducted in Unit 25C (5000 mi^2) during November 2007 by the Bureau of Land Management (BLM) with support from ADF&G. This was the first GSPE survey conducted since 1997 and only the second for this unit. Other techniques for assessing the moose population in Unit 25C, such as spatial trend surveys and aerial counts of trend areas, have been used in previous years, but were not conducted during RY07–RY08.

We estimated annual harvest and mortality from 1) data from mandatory harvest report cards (hunters received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive timely harvest reports), 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 by residents of Tanana, we used a 1987 study conducted by ADF&G Division of Subsistence (Anderson and Alexander 1992). 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. Data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 July 2007–30 June 2008).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Based on the 2007 GSPE survey without a sightability correction factor (SCF), we estimated the Unit 25C moose density at 0.59 moose/mi² of moose habitat (5149 mi² of moose habitat in 25C), with a total population estimate of 3019 moose (90% CI $\pm$ 24%). Recent data suggest that 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). Applying a conservative SCF of 1.12 yields an estimated moose density of 0.66 moose/mi². Both estimates are within the expected range of 0.1–1.1 moose/mi² found in most large areas of Interior Alaska (>800 mi²) with lightly harvested bear and wolf populations (Gasaway et al. 1992).

During this reporting period we conservatively estimated 3500–4500 moose inhabited Unit 20C: approximately 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/mi² inside Denali National Park (Oct 1991 census; T. Meier, National Park Service [NPS], personal communication) and 0.25 moose/mi² outside Denali National Park. Based on the November 1994 survey, Denali Park biologists estimated the moose density in the Lake Minchumina area at 0.34 moose/mi² (K. Stahlnecker, NPS biologist, personal communication, year).

McNay (1990) estimated 0.25–0.50 moose/mi² occurred within the roughly 4250 mi² of moose habitat in Unit 20F. Because there are no indications the population has changed substantially since that time we have used 0.25–0.50 moose/mi² to estimate 1000–2000 moose in Unit 20F.

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 2007 GSPE survey in Unit 25C, the calf to cow ratio was 38:100, and the bull to cow ratio was 58:100 (Table 1). These ratios suggest light hunting pressure and moderate calf recruitment.

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). Generally, 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. During RY95–RY08 the percentage of large bulls in the reported harvest was 26%–50% in Unit 20C and 24%–55% in Unit 20F. These data suggest that overharvest of bulls in these units during RY95–RY08 was not a concern.

MORTALITY

Harvest

Season and Bag Limit. The following hunting seasons and bag limits have been in effect since RY93.

<u>Unit and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
Unit 20C RESIDENT HUNTERS: 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken. NONRESIDENT HUNTERS: 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken.	1 Sep–20 Sep	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. NONRESIDENT HUNTERS: 1 bull.	1 Sep–15 Sep	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 RY07–RY08.

Harvest by Hunters. During RY00–RY08 reported moose harvest remained stable in Units 20C, 20F, and 25C (Table 2). During RY07 and RY08, the reported harvest was 140 moose each year in Unit 20C, 29 and 4 in Unit 20F, and 68 and 79 in Unit 25C, respectively.

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 underestimate harvest. For example, information collected by the Division of Subsistence indicates that only 10–20% of the actual harvest by Tanana residents was reported (Anderson and Alexander 1992). The reporting rate for other rural communities in this area is unknown. Gasaway et al. (1992) estimated an unreported harvest, including wounding loss, at 17.7% (Table 3).

Illegal, other, and motor vehicle deaths were obtained from the Alaska Wildlife Troopers (AWT) mortality logs. Data concerning deaths caused by train collisions in Unit 20C were obtained from the Alaska Railroad. During RY07–RY08 data were not available from the Alaska Wildlife Troopers or the Alaska Railroad. Typically, accidental death is minimal in Units 20F and 25C but more common in Unit 20C due to deaths caused by train collisions (Table 3). Data obtained for accidental deaths from either AWT or the Alaska Railroad should be considered minimum counts.

Hunter Residency and Success. During RY07–RY08, total number of hunters increased slightly in Units 20C and 20F and decreased slightly in Unit 25C compared to RY05–RY06 (Table 2). The number of moose harvested during this report period stayed about the same in Units 20C and 20F, but increased in Unit 25C (Table 2).

During RY00–RY08, as many as 6 nonresident hunters annually reported hunting in Unit 20F (Table 2), even though this unit had no open moose season for nonresidents. This 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 were residents of Unit 20. In Unit 25C, however, most successful hunters (93%) resided outside the Unit 25, including residents and nonresidents of Alaska (Table 2). This difference can be attributed to the fact that relatively few people reside in Unit 25C.

Harvest Chronology. During RY00–RY08 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 successful. In Unit 20F, 3- or 4-wheelers and 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

In remote country such as these units, the most effective means of habitat improvement is wildfire, although we believe moose densities in areas like Units 20C, 20F, and 25C are generally limited by predation rather than forage (Gasaway et al. 1992, Boertje et al. 2009). Habitat enhanced by wildfires may boost moose numbers by increasing reproductive rates of

moose. Additionally, since bears are the dominant predator of moose calves in most of Alaska (Boertje et al. 2009), wildfires may be beneficial to moose if bear densities and/or bear use of burned areas decline following wildfires (C. Gardner, ADF&G, unpublished data, Fairbanks). Wildfires also increase deadfall, which may decrease the efficiency of predators (Boertje et al. 1995). Several wildfires and prescribed burns have occurred in these areas over the last 25 years, especially during 2004 and 2005, in which several hundred thousand acres burned in the area. A map of 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 $\geq 30:100$ in areas with aerial surveys and $\geq 20\%$ 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.

LITERATURE CITED

- ANDERSON, D.B. AND C. L. ALEXANDER. 1992. Subsistence hunting patterns and compliance with moose harvest reporting requirements in rural Interior Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- BOERTJE, R. D., D. G. KELLEYHOUSE, AND R. D. HAYES. 1995. Methods for reducing natural predation on moose in Alaska and Yukon: an evaluation. Pages 505–513 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Occasional Publication No. 35.

- , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- FRANZMANN, A. W., AND C. C. SCHWARTZ. 1998. Ecology and management of the North American moose. Wildlife Management Institute. Smithsonian Institution Press, Washington D.C., USA.
- GASAWAY, W. C., S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22. University of Alaska Fairbanks.
- , R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 21 May 2008.
- M McNAY, M. E. 1990. Units 20B and 25C moose. Pages 239–259 in S. O. Morgan, editor. Moose management report of survey–inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska.
- SEATON, C. T. 2008. Units 20C, 20F, and 25C moose. Pages XX–XX in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005 through 30 June 2007. Project 1.0. Alaska Department of Fish and Game. Juneau, Alaska.
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association. pp. 93–98.
- VER HOEF, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13

PREPARED BY:

Anthony Hollis
Wildlife Biologist I

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

HOLLIS, A. L. 2010. Units 20C, 20F, and 25C moose. Pages 366–379 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007 through 30 June 2009. Project 1.0. Alaska Department of Fish and Game. Juneau, Alaska.

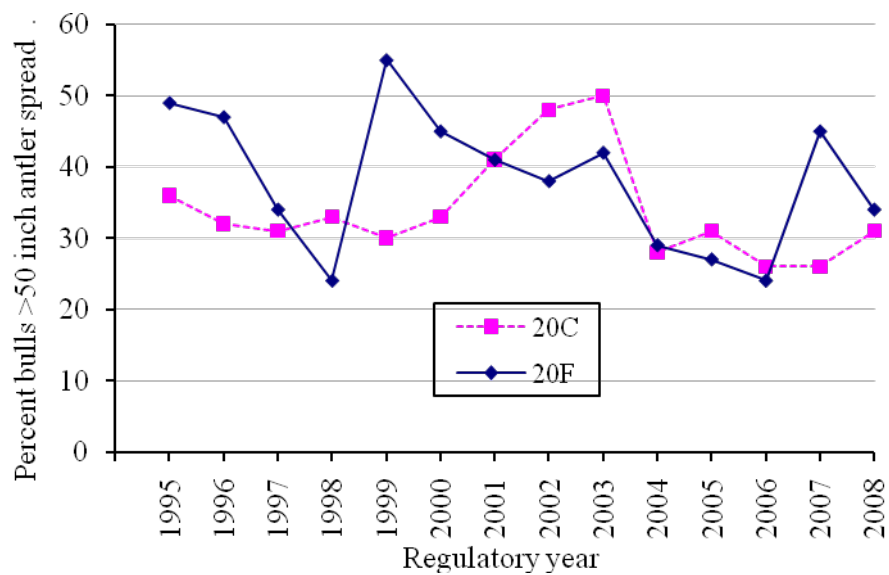


FIGURE 1 Percent of bull moose in the reported fall harvest with an antler spread >50 inches in Units 20C and 20F, regulatory years 1995–1996 through 2007–2008

TABLE 1 Unit 25C fall aerial moose composition counts, 1986–2007

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
2007 ^c	58	17	38	108	20	428	536

^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 2000–2001 through 2008–2009

Regulatory year	Successful hunters				Unsuccessful hunters				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	
<i>Unit 20C</i>									
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
2007–2008	90	34	16	140 (28)	219	130	18	367 (72)	507
2008–2009	84	40	13	137 (29)	178	136	14	328 (71)	465
<i>Unit 20F</i>									
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
2007–2008	23	6	0	29 (20)	83	29	1	113 (80)	142
2008–2009	31	19	2	52 (31)	72	41	1	114 (69)	166
<i>Unit 25C</i>									
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
2007–2008	4	55	9	68 (19)	9	247	32	288 (81)	356
2008–2009	6	63	10	79 (25)	16	184	32	232 (75)	311

^a Hunters who live within the unit in which they reported hunting were considered local.

^b some reports have unknown residency so total may not reflect the sum of local, non-local and nonresident hunters.

TABLE 3 Units 20C, 20F, and 25C estimated moose harvest and accidental death, regulatory years 2000–2001 through 2008–2009

Regulatory year	Harvest by hunters							Accidental death			Total	
	Reported ^a				Estimated			Road ^d	Train ^e	Total		
	M	F	Unk	Total	Unreported ^b	Illegal/Other ^c	Total					
<i>Unit 20C</i>												
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	
2007–2008	140	0	0	140	24	0	24	0	0	0	164	
2008–2009	140	0	0	140	24	0	24	0	0	0	164	
<i>Unit 20F</i>												
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	
2007–2008	29	0	0	29	5	0	5	0		0	34	
2008–2009	53	0	1	54	9	0	9	0		0	63	
<i>Unit 25C</i>												
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	
2007–2008	68	0	0	68	12	0	12	0		0	80	
2008–2009	78	1	0	79	13	0	13	0		0	92	

^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 Alaska Wildlife Troopers wildlife mortality logs and ADF&G records; ^d Documented kills from Fairbanks Alaska Wildlife Troopers wildlife mortality logs; ^e Confirmed dead 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, Palmer.

TABLE 4 Units 20C, 20F, and 25C reported percent moose harvest chronology by month/day, regulatory years 2000–2001 through 2008–2009

Regulatory year	Harvest chronology by month/day ^a				<i>n</i>
	9/1–9/7	9/8–9/15	9/16–9/20	12/1–12/10	
<i>Unit 20C</i>					
2000–2001	33	38	29	--	125
2001–2002	21	43	36	--	135
2002–2003	26	49	25	--	125
2003–2004	21	54	25	--	102
2004–2005	32	28	39	--	92
2005–2006	25	40	35	--	124
2006–2007	37	35	28	--	134
2007–2008	31	47	22	--	137
2008–2009	22	44	33	--	138
<i>Unit 20F</i>					
2000–2001	25	52	13	10	40
2001–2002	18	46	32	4	28
2002–2003	23	54	21	3	39
2003–2004	26	32	37	5	19
2004–2005	26	41	30	4	27
2005–2006	26	40	31	3	35
2006–2007	31	46	23	0	39
2007–2008	14	59	24	3	29
2008–2009	23	53	23	2	53
<i>Unit 25C</i>					
2000–2001	36	64	--	--	78
2001–2002	38	62	--	--	58
2002–2003	25	75	--	--	73
2003–2004	45	55	--	--	49
2004–2005	44	56	--	--	52
2005–2006	39	61	--	--	59
2006–2007	43	56	--	--	57
2007–2008	44	56	--	--	66
2008–2009	44	56	--	--	75

^a Does not include kills reported outside open hunting seasons or hunters who did not report date of kill.

TABLE 5 Units 20C, 20F, and 25C reported moose harvest percent by transport method, regulatory years 2000–2001 through 2008–2009

	Harvest percent by transport method								
Regulatory year	Airplane	Horse/Dogsled	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unk/Other	<i>n</i>
<i>Unit 20C</i>									
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
2007–2008	24	1	28	28	0	11	7	0	140
2008–2009	36	1	29	19	0	12	2	0	140
<i>Unit 20F</i>									
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
2007–2008	3	0	31	38	7	7	14	0	29
2008–2009	4	2	31	39	4	10	11	0	54
<i>Unit 25C</i>									
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
2007–2008	1	0	22	53	0	0	25	0	68
2008–2009	4	0	23	51	1	1	19	1	79

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 20D (5637 mi², 5028 mi² 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.

Antlerless moose hunting was started during RY06 in southwest Unit 20D with a limited number of permits issued in response to a high density population, moderate overwinter browse removal and moderately low twinning rates.

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 $\leq 10\%$.

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 method (GSPE, Ver Hoef 2001, Ver Hoef 2008) was used to conduct a moose population estimation survey 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 (SUs) 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. SUs varied in size from approximately 5.7 to 5.9 mi² in Unit 20D. Each SU is identified by the latitude and longitude of its southeast corner.

Selection of SUs 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 adjacent pairs were selected by first randomly selecting the first SU, and then randomly selecting an adjacent SU to form the pair. 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/mi² 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 analysis areas with separate population estimates calculated for each 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, smoothing of data was not performed in RY07–RY08. Current 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 trend line among years (i.e., regression variance). The PEB method borrows strength from multiple surveys to fit the individual yearly estimates closer to the population trend line. 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 trend line for years when 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 1.21 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 census 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 identify sex and age and to look for other moose.

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.

Twinning Survey 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 (southwest Unit 20D) 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., RY07 = 1 Jul 2007–30 Jun 2008). 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

2007

My intent was to fly a GSPE survey in southern Unit 20D because of public concerns about effects of the antlerless moose hunt that occurred in southwest Unit 20D. However, inclement weather prevented completion of all of southern Unit 20D surveys (Table 1) so the survey was confined to southwest Unit 20D (Table 2).

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 mi² averaging 5.9 mi²/SU. The high-density stratum had 143 SUs totaling approximately 843 mi² and the low-density stratum had 71 SUs totaling 418 mi². 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/mi²) but did not meet the objective in low density SUs that averaged 43.7 min/SU (7.4 min/mi²).

The population estimate was 5926 observable moose (without an SCF applied, Table 2) 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/mi².

Twinning surveys were flown on 24–29 May 2008 for a total of 12.7 hours of survey time and a cost of \$3,705. Moose were seen at the rate of 33.1 moose/hr with 420 moose observed. Fifty-seven cow–calf groups were observed with 9 (15.8%) being cows with twins (Table 3).

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.

2008

A GSPE survey was flown in southern Unit 20D (south of the Tanana River) during 26 October–1 December 2008 for a cost of \$12,120. The survey area included 320 SUs and covered 1,890 mi² averaging 5.9 mi²/SU. The high-density stratum had 189 SUs totaling approximately 1,116 mi² and the low density stratum had 131 SUs totaling 775 mi². Fifty-nine SUs were searched including 38 high-density SUs (64%) and 21 low density SUs (36%), meeting the objective of surveying 60% high density SUs. Search effort during this survey met the objective in high density SUs and averaged 48 min/SU (8.1 min/mi²) but did not meet the objective in low density SUs that averaged 44 min/SU (7.5 min/mi²).

The population estimate was 5006 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 3938–6074. Applying an SCF of 1.21 to the observed estimate resulted in an SCF-corrected estimate of 6057 moose for a density of 3.2 moose/mi².

Southwest and Southeast Unit 20D

The southern Unit 20D GSPE survey results were subdivided into two analysis areas of 1) southwest Unit 20D (SW) south of the Tanana River and west of the Johnson River, and 2) southeast Unit 20D (SE) south of the Tanana River and east of the Johnson River.

The SW Unit 20D analysis area had a population estimate of 4065 observed moose (Table 2) and 4919 with a 1.21 SCF applied, resulting in a density of 3.9 moose/mi².

The SE Unit 20D analysis area had a population estimate of 602 observed moose (Table 2) and 728 with a 1.21 SCF applied, resulting in 1.2 moose/mi².

Aerial twinning surveys were flown in southwest Unit 20D during 26-30 May 2009 for a total of 15.3 hours of survey time and a cost of \$3,920. Moose were seen at the rate of 21.9 moose/hr with 355 moose observed. Fifty-four cow-calf groups were observed with 6 (11.1%) being cows with twins (Table 3).

A survey of Ft. Greely Allen Army Airfield was conducted on 13 March 2009. Survey time totaled 52 minutes. Ten moose were located inside the airfield fence including 6 adult moose of unknown sex and two pairs of cows with single calves. This data was given to USARAK personnel.

Northern Unit 20D Population Estimate

There has not been a population estimate conducted in northern Unit 20D since 2004 (Table 4) because of the high priority of intensive management activities in southwest Unit 20D. However, the moose population is probably increasing in northern Unit 20D, likely due to several large wildfires since 2003 and wolf control conducted since 2004 to benefit the Fortymile caribou herd.

Population Composition

2007. The southwest Unit 20D population composition from the fall 2007 GSPE survey was 36 bulls:100 cows (range = 21–51) and 30 calves:100 cows (range = 18– 42) (Table 2). The increase in the bull:cow ratio compared to RY01–RY06 is due to the number of cow moose harvested in southwest Unit 20D in RY06 and RY07.

2008. The southern Unit 20D population composition from the fall 2008 GSPE survey was 34 calves:100 cows (range = 23–45) and 30 bulls:100 cows (range = 20–39; Table 1).

The SW Unit 20D analysis area had composition of 35 calves:100 cows (range = 24–47) and 27 bulls:100 cows (range = 18–36) (Table 2).

The SE Unit 20D analysis area had composition of 28 calves:100 cows (range = 8–49) and 42 bulls:100 cows (range = 19–65) (Table 1).

Distribution and Movements

No data were collected on moose distribution or movements during RY07–RY08.

MORTALITY

Harvest

Season and Bag Limit. Hunting seasons and bag limits are listed in Table 5.

Alaska Board of Game Actions and Emergency Orders.

2008 — In March 2008 the Alaska Board of Game adopted proposal 135 to reauthorize antlerless moose hunting in southwest Unit 20D and to establish a drawing permit hunt for bull moose. The

board adopted proposal 35 which extended the moose hunting season to September 20 in Unit 20D north of the Tanana River for drainages into the Volkmar River east to include Billy Creek. The board did not pass proposal 45 to close big game hunting in the city limits of Delta Junction.

Human-Induced Mortality

RY07. Estimated moose mortality from all human causes in RY07 was 996 moose (Table 6). 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 2007, an estimated unreported harvest of 142 moose, no estimate for illegal harvest, and an estimated 54 moose killed in vehicle collisions (the average of the 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.

RY08. Estimated moose mortality from all human causes in RY08 was 841 moose (Table 6) however this did not include an estimate of illegally taken moose, which is thought to be high but is undocumented. This total included 684 moose reported killed by hunters in fall 2008, an estimated unreported harvest of 120 moose, and 37 moose killed by highway vehicles (which is a decrease, probably due to antlerless moose hunts). The total reported hunting mortality of 684 met the harvest objective for Unit 20D.

Southwest Unit 20D Harvest by Hunters. General bull season moose harvest and the number of hunters in southwest Unit 20D has continued to increase since the mid 1980s, although bull harvest stabilized in RY07–RY08 (Table 7). Additional harvest in southwest Unit 20D occurred with the implementation of cow moose permit hunts in RY06 which continued through RY07 and RY08.

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 7), 6 moose during Delta Junction Management Area hunt DM790 (Table 8), 7 moose during Delta Junction Bison Range Youth Hunt DM792 (Table 9), 321 moose during antlerless moose hunt DM797, 93 moose during antlerless moose hunt DM798, and 93 moose during antlerless moose hunt DM799 (Table 10). Hunter success was 27% during the general season, 60% for DM790, 70% for DM792, 77% for DM797, 74% for DM798, and 70% for DM799.

In RY08, reported harvest by hunters totaled 551, which met the Unit 20D harvest objective. Hunters reported taking 149 moose during the general hunting season (Table 7), 10 moose during the Delta Junction Management Area hunt DM790 (Table 8), 10 moose in Delta Junction Bison Range Youth Hunt DM792 (Table 9), and 382 moose during antlerless moose hunts DM797, DM798, and DM799 (Table 10). The southwest Unit 20D harvest met the Unit 20D harvest objective. Hunter success was 35% during the general season, 37% for DM790, 100% for DM792, 10% for RM797, 51% for DM798, and 54% for DM799.

Southeast Unit 20D Harvest by Hunters. Moose harvest in southeast Unit 20D continued to be low, with a 2-year average harvest for RY07–RY08 of 23 moose/year (Table 7).

During the RY07–RY08 general seasons, reported harvest ranged 22–23 moose (Table 7) and hunter success was 37%. 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 RY07–RY08, harvest ranged 62–68 moose/year (Table 7). Hunter success ranged 22–28%. There were no permit hunts in northwest Unit 20D.

Northeast Unit 20D Harvest by Hunters. The number of hunters and harvest remained low in northeast Unit 20D during the RY07–RY08 general seasons, even with the longer hunting season. Harvest was 12–20 moose annually, with success rates of 31–56% (Table 7). 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 11).

Hunter Residency. Unit 20D resident moose hunters were evenly split between local residents (50%) and nonlocal residents (50%) during RY07–RY08 (Table 12). The proportion of nonresident hunters continued to be low.

RY07 and RY08 were the first years when more than 1,000 people hunted moose in Unit 20D, with 1,029 and 1,034 hunters each year respectively.

Hunter Effort. Mean days hunted during the general hunting season ranged 4.9–5.3 days for successful hunters and 6.7–6.8 days for unsuccessful hunters during RY07–RY08 (Table 13).

Permit Hunts. Permit hunt DM790 (DJMA) had 10 drawing permits issued RY07 and the number of permits was increased to 27 RY08 (Table 8). The number of applicants for DM790 ranged from 555 in RY07 to 723 in RY08.

Permit hunt DM792 (BRYHMA) had 10 permits in RY07–RY08 (Table 9). The number of applicants for DM792 ranged from 154 in RY07 to 197 in RY08.

Unit 20D antlerless moose hunts were implemented in RY06 and continued in RY07–RY08 for the taking of a cow moose not accompanied by a calf.

DM793 was replaced in RY07 with 3 separate antlerless moose hunts: DM797, DM798, and DM799 (Table 10). 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). 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). 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).

In RY08, the hunt boundaries were changed for DM797–DM799. DM797 was changed to a registration permit hunt (RM797) with two different zones. The Zone 1 boundary was generally in the Granite Mountains, and those portions of Granite Creek, Sawmill Creek, Bradford Creek, and July Creek drainages south of a line from the west bank of the Gerstle River at 63°41.730"N and 145°8.243"W (all coordinates were WGS 84), then northwest to the northern most point of the Granite Mountains at 63°50.467"N and 145°23.164"W, then southwest to the east bank of Jarvis Creek at its confluence with McCumber Creek at 63°44.930"N and 145°39.304"W. The Zone 2 boundary was described as that portion of the Jarvis Creek and McCumber Creek drainages, south of their confluence at 63°44.930"N and 145°39.304"W and east of the east bank of Jarvis Creek. We issued 725 registration permits for hunt RM797 and 73 hunters harvested a moose (10% success by those who hunted).

In RY08 the DM798 boundary was described as generally between the Alaska Highway and the Granite Mountains and between the Gerstle River and Jarvis Creek, bounded by a line beginning at the intersection of the Richardson and Alaska Highways, then easterly along the south side of the Alaska Highway to the west bank of the Gerstle River, then upstream along the west bank of the Gerstle River to a point at 63°41.730"N and 145°8.243"W, then northwest to the northernmost point of the Granite Mountains at 63°50.467"N and 145°23.164"W, then southwest to the east bank of Jarvis Creek at its confluence with McCumber Creek at 63°44.930"N and 145°39.304"W, then downstream along the east bank of Jarvis Creek to the Richardson Highway, then north along the Richardson Highway to its intersection with the Alaska Highway. We received 2,484 applications for the 390 DM798 permits that were issued and 201 moose were harvested.

The DM799 boundary in RY08 was described as generally north of the Alaska Highway between the Delta River and the Little Gerstle River, bounded by a line beginning at a point on the west bank of the Delta River opposite the end of the Alaska Highway at 64°2.268"N and 145°45.750"W, then north along the west bank of the Delta River to the confluence of the Tanana River, then easterly along the north bank of the Tanana River to the confluence of the Little Gerstle River, then southerly along the west bank of the Little Gerstle River to the Alaska Highway, then westerly along the north side of the Alaska Highway and across the Delta River to the beginning point. We received 1,644 applications for the 200 DM799 permits that were issued and 108 moose were harvested.

Harvest Chronology. During RY07–RY08 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 14). Harvest during the 15–20 September season extension on the north side of the Tanana River resulted in only 9 moose taken.

Transport Methods. During RY07–RY08 3- or 4-wheelers, highway vehicles, and boats continued to be the most common modes of transportation used by successful hunters (Table 15).

Natural Mortality

No estimates of natural mortality were calculated during RY07–RY08. 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

No habitat assessment was conducted during this reporting period.

Enhancement

Moose habitat in the 1987 Granite Creek Burn in southwest Unit 20D was rehabilitated by shearblading 780 acres during 4 March–11 April 2008. The treated acreage was west of and adjacent to the 1408 Road.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates were completed in southwest Unit 20D in RY07 and southern Unit 20D in RY08. No population estimates were conducted in northern Unit 20D during RY07–RY08 because of the intensive moose management issues (i.e., antlerless moose hunts) in southern Unit 20D. Without a population estimate for northern Unit 20D, a unitwide estimate was not available. However, because the RY08 population estimate for southern Unit 20D (approximately 34% of Unit 20D) was 6057 moose, it is likely that the unitwide population objective of 8,000–10,000 moose was met.

Interim population and harvest objectives were developed to supplement 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 met the objective of 500–700 moose per year in RY07 and RY08 with the advent of a liberal antlerless moose hunt in southwest Unit 20D.

A relatively high proportion of southwest Unit 20D habitat 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 likely met or exceeded population objectives and met 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.

LITERATURE CITED

- BOERTJE, R. D., M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- , K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ALDERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- DELONG, R. A. 2006. Geospatial population estimator software user's guide. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPESoftwareUsersGuide.pdf>> Accessed 29 May 2008.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* No. 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. *Biological Paper* 22. University of Alaska Fairbanks.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska. <<http://www.wildlife.alaska.gov/index.cfm?adfg=management.main>> Accessed 30 Apr 2008.
- MCILROY, C. 1974. Unit 20D moose. Pages 154–160 in D. McKnight, editor. Moose management report of survey–inventory activities. Part II. Volume IV. Alaska Department of Fish and Game. Job 1. Juneau, Alaska.
- VER HOEF, J. M. 1996. Parametric empirical Bayes methods for ecological applications. *Ecological Applications* 6(4):1047–1055.
- . 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association, pp. 93–98.
- . 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13.

PREPARED BY:

Stephen D. DuBois
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

DuBois, S. D. 2010. Unit 20D moose. Pages 380–409 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1 Results of population estimates of observed moose for southern Unit 20D using a Gasaway method survey in 1995 and a geospatial population estimator (GSPE) survey for all other years, 1995–2008

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
2007	No data					
2008	5006	3071	1049	915	34	30
(LCI–UCI) ^a	3938–6074	2348–3794	823–1275	715–1116	23–45	20–39

^a LCI = lower confidence interval at 90% and UCI = upper confidence interval at 90%.

TABLE 2 Results of population estimates of observed moose for southeast and southwest Unit 20D using geospatial population estimator (GSPE) surveys, 2001–2008

Parameter	2001	2003	2005	2006	2007	2008
<u>East of Johnson River</u>						
Total pop estimate	853	968	690	998	--	602
LCI ^a	544	321	290	328	--	408
UCI ^b	1162	1616	1090	1668	--	795
Total cows	463	356	402	625	--	542
LCI	185	139	130	198	--	288
UCI	740	573	676	1051	--	796
Total calves	128	87	97	267	--	152
LCI	74	16	6	90	--	67
UCI	182	158	189	443	--	237
Total bulls	106	139	205	128	--	229
LCI	65	47	117	36	--	167
UCI	147	230	292	225	--	292
Bulls:100 Cows	23	39	51	20	--	42
LCI	5	29	19	10	--	19
UCI	41	49	84	30	--	65
Calves:100 Cows	28	24	24	41	--	28
LCI	5	9	10	28	--	8
UCI	50	40	38	54	--	49
<u>West of Johnson River</u>						
Total pop estimate	2583	4524	4863	6245	5926	4065
LCI	1190	3269	3933	4931	4525	3189
UCI	3175	5779	5792	7559	7327	4940
Total cows	1962	3229	3070	3869	3767	2530
LCI	1507	2137	2432	3033	2697	1936
UCI	2416	4320	3708	4705	4837	3123
Total calves	447	1049	1121	1549	1128	897
LCI	358	719	913	1195	805	709
UCI	537	1379	1330	1902	1450	1086
Total bulls	286	664	613	801	1351	686
LCI	203	393	396	608	940	529
UCI	370	936	829	994	1762	844
Bulls:100 Cows	15	21	20	21	36	27
LCI	9	17	13	17	21	18
UCI	20	24	27	24	51	36
Calves:100 Cows	23	32	34	41	30	35
LCI	16	27	29	36	18	24
UCI	30	38	39	45	42	47

^a LCI = Lower confidence interval.

^b UCI = Upper confidence interval.

TABLE 3 Results of moose twinning surveys in southwest Unit 20D, 2001–2009

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
2008	48	9	15.8	33.1	420
2009	48	6	11.1	21.9	355

TABLE 4 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
Bulls: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 5 Unit 20D moose hunting seasons and bag limits, regulatory years 2005–2006 through 2007–2008

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 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:
	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: 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: NONRESIDENT:	1 Sep–15 Sep	1 bull.	
		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
2008–2009	Within the Healy River drainage.	RESIDENT: 15 Aug–28 Aug 1 Sep–15 Sep NONRESIDENT: 1 Sep–15 Sep	1 bull with spike-fork antlers. 1 bull. 1 bull.
	Remainder of Unit 20D (north of Tanana River).	RESIDENT AND NONRESIDENT: 1 Sep–15 Sep	1 bull.
	South of Tanana River and west of Johnson River, except the Delta Junction Management Area and the Bison Range Youth Hunt Management Area	RESIDENT: 1 Sep–15 Sep 10 Oct–25 Nov NONRESIDENT: 5 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side. One antlerless moose (taking calves or cows accompanied by calves is prohibited) by permit RM797 south of AK Hwy Granite Mountains; DM798 south of AK Hwy east of Jarvis Creek, DM799 north of AK Hwy west of Little Gerstle River. 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 10 Oct–25 Nov NONRESIDENT: 5 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines by drawing permits DM790. DM799 one antlerless moose (taking calves or cows accompanied by calves is prohibited). 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 NONRESIDENT: No open season	1 bull.

Regulatory year	Area	Season	Bag limit
	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 NONRESIDENT: 5 Sep–15 Sep	1 bull. 1 bull with 50-inch antlers, or at least 4 brow tines on at least one side.
	Within the Healy River drainage.	RESIDENT: 15 Aug–28 Aug 1 Sep–20 Sep NONRESIDENT: 1 Sep–20 Sep	1 bull with spike-fork antlers. 1 bull. 1 bull.
	North of the north bank of the Tanana River and draining into the Volkmar River east to and including the Billy Creek drainage, excluding the Healy River drainage	RESIDENT AND NONRESIDENT: 1 Sep–20 Sep	1 bull.
	Remainder of Unit 20D	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 6 Unit 20D moose harvest and accidental death, regulatory years 1986–1987 through 2008–2009

Regulatory year	Harvest by hunters							Accidental death		
	Reported				Estimated					Total
	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
2008–2009	297	386	1	684	120	unk	120	37	37	841

^a Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).^b Three-year average of the last 3 known years.

TABLE 7 Southwest (SW), southeast (SE), northwest (NW), and northeast (NE) Unit 20D reported moose harvest and number of hunters during general seasons, regulatory years 1984–1985 through 2008–2009

Regulatory year	Moose harvest						Hunters					
	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	26 ^c	82 ^c	19 ⁱ	4	286	517 ^h	49 ^c	279 ^c	44 ⁱ	26	915
2007–2008	164 ^h	23 ^c	68 ^c	12 ⁱ	6	273	553 ^h	63 ^c	305 ^c	39 ⁱ	35	995
2008–2009	149 ^h	22 ^c	62 ^c	20 ⁱ	2	255	425 ^h	59 ^c	221 ^c	36 ⁱ	20	761

^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.

TABLE 8 Unit 20D Delta Junction Management Area moose drawing permit harvest, regulatory years 1996–1997 through 2008–2009

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
DM790	2008–2009	27	25	50	50	50	50	0	10

TABLE 9 Unit 20D Bison Range Youth Hunt Management Area moose drawing permit harvest, regulatory years 2002–2003 through 2008–2009

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
DM792	2008–2009	10	0	0	100	20	80	0	10

TABLE 10 Unit 20D antlerless moose hunt harvest, regulatory years 2006–2007 through 2008–2009

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
RM797	2008–2009	725	58	75	25	1	99	0	73
DM798	2008–2009	390	20	35	65	2	98	0	201
DM799	2008–2009	200	28	25	76	4	96	0	108

TABLE 11 Unit 20D Healy River (Uniform Coding Unit 501) reported moose harvest, regulatory years 1993–1994 through 2008–2009

Regulatory year	Unit 20D Healy River			
	Hunters	Harvest month		
		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
2008–2009 ^c	19	0	9	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 12 Unit 20D general hunting season moose hunter residency and success^a, regulatory years 1986–1987 through 2008–2009

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
2008–2009	159	104	13	6	282 (27)	447	241	48	16	752 (73)	1034

^a Excludes hunters in permit hunts.^b Local means reside in Unit 20D.

TABLE 13 Southwestern, southeastern, northwestern, and northeastern Unit 20D general season moose and mean days hunted^a, regulatory years 1986–1987 through 2008–2009

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
2008–2009	4.8	4.6	5.1	5.6	4.9	6.6	6.4	7.4	5.3	6.8

^a Excludes permit hunt harvest.

TABLE 14 Unit 20D general season moose harvest^a chronology percent by month/day, regulatory years 1990–1991 through 2008–2009

Regulatory year	Harvest chronology percent by month/day				Unk	<i>n</i>
	9/1–9/5	9/6–9/10	9/11–9/15	9/16–20		
1990–1991	57	20	23	0	0	109
1991–1992	57	22	16	0	5	141
1992–1993	50	30	18	0	3	139
1993–1994	42	26	28	0	4	154
1994–1995	45	25	22	0	8	128
1995–1996	41	20	33	0	6	138
1996–1997	51	23	23	0	3	208
1997–1998	44	24	30	0	3	196
1998–1999	44	30	24	0	2	223
1999–2000	41	30	24	0	5	175
2000–2001	48	28	23	0	1	246
2001–2002	44	34	21	0	2	172
2002–2003	36	37	22	0	5	174
2003–2004	39	30	30	0	1	158
2004–2005	40	29	29	0	3	189
2005–2006	50	21	27	0	2	230
2006–2007	45	27	23	0	4	288
2007–2008	43	26	27	0	4	275
2008–2009	44	26	25	3	2	282

^a Excludes permit hunt harvest.

TABLE 15 Unit 20D moose harvest percent^a by transport method, regulatory years 1987–1988 through 2008–2009

Regulatory year	Harvest percent by transport method									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboats	Unknown	
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
2008–2009	5	2	18	39	0	5	26	3	2	282

^a Excludes permit hunt harvest.

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 20E (10,680 mi² total area, 8,000 mi² moose habitat)

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 an estimated 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, fluctuating at an estimated 2200–5700 moose (0.3–0.7 moose/mi² 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 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 mi² 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, possible local declines in grizzly bear numbers, and changes in the bear population age and sex structure (Gardner 1999). During 1997–2001, the Fortymile Nonlethal Wolf Control Program (nonlethal program), designed to benefit the Fortymile Caribou Herd, was conducted in western Unit 20E, northern Unit 20D, and eastern Unit 20B. Effects of the nonlethal program on moose were evaluated by ADF&G in portions of western Unit 20E and northern Unit 20D (Tok West study area) during RY98–RY05 (Boertje and Gardner 1999, Boertje et al. 2006) using the geospatial population estimator survey method (GSPE; Ver Hoef 2001, Ver Hoef 2008, Kellie and DeLong 2006), a modification of the Gasaway technique (Gasaway et al. 1986). Although surveys indicated the moose population fluctuated during 1976–

¹ At the discretion of the reporting biologist, this unit report contains data collected outside the report period.

2006, it did not increase beyond the ability of wolves and bears to maintain the population at low densities (≤ 1.0 moose/mi² of moose habitat). The most recent effort to increase the moose population in Unit 20E occurred in November 2004, when the Alaska Board of Game (board) implemented the Upper Yukon Tanana Predation Control Program (UYTPCP), encompassing portions of Unit 20E, to allow the moose population to increase. The control program was expanded by the board in May 2006 to include all of Unit 20E and parts of surrounding units and was ongoing during RY07–RY08.

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 closed. Since at least 1977, local communities have expressed concern about chronically low moose density due to predation and have proposed various predator control programs to increase moose numbers and moose harvest. Improved moose density prompted the board to approve a 10-day bulls-only season in 1982, which continued until 1991. In response to further improvement, the board lengthened the moose season to 15 days during 1991–2000.

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, likely in response to more restrictive moose hunting regulations in Southcentral Alaska, and for the opportunity to hunt moose and caribou at the same time.

In response to increased moose harvest due to increasing numbers of caribou hunters 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. The remote portions of the upper Middle Fork Fortymile River were not included in this split season (Gross 2008). The split season was designed to retain 15 days of hunting opportunity, but also to reduce moose hunting pressure by closing the moose season over the Labor Day weekend. In addition, moose and caribou permit conditions stipulated that a hunter could not hold a registration permit for both species at the same time. These actions were designed to stabilize moose harvest to maintain the bull:cow ratio within the management objective. This season structure is still 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

- Maintain a population of 8,000–10,000 moose.
- Maintain a harvest of 500–1000 moose annually.

METHODS

POPULATION STATUS

We used the GSPE technique to conduct moose population estimation surveys in southern Unit 20E within the 2,452 mi² Tok West and 2,178 mi² Tok Central (called Tok East in 1998–2003) survey areas during 1998–2009. The Tok West and Tok Central survey areas varied in size during 1998–2003, but have remained the same since 2004. In each of 2003, 2006, and 2009 a GSPE survey was conducted in a 1200 mi² portion of northern Unit 20E within the Yukon–Charley Rivers National Preserve (YCNP) by the National Park Service (NPS; Burch 2003, Burch 2006, Burch 2009). All GSPE surveys in Unit 20E used a search intensity of 4–7 min/mi² with no sightability correction factor. Therefore, we derived population estimates of observable moose by using this cost-efficient, low- to medium-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.

COMPOSITION SURVEYS

We estimated sex and age composition during 1998–2009 from population 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 2004–2009 from spring surveys conducted in southern Unit 20E. Reconnaissance-style twinning rate surveys were flown during late May 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 observed newborn calves.

HARVEST

We estimated annual harvest from mandatory harvest report cards. During 2001–2009, this included data from the registration hunt RM865 in most of Unit 20E, general season hunt in the Upper Middle Fork of the Fortymile River drainage, and drawing hunts DM794 and DM796 during November in the Ladue Controlled Use Area. General season hunters received 1 reminder letter and hunters with permits received 1 or 2 reminder letters and usually an e-mail and telephone call if we did not receive timely harvest reports. We summarized data on hunter residency, hunter success, harvest chronology, and transport methods. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 Jul 2008–30 Jun 2009).

HABITAT ENHANCEMENT

Natural wildfires were managed under the *Alaska Interagency Fire Management Plan* (Alaska Wildland Coordinating Group 1998). No prescribed fires were conducted or planned in Unit 20E during RY07–RY08.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Based on surveys conducted in the Tok West and Tok Central survey areas of southern Unit 20E in 2004–2009 (Table 1), the observable moose population increased from an estimated 2268 moose (0.49 moose/mi^2) in RY04 to an estimated 3950 moose (0.85 moose/mi^2) in RY09. This population estimate was derived for the area entirely within the Tok West and Tok Central moose survey areas, which includes 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 population trends in Unit 20E during 1981–2003 are discussed in Gross (2004).

In 2006 and 2009, the NPS estimated the moose density in the entire 3096 mi^2 YCNP survey area at 0.20 and 0.37 moose/mi^2 respectively (Burch 2006, 2009). To estimate unitwide moose numbers during RY07–RY09, I used the YCNP density estimates for the 1200 mi^2 portion of Unit 20E surveyed by the NPS.

No formal surveys were conducted in northern Unit 20E outside the YCNP (approximately 2170 mi^2 of moose habitat) during RY07–RY09. Because habitat is similar, I estimated the moose population size in northern Unit 20E outside the YCNP survey area by extrapolating the

YCNP estimates to this area. While this is not a statistical estimation, it provides a conservative estimate of the low density moose population in this area. In past reports, we assumed the moose density in this area was 0.20–0.40 moose/mi², which approximates the densities estimated in the YCNP survey area.

RY07. The 2007 observable moose population estimate for Unit 20E was 3300–5000 moose, with an estimated density of 0.41–0.62 moose/mi² of moose habitat (8000 mi²). Only habitat clearly not suitable for moose was excluded, e.g., high portions of mountains (Gasaway et al. 1986).

RY08. The 2008 observable moose population estimate was 3200–4500 moose, with an estimated density of 0.40–0.57 moose/mi² of moose habitat (8000 mi²).

RY09. The 2009 observable moose population estimate was 4300–6000 moose, with an estimated density of 0.54–0.75 moose/mi² of moose habitat (8000 mi²).

Population Composition

During RY98–RY04, ratios of 5-month-old calves:100 cows were consistently below 25 calves:100 cows (except during 2004 in Tok West = 26 calves:100 cows); ratios did not equal or exceed 30 calves:100 cows during any year in the southern Unit 20E survey areas (Table 1). Gasaway (1992) summarized data collected from 36 different sites in Alaska and Yukon that showed fall calf:cow ratios ≤ 25 calves:100 cows were generally observed in moose populations with a stable to declining trend, while populations with fall calf:cow ratios ≥ 30 calves:100 cows were generally observed in moose populations with an increasing trend. This observation provides additional information to help us assess the southern Unit 20E moose population trend.

During RY05–RY09, calf:cow ratios in the Tok West survey area exceeded 30 calves:100 cows (except in 2008 = 27 calves:100 cows), but remained lower in the Tok Central survey area ($\bar{x}$ = 23 calves:100 cows, range = 16–28). Wolf control in the UYTSP may have contributed to higher calf survival in the Tok West survey area during RY05–RY09 by reducing wolf predation on calves. Although Gasaway et al. (1992) did not show wolves as the primary predator of moose calves 0–5 months of age in southern Unit 20E, wolves likely do account for some mortality of young calves in this area. Large fires in the Tok West survey area in 2004 and 2005 may have also contributed to higher calf survival because grizzly bears (the major predator on moose calves in this area identified by Gasaway et al. 1992) may have avoided these recently burned areas (C. Gardner, ADF&G, unpublished data, Fairbanks).

The bull:cow ratio remained above 40 bulls:100 cows each year during RY03–RY09 in the Tok Central and Tok West survey areas.

Twinning Rates

Twinning rates in southern Unit 20E were moderate at 17–30% in 2004, 2005, 2007, and 2008, but higher at 47% and 41% in 2006 and 2009 (Table 2). 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 (D. Kelleyhouse, ADF&G, unpublished data, Tok). In fall 1988, 1992, 1999, and 2000, early deep snowfalls (>22 inches) appeared to cause moose to move to lower elevations during November.

MORTALITY

Harvest

Seasons and Bag Limit. Season dates and bag limits during RY03–RY09 are summarized in Table 3.

Alaska Board of Game Actions and Emergency Orders.

Predator Control Actions — 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 grizzly bear predation control implementation plan. ADF&G then developed the UYTPCP to increase moose survival in portions of Units 12 and Unit 20E.

At the November 2004 meeting, the board approved the UYTPCP, which allowed ADF&G to conduct a wolf and grizzly 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 mi² area in southern Unit 20E and in Unit 12 north of the Alaska Highway and west of the Taylor Highway. Grizzly bear control was approved for a 2700 mi² 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 mi² 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, including all of Unit 20E. Grizzly bear control was limited to 4050 mi² in southern Unit 20E to reduce grizzly bear predation on moose calves.

During the March 2009 meeting, the board reauthorized the UYTPCP but suspended grizzly bear control on July 1, 2009 because it was determined to be ineffective. This plan was authorized for 5 years beginning January 1, 2009.

Other Board of Game Actions: In spring 2000 the board 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 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.

During the March 2008 meeting, the board clarified motorized restrictions within the Ladue River Controlled Use Area (LRCUA) in southeastern Unit 20E. The board restricted the use of motorized land vehicles within the LRCUA, except on the Nine Mile and Liberty Creek trails, and the Alaska–Canada border or the Boundary Cutoff of the Taylor Highway. This change restricted moose hunters from using a network of mining trails between Liberty Creek and the Boundary Cutoff of the Taylor Highway.

During the March 2010 meeting, the board reduced the size of the LRCUA by eliminating the portion north and east of Liberty Creek. This change allows moose hunters to use the network of mining trails between Liberty Creek and the Boundary Cutoff of the Taylor Highway.

Harvest by Hunters. During RY05–RY07, reported harvest during the general season remained stable, averaging 137 bull moose (130–144) annually (Table 4), about 3–4% of the estimated population. During RY08–RY09, average reported harvest during the general season increased by 26% ($\bar{x}$ = 173, range = 169–176). This increase is likely a result of increased moose numbers in areas along the trail systems off the Taylor Highway in southern Unit 20E.

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 in the fall due to difficult access.

During RY07–RY09, 3 DM794 and 7 DM796 permits were issued annually. One bull was harvested in the DM794 hunt (in RY08) and 5 bulls were harvested in the DM796 hunt (2 in RY08 and 3 in RY09; Table 4). During RY07–RY09, an average of 66% of DM794 permit holders hunted each year, and an average of 62% 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 RY07–RY09 they were searching for large bulls. I will continue to encourage hunters to travel to this remote area when snow conditions allow.

Hunter Residency and Success. Of the 144–179 bulls harvested annually in RY07–RY09, 73–75% were taken by nonlocal Alaska residents (Table 5). Prior to 1992, most nonlocal hunters were from Interior and Southeast Alaska, but since RY92 most nonlocal hunters have been from Southcentral Alaska. Nonlocal resident hunters made up 66–71% of the hunters during RY07–RY09. Local hunters represented 19–22% of the hunters and took 13–16% 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 RY07–RY09, nonresidents represented an average of 11% (range = 9–13%) of the hunters and took an average of 11% (range = 8–13%) of the harvest.

Hunter success rate declined from an average of 28% during RY93–RY00 to an average of 19% during RY01–RY06. However, success rate increased to an average of 23% (range = 20–25%) during RY07–RY09, likely a result of increased moose numbers along the trail systems off the Taylor Highway in southern Unit 20E.

Harvest Chronology. During RY93–RY00, 16–42 bulls ($\bar{x}$ = 31) were harvested during 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–RY09, 2–15 bulls ($\bar{x}$ = 10) were harvested during 24–28 August, a 68% reduction in the average harvest during the first 5 days of the general season (Table 6). August harvest during RY07–RY09 remained at similar levels as reported during RY01–RY06.

Transport Methods. During RY01–RY09, use of 4-wheelers by successful moose hunters increased ($\bar{x}$ = 39%, range = 33–47%) compared to RY92–RY00 ($\bar{x}$ = 28%, range = 22–32%) (Table 7). Conversely, 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–RY09. This is coincident with the decline in the roadside bull:cow ratios and more restrictive regulations during RY01–RY09. The number of successful hunters who used other transportation types remained relatively constant.

In combination with increasing number of hunters, increasing access by 4-wheelers is a management concern in portions of Unit 20E. Increasing quality and dependability of ATVs has allowed hunters to access areas farther from roads that were previously refugia for moose. This likely resulted in localized reductions in bull:cow ratios 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/mi²). Boertje et al. (2009) summarized cause of death postcalving in 4 moose populations 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. Predator–prey relationships between moose, wolves and grizzly bears in Unit 20E during RY81–RY06, were discussed previously (Boertje et al. 1987, Boertje et al. 1988, Gasaway et al. 1992, Gross 2004, Gross 2008). Additional information and analysis of predator–prey relationships related to the UYTPCP in Unit 20E can be found in the March 2008, 2009, and 2010 Upper Yukon Tanana Predation Control Implementation Plan and Activities Annual Reports from ADF&G to the Alaska Board of Game (accessible on the ADF&G Boards Support website <http://www.boards.adfg.state.ak.us/archive/bog/garch.php>; Accessed 4 May 2010).

HABITAT

Assessment

Availability of browse in Unit 20E has not appeared to limit moose population growth. Boertje et al. (1985) found that use of preferred browse plants by moose was less than 5%. More recently, Paragi et al. (2008) estimated 2006 biomass removal rates by moose of 10–30% based on 30 sample plots in southern Unit 20E. Although these results indicate a higher rate of biomass removal than previously documented in southern Unit 20E, the authors caution that their estimate was derived from a small sample of a large complex landscape and should not be considered a robust estimate of total removal at the landscape scale. More importantly, these results illustrate that Unit 20E likely has moderate habitat potential and browse utilization compared to other Interior Alaska units.

Currently, southern Unit 20E appears to have a large amount of high quality moose habitat associated with 2 large mid 1960s wildfires (>1,000,000 acres), 1998–1999 prescribed and wild fires ($\geq$ 400,000 acres), and the 2004–2005 wildfires (>1,000,000 acres).

Enhancement

The *Alaska Interagency Wildland Fire Management Plan* (Alaska Wildland Fire Coordinating Group 1998) calls for restoring 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 limited fire protection 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 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 Kechumstuk burn. Moose densities in these areas have increased to some extent, but are expected to continue to increase over the next 15–20 years.

In 2004 and 2005, wildfires burned more than 1 million (1890 mi²) acres of moose habitat within or immediately adjacent to Unit 20E. These fires are expected to contribute significantly to moose habitat quantity and quality for the next 30–40 years.

In 2007, 19,000 acres burned in Unit 20E, primarily from a single fire in the lower Ladue River drainage. In 2008, wet conditions resulted in only 320 acres burned. In 2009, 26,700 acres burned, again primarily within the Laude River drainage. Fire data for 2007–2009 was taken from the Alaska Interagency Coordination Center website <<http://fire.ak.blm.gov>> Accessed 4 May 2010).

CONCLUSIONS AND RECOMMENDATIONS

Population estimates during RY07–RY09 indicated we did not meet the unitwide intensive management objective of 8,000–10,000 moose. During RY05–RY09 the population increased slowly to an estimated 4300–6000 moose, with an estimated density of 0.54–0.75 moose/mi² of moose habitat (8000 mi²).

Predation by wolves and grizzly bears appears to be the primary factor limiting the moose population. Wolf numbers were reduced in portions of southern Unit 20E for the past 12 winters (RY98–RY09). The 5-year reauthorization (July 1, 2009 – June 30, 2014) of the UYTPCP by the Board of Game in spring 2009 will likely result in further reductions in wolf numbers to reduce wolf predation on moose. Grizzly bear numbers were not reduced under the UYTPCP and grizzly bear control efforts were suspended when the plan was reauthorized in 2009. To reach the unitwide moose population objective, I recommend both wolf and grizzly bear numbers be further reduced.

We continued to meet the management objective of 40 bulls:100 cows. Human-induced mortality had little impact on the overall moose population but likely caused reductions in localized bull:cow ratios along heavily used highway and trail corridors. Annual posthunt harvest rates were historically less than 2% of the fall population estimate but increased above 2% of observable moose in RY95, were 2.5–3.5% during RY97–RY06, and approximately 3.8% during RY07–RY09.

Unitwide harvests of 144, 179, and 172 moose during RY07, RY08, and RY09 respectively, were well below the intensive management harvest objective of 500–1000 moose. This harvest objective is likely unrealistically high due to limited access to much of the Unit 20E moose population. I recommend the intensive management harvest objective be reconsidered during the next Board of Game cycle.

The number of moose hunters in Unit 20E increased substantially from RY91 to RY09. Most of the additional hunters were from Southcentral Alaska. As during previous years, the preferred transportation type during RY07–RY09 was 4-wheelers.

Maintaining a sustainable moose harvest has been a long-term management challenge in Unit 20E. Our primary concern has been the increasing number of hunters since RY91. 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. However, as moose populations continue to increase along the road system between Anchorage and Tok, it is possible that hunter numbers could plateau or decline in coming years as more hunters from Anchorage begin hunting closer to home. Also, with increasing moose numbers in southern Unit 20E, where the majority of Unit 20E hunting pressure occurs, overharvest should become less likely. If moose numbers continue to increase, it may be possible to consider more liberal hunting regulations in portions of Unit 20E during the next Board of Game cycle. Continued monitoring of the moose population will be critical for this determination.

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 1890 mi² of Unit 20E moose habitat burned in wildfires. Under Department of Natural Resources, Division of Forestry and Bureau of Land Management leadership, the interagency fire management plan has guidelines that should implement fire suppression activities that have a greater chance of benefiting the moose population.

For the next reporting period, the Management Objective will remain the same, but the Intensive Management Harvest Objective should be reconsidered through the Board process.

LITERATURE CITED

- ALASKA WILDLAND FIRE COORDINATING GROUP. 1998. Alaska interagency wildland fire management plan. <<http://forestry.alaska.gov/pdfs/98AIFMP.pdf>> Accessed 25 Mar 2008.
- BOERTJE, R. D., AND C. L. GARDNER. 1999. Reducing mortality on the Fortymile caribou herd. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Progress Report. Grant W-27-2. Study 3.43. Juneau, Alaska, USA.
- , C. L. GARDNER, AND J. GROSS. 2006. Monitoring of Fortymile ungulates and wolves following wolf sterilization and translocation. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Annual Research Performance Report. Grants W-33-4. Project 3.48. Juneau, Alaska, USA. <<http://www.wildlife.alaska.gov/index.cfm?adfg=pubs.reports#caribou>>.
- , W. C. GASAWAY, S. D. DUBOIS, D. G. KELLEYHOUSE, D. V. GRANGAARD, D. J. PRESTON, AND R. O. STEPHENSON. 1985. Factors limiting moose population growth in Game Management Unit 20E. Alaska Department Fish and Game. Federal Aid in Wildlife Restoration. Research Progress Report. Grants W-22-3 and W-22-4. Job 1.37R. Juneau, Alaska, USA.
- , ———, D. V. GRANGAARD, AND D. G. KELLEYHOUSE. 1988. Predation on moose and caribou by radio-collared grizzly bears in east central Alaska. *Canadian Journal of Zoology* 55:2492–2499.
- , ———, ———, ———, AND R. O. STEPHENSON. 1987. Factors limiting moose population growth in Game Management Unit 20E. Alaska Department Fish and Game. Federal Aid in Wildlife Restoration. Research Progress Report. Projects W-22-5 and W-22-6. Job 1.37R. Juneau, Alaska, USA.
- , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- , K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ADERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506

- BURCH, J. W. 2003. 2003 aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. NPS Technical Report NPS/ARRNR/NRTR-2004/44.
- . 2006. 2006 aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. NPS Technical Report NPS/ARRNR/NRTR-2006/38.
- . 2009. 2009 aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. In press.
- GARDNER, C. 1999. Unit 20E grizzly bear. Pages 211–234 in M. V. Hicks, editor. Grizzly bear management report of survey–inventory activities. Alaska Department Fish and Game. Study 4.0. Juneau, Alaska, USA.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22, University of Alaska Fairbanks, Alaska, USA.
- GROSS, J. A. 2004. Unit 20E moose. Pages 421–440 in C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- , J. A. 2008. Unit 20E moose. Pages 424–240 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, Alaska, USA.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 19 Sep 2008.
- PARAGI, T. F., C. T. SEATON, AND K. A. KELLIE. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: moose range assessment. Alaska Department Fish and Game, Division of Wildlife Conservation. Final Research Technical Report. Grants W-33-4, 5, 6 & 7. Project 5.10. Juneau, Alaska.
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 in 2000 Proceedings of the section on statistics and the environment of the American Statistical Association.
- VER HOEF, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. Environmental Ecological Statistics 15:3:1–13.

PREPARED BY:

Jeffrey A. Gross
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

GROSS, J. A. 2010. Unit 20E moose. Pages 410–428 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1 Moose population estimates in Tok West and Tok Central Moose Survey Areas in southern Unit 20E, fall 1998–2009^a

Survey Area	Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Percent calves	Total moose observed	Size of Survey Area (mi ²)	Density estimate	Population estimate
Tok West	1998	64	18	19	10	278	1932	0.56 (90% CI±44%)	1086 (90% CI±44%)
	1999	80	16	22	10	365	1932	0.47 (90% CI±20%)	901 (90% CI±20%)
	2000	60	11	14	8	561	1932	0.58 (90% CI±19%)	1115 (90% CI±23%)
	2001	76	9	14	7	531	1932	0.47 (90% CI±19%)	915 (90% CI±17%)
	2002	59	10	25	14	364	1932	0.60 (90% CI±19%)	1166 (90% CI±27%)
	2003	64	9	15	9	355	1944	0.58 (90% CI±25%)	1128 (90% CI±25%)
	2004	61	11	26	14	283	2452	0.59 (90% CI±22%)	1435 (90% CI±22%)
	2005	55	13	30	16	543	2452	0.73 (90% CI±17%)	1801 (90% CI±17%)
	2006	39	9	37	20	584	2452	0.98 (90% CI±19%)	2398 (90% CI±19%)
	2007	50	11	30	16	503	2452	0.86 (90% CI±18%)	2098 (90% CI±18%)
	2008	47	11	27	16	509	2452	0.83 (90% CI±15%)	2040 (90% CI±15%)
	2009	63	18	34	18	585	2452	1.00 (90% CI±16%)	2445 (90% CI±16%)
Tok Central	1998	59	14	23	14	450	2750	0.62 (90% CI±25%)	1694 (90% CI±25%)
	2000	49	11	21	13	347	1821	0.70 (90% CI±24%)	1272 (90% CI±24%)
	2001	51	6	10	6	624	2703	0.75 (90% CI±23%)	2026 (90% CI±23%)
	2002	71	8	20	10	396	2703	0.63 (90% CI±28%)	1707 (90% CI±28%)
	2003	53	5	11	6	297	2703	0.51 (90% CI±23%)	1379 (90% CI±23%)
	2004	48	11	23	14	233	2178	0.37 (90% CI±19%)	802 (90% CI±19%)
	2005	48	8	16	10	344	2178	0.50 (90% CI±19%)	1097 (90% CI±19%)
	2006	46	3	24	14	520	2178	0.45 (90% CI±19%)	979 (90% CI±19%)
	2007	46	11	22	13	440	2178	0.62 (90% CI±22%)	1348 (90% CI±22%)
	2008	82	19	28	13	356	2178	0.53 (90% CI±16%)	1162 (90% CI±16%)
	2009	51	11	25	14	461	2178	0.68 (90% CI±15%)	1471 (90% CI±15%)

^a Sampled using the geospatial population estimator (GSPE) sampling method (Ver Hoef 2001).

TABLE 2 Twinning rate in northern Unit 12 and southern 20E, 2004–2009

Calendar year	Date	Cows			Total	% Twins ^a
		w/Single calf	w/Twins	w/Triplets		
2004	26 May	26	11	0	37	30
2005	26–27 May	25	8	0	33	24
2006	31 May	16	15	1	32	50
2007	29 May	27	10	0	37	27
2008	29–30 May	29	6	0	35	17
2009	28 May	16	11	0	27	41

^a Percentage of cows with calves that had twins or triplets.

TABLE 3 Unit 20E moose hunting seasons and bag limits, regulatory years 2003–2004 through 2009–2010

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	1 bull,
			8–17 Sep	or 1 bull.
	Remainder of Unit 20E.	NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
2004–2005 through 2009–2010	Unit 20E drainages of the Middle Fork Fortymile River upstream from and including the Joseph Creek drainage.	RESIDENT:	Registration 24–28 Aug	1 bull by permit RM865,
			Registration 8–17 Sep	or 1 bull by permit RM865,
	Remainder of Unit 20E.		Drawing 1–30 Nov	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.
	Unit 20E drainages of the Middle Fork Fortymile River upstream from and including the Joseph Creek drainage.	RESIDENT:	24–28 Aug	1 bull,
			8–17 Sep	or 1 bull.
	Remainder of Unit 20E.	NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side
	Unit 20E drainages of the Middle Fork Fortymile River upstream from and including the Joseph Creek drainage.	RESIDENT:	Registration 24–28 Aug	1 bull by permit RM865,
			Registration 8–17 Sep	or 1 bull by permit RM865,
	Remainder of Unit 20E.		Drawing 1–30 Nov	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 4 Unit 20E moose harvest and accidental death, regulatory years 1998–1999 through 2009–2010

Regulatory Year	General and registration harvest							Drawing permit harvest		Accidental death		
	Reported				Estimated			DM794	DM796	Road	Total	Total
	M (%)	F (%)	Unk	Total	Unreported	Illegal	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	2	6	0	0	144–154
2000–2001	135 (100)	0 (0)	0	135	0–5	5–10	5–15	3	9	0	0	152–162
2001–2002	137 (100)	0 (0)	1	138	0–5	5–10	5–15	5	3	0	0	151–161
2002–2003	154 (100)	0 (0)	1	155	0–5	5–10	5–15	1	3	0	0	164–174
2003–2004	119 (100)	0 (0)	0	119	0–5	5–10	5–15	0	0	0	0	124–134
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
2007–2008	144 (100)	0 (0)	0	144	0–5	5–10	5–15	0	0	0	0	149–159
2008–2009	176 (100)	0 (0)	0	176	0–5	5–10	5–15	1	2	0	0	184–194
2009–2010	169 (100)	0 (0)	0	169	0–5	5–10	5–15	0	3	0	0	177–197

TABLE 5 Unit 20E moose hunter residency and success, regulatory years 1998–1999 through 2009–2010

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1998–1999	51	98	12	0	161 (32)	78	217	39	2	336 (68)	497
1999–2000	37	84	17	1	139 (24)	100	311	30	4	445 (76)	584
2000–2001	41	91	15	0	147 (27)	101	258	33	1	393 (73)	540
2001–2002	33	96	16	1	146 (19)	222	327	58	4	611 (81)	757
2002–2003	40	101	16	1	158 (19)	173	417	72	2	664 (81)	822
2003–2004	22	76	21	0	119 (16)	130	411	62	0	603 (84)	722
2004–2005	21	55	19	0	95 (20)	97	243	47	2	389 (80)	484
2005–2006	27	78	33	0	138 (22)	126	305	56	1	488 (78)	626
2006–2007	27	85	18	0	130 (19)	127	362	72	0	561 (81)	691
2007–2008	24	108	12	0	144 (20)	128	356	74	2	560 (80)	704
2008–2009	25	130	23	1	179 (25)	115	347	67	0	529 (75)	708
2009–2010 ^b	22	129	21	0	172 (23)	118	407	50	3	578 (77)	750

^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.

^b Preliminary data.

TABLE 6 Unit 20E moose harvest chronology percent by month/day, regulatory years 1998–1999 through 2009–2010

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	22	48	14	4	1	7	161
1999–2000	0	22	41	20	9	0	6	139
2000–2001	1	15	41	28	5	0	8	147
2001–2002	10	0	49	29	5	0	5	146
2002–2002	5	0	62	29	1	0	3	153
2003–2004	7	3	61	28	0	1	0	110
2004–2005	2	2	61	32	1	0	1	93
2005–2006	9	3	54	32	1	0	1	136
2006–2007	8	0	55	33	2	0	0	130
2007–2008	6	1	60	31	1	0	0	144
2008–2009	8	2	59	27	1	0	2	179
2009–2010 ^b	8	1	57	33	0	0	2	169

^a Includes moose taken on unknown dates.

^b Preliminary data.

TABLE 7 Unit 20E moose harvest and percent by transport method, regulatory years 1998–1999 through 2009–2010

Regulatory year	Harvest and percent (%) by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1998–1999	32 (20)	0 (0)	23 (14)	40 (25)	12 (7)	12 (7)	41 (26)	1 (1)	161
1999–2000	31 (22)	1 (1)	26 (18)	37 (27)	8 (6)	19 (14)	15 (11)	2 (1)	139
2000–2001	29 (20)	2 (1)	28 (19)	40 (27)	12 (8)	14 (10)	20 (14)	2 (1)	147
2001–2002	23 (16)	0 (0)	14 (10)	68 (46)	4 (3)	15 (10)	18 (12)	4 (3)	146
2002–2003	36 (23)	1 (1)	17 (11)	58 (37)	4 (2)	19 (12)	16 (10)	7 (4)	158
2003–2004	32 (27)	2 (2)	6 (5)	51 (43)	0 (0)	13 (11)	12 (10)	3 (2)	119
2004–2005	20 (21)	1 (1)	8 (8)	32 (34)	1 (1)	15 (16)	17 (18)	1 (1)	95
2005–2006	27 (20)	1 (1)	15 (11)	48 (35)	1 (1)	27 (20)	17 (12)	2 (1)	138
2006–2007	27 (21)	0 (0)	13 (10)	46 (35)	0 (0)	20 (15)	23 (18)	1 (1)	130
2007–2008	23 (16)	1 (1)	20 (14)	52 (36)	0 (0)	21 (15)	24 (16)	3 (2)	144
2008–2009	22 (12)	0 (0)	21 (12)	77 (43)	3 (2)	29 (16)	24 (13)	3 (2)	179
2009–2010 ^a	30 (17)	0 (0)	12 (7)	80 (47)	2 (1)	27 (16)	19 (11)	2 (1)	172

^a Preliminary data.

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNITS: 21A (10,797 mi²) and 21E (7,995 mi²) (18,792 mi² combined)

GEOGRAPHIC DESCRIPTION: Unit 21A, the Innoko River drainage upstream from and including the Iditarod River 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 primarily focused along the major drainages of the area. Low harvest reporting rates, particularly by local residents of 21E, 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. There are no communities in Unit 21A, and hunters who travel there are primarily nonlocal Alaskans and nonresidents. The villages of Anvik, Grayling, Holy Cross, and Shageluk are located in Unit 21E and the lower Innoko and Yukon Rivers are 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.

The Alaska Department of Fish and Game (ADF&G) has limited information on the moose population in Unit 21A, however in recent years more surveys have been initiated. Density estimates conducted by Innoko National Wildlife Refuge (INWR) as well as extrapolated data from Unit 21E are the basis for the most recent estimate of moose numbers in Unit 21A. In Unit 21E, aerial composition surveys as well as geospatial population estimator (GSPE) method (Ver Hoef 2001, Ver Hoef 2008) have been the primary means of assessing population status and trend.

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

In general, long-term historical moose survey information is limited. This is changing, however, and in Unit 21E we now have 10 years of both population and composition data. In the past, Unit 21A was a low priority for the McGrath area office; however our survey efforts have increased there as well. In Unit 21A we now regularly conduct fall composition surveys and plan to participate in a GSPE survey in 2010. We are also trying to implement spring twinning surveys in Unit 21A; however, low moose numbers make such surveys challenging. 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 (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 OBJECTIVES

Population Objectives

- 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.

Harvest Objectives

- 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 management population objective has been met.
- Provide for a sustained harvest of up to 40 antlerless moose in a winter season in Unit 21E.

MANAGEMENT ACTIVITIES

- Conduct a moose composition survey in Unit 21E every fall.
- Conduct early winter composition surveys in Unit 21A every year.
- 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.

- Prepare an intensive management plan for Board of Game meetings as scheduled by the Board of Game.

METHODS

Innoko National Wildlife Refuge (INWR) staff have conducted aerial moose density surveys since 1994 in Unit 21A using a line transect method (S. Kovach, Innoko National Wildlife Refuge, McGrath, personal communication, 2008), primarily along river corridors. We derived the current estimate for Unit 21A based on INWR survey data in Unit 21A and extrapolated ADF&G survey data from Unit 21E.

Estimates of moose numbers in Unit 21E were derived from aerial surveys in February–March 2009 using GSPE methods (Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. These surveys were conducted in a 5070-mi² area in eastern Unit 21E. We surveyed 150 (90 high density and 60 low density; 925mi²) of 822 sample units (SU; approximately 6.2 mi² per SU). 80% of all SUs were selected randomly and the remaining 20% were selected manually to fill gaps in the randomized coverage. We extrapolated the density calculated from the GSPE population estimate of the low density strata to the remaining 2925 mi² of Unit 21E to derive a unitwide population estimate. Survey time averaged 35 minutes per SU (6 min/mi²). No sightability correction factor (SCF) exists for March GSPE surveys in 21E and all results were reported as observable moose. The GSPE method typically employs greater search intensity, 8–10 min/mi² (Kellie and DeLong 2006) versus 4–6 min/mi² (Gasaway et al. 1986), resulting in a higher level of sightability. Although such high-intensity surveys provide narrow confidence intervals and improve precision on the population estimate, high intensity surveys are not likely to be conducted on a regular basis in Units 21A and 21E due to weather and logistic constraints.

In November 2007–2009 we flew fall composition surveys in Unit 21E between the Innoko and Yukon Rivers. Surveys were flown in PA-18 or similar aircraft at 70 MPH on east–west transects approximately ¾ miles apart and 500 feet above ground level (AGL). Surveys began at a point 14 miles south of Shageluk and ended at a point 5 miles north of Holy Cross. Each moose or group of moose was circled to determine composition.

In November 2007–2009 fall composition surveys were also conducted in Unit 21A. Surveys were flown in PA-18 or similar aircraft at 70 MPH on north–south transects approximately ¾ miles apart at 500 feet AGL 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 and proceeding 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 composition.

Twinning surveys were conducted in Unit 21E during late May or early June 2007–2009. These surveys were flown in PA-18 or similar aircraft at approximately 70 MPH and 500 feet AGL in east–west transects approximately 1 mile apart, along the Yukon River from Paimiut to Holy Cross and then between the Yukon and Innoko Rivers from Holy Cross north to Anvik and Shageluk.

Twinning surveys were also attempted in Unit 21A in 2008 and 2009 using similar methods along the Innoko River from the Iditarod River to the North Fork of the Innoko. In twinning surveys, all moose observed were recorded; however, only cows with calves were classified as adult cow with single or twin calves. Twinning rate was calculated as the proportion of cows with twins from the sample of all cows with calves.

Two methods were used to determine harvest in Units 21A and 21E. First, we used mandatory harvest report cards from general season harvest tickets and drawing permits on which hunters report residency, effort, location of hunt, transportation method, commercial services used, success, sex of kill, and antler width. Second, we used household surveys conducted by ADF&G, Division of Subsistence to determine the number of moose harvested by local residents (ADF&G 2006). Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 Jul 2007–30 Jun 2008).

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 ($0.4\text{--}0.6$ moose/mi²). Survey data from INWR indicate that moose densities declined in Unit 21A during 1998–2002. INWR attempted a GSPE survey in November 2009 but it was canceled due to lack of adequate snow. They will attempt this survey again in November 2010.

Unit 21E. The February 2000 GSPE survey indicated a density of 1.0 observable moose/mi² or 5151 moose $\pm 13\%$ (90% CI) in the survey area. Survey results in March 2005 indicated a density of 0.9 observable moose/mi² or 4673 moose $\pm 17\%$ (90% CI) in the survey area. In 2009 the density of moose was estimated at 1.2 observable moose/mi² or 6218 $\pm 17\%$ (90% CI). These survey results are not statistically different and indicate the winter moose population in Unit 21E was likely stable during 2000–2009 (Table 1). The current estimate in Unit 21E is 6205–8747 observable moose (no SCF was applied to this estimate). Late winter calf survival during these surveys was 16%, 18% and 21% of the population, respectively.

Population Composition

Fall composition surveys in Unit 21A in November 2007–2009 indicated 36–64 bulls:100 cows and 8–40 calves: 100 cows (Table 2A). The number of moose observed was low in both 2007 and 2008; however in 2009 we were able to fly 2 days, resulting in more observations. We will continue to monitor Unit 21A at the 2009 effort level when possible.

Fall composition surveys conducted in Unit 21E during November 2007–2009 were the first composition surveys in this unit since 1998. We found a high bull:cow ratio in all years except 2009 (Table 2B). During 2009, weather prevented us from surveying the entire area and in particular the area where high numbers of bulls were found in the past.

We attempted twinning surveys in Unit 21A in 2008 and 2009, however very few moose were found and no conclusions were made. Unit 21E twinning surveys indicated habitat was not limiting the Unit 21E moose population (Table 3).

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.

During 14–18 March 2010, 54 moose were radiocollared in Unit 21E. GPS radio collars were deployed on 24 bulls and 20 cows and 10 VHF radio collars were deployed on cows (Figure 1). These radio collars will provide detailed daily movements and allow a more thorough analysis of movements.

MORTALITY

Harvest

Seasons and Bag Limits. Bag limits and season dates by regulatory year.

<u>Unit and bag limits</u>	<u>Open season</u>
<u>RY07</u>	
<i>Unit 21A</i>	
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
<i>Unit 21E</i>	
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
<u>RY08</u>	
<i>Unit 21A</i>	
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
<i>Unit 21E</i>	
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 spring 2006 meeting, the Board of Game established a nonresident drawing permit hunt in Unit 21E. The first permit hunt occurred in RY07. In 2008 and 2009 the board considered, but deferred, a predation control plan for intensive management of the Unit 21E moose population. In 2010 the board adopted this plan.

Harvest by Hunters. Harvest by hunters during RY04–RY08 is reported in tables 4A and 4B. During this time, annual harvest in Unit 21A declined to its lowest point in RY08. In Unit 21E, annual harvest was lowest in RY07 and RY08. The YIMMP suggests the nonreporting rate is 50% in Unit 21E. This is taken into consideration when assessing actual harvest levels in relation to harvest objectives.

Permit Hunts. Beginning in RY07 nonresident hunters in Unit 21E were required to apply for a drawing permit instead of obtaining a general season harvest ticket. Initially 60 permits were offered (48 unguided and 12 guided) with the intent to take approximately 30 moose. The hunt has been undersubscribed every year; 47 of 48, 33 of 48, and 30 of 48 unguided permits were issued annually during RY07–RY09. The guided hunt has also been undersubscribed with 5 of 12 permits issued in RY07, 7 of 12 issued in RY08, and 1 of 12 issued in RY09.

Hunter Residency and Success. There are few local hunters in Unit 21A and most hunting pressure was from nonresidents and nonlocal residents (Table 5A). In Unit 21E a large number of hunters were local residents from Anvik, Grayling, Holy Cross, and Shageluk (Table 5B), though most hunters were nonlocal Alaskans. From RY04 to RY08, average reported success was 31% in Unit 21A (range = 22–37%) and 52% in Unit 21E (range = 48–58%).

Antler Size. During RY04–RY08 the average antler size of harvested bulls in Unit 21A (48.7 in) remained larger than in Unit 21E (45.2 in). 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. During RY04–RY08, 84 bulls >50", 33 >60" and 1 >70" were taken in Unit 21A. Over the same period in 21E 128 bulls >50", 84 >60" and 4 >70" were taken.

Transport Methods. During RY07–RY08, as in previous years, aircraft and then boats were the most common methods of hunter transportation in Unit 21A (Table 6A). In Unit 21E, boats followed by aircraft were the most commonly used methods of transportation (Table 6B).

Other Mortality

Predation is likely 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). Based on information from local residents, guides and transporters, predation on moose has increased in recent years, and these groups believe moose populations have declined. ADF&G surveys in 2000, 2005, and 2009 have not detected a statistically significant decline in the Unit 21E population.

No mortuary moose were reported taken in Unit 21A during RY07–RY08. Eleven (6 cows and 5 bulls) mortuary moose were taken in Unit 21E in RY07 and 10 (9 cows and 1 bull) in RY08.

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. Browse removal was estimated at 21% (Paragi et al 2008). 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 likely play a role in 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 to proactively manage moose populations in the area. The YIMMP was the result of this process and was finalized in December 2006.

The YIMMP guides moose management in Units 21A and 21E and recommended managing predation on moose to maintain an abundant moose population for human consumptive use. In 2007 we drafted an intensive management plan and the Alaska Board of Game adopted this plan in March 2010.

Maintaining or improving moose habitat was also recommended by the working group and habitat quality was assessed in Unit 21E in 2006. 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

Moose populations in Units 21A and 21E appear to be stable, although no moose population estimate has been conducted in Unit 21A in recent years. More data are available for Unit 21E; and we observed high twinning rates on the lower Innoko River in Unit 21E, indicating that nutritional status is adequate to support population growth.

The 2-year average (2008 and 2009) calf:100 cow ratio in Unit 21E was 28:100. The posthunt objective of 30–40 calves:100 cows was not met. There was very low calf survival in 2009, likely due to the extensive flooding along the Yukon and Innoko rivers during calving season. The objective to maintain at least 20% calves in the late winter moose population in 21E was met the last time it was measured in 2009. The objective to maintain harvest $\leq 4\%$ of the estimated population in both Units 21A and 21E was met in RY07–RY08. It is unclear if the objective to harvest up to 40 moose in the winter season was met as this federal hunt had a very low reporting rate.

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 management objectives and activities for moose population and harvest for the next reporting period will be:

MANAGEMENT OBJECTIVES

Population Objectives

- Manage to achieve the IM population objective of 9,000–11,000 moose in Unit 21E.
- Maintain a minimum posthunt bull:cow ratio of 25–30 bulls:100 cows in Unit 21A and Unit 21E.
- Maintain a minimum posthunt calf:cow ratio of 30–40 calves:100 cows in Unit 21A and 21E.
- Maintain at least 20% calves in the late winter moose population in Unit 21E.

Harvest Objectives

- Maintain a harvest of $\leq 4\%$ of the estimated moose population in Unit 21A, and $\leq 4\%$ of the estimated moose population in Unit 21E until the IM population objective has been met.
- Provide for a sustained harvest of up to 40 antlerless moose in a winter season in Unit 21E.
- Provide for the harvest of approximately 310 moose in Unit 21E by residents of Unit 21E and other Alaska residents.

MANAGEMENT ACTIVITIES

- Conduct moose composition surveys in Unit 21A and Unit 21E annually.
- Conduct a GSPE moose population estimation survey in Unit 21A and within the INWR in cooperation with INWR staff whenever possible.
- Conduct a GSPE moose population estimation survey in Unit 21E every 3 years.

LITERATURE CITED

- ALASKA DEPARTMENT OF FISH AND GAME. 2006. Yukon–Innoko moose management plan. Fairbanks, Alaska, USA. <http://www.wildlife.alaska.gov/management/planning/planning_pdfs/yukon_innoko_plan.pdf> Accessed 29 Sep 2008.
- BOERTJE, R. D., K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ALDERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management* 73:314–327.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22, University of Alaska Fairbanks, Alaska, USA.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed May 2008.
- OSBORNE, T. O., T. F. PARAGI, J. L. BODKIN, A. J. LORANGER, AND W. N. JOHNSON. 1991. Extent, cause, and timing of moose calf mortality in western Interior Alaska. *Alces* 27:24–30.
- PARAGI, TF, CT SEATON, AND KA KELLIE 2008. Identifying and evaluating techniques for wildlife habitat management in interior Alaska: Moose range assessment. Alaska Department of Fish and Game, Research Final Technical Report. Project 5.10. Juneau, Alaska. 76 p
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the section on statistics and the environment of the American Statistical Association.
- VER HOEF, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13.

PREPARED BY:

Joshua M. Peirce
Wildlife Biologist II

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

PEIRCE, J. M., AND R. J. SEAVOY. 2008. Units 21A and 21E moose. Pages 429–445 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

FIGURE 1 Locations of collar deployments in Unit 21E moose.

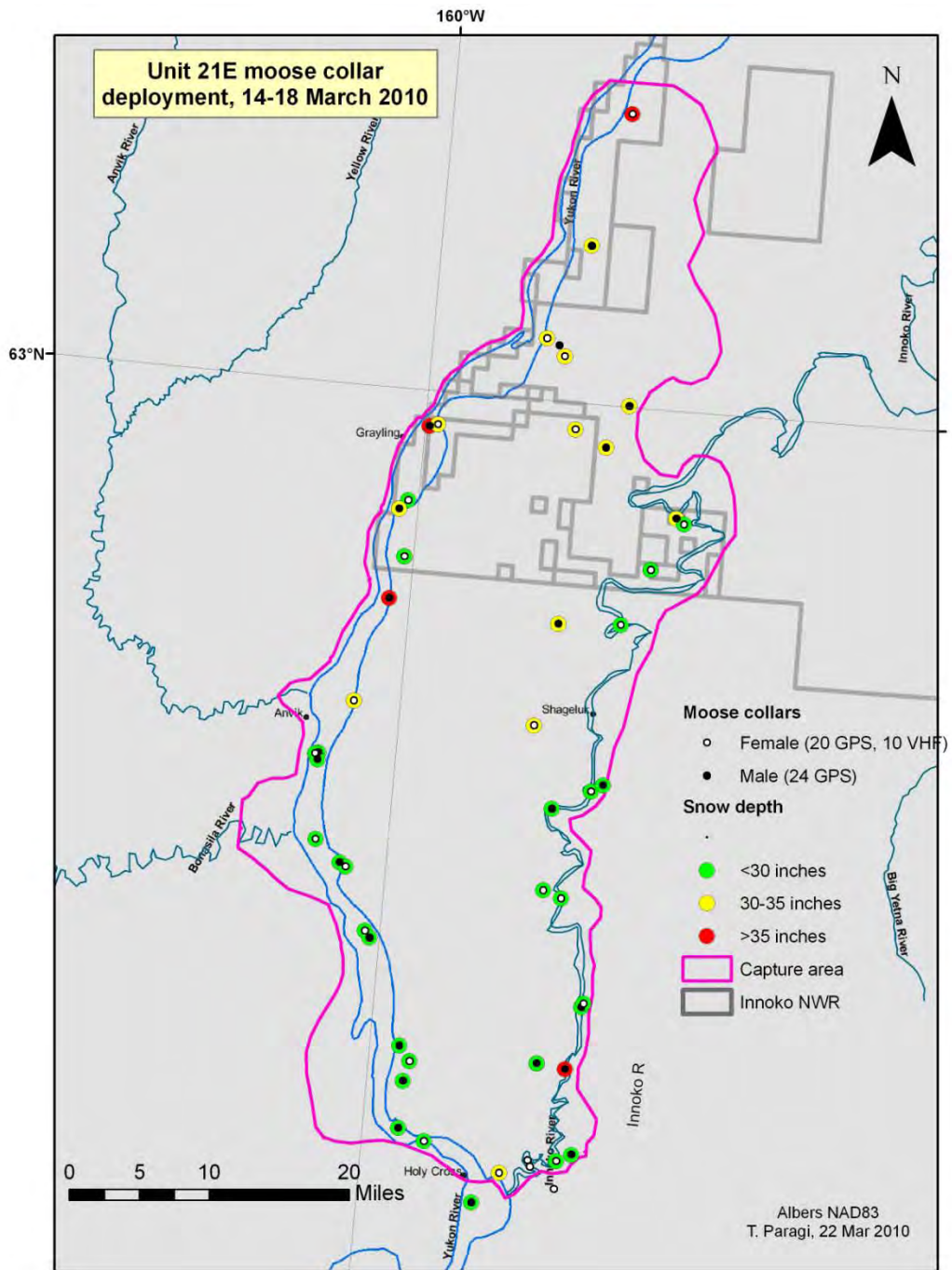


TABLE 1 Summary of geospatial moose population estimates (GSPE)^a in Unit 21E, 2000–2009

Location and survey year	Survey area (mi ²)	Strata size (mi ²)		Area searched (mi ²)		Total search area (mi ²)	No. of moose estimated by strata and density (moose/mi ²)		Total estimate @ 90% CI	Average density moose/mi ²	No. of sample units counted
		Low	High	Low	High		Low	High			
2000 GSPE ^b	5070								5151±13%	1.0	100
2005 GSPE	5070	4018	1052	321	602	923	1696(0.4)	2977(2.8)	4673±17%	0.9	150
2009 GSPE	5070	4147	923	371	554	925	1778(0.4)	4439(4.8)	6218±17%	1.2	150

^a Population estimates are of observable moose and do not include a sightability correction factor.

^b In 2000 strata were divided into low, medium and high.

TABLE 2A Unit 21A fall aerial moose composition counts, regulatory years 2007–2008 through 2009–2010

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total Moose	Survey Date
2007–2008	36	16	36	9	21	34	43	15 Nov
2008–2009	54	21	8	2	5	37	39	18 Nov
2009–2010	64	10	40	23	19	95	118	17–18 Nov

TABLE 2B Unit 21E fall aerial moose composition counts, regulatory years 2007–2008 through 2009–2010

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total Moose	Survey Date
2007–2008	74	26	66	23	27	61	84	7 Nov
2008–2009	62	29	37	35	19	151	186	4 Nov
2009–2010	32	21	18	18	12	135	153	17 Nov

TABLE 3 Unit 21E moose aerial twinning surveys, regulatory years 2000–2001 and 2008–2009

Regulatory year	Total moose	Cows w/1 calf	Cows w/twins	Twinning % ^a	Survey Date
2000–2001	^c	22	14	39	2000
2001–2002 ^b					
2002–2003	^c	32	8	20	2002
2003–2004	^c	33	14	30	2003
2004–2005	^c	19	9	32	2004
2005–2006 ^b					
2006–2007 ^b					
2007–2008	148	18	7	28	6/4
2008–2009	194	17	15	47	5/29
2009–2010	182	12	12	50	5/27-28

^a Percent of cows with calves that had twins.^b No survey.^c Data were lost in the McGrath Area office fire.

TABLE 4A Unit 21A moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Reported harvest				Unknown	Total
	Male	(%)	Female	(%)		
2004–2005	50	(100)	0	(0)	0	50
2005–2006	65	(98)	1	(2)	2	68
2006–2007	30	(100)	0	(0)	0	30
2007–2008	30	(100)	0	(0)	0	30
2008–2009	28	(100)	0	(0)	0	28

TABLE 4B Unit 21E moose harvest, regulatory years 2004–2005 through 2008–2009

Regulatory year	Reported harvest				Unknown	Total
	Male	(%)	Female	(%)		
2004–2005	113	(96)	5	(4)	0	118
2005–2006	119	(96)	5	(4)	0	124
2006–2007	125	(96)	5	(4)	1	131
2007–2008	107	(94)	7	(6)	1	115
2008–2009	100	(91)	10	(9)	0	110

TABLE 5A Unit 21A moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^a	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident ^a	Nonlocal resident	Nonresident	Unk	Total (%)	
2004–2005	4	23	23	0	50 (31)	11	44	57	0	112 (69)	162
2005–2006	4	34	30	0	68 (37)	7	38	70	0	115 (63)	183
2006–2007	1	20	9	0	30 (22)	5	47	53	1	106 (78)	136
2007–2008	1	19	10	0	30 (33)	4	29	26	1	60 (67)	90
2008–2009	1	18	9	0	28 (31)	2	31	27	3	63 (69)	91

^a Local resident from Anvik, Grayling, Holy Cross, Shageluk, McGrath, Takotna.

TABLE 5B Unit 21E moose hunter residency and success, regulatory years 2004–2005 through 2008–2009

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^a	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident ^a	Nonlocal resident	Nonresident	Unk	Total (%)	
2004–2005	32	57	26	3	118 (50)	23	50	41	3	117 (50)	235
2005–2006	40	70	14	0	124 (58)	13	49	25	1	88 (42)	212
2006–2007	39	74	17	1	131 (54)	32	47	29	2	110 (46)	241
2007–2008	34	67	14	0	115 (48)	23	50	51	1	125 (52)	240
2008–2009	28	55	10	17	110 (52)	23	43	32	5	103 (48)	213

^a Local resident from Anvik, Grayling, Holy Cross or Shageluk.

TABLE 6A 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									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
2004–2005	33 (66)	0(0)	15(30)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	50
2005–2006	41(60)	0(0)	22(32)	2(3)	1(1)	1(1)	1(1)	0(0)	1(1)	68
2006–2007	17(57)	0(0)	9(30)	2(7)	0(0)	0(0)	1(3)	0(0)	1(3)	30
2007–2008	21(72)	0(0)	6(21)	1(3)	0(0)	1(3)	0(0)	0(0)	0(0)	29
2008–2009	20(77)	0(0)	6(23)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	26

TABLE 6B 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									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
2004–2005	17(14)	0(0)	91(77)	3(3)	5(4)	0(0)	0(0)	0	2(2)	118
2005–2006	16(13)	0(0)	95(77)	0(0)	12(10)	0(0)	0(0)	0	1(1)	124
2006–2007	16(12)	0(0)	104(79)	1(1)	6(5)	2(2)	0(0)	0	2(2)	131
2007–2008	8(7)	0(0)	98(85)	0(0)	7(6)	0(0)	1(1)	0	1(1)	115
2008–2009	11(10)	1(1)	84(76)	0(0)	11(10)	0(0)	0(0)	0	3(3)	110

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 21B (9311 mi²)

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. Effective fire suppression substantially altered this fire regime. The 1982 Tanana–Minchumina Fire Plan and more recently the *Alaska Interagency Wildland Fire Management Plan* (Alaska Wildland Fire Coordinating Group 1998) allowed some fires to burn with minimal interference.

The Nowitna River to the east of Ruby is a popular hunting area for residents of Ruby, Tanana, and, to a lesser extent, Galena. It is also a popular hunting area for Fairbanks residents who use boats and aircraft for access. Because of its long history of use by both local and nonlocal hunters, this area was the focus of much of the management effort in Unit 21B over the years.

Aerial moose surveys during 1977–1979 indicated moose numbers were declining in the Nowitna drainage. Wolves were abundant compared to the number of moose available, and predation by wolves was believed responsible for the decline in moose numbers.

Moose population surveys that covered varying portions of Unit 21B were conducted, using methods described by Gasaway et al. (1986) in 1980, 1986, 1990, and 1995 (Stout 2008). In

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

2001 a population estimation survey was conducted using the geospatial population estimator (GSPE) technique in a portion of 21B, the first without a sightability correction factor (SCF) (Kellie and DeLong 2006, Ver Hoef 2008). A GSPE survey was conducted again in 2008, covering nearly all of Unit 21B.

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 related 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 it 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 resident hunters.

Previous Unit 21B management reports contained 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 mi² to 9311 mi² with the addition of the Nowitna River upstream from the Little Mud River drainage. The second change was a small increase in harvest data from the additional 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. Harvest data presented in this report, including historical harvest, encompass the area of the current Unit 21B boundaries.

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

During RY07–RY08 we surveyed 3 established trend count areas (TCAs) in cooperation with U.S. Fish and Wildlife Service (FWS) to assess population status and trend in Unit 21B. These included the 149 mi² Nowitna/Sulatna confluence (2007–2009), the 102 mi² Nowitna mouth (2007–2009), and the 130 mi² Deep Creek (2008) trend count areas. Piper PA-18 (or equivalent) aircraft were used, and contiguous survey units of approximately 12 mi² each were searched at a rate of about 4–5 min/mi².

During 2001 we conducted moose population estimation surveys in Unit 21B in a 4754 mi² portion (Below the Big Mud River) and a 1531 mi² portion (Nowitna West). During 2008 we conducted an 8565 mi² GSPE survey that covered most of Unit 21B, and encompassed the area Below the Big Mud River and the Nowitna West area surveyed in 2001 and derived population estimates for each subarea. The 2001 and 2008 surveys used the geospatial population estimator (GSPE; Kellie and DeLong 2006, Ver Hoef 2008), a modification of the standard Gasaway et al. (1986) technique. The GSPE method does not employ a sightability correction factor (SCF), thus does not correct for moose not seen during the survey. For these surveys we report estimates of observable moose. Sample units were surveyed with a search intensity of ~6 min/mi².

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. Permit hunters also received a telephone call if reports remained outstanding. 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., RY07 = 1 Jul 2007–30 Jun 2008).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Unit 21B Below the Big Mud River — Using the results of surveys conducted in 1990 and 1995, Woolington (1998) estimated there were 2324–3530 observable moose in Unit 21B below the Big Mud River (4781 mi²). Favorable habitat along the Nowitna River floodplain and immediately adjacent to the Yukon River contained the highest moose densities. Densities were relatively low to moderate away from the river.

Results from the November 2001 GSPE survey indicated a total of 3201 observable moose (1774–4627; 90% CI) over 4754 mi² of moose habitat in Unit 21B (Table 1). This total was within the range reported by Woolington (1998) for RY97–RY98 in the 4781 mi² portion of Unit 21B that covered most of the same area. The estimate from the November 2008 GSPE survey of 1438 observable moose (1226–1650; 90% CI) in the same 4754 mi² surveyed in 2001 indicates a significant decline in the population.

Unit 21B Nowitna West — The survey results from Nowitna West were variable and the area surveyed did not exactly overlap from 1980 to 2008; however, the areas surveyed were consistent enough to provide a reasonably comparable indication of the trend in the population. A direct comparison of the 2001 and 2008 surveys can be made because those areas included the same areas. Results from the November 2008 GSPE survey indicated a total of 816 observable moose (744–887; 90% CI) over 1531 mi² of moose habitat in Unit 21B (Table 1). We reported 1358 observable moose (1047–1669; 90% CI) during fall 2001 in this same survey area (Stout 2008).

Unit 21B Total Area — The 2008 GSPE survey covered 8565 mi², nearly all of unit 21B, excluding the non moose habitat portions of the game management unit. Results from the November 2008 GSPE survey indicated a total of 2317 observable moose (1899–2736; 90% CI) in the area survey block (Table 1). This was the first time the Nowitna River drainage above the Little Mud river drainage had been surveyed, so there were no previous data for comparison. However, the low estimate of 879 moose (0.23 moose/mi²) was expected, based on reconnaissance flights of the area and familiarity with habitat.

Early winter survey data from established TCAs along the lower Nowitna suggested stable or slightly increasing moose densities during 1991–1998 then declining densities in the 2000s (Tables 2 and 3). Recent TCA data indicate that total moose densities along the riparian corridor were relatively constant, as a result of an increased number of counted calves. However, despite the improvement in the calf component of the population, adult cow numbers (within the limited sampling area of high density habitat) showed a declining trend from 2000 to 2009 (Figs. 1 and 2). Apparently, calves were not surviving and were not being recruited into the adult ranks.

Population Composition

Composition surveys in established TCAs on the Nowitna National Wildlife Refuge (Tables 2–4) indicated that bull:cow ratios were lowest near the mouth of the Nowitna River (10–20 bulls:100 cows in RY94–RY03), where hunting was concentrated, but increased to 29 bulls:100 cows in RY08, likely as a result of harvest restrictions implemented in 2004. Apparent lower bull:cow ratios in 2009 (21–23 bulls:100 cows) in those TCAs, could be due to the lateness of the survey that year. We believe bull numbers decline in late November counts because some bulls begin to leave the core rutting areas near river corridors. Calf:cow ratios ranged widely among years (RY91–RY09; 6–42 calves:100 cows), as in much of Alaska. Overall, the densities indicated a fairly stable population trend since RY03, due mostly to increased numbers of calves in the 2003–2007 cohorts. However, recruitment of calves to 5 months was very low in 2009, which was probably a result of the severity of the 2008–2009 winter.

Data from the 2008 GSPE survey indicated the unitwide bull:cow ratio in 21B was 50 bulls:100 cows. Although the ratios around the mouth of the Nowitna River (29 bulls:100 cows) and at the confluence of the Nowitna and Sulatna Rivers (29 bulls:100 cows) were lower, they had improved since the 2001 survey. For the entire 2008 survey area, the GSPE analysis indicated the calf:cow ratio was 49:100 (36–62:100; 90% CI), the yearling bull:cow ratio was 12:100 (7.1–17:100; 90% CI), and the adult bull:cow ratio was 50:100 (38–62:100; 90% CI) (Table 1).

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.

<u>Unit and Bag Limits</u>	Resident Open Season (Subsistence and <u>General Hunts</u>)	Nonresident <u>Open Season</u>
<i>RY07–RY08</i>		
Unit 21B, that portion within the Nowitna River drainage upstream from the Little Mud River drainage and outside a corridor extending two 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 in the lower Nowitna River drainage and implement a resident registration hunt that requires the destruction of trophy value. A drawing permit was also implemented for resident and nonresident hunters for that portion of the 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 to include the Nowitna River above the Little Mud River drainage. 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 drainage. Also in 2006, the nonresident season was extended to 25 September to simplify regulations, and a 22–31 August subsistence season for resident hunters was added to provide additional fall hunting opportunity. No additional changes were adopted during RY07–RY08.

Although the spring 2010 board meeting occurred outside this report period, it is important to note that the board adopted a positive finding for intensive management of Unit 21B moose based on 1) the 2008 survey information, 2) changes to the size of the game management unit, and 3) increased harvest that occurs in the expanded Unit 21B.

Harvest by Hunters. Reported harvest for Unit 21B averaged 77 moose (range = 64–86) annually during RY99–RY08 (Table 5; including harvest in Nowitna River drainage above the Little Mud River). In addition, the Unit 21B annual unreported harvest was estimated at 5 moose by Ruby residents, 15 by Tanana residents, and 5 by hunters in the Nowitna River drainage above Little Mud River, for a total estimated unreported harvest of 25 moose. The lower Nowitna River corridor produced 31–75% ($\bar{x}$ = 52%) of the Unit 21B reported harvest during RY99–RY08 (Tables 6 and 7). However, in RY04–RY08, the proportion of harvest from the lower Nowitna River corridor averaged 43% of the total 21B harvest, compared to 61% during RY97–RY03, which indicates that regulations adopted in 2004 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 estimated RY99 harvest data by residents of Unit 21B provided by ADF&G, Division of Subsistence (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 were 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–RY09 to 117, with a low of 90 hunters in RY07 and RY09, when drawing and registration hunt regulations were implemented 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 RY99–RY08 was 39% (range = 26–48%). For RY99–RY03, success rate was 44% (range = 38–48%) but dropped to 33% (range = 26–45%) during RY04–RY08 (Table 7). Most of the decline can be explained by 3 changes in hunt administration. First, more hunters were forced to hunt off of the Nowitna corridor in more difficult hunting terrain as a result of 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. Third, an individual hunter could possess more than one reporting mechanism, which increased the total number of permits reported but probably did not increase the number of individual hunters. The first two outcomes were implemented by design, and improved our ability to manage moose in Unit 21B. However, because of these issues, assessing harvest success rate trends has become problematic since RY04.

Harvest Chronology. During RY99–RY08, hunter reports indicated that most moose ($\bar{x}$ = 70%), were shot during September 15–25 (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.

Winter harvest was not reported on harvest or permit report cards, but 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 (RY99–RY08; $\bar{x}$ = 74%) 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 in the data.

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 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 RY07–RY08. 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 classified 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

As recommended in the previous management report (Stout 2008), we conducted a population estimation survey in 2008, and results indicated a decline from previous estimates. The 2008 survey also established baseline information for the upper Nowitna River drainage, where no previous data existed. In contrast to the 2008 GSPE survey, classification data from the Nowitna River TCAs indicated a near stable trend in total moose numbers from 2003 to 2008, although adult cow numbers appeared to be declining. Combined data for the two Nowitna River TCAs, indicated bull:cow ratios improved to 29 bulls:100 cows in 2008 along the heavily hunted portion of the lower Nowitna River. Higher bull:cow ratios improved fall hunter success, provided for an increase in the number of desirable large bulls harvested, and served as a practical management objective. The improved bull:cow ratios concurrent with declining population estimates indicated the harvest strategy was appropriate, but predation was apparently limiting recruitment during 2003–2007. The population decrease indicated by the 2008 GSPE survey contrasts with the relatively stable numbers indicated in the TCA composition data. This suggests a population decline, and/or a higher rate of decline away from the high density river areas where TCA surveys are conducted, cannot be detected using TCA surveys.

We recommend annual or biennial GSPE moose surveys to develop a reliable population trend analysis, even if those surveys are conducted at a low sampling intensity (Kellie and DeLong 2006, Ver Hoef 2008). Although high sampling intensity surveys provide narrow confidence intervals and improve precision on an estimate, they are not likely to be conducted on a regular basis. However, analysis of nearby Unit 24 GSPE data showed that low intensity surveys, conducted in the intervening years between infrequent high intensity surveys, provided accurate composition and population estimates, and the confidence intervals for all survey years were improved (Stout 2010). This strategy provided managers with better decision-making information for the overall population than TCA composition data alone.

During RY07–08 the goal was met 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. 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 109 to 111 moose during RY07–RY08, approximately 4.7% of the Unit 21B observable population.

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 habitat benefits for moose that may be seen 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.

Based on the 2008 GSPE survey, the current population estimate for all of Unit 21B was 2317 observable moose (1899–2736; 90% CI), therefore the third management objective to maintain a moose population of ≥ 4000 –5000 was not met during RY07–RY08. This requires notification of other affected agencies. The positive finding for Unit 21B moose adopted by the Board of Game in 2010 allows for a wider range of management options, including strategies to improve recruitment, the primary concern for moose management in Unit 21B, and our ability to achieve this population objective.

Predators remained relatively abundant and likely 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.

LITERATURE CITED

- ALASKA WILDLAND FIRE COORDINATING GROUP. 1998. Alaska interagency wildland fire management plan. <http://forestry.alaska.gov/pdfs/98AIFMP.pdf>. Accessed 25 Mar 2008.
- ANDERSON, D. B., C. J. UTERMOHLE, AND L. BROWN. 2001. The 1999–00 harvest of moose, caribou, and bear in ten middle Yukon and Koyukuk river communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- BECKER, E. F., M. A. SPINDLER, AND T. O. OSBORNE. 1998. A population estimator based on network sampling of tracks in the snow. *Journal of Wildlife Management* 62:968–977.
- BOERTJE, R. D., K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ADERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- GASAWAY, W. C., S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22. University of Alaska Fairbanks, Alaska, USA.

- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 8 May 2008.
- OSBORNE, T. O., T. F. PARAGI, J. L. BODKIN, A. J. LORANGER, AND W. N. JOHNSON. 1991. Extent, cause, and timing of moose calf mortality in western interior Alaska. *Alces* 27:24–30.
- STOUT, G. W. 2003. Units 21B, 21C, and 21D wolf. Pages 195–205 *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999–30 June 2002. Alaska Department of Fish and Game. Juneau, Alaska, USA.
- . 2008. Unit 21B moose. Pages 455–476 *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, Alaska, USA.
- . 2010. Unit 24 moose. Pages 572–610 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- WOOLINGTON, J. D. 1998. Unit 21B moose. Pages 345–356 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities 1 July 1995–30 June 1997. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- VER HOEF, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecology Statistics*. 15:30–13.

PREPARED BY:

Glenn W. Stout
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

STOUT, G. W. 2010. Unit 21B moose. Pages 446–465 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

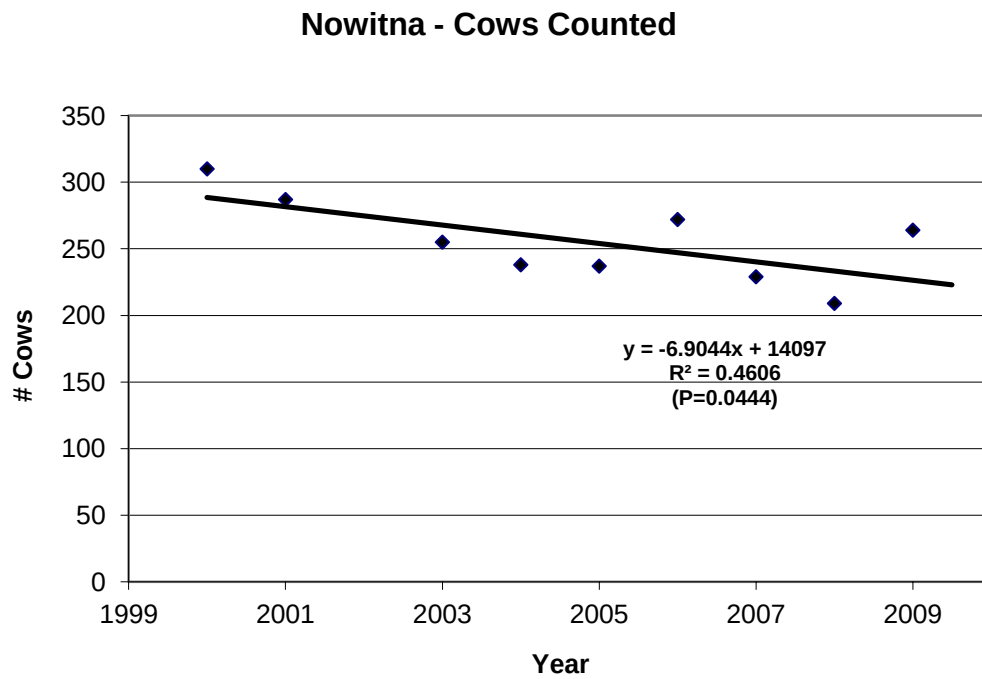


FIGURE 1 Number of cows counted in combined lower Nowitna River aerial moose composition trend count areas

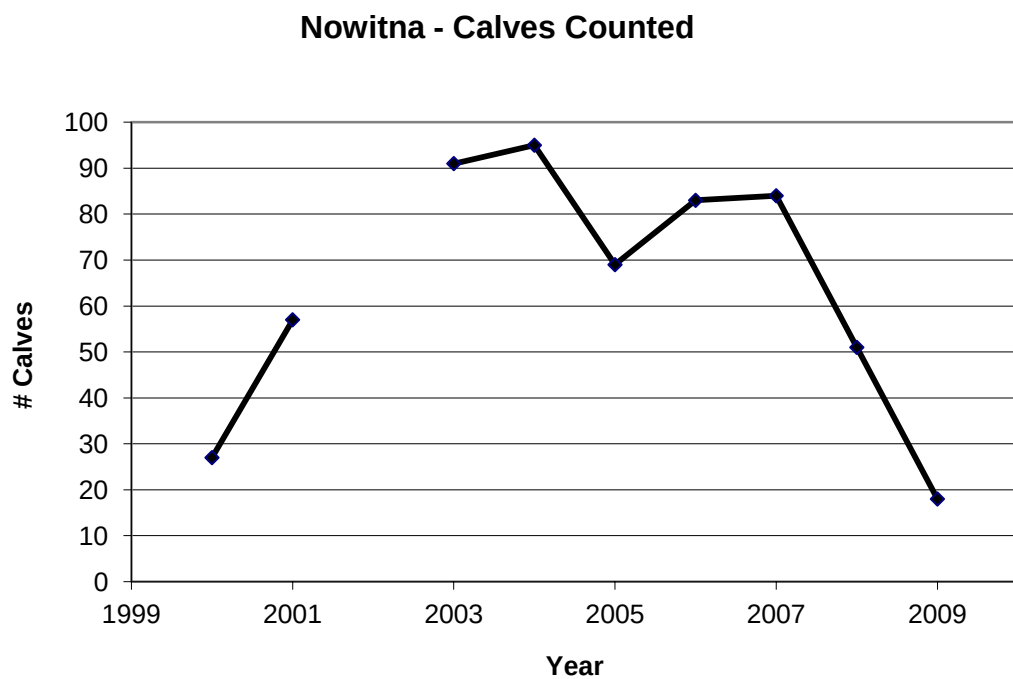


FIGURE 2 Number of calves counted in combined lower Nowitna River aerial moose composition trend count areas.

TABLE 1 Unit 21B moose population estimates, regulatory years 1980–1981 through 2008–2009

Area/Regulatory Year	Area mi ²	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Percent calves	Adults	Population Estimate (90% C.I. ^a)	Density
<i>21B–Nowitna West</i>								
1980–1981 ^b	1556	53	35	25	19	1125	1389 (±27%)	0.89
1986–1987 ^b	1596	37	39	12	22	685	878 (±24%)	0.55
1990–1991 ^b	1560	40	39	10	22	948	1214 (±18%)	0.78
1995–1996 ^c	1338	34	30	14	19	856	1052 (±20%)	0.79
2001–2002 ^d	1531	30	19	7	12	1203	1358 (±28%)	0.89
2008–2009 ^d	1531	35	36	9	21	646	816 (±9%)	0.53
<i>21B–Below Big Mud</i>								
2001–2002 ^d	4754	39	18	9	12	2772	3201 (±45%)	0.67
2008–2009 ^d	4754	45	43	12	23	1110	1438 (±15%)	0.30
<i>Total Area</i>								
2008–2009 ^d	8565	50	49	12	25	1747	2317 (±18%)	0.27

^a Confidence interval (% ±).^b MOOSEPOP analysis of Gasaway survey with sightability correction factor (SCF).^c MOOSEPOP analysis (regression design) of Gasaway survey with SCF.^d Geospatial population estimate analysis without SCF (observable moose).

TABLE 2 Unit 21B Nowitna–Sulatna confluence aerial moose composition counts, regulatory years 1991–1992 through 2009–2010^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
2008–2009	149	29	10	24	17	16	170	1.1
2009–2010	149	23	7	8	0	6	173	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 2009–2010^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
2008–2009	102	29	7	24	9	16	150	1.5
2009–2010	102	21	8	6	0	5	166	1.6

^a U.S. Fish and Wildlife Service.^b Low snow conditions during survey.

TABLE 4 Unit 21B Deep Creek aerial moose composition counts, regulatory years 1982–1983 through 2008–2009

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
1982–1983	53	90	35	42	0	18	72	1.4
1987–1988	53	43	7	55	14	27	87	1.7
1993–1994	53	45	15	20	0	12	66	1.3
1995–1996	53	48	8	30	8	17	89	1.7
1996–1997	53	29	5	24	0	16	89	1.7
2001–2002	130	33	8	18	0	12	152	1.2
2004–2005	130	28	10	48	14	27	152	1.1
2008–2009	130	28	2	38	14	23	144	1.1

TABLE 5 Unit 21B^a moose harvest, regulatory years 1996–1997 through 2009–2010

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	84	0	0	84	25	109
2008–2009	86	0	0	86	25	111
2009–2010 ^b	65	0	0	65	25	90

^a All years include 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 1997–1998 through 2009–2010^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
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
2008–2009	16	3	19	43	19	44	48	18	38	3	1	33	110	41	37
2009–2010	16	3	19	32	10	31	38	16	42	4	0	0	90	29	32

^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 2009–2010^a

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^b	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident ^b	Nonlocal Resident	Nonresident	Unk	Total	
1996–1997	1	66	10	1	78 (38)	27	78	18	2	125	203
1997–1998	10	51	7	0	68 (38)	27	74	9	0	110	178
1998–1999	9	57	9	1	76 (62)	11	30	6	0	47	123
1999–2000	13	55	12	1	81 (45)	13	69	15	3	100	181
2000–2001	8	44	18	3	73 (48)	4	54	22	0	80	153
2001–2002	14	43	21	1	79 (43)	20	65	21	0	106	185
2002–2003	8	56	13	0	77 (45)	10	69	16	0	95	172
2003–2004	14	51	10	0	75 (38)	18	86	18	1	123	198
2004–2005	15	43	5	1	64 (27)	38	108	22	1	169	233
2005–2006	17	52	8	0	77 (31)	63	99	9	0	171	248
2006–2007	11	50	8	1	70 (26)	39	142	22	0	203	273
2007–2008	25	70	11	0	106 (45)	38	76	15	0	129	235
2008–2009	16	75	5	0	96 (37)	46	109	11	0	166	262
2009–2010 ^c	15	58	3	0	76 (35)	43	88	8	0	139	215

^a Some hunters have multiple permits.^b Tanana, Ruby, and Galena.^c Preliminary data.

TABLE 8 Unit 21B moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2009–2010

Regulatory year	Harvest chronology percent by month/day			<i>n</i>
	8/22–8/31 ^a	9/1–9/14	9/15–9/25	
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	82	67
2007–2008	3	28	70	80
2008–2009	2	29	68	85
2009–2010 ^b	5	25	70	63

^a August season started in 2006.

^b Preliminary data.

TABLE 9 Unit 21B moose harvest percent by transport method, regulatory years 1996–1997 through 2009–2010

Regulatory year	Harvest percent by transport method								<i>n</i>
	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	15	0	69	4	0	5	8	0	84
2008–2009	13	0	81	2	0	0	3	0	86
2009–2010 ^a	18	0	73	0	0	5	4	0	73

^a Preliminary data.

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 21C (3671 mi²)

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.

MANAGEMENT OBJECTIVE

- Maintain ≥20% large bulls (bulls with antlers 60 inches or greater) in the harvest.

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

METHODS

POPULATION STATUS AND TREND

In order to classify moose habitat as having an expected high or low moose density, we conducted a moose stratification flight during 18 and 19 April 2000 using guidelines for the geospatial population estimator method (GSPE; Ver Hoef 2001, Kellie and DeLong 2006). The stratification provided the basis for a rough population estimate of the unit and will be used to increase the precision of future GSPE population estimation surveys. We conducted the stratification flight in a Cessna 206 flown at 95–120 mph at altitudes of 500–1000 ft above ground level, with 2 observers in the back seat and 1 observer–recorder in the front seat. Prior to the flight, we divided Unit 21C into a grid of 658 sample units (3671 mi²) that were approximately 5.5 mi². We flew on the north–south boundary between 2 sample units, and each sample unit was classified as low or high moose density, based on number of moose observed, number of tracks observed, and habitat. If moose were spotted in the sample unit during the flight, it was designated a high moose density unit. Alternatively, if no moose were observed, it was typically designated a low moose density unit unless it was judged to be good habitat and >5 sets of tracks were noted. Areas not stratified (e.g., the Kokrines Hills) included primarily high mountainous terrain and were considered low moose density strata or non-moose habitat for population estimation purposes. We stratified a total of 438 sample units (2380 mi²). Sex and age of moose were not recorded. No other surveys were completed in Unit 21C.

HARVEST

We monitored harvest and hunting pressure using mandatory harvest reports submitted by hunters. If we did not receive timely harvest reports, general season hunters received a reminder letter. Hunters with registration and drawing permits received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive timely harvest reports. 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., RY07 = 1 Jul 2007–30 Jun 2008).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

No surveys were completed in Unit 21C during RY07–RY08. Survey conditions during the April 2000 stratification were only "fair" because hilly and mountainous terrain and bright light adversely affected sightability of moose. However, conditions were not "poor" because the bright light was an advantage for locating fresh tracks, which was a stratification criterion. Because moose distribution may be dependent on seasonal influences, the current stratification will apply best to a spring survey.

During the 2000 stratification flight, 39 sample units were identified as high density and 399 as low density from a total of 438 sample units. Moose were concentrated on the north side of the Melozitna River on the hills that divide the drainages of the Melozitna and Dulbi Rivers. Additional moose and tracks were observed on the western end of the survey area within the Dulbi River drainage as we approached the Koyukuk River. Only 31 moose were observed

during this stratification flight. This was lower than expected for the area and was likely a result of reduced sightability in spring (Gasaway et al. 1986).

We estimated the Unit 21C unitwide moose density by comparing the 2000 stratification results to other areas in Alaska with similar habitat, bear and wolf harvest, and known moose densities and by extrapolating densities of the 2007 moose survey conducted in adjacent Unit 24C (Stout 2008) to sample units stratified in Unit 21C. This methodology resulted in a density of ~0.25–0.35 moose/mi² or 900–1300 moose total for all of Unit 21C (including non-moose habitat). Based on the low density of moose we estimated from the 2000 stratification and declines observed in moose numbers in similar habitat in Unit 24C 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 RY07–RY08.

MORTALITY

Harvest

Season and Bag Limit for RY07–RY08.

<u>Units and Bag Limits</u>	<u>Resident Open Season</u>	<u>Nonresident Open Season</u>
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 of 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. No regulation changes were adopted during RY07–RY08.

Harvest by Hunters. Moose harvest in Unit 21C averaged 20.0 moose/year during RY07–RY08 compared to 22.4 ± 2.6 ($\bar{x} \pm \text{SE}$) moose during RY99–RY08 (Table 1). Although data are preliminary, similar declines in numbers of moose harvested per year were noted during RY09 (Table 1). During RY99–RY08, the numbers of hunters in Unit 21C averaged 46.8 ± 3.3 ($\bar{x} \pm \text{SE}$). The total number of hunters during RY07–RY08 (48.0 per year) increased only 3% relative to the preceding 8-year average (46.5 per year, RY99–RY06). Declining success rates suggest a reduction in the number of large bulls and possibly an overall decline in the population.

Eighteen moose have been reported harvested on drawing hunt permit DM812 since RY04 (Table 2). To date, only 2 moose were reported harvested in Unit 21C by hunters using registration hunt permit RM834, presumably in part because of the stipulation to destroy the antler trophy value.

Harvest data suggested no significant change occurred in the trend of the average antler widths of all harvested bulls during RY95–RY09, however average antler width in RY09 was significantly lower than the 15-year trend (Fig. 1). 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%) and RY09 (15%), the percentage of large bulls (≥ 60 inches) in the reported harvest in Unit 21C ranged from 21% to 47% during RY95–RY09 and was 23% during RY07–RY09. Furthermore, average antler size of all bulls in the RY07–RY09 reported harvest was 52 inches ($n = 49$). Since nonresidents are limited to taking moose with antler spread ≤ 50 inches, excessive harvest may more readily be reflected in declines in the size of antler spreads in moose harvested by residents. Recently, antler widths of bulls taken by resident hunter appeared to be declining, but due to low sample size, a significant decline was not determined at this time.

Hunter Residency and Success. Alaska residents composed 60% of the 96 hunters who hunted moose in Unit 21C during RY07–RY08 (Table 1). On average, 9.5 residents per year were successful during this period, while 8.5 resident hunters per year successfully harvested moose during RY99–RY08. As in the previous reporting period, successful nonresident hunter numbers declined during RY07–RY08 by 30% ($\bar{x} = 10$ successful nonresidents per year) compared to 13.4 successful nonresidents per year during RY99–RY08. Percent success for all hunters was 46.6% during RY99–RY08, and decreased to an average of 41% during RY07–RY08. 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 second and third week in September (Table 3). During RY07–RY08, no clear trends in harvest chronology were apparent, due mostly to the small number of moose harvested.

Transport Methods. While boats were 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 restricts 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 $1/40 \text{ mi}^2$. 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 0.25–0.35 moose/mi² of all terrain, with an estimated 900–1300 moose present in the unit. Human use of the moose population was low, and recent harvest can likely be sustained even though the population appears to have declined. However, declines in hunter success indicated that moose harvest along the Melozitna River corridor was possibly approaching maximum desirable levels.

We achieved our first management goal, to protect, maintain, and enhance the moose population and its habitat by monitoring moose harvest pressure, by monitoring bear and wolf harvest, 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 and other factors on the population.

During RY07–RY08, the management objective was to maintain $\geq 20\%$ large bulls (bulls with antlers 60 inches or greater) in the harvest. Data indicate that we achieved this management objective during RY07–RY09 with a 3-year average of 23% of the bulls harvested with antler widths of >60 inches. However, the average percentage of bulls with antler widths of >60 inches was below the 15-year average of 32%, so we will monitor this closely. Because access to Unit 21C is difficult and expensive, and most hunters who use the area are nonlocal residents or nonresidents, it is generally believed that those who hunted in Unit 21C were primarily interested in harvesting large-antlered (≥ 60 inches) bulls.

LITERATURE CITED

- BOERTJE, R. D., K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ADERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management* 73:314–327.
- GASAWAY, W. C., S. D. DUBOIS, D. R. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial survey. *Biological Papers of the University of Alaska* No. 22. Institute of Arctic Biology, Fairbanks, Alaska, USA.

- , R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 30 Apr 2008.
- OSBORNE, T. O. 1996. Unit 21C moose. Pages 368–372 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- , T. F. PARAGI, J. L. BODKIN, A. J. LORANGER, AND W. N. JOHNSON. 1991. Extent, cause, and timing of moose calf mortality in western Interior Alaska. *Alces* 27:24–30.
- STOUT, G. W. 2008. Unit 24 moose. Pages 579–616 *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, Alaska, USA
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

PREPARED BY:

Glenn W. Stout
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

STOUT, G. W. 2010. Unit 21C moose. Pages 466–476 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

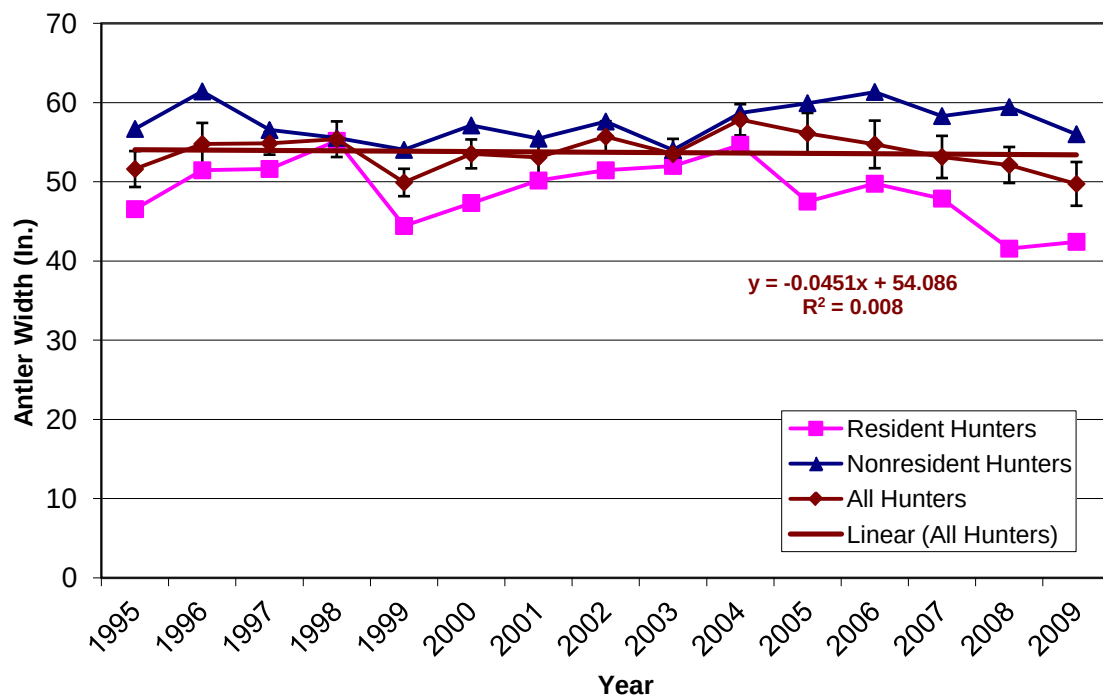


FIGURE 1 Average bull moose antler spread by hunter residency, Unit 21C, 1995–2009

TABLE 1 Unit 21C moose hunter residency and success, regulatory years 1996–1997 through 2009–2010^a

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^b	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident ^b	Nonlocal resident	Nonresident	Unk	Total	
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	0	9	6	0	15 (39)	3	15	5	0	23	38
2008–2009	1	10	14	0	25 (43)	1	19	13	0	33	58
2009–2010 ^c	0	7	7	0	14 (41)	0	14	6	0	20	34

^a Includes total number of hunters from all hunts.

^b Local resident resides in Units 21C or 21B.

^c Preliminary data.

TABLE 2 Unit 21C, outside Koyukuk Controlled Use Area, moose harvest by permit hunt, regulatory years 2004–2005 through 2009–2010

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
	2008–2009	31	68	40	60	6 (100)	0 (0)	0	6
	2009–2010	26	62	40	60	6 (100)	0 (0)	0	6
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
	2008–2009	3	0	67	33	1 (100)	0 (0)	0	1
	2009–2010	2	0	100	0	0 (0)	0 (0)	0	0

TABLE 3 Unit 21C moose harvest chronology percent by month/day, regulatory years 1995–1996 through 2009–2010

Regulatory year	Harvest chronology percent by month/day				<i>n</i>
	9/5–9/10	9/11–9/15	9/16–9/20	9/21–9/25	
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	33	33	20	13	15
2008–2009	13	38	38	13	24
2009–2010 ^a	0	57	29	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							<i>n</i>
	Airplane	Horse	Boat ^a	3- or 4-wheeler	Snowmachine	ORV	Unknown	
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	71	0	29	0	0	0	0	14
2008–2009	80	0	20	0	0	0	0	25
2009–2010 ^b	93	0	7	0	0	0	0	14

^a Includes airboats.

^b Preliminary data.

**WILDLIFE
MANAGEMENT REPORT**

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO Box 115526
Juneau, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 21D (12,096 mi²)

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 (TCAs) established in 1981 in the floodplain areas of the lower Koyukuk and Yukon Rivers indicated generally increasing moose densities through about 1993 (Tables 1–7). 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/mi²) and were very high on the Koyukuk River in the Three Day Slough TCA, where densities reached 13.3 moose/mi² in early winter 1993. We estimated that 6340 moose inhabited the portion of Unit 21D where most moose are found in the best habitat of the area, and extrapolation of the data to the remainder of Unit 21D suggested a unitwide population of 9,000–10,000 in 1993.

¹ At the discretion of the reporting biologist, this unit report contains data collected outside the report period.

Results from a population estimation survey in fall 1997 in the lower Koyukuk drainage and the Kaiyuh Flats indicated moose numbers were similar to the 1993 population estimation survey (Huntington 1998). However, a population estimation survey in 2001 suggested the population had declined marginally to 8500–9500 moose by winter 2001–2002, and declining recruitment parameters observed in the TCAs from 1997 to 2001 seemed to corroborate this. The population estimate declined slightly more 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 between nonlocal hunters in airplanes and local hunters in boats, 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 harvest tickets or they 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 educational and enforcement efforts have further improved the reporting rate by local residents, but more than a third of the harvest is still likely unreported.

A hunter checkstation has been operating on the Koyukuk River since 1983. In 1990 the Koyukuk River 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 9,000–10,000.

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 the Koyukuk River checkstation and at hunting camps by 10% each regulatory year.

Activity 1: Implement a program at Koyukuk River 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

Nine previously established TCAs of approximately 50–200 mi² each (originally 4–6 contiguous sample units; 10–14 mi²/sample unit [Gasaway et al. 1986]), were surveyed from small, fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). Surveys were flown approximately 500 feet above ground level at ground speeds of 70–80 mi/hr at a rate of approximately 5 min/mi². Moose were classified as cows, calves, yearling bull (<30" antler spread and no brow tine definition), medium bull (30–49" antler width), or large bull (≥50" antler width). Beginning in 2001, we established 7 TCAs using a grid system based on latitude and longitude coordinates (Kellie and DeLong 2006). These new TCAs used the same flight methodology (altitude, speed, and search intensity) as previously established TCAs. Prior to 2004, data were recorded on standard data forms and moose locations were recorded on 1: 63,000 U.S. Geological Survey quadrangle maps. Beginning in 2004, Global Positioning System (GPS) receivers were used to mark waypoints of moose observations and that information was also recorded on the standard data forms. 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. Within the Koyukuk CUA, which includes a portion of Unit 24D, 5 TCAs (Three Day Slough, Dulbi River Mouth, and Koyukuk River Mouth TCAs in Unit 21D [Tables 1–3], and Treat Island and Huslia Flats TCAs in Unit 24D) are referred to as the “Core 5” for analysis purposes.

We conducted population estimation surveys in a portion of Unit 21D during October and November 2001 (3577 mi²) and 2004 (3684 mi²), and used the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008, Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. The GSPE sample units averaged 5.6 mi² in size, and were flown with a search intensity of ~6 min/mi². In the 2001 survey, 291 of the 985 sample units were surveyed with an average survey intensity of 5.5 min/mi². All sample units were stratified as high or low density moose habitat 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 we surveyed 452 of 986 sample units (271 high density and 715 low density). We counted 6309 moose. The average survey intensity was 4.8 min/mi².

The current moose population estimate is based on previously reported values (Stout 2008), RY07–RY09 trend count surveys, and the GSPE population estimation surveys completed in 2001 and 2004. Declining moose recruitment among the TCAs was a key indicator of the apparent overall decline in the population. In fall 2004, we surveyed 5526 mi² in Units 21D and Unit 24D. I developed the RY09 moose population estimate for Unit 21D by individually estimating the moose densities in each of the 6 drawing permit hunt areas within Unit 21D. To accomplish this, I used data from the 2001 and 2004 population estimation surveys as well as recent (2004–2009) TCA data. For those areas that did not have survey data available, I used density estimates from surveys in similar habitat within Unit 21D. Therefore, estimates for each

permit area were a combination of population estimation survey data, trend count survey data, and extrapolated data, to varying degrees.

Population Composition

The following guidelines were used to interpret sex and age indices (Franzmann and Schwartz 1998):

- Ratios of 15 bulls:100 cows are sufficient for breeding (Woolington 1998); however, ratios of 30–40 bulls:100 cows provide for increased harvest or trophy hunting opportunity. High numbers of bulls suggest less hunting pressure in most cases, but Unit 21D is subject to unreported cow harvest, 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 areas of Three Day Slough, Pilot Mountain Slough, Kaiyuh Slough, and Squirrel Creek and Natlaratlen River. 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 predation, which might cause underestimation of twinning rates if predators killed 1 calf among twins.

I modeled population age structure and proportions of calf-bearing cows using age class data collected from hunter-killed bull moose. I assumed the ratio of each age class of bulls in the harvest was equal to the ratio of ages of cows in the population. This assumption was mostly false for yearlings because many hunters cannot identify yearling bulls (spike-fork and small antlered bulls) as animals that are legal to harvest and because some hunters selected for large antlered (older aged) bulls. However, yearling and 2-year-old cows (belonging to the same age class as bulls that may be underselected) do not calve in the Galena area, so this bias did not affect the analysis of twinning rates (a ratio of the number of cows with twins to the number of cows with calves). I excluded non-calving cows (1, 2, and ≥ 16 year-old age classes) from the proportional analysis. With respect to the number of older age class bulls (large bulls), most hunters in the Koyukuk CUA were subsistence hunters and tended to shoot the first bull they

found. Therefore, I believe the weighted average of the harvest was mostly unbiased. I also assumed the size of a cohort of males in a given year was equal to the proportion of the size of the cohort of females in that same year. For example, if 12% of the harvest in 1983 were 4-year old bulls, then I assumed 12% of the cows in the population were 4-year old cows. Finally, for simplicity, I assumed that 3-year-old and 12- to 15-year-old cows were single-calf-only bearing cows, that all cows 4–11 were twin bearing cows, and that cows had equal calving and twinning rates within each age class of the two groups.

Mortality

Hunting mortality and harvest distribution were 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 on the Koyukuk 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, and usually an e-mail and telephone calls if we did not receive timely harvest reports. 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. Moose ages were determined by counting cementum annuli of the lower incisors from hunter harvested bull moose (Matson et al. 1993). Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 July 2007–30 June 2008).

Meat evaluation was conducted to evaluate goals 3 and 4. Every moose checked at the Koyukuk River 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; FWS radiocollared an additional 29 calves in October 2006.

Wildlife Viewing

Hunters who came through the checkstation were also given a wildlife viewing survey that consisted of a 3×5 card with 8 brief questions about wildlife observed during their days in the field. At least 1 person per boat was given the voluntary questionnaire. We presented the card to several members of each hunting party while we were checking them on their way out of the area. The questions asked for RY02–RY09 are listed below:

Question 1: How many days spent viewing wildlife?

Question 2: Why were you visiting the Koyukuk?

Question 3: Did you view any wildlife that you were not hunting?

Question 4: What wildlife species did you see and how many?

Question 5: Viewing which of these animals was most important to you.....?

Question 6: How important was the activity of viewing wildlife for you?

Question 7: How important was seeing wildlife sign... to your overall experience?

Question 8: Where did you get information about the Koyukuk?

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).

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 TCA data 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 1–7). From the peak around 1994, the Unit 21D population trend was downward through RY03. Counts during 1999–2003 from the Three Day Slough, Dulbi River mouth Koyukuk River mouth, and Squirrel Creek TCAs (Tables 1–4) supported this conclusion, as did the 2001 and 2004 GSPE population estimation surveys (Table 8). 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 for the total area 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 that was indicated by the Three Day Slough TCA trend that occurred during RY93–RY97. By combining my estimates for individual drawing hunt area in Unit 21D, I estimated a unitwide population of 8103 observable moose (± 1000) at the end of RY08 (Table 9, a slight decline from my 2008 estimate (Stout 2008).

Population Composition

From 1995 through 2003, the posthunt bull:cow ratio for the Three Day Slough TCA had generally declined compared to previous years, and the fall 2003 ratio was the lowest recorded (15 bulls:100 cows; Table 1). Bull:cow ratios vary widely among other TCAs (Tables 2–7), but most indicated some level of decline beginning in the mid 1990s, and then more recent recovery (Fig. 2). The percentage of large bulls (antlers ≥ 50 ") observed in the Three Day Slough TCA was 19–33% ($\bar{x} = 27.8$) in the 2000s, while the percentage of large bulls in the harvest from Three Day Slough was 37–58% ($\bar{x} = 44.8$; Table 10). Surveys are conducted post hunt, therefore the difference in survey and harvest percentages were likely due to harvest removal of large bulls and the inability of hunters to identify young bulls. Bull:cow ratios from the 2004 GSPE survey were estimated at 30:100, well above the minimum needed for adequate productivity.

From the 2004 population estimation survey, the calf:cow ratio was estimated at 37:100, within the range (20–40:100) reported by Franzmann and Schwartz (1998) for maintaining a stable or increasing population. Data from most TCAs also had high ratios. Trend count area data in RY08 and RY09 indicated stability in bull:cow ratios, and yearling bull:cow ratios. A substantial decline in calf:cow ratios in fall 2009 followed the severe winter of 2008–2009 and poor twinning during spring 2009.

Moose twinning rates during May 2003–2008 suggested above average nutritional status (Boertje et al. 2007) and productivity in the Three Day Slough, Pilot Mountain Slough, Kaiyuh Slough and Natlatratlen River areas in Unit 21D (Tables 11 and 12). Exceptionally high twinning rates in 2006 and relatively high recruitment of that cohort, may have affected the ability of cows to produce twins during 2 consecutive years. These above average values may be related to mild winters during RY03–RY06 and/or 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) while the riparian moose population maintained relatively similar rates at high densities of moose since the early 1980s. My model that estimated the age structure of the female portion of the moose population indicated a favorable proportion of cows in the 4-year-old through 11-year-old age class from RY97 to RY01 (Fig. 3). This high proportion of potential twin bearing cows predicted by my model suggests female age structure of the population is not an explanation for the decline in the twinning rates.

A density-independent effect, such as weather, could be the explanation for the decline in twinning rates in the 1990s and subsequent increase in the 2000s. The length of winter as measured by the accumulation of 30cm of snow could be important because that snow depth was reported to restrict utilization of highly digestible sedges and forbs by moose (LaResche and Davis 1973). From 1978 to 2008, the mean date for initial accumulations of ≥ 30 cm of snow was 18 December in Galena (50 mi from Three Day Slough). When twinning rates were declining (1986–1987 through 1996–1997; except winter of 1995–1996), initial snow accumulations of ≥ 30 cm occurred consecutively and 15.8 days earlier (SE = 6.9) than 18 December in 9 of the 10 years. When twinning rates were increasing (1998–2007), accumulations of ≥ 30 cm occurred 9.4 days later (SE = 9.0) than 18 December. Prior to and following the period of declining twinning rates, snow accumulations of ≥ 30 cm occurred before 18 December in only 9 of 19 non-consecutive years.

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 uplands where they spend the summer. In August they return to the floodplain.

Moose movements 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.

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
<i>RY07</i>		
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 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 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		5 Sep–25 Sep

Seasons and Bag Limits.

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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.		
<i>RY08</i> Unit 21D, that portion within the Koyukuk Controlled Use Area. RESIDENT HUNTERS: 1 bull by registration permit 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. 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.	1 Sep–25 Sep (Subsistence hunt only) 5 Sep–25 Sep	5 Sep–25 Sep
Remainder of Unit 21D. RESIDENT HUNTERS: 1 bull by registration permit only; or 1 bull by drawing permit only; up to 600 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area. 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.	22 Aug–31 Aug 5 Sep–25 Sep (Subsistence hunt only) 5 Sep–25 Sep	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 22–31 August. The board expanded the drawing and registration permit hunts to all of Unit 21D, eliminating all general harvest ticket hunting. With 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.

The only change adopted during RY07–RY08 was shifting the season within the Koyukuk CUA from 27 August–20 September to 1–25 September.

Harvest by Hunters. Harvest of moose in Unit 21D during RY08–RY09 increased from the previous reporting period (Tables 13–15). Reduced harvest during RY04–RY07 likely 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. No cows were reported harvested during RY07–RY08, due to elimination of all antlerless moose seasons in the 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 appeared to return to the former pattern, with more hunters in northern Unit 21D within the Koyukuk River drainage than in the southern portion. Low water levels on the Yukon River that reduced the ability to access Kaiyuh Slough along with increased bull:cow ratios that resulted in improved hunter success on the Koyukuk were two factors that likely caused the change in harvest distribution. During RY98–RY04 and RY08–RY09, most harvest in Unit 21D ($\bar{x}$ = 72%) occurred in the Koyukuk River drainage, with a high of 84% in RY99 (Northern Unit 21D, Table 16). However, during RY05–RY07, harvest in the Koyukuk River drainage declined to an average of 58%, with a low of 53% in RY06.

Checkstation Results. The Koyukuk River checkstation was made mandatory in RY90. The number of hunters who checked in at the checkstation 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 15). Numbers of local residents (residents of Units 21B, 21D and 24) increased during RY00–RY06 due to expanded registration hunts and improved reporting by unsuccessful hunters who did not turn in permit reports at the checkstation. Harvest success was high for nonlocal residents ($\bar{x}$ = 55%) and nonresidents ($\bar{x}$ = 70%) during RY98–RY07. Local resident harvest success reported for the fall hunt was lower ($\bar{x}$ = 35%). 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 in RY04 and RY05 when weather was extremely warm during the fall hunting season. Additionally, success rates were also lower ($\bar{x} = 40\%$) during RY01–RY06 compared to all other years ($\bar{x} = 55\%$) due to low bull:cow ratios during that period (Table 1). Success rates in the Koyukuk CUA improved in RY08 and RY09.

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. Of the bulls observed in the Three Day Slough TCA, 24.2% had large antlers (Table 12). The 28-year average (1981–2008) percentage of harvested bulls with antler width of ≥ 60 inches was 16.8% (RY05 = 17.9%, RY06 7.3%, RY07 = 21.7%, RY08 = 11%). However, the percentage of large bulls (≥ 60 -inch antlers) harvested has declined since RY00, possibly due to 1) high harvest rates in the late 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 moose harvested in the Koyukuk CUA were summarized from RY81 through RY08. 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 $\times$ 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 less than 3 years old or more than 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 4.8 in RY09 (Table 17), with little change since RY05. In RY09 the majority of hunters (78%) had their meat out of the field in 4 days or less. In RY08 and RY07, 9 hunters (7.7%) and 4 hunters (4.8%), respectively, kept their meat out 7 days or longer. In RY09, 4 hunters (2.9%) were given average overall scores of 3 or less, while that score was applied to 0 hunters (0%) in RY08, 8 hunters (9.5%) in RY07, 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 stabilized at a high level and the number of days hunters kept their meat in the field stabilized at ~2½ days. Scores in RY07 dropped apparently because the sale of game bags and tarps at the Koyukuk River checkstation was discontinued that year.

Not all respondents answered all questions in the wildlife viewing questionnaire at the Koyukuk River checkstation; so percentage values presented are based on the number of responses to the particular question (Table 18). Only a portion of all hunters that stopped at the checkstation received the questionnaire ($\bar{x}$ = 25.2%, RY02–RY09).

With the establishment of baseline data for the meat evaluation and wildlife viewing, efforts to improve the activities were implemented according to management goal 3. Funding and prioritization limited our ability to implement a program to address goal 4.

Permit Hunts. Use of the subsistence registration permit (RM832) hunt was required in the fall within the entire Koyukuk CUA. The number of RM832 permits issued for RY03–RY09 varied by only 10% (Table 19). Use of the registration permit among local residents was relatively stable, while use of the permit by other Alaska residents declined (Table 15). With implementation of drawing hunts in the remainder of Unit 21D, hunter numbers were better regulated and distribution of hunters improved (Table 20). Hunters who did not want to destroy the trophy value of their bull moose could apply for a drawing permit.

Hunter Residency and Success. Hunter residency and success can be misleading because Unit 21D residents historically did not report unsuccessful hunt information (Table 21). 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 during RY83–RY99, but declined in RY00–RY07. The increase of nonlocals during the 1980s and 1990s created tension among user groups in the area. With implementation of drawing permits within the Koyukuk CUA in RY00, local hunter participation appeared to increase (RY01–RY09; Table 15).

Unit 21D local hunter success rates in RY05 (29%), RY06 (34%), and RY07 (28%) were low (RY00–RY09; $\bar{x}$ = 36%) compared to RY90–RY99, when success rates averaged 59% (Table 21). Success rates for nonlocal resident (RY90–RY99; $\bar{x}$ = 67% vs. RY00–RY09; $\bar{x}$ = 45%) and nonresident (RY90–RY99; $\bar{x}$ = 68% vs. RY00–RY09; $\bar{x}$ = 41%) followed similar trends. Increased reporting by unsuccessful hunters and subsequent declining success rates, can be explained by 2 changes in hunt administration in Unit 21D. First, reporting rates by unsuccessful hunters increased with the higher level of reporting accountability associated with registration and drawing permit systems. Second, an individual hunter could possess more than one reporting mechanism (harvest ticket, registration permits, and/or federal permits), which increased the total number of permits reported but did not increase proportionally the number of individual hunters. The first outcome was implemented by design, and improved our ability to manage moose in Unit 21D, while the second by-product was not anticipated. Because of these issues, assessing harvest success rate trends has become problematic since RY04. By contrast, within the Koyukuk CUA, reporting accountability has been high since permits were implemented in 1996 and each hunter can only obtain one permit so that changes in success rate

reflect hunt conditions. Therefore, success rates were not biased by recent (RY04) changes in the hunt administration processes. Success rates appeared to increase within the Koyukuk CUA, presumably due to the improving bull:cow ratios. Maintaining high success rates by 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 22 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 23). 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 on both calf and adult moose. Black bears were shown to kill more than 40% of moose calves annually in Unit 21D (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 knowledge of Unit 21D game populations reported wolf numbers had increased since the 1994 survey. Packs in excess of 20 wolves were observed during fall 1999 moose surveys. We counted 126 wolves during a wolf reconnaissance survey in March 1999. This minimum count indicated an increase of at least 17% from the number of wolves in packs observed during the 1994 survey. We do not have survey data to indicate the status of the population since 1999, but the current estimate is 309–445 wolves ($\bar{x} = 377$) in 37–55 packs (25.4–36.8 wolves/1000 mi²; 9.8–14.2 wolves/1000 km²) during RY05–RY07 (Stout 2009). The ratio of 8103 moose:377 wolves (21.5 moose:wolf) is near the 20 moose:wolf ratio where wolves would be expected to cause a decline in the moose population (Gasaway et al. 1983).

HABITAT

Assessment

Feltleaf willow is an important browse species for moose due to its nutritional quality (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 is adequate to support an increasing population if predation decreases, as indicated by the increasing moose population in Unit 20A, where nutritional status was poorest (Boertje et al. 2007).

CONCLUSIONS AND RECOMMENDATIONS

Moose were relatively numerous in the riparian lowlands of Unit 21D. I estimated 8103 (± 1000) observable moose in Unit 21D. The Unit 21D population may have declined slightly south of the Koyukuk, but numbers were stable in northern Unit 21D. Cow numbers in TCAs continue to be closely monitored throughout the unit. High calf:cow ratios and yearling bull:cow ratios in RY04, RY06, and RY07 did not appear to increase the population, although we have not conducted a formal population estimate since 2004. Because we did not complete a population estimation survey during RY07–RY08, the population status was somewhat uncertain. TCA survey data indicated an increase in the moose population, however; a corresponding increase in search intensity since RY01 among the “Core 5” TCAs, may confound interpretation of the numbers of moose counted. We recommend annual or biennial GSPE moose population estimation surveys in the high density portions of Unit 21D to develop a reliable population trend analysis, even if those surveys are conducted at a low sampling intensity (Kellie and DeLong 2006, Ver Hoef 2001, 2008). Although high sampling intensity surveys provide narrow confidence intervals and improve precision on an estimate, they are not likely to be conducted on a regular basis. Analysis of GSPE data collected in Unit 24B, showed that low intensity surveys conducted in the intervening years of infrequent high intensity surveys provided accurate composition and population estimates, yet the confidence intervals for all survey years were improved (Glenn Stout, ADF&G, Unit 24 moose report, this volume). This strategy provided managers with better decision-making information for the overall population than TCA composition data alone.

Since 2003, high productivity as a result of increased twinning rates was likely an important factor in stabilizing the population decline in Unit 21D. If adverse weather was the cause of twinning rate declines in the 1990s, it is possible that early accumulation of 30cm of snow limited availability of highly digestible forages (e.g. *Carex* spp., *Equisetum* spp.) in the fall or the extended length of winter and subsequent shortening of summer was the causal mechanism. I theorize that consecutive early winters of the 1990s, specifically early accumulation of 30cm of snow in transitional habitats, reduced the period of time in the fall when cows could increase fat stores. After several consecutive early winters, the population of cows was probably synchronized at a similar low body condition and twinning rates declined even though the age structure of the population was skewed toward high numbers of potentially twin-bearing cows. If this occurred, we should consider the high importance of managing transitional habitats where highly digestible forages are found.

The 3 key management issues facing Unit 21D were 1) cow harvest (possible declining moose numbers and unregulated harvest in the Kaiyuh portion of Unit 21D), 2) evaluation of harvest success rates, and 3) interpretation of trend count survey data. 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 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

bull-only season in August. However, moose harvest during the winter will continue depending on the level of fall hunting success. An increasing trend in bull:cow ratios within the Koyukuk CUA appeared to increase fall success, therefore decreased demand for the winter harvest, which should address this concern. Management efforts must continue to improve fall success rates by local hunters in order to reduce the winter harvest of cows.

The current population estimate of 8103 moose in 21D did not likely meet the management objective of 9,000–10,000 observable moose. However, the intensive management population objective of 7,000–10,000 moose set by the board of game in regulation 5 AAC 92.108 may have been achieved. Analysis of RY07–RY08 TCA data indicated good recruitment; however, adult numbers did not increase as expected. 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 RY07–RY09. Estimated total harvest was highest in RY08 (422 moose). Using the RY08 moose population estimate 8103 (± 1000), this was a harvest rate of 4.6–5.9%. The objective to provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year was achieved with a total of 627 hunters in RY07, 656 hunters in RY08, and 750 in RY09.

The long-term objective to implement at least 2 habitat enhancement activities was achieved during RY04–RY09. 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; most in upland sites predominately in spruce forest; relatively small amounts of prime riparian habitat were affected.

In RY07 and RY08 we continued to monitor the objective to reduce spoiled meat observed at the Koyukuk River checkstation and at hunting camps by 10% each regulatory year. Less than 5% of the hunters scored less than 3 on the overall meat care and the average number of days hunters stayed in the field with their meat was 2.6 days. Meat spoilage was very low and was probably limited to only a few individual hunters each year; therefore, the objective was met. Because the level of meat care has stabilized, an annual improvement is no longer relevant. Therefore a more meaningful objective will be to maintain a low number of instances of poor meat care among hunters. For the next reporting period this goal and objective will be changed to the following:

GOAL 3: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall Meat Assessment Score of less than “3” for $\leq 5\%$ of the hunters each regulatory year.

Finally, we continued our program to monitor and evaluate the number of people engaged in nonconsumptive activities was continued and baseline data were established to determine whether we met the objective to increase the number of people engaged in nonconsumptive uses of wildlife by $>1\%$ each regulatory year. Parameters measured by the wildlife viewing survey varied annually, but appeared to be relatively consistent. The objective was probably not achieved because a program to improve the parameters was not implemented. Increases in the

number of days spent viewing, the proportion of people that rank “viewing” or “viewing and hunting” as a purpose of the trip, and the number of “species observed” would be good indicators of an increase in nonconsumptive use. A program to increase species identification and the importance of wildlife sign by hunters would best improve those measures. Friends were the primary source of hunters learning about the area, so people that previously hunted in the area should be the target public for developing a program. As a result of our baseline data and learning the best way to evaluate changes in wildlife viewing by the public, the wildlife viewing objective will also be changed for the next reporting period to the following:

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

OBJECTIVE 1: Maintain “Hunting and Viewing” as the response to question #2 (Purpose of Trip) among $\geq 65\%$ of the hunters who respond to the survey each regulatory year.

LITERATURE CITED

- ANDERSON, D. B., C. J. UTERMOHLE, AND L. BROWN. 1998. The 1997–1998 harvest of moose, caribou, and bear in middle Yukon and Koyukuk River communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- BECKER, E. F., M. A. SPINDLER, AND T. O. OSBORNE. 1998. A population estimator based on network sampling of tracks in the snow. *Journal of Wildlife Management* 62:968–977.
- BOERTJE, R. D., K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ALDERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- BRYANT, J. M., AND G. STOUT. 2003. Koyukuk/Nowitna National Wildlife Refuge Complex, moose population estimation surveys, Koyukuk and Northern Unit of Innoko National Wildlife Refuges, Game Management Units 21D and southern 24, Alaska. Progress Report FY-03-01. Galena, Alaska, USA.
- FRANZMANN, A. W., AND C. C. SCHWARTZ. 1998. Ecology and management of the North American moose. Wildlife Management Institute. Smithsonian Institution Press, Washington D.C., USA.
- GASAWAY, W. C., R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPHERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Wildlife Monographs*. No. 84.
- , W. C., S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. *Institute of Arctic Biology*. No. 22.
- HUNTINGTON, O. 1998. Koyukuk/Nowitna National Wildlife Refuge Complex Lower Koyukuk River and Kaiyuh Flats 1997 Moose Census, Unit 21D, Alaska. Final Progress Report. Galena, Alaska, USA.

- HUNTINGTON, S. 1993. *Shadows on the Koyukuk: an Alaskan Native's life along the river*. Alaska Northwest Books, Seattle, Washington, USA.
- KELLIE, K. A., AND R. A. DELONG. 2006. *Geospatial survey operations manual*. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 21 May 2008.
- KIELLAND, K. 1997. *Browse relations of moose in the middle Koyukuk River*. Final report to Alaska Department of Fish and Game. Institute of Arctic Biology, University of Alaska Fairbanks, Alaska, USA.
- LARESCE, R. E., AND J. L. DAVIS. 1973. Importance of nonbrowse foods to moose on the Kenai Peninsula, Alaska. *Journal of Wildlife Management*. 37:279–287.
- MATSON, G. M., L. VAN DAELE, E. GOODWIN, L. AUMILLER, H. REYNOLDS, H. HRISTENKO. 1993. *A laboratory manual for cementum age determination of Alaska brown bear PM1 teeth*. Alaska Department of Fish and Game. Juneau, Alaska, USA.
- OSBORNE, T. O. 1996. Unit 21D moose. Pages 373–385 in M. V. Hicks, editor. *Moose management report of survey and inventory activities*. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- , T. F. PARAGI, J. L. BODKIN, A. J. LORANGER, AND W. N. JOHNSON. 1991. Extent, cause, and timing of moose calf mortality in western Interior Alaska. *Alces* 27:24–30.
- , AND M. A. SPINDLER. 1993. *Moose population identification study: Three Day Slough, Koyukuk NWR, Alaska, Unit 21D*. Progress Report 93-3. U.S. Fish and Wildlife Service, Galena, Alaska.
- STOUT, G. W. 2000. Unit 21D moose. Pages 413–435 in M. V. Hicks, editor. *Moose management report of survey and inventory activities 1 July 1997–30 June 2000*. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- . 2006. Unit 21D moose. Pages 472–513 in P. Harper, editor. *Moose management report of survey and inventory activities 1 July 2003–30 June 2005*. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- . 2008. Unit 21D moose. Pages 487–529 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, Alaska, USA.
- . 2009. Units 21B, 21C and 21D wolf management report. Pages 209–219 in P. Harper, editor. *Wolf management report of survey and inventory activities 1 July 2005–30 June 2008*. Alaska Department of Fish and Game. Project 14.0. Juneau, Alaska, USA.

VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

———. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13.

WOOLINGTON, J. D. 1998. Unit 21D moose. Pages 361–377 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.

PREPARED BY:

Glenn W. Stout
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

STOUT, G. W. 2010. Unit 21D moose. Pages 477–521 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0 Juneau, Alaska, USA.

Moose Density Estimates in Unit 21D

Kaiyuh and Western Galena Sub-Areas

('87 & '97 adjusted w/o SCF)

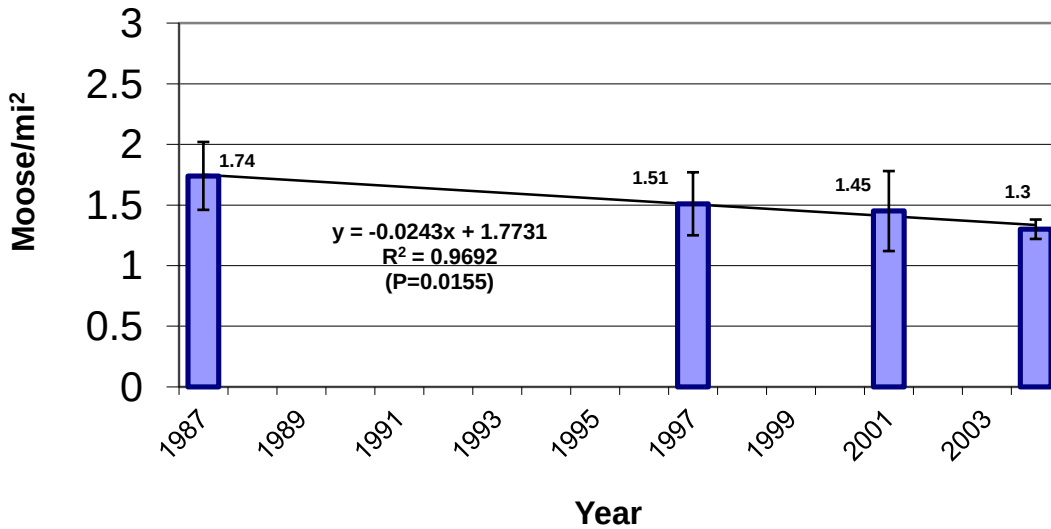


FIGURE 1 Moose density estimates and regression analysis based on 4 population estimation surveys. The 1987 estimate was calculated using MOOSEPOP; 1997 was a regression analysis estimate; and 2001 and 2004 were geospatial population estimates. All values presented do not include sightability correction factors and are presented as density of observable moose/mi². Although survey areas differed in size (see Table 8), survey areas overlapped substantially between years. The density decline was believed to be due to actual population changes, and potential influence as a result of changes in area size was considered for this analysis.

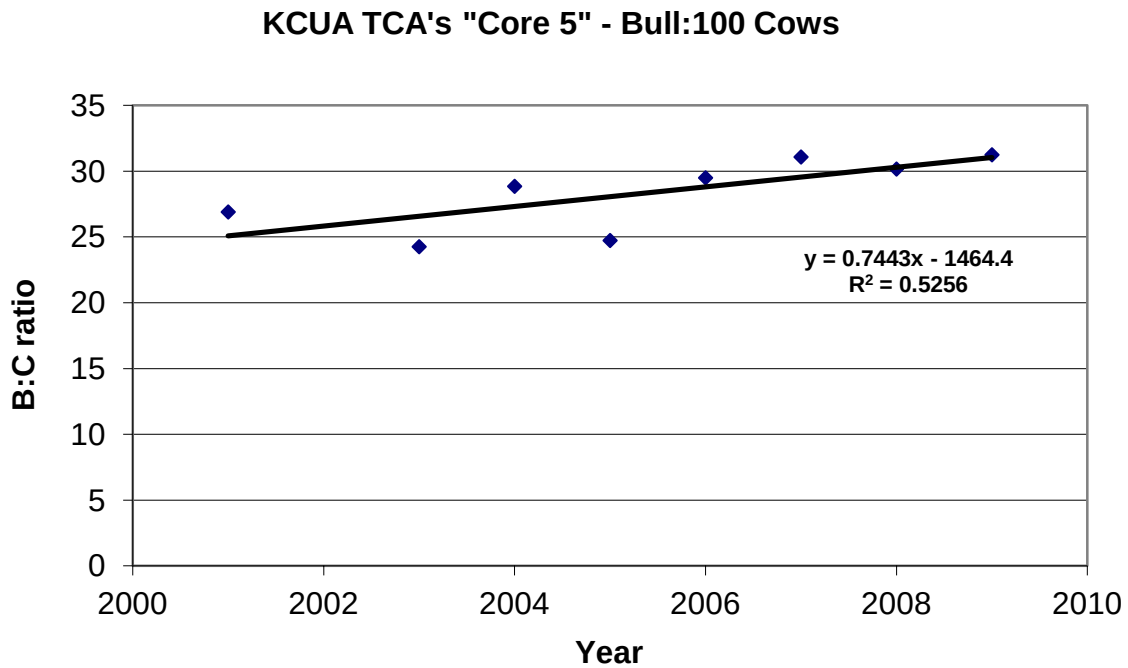


FIGURE 2 Cumulative bull:100 cow ratio for the Koyukuk Controlled Use Area that includes the 5 aerial trend count survey areas surveyed each year since 2001. “Core 5” trend count areas are the Three Day Slough, Dulbi River Mouth, and Koyukuk River Mouth Trend Count Areas in Unit 21D, and the Treat Island and Huslia Flats Trend Count Areas in Unit 24.

Model-Estimated Proportions of Cows Producing Twins

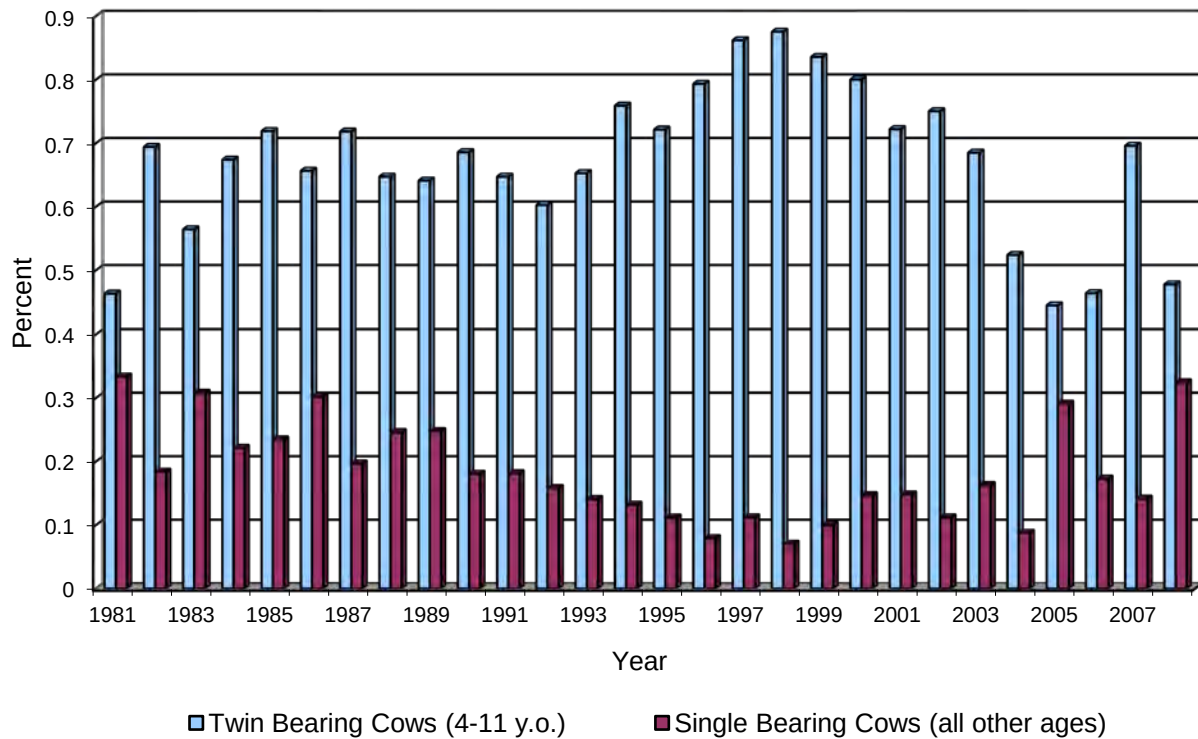


FIGURE 3 Model-estimated proportion of cows that were likely to bear twins (4–11 years old) compared to cows that were likely to bear single calves (all other age classes). Proportions were estimated using age class data from the teeth collected from hunter harvested bull moose.

TABLE 1 Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years 1981–1982 through 2009–2010

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
2008–2009	85.0	31	8	15	5	14	773	9.1
2009–2010 ^b	85.0	26	8	12	2	8	696	8.2

^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 2009–2010^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
2008–2009	116.7	33	12	32	5	19	505	4.3
2009–2010	116.7	36	11	16	6	11	534	4.6

^a Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 3 Unit 21D Koyukuk River mouth aerial moose composition counts, regulatory years 1984–1985 through 2009–2010^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
2008–2009	118.8	32	16	38	7	22	427	3.6
2009–2010	118.8	32	14	13	0	9	478	4.0

^a Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 4 Unit 21D Squirrel Creek aerial moose composition counts, regulatory years 1981–1982 through 2009–2010^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
2008–2009	96.6	45	14	20	7	12	252	2.6
2009–2010	90.9	34	10	17	0	12	278	2.9

^a Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 5 Unit 21D Pilot Mountain Slough aerial moose composition counts, regulatory years 1983–1984 through 2009–2010^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
2008–2009	91.0	15	7	31	7	21	354	3.9
2009–2010	91.0	12	3	21	6	16	345	3.8

^a Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 6 Unit 21D Kaiyuh Slough aerial moose composition counts, regulatory years 1985–1986 through 2009–2010^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
2008–2009	126.3	59	8	47	19	23	136	1.1
2009–2010	126.3	50	12	10	0	6	180	1.4

^a Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 7 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 8 Unit 21D aerial moose population estimates, regulatory years 1987–2004

Area/Regulatory Year	Area mi ²	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Percent calves	Adults	Population Estimate (90% C.I. ^a)	Density
<i>21D–Kaiyuh Flats</i>								
1987–1988 ^a	1582	60.6	46.4	15.0	22.4	1389	1790±18%	1.13
1997–1998 ^b	1582	42.3	28.4	13.0	16.6	1113	1335±17%	0.84
2001–2002 ^c	1843	44.5	22.1	8.8	13.4	1558	1800±32%	0.98
2004–2005 ^c	1843	35.1	43.3	12.2	24.7	1119	1487±10%	0.81
<i>21D–Western Galena</i>								
1987–1988 ^a	1508	36.7	38.2	12.4	21.8	3220	4118±14%	2.73
1997–1998 ^b	1508	31.3	32.1	8.0	19.6	2612	3250±12%	2.15
2001–2002 ^c	1734	26.6	17.1	6.4	12.0	2995	3403±19%	1.96
2004–2005 ^c	1841	26.2	36.2	10.5	22.3	2564	3299±5%	1.79
<i>24D–Upper Koyukuk</i>								
2001–2002 ^c	1949	35.0	17.6	6.1	11.4	3228	3642±16%	1.87
2004–2005 ^c	1843	32.7	33.9	12.6	20.4	2531	3181±5%	1.73
<i>Total Area</i>								
1987–1988 ^a	3090	43.1	40.4	13.1	6.7	4609	5908±15%	1.91
1997–1998 ^b	3090	34.4	31.1	9.4	17.8	3725	4585±14%	1.48
2001–2002 ^c	5526	33.4	18.3	6.7	12.0	7849	8924±13%	1.62
2004–2005 ^c	5527	30.4	36.5	11.6	18.2	6514	7967±4%	1.44

^a Gasaway survey, MOOSEPOP analysis estimate, with sightability correction factor.^b Gasaway survey, Regression analysis estimate, with sightability correction factor.^c Geospatial population estimation survey, without sightability correction factor.

TABLE 9 Unit 21D moose population estimate by drawing hunt areas, regulatory year 2009–2010^a

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 @ 1.10 moose/mi ²)	673
	(2329 mi ² @ 0.30 moose/mi ²)	699
	Subtotal	1372
(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)	8103 (±1000) ^a

^a Population estimates for each permit area were a combination of population estimation survey data, trend count survey data, and extrapolation data to varying degrees.

^b The range on the estimate is not a statistically derived confidence interval. It was an approximated range based on my experience at being able to estimate moose numbers for this area.

TABLE 10 Unit 21D large bull^a moose percent harvested and number measured during the hunting season and percent counted during aerial surveys in the Three Day Slough area (UCU 0804), regulatory years 1990–1991 through 2009–2010

Regulatory year	% Harvested (Sep)	Number measured (Sep)	% Counted (Nov)
1990–1991	54	91	— ^b
1991–1992	45	134	15
1992–1993	54	88	15
1993–1994	53	107	18
1994–1995	67	88	28
1995–1996	61	150	27
1996–1997	68	123	20
1997–1998	63	120	16
1998–1999	61	209	30
1999–2000	65	220	21
2000–2001	37	119	— ^b
2001–2002	40	83	30
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	47	115	30
2008–2009	41	156	25
2009–2010	38	177	33

^a Fifty-inch or greater antler spread.

^b No survey.

TABLE 11 Unit 21D moose aerial twinning surveys in the Three Day Slough trend count area, regulatory years 1989–1990 through 2008–2009

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
2007–2008	49	40	23	37	43	25–27
2008–2009	119	39	10	20	29	26–28

^a Percent of cows with calves that had 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 12 Unit 21D moose aerial twinning surveys in the Pilot Mountain Slough to Kaiyuh Slough trend count areas, regulatory years 2003–2004 through 2008–2009^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
2007–2008	76	30	22	42 ^c	7	23,24,29
2008–2009	69	27	20	43	14	26–28

^a U.S. Fish and Wildlife Service data.

^b Percent of cows with calves that had twins.

^c Including 1 cow w/3 calves.

TABLE 13 Unit 21D moose harvest, regulatory years 1995–1996 through 2009–2010

Regulatory year	Harvest by hunters				Unreported harvest ^a	Potlatch/ Stickdance ^c	Total
	Bull	Cow	Unk	Total			
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	14	462
2002–2003	316	10	0	326	150	13	489
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	17	378
2007–2008	204	1	0	205	150	25	380
2008–2009	263	0	0	263	150	9	422
2009–2010 ^b	244	0	0	244	150	14	408

^a Unreported harvest based on ADF&G–Subsistence Division’s door-to-door survey and other sources.

^b Preliminary data.

^c Includes all Potlatch, Stickdance, Ceremonial and Cultural permit harvest.

TABLE 14 Koyukuk River checkstation moose harvest, regulatory years 1995–1996 through 2009–2010^a

Regulatory year	Bull	Cow	% Cow	Total
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
2008–2009	201	0	0	201
2009–2010	223	0	0	223

^a Contains moose harvested in Units 21D and 24.

^b Including one moose of unknown sex.

^c Including two moose of unknown sex.

TABLE 15 Koyukuk River checkstation^{a,b} moose hunter residency and success, regulatory years 1989–1990 through 2009–2010

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	212	78	122	70	8	8	342	156
2008–2009	209	98	138	92	14	11	361	201
2009–2010	244	110	183	104	14	9	441	223

^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 16 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, 1998–1999 through 2009–2010

Regulatory year	Percent harvest		Total Harvest
	Northern Unit 21D	Southern Unit 21D	
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	63	37	201
2008–2009	66	34	258
2009–2010 ^a	71	29	237

^a Preliminary data.

TABLE 17 Overall scores for meat evaluation at Koyukuk River Checkstation, regulatory years 2002–2003 and 2009–2010

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
2008–2009	2.6	4.6	4.9	5.0	4.9	118
2009–2010	2.6	4.6	4.8	4.9	4.8	140

^a Subjective ranking scale of 1–5, with a score of 1 being lowest.

TABLE 18 Wildlife viewing survey at Koyukuk River Checkstation, regulatory years 2002–2003 through 2009–2010

Regulatory year	Question #1	Question #2			Question #3		Question #4	Question #5								Question #6			Question #7			Question #8				
	# Days viewing ($\bar{X}$)	Purpose of Trip? ^a			Wildlife Seen?		# Species observed	Wildlife Rank? ^b								Seeing Wildlife Important? ^c			Wildlife Sign Important? ^b			Source of Hunting Information? ^d				
		H %	V %	B %	Yes %	No %		M	B	Wo	Wa	F	C	SM	So	V %	S %	N %	V %	S %	N %	Fr %	P %	Fa %	A %	O %
2002–2003	7.0	43	2	55	83	17	23	1	2	3	4	5	8	6	7	--	--	--	--	--	--	45	23	4	17	11
2003–2004	6.9	45	1	53	81	19	32	1	2	3	4	5	6	8	7	62	33	5	52	44	4	51	18	9	9	13
2004–2005	5.2	40	2	58	73	27	19	1	2	3	6	4	5	7	8	63	33	4	71	25	4	42	31	18	7	2
2005–2006	7.2	47	2	51	85	15	23	1	2	3	4	7	5	8	6	53	42	5	56	39	5	37	37	17	6	4
2006–2007	6.7	59	6	35	80	20	28	1	2	3	4	5	8	6	7	45	42	13	54	35	12	39	38	16	4	3
2007–2008	6.6	56	6	38	77	23	22	1	2	3	4	5	7	6	8	55	37	8	59	33	8	33	34	11	16	7
2008–2009	6.4	66	0	34	81	19	29	1	2	3	4	6	5	7	8	59	35	6	61	33	6	53	20	20	4	3
2009–2010	6.9	66	4	30	72	28	26	1	2	3	4	7	5	8	6	58	39	3	54	43	3	49	35	9	1	7
Average	6.6	52.8	2.9	44.3	79.0	21.0	25.3	1.0	2.0	3.0	4.3	5.5	6.1	7.0	7.1	56.4	37.3	6.3	58.1	36.0	6.0	43.6	29.5	13.0	8.0	6.3

^a H=Hunting only, V=Viewing only, B=Both^b M=moose, B=Bears, Wo=Wolves, F=Furbearers, C=Caribou, SM=Small Mammals, So=Songbirds.^c V=Very Important, S=Somewhat Important, N=Not Important.^d Fr=Friends, P=Personal Experience, Fa=Family, A=ADF&G, O=Other (Internet, USFWS, Magazines, etc.).

TABLE 19 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2009–2010^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
	2008–2009	341	6	47	53	168 (99)	1 (1)	0	169
	2009–2010	431	9	52	48	187 (100)	0 (0)	0	187
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
	2008–2009	4	0	25	75	3 (100)	0 (0)	0	3
	2009–2010	4	0	0	100	4 (100)	0 (0)	0	4
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
	2008–2009	6	33	0	100	4 (100)	0 (0)	0	4
	2009–2010	4	0	50	50	2 (100)	0 (0)	0	2
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

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk	Total harvest
DM828	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
	2008–2009	4	50	50	50	1 (100)	0 (0)	0	1
	2009–2010	4	50	50	50	1 (100)	0 (0)	0	1
	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	3 (75)	1 (25)	0	4
	2008–2009	32	50	44	56	9 (100)	0 (0)	0	9
	2009–2010	32	50	31	69	11 (100)	0 (0)	0	11
	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
DM829	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 (100)	0 (0)	0	2
	2007–2008	2	0	0	100	2 (100)	0 (0)	0	2
	2008–2009	4	0	25	75	3 (100)	0 (0)	0	3
	2009–2010	4	0	50	50	2 (100)	0 (0)	0	2
	2000–2001	103	41	25	75	45 (100)	0 (0)	0	45
	2001–2002	103	51	43	57	26 (100)	0 (0)	0	26
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

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk	Total harvest
	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	30	0	100	14 (100)	0 (0)	0	14
	2008–2009	32	56	14	86	12 (100)	0 (0)	0	12
	2009–2010	32	25	30	70	16 (100)	0 (0)	0	16
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
	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (99)	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 (99)	0 (0)	1	166
	2007–2008	400	13	54	46	157 (99)	1 (1)	0	158
	2008–2009	423	14	44	56	200 (99)	1 (1)	0	201
	2009–2010	511	13	49	51	223 (100)	0 (0)	0	223

^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 20 Unit 21D outside Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2004–2005 through 2009–2010

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
	2008–2009	16	44	44	56	5 (100)	0 (0)	0	5
	2009–2010	16	56	43	57	4 (100)	0 (0)	0	4
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
	2008–2009	2	0	50	50	1 (100)	0 (0)	0	1
	2009–2010	2	0	0	100	2 (100)	0 (0)	0	2
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
	2008–2009	25	48	38	62	8 (100)	0 (0)	0	8
	2009–2010	25	28	61	39	7 (100)	0 (0)	0	7
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
	2008–2009	31	55	50	50	7 (100)	0 (0)	0	7
	2009–2010	28	57	58	42	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
	2008–2009	25	80	60	40	2 (100)	0 (0)	0	2
	2009–2010	17	35	100	0	0 (0)	0 (0)	0	0
DM819	2007–2008	1	0	100	0	0 (100)	0 (0)	0	0

	2008–2009	1	100	0	0	0 (0)	0 (0)	0	0
	2009–2010	0	0	0	0	0 (0)	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
	2008–2009	34	50	82	18	3 (100)	0 (0)	0	3
	2009–2010	34	59	71	29	4 (100)	0 (0)	0	4

TABLE 21 Unit 21D moose hunter residency and success, regulatory years 1990–1991 through 2009–2010

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	112	79	13	1	205	274	126	22	0	422	627
2008–2009	141	112	10	0	263	268	106	18	1	393	656
2009–2010 ^b	121	115	9	0	245	319	157	29	0	505	750

^a Unit 21D and Ruby residents only.^b Preliminary data.

TABLE 22 Unit 21D moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2009–2010

Regulatory year	Harvest chronology percent by month/day				<i>n</i>
	8/22–8/31	9/1–9/14	9/15–9/25	2/1–2/10	
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	7	37	56	0	199
2008–2009	7	36	58	0	259
2009–2010 ^a	3	45	52	0	242

^a Preliminary data.

TABLE 23 Unit 21D moose harvest percent by transport method, regulatory years 1990–1991 through 2009–2010

Regulatory year	Harvest percent by transport method								<i>n</i>
	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	6	0	88	4	0	1	2	1	201
2008–2009	3	0	92	4	0	1	1	0	261
2009–2010 ^a	4	0	90	4	0	1	1	0	239

^a Preliminary data

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi²).

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 5,100–6,800 moose.
 - Unit 22A: maintain a population of 600–800 moose.

- Unit 22B West: increase and stabilize the population at 1,000–1,200 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: maintain a population of 2,000–2,500 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 (5,100–6,800 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 5,700–7,300 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 appears 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, 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. Aerial composition and recruitment surveys were completed using a Robertson R44 helicopter and a fixed-wing Piper PA12. Geospatial population estimation (GSPE) techniques were used in March 2008 to estimate abundance of moose in Units 22A (J. VerHoef, ADFG, pers. comm.). Poor survey conditions prevented a successful census in 2009. Population estimates from this reporting period are comparable to previous geospatial census efforts completed in Units 22A (March 2003) and Unit 22A (March 2005). The department administered registration moose hunts in the most heavily hunted areas along the Nome road system in Units 22B, 22C, and 22D. A registration hunt was also administered in the central portion of Unit 22A where the moose population is recovering and in season management of harvest is required. Short yearlings were weighed in Unit 22C and 22D to assess health of moose populations.

Browse surveys, using methods developed by Seaton (2002), were completed in 2004 and 2006 to assess shrub architecture of willows commonly found in areas of Unit 22 winter moose habitat. The surveys were completed to provide baseline information on browse health and to determine if winter browse quality played a role in areas with declining moose populations. Shrub architecture was categorized to estimate the proportion of shrubs exhibiting "broomed" growth form caused by repeated heavy browsing, and to determine shrub health by estimating the proportions of dead stems versus live biomass.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Summary results for population censuses completed in Units 22A, 22B, and 22C are discussed below, respectively, and are presented in Table 2.

Population Size

In the central portion of Unit 22A, a 2008 census estimated 339 moose (90% C.I. $\pm 23.5\%$) and showed a 40% increase since the previous census completed in 2005 (Table 2). Moose hunting was not allowed from 2005–2007 due to results from censuses completed in 2003 and 2005. We used a C-185 aircraft with 4 occupants (pilot and three observers) to stratify the census area of 406 sample units into 251 "highs" and 155 "lows". Low level intensive searches were conducted in 105 sample units (71 "highs" and 34 "lows") to locate and count moose. The GSPE technique found 0.14 moose/mi², 21 calves:100 adults (90% C.I. $\pm 29\%$) and a 21% recruitment rate. The 339 moose estimated in 2008 and 21% recruitment rate are the most encouraging numbers of moose estimated in the central portion of Unit 22A since census counts began in 1989 (Table 2).

The census scheduled in Unit 22B and 22C in 2009 was cancelled due to unfavorable weather conditions. Spring recruitment surveys were completed in the area to supplement the lack of census data and are summarized below.

Population Composition

Fall. We completed fall composition surveys using Piper PA-12 aircraft in several areas during the reporting period (Table 3). During October and November 2007 and 2008 we completed comprehensive surveys in Unit 22C. In 2008 composition surveys were completed in the Niukluk River drainage in Unit 22B and the Kuzitrin River drainage in Unit 22D.

Unit 22B. The 2008 moose composition survey completed in Unit 22B classified 122 moose in the Niukluk River drainage and found 34 bulls:100 cows, 15 calves:100 cows, and 10% calves. These results are consistent with surveys completed in the area since 1992.

Unit 22C. The 2007 moose composition survey completed in Unit 22C classified 137 moose in the Snake, Stewart, and Sinuk river drainages and found 17 bulls:100 cows, 27 calves:100 cows, and 19% calves. The composition survey completed in 2008 classified 211 moose in an expanded area (the Flambeau, Eldorado, and Bonanza rivers were added to the 2007 survey area) yielding summary data of 11 bulls:100 cows, 19 calves:100 cows, and 8% calves (Table 3). Surveys have historically found depressed bull:cow ratios in Unit 22C suggesting that hunt management should continue to protect bulls in the population.

Unit 22D. In 2008, we completed a composition survey in a portion of the Kuzitrin drainage, classified 174 moose and found 33 bulls:100 cows, 10 calves:100 cows, and 7% calves. (Table 3).

Spring. Results of short yearling recruitment surveys completed in several areas of Unit 22 during the reporting period are found in Table 4.

Unit 22C. In 2009 a spring survey was completed in Unit 22C including the Cripple, Sinuk, Penny, Snake, Nome, Flambeau, and Eldorado rivers. Staff observed 335 moose including 299 adults and 36 short yearlings and an 11% recruitment rate.

In spring 2009, we completed a survey covering the central portion of Unit 22D including the Kuzitrin, Kougarok, Noxapaga, and Pilgrim rivers. Staff observed 655 adults and 45 calves and a 6% recruitment rate.

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 1 moose originally captured and marked with an ear tags as a 10-month-old calf in a calf weight study project. A male moose, originally captured in the Eldorado River drainage near Nome, was harvested in the Nome River drainage approximately 20 air miles west of the capture site.

MORTALITY

Harvest

Seasons and Bag Limits. Changes were implemented in Units 22A, 22B, and 22D during the reporting period.

<i>2007–2008</i> Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik river drainages.</i>		
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
<i>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.</i>		
Residents: 1 bull.	15 Aug–25 Sep	
Nonresidents:		No open season
<i>Remainder of Unit 22A</i>		
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

2007–2008 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, Koyuk and Inglutalik rivers.</i>		
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
<i>Remainder of Unit 22B,</i>		
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
<i>Unit 22C</i>		
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
<i>Unit 22D, that portion within the Kougarok, Kuzitrin and Pilgrim river drainages</i>		
Residents: 1 antlered bull by registration permit only; or 1 antlered bull by registration permit only.	1 Sep–14 Sep 1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season

2007–2008 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>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.</i>		
Residents: 1 bull by registration permit only; or 1 bull by registration permit only.	1 Sep–14 Sep 1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
<i>Remainder of Unit 22D</i>		
Residents: 1 antlered bull or 1 moose; however antlerless moose may be taken only from 1 Dec 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
<i>Unit 22E</i>		
Residents: 1 antlered bull.	1 Aug–31 Dec	
Nonresidents:		No open season

2008–2009 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik river drainages.</i>		
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
<i>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.</i>		
Residents: 1 bull.	1 Sep–14 Sep	
Nonresidents:		No open season
<i>Remainder of Unit 22A,</i>		
Residents: 1 bull; or 1 antlered bull	1 Aug–30 Sep 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
<i>Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, Koyuk and Inglutalik rivers.</i>		
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

2008–2009 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>Remainder of Unit 22B</i>		
Residents: 1 bull by registration permit only; or 1 antlered bull by registration permit only.	1 Sep–14 Sep 1 Jan–31 Jan	
Nonresidents:		No open season
<i>Unit 22C</i>		
Residents: 1 bull by registration permit only; or 1 antlerless moose by registration permit; or 1 antlered bull by registration permit only.	1 Sep–14 Sep 15 Sep–30 Sep 1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents: 1 bull with 50- inch antlers or with 4 or more brow tines on at least one side.		1 Sep–14 Sep
<i>Unit 22D, that portion within the Kougarok, Kuzitrin and Pilgrim river drainages</i>		
Residents: 1 antlered bull by registration permit only; or 1 antlered bull by registration permit only.	1 Sep–14 Sep 1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
<i>Table continues next page</i>		

2008–2009 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
<i>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.</i>		
Residents: 1 bull by registration permit only; or 1 bull by registration permit only.	1 Sep –14 Sep 1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
<i>Remainder of Unit 22D</i>		
Residents: 1 antlered bull or 1 moose; however antlerless moose may be taken only from 1 Dec 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
<i>Unit 22E</i>		
Residents: 1 antlered bull.	1 Aug–31 Dec	
Nonresidents:		No open season

Board of Game Actions and Emergency Orders (EO).

In November 2007, several changes were made to moose regulations in Unit 22. The closure to hunting in central Unit 22A, initiated in 2005 in response to declining population, ended when the Board of Game authorized a resident registration hunt with 1–14 September season dates. The Board also authorized a “to be announced” resident winter season in Unit 22C to take place if the harvest quota wasn’t met during the 1–14 September registration hunt. The final change in

regulations applied to Unit 22E where the Board adopted a nonresident registration hunt with quota while also lengthening the resident winter hunting season one month to end 31 January.

There were no actions taken effecting Unit 22 moose regulations at the 2009 Board of Game meeting (after the reporting period).

In September 2007, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22D Southwest. The registration hunt area had a harvest quota of 8 bull moose that was anticipated to be met by 6 September. The EO was issued to prevent overharvest.

In September 2007, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22B, west of the Darby Mountains and Unit 22D, in the Kuzitrin River drainage (including the Pilgrim and Kougarok river drainages). The harvest quota of 18 bulls in Unit 22(B), west of the Darby Mountains and 39 bulls in Unit 22(D) Kuzitrin River drainage, were expected to be reached on September 9. The EO was issued to prevent overharvest.

In December 2007, the department issued an EO that opened winter registration permit hunt RM849 in Unit 22C. The fall harvest quota of 50 bulls during fall registration hunt RM840 was not met which left a surplus of 15 antlered bulls available for harvest during the winter hunt.

In January 2008, the department issued an EO that closed winter registration permit hunt RM849 in Unit 22C. The harvest quota of 15 antlered bulls was expected to be met on January 4. The EO was issued to prevent overharvest.

In January 2008, the department opened the resident season for antlered bull moose in Unit 22E. The season remained open until 31 January 2008. The EO expedited the January portion of the longer season adopted by the Board of Game in November 2007 by applying it to regulatory year 2007–2008, and also helped to satisfy the emergency request for additional moose hunting opportunity from residents of Wales, Alaska.

In January 2008, the department issued an EO that closed winter registration permit hunt RM849 in Unit 22B, west of the Darby Mountains. The winter harvest quota of 5 antlered bulls was reached, and the EO was issued to prevent overharvest.

In September 2008, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22B, west of the Darby Mountains. The harvest quota of 18 bulls was expected to be met by September 10, and the EO was issued to prevent overharvest.

In September 2008, the department issued an EO that closed fall registration permit hunt RM850 in Unit 22C. The harvest quota of 10 antlerless moose was reached on September 24, and the EO was issued to prevent overharvest.

In December 2008, the department issued an EO that opened winter registration permit hunt RM849 in Unit 22D Southwest and Unit 22D within the Kuzitrin River drainage (including the Pilgrim and Kougarok river drainages). The harvest quota of 47 bulls in these portions of Unit 22D was not met during the fall 2008 season leaving a surplus of antlered bulls available for harvest during the winter hunt. The hunt was open to residents only by registration permit and it had a harvest quota of 8 antlered bulls.

In January 2009, the department issued an EO that closed winter registration permit hunt RM849 in Unit 22B, west of the Darby Mountains. The winter harvest quota of 5 antlered bulls was reached on January 14, and the EO was issued to prevent overharvest.

Hunter Harvest. During the 2007–2008 season, harvest report data shows that 653 hunters harvested 200 moose (184 males, 15 females, and 1 unknown). A harvest of 175 moose (159 males and 16 females) was reported taken by 520 hunters during the 2008–2009 season (Table 1). The 200 moose harvested during the 2007 regulatory year was the highest reported moose harvest since the 2000 regulatory year when 221 moose were reported.

Moose harvest remained well below harvest levels seen in the 1980s. Hunters reported an annual average harvest of 343 moose from 1980–1989 when moose populations were at their highest densities. 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.

Permit Hunts. Two registration permit hunts for antlerless moose are administered in Unit 22C. Hunt RM850 occurs in the Nome and Snake river drainages, and RM852 occurs in the remainder of Unit 22C. In 2007, 4 cows were harvested in RM850, and 10 cows were harvested in RM852. In 2008, 9 cows were taken in RM850 and 12 cows were harvested in RM852 (Table 5).

Registration moose hunts with harvest quotas have been in place in the heavily hunted portions of Units 22B, 22C and 22D along the Nome road system. In 2007 a total of 492 people reported hunting in RM840 and 95 bull moose were harvested (Table 5). In Unit 22B West hunters harvested 18 bulls (100% of quota). In Unit 22C hunters harvested 30 bulls (60% of 50 bull quota). In Unit 22D Kuzitrin hunters harvested 39 bulls (100% of quota). In 22D SW, hunters harvested the full quota of 8 moose.

In 2007, winter registration moose hunt RM849 was administered in Unit 22B, west of the Darby Mountains, and hunters harvested 5 antlered bulls (100% of 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. A RM849 winter registration hunt also occurred in Unit 22C, with a quota of 15 antlered bulls. The fall harvest quota in Unit 22C was not reached and hunters harvested 11 antlered bulls (73% of quota) during the winter hunt.

In 2008, a total of 477 people reported hunting in RM840 and 98 bull moose were harvested (Table 5). In Unit 22B West hunters harvested 19 bulls out of the 18 bull quota (105% of quota). In Unit 22C, hunters harvested 40 bulls (100% of quota). In Unit 22D, Kuzitrin, hunters harvested 36 bulls (77% of 47 bull quota). In 22D SW hunters harvested 3 moose out of an 8 bull quota (38% of 8 bull quota). In Unit 22A hunters harvested 15 moose (14 bulls and 1 cow) in RM841 the central portion of Unit 22A where the combined state and federal quota was 14 bull moose (107% of quota).

In 2008, winter registration hunt RM849 was administered in Unit 22B, Unit 22D Southwest and Unit 22D within the Kuzitrin River drainage (including the Pilgrim and Kougarok river

drainages). Hunters harvested 5 antlered bulls (100% of quota) in Unit 22B West, and 1 of 8 antlered bulls (13% of quota) in the Unit 22D hunt areas.

In 2007, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Seventeen hunters reported in RM842, 15 nonresidents hunted, and 10 bulls were taken. In 2008, nonresident registration hunt RM842 was administered in Unit 22D Remainder, and 15 hunters reported. Fourteen nonresident hunters hunted and 7 bulls were harvested (Table 5).

There was one drawing permit hunt administered during the reporting period. There are up to 8 permits issued annually for DM845 that allow nonresident hunters to harvest moose in Unit 22B, east of the Darby Mountains. In 2007, 8 permits were issued and 6 hunters hunted, of which 4 hunters harvested bull moose. In 2008, 8 permits were issued and 2 hunters hunted, of which 0 hunters harvested bull moose.

The registration hunts with harvest quotas require reporting within 3 days of harvesting a moose. 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 88% of the harvest in 2007–2008 and 90% of the harvest in 2008–2009 (Table 6). From 1994–2004 the proportion of harvest attributable to local residents remained between 69–74%; however, 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 8% of the harvest in 2007 and 5% in 2008.

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 (75%), and January 9%. Hunters harvested 88% of Unit 22 moose during the months of August, September, and October during the reporting period.

Transport Methods. During this reporting period 38% of successful moose hunters used four wheelers (three-wheelers not used in reporting period), 25% used boats, 11% used highway vehicles, 10% used snowmachines, and 8% used off road vehicles (Table 8). Only 4% 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, presumably by brown bears since anecdotal and harvest information suggest wolf numbers were relatively low during the collaring study period. Wolves have become more numerous on the Seward Peninsula, especially in areas occupied by wintering caribou from the Western Arctic herd and muskox populations increased and expanded range eastward.

HABITAT

Assessment

Habitat surveys were not completed during the reporting period, and are next scheduled for March 2010. We completed browse surveys in 2004 and 2006 to help determine whether habitat limitations are contributing to the long-term decline of moose populations in parts of the unit. 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.

Along with moose browse biomass surveys, adult female twinning rates, and adult female parturition rates, 10-month old calf weights are considered an indicator of nutritional health in interior Alaska moose populations (Boertje et al 2007). Research completed on interior Alaska moose populations found short-yearling weights less than 385 lbs. were an indication moose were resource limited. During April 2006–2009 department staff weighed male and female 10-month old moose calves to further assess nutritional health of Unit 22 moose populations. A total of 118 moose were weighed, with no significant difference between males and females ($P=0.12$). A sample of 29 moose weighed during April 2006 in Units 22B and 22C found average weights of 417 lbs and 411 lbs respectively. A sample of 30 moose weighed during April 2007 in Units 22C and 22D found average weights of 419 lbs and 379 lbs respectively (Table 10). A sample of 30 moose weighed during April 2008 in Units 22C and 22D found average weights of 374 lbs and 393 lbs respectively. Short yearlings weighed during 2008 were born during the deeper than normal snow year of 2007, which National Weather Service data show as the 3rd deepest snow fall in Nome's history. A sample of 30 moose weighed during April 2009 in Units 22C and 22D found average weights of 371 lbs and 372 lbs respectively. Short yearlings weighed during 2009 were born during another deep snow year in 2008, which National Weather Service show as the 2nd deepest snow fall in Nome's history. Although the sample set from this project is small ($n=118$), initial results indicate short yearlings from the smaller river drainages in Unit 22C tended to be more affected by changes in annual snow depth than their counterparts in the central portions of the Seward Peninsula during 2006–2009 compared to moose weighed in the larger Kuzitrin and Pilgrim river drainages. Although calf weights in Unit 22D are consistently low (381 lbs, 2007–2009), low weights in Unit 22D may be influenced by competition for browse related to higher densities of moose associated with broad riparian zones. In contrast, the smaller drainages in Unit 22C have lower density, less competition for browse yielding high calf weights, except in years when browse is unavailable due to deep accumulation of snow. Less extensive winter habitat in Unit 22C compared to the larger river drainages may mean that deep snow limits moose mobility and dramatically reduces the availability of forage. Future research may substantiate this snow-forage interaction.

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. Subsequent declines since the 1980s were likely caused by a combination of winter mortality, reduced productivity, low recruitment, and increased predation, reducing the population size to between 4,500 and 6,500 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 the Western Arctic caribou herd 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 provide 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 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. 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: 2010–Units 22B/C, 2011–Units 22D/E, 2012–Units 22A, and 2013–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 regulatory change is required in areas of Unit

22 off the Nome road system this program should be continued to provide ongoing estimates of moose harvest and subsistence use of moose by village residents.

LITERATURE CITED

GEORGETTE S. 1999. Subsistence harvests in Northwest Alaska: caribou, moose, bear, wolf, wolverine May 1998 through April 1999. Unpublished. Maniilaq Association, Kawerak, Inc., and Alaska Department Fish and Game. Kotzebue. 20pp.

GEORGETTE S. 2000. Subsistence Harvests in Northwest Alaska: caribou, moose, bear, wolf, wolverine 1999–2000. Unpublished. Alaska Department Fish and Game. 16pp.

GEORGETTE S. 2001. Subsistence Wildlife Harvests in Four Communities on the Western Seward Peninsula, Alaska: 2000–2001. Unpublished. Alaska Department Fish and Game. 19pp.

GEORGETTE S. 2004. Subsistence Wildlife Harvests in Five Northwest Alaska Communities, 2001–2003. Unpublished. Alaska Department Fish and Game. 19pp.

MACHIDA S. 1997. Unit 22 moose survey-inventory progress report. Pages 38–39 in MV HICKS, ed. Moose. Survey-Inventory Management Report. Alaska Department Fish and Game. Federal Aid Wildlife Restoration. Progress Report. Grant W–24–5 Study 1.0 Juneau. 43pp.

NELSON R.R. 1995. Unit 22 moose survey-inventory progress report. Pages 405–419 in MV HICKS, ed. Moose. Survey-inventory management report. Alaska Department Fish and Game. Federal Aid Wildlife Restoration. Progress. Report. Grant W–23–1, W–24–1 and W–24–2. Study 1.0. Juneau. 510pp.

PARAGI T. 2002. Moose range reconnaissance in GMU 18 (Lower Yukon and Kuskokwim rivers). Memorandum, ADF&G files, Fairbanks. 8p.

PARAGI T. 2004. Moose range reconnaissance in GMU 22C. Memorandum, ADF&G files, Fairbanks. 7p.

PERSONS K. 2005. Summary of a 2005 Moose Browse Survey in the Unalakleet River drainage. ADF&G files, Nome. 5p.

BOERTJE, R., K. KELLIE, C. T. SEATON, M. KEECH, D. YOUNG, B. DALE, L. ADAMS, AND A. ADERMAN. 2007. Ranking Alaska Moose Nutrition: Signals to Begin Liberal Antlerless Harvests. *J. Wildl. Mgmt* 71(5): 1494–1506; 2007.

SEATON, C.T. 2002. Winter foraging ecology of moose on the Tanana Flats and Alaska Range foothills. M.S. Thesis. University of Alaska, Fairbanks. 101 p.

SEATON C.T., R.D. BOERTJE, T. F. PARAGI, C.L. FLEENER, S.D. DUBOIS, D.B. GRIFFITH. *In Press*. Relationships between removal of browse biomass and moose productivity and density. *Alces* 00:000–000.

KAWERAK, INC., NORTH PACIFIC RESEARCH BOARD, ALASKA DEPARTMENT OF FISH & GAME, 2005–2006. Comprehensive Subsistence Harvest Survey, Bering Strait/Norton Sound Region.

PREPARED BY:

Tony Gorn
Wildlife Biologist III

SUBMITTED BY:

Peter Bente
Management Coordinator

Please cite any information taken from this section, and reference as:

GORN, T. 2010. Unit 22 moose management report. Pages 522–550 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 22 historical moose harvest by sex, hunter effort, and success rate for regulatory years 1969–1970 through 2008–2009.

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
2007–2008	184	15	1	200	653	31
2008–2009	159	16	0	175	520	34

^a Minimum known number of hunters.

Table 2. Summary of Unit 22 spring moose censuses, 1987–2008.

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 22A Unalakleet Drainage	2008	2400	282	60	339	0.12	0.14	21	21	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	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	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
Unit 22E	1996	NA	164	32	196	NA	NA	20	16	Riparian
Unit 22E	2001	NA	157	12	169	NA	NA	8	7	Riparian
Unit 22E	2003	4500	408	96	504	0.09	0.11	2324	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 2000–2009.

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	66
Golsovia River	2003	50	67	8	31	18	26
Unalakleet River	2006	69	34	20	26	58	78
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
	2008	34	15	12	10	110	122
	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
	2007	17	27	26	19	111	137
	2008 ¹¹	11	10	17	8	194	211
	2009 ¹	13	19	38	14	230	268

--continues next page--

Table 3 continued.

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
	2008	33	10	12	7	162	174
Agiapuk	2000	44	23	43	14	275	318
	2001	30	6	5	4	107	112
	2003	24	27	40	18	183	223

¹ Expanded survey area included Snake, Stewart, Flambeau, Eldorado, and Bonanza river drainages.

Table 4. Unit 22 short yearling recruitment surveys, spring 1991–2009.

Survey area and survey year	Nr. calves	Nr. adults	Total	Percent Calves
<u>Unalakleet, main stem (Unit 22A)</u>				
2000	7	77	84	8
2003	3	16	19	16
2006	13	37	50	26
2007	12	70	82	15
<u>Central Portion (Unit 22A)</u>				
2006	27	137	164	16
2007	12	82	94	13
<u>Shaktoolik, main stem (Unit 22A)</u>				
2000	5	40	45	11
2003	2	11	13	15
<u>Ungalik, main stem (Unit 22A)</u>				
2000	1	28	29	3
2003	0	1	1	0
<u>Golsovia drainage (Unit 22A)</u>				
2000	4	11	15	27
2003	6	23	29	21
<u>Pikmiktalik main stem (Unit 22A)</u>				
2000	2	4	6	33
2003	6	11	17	35
<u>Fish River (Unit 22B)</u>				
1991	12	202	214	6
1993	11	227	238	5
1994	15	255	270	6
1995	16	384	400	4
<u>Niukluk River (Unit 22B)</u>				
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
<u>West of Darby Mountains (Unit 22B)</u>				
2006	19	189	208	9
2007	3	83	86	3
<u>Koyuk River (Unit 22B)</u>				
1999	21	208	229	9
2000	19	223	242	8
2004	12	54	66	18
2005	13	89	102	13

--continues next page--

Table 4 continued

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
2009	9	69	78	12

22C Expanded ¹

2009	36	299	335	11

Lower Kougarak 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
2009	14	196	210	7

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
2007	25	298	323	8
2009	8	164	172	5

Kuzitrin Below Bridge (Unit 22D)

2000	17	271	288	6
2003	16	87	103	16
2009	20	226	246	8

Pilgrim River (Unit 22D)

2009	3	69	72	4

American River (Unit 22D)

1995	51	248	299	17

Agiapuk/American (Unit 22D)

2003	74	246	320	23

¹ Includes Cripple, Sinuk, Penny, Snake, Nome, Flambeau, and Eldorado rivers.

Table 5. Unit 22 Registration moose hunt statistics for regulatory years 2007–2008 and 2008–2009.

Reg Year	Hunt	Total moose killed	Males killed	Females killed	Unknown killed	Total permittees reporting	Hunted	Did not hunt
2007	RM840	95	95	0	0	492	407	85
2007	RM842	5	5	0	0	17	12	5
2007	RM849	16	16	0	0	73	39	34
2007	RM850	4	0	4	0	7	5	2
2007	RM852	10	0	10	0	17	15	2
2008	RM840	98	93	0	5	477	394	83
2008	RM841	10	9	1	0	84	59	25
2008	RM842	7	7	0	0	15	14	1
2008	RM849	7	7	0	0	21	16	5
2008	RM852	12	0	12	0	26	21	5
2008	RM850	9	0	9	0	15	14	1

Table 6. Residency and success of moose hunters in Unit 22, regulatory years 2007–2008 and 2008–2009.

Regulatory Year/Unit	Residency of successful hunters					Residency of unsuccessful hunters				
	Unit ^a	State ^b	Nonresident	Unknown	Total	Unit ^a	State ^b	Nonresident	Unknown	Total
<u>2007–2008</u>										
22A	14	2	3	0	19	15	1	0	0	16
22B	27	4	7	0	38	62	15	5	5	87
22C	51	2	1	1	55	144	18	8	0	170
22D	51	14	5	1	71	122	18	8	0	148
22E	15	2	0	0	17	17	5	1	0	23
22	0	0	0	0	0	8	2	0	0	10
Total	158	24	16	2	200	368	59	22	5	454
<u>2008–2009</u>										
22A	13	0	1	4	18	55	3	1	1	60
22B	29	1	0	2	32	64	9	1	0	74
22C	58	3	0	0	61	156	7	6	2	171
22D	42	10	7	1	60	110	20	7	1	138
22E	6	4	1	6	17	6	3	6	7	22
22	0	0	0	0	0	0	0	0	0	0
Total	148	18	9	13	188	391	42	21	11	465

^a Resident of Unit 22.^b Other Alaska resident.

Table 7. Chronology of Unit 22 moose harvest, regulatory years 2007–2008 and 2008–2009.

Regulatory year/ Unit	Month of harvest									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
<u>2007–2008</u>										
22A	8	7	0	0	0	3	0	0	1	19
22B	5	24	0	0	0	8	0	0	1	38
22C	0	44	0	0	0	11	0	0	0	55
22D	1	59	8	0	2	1	0	0	0	71
22E	2	5	8	0	2	0	0	0	0	17
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	16	139	16	0	4	23	0	0	2	200
<u>2008–2009</u>										
22A	1	13	0	0	0	4	0	0	0	18
22B	7	20	0	0	0	5	0	0	0	32
22C	0	59	0	0	0	0	0	0	2	61
22D	1	51	6	0	1	1	0	0	0	60
22E	2	8	1	0	3	0	0	3	0	17
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	11	151	7	0	4	10	0	3	2	188

Table 8. Means of transportation reported by successful Unit 22 moose hunters, regulatory years 2007–2008 and 2008–2009.

Regulatory Year/Unit	Aircraft	Horse	Boat	3 or 4 Wheeler	Snowmobile	Off-road vehicle	Highway vehicle	Air boat	Unknown	Total
<u>2007–2008</u>										
22A	3	0	10	3	2	0	0	0	1	19
22B	2	0	18	9	5	2	0	0	2	38
22C	1	0	6	17	10	4	15	0	2	55
22D	0	0	19	29	3	10	8	1	1	71
22E	2	0	2	8	2	3	0	0	0	17
Total	8	0	55	66	22	19	23	1	6	200
<u>2008–2009</u>										
22A	0	0	10	3	4	0	1	0	0	18
22B	0	0	20	6	5	0	1	0	0	32
22C	5	0	2	36	0	3	15	0	0	61
22D	2	0	11	28	3	8	4	0	4	60
22E	0	0	0	8	6	2	0	0	1	17
Total	7	0	43	81	18	13	21	0	5	188

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

^aNumber of shrubs categorized along linear transect, across all transects in count area.

^bIndex is proportion of shrubs receiving any browsing that were broomed ($((\text{broomed} / [\text{browsed} + \text{broomed}]) * 100)$), by respective herbivore.

^cAverage number of dead shrubs encountered during the course of getting 30 live shrubs to evaluate.

Table 10. Short-yearling moose weight results in parts of Unit 22, 2006- 2009.

Year	Unit 22B		Unit 22C		Unit 22D Kuzitrin drainage	
	Nr	Mean weight, lbs	Nr	Mean weight, lbs	Nr	Mean weight, lbs
2006	15	417	14	411		
2007			14	419	16	379
2008			5	374	24	393
2009			16	371	14	372

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009

LOCATION

GAME MANAGEMENT UNIT: 23 (43,000 mi²)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range and Kotzebue Sound.

BACKGROUND

Moose began to appear in the eastern portion of Unit 23 during the 1920s and expanded their range to the Chukchi Sea coast by the mid-to-late 1940s (LeResche et al., 1974). Moose currently rank second to caribou as a source of terrestrial meat for most residents of the unit. Moose are also avidly sought 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 grizzly bears 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 remained at low levels in large portions of the unit (Dau, 2008).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Sustain moose populations at stable or increasing levels in all major drainages.
- Maintain healthy age and sex structures of moose populations within Unit 23.
- Monitor human and natural mortality factors affecting moose.
- Improve public understanding of regulations and their purpose.

MANAGEMENT OBJECTIVES

- Annually monitor the size and sex/age composition of moose populations in the Noatak, Kobuk, and Selawik river drainages or Northern Seward Peninsula drainages on a rotational basis through aerial surveys.
- Maintain a Unit 23 adult moose population of 8,100– 10,000.
 - Noatak River and northern drainages 2,000– 2,300 moose.
 - Upper Kobuk River drainage 600– 800 moose.
 - Lower Kobuk River drainage 2,800– 3,400 moose.
 - Northern Seward Peninsula drainages 700– 1,000 moose.
 - Selawik River Drainage 2,000– 2,500 moose.
- Maintain a minimum November ratio of 40 bulls:100 cows in all areas but the Lower Kobuk, where bull:cow ratios are known to be skewed by its disproportional use by maternal cows.
- Analyze harvest data for changes that may indicate a potential conservation concern.
- Evaluate hunting regulations and recommend changes if necessary.
- Through public education, vendor support, and communication, increase the understanding of regulations and improve reporting compliance.

METHODS

During this reporting period moose population trend and sex/age composition data were collected through aerial surveys using the geospatial technique (Geospatial Population Estimate, or GSPE; Kelly and DeLong 2006). Geospatial surveys have been performed in the spring to monitor density of moose since 1999 due to difficult fall survey conditions. Surveys are conducted in coordination with federal partners that may include USFWS, NPS, and BLM. Two spring moose surveys were conducted in Unit 23 since the last report was prepared:

1. 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).
2. That portion of Unit 23 west of and including the Buckland River drainage (April 2009; cooperative project with NPS, FWS and BLM).

In defining geospatial moose survey areas we excluded areas that were obviously not moose habitat, e.g. high alpine areas typical of sheep habitat and very large lakes. For most moose survey areas sample boxes were subjectively excluded; however, for some areas, a quantitative

GIS based exclusion criteria was generated. Included were large areas of open tundra, as well as the headwaters of rivers and creeks even though such areas are often poor moose habitat. These more marginal areas are considered because at higher moose densities, e.g. the late 1980s, they were utilized. Even now, at lower densities, a few moose still use these poor to marginal habitats. An inclusive survey approach that covers geographically large areas (e.g., >4000 mi²) 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 survey results; and 3) reduces the temptation to perpetually ‘adjust’ survey boundaries through time to fit changing environmental conditions. Adult moose densities are reported here, rather than total moose densities, as a measure of abundance to avoid natural, short-term variation associated with calf production and survival.

In addition to quantitative moose surveys, moose were classified by aerial survey in the western half of Unit 23 during October through early December 2004– 2007. Fall weather is chronically poor in northwest Alaska and snow conditions are often not conducive to observing moose. As a result, a fall moose composition survey had not been conducted in Unit 23 since 1999. These factors remain unchanged; however, new sampling strategies have allowed for fall moose composition estimates to be completed despite these obstacles. Sampling efforts focused on the Noatak River drainage below and including the Nimiuktuk River drainage; the main stem of the lower Kobuk River drainage; the main stem of the Squirrel River drainage; the Kiana and Selawik Hills; the Selawik River drainage below and including the western portion of the Purcell Mountains; and most drainages on the Northern Seward Peninsula. Sampling protocol is further described in Dau (2008). These reconnaissance surveys provided information for desktop stratification to be used in future quantitative geospatial composition surveys. It also provided intermediary “red flags” for potential sex ratio issues while a geospatial approach was developed.

In 2008, ADFG, in cooperation with USFWS and NPS, conducted a fall moose geospatial composition survey of the Selawik and Kauk river drainages. This survey area matched that used for the 2007 Selawik spring moose population estimate. Desktop stratification and several reconnaissance flights were used to determine ‘high’ and ‘low’ strata.

Harvest information was derived from harvest reports. Community-based harvest assessments were also used to estimate moose harvests by unit residents and are believed to be a more accurate indicator of local resident harvests. Hunters, both successful and unsuccessful reported the drainage in which they hunted. The term “nonlocal hunters” refers to residents of Alaska who reside outside Unit 23 and nonresidents. “Local hunters” refers to residents of Unit 23. “Nonlocal Alaskan” hunters refer to residents of Alaska who reside outside Unit 23.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Spring geospatial population estimates indicate Unit 23 adult moose densities range from 0.1–0.6 adult moose/mi² (Table 1). Adult density appears to be stable based on the 3 large sample areas that have been surveyed at least twice using the GSPE approach (Lower Noatak-Upper Squirrel; Northern Seward Peninsula; and Upper Kobuk).

We have not applied a sightability correction factor (SCF) in any geospatial population estimates conducted in Unit 23 and therefore likely underestimate the population to some degree. Sightability of moose is probably high in those portions of this unit with open cover. Even so, moose densities are undoubtedly underestimated to some degree even where trees are sparse (Quayle et al. 2001). Given the relatively low density of moose throughout Unit 23, these slightly conservative estimates of moose afford 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 (Harper 2008) 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/mi², 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 River drainage and northern portion of the Selawik Hills also have high, localized densities of moose on a seasonal or even annual basis.

Population Composition

Spring (March/April) calf:adult ratios were 10–15:100 during this reporting period (Table 1). Due to conflicts with other work, we have not conducted moose parturition surveys in Unit 23. Calf:cow ratios in fall composition surveys range from 12– 34:100 cows as some areas naturally contain higher concentrations of maternal cows.

Reconnaissance surveys conducted from 2004–2007 found a unitwide mean bull:cow ratio of 39:100 (Table 2). Bull:cow ratios ranged from 26–50:100 among drainages covered. Based on spring survey density estimates, the proportion of moose population observed each year was 20–35%.

The fall 2008 geospatial composition estimate for the Selawik River drainage resulted in a bull:cow ratio of 54:100 (Table 2). These data are not comparable to reconnaissance surveys and are therefore not indicative of a change in sex and age composition. Rather, it may suggest that bulls are more likely to be missed in non-randomized surveys. Conversely, reconnaissance surveys and the geospatial composition estimate show the same calf:cow ratio in the Selawik River drainage, 18:100.

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 congregate during periods of deep snow (Coady 1974)).

MORTALITY

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
<u>2007–2008 and 2008–2009</u>		
Unit 23 north of and including the Singoalik River drainage: One bull with 50-inch antlers or antlers with 4 or more brow tines on one side. OR One 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 Sep–20 Sep (general hunt) (harvest ticket) 1 Jul–31 Dec (registration hunt)	1 Sep–20 Sep (drawing permit only)
Remainder of Unit 23: One bull with 50-inch antlers or antlers with 4 or more brow tines on one side. OR One 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 Sep–20 Sep (general hunt) (harvest ticket) 1 Aug–31 Dec (registration hunt)	1 Sep–20 Sep (drawing permit only)

Board of Game Actions and Emergency Orders. The board reauthorized antlerless moose seasons for the 2007–2008 and 2008–2009 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 64 and 60 moose unit residents indicated on harvest reports in 2007–2008 and 2008–2009, respectively. Although establishment of registration permit hunt (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. Harvest ticket and registration permit data are likely reasonably accurate for nonlocal hunters based on field contacts by the local Alaska wildlife trooper. Combining harvest report data for nonlocal hunters (59 moose in 2007–2008 and 85 moose in 2008–2009) with community harvest assessments for local hunters (mean harvest of 417 moose annually) indicates the total annual moose harvest in Unit 23 was roughly 475–500 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. Conversely, local moose harvests during 1979–1994 (Figure 3) may have declined due to increased caribou availability.

Based on harvest report data, there has been a stable trend in the total moose harvest from since the late 1970s (Table 4; Figure 1). In contrast, the total number of moose hunters generally increased since the early 1980s (Figure 1). Prior to the 2003–2004 regulatory year, most of this increase in hunters was due to nonlocal Alaskan hunters and nonresident hunters (Figure 2). However, after 2003–2004 harvest reports indicate that the number of local moose hunters increased rapidly. This is likely not indicative of an actual increase in local moose hunters, but is a product of better effort and harvest tracking with the establishment of the RM880 hunt. As overall hunter numbers in Unit 23 increased, success rates slowly declined (Figure 3). However, in the years following establishment of nonresident drawing moose hunts, success rates among that group increased. As in the past, the reported harvest of female moose was small during 2007–2008 and 2008–2009 in terms of absolute numbers (about 7 taken each year; Table 5), and in relation to total harvest (6% and 5%, respectively).

Since the early 1980s, numbers of moose hunters and harvest levels have generally declined in the Noatak River drainage and increased in the Kobuk River drainage (Figure 4). Effort in the Wulik-Kivalina drainages and the drainages of the Northern Seward Peninsula has remained low and stable over time. The Selawik River drainage was increasingly used until 2002. Since that time, the Selawik has received a decreasing number of hunters. This may be attributable to the scarcity of caribou in southern portions of the unit during most recent years until late fall (October) and the desire of many hunters to conduct a multi-species hunt.

Permit Hunts. At the 2003 Board of Game meeting, 2 types of permit hunts were established for moose in Unit 23: an optional registration hunt (RM880) for resident hunters, and mandatory drawing permit hunts (DM871–877) 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 and disproportionate hunting pressure.

Drawing permit hunts for nonresident hunters were instituted 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 (Figures 2 and 3).

The resident registration hunt (RM880) was instituted in 2004–2005 and is described by Dau (2006). During this reporting period, most local resident moose hunters (mean=80%) participated in RM880 (Table 6). In contrast, most nonlocal Alaskan moose hunters (mean=75%) hunted under the general hunt. However, this pattern appears to be changing as a higher proportion of nonlocal hunters are acquiring RM880 permits. RM880 permits provide a longer season and allow for the take of “any bull.” Additionally, RM880 hunters may take an antlerless moose after 1 November. Therefore, the RM880 permit is attractive as it provides the most liberal hunt opportunity. Patterns in moose harvest by hunt type were similar among local and nonlocal Alaska hunters (Table 6).

Hunter Residency and Success:

As mentioned previously, the number of hunters in Unit 23 generally increased from the early 1980s until 2005–2006, when the overall number of moose hunters in Unit 23 dipped below the level of 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; however, the following year the total number of hunters increased sharply. This was mostly accounted for by an increase in the number of local resident hunters as they learned about RM880 (Figure 2). The number of nonlocal Alaskan hunters has remained mostly constant but did decline slightly when RM880 came in place. Nonlocal Alaskan hunters may be more affected by changes in the economy than changes in regulations.

Success rates among all users declined steadily beginning in 1970 and stabilized in the mid-1990s (Figure 3). This is likely related to changes in the moose population. As in past years, nonresident hunters had a higher success rate than nonlocal Alaskan 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, the majority of moose were harvested in September, a time when several factors contribute to successful hunting: mild weather conducive to airplane and boat access, seasons open for residents and nonresidents, and antlers free of velvet. In 2007–2008, 76% of the reported harvest occurred during September, and in 2008–2009, this percentage was 75%. Eleven and 14% of the total harvest was taken during August during these regulatory years, respectively.

Transport Methods: Airplanes were the primary mode of transportation for most hunters who reported hunting moose in Unit 23 until 2005 (Table 7). However, as numbers of local residents who reported hunting moose have increased while numbers of nonlocal hunters have decreased, since 2005–2006 boat hunters have equaled or exceeded numbers of airplane hunters. 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 affects moose population dynamics in Unit 23; however, the relative importance of predators in relation to other factors affecting moose, such as weather conditions, snow depth, forage, disease and human harvests is unknown. 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 ADF&G 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 River 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 River 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 seem to have diminished since fall 2006. The nature and reasons contributing to user conflicts have been previously described (Dau 2002). User conflicts are still perceived by some, but may have decreased due to the following reasons:

- In 2008, a stakeholder group was formed to address conflicts among users in Unit 23.
- ADFG has developed outreach materials highlighting issues that have contributed to tensions and how they can be avoided.
- The presence or absence of high profile individuals may influence the perception of commercial operators as a whole.
- Economic factors may influence the number of hunters visiting the area.
- Regulatory changes have influenced the number of nonresidents and nonlocal Alaska residents using the area.

CONCLUSIONS AND RECOMMENDATIONS

Continued monitoring of the moose populations in Unit 23 is essential to our understanding of moose management in areas with low moose densities. Adult density appears to be stable based on comparison of GPSE results in 3 large sample areas that have been surveyed at least twice since 2000 (Lower Noatak-Upper Squirrel; Northern Seward Peninsula; and Upper Kobuk). Calf production in the same areas appears stable or increasing.

The department should continue with the strategy of monitoring moose abundance by conducting spring population estimates over large areas (4,000–10,000 mi²). Covering large areas minimizes the effects of moose movements on density estimates, and ensures the full range of habitat types and qualities are included. Snow and light conditions are optimal for observing moose during spring. Sampling areas should rotate each year so data is regularly collected from each area.

Collecting information on sex and age composition is essential for monitoring the effects of potentially selective harvest. Use of a geospatial approach provided better results with measures of precision compared to reconnaissance surveys, but requires more time and resources. The department continues to examine ways to increase sampling efficiency.

As hunters continue to improve their understanding of the requirements for hunting in Unit 23, reporting compliance will continue to improve. However, community-based harvest assessments in villages throughout Unit 23 will likely continue to be the most accurate way to monitor local harvests.

Future effort in Unit 23 should focus on habitat assessment using browse surveys, parturition surveys or twinning surveys (or some combination.)

LITERATURE CITED

- ALASKA DEPARTMENT OF FISH AND GAME. 2008. Moose management progress report of survey-inventory activities. P. Harper, editor. Alaska Department Fish and Game. Federal Aid in Wildlife Restoration. Grants W-33-4 and W-33-5. Study 1.0. Juneau, Alaska.
- COADY J. W. 1974 Influence of Snow on Behavior of Moose. *Le Naturaliste Canadien* 101: 417–436.
- DAU J. 2008. Unit 23 moose management report. Pages 558–578 *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, Alaska.
- GASAWAY W. C., S. D. DUBOIS, D. J. REED AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biology Paper No. 22. University Alaska Fairbanks, Alaska.
- KELLY K. A. AND R. A. DELONG. 2006 Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA.
- LERESCHE R. E., R. H. BISHOP, AND J.W. COADY. 1974. Distribution and habitats of moose in Alaska. *Le Naturaliste Canadien*, Vol. 101: 143–178.

QUAYLE J. F., A. G. MACHUTCHON, AND D. N. JURY. 2001. Modeling moose sightability in South-Central British Columbia. *Alces* Vol. 37 (1): 4354.

PREPARED BY:

Charlotte Westing
Wildlife Biologist III

SUBMITTED BY:

Peter Bente
Management Coordinator

REVIEWED BY:

Jim Dau
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

Westing, C. 2010. Unit 23 moose management report. Pages 551–571 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

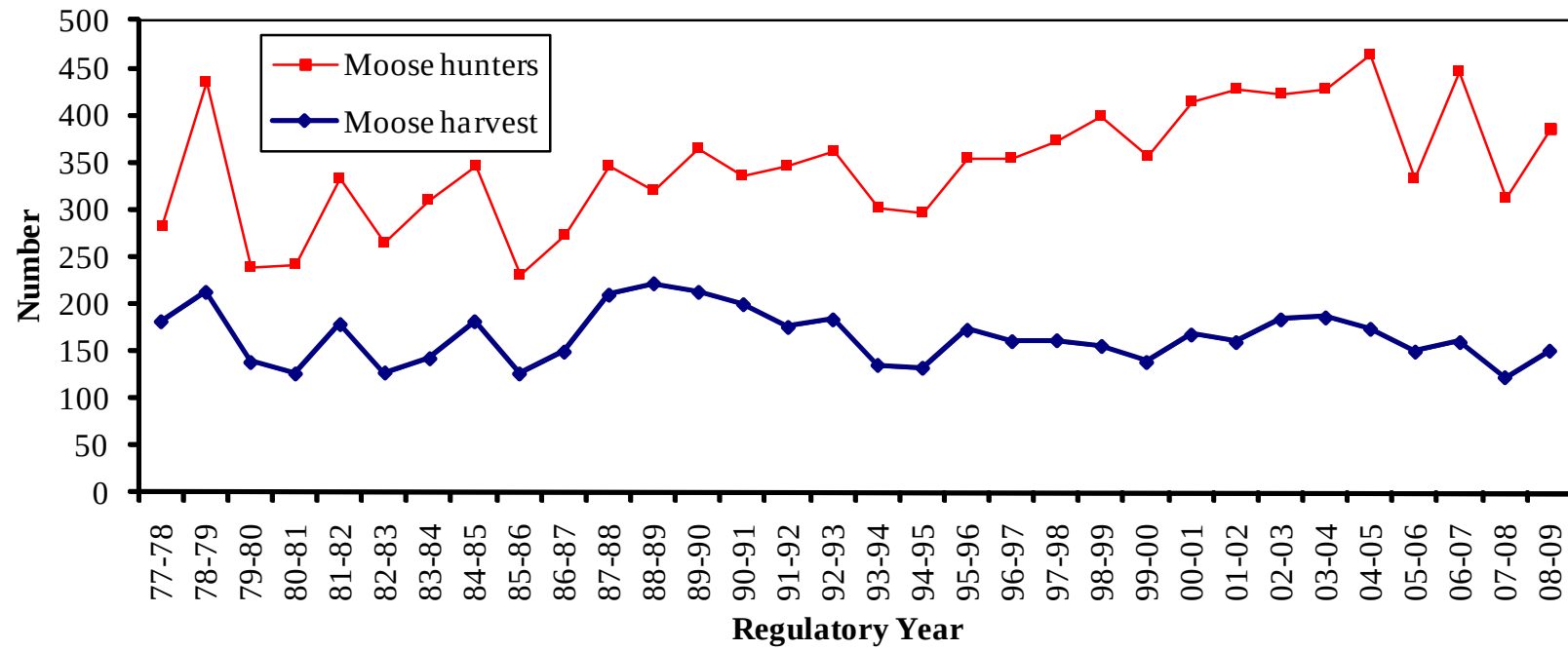


Figure 1. Unit 23 moose hunters and harvests (harvest and registration report data), 1977–1978 through 2008–2009.

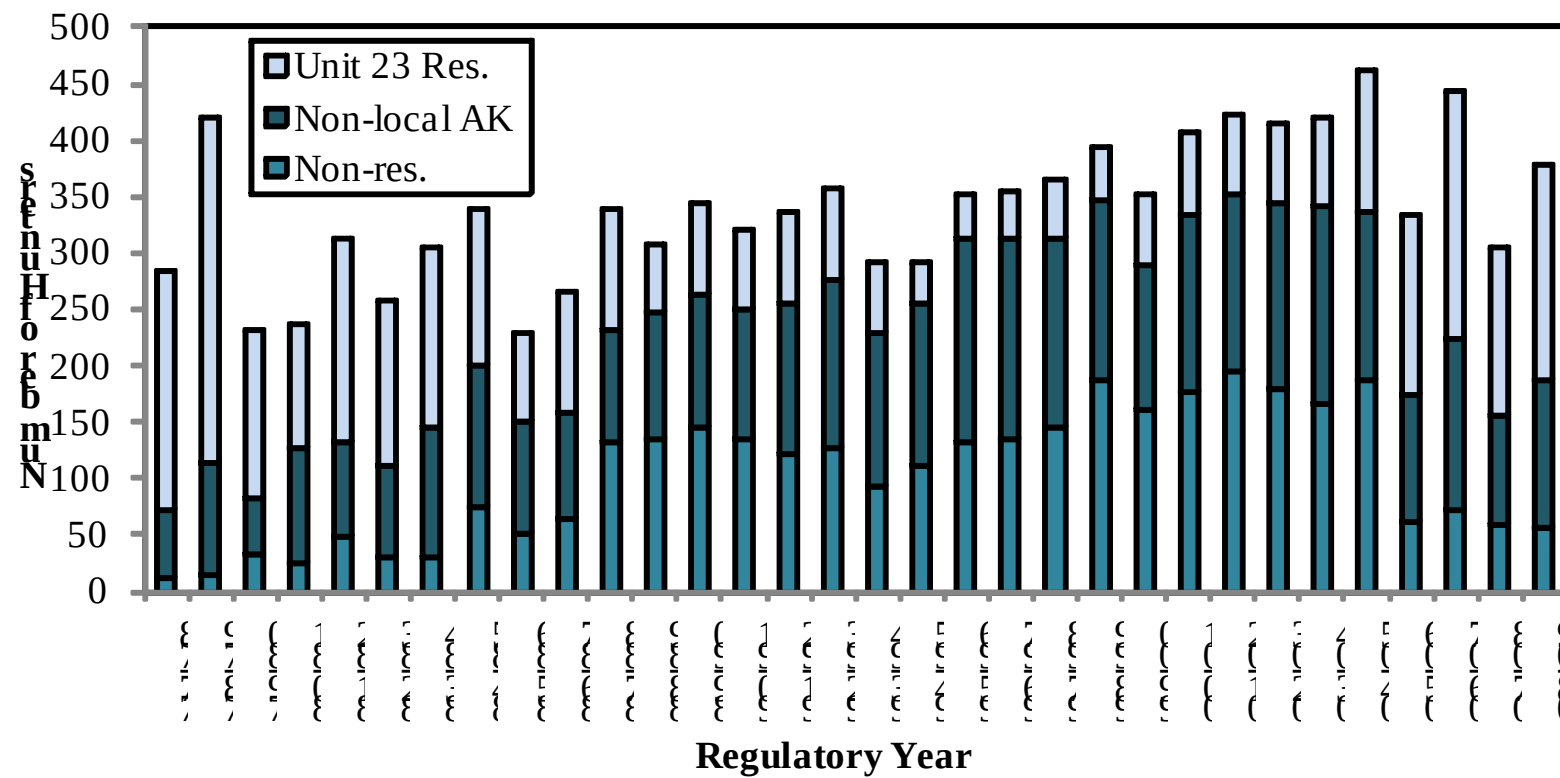


Figure 2. Numbers of moose hunters in Unit 23 by residency (harvest and registration report data), 1977–1978 through 2008–2009.

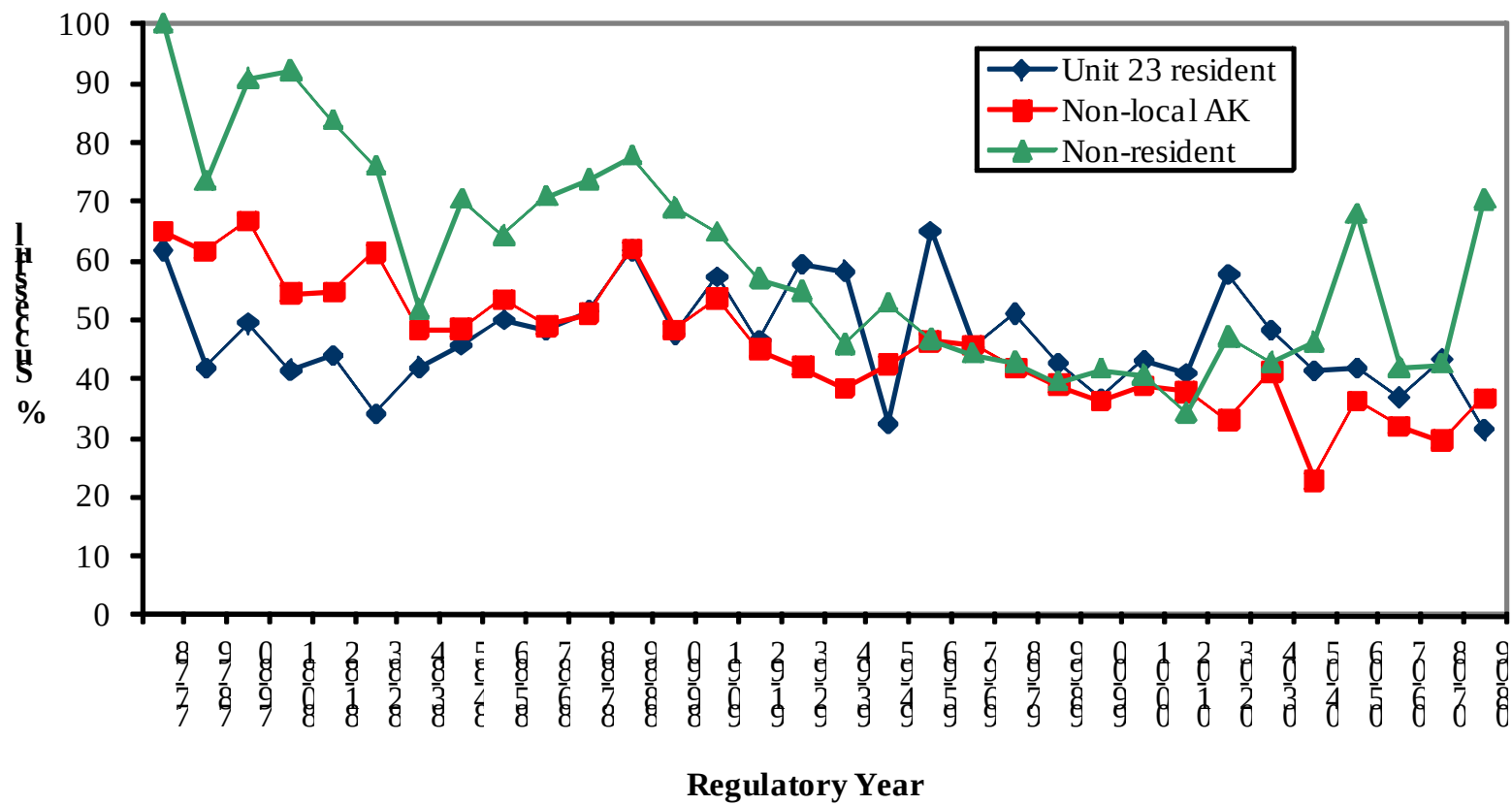


Figure 3. Unit 23 moose hunter success by residency (harvest and registration report data), 1977–1978 through 2008–2009.

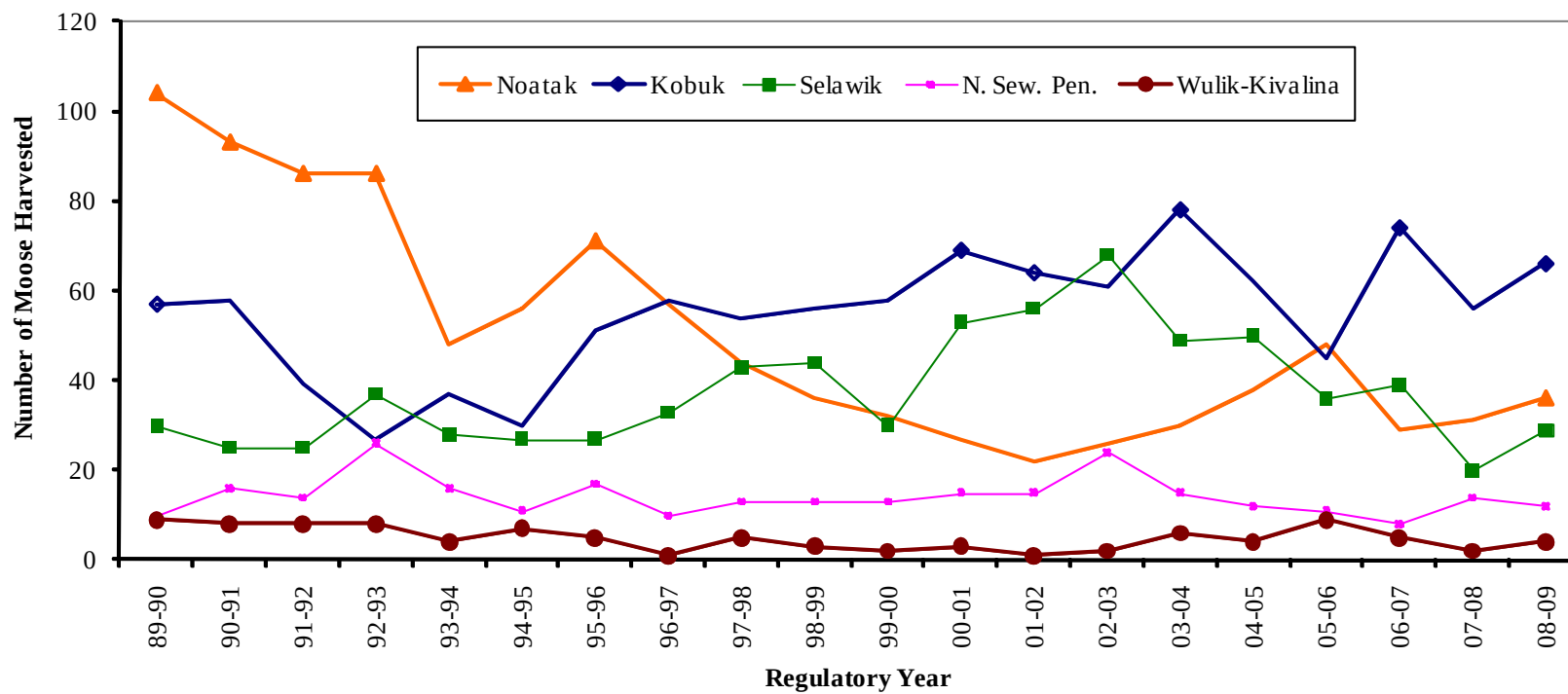


Figure 4. Unit 23 moose harvest by drainage (harvest and registration report data), 1989–1990 through 2008–2009.

Table 1. Unit 23 spring geospatial moose survey results, 2000–2009 (all surveys conducted cooperatively by ADF&G, NPS, USFWS and BLM, except noted ^b).

Area	Year	Size (mi ²)	Survey estimate (Nr.)			Density (Nr./mi ²)		Calves:100 Adults
			Adults	Calves	Total ^a	Adult	Total	
Selawik	2007	6580.1	2114	208	2319	0.35	0.32	10
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	15
N. Seward Peninsula ^b	2002	5888.5	575	38	612	0.10	0.10	7
N. Seward Peninsula ^b	2004	5882.9	728	86	810	0.12	0.14	12
N. Seward Peninsula	2009	5773.2	904	74	966	0.16	0.17	12
Upper Kobuk	2003	4001.5	760	91	856	0.19	0.21	12
Upper Kobuk	2006	4001.5	653	96	737	0.16	0.18	15
Lower Kobuk-Lower Squirrel	2006	4870.5	2891	511	3398	0.59	0.70	18

^a Generated as Total Moose in the geospatial model and therefore, does not usually equal the sum of adults and calves.

^b Survey completed by ADF&G.

Table 2. Late fall (October-early December) moose classification counts from western portions of Unit 23, 2004–2007 and Geospatial composition estimate. (Not for cross comparison).

Area	Bull antler size			Cows with calves					Total Moose		Ratio (per 100 cows)	
	Sp-Fk	Med	Large	0 ca	1 ca	2 ca	3 ca	Lone calf	Observed (% of GSPE)	Spring GSPE (year conducted)	Bulls	Calves
<u>2004–2007 Avg. Reconnaissance Surveys^a</u>												
Lower Noatak-Upper Squirrel	22	82	94	352	38	5	0	0	641 (35)	1838 (2005)	50	13
Northern Seward Peninsula	7	24	28	131	15	2	0	0	224 (28)	810 (2004)	41	12
Lower Kobuk-Lower Squirrel	20	63	31	302	116	10	0	2	677 (20)	3398 (2006)	26	34
Selawik	20	52	34	222	41	4	0	0	558(24)	2319 (2007)	40	18
Total	69	221	187	1,007	210	21	0	2			39	21
<u>Geospatial Composition Estimate^{bc}</u>												
Selawik (2008)	131	452	375	1455	230	34	0	0	464 (20)	2319(2007)	54	18

^a Data from reconnaissance surveys are presented as averaged raw counts from the period 2004–2007. Totals (percentages) may not equal the sum (proportion) of contributing values.

^b Data are estimates generated from geospatial composition estimate. Totals may not equal the sum of contributing values. Each census estimate column is an independent computer-generated estimate using the census method noted in the census method column.

^c Survey conducted cooperatively by ADF&G, NPS, and USFWS.

Table 3. Estimated moose harvest in Unit 23 villages from community harvest estimates 1989–2008 (Subsistence Division unpublished data, except as noted).

Village	Year of survey	Mean human population in survey years	Mean number moose reported harvested	Per capita moose harvest	Estimated village population in 2008	Estimated annual moose harvest in 2008–2009
Ambler	2002	295	11	0.04	259	10
Buckland	2003	409	17	0.04	458	19
Deering	1994, 2007	147	8	0.05	145	7
Kiana	1999, 2006	383	12	0.03	383	12
Kivalina	1992, 2007	388	10	0.03	406	11
Kobuk	2004	126	7	0.06	109	6
Kotzebue	1991	3,649	235	0.06	3,126	201
Noatak	1994, 1999, 2001, 2007	447	5	0.01	512	5
Noorvik	1996, 2002, 2008	630	41	0.07	642	49
Point Hope ^a	1992	685	14	0.02	689	16
Selawik	1999, 2006	736	55	0.08	846	64
Shungnak	1998, 2008	266	16	0.06	272	17
Unit 23 Total					7,847	417

^a North Slope Borough, unpublished data.

Table 4. Numbers of moose hunters (effort) and harvest by residency (harvest and registration report data) 1989–1990 through 2008–2009.

Regulatory year	Nonlocal AK			Nonresident			Unit 23 resident			Unknown	Total		
	Harvest	Effort	% Success	Harvest	Effort	% Success	Harvest	Effort	% Success	Harvest	Harvest	Effort	% Success
1989–1990	57	118	48	99	144	69	39	82	48	18	213	365	58
1990–1991	61	114	54	88	136	65	40	70	57	11	200	336	60
1991–1992	59	131	45	70	123	57	38	82	46	9	176	347	51
1992–1993	63	150	42	69	126	55	48	81	59	4	184	363	51
1993–1994	53	138	38	42	92	46	36	62	58	5	136	302	45
1994–1995	61	144	42	59	112	53	12	37	32	1	133	298	45
1995–1996	85	183	46	61	131	47	24	37	65	3	173	355	49
1996–1997	81	177	46	60	136	44	19	42	45	1	161	356	45
1997–1998	70	167	42	62	145	43	27	53	51	3	162	372	44
1998–1999	62	159	39	74	188	39	20	47	43	0	156	399	39
1999–2000	46	127	36	67	161	42	23	63	37	3	139	357	39
2000–2001	61	157	39	72	178	40	31	72	43	4	168	414	41
2001–2002	59	156	38	67	196	34	29	71	41	5	160	428	37
2002–2003	54	164	33	84	179	47	42	73	58	4	184	422	44
2003–2004	72	175	41	71	167	43	38	79	48	5	186	428	43
2004–2005	34	149	23	86	187	46	52	126	41	2	174	465	37
2005–2006	41	113	36	42	62	68	66	158	42	1	150	334	45
2006–2007	49	153	32	30	72	42	81	220	37	0	160	447	36
2007–2008	29	98	30	25	59	42	64	148	43	5	123	313	39
2008–2009	48	131	37	40	57	70	60	191	31	3	151	386	39

Table 5. Sex of moose harvested (harvest and registration report data) 1989–1990 through 2008–2009.

Year	Sex of moose harvested		
	Male	Female	Unknown
1989–1990	200	11	2
1990–1991	185	14	1
1991–1992	143	33	0
1992–1993	159	25	0
1993–1994	118	17	1
1994–1995	127	6	0
1995–1996	164	8	1
1996–1997	145	15	1
1997–1998	154	8	0
1998–1999	146	8	2
1999–2000	127	11	1
2000–2001	157	11	0
2001–2002	150	9	1
2002–2003	172	11	1
2003–2004	175	11	0
2004–2005	174	0	0
2005–2006	137	11	2
2006–2007	151	7	2
2007–2008	116	7	0
2008–2009	143	6	2

Table 6. Numbers of resident Alaskan moose hunters and harvests in Unit 23 by hunt type and location of residence (harvest and registration report data).

Regulatory Year	General Hunt				RM880			
	<u>Non-local AK</u>		<u>Unit 23 Res.</u>		<u>Nonlocal AK</u>		<u>Unit 23 Res</u>	
	Harvest	Effort	Harvest	Effort	Harvest	Effort	Harvest	Effort
2004–2005	30	130	11	18	4	19	41	108
2005–2006	30	87	14	41	11	26	52	117
2006–2007	31	115	14	37	18	38	67	183
2007–2008	16	70	9	37	13	28	55	111
2008–2009	24	81	4	32	24	50	56	159
Total	131	483	52	165	70	161	271	678

Table 7. Percent of moose hunters by transportation type in Unit 23 (harvest and registration report data), 1989–1990 through 2008–2009.

	Airplane	Boat	Snow machine	Horse/Dog	3 or 4 wheeler	Off-road Vehicle	Highway Vehicle	Airboat	Unknown
1989–1990	63	24	4	0	2	0	1	0	6
1990–1991	67	18	6	0	3	0	0	0	6
1991–1992	67	19	8	1	2	0	1	0	3
1992–1993	68	17	6	0	2	0	1	0	5
1993–1994	64	24	6	0	3	1	1	0	2
1994–1995	64	25	4	1	2	0	1	0	3
1995–1996	68	22	3	0	5	0	0	0	3
1996–1997	66	22	6	0	4	0	1	0	2
1997–1998	67	20	5	1	3	0	1	0	3
1998–1999	72	19	3	0	3	0	0	0	3
1999–2000	69	22	5	1	3	0	1	0	0
2000–2001	63	28	4	1	2	0	0	0	1
2001–2002	66	27	3	0	2	0	0	0	1
2002–2003	65	28	3	0	1	0	0	1	1
2003–2004	59	35	2	1	1	0	0	0	2
2004–2005	58	35	3	0	2	0	0	0	1
2005–2006	43	45	5	1	3	0	0	0	2
2006–2007	37	51	4	0	2	0	0	1	4
2007–2008	43	46	4	0	2	1	0	0	4
2008–2009	38	51	4	1	3	0	1	0	3

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 24 (26,068 mi²) (24A = 4,146 mi², 24B = 13,523 mi², 24C = 3,049 mi², 24D = 5,350 mi²)

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/mi²) 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 activities. The Dalton Highway Corridor Management Area (DHCMA) prohibits use of off-road

¹ At the discretion of the reporting biologist, this unit report contains data collected outside the report period.

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 December and March also provide hunting opportunity for residents of Alaska in state and federal regulation. 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

POPULATION STATUS AND TREND

Population Estimates

Nine previously established trend count areas (TCAs) of approximately 50–200 mi² (originally 4–6 contiguous sample units [SUs]; 10–14 mi²/SU) were surveyed from small fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). 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). Beginning in 2000 on Henshaw Creek and Kanuti Canyon TCAs and in 2001 on the remainder of the TCAs, we established a grid system based on latitude and longitude coordinates (SUs ~5.7 mi² in size; Ver Hoef 2001, 2008, Kellie and DeLong 2006). These new TCAs used the same flight methodology (altitude, speed, and search intensity) as previously established TCAs. Prior to 2004, data were recorded on standard data forms and moose locations were recorded on 1:63,000 U.S. Geological Survey quadrangle maps. Beginning in 2004, Global Positioning System (GPS) receivers were used to mark waypoints of moose observations and that information was also recorded on the standard data forms. Surveys were flown during the fall, approximately 500 ft above ground level at ground speeds of 70–80 mi/hr. Sample units were searched in the TCAs at a rate of approximately ~6 min/mi². Data were recorded on standard data forms, and moose locations were also recorded on 1:63,000 U.S. Geological Survey quadrangle maps or GPS units. 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 and 2009 due to low snowfall.

Beginning in 1999, we analyzed data from all population estimation surveys using the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008, Kellie and DeLong 2006). 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 and are approximately 5.7 mi² in size. Sample units (SUs) were stratified as having an anticipated high or low density of moose during the GSPE survey based on previous or updated stratification survey flights (Kellie and DeLong 2006) and existing knowledge of the area. During 1999 we conducted a population estimation

survey covering 8390 mi² (ADF&G files, Galena, 12 May 2000) in northern Unit 24, a survey of 1949 mi² in southern Unit 24 in 2001 (Bryant and Stout 2003), and in 2004 surveys of 1843 mi² and 11,494 mi² in southern and northern Unit 24 respectively (Lawler et al. 2006). In 2007 we conducted surveys on the Kanuti NWR (Unit 24B), in the eastern Koyukuk NWR (Unit 24D) and in the Hogatza River drainage (Unit 24C) (Stout 2008).

During 2007, our GSPE surveys covered most of Unit 24C and eastern Unit 24D on the Koyukuk NWR. The entire survey area covered 4295 mi², and the survey conditions (snow cover and visibility) were good to excellent for the entire survey. We based 3 airplanes 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 had 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 in Galena surveyed primarily to the south in Unit 24D. The Unit 24C and 24D survey area included 794 SUs (63 high density, 732 low density; 4295 mi²). Of the 732 low density SUs, 121 of the northernmost SUs were assigned as low density 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 (Kellie and DeLong 2006). The stratification survey required 16.97 hours of flight time. We intensively surveyed 196 SUs (62 high density, 134 low density; 1061 mi²) during 17–24 November, and classified 787 moose in 96.6 hours of survey time. The Hogatza River survey block was 2672 mi², and contained 498 SUs (23 high density, 475 low density), of which 114 SUs were intensively surveyed (23 high density, 91 low density; 611 mi²). The eastern Koyukuk NWR survey block was 1623 mi², and contained 296 SUs (39 high density, 257 low density), of which 82 SUs were intensively surveyed (39 high density, 43 low density; 450 mi²).

In 2007, we also completed a GSPE survey on the Kanuti NWR in Unit 24B, covering 2715 mi². The area was contiguous with surveys in 1999, 2004, and 2005. We compared estimates among all years (Figure 1). Conditions (snow cover and visibility) for the 2007 Kanuti NWR survey were good to excellent. We based planes, and their respective survey teams, at the FWS and NPS facilities in Bettles. Stratification of SUs was conducted using a Cessna 207 (69 high density and 439 low density SUs). We intensively surveyed 136 SUs (63 high density, 73 low density; 725 mi²) of 508 SUs (2715 mi²; Stout 2008).

In 2008 we completed a GSPE survey on the Kanuti NWR in Unit 24B covering 2715 mi². The area was contiguous with surveys in 1999, 2004, 2005, and 2007. We compared estimates among all years (Figure 1). Conditions (snow cover and visibility) for the 2008 Kanuti NWR survey were good to excellent. We based planes and their respective survey teams at the FWS and NPS facilities in Bettles. Stratification of SUs was conducted using data from previous years due to limited funding (70 high density SUs, 438 low density). We intensively surveyed 80 (44 high density, 36 low density; 428 mi²) of 508 SUs (2715 mi²). Using radiocollared moose, we estimated a sightability correction factor for the 2008 survey (Boertje et al. 2009).

To obtain a moose population estimate for RY07–RY08 in a 18,046-mi² area including Units 24A and 24B and a 377-mi² portion of Unit 24C, I used the 2008 Kanuti NWR GSPE estimate for a 2715-mi² portion of 24B and extrapolated a 13% decline observed in the Kanuti area since the 2004 survey (Stout 2006), to the 8779 mi² of Units 24A and 24B area not surveyed in 2008. For the 3402 mi² of 24A and 24B of viable year-round habitat, I extrapolated a density

of 0.17 moose/mi² based on our 2004 survey in Unit 24 and a 2002 survey in Unit 23 in similar habitats (Lawler et al. 2003). For the remaining 3150 mi² portion of Units 24A, 24B and 24C with habitat infrequently occupied by moose, I approximated a density of 0.05 moose/mi². In the remaining 2672-mi² portion of Unit 24C I used the 2007 GSPE survey. To obtain the Unit 24D estimate I used the 2004 GSPE survey conducted in the 1843-mi² central portion of Unit 24D, I added the 2007 estimate for the eastern portion of 24D, and extrapolated a density of 0.25 moose/mi² to the remaining 1884-mi² of 24D (Table 9). Range approximations were included for estimates in Table 9 to indicate uncertainty in the estimate based on knowledge of the area and previously conducted surveys. However, values followed by a (±) symbol that do not have a 90% CI designation were not statistically derived confidence intervals.

Composition data presented in this report are either estimates from results of GSPE surveys or counts from TCA surveys. These surveys were conducted in cooperation with FWS staff from the Koyukuk NWR, Kanuti NWR, and the Bureau of Land Management.

Twinning Surveys

Twinning surveys were flown in May to determine the proportion of moose calf twins among all cows with calves in the Huslia Flats and Kanuti Flats areas. Search and survey techniques and sample units were similar to those used in early winter. Observations of 50 cows with calves was the desired minimum, but funding and weather sometimes 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 predation, which could lead to underestimating twinning rates when predators kill 1 calf among twins.

Moose Distribution and Movement

A cooperative moose distribution and movements study involving the department, Kanuti NWR, Bureau of Land Management, and Gates of the Arctic National Park was initiated in 2008, with the deployment of 58 radio collars in March 2008, 10 radio collars in October 2008 and 15 radio collars in October 2009 (83 total). Radio collars were fitted primarily to cows (74), but 9 bulls were also collared. In total, 72 VHF transmitters and 11 GPS transmitters were deployed. Relocation flights were flown once a month and GPS data were transmitted every 23 hours. Each agency developed its own set of study objectives. The department's primary objective was to relocate cows in spring to determine twinning rates. Our secondary objectives were to 1) determine calving rates, 2) determine adult mortality rates and mortality factors in Units 24A and 24B, 3) evaluate October–November movements relative to snow depth and timing of snow accumulation, and 4) evaluate sex-biased movements in late October–November.

HARVEST AND OTHER MORTALITY

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) and did not

report were sent an e-mail notification if they provided an e-mail address, 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 they did not report their hunt activity. 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 archived in the department's WINFONET database and accessed 15 April 2010. These data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 Jul 2007–30 Jun 2008).

Predation was evaluated using interviews with trappers, field observations, and aerial wolf reconnaissance surveys conducted in cooperation with FWS.

HABITAT

Habitat monitoring was conducted in RY06 in Units 24B and 24C. Spatial sampling was allocated among GSPE SUs used in moose surveys, with past density category information 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).

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 mi² of Unit 24, which is 69% of the 26,068-mi² game management unit.

During RY07–RY08, moose were numerous (2.9–4.9 moose/mi², Tables 1–3) 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 observed in the mid 1990s in the Dulbi Slough, Huslia River Flats, and Treat Island areas (Tables 1–3). Combined Huslia River flats and Treat Island TCA calf:cow ratios declined to 23 and 15 calves:100 cows in 2008 and 2009, compared to highs of 31 and 34 calves:100 cows in 2004 and 2006. Further upriver, in the Henshaw–Peavey Creek and Kanuti Canyon TCAs, moose densities during RY04 were 0.65 and 0.41, and in RY08 moose density in Middle Fork TCA was 0.87 moose/mi² without SCFs (Tables 4–6). TCA surveys were last conducted on Kanuti Canyon and Henshaw Creek TCAs in RY04, and were 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, 2007, and in 2008, providing composition data as well as comparable population estimates.

Population Size

In the RY05–RY06 management report (Stout 2008), the Unit 24 population estimate of 8467 $\pm$ 1460 moose (7007–9927 moose) was based on population estimation surveys (Martin and Zirkle 1996, Huntington 1998, Woolington 1998, Stout 2004, Stout 2006) and extrapolations (Dale et al. 1995, Lawler et al. 2003, Lawler et al. 2006). Most of the information prior to 2004 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 results of the 2007 Kanuti NWR survey were reported in Stout (2008).

In 2008, we classified 175 moose, and estimated 872 moose (0.32 moose/mi²) on the Kanuti NWR of Unit 24B, not including a sightability correction factor (SCF), with an error on the estimate of $\pm$ 23% at the 90% confidence interval (CI). The 2008 estimate was not significantly different from the 2007 estimate of 588 observable moose (0.22 moose/mi², Table 7). However, using the Bayesian analysis described by Ver Hoef (2001), the estimates from 1999–2008 indicated a significant ($P=0.1$) decline in the population trend of 4.5% annually (Figure 1).

For the portions of Unit 24A and Unit 24B (8779 mi²) surveyed in 2004 my extrapolated estimate was 1929 $\pm$ 550 moose. In the Kanuti NWR portion of Unit 24B (2715 mi²) surveyed in 2008, the estimate was 872 ($\pm$ 203; 90% CI) observable moose. In the unsurveyed portions of Units 24A and 24B (3402 mi²) that could support moose year-round, my extrapolated estimate was 595 $\pm$ 200 moose. In the remainder of Unit 24A, 24B, and the 377 mi² portion of 24C (total = 3150 mi²), my approximated estimate was 158 $\pm$ 100 moose. Therefore, I estimated 3554 $\pm$ 1050 observable moose, (Table 9) in Units 24A, 24B and the 377 mi² portion of 24C.

For the portions of Unit 24C (2672 mi²; excluding the 377 mi² portion included with Units 24A and 24B) and Unit 24D (1623 mi²) surveyed in 2007, we estimated 1545 ($\pm$ 163; 90% CI) moose in the survey area not including an SCF, of which 983 ($\pm$ 93; 90% CI) moose were in the eastern Koyukuk NWR survey block and 562 ($\pm$ 130; 90% CI) moose were in the Hogatza River survey block (Table 8). For the central portion of 24D (1843 mi²), I used the 2004 estimate of 3181 ($\pm$ 148; 90% CI), and in the remaining 1884 mi² the extrapolated estimate was 471 $\pm$ 480 moose. Therefore, I estimated 5197 $\pm$ 480 observable moose (Table 9) in Units 24C and 24D.

I estimated the total Unit 24 population to be 8751 observable moose $\pm$ 1530 (7221–10,281) at the end of RY08 (Table 9). This estimate is based on the addition of my extrapolated population estimate for Unit 24A, 24B (including the 377-mi² unsurveyed portion of Unit 24C; 3554 $\pm$ 1050 observable moose), and my extrapolated population estimate for 24C and 24D (5197 $\pm$ 480 observable moose).

Population Composition

Population composition from TCA and GSPE surveys conducted through RY09 were highly variable. Bull:cow ratios were generally high on the Huslia River Flats and Kanuti NWR. High bull:cow ratios were consistent with the population estimation surveys (Tables 7–9). However, the Dulbi Slough, Treat Island, and Middle Fork TCAs bull:cow ratios were typically lower than the broader area (Tables 1–6). I believe this was mostly explained by the influence of hunting pressure in those relatively higher density moose areas on the lower Koyukuk River drainage. The higher density moose areas typically attracted higher levels of hunting pressure and are generally more accessible.

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 and breeding activity was unaffected even in southern Unit 24. 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 in Unit 24D, but ranged as high as 65–70 bulls:100 cows in Units 24B and 24C. Ratios for RY01–RY02 in the Middle Fork TCA were questionable due to small sample size but improved from RY03 through RY08 (Table 6). In general, most ratios in TCAs with counts of less than 100 moose tended to have larger annual variation that made interpretation difficult.

Calf and yearling ratios for Unit 24D were variable. During RY07–RY09, TCAs in Unit 24D indicated calf recruitment to 5 months of age had dropped (3-yr $\bar{x}$ = 22 calves:100 cows; 27, 23 and 15 calves:100 cows in 2007, 2008 and 2009 compared to highs of 31 and 34 calves:100 cows in 2004 and 2006). However, yearling recruitment appeared unchanged at a relatively high level (3-yr $\bar{x}$ = 12 yearling bulls:100 cows). Because yearling bull:cow ratios were generally high, it indicated that over-winter survival of the remaining calves was good. High productivity, as evidenced by high twinning rates then low fall calf ratios, suggests high mortality during summer, which is typical of high bear predation. I could not explain why the high calf count years of 2004 and 2006 did not result in a stronger response in the yearling counts of 2005 and 2007 or a stronger positive response in the total number of moose counted.

Calf and yearling ratios for Unit 24B in RY05, RY07, and RY08 indicated that recruitment to 5 months of age (3-yr $\bar{x}$ = 51.3 calves:100 cows) and recruitment to 17 months of age (3-yr $\bar{x}$ = 15.7 yearling bulls:100 cows) were high. Therefore, the population decline observed in the upper drainage is more difficult to explain. Unreported harvest of adult cows by hunters may have contributed to the decline, but high levels of wolf predation on adult cows in the population may also be another important factor.

Densities of moose in TCAs 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 RY07–RY08.

Radio collars deployed in March 2008 in the upper Koyukuk River drainage allowed us to obtain an adequate sample size in the spring of 2008 and 2009, and results indicated high twinning rates (35% in 2008; 60% in 2009; Table 13).

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 northern Unit 24 in early winter, utilizing 10- to 20-year-old burns, and move into the river bottoms during late winter and summer. In southern Unit 24, moose appear to occupy the broad riparian habitats year-round with much shorter seasonal migrations.

A comprehensive analysis of the data for moose that were radiocollared in 2008 in the upper Koyukuk River drainage was not available for this report. Preliminary analysis of the first year of data indicated only 40% of the cows were migratory and moved more than 12 miles between summer and winter ranges. The proportion of migratory moose was lower than reported by

Osborne and Spindler (1993) on the lower Koyukuk River drainage to the south (83% migratory) and by Mauer (1998) in the Porcupine River drainage to the east (86% migratory; including some bulls). The average distance traveled from summer to winter range of GPS collared moose in Unit 24 was 22.7 miles, compared to 76 miles in the Porcupine River drainage (Mauer 1998).

Mortality

Harvest

Seasons and Bag Limits.

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
<i>RY07</i>		
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
Remainder Unit 24B.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep 1 Dec–10 Dec	

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side. Unit 24C, that portion within the Koyukuk Controlled Use Area. RESIDENT HUNTERS: 1 bull by registration permit only; or 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 1 bull. 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. Remainder of Unit 24C. RESIDENT HUNTERS: 1 bull by registration permit only; or 1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk Controlled Use Area.	27 Aug–20 Sep (Subsistence hunt only) 5 Sep–25 Sep 1 Dec–10 Dec (Subsistence hunt only) 5 Sep–25 Sep (Subsistence hunt only) 5 Sep–25 Sep	5 Sep–25 Sep 5 Sep–25 Sep

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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. Unit 24D, that portion within the Koyukuk Controlled Use Area. RESIDENT HUNTERS: 1 bull by registration permit only; or 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 1 bull. 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. <i>RY08</i> 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.	27 Aug–20 Sep (Subsistence hunt only) 5 Sep–25 Sep 1 Dec–10 Dec (Subsistence hunt only) 1 Sep–25 Sep	5 Sep–25 Sep 5 Sep–25 Sep

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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
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	
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 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 1 bull.	1 Sep–25 Sep (Subsistence hunt only) 5 Sep–25 Sep 1 Dec–10 Dec (Subsistence hunt only)	

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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 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 (Subsistence hunt only) 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
Unit 24D, that portion within the Koyukuk Controlled Use Area. RESIDENT HUNTERS: 1 bull by registration permit only; or 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 1 bull.	1 Sep–25 Sep (Subsistence hunt only) 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 80 permits may be issued in	1 Dec–10 Dec (Subsistence hunt only)	5 Sep–25 Sep

<u>Units and Bag Limits</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
combination with Units 21D and 24C, those portions within the Koyukuk Controlled Use Area.		
Remainder of Unit 24D. RESIDENT HUNTERS: 1 bull by registration permit only; or 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 (Subsistence hunt only) 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
Remainder of Unit 24D. RESIDENT HUNTERS: 1 bull by registration permit only; or 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 (Subsistence hunt only) 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 when a higher percentage of cows are generally harvested. 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 divided Unit 24 into 4 subunits (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.

At the 2008 Board of Game meeting, the board adopted only one change to Unit 24, which was to shift the registration hunt in the Koyukuk Controlled Use Area from 27 August–20 September to 1 September–25 September

Harvest by Hunters. Hunting seasons in Unit 24 were diverse and reflected various moose densities and consumptive use patterns. Annual reported harvest during RY99–RY08 averaged 180 moose (128–240, Table 14). Potlatch, ceremonial, and cultural and education permit reported harvest averaged 5.3 moose/year from RY01–RY08 and was included in the unreported column of Table 14. Typically, 60%–70% of that harvest was cows.

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, which 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, are found in the RY07–RY09 Unit 21D moose management report (Glenn Stout, 2007–2009 Unit 21D moose management report, this volume).

Harvest under federal permits increased during RY07–RY08 and was an increasingly larger proportion of the total harvest. The federal harvest during RY00–RY03 averaged 4.8 moose/year, but increased to 13.6 moose/year during RY04–RY08. Federal harvest data that the department received were incomplete and reporting requirements and data entry protocols were not comparable to the department's methodology. As the sustainable harvest of moose in Unit 24 is reallocated to federal hunts, the number of moose available to state permitted hunts will have to be reduced. Additionally, some federal hunts in Unit 24 allowed the harvest of cows, which contradicted the current management strategy for growth of the moose population.

Harvest Chronology. Over 95% of reported harvest occurred in the September hunting seasons (Table 15). However, much of the unreported harvest probably occurred during October–March (Brown et al. 2004). Historically, timing of harvest occurred equally in the first and second half of the September season, but from RY99 to RY09 there was a slight shift in percent of harvest from the first half ($\bar{x}$ = 42%) to the second half of September ($\bar{x}$ = 55%).

Permit Hunts. Beginning in RY00 in the Koyukuk CUA, drawing permit hunts DM827, DM828, DM829, and DM830 replaced the general registration permit RM830. Either the 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 to RY09 was consistent ($\bar{x}$ = 383; σ = 28.9; range = 341–431; 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 (Glenn Stout, 2007–2009 Unit 21D moose management report, this volume). Nonlocal use of the RM832 was linked closely to the number of drawing permits. Therefore, an increase in the number of Alaska resident hunters using the subsistence permit with the potential to exceed the sustainable yield of the moose population was a management concern. With the implementation of the 6 drawing hunts, DM823, DM825 (RY05), DM827, DM828, DM829 and DM830 (RY00), in the Koyukuk CUA and the 2 permit hunts outside the Koyukuk CUA (DM892, DM896; RY04), management of hunter numbers and distribution improved (Table 17).

Within the DHCMA, drawing permit hunts DM920 and DM922 (RY02) resulted in reduced moose harvest compared to harvest under the general harvest ticket. Average rates for successfully drawing a DHCMA permit were relatively high in RY07–RY09, at 18.0% for DM920 and 46.7% for DM922. However, hunting success rates among the permitted hunters was low at 9.5% north of Slate Creek (DM920) and an average of 10.6% south of Slate Creek (DM922; Table 18).

Hunter Residency and Success. Based on harvest reports, the average annual number of moose hunters was 417 during RY99–RY08; 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. This became especially apparent beginning in RY04, when Failure to Report (FTR) reporting requirements were initiated that fined hunters who failed to report and barred them from obtaining any drawing or registration permits during the following year. Reporting rates (especially by unsuccessful hunters) increased when these FTR requirements were implemented but apparent success rates declined (Figure 2), despite an increase in total harvest (Figure 3). Increased reporting by unsuccessful hunters and subsequent declining success rates, can be explained by 2 changes in Unit 24 hunt administration. First, reporting rates by unsuccessful hunters increased with the higher level of reporting accountability associated with registration and drawing permit systems. Second, an individual hunter could possess more than one reporting mechanism (harvest ticket, registration permits, and/or federal permits), which increased the total number of permits reported but did not increase proportionally the number of individual hunters. The first outcome was implemented by design, and improved our ability to manage moose in Unit 24, while the second by-product was not anticipated. Because of these issues, assessing harvest success rate trends has become problematic in Unit 24 since RY04.

Harvest and hunter participation by Unit 24 residents was relatively constant during 2000–2004, according to ADF&G Division of Subsistence surveys (Brown et al. 2004). However, nonresident and nonlocal resident hunter participation that increased steadily beginning in the late 1980s, declined after RY01. The increase in nonlocal hunters created tension among user groups.

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. The estimated unreported harvest incorporated recent Subsistence Division data, less the reported harvest by Unit 24 residents (Table 14).

Transportation Methods. In RY07–RY08, boats continued to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 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 winter, but were 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 highway construction was completed, but was opened to public use in 1981. The number of hunters and moose harvest for hunters accessing Unit 24 by the Dalton Highway during RY07–RY08 was similar to previous years (Table 19).

Other Mortality

A minimum of 400–440 wolves in 55–60 packs (Stout 2009) 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 Unit 24. Annual adult mortality was approximately 7.8% for radiocollared moose in Units 24A and 24B during 2008–2009, which was higher than values reported by Boertje et al. (2009).

HABITAT

Assessment

In March 2007, we flew to 64 browse plots in Unit 24B but available browse was not evident from the air at 26 plots; therefore we only landed at 38 (59%) where available browse was evident. 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 (Paragi et al. 2008).

In March 2007, we visited 48 plots in Unit 24C but available browse was not evident in 19 plots, therefore we only landed at 29 plots (39%) 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.

CONCLUSIONS AND RECOMMENDATIONS

Hunting activity in Unit 24 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. In addition to user conflicts, management concerns in Unit 24 during RY07–RY08 included the reallocation of harvest from state permitted users to federal permitted users and the harvest of cow moose.

Without current Subsistence Division survey data, it was not clear if Unit 24 residents met their wild food requirements, but public comments suggest those needs were not being met. Subsistence hunters will not meet their needs and hunting opportunities cannot be expanded for people living outside Unit 24 until moose numbers increase. With the exception of limited areas around Allakaket, Bettles, and Huslia, predation on moose by wolves and bears was likely a major factor limiting Unit 24 moose populations. Where predators were lightly harvested for long periods, predation seems to keep moose densities low (0.1–1.1 moose/mi² in areas >800 mi², Gasaway et al. 1992).

Initiation of the moose telemetry study in Units 24A and 24B was an important accomplishment in RY08 and data from that study will improve our understanding of population dynamics and distribution in the low-density portion of Unit 24. The population estimation surveys completed on the Hogatza River, Indian River (eastern Koyukuk NWR), and Kanuti NWR were also an important accomplishment in RY07. 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.

We recommend annual or biennial GSPE moose surveys in the high density portions of Unit 24D to develop a reliable population trend analysis, even if those surveys are conducted at a low sampling intensity (Kellie and DeLong 2006, Ver Hoef 2008). Although high sampling intensity surveys provide narrow confidence intervals and improve precision on an estimate, they are not likely to be conducted in the low density portions of Unit 24 on a regular basis for a variety of reasons. Analysis of GSPE data collected in Unit 24B, showed that low intensity surveys conducted in the intervening years of infrequent high intensity surveys provided accurate composition and population estimates, and improved the confidence intervals for all survey years when estimates were smoothed. This strategy provided managers with better decision-making information for the overall population than TCA composition and density data alone.

A baseline population estimate for all of Unit 24A should be conducted in cooperation with Bureau of Land Management, and low intensity (100 SUs) population estimates of the Kanuti

NWR should be conducted annually in lieu of trend count surveys. High intensity estimation surveys (150–200 SUs) should continue to be conducted every 5 years on the Kanuti NWR.

For the first goal concerning harvest within sustained yield principles, my extrapolated estimate of 8751 moose ± 1530 (7221–10281), not including a sightability correction factor, probably did not achieve the objective to maintain a population of 10,000–12,000 moose for the fifth consecutive reporting period. We achieved the objective to provide for an adequate moose harvest without exceeding 360 moose or a 5% harvest rate (RY08 estimated harvest rate = 3.6%). We also achieved the objective to provide for hunting opportunity that did not exceed 500 hunters.

Under the second goal of protecting and enhancing moose habitat, our long-term objective of implementing at least 2 habitat enhancement activities was not achieved during RY07–RY08. However, habitat appeared excellent throughout much of the unit, with an abundance of successional willow growth due to either fire or riverine erosion. Availability of browse was not limiting the moose population during RY07–RY08.

The third goal was reducing meat spoilage by hunters. In RY07 and RY08 we continued to monitor the objective of reducing spoiled meat observed at Koyukuk River checkstation and at hunting camps by 10% each regulatory year. Less than 5% of the hunters scored less than 3 on the overall meat care and the average number of days hunters stayed in the field with their meat was 2.6 days. Meat spoilage was very low and was probably limited to only a few individual hunters each year; therefore, the objective was met. Because the level of meat care has stabilized, an annual gain is no longer relevant. Therefore a more meaningful objective will be to maintain a low number of instances of poor meat care among hunters. The objective for the next reporting period will be changed to the following.

GOAL 3: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall Meat Assessment Score of less than “3” for $\leq 5\%$ of the hunters each regulatory year.

Finally, our monitoring program continued to evaluate the number of people engaged in nonconsumptive activities (goal 4) was continued and baseline data were established to evaluate the objective to increase the number of people engaged in nonconsumptive uses of wildlife by $>1\%$ each regulatory year. Parameters measured by the wildlife viewing survey varied annually, but appeared to be relatively consistent. The objective was probably not achieved because a program to improve the parameters was not implemented. Increases in the number of days spent viewing, the proportion of people who ranked “viewing” or “viewing and hunting” as a purpose of the trip, and the number of “species observed” would be good indicators of an increase in nonconsumptive use. A program to increase species identification and the importance of wildlife sign by hunters would best improve those measures. Friends were the primary source from which hunters learned about the area, so people that previously hunted in the area should be the target public for developing a program. As a result of our baseline data and learning the best way to evaluate changes in wildlife viewing by the public, the wildlife viewing objective will also be changed for the next reporting period to the following.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

OBJECTIVE 1: Maintain “Hunting and Viewing” as the response to question #2 (Purpose of Trip) for $\geq 65\%$ of the hunters who respond to the survey each regulatory year.

LITERATURE CITED

- ANDERSON, D. B., C. J. UTERMOHLE, AND L. BROWN. 1998. The 1997–98 harvest of moose, caribou, and bear in middle Yukon and Koyukuk River communities, Alaska. Division of Subsistence, Alaska Department of Fish and Game. Fairbanks, Alaska, USA.
- BOERTJE, R. D. , M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in interior Alaska. *Journal of Wildlife Management* 73(3):314–327
- BROWN, C. L., R. WALKER, AND S. B. VANEK. 2004. The 2002–03 harvest of moose, caribou, and bear in middle Yukon and Koyukuk River communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- BRYANT, J. M., AND G. STOUT. 2003. Koyukuk–Nowitna National Wildlife Refuge Complex, moose population estimation surveys, Koyukuk and Northern Unit of Innoko National Wildlife Refuges, game management units 21D and southern 24, Alaska. Progress Report FY-03-01. Galena, Alaska, USA.
- DALE, B. W., L. G. ADAMS, AND R. T. BOWYER. 1995. Winter wolf predation in a multiple ungulate prey system, Gates of the Arctic National Park, Alaska. Pages 223–230 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. *Ecology and conservation of wolves in a changing world*. Canadian Circumpolar Institute, Occasional Publication 35, Edmonton, Alberta, Canada.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- , S. D. DUBOIS, D. J. REED, AND S. J. HARBO. 1986. Estimating moose population parameters from aerial surveys. Biological Paper 22. University of Alaska, Fairbanks, Alaska, USA.
- HUNTINGTON, O. 1998. Koyukuk–Nowitna National Wildlife Refuge Complex Lower Koyukuk River and Kaiyuh Flats 1997 moose census, Unit 21D, Alaska. Final Progress Report FY98-08. Galena, Alaska, USA.
- HUNTINGTON, S. 1993. *Shadows on the Koyukuk: an Alaskan Native’s life along the river*. Alaska Northwest Books. Seattle, Washington, USA.

- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 23 Sep 2008.
- LAWLER, J., J. DAU, AND J. BURCH. 2003. Aerial moose survey in the upper Kobuk drainage, Alaska. Project report November 2002 and March 2003. National Park Service, Resource report, NPS/AR/NR/NRTR-2003/42. Fairbanks, Alaska, USA.
- , L. SAPERSTEIN, T. CRAIG, AND G. STOUT. 2006. Aerial moose survey in the upper Game Management Unit 24, Alaska, fall 2004, including state land and lands administered by the Bureau of Land Management, Gates of the Arctic National Park and Preserve, and Kanuti National Wildlife Refuge. Project report April 2006. National Park Service, Resource report, NPS/AR/NR/TR-2006-55. Fairbanks, Alaska, USA.
- MARCOTTE, J. R. 1986. Contemporary resource use patterns in Huslia, Alaska, 1983. Technical Paper 133. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- , AND T. L. HAYNES. 1985. Contemporary resource use patterns in the upper Koyukuk region, Alaska. Technical Paper 93. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska, USA.
- MARTIN, P. A., AND A. H. ZIRKLE. 1996. Moose population estimate, Kanuti National Wildlife Refuge, November 1993. Final Report. U.S. Fish and Wildlife Service. Fairbanks, Alaska, USA.
- MAUER, F. J. 1998. Moose migration: Northeastern Alaska to northwestern Yukon Territory, Canada. *Alces* 34:75-81.
- OSBORNE, T. AND M. A. SPINDLER. 1993. Moose Population identification study Three Day Slough, Koyukuk NWR, Alaska, Game Management Unit 21D. Progress Report 93-3, Koyukuk National Wildlife Refuge, Galena, Alaska.
- PARAGI, T. F., C. T. SEATON, AND K. A. KELLIE. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: moose range assessment. Alaska Department of Fish and Game, Division of Wildlife Conservation. Final Research Technical Report. Grants W-33-4, 5, 6 & 7. Project 5.10. Juneau, Alaska, USA.
- SCHWARTZ, C. C. 1998. Reproduction, natality, and growth. Pages 141–171 in A. W. Franzmann and C. C. Schwartz, editors. *Ecology and management of the North American moose*. Wildlife Management Institute. Edmonton, Canada.
- SEATON, C. T. 2002. Winter foraging ecology of moose in the Tanana Flats and Alaska Range foothills. Thesis, University of Alaska Fairbanks, Alaska, USA.
- STOUT, G. W. 2004. Unit 24 moose. Pages 548–565 in C. Brown, editor. *Moose management report of survey and inventory activities 1 July 2001–30 June 2003*. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

- . 2006. Unit 24 moose. Pages 566–598 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- . 2008. Unit 24 moose. Pages 579–616 *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, Alaska, USA.
- . 2009. Unit 24 wolf. Pages 237–247 *in* P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2005–30 June 2008. Alaska Department of Fish and Game. Project 14.0. Juneau, Alaska, USA.
- VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the section on statistics and the environment of the American Statistical Association.
- . 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental Ecological Statistics* 15:3:1–13
- WOOLINGTON, J. D. 1998. Unit 24 moose. Pages 421–433 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.

PREPARED BY:

Glenn W. Stout
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

STOUT, G. W. 2010. Unit 24 moose. Pages 572–610 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

Kanuti Moose Population (1999-2008)

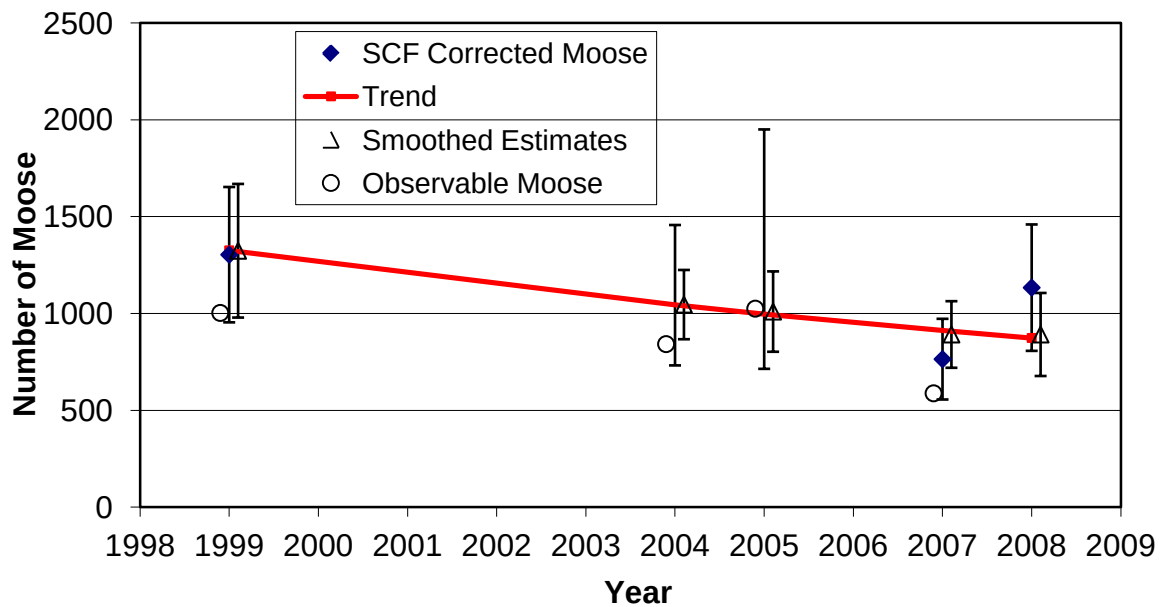


FIGURE 1 Unit 24 Kanuti National Wildlife Refuge moose density estimates and smoothed estimates fitted to the modeled regression line, indicating population decline for regulatory years 1999–2000 through 2008–2009. Sightability correction factors were based on the estimate derived from radiocollared moose during the 2008 survey, and applied as a correction factor constant of 1.30 to all years. Rate of decline = 4.5%/year ($P=0.1$)

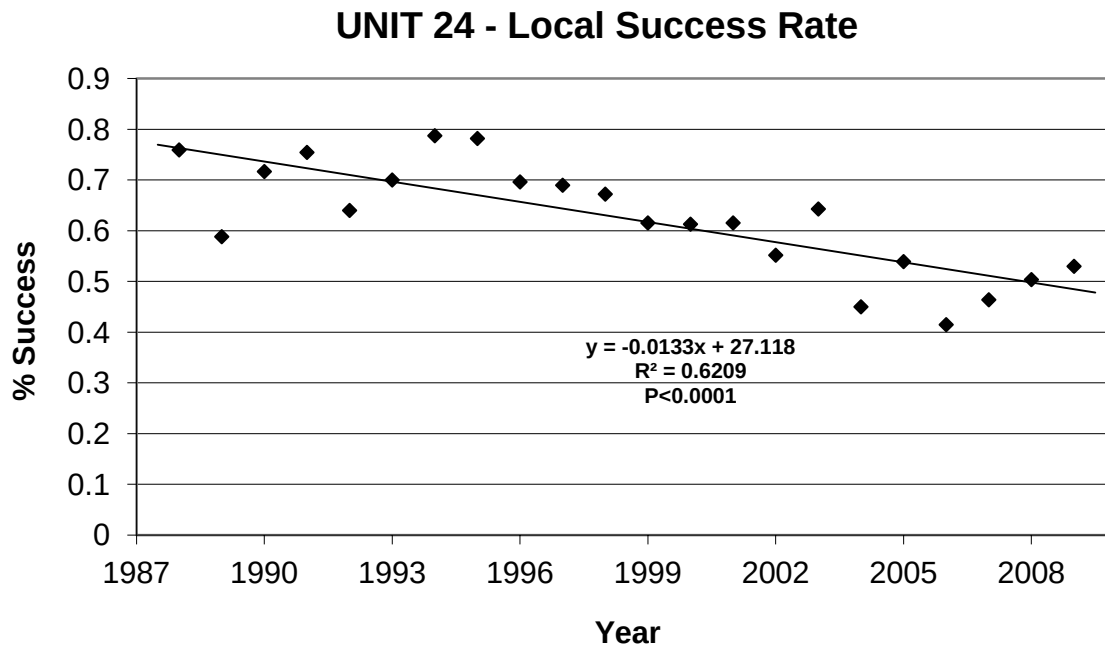


FIGURE 2 Unit 24 moose harvest success rate Unit 24 local resident hunters, regulatory years 1988–1989 through 2009–2010

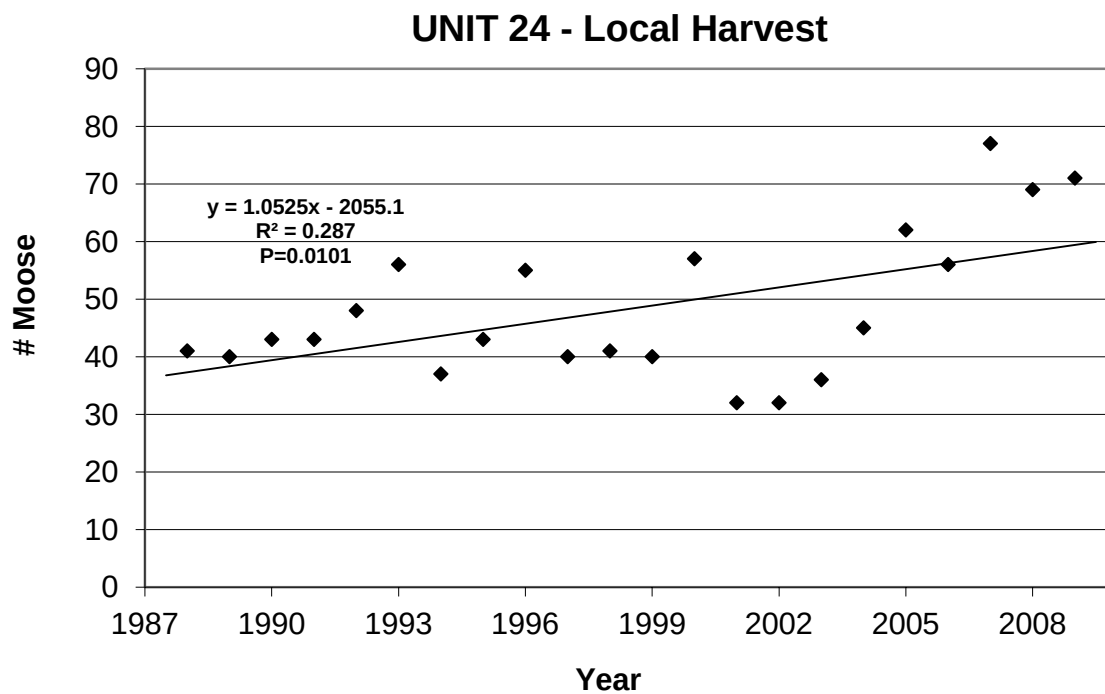


FIGURE 3 Unit 24 moose harvest reported by Unit 24 local residents, regulatory years 1988–1989 through 2009–2010

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 2009–2010^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
2008–2009	142.3	35	11	29	7	14.5	509	3.6
2009–2010	142.3	34	13	19	6	12.4	693	4.9

^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 3 Unit 24D Treat Island aerial moose composition counts, regulatory years 1985–1986 through 2009–2010^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	4.2
2000–2001	67.1	16	4	13	5	10.0	430	6.4
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
2008–2009	163.3	29	13	20	4	13.1	724	4.4
2009–2010	163.3	34	11	11	11	7.7	689	4.2

^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	0.96
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 2008–2009

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	1.33
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
2008–2009	113	40	13	18	0	11	99	0.87

TABLE 7 Unit 24B Kanuti National Wildlife Refuge population estimation surveys, regulatory years 1989–1990 through 2008–2009

Regulatory year	Survey area (mi ²)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% C.I. ^c)	Moose/mi ²
1989–1990 ^a	2615	64	17	4	9.2	--	1172 (±25.1%)	0.45
1993–1994 ^a	2644	61	33	8	17.0	--	2010 (±22.0%)	0.76
1999–2000 ^d	2714	61	28	4	14.7	858	1003 (±20.8%)	0.37
2004–2005 ^d	2710	62	46	9	20.7	650	842 (±28.6%)	0.31
2005–2006 ^{bd}	2710	70	43	20	19.7	810	1026 (±43.3%)	0.38
2007–2008 ^d	2715	60	53	13	24.7	451	588 (±21.4%)	0.22
2008–2009 ^d	2715	46	58	14	28.5	624	872 (±23.3%)	0.32

^a Martin and Zirkle 1996, estimate with sightability correction factor (1.00 in 1989; 1.17 in 1993).

^b Lawler et al. 2006.

^c Confidence interval (% ±).

^d Without sightability correction factor.

TABLE 8 Unit 24C and 24D population estimation survey, regulatory year 2007–2008

Area	Survey area (mi ²)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% C.I. ^a)	Moose/mi ²
Eastern Koyukuk NWR	1623	78	42	14	18.7	796	983 (±9.5%)	0.61
Hogatza River	2672	70	45	16	20.7	442	562 (±23.0%)	0.21
Total Block	4295	75	43	14	19.4	1239	1545 (±10.6%)	0.36

^a Confidence interval (% ±).

TABLE 9 Unit 24 total population estimation summary, regulatory years 2004–2009

Survey area	Area mi ²	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate without sightability correction factor ^e
Unit 24A and 24B ^a					
2008 Estimated (13% decline since 2004)	8,779				1,929±550
2008 Survey block (Kanuti NWR)	2,715	508	46:100	58:100	872±203 (90% CI)
Moose habitat Unit 24/North ^b	3,402				595±200
Remainder Unit 24/North ^c	3,150				158±100
Subtotal (2007)	18,046				3,554±1050
Unit 24C ^a					
2007 Survey block (Hogatza River)	2,672	498	70:100	45:100	562±129 (90% CI)
Subtotal (2007)	2,672				562±130
Unit 24D ^d					
2004 Survey block (lower Koyukuk)	1,843	336	33:100	34:100	3,181±148 (90% CI)
2007 Survey block (eastern Koyukuk refuge)	1,623	296	78:100	42:100	983±93 (90% CI)
Remainder Zone 1	1,884				471±100
Subtotal (2007)	5,350				4,635±350
Unit 24 – Total	26,068				8,751±1,530

^a Cumulatively, Units 24A (4,146 mi²), 24B (13,523 mi²), and 24C (3,049 mi²) were formerly defined as Management Zone 2 (Stout 2006).

^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 mi²) was formerly defined as Management Zone 1 (Stout 2006).

^e Values following (±) symbol without a 90% CI designation are range approximations and are not statistically derived confidence intervals.

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 2009–2010

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
2007–2008	47	38	18	32	22	28 and 29 May
2008–2009	97	37	13	26	29	28–30 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 2008–2009

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
2007–2008 ^b	n/a	32	17	35	n/a	27–31 May
2008–2009 ^b	n/a	19	28	60	n/a	29–31 May

^a Percent of cows with calves that had twins.

^b Sample from radiocollared cows

TABLE 14 Unit 24 moose hunter harvest, regulatory years 1997–1998 through 2009–2010

Regulatory year	Harvest by hunters				Unreported	
	Bull	Cow	Unk	Total	harvest ^a	Total
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	199	3	0	202	145	347
2008–2009	168	1	0	169	145	314
2009–2010 ^b	177	3	3	183	145	328

^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 1997–1998 through 2009–2010

Regulatory year	Harvest chronology percent by month/day				n
	9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	
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	36	60	0	4	191
2008–2009	44	56	0	0	159
2009–2010 ^b	44	53	0	3	179

TABLE 16 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2009–2010^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
	2008–2009	341	6	47	53	168	(99)	1	(1)	0	169
	2009–2010	431	9	52	48	187	(100)	0	(0)	0	187
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
	2008–2009	4	0	25	75	3	(100)	0	(0)	0	3
	2009–2010	4	0	0	100	4	(100)	0	(0)	0	4
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
	2008–2009	6	33	0	100	4	(100)	0	(0)	0	4
	2009–2010	4	0	50	50	2	(100)	0	(0)	0	2
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

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk	Total harvest
605	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
	2008–2009	4	50	50	50	1 (100)	0 (0)	0	1
	2009–2010	4	50	50	50	1 (100)	0 (0)	0	1
	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	3 (75)	1 (25)	0	4
	2008–2009	32	50	44	56	9 (100)	0 (0)	0	9
	2009–2010	32	50	31	69	11 (100)	0 (0)	0	11
	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 (100)	0 (0)	0	2
	2007–2008	2	0	0	100	2 (100)	0 (0)	0	2
	2008–2009	4	0	25	75	3 (100)	0 (0)	0	3
	2009–2010	4	0	50	50	2 (100)	0 (0)	0	2

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^b	Percent successful hunters ^b	Bulls (%)	Cows (%)	Unk	Total harvest
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	30	0	100	14 (100)	0 (0)	0	14
	2008–2009	32	56	14	86	12 (100)	0 (0)	0	12
	2009–2010	32	25	30	70	16 (100)	0 (0)	0	16
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
	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (99)	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 (99)	0 (0)	1	166
	2007–2008	400	13	54	46	157 (99)	1 (1)	0	158
	2008–2009	423	14	44	56	200 (99)	1 (1)	0	201
	2009–2010	511	13	49	51	223 (100)	0 (0)	0	223

^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 2009–2010

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	27	73	19 (100)	0	0	0	19
	2008–2009	35	34	61	39	9 (100)	0	0	0	9
	2009–2010	35	40	38	62	13 (100)	0	0	0	13
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	63	57	43	9 (100)	0	0	0	9
	2008–2009	31	39	56	44	8 (100)	0	0	0	8
	2009–2010	48	48	57	43	10 (100)	0	0	0	10

TABLE 18 Unit 24A Dalton Highway Corridor Management Area moose harvest by permit hunt, regulatory years 2002–2003 through 2009–2010

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
	2008–2009	20	20	100	0	0 (100)	0 (0)	0	0
	2009–2010	20	25	87	13	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
	2008–2009	50	30	94	6	2 (100)	0 (0)	0	2
	2009–2010	50	30	91	9	3 (100)	0 (0)	0	3

TABLE 19 Unit 24 moose hunter residency and success, regulatory years 1997–1998 through 2009–2010^a

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total	
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	77	89	36	0	202	89	170	30	0	289	491
2008–2009	69	69	30	1	169	68	151	40	0	259	428
2009–2010	71	88	24	0	183	63	135	35	2	235	418

^a Some hunters have up to 3 reporting mechanisms (1 harvest permit and 2 harvest permits). Data presented here count each reporting mechanism as one “hunter,” in terms of effort.

^b Unit resident only.

TABLE 20 Unit 24 moose harvest percent by transport method, regulatory years 1997–1998 through 2009–2010

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
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	15	1	70	2	4	2	7	0	201
2008–2009	16	1	70	2	1	1	8	1	167
2009–2010	12	0	75	5	3	0	4	1	179

**WILDLIFE
MANAGEMENT REPORT**

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO Box 115526
Juneau, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNITS: 25A, 25B, and 25D (47,968 mi²)

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 (F. Thomas, H. Petersen, K. Peter, personal communication). However, 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/mi² in the western Yukon Flats in 1984 to a high of 0.64 moose/mi² 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 the different statuses 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 for 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 hunting seasons were

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

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 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 by ADF&G and federal agencies significantly affected regulations in Unit 25D. 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 the 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 moose hunting season was 5–25 September and 1–15 December with an any-bull bag limit. The nonresidents season was 5–25 September with an antler restricted bag limit (50-inch antlers or at least 4 brow tines on one side). 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 for most of Unit 25B with a bag limit of any bull and a season during 5–25 September and 1–15 December.

Separate survey areas have been conducted in Units 25D East and 25D West by ADF&G and FWS, respectively. Since 1999, population surveys were conducted by ADF&G and FWS using geospatial population estimators (GSPE) described by Ver Hoef (2001, 2008) and Kellie and DeLong (2006). From 1999 to 2009, estimated densities from fall surveys have ranged from 0.18 to 0.41 moose/mi². Survey data indicated that moose numbers were slightly higher in the eastern Yukon Flats compared to the western Yukon flats. Both populations are at 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 moose numbers declined in this area from the late 1980s through the early 2000s, 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 for 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 in order to increase moose survival. 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.

The following management goals and objectives for RY07–RY08 were developed 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 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.

METHODS

POPULATION STATUS AND TREND

Unit 25D East Survey Area and Methods

The Unit 25D East survey area (2936 mi²) includes 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. This survey area encompasses the 1534-mi² 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 GSPE sample units, each defined by 2 minutes of latitude and 5 minutes of longitude, or approximately 5.3 mi² (Kellie and DeLong 2006, DeLong 2006). 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 (R. O. Stephenson and T. 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 annually modified to reflect count data from previous surveys (R. O. Stephenson and B. Thomas, ADF&G and Council of Athabascan Tribal Governments, 2006 unpublished eastern Yukon Flats moose population survey report).

In 2007, we surveyed 110 randomly selected sample units (76 high-density units and 34 low-density units) during 2–7 November in the Unit 25D East survey area. An additional 17 non-random units from high-density strata were selected to increase sample size for composition estimates. Non-random units were selected primarily from high-density strata and filled “holes” created by the random selection (Kellie and DeLong 2006). Search intensity averaged 7.2 min/mi² ($n = 127$) across all sample units.

Unit 25D Fort Yukon Area Survey and Methods

The 533 mi² Fort Yukon Survey Area (FYSA) is in eastern Unit 25D and consists of 100 GSPE sample units. The survey area generally consisted of low elevation riparian habitat, contains a

portion of the middle Yukon, lower Christian, and lower Porcupine Rivers, and the community of Fort Yukon. Most of the FYSA is within the larger 2936 mi² Unit 25D East moose survey area (Caikoski 2008).

In 2008 we sampled 51 randomly selected sample units in the FYSA during 28–30 October. The survey area was not stratified and all sample units were classified to a single stratum. After adjusting for available moose habitat (excludes large lakes and portions of the Yukon River) search intensity averaged 7.2 minutes/mi² across all sampled units and 7.3 minutes/mi² among sample units that contained no observable moose.

Unit 25D Beaver Management Survey Area and Methods

The 536 mi² Beaver Management Survey Area (BMSA) is located in western Unit 25D and consists of 100 GSPE sample units. The BMSA is centered on the village of Beaver and consisted primarily of low-elevation riparian habitat. It contains a portion of the middle Yukon River, lower Beaver Creek, and Mud Lakes, George Meadow, and Tony Lake wetlands complexes. The BMSA lies completely within the traditional Unit 25D west survey area typically surveyed by the FWS (Lake 2008).

In 2008, we sampled 50 systematically selected (every other) sample units in the BMSA during 2–6 November. Sampling density was 50%, representing one-half of the total survey area. The survey area was not stratified and all sample units were classified to a single stratum. After adjusting for available moose habitat (excludes large lakes and portions of the Yukon River), search intensity averaged 7.3 minutes/mi² across all sample units ($n=50$) and did not differ from sample units with no observable moose.

In 2009, we sampled 50 systematically selected (every other) sample units in the BMSA during 18–20 November. Sampling density was 50%, representing one-half of the total survey area. Survey units selected for sampling in 2009 were those not sampled in the 2008 survey. The survey area was not stratified and all sample units were classified to a single stratum. After adjusting for available moose habitat (excludes large lakes and portions of the Yukon River), search intensity averaged 7.5 minutes/mi² across all sample units ($n=50$) and 7.3 minutes/mi² for sample units with no observable moose ($n=17$).

For the Unit 25D East survey area, the FYSA, and the BMSA, survey data were analyzed using GSPE methods described by Ver Hoef (2001, 2008) with web-based software developed by ADF&G (DeLong 2006, Kellie and DeLong 2006) during all years. For the 2007 Unit 25D East survey area, we analyzed population size and population composition using separate data sets. Analysis of population size included only the 110 survey units that were randomly selected. Because relatively few moose were counted in randomly selected units, an additional 17 units were selected nonrandomly to increase sample size for analysis of population composition estimates (127 total units used). 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 West Survey Area and Methods

The Unit 25D West survey area is 2269 mi², consists of 421 GSPE sample units, 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 2007, the US Fish and Wildlife Service did not survey the Unit 25D West survey area due to poor survey conditions (lack of snow) in early November.

In 2008, the FWS surveyed 174 sample units (includes those sampled by ADF&G during the 2008 BMSA survey) during 2–8 November (Lake, 2008). Sample units surveyed by the FWS included 101 (70%) of the 144 units stratified as high-density strata and 73 (26%) of the 277 units stratified as low-density strata. Search intensity averaged 6.3 min/mi² across all sample units. 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 Sheenjok and Coleen River drainages in eastern Unit 25A in fall 2000 and 2002 (FWS–Arctic National Wildlife Refuge, unpublished data, Fairbanks). 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 1989 and 1991 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/mi² in 1994 and 0.23 observable moose/mi² in 1997 and 1999 (Burch 1999). Total moose numbers are likely $\geq 20\%$ higher than observable moose numbers (Boertje et al. 2009; M. Keech, ADF&G, unpublished data, Fairbanks).

Unit 25D East Survey. Density estimates for Unit 25D East have been low (0.18–0.34 observable moose/mi² in fall surveys) since GSPE survey methods were implemented in 1999 (Table 2A). Population estimates declined between 2005 and 2007 from 1008 ($\pm 20\%$) to 585 ($\pm 23\%$) moose, respectively, even though search intensity increased (4.3 min/mi² in 2005, 5.0 min/mi² in 2006, and 7.2 min/mi² in 2007). Long-term estimates have been highly variable between years, estimates of annual abundance between years are not significantly different ($\alpha=0.10$), and the trend across all years is not significant ($\alpha=0.05$, Kellie 2009).

It is unclear whether the current 2-year trend represents a recent decline in the moose population, annual or seasonal differences in moose distribution, or sampling error. It is possible that fluctuations are real and typical of a population in low density dynamic equilibrium. In addition, current implementation of GSPE surveys in areas of low moose density lack the power to detect trends in abundance due to poor precision associated with annual estimates (Kellie 2009).

Unit 25D Fort Yukon Area Survey (FYAS) and Beaver Management Area Survey (BMAS) In 2008 and 2009, ADF&G conducted 3 GSPE moose surveys to estimate population size and composition. We surveyed the FYSA in 2008 and the BMAS in 2008 and 2009. Unlike previous surveys, the FYSA and BMAS surveys were conducted in small areas and a high proportion of survey units were sampled ($\geq 50\%$). We used this approach to 1) obtain more precise estimates in smaller areas that correspond with potential intensive management and research areas, and 2) facilitate research to improve sampling methods in low density moose populations where moose are “sparsely pocketed” across large expanses of good habitat (Kellie 2009). More precise estimates have become increasingly important to evaluate the effects of intensive management (IM) actions on moose populations. More specifically, it has become evident that current techniques do not have the power to detect small or moderate changes in population size in low density moose populations (such as Unit 25D) over time periods applicable to management actions.

The population estimate for the FYAS in 2008 was 76 observable moose ($\pm 25\%$, 90% CI) or a density of 0.14 moose/mi² (Table 2B). Despite a considerable increase in sampling density (51% in 2008 compared to 18%–22% for surveys in Unit 25D East during 1999–2007), precision did not improve ($\pm 25\%$ in 2008 compared to 17–27% during 1999–2007).

The population estimate for the BMSA was 182 observable moose ($\pm 15\%$, 90% CI) or a density of 0.34 moose/mi² in 2008 and 221 observable moose ($\pm 16\%$, 90% CI) or a density of 0.41 moose/mi² (Table 2B). Although precision increased slightly for these estimates ($\pm 15\%$ – 16%) compared to surveys conducted during 1999–2008 in Unit 25D West ($\pm 13\%$ – 24%), these levels of precision are poor relative to sampling density and inadequate to detect moderate changes in moose population size (2%–5% annual change).

ADF&G researchers included Unit 25D in a study evaluating the performance of the GSPE at low density (Kellie 2009). Results will include recommendations for sampling and the timeline needed to detect moderate change in population size using the GSPE.

Unit 25D West – FWS. Density estimates for Unit 25D West have been low (0.18–0.30 observable moose/mi²) since GSPE survey methods were implemented in 1999 (Table 2A). The FWS conducted surveys in fall 2006 and 2008 but was unable to conduct surveys in 2005 or 2007. Fall population estimates declined from 862 ($\pm 19\%$) in 1999 to 418 ($\pm 21\%$) moose in 2006 and subsequently increased to 490 ($\pm 13\%$) in 2008. Although point estimates of moose abundance have generally declined since 1999, estimates of annual abundance between years are not significantly different ($\alpha=0.10$) and the trend across all years is not significant ($\alpha=0.05$, Kellie 2009).

Unit 25D Totals. Based on the estimated moose densities (0.15–0.25 moose/mi²) from the 2007 fall survey conducted in a portion of Unit 25D East, the extrapolated observable moose

population in all of Unit 25D East (10,750 mi²) is 1600–2700 moose. Based on the estimated moose densities (0.19–0.25 moose/mi²) from the 2008 fall survey conducted in a portion of Unit 25D West, the extrapolated observable moose population in all of Unit 25D West (6,750 mi²) is 1300–1700 moose. Combining extrapolated estimates for Unit 25D East and West, the total observable moose population for Unit 25D (17,500 mi²) is 2900–4400 moose (0.16–0.25 moose/mi²). Assuming a minimum sightability correction factor of 1.23 for GSPE surveys conducted at 7–8 min/mi², we estimate the total moose population in Unit 25D at 3500–5400 moose (0.2–0.3 moose/mi²).

Population Composition

Units 25A and 25B. No moose surveys were conducted in RY05–RY08 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/mi²) 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. Estimates from fall surveys during 2007–2009 resulted in high bull:cow ratios (range: 33–64 bulls:100 cows) and moderate calf:cow ratios (range: 35–44 calves:100 cows; Table 3). Yearling recruitment, as indicated by yearling bull:cow ratios, was highly variable (range: 0–15 yearling bulls:100 cows) and generally lower than during RY05–RY06 (Table 3). Significant variation between years and survey areas and poor precision in ratio estimates due to small sample sizes make detection of trends in demographics difficult. Causes for large variation in estimated ratio data may be the results of: 1) natural fluctuations typical of moose populations in low density dynamic equilibrium (Gasaway et al., 1992), 2) poor performance of current moose survey techniques, 3) changes in moose distribution between years, and 4) annual variation in the extent of cow harvest.

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/mi² 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 RY07–RY08.

<u>Units and Bag Limits</u>	<u>Resident Open Season</u>	<u>Nonresident Open Season</u>
Unit 25A, within the DHCMA. RESIDENT HUNTERS: 1 bull by bow and arrow only, by drawing permit. 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	1 Sep–25 Sep
Unit 25A, remainder. RESIDENT HUNTERS: 1 bull. 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	5 Sep–25 Sep
Unit 25B, Porcupine River drainage upstream from the Coleen River drainage. RESIDENT HUNTERS: 1 bull. 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	10 Sep–25 Sep
Remainder of Unit 25B. RESIDENT HUNTERS: 1 bull; or 1 bull per community harvest report by community harvest permit in an established community harvest area. 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 1 Dec–15 Dec	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

<u>Units and Bag Limits</u>	<u>Resident Open Season</u>	<u>Nonresident Open Season</u>
Unit 25D East (remainder of Unit 25D).		
RESIDENT HUNTERS: 1 bull; or 1 bull per community harvest report by community harvest permit in an established community harvest area.	10 Sep–20 Sep 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 RY07–RY08.

Harvest by Hunters. The annual reported moose harvest in Unit 25A was 32 in RY07 and 47 in RY08, and was similar to previous years (Table 4). Slightly fewer moose were reported harvested in Unit 25B (37 and 36 animals) but harvest was similar to prior years (Table 5).

In Unit 25D East, reported harvest was 15 in RY07 and 19 in RY08, including one reported cow taken in RY08 (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. In RY08, ADF&G Division of Subsistence conducted household surveys in conjunction with CATG. Results of those surveys will be available during the next report period.

Permit Hunts. In RY07 and RY08, 75 TM940 permits were issued annually in Unit 25D West with reported harvests of 2 and 0 moose, respectively (Table 7). Low success rates (0%–11%) likely reflect low moose density in the area and harvest that may have occurred on a simultaneous federal permit hunt. 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 annual federal subsistence harvests in RY07 and RY08 were 10 and 5, respectively.

No moose have been reported taken on a Chalkyitsik community harvest permit since 2004. During RY00–RY03, 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, Alaska residents composed 49% of moose hunters during RY07–RY08, consistent with prior years (Table 8). Total hunters remained consistent with RY06, but increased slightly compared to the previous years. Success rates were 27% and 42%, consistent over the prior 10 years but slightly lower than during RY05–RY06.

In Units 25B and 25D, residents comprised $\geq 85\%$ of hunters during RY07–RY08, consistent with prior years (Tables 9 and 10). In Unit 25B, total hunters and success rates also remained similar to prior years with 99 and 90 hunters in RY07 and RY08, respectively, and 40% success rates in both years. The total number of hunters in Unit 25D East was 83 and 68 with success rates of 18% and 28%. Although success rates varied during RY07 and RY08, they fell within the 10-year range of 15%–33%. 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 25A occurred during the third and fourth weeks of September in RY07–RY08 (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–RY02, 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 the later portion of the season. In Unit 25D East, most moose harvest occurred during the second and third weeks of September and remained 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 were the most common transport method in Unit 25A, used by 69% and 66% of the successful hunters, respectively, in RY07 and RY08. Boats were used by most of the remaining successful hunters (Table 14). Transport methods remained consistent in Unit 25A during RY07–RY08 compared to RY98–RY06 and reflect difficulty in accessing this unit due to the lack of roads. Boats were used by 77% and 82% of successful hunters in Units 25B and 25D East, respectively, during RY07–RY08, 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 appear to be well below carrying capacity and are 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, Fairbanks). 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 successional 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. No large fires occurred during 2007–2008 and two fires in excess of 150,000 acres occurred in 2009.

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. Survey data for the Yukon Flats indicate adult cow mortality remains higher than would be expected from predation alone (ADF&G 2002). 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.

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 twinning rates, low browse removal rates, and high browse production indicate habitat quality and moose nutritional status are excellent (Boertje et al. 2007). However, early calf mortality primarily from black and grizzly bear predation combined with wolf predation of calves and adult moose during winter limit annual recruitment and population growth (Bertram and Vivion 2002, Lake et al. 2009). In addition, harvest of cow moose by local residents likely results in additive mortality to this segment of the moose population.

Monitoring moose population status in Unit 25D has been difficult using current GSPE techniques. Poor precision associated with estimates of population size and demographics are inadequate to measure efficacy of potential intensive management actions that are expected to result in moderate changes in population size. Current research will evaluate the performance of the GSPE surveys on low-density moose populations and results will include recommendations for sampling and the timeline needed to detect moderate change in population size using the GSPE.

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 and limited survey data suggest that the population may have declined from the late 1980s through the early 2000s. 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. Future moose surveys may help determine current trend in moose abundance and distribution.

UNITS 25A, 25B, AND 25D

We did not likely meet our first management objective to increase the size of the moose population by 2%–5% annually in key hunting areas near local communities. In addition, current survey techniques do not have the power to detect small to moderate changes in moose population size.

We met our second management objective, to implement and conduct systematic household harvest surveys (in coordination with the Division of Subsistence) for communities in Unit 25D in 2009. Result of those surveys will be available in the next reporting period.

We did not likely meet our third management objective to reduce illegal and potlatch harvest of cow moose to less than 5% of total annual harvest. However, some local residents believe progress has been made toward reducing cow harvest. Results of household harvest surveys conducted in 2009 may provide additional insight to the extent of cow harvest in Unit 25D.

We met our fourth management objective to maintain a minimum of 40 bulls per 100 cows as observed in fall surveys.

LITERATURE CITED

- ALASKA DEPARTMENT OF FISH AND GAME. 2002. Yukon Flats cooperative moose management plan. Division of Wildlife Conservation. Fairbanks, Alaska, USA. <http://www.wildlife.alaska.gov/management/planning/planning_pdfs/yukonflats_plan.pdf> Accessed 29 May 2008.
- BERTRAM, M., AND M. VIVION. 2002. Moose mortality in eastern Interior Alaska. *Journal of Wildlife Management* 66:747–756.
- BOERTJE, R. D., M. A. KEECH, D. D. YOUNG, K. A. KELLIE, AND C. T. SEATON. 2009. Managing for elevated yield of moose in Interior Alaska. *Journal of Wildlife Management*. 73:314–327.
- , K. A. KELLIE, C. T. SEATON, M. A. KEECH, D. D. YOUNG, B. W. DALE, L. G. ADAMS, AND A. R. ADERMAN. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- BURCH, J. 1999. 1999 Aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. Technical report, National Park Service, Alaska Region. Fairbanks, Alaska, USA.

- . 2003. 2003 Aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. Technical report, National Park Service, Alaska Region. Fairbanks, Alaska, USA.
- . 2006. 2006 Aerial moose survey along the Yukon River corridor, Yukon–Charley Rivers National Preserve, Alaska. Technical report, National Park Service, Alaska Region. Fairbanks, Alaska, USA.
- CAIKOSKI, J. R. 2008. Units 25A, 25B, and 25D moose. Pages 617–647 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, Alaska, USA.
- COUNCIL OF ATHABASCAN TRIBAL GOVERNMENTS. 2007. Yukon Flats moose, bear, waterfowl, and furbearing harvest data collection. Natural Resources Department. Fort Yukon, Alaska, USA.
- DELONG, R. A. 2006. Geospatial population estimator software user's guide. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPESoftwareUsersGuide.pdf>> Accessed 9 Sep 2008.
- GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.
- KEECH, M. A., AND T. BOUDREAU. 2006. Response of moose and their predators to wolf reduction and short-term bear removal in a portion of Unit 19D. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Annual Research Performance Report 1 July 2005 through 30 June 2006. Project 1.62. Grant W-33-4. Juneau, Alaska, USA.
- KELLIE, K. A. 2009. Evaluating research options for developing a GSPE sightability correction factor. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Annual Performance Report 1 July 2008–30 June 2009. Grant W-33-7. Project 1.66. Juneau, Alaska, USA. http://www.wildlife.alaska.gov/pubs/techpubs/research_pdfs/1.66_09_final.pdf (Accessed 28 May 2010)
- KELLIE, K. A., AND R. A. DELONG. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game. Fairbanks, Alaska, USA. <<http://winfonet.alaska.gov/sandi/moose/surveys/documents/GSPEOperationsManual.pdf>> Accessed 9 Sep 2008.
- LAKE, B. C., 2008. Moose population survey of the western Yukon Flats, November 2008. Yukon Flats National Wildlife Refuge Report 2008-08. 19pp.
- LAKE, B. C., M. R. BERTRAM, N. GULDAGER, and J. R. CAIKOSKI. 2009. Kill rate of wolves on moose in a low density prey population: results from eastern interior Alaska. Yukon Flats National Wildlife refuge Report 2009-01. 14pp.

MACLEAN, L. S., AND H. N. GOLDEN. 1991. Moose population status in the eastern Yukon Flats, Yukon Flats National Wildlife Refuge. Progress Report 91-1. U.S. Fish and Wildlife Service. Fairbanks, Alaska, USA.

MAUER, F. J. 1998. Moose migration: northeastern Alaska to northwestern Yukon Territory, Canada. *Alces* 34:75–81.

VER HOEF, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 *in* 2000 Proceedings of the Section on Statistics and the Environment of the American Statistical Association.

———. 2008. Spatial methods for plot-based sampling of wildlife populations. *Environmental and Ecological Statistics*. 15:3–13.

PREPARED BY:

Jason R. Caikoski
Wildlife Biologist II

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

CAIKOSKI, J. R. 2010. Units 25A, 25B, and 25D moose. Pages 611–642 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

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
<i>Unit 25A</i>								
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
<i>Unit 25B^e</i>								
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 2A Summary of geospatial moose population estimates (GSPE)^a in Unit 25D, 1999–2009

Location and survey year	Survey area (mi ²)	Strata size (mi ²)		Area searched (mi ²)		Total search area (mi ²)	No. of moose estimated by strata and total, and density (moose/mi ²)		Population estimate ± 90% CI	Average density moose/mi ²	No. of sample units counted
		Low	High	Low	High		Low	High			
Unit 25D East											
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 ^b											
2006 GSPE	3630	2295	1335	195	277	472	495/0.21	237/0.18	732±33%	0.20	87
Venetie Survey ^b											
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
Unit 25D West ^c											
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
2008 GSPE	2269	1493	776	393	544	937	n/a	n/a	490±13%	0.22	174

^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 Methods are provided in Caikoski 2008.

^c 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, and Lake 2008, unpublished moose survey report)..

Table 2B Summary of geospatial moose population estimates (GSPE)^a in Unit 25D, 2008-2009.

Location and survey year	Survey area (mi ²)	Area searched (mi ²)	Population estimate± 90% CI	Average density (moose/mi ²)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	No. of sample units counted
Beaver Management Area Survey 2008	536	268	182±15%	0.34	54	7	35	50
Beaver Management Area Survey 2009	536	268	221±16%	0.41	33	5	37	50
Fort Yukon Survey 2008	533	270	76±25%	0.14	43	0	43	51

TABLE 3 Estimated moose population composition based on fall GSPE surveys in Unit 25D, 1999–2009

Survey year and area (mi ²)	Bulls:100 Cows	Yrlg bulls:100 Cows	Calves: 100 Cows
<i>Unit 25DEast</i>			
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
<i>Fort Yukon Survey</i>			
2008 (533)	43	0	43
<i>Venetie Survey</i>			
2004 (2858)	75	24	41
2005 (2858)	44	4	58
<i>Birch Creek Survey</i>			
2006 (3630)	55	8	29
<i>Unit 25D West</i>			
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
2008 (2269)	51	3	44
<i>Beaver Survey</i>			
2008 (536)	54	7	35
2009 (536)	33	5	37

TABLE 4 Unit 25A reported moose harvest, regulatory years 1998–1999 through 2008–2009

Regulatory	Reported ^a harvest			
year	M	F	Unk	Total
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
2007–2008	32	0	0	32
2008–2009	47	0	0	47

^a Source: moose harvest reports.

TABLE 5 Unit 25B reported moose harvest, regulatory years 1998–1999 through 2008–2009

Regulatory	Reported harvest ^a			
year	M	F	Unk	Total
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
2007–2008	37	0	0	37
2008–2009	36	0	0	36

^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 1998–1998 through 2008–2009

Regulatory year	Reported harvest ^a			
	M	F	Unk	Total
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
2007–2008	15	0	0	15
2008–2009	18	1	0	19

^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 and federal subsistence permits, regulatory years 1998–1999 through 2008–2009

Regulatory year	Tier II permit hunt (TM940)														Federal permit harvest	
	Permits issued	Did not hunt (%)		Did not report (%)		Unsuccessful hunters (%)		Successful hunters (%)		Bulls (%)		Cows (%)		Unk		Total harvest
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
2007–2008	75	57	(76)	0	(0)	16	(89)	2	(11)	2	(100)	0	(0)	0	2	10
2008–2009	75	55	(73)	0	(0)	20	(100)	0	(0)	0	(0)	0	(0)	0	0	5

^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 1998–1999 through 2008–2009^a

	Successful							Unsuccessful						
Regulatory year	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)			Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)		Total hunters
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
2007–2008	2	16	14	0	32	(27)		1	45	41	0	87	(73)	119
2008–2009	1	17	27	2	47	(42)		0	32	34	0	66	(58)	113

^a Source: moose harvest reports.

^b Resident of Unit 25ABD.

TABLE 9 Unit 25B moose hunter residency and success, regulatory years 1998–1999 through 2008–2009^a

	Successful							Unsuccessful							
Regulatory year	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)			Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)		Total hunters	
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	
2007–2008	4	28	5	0	37	(40)		1	50	11	0	62	(63)	99	
2008–2009	6	26	4	0	36	(40)		1	43	10	0	54	(60)	90	

^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 25ABD.

TABLE 10 Unit 25D East moose hunter residency and success, regulatory years 1998–1999 through 2008–2009^a

Regulatory year	Successful						Unsuccessful					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)		Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2007–2008	9	6	0	0	15 (18)		22	39	4	3	68 (82)	83
2008–2009	10	6	3	0	19 (28)		20	24	5	0	49 (72)	68

^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 1998–1999 through 2008–2009^a

Regulatory	Harvest chronology percent by month/day						
year	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5 ^b	Unk	<i>n</i>
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
2007–2008	3	9	50	31	6	0	32
2008–2009	0	15	46	35	4	0	46

^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 1998–1999 through 2008–2009^a

Regulatory	Harvest chronology percent by month/day								
year	Aug ^b	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	<i>n</i>
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
2007–2008	3	3	22	44	24	0	3	0	36
2008–2009	3	3	31	49	14	0	0	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 1998–1999 through 2008–2009^a

Regulatory	Harvest chronology percent by month/day							
year	Aug ^b	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Unk	<i>n</i>
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
2007–2008	0	13	33	40	13	0	0	15
2008–2009	0	5	42	42	11	0	0	19

^a Source: moose harvest reports.

^b No open season.

TABLE 14 Unit 25A moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009^a

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	<i>n</i>
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
2007–2008	69	6	22	0	0	0	0	0	3	32
2008–2009	66	4	21	2	0	0	0	0	6	47

^a Source: moose harvest reports.

TABLE 15 Unit 25B moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009^a

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	<i>n</i>
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	6	3	0	0	0	0	35
2007–2008	19	0	73	3	3	0	0	0	3	37
2008–2009	14	0	81	3	0	0	0	0	3	36

^a Source: moose harvest reports.

TABLE 16 Unit 25D East moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009^a

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	<i>n</i>
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
2007–2008	6	0	80	13	0	0	0	0	0	15
2008–2009	11	0	84	5	0	0	0	0	0	19

^a Source: moose harvest reports.

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: 26A (56,000 mi²)

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 1,219 moose in 1970 to 1,535 in 1991, declined to 757 in 1995 and 326 in 1999, then increased to 576 moose in 2002 and 1,048 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 interrupted, 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 2007. The trend area count increased from 152 moose in 1996 to 610 moose in 2007 (Carroll 2008).

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 2002–2007, hunters harvested from 5 to 10 moose (Carroll 2008).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Allow for the recovery of the Unit 26A moose population and maintain a population of over 1,000 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 unit wide 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 Piper PA-18 and Cessna 182 aircraft to conduct census, trend area, and fall composition counts. During the riparian zone minimum direct count 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 these surveys.

We conducted calving success and twinning rate surveys each year during the first 2 weeks of June. In 2008, we did not have an adequate number of collared cows so we flew calving surveys by flying to calving areas and finding as many cows as possible. In 2009, we located and observed all of the collared cows plus a substantial number of uncollared cows. We obtained global positioning system locations for all moose observed during surveys and noted whether females had 0, 1, or 2 calves.

We used a Robinson 440 helicopter and standard chemical immobilization techniques to capture moose in April of 2008 and 2009. Moose were immobilized using carfentanil citrate and xylazine and the drugs were reversed with naltrexone and tolazoline. We captured moose on the Colville, Anaktuvuk, and Chandler rivers. In 2008, we captured 22 short yearling (10-month-old) females and 3 adult females on April 15–16. The short yearlings were weighed and measured; blood, fecal, and hair samples were collected; and expandable VHF radiocollars were attached. We measured the adults; blood, fecal, and hair samples were collected; and we removed radiocollars that had been attached in 1996 and 1997 from 2 of them. In 2009, we captured 20 adult females on April 11–12; took standard measurements; collected blood, fecal, and hair samples; and attached VHF radiocollars. Samples were analyzed to test for disease, mineral status, parasites, and contaminants.

In 2009, we assessed browse quantity and utilization in the study area using protocol developed by Seaton (2002). We chose locations for 20 random and 20 systematic plots along the Colville, Anaktuvuk, and Chandler rivers and flew to these locations in a Robinson 440 helicopter. When we got to the location, we defined a circle with a 15 meter radius around the spot. Within each plot we counted how many browse plants of each species there were and the degree of browsing on each plant.

We also worked with another department employee in 2009, to initiate a study to assess the quality of browse that moose in Unit 26A are eating. Browse samples were collected from areas where moose were browsing in late winter, at green-up, at peak growth, and at senescence of the

plants. These samples are being analyzed for leaf nitrogen, digestible proteins, and tannin-protein precipitation capacity. These results can be compared to samples from other parts of the state to give us an idea of the relative quality of the browse in Unit 26A.

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

We completed a census from 8–12 April 2008 and counted a total of 1,180 moose, including 1,023 adults and 157 short yearlings for a 13% recruitment rate. This was a slight increase from the 2005 census when we counted 1,048 moose. (Table 1)

Census results of 1,219, 1,258, 1,447, and 1,535 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, 1,048 moose in 2005, and 1,180 in 2008 (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 2008, there were 64 moose including 4 calves on the Itkillik River

Trend area counts were conducted on 8–10 April 2008 and 7–8 April 2009. In 2008, we counted 559 moose, including 475 adults and 84 short yearlings (15% recruitment rate). In 2009, we counted 364 moose, including 356 adults and only 8 calves (2% recruitment rate). These counts indicate that the population began to decline in 2008 and declined substantially in 2009. (Table 2, Figure 1) The decline is the result of adult mortality and very poor recruitment, and is probably due to predation from wolves and bears, malnourishment, and mineral deficiency.

Past 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), was fairly stable until 2007 (610 moose), then declined to 356 moose in 2009. (Table 2, Figure 1).

Population Composition

The percentage of short yearlings counted in spring surveys declined substantially during the reporting period. The recruitment rate dropped from 22% in 2007 to 15% in 2008 and only 2% in 2009. This very low recruitment is very similar to what we saw in the Unit 26A moose population decline which occurred in the early 1990s, when the percentage of short yearlings was 3%, 2%, and <1% from 1994 to 1996. During the time of population recovery, we observed from 17% to 26% short yearlings from 1998 through 2007. (Table 2, Fig. 1)

During spring calving surveys, we generally observe collared cows; record whether they have 0, 1, or 2 calves; and calculate the number of calves per 100 cows and the twinning rate (number of

sets of twins divided by the number of parturient collared females). However, we had very few collared cows in 2008 so we flew to known calving areas and observed 78 cows. Of those we saw 51 cows with no calf, 20 cows with 1 calf, and 7 cows with twins (43.6 calves per 100 cows and 25.9% twins). In 2009, we observed 16 collared cows and 31 cows with no collars. Of the collared cows, we observed 8 with no calf, 5 with 1 calf, and 3 with twins (68.8 calves/100 cows and 37.5% twins). Of the cows without collars, we observed 19 with no calf, 7 with 1 calf, and 5 with twins (54.6 calves/100 cows and 41.7% twins). (Table 3)

The calculated number of calves and percentage of twins were less in 2008 than in most other years, but was more mid-range in 2009. It is possible that results are influenced by whether or not radiocollars are used to find the cows that are sampled. If collars are not used, it is more difficult to find cows that have left the river corridor to have a calf and this may bias the sample. On the other hand, if only radiocollared cows are used in the sample and new cows are not collared periodically, older, more experienced cows are being observed each year; that may influence calving and twinning results.

During fall composition surveys in 2007, 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, 18% calves). During fall 2008, we observed 247 moose in the trend count area, including 94 bulls (69 bulls:100 cows), 137 cows, and 16 calves (12 calves:100 cows, 7% calves). During 2009, composition surveys (after the reporting period) we observed 219 moose within the trend count area, including 85 bulls (71 bulls:100 cows), 119 cows, and 15 calves (13 calves:100 cows, 7% calves). (Table 4).

The 2008 and 2009, fall composition survey results indicate that part of the current population decline is due to low summer calf survival. However, the fact that the short yearling percentage in April of 2009 was 2% indicates that high calf mortality continued through the winter.

With improved calf survival, the percentage of bulls in the younger age groups gradually increased, and there was good representation in all bull antler size groups until 2008. However, poor recruitment appears to be resulting in fewer bulls in the younger age groups in 2009.

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%

Inches	<30	30–39	40–49	50–59	60+
2005	19%	15%	19%	25%	22%
2006	18%	16%	19%	26%	21%
2007	21%	14%	17%	25%	23%
2008	20%	18%	22%	29%	11%
2009	8%	5%	34%	41%	12%

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 many 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. Twenty-five 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. Sixteen 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. Twenty 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. Twenty-eight 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.

<u>2007–2008</u>	<u>Resident Open Season (Subsistence and General Hunts)</u>	<u>Nonresident Open Season</u>
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 upstream 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 bull.	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.		

<i>2008–2009</i>	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 upstream 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 DM980-982)	1 Sep–14 Sep (Permit Hunt DM980-982)
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 DM980–982. Aircraft cannot be used to hunt moose in the Anaktuvuk Pass Controlled Use Area.		

Board of Game Actions and Emergency Orders (EO). During its November 2007 meeting, the Board of Game approved a nonresident season with up to 20% of available drawing permits to be allocated to nonresidents. The Board also ruled that the use of aircraft in the drawing permit area would not be allowed for moose hunting in the Anaktuvuk Pass Controlled Use Area. The department divided the drawing permit area into 3 areas (DM980, DM981, and DM982). No EOs were issued during the reporting period.

Hunter Harvest. Hunter harvest and antler size is summarized in Tables 5 and 6.

Permit Hunts. Twenty permits were issued in 2007, 10 people hunted, and 6 bull moose were harvested under DM992. Twenty-five permits were issued in 2008, 14 people hunted, and 7 bull moose were harvested under DM980, DM981, and DM982.

Hunter Residency and Success. Hunter residency is summarized in Table 7.

Harvest Chronology. Harvest Chronology is summarized in Table 8.

Transport Methods. Transportation methods are summarized in Table 9.

Other Mortality

Recent counts indicate that the number of adult moose declined from 475 to 356 and the percent of short yearlings declined from 22% to 2% from 2007 to 2009 within the trend count area, due to some mortality in adults and high mortality in calves. This decline appears to be a result of predation and malnourishment.

Wolf surveys indicated that wolf density declined from 4.1 wolves/1,000 km² in 1994 to 1.6 wolves per 1000 km² in 1998 and remained low through most of the period of moose population growth. However, during the fall 2007 moose composition count we observed 37 wolves compared to less than 10 in previous years. During a 2008 reconnaissance track wolf survey, we found 4.4 wolves/1,000 km² in the core area for the Unit 26A moose population. In addition, the number of wolves seen during moose surveys has also increased substantially in recent years from 0.13 per hour in 2002 to 1.78 per hour in 2008. (Carroll, 2009)

Wolves per hour seen during spring moose surveys:

Year	1991	1995	1999	2002	2005	2008
Wolves/hour	0.74	0.46	0	0.13	0.44	1.78

Bear predation, particularly of calves, is probably also a substantial factor. Bear surveys have not been conducted. However, from observations during surveys for other species and hunter's reports, bears appear to be plentiful in the area.

Malnourishment also appears to be a factor. In 2008, we captured 22 short yearlings (10-month-old) females and most of them were small and appeared to be malnourished. The weights of the short yearlings ranged from 252–400 pounds and averaged 322 pounds. Short yearling moose calves have been weighed in other areas and the Unit 26A short yearlings were the lightest recorded in the state. In other areas the average weight has ranged from 341–470 pounds. During the time of the capture operation, samples were collected from several carcasses that were found during surveys and bone marrow indicated that most of those were malnourished. The survival rate of the collared animals was quite low, with only 7 still alive after the first year.

It appeared that the poor condition of the short yearlings in 2008 and the poor survival was a recent development. During surveys in previous years the calves and short yearlings had

appeared to be in good condition and the percent of short yearlings in the population ranged from 20% –25% (Table 2), indicating a good survival rate.

Thus far, analyses of blood, hair, and fecal samples have not identified an obvious cause for the increased mortality. Earlier, during the mid 1990s population decline, several cows tested positive for antibodies to the bacteria *Brucella suis* Biovar 4 (8 of 43) and *Leptospira interrogans* serovar pomona (6 of 30). However, analyses of the current samples have not indicated a prevalence of bacterial disease. There have been no contaminants or parasites found that would lead to increased mortality. Nearly all of the moose have tested to be marginally deficient in copper, and this could affect their immunity and general fitness, but this probably has not changed from past years.

One cause for the increased mortality could be starvation due to a change in food quantity or quality (see section on Habitat). Another possible cause for the poor condition of many of the moose, particularly the calves, could be the increased stress due to the sudden increase in the number of wolves. Before 2007, they probably encountered very few predators. After 2007, there were large packs of wolves that were working all of the major drainages and probably caused stress to most of the moose that were present there.

HABITAT

Assessment

A survey was conducted to determine the quantity of browse available to moose in the winter in the riparian area in April of 2008. Results of the study indicated a 12% browse removal rate, which is similar to other areas in the state with moderate browsing and twinning rates. It would appear that the quantity of browse is adequate and is not the reason for starvation in some of the moose.

In a collaborative effort, another department employee collected browse samples in Unit 26A and is assessing its quality. Samples were collected from areas where moose were browsing in late winter, at green-up, at peak growth, and at senescence of the plants. These samples are being analyzed for leaf nitrogen, digestible proteins, and tannin-protein precipitation capacity. When the analysis is complete results will be compared to samples from other parts of the state to give us an idea of the relative quality of the browse in Unit 26A.

One factor that could affect browse plants is that there is a large population of snowshoe hares in the area, which also consume willows. Hares often eat bark as well as branch ends from the willows, which may cause the plants to produce more tannins or other substances that may make them difficult to digest and/or less nourishing.

Enhancement

There were no habitat enhancement projects.

NONREGULATORY MANAGEMENT ISSUES/NEEDS

Under land-claims procedures, the Arctic Slope Regional Corporation selected most of the land along the Colville, Anaktuvuk, Chandler, and Killik rivers and this land has been transferred to them. The corporation is closing these lands to sport hunting and fishing and they will only be open for subsistence activities for shareholders and other qualified subsistence users that are residents of native communities of the North Slope. The corporation lands encompass much of the hunt area for Unit 26A moose, so this will have a large influence on how we manage hunts in this area.

CONCLUSIONS AND RECOMMENDATIONS

After several years of increasing population numbers, the Unit 26A moose population began to decline in 2008. The number of moose in the trend count area declined from 610 in 2007 to 559 in 2008 to 364 in 2009. The percentage of yearlings declined from 22% to 15% to only 2%. The census that was flown in 2008, indicated an increase over the 2005 census from 1,048 to 1,180 moose, but that was due to good survival and recruitment numbers in 2006 and 2007.

The reasons for the population decline appear to be predation and malnourishment. Wolf surveys indicated that the density of wolves in the core moose area increased from 1.6 wolves per 1,000 km² to 4.4 wolves/1,000 km². The number of wolves seen during moose surveys has also increased substantially in recent years from 0.13 per hour in 2002 to 1.78 per hour in 2008. Bear predation, particularly of calves, is probably also a substantial factor.

Malnourishment also seems to be an issue. Twenty-two short yearlings were captured in April of 2008 and most of them were small and malnourished. The Unit 26A short yearlings were the lightest that have been recorded anywhere in the state. During the time of the capture operation, samples were collected from several carcasses that were found dead during surveys and bone marrow indicated that most of those were malnourished. The survival rate of the collared short yearlings was quite low, with only 7 still alive after the first year.

It appeared that the poor condition of the short yearlings in 2008 and the poor survival was a recent development. During surveys in previous years the calves and short yearlings had appeared to be in good condition and the percent of short yearlings in the population ranged from 20% to 25% (Table 2), indicating a good survival rate.

Analysis of blood, hair, and fecal samples have not thus far not identified an obvious cause for decline. There has been no indication the bacterial diseases that were present during the population decline of the mid-90s. There have been no contaminants or parasites found that would lead to increased mortality. Nearly all of the moose have tested to be marginally deficient in copper, and this could affect their immunity and general fitness, but this probably has not changed from past years.

We initiated studies in 2009 to determine if the quantity and/or quality of browse plants could be the reason for malnourishment. We found that the quantity of browse seemed to be adequate to support the population. Results are still pending on the quality of the browse. The fact that the Unit 26A moose are at the northern limit of possible moose range, and that the vegetation they utilize has a very short growing season, probably has an effect on the quality of the browse. In

addition, snowshoe hares are numerous in the area and the combined impact of both species on browse plants could cause the plants to produce tannins, reducing their nutritional value.

In response to the increasing moose population between 1998 and 2007, the Board of Game incrementally liberalized regulations. Currently the general season is from Aug 1–Sept 14 for much of the hunt area. In addition there is a summer (July 1–Sept 14) for moose that disperse into western Unit 26A and a winter hunt (Feb 15–Apr 15). There are also limited drawing hunts for residents and nonresidents that allow the use of aircraft. Restrictions on the use of aircraft for all other hunts has remained. Even with the liberalized regulations the number of moose harvested per year has been 12 or less per year, with only 0 to 3 per year being cows. However, with the declining population we must once again consider making hunting regulations more restrictive. The fact that the Arctic Slope Regional Corporation has closed access to much of the hunting area to people who are not residents of North Slope villages, will remove some of the hunting pressure. If it appears that hunting pressure is a problem, the department can close the drawing hunts, which would eliminate using aircraft to hunt, and reduce the total harvest to very low levels.

LITERATURE CITED

- CARROLL G.M. 1998. Moose survey-inventory management report. Pages 457–471 in M.V. Hicks, ed. Report of survey-inventory activities, 1995–1997. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grants W–24–4, W–24–5. Juneau, Alaska USA.
- _____. 2000. Moose survey-inventory management report. Pages 523–537 in M.V. Hicks, ed. Report of survey-inventory activities, 1997–1999. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grants W–27–1, W–27–2. Juneau, Alaska USA.
- _____. 2002. Unit 26A moose management report. Pages 567–581 in C. Healy, editor. Moose management report of survey and inventory activities 1 July 1999–30 June 2001. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- _____. 2004. Unit 26A moose management report. Pages 597–612 in C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.
- _____. 2006. Unit 26A moose management report. Pages 631–649 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau.
- _____. 2008. Unit 26A moose management report. Pages 648–667 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, Alaska, USA.

_____. 2009. Unit 26A wolf management report. Pages 265–278 in P. Harper, editor. Wolf management report of survey and inventory activities 1 July–30 June 2008. Alaska Department of Fish and Game. Juneau, Alaska.

Seaton, C.T. 2002. Winter foraging ecology of moose in the Tanana Flats and Alaska Range Foothills. MS Thesis. University of Alaska Fairbanks.

TRENT J.N. 1989. Moose survey-inventory progress report. Pages 353–360. In S.O. Morgan, ed. Annual report of survey-inventory activities, 1989. Volume XIX, Part VIII, Alaska Department Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-1, Study 1.0. Juneau, Alaska USA.

PREPARED BY:

Geoffrey Carroll

Wildlife Biologist III

SUBMITTED BY:

Peter Bente

Management Coordinator

Please cite any information taken from this section, and reference as:

CARROLL, G. 2010. Unit 26A moose management report. Pages 643–665 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1. Number of adult and calf moose from Unit 26A censuses, April 1970–2008.

Year	Adults	Calves	Total ^a	% Calves
1970	911	308	1,219	25
1977	991	267	1,258	21
1984	1,145	302	1,447	21
1991	1,231	304	1,535	20
1995	746	11	757	1
1999	274	52	326	16
2002	502	74	576	13
2005	863	185	1,048	18
2008	1,023	157	1,180	13

^aIncludes moose counted on the Itkillik River which is part of the Colville River drainage, but is in Unit 26B. In 2008, there were 64 moose, including 4 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 1983–2009.

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
2008	559	475	84	15
2009	364	356	8	2

TABLE 3. Calving surveys of radiocollared cows with twinning rate, June, 1996–2009.

Year	Total cows	Calves:100 Cows	Pairs of Twins	Twins:100 Cows	Percent Twins ^a
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 ^b	18	83	2	11	15%
2002	28	82	6	21	35%
2003	25	92	7	28	44%
2004	16	68	4	25	57%
2006 ^c	83	42	10	12	40%
2008 ^c	78	44	7	9.0	26%
2009	16	69	3	19	38%
2009 ^c	31	55	5	16	42%

^a Number of sets of twins/number of parturient females.

^b Incomplete survey.

^c Survey done without radiocollars.

TABLE 4. Unit 26A fall aerial moose composition trend area counts, November, 1983–2009.

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	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
2008	69	12	7	231	247
2009	71	13	7	204	219

TABLE 5. Unit 26A moose harvest, 1985–2009.

Regulatory year	Reported hunter harvest		
	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
2007–2008	11	1	12
2008–2009	11	0	11

TABLE 6. Number of bull moose harvested in antler width categories (inches) in Unit 26A, 1996–2009.

Regulatory year	Unknown	<20	20–29	30–39	40–49	50–59	60+	<i>N</i>
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
2007–2008	7 ^a	0	0	0	4	0	1	12
2008–2009	4 ^a	0	0	1	0	3	3	11

^a Antler size was inadvertently excluded from hunter report cards for the drawing hunt.

TABLE 7. Moose hunter residency and success, Unit 26A, 1985–2009.

Regulatory year	Successful hunters						Total hunters				
	Local res ^a	Non- local res ^b	Nonres ^c	Unknown	Total	(%)	Local res ^a	Non- local res ^b	Nonres ^c	Unknown	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 ^d	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
2007–2008	4	7	0	1	12	57	5	15	0	1	21
2008–2009	4	4	3	0	11	65	4	10	3	0	17

^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 number of total hunters. Moose population was low and the hunt was restricted.

TABLE 8. Percent chronology of moose harvest, Unit 26A, 1996–2009.

Regulatory year	Harvest periods					Unknown	<i>N</i>
	July	Aug	1–7 Sep	8–14 Sep	15 Feb–15 Apr		
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
2007–2008	8	26	58	8	0		12
2008–2009	0	18	64	9	9		11

* Season open only in August.

TABLE 9. Percent transport methods for moose harvest in Unit 26A, 1987–2009.

Regulatory year	Percent method of transportation					<i>N</i>
	Airplane	Boat	3 or 4 wheeler	Snowmachine	ORV	
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
2007–2008	59	33	8	0		12
2008–2009	55	36		9		11

Colville River Moose Trend Area Counts 1991 - 2009

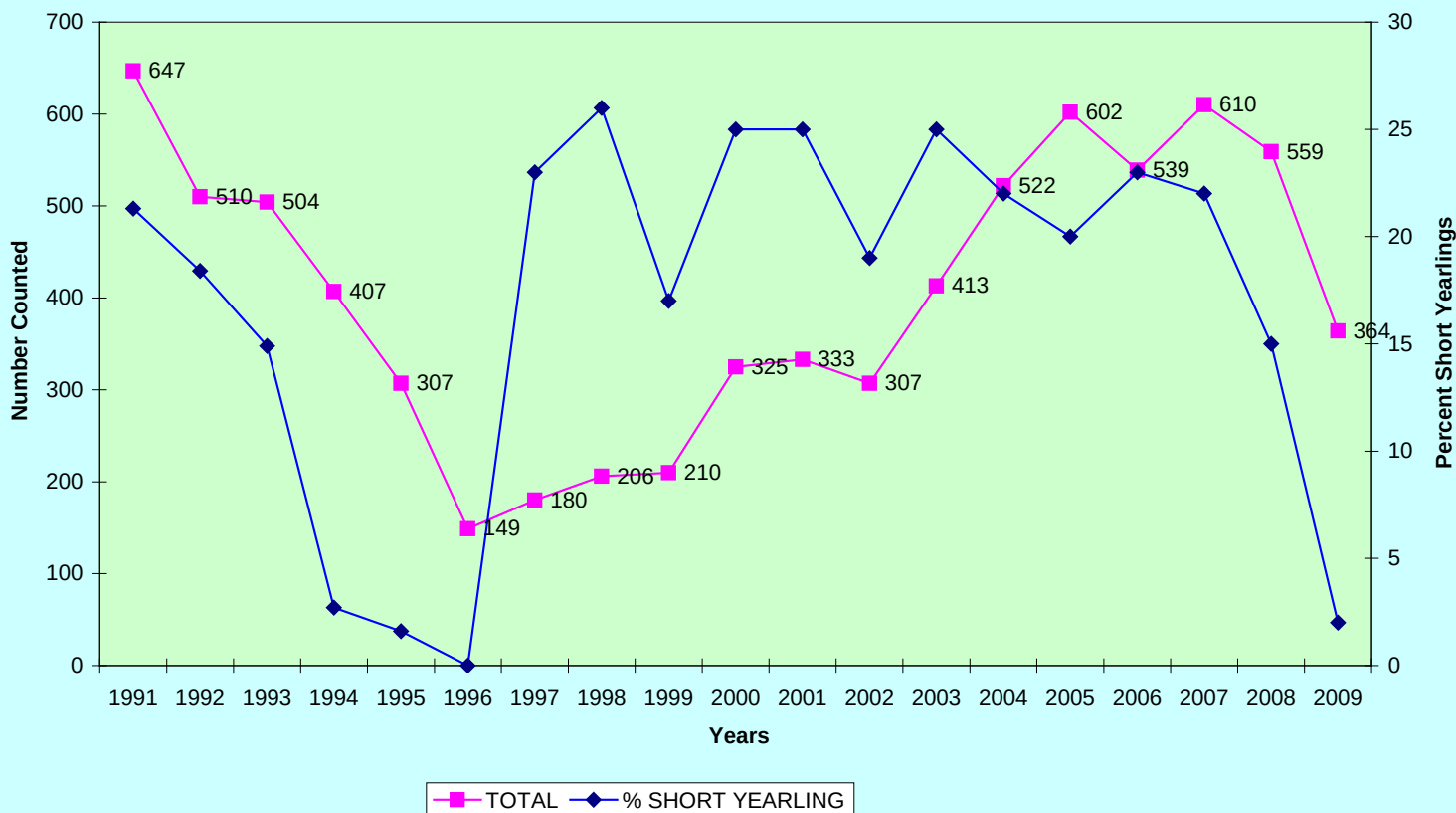


FIGURE 1. Unit 26A moose trend counts and percentage of short yearlings: Colville River between the mouths of Anaktuvuk and Killik rivers, Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, 1991–2009.

MOOSE MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNITS: Units 26B and 26C (26,000 mi²)

GEOGRAPHIC DESCRIPTION: North Slope of the Brooks Range and Arctic Coastal Plain east of the Itkillik River

BACKGROUND

Moose were scarce in Arctic Alaska prior to the early 1950s, when populations expanded and reached high densities in the limited riparian habitat of major drainages (LeResche et al. 1974). Predation, as well as hunting, probably contributed to the historical scarcity of moose. The reduction in wolf numbers by federal control programs during the late 1940s and early 1950s was likely important in allowing moose populations to increase and become established in most of the riparian shrub habitat on the North Slope. This area represents the northern limit of moose range in North America and habitat limits the potential size of moose populations. 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 1400 moose (Lenart 2004, 2008, Martin and Garner 1984, Mauer and Akaran 1994). Numbers of moose declined in the early 1990s by at least 50% and remained at lower numbers throughout the 1990s (Mauer 1997, Lenart 2008). The decline in moose numbers appeared to be widespread on the eastern North Slope, including Unit 26A (Carroll 1998; Lenart 2006). Historical survey data for trend areas can be found in Mauer 1997 and Lenart 2008. During the 2000s, the moose population slowly increased in Unit 26B and stabilized at approximately 500 observable moose. Although surveys were not conducted in Unit 26C during the 1990s, we suspected moose numbers were very low, based on anecdotal observations from residents, biologists, and hunters. Surveys conducted in central Unit 26C on the coastal plain during the 2000s indicated moose numbers appeared to be stable at 50–60 observable moose. Surveys conducted in eastern 26C in the Brooks Range in the early 2000s indicated approximately 200 moose were observed.

¹ At the discretion of the reporting biologist, this unit report contains data collected outside the report period.

The low numbers of moose observed during the early 1990s resulted in closing the moose hunting seasons in Units 26B and 26C beginning in fall 1996. Two moose hunting seasons were reopened in RY06 in Unit 26B (excluding the Canning River drainage) to resident hunters only, by drawing permit for a fall season and by general harvest ticket for a late winter season. Unit 26C remains closed to moose hunting. Regulations varied somewhat prior to closure of the hunting season in RY96 and an historical summary can be found in Lenart (2008).

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, maintain a population of ≥ 300 moose with a 3-year mean proportion of $\geq 15\%$ 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 $\geq 15\%$ short yearlings in the population.
Activity: Maintain an open moose season when the objective is met
- Maintain a bull:cow ratio of $\geq 35:100$ when hunting seasons are open.

METHODS

POPULATION STATUS AND TREND

Population Size and Composition

The limited and relatively open nature and sparse, low vegetation of winter moose habitat on the North Slope make 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 (drainages east of the Canning River and the lower Kongakut below Drain Creek) 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. Identification of bulls was likely conservative because we probably misclassified young bulls with little early antler development.

Unit 26B East. This area encompasses Unit 26B east of the Sagavanirktok River, including a portion of the Canning River in Unit 26C. (The west bank of the Canning River is the boundary between Unit 26B and 26C). 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. Moose in Unit 26B East are found primarily in the northern foothills of the Brooks Range. 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.

Unit 26B West. This area encompasses Unit 26B west of the east bank of the Sagavanirktok River. ADF&G conducted spring moose surveys in Unit 26B West in April 1996 and during 1999–2008. Moose in Unit 26B West are found along major drainages on the coastal plain. 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.

Unit 26B West, Itkillik River drainage. Parts of the Itkillik River have been surveyed periodically since 1981, but because of incomplete surveys during 1996–2004, these data were treated separately from Unit 26B West. The lower Itkillik River from the mouth to Itkillik Lake was surveyed during 1999–2004. In 1999, a portion of the Upper Itkillik (upstream of Itkillik Lake) was also surveyed. Beginning in spring 2005, we surveyed the Itkillik River from its mouth upstream to the headwaters.

Additional areas in Unit 26B. In 2006 we surveyed a portion of the upper Canning River, upstream of Eagle Creek. In 2006 and 2008–2010, we surveyed that portion of the Sagavanirktok River, upstream of Happy Valley to the extent of moose habitat. Beginning in 2007, we surveyed Oksrukuyik Creek.

Unit 26C Central. This area encompasses drainages in central Unit 26C east of the Canning River and the lower Kongakut River below Drain Creek. This area was surveyed by ANWR staff during April 2003, 2005, 2007 and 2009. The following drainages were surveyed as weather permitted: Itkilyariak, Sadlerochit, Hulahula, Okpilak, Jago, Aichilik, Leffingwell, Egaksrak, Ekaluakut, and lower Kongakut.

Unit 26C Eastern. In eastern Unit 26C, the upper drainages of the Kongakut and Firth–Mancha rivers were surveyed by ANWR staff during fall and early winter 1991, 2000, and 2002.

Survey data are reported as Unit 26B East, Unit 26B West, Itkillik River drainage, and the 3 areas combined, and as Unit 26C Central and Unit 26C Eastern. In some years additional drainages or portions of drainages in Unit 26B 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.

Twinning Surveys

In early June 2007 and 2009, twinning rates were estimated along riparian willow habitat in Unit 26B in the west and middle fork of Kuparuk River, Oksrukuyik Creek, Ivishak and Lupine Rivers, Gilead, Juniper, and Fin Creeks and parts of the Sagavanirktok and Canning rivers. 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.

HARVEST

Harvest and hunting pressure were monitored using harvest and drawing permit reports. Reminder letters were sent to hunters who did not report. Hunters received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive drawing permit reports. We summarized data on hunter residency, hunter success, harvest chronology, and transport methods. Total harvest, residency and success, chronology, and transportation data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY07 = 1 Jul 2007–30 Jun 2008).

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 terrain and sparse, low vegetation in these units makes trend surveys appropriate for counting a large percentage of the moose in areas supporting major concentrations. The Unit 26B moose population within the trend survey areas gradually increased beginning in 1999 from the population decline in the 1990s, and appeared to stabilize during RY02–RY08 (Tables 1, 2, 3, and 4). In RY09, the population declined by approximately 100 moose (24%) compared to the mean of the previous 5 years (Table 4).

Unit 26B East. In spring 1999 the number of moose observed in Unit 26B East was low (149) and the population had not recovered from the decline during the 1990s (Lenart 2006). The population remained relatively stable for a few years and by 2002 began to increase. During RY04–RY08, the number of moose ranged 288 to 339 (Table 1). In RY09 we observed 254

moose, an apparent decline in numbers compared to the previous 5 years (Table 1). 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 approximately 100 more moose (160 moose total) in Unit 26B West (excluding the Itkillik River drainage). This increase in number 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. However, during this same time period, we also observed a gradual increase in the number of moose observed in Unit 26B East. Therefore, the large increase in moose numbers observed in Unit 26B West likely did not result solely from changes in moose distribution. During RY04–RY07 the number of moose in Unit 26B West ranged from 140 to 175 (Table 2). We observed 78 moose in spring 2009 (RY08) and 70 moose in spring 2010 (RY09); approximately a 50% decline in observable moose compared to the previous 4 years (Table 2). Most of the moose observed in Unit 26B West were in the Kuparuk drainage.

Unit 26B West, Itkillik River. Spring surveys along the lower Itkillik River during 1999–2004, indicated moose numbers were low, ranging 9–27 moose. Beginning in 2005, we included the upper Itkillik River in our surveys and during RY04–RY09, the number of moose observed ranged 50–74 moose (Table 3).

All Unit 26B Trend Count Areas combined. Overall, the moose population increased slowly during the 2000s in Unit 26B. Combined survey data for Units 26B East, 26B West, and the Itkillik River drainage trend areas indicated a gradual increase from approximately 400 moose to 500 moose during RY03–RY08; with some years exceeding 500 (Table 4). Substantially lower numbers of moose were observed in spring 2010, indicating that the moose population may be declining.

Beginning in RY07, additional portions of drainages were surveyed to determine the extent moose occupied these drainages and changes in distribution. In spring 2008–2010, we included Oksrukuyik Creek and the Upper Sagavanirktok River. Including this expanded area in the total count for Unit 26B, we observed 570 moose (14% short yearlings) in spring 2008, 564 moose (8% short yearlings) in spring 2009, and 454 moose (7% short yearlings) in 2010. This trend follows the same trends observed in the separate trend count areas analyzed in Unit 26B. Additionally, moose numbers and recruitment declined in Unit 26A during RY08–RY09 (556 moose observed in spring 2008 compared to 265 in spring 2010; L. Parrett, ADF&G, personal communication).

Unit 26C Central. In central Unit 26C, moose numbers appeared to remain stable. ANWR staff observed 52, 47, 59, and 61 moose in April 2003, 2005, 2007, and 2009. No survey was conducted in spring 2010; therefore it is unknown if Unit 26C experienced a decline similar to Units 26A and 26B.

Unit 26C Eastern. In eastern Unit 26C, no surveys have been conducted 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–RY07 was moderately good, ranging 13–22%, except in RY03 when it was 6% (Table 1). The proportions of short yearlings in RY08 and RY09 were 10% and 8%, respectively.

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. During a May 2002 survey, we observed a high bull:cow ratio of 72:100. This is likely conservative because we probably misclassified young bulls with little early antler development. Bull:cow ratios were not available during RY03–RY09 because surveys were conducted after bulls had shed antlers and prior to early antler development. A limited drawing hunt season was opened in RY06 and we believe that bull:cow ratios remained high ($\geq 50\%$) since the season was reopened because harvest was low (range: 3–7 bull moose annually). However, if recruitment continues to decline and remain low for consecutive years, bull:cow ratios will likely drop.

Unit 26B West. In Unit 26B West, excluding the Itkillik drainage, the proportion of short yearlings in the population ranged 13–25% during RY99–RY07, except in RY00 when it was 7% (Table 2). The proportion of short yearlings in RY08 and RY09 was 1% and 6%, respectively (Table 2). These proportions are similar to those observed in Unit 26B East.

During the May 2002 survey we observed a 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. Bull:cow ratios were not available in Unit 26B West during RY03–RY09 because surveys were conducted after bulls had shed antlers and prior to early antler development.

Unit 26B West, Itkillik River. The proportion of short yearlings in the population ranged 3–10% during RY05–RY09 (Table 3). We suspect that mostly bulls inhabited the Itkillik River drainage during the time of year our surveys were conducted.

All Unit 26B. The proportion of short yearlings for the combined survey areas of Unit 26B East, Unit 26B West, and Itkillik River drainage was 12–18% during RY03–RY07 (Table 4). The proportion of short yearlings in was 8% in RY08 and 7% in RY09, similar to proportions observed when the areas were analyzed separately. The overall bull:cow ratio in the Unit 26B survey areas in May 2002 was 57:100.

Unit 26C Central. No data were available on the proportion of short yearlings in central Unit 26C during RY02–RY08 because moose were not classified during surveys.

Unit 26C Eastern. 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 (92:100 bulls) and modest numbers of calves and yearlings (24–35 calves:100 cows and 21–26 yearling bulls:100 cows) in the population (Table 5).

Twinning Rates

In June 2007 we observed 9 cows with single calves and 1 cow with twins. In June 2009, we observed 10 cows with single calves and 1 cow with twins. Sample sizes were too small to estimate twinning rates.

Distribution and Movements

Moose were generally associated with narrow strips of shrub communities along drainages, except during calving and summer when some seasonal movement occurred off of the riparian corridors. 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 surveys indicate there may be 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–RY09.

<u>Units and Bag Limits</u>	<u>Resident Open Season</u>	<u>Nonresident Open Season</u>
<i>RY06–RY09</i>		
Unit 26B, excluding the Canning River drainage.		
RESIDENT HUNTERS: 1 bull by drawing permit; up to 30 permits may be issued, or 1 bull.	1 Sep–14 Sep To be announced; up to 14-day season; 15 Feb–15 Apr	No open season

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 during 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. No Board of Game actions occurred since November 2007.

Emergency Orders to open the general moose season in Unit 26B were issued during RY06–RY09. The season during RY06–RY09 was 2–15 April.

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

Unit 26B: Moose were reported harvested or hunted under the general moose season in Unit 26B during RY06–RY09. However, most of the hunting was illegal and took place during September when there was not a general moose hunting season (Table 6). In RY06, one hunter either hunted illegally in September or reported the incorrect game management unit. In RY07, 1 hunter hunted illegally in September or October and reported taking a moose and another hunter also may have hunted illegally, but did not harvest a moose. In RY08, 2 nonresident hunters hunted moose illegally in Unit 26B because there is no open season for nonresidents. In addition, in RY08, 5 resident hunters hunted illegally in September and 2 resident hunters hunted legally during the general season opening in April. No one reported taking a moose during the general moose hunting season in RY08. In RY09, preliminary data indicated that at least 2 hunters hunted illegally during September and possibly 4. No one reported taking a moose during the general moose hunting season in RY09. Prior to the 1996 hunting season closure, the reported moose harvest in Unit 26B was relatively stable during the early 1990s, ranging 24–37, except in RY92, when harvest was 45 (Lenart 2006).

Drawing permit hunt DM966. The number of moose harvested in drawing hunt DM966 (Unit 26B, excluding the Canning River drainage) ranged 3–7 moose and number of hunters ranged 11–13 (Table 7). Fifteen permits were available and issued annually in RY06 and RY07 and 20 permits were issued annually in RY08 and RY09. All hunt reports were returned.

Unit 26C. There has been no open state season in Unit 26C since 1996. During RY90–RY95, harvest was low and ranged 3–6 moose by 5–12 hunters (Lenart 2006).

Hunter Residency and Success. The moose season in Unit 26B was open only to Alaska residents during RY06–RY09. Success rates ranged 25–54% in the DM966 permit hunt (Table 8). Prior to

the 1996 closure (RY90–RY95), Alaska residents living outside the area represented the majority of the resident hunters in Units 26B and 26C (Lenart 2008).

Harvest Chronology. In the DM966 permit hunt, 100% of moose were harvested within the first week of September during RY06 and RY07, and 83% and 66% were harvested within the first of September during RY08 and RY09, respectively (Table 9). The remaining moose were taken during the second week of September.

Transport Methods. In the DM966 permit hunt, aircraft was the most common method of transport for successful hunters (71% and 67%) in RY06 and RY08. In RY07, the most common method was split among airboat, aircraft, and highway vehicle (33%). In RY09, airboat was the most common method of transport for successful hunters (67%). Highway vehicle represented the remainder (Table 10). Note that successful hunters took only 3–7 moose annually.

Natural Mortality

No intensive studies of the causes of moose mortality were conducted in Units 26B and 26C. The decline in the early 1990s was probably due to a combination of mortality factors unrelated to humans.

Among radiocollared moose in Unit 26A along the Colville River, the average annual mortality rate was 6.7% during 1996–2003 (Carroll 2004). This suggests that mortality rates for adult female moose may have been relatively low in Units 26B and 26C in recent years if mortality rates are the similar to 26A.

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, predation by wolves and grizzly bears, and possibly insect harassment (Lenart 2008). In Unit 26B, the population gradually increased during the 2000s to approximately 550 observable moose. Lower recruitment was initially observed in RY08. In RY09, we observed a second year of low recruitment (7%) and we only observed 398 moose (Table 4). We do not know why we observed approximately 100 fewer moose in RY09 compared to RY08 (Table 4), but suspect high adult mortality occurred. Moose appeared to be in good condition during the spring survey; although snow was moderately deep in RY09 and may have had an influence on moose condition or vulnerability to wolves. We did note numerous moose kills, apparently by wolves, during our survey in spring 2010. Moose numbers in central Unit 26C remained stable at approximately 50–60 moose during the 2000s. Because no surveys were conducted in 2010, we do not know if Unit 26C is experiencing a decline similar to that observed in Units 26B and 26A.

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. A decline in moose on the eastern North Slope appears to be following the same pattern as observed when it increased: the population appears to be decreasing substantially and rapidly in Unit 26A, gradually and steadily in Unit 26B, and remaining stable in

central Unit 26C. Substantially lower moose numbers were first noted in Unit 26A in RY08 and subsequently in Unit 26B in RY09.

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 staff is initiating a movement study using GPS radio collars to help address this question. 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 note that results of the surveys indicated a stable population rather than an increasing population and are managing conservatively because the population has not increased.

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. 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. In RY07, we met our objective to maintain a population of ≥ 300 moose with a 3-year mean proportion of $\geq 15\%$ short yearlings in the population in Unit 26B (Table 4). In RY08 and RY09, only a portion of this objective was met such that the population remained greater than 300 moose. However, the 3-year mean proportion of short yearlings in the population was 13% for RY06–RY08 and 10% in RY07–RY09 (Table 4).

We do not know if our objective in Unit 26C to maintain a population of ≥ 150 moose with a 3-year mean proportion of $\geq 15\%$ short yearlings in the population was met because only the central portion of 26C was surveyed and moose were not classified.

The third population objective, to maintain a posthunting sex ratio of 35 bulls:100 cows when hunting seasons are open, was likely met. Based on the high bull:cow ratios observed in early May 2002 (57:100), and little hunting pressure during RY06–RY09, we believe our bull:cow ratios exceeded 35:100 in Units 26B.

RECOMMENDATIONS

I recommend keeping the Unit 26B moose season open for RY10 because drawing permits have already been awarded and harvest is usually low (3–7 moose annually). Beginning in RY11, I recommend closing both the drawing hunt and general hunt seasons, unless moose numbers observed in spring 2011 increase by approximately 100 moose.

I also recommend cooperating with ANWR to determine moose movements in Units 26B East and 26C and conducting a spring survey in central 26C and the foothills of 26C using PA-18 aircraft in 2011 or 2012.

LITERATURE CITED

- CARROLL, G. M. 1998. Unit 26A moose. Pages 457–471 *in* M. V. Hicks, editor. Moose management report of survey and inventory activities 1 July 1995 through 30 June 1997. Alaska Department of Fish and Game. Study 1.0. Juneau, Alaska, USA.
- . 2004. Unit 26A moose. Pages 597–612 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- . 2006. Unit 26A moose. Pages 631–649 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- LENART, E. A. 2004. Units 26B and 26C moose. Pages 613–628 *in* C. Brown, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- LENART, E. A. 2006. Units 26B and 26C moose. Pages 652–668 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.
- . 2008. Units 26B and 26C moose. Pages 668–687 *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, Alaska, USA.
- LERESCHE, R. E., R. H. BISHOP, AND J. W. COADY. 1974. Distribution and habitats of moose in Alaska. *Naturaliste Canadien* 101:143–178.
- MAUER, F. J. 1997. Moose surveys on the north slope of the Arctic National Wildlife Refuge. Arctic National Wildlife Refuge. Progress Report FY97–01. U.S. Fish and Wildlife Service. Fairbanks, Alaska, USA.
- . 1998. Moose migration: northeastern Alaska to northwestern Yukon Territory, Canada. *Alces* 34:75–81.
- , AND J. AKARAN. 1994. North Slope moose surveys on the Arctic National Wildlife Refuge. Arctic National Wildlife Refuge. Progress Report FY94-02. US Fish and Wildlife Service. Fairbanks, Alaska.
- MARTIN L. D., AND G. W. GARNER. 1984. Population size, composition, and distribution of moose along the Canning and Kongakut Rivers within the Arctic National Wildlife Refuge, Alaska, fall 1983. Pages 119–132 *in* GW Garner and PE Reynolds, editors. 1983

update report of the fish, wildlife, and their habitats. US Fish and Wildlife Service. Anchorage, Alaska.

PREPARED BY:

Elizabeth A. Lenart
Wildlife Biologist III

SUBMITTED BY:

Doreen I. Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Mark A. Keech
Wildlife Biologist III

Please cite any information taken from this section, and reference as:

LENART, E. A. 2010. Units 26B and 26C moose. Pages 666–684 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

TABLE 1 Unit 26B East (east of the Sagavanirktok, including Canning River) aerial moose composition counts, regulatory years 1998–1999 through 2009–2010^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	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
2008–2009	304	35 (10)	--	339	10:18
2009–2010 ^d	234	20 (8)	--	254	12:58

^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 2009–2010

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	119	21 (15)	--	140	6:00
2008–2009	77	1 (1)	--	78	3:41
2009–2010	66	4 (6)	--	70	4:18

^a Short yearlings are 11-month-old calves.

^b The Sagavanirktok River was not surveyed.

^c Longer search time because sightability was poor due to low snow cover.

TABLE 3 Unit 26B, Itkillik River drainage^a spring aerial moose surveys, regulatory years 1998–1999 through 2009–2010

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 (15)	--	13	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
2008–2009	71	2 (3)	--	73	2:35
2009–2010 ^c	70	4 (5)	--	74	3:38

^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 2009–2010

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	450	85 (16)	--	535	16:07
2007–2008	440	72 (14)	--	512	22:56
2008–2009	452	38 (8)	--	490	16:34
2009–2010 ^c	370	28 (7)	--	398	20:54

^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 mi²) and Firth Rivers and Mancha Creek (372 mi²) early winter aerial moose composition, regulatory years 1991–1992 through 2002–2003^a

Regulatory year	Bulls:100 Cows (<i>n</i> bulls)	Yearling bulls:100 Cows (<i>n</i> yearling bulls)		Calves:100 Cows Calves (<i>n</i> cows)		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 2006–2007 through 2009–2010

Regulatory year	Reported harvest					Hunters (% success)
	M (%)	F (%)	Unk	Illegal	Total	
2006–2007	0	0	0	0	0	0
2007–2008	0	0	0	1	1	na
2008–2009	0	0	0	0	0	0
2009–2010	0	0	0	0	0	0

^a No open season.TABLE 7 Unit 26B DM996 permit moose harvest, regulatory years 2006–2007 through 2009–2010^a

Regulatory year	No. Permits	DM996 harvest				No. Hunters (% success)
		M (%)	F (%)	Unk	Total	
2006–2007	15	7 (100)	0 (0)	0	7	13 (54)
2007–2008	15	3 (100)	0 (0)	0	3	11 (27)
2008–2009	20	6 (100)	0 (0)	0	6	12 (50)
2009–2010	20	3 (100)	0 (0)	0	3	12 (25)

TABLE 8 Unit 26B moose hunter residency and success, regulatory years 2006–2007 through 2009–2010

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2008–2009	0	6	n/a	0	6 (50)	0	6	n/a	0	6 (50)	12
2009–2010	0	3	n/a	0	3 (25)	0	9	n/a	0	9 (75)	12

^a Residents of Units 26B

TABLE 9 Units 26B moose harvest chronology percent by time period, regulatory years 2006–2007 through 2009–2010

Regulatory year	Harvest chronology percent by time period								<i>n</i>
	9/1–9/8	9/9–9/15	9/16–9/22	9/23–9/28	9/29–10/5	Oct	Mar	Dec/Jan	
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
2008–2009	83	17	n/a	n/a	n/a	n/a	n/a	n/a	6
2009–2010	66	33	n/a	n/a	n/a	n/a	n/a	n/a	3

TABLE 10 Units 26B moose harvest percent by transport method, regulatory years 2006–2007 through 2009–2010

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Airboat	Highway vehicle	Unknown	
2006–2007	71	0	0	0	0	14	14	0	7
2007–2008	33	0	0	0	0	33	33	0	3
2008–2009	67	0	17	0	0	0	17	0	6
2009–2010	33	0	0	0	0	67	0	0	3



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.



©2011 Ken Marsh.