Species Management Report ADF&G/DWC/SMR-2012-5

Moose management report of survey-inventory activities, 1 July 2009–30 June 2011

Patricia Harper, editor

2012 Set

Alaska Department of Fish and Game Division of Wildlife Conservation

Species Management Report ADF&G/DWC/SMR-2012-5

Moose management report of survey-inventory activities, 1 July 2009–30 June 2011

Alaska Department of Fish and Game
Division of Wildlife Conservation
P.O. Box 115526
Juneau, Alaska 99811-5526

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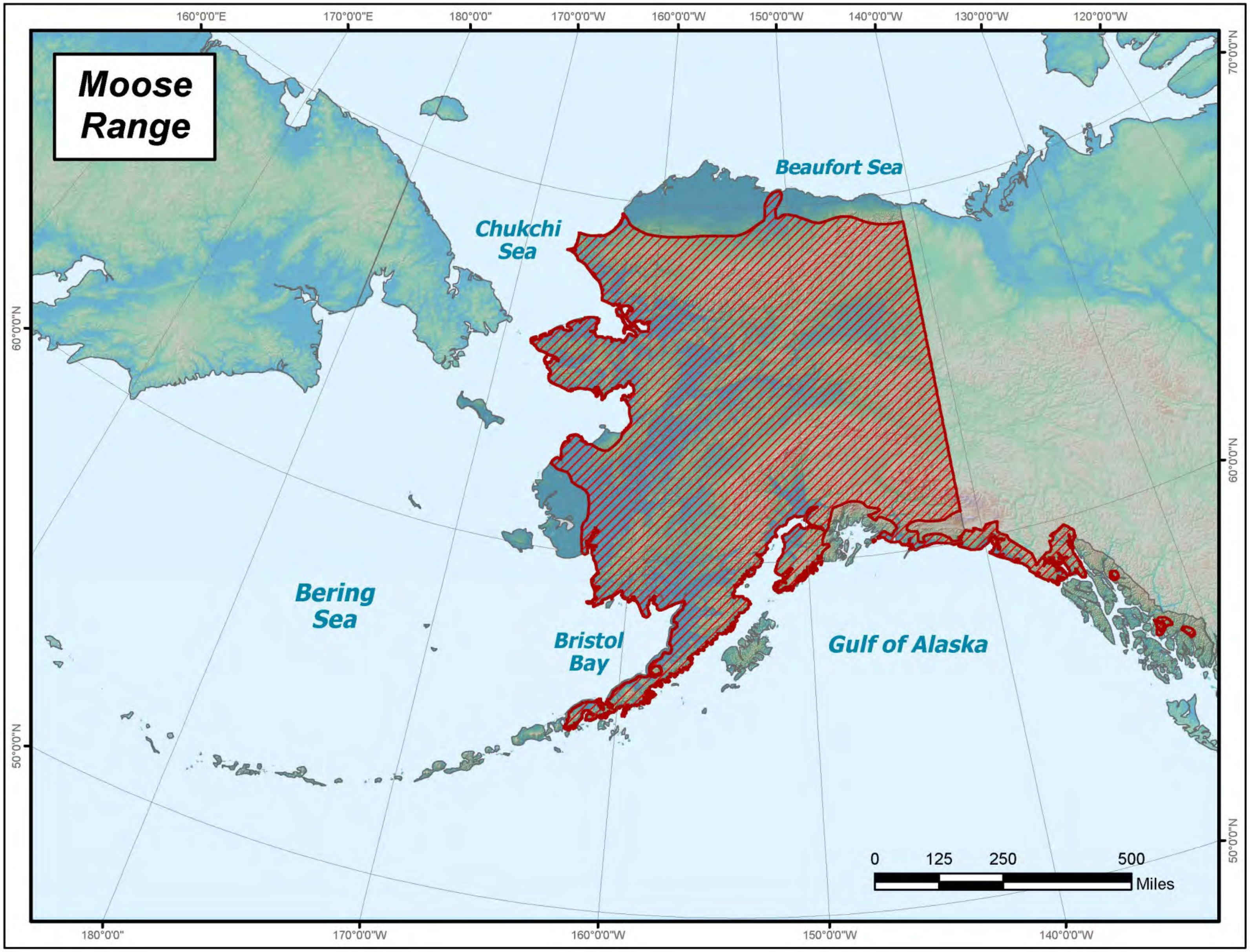
Cover Photo: A bull moose is alert for challengers during the rut in mid-October. ©2011 Ken Marsh.

MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

TABLE OF CONTENTS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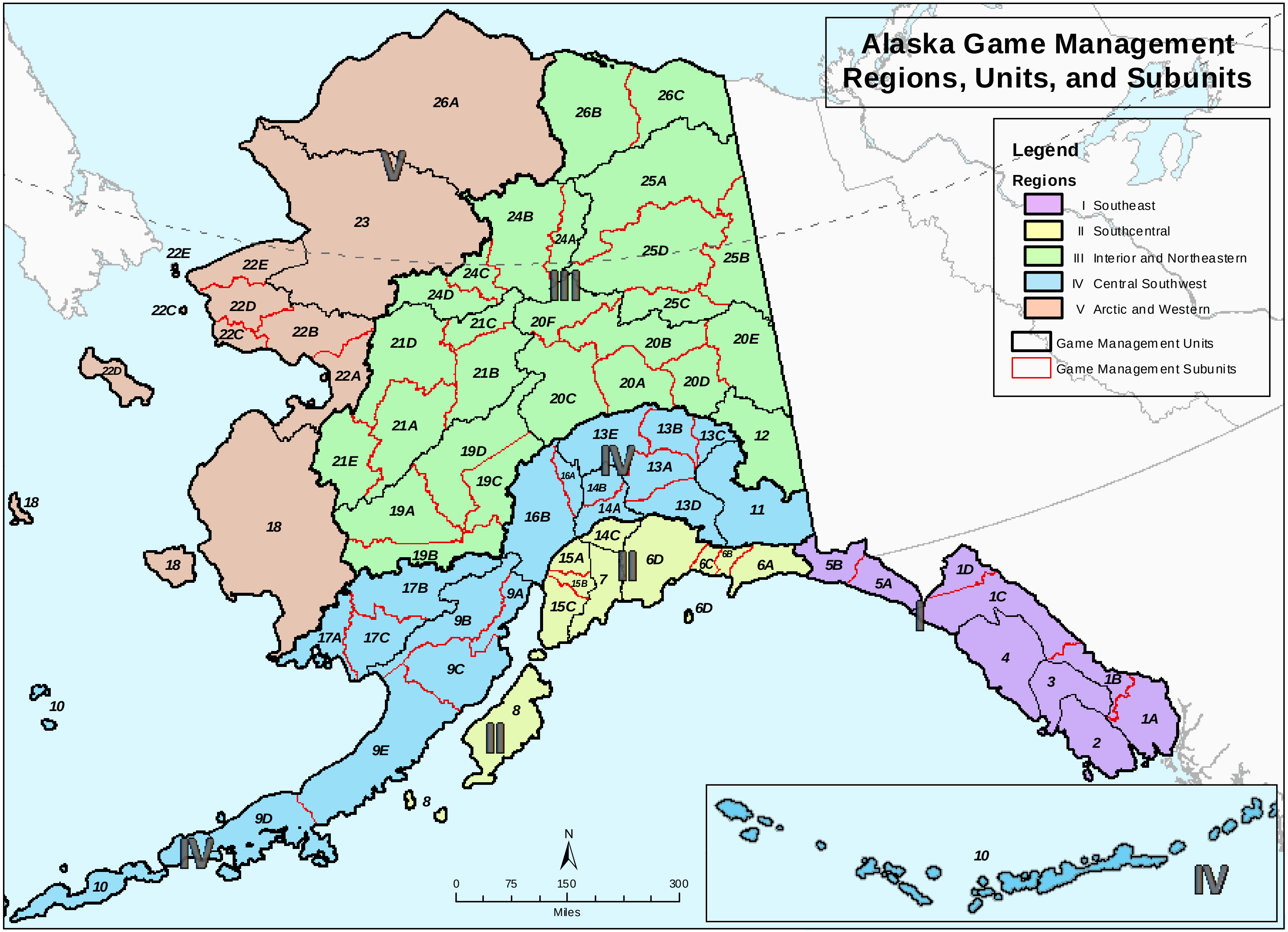
Alaska Game Management Regions, Units, and Subunits
Legend
Regions
I Southeast
II Southcentral
III Interior and Northeastern
IV Central Southwest
V Arctic and Western
Game Management Units
Game Management Subunits
26A
26B
26C
V
23
24B
24A
25A
25D
25B
25C
22E
22E
22D
22C
22C
22B
22D
22A
24C
24D
III
21C
20F
20B
20E
21D
21B
20C
20A
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13C
12
IV
13A
16A
14B
14A
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16B
14C
15A
15B
15C
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II
6D
6C
6B
6A
6D
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5A
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SPECIES

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 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNITS: 1A (5,300 mi^2) and 2 (3,600 mi^2)

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

BACKGROUND

The status and state management of moose in these units has been relatively unchanged for the past few management periods, about 8 years. The introduction of a federally managed subsistence hunt in 2003 changed harvest and effort between those hunting under the state permit and those hunting under federal permits. 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, and the Cleveland Peninsula.

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.

METHODS

Moose surveys are flown during winter (December–February) if or when weather and snow conditions become favorable. A registration hunt harvest report provides all the important information regarding hunter effort, timing, mode of transport, and success. Effort is also made to obtain federal registration permit hunt information prior to compiling this report.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

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

After more than 2 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 in this area from at least 1 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.

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 and complete counts during aerial surveys difficult and infrequent.

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 RM022	(General hunt only)

Unit 2	No open season.

Board of Game Actions and Emergency Orders. The Alaska Board of Game made no regulatory changes during this report period, nor were any emergency orders issued in relation to Unit 1A moose management.

Hunter Harvest. The Unit 1A 10-year (RY01–RY10) mean annual harvest is 2 bulls. During RY09 hunters reported 3 bulls taken under state registration permit and no additional harvest was reported from the federal permit. During RY10, 1 bull was taken by state permit and 1 bull was reported under the federal permit (Table 1).

Permit Hunts. During RY09, 33 individuals obtained a Unit 1A state moose registration permit for RM022 and 17 hunted. During the RY10 season 24 hunters registered and 13 of them reported hunting (Table 1).

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 communities. During the past 10 years (RY01–RY10) on average 13% of the hunters who spend time afield are successful. During RY09 18% of hunters were successful and in RY10 only 4% were 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). Moose were harvested during the early federal season in 6 of the last 10 years. Most hunters using federal permits continue to hunt under federal regulations after the state season opens. Also a few hunters who are federally qualified obtain both the state and the federal permits which allow them to hunt on state and private lands near the Unuk River.

Transport Methods. Most hunters use boats to access the Unuk River. Occasionally hunters 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 predation 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 population.

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 them. Most moose harvested are young bulls with relatively small antlers, which have historically averaged about 20 to 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 or harvest to exceed current levels.

The Unit 1A registration permit provides accurate hunt-based data although the Federal permit is making it difficult to account for all the hunting effort and activity. We will continue to gather information about this moose population and continue to document moose sightings in other areas of Unit 1A. We do not recommend any changes to the Unit 1A moose hunting regulations at this time.

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Porter, B. 2012. Unit 1A moose management report. Pages 1–8 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2012-5, Juneau.

Table 1. Unit 1A moose harvest data for permit hunt (RM022) for regulatory years 2001 through 2010.

Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Harvest Males	(%)	Females	(%)	Unk	(%)	Total harvest
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[a]	(100)	0	(0)	0	(0)	2[a]
2004	24	0	21	3[b]	3[b]	(100)	0	(0)	0	(0)	3[b]
2005	41	24	24	3[c]	3[c]	(100)	0	(0)	0	(0)	3[c]
2006	16	0	14	2[c]	2[c]	(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[c]	(100)	0	(0)	0	(0)	2[c]
2009	33	16	14	3	3	(100)	0	(0)	0	(0)	3
2010	24	11	12	1[c]	1[c]	(100)	0	(0)	0	(0)	1[c]
Average	25	7	16	2	2	(100)	0	(0)	0	(0)	2

[a] Three 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 2001 through 2010.

Year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	
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
2009	3	0	0	3	(18)	13	1	0	14	(82)	17
2010	1	0	0	1 [c]	(4)	15	6	0	21	(88)	22
Average	2	0	0	2	(11)	17	1	0	18	(89)	20

[a] Three additional bulls harvested under federal regulations.
[b] Two additional bulls harvested under federal regulations.
[c] One additional bull harvested under federal regulations.

Table 3. Unit 1A moose harvest chronology for regulatory years 2001 through 2010.

Year	15–21 Sep	(%)	22–28 Sep	(%)	29 Sep–5 Oct	(%)	6–15 Oct	(%)	*n*
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]
2009	0	(0)	0	(0)	1	(33)	2	(66)	3
2010	0	(0)	0	(0)	1	(100)	0	(0)	1 [c]
Average	>1	(22)	<1	(13)	<1	(30)	<1	(35)	2

[a] Three additional bulls harvested under federal regulations.
[b] Two additional bulls harvested under federal regulations.
[c] One additional bull harvested during early federal season.

Table 4. Unit 1A moose harvest percent by transport method for regulatory years 2001 through 2010.

Year	Harvest percent by transport method										
	Airplane	(%)	Boat	(%)	Highway vehicle	(%)	Off-road vehicle	(%)	Unk	(%)	*n*
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 [a]
2004	0	(0)	3	(100)	0	(0)	0	(0)	0	(0)	3 [b]
2005	0	(0)	3	(100)	0	(0)	0	(0)	0	(0)	3[c]
2006	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2[c]
2007	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
2008	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2 [c]
2009	1	(33)	2	(66)	0	(0)	0	(0)	0	(0)	3
2010	0	(0)	1	(100)	0	(0)	0	(0)	0	(0)	1 [c]
Average	0	(5)	2	(95)	0	(0)	0	(0)	0	(0)	2

[a] Three additional bulls harvested under federal regulations.
[b] Two additional bulls harvested under federal regulations.
[c] One additional bull harvested under federal regulations.

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

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

BACKGROUND

HABITAT DESCRIPTION

Isolated populations of moose (*Alces alces*) occur in Unit 1B and are believed to be the *andersonii* subspecies. They 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 3 or more brow tines on at least 1 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 3 or more brow tines on at least 1 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 3 brow tines on at least 1 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 a*ndersonii* subspecies inhabiting the Central Panhandle. In fall 2004 the BOG adopted a department sponsored proposal to implement drawing permit hunts allowing the taking of a limited number of "any-bull" moose in Unit 1B. 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.

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 1 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.

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 12 moose annually from 2000 to 2010.

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

	Plan Objective	2009	2010
Post-hunt numbers	300	N/A	N/A
Annual hunter kill	30	29	22
Number of hunters	250	182	162
Hunter-days of effort	1,750	1,352	1,257
Hunter success	12%	16%	14%

Thomas Bay

	Plan Objective	2009	2010
Post-hunt numbers	200	N/A	N/A
Annual hunter kill	20	14	6
Number of hunters	160	101	83
Hunter-days of effort	675	648	582
Hunter success	12%	14%	7%

METHODS

We flew late winter population surveys along the Stikine River valley to count moose and to gather composition data (calves and adults). Determining sex of adult moose observed was not possible due to antler drop by bulls prior to our survey. All successful hunters were required to present the antlers attached to the skull plate to ADF&G representatives to verify compliance with antler restrictions. They were also required to turn in the lower front teeth for aging. We also checked hunters and any moose they harvested while we were 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.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY08 = 1 July 2008–30 June 2009).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Two surveys were conducted during this report period, RY09 (142 moose observed) and RY10 (125 moose observed). We do not have the capability to estimate sightability during these surveys, so these numbers represent minimum counts.

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.

Two surveys were conducted during this report period (Table 1), in RY09 142 moose were observed, 21 were calves (20%). In RY10, 125 moose were counted, 26 were calves (21%). We were unable to get bull:cow ratios due to antler drop prior to the survey.

The number of moose observed and recorded by hunters on registration hunt reports provides some of the limited information on population composition in the subunit. Because these data are based on anecdotal accounts from hunters, we expect a high likelihood of replicate sightings and so interpret the data cautiously. In RY09 a total of 283 RM038 hunters reported seeing a total of 1329 moose in Unit 1B, including 470 bulls, 614 cows, and 245 calves, for a bull-to-cow ratio of 77:100, and a calf-to-cow ratio of 40:100. In RY10, 246 RM038 hunters reported seeing a total of 1301 moose, including 435 bulls, 615 cows, and 251 calves, for a bull-to-cow ratio of 71:100, and a calf-to-cow ratio of 41:100.

MORTALITY

Harvest

Season and Bag Limit	Resident and nonresident hunters
Unit 1B	15 Sep–15 Oct
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on 1 side, or 2 or more brow tines on both sides by registration permit only	

Game Board Actions and Emergency Orders. The Board of Game took no actions, and we issued no emergency orders regarding Unit 1B moose during the report period.

Hunter Harvest. Due to a Board of Game action at the 2008 SE Alaska meeting, the moose antler restrictions that identified a legal moose in registration permit hunt RM038 were liberalized, beginning in fall 2009. This change allowed the harvest of bulls with 2 or more brow tines on both antlers in addition to the standard spike/fork, 50", 3-brow tine antler configurations that were already in place. This liberalization led to a substantial increase in harvest in RY09 (Tables 2 and 3).

For the Stikine River portion of Unit 1B, in RY09, 182 hunters harvested 29 moose. In RY10, 162 hunters harvested 22 moose, including 2 illegal kills (Tables 2 and 4). For the Thomas Bay/Farragut Bay portion of Unit 1B, in RY09, 101 hunters harvested 14 moose in the general vicinity of Thomas Bay, including 4 from Farragut Bay (Tables 3 and 5). Two additional moose, including 1 illegal kill, were harvested at Port Houghton in southern Unit 1C which is within the RM038 hunt boundaries. Because Port Houghton is in Unit 1C, numbers for moose harvested there appear in the Unit 1C management report and are not included in the tables for this report. In RY10, 83 hunters harvested 6 moose in the Thomas Bay vicinity, including 1 from Farragut Bay.

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 RY09, local residents of Wrangell and Petersburg represented 93% of successful hunters on the Stikine River, with non-local hunters representing 7%. In RY10, local residents of Wrangell and Petersburg represented 95% of successful hunters on the Stikine River, with non-local hunters representing 5% (Table 4). The overall success rate for Stikine River moose hunters was 16% in RY09 and 14% in RY10.

Petersburg residents continued to dominate the Thomas Bay and Farragut Bay moose hunts (Table 5). In RY09, local residents of Petersburg and Wrangell represented 86% of successful hunters in the vicinity of Thomas Bay and Farragut Bay, with non-local hunters representing 14%. In RY10, 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 14% and 7%, respectively, in RY09 and RY10.

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 6). In RY09, the largest percentage of the annual harvest in the Thomas Bay Area occurred during the third week of the season, followed by the first and fourth weeks. The largest percentage of the annual harvest on the Stikine River occurred during the first, fourth and second weeks of the season, respectively. In RY10 the largest percentage of the annual harvest at Thomas Bay occurred during the first, fourth and second weeks of the season. The largest percentage of the annual harvest on the Stikine occurred during the first, second and third weeks of the season. Most hunters are in the field early in the season, and except for weekends, effort tends to drop off as the season progresses. Inclement weather does not appear to slow hunting effort early in the season.

Harvest in particular WAA's. During the report period, moose harvest was reported in 6 Unit 1B WAA's and 1 Unit 1C WAA. In both RY09 and RY10 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. During the report period all successful Unit 1B hunters reported using boats to reach the areas they hunted (Table 7). 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 prey on moose calves, 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 the main predators of moose. Poaching of moose undoubtedly occurs in Unit 1B, however we don't know how prevalent it is.

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 12 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 both RY09 and RY10. The success rate of 16% in RY09 and 14% in RY10 exceeded the management objective of 12%. The total number of hunters increased by 8% from the previous report period, and the actual days of effort increased by nearly 9%. The harvest of 29 moose on the Stikine River in RY09 and 22 moose in RY10 were both 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 objective for hunter success was met in RY09. The number of hunters has been declining in recent years; however that trend ended during the current report period, likely due to the liberalized antler restrictions in RY09. Hunter-days of effort increased in RY09 and RY10 reflecting similar increases in the number of hunters. The success rate of 14% in RY09, and 7% in RY10, were above and below, respectively, the management objective of 12% success. The Thomas Bay moose population currently appears to be in decline and is thought to be at or above carrying capacity.

After a sharp decline, which began in 1989 and culminated in the RY94 emergency closure of the Stikine moose hunting season, the moose population and harvest has rebounded in recent years. The harvest of 29 bulls in RY09, was equal to 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 steadily declined from the all time high of 199 in 2006, to 142 in 2009 and 125 in 2010.

In 2008 the Board of Game adopted a department-sponsored proposal to liberalize the moose antler restrictions for the RM038 hunt area to allow the harvest of bulls with 2 or more brow tines on both antlers. The new antler regulation took effect at the beginning of the 2009 season and is believed to be partially responsible for the relatively high harvest that year. In RY09, 19 (44%) of the 43 bulls harvested in Unit 1B had 2 brow tines on both antlers. In RY10, 9 (32%) of the 28 bulls harvested had 2 brow tines on both antlers. We recommend that the current antler regulations remain in effect while we continue to monitor the impact of the new liberalized antler restrictions on the moose herd.

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 or more 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.

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Table 1. Unit 1B Stikine area aerial moose surveys, regulatory years 1996 through 2010.

Yr month/day	Adults	Calves	(%) Calves	Unidentified	Total moose	Moose/hour
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						
1/23	54	11	(17)	0	65	30
2009						
2/18	82	21	(20)	39	142	53
2010						
12/14	96	26	(21)	3	125	49

[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[a]) moose harvest by permit hunts, regulatory years 1999 through 2010.

	Hunter harvest reported						
Year	M	(%)	F	(%)	Illegal	Unk	Total
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
2009	27	(100)	0	(0)	2	0	29
2010	22	(100)	0	(0)	0	0	22

[a] Includes Unit 1B south of the Stikine River.
[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 1999 through 2010.

Year	Hunter harvest reported						
	M	(%)	F	(%)	Illegal	Unk.	Total
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[a]	9	(100)	0	(0)	0	0	10
2009	14	(100)	0	(0)	0	0	14
2010	5	(100)	0	(0)	1	0	6

[a] Includes RM038 and DM033 harvest.

Table 4. Unit 1B (Stikine[a]) moose hunter residency and success by permit hunt, regulatory years 1999 through 2010.

	Successful						Unsuccessful						
Year	Local[a] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Local[b] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Total hunters
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
2009	27	2	0	0	29	(16)	145	7	1	0	153	(84)	182
2010	21	1	0	0	22	(14)	130	9	1		140	(86)	162

[a] Includes Unit 1B south of the Stikine River.
[b] Residents of Petersburg and Wrangell.

Table 5. Unit 1B (Thomas and Farragut bays) moose hunter residency and success by permit hunt, regulatory years 1999 through 2010.

	Successful					Unsuccessful					
Year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
1999	19	1	0	20	(19)	79	8	0	87	(81)	107
2000	6	0	0	6	(6)	91	5	2	98	(94)	104
2001	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[b]	13	0	0	13	(12)	90	7	0	97	(88)	110
2006[b]	12	1	0	13	(15)	65	6	0	71	(85)	84
2007[b]	8	2	0	10	(15)	52	5	0	57	(85)	67
2008[b]	10	0	0	10	(14)	57	5	0	62	(86)	72
2009	12	2	0	14	(14)	79	8	0	87	(86)	101
2010	6	0	0	6	(7)	66	11	0	77	(93)	83

[a] Residents of Petersburg and Wrangell.
[b] Includes RM038 and DM035 harvest.

Table 6. Unit 1B moose harvest chronology, regulatory years 1999 through 2010.

Area	Year	15–21 Sep	22–28 Sep	29 Sep–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
	2009	4	2	5	3
	2010	3	1	0	2
Stikine[a]					
	1999	6	3	4	7
	2000	3	1	5	5
	2001[b]	6	2	2	7
	2002	6	1	2	2
	2003	2	3	7	6
	2004	10	5	2	10
	2005	10	2	3	6
	2006[c]	21	3	9	2
	2007	8	6	4	2
	2008	6	5	3	2
	2009	17	3	2	7
	2010	10	5	4	3

[a] Includes Unit 1B south of the Stikine River.
[b] Excludes one unknown.
[c] State season closed emergency order on October 6.

Table 7. Unit 1B successful moose hunter transport methods by area, regulatory years 1999 through 2010.

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
	2009	0	14	0	0	0	0	14
	2010	0	6	0	0	0	0	6
Stikine[a]								
	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
	2009	0	29	0	0	0	0	29
	2010	0	22	0	0	0	0	22

[a] Includes Unit 1B south of the Stikine River.

MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 1C (7,600 mi^2)

GEOGRAPHICAL DESCRIPTION: That portion of the Southeast Alaska mainland from Cape Fanshaw to the latitude of Eldred Rock.

BACKGROUND

Moose are relative newcomers to many parts of Southeast Alaska, with many of the populations becoming established in the early to mid-1900s. Some areas, such as the Gustavus Forelands, did not have moose present until the 1960s. It is likely that coastal mountains inhibited the movement of moose into these areas. Once moose discovered these unexploited areas, the presence of high quality habitat led to rapid expansions of new populations. In 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 6 more calves occurred in 1960. In June 1960, 3 cows with a single calf each were observed, indicating that cows had bred at about 16 months of age (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 past 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. However, recently acquired body condition and productivity data for moose in Berners Bay indicates moose are in good physical condition. Body condition is an indication of habitat quality, and in Berners Bay, good body condition suggests the habitat may be able to support a higher number of moose.

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 monitor this population using marked animals for insight into annual survival as well as using marked animals to estimate sightability during aerial surveys. 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. During the report period two registration permits were used to manage moose hunting effort in Unit 1C. Prior to the current period, a combination of registration (RM046, RM049) and drawing (DM041, DM042, DM043, DM044, DM045) permits were used to manage moose hunting opportunities in Unit 1C. 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 Berners Bay moose 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; no antlerless hunts (DM043, DM044, and DM045) were held in the Gustavus area during the report period. 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. 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. Both of these studies have met their objectives and been completed, however, we continue to keep a collared sample of cow moose in each population to monitor adult female survival, and to use marked animals to determine twinning rates and fecundity, and calf survival.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY10 = 1 July 2010–30 June 2011)

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Berners Bay: Aerial surveys conducted in Berners Bay in RY09 and RY10 enumerated 51 and 73 moose, respectively (Table 1). 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 (2006-2009) of severe winter weather. An additional moose sightability survey associated with the Juneau Access Project was conducted in February 2009; a total of 57 moose were observed.

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. Staff attempted a survey in 2009 but cancelled the survey halfway through the flight due to strong winds in the drainage. 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 RY09 and RY10 counted 98 and 165 moose respectively (Table 1). However, using radiocollared moose for sightability purposes, produced estimates of 238 moose for RY09 and 252 moose for RY10. Radio collared moose allow managers to estimate moose populations based on sightability estimates determined when conducting surveys. By knowing the number of collared moose in an area and the number of collared moose actually seen on surveys managers can use a ratio to estimate population numbers at the time of the survey.

Population Composition

We were able to conduct composition surveys of the Berners Bay moose population in RY10, and composition surveys were conducted in Gustavus during both years of the report period (Table 1). We were unable to conduct composition surveys in the Taku River or in the Chilkat

Range. 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 RY10, we conducted one aerial survey that allowed us to gather reliable composition data for this population. We observed ratios of 40 bulls:100 cows, and 22calves:100 cows. The bull:100 cow ratio is higher than our objective of 25:100 due to no harvest since the season was closed in 2006. The increased number of calf moose detected in RY10 is likely related to mild-moderate winter severity in RY09. Historically, 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 4.9 years, higher than the previous report period. However, during the report period only 3 of 29 bull moose taken were yearlings (10%). The yearling bull proportion of the harvest from the Chilkat Range continues to decline (Table 3.) 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: We flew herd composition surveys in both years of the report period. These surveys are intended to provide herd demographic data rather than a total moose count. In RY09, we observed 98 moose with a bull:cow ratio of 13 bulls:100 cows, and a calf:cow ratio of 6 calves:100 cows. In RY10, we observed 165 moose with a bull:cow ratio of 11 bulls:100 cows, and a calf: cow ratio of 17 calves:100 cows. The number of calves observed is significantly higher than in previous years. The bull:cow ratio continues to be below the management objective of 25 bulls:100 cows. A proposal for the Alaska Board of Game in RY08 to implement an antler restriction bull moose hunt on the Gustavus Forelands is intended to increase the bull:cow ratio, and ultimately result in higher bull numbers (Schwartz et al. 1992).

The mean bull moose age at harvest was 5.2 and 53.2 years for RY09 and RY10 respectively (table 3). The age of harvest began to decline in the early 2000s when a larger number of bull moose were harvested in Gustavus. The proportion of yearling bulls taken during the report period compared to previous reports is not significantly different but a few older bulls taken in a year with a low overall harvest can skew the age structure. In 2009, 5 of the 13 bulls taken were >7.5 years of age resulting in higher average age at harvest. In 2010, a higher proportion of yearling bulls were taken (54%) and the age of the remaining harvest was evenly distributed across age classes. Overall, it appears there are older bulls available for harvest which is a product of the antler restricted hunt strategy which protects some bulls from harvest based on antler configuration providing them an opportunity to be recruited into older age classes. Prior to the antler restricted bull moose hunt in Gustavus bulls often were harvested before attaining older age. No antlerless moose hunts were held in Gustavus during the report period.

Taku River: A single aerial survey was attempted during the report period but was abandoned halfway through the flight due to strong easterly winds in the drainage. Herd composition data was not collected during the flight. 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 2.2 years during RY09, and 1.9 years during RY10 (Table 3). During the report period 60% of the 30 bulls taken were yearling animals. This harvest of young bulls indicates a population with good recruitment. Very few older bulls were taken during the report period; only 3 of the 30 (10%) bulls taken were older than 3.5 years.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 1(C), Berners Bay Drainages:	15 September–15 October (General hunt only)
1 moose by drawing permit only; up to 30 permits may be issued	
Unit 1(C), that portion south of Point Hobart, including all Port Houghton drainages:	15 September–15 October (General hunt only)
1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on one side by registration permit only	
Unit 1(C), that portion west of Excursion Inlet and north of Icy Passage:	
1 moose per regulatory year, only as follows:	
1 bull by registration permit only or	15 September–15 October (General hunt only)
1 antlerless moose by drawing permit only; up to 100 permits may be issued	15 November–30 November (General hunt only)
Remainder of Unit 1(C) 1 bull by registration permit only	15 September–15 October (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 selective harvest strategy. In Gustavus, the RY09 season was the first season under the selective harvest strategy. We issued an emergency order closing the season for the Gustavus bull moose hunt in October 2010 after 13 bull moose of a 15 moose guideline harvest level, had been taken.

Hunter Harvest. *Berners Bay:* No moose were harvested in Berners Bay during the report period because the season remained closed. Historical harvest data can be found in Table 4.

Chilkat Range: The mean annual harvest during this report period was 15 moose, the same as the previous report period, and slightly less than the average of 18 bulls taken between 2001 and 2008 (Table 4).

Gustavus: During this report period, the antler restricted hunt at Gustavus was managed for a guideline harvest of 15 bulls in RY09 and RY10. Hunters took 13 bulls in RY09 and 12 bulls in RY10 (Table 4). Because these are the first 2 years of the hunt under a new management strategy it is inappropriate to make comparisons of the overall harvests between this and previous report periods except to say the guideline harvest level had been set at 15 bulls prior to implementing the antler restricted hunt and will be used until survey data supports an increase in harvest guideline. Anytime a new hunt strategy is introduced it is important to provide training opportunities for hunters, and to expect, in the case of a selective harvest strategy hunt, some harvest of bulls that do not meet legal antler requirements. Staff provided a community training event for moose hunters in Gustavus in both RY09 and RY10 at which antler architecture was discussed. Two bulls not meeting legal antler requirements were taken in each year. No antlerless permits were offered during either year of the report period.

Taku River: The annual harvest of moose during this report period averaged 15 moose, with 18 taken in RY09 and 12 in RY10. The mean harvest for the report period is equal to the mean annual harvest of 15 moose during 2001–2008 (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 at Chilkat Peninsula and Taku River are managed under an any bull registration permit (RM046).

No drawing permits for moose were offered during the report period in Unit 1C.

Under the Unit 1C bull moose registration permit (RM046) a total of 335 permits were issued in RY09, followed by 330 in RY10. 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 that of those actually hunting (57%) hunted the Chilkat Range and (43%) hunted the Taku River.

For RM049 at Gustavus, 147 permits were issued in RY09, and 142 in RY10. The number of hunters decreased significantly from previous reporting periods (Table 5) which is likely due to the implementation of the selective harvest strategy. As in most hunts, not all the permittees actually participated in a hunt. Combining both years of the report period, 70% of the permittees hunted. Overall, during the report period, the Gustavus bull moose hunt accounted for 34% of the bull moose hunting activity in Unit 1C.

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 70 of 85 harvested moose, other Alaska residents took 14, 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. Fourteen percent of hunters pursuing bull moose in Unit 1C were successful during the report period. Gustavus moose hunters had a success rate of 13%; 18% of the Taku River hunters were successful; and Chilkat Range hunters had a success rate of 13%.

Harvest Chronology. Similar to recent years, the RY09 and RY10 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. The pace of the hunts on the Chilkat Range and the Taku River are much slower than at Gustavus, but even those areas experience the majority of their respective harvests within the first 2 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 34% and 38% of the hunters respectively (Table 7). Generally, most airplane access (24%) 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 81% used highway vehicles, 8% used a boat, and 12%

walked; no hunters reported using ORVs or airplanes for access during the report period. 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: 100% of all successful Taku River moose hunters used boats to access the area during the report period (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.

Other Mortality.

The result of the severe winter in 2006-2007 and subsequent greater than average snowfall winters in 2007-2008 and 2008-2009 (Western Regional Climate Center 2012) was a decline in the Berners Bay moose population. During this report period survival estimates for radio-collared female moose in Berners Bay improved; survival rates in 2009 and 2010 were 94% and 82%, respectively (White et al. 2012). Calf moose survival for Berners Bay also improved during the report period. In 2009 calf survival was estimated at 25%; and in 2010, survival was estimated at 50% (White et al. 2012). 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 has negatively impacted this herds' ability to grow, prolonging the need to keep moose hunting seasons closed. Predation by bears and wolves has always been a factor in the 1C moose populations.

Habitat.

We initiated a moose browse monitoring project at Gustavus in 1999 that continues. The aim of this project is to assess willow utilization by moose on the Gustavus Forelands. Data indicate that moose are using a very high proportion of available willow browse, resulting in a shortage of browse that likely leads to the poor nutritional condition of many of the moose in this population. We continue to use the data from this study to monitor the level of habitat use by moose on the Gustavus forelands and to guide management of the moose population.

CONCLUSIONS AND RECOMMENDATIONS

Berners Bay: The RY10 (no composition data available for RY09) bull:cow ratio exceeds the management objective of 25:100. Aerial survey data failed to enumerate 80–90 moose as listed in the Berners Bay management objectives; however, the number of moose observed nearly met management objectives. During the report period, milder winters resulted in several positive signs associated with indices collected through research efforts (pregnancy rates and decreasing mortality) that suggest the Berners Bay moose population is increasing. Moose research in Berners Bay ended in 2009 and efforts are now focused on the long term monitoring of this population. Management and research staff will continue to monitor this population using a sample of radiocollared cow moose to determine adult female survival, productivity and fecundity. The collared sample will also help during aerial surveys by allowing us to determine sightability.

Chilkat Range: We have 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 must use hunter harvest and effort data to gauge how this population is doing. Harvest during this report period was similar to 1999–2002, but less than 2003–2006. The age structure of the harvest during the current report period is older than has been seen in recent years and the mean number of days for all hunters is consistent with previous report periods. Fewer yearling bulls were taken during the report period which may be due to mortality caused by severe winter weather. With decreasing opportunity in Gustavus, this population is fast becoming the most utilized in Unit 1C. Hunters have figured out that ATV's and other vehicles can be used on the logging roads in the Homeshore-Couverdon area 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 present strategy, allowing harvest of any bull, should be sustainable.

Taku: The harvest management objective of at least 10 bull moose was met during the report period. Without the ability 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 high representation of yearling bulls in the harvest indicates that this population is relatively productive, but the lack of many older age class animals also suggests that we may be harvesting nearly all available bulls on a yearly basis. Although some have suggested 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. We will attempt to survey the area on a more consistent basis and 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 remains low, 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. 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 not needed to limit the size of this moose population. Although there is variability between years in the report period, some indices suggest the fitness of the Gustavus moose population is improving. Estimated survival and pregnancy rates of adult female moose improved during the report period; however, low calf survival resulted in little population growth. 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 has changed the 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. Although hunters would prefer to harvest more moose than currently are being taken, the hunt has been well received and should improve moose hunting opportunity in the future.

We have made acquiring additional information on browse utilization and herd composition a priority.

We believe that a continuation of the permit registration system should help meet 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 need to be analyzed, even if cursorily, to estimate the status of moose populations in relation to carrying capacity. We hope that research conducted at Gustavus and Berners Bay will serve as a template for investigations in other areas and on other populations.

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Table 1. Unit 1C aerial moose survey data, regulatory years 1995 through 2010.

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
					Berners Bay 1999–2008					
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
2009	12	20	4	15	51	3.0	---	---	8	17
2010	18	45	10	0	73	4.3	40	22	14	17
					Chilkat Range 1995–2008					
1995					No survey					
1996	---	---	---	20	20	---	---	---	---	
1997					No survey					
1998	6	15	16	35	72	1.1	---	---	22	65
1999					No survey					
2000	---	6	6	113	125	1.7	---	---	---	74
2001–2010					No survey					
					Taku River 1995–2008					
1995–1997					No survey					
1998	---	1	1	3	5	---	---	---	---	---
1999					No survey					
2000	---	5	7	25	37	2.1	---	---	19	18
2001–2010					No survey					

Table 1 continues on the next page

Table 1. continued.

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
					Gustavus Forelands 1998–2008					
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
2009	11	82	5	0	98	2.0	13	6	5	49
2010	14	22	22	107[a]	165	3.0	11	17	13	55

[a] Moose of unknown sex are presumed to be female for bull:cow and calf:cow calculations.

Table 2. Unit 1C moose age at harvest, Berners Bay, regulatory years 1999 through 2010.

								Age Class									Total	%	Mean
Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	kill	aged	age
								Males											
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									
2009										HUNT CLOSED									
2010										HUNT CLOSED									
								Females											
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									
2009										HUNT CLOSED									
2010										HUNT CLOSED									

Table 3. Unit 1C moose age at harvest, excluding Berners Bay, regulatory years 2001 through 2010.

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
								Chilkat Range											
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
2009	1	1	2	3	2	3	2	3	0	0	0	0	0	0	0	0	18	94	4.6
2010	0	2	1	1	1	0	3	1	0	0	0	0	1	0	0	0	11	91	5.3
								Gustavus Forelands											
2001	2	18	9	6	4	0	0	1	1	0	0	0	0	0	0	0	46[1]	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
2009	0	4	0	1	1	1	1	3	1	0	1	0	0	0	0	0	13	100	5.2
2010	0	7	1	1	1	1	1	0	1	0	0	0	0	0	0	0	13	100	3.2

[a] Includes 1 cow moose shot inadvertently.

Table 3 continues on the next page

Table 3. continued.

Year	Age Class 0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% Aged	Mean Age
									Taku River										
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
2009	0	8	7	1	1	0	0	0	0	0	0	0	0	0	0	0	18	94	2.2
2010	0	10	1	0	0	1	0	0	0	0	0	0	0	0	0	0	12	100	1.9
									Gustavus Forelands (Antlerless Harvest)										
2002	0	1	1	2	1	3	1	0	0	0	0	0	0	0	0	1	10	100	5.4
2003	2	2	6	9	1	2	1	0	1	0	0	0	0	0	1	1	32	88	4.3
2004	2	14	2	8	5	4	4	1	6	1	2	2	0	0	1	0	53	98	4.8
2005	3	3	11	4	3	9	5	5	10	3	6	0	1	1	1	0	69	94	6.1
2006	0	1	3	2	1	0	2	0	0	0	0	1	0	0	0	0	12	83	4.5
2007										HUNT CLOSED									
2008	0	0	2	3	0	1	0	3	0	0	1	0	0	0	0	0	10	100	5.4
2009										HUNT CLOSED									
2010										HUNT CLOSED									

Table 4. Unit 1C moose historical harvests, number of hunters, and percent success, regulatory years 2001 through 2010.

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% success[b]
			Berners Bay			
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			
2009			HUNT CLOSED			
2010			HUNT CLOSED			
			Chilkat Range			
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
2009	18	0	0	18	116	16
2010	11	0	0	11	108	10

Table 4 continues on the next page

Table 4. continued.

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% Success[b]
			Gustavus Forelands			
2001	45	1[a]	0	46	206	22
2002	49	0	0	49	179	27
2003	51	1[a]	0	52	179	28
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
2009	13	0	0	13	107	12
2010	12	1[a]	0	13[c]	96	13
			Taku River			
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
2009	18	0	0	18	83	22
2010	12	0	0	12	84	14
			Gustavus Forelands (Antlerless Harvest)			
2002	0	10	0	10	10	100
2003	1	31	0	32	32	100
2004	1	52	0	53	57	93
2005	3	66	0	69	80	86
2006	0	12	0	12	18	67
2007			HUNT CLOSED			
2008	0	10	0	10	11	91
2009			HUNT CLOSED			
2010			HUNT CLOSED			

[a] Illegal take
[b] Includes only legally harvested bull moose
[c] Includes two illegal bull moose

Table 5. Unit 1C moose hunter effort and success, regulatory years 2001 through 2010.

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits issued[1]	Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days	Nr. hunters	Total days	Avg. days
					Berners Bay-DM041 and DM042					
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					
2009					HUNT CLOSED					
2010					HUNT CLOSED					
					Chilkat Range					
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
2009	335	18	71	3.9	98	404	4.1	116	475	4.1
2010	330	11	35	3.2	97	446	4.6	108	481	4.5
					Gustavus Forelands					
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
2009	147	13	95	7.3	94	764	8.1	107	859	8.0
2010	142	13	45	3.5	83	452	5.4	96	497	5.2

Table 5 continues on the next page

Table 5. continued.

Year	Permits issued	Successful hunters Nr. hunters	Successful hunters Total days	Successful hunters Avg. days	Unsuccessful hunters Nr. hunters	Unsuccessful hunters Total days	Unsuccessful hunters Avg. days	Total hunters Nr. hunters	Total hunters Total days	Total hunters Avg. days
					Taku River					
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
2009	---	18	42	2.3	65	246	3.8	83	288	3.5
2010	---	12	22	1.8	72	419	5.8	84	441	5.3
					Gustavus Forelands (Antlerless Harvest)—DM043, DM044, DM045					
2002	10	10	14	1.4	0	0	0	10	14	1.4
2003	35	32	47	1.5	0	0	0	32	47	1.5
2004	60	53	95	1.8	4	18	4.5	57	113	2.0
2005	90	69	163	2.4	11	36	3.3	80	199	2.5
2006	23	12	19	1.6	6	9	1.5	18	28	1.6
2007					HUNT CLOSED					
2008	15	10	15	1.5	1	5	5.0	11	20	1.8
2009					HUNT CLOSED					
2010					HUNT CLOSED					

[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 2001 through 2010.

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
					Berners Bay				
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				
2009					HUNT CLOSED				
2010					HUNT CLOSED				
					Chilkat Range				
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
2009	18	1	12	4	0	0	1	0	0
2010	11	0	8	1	0	0	0	2	0
					Gustavus Forelands				
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
2009	13	10	2	0	0	0	1	0	0
2010	13[a]	12	1	0	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
					Taku River				
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
2009	18	0	13	2	0	0	0	2	1
2010	12	0	11	0	0	0	0	1	0
					Gustavus Forelands (Cow Harvest)				
2002	10	0	10	0	0	0	0	0	0
2003	32	5	23	1	0	1	1	1	0
2004	53	6	39	3	0	2	1	2	0
2005	69	10	41	4	0	1	3	9	1
2006	12	0	9	1	0	0	0	1	1
2007					HUNT CLOSED				
2008	10	0	9	1	0	0	0	0	0
2009					HUNT CLOSED				
2010					HUNT CLOSED				

Table 7. Unit 1C successful moose hunters transport methods, regulatory years 2001 through 2010.

Year	Airplane Total	Airplane (%)	Boat Total	Boat (%)	3 or 4 wheeler Total	3 or 4 wheeler (%)	Hwy vehicle Total	Hwy vehicle (%)	Foot Total	Foot (%)
					Berners Bay					
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					
2009					HUNT CLOSED					
2010					HUNT CLOSED					
					Chilkat Range					
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	---
2009	5	(28)	5	(28)	7	(39)	1	(5)	0	---
2010	2	(18)	5	(46)	4	(36)	0	---	0	---
					Gustavus Forelands					
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)
2009	0	---	1	(8)	0	---	9	(69)	3	(23)
2010	0	---	1	(8)	0	---	12	(92)	0	---

Table 7 continues on the next page

Table 7. continued .

Year	Airplane Total	Airplane (%)	Boat Total	Boat (%)	3 or 4 wheeler Total	3 or 4 wheeler (%)	Hwy vehicle Total	Hwy vehicle (%)	Foot Total	Foot (%)
					Taku River					
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	---
2009	0	---	18	(100)	0	---	0	---	0	---
2010	0	---	12	(100)	0	---	0	---	0	---
					Gustavus Forelands (Cow Harvest)					
2002	2	(20)	1	(10)	0	---	7	(70)	0	---
2003	5	(16)	3	(9)	2	(6)	22	(69)	0	---
2004	2	(4)	2	(4)	2	(4)	47	(88)	0	---
2005	1	(1)	4	(6)	2	(3)	56	(81)	6	(9)
2006	0	---	2	(17)	1	(8)	8	(67)	1	(8)
2007					HUNT CLOSED					
2008	0	---	0	---	1	(10)	9	(90)	0	---
2009					HUNT CLOSED					
2010					HUNT CLOSED					

Table 8. Unit 1C moose hunters commercial services use, regulatory years 2001 through 2010.

Year	Unit residents		Other AK residents		Non-residents		Total use		Transport	Non-guided services	Other services
	No	Yes	No	Yes	No	Yes	No	Yes			
					Berners Bay						
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						
2009					HUNT CLOSED						
2010					HUNT CLOSED						
					Chilkat Range						
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
2009	73	3	38	0	0	2	111	5	5	0	0
2010	75	6	21	2	4	0	100	8	7	0	2
					Gustavus Forelands						
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
2009	102	0	4	0	1	0	107	0	0	0	0
2010	89	1	4	0	2	0	95	1	1	0	0

Table 8 continues on the next page

Table 8. continued.

Year	Unit residents No	Unit residents Yes	Other AK residents No	Other AK residents Yes	Non-residents No	Non-residents Yes	Total use No	Total use Yes	Transport	Non-guided services	Other services
					Taku River						
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
2009	77	0	5	0	1	0	83	0	0	0	0
2010	80	2	2	0	0	0	82	2	2	0	0
					Gustavus Forelands (Cow Harvest)						
2002	7	3	0	0	0	0	7	3	2	0	1
2003	25	3	4	0	0	0	29	3	2	0	1
2004	44	5	6	2	0	0	50	7	4	0	3
2005	54	5	17	3	1	0	72	8	4	0	4
2006	14	0	3	0	1	0	18	0	0	0	0
2007						HUNT CLOSED					
2008	6	2	3	0	0	0	9	2	1	1	0
2009						HUNT CLOSED					
2010						HUNT CLOSED					

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 1D (2,854 mi^2)

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

BACKGROUND

Most Unit 1D moose inhabit the Chilkat River watershed and the Chilkat Peninsula. Within this area there are an estimated 200–250 mi^2 of summer range and 110–120 mi^2 of winter range, including 80 mi^2 of preferred winter range. Small areas of moose habitat are also located in the Chilkoot, Katzehin, and Warm Pass valleys, and along the western shore of Lynn Canal (ADFG 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 RY09 and RY10 (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.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY09 = 1 July 2009–30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We conducted aerial surveys in the fall of 2009 and 2010. In fall 2009 we counted 183 moose and in fall 2010 we counted 197 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 the 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 fall 2009 survey were adequate enough to classify animals that were observed (183 total) as bulls, cows or calves. We classified 27 (15 %) of the moose seen on this survey as calves, which is slightly higher than the 11% of calves seen in the fall 2007 and fall 2008 surveys (Table 1). The bull:cow ratio was determined to be 35:100 and the calf:cow ratio was 25:100. Survey conditions in fall 2010 were also adequate enough to collect reliable herd composition, and we were able to classify 197 animals as bulls, cows or calves. We classified 27 (14%) of the moose seen as calves, while the bull:cow and calf:cow ratios were determined to be 39:100 and 23:100 respectively. The high bull:cow ratio during the R09 and RY10 surveys 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 13% below the 10-year mean count of 31 calves. It is more difficult to quantify bull moose because of survey timing. The highest bull:cow ratios in the last ten years were recorded in RY05, RY06 and RY10 (Table 1).

The harvest age structure (Table 2) has remained consistent between the current and past reporting periods (RY07-RY10). Mean age at harvest during this report period was 3.7 years, which was similar to the mean age of 3.8 during the last report period.

MORTALITY

Harvest

Season and bag limit	Resident hunters	Nonresident hunters
1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on 1 side by Tier II subsistence hunting permit only; up to 250 permits may be issued.	15 September–7 October (Subsistence hunt only)	No open season.

Game Board Actions and Emergency Orders: During the fall 2010 BOG meeting there were no proposals submitted that pertained to Unit 1D moose. Similarly, there were no closures to the TM059 moose harvest during either of these reported periods.

Hunter Harvest: During this report period, the mean annual harvest was 19.5 moose, a significant decrease from the 26 reported during the last report period. In RY09, 18 bull moose were taken, and in RY10, 21 bull moose were harvested. The RY08 harvest had been the highest harvest during the past 10 years, which is the cause of the inflated mean harvest during the last reporting period. The reason for the additional harvest in RY08 was likely due to 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. During the previous report period, only 220 permits were available during each hunting season, but this was increased to 250 in RY09. Two hundred and fifty permits were available during each year of the report period (Table 3), and all 250 permits were issued in each of the RY09 and RY10 seasons.

Hunter Residency and Success: During the report period local residents were the primary Unit 1D moose hunters even though all Alaskan residents were eligible to apply for this or any other Tier II hunt. Residents of Haines and Klukwan (Table 4) took 36 of the 39 moose harvested during the report period. Hunter success was 8% and 11% in RY09 and RY10, respectively. Success rates during RY09 are the lowest they have been in the past decade (RY01–RY10) (Table 5). Successful hunters took an average of 5.0 days in RY09 and RY10 to harvest a bull moose (Table 3). Hunter days were 1,953 in RY09 and 1,555 in RY10 (Table 3).

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 67% and 57% of the harvest in the first week of the season in RY09 and RY10, 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 12 bulls (50% of the total harvest) harvested the first week had 3 or more brow tines, 2 spike/fork and one 50 inch + bulls were taken during this period in RY09. All 4 sublegal moose in RY09 were taken during this time with 3 bulls having fewer than 3 brow tines, and 1 illegal bull being left unsalvaged in the field. In RY10 4 bulls with spike/fork antlers and 3 bulls with 3 brow tines (14% of the total harvest) were taken in the first week. Four of the 5 sublegal bulls in RY10 were taken within this period with 2 bulls harvested having less than 3 brow tines, 1 bull with <50 inch spread, and 1 illegal bull taken before the start of the moose season.

Transport Methods: Most Unit 1D moose hunters use boats or highway vehicles during the harvest (Table 6). During the RY09 and RY10 hunting seasons, 56% and 48% of successful hunters used boats, respectively. Many of the remaining successful hunters used highway vehicles (11% in RY09 and 24% in RY10; Table 6).

Commercial Services: One unit resident and no 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 RY09 and RY10 for cultural education and another bull was harvested in RY10 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 prey 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 RY98–RY10 (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 5 wolves per year over the last 10 years (range 0–12) (Scott 2009b). During this report period 7 and 11 wolves were taken in RY09 and RY10, respectively. Wolf harvest data is inadequate to provide anything but general information on the wolf population in this area. 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 RY09 and RY10 (15% and 14% respectively) is on par with or just above the 10-year average of 14% calves. In some years deep snow may contribute to calf mortality and that may have been the case during the heavy snow winters during the previous 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. When possible these moose are salvaged and distributed to local charities.

Only 1 unreported hunter kill was discovered in this 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 and illegal bull harvest is monitored on a yearly basis and during this reporting period it did not appear to be a significant problem for the survival of moose in Unit 1D. A small number of sublegal harvest 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 (ADNR 2002). 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 enabling moose to avoid predators.

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 post glacial land uplift (isostatic rebound) is causing permanent habitat change. In May 2007 and 2008 department staff conducted moose browse surveys in 3 areas of the Unit 1D moose range. The department would like to continue browse surveys in the future, however limitations in staff and time prevented us from conducting a survey this report period. Winter weather is an important factor to consider when reviewing these data. In years with high snow fall, important winter browse <1m in height might not be available for moose, whereas taller vegetation could be available in limited supply until fully consumed above the snow pack. 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 be conducted in the next report period.

CONCLUSIONS AND RECOMMENDATIONS

The management objectives at the beginning of this report were taken 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 not met in RY09 (18) but met in RY10 (21). We also did not meet the objective of a 12% hunter success rate in RY09 (8%) or in RY10 (11%).

The effect of predation upon moose calf survival in this area is unknown. An apparently healthy brown bear population (as well as a less prominent black bear population) may account for substantial early summer mortality, according to anecdotal accounts, but no one has investigated predator-prey relationships in the Chilkat River Valley. Winter wolf predation could be a serious problem when moose movements are restricted by extremely deep snow. However, active local trappers seem to be keeping this source of predation in check.

McCarthy (ADF&G 1990a) called for investigating the relationship between timber harvest and moose habitat in the Chilkat River valley. We recommend pursuing pilot projects that convert decadent hardwood stands to younger aged stands that allow for increased growth of browse species, while maintaining adequate conifer growth in other areas 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 (51%), 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 to continue regular surveys to better understand the status and trend of the population.

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Table 1. Unit 1D (Chilkat Valley) moose aerial survey data, regulatory years 1998 through 2010[a].

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
2009	38	110	27	8	183	4.7	35	25	15	39
2010	47	120	27	3	197	6.0	39	23	14	33

[a] Missing data is due to surveys conducted “post” antler drop which prevented us from acquiring herd composition data.

Table 2. Unit 1D age structure of harvested moose, regulatory years 2001 through 2010.

Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	Age Class 7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% aged	Mean age
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
2009[a]	0	6	3	2	2	1	2	1	1	0	0	0	0	0	0	0	18	100	3.7
2010	0	7	4	1	4	2	1	1	0	0	1	0	0	0	0	0	21	100	3.7

[a] Does not include 1 unsalvaged illegal harvest.

Table 3. Unit 1D moose hunter effort and success, regulatory years 2001 through 2010.

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits Issued	# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days
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
2009[a]	251	18	90	5.0	197	1863	9.5	215	1953	9.1
2010	250	21	104	5.0	168	1451	8.6	189	1555	8.2

[a] Does not include 1 unsalvaged illegal harvest.

Table 4. Unit 1D annual moose kill by community of residence, regulatory years 2001 through 2010.

Regulatory year	Total kill	Haines	Skagway	Juneau	Sitka	Other Alaska	Non-resident
2001	17[a]	16	0	0	1	0	0
2002	22	21	1	0	0	0	0
2003	21	18	0	3	0	0	0
2004	19[b]	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
2009	18[b]	17	0	1	0	0	0
2010	21	19	0	0	1	0	0

[a] Includes 1 illegally harvested bull.

[b] Does not include 1 unsalvaged illegal harvest.

Table 5. Unit 1D historical moose harvests, number of hunters, and percent success, regulatory years 2001 through 2010.

Regulatory year	# males	# females	# unknown	Total kill	# hunters	Percent success
2001	17	0	0	17	154	11
2002	22	0	0	22	157	14
2003	21	0	0	21	161	13
2004[a]	19[a]	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
2009[a]	18	0	0	18	215	8
2010	21	0	0	21	189	11

[a] Does not include 1 unsalvaged illegal harvest.

Table 6. Unit 1D transport methods used by successful moose hunters, regulatory years 2001 through 2010.

	Airplane		Boat		ORV		Highway vehicle		Other	
Year	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
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)
2009	0	---	10	(56)	3	(17)	2	(11)	3	(17)
2010	1	(5)	10	(48)	4	(19)	5	(24)	1	(5)

Table 7. Unit 1D commercial services used by moose hunters, regulatory years 2001 through 2010[a].

	Unit residents		Other AK residents		Total use		Other
Year	No	Yes	No	Yes	No	Yes	services
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
2009	201	1	12	0	214	1	0
2010	179	0	9	0	188	0	0

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

SPECIES

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 2009
To: 30 June 2011

LOCATION

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

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

BACKGROUND

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

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 new liberalized antler restrictions on the RM038 moose herd could be evaluated.

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.

Unit 3:	Plan Objective	2009	2010
Post hunt numbers	400	N/A	N/A
Annual hunter kill	40	64	53
Number of hunters	470	486	512
Hunter-days of effort	2300	2509	3296
Hunter success	10%	13%	10%

METHODS

We opportunistically checked hunters and harvested moose in the field. We also required hunters 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.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY09 = 1 July 2009–30 June 2010).

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 RY09 486 RM038 moose hunters reported observing 1024 moose in Unit 3, including 389 bulls, 420 cows, and 215 calves, for a bull-to-cow ratio of 93:100 and a calf-to-cow ratio of 51:100. In RY10, 512 RM038 moose hunters reported observing 1526 moose, including 476 bulls, 652 cows, and 398 calves, for a bull-to-cow ratio of 73:100 and a calf-to-cow ratio of 61:100.

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 September–15 October
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on 1 side, or 2 or more brow tines on both sides by registration permit only	

Game Board Actions and Emergency Orders. The Board of Game took no actions, and we issued no emergency orders regarding Unit 3 moose during the report period.

Hunter Harvest. In RY09, 486 hunters harvested 64 moose, including 4 illegal kills, in Unit 3 (Tables 1 and 2). The harvest of 64 moose in RY09 was the highest unitwide harvest on record. This record unitwide harvest was due in large part to liberalization of the moose antler restrictions to allow the harvest of bulls with 2 or more brow tines on both antlers. In RY10, 512 hunters harvested 53 moose, including 3 illegals. The unitwide harvest of 53 moose in RY10 represents the third highest harvest on record.

Hunter Residency and Success. The overwhelming majority of those who participate in the Unit 3 moose hunt are local residents of Petersburg, Wrangell, and Kake (Table 2). Local residents, therefore, typically represent the largest group of successful hunters. The overall success rate for all residency groups combined was 13% in RY09 and 10% in RY10, both of which exceeded the preceding 10-year average of 7% success. Just 3 and 2 nonresident hunters participated in the Unit 3 moose hunt in RY09 and RY10, 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 RY09 most of the annual harvest occurred during the third and fourth weeks of the season, each with an equal percentage of the harvest. In RY10 most of the annual harvest occurred during the second and fourth weeks of the season, respectively (Table 3).

Harvest in particular Wildlife Analysis Areas (WAAs). During the report period hunters reported harvesting moose in 15 Unit 3 WAAs. In RY09 the largest percentage of the annual harvest occurred in WAA # 5132 on northwest Kupreanof Island, followed by WAA # 2007 on Mitkof Island. In RY10 the largest percentage of the harvest also occurred in WAAs # 5132 and # 2007, each with an equal percentage of the harvest.

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 4).

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 we don’t know how prevalent it is.

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 of the land in Unit 3.

The annual hunter kill exceeded the management objective of 40 moose during both years of this report period. The number of hunters was also above the management objective of 470 hunters during both RY09 and RY10. Hunter days of effort was well above the management objective of 2300 days during both years. Success rates of 13% in RY09 and 10% in RY10 were both up from the previous report period, and above and equal to, respectively, the management objective of 10% annually. The relatively high success rates during the report period are likely attributable to liberalization of the moose antler restrictions beginning with the RY09 season. The harvest of 64 moose in RY09, the first year the harvest of bulls with 2 or more brow tines on both antlers was allowed, represents the highest Unit 3 moose harvest since the inception of the moose hunt in 1993. The harvest of 53 moose in RY10 was the third highest harvest on record. In RY09, 17 (27%) of the 64 bulls harvested in Unit 3 had 2 brow tines on both antlers. In RY10, 20 (38%) of the 53 bulls harvested had 2 brow tines on both antlers. We recommend that the current antler regulations remain in effect while we continue to monitor the impact of the new liberalized antler restrictions on the moose herd.

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.

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 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 tines on at least 1 side, or 2 or more brow tines on both sides.

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Table 1. Unit 3 moose harvest, regulatory years 1999 through 2010.

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[bc]	28	(100)	0	(0)	0	28	6	34
2009	59	(98)	1	(2)	0	60	4	64
2010[a]	50	(100)	0	(0)	0	50	3	53

[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 hunter residency and success, regulatory years 1999 through 2010.

	Successful					Unsuccessful					
Year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
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
2009	48	16	0	64	(13)	375	44	3	422	(87)	486
2010	40	12	1	53	(10)	400	58	1	459	(90)	512

[a] Residents of Kake, Petersburg, and Wrangell

Table 3. Unit 3 moose harvest chronology in, regulatory years 1999 through 2010.

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
2009	14	12	19	19	64
2010	8	18	13	14	53

[a] Numbers do not equal total due to one unknown

Table 4. Unit 3 successful moose hunter transport methods, regulatory years 1999 through 2010.

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
2009	0	13	38	12	0	1	64
2010	1	14	33	4	0	1	53

Alaska Department of Fish and Game
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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

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

BACKGROUND

Moose were first documented along the lower Alsek River in eastern Game Management Unit 5 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 immigrated 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 Yaktuat 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 2009 – RY 2011)	Plan objective
Unit 5A Yakutat Forelands		
Post-hunt moose numbers (estimated)	600–800	1000
Annual hunter kill (average)	38	70
Number of hunters (annual average)	140	250
Hunter-days of effort (annual average)	622	1025
Hunter success (annual average)	27%	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)	8	25
Number of hunters (annual average)	21	50
Hunter-days of effort (annual average)	77	200
Hunter success (annual average)	36%	50%

METHODS

We only conducted aerial surveys on the Yakutat Forelands of Unit 5A and Nunatak Bench in first year (RY09) of the report period (Table 1). All surveys were flown with a Cessna 185 or 206 aircraft because better-suited survey aircraft are not available in Yakutat.

Two state 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. When possible department staff contacts hunters in the field to collect hunt information, permit report cards, biological samples, and photographs of harvest moose.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY09 = 1 July 2009–30 June 2010).

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 301 moose on the forelands (Table 1). This survey was conducted in March 2010 (RY09) after a significant late season snowfall. Although snow covered 100% of the ground, warmer weather had moved into the Yakutat area a day or two prior to the survey resulting in little to no snow on trees and ground vegetation. In addition to mediocre snow conditions for observation, moose on the Yakutat forelands begin moving inland and to dense spruce forests in early spring where it is difficult to detect them; these factors likely contributed to the lower number of moose observed

Moose surveys were not conducted on the Yakutat Forelands in RY10 due to weather and aircraft availability limitations.

Unit 5(A) Nunatak Bench: Aerial surveys of the Nunatak Bench area were completed only during RY09. In March 2010 (RY 2009) 14 moose were observed with only 1 calf. This moose herd continues to suffer the effects of habitat depletion from the 2002 flooding. Managers will continue to survey this area on an every other year basis until a sufficient number of moose are present and can support a hunt.

Unit 5(B) Malaspina Forelands: No surveys were conducted in 5(B) during the reporting period.

Population Composition

Unit 5A, Yakutat Forelands: During this report period the RY09 aerial survey was conducted after antler drop began; therefore we were unable to collect reliable composition data. Thus, survey data lists cows, calves, bulls, and adult moose of unknown sex (Table 1). We counted no antlered bulls and had difficulty identifying calf moose because they are relatively large almost a year after partition. The minimum percent calves were 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 3.0 years in RY05 and RY10 to a high of 4.4 years in RY02 (Table 2). Mean age at harvest during this report period was 3.0 years. The number of yearling and 2-year-old bulls was 24 and 16 during RY09 and RY10 respectively. The number of 3- and 4-year-old bulls decreased during the report period, but the 5 and 6 year old bulls increased to 9 and 3 in RY09 and RY10, respectively. Based on the strong representation in the harvest, the calf cohort from RY06 and RY07 had good survival levels and continues to contribute to the herd. The 2009 and 2010 harvest is more consistent with the long-term mean harvest, but the number of yearling bulls in the RY10 (Table 2) 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 RY09 survey did not provide reliable composition data (Table 1).

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 2001. The mean age of 3.5 years 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 1, respectively) is slightly lower than the previous report period. Typically, the presence of young bulls in the harvest occurs when the total harvest is higher than the 10-year average but because of the low hunter effort and harvest in the unit, the usefulness of the age data for analyzing the effects of harvest on population is limited.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 5A, except Nunatak Bench	15 October–15 November
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	15 November–15 February
1 moose by registration permit only; up to 5 moose may be taken	
Unit 5B 1 bull by registration permit Only; up to 25 bulls may be taken	15 September–15 December

Game Board Actions and Emergency Orders. We issued no Emergency Orders for Unit 5 moose hunts during the reporting period. In RY09 and RY10, the Alaska Board of Game reauthorized the Nunatak Bench Antlerless Moose hunt. The board must reauthorize antlerless moose hunts annually.

Hunter Harvest. The annual harvest of moose in Unit 5A (Yakutat Forelands) ranged from 30 to 48 during RY99–RY08, with a mean of 39. The average harvest for this report period was 38 moose/year. The number of moose harvested since RY02 has declined; however, RY04 and RY07 both saw harvests of 40 or more moose. The yearling and 2.5 year old bull component of the harvest was very strong in both of these years suggesting good survival for the age classes. 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 RY06 due to low numbers of moose observed during aerial surveys (Table 1).

The harvest in Unit 5B decreased slightly from the previous report period to 11 in RY09, and 4 in RY10 (Table 3). Total harvest for the report period (15 moose) is similar to harvests in the 1990s. The number of hunters and days hunted (Table 5) decreased in RY10 which was reflected in a decline in the number of moose taken. 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 RY09–RY10 totaled 192 and 174 respectively. The number of permittees who actually hunted in RY09–RY10 was similar to the previous report period with 143 and 136 hunters respectively (Table 5).

The number of permits issued for the Unit 5B hunt (RM062) varies year-to-year. In RY09 and RY10, 55 and 35 permits, respectively, were issued; and 30 and 12 hunters, respectively, hunted. The mean number of permits issued for the period RY99–RY08 is 41; and the mean number of hunters for the same period is 22. The number of permits and hunters for the current report period are similar to the long term means and demonstrate the variation in interest and moose hunting effort in Unit 5B. As noted above, Unit 5B can be difficult to access so if hunters can participate in the Unit 5A hunt they likely choose to because of easier access and relatively good harvest opportunities close to Yakutat. 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 RY04 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 45 of 75 bulls (60%) 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 Alaskan residents hunting but not living in Unit 5 took 28 moose (13%) during the report period. Nonresidents took only 2 moose during the report period, lower than the mean of 3.7 moose harvested per 2-year period for the past 4 report periods (Table 4). Since RY01 the overall success of Unit 5A hunters has ranged from 22% to 32% (Table 3). Hunter success was 27% in RY09 and 27% in RY10.

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 33% of the Unit 5B moose harvest, nonresidents took 20%, and other Alaska residents took the remaining 47% of the harvest (Table 4). Harvest Chronology. Most of the Unit 5A harvest on the Yakutat Forelands took place during the first 3 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, roughly half (53%) of the moose (8) were taken in September; 2 were taken in October; and 5 in November. Clusters in the harvest chronology often represent several boat loads of hunters working together to get moose, as is the case for most of the November moose harvest during the report period. 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 on the Yakutat Forelands changed slightly during the current report period. The use of aircraft increased to 33% this period from 22% during R07–RY08; and the use of boats decreased from 31% in RY07–RY08 to 23% in RY09–RY10 (Table 6). The use of 3 or 4 wheelers and other ORVs and highway vehicles remained about the same as the previous report period. 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 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, and 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 (48%) than Unit 5A hunters (27%). This difference in commercial services used can be attributed to the difficulty in accessing Unit 5B.

Other Mortality

As noted in the RY08 management report, the winter of RY06 was the most severe on record in many parts of Southeast Alaska, and snowfall was above average in Yakutat. The winters of RY07–RY08 were only slightly less extreme. Snowfall amounts were below average during the winter of RY09 giving moose a respite after a series of difficult winters. 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 RY06 surveys) are near management objectives and traditionally have supported a higher moose harvest. The number of yearling and 2-year-old bulls in the harvest remains strong suggesting recruitment continues to be good. We hope that will translate into higher moose harvests in the future. The Nunatak moose population continues to be depressed. The department will continue to monitor this population and will allow hunting when moose numbers can support a harvest. 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.

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Table 1. Unit 5 aerial survey data, regulatory years 1999 through 2010.[a]

Year	MM	FF	Calves	Unk	Total	Count time (hrs)	MM Per 100 FF	Calves per 100 FF	Percent calves in herd	Moose per hour
					5A Yakutat Forelands					
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[b]	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
2009	NA	NA	25	276	301	8.5	NA	NA	8	35
2010						No survey				
					5A Nunatak Bench					
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				
2009	NA	NA	1	13	14	.6	NA	NA	7	23
2010						No survey				
					5B Malaspina Forelands					
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				
2009						No survey				
2010						No survey				

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

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

Table 2. Unit 5 age structure of harvested moose, regulatory years 2001 through 2010.

Year							Age	Class								Total	%	Mean
	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	kill	Aged	Age
									Yakutat Forelands										
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
2009	0	9	10	7	3	5	1	0	2	0	0	0	0	0	0	0	38	97	3.4
2010	0	15	6	8	0	4	2	1	0	0	0	0	0	0	0	0	37	97	3.0
									5A Nunatak Bench										
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	---	---
2006-2010									No Harvest										
									5B Malaspina Forelands										
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
2009	0	2	3	1	1	2	0	0	0	0	0	0	0	0	0	0	11	82	3.3
2010	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	4	100	3.5

Table 3. Unit 5 historical harvests, hunters, and success, regulatory years 2001 through 2010.[a]

Year	Nr MM	Nr FF	Nr unk.	Total kill	Nr hunters	Percent success
			5A Yakutat Forelands			
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
2009	38	0	0	38	143	27
2010	37	0	0	37	136	27
			5A Nunatak Bench			
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				---		
2009				---		
2010				---		
			5B Malaspina Forelands			
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
2009	11	0	0	11	30	37
2010	4	0	0	4	12	33

[a] Includes moose harvested under federal ceremonial permit

Table 4. Unit 5 annual moose kill by community of residence, regulatory years 2001 through 2010.

Year	Total kill	Yakutat	Juneau	Ketchikan	Sitka	Pelican	Hoonah	Petersburg	Haines	Wrangell	Other AK	Non-resident
5A Yakutat Forelands												
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
2009	38	23	10	0	2	0	0	0	0	0	3	0
2010	37	22	5	0	1	0	0	0	0	0	7	2
5A Nunatak Bench												
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	---											
2009	---											
2010	---											
5B Malaspina Forelands												
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
2009	11	3	0	0	1	0	1	0	0	0	3	3
2010	4	2	1	0	1	0	0	0	0	0	0	0

Table 5. Unit 5 hunter effort and success, regulatory years 2001 through 2010.[a]

Year	Permits issued	Successful hunters Nr hunters	Successful hunters Total days	Successful hunters Avg. days	Unsuccessful hunters Nr hunters	Unsuccessful hunters Total days	Unsuccessful hunters Avg. days	Total hunters Nr hunters	Total hunters Total days	Total hunters Avg. days
5A Yakutat Forelands										
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
2009	192	38	134	3.5	105	564	5.4	143	698	4.9
2010	174	37	96	2.6	99	449	4.5	136	545	4.0
5A Nunatak Bench										
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	---									
2009	---									
2010	---									
5B Malaspina Forelands										
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
2009	55	11	22	2.0	19	98	5.2	30	120	4.0
2010	35	4	5	1.3	8	28	3.5	12	33	2.8

[a] 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 2001 through 2010[a].

Year	Airplane		Boat		3 or 4 wheeler		ORV		Highway vehicle		Foot	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
					5A Yakutat Forelands							
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)
2009	13	(34)	7	(18)	11	(29)	1	(3)	6	(16)	0	---
2010	12	(32)	10	(27)	11	(30)	0	---	4	(11)	0	---
					5A Nunatak Bench							
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							---					
2009							---					
2010							---					
					5B Malaspina Forelands							
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	---
2009	5	(46)	0	---	4	(36)	2	(18)	0	---	0	---
2010	1	(25)	3	(75)	0	---	0	---	0	---	0	---

[a] 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 2001 through 2010[a].

Year	Unit residents No	Unit residents Yes	Other AK residents No	Other AK residents Yes	Nonresidents No	Nonresidents Yes	Total use No	Total use Yes	Transport	Registered guide	Other Services
					5A Yakutat Forelands						
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
2009	79	7	21	31	3	1	103	39	38	0	3
2010	78	9	21	24	1	3	100	36	36	0	3
					5A Nunatak Bench						
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						---					
2009						---					
2010						---					
					5B Malaspina Forelands						
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
2009	9	0	4	7	0	10	13	17	17	6	9
2010	7	0	2	2	0	1	9	3	3	0	0

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

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Prince William Sound and North Gulf Coast

BACKGROUND

Moose populations in most of Unit 6 originated from translocations of calves from the Kenai Peninsula, Anchorage, and the Matanuska–Susitna area (Paul 2009). The only moose endemic to Unit 6 are small populations in the Lowe River drainage in Unit 6D, numbering about 40 animals total. 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). 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/mi^2 after a severe winter in 1971–1972 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 better estimates of population size. Moose populations in Units 6A and 6B fell below management objectives a decade ago because of wolf and bear predation and have not recovered despite reduced harvest and elimination of antlerless hunts. In contrast, in Unit 6C where wolf and brown bear numbers are controlled by hunter harvest, the moose population regularly exceeds the management object and must be heavily hunted relative to the other units.

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 2 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 RY00, as was 75% of the bull harvest quota during RY02. This increased rural harvest opportunity for Cordova residents from an average 75% under state regulations to more than 90% under combined state and federal regulations. Average annual harvest was 124 during the RY90–RY99 and 112 during RY00–RY09.

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 was maintain a population of 400 moose and 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. I flew repeated surveys beginning shortly after May 20 to determine the twinning rate for cows with calves at heel.

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

I summarized survey and harvest data by unit, except for Unit 6A, which was divided into eastern and western portions. The eastern portion encompassed all drainages into the Gulf of Alaska between Cape Suckling and the head of Icy Bay. The western portion encompassed all drainages into the Gulf between Cape Suckling and Palm Point. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY09 = 1 July 2009–30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We conducted 6 modified Gasaway surveys and 2 composition counts in Unit 6 (Table 1) during the reporting period. Gasaway surveys were flown in February and March, after most bulls had cast antlers. We flew composition counts in Units 6B and 6C in November or early December while most bulls still retained antlers (Table 1).

Population Size

Survey results indicated moose populations were fairly stable in Units 6A, possibly increasing in 6B, and increasing in 6C. Moose on the Copper River Delta have lower detectability during later-season surveys; consequently I suspect that both estimates of population size in 6C were biased somewhat low. Actual population size was probably toward the high end of the 90% confidence interval (Table 1). The posthunt moose population in Unit 6 during the reporting period was approximately 1,260 moose, including 280 in Unit 6A East, 245 in Unit 6A West, 242 in Unit 6B, 450 in Unit 6C, and 40 in Unit 6D. Populations remained below management objectives in 6A and 6B.

Population Composition

Bull:cow ratios were obtained for Units 6B and 6C during the reporting period (Table 1). Bull:cow ratio was unusually low (22 bulls:100 cows) in Unit 6C because of heavy harvest to reduce population size during 2006 through 2008. Harvest was adjusted accordingly to increase the proportion of cows in the harvest. The proportion of calves in the population in Unit 6B was typically low. We flew 5 twinning surveys in Unit 6C: 1 during 29 May–19 June 2008, and 4 during 26 May–1 June 2009. 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, which is among the highest reported in Alaska and an indicator of favorable habitat conditions (Boertje et al. 2007).

MORTALITY

Harvest

Reported moose harvest for Units 6A, 6B, and 6D during the reporting period were typical, while 6C harvest quota was reduced because of lower bull:cow ratio and the RY09 population estimate (Table 1). Hunters and wildlife viewers expressed a desire to see more and bigger bulls in Unit 6C than provided by the minimum management objective. Higher harvest will resume in 6C during the next reporting period.

Season and Bag Limit. The bag limit and season 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 1 moose. Resident harvest quota was up to 20 bulls by registration permit, and nonresident quota was up to 5 bulls by drawing permit.

The season in Unit 6B was 1 September–30 November for resident hunters only with a bag limit of 1 moose. We authorized a harvest of 25 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 4 days of the season were open to nonmotorized 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 limit was 1 bull moose by drawing permit with the quota varying by year (Table 3). Of the 104 moose permits issued during the reporting period, 19 were state drawing permits, of which 10 were issued to Cordova residents. The state drawing hunt is for residents only specifically to provide Cordova residents with a large proportion of the permits. The remaining quota was allocated to federal subsistence permits, which required Cordova residency (Table 1). This provided a 91% 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.

Board of Game Actions and Emergency Orders. We issued emergency orders each year of this period to close the registration permit hunts for bull moose in Unit 6B (20 and 29 October, respectively). These were normal management actions. The Board of Game reauthorized all antlerless moose hunts during the reporting period, and increased the brown bear season in Units 6A–6C from 31 May to 10 June beginning in RY09 in an effort to reduce predation on moose calves.

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). The number of permits issued was typical.

Hunter Residency and Success. Local residents composed 69–75% of successful moose hunters in Unit 6 during reporting period (Table 4). This was driven primarily by federal subsistence hunting in Unit 6C (open to Cordova residents only), where 91–97% of successful hunters were local residents. 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 since the early 2000s when most of the harvest quota was moved into the federal subsistence system.

Harvest Chronology. Most of the Unit 6 harvest over the past 2 years occurred during September (Table 5).

Transport Methods. Boats (primarily airboats) and airplanes were the most commonly used transport method during this reporting period (Table 6). Unit 6C has good road access from Cordova, allowing both highway vehicle and airboat access to moose. This pattern of use has not changed over the past 5 years.

Other Mortality

Predation by brown bears and wolves was the primary cause of calf and adult (nonhunter) mortality. As in previous periods, 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 low compared to other areas of Alaska CCarnes 2004), indicated that approximately one-quarter of the moose population in Units 6A and 6B potentially could be killed by wolves each year. Occasional deep snow and severe weather can contribute to mortality. The proportion of calves in the population in Unit 6A West declined by 5 and 8% in Unit 6A West between November and February in RY05 and RY08 (Table 1), respectively. In contrast, in 6C it is typical to see more calves during the February Gasaway survey than the November composition count (see RYs 07, 09, and 10 in Table 1) because there is little predation and calves become more visible.

Wolves were maintained at low density in Unit 6C by hunting and trapping. Posthunt wolf population size was generally 6 or fewer in 2 small packs, which had relatively little impact on the moose population. Therefore, moose in 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 survival in Unit 6C to spike every 2–3 years (Table 1). The proportion of calves in the population 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 18, 8, and 13 years respectively, because of wolf and brown bear predation. The brown bear season was increased but liberalizing the wolf season would have little to no effect. In contrast, the population objective in Unit 6C of 400 has been met and surpassed in recent years. The population objective for Unit 6C should be changed from 400 to a range of 400–500. The minimum bull:cow ratio should be increased to 25 because the public and hunters prefer to see more and bigger bulls in the population in Unit 6C. Based on twinning rates and informal willow assessment the habitat can sustain this population. Over 90% of the moose harvest in Unit 6C is taken by residents of Cordova because both state and federal rural priorities apply to local subsistence hunters.

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Table 1. Unit 6 estimated moose population size and composition by sex and age, 2001–2010.

Unit	Regulatory Year	Survey date (m/d/y)	Bulls: 100 cows	Calves (%)	Adults	Population size	90% C.I	Total moose observed
6A East	2001–02	25 Feb 02	-	15	265	285	220–360	218
	2007–08	29 Jan 08	-	7	213	230	212–247	230
	2009–10 [a]	02 Feb 10	-	-	44	280 [a]	-	49
6A West	2005–06	04 Dec 05	18	15	143	275	238–311	206
	2005–06[b]	31 Jan 06	-	10	163	-	-	187
	2007–08	31 Jan 08	-	7	215	276	249–301	232
	2008–09[b]	17 Nov 09	20	11	150	-	-	174
	2008–09	14 Feb 09	-	3	187	245	212–279	194
6B	2001–02	21 Feb 02	-	13	144	198	176–219	168
	2003–04[b]	25 Nov 03	57	6	111	-	-	124
	2005–06[b]	02 Dec 05	45	15	103	-	-	129
	2007–08	18 Jan 07		9	179	242	225–258	195
	2009–10 [b]	17 Nov 09	26	11	150	-	-	174
6C	2006–07	18 Jan 07	-	20	273	560	453–667	361
	2007–08 [b]	30 Nov 07	36	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
	2009–10 [b]	16 Nov 09	14	11	246	-	-	298
	2009–10	16 Mar 10	-	17	200	296	164-426	251
	2010–11 [b]	02 Dec 10	22	14	195	-	-	258
	2010–11	23 Feb 11	-	17	248	398	324-471	308

[a] Brief survey between Cape Yakataga and Icy Bay east of established survey, colonized by moose and now hunted regularly. Added to survey results of 2008.
[b] Composition count.

Table 2. Unit 6 moose harvest and other mortality, 2006–2010.

		Hunter harvest									
	Regulatory	Reported					Estimated			Accidental	
Unit	year	M	(%)	F	(%)	Total	Unreported	Illegal	Total	death	Total
6A East	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
	2009–10	11	(100)	0	(0)	11	1	0	1	0	12
	2010–11	18	(100)	0	(0)	18	1	0	1	0	19
6A West	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
	2009–10	16	(100)	0	(0)	16	0	1	1	0	17
	2010–11	12	(100)	0	(0)	12	0	1	1	0	13
6A TOTAL	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
	2009–10	27	(100)	0	(0)	27	1	1	2	0	29
	2010–11	30	(100)	0	(0)	30	1	1	2	0	32

Table 2, continued.

		Hunter harvest									
	Regulatory	Reported					Estimated			Accidental	
Unit	year	M	(%)	F	(%)	Total	Unreported	Illegal	Total	death	Total
6B	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
	2009–10	29	(100)	0	(0)	29	0	1	1	0	30
	2010–11	25	(100)	0	(0)	25	0	1	1	0	26
6C	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
	2009–10	48	(83)	10	(17)	58	0	0	0	0	58
	2010–11	18	(58)	13	(42)	31	0	0	0	0	31
6D	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
	2009–10	5	(100)	0	(0)	5	0	0	0	0	5
	2010–11	4	(100)	0	(0)	4	0	0	0	0	4
Unit 6 TOTAL	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
	2009–10	109	(92)	10	(8)	119	1	2	3	0	122
	2010–11	77	(86)	13	(14)	90	1	2	3	0	93

Table 3. Unit 6 moose harvest data by permit hunt, 2006–2010.

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]	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
	2009–10	Bull	59	51	59	41	12	(100)	0	(0)	12
	2010–11	Bull	70	61	59	41	11	(100)	0	(0)	11
6A/DM160	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	67	2	(100)	0	(0)	2
	2009–10	Bull	5	20	0	100	4	(100)	0	(0)	4
	2010–11	Bull	5	40	67	33	1	(100)	0	(0)	1
6A/DM162	2006–2010	Antlerless	0								
6B/RM164	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
	2009–10	Bull	264	22	85	14	29	(100)	0	(0)	29
	2010–11	Bull	232	37	83	17	25	(100)	0	(0)	25

Table 3, continued.

Unit/ Hunt	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessfu hunters	Percent successful hunters	Bulls	(%)	Cow	(%)	Total reported harvest
6C/DM167	2006–07	Bull	9	0	0	100	9	(100)	0	(0)	9
	2007–08	Bull	18	11	19	81	13	(100)	0	(0)	13
	2008–09	Bull	13	0	8	92	12	(100)	0	(0)	12
	2009–10	Bull	13	15	0	100	11	(100)	0	(0)	11
	2010–11	Bull	6	17	20	80	4	(100)	0	(0)	4
6C/ Federal subsistence[b]	2006–07	Both	66	3	2	98	23	(38)	38	(62)	61
	2007–08	Both	105	2	1	99	55	(55)	45	(45)	100
	2008–09	Both	63	2	5	95	36	(62)	22	(38)	58
	2009–10	Both	51	2	4	96	37	(79)	10	(21)	47
	2010–11	Both	34	6	9	91	14	(48)	15	(52)	29

[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, 2006–2010.

Unit	Regulatory year	Successful					Unsuccessful					Total hunters
		Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local resident	Nonlocal resident	Non-resident	Total	(%)	
6A East	2006–07	5	1	14	21[b]	(55)	4	4	9	17	(45)	38
	2007–08	1	1	21	24[b]	(49)	3	2	19	25[b]	(51)	49
	2008–09	0	0	14	14	(40)	1	1	19	21	(60)	35
	2009–10	0	1	10	11	(34)	1	1	19	21	(66)	32
	2010–11	0	0	18	18	(60)	1	0	11	12	(40)	30
6A West	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
	2009–10	10	2	4	16	(47)	12	5	1	18	(53)	34
	2010–11	10	1	1	12	(40)	12	4	2	18	(60)	30
6A TOTAL	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
	2009–10	10	3	14	27	(41)	13	6	20	39	(59)	66
	2010–11	10	1	19	30	(50)	13	4	13	30	(50)	60
6B	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
	2009–10	22	7	0	29	(14)	139	37	0	176	(86)	205
	2010–11	19	6	0	25	(17)	108	15	0	123	(83)	148

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	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
	2009–10	53	5	-	58	(91)	6	0	-	6	(9)	64
	2010–11	30	1	-	31	(79)	8	0	-	8	(21)	39
6D	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
	2009–10	4	1	0	5	(9)	37	8	7	52	(91)	57
	2010–11	3	1	0	4	(13)	24	3	1	28	(88)	32
Unit 6 TOTAL	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
	2009–10	89	16	14	119	(30)	195	51	27	273	(70)	392
	2010–11	62	9	19	90	(32)	153	22	14	189	(68)	279

[a] Residents of Unit 6.

[b] Includes 1 hunter with unknown residency.

Table 5. Unit 6 moose harvest percent by time period, 2006–2010.

		Harvest periods (%)							
	Regulatory	August	September		October		November	December	
Unit	year	20–31	1–15	16–30	1–15	16–31	1–30	1–31	*n*
6A	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
	2009–10	0	37	30	26	4	4	0	27
	2010–11	0	30	17	20	33	0	0	30
6B	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
	2009–10	0	69	10	3	17	0	0	29
	2010–11	0	48	44	0	8	0	0	25
6C [a]	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
	2009–10	0	33	36	9	16	7	0	45
	2010–11	0	25	0	25	50	0	0	4
6D	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
	2009–10	0	40	60	0	0	0	0	5
	2010–11	0	50	50	0	0	0	0	4
Unit 6 TOTAL	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
	2009–10	0	44	28	11	12	4	0	106
	2010–11	0	45	39	3	12	0	0	33

[a] Number of moose harvested (n) in 6C does not include all federal subsistence harvest because date of kill is not consistently reported.

Table 6. Unit 6 moose harvest percent by transport method, 2006–2010.

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	*n*
6A	2006–07	61	23	10	6	0	33
	2007–08	56	33	5	3	3	39
	2008–09	36	46	0	18	0	28
	2009–10	56	37	4	4	0	27
	2010–11	40	37	20	3	0	30
6B	2006–07	10	52	0	5	33	25
	2007–08	8	63	4	0	25	27
	2008–09	0	65	0	0	35	26
	2009–10	22	59	0	0	19	29
	2010–11	22	70	0	0	9	25
6C[a]	2006–07	0	47	0	6	47	70
	2007–08	0	54	5	16	25	112
	2008–09	0	52	3	21	24	70
	2009–10	18	55	0	0	27	11
	2010–11	25	50	25	0	0	4
6D	2006–07	0	0	17	0	83	6
	2007–08	25	0	50	0	25	4
	2008–09	0	17	0	17	67	7
	2009–10	0	60	0	0	40	5
	2010–11	0	75	25	0	0	4
Unit 6	2006–07	17	40	3	6	35	135
	2007–08	15	49	6	10	20	182
	2008–09	8	51	2	16	23	131
	2009–10	33	50	1	1	14	72
	2010–11	30	52	13	2	3	63

[a] Percentage and number of moose harvested (n) in 6C do not include federal subsistence harvest because hunter transportation is not recorded.

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Eastern Kenai Peninsula

BACKGROUND

Federal public lands cover approximately 78% of Unit 7, 50% managed by the U.S. Forest Service–Chugach National Forest, 22% by the National Park Service–Kenai Fjords National Park, and 5% by the U.S. Fish and Wildlife Service–Kenai National Wildlife Refuge. The moose population in Unit 7 is at a low density relative to other units on the Kenai Peninsula. Severe winters with deep snow are normal for this region and probably contribute to a high mortality rate for moose in this area. Less than 10% of the moose harvest on the Kenai Peninsula over the past 20 years has come from Unit 7. Very little moose monitoring or research has been done by the Alaska Department of Fish and Game (ADF&G) in this unit since the 1970s and early 1980s due to budget constraints and other priorities. Survey efforts were increased during the 1990s, with the Resurrection Creek and the Juneau Creek areas counted every other year. From 2000 through 2010 these two areas were each counted 4 times. The two most recent counts were 2005 and 2010 where we counted 242 and 76 moose respectively. Given the recent decline in these composition count areas, we lowered the estimated moose population for this nit (Table 1).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

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

METHODS

Composition surveys are flown in traditional count areas as funding allows. Harvest data come from hunter information taken from harvest tickets and are reported by regulatory year (RY). A regulatory year runs from 1 July through 30 June (e.g., RY10 = 1 July 2010–30 June 2011) 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 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 2 count areas in December of 2010 showed 17 bulls:100 cows and 18 calves:100 cows, and a total of 76 moose observed (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The traditional hunting period 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 1 bull with a spike or fork on at least 1 antler, or 50-inch antlers, or antlers with 3 or more brow tines on at least 1 side (spike/fork 50/3). These antler restrictions have increased the bull:cow ratios in many areas and contribute to the long-term sustainability of the moose population in Unit 7.

The average reported harvest from 2006 through 2010 in Unit 7 was 26 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 and 5 bulls harvested each year for 2006 and 2007 respectively (Table 3). Due to low counts, no permits were issued for DM522 in 2008 and this hunt has been suspended since then.

Board of Game Action and Emergency Orders. During its March 2011 meeting the Board of Game reauthorized the antlerless moose permit hunt for the Placer River area (DM211).Other actions taken at the March 2011 meeting included changing the antler requirements for a legal bull from spike/fork 50/3 to 50/4 only for all general season hunts in Units 7 and 15.

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 vehicle is the main transportation method used by successful hunters in Unit 7 (Table 6).

Other Mortality

Highway vehicles killed an average of 20 moose per year during the past 5 seasons in Unit 7 (Table 2). The effect of wolf and bear predation on moose and the degree of illegal take 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

Our main concern for the moose populations in Unit 7 is the decline in moose numbers. Anecdotal reports from local residents and hunters suggest the population has declined from populations in the 1980s. Long-term harvest trends also indicate decline. We believe the main cause is generally poor habitat due to forest succession and predation. In the future it would be beneficial to work with the U.S. Forest Service and generate a long-term plan to address habitat concerns.

Moose densities in Unit 7 are chronically low. In spite of conservation concerns raised by ADF&G and the fact that hunting seasons had never begun before 20 August, the Federal Subsistence Board granted residents of Cooper Landing and Hope a moose season that starts on 10 August in Units 15A and 7. The department will be working closely with the Board of Game to address Kenai Peninsula moose population concerns and moose management strategies. We will continue to recommend to the Federal Board similar and consistent strategies.

ADF&G is dedicated to mitigating moose-human conflicts, especially conflicts which pose risks to public safety. Therefore we also recommend a new objective:

- Maintain the moose population at a level to promote public safety by reducing conflicts with Unit 7 residents, and participate in land management decisions that affect moose movements in an effort to direct moose into areas with lower vehicle traffic.

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

Selinger, J. 2012. Unit 7 moose management report. Pages 102–107 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/ DWC/SMR-2012-5, Juneau.

Table 1. Unit 7 moose aerial composition counts and estimated population size, regulatory years 2006–2010.

Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
2006	No Surveys Conducted					700–1000
2007	No Surveys Conducted					700–1000
2008	No Surveys Conducted					700–1000
2009	No Survey	Conducted				700–1000
2010	17	18	8	70	76	600–800

Table 2 Unit 7 reported general season moose harvest and accidental death, regulatory years 2006–2010.

Regulatory	Reported Hunter Harvest				Accidental death			Total Reported
Year	Bull	Cow	Unk	Total	Road	Train	Total	Mortality
2006	30	0	0	30	25		25	55
2007	18	0	0	18	19		19	37
2008	31	0	1	32	23		23	55
2009	25	0	2	27	18		18	45
2010	23	0	1	24	15		15	39

Table 3 Unit 7 harvest for drawing permit hunts, regulatory years 2006–2010.

Hunt Nr	Regulatory Year	Permits Issued	Permittees that hunted	Percent Success	Harvest Bulls	Harvest Cows	Harvest Unk.	Harvest Total
DM522[a]	2006	25	21	10	2	0	0	2
	2007	25	22	23	5	0	0	5
	2008	0						0
	2009	0						0
	2010	0						0

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

Table 4 Unit 7 residency and success of moose hunters for the general season, regulatory years 2006–2010.

	Successful				Unsuccessful				
Regulatory Year	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b] (%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	Total Hunters
2006	18	10	2	30 (9)	127	143	25	299	329
2007	8	9	1	18 (6)	128	144	15	288	306
2008	15	15	2	32 (11)	116	145	7	269	301
2009	14	10	3	27 (9)	126	133	8	272	299
2010	14	8	1	24 (10)	101	111	10	225	249

[a] Local = residents of Unit 7.
[b] Includes unspecified residency.

Table 5 Unit 7 moose general season harvest chronology (percent of harvest), regulatory years 2006–2010.

Regulatory Year	Harvest Periods							
	8/20–8/25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	Harvest
2006	23	0	17	13	13	33	0	30
2007	11	17	17	17	11	17	11	18
2008	22	9	9	9	19	28	3	32
2009	11	11	11	11	30	22	4	27
2010	17	4	17	13	25	21	4	24

Table 6 Unit 7 general season transport methods for successful moose hunters (percent of harvest), regulatory years 2006–2010

Regulatory Year	Percent of Harvest							
	3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/Dogteam	ORV	Unknown	Harvest
2006	7	13	10	50	13	0	7	30
2007	0	22	11	39	28	0	0	18
2008	3	6	9	50	28	0	3	32
2009	7	4	0	63	19	0	7	27
2010	4	8	4	50	21	4	8	24

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Alaska Peninsula

BACKGROUND

Moose were scarce on the Alaska Peninsula before the mid-1900s, but they increased dramatically and spread southwest during the 1950s and 1960s. The scarcity of suitable habitat south of Port Moller limited expansion into Unit 9D. Even during the 1960s, when the population was growing, calf:cow ratios were relatively low and the ratio declined as the population reached its peak. Evidence of range damage from overbrowsing was evident, and nutritional stress probably contributed to poor calf survival.

Liberal hunting regulations were in effect from regulatory year (RY) 1964 to RY73 (A regulatory year runs 1 July through 30 June; e.g., RY64 = 1 July 1964 through 30 June 1965). These were implemented 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 RY73, the population continued to decline, especially in Subunit 9E. By the early 1980s moose densities in Subunit 9E were 60% below peak levels and calf:cow ratios were extremely low, despite evidence that range conditions had improved. Brown bear predation on neonatal moose was considered the primary limiting factor of moose in Unit 9. Since the 1990s, the Unit 9 moose population has been considered stable, despite local variation and declines in some areas. Illegal hunting activities, including cow harvests, have likely contributed to localized declines.

Moose harvests have declined in Unit 9 since the 1980s. This decline is attributed primarily to decreases in hunter participation, which peaked in RY87 at 694 hunters. Participation in the moose hunt dropped to an average of 569 hunters annually during the 1990s then to an average of 414 hunters annually during the 2000s. 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 moose and caribou. Declines in participation are evident primarily among nonlocal residents and nonresidents rather than local Unit 9 residents.

MANAGEMENT DIRECTION

POPULATION OBJECTIVES

- Maintain existing densities in areas with moderate (0.5–1.5 moose/mi^2) or high (1.5–2.5 moose/mi^2) densities,
- Increase low density populations (where habitat conditions are not limiting) to 0.5 moose/mi^2, and
- Maintain sex ratios of at least 25 bulls:100 cows in medium to high density populations and at least 40 bulls:100 cows in low density areas.

METHODS

We scheduled fall sex and age composition surveys within established trend areas in Units 9B, 9C, and 9E during November through early December when adequate snow cover was available. We collected harvest data from harvest tickets and monitored moose harvest.

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 low in Subunits 9A, 9B, 9D, and the southern portion of 9E.

Population Size

A 1983 census in the central portion of Subunit 9E resulted in an estimate of 1,148 moose (90% CI = $\pm$ 16%) in the 1,314 mi^2 study area. Extrapolation of this census to the remainder of Subunit 9E provided a rough estimate of 2,500 moose. The area of Subunit 9C outside of Katmai National Park had approximately 800 moose. There were approximately 2,000 moose in Subunit 9B. Subunits 9A and 9D probably contained about 300 and 600 moose, respectively.

Population Composition

Poor weather conditions and inadequate snow cover frequently limit moose surveys in Unit 9. This has led to most trend areas being surveyed irregularly. 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.

Poor survey conditions and pilot availability prevented ADF&G surveys of population trend count areas in 2009. Surveys were limited in 2010 due to lack of snow cover and were restricted to Subunits 9C and 9E. Additional data for Subunits 9C and 9E were provided by federal agencies during this reporting period.

Based on average bull:cow and calf:cow ratios observed in Unit 9B over the past 25 years (43 bulls:100 cows and 23 calves:100 cows, respectively), the 2007 bull:cow ratio was near average while the calf:cow ratio was well below average (Table 1). Bulls appeared to be adequately represented on the landscape.

In Subunit 9C, a single trend area was surveyed by USFWS staff in 2009 and 3 trend areas were surveyed by Alaska Department of Fish and Game (ADF&G) and National Park Service (NPS) staff in 2010. Bull:cow ratios have been relatively stable in Subunit 9C since 2000 (Table 1). The bull:cow ratios observed in 2009 and 2010 were within range of the average bull:cow ratio observed in Subunit 9C over the past 25 years (40 bulls:100 cows) and was near the management objective of 40 bulls:100 cow. Calf:cow ratios are often variable between years in Subunit 9C (Table 1). The calf:cow ratios observed in 2009 and 2010 were close to the average calf:cow ratio observed in Subunit 9C over the past 25 years (19 calves:100 cows). The population in Subunit 9C appears stable based on recent surveys.

Trend area surveys in Subunit 9E were conducted by USFWS staff in 2009. Composition data were collected by ADF&G staff in 2010 by subsampling established trend survey areas. Bull:cow ratios are generally above management objectives in Subunit 9E (40 bulls:100 cows) as was the case during this reporting period (Table 1). The 2010 bull:cow ratio was especially high compared to the average bull:cow ratio observed in Subunit 9E over the past 25 years (53 bulls:100 cows), indicating light harvest in the subunit overall. Calf:cow ratios have been above the 25-year average for Subunit 9E (21 calves:100 cows) since 2005 (Table 1). The population in Subunit 9E appears stable based on recent surveys.

MORTALITY

Harvest

Seasons and Bag Limit. In Unit 9A, residents could hunt 1–15 September and nonresidents could hunt 5–15 September, each with a bag limit of one bull. In Subunit 9B nonresidents could hunt 5–15 September with a bag limit of one bull with ≥50-inch antlers or ≥4 brow tines on at least one side. Subunit 9B residents could hunt 1–15 September and 15 December–15 January, with a bag limit of 1 bull. Only antlered bulls could be harvested during the 15 December–15 January hunt. Effective in 1997, meat of moose taken in Subunit 9B was required to remain on the bone until processed for human consumption. The federal subsistence season in Subunit 9B was 20 August–15 September and 1 December–15 January with a bag limit of 1 bull.

The nonresident season dates in Subunit 9C were the same as for Subunit 9B; however, the nonresident bag limit was 1 bull with ≥50-inch antlers or ≥3 brow tines on at least one side. The resident fall season was 1–15 September throughout 9C, but 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 bag limit was one bull; however only antlered bulls could be harvested during the winter season. Within the southern portion of the Naknek drainage, the federal subsistence season was open 20 August–15 September and 1–31 December with a bag limit of 1 bull under a registration permit. The winter season was open only to local rural residents of Subunits 9A, 9B, 9C, and 9E.

The nonresident season in Subunit 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 one side. The resident season was 10–20 September and 1 December–20 January in Subunit 9E. The resident bag limit in Subunit 9E was 1 bull; however, moose taken 10–20 September were required to have a spike or fork, an antler spread of ≥50 inches, or ≥3 brow tines on at least one side and moose taken during 1

December–20 January were required to be antlered. The federal subsistence season in Subunit 9E was 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.

Subunit 9D was open to residents only, 15 December—20 January with a bag limit of 1 bull under state regulations. Federal subsistence permits were issued in Subunit 9D for a federal hunt with the same season and bag limit. However, 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. The 9A nonresident hunt was shortened in 2009 by 5 days, from 1–15 September to 5–15 September. The bag limit for residents hunting during December and January was changed in 2009 from 1 bull to 1 antlered bull for Units 9B, 9C, and 9E. In March 2011, the board converted all moose hunts in Unit 9 from a general harvest ticket hunt to a registration permit hunt. Fall season dates were also extended by 5 days in Units 9C (from 1–15 September to 1–20 September) and 9E (from 10–20 September to 10–25 September). The proposal for these season extensions was precipitated by the high bull:cow ratios observed in composition surveys conducted in Subunits 9C and 9E in recent years.

Federal Subsistence Board Actions. No changes were made to the federal moose hunting regulations in Unit 9 during this reporting period.

Hunter Harvest. Harvest data were summarized by regulatory year. Reported moose harvests have ranged between 84 and 179 moose annually since RY01 (Table 2), with an annual average of 143. Reported harvest was lower during this reporting period than in previous years, continuing a downward trend that began in the 1990s. 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. This illegal harvest has likely contributed to localized declines of the moose population in areas with good accessibility.

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 low.

Hunter Residency and Success. Participation in the Unit 9 moose hunt continued to decline during this reporting period and reached the lowest level ever reported in RY10, with 263 hunters participating (Table 3). While participation has decreased for hunters from all 3 residency categories (local resident, nonlocal resident, and nonresident) in the 2000s, the decline has been more pronounced among nonlocal residents and nonresidents than local residents.

Reported success rates have been relatively stable for all 3 residency groups since the 1980s. Nonresidents typically had a higher success rate (average = 52% RY00–RY09) than either residents of Unit 9 (average = 26%, RY00–RY09) or other Alaska residents (average = 28% from RY00–RY09) because virtually all of them flew out to hunt, and many employed guides. The success rate for all hunters has varied, approximately 30–40% during the 2000s (Table 3).

Harvest Chronology. Since RY01 most of the reported moose harvest has occurred in September (Table 4), with an average of 87% of the harvest occurring in that month. Reported harvest levels during the winter season have remained low and ranged 4–16% of the total harvest. However, the total winter harvests exceed reported values according to local reports.

Transportation Methods. No major change in transportation type has occurred during this reporting period. Aircraft continues to be the most common method of transportation reported in Unit 9. Boats were the second most common method of transportation (Table 5).

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 a primary factor. Bear:moose ratios in Unit 9 ranged from >1:1 to 1:10 and are much higher than many other locations in Alaska.

CONCLUSIONS AND RECOMMENDATIONS

Compared to other units statewide, harvests in Unit 9 have remained relatively stable for the past 30 years, despite major changes to moose regulations. Recent declines in moose harvest have been associated with a decrease in the number of people hunting moose in Unit 9. The average annual harvest reported since RY01 (143 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 Unit 9. Recent proposals to change moose regulations typically ask for exclusion of select user groups to 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 difficulty of access would limit 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 met in 2010 and came to consensus on a number of recommendations for moose management in Unit 9. The working group decided to draft a proposal to the Board of Game to convert the Unit 9 moose hunt from a general harvest ticket hunt to a registration permit hunt and asked the department to provide educational outreach on moose conservation and wolf trapping to Unit 9 residents. The working group drafted and submitted a proposal for the conversion to a registration permit hunt, which was adopted by the Board of Game in March 2011.

Brown bear predation on neonate moose and illegal harvest 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 powerful segment of the public. Concern about the detrimental effects of illegal harvest 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. With implementation of the new registration permit hunt, area staff intends to travel to Unit 9 villages to issue hunting licenses and permits. These visits will allow for improved exchange of information with the public and afford biologists additional opportunities to address the conservation concerns associated with illegal harvest.

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Riley, M. D. 2012. Unit 9 moose management report. Pages 108–116 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report, ADF&G/SMR/DWC-2012-5, Juneau.

Table 1. Moose composition counts in Unit 9, regulatory years 2000 through 2010.

Subunit	Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
9B	2005	23	6	19	13	158	182	20
	2007	39	4	4	3	71	73	-
9C	2000[a]	45	4	12	8	445	493	56
	2001	30	3	9	7	269	290	33
	2005[a]	34	20	19	12	440	502	36
	2006	24	9	9	7	57	61	-
	2007	42	9	21	13	231	265	-
	2008	47	4	13	8	166	181	-
	2009[b]	35	1	16	10	111	125	-
	2010[a]	48	12	13	8	180	199	18
9E	2000[b]	50	5	19	11	298	338	-
	2001[c]	48	12	11	7	305	328	30
	2003[b]	46	10	10	6	131	140	19
	2005[b]	25	5	22	15	81	95	19
	2006	39	7	29	17	43	52	27
	2009[b]	43	-	33	19	60	74	-
	2010	62	18	24	13	172	197	-

[a] Includes surveys conducted by NPS staff.
[b] Surveys conducted by USFWS staff.
[c] Includes surveys conducted by USFWS staff.

Table 2. Annual moose harvest in Unit 9, regulatory years 2001 through 2010.

	Reported				Estimated	
Regulatory Year	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	1	0	148	100	248
2008	107	0	0	107	100	207
2009	116	0	0	116	100	216
2010	83	0	1	84	100	184

Table 3. Moose hunter residency and success in Unit 9, regulatory years 2001 through 2010.

	Successful Hunters					Unsuccessful Hunters					
Regulatory Year	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Total Hunters
2001	33	51	89	2	175 (40)	99	93	67	1	260 (60)	435
2002	39	39	100	1	179 (39)	80	110	84	5	279 (61)	458
2003	41	32	102	2	177 (39)	88	92	90	3	273 (61)	450
2004	34	29	94	4	161 (38)	94	82	79	3	258 (62)	419
2005	43	32	84	1	160 (39)	87	73	91	4	255 (61)	415
2006	28	24	73	0	125 (32)	118	67	84	1	270 (68)	395
2007	32	32	81	3	148 (36)	92	81	85	2	260 (64)	408
2008	33	18	54	3	108 (29)	104	83	76	0	263 (71)	371
2009	20	30	60	7	117 (37)	98	60	39	4	201 (63)	318
2010	33	17	34	2	86 (33)	93	52	29	3	177 (67)	263

[a] Local residents reside in Unit 9.

Table 4. Reported moose harvest chronology (percent) in Unit 9, regulatory years 2001 through 2010.

Regulatory Year	August 20–31	September 1–5	September 6–10	September 11–15	September 16–20	December 1–15	December 16–31	Janua20 1–20	Other
2001	1	7	26	40	14	3	7	1	1
2002	0	8	21	39	15	12	3	0	2
2003	0	7	26	41	15	5	4	1	1
2004	0	9	22	45	13	6	3	1	1
2005	0	11	20	38	19	3	4	4	1
2006	0	12	16	35	25	2	4	4	2
2007	1	3	19	44	19	6	5	3	0
2008	0	10	15	44	14	2	12	2	1
2009	2	7	27	41	18	1	2	1	1
2010	1	10	18	39	17	5	9	1	0

Table 5. Successful moose hunter transport methods (percent) in Unit 9, regulatory years 2001 through 2010.

Regulatory Year	Airplane	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway Vehicle	Airboat	Unspecified
2001	59	25	6	7	0	2	1	0
2002	67	27	3	0	1	2	0	0
2003	57	22	8	9	1	2	1	0
2004	62	26	4	3	3	2	0	0
2005	61	26	8	2	0	3	0	0
2006	62	22	5	8	0	1	2	0
2007	68	14	11	5	0	1	1	0
2008	56	21	8	11	2	2	0	0
2009	65	23	6	2	0	2	2	0
2010	53	28	13	5	0	1	0	0

SPECIES MANAGEMENT REPORT

Alaska Department of Fish and Game
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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 11 (12,784 mi^2)

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

BACKGROUND

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 the National Park Service (NPS) more closely manages hunting on park lands, specifically by controlling access based on hunter residency.

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. The moose population declined from the late 1960s until 1979, when the population was thought to have reached its lowest level. Moose numbers stabilized, then started increasing during the early 1980s and probably peaked again in 1987. Moose numbers declined again until 2001 due to severe winters and increased wolf predation, but have been increasing since that time.

The existing state season dates of 20 August–20 September have been in place since regulatory year (RY) 1993 (RY1993 = 1 July 1993 through 30 June 1994). The bag limit has been 1 bull with spike-fork antlers, or 50-inch antlers, or antlers with 3 or more brow tines on at least one side. Harvests averaged 34 (range = 22–42) bulls by 131 hunters during the 1990s. In RY2000, a federal subsistence season for local residents was opened with a bag limit of 1 bull. Unit 11 moose harvests under state regulations have averaged 28 (range = 20–37) bulls per year since by an average of 116 hunters.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

- 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 in a 287 mi^2 area along the western slopes of Mount Drum during the late fall to determine sex and age composition and population trends. In some years surveys are not possible due to a lack of snow or funding. An additional count area in the Upper Copper River drainage has also been counted in some years by the NPS. In 2007 and 2010 the NPS completed large scale moose surveys across Unit 11 using GeoSpatial Probability Estimation (GSPE) techniques. 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Moose density has been considered low throughout Unit 11 for many years. In 2008, 164 moose (0.6 moose/mi^2) were observed in Count Area (CA) 11 (western slopes of Mount Drum; Table 1). This was appreciably higher than the count of 93 (0.3 moose/mi^2) obtained in 2001. Within the NPS Upper Copper River count area to the north (CA 11-02; Boulder Creek to Drop Creek) moose numbers remained stable between 2003 and 2008, with observed moose densities ranging 0.3–0.4 moose/mi^2 (USFWS 2011).

In 2007 the NPS conducted a GeoSpatial Probability Estimation survey across most of Unit 11 (north of the Chitina River). Results were similar to the corresponding count area data, with 0.7 and 0.8 moose/mi^2 estimated in the Mt. Drum and Upper Copper River areas, respectively. In 2010 the NPS repeated the GSPE survey, and found 0.5 and 1.0 moose/mi^2 in the same respective areas. In both years, 0.7 moose/mi^2 were estimated for the Crystalline Hills area in southern Unit 11 (USFWS 2011).

Even though moose numbers appear have increased in the Upper Copper River area during this reporting period, the overall moose population remains at a low density throughout Unit 11.

Population Size

An accurate population estimate is not available for all of Unit 11 because a complete unitwide census has never been conducted. The most recent GSPE surveys conducted by NPS in 2007 and 2010 both resulted in moose density estimates of 0.5 moose/mi^2 over a 3,170 mi^2 area of Unit 11 north of the Chitina River (USFWS 2011). Extrapolation of this density to the entire unit would result in a population estimate of approximately 2,900 moose.

Population Composition

The bull:cow ratio in CA11 was 73:100 in 2008 (Table 1). This was lower than the long-term average for the area of 98 bulls:100 cows (1990–2008), but it is still high compared to the management objective (30 bulls:100 cows). The bull:cow ratio in CA 11-02, between Boulder

Creek and Drop Creek, was 41:100 in 2008 (USFWS 2011). The lower bull:cow ratio in this area reflects better hunter access. For the entire Unit 11 GSPE survey area, 52 bulls:100 cows were observed in 2007, and 50 bulls:100 cows were observed in 2010 (USFWS 2011). 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 was 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 increased calf production and/or survival in this area. The calf:cow ratio in CA 11-02 in 2008 was 12 calves:100 cows. During the Unit 11 GSPE surveys, 19 calves:100 cows were observed in 2007 and 17 calves:100 cows were observed in 2010 (USFWS 2011).

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 was 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 one side. The federal subsistence season had a bag limit of 1 bull, though season dates were the same as for the state general season. In RY09 a community subsistence harvest (CSH) hunt (CM300) was held in Unit 11 with season dates of 10 August–20 September with a bag limit of 1 bull. The CSH hunt was not held in RY10.

Board of Game Actions and Emergency Orders. During its March 2009 meeting the Board of Game opened Unit 11 to a CSH hunt for moose by the 8 Ahtna communities: Chitina, Kluti-kaah, Tazlina, Gakona, Gulkana, Chistochina, Mentasta and Cantwell. Other Alaska residents were allowed to participate if they had ties to one of the 8 Ahtna communities. Community hunters were allowed to hunt in Unit 11, Unit 13, and a small portion of Unit 12 near Mentasta. CSH hunters were allowed to take up to 15 bulls that did not meet the state general hunt antler restrictions for the hunt area, and an unlimited number of bulls meeting the state general hunt antler restrictions. Due to a court ruling, the board eliminated the CSH hunt for the RY2010 season.

Hunter Harvest. The state general hunt harvest for this reporting period averaged 28 bulls per year (Table 2). The reported moose harvest in RY09 of 36 bulls was the highest take since RY99 when 38 bulls were taken; otherwise, harvest has been relatively consistent. The long-term average harvest in the Unit 11 general hunt has been 30 bulls per year since RY90.

In RY2009, 6 CSH hunters reported hunting in Unit 11. One was successful in taking a 50-inch bull with 4 brow tines.

Hunter Residency and Success. Local rural residents accounted for a little more than 12% of the total moose taken in Unit 11 during this the state general seasons in this reporting period, nonlocal Alaska residents took 29%, and nonresidents took 59% (Table 2). However, most of the moose harvested by area residents are now reported through the federal permit system. Established by the NPS in RY00 and open only to local residents, the federal hunt has been more appealing to local hunters than the state hunt. The federal bag limit was 1 bull and the hunt area included both the preserve and park. In RY10, 143 local resident hunters reported taking 19 bulls in the federal hunt, accounting for 49% of the total Unit 11 harvest.

The overall hunter success rate during this reporting period was 27% for the state general hunt, similar to the long-term average of 25% since RY90. Success rates for federal subsistence hunters remain lower despite the more liberal bag limit, averaging 14% over this reporting period.

Successful state general hunters averaged 6.6 days in the field to kill a moose during this reporting period, while unsuccessful hunters averaged 7.4 days in the field. No trends were evident in the effort data.

Of the 6 CSH hunters, one was a nonlocal resident and 5 were local residents. The one successful Unit 11 CSH hunter was a local resident; a total of 10 days were spent hunting. The unsuccessful CSH hunters averaged 12.8 days in the field.

Harvest Chronology. Chronology data indicate most moose are taken late in the season, especially during the last week, in Unit 11 (Table 3). Bull moose are more vulnerable toward the end of the season. 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 typically use aircraft, 3- or 4-wheelers, or highway vehicles to reach hunting areas (Table 4). Except for federally-qualified subsistence hunters, all off-road vehicle use on federal lands in Unit 11 is restricted to existing trails by permit only. Lower use of 3- and 4-wheelers in RY08 and RY09 was the result of trail closures imposed by the NPS in response to legal issues. Most of the transportation restrictions were removed in RY10, just prior to hunting season. Aircraft can still be used for hunter transportation in the preserve, but not in the park.

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 is limited by nutritional factors that could affect productivity. Given the consistent low density of moose, browse removal is minimal across the unit. Even within the small clearcuts 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 mi^2). 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 mi^2). 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.

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 to protect valued natural resources. The checkerboard pattern of private lands in the unit may encourage fire suppression on adjacent lands as well.

CONCLUSIONS AND RECOMMENDATIONS

Moose numbers in the western portion of Unit 11 appear to have increased slightly over the past decade. However, moose densities remain below 1 moose / mi^2 and are still considered low. Recent winters have been mild and snow depths have been average. Predation appears to be 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 not expected to increase significantly. The Chakina fire should provide substantial new early succession browse near McCarthy in the next 3–10 years. However without a decrease in predation rates, 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. Many hunters participate in both the state and federal hunts. 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 off-road vehicle use in the federal subsistence hunt draw considerably more interest than the state general hunt, which has antler restrictions. The lower success rates in the federal hunt reflect the relatively low density of moose as well as high hunter concentration in accessible areas.

The combination of current state and federal regulations in Unit 11 is complicated, and often results in double reporting. Options should be pursued to help simplify moose hunting for Unit 11 hunters.

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Table 1. Count Area 11 (western slopes of Mt. Drum) fall aerial moose composition counts, regulatory years 2006 through 2010.

Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calf %	Adults	Total moose	Moose/ hour	Density moose/mi^2
2006	92	4	48	20	119	149	32	0.5
2007	No data	--	--	--	--	--	--	--
2008	73	7	17	9	149	164	38	0.6
2009	No data	--	--	--	--	--	--	--
2010	No data	--	--	--	--	--	--	--

Table 2. Unit 11 Moose hunter residency and success for general state harvest ticket hunt only, regulatory years 2006 through 2010.

	Successful				Unsuccessful			
Regulatory Year	Local resident	Nonlocal resident	Non-Resident	Total [a]	Local resident	Nonlocal resident	Non-resident	Total [a]
2006	7	7	8	22	27	38	4	72
2007	3	8	13	24	48	40	12	100
2008	3	10	12	25	40	52	8	100
2009	6	10	20	36	36	34	5	75
2010	1	6	13	20	42	42	8	92

[a] Includes unspecified residency.

Table 3. Unit 11 Moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, regulatory years 2006 through 2010.

Regulatory	Season	*Week of Season*				
Year	Dates	1st	2nd	3rd	4th	5th
2006	20 Aug–20 Sep	0	14	27	23	36
2007	20 Aug–20 Sep	8	13	8	29	42
2008	20 Aug–20 Sep	8	12	16	12	52
2009	20 Aug–20 Sep	11	8	17	33	31
2010	20 Aug–20 Sep	11	5	16	42	26

Table 4. Unit 11 Successful moose hunter transport methods (%) for general state harvest ticket hunt only, regulatory years 2006 through 2010.

Regulatory Year	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle
2006	41	9	0	36	0	0	14
2007	52	9	4	26	0	9	0
2008	58	9	4	8	0	8	13
2009	40	16	9	9	0	9	17
2010	63	11	0	21	0	0	5

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Upper Tanana and White River drainages

BACKGROUND

Following federal predator control, the Unit 12 moose population irrupted during the 1950s through the mid-1960s. Moose numbers declined rapidly during the early 1970s, similar to populations in adjacent road-accessible areas. Several severe winters, high wolf and grizzly bear predation, and high localized cow moose harvests all contributed to the population decline. Between the mid-1970s and early 1980s, the Unit 12 moose density was estimated at 0.2–0.4 moose/mi^2 (ADF&G, unpublished data, Tok).

In response to the declining moose populations, wolf control programs were conducted in adjacent Units 20D (1980), 20E (1981–1983), and in northern Unit 12 (1981–1983). Beginning in regulatory year (RY) 1982 (RY = 1 July through 30 June, e.g., RY82 = 1 July 1982–30 June 1983), attempts were made to reduce the grizzly bear population by liberalizing grizzly bear hunting regulations. Dozer crushing of willow and some poplar occurred on about 1,600 acres, primarily in the floodplain of the Tok River, during 1982–1989 to enhance browse production. Between 1982 and 1989 the moose population in Unit 12 increased, probably due to a combination of these management programs and favorable weather conditions that prevailed during this period. However, the population remained at low density (0.4–0.6 moose/mi^2).

Based on data collected during October–November aerial composition surveys and area-specific population estimation surveys from 1989 through 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 mi^2). Population estimates indicate this area supported 0.19 moose/mi^2 in 1989, 0.6 moose/mi^2 by 1994, and about 1.0 moose/mi^2 in 1997.

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: 4,000–6,000 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, 2008, 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 (USFWS), Tetlin National Wildlife Refuge (Tetlin NWR) staff. ADF&G staff also conducted GSPE moose population estimation surveys during fall 2005 (2,845 mi^2) and 2006 (2,702 mi^2) on state and private lands in northwest Unit 12. Search intensity was approximately 4.0–5.0 min/mi^2 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 2,702 mi^2 northwest Unit 12 survey area. A simple random sample of 171 survey units (109 high density and 62 low density) were surveyed. Survey conditions were good to excellent on each day flights were conducted (T. Bentzen, ADF&G Tok, memo 2 January 2009). Comparisons of the 2008 survey (search intensity of 7.0 to 8.0 min/mi^2) with previous surveys (search intensity of 4.0 to 5.0 min/mi^2)

should be made with caution because of the differences in search intensity, which affects moose sightability (R. Boertje and K. Kellie, ADF&G Fairbanks, memo 22 May 2007).

A sightability correction factor (SCF) specific to Unit 12 GSPE surveys does not exist. Based on studies conducted in Units 20A and 19D during 2003–2006 we applied an SCF of 1.25 to the Unit 12 GSPE estimates of observable moose during 2000–2006. Because average search intensity was higher during the 2008 moose survey we applied an SCF of 1.2 to the 2008 estimate of observable moose.

In 2009, we surveyed 20 randomly selected GSPE survey units (10 high density and 10 low density) bordering Unit 20E in a 120 mi^2 of Unit 12 north of the Alaska Highway within the Upper Yukon–Tanana Predation Control Area (UYTPCA) to improve our estimates of the moose population in areas burned during the 2004 and 2005 wildfires (T. Bentzen, ADF&G Tok, memo 10 March 2010). Results from this survey were included in moose population estimates in the UYTPCA and were used to improve the population estimate in Unit 20E. In 2010 we surveyed a 100 mi^2 trend count area within the Tok River drainage upstream of the Tok Cutoff to estimate moose composition in the trend area.

In October 2011 we placed radio collars on 22 adult moose (11 cows and 11 bulls) in the Nabesna Road area to determine moose distribution and movement patterns between the September hunting season and late November when moose surveys are generally conducted. This information was used to develop a 1,602 mi^2 GSPE moose survey area in the portions of Units 11 and 12 accessible from the Nabesna Road and adjacent trail system. We surveyed a random sample of 81 GSPE cells (50 high density and 31 low density) within the area in cooperation with the National Park Service (NPS in November 2011 with a search intensity of 7.0 to 8.0 min/mi^2. Snow cover was complete in all areas, and survey conditions were good in most survey units (T. Bentzen, ADF&G Tok, memo 17 January 2012).

Data collected for the GSPE surveys were also used to determine moose population trends and sex and age composition within the survey areas and to infer composition within the entire unit. During GSPE surveys, moose were classified as large bulls (antlers $\geq$50 inches), medium bulls (antlers larger than yearlings but <50 inches), yearling bulls (spike, forked 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 RY09–RY10.

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 were 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

We continued work with the Department of Natural Resources, Division of Forestry on an 880-acre timber sale for the lower Tok River drainage designed to increase deciduous browse and cover for wildlife while providing nursery structure for spruce regeneration. We completed a burn plan to create early seral habitat for the Robertson River with the Division of Forestry in 2001. If the plan is updated to include subsequent land dispersals to the public, it may be implemented when prescription conditions and funding allow.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In RY03 we estimated the Unit 12 observable moose population at 4,000 moose (±22%, 90% CI). We estimated the total number of moose at 3,600–6,400 using an SCF of 1.25. This yielded an estimated density of 0.6–1.1 moose/mi^2 within the 6,000 mi^2 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/mi^2 in 2003, 2005, 2006, and 2008, respectively, suggested a stable population trend (Table 1).

The 2008 combined ADF&G and Tetlin NWR GSPE moose surveys produced an estimated 5,000 (±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 6,000 mi^2 of suitable moose habitat was 5,160–6,720 (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).

The population estimate derived from the 2011 survey in the 1,602 mi^2 Nabesna Road moose survey area was 1,272 observable moose (1,009–1,536 moose; 95% CI; 0.79 moose/mi^2). No SCF was determined for this survey. However, using an SCF of 1.20 similar to all Unit 12 surveys since 2008, the total estimated number of moose in the area was 1,210–1,843 (0.8–1.2 moose/mi^2).

Population Composition

Based on a sample of 350 moose observed in the upper Tok River trend count area in 2010, we observed 23 calves:100 cows and a bull:cow ratio of 34:100. This was a noticeable increase from the low of 22 bulls:100 cows observed in 2005. Conservative antler restrictions were implemented based on the 2005 results which required resident hunters to harvest bulls with spike–fork antlers or ≥50-inch antlers, or antlers with ≥4 brow tines. Nonresidents were required to harvest bulls with ≥50-inch antlers or antlers with ≥4 brow tines.

The most recent population composition data for northwest Unit 12 is from 2008 (Table 2) and we expect the moose population has been stable since then. In 2008 we observed 46 bulls:100 cows, 35 calves:100 cows and 15 yearling bulls:100 cows. This is similar the 37 bulls:100 cows, 35 calves:100 cows, and 7 yearling bulls:100 cows observed in 2006. The next northwestern Unit 12 survey is planned for fall 2013. During 2011 within the Nabesna Road area of Units 11 and 12 we estimated a bull:cow ratio 34:100 and a calf:cow ratio of 27:100.

Distribution and Movements

Moose do not occupy the large portions of Unit 12 composed of rock and ice at high elevation in the Alaska, Wrangell, and Nutzotin mountains. Moose generally occur below 4,500 feet throughout Unit 12. Based on this criterion, 6,000 mi^2 (15,540 km^2) of Unit 12 is suitable moose habitat. The Landscape Fire and Resource Management Planning Tools (LANDFIRE™) vegetation classification based on 2001 Landsat™ imagery was used to estimate 5,250 mi^2 (13,597 km^2) of available winter moose habitat (deciduous woody browse ≥0.5 m tall) and 6,572 mi^2 (17,021 km^2) of summer range (winter range plus all other vegetated types) (Paragi and Kellie 2011: Table 2). I continued to use the more general 6,000 mi^2 of moose habitat for this report because the LANDFIRE classification system has not yet been validated.

Radiotelemetry data indicate that 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 to calve, return to the Tok River for the rut, then move north to winter either in the area burned by the 1990 Tok wildfire or along the Tanana River, a straight-line distance of 90–100 miles (144–160 km; ADF&G, unpublished data, Tok). These movements were especially pronounced following above average snow accumulation in November and early December 2011 in the Alaska Range and Mentasta mountains. Large numbers of moose were observed moving out of the Tok River drainage, and many were observed crossing the Tok Cutoff highway in December presumably moving to areas with less snow along the Tanana River, lower Tok River and the Tetlin hills. Similar movements during December 2011 were also reported along the Slana and Chistochina River drainages in Unit 13C. During RY99–RY10, few resident moose existed on the Northway Flats.

In October and November 2011 NPS staff conducted radiotracking flights in the Nabesna Road area of Units 11 and 12. By late November, most moose had aggregated in several subalpine areas. Although some of the radiocollared moose remained close to their October capture locations, very few moose remained along the Nabesna road, in the flats along Tanada Creek, or along the Copper River. One cow moose had moved east across the Nabesna River to Camp Creek, and two cows and one bull moved from Platinum Creek and Devil Mountain Pass north to the Upper Tetlin River. One bull moved from lower Tanada Creek west into upper Drop Creek. These radiocollar locations were used to assist in defining the moose survey area and to provide preliminary stratification information for the November 2011 GSPE moose survey.

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]). The board set the Unit 12 IM population objective at 4,000–6,000 moose and the IM harvest objective at 250–350 moose.

At its November 2004 meeting, the board approved the Upper Yukon–Tanana Predator Control Plan (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.

During the May portion of the spring 2006 board meeting, the Upper Yukon–Tanana predator control area was enlarged to 18,750 mi^2 to include most of the Fortymile caribou herd's annual range, largely to benefit the caribou herd. The board authorized wolf control in the entire predator control area, and expanded the Unit 12 portion of the predator control area to include all of Unit 12 north of the Alaska Highway. The UYTPCP was renewed by the board in March 2009 for another 5 years.

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; Table 2), which appeared likely to fall in the future below the management objective of 20 bulls:100 cows.

In March 2009 the board approved a community harvest hunt (CM300) within the Little Tok and Tok river drainages of Unit 12. This allows permits to be issued to resident hunters within the community harvest hunt area under the Tier II permit system. Season dates and antler restrictions ware aligned with the existing general harvest moose season in this portion of Unit 12. Additional information for the CM300 community harvest moose hunt is available in the Unit 13 moose management report (Tobey and Schwanke 2010).

Harvest by Hunters. Reported harvest in Unit 12 was 143 bulls, 1 cow moose, and 2 moose of unknown sex in RY09, and 105 bulls and 2 moose of unknown sex in RY10 (Table 4). The harvest during the 5 years previous to this period was similar, averaging 134 bulls annually (range 118–159).

Total unitwide harvest has represented ≤4% of the estimated prehunt population in recent years and has likely had little impact on unitwide population dynamics. During RY09–RY10 the annual out-of-season take was estimated at 25–40 moose, mostly cows. RY09–RY10 reported potlatch moose harvest averaged 10 moose per year (35% 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 548 in RY09 and 506 in RY10 (Table 5). Hunter numbers were lower than the previous 5-year average of 587 hunters, but were similar to the average 535 hunters reported during 2000–2004. In RY09 the success rate of 27% was slightly above the previous 5-year average of 23%. In RY10 the success rate dropped to 21%.

During RY09–RY10, local residents accounted for an average of 51% of moose hunters, nonlocal residents averaged 40%, and nonresidents 9%. The number of local resident and nonresident hunters has remained relatively constant since RY94. However, the number of nonlocal resident hunters has increased. Local hunters took 41% of the reported harvested bulls in both RY09 and RY10; nonlocals took 39% and 44%, and nonresidents took 18% and 15%, in RY09 and RY10, respectively (Table 5). Harvest by nonlocal Alaska residents increased during RY99–RY10 compared to RY93–RY98, due to increasing numbers of nonlocal Alaska resident hunters.

After the community harvest hunt (CM300) was implemented, 3 hunters harvested 1 moose in Unit 12 in RY09. No CM300 permits were issued in Unit 12 in RY10.

<u>Harvest Chronology</u>. 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 early portion of the season in RY01–RY08 (24–28 Aug) harvest was reduced 36% ($\bar{x}$ = 12 bulls) compared to RY93–RY00 (1–6 Sep, $\bar{x}$ = 33 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.

<u>Transport Methods</u>. During RY09–RY10, the type of transportation used most by successful hunters was 4-wheelers ($\bar{x}$ = 36%), followed by highway vehicle ($\bar{x}$ = 19%), boat ($\bar{x}$ = 17%) and airplane ($\bar{x}$ = 16%), other ORV ($\bar{x}$ = 6%), and horse ($\bar{x}$ = 5%, Table 7). During RY90–RY00, an average of 19% of successful hunters used 3- or 4-wheelers and 24% used highway vehicles, compared to 34% and 17% respectively during RY04–RY08. This represents a 79% 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

Based on research in adjacent Unit 20E (Boertje et al. 1988, Gasaway et al. 1992), 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; USFWS 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. During RY09–RY10 an average of 14 moose were killed annually in collisions with highway vehicles in Unit 12 (Table 4).

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 RY09–RY10. 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, and the 1990 Tok burn (Gardner 2000), as well as 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 few 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 or at least increase survival of yearling bulls available to harvest, 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 has likely occurred following wolf control efforts during RY05–RY11 and the 2004 wildfires.

Enhancement

In 1990 a wildfire burned approximately 156 mi^2 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/mi^2 in 1989 to 1.0 moose/mi^2 by 1997. Excellent moose winter browse is expected to persist for the next 5–10 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. Wildfires occurred on 434 mi^2 and 28 mi^2 in Unit 12 during 2004 and 2010 respectively, improving habitat quality for moose in the area. No prescribed burns were conducted during RY09–RY10.

Since 1998, we have been working in cooperation with the Alaska Department of Natural Resources (DNR), Division of Forestry to determine suitable timber harvest sites within a proposed 880-acre timber sale area in the Tok River valley. Timber harvest began in 2008 and will be completed over the next 5 or more 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 harvest units may be partially harvested (e.g., trees greater than a certain diameter) or clearcut depending on market demand and silvicultural objectives. The intent is to scarify sites after harvest as warranted to encourage hardwood regeneration and leave some late-seral features to simulate natural disturbance and succession (Alaska Department of Natural Resources 2003). Scarification 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 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 5,160–6,720 moose (average density = 0.9–1.1 moose/mi^2 of suitable moose habitat), which met the IM population objective. However, moose numbers in portions of Unit 12, especially near roads, remain low, which primarily affects 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 RY09–RY10 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 now appears stable above 30:100 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 2010, the bull:cow ratio in the upper Tok River drainage improved to 34 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–RY10 the most significant change in harvest patterns was the increase in the portion of moose harvested by hunters who used 4-wheelers (39%) compared to RY90–RY00 (19%). Since RY06, harvest has averaged 130 moose (range 107–159). This harvest rate is within sustainable levels, based on a 3–4% harvest rate of bulls only. However, continued harvest of cows may be unsustainable in localized areas (causing decline or hindering population growth). Additional efforts are needed to track overall cow harvest within the unit.

Harvest of 146 moose in RY09 and 107 in RY10 did not meet the IM harvest objective of 250–450 moose. Difficult hunter access especially on the Tetlin National Wildlife Refuge and on private lands in Unit 12 combined with low moose recruitment make it unlikely we will achieve the IM harvest objective. Recruitment of young moose into the population must be improved, especially near roads and trails, to make progress toward this harvest objective.

We monitored population trends during RY09–RY10. Additional habitat enhancement programs are ongoing. 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.

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Table 1. Unit 12 population estimates using the geospatial population estimator, 2000–2011.

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	2,846	60	2,575 (±23%)	3,219[a]	1.13[a]
2001	Northwest Unit 12	2,865	79	2,204 (±15%)	2,755[a]	0.96[a]
2003	Northwest Unit 12	2,845	69	3,064 (±35%)	3,830[a]	1.35[a]
2005	Northwest Unit 12	2,845	48	2,129 (±15%)	2,661[a]	0.94[a]
2006	Northwest Unit 12	2,702	89	2,317 (±18%)	2,896[a]	1.07[a]
2008	Northwest Unit 12	2,702	92	3,225 (±18%)	3,870[b]	1.43[b]
2011	Nabesna Road[c]	1,602	81	1,272 (±17%)	1,526[b]	0.95[b]

[a] Sightability correction factor of 1.25 used in estimate.
[b] Sightability correction factor of 1.20 used in estimate.
[c] Includes portions of Units 11 and 12.

Table 2. Unit 12 aerial moose composition counts, fall 1994–2011.

Calendar Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Percent calves	Calves observed	Adults observed	Moose observed
Northwestern Unit 12							
1994[a]	38	16	39	21	87	327	414
1997[a]	36	11	41	23	138	458	596
2000[b,c]	40	9	18	11	72	558	630
2001[b,c]	40	11	27	16	106	566	672
2002[b,c]	42	12	15	13	45	305	350
2003[b,c]	25	7	32	19	111	464	575
2005[b,c]	22	11	30	18	69	315	384
2006[b,c]	37	7	41	21	185	688	873
2008[b,c]	46	15	35	20	218	899	1,117
2011[d,c]	34	3	27	14	75	476	551
Southeastern Unit 12							
1994[e]	97	13	25	11	47	374	421
1995[e]	82	12	26	12	65	461	526
1997[e]	87	22	31	14	73	439	512
1998[f]	65	14	34	17	48	229	277
2000[g,c]	84	10	34	15	39	229	268
2001[g,c]	64	18	33	14	66	400	466
2003[g,c]	89	15	33	16	89	475	564
2004[g,c]	70	16	48	20	89	351	440
2008[g,c]	62	14	24	13	81	552	633

[a] Based on population estimation results from northwest Unit 12.
[b] Survey area includes state and private lands in northwest Unit 12. Survey conducted by Alaska Department of Fish and Game.
[c] Ratios determined using weighted contributions from high and low sample areas. Actual counts of cows, calves, and bulls were not used in estimates.
[d] Nabesna Road survey area includes portions of Unit 11 and 12 mostly within the Wrangell St. Elias National Park and Preserve.
[e] Cheslina, Kalukna, Nabesna, and Chisana count areas were sampled using contour survey techniques.
[f] Based on population estimation results from the Chisana area, southwest Unit 12 using the "No stratification" technique.
[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 2009–2010 through 2010–2011.

Regulatory year	Area	Season		Bag limit[a]
2009–2010 through 2010–2011	Unit 12, that portion in the Tok River drainage upstream from the Tok Cutoff Bridge, including the Little Tok River drainage.[b]	RESIDENT:	24–28 Aug 8–17 Sep	1 bull with spike–fork antlers or 50-inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Unit 12, east of the Nabesna River and south of the winter trail running southeast from Pickerel Lake to the Canadian Border.	RESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Remainder of Unit 12.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull. Or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.

[a] Fifty-inch antlers defined as having a spread of at least 50 inches at the widest point or at least 4 brow tines on at least one side.
[b] This and hunt area and season dates include hunters using general harvest tickets and those hunting under the CM300 permit.

Table 4. Unit 12 moose harvest and accidental death, regulatory years 1990–1991 through 2010–2011.

Regulatory year	Harvest by hunters: Reported M (%)	F (%)	Unk	Total	Estimated: Unreported	Illegal	Total	Accidental death: Road	Total	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
2009–2010	143 (99)	1 (1)	2	146	20–30[a]	5–10	25–40	14	14	185–200
2010–2011	105 (100)	0 (0)	2	107	20–30[a]	5–10	25–40	13	13	145–160

[a] Includes reported ceremonial potlatch harvest of 9, 11, 11, 12, 19 and 1 moose during RY05–RY10.

Table 5. Unit 12 moose hunter residency and success, regulatory years 1990–1991 through 2010–2011.

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
1990–1991	45	26	17	10	98 (23)	186	131	15	0	332 (77)	430
1991–1992	48	49	13	0	110 (27)	160	132	9	4	305 (73)	415
1992–1993	23	35	12	1	71 (15)	222	164	13	9	408 (85)	479
1993–1994	38	33	18	2	91 (24)	186	90	12	1	289 (76)	380
1994–1995	43	28	17	0	88 (19)	240	118	15	1	374 (81)	462
1995–1996	55	34	26	3	118 (24)	249	113	16	0	378 (76)	496
1996–1997	62	41	20	1	124 (24)	251	119	14	0	384 (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
2009–2010	60[b]	57	26	3	146 (27)	217[b]	162	23	0	402 (73)	548
2010–2011	44	47	16	0	107 (21)	215	151	28	5	399 (79)	506

[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.
[b] Includes hunters hunting under the CM300 community harvest permit.

Table 6. Unit 12 moose harvest chronology by month/day, regulatory years 1990–1991 through 2010–2011.

Regulatory year	Harvest chronology by month/day (%)							*n*
	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
2009–2010	22 (15)	2 (1)	71 (49)	42 (29)	6 (4)	2 (1)	1 (1)	146
2010–2011	8 (8)	1 (1)	55 (51)	39 (36)	3 (3)	1 (1)	0 (0)	107

[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 2010–2011.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
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
2009–2010	17	6	13	38	0	6	19	1	146
2010–2011	15	4	21	34	0	6	20	0	107

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Nelchina and Upper Susitna River

BACKGROUND

Unit 13 has long been an important area for moose hunting in Alaska. During the late 1960s and early 1970s annual harvests were large, averaging more than 1,200 bulls and 200 cows. Hunting seasons were long, with both fall and winter hunts. As moose numbers began to decline, harvests were reduced by eliminating both the cow hunt and winter season in 1972 and reducing fall bull seasons to 20 days in 1975.

In 1980, the bag limit was changed from any bull to bulls with an antler spread of at least 36 inches or 3 brow tines on at least one side. Under this management strategy, the bull harvest dropped 34% from the previous season. Through the 1970s and the 1980s the moose population increased steadily, increasing at an average annual rate of 5% until the population peaked. In 1987 a high of 6,892 moose were observed in established trend count areas, and the harvest peaked one year later when 1,259 moose were taken.

The population soon began to decline due to severely deep snow (1988–1994) and increased wolf predation. Moose harvest regulations were restricted beginning in regulatory year (RY) 1990, though the population continued to decline. During the fall of 1999 and 2000, unitwide wolf estimates peaked at more than 500 wolves (>12 wolves/1,000km^2) and were the highest in more than 25 years. Snow depths during the winters of 1999–2000 and 2000–2001 were considered severe. Moose harvests continued to decline, reaching a low of 468 in RY01. From the peak, the number of moose observed had declined by 47%.

In January 2000, a wolf control implementation plan was initiated in Unit 13 for the benefit of moose. Some increased take of wolves occurred with the use of snowmachines, though land-and-shoot control was not allowed until January 2004. With the Unit 13 wolf population held at or near objective levels since the spring of 2006 (Schwanke 2009), the moose population has been able to grow steadily.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Population Objective

- Maintain a combined population of 17,600–21,900 moose in Unit 13:
  - 3,500–4,200 moose in Subunit 13A
  - 5,300–6,300 moose in Subunit 13B
  - 2,600–3,500 moose in Subunit 13C
  - 1,200–1,900 moose in Subunit 13D
  - 5,000–6,000 moose in Subunit 13E

- Maintain minimum fall composition ratios:
  - 25 calves:100 cows in Subunit 13A
  - 30 calves:100 cows in Subunits 13B, 13C, and 13E
  - 25 bulls:100 cows in all subunits
  - 10 yearling bulls:100 cows in all subunits

Human Use Objective

- Maintain a combined annual harvest of 1,050–2,180 moose in Unit 13:
  - 210–420 moose in Subunit 13A
  - 310–620 moose in Subunit 13B
  - 155–350 moose in Subunit 13C
  - 75–190 moose in Subunit 13D
  - 300–600 moose in Subunit 13E

METHODS

Aerial surveys are conducted during the fall to document sex and age composition and population trends in large count areas distributed throughout Unit 13. These surveys are repeated annually using consistent pilots, timing, and conditions. An established group of 8 count areas has been surveyed annually for more than 40 years (CAs 3, 5, 6, 10, 13, 14, 15, and 16). These areas cover 3,569 mi^2 of moose habitat and take 3 pilot/observer teams 90–115 hours to complete. With the advent of Geographic Positioning System (GPS) units in the 1990s, area coverage and data quality during these surveys have increased.

Additional surveys, using techniques developed by Gasaway (1986) and Ver Hoef (2001), have been conducted periodically in different portions of the unit to obtain precise 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 Safari Club International allowed for establishment of 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.

In addition to general habitat projects, staff evaluated and responded to several land-use proposals that could affect moose habitat and hunter access.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population trends for moose in Unit 13 are monitored by observing changes in the number of moose counted in established trend count areas each year (Table 1). The number of moose counted in the continuous trend count areas declined through the 1990s and reached a low in 2002. When all continuous trend count data were combined, the observed unitwide moose density averaged 1.0 moose/mi^2, with individual count areas ranging 0.5–1.2 moose/mi^2 in 2002. Due to a combination of predation control, mild winters, and more conservative hunting regulations, the population began to increase steadily.

Within the core of the predator control program area, increases in moose numbers through 2011 have been clearly evident. From the Alphabet Hills north through the Upper Tangle Lakes and Gulkana River (CA 5), the number of moose observed increased from 1,051 to 1,719 (64%) between 2002 and 2011. For the foothills of the eastern Talkeetna Mountains in subunit 13A (CA13 and CA14), the number of moose observed increased from 917 to 1,705 (86%) during the same period. While these data are from trend counts, and some movement is captured annually, the increases were relatively consistent through time.

During this reporting period, the observed unitwide moose density within continuous count areas reached 1.4 moose/mi^2 in 2009 and further increased to 1.6 moose/mi^2 in 2011 (Table 1). For those areas completely within the predation control area, the density averaged 1.5 moose/mi^2 in 2009 and further increased to 1.7 moose/mi^2 in 2011.

While the Unit 13 intensive management predator control program has expanded since inception (Schwanke 2009), the area still excludes peripheral areas such as Subunit 13D and western Subunit 13E within Denali National Park and Preserve. The Subunit 13D count area (CA15) has consistently been a low density moose area for nearly 30 years (average = 0.5 moose/mi^2; range = 0.2–0.7 moose/mi^2). The western portion of subunit 13E from Windy Creek south to the West Fork Chulitna River (Cantwell federal count area) has also had a consistently low moose density in recent years. Owen and Meier (2009) with the National Park Service reported an average of 0.65 moose/mi^2; range = 0.62–0.67 moose/mi^2 for the 2003, 2005, and 2008 survey periods.

Population Size

Estimated moose population sizes were calculated using conservative estimates of sightability (1.10 correction factor) and extrapolation of trend count data based on information about moose movements, habitat, and terrain features. Moose population estimates in 2011 by subunit were: 3,890 in Subunit 13A, 5,340 in Subunit 13B, 1,950 in Subunit 13C, 1,950 in Subunit 13D, and 5,780 in Subunit 13E. The unitwide estimate was 18,910 moose.

Population Composition

Composition data collected during fall trend counts are presented in Table 1, with data by subunit presented in Table 2 for 2011. The Unit 13 bull ratio for all continuous count areas increased steadily from 23 bulls:100 cows in 2001 to 35 bulls:100 cows in 2008. The ratio declined in 2010 to 30 bulls:100 cows, though rebounded to 33 bulls:100 cows in 2011. While lowest in areas near roads and trail systems, the bull ratio now meets management goals for each subunit.

An analysis of the bull ratio by size class indicates an average of 10 yearling bulls:100 cows in 2011 (Table 1). Subunit 13D has moderate to high densities of black and brown bears, likely the cause of lower calf survival in this area (Table 2). High rates of predation are also suspected in portions of Subunit 13E, though good hunter access in surveyed portions of this subunit may also be partially responsible for lower yearling bull ratios.

An average of 1,104 bulls were observed annually 2009–2011 in continuous count areas. This sample represents nearly one-third of the 4,000 bulls estimated to be in the unit post-hunting season. An average of 30% of bulls were classified as yearlings (spike, fork, or paddle bulls), while the 30–39 inch class accounted for another 30%. Bulls in this size class are typically 2–4 years of age. Bulls in the 40–49 inch class accounted for 23%, and are typically 3–5 years of age. The >50” class accounted for the remaining 17%, bulls that are typically 4 years of age and up.

Of the bulls observed, very few had 4 or more brow tines (6%). In the 30–39 inch class, an average of 1% had 4 or more brow tines. The majority had 2 brow tines. Within the 40–49 inch class, an average of 7% had 4 or more brow tines. Of this class, 53% had 2 brow tines, and 38% had 3 brow tines. Of the bulls with antlers >50 inches, 20%, 51%, and 29% had 2, 3, and 4 brow tines respectively. Of all the bulls observed, an average of 22% had 3 or more brow tines.

An average of 31% of the bulls observed were estimated to be legal under existing state general season antler restrictions. The vast majority of these bulls were observed in remote portions of the unit where bull ratios were relatively high. The average bull in Unit 13 post-hunting season is estimated to be 2–4 years of age based on aerial observations, representative of the heavy hunting pressure in the unit.

For purposes of estimating annual recruitment, fall calf ratios are monitored. During the last population peak in the late 1980s, the unitwide calf ratios were the highest ever observed in this area, topping 31 calves:100 cows. These highs were followed by a steep decline throughout the 1990s. Despite early increases observed following initiation of the intensive management program in the early 2000s, unitwide calf ratios have been consistent since 2004, averaging 22 calves:100 cows (Table 1).

Distribution and Movements

Moose continue to be most abundant along the southern slopes of the Alaska Range in Subunits 13B and 13C and in the eastern Talkeetna Mountains in western Subunit 13A. The Denali

National Park portion of western Subunit 13E, the Lake Louise Flats in eastern Subunit 13A, and Subunit 13D continue to have the lowest densities unitwide. Historically, moose numbers in Subunits 13B, 13C, and western 13A have fluctuated more than the lower density areas of Subunit 13D and eastern 13A.

Fall rutting and postrutting concentrations are in subalpine habitats throughout Unit 13. 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. 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 season moose hunt under state regulations for this reporting period. The bag limit was 1 bull with a spike-fork antler on one side, or 4 or more brow tines on one side, or a spread of 50 inches or more (SF-50-4bt).

In RY09, 5 remote drawing hunt areas were offered (DM330–334) for any bull. The hunts were limited to Alaska residents. Two hunt areas were offered in Subunit 13A, 2 in Subunit 13B, and 1 in Subunit 13C. Along subunit boundaries, 5 nonresident hunt areas were also offered (DM335–339), with a bag limit of 1 bull with 4 or more brow tines on 1 side, or a spread of 50 inches or more.

Also new in RY09 was the Ahtna community subsistence harvest (CSH) hunt for Alaska residents. The CSH area covered all of Unit 13, Unit 11 and a portion of Unit 12 (south of the Tok River). For the CSH hunt, up to 100 bulls not meeting general season antler restrictions could be taken 10 August–20 September (additional SF-50 bulls could also be taken, not to exceed the total number of hunt participants).

No CSH hunt was held in RY10. As a replacement subsistence opportunity, an early 15–25 August general season was opened to all Alaska residents, with a bag limit of 1 bull with spike-fork antlers, 3 or more brow tines on one side, or a spread of 50 inches or more.

A federal subsistence registration hunt has also been in place in Unit 13 since RY90 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. In March 2009, the Board of Game adopted a drawing permit hunt for Alaska residents to take any bull; up to 1,000 permits could be issued. The board also adopted a drawing permit hunt for nonresidents with a bag limit of 1 bull with 4 or more brow tines on 1 side, or a spread of 50 inches or more; up to 150 permits could be issued.

The board also eliminated the Tier II moose hunt in March 2009. For RY09, the board adopted a CSH hunt for Unit 13, Unit 11, and a portion of Unit 12. Ahtna Inc. submitted the proposal and it was the only community group approved at the time. Participant eligibility was initially limited to members of 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.

In July 2010 the Alaska Supreme Court ruled the community hunt unconstitutional due to the residency requirements. To comply with the ruling, the board held an emergency meeting within weeks and rescinded the community harvest hunt. Due to a court-mandated subsistence priority for Unit 13, during the same meeting they added an early general season hunt opportunity for all Alaska residents for RY10. These were emergency regulations and were valid for a limited term of 60 days.

In March 2011, the board adopted a new version of the CSH hunt using previously established boundaries. For RY11, any community or group of Alaskan hunters numbering 25 or more could apply for the hunt. The season dates were 10 August–20 September. Up to 70 bulls not meeting general season antler restrictions could be taken (additional SF-50 bulls could also be taken).

Harvest

Total Harvest. The total Unit 13 reported harvest has increased steadily from a low of 468 in 2001. Over this reporting period, harvests increased from 862 in RY09 to 938 in RY10 (Table 3).

General Hunt. The Unit 13 general hunt has had increasing participation since RY02, when the moose population started to rebound. Likely due to the addition of an early general season opportunity in RY10, hunter numbers in this season jumped considerably, to 4,088 (Table 4).

The general moose harvest also has increased steadily, from only 395 moose reported in 2001 to 756 in RY10 (Table 4). This is the highest general season harvest since 860 were taken in RY98.

Permit Hunts. RY09 was the first year that 5 any bull resident drawing hunts (DM330–334) were offered. A total of 160 permits were issued for RY09. Permit numbers increased to 325 for RY10, though were reduced to 225 for RY11. Permit success was relatively high despite the remote location of the hunt areas. In RY09, a total of 111 permittees reported hunting (69%), taking 64 bulls (58% hunt success). In RY10, 198 permittees reported hunting (61%), taking 92 bulls (46% hunt success).

There were also 5 new nonresident drawing hunts (DM335–339) that began in RY09. A total of 50 nonresident permits were issued for RY09, resulting in a harvest of 12 bulls. Permit numbers were increased to 110 for RY10, in which a total of 13 bulls were harvested.

A total of 378 hunters participated in the CSH moose hunt in RY09. Of those, 297 reported hunting (some utilized designated hunters). A total of 100 bulls were taken (34% success), with 70 qualifying as "any bulls" (Table 5).

Illegal Harvests. Unreported, accidental, and illegal harvest estimates are presented in Table 3.

Hunter Residency and Effort. Local residents (residents of Unit 13) accounted for 6–9% of the moose harvested under the general season this reporting period (Table 4). The success rate for general season moose hunters has been stable over time, averaging 16% from RY94 through RY08. Success increased to a little over 18% during this reporting period. Successful hunters are now spending less time in the field, averaging 6.8 days per hunter, compared to 7.6 days in the previous reporting period. Unsuccessful hunter effort declined slightly to 7.4 days per hunter compared to 7.7 days in the previous period.

Resident any bull drawing hunters on average spent 5–6.5 days in the field per successful hunter for the 5 hunts during this reporting period, nearly identical to the unsuccessful drawing hunters. Successful resident community hunters spent an average of 6.3 days in the field in RY09, while unsuccessful hunters spent an average 8.7 days in the field. Nonresident drawing hunters on average spent 3.5–5.9 days to take a bull, while unsuccessful nonresidents spent 6.4–6.9 days in the field.

Harvest Chronology. Chronology data for the general hunt are presented in Table 6. Moose become increasingly vulnerable throughout September, and harvest typically increases because of it. Leaf fall starts occurring, bull movements increase, and onset of the rut increases the effectiveness of calling. In RY10, 20% of the total general season take occurred during an early 10-day season, reducing the number of available bulls for the remainder of the hunt.

For the resident any bull drawing hunts, the majority of the harvest occurred during the first 7 days of the season. The nonresident drawing hunters harvested bulls throughout the season.

Although the CSH hunt began 10 August in RY09, prior to the other moose hunts in the unit, the harvest chronology was similar to the general hunt. Most (56%) of the harvest occurred after 9 September. Of the total take, 7% occurred prior to the opening of other state moose hunts.

Transport Methods. The most important method of transportation for moose hunters in Unit 13 has been 4-wheelers since RY93 (Table 7). Hunters using 4-wheelers and off-road vehicles (ORVs) took 75% of the total moose harvest during this reporting period.

Resident any bull drawing hunters generally utilized the same transportation methods as general season hunters. The only other common transportation methods were boats in the DM332 hunt (eastern Alphabet Hills) and aircraft in the DM334 hunt (Upper Chistochina River drainage). Nonresident drawing hunters primarily used 4-wheelers, ORVs and highway vehicles, which suggests that many of them were likely hunting with resident relatives. Hunters participating in DM338 (Subunit 13D) primarily used aircraft.

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 6 weeks of life (Ballard et al. 1981). Although brown bears kill adult moose, the rate is much lower than for calves. A substantial reduction in bear numbers (1,979 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, calf recruitment has not increased.

Wolf numbers in Unit 13 peaked in the falls of 1999 and 2000, with unitwide estimates exceeding 500 wolves (>12 wolves/1,000km^2). Snow depths during the winters of 1999–2000 and 2000–2001 were 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. During this reporting period fall wolf estimates averaged 254 wolves and spring estimates averaged 166 (3.9 wolves/1,000km^2). The fall 2010 moose:wolf ratio was estimated to be 60:1.

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. 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. Increased snowpack often helps wolves pursue and take prey. 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. The winter severity index for this reporting period was below average across the unit.

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 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.

Research throughout the 1990s in western Subunit 13A suggested that browse utilization rates were sustainable (Collins 2001). There are indications that browse quality in Subunit 13A may not be as good as in other portions of the state. Bill Collins (personal communication) has found higher levels of tannins and lower nitrogen in Subunit 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 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 moisture was too high and the weather changed abruptly. The burn plan remains active, and future ignition will be attempted if the fire prescription is met.

The number of moose counted within the 65 mi^2 burn count area was stable through 2007, averaging 64 moose. Numbers began increasing in 2008, with 209 moose observed in 2009. Since then the number has declined, with 186 observed in 2010, and 109 in 2011.

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 Subunit 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 significantly in Unit 13 over the past decade. A comparison of the number of moose counted indicates there has been an increase in all sex and age categories of moose. Overall, observed numbers of moose are up 60% since the last low in 2002, with the largest increases in Subunits 13A, 13B, and 13C.

The increase in moose observed is attributed primarily to increased winter 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 ratios during this reporting period are well above those observed in the late 1990s, when moose were rapidly declining, but are still below management objectives across the unit. Neonatal calf mortality due to brown bear predation continues to be significant. Liberalized hunting regulations since 1994 have resulted in an increase in brown bear harvests, but no effect on neonatal calf mortality has been detected. A multi-year brown bear study was recently conducted 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 Unit 13.

The objective bull ratio was met during this reporting period for each subunit. Much of the recent increase in the number of bulls is attributed to higher overwinter calf survival and increased recruitment of yearlings. While yearling cows are also being recruited, the influx is likely being offset by the loss of older cows and the overall increase in the number of cows has not kept up with increasing the increasing number of bulls. To take advantage of increased bull ratio in areas that are hard to access, harvest strategies were modified to include any bull hunts beginning in RY09.

Also new in RY09 were the resident CSH and nonresident drawing hunts. Each additional hunt opportunity has resulted in increased take. While the CSH hunt was not held in RY10, the 10-day August general hunt which allowed the take of bulls with spike-fork, 3 brow tine, or 50-inch antlers offered a replacement subsistence opportunity. A number of moose previously not legal, those with 3 brow tines, were harvested during the hunt, increasing the overall harvest substantially.

Harvests and hunting pressure in Unit 13 continued to increase during this reporting period; however, both harvests and hunting effort remain well below the level observed in the late 1980s. Whether Unit 13 can meet harvest objectives for moose 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.

We recommend continuing to increase 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 as long as the bull ratio remains above objectives. Also, limited cow harvests may now be utilized to provide additional opportunity in specific areas given public support. Given the controversial nature of antlerless hunts, a limited number of permits should be made available for clearly identified hunt areas where moose are abundant, and the permit hunts should be limited by conservative harvest objectives for each area.

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Table 1. Unit 13 fall composition estimates for moose in Count Areas 3, 5, 6, 10, 13, 14, 15, and 16, calendar years 2007 through 2011.

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)
2007 [a]	32	11	22	14	3869	4511	40	1.3 (0.5–1.8)
2008	35	12	19	13	3918	4481	54	1.3 (0.5–2.0)
2009 [a]	34	9	23	15	4326	5061	50	1.4 (0.5–2.0)
2010	30	10	21	14	4558	5313	53	1.5 (0.6–2.2)
2011	33	10	23	15	4777	5604	53	1.6 (0.5–2.2)

[a] Count area 15 was not flown, data was estimated.

Table 2. Unit 13 fall composition estimates by subunit for moose in Count Areas 3, 5, 6, 10, 13, 14, 15, and 16, calendar year 2011.

Subunit	Bulls: 100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves %	Total moose observed	Moose/ hour	Density moose mi^2
13A	27	9	22	15	1705	59	1.7
13B	36	10	25	15	2677	51	1.8
13C	30	11	19	13	606	67	2.0
13D	62	7	10	6	172	45	0.5
13E	32	7	26	16	444	39	1.0

Table 3. Unit 13 moose harvest[a] and accidental death, regulatory years 2006 through 2010.

Regulatory	Reported				Estimated			Accidental			Grand
year	M	F	U	Total [b]	Unreported	Illegal	Total	Road	Train [c]	Total	total
2006	685	0	4	689	25	25	50	15	9	24	763
2007	644	0	4	648	25	25	50	30	21	51	749
2008	730	1	4	735	25	25	50	40	42	82	867
2009	859	1	2	862	25	25	50	15	11	26	938
2010	937	1	0	938	25	25	50	50	63	113	1101

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

Table 4. Unit 13 moose hunter residency and success for general harvest ticket hunt only, regulatory years 2006 through 2010.

	Successful				Unsuccessful				
Regulatory year	Local [a] resident	Nonlocal resident	Non-resident	Total [b]	Local [a] resident	Nonlocal resident	Non-resident	Total [b]	Total hunters
2006	53	533	5	593	384	2476	20	2908	3501
2007	72	468	0	545	341	2400	10	2774	3319
2008	51	560	1	616	363	2592	3	2970	3586
2009	38	584	0	627	277	2383	11	2690	3317
2010	67	677	0	756	428	2858	16	3332	4088

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

Table 5. Unit 13 moose harvest data for state permit hunts, regulatory years 2006 through 2010.

Hunt Number	Regulatory Year	Permits issued [a]	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Harvest
Tier II	2006	150	13	60	40	51	0	0	51
TM300	2007	150	13	63	37	47	0	0	47
	2008	150	11	53	47	62	0	0	62
Resident	2009	160	29	42	58	64	0	0	64
Any Bull	2010	325	39	54	46	92	0	0	92
DM330-334									
Nonresident	2009	50	34	64	36	12	0	0	12
Antler Restricted	2010	115	48	78	22	13	0	0	13
DM335-339									
Community	2009	377	23	66	34	100	0	0	100
Subsistence									
Harvest Hunt	2010	No Hunt							
CM300									

[a] One permit was issued to the Community Subsistence Harvest hunt coordinator; community hunt harvest tickets were issued to individual hunters.

Table 6. Unit 13 moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, regulatory years 2006 through 2010.

Regulatory year	Season dates	Week of harvest [a] 1st	2nd	3rd	4th
2006	1 Sep–20 Sep	7	24	36	33
2007	1 Sep–20 Sep	7	26	36	31
2008	1 Sep–20 Sep	9	25	36	30
2009	1 Sep–20 Sep	8	31	34	27
2010 [b]	1 Sep–20 Sep	3	22	32	24

[a] For the conventional moose season, weeks end 1 September, 8 September, 15 September, and 22 September.
[b] An additional 20% (146 moose) were harvested during an early August hunt period 15 Aug–25 Aug.

Table 7. Unit 13 successful moose hunter transport methods (%) for general state harvest ticket hunt only, regulatory years 2006 through 2010.

Regulatory year	Percent of Harvest Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat
2006	7	1	5	53	0	20	13	1
2007	6	1	6	58	0	14	13	2
2008	6	1	4	57	0	19	12	1
2009	6	1	7	59	0	16	10	1
2010	6	1	4	58	0	17	13	1

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 14A (2,561 mi^2)

GEOGRAPHIC DESCRIPTION: Matanuska Valley

BACKGROUND

Moose in the Matanuska Valley were described as scarce when the area was settled by relocated farmers and others during the 1930s. The 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 improved habitat which likely offset losses due to agricultural and development activities and helped increase the population to over 6,000 by the late 1990s.

Annual harvest levels in the first 12 years after statehood (1959–1971) 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 regulatory year (RY) 1962 (Griese 2000). A regulatory year begins 1 July and ends 30 June (e.g., RY07 = 1 July 2007 – 30 June 2008). Following severe winters, antlerless moose seasons were discontinued RY72–RY77 and the mean annual harvest of bulls declined to 251 (range 167–346). Antlerless seasons began again in RY78 and RY78–RY98 the annual cow harvest ranged from zero (RY90) to 284 (RY96). Harvest during the “any bull” period of RY79–RY92 averaged 367 (range 201–530; Griese 2000).

Starting in RY93, 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 3 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 implementation of antler restrictions, the general season harvest has averaged 371 from RY93 though RY10 (range 226–503).

The human population in the Matanuska–Susitna Valley continues to be one of the fastest growing areas in the state. Land clearing activities associated with agriculture, development, and road construction have been responsible for an increase in moose browse. As the area continues to grow, much of the early seral moose habitat will be replaced with homes, roads, and associated industry. During the 1990s, motorists killed an average of 180 moose annually in the Matanuska/Susitna Valley. From 2000 to 2004, the average 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. Railroad kill estimates are a minimum number and moose kills by train are often under reported.

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 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 hunting opportunity.
- Provide opportunities for nonconsumptive uses.

MANAGEMENT OBJECTIVES

- Maintain a posthunt population of 6,000–6,500 moose with a sex ratio of 20–25 bulls:100 cows.
- Achieve an annual harvest of 360–750 moose.

METHODS

Moose populations were surveyed on 18 November 2009 for herd sex and age composition. This survey method required selecting known wintering areas for moose. A sample of at least 700 moose was selected in order to get representative bull: 100 cow and calf: 100 cow ratios. This information was used to compare current information with the Geospatial Population Estimator (GSPE) surveys based on Ver Hoef (2001) that were conducted 13–17 November 2008.

Harvest was monitored with harvest and permit reports from Unit 14A 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. 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

No population size surveys were completed during the reporting period. The last GSPE survey was conducted 13–17 November 2008 in Unit 14A (Peltier 2010). The population was estimated at 6,613 ± 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 (6,679 ± 453).

Population Composition

We complete a population composition survey 18 November 2009. The results of that survey showed a bull: 100 cow ratio of 24.7 which was slightly higher than the 2008 GSPE survey of 23 bulls:100 cows. The calf:100 cow ratio was 48.9 which was also higher than the 2008 GSPE (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The fall general open season was 25 August–25 September for all resident and nonresident hunters for both years, and 10–17 August for archery-only hunters. During this period, the bag limit was 1 bull with a spike or fork antler on at least one side, or with an antler spread at least 50 inches or 3 or more brow tines on at least one side (SF-50).

The season for the antlerless moose permit hunt was 20 August–25 September period during the reporting period.

Board of Game Actions and Emergency Orders. During its spring 2009 meeting, the board shifted the general season dates 5 days later to address concerns about hunting in warm weather, and to provide greater opportunity to take moose when they are more vulnerable closer to the rut. The board also instructed the department to address the increasing number of potlatch moose being taken in the unit. The department met with local tribal associations and developed a standardized process for those people wishing to take a moose out of the regular hunting season for traditional and customary funeral and mortuarial potlatches.

Hunter Harvest. During the past 10 years, the moose harvest has fluctuated from 383 to 707 moose, depending on herd status, hunter participation, and the number of permit hunts (Table 2). Overall the harvest has increased the past few years.

Permit Hunts. Periodically the department issues antlerless permits in order to keep the moose population within objectives (Table 3). Up to 400 permits may be issued by drawing and the unit is divided into several hunt areas. There were 360 permits issued each year during the reporting period, resulting in 215 moose harvested 2009 and 204 moose harvested in 2010.

Hunter Residency and Success. Over the past 5 years (RY06–RY10), an average of 3,038 people hunted bulls in Unit 14A each year. Local residents of Subunit 14 consistently make up the majority of hunters and harvest 96–98% percent of all moose taken in Subunit 14A. Annual hunter success averaged 13% during the last 5years (Table 4). Residency composition of hunters changed little from previous years.

Harvest Chronology. Most moose are taken either during the first week or the last week of the general season (Table 5). Typically, moose become more vulnerable to hunters during the end of the season as they approach the rut; however, competition for moose in 14A may lead a lot of hunters into the field at the start of the season. The number of moose taken during the archery only season of August 10–17 has increased in the past few years.

Transport Methods. 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 6). Access throughout unit 14A is good compared with the surrounding units and continues to improve each year.

Accidental and Illegal Mortality

Accidental human-caused moose mortality during the 10-year period (2001–2010) averaged 230 (range 130–345) moose killed by highway vehicles and 20 (range 2–41) by train (Table 2). These estimates are minimums as it has been difficult to get accurate numbers from both the railroad and MATCOM dispatch. There appears to be an increasing trend of highway collisions as a result of higher moose numbers and many more vehicles on valley roads. Road and rail kill are both strongly affected by snow depth in the valley.

HABITAT

Enhancement

From RY01 through RY07, ADF&G, in cooperation with the Ruffed Grouse Society and Division of Forestry, 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. A lack of time and available aspen stands precluded contracting for habitat enhancement during the reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The harvest objective (360–750) has been met since 2001 (Table 2). Use of antlerless hunts as a management strategy has 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 in seasons other than winter. The Point MacKenzie winter population exceeds 10 moose/mi^2, one of the highest densities in the state. These areas are critical to moose in the unit and may be used by moose that summer within adjacent units, where moose populations may have declined 30–40% in the past few years. Movement and available habitat studies may help us understand how much moose the unit can hold not only from a biological standpoint, but determine what the optimum population would be considering negative interactions with the public through collisions, property damage, and personal harm as well. The valley is projected to grow in the future. Growth and development will at some point result in increased conflicts with a growing moose population.

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Table 1. Subunit 14A, fall moose population size and composition estimates, regulatory years 2001 through 2010.

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults Observed	Moose Observed	Moose /mi^2	Estimated Population Size
2001[a]	19	8	34	22	1781	2301	4.2	6679±453[b]
2002[c]	--	--	--	--	--	--	--	--
2003[d]	21	9	29	19	1498	1869	4.1	6564±748[b]
2004[c]	--	--	--	--	--	--	--	--
2005[c]	--	--	--	--	--	--	--	--
2006[c]	--	--	--	--	--	--	--	--
2007[e]	33	--	32	19	540	665	--	--
2008[d]	23	8	42	25	1498	2158	4.1	6613±727[b]
2009[e]	24.7	--	48.9	28	546	761	--	--
2010[c]	--	--	--	--	--	--	--	--

[a] Modified Becker survey (nonrandom sampling but duplication of 1991 sampling units.)
[b] 80% confidence interval.
[c] No surveys.
[d] Ver Hoef Spatial Estimator Survey method.
[e] Composition count of known wintering areas.

Table 2. Unit 14A, moose general season and permit harvest and accidental death, regulatory years 2001 through 2010.

Regulatory year	Reported				Estimated			Accidental deaths[c]			Grand total
	M	F	Unknown	Total	Unreported[a]	Illegal[b]	Total	Road	Train	Total	
2001	345	31	7	383	24	60	84	252	15	267	734
2002	328	215	1	544	23	60	83	130	2	132	759
2003	415	177	2	594	29	60	89	247	21	268	951
2004	360	135	3	498	25	60	85	209	14	223	806
2005	379	160	2	541	27	60	87	200[d]	14	214	842
2006	397	131	3	531	28	60	88	200[d]	23	223	842
2007	269	146	2	417	19	60	79	245	15	260	756
2008	390	157	2	549	27	60	87	345	37	382	1,018
2009	474	213	6	693	33	60	93	247	22	269	962
2010	492	212	3	707	49	60	109	229[e]	41	270	1,086

[a] Derived by taking 7% of the reported harvest of bulls.
[b] Includes moose taken in defense of life or property, enforcement cases and an estimate of out of season take.
[c] Road and train kills are minimum numbers.
[d] Road kill estimates for 2005–06 and 2006–07 are minimum estimates based on reported numbers which were known to be incomplete.
[e] Roadkill estimate is based on the number of heads turned in to the Palmer office.

Table 3. Moose permit hunt harvest data by hunts in Subunit 14A, regulatory years 2001 through 2010.

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
DM400, 14A, Susitna River, Redshirt Lake										
	2005	1,460	30	17	60	40	0	10	0	10
	2006	1,258	30	13	73	27	0	7	0	7
	2007	1,086	20	15	63	37	1	9	0	10
	2008	1,180	20	15	47	53	0	8	0	8
	2009	1,294	25	8	39	61	1	13	0	14
	2010	1,291	25	0	36	64	0	16	0	16
DM401, 14A, Susitna River, Figure Eight Lake										
	2005	477	10	0	10	90	1	8	0	9
	2006	440	10	20	75	25	1	1	0	2
	2007	435	10	30	29	71	0	2	0	2
	2008	425	10	0	40	60	0	6	0	6
	2009	497	10	0	40	60	0	6	0	6
	2010	394	10	30	29	71	0	5	0	5
DM402, 14A, Point Mackenzie										
	2005	2,985	50	6	26	74	2	33	0	35
	2006	2,844	50	6	30	70	1	31	0	32
	2007	2,595	40	5	18	82	0	31	0	31
	2008	2,595	40	10	42	58	0	21	0	21
	2009	2,704	48	8	30	70	2	28	0	30
	2010	2,972	48	4	24	76	4	31	0	35
DM403, 14A, Big Lake										

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
	2005	1,425	20	5	32	68	0	12	1	13
	2006	1,521	20	5	37	63	1	11	0	12
	2007	1,517	20	10	33	67	0	12	0	12
	2008	1,639	20	5	28	72	0	13	0	13
	2009	1,846	30	7	14	86	1	23	0	24
	2010	2,199	30	9	26	74	0	20	0	20
DM406, 14A, Bald Mountain Ridge										
	2005	1,925	40	5	39	61	0	23	0	23
	2006	1,892	40	13	52	48	0	16	0	16
	2007	1,853	40	15	46	54	3	16	0	19
	2008	1,974	40	13	32	68	0	23	0	23
	2009	2,199	50	8	48	52	0	24	0	24
	2010	2,508	50	22	26	74	0	20	0	20
DM407, 14A, Matanuska River, North										
	2005	2,879	60	12	43	57	0	30	0	30
	2006	2,927	60	10	37	63	2	32	0	34
	2007	3,117	60	10	45	55	1	28	0	29
	2008	3,337	60	5	30	70	1	38	0	39
	2009	3,592	80	17	32	68	0	45	0	45
	2010	4,028	80	4	34	66	0	52	0	52
DM408, 14A, Matanuska River, South										
	2005	819	30	13	54	46	0	12	0	12

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
	2006	868	30	13	52	48	1	11	0	12
	2007	1,195	50	10	38	62	1	27	0	28
	2008	1,359	50	14	43	57	2	21	0	23
	2009	1,469	65	18	30	70	2	35	0	37
	2010	1,496	65	26	66	44	0	20	1	21
DM410, 14A, Knik River										
	2005	1,992	40	8	22	78	0	29	0	29
	2006	1,954	40	5	45	55	0	21	0	21
	2007	2,025	30	7	39	61	0	17	0	17
	2008	2,189	30	13	23	77	1	19	0	20
	2009	2,226	40	5	32	68	0	26	0	26
	2010	2,655	40	12	23	77	1	26	0	27
DM412, 14A, Point MacKenzie[a]										
	2007	300	10	0	50	50	1	4	0	5
	2008	221	10	0	70	30	0	3	0	3
	2009	361	12	0	25	75	0	9	0	9
	2010	380	12	8	27	73	0	8	0	8

[a] DM412 added in 2007, boundaries are the same as DM402.

Table 4. Subunit 14A, moose hunter residency and success[a], regulatory years 2001 through 2010.

Regulatory year	Successful						Unsuccessful						Total hunters
	Local resident[b]	Nonlocal resident	Non-resident	Un-known	Total	%	Local resident[b]	Nonlocal resident	Non-resident	Un-known	Total	%	
2001	327	13	11	2	353	13	2,256	46	30	12	2,344	87	2,697
2002	306	11	12	0	329	11	2,489	51	46	4	2,590	89	2,919
2003	385	16	14	0	415	13	2,590	63	38	0	2,691	87	3,106
2004	329	9	14	8	360	13	2,295	56	47	0	2,398	87	2,758
2005	344	19	13	6	382	13	2,419	58	42	20	2,539	87	2,921
2006	363	14	14	4	395	13	2,530	53	50	37	2,670	87	3,065
2007	247	10	6	3	266	10	2,208	59	50	5	2,322	90	2,588
2008	355	22	15	1	393	13	2,599	59	33	15	2,706	87	3,099
2009	430	27	18	2	477	15	2,662	63	45	20	2,790	85	3,267
2010	473	15	13	4	505	16	2,526	59	63	16	2,664	84	3,169

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

Table 5. Subunit 14A, moose harvest chronology [a], regulatory years 2001 through 2010.

Regulatory	August			September					November	December			
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unknown	Total
2001[b]	10	61	28	36	43	48	46	68	--	--	--	13	353
2002[b]	6	71	20	32	35	51	45	53	--	--	--	16	329
2003[b]	13	87	34	57	41	67	54	50	--	--	--	12	415
2004[b]	11	73	17	48	36	62	45	53	--	--	--	15	360
2005[b]	9	70	21	43	50	62	57	57	--	--	--	13	382
2006[b]	10	65	22	47	34	74	50	78	--	--	--	15	395
2007[c]	13	65	22	26	51	83	--	--	--	--	--	6	266
2008[c]	19	108	38	43	71	100	--	--	--	--	--	14	393
2009[d]	32	64	68	62	71	94	72	--	--	--	--	14	477
2010[d]	33	65	73	74	68	76	100	--	--	--	--	16	505

[a] Does not include drawing permit hunts.
[b] Open season=10–17 Aug (Archery only), 20 Aug–30 Sep (Gen. SF-50).
[c] Open season=10–17 Aug (Archery only), 20 Aug–20 Sep (Gen. SF-50).
[d] Open season =10-17 Aug (Archery only), 25 Aug–25 Sep (Gen. SF-50).

Table 6. Subunit 14A, percent of transport methods of successful moose hunters[a], regulatory years 2001 through 2010.
[a] Does not include drawing permit hunts.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Airboat	Sample size
2001	5	1	10	37	0	7	36	3	1	353
2002	6	3	12	36	0	5	32	5	1	323
2003	4	2	11	39	0	6	35	3	0	417
2004	7	3	10	38	0	5	30	6	1	361
2005	7	3	10	37	0	7	34	1	1	380
2006	6	2	9	39	0	6	36	2	0	381
2007	7	2	11	40	0	4	36	0	0	254
2008	5	2	9	44	0	6	31	1	2	378
2009	4	2	6	46	0	6	35	1	0	468
2010	4	2	8	46	0	7	30	2	0	492

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 14B (2,152 mi^2)

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 likely contributed to declining populations 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). Weather or available funding for surveys often hampers our ability to monitor the population and prolonged periods without current information are known to occur (Peltier 2010).

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 3 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

Population estimates and sex and age composition data were compiled from a Ver Hoef (2001) geospatial (GSPE) survey conducted in the fall of 2009.

The harvest was monitored with harvest reports from Subunit 14B 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 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

The moose population was surveyed using the GSPE technique (Kellie and Delong 2006) during November 2009. The population is believed to be 1,662 ± 220 (80% CI). This is an increase from the 2005 estimate of 1,413 ± 215 (80% CI;Table 1).

Population Composition

The bull to 100 cow ratio for the 2009 GSPE survey was 34 and the calf to 100 cow ratio was 18.4 (Table 1). In our November 2005 survey, we observed 29.8 bulls:100 cows and 15.5 calves:100 cows. Calves made up 12.2% of the sampled population in 2009, up from 10.7% in 2005.

The overall population and calf to cow ratios indicate an increase in the population and a positive trend for recovery from the population low in 2005. However, caution should be taken in giving too much credence to these results, as the pre-survey stratification flight in 2009 missed several groups of moose that would have altered the stratification of the unit. Modeling the corrections for these missed moose groups demonstrated that the population increases may not be that significant. Future surveys will help determine whether this is the case.

MORTALITY

Harvest

Season and Bag Limit. The fall general open season was 25 August–25 September for all resident and nonresident hunters and 10–17 August for the archery-only hunt. The bag limit was one SF-50 bull.

Board of Game Actions and Emergency Orders. During the spring 2009 meeting, the board shifted the season dates 5 days later to address concerns about hunting in warm weather, and to provide greater opportunity to take moose when they are more vulnerable closer to the rut.

Hunter Harvest. The reported harvest averaged 86 bulls during the reporting period (Table 2). This is higher than the previous 8-year average of 57 bulls; however, it is substantially lower than the historic highs reported in the 1980s.

Hunter Residency and Success. Consistently, most of the hunters in Subunit 14 are local residents (Table 3). There was a slight increase in the amount of local hunters and non-residents during the reporting period (Table 3).

Harvest Chronology. Typically, the greatest proportion of moose is taken during the last 10 days of the season, as moose become more vulnerable closer to the rut. However the proportion of moose taken during the last 5 days of the season during this reporting period actually decreased (Table 4). There was also a significant increase in the number of animals taken during the August archery-only season.

Transport Methods. 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 30 and 39 in RY 09 and RY 10, respectively (Table 2). We believe this to be a minimum estimate by the railroad. The number of moose killed on roads in vehicle collisions reported for this period was estimated as a minimum using data from 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.

Predation by black and brown bears as well as wolves in 14B is thought to contribute to moose calf mortality and recruitment. Low calf to 100 cow ratios has existed since the late 1980s. Predation and possibly poor habitat are likely contributing factors delaying the recovery of the population.

CONCLUSIONS AND RECOMMENDATIONS

Even before the severe winter of 1999–00, the moose population was below the objective level of 2,500–2,800. Currently, the moose population is about 50% of the population objective. The average annual harvest by hunters has increased in recent years; however, it is still well below the objective of 100–200. Currently, hunters are limited by access in the unit, and by the low moose population.

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.

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Table 1. Unit 14B, fall aerial moose composition surveys, regulatory years 1999 through 2010.

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[a]	40.2	12.3	21.3	13.2	616	699	1.6	1,687 ± 244
2000[b]	--	--	--	--	--	--	--	--
2001[b]	--	--	--	--	--	--	--	--
2002[b]	--	--	--	--	--	--	--	--
2003[b]	--	--	--	--	--	--	--	--
2004[b]	--	--	--	--	--	--	--	--
2005[c]	29.8	5.4	15.5	10.7	582	646	--	1,413 ± 215
2006[b]	--	--	--	--	--	--	--	--
2007[b]	--	--	--	--	--	--	--	--
2008[b]	--	--	--	--	--	--	--	--
2009[c]	34	11.7	18.4	12.2	653	744	2.2	1662 ±220
2010[b]	--	--	--	--	--	--	--	--

[a] 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.
[b]No surveys conducted.
[c] Data from Geospatial Population Estimator surveys.

Table 2. Unit 14B, moose harvest and accidental death, regulatory years 2001 through 2010.

Regulatory year	Reported				Estimated			Accidental deaths[c]			Grand Total
	M	F	Unknown	Total	Unreported[a]	Illegal[b]	Total	Road	Train	Total	
2001	66	0	1	67	7	20	27	31	15	46	140
2002	67	0	0	67	7	20	27	13	2	15	109
2003	56	0	0	56	6	20	26	29	10	39	121
2004	56	0	0	56	6	20	26	29	78	107	189
2005	47	1	0	48	5	20	25	20[d]	19	39	112
2006	57	0	0	57	6	20	26	20[d]	6	26	109
2007	49	0	0	49	5	20	25	20[d]	19	39	113
2008	57	0	1	58	6	20	26	20[d]	36	56	140
2009	78	0	2	80	8	20	28	20[d]	30	50	158
2010	91	1	0	92	9	20	29	20[d]	39	59	180

[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 data from previous years as data was missing for this period.

Table 3. Unit 14B, moose hunter residency and success, regulatory years 2001 through 2010.

Regulatory year	Successful					Unsuccessful					
	Local resident[a]	Nonlocal resident	Non-resident	Unknown	Total (%)	Local resident[a]	Nonlocal resident	Non-resident	Unknown	Total	Total hunters
2001	62	2	3	0	67 (16)	331	12	13	3	359	426
2002	57	4	6	0	67 (14)	364	13	23	2	402	469
2003	54	1	1	0	56 (12)	372	15	17	1	405	461
2004	52	1	2	1	56 (13)	355	13	13	6	387	443
2005	46	1	1	0	48(11)	345	16	18	3	382	430
2006	43	6	8	0	57(13)	343	16	11	4	374	431
2007	43	4	2	0	49(12)	340	13	17	0	370	419
2008	49	2	7	0	58(13)	370	20	12	0	402	460
2009	62	8	10	0	80(14)	466	17	19	8	510	590
2010	83	3	6	0	92(17)	415	11	17	1	444	536

[a] Unit 14 residents.

Table 4. Unit 14B, moose harvest chronology, regulatory years 2001 through 2010.

Regulatory	August			September						
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	Unknown	Total[d]
2001[a]	0	10	0	4	6	6	15	23	3	67
2002[a]	1	7	5	5	7	8	19	14	1	67
2003[a]	0	5	2	5	4	12	12	16	--	56
2004[a]	0	8	1	6	7	12	9	13	--	56
2005[a]	0	3	6	2	5	8	6	16	2	48
2006[a]	1	7	3	7	9	12	4	13	--	56
2007[b]	1	4	1	6	9	26	--	--	--	47
2008[b]	0	17	5	2	10	21	--	--	3	58
2009[c]	4	5	8	9	14	23	13	--	4	80
2010[c]	3	4	7	12	23	23	17	--	3	92

[a] Open season=10–17 Aug (Archery only), 10 Aug–30 Sept (general SF-50).
[b] Open season=10–17 Aug (Archery only), 20 Aug–20 Sept (general SF-50).
[c] Open season= 10–17 Aug (Archery only), 25 Aug–25 Sept (general SF-50).
[d] Chronology does not include moose taken out of season.

Table 5. Unit 14B, percent transport methods of successful moose hunters, regulatory years 2001 through 2010.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Airboat	Number moose harvested
2001	15	2	4	42	0	15	22	0	0	67
2002	8	0	7	46	0	9	27	3	0	67
2003	5	2	3	52	0	16	20	2	0	56
2004	2	0	1	58	0	11	21	7	0	57
2005	10	0	8	44	0	17	19	2	0	48
2006	11	0	3	53	0	11	16	2	4	57
2007	4	0	2	55	0	14	25	0	0	49
2008	9	0	10	44	2	19	16	0	0	57
2009	12	1	9	50	0	3	19	6	0	80
2010	7	1	0	58	0	12	18	4	0	90

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Anchorage area

BACKGROUND

Moose were uncommon in the Anchorage area before the 1940s. They increased in the late 1940s as brushy 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. There was a reduction in numbers due to severe winters in the 1970s, but since then the moose population has remained relatively high, peaking in 2003. Since 2003, moose numbers have fluctuated, but have remained within population objectives.

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 the last few years 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

Every fall, we attempt to conduct both population and composition surveys for moose in the majority of Unit 14C. However, during some years, inadequate snow cover or inclement weather impedes survey activities. Composition counts are conducted in the Twentymile, Placer, and Portage River drainages, as well as in the Eklutna Management Area, Peters Creek valley, Thunderbird valley, and the front range of Chugach State Park. We also conduct a Gasaway census (Gasaway et al, 1986) in Ship Creek valley and on the Joint Base Elmendorf Richardson (JBER). Beginning in 2008, we were unable to count moose in one of 14 sample areas in the JBER census area due to a housing expansion on Elmendorf Air Force Base (AFB); as a result, the 138.8 mi^2 census area was modified to exclude this 6.9 mi^2.

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. Harvest data were analyzed by regulatory year (RY). A regulatory year runs from 1 July through 30 June (e.g., RY09 = 1 July 2009–30 June 2010).

A significant amount of time is spent by Area staff managing moose/human interactions in Anchorage. This includes responding to reports of resident conflicts with moose, conducting various educational efforts such as wildlife safety presentations and coordinating with media outlets to inform the public about wildlife hazards.

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 (i.e., greater than 30-inch depth), 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 (Sinnott 2002). With milder winters and a reduction in harvest, the unit's moose population recovered by fall 1998 above the upper management objective of 1800 moose. Another severe winter in 1998–99 reduced the population to an estimated 1650. 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 was one of the worst in recent years for moose mortality. From 2005 to 2008, the population rose to 1800, but has declined since, and is now at the low end of the population objective.

During this reporting period we conducted aerial surveys annually in some hunt areas to estimate sex and age composition during fall and early winter. In 2009, the only survey conducted was in the Twentymile River area. Fall surveys were not flown in most hunt areas in 2009 because there was inadequate snow cover until late December, after most bulls had shed antlers.

The winter of 2011–2012 saw the deepest snowfall on record. While we will not know the impact on the moose population until after the fall 2012 surveys, available evidence suggests that the moose population in the Anchorage area did not decline as dramatically as in previous deep snow winters. This is most likely a result of low moose numbers prior to winter snowfall. 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

Both composition and census information is used to estimate the moose population in GMU 14C. A Gasaway census was conducted only once (2010) during this reporting period. That census found an estimated 339 moose on JBER and in the upper Ship Creek Valley. In addition, composition counts were conducted in the Twentymile, Portage, and Placer River valleys in both 2009 and 2010 (Table 1). During those composition counts, 138 moose were counted in that area in 2009 and 160 moose were counted in 2010. We estimated a fall 2010 population of 1,500 moose in Unit 14C.

Population Composition

In the composition survey conducted in the Twentymile area in 2009 (the only area surveyed that year), the bull:cow ratio in that area was estimated to be 19 bulls:100 cows and the calf:cow ratio was 28 calves:100 cows. In the same area in 2010, these ratios increased to 30 bulls:100 cows and 68 calves:100 cows. In 2010, the total bull:cow ratio for GMU 14C was estimated to be 31 bulls:100 cows (Table 1), which was a decline since the last reporting period (45:100 in 2008). The overall calf:cow ratio increased since the last reporting period (19:100 in 2008 vs. 37:100 in 2010). The unit had 9 yearling bulls per 100 cows, which was slightly less than reported in 2008.

Distribution and Movements

Moose are year-round residents of Unit 14C, ranging from sea level to an elevation of 3,500 feet. During winters with substantial snow accumulation, most moose are found at elevations below 1,500 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. A lack of dedicated wildlife crossing structures persists throughout municipal road corridors, despite consistent recommendations to the Alaska Department of Transportation and Public Facilities (DOT&PF). Current research being conducted by ADF&G and JBER Natural Resources staff intended to delineate movement corridors used by moose on JBER may provide more data identifying the need for crossing structures on high traffic roads such as the Glenn Highway.

MORTALITY

Harvest

Season and Bag Limit. Moose are harvested in Unit 14C during a general season hunt, 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 (SF-50).

Formerly, Fort Richardson Army Post comprised the Fort Richardson Management Area, and Elmendorf Air Force Base was included in 'the Remainder of GMU 14C.' During this reporting period, Fort Richardson Army Post and Elmendorf Air Force Base combined to form Joint Base Elmendorf-Richardson (JBER). The Board of Game subsequently created the JBER Management Area. Drawing permit hunts (DM) on JBER included DM421–430, and were open to resident and nonresident hunters. Hunts DM421–427 are located on the historic Fort Richardson Army Post, with open seasons from the day after Labor Day through 15 November and 15 December–15 January. The bag limit for hunts DM422 and 424 was 1 bull; the bag limit for hunt DM423 was 1 antlerless moose; and the bag limit for drawing hunts DM421, 426, and 427 was 1 moose of either sex. Hunting was limited to archery south of Eagle River (DM424–427) and muzzleloading rifle north of Eagle River (DM421–423). We issued 95 archery permits and 25 muzzleloader permits in 2009 and 99 archery permits and 27 muzzleloader permits in 2010 in this portion of the JBER management area (Table 4).

Moose harvest in the historic Elmendorf portion of the JBER Management Area was by drawing permit only and archery only (DM428–430). The open seasons for resident and nonresident hunters were the day after Labor Day through 30 September and 15 October—15 November, with a bag limit of 1 bull only. We issued a total of 36 drawing permits each year for these hunts.

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, 1–30 November. Ten drawing permits were issued for 2 separate hunt areas (6 for upper Campbell Creek and 4 for McHugh Creek) in both 2009 and 2010 (Table 4).

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 per year have been issued since 2008 (Table 4). 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 land 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 20 October. The bag limit was 1 bull by registration permit by archery only, with a quota of 4 bulls.

The open season for the Twentymile River area was 20 August–30 September by drawing permit for bull moose and 20 August–10 October by drawing permit for antlerless moose. The bag limit was 1 moose by drawing permit with 40 bull permits and 30 antlerless permits issued in each of RY09 and RY10..

Moose harvest in the Ship Creek area is managed with drawing and registration permit hunts. Drawing hunts occur the day after Labor Day—30 September. Fifty drawing permits were issued in RY09 and 40 drawing permits were issued in RY10. In previous years, drawing permits have been issued for either sex in this area, but during this reporting period, the bag limit was any bull. The registration hunt opens 25 October and runs through the end of November. The bag limit for registration permits was 1 bull. The quota for the registration hunt is based on the moose population and the number of animals harvested during the drawing hunt season.

Board of Game Actions and Emergency Orders.

The Board of Game reauthorized all antlerless moose hunts annually during this reporting period.

The Fort Richardson Army Post and Elmendorf Air Force Base combined to form Joint Base Elmendorf-Richardson (JBER). The Board of Game subsequently created the JBER Management Area in 2009.

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.

In 2009, the Board of Game authorized the creation of a new drawing permit hunt in the Remainder of 14C. The boundary for this hunt includes Edmonds and Mirror Lake municipal parks, with a season of 20 October 20–15 November.

Hunter Harvest. During RY09 and RY10, 148 and 135 moose were harvested, respectively, with a 2-year mean of 94 bulls and 47 cows (Table 2). Approximately 25% of the bulls were taken during the general season harvest.

Permit Hunts. During RY09, we issued 748 permits to hunt moose in Unit 14C and had a permit success rate of 17% (125 hunters). In RY10, 717 permits were issued and 109 of those hunters (15%) harvested moose (Table 4).

Drawing permit hunts are very popular. In RY09, 6,200 hunters applied for 273 drawing permits (1,405 applications were for the 40 bull permits for the Placer/Twentymile hunts). In RY10, 8,391 hunters applied for 271 drawing permits (3,553 of the applications were for the 70 permits for the Placer/Twentymile hunts). The number of drawing permits has increased substantially in the last several years (e.g., 140 permits were issued in 2003). In addition to those receiving drawing permits, in RY09 and RY 10, 363 and 346 bow hunters registered for a permit for the Eklutna Lake archery hunt, and 102 and 100 hunters registered for a permit for the Ship Creek registration, respectively. The high number of unsuccessful bow hunters in the Eklutna hunt reduced the total success rate for permit hunts in Unit 14C (Table 4).

Hunter Residency and Success. Residents of Unit 14C accounted for 67% and 68% of the moose harvested in Unit 14C in RY09 and RY10, respectively (Table 3), which is roughly the same rate as in RY07(70%) and RY08(69%). Nonlocal resident harvest also held relatively stable at 29% and 26% of the moose harvest in Unit 14C in RY09 and RY10, respectively, compared to 24% in RY07 and 28% in RY08. Nonresidents accounted for 4% and 6% of the total harvest in Unit 14C in RY09 and RY10, respectively.

Harvest Chronology. In the general-season SF-50 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 (Table 5). The day after Labor Day was 8 September in 2009 and 7 September in 2010.

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 59% of all successful hunters used a highway vehicle for transportation to their hunting area during this reporting period (Table 6). This is a decrease from the previous reporting period, during which 73% of hunters used highway vehicles to access their hunting areas. This is probably primarily due to the increase in the number of permits issued for the Twentymile River area. 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 a large percentage of known, human-caused mortality during the past 5 years. Vehicles killed at least 239 moose and trains killed 22 moose in RY94, 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 133 moose per year were killed in vehicle collisions between RY09 and RY09 (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 over the years 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. The majority of these deaths occur during winter. In recent years, several moose that have died of unknown causes during winter were necropsied. At least three (all calves) died from cyanide gas produced during the digestion of what appeared to be Mayday tree (*Prunus padus*) or chokecherry tree (*Prunus virginianus*) (K. Beckmen, ADF&G wildlife veterinarian, personal communication). Thousands of Mayday and chokecherry trees have been planted as ornamentals in Anchorage. In some parts of the municipality, they have become invasive, 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. At least one of the moose that consumed toxic chokecherry also consumed Japanese yew, so exact cause of death could not be determined.

Natural mortality was low in the Anchorage area from the mid 1950s to the late 1960s because of moderate annual snowpack and relatively low numbers of predators. The severe winters of the early 1970s reduced numbers significantly, but the population rebounded by the 1980s. 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 found only 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. Approximately 5–8 moose are reported dead and salvaged in the Anchorage area each year. 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. Several new roads and road expansion projects bisect natural areas and may result in increased moose-vehicle collisions. 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 has not occurred and is not economically feasible because burning, the most cost-effective method, is difficult to do safely in a densely populated area. The Chugach National Forest enhanced moose habitat in a limited area near Portage, primarily to enhance viewing opportunity. Limited habitat enhancement projects have also taken place on JBER lands. 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

Management objectives for Unit 14C moose were met during this reporting period; fall 2010 surveys estimated the population at 1,500 moose with a bull:cow ratio of greater than 25 bulls:100 cows. The moose population has declined 17% since 2008, placing it at the lower end of our population objective. The creation of several new hunts has helped maintain moose numbers within population goals, resulting in a healthier population and decreased moose-human conflicts.

Moose-vehicle collisions in Unit 14C remain a significant problem. Over a decade ago, DOT&PF estimated rural moose-vehicle collisions cost an average of $15,150 each 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. Development of new roads and expansion of existing roads continues to destroy and fragment important moose habitat and increase the risk of moose-vehicle collisions. During this reporting period, wildlife staff participated in planning for a number of transportation infrastructure projects. Dedicated wildlife crossing structures coupled with fencing would help mitigate negative impacts on moose. 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.

Unfortunately, DOT&PF project engineers and environmental staff have been largely unresponsive to requests for adequate moose-crossing structures due to the cost of construction. Rather, more inexpensive mitigation measures are often selected. For example, DOT&PF is fencing a significant portion of Minnesota Road in hopes of reducing moose-vehicle collisions along several moose crossing areas. Unfortunately, this section of road has numerous vehicle overpasses and underpasses, which will require breaks in the moose fencing. No dedicated wildlife crossing structures will be constructed. As a result, moose will be funneled to the opening in the fences, at the vehicular intersections, transferring moose-vehicle collisions to already congested portions of the road corridor. This is not a view necessarily shared by DOT&PF staff. In a 6 September 2012 letter to ADF&G Anchorage Area Wildlife Biologist Jessica Coltrane, DOT&PF Regional Traffic Engineer Scott Thomas stated that directing moose to arterial roads reduces the risk of moose-vehicle crashes because motorists are in the mindset of watching for pedestrians, bicycles, etc., and therefore are more likely to notice moose. We have consistently recommended against these types of mitigation efforts in favor of more effective measures, but due in part to budget constraints, DOT&PF continues to choose the most inexpensive effort, i.e., fencing.

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. Area biologists need to be involved early in planning of roads and long fences and must have information on moose distribution and movement corridors.

Moose are also considered residential pests in Unit 14C. They can 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 (Responsive Management 2010). In fact, many Anchorage residents feel that moose enrich their lives in Anchorage and make the city a unique place to live. In addition, they feel that the benefits of having moose in Anchorage outweigh the inconveniences that moose cause. 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. Spring calving in late May through early June is a particularly dangerous time, as cow moose aggressively defend their newborn calves. Each spring, people are injured by cow moose defending their calves. Area biologists and education specialists devote considerable amounts of time teaching moose safety in schools and in other public venues. Area biologists also assist schools with moose on school grounds. A moose-safety video was produced in 2003–2004 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. In addition, during the 2009-2010 school year, education staff gave approximately 150 wildlife safety presentations to a total of 6,500 Anchorage students. During the 2010–2011 school year, education staff conducted approximately 240 wildlife safety presentations to a total of 11,000 Anchorage students.

In the fall of 2011, over 8 miles of single track mountain bike trails were constructed in Kincaid Park. These trails traverse moose calving areas and likely overlap with existing game trails. Mountain biking is a high-risk activity in wildlife habitat, due to the speed that bikers travel. During spring calving in 2012, numerous groups of mountain bikers encountered cows with calves at close range. Multiple bikers sustained minor injuries from cow moose protecting their calves. We worked with several local bike groups, including Mighty Bikes and Single Tract Advocates, to encourage bikers to avoid using the single track trail system during late May through late June to avoid dangerous surprise encounters with moose. While numerous efforts were made to notify the public of this issue, many bikers continued to use these trails, and additional injuries were sustained. Since biking has increased dramatically in popularity and the desire to build additional single track trails in local parks exists, we anticipate increases in injuries to bikers from moose. We will continue to work with local trail advocate groups, and municipal and state parks to educate the public on wildlife hazards.

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. In spring 2011, the Alaska Moose Federation (AMF), a private organization, was issued a permit by ADF&G to capture, hold, and translocate orphaned moose calves. During 2011, 3 calves from Unit 14C were delivered to AMF, but all had to be euthanized due to various injuries; 2 were injured at the captive facility and one had *Cryptosporidium* when captured.

Due to the high number of moose-human conflicts within Unit 14C, we recommend maintaining the population at the low end of the current objective. The most effective and socially acceptable manner to control moose numbers is through regulated hunting. Currently, the majority of moose habitat in Unit 14C is open to moose hunting, with the exception of highly developed areas of Eagle River and Anchorage and most municipal parks. Moose hunting in residential areas is not practical due to safety concerns and negative public perception. However, limited harvest of moose in large municipal parks is feasible, although currently not permissible under municipal regulations. We recommend continued discussion with the municipality, in hopes of opening limited moose hunting opportunities in city parks at a future date. Harvesting moose in municipal parks would help remove moose from high conflict areas in parks and adjacent neighborhoods. ADF&G is dedicated to mitigating moose-human conflicts, especially conflicts which pose risks to public safety. Therefore we also recommend a new objective:

- Maintain the moose population at a level to promote public safety by reducing conflicts with Anchorage residents, and participate in land management decisions that affect moose movements in an effort to direct moose into areas with lower vehicle and foot traffic.

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Table 1. Unit 14C fall aerial moose composition counts and estimated population size, 2004–2011.

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	61	34	52	24	94	30	120
Portage River	2005	--	--	--	--	--	--	
Placer River	2006	--	--	--	--	--	--	150
	2007 [b]	--	--	--	--	--	--	
	2008	30	12	25	16	192	50	192
	2009	19	5	28	19	138	46	138
	2010	30	14	68	34	160	39	160
Hillside	2004 [c]	28	11	40	24	99 [d]	30	120
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	140 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	155 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	129 [e]
Anchorage Bowl	2004	--	--	--	--	--	--	
(except Hillside)	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	250 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	280 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	242 [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]
JBER	2004 f	--	--	--	--	--	--	
Upper Ship Cr.	2005	59	16	31	17	395	38	435
	2006	45	14	30	17	404	26	452
	2007 b	--	--	--	--	--	--	
	2008	48	11	15	9	335	25	473
	2009	--	--	--	--	--	--	
	2010	31	7	26	16	211	31	339
Eagle River [g]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	120 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	135 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	122 [e]
Peters Creek [h]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	65 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	73 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	48 [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]
Eklutna River Thunderbird Cr.	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	45 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	58	--	37	15	48	12	58
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	78 [e]
Bird Creek Indian River [i]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	110 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	124 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	
Hunter Creek [h] Knik River	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	150 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	165 [e]
	2009–	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	148 [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]
Lake George [j]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	140 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	155 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	129 [e]
Unit 14C Total	2004 [f]	43	22	45	24	183	28	
	2005	57	16	31	17	395	38	
	2006	45	14	30	17	404	26	1600
	2007 [b]	--	--	--	--	--	--	
	2008	45	11	19	5	574	29	1800
	2009	--	--	--	--	--	--	
	2010	31	9	37	30	371		1500

[a] Estimates based on sightability correction factors (SCF) of 1.12 (2006), 1.41 (2008), and 1.49 (2010) calculated with MOOSPOP for the Fort Richardson/Elmendorf/Upper Ship Creek census area, except estimates in unsurveyed drainages are extrapolated based on trends on the Fort Richardson/Elmendorf/Upper Ship Creek census area; [b] Fall surveys not conducted due to lack of snow; [c] Bear Valley not surveyed due to turbulence; [d] Total includes 10 adult/yearling moose of unknown sex; [e] No recent aerial surveys completed; therefore, estimate is best guess; [f] No aerial survey of Fort Richardson/Elmendorf/Upper Ship Creek census area because of difficulty obtaining flight clearances from Range Control due to military training activities; [g] Eagle River count area last surveyed in 1998; [h] Peters Creek count area and Hunter/Knik count area last surveyed in 2001; [i] Bird/Indian count area last surveyed in 1988; [j] Lake George count area last surveyed in 1997.

Table 2. Unit 14C moose harvest and accidental death, regulatory years 2004–2010.

	Hunter harvest									
	Reported			Estimated			Accidental death [b]			
Regulatory year	M (%)	F (%)	Total[a]	Unreported	Illegal	Total	Road	Train	Total	Total
2004	62 (75)	21 (25)	83	10	10	20	167	7	174	277
2005	70 (67)	34 (33)	104	10	10	20	138	8	146	269
2006	80 (71)	33 (29)	113	10	10	20	134	9	143	266
2007	84 (68)	38 (31)	123	10	10	20	124	-- [c]	--	290 [d]
2008	94 (71)	37 (28)	132	10	10	20	142	-- [c]	--	302 [d]
2009	101 (68)	46 (31)	148	10	10	20	-- [c]	--[c]	--[c]	--[c]
2010	86 (64)	47 (35)	135	10	10	20	-- [c]	--[c]	--[c]	--[c]

[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, regulatory years 2004–2010.

	Successful				Unsuccessful				
Regulatory Year	Local resident[a]	Nonlocal resident	Nonresident	Total[b] (%)	Local resident[a]	Nonlocal resident	Nonresident	Total[b] (%)	Total hunters[b]
2004	72	8	3	83 (18)	353	18	13	384 (82)	467
2005	94	6	4	104 (20)	376	13	11	401 (80)	500
2006	80	23	8	113 (21)	305	98	19	422 (79)	535
2007	86	29	8	123 (17)	423	165	16	604 (83)	730
2008	90	37	5	132 (20)	366	156	9	531 (80)	665
2009	99	43	6	148 (20)	390	188	15	593 (80)	741
2010	91	36	8	135 (20)	350	181	19	550 (80)	691

[a] Residents of Unit 14C. Includes only Unit 14C portion of DM210.
[b] Includes hunters with unspecified residency.

Table 4. Unit 14C moose harvest data by permit hunt, regulatory years 2004–2010.

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	2004	25	28	57	43	89	11	25
	2005	20	5	37	63	100	0	20
	2006	20	5	58	42	100	0	8
	2007	20	15	29	71	100	0	12
	2008	20	15	24	76	100	0	13
	2009	70	11	32	68	60	40	42
	2010	70	10	51	49	50	50	30
DM421,422,423 JBER (muzzleloader)	2004	25	12	73	27	83	17	6
	2005	25	8	48	52	70	30	12
	2006	25	8	74	26	83	17	6
	2007	25	16	67	33	71	29	7
	2008	25	12	55	45	90	10	10
	2009	25	12	73	27	100	0	6
	2010	27	26	50	50	90	10	10
DM424,425,426, 427 JBER (archery)	2004	100	13	67	33	55	45	29
	2005	100	19	60	40	56	44	32
	2006	100	17	57	43	53	47	36
	2007	100	14	66	44	50	50	38
	2008	100	13	51	49	53	47	43
	2009	95	17	53	47	49	51	37
	2010	99	20	54	46	39	61	36

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]
DM428,429,430 JBER (archery)	2004	20	10	50	50	67	33	9
	2005	25	24	21	79	60	40	15
	2006	25	12	45	55	58	42	12
	2007	25	12	55	45	40	60	10
	2008	25	12	45	55	58	42	12
	2009	18	17	47	53	100	0	8
	2010	18	17	60	40	83	17	6
DM441 Hunter (antlerless)	2004	10	30	86	14	0	100	1
	2005	10	40	83	17	0	100	1
	2006	10	30	57	43	0	100	3
	2007	5	0	40	60	33	67	3
	2008	5	40	67	33	0	100	1
	2009	5	60	50	50	100	0	1
	2010	5	40	66	33	0	100	1
DM442 Ship (antlerless)	2004	40	30	93	7	0	100	2
	2005	0	--	--	--	--	--	--
	2006	0	--	--	--	--	--	--
	2007	0	--	--	--	--	--	--
	2008	0	--	--	--	--	--	--
	2009	0	--	--	--	--	--	--
	2010	0	--	--	--	--	--	--

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]
DM443	2004	10	20	100	0	0	0	0
Peters and	2005	10	40	67	33	0	100	2
Little Peters	2006	10	20	75	25	50	50	2
	2007	5	20	100	0	0	0	0
	2008	5	20	100	0	0	0	0
	2009	5	25	100	0	0	0	0
	2010	5	0	80	20	0	100	1
DM446, 447	2005	40	28	66	34	70	30	10
Ship Creek	2006	50	24	61	39	80	20	15
	2007	50	30	66	34	75	25	12
	2008	50	36	69	31	60	40	10
	2009	50	29	62	38	67	33	15
	2010	40	30	68	32	89	11	9

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	15	20	83	17	100	0	2
	2005	15	13	100	0	0	0	0
	2006	10	30	100	0	0	0	0
	2007	15	47	88	12	100	0	1
	2008	5	60	100	0	0	0	0
	2009	5	60	0	100	100	0	2
	2010	5	40	66	33	100	0	1
DM666 Anchorage (muzzleloader, shotgun only)	2005	4	0	0	100	0	100	4
	2006	4	0	25	75	0	100	3
	2007	8	0	37	63	0	100	5
	2008	8	25	17	83	0	100	5
	2009	10	30	29	71	0	100	5
	2010	10	20	25	75	17	83	6
RM435[b] Ship	2007	355	55 [c]	89	11	94	6	18
	2008	139	30 [d]	89	11	100	0	11
	2009	102	25 [e]	90	10	100	0	7
	2010	100	28 [f]	91	9	100	0	6

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
RM445 [b]	2004	218	58 [g]	96	4	100	0	4
Eklutna	2005	257	32 [h]	98	2	100	0	3
(archery only)	2006	249	31 [i]	99	1	100	0	2
	2007	298	37 [j]	100	0	0	0	0
	2008	325	36 [k]	99	1	100	0	2
	2009	363	34 [l]	99	1	100	0	2
	2010	346	33 [m]	99	1	100	0	3
Totals for all	2004	463	36	79	21	66	34	62
permit hunts[n]	2005	506	26	76	24	63	37	91
	2006	508	24	77	23	62	38	87
	2007	906	39	81	19	64	36	107
	2008	707	36	80	20	63	37	102
	2009	748	27	79	21	52	48	125
	2010	725	28	79	21	56	44	109

[a] Includes moose with unspecified sex; [b] Registration hunt; [c]Includes 12 permittees who did not report; [d]Includes 3 permittees who did not report; [e]Includes 6 permittees who did not report; [f]Includes 4 permittees who did not report; [g]Includes 86 permittees who did not report; [h]Includes 9 permittees who did not report; [i]Includes 2 permittees who did not report; [j]Includes 5 permittees who did not report; [k] Includes 2 permittees who did not report; [l]Includes 2 permittees who did not report; [m]Includes 4 permittees who did not report; [n]Includes all DM210 hunt area.

Table 5. Unit 14C moose harvest [a] chronology, regulatory years 2004–2010.

Regulatory year	Percent of harvest						
	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29	9/30–10/6	*n*
2004 [b]	10	19	24	24	24	0	21
2005 [c]	4	20	24	28	20	4	25
2006 [d]	4	20	25	27	20	4	26
2007 [e]	0	13	31	25	25	6	16
2008 [f]	0	11	15	19	44	11	27
2009 [g]	0	10	5	40	45	0	20
2010 [h]	0	0	35	17	43	5	23

[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
[g] Season 9/8–9/30
[h] Season 9/7–9/30

Table 6. Unit 14C moose harvest[a] percent by transport method, regulatory years 2004–2010.

Regulatory Year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown/ Other	*n*
2004	2	4	11	6	0	0	76	1	83
2005	2	3	9	1	0	1	77	7	99
2006	4	6	8	4	0	2	66	11	113
2007	4	11	9	3	0	1	72	0	123
2008	4	6	10	3	0	0	73	4	134
2009	3	4	24	2	0	0	58	9	148
2010	0	8	19	4	0	0	61	8	137

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

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

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

GEOGRAPHIC DESCRIPTION: Western Kenai Peninsula

BACKGROUND

Unit 15A. Historical records and reports from residents indicate moose were abundant throughout the 1900s in Unit 15A. The most recent population peak occurred in 1971. The near absence of wolves from 1913 to 1968 and increased moose survival following a 500-square-mile forest fire in 1947 were 2 factors that increased moose numbers throughout the 1950s and 1960s. Although seasons were long and either-sex harvest was allowed, the moose population increased beyond its carrying capacity and extensive overbrowsing occurred by the late 1960s. A wildfire in 1969 burned approximately 135 mi^2 (11 percent of 15A), initially reducing moose habitat in 15A. Then harsh winters from 1971 to 1974 reduced the moose population over the entire Kenai Peninsula. Estimates for Units 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 winter and high utilization of the 1969 burn area, the moose population estimate for 15A increased to about 3,000. The moose population peaked by the early 1990s and has declined since.

From 1947–1969, wildfires that occurred in Unit 15A were within an area with a perimeter of about 388,000 acres. From 1970–2010 fire perimeters have encompassed only 5,000 acres. Consequently, less browse associated with successional forest stages has been available to moose, and a gradual decline in moose population size is anticipated during normal winters.

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 Unit 15A and actively participates in a variety of cooperative moose management programs. These include support of the Alaska Department of Fish and Game Moose Research Center near Sterling, cooperative management of Skilak Loop as a wildlife viewing area, and recent attempts to provide increased access for hunters. 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.

Unit 15B. The moose population in Subunit 15B is believed to have been relatively stable from 1990 through 2001, with an estimated the population at around 1000, then declined to lower numbers. Composition counts in 15B west suggest a decline from regulatory years 1994 to 2009. A regulatory year (RY) runs from 1 July through 30 June (e.g., RY09 = 1 July 2009–30 June 2010).Because these were not censuses, it is difficult to determine the extent of the decline, but the total moose counted in RY09 was less than one-half of the 1994 count. Forests within 15B have succumbed to widespread spruce bark beetle (*Dendroctonus rufipennis*) infestations that began in the 1990s. More than 500,000 hectares of spruce forests have been affected (Kenai Peninsula Borough 2006). Since 2001, infestation rates have been decreasing as the number of unaffected trees has become scarce (U.S. Forest Service and Alaska Department of Natural Resources. 2002). Salvage logging efforts are limited because most of 15B is within the Kenai National Wildlife Refuge and has a "wilderness" designation, which limits many commercial activities.

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

During 2004–2010 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.

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

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

As far as moose habitat is considered, Unit 15C has the most potential. Since 2004, the perimeter of wildfires has encompassed over 87,000 acres in this unit. Time will tell how much quality moose habitat is regenerated from theses fires, but relative to Units 15A and 15B, Unit 15C has more potential for large areas of quality moose habitat in the near (by 2015) future. The main concern for moose in this unit is the low bull:cow ratio, which dropped to 9 bulls:100 cows in 2010. A census conducted north of Kachemak Bay resulted in a point estimate of 2,919 (Sightability Correction Factor [SCF] 1.33) which equates to approximately 2.5 moose per square mi.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

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

Primary moose management objectives in the SLWMA are as follows:

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

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

Unit 15B-West

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

Unit 15B-East

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

Unit 15C

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

METHODS

Unit 15A. During years with adequate snowfall, we conducted aerial surveys in November and December in selected trend count areas to ascertain sex and age composition. Recently, weather conditions permitted limited composition surveys during 2006, 2008, and 2009; we surveyed all of our desired count areas during 2010.

Population estimates for Subunit 15A were developed from data collected with geospatial surveys (Kellie and Delong 2006) in February 2001 and in February 2008.

Unit 15B. Composition surveys were flown in November of 2009 and 2010. This was the first time this area had been surveyed since November 1994.

Unit 15C. Fall composition surveys were conducted during 2009 and 2010. In 2010 we added 2 additional count areas. We completed a Geostat census in February 2010.

Harvest data are compiled from hunter information provided on harvest reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Composition in Unit 15A

Data from the 1991 census resulted in a 15A population point estimate of 3,432 (Confidence Interval [CI]: 2,921–3,943, SCF 1.21). The February 2001 point estimate for moose was 2,914 (95% CI: 2,429–3,378, SCF 1.20), while the February 2008 census resulted in a population point estimate of 2,088 (95% CI: 1,824–2352, SCF 1.25). These data indicate that the population was approximately 39 percent lower in 2008 compared to 1991. The next census is scheduled for 2012.

The bull:cow ratio calculated from the November 2010 composition surveys was 20 bulls:100 cows (Table 1). However, most of the bulls were found on the eastern extreme of the unit. Areas to the west had bull:cow ratios as low as 5 bulls:100 cows. Information for 2009 only includes 1 area in the eastern portion of the unit and should not be compared to other years. The calf:cow ratio of 23 calves:100cows for the 2010 survey was similar to the 21 calves:100 cows seen in 2008 (Table 1).

Population Size and Composition in Unit 15B

A February 2001 census of the 650.4 square miles of suitable moose habitat in Unit 15B estimated the population at 958 moose (95% CI: 777–1,139). This produced a density of about 1.5 moose/mi^2. Because the census was conducted during February, after most bulls had shed their antlers, composition by sex was not determined. Calves composed 21% of the population, compared to 10% found in the February 1990 census. Composition surveys were flown in 3 areas in the fall of 2009 and 2 in 2010 (Table 1). Comparing these data to data obtained in 1994 (the last time these areas were surveyed) indicates there were more than twice the number of moose in 1994 (N=489) compared to 2009–2010 (N=229). Because these were composition surveys we cannot determine the extent of the population decline, but we can compare the bull:cow ratio, which decreased from 57 bulls:100 cows in 1994 to an average 35 bulls:100 cows for the 2009–2010 surveys. All indications are that the moose population has declined in Unit 15B.

Population Size and Composition in Unit 15C

A random-stratified census (Gasaway 1986) was conducted in lowland portions of Unit 15C north of Kachemak Bay (1,190 mi^2) during the winter of 1992–1993. The population was estimated at 2,079 moose (95% CI: 1,425–2,734, SCF 1.49). During the winter of 2001–2002, a geospatial census (Ver Hoef 2001) conducted over the same area produced an estimate of 3964 moose (95% CI: 3491–4438, assumed SCF 1.33), as shown in Table 1. However, this survey was not conducted using currently accepted sampling protocols and it is likely biased high. A geospatial census was also conducted in this area during March 2010. This census produced an estimate of 2919 moose (95% CI: 2641–3197) assuming a sightability correction factor of 1.33 (Table 1). The next census is scheduled for 2012.

The actual number of moose seen during composition counts is not comparable from year to year, because survey intensity and conditions are inconsistent. Composition counts are performed in order to get an adequate sample of moose to calculate ratios of bulls to cows and calves to cows. Composition counts conducted in 2009 in two traditional count areas, one around the Caribou Hills and the other south of the Anchor River, showed 13 bulls: 100 cows and 18 calves:100 cows (Table 1). The bull:cow ratio was below the minimum management objective of 15:100. Composition data from the fall 2010 surveys (Table 1) included 2 additional areas. The new areas were added because we thought it would give us a better representation of the overall moose population due to concerns that the moose may have redistributed after the 2007 Caribou Hills fire. The 9 bulls:100 cows ratio observed during the 2010 surveys (Table 1) indicates a unitwide issue and management action would need to be taken to address it.

MORTALITY

Harvest

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

Board of Game Actions. During the March 2011 meeting The Board of Game reauthorized the antlerless moose permit hunt for the Homer area (DM549), but did not reauthorize the Skilak Loop (DM524) hunt. Other actions taken at the March 2011 meeting included changing the antler requirements for a legal bull from spike-fork 50-3bt to 50-4bt only for all general season hunts in Units 7 and 15. The board also eliminated nonresident moose hunting in Units 15A and 15C. It also requested that the department develop an intensive management proposal that included aerial shooting of wolves in Units 15A and 15C and present the proposal at the November 2011 meeting in Barrow.

During its 2006 meeting the Federal Subsistence Board liberalized the moose hunting season in Units 15B and 15C for federally qualified subsistence users. The additional season dates are 20 October–10 November. The SF-50 or 3 brow-tine restrictions still apply to this hunt.

Permit Hunts

Unit 15A. No permits were issued for the SLWMA during this report period and this hunt no longer exists due to action taken at the March 2011 Board of Game meeting.

Unit 15B. 15B East is managed as an area where hunters are able to view large-antlered bulls, and to harvest them through a drawing permit system. Permittees reported harvesting 5 bulls in 2007 and 2 in 2008 (Table 3). During 2008, the number of permits issued for the 26 September–15 October season was reduced from 50 to 10. Following results from the composition surveys in

2010, coupled with low harvests of relatively small antlered bulls, and complaints from the public, no permits have been issued for the 26 September–15 October hunt since 2009.

Unit 15C. Since 1987 there has been a Tier II subsistence hunt (TM549) for any bull in a portion of Unit 15C southwest of a line from Point Pogibshi to the point of land between Rocky and Windy bays. One to 2 bulls have been taken during this season in the last 5 years (Table 3). Also, in 2010, the Board of Game provided additional hunting opportunity 15–19 October due to poor hunting conditions during the regularly scheduled dates and hardships caused by poor salmon returns.

The antlerless hunt for moose near Homer was initiated in 1995 (DM549). No permits were issued in 2001. During the last 5 years, 50 permits were issued each year with a 5-year average annual harvest of 21 moose (Table 3).

Hunter Residency and Success

Unit 15A. Hunter success ranged 10–13% during the last 5 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the majority (82–84%) of successful moose hunters.

Unit 15B-West. Hunter success ranged 13–19% during the last 5 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the majority (81–90%) of successful moose hunters.

Unit 15C. Hunter success ranged 14–19% during the last 5 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the majority (78–87%) of successful moose hunters.

During this reporting period (1 July 2009–30 June 2011) 29% of the reported moose harvest came from Unit 15A, 11% from 15B and 59% from Unit 15C.

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 5).

Transport Methods. Most moose hunters use highway vehicles as their primary method of transportation to access hunting areas in Units 15A and 15B (Table 6). The most popular method used in Unit 15C was the all-terrain vehicle (ATV).

Other Mortality

Unit 15A. Crippling loss by hunters and loss to predation were unknown. During the last 5 years (RY06–RY10), a yearly average of 83 moose have been killed by motor vehicles in Unit 15A (Table 2). The majority of moose killed by vehicles are cows and calves. These data include only 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, we suspect 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.

Unit 15B. Crippling loss by hunters and loss to predation were unknown. During the last 5 years (RY06–RY10), a yearly average of 53 moose have been killed by motor vehicles in Unit 15B (Table 2).

Unit 15C. Crippling loss by hunters and loss to predation were unknown. During the last 5 years (RY06–RY10), a yearly average of 54 moose have been killed by motor vehicles in Unit 15C (Table 2). The high number of moose wintering within the Homer Bench continues to be habitat limited during deep snow winters. The level of mortality for these moose during severe winters is high.

HABITAT

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 the area has lost its value for producing significant amounts of quality browse. 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 7,000 acres burned in the southeastern portion of 15A near Pothole Lake. This burn increased available moose habitat; however, this benefited only 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. Generally speaking, forage benefits for moose last 20–25 years post burn, so this area is in the final years of producing quality moose habitat.

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 revegetation.

15B

Assessment

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

Enhancement

No significant enhancement projects have been identified for this unit.

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 is 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, are unknown at this time.

CONCLUSIONS AND RECOMMENDATIONS

Unit 15A. ADF&G completed a 10-year review of the selective harvest strategy in 1999. The bull-to cow-ratio increased from a 5-year (1982–1986) 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, 24:100 in 2004, and 20:100 in 2010).

Currently, the largest impacts on the 15A moose population are declining habitat quality, predation, and deaths caused by collisions with motor vehicles. The downward trend in Unit 15A moose numbers will likely continue in the absence of significant habitat altering events (such as burns encompassing more than 50,000 acres).

Since 1999, Unit 15A has been below intensive management (IM) harvest objectives every year excluding 2001. This unit 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). The Board of Game (BOG) has considered IM action, and 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 of this request a project 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 was funded to begin in late 2011.

Schwartz and Franzmann (1991) stated that by 1989, the moose population in Unit 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 (50,000 acres or more) wildfire or other habitat events, it is unlikely we can maintain a moose population of 3,000–3,500 moose (the IM population objective) in Unit 15A. Without periodic and significant habitat alteration, a more reasonable expectation would be for Unit 15A to support a moose density of 1–2 moose per square mile on a sustained basis. That would equate to a population of about 1,300–2,600 moose. Given current conditions the moose population will not recover to the numbers observed during the late 1980s to mid–1990s unless aggressive habitat management is initiated. We will continue to work with the Kenai National Wildlife refuge regarding these issues.

Unit 15B. The number and "quality" of moose taken in the permit hunts in Unit 15B East, complaints from hunters who had difficulty locating and harvesting animals, along with population survey results suggested the department needed to take action. Consequently, the number of late season (26 September–15 October) permits was reduced to 10 (down from 50) for the 2008 season and no permits were issued in RY09 or RY10. 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 and the population will respond. 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 western part of the unit. The eastern part is designated wilderness and will have to burn naturally.

Unit 15C. The bull:cow ratio dropped below 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 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 identify and 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. Additional funding was secured for research on moose productivity, calf survival, and seasonal movement of cow moose and will also begin in late 2011.

ADF&G is dedicated to mitigating moose-human conflicts, especially conflicts which pose risks to public safety. Therefore we also recommend a new objective:

- Maintain the moose population at a level to promote public safety by reducing conflicts with Peninsula residents, and participate in land management decisions that affect moose movements in an effort to direct moose into areas with lower vehicle traffic.

The expansion of federal subsistence hunting opportunities and the increased effort associated with these new opportunities have restricted the potential to allow any additional hunting opportunity for the general public. This dual system will continue to challenge wildlife managers into the future.

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Table 1. Unit 15 aerial composition counts for moose and estimated population size, regulatory years 2006–2010.

Unit	Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
15A	2006	11	13	10	226	252	1000–2000[a]
	2007			12			1800–2300[b]
	2008	11	21	16	171	204	1000–2000[c]
	2009	84	16	8	79	86	1000–2000[d]
	2010	20	23	16	288	345	1000–2000[e]
15B	2006	No Surveys Conducted					700–1000
	2007	No Surveys Conducted					700–1000
	2008	No Surveys Conducted					700–1000
	2009	51	11	7	153	164	500–1000
	2010	33	9	6	61	65	500–1000
15C	2006	No Surveys Conducted					2500–3500
	2007	12	18	14	183	212	2500–3500
	2008	13	10	8	492	537	2500–3500
	2009	13	18	14	368	426	2600–3200[b]
	2010	9	19	15	625	735	2500–3500[f]

[a] Data from 2 count areas in the western portion of the Unit.
[b] Estimates from geostatistical census method, estimated population size shown = 95% CI.
[c] Data from 2 count areas in the western portion of the Unit.
[d] Data from 1 count area in the western portion of the Unit.
[e] Data from 6 count areas dispersed throughout the Unit used to adjust population estimate.
[f] Data from expanded count area used in new population estimate.

Table 2. Unit 15 Reported general season moose harvest and accidental death, regulatory years 2006–2010.

Unit	Regulatory Year	Reported Hunter Harvest				Accidental death			Total Reported Mortality
		Bull	Cow	Unk	Total	Road	Train	Total	
15A	2006	128	1	1	130	56	0	56	186
	2007	109	0	2	111	78	0	78	189
	2008	114	1	0	115	101	0	101	216
	2009	110	0	0	110	45	0	45	155
	2010	117	0	2	119	137	0	137	256
15B	2006	39	1	0	40	56	0	56	96
	2007	40	0	0	40	41	0	41	81
	2008	33	0	0	33	41	0	41	74
	2009	38	0	0	38	61	0	61	99
	2010	51	0	1	52	65	0	65	117
15C	2006	212	1	2	215	79	0	79	294
	2007	208	2	0	210	52	0	52	262
	2008	194	0	1	195	40	0	40	235
	2009	242	2	4	248	51	0	51	299
	2010	214	3	3	220	46	0	46	266

Table 3. Unit 15 harvest data for drawing permit hunts, regulatory years 2006–2010.

	Hunt No.	Regulatory Year	Permits Issued	Permittees that hunted	Percent Success	Harvest Bulls	Harvest Cows	Harvest Unk.	Harvest Total
15A	DM524	2006	0						
		2007	0						
		2008	0						
		2009	0						
		2010	0						
	DM526	2006	0						
		2007	0						
		2008	0						
		2009	0						
		2010	0						
15B	DM530-539 (combined totals)	2006	100	67	13	9	0	0	9
		2007	100	54	9	5	0	0	5
		2008[a]	60	42	5	2	0	0	2
		2009	50	31	6	2	0	0	2
		2010	50	19	16	3	0	0	3
15C	DM549	2006	50	44	41	1	17	0	18
		2007	50	44	48	1	20	0	21
		2008	50	40	58	0	23	0	23
		2009	50	43	60	0	26	0	26
		2010	50	43	44	0	19	0	19
	TM549	2006	4	2	50	1	0	0	1
		2007	4	4	50	2	0	0	2
		2008	4	4	25	1	0	0	1
		2009	4	4	50	2	0	0	2
		2010[b]	4	4	25	1	0	0	1

[a] The drop in permits issued occurred because only 10 permits were issued for the 26 Sep-15 Oct season.

[b] Season dates expanded to include October 15–19.

Table 4. Unit 15 residency and success of moose hunters for the general season, regulatory years 2006–2010.

Unit	Regulatory Year	Successful				Unsuccessful				
		Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b] (%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	Total Hunters
15A	2006	106	12	8	130 (12)	784	158	24	973	1103
	2007	91	13	7	111 (10)	798	166	25	991	1102
	2008	97	12	4	115 (10)	827	162	24	1020	1135
	2009	91	11	7	110 (11)	763	137	17	928	1038
	2010	98	12	4	119 (13)	642	124	14	789	908
15B	2006	33	4	3	40 (14)	213	24	7	244	284
	2007	36	2	1	40 (15)	213	18	4	235	275
	2008	29	3	1	33 (13)	198	23	1	222	255
	2009	34	2	2	38 (13)	220	32	5	261	299
	2010	42	4	4	52 (19)	186	25	6	221	273
15C	2006	186	18	10	215 (16)	908	155	25	1097	1312
	2007	164	34	10	210 (17)	884	148	25	1060	1270
	2008	165	21	5	195 (14)	999	128	23	1153	1348
	2009	209	24	12	248 (19)	909	126	21	1071	1319
	2010	186	24	7	220 (18)	819	131	17	986	1204

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

Table 5 Unit 15 moose general season harvest chronology (percent of harvest), regulatory years 2006–2010

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	2006	22	19	8	8	5	14	21	4	130
	2007	23	19	9	3	10	15	18	4	111
	2008	27	21	6	7	3	12	20	4	115
	2009	25	25	7	4	6	10	19	4	110
	2010	27	24	8	5	8	11	12	7	119
15B	2006	30	25	5	5	15	3	15	3	40
	2007	30	20	3	5	10	20	13	0	40
	2008	30	21	9	3	3	6	24	3	33
	2009	29	16	5	11	8	11	16	5	38
	2010	25	25	6	4	4	10	23	4	52
15C	2006	0	37	10	7	10	10	20	5	215
	2007	1	29	11	11	11	11	19	6	210
	2008	1	34	13	11	8	9	19	4	195
	2009	0	34	10	13	10	11	17	5	248
	2010	2	38	12	7	12	11	13	4	220

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

Table 6 Unit 15 general season transport methods for moose hunters (percent of harvest), regulatory years 2006–2010

Unit	Regulatory Year	Percent of Harvest							Harvest
		3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/ Dog team	ORV	Unknown	
15A	2006	13	5	11	63	2	2	4	130
	2007	14	4	11	62	1	5	3	111
	2008	19	2	10	62	2	3	3	115
	2009	15	3	8	65	1	5	4	110
	2010	23	3	6	60	0	6	3	119
15B	2006	10	0	3	70	5	0	13	40
	2007	10	3	5	64	8	5	5	39
	2008	18	0	3	64	9	3	3	33
	2009	11	0	3	79	5	0	3	38
	2010	8	0	6	79	0	4	4	52
15C	2006	43	1	4	33	7	7	5	215
	2007	51	0	2	27	9	6	5	210
	2008	50	0	4	28	7	6	6	195
	2009	46	1	3	33	8	6	3	248
	2010	48	0	2	34	6	8	2	220

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 16A (1,850 mi^2)

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

BACKGROUND

The 16A moose population has historically experienced large fluctuation in population size as a result of die-offs during severe winters. Recovery of the moose population after a severe winter can be hampered by predation (Peltier 2010). 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 from wolves, 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 of both wolves and bears in the late 1990s and early 2000s.

Unit 16A is mostly a roadless area consisting of swamp, tiaga, and boreal forest, with some rolling foot lands and some mountainous terrain. Unit 16A includes some of Denali National Park and Denali State Park land on its northern end. Access is limited to a few points from the Parks Highway, Petersville Road or Oil Well Road. Boats, 4-wheelers, snowmobiles, and airplanes are used to access more remote portions of the unit. Since Unit 16A was separated from Unit 16B in 1973, annual hunter harvests have fluctuated as a result of variable moose densities, availability of cow moose hunts, and improved hunter access that resulted from the development of 4-wheelers (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 from 2002 through 2006 (Kavalok 2008).

Beginning in regulatory year 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 3 brow tines on at least one side or a minimum total width of 50 inches. (A regulatory year begins 1 July and goes to 30 June; e.g., RY07 = 1 July 2007 – 30 June 2008.) This selective harvest strategy is referred to as “spike-fork-50-inch” (SF-50) (Schwartz et al. 1992).

A predator control program implemented in Game Management Unit 16B was expanded in 2006 to include the non-roaded portions of Unit 16A. This was done in an effort to expand control efforts on wolf packs that existed near the boundary of Units 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, among others, included provisions for an unlimited take of black bears, the taking of sows with cubs, and the taking of cubs. 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.

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

Population estimates and sex and age composition data were compiled from a Ver Hoef (2001) Geospatial Population Estimator (GSPE) survey conducted in the fall of 2009.

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; 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 increased about 59% between the fall surveys in 2005 (1,619 ± 197, 80% CI) and 2009 (2,574 ± 294, 80% CI; Table 1). While the trend is positive the population still lags behind the 1997 estimate of 3,636 ± 614 (80% CI)

Population Composition

The bull: 100 cow ratio for the 2009 survey was 26 and the calf: 100 cow ratio was 29. The composition assessed in 2005 included 22 bulls and 19 calves:100 cows (Table 1). Estimates for both years were down from the 33 bulls:100 cows and and 35 calves:100 cows found in 1997.

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 1 bull with a spike or fork antler on at least one side or with an antler spread at least 50 inches or 3 or more brow tines on at least one side (SF-50).

Board of Game Actions and Emergency Orders. At its spring meeting in 2011, the board increased the season length by 5 days to close on 25 September. This was done to bring some alignment with the neighboring game management units.

Hunter Harvest. Harvest increased during this period compared to the previous reporting period (Table 2). However, the 5-year average (RY06 – RY10) was 109 moose, which was less than the previous 5-year (RY01–RY05) average of 144 moose, 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 Unit 16A averaged 794 per year during RY06–RY10, down from the average of 912 during RY01–RY05 (Table 3). Most hunters were not considered local residents (i.e., residents of Unit 16). Hunter success during the reporting period was 16.5%. This is higher than the previous 8-year average of 14.6%.

Harvest Chronology. Two moose were taken in the 10–17 August archery season in each of RY 09 and RY10 (Table 4). Hunters generally waited until the end of the season to hunt in GMU 16A, harvesting more than 70% of moose taken during the general season moose in the last 2 weeks.

Transport Methods. Over the last 10 seasons, successful hunters have used mostly 4-wheelers and boats for transportation (Table 5). In 1998 the department began tracking harvest by hunters who use airboats. Since that time up to 5 percent of the successful hunters have reported using airboats in GMU 16A each year.

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 but did not occur. (W. Collins, ADF&G, personal communication). During spring and summer 2007, a 10,000-acre wildfire burned over major portions of the same prescription area (G. Holt personal communication). This was expected to result in improved habitat and forage for moose. Because of negative public sentiment towards fire after the 1995 Miller's Reach/Big Lake wildfire and the 2007 wildfire that occurred in the prescribed burn area, it is unlikely the planned prescribed burn will take place anytime soon, if at all.

Timber harvest and forest regeneration has produced limited enhancement opportunities during this reporting period. The Alaska Department of Natural Resources, Division of Forestry proposed additional timber sales that would have potential to enhance habitat for moose. While some of this sale activity was curtailed or shut down due to local sentiment or court order, it is hoped that future proposed sales will occur to allow for habitat and forage enhancement opportunities.

The National Park Service has continued its planning and design efforts to build a new visitor's center located in Denali State Park. This NPS facility will be located in Unit 13E adjacent to the northeast corner of Unit 16A. Construction of the visitor's center and access road may have an impact on moose habitat and movement. More importantly, the associated infrastructure, support industry, and visitor traffic associated with this development may affect moose hunting and other consumptive uses in the area.

CONCLUSIONS AND RECOMMENDATIONS

It appears that the moose population in Unit 16A may be slowly recovering. The population has increased from the low numbers of 2005, and the increase in the amount of bulls harvested in the area shows promise. Some of these trends may be due to the predator control program that is taking place in about half of the unit and in neighboring 16B. A prolonged suppression of predators and a string of mild winters would improve the 16A moose population.

Unit 16A has become inundated with all-terrain-vehicle trails in recent years. This improved access will result in hunters getting to the more remote corners of the unit and this should be reflected in an increase in harvest.

Survey information for Unit 16A is sporadic. Biennial surveys with a consistent methodology would go a long way toward capturing accurate population trends and help managers be more responsive to fluctuation in populations and sex and age components.

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Table 1. Unit 16A fall aerial moose composition surveys and censuses, 2000–2010.

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose / mi^2	Population Size[a]
2000[b]	28	6	22	15	661	787	1.4	2420 ± 528
2001[c]	--	--	--	--	--	--	--	--
2002[c]	--	--	--	--	--	--	--	--
2003[c]	--	--	--	--	--	--	--	--
2004[c]	--	--	--	--	--	--	--	--
2005[d]	22	3	19	14	510	590	1.1	1619 ± 197
2006[c]	--	--	--	--	--	--	--	--
2007[c]	--	--	--	--	--	--	--	--
2008[c]	--	--	--	--	--	--	--	--
2009[d]	26	6	29	19	691	853	1.9	2574±294
2010[c]	--	--	--	--	--	--	--	--

[a] Population estimate and 80% confidence interval.
[b] Becker and Reed (1990) survey methodology.
[c] No survey conducted.
[d] Ver Hoef (2001) survey methodology.

Table 2. Unit 16A moose harvest and accidental death, 2001–2010.

Regulatory year	Reported				Estimated			Accidental_deaths[c]			Grand total
	M	F	Unk	Total	Unreported[a]	Illegal[b]	Total	Road	Other	Total	
2001	153	0	0	153	11	25	36	15	0	15	204
2002	155	0	0	155	11	25	36	12	0	12	203
2003	168	0	0	168	12	25	37	17	0	17	222
2004	139	0	0	139	10	25	35	15	0	15	189
2005	107	2	0	109	8	20	28	10[d]	0	10	147
2006	115	0	0	115	8	20	28	10[d]	0	10	153
2007	85	0	1	86	6	20	26	10[d]	0	10	122
2008	103	0	0	103	7	20	27	10[d]	0	10	140
2009	116	0	1	117	8	20	28	10	0	10	155
2010	125	0	1	126	9	20	29	10	0	10	165

[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, 2001–2010.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total	
2001	12	131	10	0	153 (18)	40	649	19	5	713	866
2002	7	134	14	0	155 (16)	43	730	29	0	802	957
2003	12	144	11	1	168 (19)	48	696	38	0	782	950
2004	7	119	10	3	139 (16)	33	646	40	0	719	858
2005	4	101	4	0	109 (12)	42	726	49	3	820	929
2006	3	100	10	2	115 (13)	40	676	26	15	757	872
2007	5	73	7	1	86(11)	41	599	37	0	677	763
2008	7	85	11	0	103(12)	42	680	29	0	751	854
2009	2	103	11	1	117(16)	29	566	33	5	633	750
2010	5	113	7	1	126(17)	40	529	29	5	603	729

[a] Unit 16 residents.

Table 4. Unit 16A moose harvest chronology 2001–2010.

Regulatory year	August			September					Unknown	Total
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30		
2001[a]	0	8	3	7	10	34	37	52	2	153
2002[a]	0	17	2	9	12	33	34	44	4	155
2003[a]	0	13	6	10	15	34	34	47	9	168
2004[a]	0	8	4	9	20	35	37	21	5	139
2005[a]	1	5	2	8	11	19	24	36	3	109
2006[a]	0	4	5	6	14	33	24	25	4	115
2007[b]	0	1	3	11	22	48	--	--	1	86
2008[b]	1	13	2	8	25	52	--	--	2	103
2009[b]	2	11	6	12	28	55	3	--	0	117
2010[b]	2	10	6	14	39	53	1	--	1	126

[a] Open season = 10–17 Aug (Archery-only), 20 Aug–30 Sep (SF-50).
[b] Open season = 10–17 Aug (Archery-only), 20 Aug–20 Sep (SF-50).

Table 5. Unit 16A percent transport methods of successful moose hunters, 2001–2010.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Total
2001	10	0	25	38	0	8	16	0	3	153
2002	10	0	23	33	0	11	16	2	5	155
2003	11	0	21	40	0	8	14	1	5	168
2004	9	1	15	52	0	6	15	2	0	139
2005	12	1	19	47	0	6	13	1	1	109
2006	13	1	17	45	0	6	10	4	4	115
2007	6	1	25	45	1	6	13	0	4	86
2008	9	0	28	32	0	12	14	0	5	103
2009	10	0	22	51	0	9	6	0	2	117
2010	7	0	30	29	0	14	15	2	3	126

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 16B (10,405 mi^2)

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 1989–1990, there probably were 8,500–9,500 moose (Harkness 1993). Following a 15–20% decline after the winter of 1989–1990, moose numbers in the unit continued to decline in response to deep snow winters and growing predator influence (Griese 2000).

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 (ADF&G biologist, 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). Studies in Unit 16B strongly suggest that bear predation has a strong influence on calf recruitment as well (Faro, 1989; J. Crouse ADF&G, unpublished data). Black and brown bear surveys were conducted in spring of 2007 and indicated a very high density of bears in the unit (Peltier, 2011). Brown bear season and bag limits were liberalized and a black bear control program began in the fall of 2007 (Peltier 2008*a*, 2010).

During 1962–1974, hunting seasons were liberal in Subunit 16B (20 August–30 September and 1–30 November, both seasons for either-sex moose). From 1976 through 1989, an antlerless moose hunt was held during September. Increasing numbers of hunters and lower moose recruitment caused the November 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 1 side or a minimum of 3 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 Unit16B.

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 3 areas: TM565, TM567, and TM569 (Del Frate 2004).

The Kalgin Island moose population resulted from a translocation of calves during 1957–1959. Numbers grew to a density of 7 moose/mi^2 during 1981 (Taylor 1983), but were reduced to approximately 1 moose/mi^2 by 1985. High moose densities severely degraded habitat and the department adopted restrictive population objectives to maintain moose densities at less than 1 moose/mi^2 while vegetation recovered (Faro 1990). In 1999 the Board of Game, adopted an any-moose registration hunt 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 posthunt 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 composition surveys were conducted in Unit 16B Middle in 2009. A Geospatial Population Estimator (GSPE) was conducted in 16B South, and a trend survey was conducted on Kalgin Island in 2010. All previous surveys in 16B South were age and sex trend counts. 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

The population of 16B South was estimated at 2,372 ± 778 (Table 1). This estimate includes a sightability correction factor. The previous estimate was about 960 moose based on a sex and age composition survey in 2004 (Peltier 2008*b*). Based on the 2008 surveys of 16B Middle at 2,446 ± 322 and 16B North at 834 ± 121 the estimated population for all of Unit 16B is 4,818 ± 1,221. The moose population on Kalgin Island was estimated to be 70–90 moose in November 2010.

Population Composition

We completed composition surveys of 16B Middle in fall of 2009. The survey results suggest drops in the bulls to 100 cows and calves to 100 cows ratios. The bulls to 100 cows ratio decreased from 54 in 2008 to 39 in 2009, and the calves to 100 cows ratio decreased from 21 to 19 (Table 1). However, these numbers should be considered with caution. Results of a multi-year calf recruitment study in the area indicate that calves to 100 cow ratios can vary greatly (unpublished ADF&G data, Palmer office); survey results may reflect this. However, it is unlikely the bull to cow ratio actually decreased by this amount; the survey result more likely reflects that the trend count area was not representative of the whole survey unit

The bulls to 100 cows ratio in 16B South went from 78 during the fall 2008 composition survey to 52 in the 2010 GSPE survey. The calves to 100 cows ratio was 18 and did not change between surveys.

Mortality

Harvest

Season and Bag Limit The general resident-only hunting season for RY09 and RY10 was August 20 to September 20 (Table 2). Tier II (TM 565, TM 567, and TM 569) hunting was open for any bull 15 November–28 February. There were 262 Tier II permits issued for RY09 and 260 permits issued for RY10 (Table 3). Kalgin Island was open to registration hunting (RM572) 20 August–20 September (any moose).

Board of Game Actions and Emergency Orders. During the BOG meeting in the spring of 2011 the board passed a nonresident hunting season for the unit which was to be implemented in the fall of 2011. The board also approved a brown bear control program in a 960 square mile subsection of unit 16B between the McArthur and Beluga Rivers.

Hunter Harvest. Harvest increased during RY09–RY10 over the previous reporting period, consistent with the return of a general resident season (Table 2). The Tier II harvest decreased from the previous reporting period (Table 3). The harvest on Kalgin Island averaged 25 moose during the reporting period, down from an average of 32 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 resident and nonresident hunters, excluding Tier II hunters, during RY06–RY08 (Table 4). The majority of resident hunters were nonlocal residents.

Harvest Chronology. Bulls become more vulnerable to hunters the closer the season gets to the rut, which is evident by the fact that most moose were taken during the last 2 weeks of the season both years (Table 5).

Transport Methods. The lack of road accessibility to the unit is reflected by the dominance of aircraft and boat transportation as transportation modes used by successful hunters (Table 6). ATV access in the unit is from hunters starting at privately-owned seasonally-occupied cabins.

Other Mortality

The severe winter of 1999-2000 had a negative impact on the moose population in unit 16B, which has struggled to recover (Peltier 2010). Predation has been thought to be a limiting factor in the recovery. As a result a wolf control program was implemented in 2004, a black bear control program began in 2007, and an experimental brown bear control program began on a portion of 16B in 2011. At this time the effects of these programs are not clear. Calf recruitment is still relatively low compared with other moose populations; however, overall survey numbers appear to be increasing.

CONCLUSIONS AND RECOMMENDATIONS

Our estimate of 5,860 moose in Subunit 16B was below the minimum population objective of 6,500; however, that objective is within the 80% confidence interval for the estimate. Twinning rates and other nutritional indices suggest habitat quality is not limiting the population. Current season and bag limit structure will allow bull:cow ratios to remain above minimum objective levels. If the moose density remains low, caution should be exercised by maintaining 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 RY12 if snow cover and weather conditions allow. Additional measures to determine the size of the black bear and brown bear populations should be taken to help determine their impact on the moose population and recovery potential.

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Table 1. Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, RY01–RY10.

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[b]
2001	North [a]	11/5–7	40	7	14	9	393	438	0.8	1187±182
	Middle [a]	11/8–11	32	4	10	7	494	537	0.7	1836±267
	South[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[e]	--	--	--	--	--	--	--	--	--	--
2003	North [f]	11/24–12/6	35	7	17	9	292	326	--	898±163
	South [c]	12/1	46	17	23	14	133	154	--	700-850
	Kalgin Is.[d]	11/25	38	25	89	39	76	125	--	179
2004	South [c]	12/5-9	23	10	23	16	509	604	--	960
2005	Middle [g]	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	Kalgin Is.[d]	2/9/07	--	--	--	30	26	37	1.6	50-70
2007	Kalgin Is.[d]	11/19/07	26	13	67	37	77	118	5.2	120-140
2008	North[g]	10/29–30	58	16	12	7	318	340	1.9	834±188
	Middle[g]	11/15–17	54	11	21	12	600	678	1.1	2446±322[h]
	South[c]	12/2/08	78	13	18	9	224	247	--	--
2009	Middle[c]	11/15–11/17	39	--	19	12	315	359	--	--
2010	South[g]	11/13-11/18	52	15	18	11	628	703	1.1	2372±778[h]
	Kalgin Is.[d]	12/7	23	--	48	28	38	53	2.3	70-90

[a] Becker survey (Becker and Reed 1990).
[b] Includes 80% confidence intervals where appropriate.
[c] Trend area composition survey (2–4 min/mi^2).
[d] Trend area composition survey (6–8 min./mi^2).
[e] No surveys completed.
[f] 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.
[g] GSPE.
[h] Includes a sightability correction factor.

Table 2. Unit 16B moose harvest and accidental death, RY01–RY10.

Regulatory year	Reported				Estimated			Accidental deaths			Grand Total
	M	F	Unk	Total[a]	Unreported[b]	Illegal	Total	Road	Other	Total	
2001[c]	131	22	1	154	10	25	35	0	0	0	189
2002[c]	91	16	2	109	10	25	35	0	0	0	144
2003[d]	206	25	1	232	15	25	40	0	0	0	272
2004[d]	184	34	0	218	15	25	40	0	0	0	258
2005[d]	149	10	0	159	15	25	40	0	0	0	199
2006[e]	117	11	0	128	15	25	40	0	0	0	168
2007[e]	116	10	0	126	15	25	40	0	0	0	166
2008[e]	137	15	0	152	15	25	40	0	0	0	192
2009[f]	196	8	4	208	15	25	40	0	0	0	248
2010[f]	217	10	0	227	15	25	40	0	0	0	267

[a] Includes all reported harvest including Federal Subsistence.
[b] Includes moose taken in defense of life or property.
[c] Season is Tier II only, Aug 20 –Sep 30 (SF-50) and Nov 15 – Feb 28 (any bull); Kalgin Island Aug 20 – Sep 20.
[d] Season is Resident Harvest, Sep 1 – Sep 20 (SF-50), Tier II Nov 15 – Feb 28(any bull); Kalgin Island Aug 20 – Sep 20.
[e] Season is Tier II only, Sep 1 – Sep 20 (SF-50) and Nov 15 – Feb 28 (any bull); Kalgin Island Aug 20 – Sep 20.
[f] Season is Resident Harvest, Aug 20 – Sep 20 (SF-50), Tier II Nov 15 – Feb 28 (any bull); Kalgin Island Aug 20 – Sep 20.

Table 3. Unit 16B moose harvest data by permit hunt, RY01–RY10.

Hunt Number [a]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest Bulls	Harvest Cows	Harvest Unk	Harvest Total
TM565	2001	140	29	64	36	42	0	0	42
	2002	141	25	67	33	33	0	0	33
	2003	141	27	57	43	43	1	0	44
	2004	100	11	42	58	43	1	0	44
	2005	141	28	51	49	48	0	0	48
	2006	120	14	53	47	46	0	0	46
	2007	100	21	48	52	40	1	0	41
	2008	110	20	49	51	44	0	0	44
	2009	102	25	48	52	39	0	1	40
	2010	99	21	42	58	44	0	0	44
TM567	2001	160	31	64	36	45	0	1	46
	2002	160	37	86	14	14	0	0	14
	2003	60	22	49	51	23	0	0	23
	2004	60	8	32	68	26	0	0	26
	2005	60	25	55	45	20	0	0	20
	2006	140	21	59	41	42	0	0	42
	2007	80	20	48	52	33	0	0	33
	2008	120	18	48	52	50	0	0	50
	2009	80	20	48	52	32	0	1	33
	2010	80	24	37	63	37	0	0	37

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	2001	100	42	67	33	32	0	0	32
	2002	100	26	69	31	21	0	0	21
	2003	60	28	68	32	13	0	0	13
	2004	60	13	64	36	9	0	0	9
	2005	59	36	74	26	9	0	0	9
	2006	85	34	69	31	17	0	0	17
	2007	100	19	63	37	29	0	0	29
	2008	101	30	58	42	23	0	0	23
	2009	80	36	76	24	12	0	0	12
	2010	81	40	55	45	22	0	0	22
DM571/ RM572	2001	142	30	67	33	10	21	0	31
	2002	130	27	59	41	21	16	1	38
	2003	202	29	61	39	30	24	0	54
	2004	255	28	70	30	22	32	0	54
	2005	194	34	83	17	10	10	0	20
	2006	143	41	76	24	9	11	0	20
	2007	131	44	68	32	14	9	0	23
	2008	134	10	70	30	13	0	0	13
	2009	131	32	74	26	14	8	0	22
	2010	131	26	70	30	18	10	0	28

[a] TM = Tier II permit, RM = registration permit, DM = drawing permit.

Table 4 Unit 16B moose hunter[a] residency and success RY01–RY10

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total	Total hunters
2001[c]	--	--	--		--	--	--	--	--	--	--
2002[c]	--	--	--		--	--	--	--	--	--	--
2003	9	88	1	1	99 (24)	20	281	3	5	309	408
2004[d]	7	75	0	3	85 (20)	29	300	6	5	340	425
2005[d]	3	59	0	0	62(16)	17	293	2	3	315	377
2006[c]	--	--	--	--	--	--	--	--	--	--	--
2007[c]	--	--	--	--	--	--	--	--	--	--	--
2008[c]	--	--	--	--	--	--	--	--	--	--	--
2009[d]	7	91	0	2	100(23)	22	305	0	6	333	433
2010[d]	8	88	0	1	97(25)	23	269	0	3	295	392

[a] Does not include individuals participating in permit hunts.
[b] Unit 16 residents.
[c] No general open season.
[d] No general nonresident open season.

Table 5. Unit 16B moose harvest chronology[a] by months of season, RY01–RY10.

Regulatory year	August		September					Unknown	Total
	20–26	27–31	1–7	8–14	15–20	21–25	26–30		
2001[b]	--	--	--	--	--	--	--	--	--
2002[b]	--	--	--	--	--	--	--	--	--
2003[c]	--	--	15	28	47	1	2	6	99
2004[c]	1	--	12	22	47	1	1	1	85
2005[c]	1	--	7	21	32	1	--	--	62
2006[b]	--	--	--	--	--	--	--	--	--
2007[b]	--	--	--	--	--	--	--	--	--
2008[b]	--	--	--	--	--	--	--	--	--
2009[d]	2	4	11	24	58	--	--	1	100
2010[d]	4	2	8	39	43	--	--	1	97

[a] Does not include harvest from permit hunts.
[b] No general open season.
[c] Open season = Sep 1–20 (SF-50).
[d] Open season = 20 Aug–20 Sep (SF-50).

Table 6. Unit 16B percent transport methods of successful moose hunters[a], RY01–RY10.

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Sample size
2001[b]	--	--	--	--	--	--	--	--	--	--
2002[b]	--	--	--	--	--	--	--	--	--	--
2003	56	1	16	14	1	1	5	5	1	99
2004	64	0	15	12	0	1	5	4	0	85
2005	63	--	19	13	--	--	1	1	1	62
2006[b]	--	--	--	--	--	--	--	--	--	--
2007[b]	--	--	--	--	--	--	--	--	--	--
2008[b]	--	--	--	--	--	--	--	--	--	--
2009	59	3	19	12	0	2	4	1	0	100
2010	56	1	27	7	1	3	3	2	0	97

[a] Does not include harvest from permit hunts.
[b] No general open season.

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 17 (18,800 mi^2)

GEOGRAPHIC DESCRIPTION: Northern Bristol Bay

BACKGROUND

Moose are relatively new inhabitants in the Bristol Bay area, possibly migrating 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 legal bag limit has always been restricted to bulls. In the past, a general disregard for seasons and bag limits by unit residents was suspected to be the principal factor contributing to low densities of moose in the unit (Taylor 1990).

In the last three decades, moose populations throughout Unit 17 have increased substantially in number and range. Reasons for this increase 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 throughout the unit in areas of suitable habitat. Moose successfully extended their range westward into and beyond the 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

- Achieve and maintain a density of 1 moose/mi^2 on habitat considered good moose range. Intensive management objectives: Manage for a population of 4,900–6,000 moose with human use of 200–400 moose.

Subunit 17C

- Maintain a minimum density of 0.5 moose/mi^2. Intensive management objectives: Manage for a population of 2,800–3,500 moose, with human use of 165–350 moose.

METHODS

Moose populations in Subunit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Movements along the border of Subunits 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994. In March 1998, 36 moose were radiocollared in 17A to study movements and population parameters (Aderman, et al. 1999). Additional moose in 17A are periodically radiocollared to support this continuing study. 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 in various portions of Subunits 17B and 17C. Historically surveys were conducted using the Gasaway population estimation technique (Gasaway et al. 1986) in 1983 in a portion of 17C, in 1987 in a portion of the upper Mulchatna River area of 17B, and in 1995 in western 17C and most of 17A. Beginning in March 1999, a geospatial population estimator (GSPE) technique (Kellie and DeLong 2006, DeLong 2006) was used for population estimation surveys in 17B and 17C. However, because the survey units were classified into one of four strata (super low, low, medium or high) the data was analyzed using the MoosePop program (Reid, D.J. 1989) rather than the standard GSPE two strata (low and high) analysis.

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 2011 indicated a minimum population of 1,166 moose in 17A (A. Aderman, Wildlife Biologist, TNWR, Dillingham, personal communication). 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 Subunit 17B is good moose habitat, we established the intensive management population objective for 17B as 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, 2006, and 2010 moose population estimation surveys were completed in the western portion of 17B using the Geospatial Survey technique. These estimates indicate the 17B moose population is less than the intensive management population objective (Table 1).

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, 2004, and 2008 moose population estimation surveys were completed in 17C north of the Igushik River using the geospatial survey technique and MoosePop analysis. These estimates indicate the 17C moose population is above the minimum intensive management population objective (Table 1).

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. Minimum calf percentages obtained during population estimation surveys conducted in Unit 17 since 1999 indicate percentages are generally less in 17B than in 17C (Table 1).

Distribution and Movements

Much of Unit 17 is wet or alpine tundra, and moose are located predominantly along the riparian areas. We know little about specific movement patterns, except that they are influenced primarily by the rutting season in late September and by snow conditions throughout the winter.

Data from a joint ADF&G and TNWR radiotelemetry study indicated most moose radiocollared in western 17C stayed in that area, but there was some movement into 17A. One collared moose and her calf moved from Weary River to Kulukak River (Jemison 1994). During the February 1995 population estimation survey, 29 moose moved into 17A from the upper Sunshine Valley in 17C (Aderman et al. 1995). Aderman et al. (2000) found that in 17A some collared moose remained in the same range during winter and summer while others used different ranges during those seasons. Since then, moose collared in 17A have moved into western 17A and the southern part of Unit 18. These moose seem to be part of a continued westward expansion of moose into previously unpopulated moose habitat (Aderman and Woolington 2005, Aderman 2008).

MORTALITY

Harvest

Season and Bag Limit. 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). 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 RY09 was 18–31 January. The winter resident-only 2-week registration hunt in 17A and western 17C (RM575) for RY10 was 27 December–9 January. Registration permit holders could take 1 bull in a regulatory year. There was no general hunt or nonresident hunting season for moose in Subunit 17A.

The general moose hunt in Subunits 17B and 17C was open for resident hunters 1–15 September. The bag limit for residents was 1 bull with spike-fork (SF) or 50-inch or greater antler spread or with 3 or more brow tines on at least one side (SF-50-3bt). The general moose hunt in 17B for nonresident hunters was 5–15 September with a bag limit of one 50-inch bull with at least 4 brow tines on one side (SF-50-4bt). Nonresidents were prohibited from hunting moose in 17C.

The fall Alaska resident-only registration hunt in 17B and 17C (RM583) was open 20 August–15 September. Resident registration permit holders could take 1 bull (no antler size restriction) in a regulatory year. The fall nonresident-only registration moose hunt in the 17B nonresident corridor (RM587) was 5–15 September. Nonresident registration permit holders could take one 50-inch bull with at least 4 brow tines on one side. The area open for this registration hunt was a corridor extending 2 miles on either side of, and including the Nushagak River beginning at the southern boundary of Unit 17B and extending north to the Chichitnok River, and including Harris Creek, King Salmon River, and the Chichitnok River; Mulchatna River upstream to the mouth of the Chilchitna; Nuyakuk River extending west to the falls; Koktuli River upstream to the mouth of the Swan River; and Stuyahok River to the confluence of the East and West Forks.

The winter resident-only registration hunt in 17B and 17C (RM585) was open 1–31 December. Registration permit holders could take 1 bull in a regulatory year.

Registration hunt RM573 permits were valid only in 17A and were available 5 August–20 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 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. Board of Game actions regarding moose hunting regulations during this reporting period consisted of changing the winter resident registration hunt to include all of 17B and 17C. That is, those areas previously closed by regulation during the winter season (Mulchatna River drainage above the Chilchitna River, the Iowithla River drainage, and 17C west of the Wood River) were included within the hunt area. However, the Iowithla River drainage and the area within one-half mile of the Aleknagik Lake Road were closed by discretionary permit authority for conservation concerns. Emergency orders during this reporting period consisted of the opening of registration hunt RM575 each winter.

Hunter Harvest. As a result of a more than 2-fold increase in moose hunters afield in Unit 17 since 1983 (RY83=580; RY10=1,289), reported moose harvests have more than doubled (RY83=127; RY10=343). However, the most recent years have seen a decline in harvest from the peak year of RY03 (Table 2). Also, it is important to note that since the peak year of RY03, the harvest in Subunits 17B and 17C has been trending downward, while harvest in Subunit 17A has been increasing. This is reflective of the eruptive moose population in 17A and eastern Unit 18, while the populations in 17B and 17C are settling into a lower level of harvest than they experienced during their more productive earlier years.

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last 5 seasons, at least 42% of the harvest reports on which hunters included the antler size consisted of moose with antler spreads of 50 inches or greater. The largest antlers reported for each of these seasons has been at least 70 inches (Table 3).

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 4). Subunit 17A has not had an open general moose hunting season since RY80. The reported harvest in the past 5 years (RY06–RY10) for the general moose season in 17B has ranged 18–53, with a mean annual harvest of 39 moose (Table 5). In 17C, the 5-year mean annual harvest for the general hunt was 18 moose, with a range of 11–25 (Table 6).

Permit Hunts. Longer seasons and more liberal bag limits have enticed many hunters to participate in the registration hunts (RM573, RM575, RM583, RM585, and RM587). The following is a breakdown of the fall and winter hunts by Subunit during RY09 and RY10. In Subunit 17A (RM573), 155 permits were issued, 87% of those who reported actually hunted, and they harvested 31 bull moose for a success rate of 24%. In Subunit 17B, (RM583 &RM585) 1,209 permits were issued, 79% of the permittees who reported actually hunted, and they harvested 63 bull moose for a success rate of 31%. In Subunit 17C, (RM583 & RM585) 1,182 permits were issued, 81% of the permittees who reported actually hunted, and they harvested 251 moose (245 bulls and 6 of unknown sex) for a success rate of 27%. The winter hunt (RM585) in 17B&C was highly successful with 49 moose being taken each year.

In RY10, 144 permits were issued in 17A, 87% of the permittees who reported actually hunted, and they harvested 37 bull moose for a success rate of 30%. In 17B, 1,203 permits were issued, 83% of the permittees who reported actually hunted, and they harvested 45 bull moose for a success rate of 24%. In 17C, 1,166 permits were issues, 83% of the permittees who reported actually hunted, and they harvested 251 moose (244 bulls and 7 of unknown sex), for a success rate of 26%. Each year 15% to 20% of those receiving registration moose hunting permits for Unit 17 reported that they did not hunt (Tables 7, 8, 9, 10).

RM587 which is hunt in 17B and for nonresident hunters saw 32 and 38 permits issued annually for RY09 and RY10 respectively. Nearly 95% of the permittees hunted each year which is well above what was seen for residents in the other permit hunts. This is because nonresident hunters need to come to Dillingham to get their permits and at that point are already geared up and ready to go on their hunt. Twelve moose were taken in RY09 and 9 in RY10.

Hunter Residency and Success. The mean number of moose hunters participating each year in the general moose hunting season in Unit 17 during the past 5 years (RY06–RY10) was 226, a continued decline from the previous reporting periods (Table 4). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. The number of nonresident hunters has followed a similar statewide decline in nonresident moose hunters. Unitwide success during the general hunt ranged 20–29% during the past 5 years, with a mean annual success rate of 25%. DuringRY06–RY10, nonresidents accounted for 46% of reporting hunters in the general hunt, residents of Unit 17 accounted for 16%, and other residents of Alaska made up 37% (Table 4). Resident hunters from Unit 17 generally try to hunt under the permit hunts that are "any bull" hunts and only hunt under the general season if they inadvertently miss the timing window for obtaining a registration permit.

The mean annual number of resident moose hunters participating in registration moose hunts in Unit 17 during this report period was 1,072, compared to the past report period of 897. This represents a 16% increase in resident hunting effort, and continues the trend that has been evident since RY92 (Table 10).. Success during the registration hunts in Unit 17 averaged 27% during the report period, lower than any report period going back to RY92/93, and the first to be below 30% during that period. Residents of Unit 17 composed 88%, and other residents of Alaska made up 12% of hunters in the resident registration hunts during the report period. (Table 10).

Harvest Chronology. Because of changes in seasons and weather, chronology data did not indicate consistent patterns (Table 11 and 12). 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 continued to be the primary means of access for successful moose hunters in the general hunt in Unit 17 during this reporting period (5-yr mean = 64%, Table 13). Most successful hunters in the registration hunts used boats for access (5-yr mean = 69%, Table 14). In RY90, 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. As participation increases for the winter hunts, snowmachines have become an increasingly important means of transportation.

Other Mortality

Observations of predation by wolves and bears occurred regularly throughout this reporting period. Reports from local resident and nonlocal hunters suggest wolf numbers have been increasing unitwide, and brown bears are common. Snow depths throughout the unit were moderate during the winters of this reporting period, and there were no reports of excessive winter mortality. Moose were apparently able to find abundant forage on winter ranges in riparian areas.

Illegal harvest of moose in Unit 17 was probably more of a problem in the past than during recent years. Unit residents used to actively pursue moose with snowmachines during the winter and spring, when both male and female moose were taken. Attitudes are changing following considerable efforts by state and federal management agencies, working with local communities, to help hunters see the benefits of reducing illegal moose kills. It is now common to see moose near local villages throughout the winter.

HABITAT

Assessment

Aderman, et al. (1999) established 7 intensive mapping areas in Subunit 17A, based on computer-aided analysis of Landsat photos. He visited 104 sites for ground-truthing in July 1998. Information collected included dominant vegetation species, slope, aspect, and drainage. Aderman (1999) estimated a minimum of 560 mi^2 of optimal moose winter habitat and another 520 mi^2 of secondary moose winter habitat in 17A.

No formal habitat-monitoring programs were conducted in the remainder of Unit 17. Moose winter ranges along the Nushagak and Mulchatna rivers, and along the lower reaches of the major tributaries to those rivers, are probably in good condition. Although there is evidence of heavy browsing in some areas, willow stands on gravel bars are abundant and include a good mix of brush heights. 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

A small-scale willow regeneration project in the lower Nushagak River sponsored by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) was conducted during winters of RY09 and RY10 (J. Loiland, District Conservationist, NRCS, Dillingham, personal communication). Though willow growth in the study plots was encouraging, no quantitative analysis was conducted. Because of the relative inaccessibility of most of the unit and the occurrence of natural habitat change, human-caused habitat enhancement activity on a large scale is not practical.

Lightning-caused wildfires occur in the unit; however, these are typically too small to produce substantial amounts of enhanced moose habitat. 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, Togiak, and Mulchatna rivers and the lower reaches of the major tributaries to those rivers.

NONREGULATORY MANAGEMENT PROBLEMS

Dramatic increases in the number of caribou in the Mulchatna caribou herd (MCH) 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 provided by the once abundant Mulchatna caribou herd. There is documentation in other studies where wolves increased in response to caribou population growth, but maintained their higher numbers even after caribou declined by switching to alternate prey species such as moose. This may be the case here in Unit 17, whereas the Mulchatna caribou herd has declined dramatically over the past 15 years, wolves were able to redirect their efforts toward an abundant moose population. The same prey shift can be expected over a larger area of the unit as the caribou herd declines (Woolington 2005). As the MCH has declined, reduction in nonresident hunting opportunity for caribou has likely resulted in a lower 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.

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Table 1. Unit 17 moose population estimation surveys, RY98 through RY09.

Survey Area	Regulatory Year	Population Estimate	Moose/ $Mi.^2$	Total Survey $Mi.^2$	Moose Habitat (Mi^2)	Moose/Mi^2 Moose Habitat	Min. % Calves
17B (west)[a]	RY00	1,202 (+/- 141)	0.22	5,524	2,932	0.41	5%
	RY05	1,210 (+/- 120)	0.22	5,524	3,140	0.39	12.5%
	RY09	1,137 (+/- 159)	0.21	5,510	3,146	0.36	8%
17B(east)[b]	RY01	1,953 (+/- 254)	0.46	4,269	2,914	0.67	4%
	RY08[c]	1,466 (+/- 424)	0.37	3,981	2,913	0.50	8%
17C	RY98	2,955 (+/- 488)	0.54	5,447	3,795	0.78	15%
	RY03	3,670 (+/- 542)	0.67	5,447	4,096	0.90	11%
	RY07	3,235 (+/- 354)	0.59	5,447	4,280	0.76	12%

[a] That area of the Nushagak River drainage upstream of the confluence of the Nushagak and Mulchatna rivers.
[b] That area of the Mulchatna River drainage upstream of the confluence of the Nushagak and Mulchatna rivers. Does not include that area of Lake Clark National Park within Unit 17B.
c Estimate for entire survey area, however high winds/turbulence prevented counting in some selected sample units, especially some considered High Density strata in riparian areas of the lower Mulchatna River.

Table 2. Reported moose harvest data for all hunts in Unit 17, RY70 through RY10.

Regulatory Year	Reported Harvest	Hunters afield	Success rate	Unit[a]			
				17A	17B	17C	Unk
RY70	25	35	71%	---	---	---	---
RY71	37	63	59%	---	---	---	---
RY72	38	74	51%	---	---	---	---
RY73	42	93	45%	---	---	---	---
RY74	69	119	58%	---	---	---	---
RY75	115	207	56%	---	---	---	---
RY76	49	168	29%	---	---	---	---
RY77	54	113	48%	---	---	---	---
RY78	65	160	41%	---	---	---	---
RY79	33	68	49%	---	---	---	---
RY80	89	212	42%	---	---	---	---
RY81	76	209	36%	---	---	---	---
RY82	49	149	33%	---	---	---	---
RY83	127	293	43%	0	72	48	7
RY84	158	344	46%	0	86	70	2
RY85	148	401	37%	0	94	52	2
RY86	202	486	42%	0	122	73	7
RY87	207	499	41%	0	152	42	13
RY88	187	457	41%	0	157	28	2
RY89	175	438	40%	0	122	48	5
RY90	225	489	46%	0	178	44	3
RY91	268	590	45%	0	172	85	11
RY92	263	705	37%	0	160	90	13
RY93	249	705	35%	1	150	78	20
RY94	296	800	37%	0	167	94	35
RY95	336	881	38%	0	192	109	35
RY96	373	913	41%	0	207	113	53
RY97	347	956[b]	36%	15	168	126	38
RY98	389	1048[b]	37%	10	168	171	40
RY99	425	1116[b]	38%	10	170	192	53
RY00	373	1112[b]	34%	10	226	136	1
RY01	419	1175[b]	36%	7	186	222	4
RY02	404	1147[b]	35%	8	183	210	3
RY03	426	1168[b]	36%	11	163	251	1
RY04	383	1204[b]	32%	20	168	193	2
RY05	380	1182 [b]	32%	25	117	232	6
RY06	384	1103 [b]	35%	36	113	233	2
RY07	388	1142[b]	34%	40	113	213	22
RY08	353	1230[b]	29%	45	79	229	0
RY09	322	1231	26%	31	81	206	4
RY10	343	1289	27%	37	75	151	80

[a] Harvest data not broken down by unit before RY83.
[b] Includes hunters who registered for both fall and winter registration hunts.

Table 3. Unit 17 moose antler sizes (percent) in the reported harvest, RY92 through RY10.

Regulatory Year	Antler size[a]			Largest Antlers (inches)
	<30 in	30–50 in	>50 in	
RY92	6	36	57	80
RY93	3	30	68	73
RY94	9	29	62	73
RY95	7	35	57	78
RY96	9	26	65	75
RY97	6	36	57	73
RY98	9	35	56	74
RY99	7	37	56	71
RY00	8	27	65	80
RY01	19	28	53	72
RY02	20	35	46	69
RY03	13	33	54	78
RY04	15	33	52	72
RY05	18	30	52	73
RY06	17	38	45	76
RY07	13	41	46	77
RY08	5	35	59	73
RY09	3	25	42	72
RY10	5	38	57	70

[a] Includes only those with antler size reported on harvest card.

Table 4. Unit 17 general season moose hunter[a] residency and success, RY92 through RY10.

	Successful				Unsuccessful				
Regulatory Year	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal Resident	Nonresident	Total(%)	Total hunters
RY92	61	79	64	212 (41)[b]	65	114	124[b]	310 (59)[b]	522
RY93	21	28	93	144 (33)[c]	27	117	142[c]	292 (67)[c]	436
RY94	22	41	91	161 (33)[d]	24	117	180[d]	329 (67)[d]	490
RY95	23	30	115	171 (35)[e]	28	103	177[e]	314 (65)[e]	485
RY96	16	35	144	196 (40)[f]	33	82	174[f]	291 (60)[f]	487
RY97	13	33	100	150 (35)[g]	29	79	161	277 (65)[g]	427
RY98	15	34	120	169 (32)	27	111	220	359 (68)[h]	528
RY99	16	26	99	146 (29)[i]	20	91	235	358 (71)[i]	504
RY00	4	41	139	184 (34)	18	98	236	353 (66)[j]	537
RY01	11	27	125	169 (36)[k]	14	97	191	304 (64)[k]	473
RY02	12	25	77	120 (25)[l]	19	115	217	351 (75)	471
RY03	6	38	97	141 (36)	27	96	127	253 (64)[m]	394
RY04	4	26	97	129 (31)[n]	20	92	169	283 (69)[o]	412
RY05	12	27	61	100 (29)	21	93	130	245 (71)[p]	345
RY06	12	25	38	76 (27)[q]	31	60	115	209 (73)[q]	285
RY07	9	28	40	78 (28)[r]	23	70	108	201 (72)[r]	283
RY08	3	23	24	51 (20)[s]	37	82	76	199 (80)[s]	250
RY09	3	15	14	32 (21)[t]	29	48	39	119 (78)[t]	153
RY10	3	15	29	47 (29)	29	49	36	114 (71)	161

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

Table 5. Unit 17B reported general season moose harvest[a] and accidental death, RY92 through RY10.

Regulatory Year	Hunter Harvest								
	Reported				Estimated[b]				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	Total	Accidental death	Grand total
RY92	152 (100)	0	0	152	0	0	0	0	152
RY93	125 (100)	0	1	126	0	0	0	0	126
RY94	132 (100)	0	0	132	0	0	0	0	132
RY95	148 (100)	0	0	148	0	0	0	0	148
RY96	171 (100)	0	0	171	0	0	0	0	171
RY97	127 (100)	0	0	127	0	0	0	0	127
RY98	139 (100)	0	0	139	0	0	0	0	139
RY99	122 (100)	0	0	122	0	0	0	0	122
RY00	165 (100)	0	0	165	0	0	0	0	165
RY01	141 (100)	0	0	141	0	0	0	0	141
RY02	96 (100)	0	0	96	0	0	0	0	96
RY03	114 (100)	0	0	114	0	0	0	0	114
RY04	107 (100)	0	0	107	0	0	0	0	107
RY05	68 (100)	0	0	68	0	0	0	0	68
RY06	53 (100)	0	0	53	0	0	0	0	53
RY07	53 (100)	0	0	53	0	0	0	0	53
RY08	34 (100)	0	0	34	0	0	0	0	34
RY09	18 (100)	0	0	18	0	0	0	0	18
RY10	35 (100)	0	0	35	0	0	0	0	35

[a] Excludes permit hunt harvest.
[b] No estimates of unreported/illegal harvests have been made for this unit.

Table 6. Unit 17C reported general season moose harvest[a] and accidental death, RY92 through RY10.

Regulatory Year	Hunter Harvest: Reported M (%)	Reported F (%)	Reported Unk.	Reported Total	Estimated[b] Unreported	Estimated Illegal	Estimated Total	Accidental death	Grand total
RY92	56 (100)	0	0	56[c]	0	0	0	0	56
RY93	18 (100)	0	0	18	0	0	0	0	18
RY94	28 (100)	0	0	28[d]	0	0	0	1[e]	29
RY95	32 (100)	0	0	32[f]	0	0	0	0	32
RY96	23 (100)	0	0	23[g]	0	0	0	2[h]	25
RY97	21 (100)	0	0	21[i]	0	0	0	0	21
RY98	27 (100)	0	0	27[j]	0	0	0	1	28
RY99	23 (100)	0	0	23[k]	0	0	0	0	23
RY00	18 (100)	0	0	18[l]	0	0	0	1	19
RY01	26 (100)	0	0	26[m]	0	0	0	2	28
RY02	21 (100)	0	0	21[n]	0	0	0	0	21
RY03	26 (100)	0	0	26[o]	0	0	0	0	26
RY04	21 (100)	0	0	21[p]	0	0	0	0	21
RY05	32 (100)	0	0	32	0	0	0	0	32
RY06	21 (100)	0	0	21[q]	0	0	0	0	21
RY07	25 (100)	0	0	25	0	0	0	0	25
RY08	17 (100)	0	0	17	0	0	0	0	17
RY09	15 (100)	0	0	15	0	0	0	0	15
RY10	11 (100)	0	0	11	0	0	0	0	11

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

Table 7. Unit 17A reported moose harvest data by permit hunt, RY97 through RY10.

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
RM573	RY97	44	11	62	38	15 (100)	0	0	15
	RY98	48	10	77	23	10 (100)	0	0	10
	RY99	57	28	76	24	10 (100)	0	0	10
	RY00	56	13	80	20	10 (100)	0	0	10
	RY01	56	16	87	15	7 (100)	0	0	7
	RY02	40	10	78	22	8 (100)	0	0	8
RM573	RY03	77	21	82	18	11 (100)	0	0	11
&	RY04	97	20	74	26	20 (100)	0	0	20
RM575[c]	RY05	149	30	75	25	25 (100)	0	0	25
	RY06	121	24	61	39	36 (100)	0	0	36
	RY07[d]	181	38	64	36	40 (100)	0	0	40
	RY08[d]	213	26	72	28	45 (100)	0	0	45
	RY09[e]	155	17	76	24	31 (100)	0	0	31
	RY10	144	13	70	30	37 (100)	0	0	37

[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 RY07, RM575 winter hunt included western portion of Unit 17C.
[e] Beginning RY09, western portion of Unit 17C deleted from RM575 winter hunt.

Table 8. Unit 17B reported moose harvest data by permit hunt, RY92 through RY10.

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
RM983	RY92	277	30	63	27	8(100)	0	0	8
RM583	RY93	433	19	61	39	23 (100)	0	1	24
	RY94	438	18	56	44	35 (100)	0	0	35
	RY95	521	21	56	44	44 (100)	0	0	44
	RY96	546	20	63	37	36 (100)	0	0	36
RM583	RY97[c]	629	25	63	37	41 (100)	0	0	41
& RM585	RY98	634	25	69	31	29 (100)	0	0	29
	RY99	749	24	53	47	48 (100)	0	0	48
	RY00	685	23	61	39	61 (100)	0	0	61
	RY01	814	20	72	28	41 (100)	0	0	41
	RY02	794	19	66	34	83 (100)	0	0	83
	RY03	880	20	69	31	47 (100)	0	0	47
	RY04	878	20	75	25	60 (100)	0	0	60
& RM587	RY05[d]	887	22	74	26	39 (100)	0	0	39
	RY06	841	19	61	39	54 (100)	0	0	54
	RY07	953	22	62	38	60 (100)	0	0	60
	RY08	1037	21	69	31	45 (100)	0	0	45
	RY09	1209	21	69	31	63 (100)	0	0	63
	RY10	1203	17	76	24	10 (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] Beginning RY97, includes permits issued and harvest for both fall (20 Aug–15 Sep) and winter (1–31 Dec) permit hunts.
[d] Beginning RY05, includes resident (RM583 and 585) and nonresident (RM587) registration hunts.

Table 9. Unit 17C reported moose harvest data by permit hunt, RY92 through RY10.

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
RM983	RY92	277[b]	30	63	27	31[d] (100)	0	3	34
RM583	RY93	433	19	61	39	59[e] (100)	1	0	60
	RY94	438	18	56	44	65[f] (100)	0	1	66
	RY95	521	21	59	41	87[g] (100)	0	0	87
	RY96	546	20	54	46	89[h] (99)	0	1	90
RM583	RY97[c]	629	25	60	40	105[i] (100)	0	0	105
& RM585	RY98	634	25	48	52	144[j] (100)	0	0	144
	RY99	749	24	49	51	169[k] (100)	0	0	169
	RY00	685	23	68	32	118[l] (100)	0	0	118
	RY01	814	20	60	40	200[m](100)	0	0	200
	RY02	794	19	51	49	193 (100)	0	0	193
	RY03	880	20	56	44	227 (100)	0	0	227
	RY04	878	20	65	35	173 (100)	0	0	173
	RY05[n]	887	22	63	37	199[n] (100)	0	0	199
	RY06	841	19	61	39	211 (100)	0	0	211
	RY07	953	22	60	40	188 (100)	0	0	188
	RY08	1,037	21	69	31	212 (100)	0	0	212
	RY09	1,182	19	73	27	245 (98)	0	6	251
	RY10	1,166	17	74	26	244 (97)	0	7	251

[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] Beginning RY05, includes resident (RM583 and 585) and nonresident (RM587) registration hunts.
[m] Not included are 6 bulls from an unspecified portion of Unit 17.

Table 10. Unit 17 moose hunter residency and success[a] for permit hunts, RY92 through RY10.

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local[b] Resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total(%)	
RY92	43	7	0	50 (27)	122	11	0	133 (73)	183
RY93	84	21	0	105 (39)	130	33	0	163 (61)	269[c]
RY94	106	29	0	135 (44)	128	45	0	173 (56)	310[d]
RY95	117	48	0	165 (42)	131	100	0	231 (58)	396
RY96	117	60	0	177 (42)	157	92	0	249 (58)	426
RY97	164	33	0	197 (37)	272	60	0	332 (63)	529
RY98	183	37	0	220 (42)	251	54	0	305 (58)	525
RY99	221	58	0	279 (46)	262	71	0	333 (54)	612
RY00	144	45	0	189 (33)	304	82	0	386 (67)	575
RY01	193	57	0	250 (36)	370	82	0	452 (64)	702
RY02	228	56	0	284 (42)	323	69	0	392 (58)	676
RY03	214	71	0	285 (37)	407	82	0	489 (63)	774
RY04	204	50	0	254 (32)	446	92	0	538 (68)	792
RY05	224	45	10	279 (34)	451	80	10	541 (66)	820
RY06	254	47	6	307 (38)	405	68	36	509 (62)	816
RY07	260	39	11	310 (36)	469	65	15	549 (64)	859
RY08	257	38	7	302 (31)	596	70	12	678 (69)	980
RY09	238	41	12	291 (27)	712	62	15	789 (73)	1080
RY10	248	40	9	297 (26)	751	53	27	831 (73)	1128

[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 11. Unit 17 reported general season moose harvest chronology percent by month, RY92 through RY10.

Regulatory Year	Harvest periods									
	Aug 10–20	Aug 21–31	Sep 1–10	Sep 11–20	Sep 21–30	Dec 1–10	Dec 11–20	Dec 21–31	Unk.	n[b]
RY92[c]	0	3	44	41	0	2	2	4	3	212
RY93[d]	1	2	54	35	0	0	1	1	6	144
RY94	1	3	47	37	3	1	2	3	5	161
RY95	1	2	55	32	0	0	1	1	9	171
RY96	1	2	63	27	0	1	0	2	6	196
RY97	0	1	55	36	0	1	1	1	5	150
RY98	0	2	60	35	0	0	0	0	2	169
RY99	0	3	51	42	0	2	0	1	1	146
RY00	0	0	55	40	0	0	0	0	5	184
RY01	0	3	57	38	0	1	1	0	1	169
RY02	0	2	55	38	0	0	1	0	3	120
RY03	0	0	57	39	0	0	0	0	4	141
RY04	0	0	50	46	0	0	0	0	4	129
RY05	0	0	53	39	0	2	1	3	2	100
RY06	0	0	42	53	0	0	0	0	5	76
RY07	0	0	40	56	0	0	0	0	4	78
RY08	0	0	37	57	0	0	0	0	6	51
RY09	0	0	43	55	0	0	0	0	3	33
RY10	0	0	43	57	0	0	0	0	0	47

[b] Reported harvest.

[c] RY92 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] RY93 to present general season dates:
- Unit 17B - Residents: 1–15 Sep, Nonresidents: 5–15 Sept
- Unit 17C - Residents: 1–15 Sep

Table 12. Unit 17 reported moose harvest chronology for permit hunts, percent by month, RY92 through RY10.

Regulatory Year	Harvest periods: Aug 10–20	Aug 21–31	Sep 1–10	Sep 11–20	Sep 21–30	Dec 1–10	Dec 11–20	Dec 21–31	Other/ Unk.	n^a
RY92[b]	20	72	2	0	0	0	0	0	6	50
RY93[c]	9	40	19	10	2	3	6	5	8	105
RY94[c]	7	30	29	10	1	2	7	8	6	135
RY95[c]	15	33	26	14	1	2	1	4	6	165
RY96[c]	7	33	23	20	1	2	5	3	5	177
RY97[d]	6	35	16	21	0	2	4	11	5	197
RY98[d]	10	44	22	14	0	1	1	6	2	220
RY99	13	44	16	13	0	1	4	4	6	279
RY00	17	32	24	19	0	2	1	1	5	189
RY01	11	46	21	10	0	2	2	7	1	250
RY02	12	41	20	15	0	6	1	1	3	284
RY03	14	44	20	13	0	1	2	4	2	285
RY04	8	33	16	22	0	5	5	5	5	254
RY05	6	42	23	20	0	1	1	1	5	277
RY06	15	34	19	17	0	1	4	10	1	306
RY07	13	26	20	24	0	1	3	8	5[e]	310
RY08	11	22	15	25	0	1	6	13	8[f]	302
RY09	6	24	21	29	0	5	5	6	4	289
RY10	12	22	21	25	0	5	4	9	4[g]	297

[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 2–15 Jan in Unit 17A and western 17C.
[f] Includes 21 bulls taken 5–18 Jan in Units 17A and western 17C.
[g] Includes 5 bulls taken 1–10 Jan in Unit 17A.

Table 13. Unit 17 reported general season moose harvest percent by transport method, RY92 through RY08.

Regulatory Year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
RY92	64	0	29	0	2	0	1	3	212
RY93	71	0	26	0	9	0	0	1	144
RY94	71	0	22	0	2	0	1	3	161
RY95	64	0	33	1	1	0	1	1	171
RY96	68	0	29	0	2	0	1	1	196
RY97	65	0	30	1	3	0	1	0	150
RY98	67	0	32	0	1	1	0	1	169
RY99	61	0	36	0	3	0	0	0	146
RY00	75	0	23	0	0	0	0	2	184
RY01	64	0	34	1	0	0	0	1	169
RY02	61	0	38	1	0	0	0	1	120
RY03	70	0	29	1	0	0	0	0	141
RY04	75	0	23	1	0	0	0	1	129
RY05	66	0	28	3	0	0	0	3	100
RY06	63	0	33	0	0	0	0	4	76
RY07	62	0	32	3	0	1	0	3	78
RY08	63	0	35	0	0	0	0	2	51
RY09	58	0	42	0	0	0	0	0	33
RY10	75	0	23	2	0	0	0	0	47

Table 14. Unit 17 reported moose harvest by permit hunt, percent by transport method, RY92 through RY08.

Regulatory Year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
RY92	9	0	83	1	0	1	1	5	50
RY93	15	0	73	0	6	0	4	3	105
RY94	18	0	59	0	12	0	3	8	135
RY95	25	0	68	0	4	0	1	2	165
RY96	26	0	63	0	6	0	2	3	177
RY97	8	1	73	0	16	0	1	2	197
RY98	5	0	81	3	6	0	0	5	220
RY99	11	0	74	1	9	0	2	2	279
RY00	13	0	78	1	3	0	1	4	189
RY01	10	0	74	1	10	0	1	4	250
RY02	12	0	82	1	1	1	2	2	284
RY03	11	0	79	1	7	1	1	1	285
RY04	6	0	72	3	16	0	0	2	254
RY05	12	0	79	1	3	0	1	3	277
RY06	4	0	76	2	14	1	2	1	307
RY07	5	0	75	2	14	1	2	1	310
RY08	8	0	59	2	27	0	2	1	302
RY09	10	0	66	4	15	0	2	3	303
RY10	6	0	68	1	21	0	1	3	298

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Moose are thought to have begun immigrating to the Yukon-Kuskokwim Delta during the mid-to-late 1940s. Local elders from the Yukon River have confirmed this timing. The Yukon population occupies most of the available riparian habitat and the population is growing. The Kuskokwim population is growing 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 2,500–3,500 moose. Allow the lower Kuskokwim River moose population to increase above its estimated size of 75–250 moose to at least 2,000 moose.
  - Maintain the current age and sex structure for both populations, with a minimum of 30 bulls:100 cows.
  - Conduct seasonal sex and age composition surveys as weather allows.
  - Conduct winter censuses and recruitment surveys in the established survey areas on a rotating basis.
  - Conduct fall and/or winter trend counts to determine population trends.
  - Conduct hunts 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 2011 we conducted a moose population survey in the Kuskokwim count area using the Geospatial Population Estimator (GSPE) method developed by Ver Hoef (2001). In the winter of 2010 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 2 GSPE surveys per year and alternate with the remaining 2areas in 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 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 Alaska Wildlife Troopers (AWT) in Bethel and Aniak.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In January and February 2011, we conducted moose population censuses in the Lower Kuskokwim count area (Table 1). Unless otherwise noted, the following results are reported at the 95% CI.

The moose population in the Lower Kuskokwim count area grew from an estimate of 515 ± 17.5% in 2008 to 672 ± 21.2% moose in 2011. For consistency, both of these numbers are reported here without a Sightability Correction Factor (SCF) because of technical difficulties with the SCF in 2011. The density of this moose population has changed from 0.1 moose/mi^2 in 2004 to 0.8 moose/mi^2 in 2011.

Population Composition

In November 2010 we classified bulls, cows, and calves in the Lower Kuskokwim count area, the Andreafsky Count area, and the Lowest Yukon 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 a high bull to cow ratio, probably due to the fact that it had been unhunted before 2009 and is growing rapidly.

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 nearly the mouth of the Kuskokwim near the community of Tuntutuliak. 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. These moose appear to have established local populations, most notably in the Kwethluk and Eek River drainages. In March 2010, YDNWR conducted a line transect method moose population estimate on the Eek, Kwethluk, Kisaralik, Kasigluk and Tuluksak rivers. The midpoint of that estimate was 340 moose (Wald, USFWS, personal communication, 2010).

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 TNWR staff observed 204 moose in March 2011. We also have reports from local residents of increasing numbers of moose in this area. (Aderman, USFWS, personal communication, 2011).

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. A regulatory year (RY) begins on 1 July and ends on 30 June (e g., RY09 = 1 July 2009–30 June 2010). The bag limit throughout Unit 18 is 1 antlered bull in the fall. In the winter the bag limit is 1 antlered bull, except in the hunt area below Mountain Village where it is 1 moose.

Federal seasons in Unit 18 were mostly 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 and in 2009 there was no federal season in the Kuskokwim Drainage.

Regulatory year RY09 Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Lower Kuskokwim; easterly of a line from the mouth of the Ishkowik River to the closest point of Dall Lake then to the easternmost point of Takslesluk Lake then along the Kuskokwim drainage boundary to the Unit 18 border and north of and including the Eek River drainage,		
1 antlered bull	1 Sep – 10 Sep	No open season
Unit 18, that portion south of and including the Goodnews River drainage		
1 antlered bull	1 Sep – 30 Sep	No open season
Unit 18, that portion south of the Eek River drainage and north of the Goodnews River drainage:		
1 antlered bull	1 Sep – 30 Sep	No open season
Unit 18, that portion north and west of a line from Cape Romanzof to Kuzilvak Mt to Mt. Village and excluding all Yukon River drainages upriver from Mt. Village(lower Yukon)		
1 antlered bull	1 Sep – 30 Sep	1 Sep – 30 Sep
1 antlered bull OR 1 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

Regulatory year *RY10* Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Lower Kuskokwim; east of a line from the mouth of the Ishkowik River to Dall Lake then to the Johnson /River at its entrance to Nunavaksanukakslak Lake, then upstream one-half mile south of the south bank of the Johnson River to Crooked Creek, then upstream along the creek to Arhymot Lake to the Unit 18 boundary, and north of and including the Eek River drainage,		
1 antlered bull	1 Sep – 10 Sep	No open season
Unit 18 that portion south of and including the Goodnews River drainage		
1 antlered bull	1 Sep – 30 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 1 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 (BOG) Actions and Emergency Orders (EO). At the November 2009 Board of Game meeting in Bethel the board extended the moose season below Mountain Village by extending the winter season to February 28. The department issued an EO in early January 2010 to make this change effective for the remainder of RY09.

In January 2010 the BOG approved a public request for the department to issue an EO extending the winter moose hunt in the remainder of Unit 18 to February 28 and changing the bag limit to 1 moose. A nearly identical EO was issued the following year in February 2011 to open a registration hunt and season in the area south of and including the Goodnews River drainage.

Human-Induced Harvest. During RY09 general season, 964 hunters reported a harvest of 486 moose**.** For RY10, 1,121 hunters reported a harvest of 582 moose. This continues the general trend of increasing reported moose harvest in Unit 18 that began in the early 1990s (Table 3). The hunt statistics for the permit hunts are reported under that following section.

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 and reporting, the willingness of most hunters to harvest only bulls, and the successful cooperative effort that resulted in both a huntable moose population below Mountain 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 80% (389 moose) of the reported harvest in RY09 and 84% (489 moose) in RY10. The other moose reported harvested were either in the new Kuskokwim River drainage hunt (110 moose in RY09 and 3 in RY10) or in the Goodnews drainage where 10 and 11 were harvested in these 2 years, respectively.

There is recurring harvest of moose through Alaska State regulation 5 AAC 92.019, 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 regulation and the department provides a letter of authorization 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 Wildlife Troopers 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 were 2 permit hunts for moose in Unit 18 during the reporting period. Forty-five and 48 hunters obtained RM620 registration permits in RY09 and RY10, respectively. In RY09, 12 reported that they did not hunt, 10 were successful and 23 hunted but were not successful. In RY10, 4 reported that they did not hunt, 11 were successful and 33 were not successful. Almost all hunters used boats to access the area.

For the RM615 permit, 1,397 and 1,527 potential hunters obtained registration permits in RY09 and RY10, respectively. In RY09, 355 did not hunt, 1,042 reported that they did hunt, and 110 harvested moose. In RY10, 378 did not hunt, 1,149 reported hunting and 102 harvested moose (Table 5). The success rate in RY09 was 11% and 9 % in RY10.

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 964 hunters who participated in the general season hunts during the RY09 season, 21 were nonresidents. Of 1,121 hunters who participated during the RY10 season, 29 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. Nonresidents are not eligible to participate in either of the registration permit hunts.

Based on reported harvest in the general season, the moose hunter success rates based on harvest ticket reports were 50% for RY09 and 52% for the RY10 seasons. Registration Permit hunt success rates were reported in the previous section. Successful hunters spent an average of 6.8 days hunting in RY09 and 5.1 days in RY10.

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. The new registration permit hunt on the Kuskokwim occurs in the first 10 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 understandable 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 is the main prey item for wolves and wolf distribution is not as closely linked to moose.

HABITAT

Assessment

We estimate a minimum of 8,000 mi^2 of moose habitat exists in Unit 18. Approximately 4,500 mi^2 of this habitat occurs along the riparian zone of the Yukon River and the remaining 3,500 mi^2 is found along the Kuskokwim River and its tributaries. The islands and adjacent sloughs along the Yukon River corridor from Paimiut to Mountain Village represent the most productive moose habitat in Unit 18. 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 provide 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 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 within 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. In September of 2009 the first hunt in 5 years was allowed in the Lower Kuskokwim. Participation in this hunt was higher than expected, with more than 1,300 hunters obtaining permits. It is noteworthy that more moose were harvested during this 10 day hunt (110) than were estimated in a survey 5 years previously (67) By any measure the cooperative effort between USFWS, AVCP, ADF&G and the local communities has been a success. Continued close monitoring and limited harvest on this population should ensure continued growth and greater opportunities for harvest.

The illegal harvest, particularly of cows and particularly within the Kuskokwim River drainage, has decreased dramatically during this reporting period. Other factors that can still affect moose management are a poorly developed cash economy, declining commercial fishing opportunities, and a high and growing density of people along the major rivers. These factors complicate moose management considerably. More than 20,000 rural residents live in 42 communities throughout Unit 18 and we need continued effort to curb illegal harvest of moose. Another factor is the declining number of Mulchatna caribou, which will affect the ability of local hunters to gather meat.

Recent actions by user groups to shoulder some responsibility for the growth of local moose populations are welcome signs of increasing participation with existing management systems. Continued efforts to work with local user groups are vital for effective management and we are encouraged by the efforts of the LKAC to adopt a strategy to improve moose numbers within the Kuskokwim drainage.

We recommend that monitoring and taking inventory of the moose population remain a priority in Unit 18, especially the continuation of the population censuses along the Yukon and Kuskokwim rivers. We should also continue to conduct composition counts and trend counts. As populations have increased, habitat assessment will become a more important part of our management activities. The census results, in conjunction with composition surveys, will provide the department with baseline demographic and recruitment information to properly manage the moose population.

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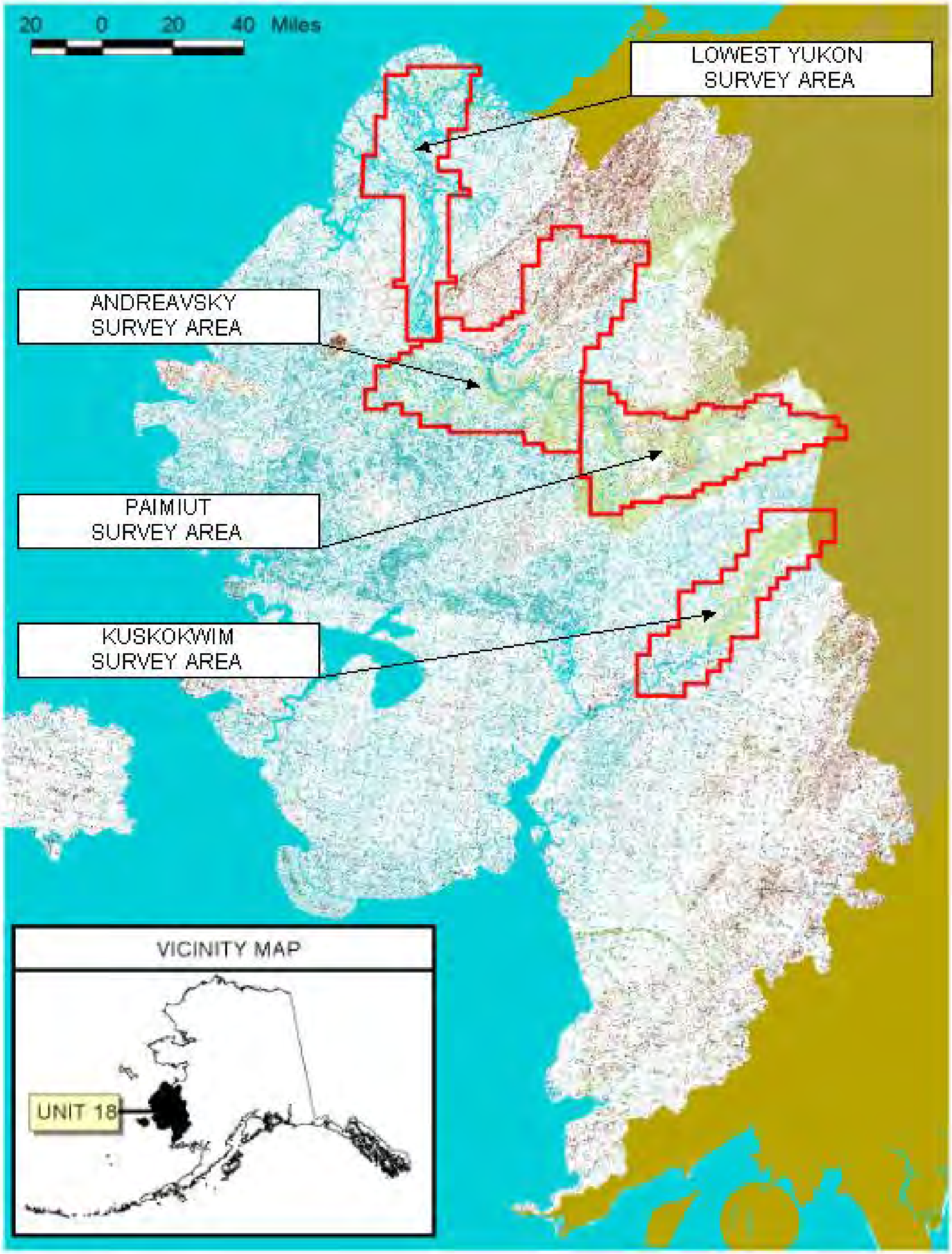

Figure 1. Unit 18 showing geostatistical population survey areas (Ver Hoef style survey areas).

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[b]
	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]
	2011	869	672±21.2%	0.8	Spatial method

[a] Sightability correction factor applied to census estimate.

[b] Census technique reference: 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.

Table 2. Moose composition surveys, Unit 18, November 2010.

Survey area	Calves:100 cows	Bulls:100 cows
Lower Kuskokwim	49	50
Lowest Yukon	69	30
Andreafsky	61	42

Table 3. Number of hunters and reported general season harvest in Unit 18, RY93 through RY10.

Regulatory year	Number of hunters	Reported harvest
RY93	249	96
RY94	247	87
RY95	301	74
RY96	350	97
RY97	363	95
RY98	383	125
RY99	436	143
RY00	421	175
RY01	428	162
RY02	589	223
RY03	633	233
RY04	528	226
RY05	661	317
RY06	648	330
RY07	827	458
RY08	849	465
RY09	964	486
RY10	1121	582

Table 4. Fall and winter moose harvests for Unit 18, all hunts RY85 through RY10.

	Fall harvest		Winter harvest		Unknown harvest		Total
RY	(N)	(%)	(N)	(%)	(N)	(%)	harvest (N)
RY85	43	83	8	15	1	2	52
RY86	54	90	6	10	0	0	60
RY87	40	83	8	17	0	0	48
RY88	67	98	0	2	1	0	68
RY89	31	94	1	3	1	3	33
RY90	55	90	6	10	0	0	61
RY91	63	94	4	6	0	0	67
RY92	64	83	13	17	0	0	77
RY93	93	97	3	3	0	0	96
RY94	76	87	11	13	0	0	87
RY95	71	96	3	4	0	0	74
RY96	97	100	0	0	0	0	97
RY97	95	100	0	0	0	0	95
RY98	124	99	1	1	0	0	125
RY99	136	95	7	5	0	0	143
RY00	166	95	5	3	4	2	175
RY01	140	86	9	6	13	8	162
RY02	202	91	10	4	11	5	223
RY03	220	94	13	6	0	0	233
RY04	189	84	36	16	1	1	226
RY05	253	80	64	20	0	0	317
RY06	256	78	70	21	4	1	330
RY07	370	81	86	19	2	1	458
RY08	374	78	81	17	23	5	478 [a]
RY09	479	79	123	20	4	1	606 [b]
RY10	494	71	175	25	26	4	695 [b]

[a]Total general season harvest plus RM620 Registration permit harvests

[b]Total general season harvests plus RM620 and RM615 registration permit harvests.

Table 5. Unit 18 Moose registration permit hunts, RY08 through RY10.

	RM615			RM620		
RY	Permits issued	Hunted	Harvested	Permits issued	Hunted	Harvested
RY08	Na	Na	Na	40	35	13
RY09	1397	1042	110	45	33	10
RY10	1527	1149	102	48	44	11

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNITS: 19A, 19B, 19C, and 19D (36,486 mi^2)

GEOGRAPHIC DESCRIPTION: All Kuskokwim River drainages upstream from Lower Kalskag

BACKGROUND

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 also is an important consideration.

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. Nonresident closed areas established within 2 miles of most major rivers in Units 19A and 19B prohibit 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. Additionally, there are meat care education requirements for nonresidents and meat-on-the-bone requirements in various areas.

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 led to 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 et al. 2011). With this understanding we began managing to reduce predation in eastern Unit 19D (Unit 19D East), an 8,513 mi^2 area of Unit 19D upriver of the Black and Selatna River drainages. In 2001, the Experimental Micro Management Area (EMMA), a 528 mi^2 area of eastern Unit 19D, was established within an approximately 20 mi radius of McGrath. 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, including the establishment of the Upper Kuskokwim Villages Moose Management Area (UKVMMA; Fig. 2) in an area that was formerly known as the expanded EMMA, 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, the Central Kuskokwim Villages Moose Management Area (CKVMMA) was established (Fig. 3) within the area where aerial wolf control was permitted, and the plan was reauthorized through June 2014.

Predation control programs in Units 19A and 19D are critical for compliance with intensive management 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; and research efforts were undertaken. Despite wide local support for predator control, legal challenges to these programs remain. Efforts to increase the moose populations in Unit 19 are 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

The Units 19A and 19B intensive management population and harvest objectives, as listed in regulation 5 AAC 92.108, were:

- Achieve a moose population of 13,500–16,500 moose (7,600–9,300 in Unit 19A) with a harvest of 750–950.

Objectives for Units 19A and 19B recommended in the CKMMP::

- 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.

Unit 19C:

- Maintain a fall posthunt bull:cow ratio of at least 30 bulls:100 cows.

Unit 19D intensive management population and harvest objectives:

- Achieve a moose population of 6,000–8,000 moose with a harvest of 400–600 moose in Unit 19D East.
- Achieve a moose population of 4,000–6,000 with a harvest of 250–600 in the remainder of Unit 19D (that portion of Unit 19D downriver of the Selatna and Black River drainages).
- Achieve a population of 2,500 moose with a harvest of 100 moose within the UKVMMA.

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 conducted aerial surveys using the geospatial population estimator method (GSPE; Ver Hoef 2001, Ver Hoef 2008, Kellie and DeLong 2006). We conducted surveys during March 2005 in approximately 7,156 mi^2 south of and along the Kuskokwim River (South of the Kuskokwim); during March 2006 and 2010 in the western 3,444 mi^2 of this area (19A West [Aniak]); and during March 2008 and 2011 in the eastern 3,874 mi^2 of this area (19A East [Holitna]; Fig. 4). All survey units (SUs) were stratified as high or low density moose habitat at the start of each survey. A simple random sample of survey units was selected from each stratum and additional SUs were selected to fill gaps in the randomized coverage. Sightability correction factors (SCFs) were not obtained for these surveys except during the March 2011 survey in 19A East (Holitna). To estimate sightability for the March 2001 survey, we randomly selected north or south halves of sample units and intensively searched those portions with the most experienced pilot–observer crew using methods described by Gasaway et al. (1986). Overall and strata-specific densities calculated from these surveys are extrapolated to similar areas where no population estimation surveys were conducted.

Since 2001, early winter moose numbers have been estimated in 3 overlapping survey areas in Unit 19D. These areas are: 1) the 528 mi^2 BCA; 2) the 1,118 mi^2 UKVMMA; and 3) the 5,313 mi^2 moose survey area (MSA, Fig. 2). With the exception of the 2003 BCA estimate, all estimates of moose numbers in 19D are based upon GSPE techniques. The 2 strata Gasaway method (Gasaway et al. 1986) was used for estimating moose numbers in the BCA during 2003. Estimates of total numbers of moose in Unit 19D generally 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 2009–2011, 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. We used 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). For fall trend and composition surveys PA-18 aircraft were flown along 3–10 mile long transects generally at ½-mile intervals perpendicular to riparian moose habitats. Aircraft maintained altitudes of ≤500 feet above ground level. Pilots used a Global Positioning System (GPS) to maintain the aircraft on transect. Most habitats in these areas are roughly linear and parallel to rivers, and transect direction was selected to run perpendicular to habitat types to ensure that all habitat types in the area were sampled. We recorded the number of moose and classified them as cows, calves, and small, medium, or large bulls.

To determine twinning rates in Unit 19D, radiocollared cows were located using PA-18 and Bellanca Scout aircraft during May and early June. These cows, as well as uncollared cows observed during these flights or observed during specific twinning rate flights, were enumerated and classified as being accompanied by single calves or multiple calves. Specific twinning rate flights were conducted with a systematic search for uncollared cows along transects generally at ½-mile intervals perpendicular to riparian moose habitats. 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 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., RY09 = 1 July 2009–30 June 2010). We also received notification of mortuary moose requests consistent with regulation 5 AAC 92.019, coordinated these hunts with enforcement personnel, and recorded harvests.

We have also conducted snow depth surveys in Units 19A and 19D since 2008 (Paragi et al. 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

<u>Units 19A and 19B</u>. From the February 2005 survey south of the Kuskokwim River, we calculated a moose density of 0.27 observable moose/mi^2 (±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/mi^2 (±15%, 90% CI) with 9% calves. In this area in March 2010, we calculated a moose density of 0.33 observable moose/mi^2 (±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/mi^2 (±28%, 90% CI; Table 1a) with 21% calves and in March 2011, we calculated 0.25 observable moose/mi^2 (±18%, 90% CI; Table 1a) with 15% calves. Analysis of the March 2011 survey data including SCFs of 1.24 in low density strata and 1.89 in high density strata produced a density of 0.43 total moose/mi^2 (± 36%, 90% CI; Table 1a). A subanalysis of data from within the 19A East (Holitna) portion of the March 2005 survey produced a density of 0.28 observable moose/mi^2 (± 17%, 90% CI). Confidence intervals overlap for these surveys 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 BCA and UKVMMA, moose densities were estimated as high as 1.6 moose/mi^2 in 2009. This compares to an estimated density of 0.8 moose/mi^2 in 2001 in the UKVMMA. Data on tables 1b and 1c show the population has increased since predator reductions began in RY03. This increase appears to have slowed between 2007 and 2011.

In the 5,313 mi^2 MSA, we calculated a moose population density of 0.7 moose based on the GSPE estimate of 3,889 moose (±25%, 90% CI; Table 1d) during early winter 2008. We estimate 2,171 moose (0.5 moose/mi^2) in the 4,086 mi^2 portion of the MSA excluding the UKVMMA (3,889 moose in the entire MSA minus the 1,718 moose in the UKVMMA). Because habitat in this area is similar to the unsurveyed portions of 19D East, and we believe moose densities are also similar, and used this density to extrapolate to the unsurveyed portion of Unit 19D East to obtain an estimate of about 5,400 moose in all of 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 indicate 134 moose/hour were detected in 2009 and 110 moose/hour were detected in 2010. These detection rates are similar to those during 1987–1997 when an average of 150 moose/hour were detected (range 100–194 moose/hour; Table 2a).

Population Composition

Units 19A and 19B. No composition surveys were conducted in the Aniak Trend Count Area during 2009 or 2010 due to unfavorable weather. Results from previous surveys are in Table 2b.

In the November 2009 moose composition surveys in the Holitna Trend Count Area we observed 129 moose; with ratios of 51 bulls:100 cows; 6 yearling bulls:100 cows; and 36 calves:100 cows. In November 2010 we observed 212 moose; with ratios of 61 bulls:100 cows; 10 yearling bulls:100 cows; and 19 calves:100 cows (Table 2c). Bull:cow ratios in this area appear to have recovered from 8 bulls:100 cows in 2005. This improvement is consistent with the closed hunting season since RY06.

Unit 19C. In the Farewell Trend Count Area surveys during November 2009 we found 245 moose, including 138 cows, 34 calves, and 73 bulls. There were 25 calves:100 cows, 23 yearling bulls, 30 medium bulls:100 cows, 11 large bulls:100 cows, and 53 total bulls:100 cows. In November 2010, we found 312 moose including 200 cows, 54 calves, and 58 bulls. There were 27 calves:100 cows, 20 yearling bulls:100 cows, 27 medium bulls:100 cows, 11 large bulls:100 cows, and 29 total bulls:100 cows (Table 2a).

Unit 19D. Within the BCA in 2009 there were 31 bulls:100 cows, 7 yearling bulls:100 cows ; and 44 calves:100 cows. In 2010 the BCA had 38 bulls:100 cows; 15 yearling bull:100 cows, and 43 calves:100 cows. In 2011 there were 31 bulls:100 cows, 12 yearling bulls:100 cows, and 49 calves:100 cows. Since 2001, the calf:cow ratio has varied, with a low of 34:100 in 2001 and a high of 63:100 in 2004; the bull:cow ratio varied also, with a low of 13:100 in 2004 and a high of 39:100 in 2007, and yearling bull:cow ratios ranged from 5:100 in 2003 to 16:100 in 2007 (Table 1b). Similar composition data were obtained in the UKVMMA (Table 1c). Moose population composition in the MSA during 2008 indicated 55 bulls:100 cows; 17 yearling bulls:100 cows; and 41 calves:100 cows (Table 1d).

Table 3 shows twinning rates for moose in Unit 19D East during spring 2001–2011. Twinning rates of radiocollared cows are kept separate from randomly observed cows because it is known that our radiocollared sample is biased toward more reproductive age classes. Twinning rates were generally high and ranged 24–59% suggesting that the habitat is capable of supporting higher moose populations (Boertje et al. 2007).

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. The few moose that moved considerable distances moved south and wintered in Unit 17. In Unit 19C fewer moose are found in the Farewell Trend Count Area during spring bison surveys than during fall trend and composition surveys, suggesting that this population includes a large migratory component. In Unit 19D moose radiocollared in and around the BCA as part of mortality research generally remained within 25–30 miles of their capture location and were nonmigratory.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Units 19A, 19B, and 19C for RY09 through RY11 were as follows:

Units and Bag Limits	Open Seasons
Unit 19A, Lime Village Management Area, that portion drained by the Stony River from the mouth of the Stink River, including the Stink River drainage upstream to, but not including the Can Creek drainage.	
RESIDENT HUNTERS: 2 antlered bulls by Tier II permit TM684; or	10 Aug–25 Sep
2 antlered bulls by Tier II permit TM684;	20 Nov–31 Mar

Units and Bag Limits	Open Seasons
NONRESIDENT HUNTERS:	No open season
Unit 19A, Kuskokwim River drainage downstream of and including the George River drainage and downstream of and excluding the Downey Creek drainage.	
RESIDENT HUNTERS: 1 antlered bull by Tier II permit TM680	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Remainder of Unit 19A	
RESIDENT AND NONRESIDENT HUNTERS:	No open season
Unit 19B within the Nonresident Closed Area	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Remainder of Unit 19B	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side	1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side. Hunter orientation required.	5 Sep–20 Sep
Unit 19C	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers, or antlers with 4 or more brow tines on at least one side	1 Sep–20 Sep
Or, 1 bull by registration permit RM655	1 Feb–28 Feb
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side	1 Sep–20 Sep
Seasons and bag limits in Unit 19D for RY09 —	
Unit 19D, that portion of the Kuskokwim River drainage upstream from the Selatna and Black River drainages, but excluding the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650	1 Sep–25 Sep
NONRESIDENT HUNTERS:	No open season

Units and Bag Limits	Open Seasons
Unit 19D, that portion of the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Unit19D, that portion between and including the Cheeneetnuk and Gagaryah River drainages, excluding that portion within 2 miles of the Swift River	
RESIDENT HUNTERS: 1 bull	1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side	1 Sep–20 Sep
Remainder of Unit 19D	
RESIDENT HUNTERS: 1 bull	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Seasons and bag limits in Unit 19D for RY10 and RY11 —	
Unit19D, that portion within the Upper Kuskokwim Controlled Use Area	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650; or	1 Sep–25 Sep
1 moose by registration permit; during a period 1 Feb–28 Feb, a season may be announced by emergency order.	(to be announced)
NONRESIDENT HUNTERS:	No open season
Unit19D, that portion between and including the Cheeneetnuk and Gagaryah River drainages, excluding that portion within 2 miles of the Swift River	
RESIDENT HUNTERS: 1 antlered bull; or	1 Sep–20 Sep
1 antlered bull by registration permit RM650; or	1 Sep–25 Sep
1 moose by registration permit; during a period 1 Feb–28 Feb, a season may be announced by emergency order.	(to be announced)
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side	1 Sep–20 Sep

Units and Bag Limits	Open Seasons
Remainder of Unit 19D	
RESIDENT HUNTERS: 1 antlered bull; or	1 Sep–20 Sep
1 antlered bull by registration permit RM650; or	1 Sep–25 Sep
1 moose by registration permit; during a period 1 Feb–28 Feb, a season may be announced by emergency order.	(to be announced)
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, and since RY10 the area has been open throughout the 1–25 September season.

The Board of Game redefined the Upper Kuskokwim CUA during its March 2008 meeting. Effective in RY09, this area became 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 its 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 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 268 and 302 moose in RY09 and RY10, respectively (Table 4a). Moose harvest increased (20%) from RY09 to RY10 in Unit 19A; in Unit 19B harvest was steady, but remained low; harvest increased by 23% in Unit 19C and by 6% in Unit 19D (Tables 4b–4e). A few moose were reported taken elsewhere 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 number 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 is typically low (Table 5).

During RY09 and RY10, a total of 4 bulls were taken under TM684 and 3 bulls were taken under RM655.

In western Unit 19A, TM680 permittees reported taking 52 moose in RY09 and 72 in RY10. A federal permit hunt (FM019) for local rural resident hunters is also held on federal public lands within the TM680 hunt area. Although reported data are taken from the state's internal harvest recording website (WinfoNet), harvest reporting for FM019 is incomplete and these data should be considered minimums (Table 5).

In Unit 19D during RY06–RY10, an annual average of 277 permittees took an average of 90 bulls using the RM650 permit (Table 5). Hunters reported taking 92 moose in RY09 and 107 in RY10.

Hunter Residency and Success. Hunter residency and success for all hunts during RY06–RY10 were subdivided by local, nonlocal resident hunters, and nonresident hunters (Tables 6a–6e). Hunter success in Unit 19 was 35% in RY09 and 42% in RY10, compared to a low of 25% in RY06 (Table 6a).

Hunter success in Unit 19A improved from a low of 15% in RY06, to 25% in RY09 and 38% in RY10 (Table 6b). During RY06, hunters complained of low water levels and persistent warm weather. Increased hunter success in RY09 and RY10 may be due to improved weather conditions.

In Unit 19B, success rates were 31% in RY09 and 33% in RY10 compared with 26% in RY06 (Table 6c). Also, the number of hunters declined from 107 in RY06 to 65 in RY09 and 60 in RY10. Moose antler restrictions and a much smaller caribou herd, which drew fewer hunters, may explain much of this decline.

In Unit 19C, success rates improved from 32% in RY06 to 45% in RY09 and 53% in RY10. Total number of moose taken also increased from 38 in RY06 to 57 in RY09 and 70 in RY10 (Table 6d).

Success rates in Unit 19D were 39% in RY09 and 44% in RY10, higher than the 33% success rate in RY06. Total moose taken was at its highest in the last 5 years at 126 taken in RY10 (Table 6e).

In Units 19A and 19D, residency restrictions eliminated or reduced nonresident hunting. In Unit 19A, nonresidents reported taking 1 moose in RY09 and 2 in RY10. During both years, nonresident seasons were closed and these locations are likely misreported (Table 6b). In Unit 19D, 5 nonresidents reported taking moose in RY09 and 3 in RY10 (Table 6e).

Nonresidents still take a substantial portion of the harvest in Units 19B and 19C. In Unit 19B, 27 of 40 moose reported taken during RY09–RY10 were taken by nonresidents (Table 6c). In Unit 19C, 45 of 127 moose taken during RY09–RY10 were 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 RY09–RY10.

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. During RY09, 6 bulls and 4 cows were taken and 6 unsuccessful hunts were reported in Unit 19A; 2 cows were taken and 2 unsuccessful hunts were reported in Unit 19D. During RY10, 7 bulls and 2 cows were taken and 4 unsuccessful hunts were reported in Unit 19A and 1 bull and 2 cows were taken in Unit 19D..

Other known mortality during RY09–RY10 includes reports of moose caught on shelf ice during breakup, a calf hit by a car in McGrath, a moose caught by a snare near McGrath, multiple wolf kills, and multiple calves that died during the deep snow winter during RY11. This list is incomplete, but illustrates the variety of deaths that occur unrelated to harvest.

Keech et al. (2011) 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

Snow can restrict moose movement when it reaches about 28 inches and can make movement very difficult at about 35 inches (Coady 1974). 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 10 inches in April 2010, 15 inches in April 2011, and 41 inches in April 2012 (Fig. 5) and we observed many calf carcasses during late winter 2012.

High twinning rates indicate that habitat in Unit 19 was adequate to support an increasing moose population (Boertje et al. 2007). In Unit 19D, twinning rates were thought to be declining as the 2009 observed twinning rate of uncollared cows was 26%. This lower twinning rate, combined with the high browse removal rate of 40.5% recorded during winter RY08, suggested that habitat quality was be beginning to decline in Unit 19D East. However, subsequent surveys revealed higher twinning rates of 29% in 2010 and 37% in 2011 (Table 3) suggesting that lower twinning rates may lag behind browse removal.

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 over half a million acres burned in southwestern Alaska.

Ice scouring events regularly reset habitat succession along rivers in Unit 19. Major flooding events have not widely occurred since the 1980s but significant flooding events occurred in 2002, 2009, and 2011. These events produced ice-scouring that helped rejuvenate some willow stands. Nevertheless, 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 UKVMMA, 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. This intensive management population objective would require a moose density within the entire area of approximately 0.75–0.93 moose/mi^2. Our recent moose density estimate of 0.43 moose/mi^2 in eastern Unit 19A (Holitna) during March 2011 was well below this objective. The combined harvests of 90 moose in RY09 and 104 in RY10 in Units 19A and 19B (Tables 4b and 4c) are below the intensive management harvest objective of 750–950 moose.

We could not detect a change in moose numbers in 19A West (Aniak) (Table 1a). The March 2006 density estimate of 0.39 observable moose/mi^2 ±15% (90% CI) was not significantly different from the March 2010 estimate of 0.33 observable moose/mi^2 ±15% (90% CI).

We also could not detect a change in moose numbers in 19A East (Holitna). We found no significant difference between our subanalysis of the Holitna portion of the March 2005 survey (0.28 observable moose/mi^2 ±17% [90% CI]), the March 2008 estimate (0.44 observable moose/mi^2 ±28% [90% CI]), and the March 2011 estimate (0.25 observable moose moose/mi^2 ±18% [90% CI]; 0.43 moose/mi^2 ±36% [90% CI] with SCF). Confidence intervals of all surveys overlapped and no trend is evident. Further, 2 of the 3 estimates are of observable moose and variations in sightability complicate interpretation of these data.

We met our objective of at least 20–30 bulls:100 cows in eastern Unit 19A. November ratios in the Holitna Trend Count Area were 51 bulls:100 cows in 2009 and 61 bulls:100 cows in 2010. However, weather prevented surveys in the Aniak Trend Count Area and it is unknown whether we maintained this objective there.

We achieved our fall calf composition objective of a minimum of 30–40 calves:100 cows in eastern Unit 19A in November 2009 (36 calves:100 cows in the Holitna Trend Count Area) but did not meet the objective in November 2010 (19 calves:100 cows).

Our objective for no fewer than 20% calves in late winter surveys was achieved in March 2010 in the 19A West (Aniak) survey area where we estimated 23% calves. However, we did not achieve this objective in March 2011 in the 19A East (Holitna) survey area where we estimated 15% calves.

The number of moose in Unit 19A is well below our intensive management objectives and in eastern Unit 19A calf numbers are lower than objectives. More aggressive predator management addressing bear predation in part of Unit 19A was recommended to the Board of Game and adopted during their March 2012 meeting. It will be implemented during March 2013.

No composition data has been collected in Unit 19B since 2005. Therefore, we are unable to determine whether we have achieved our composition objectives in Unit 19B.

The objective in Unit 19C to maintain a fall posthunt bull:cow ratio of at least 30 bulls:100 cows was achieved in RY09 (53 bulls:100 cows), but not in RY10 (29 bulls:100 cows). Even though we did not achieve our objective in 2010, the difference is small and we do not recommend any regulatory changes.

We estimate the population in Unit 19D East to be about 5,400 moose, which is below our objective of 6,000–8,000. Within the remainder of Unit 19D, our assessment is that we are below the population objective of 4,000–6,000 there as well. Reported harvests of 119 and 126 moose in Unit 19D during RY09 and RY10 (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 92 in RY09 and 107 in RY10 (Table 5); these harvests were below the amount of moose needed locally.

The UKVMMA has a population objective of 2,500 moose (2.2 moose/mi^2) and a harvest objective of a least 100 moose. The midpoint of the fall 2010 population estimate for this area is 1,796 moose. About 60 moose were harvested in RY09 and about 65 were taken in RY10. Both population and harvest were below our 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 2–5 spring twinning surveys. Therefore, we conduct a single moose population 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 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 UKVMMA. If the opportunity presents itself to conduct a survey in 19A West (Aniak), we take advantage of it, but this is not part of the normal cycle. When population estimates are necessary beyond these areas, we extrapolate from these surveys to obtain those estimates.

Within Unit 19A, we recommend establishing an area within the CKVMMA where moose numbers can be more intensively evaluated similar to the UKVMMA in Unit 19D. The area recently established by the Board of Game where bear numbers are to be reduced is a logical choice.

Survey–specific sightability estimates are important when evaluating populations because sightability correction values can vary from survey to survey. We recommend obtaining these for each GSPE survey when resources are available.

To augment the GSPE population estimates, we should continue fall composition and trend surveys and spring twinning surveys throughout the McGrath area. We should make areas that have not been recently surveyed, such as the Aniak Trend Count Area, a high priority during the next reporting period.

Unit 19 twinning rates are generally above 25% and suggest higher moose densities could be supported by existing moose habitat. However, as the moose population has increased, especially in the UKVMMA, browse removal rates have increased 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.

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.

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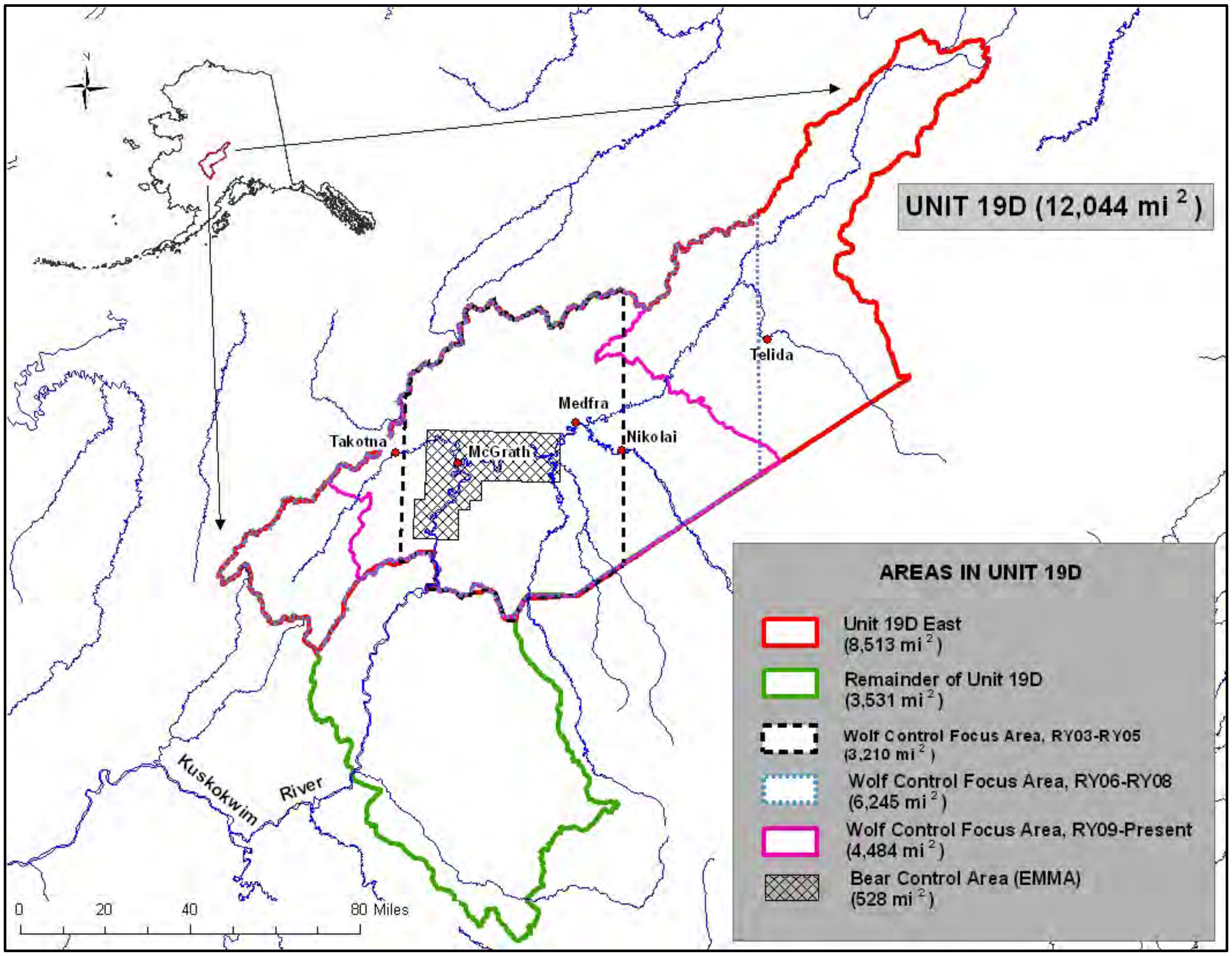

Figure 1. Predation control areas in Unit 19D showing the Bear Control Area (formerly known as the EMMA) and wolf control focus areas in place at various times during RY03 through RY11.

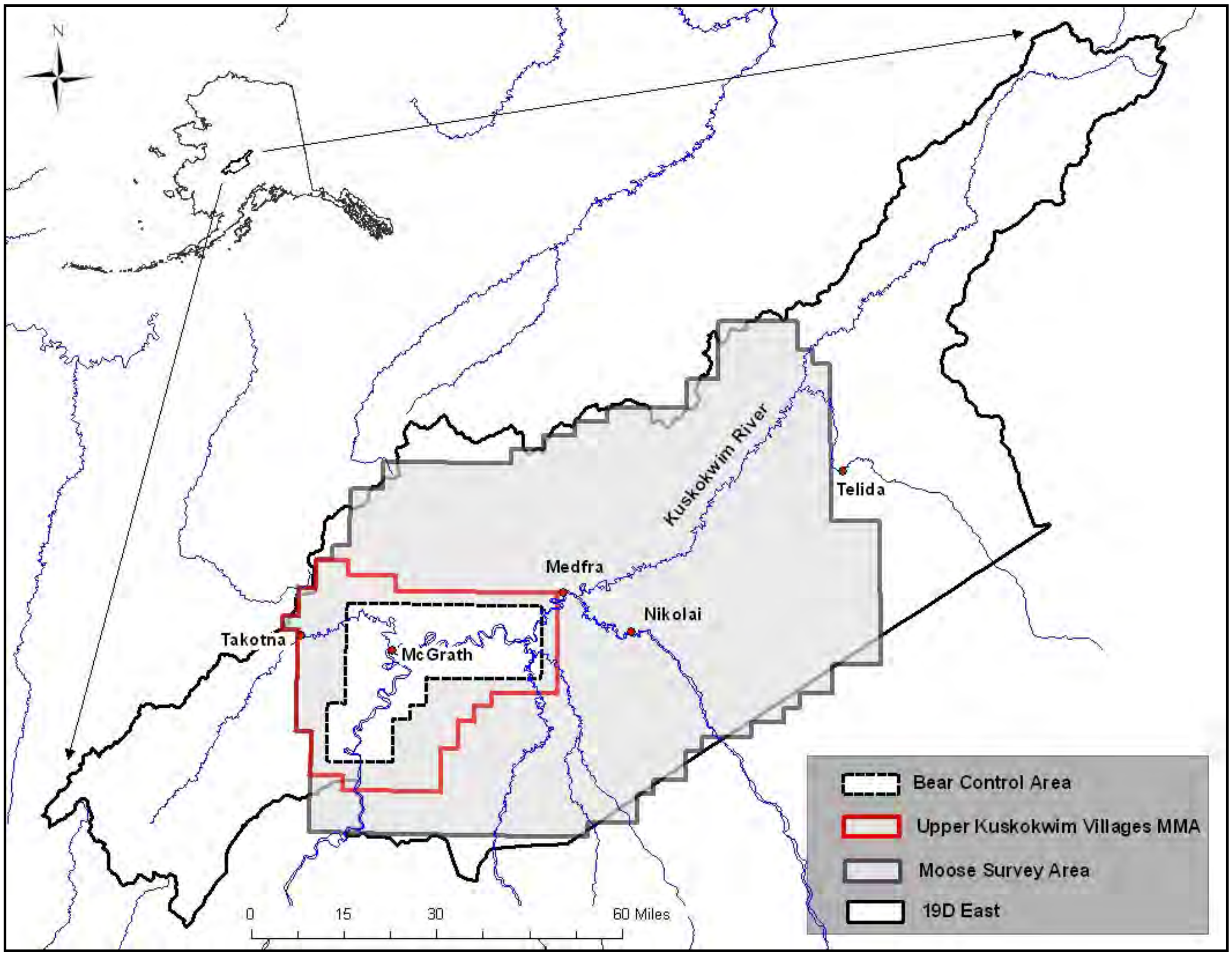

Figure 2. Unit 19D East showing the 3 Unit 19D moose survey areas that have been surveyed since 2001.
Dashed line: Bear Control Area (BCA; 528 mi^2)
Red line: Upper Kuskokwim Villages MMA (UKVMMA; 1,118 mi^2)
Gray line: Unit 19D East Moose Survey Area (MSA; 5,313 mi^2)

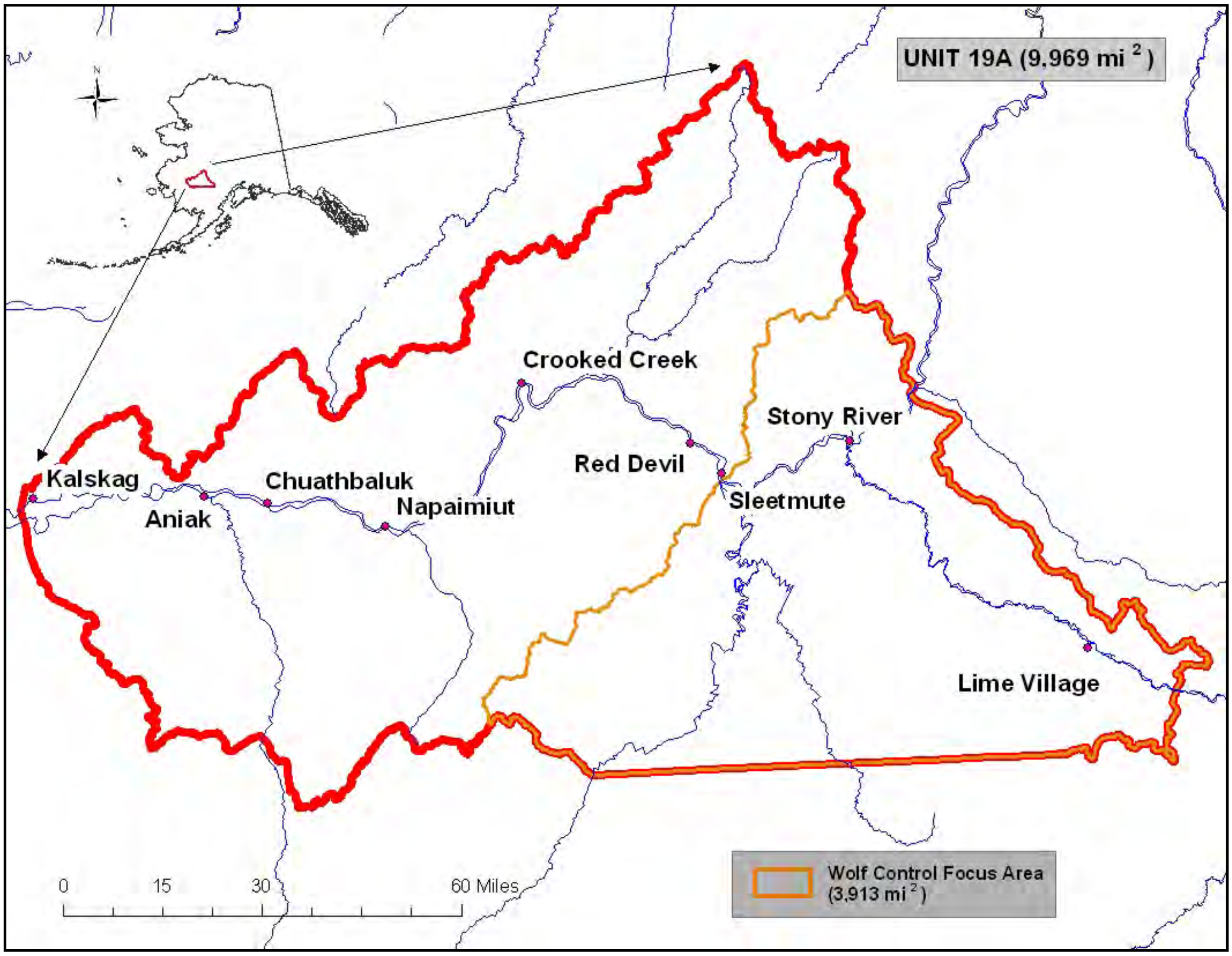

Figure 3. Unit 19A aerial wolf control area permitted throughout Unit 19A during RY04–RY08 (red border). Beginning in RY09, aerial wolf control was limited to the Wolf Control Focus Area, also called the Central Kuskokwim Villages MMA. Both the Central Kuskokwim Villages MMA and the Wolf Control Focus Area are defined as those portions of Unit 19A within those drainages upriver of Sleetmute.

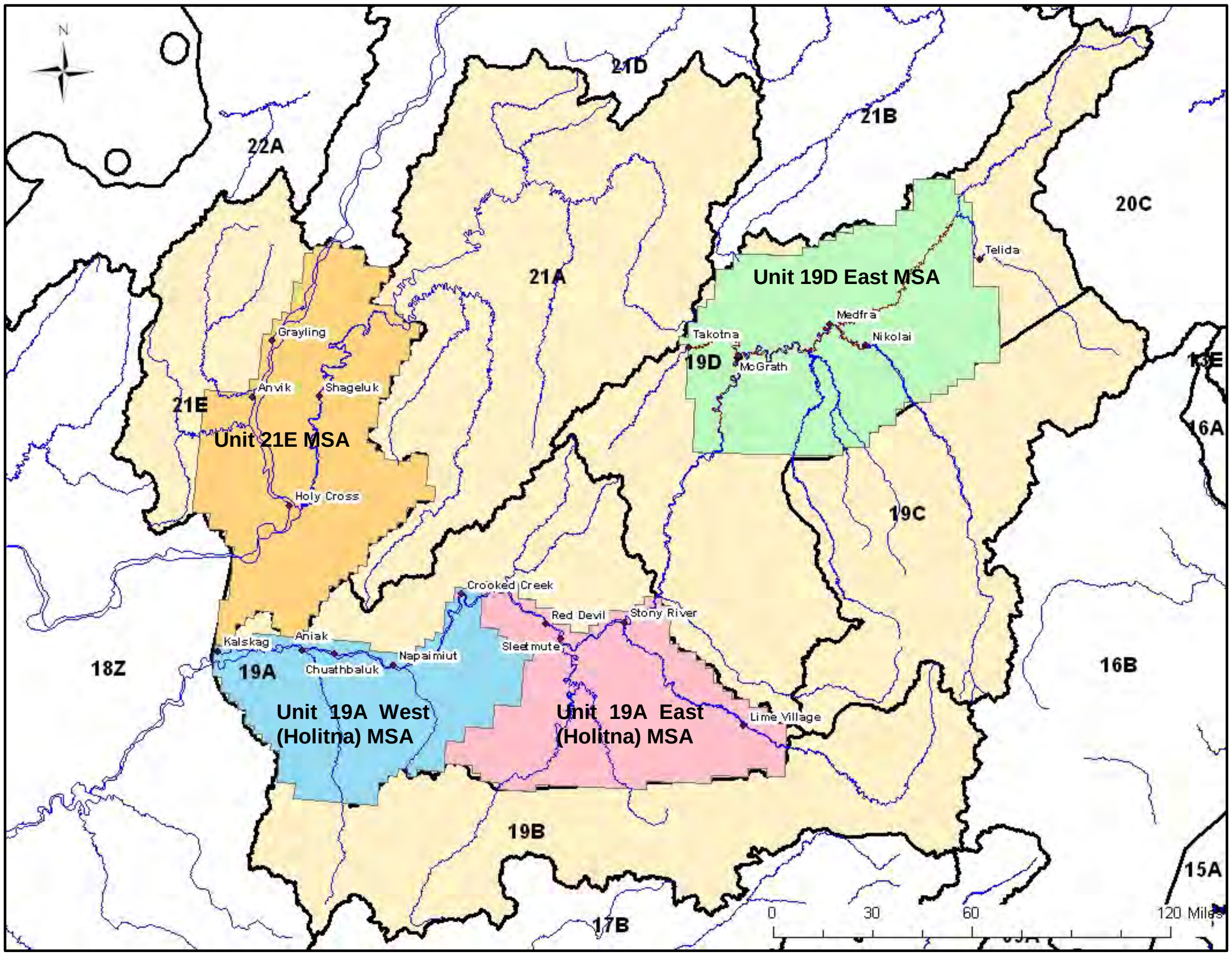

Figure 4. Units 19, 21A and 21E showing the 3 scheduled moose survey areas: Unit 19D East Moose Survey Area, 19A East (Holitna), and Unit 21E Moose Survey Area. Also shown is the 19A West (Aniak) moose survey area which is surveyed opportunistically. The area South of the Kuskokwim River includes both the 19A East (Holitna) and 19A West (Aniak) survey areas.

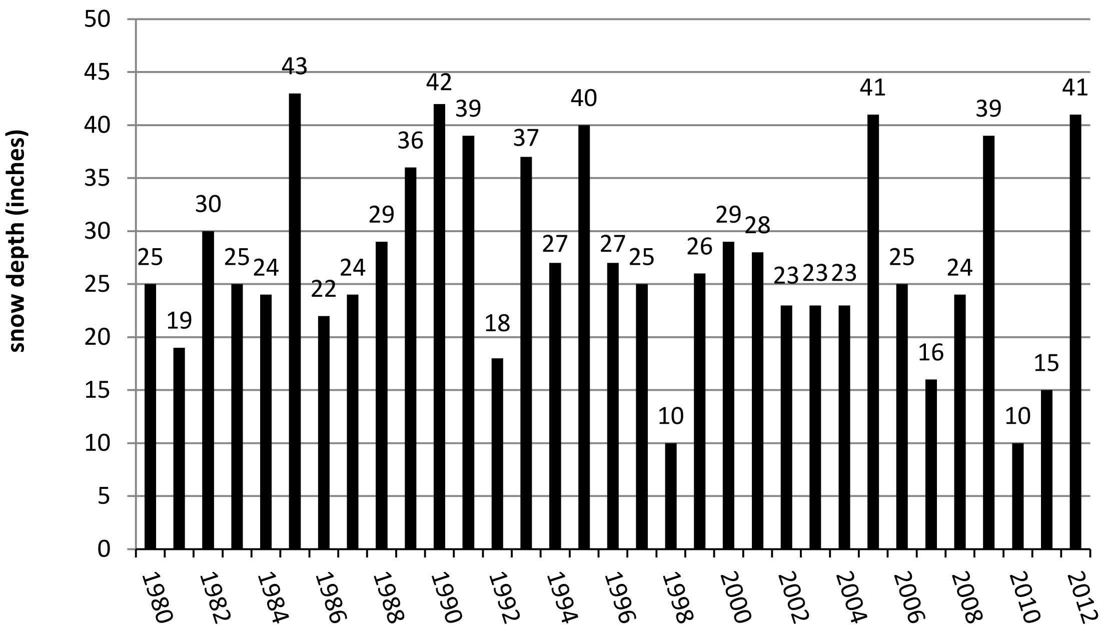

Figure 5. Snow depth in inches at McGrath as reported on 1 April from 1980 through 2012.

Table 1a. Summary of geospatial population estimates (GSPE)[a] for moose in Unit 19A, 2005–2010.

Location and survey year	Survey area (mi²)	Strata size (mi²) Low	Strata size (mi²) High	Area searched (mi²) Low	Area searched (mi²) High	Total search area (mi^2)	No. of moose estimated by strata and density (moose/mi²) Low	No. of moose estimated by strata and density (moose/mi²) High	Total estimate @ 90% CI	Average density moose/mi²	No. of survey units counted
Unit 19A											
South of Kuskokwim											
February 2005	7,156	5,709	1,446	306	719	1,025	623 (0.11)	1,330 (0.92)	1,953±16%	0.27	161
19A West (Aniak)											
March 2006	3,444	2,404	1,040	192	408	600	NA[b]	NA[b]	1,329±15%	0.39	94
March 2010	3,444	2,404	1,040	441	498	939	466 (0.19)	663 (0.64)	1,130±15%	0.33	147
19A East (Holitna)											
March 2008	3,874	2,833	1,041	223	255	478	339 (0.12)	1,364 (1.31)	1,703±28%	0.44	75
March 2011	3,874	2,833	1,041	345	632	977	235 (0.08)	727 (0.70)	962±18%	0.25	135
March 2011[c]	3,874	2,833	1,041	345	632	977	291 (0.10)[c]	1,374 (1.32)[c]	1,666±36%[cd]	0.43[c]	135

[a] Population estimates are of observable moose and do not include a sightability correction factor (SCF).
[b] Data not available due to office fire December 2006.
[c] Estimate includes a sightability correction factor (SCF) of 1.24 in low density strata and 1.89 in high density strata.
[d] Total is greater than sum of strata due to rounding error.

Table 1b. Unit 19D, aerial moose fall composition counts and estimated population size within the BCA, 2001–2011.

Calendar year	Moose observed	Estimated population (90% CI)[a]	SCF[b] ($n_{observed}$, $n_{available}$)	Estimated population w/SCF	Bulls:100 cows[c]	Yearlings: 100 cows[cd]	Calves: 100 cows[c]	Moose/mi^2 w/SCF[e]
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 (±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
2010	311	625 (±12%)	1.27	793 (±19%)	38	30	43	1.5
2011[f]	335	658 (±14%)	1.27	836	31	24	49	1.6

[a] All survey units were sampled during 2001 and 2004–2007, estimates/counts of observable moose have no variance or CIs.
[b] Sightability Correction Factor
[c] Ratios based on estimates rather than counts of sex and age classes.
[d] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[e] Based on an estimated 528 mi^2 of moose habitat in the Bear Control Area (BCA).
[f] Preliminary data.

Table 1c. Unit 19D, aerial moose fall composition counts and estimated population size within the Upper Kuskokwim Villages Moose Management Area, 2001–2011.

Calendar year	Moose observed	Estimated population (90% CI)	SCF ($n_{observed}$, $n_{available}$)	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 (±12%)	1.19 (32,38)	868 (±17%)	21	16	36	0.8
2002								
2003								
2004	578	940 (±11%)	1.27	1192 (±19%)	18	16	66	1.1
2005								
2006	762	1117 (±9%)	1.17 (42,49)	1308 (±13%)	30	24	55	1.2
2007	844	1290 (±10%)	1.33 (31,41)	1720 (±20%)	36	30	53	1.5
2008	678	1356 (±9%)	1.27 (16,20)	1718 (±20%)	40	28	44	1.5
2009	711	1435 (±9%)	1.27	1820 (±18%)	40	22	38	1.6
2010	712	1416 (±8%)	1.27	1796 (±17%)	49	32	43	1.6
2011[d]	639	1298 (±9%)	1.27	1648	33	20	42	1.5

[a] Ratios based on estimates rather than counts of sex and age classes.
[b] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[c] Based on an estimated 1,118 mi^2 of moose habitat in the Upper Kuskokwim Villages Moose Management Area.
[d] Preliminary data.

Table 1d. 19D aerial moose fall composition counts and estimated population size within the Moose Survey Area (MSA), 2001–2008.

Calendar year	Moose observed	Estimated population (90% CI)	SCF ($n_{observed}$, $n_{available}$)	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 (±26%)	1.19 (32,38)	2564 (±28%)	34	14	25	0.5
2004	764	2163 (±19%)	1.27	2744 (±24%)	31	24	54	0.5
2008	982	3071 (±16%)	1.27 (16,20)	3889 (±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 × 2.
[c] Based on an estimated 5,313 mi^2 of moose habitat in the 19D East MSA.

Table 2a. Unit 19C Farewell Trend Count Area fall aerial moose composition counts, regulatory years 1987–1988 through 2010–2011.

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
2010–2011	29	20	27	54	17	258	312	110

[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] Only 77.5% of the survey area flown.
[d] Additional data lost in McGrath office fire December 2006.
[e] Weather influenced survey, likely 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 2004–2005 through 2010–2011.

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]								
2010–2011[a]								

[a] No survey.

Table 2c. Unit 19A Holitna Trend Count Area fall aerial moose composition counts, regulatory years 1987–1988 through 2010–2011.

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]								
2000–2001[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
2010–2011	61	10	19	24	11	188	212	55

[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 3. Twinning rates for moose in Unit 19D East, 2000–2001 through 2010–2011.

Regulatory Year	Observed rate of twinning for radiocollared cows >2 yr old (*n*)	Observed rate of twinning for uncollared cows (*n*)
2000–2001	25% (16)	
2001–2002	59% (22)	39% (46)
2002–2003	24% (25)	36% (39)
2003–2004	32% (31)	39% (31)
2004–2005	44% (45)	50% (40)
2005–2006	40% (60)	35% (29)
2006–2007	52% (56)	50% (30)
2007–2008	55% (51)	
2008–2009	33% (43)	26% (87)
2009–2010	33% (40)	29% (45)
2010–2011	--	37% (38)

Table 4a. Unit 19 reported moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Reported harvest					
year	M	(%)	F	(%)	Unk	Total
2006–2007	193	(100)	0	(0)	1	194
2007–2008	263	(100)	0	(0)	0	263
2008–2009	277	(100)	0	(0)	1	278
2009–2010	268	(100)	0	(0)	0	268
2010–2011	302	(100)	0	(0)	0	302

Table 4b. Unit 19A moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Moose harvest				Hunt type			
year	M	F	Unk	Total	General[a]	TM684	TM680	FM019[b]
2006–2007	43	0	0	43	10	1	26	6
2007–2008	80	0	0	80	8	2	54	16
2008–2009	76	0	0	76	8	1	56	11
2009–2010	70	0	0	70	4	1	52	13
2010–2011	84	0	0	84	9	3	72	0[c]

[a] Incorrect permit for this hunt area.
[b] Federal permits were issued to federally qualified subsistence users to hunt on federal public lands within the hunt area. One hundred permits are issued every regulatory year beginning in regulatory year 2006–2007.
[c] FM019 data unavailable.

Table 4c. Unit 19B moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Moose harvest			
Year	M	F	Unk	Total
2006–2007	28	0	0	28
2007–2008	20	0	0	20
2008–2009	26	0	0	26
2009–2010	20	0	0	20
2010–2011	20	0	0	20

Table 4d. Unit 19C moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Moose harvest				Hunt type	
Year	M	F	Unk	Total	General	RM655
2006–2007	38	0	0	38	38	0
2007–2008	44	0	0	44	40	4
2008–2009	54	0	0	54	51	3
2009–2010	57	0	0	57	56	1
2010–2011	70	0	0	70	68	2

Table 4e. Unit 19D moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Moose harvest				Hunt type	
year	M	F	Unk	Total	General	RM650
2006–2007	82	0	1	83	21	62
2007–2008	114	0	0	114	28	86
2008–2009	120	0	1	121	18	103
2009–2010	119	0	0	119	27	92
2010–2011	126	0	0	126	19	107

Table 4F. Moose harvest from Unit 19 where specific harvest location was not reported, regulatory years 2006–2007 through 2010–2011.

Regulatory	Moose harvest			
year	M	F	Unk	Total
2006–2007	2	0	0	2
2007–2008	5	0	0	5
2008–2009	1	0	0	1
2009–2010	2	0	0	2
2010–2011	2	0	0	2

Table 5. Permit hunt results from Unit 19A Lime Village Management Area Tier II (TM684), Unit 19A TM680 and FM019[a], Unit 19C (RM655) and Unit 19D (RM650), regulatory years 2006–2007 through 2010–2011.

Permit hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Male (%)	Female (%)	Unk	Total Harvest
Unit 19A, TM684[b]	2006–2007	14	6 (43)	7 (50)	1 (7)	1 (100)	0 (0)	0	1
	2007–2008	13	6 (46)	6 (46)	1[c] (8)	2 (100)	0 (0)	0	2
	2008–2009	14	5 (36)	8 (57)	1 (7)	1 (100)	0 (0)	0	1
	2009–2010	14	7 (50)	6 (43)	1 (7)	1 (100)	0 (0)	0	1
	2010–2011	15	6 (40)	6 (40)	3 (20)	3 (100)	0 (0)	0	3
Unit 19A, TM680	2006–2007	200	31 (15)	143 (72)	26 (13)	26 (100)	0 (0)	0	26
	2007–2008	230	35 (15)	141 (61)	54 (23)	54 (100)	0 (0)	0	54
	2008–2009	230	33 (14)	141 (61)	56 (24)	56 (100)	0 (0)	0	56
	2009–2010	231	47 (20)	132 (57)	52 (23)	52 (100)	0 (0)	0	52
	2010–2011	200	23 (11)	105 (53)	72 (36)	72 (100)	0 (0)	0	72
Unit 19A, FM019[a,d]	2006–2007	--	-- --	36 (--)	6 (--)	6 (100)	0 (0)	0	6
	2007–2008	--	-- --	45 (--)	16 (--)	16 (100)	0 (0)	0	16
	2008–2009	--	-- --	66 (--)	11 (--)	11 (100)	0 (0)	0	11
	2009–2010	--	-- --	1 (--)	13 (--)	13 (100)	0 (0)	0	13
	2010–2011	--	-- --	-- (--)	0 (--)	0 (0)	0 (0)	0	0
Unit 19C, RM655	2006–2007	3	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0	0
	2007–2008	8	2 (25)	2 (25)	4 (50)	4 (100)	0 (0)	0	4
	2008–2009	10	5 (50)	2 (20)	3 (30)	3 (100)	0 (0)	0	3
	2009–2010	14	5 (36)	8 (57)	1 (7)	1 (100)	0 (0)	0	1
	2010–2011	2	0 (0)	0 (0)	2 (100)	2 (100)	0 (0)	0	2
Unit19D, RM650	2006–2007	248	74 (30)	112 (45)	62 (25)	62 (100)	0 (0)	0	62
	2007–2008	253	69 (27)	98 (39)	86 (34)	86 (100)	0 (0)	0	86
	2008–2009	291	74 (25)	114 (39)	103 (35)	103 (100)	0 (0)	0	103
	2009–2010	294	72 (24)	130 (44)	92 (31)	92 (100)	0 (0)	0	92
	2010–2011	300	77 (26)	116 (39)	107 (36)	107 (100)	0 (0)	0	107

[a] Includes data not available in WinfoNet.
[b] Successful hunters for TM684 may not equal the number of moose taken. The bag limit is 2 antlered bulls.
[c] One hunter took 2 bulls.
[d] RY09 and RY10 reports from WinfoNet 1-11-2012.

Table 6a. Unit 19 moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Successful					Unsuccessful					Total hunters[b]
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	136	80	43	0	259 (35)	237	187	67	0	491 (65)	750
2009–2010	112	97	36	10	255 (35)	240	178	44	13	475 (65)	730
2010–2011	140	110	48	4	302 (42)	210	149	50	2	411 (58)	713

[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 2006–2007 through 2010–2011.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	43	18	0	0	61 (25)	113	65	5[b]	0	183 (75)	244
2009–2010	33	22	1[b]	1	57 (25)	98	64	3[b]	4	169 (75)	226
2010–2011	50	32	2[b]	0	84 (38)	88	50	0	0	138 (62)	222

[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 2006–2007 through 2010–2011.

	Successful					Unsuccessful					
Regulatory Year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
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	8	14	0	23 (27)	1	32	29	0	62 (73)	85
2009–2010	0	3	16	1	20 (31)	2	21	17	5	45 (69)	65
2010–2011	1	6	11	2	20 (33)	4	15	18	3	40 (67)	60

[a] Local residents reside in Units 19A or 19B.

Table 6d. Unit 19C moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
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)	5	39	26	0	70 (57)	123
2009–2010	1	36	13	7	57 (45)	7	46	15	1	69 (55)	126
2010–2011	2	36	32	0	70 (53)	0	37	26	0	63 (47)	133

[a] Local residents reside in Units 19C or 19D.

Table 6e. Unit 19D moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
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	29	5	0	121 (42)	104	56	7	0	167 (58)	288
2009–2010	76	37	5	1	119 (39)	126	49	6	2	183 (61)	302
2010–2011	86	36	3	1	126 (44)	99	58	3	0	160 (56)	286

[a] Local residents reside in Unit 19D.

Table 7a. Unit 19[a] moose harvest percent by transport method, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Harvest percent by transport method[b]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
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	1	0	277
2009–2010	26	3	58	9	<1	1	2	1	0	255
2010–2011	22	1	66	9	1	0	1	<1[c]	0	300

[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.
[c] Includes transportation method “on foot”.

Table 7b. Unit 19A moose harvest percent by transport method, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
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	76
2009–2010	2	0	84	12	0	0	0	2[b]	0	57
2010–2011	5	0	94	1	0	0	0	0	0	84

[a] Successful hunters only.
[b] Includes transportation method “on foot”.

Table 7c. Unit 19B moose harvest percent by transport method, regulatory years 2006–2007 through 2010–2011.

Regulatory Year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
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	26
2009–2010	80	0	20	0	0	0	0	0	0	20
2010–2011	80	0	20	0	0	0	0	0	0	20

[a] Successful hunters only.

Table 7d. Unit 19C moose harvest percent by transport method, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
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	7	0	54
2009–2010	68	11	0	18	2	2	0	0	0	57
2010–2011	60	3	0	34	3	0	0	0	0	70

[a] Successful hunters only.

Table 7e. Unit 19D moose harvest percent by transport method, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
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	0	0	121
2009–2010	8	1	80	4	0	2	5	1	0	119
2010–2011	3	0	90	2	0	0	3	1[b]	0	126

[a] Successful hunters only.
[b] Includes transportation method "on foot".

SPECIES
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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 20A (6,796 mi^2; ~5,040 mi^2 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, 2011), 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 5,040 mi^2 of the unit (the area below 4,000 feet in elevation exclusive of large lakes).

Moose numbers increased in Unit 20A during the 1950s and reached high densities in the early 1960s, perhaps 4–5 moose/mi^2. Reported annual moose harvests averaged 311 moose between 1963 and 1969 (McNay 1993). During 1969–1974, reported harvest increased to an average of 617 moose per year. Cow moose composed 34% of the annual harvest during 1963–1974.

Similar to numerous other ungulate populations in Alaska, the moose population declined beginning in the late 1960s and reached its lowest point in the mid-1970s. Beginning in 1975, seasons and harvests were dramatically reduced and taking of cows was prohibited. During 1975–1978, mean annual reported moose harvest was 64 bulls.

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. ADF&G 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 2004–2011 (Young et al. 2006; Boertje et al. 2007; Young and Boertje 2011) to reduce and/or stabilize the moose population.

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 drawing permit hunt for bull moose (1996–2000 and 2004–2011), drawing permit hunts for "any bull" moose (2006–2011) concurrent with the antler restricted general season hunt, and antlerless moose hunts by drawing (1996–1998, 2001–2003, 2009–2011) and registration permits (2004–2011) with seasons extending up to 7 months in portions of the unit.

Approximately one-third of Unit 20A is military land, including 1,003 mi^2 used by the U.S. Army at Fort Wainwright, 893 mi^2 by the U.S. Army at Fort Greely, and 17 mi^2 by the U.S. Air Force at Clear Air Force Station. A variety of access restrictions, both spatial and temporal, apply to portions of these military lands.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide the greatest sustained opportunity to participate in hunting moose.
- Provide an opportunity to view and photograph moose.

MANAGEMENT OBJECTIVES

- Manage for a November population of between 10,000 and 12,000 moose.
- Manage for a harvest of 1,400–1,600 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

2010 Geospatial Population Estimation Survey

We surveyed 114 (78 high-density and 36 low-density; 670 mi^2) of 987 survey units (SUs; 5,747 mi^2) during 3–7 and 12 December. 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. A simple random sample of 100 SUs (70 high density and 30 low density) was selected from each stratum using Microsoft®Excel Windows®07 software. An additional 13 SUs (8 high density and 5 low density) were selected to fill gaps in the randomized coverage, and 1 SU (low-density SU 225) was done by mistake.

The GSPE method does not correct for moose not seen in surveyed units. Rather, the GSPE method employs greater search intensity, 8–10 min/mi^2 versus 4–6 min/mi^2 (Gasaway et al. 1986), resulting in a higher level of sightability. Search time per SU in SUs with 100% moose habitat averaged 8.3 min/mi^2 (n = 76 SUs). We applied a sightability correction factor (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 mostly good (55%) with the remainder being fair (26%), excellent (14%), and poor (5%) (n = 111).

2011 Geospatial Population Estimation Survey

We used the GSPE method (described above) and surveyed 138 SUs (94 high density and 44 low density; 802 mi^2) of 987 SUs (5,747 mi^2) during 16–28 November. A simple random sample of 100 SUs (70 high density and 30 low density) was selected from each stratum using Microsoft®Excel Windows®07 software. An additional 15 SUs (8 high density and 7 low density) were selected to intensively survey (i.e., a total of 21 contiguous SUs) in the northcentral Tanana Flats and another 23 SUs (16 high density and 7 low density) were selected to fill gaps in the randomized coverage.

Search time per SU with 100% moose habitat averaged 7.9 min/mi^2 (n = 97 SUs). Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were mostly excellent (51%) and good (47%) with the remainder being fair (1%) (n = 138).

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 with observers. 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. To increase the power of statistical comparisons between survey areas and across years, we established, a priori, a desired 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.

Antler Development Studies 2006–2010. Because of the poor nutritional plane documented for moose in Unit 20A, anecdotal information regarding retarded antler development, and adoption of antler restrictions in 2002, we initiated studies to measure the relationship between antler width and age, and to characterize antler development of known–age radiocollared moose.

The purpose of the antler width and age study was to determine the average number of years it takes for a bull moose to attain 50–inches in antler width; useful information regarding the efficacy of antler restrictions. During 2006–2010, 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 [I1]) for aging in order to regress antler width and age data. We collected antler width data and teeth for aging from 69 bulls in 2006, 106 in 2007, 154 in 2008, 174 in 2009, and 165 in 2010. Age determination from tooth (I1) cementum annuli was conducted by ADF&G personnel in Fairbanks, AK (2006, n=69) and Matson's Laboratory, Milltown, MT (2007–2010, n=599).

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 separation of brow–main palm) 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.

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., antlerless hunts DM683–DM697, November muzzleloader bull hunt DM766, 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., RY09 = 1 July 2009–30 June 2010).

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/mi^2 during RY08–RY11 (Table 2). These are the highest reported moose densities in Alaska for any comparably-sized area, although a smaller 1,890-mi^2 area in southern Unit 20D which includes agricultural lands and recent large burns had 4.6 moose/mi^2 in 2006 (DuBois 2008).

The Unit 20A moose population increased between 1999 and 2003, peaking at 15,000–20,000 moose (Young 2008). Lower population estimates in 2004–2006 and 2008–2011 (Table 2) in conjunction with poor productivity, particularly in 2001, 2003, 2007 and 2010 (R. Boertje, ADF&G files, Fairbanks), and liberal antlerless harvests in RY04–RY07 suggest a modest population decline. Our most recent trend model of the cow segment of the population (i.e., that segment of the population with the least annual variability), declined from an estimated (with SCF = 1.21) 9,483 cows in 2004 to 8,059 cows in 2011 (i.e., an average annual finite growth rate of 0.98 [SE=0.016] during that period).

Population Composition

Bull:cow ratios steadily increased between 2000 and 2005 and remained high through 2008 (Table 2). We deliberately increased bull harvest in RY08 and RY09 by issuing additional "any bull" drawing permits (750 in RY08 and 1,000 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. By 2009, bull:cow ratios had declined to 32:100. To stabilize bull:cow ratios at that level, we reduced the number of "any bull" drawing permits (896 in RY10 and 752 in RY11) to reduce the harvest of bulls to 4–5% of the estimated prehunt moose population or 15–20% of the prehunt bull moose population. This harvest strategy resulted in mean bull:cow ratios of 32:100 (range 32–33) during 2009–2011.

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 2003–2006 and 2008 (Young 2010). This trend continued during 2009–2011 (2009: Tanana Flats 31:100, western foothills–mountains 31:100, and eastern foothills–mountains 36:100; 2010: Tanana Flats 31:100, western foothills–mountains 32:100, and eastern foothills–mountains 31:100; 2011: Tanana Flats 35:100, western foothills–mountains 31:100, and eastern foothills–mountains 32:100).

Yearling recruitment (i.e., yearlings:100 cows) was relatively strong during 2003–2011, averaging 20:100 (range = 17–25:100; Table 2). Also, estimated percent yearlings in the population was 11–15% during that period. 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 winter 1992–1993 and predation has been relatively low (Boertje et al. 2009), which suggests the moose population could have increased during 2003–2011 had harvest rates of antlerless moose remained low. The proportion of yearlings in the Unit 20A moose population likely would have been even higher had it not been for 1) spike, forked, or 50-inch antler restrictions initiated in RY02, 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

2010 Twinning Surveys. Surveys were flown late mornings–early evenings (10:48–20:12 ADT). Leaf-out was complete. Weather, turbulence, and airsickness were not factors. We were unable to obtain a sample of 50 cows with calves in the eastern (n = 30) or western (n =36) portions of Unit 20A. Total flight time (including ferry time) was 19.5 hours and total survey time was 16.4 hours. We observed 736 moose ≥1 year (45 moose/hour); 120 (16%) parturient moose; and 7 parturient moose/hour. Mean (Northcentral, Western and Eastern Tanana Flats–foothills) observed twinning rate was 12% (Table 1). We observed 2 grizzly bears (eastern 20A), but no black bears (unlike 2009 when we observed 9 independent black bears).

Northcentral Tanana Flats — Surveys were conducted on 24 and 26 May east of Crooked Creek, east of the Tanana River and north of approximately N64˚28.00′. Total flight time was 6.8 hours and actual survey time was 5.98 hours. We observed 338 adult/juvenile moose; 56.5 adult/juvenile moose/hour; 54 (16.0%) parturient moose; and 9.0 parturient moose/hour. The observed twinning rate was 6% (3/54; 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, except that we did not survey the area between 64° 18.252′ and the Rex Trail and 148° 36.877′ and the Parks Highway because most of that area was severely burned in 2009. Total flight time was 6.63 hour and actual survey time was 5.88 hours. We observed 191 adult/juvenile moose; 32.5 adult/juvenile moose/hour; 36 (18.8%) parturient moose; and 6.1 parturient moose/hour. The observed twinning rate was 17% (6/36; Table 1).

Eastern Tanana Flats-Foothills — Surveys were conducted on 28 May east of Delta Creek and west of the Delta River. Total flight time was 6.1 hours and actual survey time was 4.5 hours. As in 2008 and 2009, most moose were observed in the northern portion of the survey area (i.e., within the Karla Lake fire perimeter). We observed 207 adult/juvenile moose; 45.7 adult/juvenile moose/hour; 30 (14.5%) parturient moose; and 6.6 parturient moose/hour. The observed twinning rate was 13% (4/30; Table 1).

2011 Twinning Surveys. Surveys were flown mornings/afternoons (09:37–13:10 ADT) and afternoons/evenings (16:30–20:30). Leaf-out was approximately 70%. Weather, turbulence and airsickness were not factors. We were unable to obtain a sample of 50 cows with calves in western (n = 43) and eastern (n = 30) Unit 20A. Total flight time (including ferry time) was 12.9 hours and total survey time was 10.8 hours. We observed 518 moose ≥1 year old (48 moose/hour); 123 (24%) parturient moose; and 11 parturient moose/hour. Mean (Northcentral, Western and Eastern Tanana Flats-foothills) observed twinning rate was 19% (Table 1). We observed 5 independent black bears (4 in the Northcentral Tanana Flats; 1 in the Western Tanana Flats).

Northcentral Tanana Flats — Surveys were conducted on 24 May east of Crooked Creek, east of the Tanana River and north of approximately N64˚38.00′. Total flight time was 3.1 hours and actual survey time was 3 hours. We observed 247 moose (≥1 year old) or 82 moose/hour; 50 (20%) parturient moose; and 17 parturient moose/hour. The observed twinning rate was 10% (5/50; Table 1).

Western Tanana Flats — Surveys were conducted on 26 May west of Tatlanika Creek, east of the George Parks Highway and north of the Rex Trail. Total flight time was 4.6 hours and actual survey time was 4 hours. We observed 148 moose (≥1 year old) or 37 moose/hour; 43 (29%) parturient moose; and 11 parturient moose/hour. The observed twinning rate was 26% (11/43; Table 1).

Eastern Tanana Flats–foothills — Surveys were conducted on 27 May east of Delta Creek and west of the Delta River. Total flight time was 5.2 hours and actual survey time was 3.8 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 123 moose (≥1 year old) or 32 moose/hour; 30 (24%) parturient moose; and 8 parturient moose/hour. The observed twinning rate was 20% (6/30; Table 1).

Overall twinning rates (i.e., northcentral Tanana Flats, western Tanana Flats and eastern Tanana Flats–foothills) were relatively poor in 2010 ($\bar{x}$ = 12%; Table 1). Twinning rates were lowest in the northcentral Tanana Flats (6%) followed by the eastern Tanana Flats–foothills (13%) and the western Tanana Flats (17%). In 2011, overall twinning rates ($\bar{x}$ = 19%), as well as, those in the northcentral Tanana Flats (10%), western Tanana Flats (26%) and eastern Tanana Flats–foothills (20%) were higher. However, this may have been a region–wide phenomenon resulting from unknown environmental factors as higher than average twinning rates were reported in various parts of Interior Alaska during 2011 (D. Bruning, R. Seavoy, and G. Stout, Wildlife Biologists, ADF&G, Region III, personal communications, 2011).

Antler Development

Antler study data were presented as an oral paper at the 46th North American Moose Conference and Workshop, 23–26 May 2011 in Jackson, Wyoming. The manuscript titled *Moose age and antler characteristics and the importance to management, Alaska* is currently in preparation. The abstract is presented in the Appendix.

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, and 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 2,598-mi^2 study area in central Unit 20A contained about 50% of the moose habitat, but about 67% of the moose in November. For example, in 1996 he found 30% higher moose density in the study area compared to the total Unit 20A moose density. In addition, the moose population consists of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From March to May many bull and cow moose migrate from the surrounding foothills (Alaska Range and Chena and Salcha River drainages) to summer range on the Tanana Flats in Unit 20A. They remain there at least through June in most years and return to the foothills from July through October. Although we do not know what proportion of the moose migrate, Gasaway et al. (1983) estimated that 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 1,807 mi^2 Tanana flats portion of their central study area, both calving and summer density were 1.85 times the November (1996) density.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY09 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area, Wood River Controlled Use Area, and the Yanert Controlled Use Area.		
RESIDENT HUNTERS:		
1 bull with spike/fork antlers or 50-inch antlers or antlers with 4 or more brow tines on one side; or	1 Sep–25 Sep (General hunt only)	

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 antlerless moose by drawing permit only, up to 500 permits may be issued; a person may not take a calf or a cow accompanied by a calf; a recipient of an antlerless drawing permit is prohibited from taking a bull moose in Unit 20A; or	25 Aug–31 Oct (General hunt only)	
1 antlerless moose by registration permit only; a person may not take a calf or a cow accompanied by a calf; or	10 Jan–28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1000 permits may be issued; or	1 Sep–25 Sep (General hunt only)	
1 bull by drawing permit only; by muzzleloader only; up to 75 permits may be issued.	1 Nov–30 Nov (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 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 muzzleloader only; up to 75 permits may be issued.		1 Nov–30 Nov

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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 drawing permit only, up to 500 permits may be issued; a person may not take a calf or a cow accompanied by a calf; a recipient of an antlerless drawing permit is prohibited from taking a bull moose in Unit 20A; or	25 Aug–31 Oct (General hunt only)	
1 antlerless moose by registration permit only; a person may not take a calf or a cow accompanied by a calf; or	25 Aug –28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1000 permits may be issued;	1 Sep–25 Sep (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 RY10 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area, Wood River Controlled Use Area, and the Yanert Controlled Use Area.		
RESIDENT HUNTERS: 1 bull with spike/fork antlers or 50-inch antlers or antlers with 4 or more brow tines on one side; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by drawing permit only, up to 1000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; a recipient of an antlerless drawing permit is prohibited from taking a bull moose in Unit 20A; or	25 Aug–31 Oct (General hunt only)	
1 antlerless moose by registration permit only; a person may not take a calf or a cow accompanied by a calf; or	10 Jan–28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1000 permits may be issued; or	1 Sep–25 Sep (General hunt only)	
1 bull by drawing permit only; by muzzleloader only; up to 75 permits may be issued.	1 Nov–30 Nov (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; or		1 Sep–25 Sep

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; by muzzleloader 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 drawing permit only, up to 1000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; a recipient of an antlerless drawing permit is prohibited from taking a bull moose in Unit 20A; or	25 Aug–31 Oct (General hunt only)	
1 antlerless moose by registration permit only; a person may not take a calf or a cow accompanied by a calf; or	25 Aug –28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1000 permits may be issued;	1 Sep–25 Sep (General hunt only)	
1 bull by drawing permit only; by muzzleloader 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.		1 Sep–25 Sep

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; by muzzleloader only; up to 75 permits may be issued.		1 Nov–30 Nov

Alaska Board of Game Actions and Emergency Orders. In RY91 the bag limit for the FTMA and YCUA was 1 bull moose with spike–fork or 50-inch antlers or antlers with 3 or more brow tines on 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 bag limit of SF50/4 to SF50/3; adopted a drawing permit hunt for "any bull" moose; and authorized issuance of up to 500 permits. In 2008, the board authorized the department to issue up to 1,000 "any bull" permits in Unit 20A.

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. In 2009, the board adopted language restricting 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.

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. In 2010, the board expanded the department's authority to hold the hunt anywhere in Unit 20A, but asked that the department avoid holding it in the eastern portion of the WRCU (i.e., the "original" hunt area) for some undetermined period of time. During RY11–RY12, DM766 was moved north and east of the WRCUA to alleviate social conflicts. In 2012, there was a public proposal to move the hunt back to the "original" hunt area and the board approved the change.

Alaska Board of Game Actions, March 2010 — The board took the following actions for moose in Unit 20A:

- Increased the "up to" language from 500 to 1,000 permits for the drawing permit hunts for antlerless moose.
- Expanded the muzzleloader bull moose hunt DM766 hunt area to include all of Unit 20A.

Alaska Board of Game Actions, March 2011 — The board took the following actions for moose in Unit 20A:

- Extended the antlerless drawing permit hunts from August 25–October 31 to August15–November 15 and "up to" language from 1,000 to 2,000 permits; and

- Extended the antlerless registration permit season from January 10–February 28 to October 1–February 28.

Alaska Board of Game Actions, March 2012 — The board took the following actions for moose in Unit 20A:

- Increased the Intensive Management population objective from 10,000–12,000 to 12,000–15,000 moose and reduced the harvest objective from 1,400–1,600 to 900–1,110 moose;

- Modified the bag limit in antlerless hunts to allow the take of calves, but retained the prohibition on taking cows accompanied by calves (i.e., antlerless moose, a person may not take a cow accompanied by a calf);

- Changed the DM766 muzzleloader hunt back to the eastern portion of the Wood River Controlled Use Area (via 5 AAC 92.051. Discretionary permit hunt conditions and procedures);

- Granted the department discretionary permit hunt authority to require latitude and longitude of kill locations for antlerless moose permit hunts; and

- Granted the department discretionary permit hunt authority to require a locking tag be attached to the antlers in drawing permit hunts for “any moose” (DM768–DM774).

Harvest by Hunters. Reported harvests of 849 moose in RY09 and 824 in RY10 (Table 3) fell short of the intensive management harvest objective of 1,400–1,600 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 then 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 (Young 2006) after the general season was reduced by 5 days (1–20 September) 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; Table 4) was likely the result of a drawing permit hunt initiated for “any bull” moose that ran concurrent with the September general season hunt (Table 5). During RY06, 300 “any bull” drawing permits were issued and 71 bulls were reported harvested; in RY07, 500 permits were issued and 96 bulls were harvested; in RY08, 750 permits were issued and 142 bulls were harvested; in RY09, 1,000 permits were issued and 194 bulls were 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 SF/50 regulation were reported as being taken under the permit hunt regulation). An increase in total reported harvest of bulls from 497 in RY05 to 642 in RY08 and 637 in RY09, supports this assertion (Table 3).

Permit Hunts

Bull — Beginning in RY06, in addition to the 75 drawing permits issued for bull moose during the November muzzleloader hunt (DM766), we issued drawing permits (DM768–DM774; Figs. 1and 2) for “any bull” 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–RY09 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–RY09 and harvest increased commensurately (Table 5) and bull:cow ratios declined to 32:100 by 2009 (Table 2). Beginning in 2010, we reduced the number of “any bull” drawing permits (896 in RY10 and 752 in RY11) to reduce the harvest of bulls and maintain bull:cow ratios near 30:100.

Antlerless — Drawing permit hunt harvest increased only from 127 to 175 antlerless moose during RY02–RY03 because of 2 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, registration permit hunt (Fig. 3) annual harvest jumped to 595, 679, 559, and 469 antlerless moose during RY04–RY07 (Table 5). There was nearly a 10-fold increase in the number of antlerless permits (registration) issued each year during RY04–RY07 ($\bar{x}$ = 4,501) compared to RY02–RY03 ($\bar{x}$ = 263). 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* = 1,852) and antlerless moose harvested (*n* = 197).

Beginning in RY09, we again began issuing drawing permits for antlerless moose with the goal of obtaining as much of the antlerless harvest as possible during the fall (versus the winter registration hunt) in order to address social issues (e.g., reduce the take of antlerless bulls, reduce conflicts with trappers). That year, 372 permits for drawing hunts (Fig. 4) and 685 permits for registration hunts (Figs. 5 and 6) were issued which resulted in a reported harvest of 242 antlerless moose (Table 5). During RY10, 645 drawing (Fig. 4) and 710 registration permits (Figs. 6 and 7) were issued which resulted in a reported harvest of 269 antlerless moose.

<u>Hunter Residency and Success</u>. 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. During RY09–RY10, success rates were similar to the previous 5-year average of 26%. Nonresidents had higher success rates than residents. During RY09–RY10, the average success rate was 52% for nonresident hunters compared to 22% for resident hunters. This can likely be explained by the greater use of guides by nonresident hunters (Young 2008, 2010).

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 1,189 to 1,628 (37%) in RY04, likely because of strong participation in the liberal antlerless hunts (*n* = 2,361 hunters) that were concurrent with the general season. The number of general season hunters reached an all-time high of 1,816 in RY05, as interest in the antlerless hunts peaked (*n* = 2,717 hunters), and then fell back to 1,608 in RY06, apparently as participation in the antlerless hunts waned (*n* = 2,057 hunters). This trend continued through RY09 (1,457 general season hunters; 764 antlerless moose hunters) and RY10 (1,312 general season hunters; 705 antlerless moose hunters).

<u>Harvest Chronology</u>. Moose harvest in Unit 20A has traditionally been well distributed throughout the season and consistent across years with no deviations apparent during RY09–RY10 (Table 6).

<u>Transport Methods</u>. All-terrain vehicles (3- or 4-wheeler and other off-road vehicles) and airplanes remained the primary modes of transportation used by successful hunters, and no deviations from their use in recent years were apparent during RY09–RY10 (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 has been relatively low since 2001 (Table 3). This may be the result of mostly below normal snowfall (long-term mean annual snowfall for Fairbanks = 68 inches) during this period (Young 2008, 2010; Young and Boertje 2011).

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 habitat capability and is vulnerable to severe weather patterns. Moreover, we deem a higher moose density as undesirable until productivity and/or habitat improves. Short-yearling weights, an indicator of habitat quality, were below the threshold of 385 lb (175 kg; Table 8) used as a signal to justify liberal antlerless hunts to reduce moose densities (Boertje et al. 2006). However, 2 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 use that burn is not known. In 2009, there were 2 additional large wildfires: the 125,000 acre Wood River Buttes 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 during 1996–2004 concluded that predation and low productivity of moose had similar major limiting effects on yield, while other factors had minor limiting effects (Boertje et al. 2009). Current research is assessing the effect of these large burns on several factors that affect moose productivity: 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.

ADF&G Draft Scoping Comment 2011 regarding the military's proposed Joint Pacific Alaska Range Complex (JPARC) addressed concerns about the long-standing, comprehensive management and research projects for moose in portions of Unit 20. Proposed restricted access corridors and expansion within Unit 20 could impair the ability of the department to continue long-standing, ongoing research projects; increase costs due to the need to circumvent airspace, and schedule additional flights; and cause researchers to reduce, abandon or not undertake future projects monitoring moose or other species if predictable, adequate access to airspace cannot be assured. Without the continued ability to freely access airspace in the region, particularly below 7,000 feet above ground level, necessary fish and wildlife population management in this area could be compromised A reduction in the quantity and quality of data could result in a need to manage species on a more conservative basis, leading to fewer opportunities for harvest, including subsistence. Of particular concern is the active management of the Nelchina Caribou Herd, Units 13 and 20 moose and wolf populations, and Gulkana River Chinook and sockeye salmon, all of which are highly sought by the public. These species are managed by the department through extensive oversight and deliberative processes, including direction from the Alaska Boards of Fisheries and Game. Proposed access restrictions that could accompany the expansion may have a chilling effect on the ability of the public to freely use and enjoy the area. Public access and spontaneous use associated with good weather days could be curtailed, as would public access to desired areas due to possible corridor closures, the need to request entry authorizations, and other restrictions to airspace necessitating the public to incur extra monetary expenditures in fuel and time to avoid military operations. Additionally, Alaska is notorious for poor weather related flying conditions and the ability of the average private pilot to understand and comply with flight restriction under poor flying conditions may pose a hazard to both military and private pilots operating in the area.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates indicate the Unit 20A moose population remained above the upper limit of the population objective through 2011. 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, through RY07 we 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 during RY08–RY11 (i.e., 200–350 antlerless moose) aimed at population stability. Our long-term objective is to stabilize the moose population unless we observe improvements in moose productivity, condition, or winter forage from reduced moose densities and recent habitat improvements (i.e., 2001 Fish Creek and Survey Line burns, 2006 Parks Highway burn, 2009 Rex Creek and Wood River Buttes burns). 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 RY09–RY10, 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. For RY11–RY12, 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., Unit 20A, 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 IM harvest objective of 1,400–1,600 moose annually in RY09 or RY10. 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.

Goals for next reporting period:

MANAGEMENT OBJECTIVES

- Manage for a November population of between 12,000 and 15,000 moose.
- Manage population levels based on 2-year mean twinning rates in conjunction with at least one of the following signals to substantiate low twinning-based nutritional status: 50% of 36-month-old moose are parturient, average multiyear short yearling mass is <385 pounds (175 kg), or >35% of annual browse biomass is removed by moose (Boertje et al. 2006):
    - <10% twinning rate — reduce the moose population
    - 10–20% twinning rate — maintain a stable moose population
    - >20% twinning rate — manage for population growth
- Manage for a harvest of 900–1,100 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.

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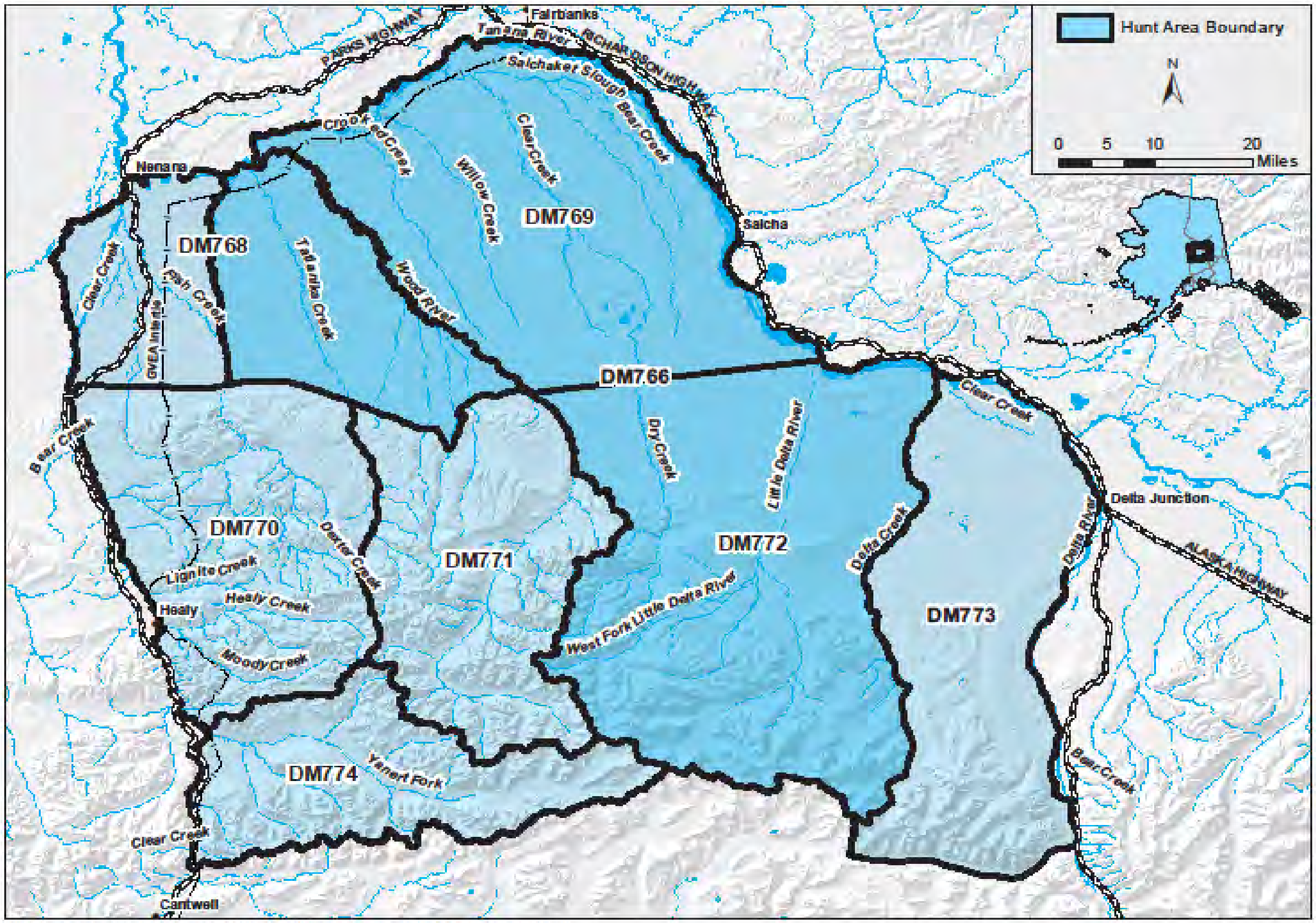


Figure 1. Bull drawing permit hunts DM768–DM774, regulatory years 2006–2007 through 2007–2008

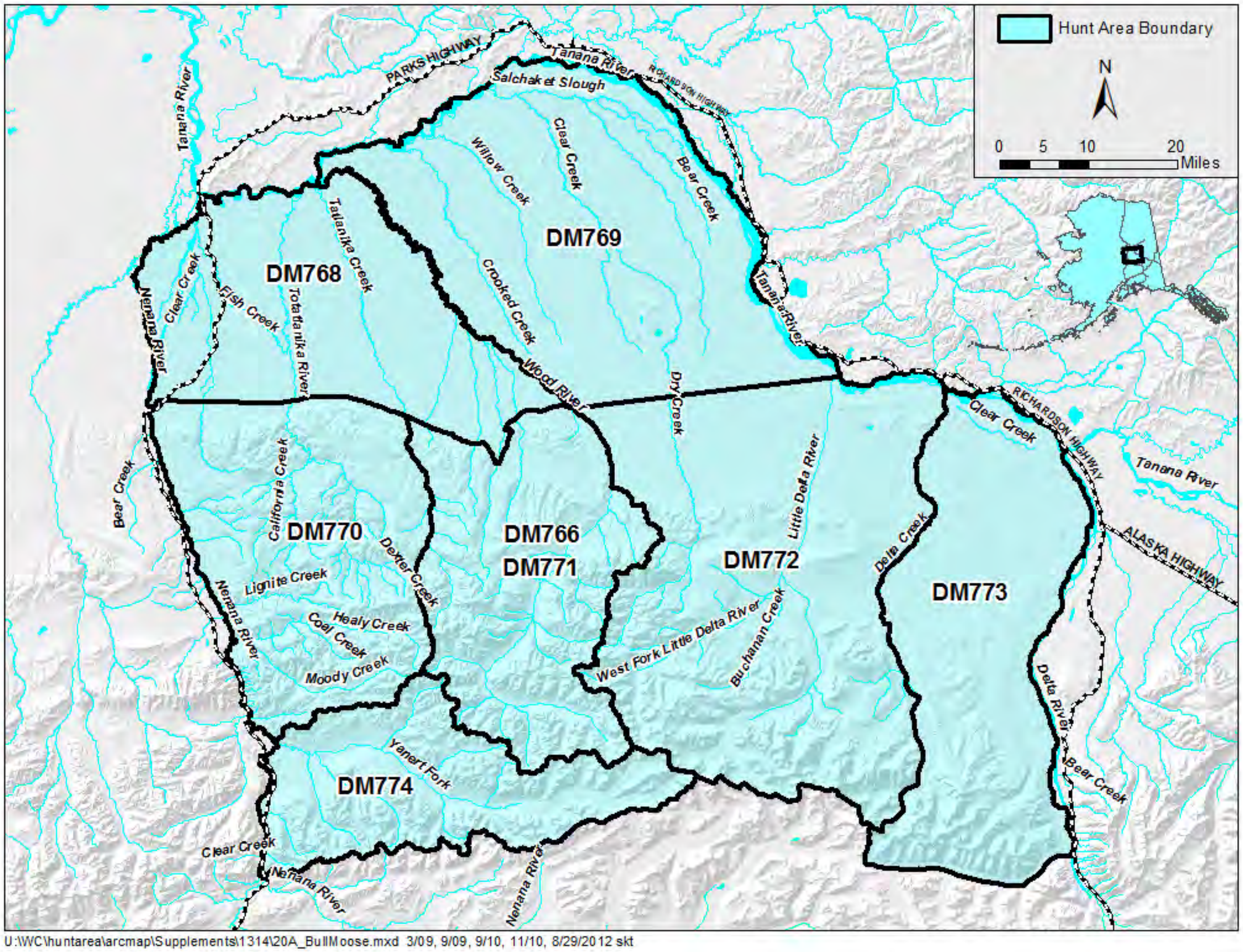


Figure 2. Bull drawing permit hunts DM768–DM774, regulatory years 2008–2009 through 2011–2012.

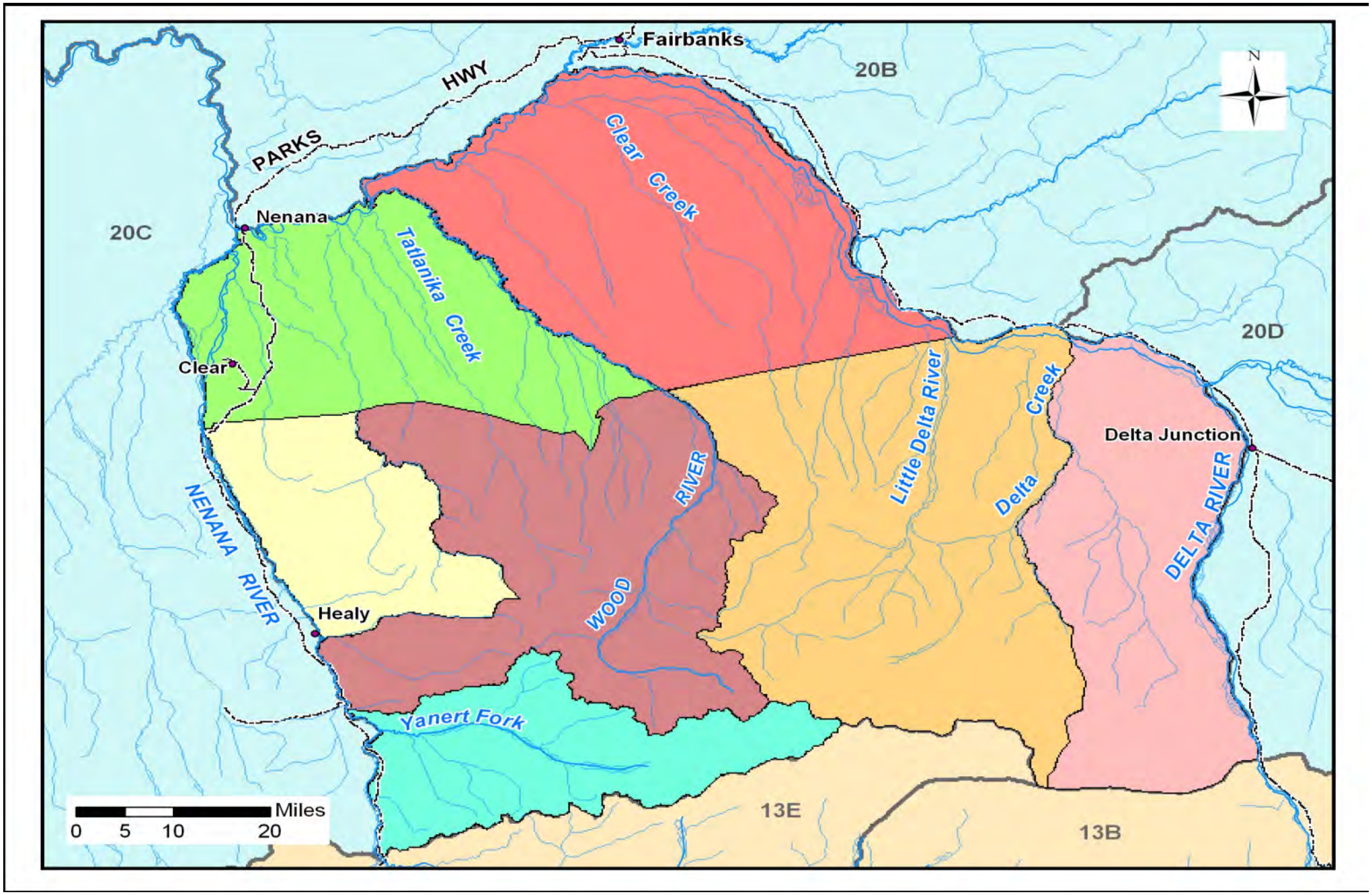


Figure 3. Antlerless moose registration hunt RM764 hunt areas, regulatory year 2004–2005.

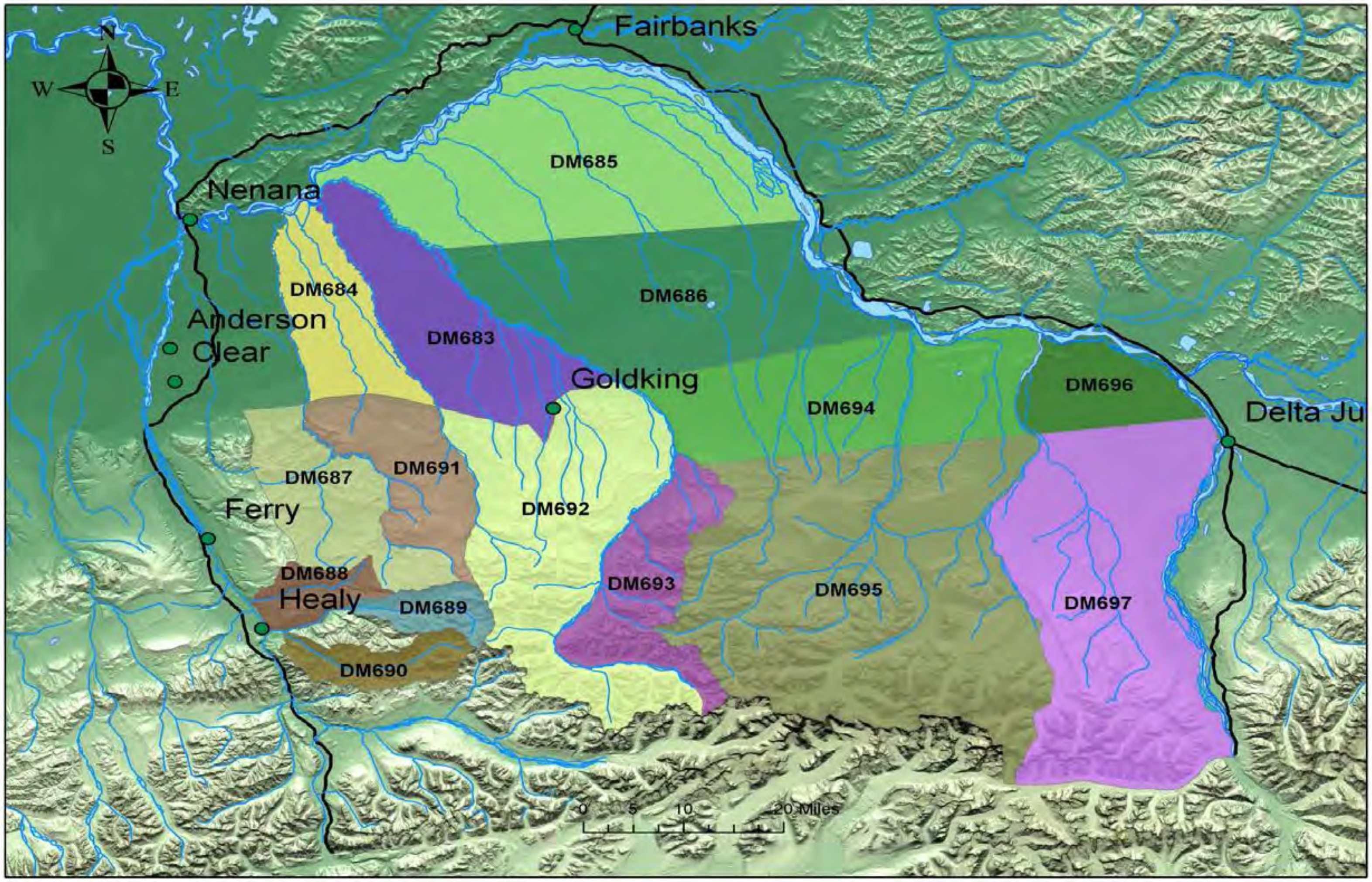


Figure 4. Antlerless drawing permit hunts DM683–DM697 hunt areas, regulatory years 2009–2010 through 2011–2012.

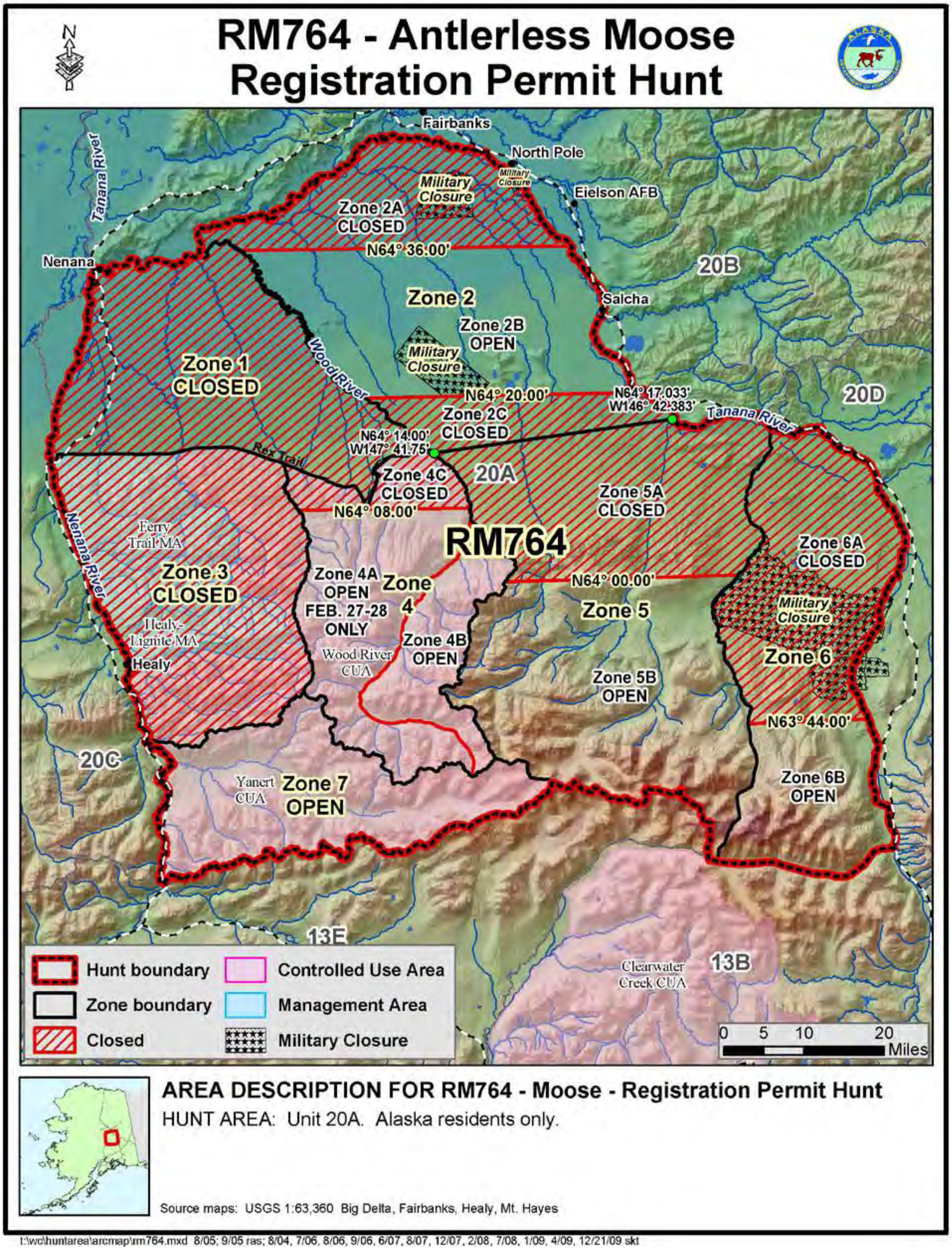
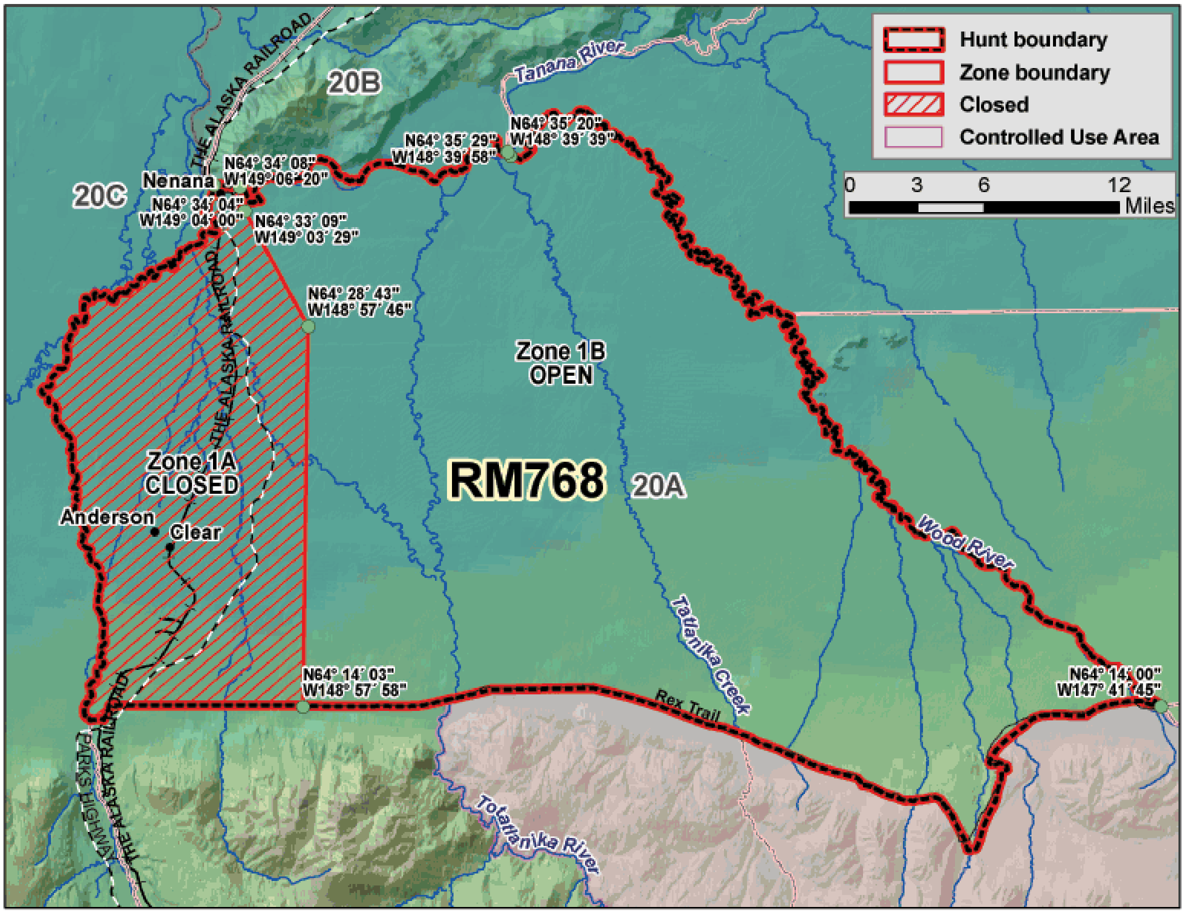


Figure 5. Antlerless moose registration hunt RM764 hunt areas, regulatory year 2009–2010.

RM768 - Antlerless Moose Registration Permit Hunt

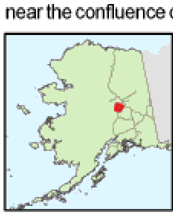


AREA DESCRIPTION FOR RM768 - Moose - Registration Permit Hunt

HUNT AREA: that portion of Unit 20A bounded on the north by the north bank of the Tanana River, bounded on the east by the east bank of the Wood River, bounded on the south by the south side of the Rex Trail, and bounded on the west by the east bank of the Nenana River. Alaska residents only.

Zone 1A: that portion of Unit 20A Zone 1 bounded by a line beginning at unnamed trail originating at the east end of the Nenana Municipal Airport near the confluence of Meriwether Slough and the Tanana River at approximately N64°33'09", W149°03'29"; then southeasterly along said trail to its intersection with the Northern Intertie right-of-way at N64°28'43", W148°57'46"; then south along the west side of the Northern Intertie right-of-way to its intersection with the Rex Trail at N64°14'03", W148°57'58"; then west along the south side of the Rex Trail to the Nenana River; then downstream along the east bank of the Nenana River to the confluence of the Tanana River; then northerly in a straight line to the north bank of the Tanana River at N64°34'08", W149°06'20"; then upstream along the north bank of the Tanana River to a point approximately 0.4 miles above the Alaska Railroad train bridge at N64°34'04" W149°04'00"; then southerly to the point of origin is CLOSED.

Zone 1B: that portion of Unit 20A Zone 1 bounded by a line beginning at unnamed trail originating at the east end of the Nenana Municipal Airport near the confluence of Meriwether Slough and the Tanana River at approximately N64°33'09", W149°03'29"; then southeasterly along said trail to its intersection with the Northern Intertie right-of-way at N64°28'43", W148°57'46"; then south along the west side of the Northern Intertie right-of-way to its intersection with the Rex Trail at N64°14'03", W148°57'58"; then east along the south side of the Rex Trail to its intersection with the Wood River at N64°14'00", W147°41'45"; then downstream in a northwesterly direction along the east bank of the Wood River to its confluence with the south bank of the Tanana River at N64°35'20", W148°39'39"; then northwesterly in a straight line to the north bank of the Tanana River at N64°35'29", W148°39'58"; then downstream along the north bank of the Tanana River to a point approximately 0.4 miles upstream from the Alaska Railroad train bridge at N64°34'04", W149°04'00"; then southerly in a straight line to the point of origin. is OPEN.



Source maps: USGS 1:63,360 Fairbanks

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Figure 6. Antlerless moose registration hunt RM768 hunt area, regulatory year 2009–2010.

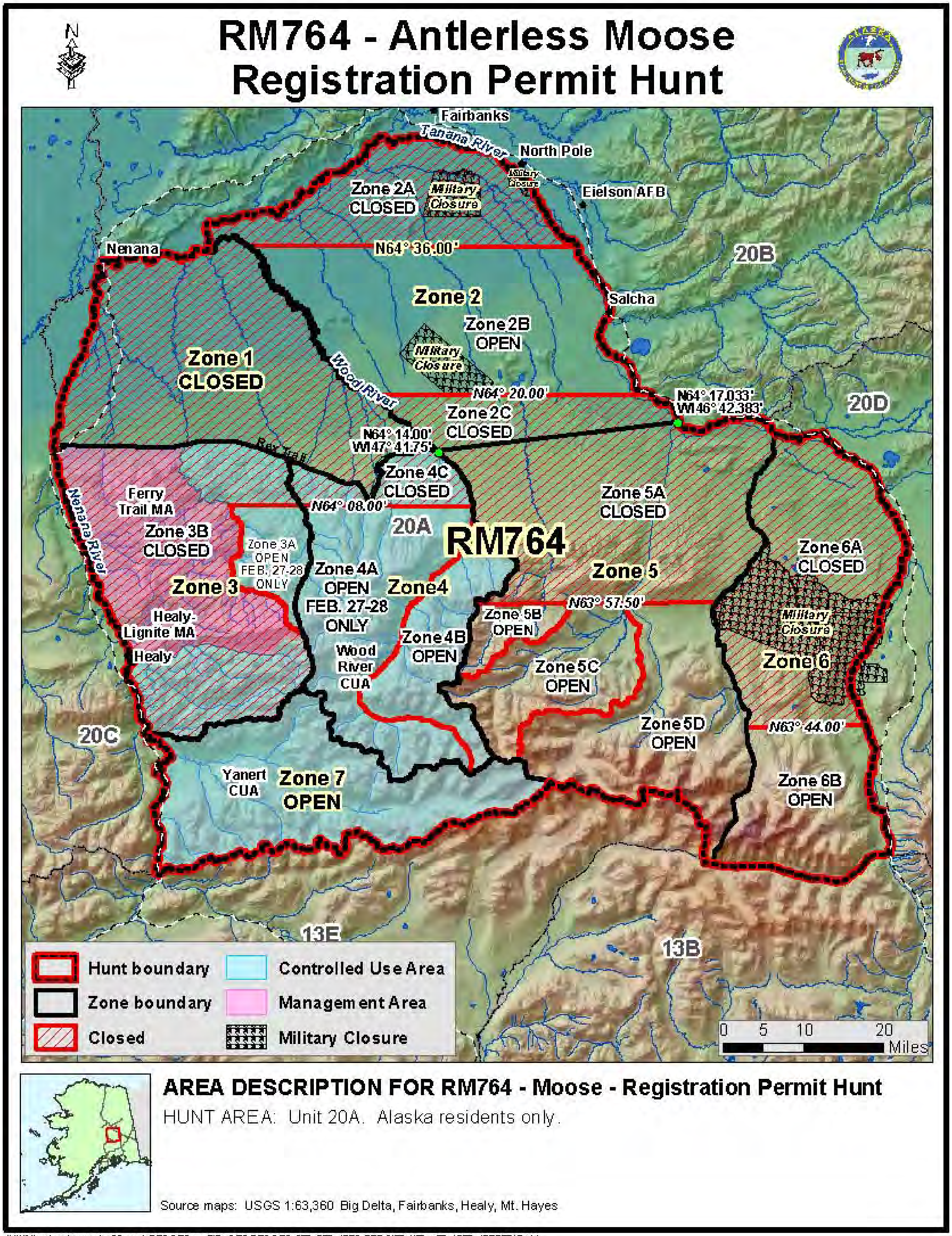

Figure 7. Antlerless moose registration hunt RM764 hunt areas, regulatory year 2010–2011.

Table 1. Unit 20A moose twinning rates from transect surveys, 2002–2011.

Calendar Year	Date	Cows w/Single calf	Cows w/Twins	Cows Total	% Twins[a]	Mean[b]
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	
2010[c]	24, 26 May	51	3	54	6	
2010[d]	27 May	30	6	36	17	12
2010[e]	28 May	26	4	30	13	
2011[c]	24 May	45	5	50	10	
2011[d]	26 May	32	11	43	26	19
2011[e]	27 May	24	6	30	20	

[a] Percentage of cows with calves that had twins.
[b] Mean of percent twins for central, western, and eastern Tanana Flats.
[c] Northcentral Tanana Flats.
[d] Western Tanana Flats.
[e] Eastern Tanana Flats.

Table 2. Unit 20A aerial moose fall composition counts and estimated population size, 1999–2011.

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	1,089	1,377	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	1,212	1,483	14,684 (±13%)	17,768	3.5
2004	35	21	36	21	1,512	1,922	13,566 (±15%)	16,415	3.3
2005	38	18	30	19	1,370	1,684	13,348 (±15%)	16,151	3.2
2006	36	22	34	20	1,232	1,536	12,773 (±16%)	15,455	3.1
2007[e]									
2008	37	25	35	20	1,335	1,672	10,361 (±11%)	12,537	2.5
2009	32	18	30	19	1,411	1,740	12,956 (±12%)	15,677	3.1
2010	32	17	32	20	1,196	1,486	11,981 (±13%)	14,497	2.9
2011	33	17	28	21	1,363	1,651	10,515(±12%)	12,724	2.5

[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 mi^2 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 2010–2011.

Regulatory year	Human Take					Accidental death			Grand Total
	Reported Hunter Harvest				Estimated	Reported			
	M	F	Unk	Total	Total[b]	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	1,334	0	11	11	1,345
2005–2006	497	634	0	1,131	1,527	0	6	6	1,533
2006–2007	558	493	0	1,051	1,419	2	8	10	1,429
2007–2008	538	417	7	962	1,299	0	8	8	1,307
2008–2009	642	171	8	821	1,108	1	11	12	1,120
2009–2010	637	201	11	849	1,146	1[e]	9[e]	10	1,156
2010–2011	588	229	7	824	1,112	1[e]	9[e]	10	1,122

[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 Alaska Railroad mileposts 371.0 and 411.7; "Missing" moose (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[e]Average reported killed 2003–2008.

Table 4. Unit 20A general season moose hunter[a] residency and success, regulatory years 2001–2002 through 2010–2011.

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	1,012 (65)	1,551
2002–2003	190	77	85	1	353 (30)	567	190	70	1	828 (70)	1,181
2003–2004	185	68	78	0	331 (28)	551	202	99	6	858 (72)	1,189
2004–2005	191	95	92	15	393 (24)	815	320	85	15	1,235 (76)	1,628
2005–2006	211	112	119	2	444 (24)	892	385	86	9	1,372 (76)	1,816
2006–2007	177	107	123	1	408 (25)	755	327	108	10	1,200 (75)	1,608
2007–2008	176	90	116	2	384 (24)	694	374	132	1	1,201 (76)	1,585
2008–2009	197	113	136	5	451 (30)	596	304	116	22	1,038 (70)	1,489
2009–2010	173	104	110	10	397 (27)	620	322	97	21	1,060 (73)	1,457
2010–2011	133	79	103	30	345 (26)	547	268	101	51	967 (74)	1,312

[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 2010–2011.

Permit hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Male (%)	Female (%)	Unk	Harvest
Totals for antlerless permit hunts DM683–DM697, RM764 & RM768	2004–2005	5,430	3,069 (57)	1,766 (75)	595 (25)	37 (6)	553 (94)	5	595
	2005–2006	5,114	2,397 (47)	2,038 (75)	679 (25)	47 (7)	629 (93)	3	679
	2006–2007	3,737	1,680 (45)	1,498 (73)	559 (27)	66 (12)	484 (88)	9	559
	2007–2008	3,721	1,833 (49)	1,419 (75)	469 (25)	44 (9)	421 (91)	4	469
	2008–2009	1,852	1,208 (65)	447 (69)	197 (31)	24 (12)	171 (88)	2	197
	2009–2010	1,057	293 (28)	522 (68)	242 (32)	33 (15)	189 (85)	20	242
	2010–2011	1,355	650 (48)	436 (62)	269 (38)	39 (15)	225 (85)	5	269
Totals for antlered permit hunts DM766 & DM768–DM774	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
	2009–2010	1,040	498 (48)	332 (61)	210 (39)	209 (100)	0 (0)	1	210
	2010–2011	936	421 (45)	307 (60)	208 (40)	208 (100)	0 (0)	0	208
Totals for all permit hunts	2004–2005	5,430	3,069 (57)	1,766 (75)	595 (25)	37 (6)	553 (94)	5	595
	2005–2006	5,189	2,437 (47)	2,065 (75)	687 (25)	55 (8)	629 (92)	3	687
	2006–2007	4,112	1,844 (45)	1,624 (72)	644 (28)	151 (24)	484 (76)	9	644
	2007–2008	4,297	2,073 (48)	1,642 (74)	582 (26)	157 (27)	421 (73)	4	582
	2008–2009	2,677	1,621 (61)	689 (65)	367 (35)	194 (53)	171 (47)	2	367
	2009–2010	2,097	791 (38)	854 (65)	452 (35)	242 (56)	189 (44)	21	452
	2010–2011	2,291	1,071 (47)	743 (61)	477 (39)	247 (52)	225 (48)	5	477

Table 6. Unit 20A moose harvest[a] chronology percent by month/day, regulatory years 2007–2008 through 2010–2011.

Regulatory	Harvest chronology percent by month/day						
year	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29	Unk/Other	*n*
2007–2008	7	17	28	35	11	1	383
2008–2009	3	20	26	36	13	2	450
2009–2010	3	23	31	29	13	2	393
2010–2011	2	21	28	35	13	1	344

[a] Excludes permit hunt harvest.

Table 7 Unit 20A moose harvest[a] percent by transport method, regulatory years 2001–2002 through 2010–2011.

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
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	32	5	15	25	1	12	2	5	2	387
2008–2009	38	5	15	30	0	6	2	4	1	455
2009–2010	30	8	12	32	0	9	3	3	2	397
2010–2011	33	7	12	31	0	10	3	3	2	345

[a] Excludes permit hunt harvest.

Table 8. Unit 20A short-yearling weights, 2009, 2010, and 2012.

Area	Year	Avg. weight (lb)	*n*	Variance	se	Dates
Central 20A	2009	340.2	49	2,141.147109	6.6	1–13 Mar 2009
	2010	348.8	77	1,930.214627	5.0	24 Feb–10 Mar 2010
Western 20A	2009	348.4	22	2,405.777056	10.5	1–13 Mar 2009
	2012	349.8	37	2,447.063063	8.1	1–8 Mar 2012

APPENDIX

MOOSE AGE AND ANTLER CHARACTERISTICS AND THE IMPORTANCE TO MANAGEMENT, ALASKA

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Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701-1599 (907-459-7233; don.young@alaska.gov)

ABSTRACT: During 2007–2010, we studied relationships between age and antler characteristics of moose (*Alces alces*) in Game Management Unit 20A (Unit 20A) because of concerns of poor antler development due to the moose population's poor nutritional status. Also, the Alaska Department of Fish and Game adopted a selective harvest strategy (i.e., (1) spike-fork antlers, (2) antlers ≥50 inches wide, or (3) ≥3 brow tines on ≥1 antler) in 2002. As such, we were concerned about potential low annual recruitment of bull moose into the 50-inch antler class. Moreover, because of habitat concerns (i.e., high browse utilization along with indices of poor nutritional status, such as low calf weights and low reproduction), we did not want to carry more moose on the range than was necessary to meet population and harvest objectives. Regression analysis of age and antler data indicated that, on average, it took bull moose 6 years to grow antlers ≥50 inches wide. These results were similar to values in other areas of Interior Alaska with lower moose densities and improved nutrition. We also were concerned that yearling and 2-year old bulls with retarded antler development might be misclassified during aerial moose surveys resulting in biased bull:cow and yearling:cow ratios. During intensive, low-level aerial inspection of known-age radiocollared moose, 22% (11/51) of yearling bull moose had spiked antlers ≤ 3 inches in length which probably would have gone undetected during standard aerial composition surveys. These bulls would likely have been misclassified as female moose. Similarly, 19% (8/43) of known-age, 2-year old radiocollared bull moose probably would have been misclassified as yearling bulls based on brow and main palm development alone. However, when brow and main palm development, antler spread and antler length were used collectively, all known age 2-year old radiocollared bulls (n=43) were correctly classified during aerial inspection. We recommend for Unit 20A and similar high-density, nutritionally stressed moose populations that all subadult moose be highly scrutinized during aerial composition surveys to reduce the likelihood of misclassifying yearling and 2-year old males with retarded antler growth. Also, because the 2- through 5-year cohorts are largely protected from harvest, we recommend the spike-fork/50-inch selective harvest strategy include an "any bull" component (e.g., limited permit hunt) to meet harvest objectives.

SPECIES 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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 20B (9,196 mi^2)

GEOGRAPHIC DESCRIPTION: Drainages into the north bank of the Tanana River between Delta Creek and Manley Hot Springs

BACKGROUND

Moose numbers increased in Unit 20B throughout the 1950s and early 1960s after extensive wildfires improved moose habitat and federal predator reduction programs reduced wolf predation on moose (McNay 1993). Moose numbers declined following severe winters in 1965, 1970, 1971, and 1974. Increasing wolf predation and liberal either-sex hunting seasons contributed to the moose population decline. By 1976 moose densities were low, and the hunting season had been reduced to 10 days for bulls only in most of Unit 20B. Moose populations again increased following wolf reduction programs during 1980–1986. Moose hunting seasons were extended from 10 days in 1981 and 1982 to 20 days during 1983–1987. 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, 2008, and 2009 indicated that the moose population increased from an estimated 9,800 (about 1.1 moose/mi^2) in 1990 to 20,000 (about 2.2 moose/mi^2) in 2009.

Demand for moose hunting opportunities in Unit 20B is high. Extensive road and trail systems provide overland access, and numerous waterways such as the Tolovana, Tatalina, Chatanika, Goldstream, Salcha, and Chena Rivers provide boat access.

Both general season and permit hunts are available to meet the demand to harvest moose in Unit 20B. Many of the permits hunts are available only to residents hunters. Fifty-five permit hunts were available to hunt moose in Unit 20B during RY09–RY10: 2 hunts for “any moose” in the Minto Flats Management Area (MFMA) and 53 hunts for “antlerless moose” (i.e., 1 in the Fairbanks Management Area [FMA] by bow and arrow, 1 in the Creamer’s Field Migratory

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

Waterfowl Refuge [Creamer's Refuge] within the FMA by muzzleloader, and 51 in central and western Unit 20B outside the FMA).

The MFMA was established in 1979 to restrict harvest in a low-density moose population. In 1988 the Alaska Legislature established the Minto Flats State Game Refuge to ensure the protection and enhancement of habitat and the conservation of fish and wildlife; and to guarantee the continuation of hunting, fishing, trapping, and other compatible public uses within approximately 900 mi^2 of the Minto Flats area.

The FMA was established in 1983 to provide moose hunting opportunities around the Fairbanks urban area by bow and arrow only. This area was closed to hunting in the late 1970s and early 1980s to prevent excessive harvest. Boundaries of the FMA changed numerous times. The most recent changes went into effect in July 2004. The FMA currently encompasses about 300 mi^2, about 50 mi^2 of which 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 (2,942 mi^2), including the Minto Flats, Tatalina Creek drainage, Tolovana River drainage, and areas farther west; 2) eastern Unit 20B (2,425 mi^2) including the Little Salcha and Salcha River drainages; and 3) central Unit 20B (3,829 mi^2), 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

During 14–20 November 2009, we completed a unitwide population survey in 20B. We surveyed 115 sample units (SUs) of the 1,628 in Unit 20B (9,196 mi^2) using 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 07® software. Additional SUs (*n* = 15) were selected to fill in gaps in the coverage. Preliminary studies suggest using a sightability correction factor (SCF) of 1.16–1.25 for moose that were present, but not observed, during the survey using the GSPE method (Boertje et al. 2009). Because an SCF has not been determined in Unit 20B, we used the midpoint of SCF data suggested by Boertje et al. (2009) and applied an SCF of 1.21 to GSPE estimates in Unit 20B to estimate total moose numbers.

In 2010, adequate snow conditions did not develop until late November; therefore, we did not complete a unitwide survey. However, we did complete an intense GSPE survey in Minto Flats Management Area during 30 November–2 December. We surveyed 83 of the 169 SUs (49%) within the 951 mi^2 survey area and distributed SUs systematically in a checkerboard fashion: every other unit was selected and no 2 samples shared the same border. Systematic sampling of the study area yielded only 15 low density SUs. A minimum of 20 SUs in each stratum is required to estimate autocorrelation in the GSPE technique. Therefore, we analyzed these as a single stratum sample.

Twinning Rate Surveys

Twinning rates were estimated from surveys conducted in traditional twinning survey trend count areas on Minto Flats and areas surveyed in central Unit 20B since 2006. Surveys in the MFMA consisted of parallel transects flown at approximately ½-mile intervals at ≤500 feet above ground level (AGL) in PA-18 or Bellanca Scout aircraft by experienced pilots. This method is most effective in the MFMA because of the high density of moose and the open habitat. A high proportion of central Unit 20B is forested, so surveys in central Unit 20B consisted of searching good moose habitat at 500–1,000 feet AGL in a Bellanca Scout. 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.

2010 Twinning Surveys

<u>Minto Flats Management Area</u>. 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. The survey was flown with a PA-18 super cub. Leaf-out was approximately 85%. Weather may have been a factor during the survey because of high

temperatures (75°F). Turbulence and airsickness were not factors. Survey flight time was 3.25 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 during 28–30 May. Due to high temperatures, the surveys were flown between 9 p.m. and midnight when temperatures were cooler. Survey flight time was 9.6 hours.

2011 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. The survey was flown with a PA-18 super cub. Leaf-out was approximately 70%. Weather, turbulence and airsickness were not factors. Survey flight time was 2.8 hours.

Central Unit 20B. A Bellanca Scout 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 on 25–26 May. Surveys were flown from 6 a.m. to 10 a.m. the first morning and 9 p.m. to midnight for 2 evenings to avoid high temperatures. Survey flight time was about 7.5 hours.

MORTALITY

We estimated harvest based on mandatory harvest report cards. This included report card data from general season harvest tickets; the MFMA registration permit hunt; and the FMA, Creamer's Refuge, and central and western Unit 20B antlerless drawing permit hunts. Reminder letters were sent to non-reporting 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., RY09 = 1 July 2009 through 30 June 2010).

We estimated accidental mortality by motor vehicles and trains from Alaska Department of Public Safety (DPS) 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 by DPS or ADF&G personnel, potlatch, stickdance, and other reported deaths) mortality from DPS and ADF&G records and added an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on a radiocollared sample of moose in Unit 20A).

HABITAT

Browse removal surveys were conducted in March 2010 in the MFMA. Data on browse production and removal were estimated using plant sampling methods (Seaton 2002). To evaluate population nutrition in current habitat conditions (Boertje et al. 2007), we captured and weighed short yearlings in central Unit 20B and the MFMA.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Moose numbers have doubled in Unit 20B since the early 1990s. In 1990 the population was estimated at 9,800 moose (1.1 moose/mi^2; McNay 1993). The population was estimated at 12,313 moose (1.3 moose/mi^2) by 2001 (Table 1) and >16,080 moose (>1.7 moose/mi^2) in 2003. The population then appeared to stabilize during 2004–2006. In 2008, the population estimate increased again to 17,806 (1.9 moose/mi^2) moose. In 2009, the population estimate was 20,173, with the lower end of the 90% confidence interval 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 during 2000–2009, are consistent with this population growth (Seaton 2010).

At the scale of the 3 geographic zones in Unit 20B, moose numbers in central and western Unit 20B (including the MFMA) showed similar increasing trends (Table 1). During 2001–2009, central Unit 20B moose population estimate increased from 4,806 (1.3 moose/mi^2) to 6,856 (1.8 moose/mi^2), western Unit 20B moose numbers increased from 4,562 (1.6 moose/mi^2) to 9,742 (3.3 moose/mi^2), and during 2001–2010 the MFMA estimate increased from 2,252 (2.4 moose/mi^2) to 4,181 (4.4 moose/mi^2). Population estimates in eastern Unit 20B, however, increased slightly during 2001–2006 and have remained stable since 2006 (Table 1). Gasaway et al. (1992) reported that areas of Interior Alaska and Yukon Canada where predators were lightly harvested had densities of 0.1–1.1 moose/mi^2. Higher moose 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 high 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 2003–2010 were highly variable (Table 1), possibly the result of varying sampling effort, survey conditions, and the small size of the area surveyed. The 2010 estimate was the best survey completed in regards to sampling effort. During that survey, 49% of all the sample units in MFMA were surveyed. Therefore our estimate resulted in the lowest 90% confidence interval (±9%) since 2001. However, surveys in the MFMA may provide inconsistent results regardless of sampling effort if estimates are influenced by changes in moose distribution and the timing of the October or November migration (P. Valkenburg and R. Boertje, ADF&G, personal communication 2000)

Population Composition

Bull:Cow Ratios. The 2009 survey indicated posthunting bull:cow ratios of ≥37 bulls:100 cows (90% CI) unitwide and ≥30 bulls:100 cows (90% CI) in eastern, central, and western Unit 20B (Table 1). The estimated bull:cow ratio was 34:100 in the MFMA in 2010. Changes in moose distributions in this relatively small survey area and/or survey sample size may be factors in the highly variable sex ratios as well as the population estimates.

Historically, bull:cow ratios in most of Unit 20B have exceeded the lower limit of the management objective of ≥30:100, but 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 drainage had bull:cow ratios of 44:100 (1990) and the MFMA had 49:100 (1989) and 47:100 (1994). In contrast, the ratio was 28 bulls:100 cows (1990) in the more intensively harvested Chena River drainage and the even most intensively harvested FMA had 9–14 bulls:100 cows (1989–1994).

Calf:Cow Ratios. Calf:cow ratios were high during 2001–2010 (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

The twinning rate in MFMA was low in 2001 (8%), but relatively stable during 2002–2011 ($\bar{x}$ = 25%; range = 18–34%; Table 2). The MFMA twinning rate was 18% in 2010, but rebounded to 34% in 2011.

The central Unit 20B twinning rate was 3% in 2010, and 8% in 2011. Twinning surveys have been conducted in central Unit 20B since 2006 and have been consistently lower ($\bar{x}$ = 8%, range = 2–18) than in the MFMA during 2006–2011.

Distribution and Movements

Moose are distributed throughout Unit 20B, consisting of nonmigratory and migratory subpopulations (Gasaway et al. 1983). During February–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 Unit 20B foothills during August–October. Boertje et al. (2009) estimated that 9% of the moose that calve 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 RY09 and RY10 were:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Creamer's Migratory Waterfowl Refuge.		
1 bull with spike–fork or greater antlers by bow and arrow only; or	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 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; or	1 Sep–27 Nov	1 Sep–27 Nov
1 antlerless moose by muzzleloader only, by drawing permit; up to 10 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	21 Nov–27 Nov	21 Nov–27 Nov
Remainder of the Fairbanks Management Area.		
1 bull with spike–fork or greater antlers by bow and arrow only, or;	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 10 Jan–28 Feb	No open season No open season
1 bull with spike–fork or 50-inch antlers, or antlers with ≥4 brow tines on 1side.	11 Sep–25 Sep	No open season

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull; or	1 Sep–20 Sep	1 Sep–20 Sep
1 bull by bow and arrow only; or	21 Sep–30 Sep	21 Sep–30 Sep
1 antlerless moose by drawing permit only; up to 300 permits may be issued; a person may not take a calf or cow accompanied by a calf.	15 Aug–15 Nov	No Open Season
Remainder of Unit 20B.		
1 bull; or	1 Sep–15 Sep	5 Sep–15 Sep
1 antlerless moose by drawing permit only; up to 900 permits may be issued; a person may not take a calf or cow accompanied by a calf.	15 Aug–15 Nov	No open season

Alaska Board of Game Actions and Emergency Orders. No emergency orders were issued during the report period.

Board of Game Actions effective beginning 1 July 2009 — At the spring 2008 meeting, the Alaska Board of Game 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 (396 permits). Much of the reasoning was based on lack of survey data in RY07.

At its spring 2009 meeting, the board authorized ADF&G to split the 4 antlerless hunt areas in central and western Unit 20B into 17 hunt areas, each with 3 different hunt periods. This generated 51 different drawing permit hunts. The board also authorized ADF&G to issue up to a total of 600 antlerless moose permits in these hunts.

At the spring 2010 meeting, the board authorized ADF&G to issue up to 900 drawing permits for antlerless moose in Unit 20B and eliminated the prohibition on taking calf moose or cows accompanied by calves in the FMA. The board authorized 2 new resident-only drawing permit hunts with a bag limit of any moose: a muzzleloader hunt in the Middle Fork of the Chena River and Upper Salcha River drainage (DM782) and an archery or muzzleloader hunt along the Richardson Highway (DM782). Because the application period for drawing permits is in

November and December (prior to the board passing these new hunts), both DM782 and DM783 will first be available to hunters during the RY11 hunting season.

Historical Board of Game Actions — At the spring 2004 meeting the board eliminated the *Take a Child Hunting* early season they had authorized beginning in RY02 for moose in Unit 20B; created a new winter (21–27 November) 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, and redefined the FMA boundaries. At its spring 2006 meeting, the board authorized the department to issue up to 300 drawing permits for antlerless moose in central Unit 20B.

Earlier board actions are summarized by Seaton (2010) and Young (2006).

<u>Harvest by Hunters</u>.

General Season — Reported harvests of 675 bulls in RY09 and 543 bulls in RY10 ($\bar{x}$ = 609) on average were higher than the average reported harvest of 549 bulls during RY05–RY08 (Table 3). Most harvest during RY09–RY10 was in central Unit 20B, followed by western Unit 20B, then eastern Unit 20B (Table 3).

Reported harvest in the FMA was 50 moose in RY09 and 36 in RY10 ($\bar{x}$ = 43; Table 3), an increase from the RY01–RY08 average of 34. Relatively high harvest in the FMA is likely the result of high densities and survival rates of moose in the FMA.

Permit Hunts — There were no apparent trends in harvest, effort, or success rates in permit hunts during RY02–RY10 (Table 4). Harvest of antlerless moose increased in hunt DM788 in RY04, and hunts RM775 and RM785 in RY05, but 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. During RY10 successful hunters declined to 44%, the lowest in the last 6 years. This is likely due to the increased number of drawing permits for antlerless hunts and the resulting increased hunting pressure.

<u>Hunter Residency and Success</u>. Primarily, local residents hunted moose in Unit 20B (Table 3). Participation by nonlocal Alaska residents and nonresidents was relatively low, but increased by 50% in RY10 with the increased number of antlerless drawing permits. In RY09, 375 of 3,619 hunters (10%) were nonlocal Alaskans or nonresidents. In RY10, 742 of 3,719 (19%) were nonlocals or nonresidents.

The average success rate of 21% in general hunts during RY09–RY10 was similar to the average (20%) reported during RY01–RY08. During RY09–RY10, central Unit 20B had the lowest success rates ($\bar{x}$ = 19%), followed by eastern Unit 20B ($\bar{x}$ = 23%) and then western ($\bar{x}$ = 27%). By comparison, success rates during RY01–RY08 were similar in central ($\bar{x}$ = 19%), eastern ($\bar{x}$ = 23%), and western Unit 20B ($\bar{x}$ = 22%). 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. Hunter success during the general season was typically lower in Unit 20B than elsewhere in Unit 20. For example, during RY01–RY10, 18–23% ($\bar{x}$ = 20%) of hunters in Unit 20B were successful

(Table 3), whereas annual success rates in Units 20A and 20C typically exceed 35% (Hollis 2010, Young 2010).

Harvest Chronology. Most harvest was during 1–5 September ($\bar{x}$ = 33%) in RY09 and 11–15 September ($\bar{x}$ = 35%) in RY10. 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 toward the 11–15 September period ($\bar{x}$ = 34%; Table 5).

Transport Methods. Most successful hunters used 3- or 4-wheelers, highway vehicles, or boats to access hunting areas. (Table 6). Methods of transportation were relatively consistent during RY01–RY10.

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 77 animals during RY07–RY10 compared to 84 animals during RY03–RY06. This is an indication that the increased antlerless hunts in the FMA may be helping to reduce roadkill. An additional 72 and 59 moose were reported killed on roads in the remainder of Unit 20B during RY09 and RY10, respectively Generally, few moose are reported killed by trains in Unit 20B (Young 2006). This trend continued during RY07 and RY08 ($\bar{x}$ = 9; range 6–12) but no data were available for RY09–RY10.

HABITAT

Assessment/Enhancement

A 2010 browse removal study in the MFMA estimated browse biomass removal at 29.5% (27–32%, 95% CI), a moderately high removal rate. This was similar to the 2007 removal rate of 25.1% (20.6–29.6%, 95% CI; Paragi et al. 2008) in central Unit 20B. Short yearling weights in both the MFMA and central Unit 20B were below the threshold of 385 lb (175 kg) used as a signal to begin reducing moose density through liberal antlerless harvest (Boertje et al. 2007). This supported our recommendation to limit population growth through conservative antlerless harvests in portions of western and central Unit 20B. A browse architecture survey in spring 2003 had previously indicated that moose utilization of preferred browse species in the MFMA was high (Young 2004; T. Paragi, ADF&G unpublished data, Fairbanks).

Previous moose habitat enhancement projects in Unit 20B included prescribed fire and promoting regeneration of decadent willows by planting and crushing willows in recently logged areas as well as habitat improvement projects for grouse, which also benefit moose (Young 2006).

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

During RY09–RY10 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 important sources 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, we continue to work with the public through direct interaction and through the media to reduce nonhunting mortality and human–moose conflicts.

CONCLUSIONS AND RECOMMENDATIONS

The 2009 unitwide population estimate suggests that the intensive management population objective of 12,000–15,000 moose has been exceeded, so this objective was not met during RY09–RY10. Reported harvests reached the intensive management objective's lower limit of 600 moose in RY05–RY10, therefore we met this objective during RY09–RY10. I recommend continuing a conservative antlerless moose harvest (2% of the prehunt moose population) in central Unit 20B and in the MFMA of western Unit 20B to limit population growth and increase yield to meet the intensive management harvest objective. If unitwide surveys continue to indicate population growth, more aggressive antlerless harvest may be necessary to curb this growth.

During RY09–RY10 we 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). This is consistent with surveys conducted during 2001–2008 that indicate we consistently met this management objective, except occasionally in the relatively small (900 mi^2) MFMA (e.g. 12 bulls:100 cows in fall 2005). Lower bull:cow ratios in the MFMA and FMA (300 mi^2) 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 annual unitwide population data to better assess the status of the moose population, particularly now that we have antlerless hunts in most of western and central Unit 20B, as well as in the MFMA and FMA. I recommend continued twinning rate surveys in the MFMA and central Unit 20B to evaluate nutritional status of moose 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 on alternating 4–6 year cycles to evaluate the effectiveness of increased antlerless harvests to reduce moose numbers and densities and moose–vehicle collisions. Browse utilization surveys should be conducted every few years to evaluate habitat condition.

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Table 1. Unit 20B aerial moose fall composition counts and estimated population size, 2001–2010.

Count area	Calendar year	Bulls:100 Cows	Yearlings: 100 Cows[a]	Calves:100 Cows	Percent calves	Adults	Moose observed	Estimated population[b] (90% CI)	Estimated population w/SCF = 1.2[c]	Moose/mi^2 w/SCF = 1.2
Unit 20B	2001	33	15	30	18	751	914	10,261 (±17%)	12,313	1.3
Unit 20B	2003	33	23	39	22	399	514	13,400 (±23%)	16,080	1.7
Unit 20B	2004	32	18	42	25	551	730	13,810 (±28%)	16,572	1.7
Unit 20B	2006	29	22	43	26	838	1127	13,321 (±21%)	15,986	1.6
Unit 20B	2008	28	20	36	24	1177	1558	14,838 (±16%)	17,806	1.9
Unit 20B	2009	37	16	36	21	891	1128	16,672 (±20%)	20,173	2.2
Eastern[d]	2001	47	15	24	11	271	305	2,454 (±22%)	2,945	1.2
Eastern[d]	2006	36	24	46	24	180	236	2,728 (±34%)	3,274	1.4
Eastern[d]	2008	31	13	26	20	106	132	3,126 (±31%)	3,751	1.5
Eastern[d]	2009	40	16	27	18	155	189	2,954 (±41%)	3,574	1.5
Central[e]	2001	27	13	34	26	205	278	4,005 (±25%)	4,806	1.3
Central[e]	2003	26	21	35	21	191	242	3,995 (±37%)	4,794	1.3
Central[e]	2004	33	22	46	27	158	216	5,276 (±41%)	6,331	1.7
Central[e]	2005	26	26	40	24	493	645	5,881 (±18%)	7,057	1.8
Central[e]	2006	28	22	41	17	328	397	5,451 (±29%)	6,541	1.7
Central[e]	2008	26	24	36	26	627	852	6,197 (±20%)	7,436	1.9
Central[e]	2009	32	16	33	21	258	328	5,666 (±38%)	6,856	1.8
Western[f]	2001	30	16	29	17	274	331	3,802 (±22%)	4,562	1.6
Western[f]	2006	27	20	44	22	384	494	5,142 (±24%)	6,170	2.1
Western[f]	2008	27	22	44	23	444	574	5,515 (±19%)	6,618	2.2
Western[f]	2009	39	16	41	22	478	611	8,051 (±19%)	9,742	3.3

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
MFMA[g,h]	2001	30	16	28	17	191	230	1,877 (±21%)	2,252	2.4
MFMA[h]	2003	44	20	36	23	89	116	1,352 (±63%)	1,622	1.7
MFMA[h]	2004	26	11	47	24	302	399	3,447 (±19%)	4,136	4.3
MFMA[h]	2005	12	12	40	26	296	400	2,937 (±17%)	3,524	3.7
MFMA[h]	2006	19	15	45	28	243	337	2,724 (±23%)	3,269	3.4
MFMA[h]	2008	30	23	37	18	309	375	2,487 (±20%)	2,984	3.1
MFMA[h]	2009	40	12	40	21	235	298	4,749 (±19%)	5,746	6.0
MFMA[h]	2010	34	20	41	23	1309	1709	3,455 (±9%)	4,181	4.4
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; Kellie and DeLong 2006).
[c] Preliminary sightability studies suggest a sightability correction factor (SCF) of 1.16 to 1.25 using the GSPE method.
[d] 2,425 mi^2 survey area.
[e] 3,829 mi^2 survey area.
[f] 2,942 mi^2 surveyarea.
[g] Minto Flats Management Area within western Unit 20B.
[h] A 951-mi^2 count area.
[i] Fairbanks Management Area.
[j] A 318-mi^2 count area.
[k] A 293-mi^2 count area.
[l] Census, all sample units surveyed.

Table 2. Results of twinning rate surveys for moose in Unit 20B (Minto Flats Management Area and central Unit 20B), 1997–2011.

Year	Date	Cows			% Twins[a]
		w/Single calf	w/Twins	Total	
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
2010[b]	25 May	42	9	51	18
2010[c]	28–29 May	28	1	29	3
2011[b]	25 May	33	17	50	34
2011[c]	25–26 May	22	2	24	8

[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 2010–2011.

	Successful						Unsuccessful					
Area/ Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	Total hunters
Eastern Unit 20B— Uniform Coding Units[f] (UCUs) 600, 601, 602, 603, 604, 605, 684												
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
2009–2010	54	15	6	1	76	23	208	36	7	4	255	331
2010–2011	54	14	6	2	76	2	204	38	15	11	268	344
Central Unit 20B (UCUs 207, 208, 209, 211, 212, 213, 301, 401, 402, 403, 404, 405, 406, 484, 485,486,487, 501, 583, 584)												
2001–2002	241	16	20	2	279	19	1,009	77	84	4	1,174	1,453
2002–2003	275	40	20	1	336	21	1,095	82	50	6	1,233	1,569
2003–2004	232	33	23	0	288	19	1,099	94	55	5	1,253	1,541
2004–2005	203	18	25	5	251	19	916	56	57	22	1,051	1,302
2005–2006	211	21	29	0	261	17	1,070	97	70	8	1,245	1,506
2006–2007	239	25	28	2	294	18	1,110	109	76	8	1,303	1,597
2007–2008	216	31	33	0	280	18	1,072	118	63	14	1,267	1,547
2008–2009	276	45	20	19	360	23	1,005	100	44	62	1,211	1,571
2009–2010	261	42	25	1	329	21	1,093	106	48	26	1,273	1,602
2010–2011	183	21	18	4	226	17	937	118	48	21	1,124	1,350
Western Unit 20B (UCUs 101, 201, 202, 203, 204, 205, 206, 210)												
2001–2002	58	18	9	0	85	20	249	67	23	2	341	426
2002–2003	72	22	8	0	102	22	256	71	22	3	352	454
2003–2004	65	19	3	0	87	21	244	69	17	1	331	418
2004–2005	56	16	6	2	80	22	214	51	13	4	282	362
2005–2006	53	15	8	0	76	20	233	47	15	1	296	372
2006–2007	57	16	5	0	78	20	241	63	8	4	316	394
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
2009–2010	83	35	11	1	130	29	245	58	15	5	323	453
2010–2011	80	29	4	3	116	25	246	98	7	5	356	472

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	
FMA[c] general archery hunt[d] (UCUs 0212, 0213, 0300, 0301, 0401, 0402, 0403, 0501; archery only)												
2001–2002	38	1	1	0	40							
2002–2003	44	3	1	0	48							
2003–2004	54	5	1	0	60							
2004–2005	31	0	2	0	33							
2005–2006	18	2	1	0	21							
2006–2007	21	1	1	0	23							
2007–2008	21	2	0	0	23							
2008–2009	26	1	0	0	27							
2009–2010	48	2	0	0	50							
2010–2011	33	1	2	0	36							
MFMA[e] general hunt (UCUs 0201, 0205, 0210; Nonresident hunters and antlerless harvest censored)												
2001–2002	27	9	0	0	36	26	80	19	0	1	100	136
2002–2003	40	12	0	0	52	30	103	20	0	1	124	176
2003–2004	39	10	0	0	49	30	96	19	0	0	115	164
2004–2005	28	8	0	0	36	25	90	16	0	0	106	142
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
2009–2010	36	14	0	1	51	29	107	16	0	3	126	177
2010–2011	39	15	0	2	56	24	121	45	0	3	169	225
Unit 20B remainder, general hunt (Includes FMA general archery hunt, but excludes MFMA)												
2001–2002	388	35	44	3	470	18	1,845	187	145	7	2,184	2,654
2002–2003	475	76	43	2	596	20	1,991	226	110	9	2,336	2,932
2003–2004	358	47	38	0	443	18	1,775	198	99	8	2,080	2,523
2004–2005	324	41	45	13	423	20	1,479	129	101	35	1,744	2,167
2005–2006	368	43	47	0	458	19	1,690	170	114	14	1,988	2,446
2006–2007	394	45	42	2	483	19	1,784	203	109	17	2,113	2,596
2007–2008	350	67	54	1	472	18	1,772	241	118	19	2,150	2,622
2008–2009	440	93	33	24	590	22	1,653	221	81	90	2,045	2,635
2009–2010	451	116	54	3	624	22	1,835	262	87	44	2,228	2,852
2010–2011	364	71	44	8	487	19	1,684	301	84	47	2,116	2,603

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	
All general hunts												
2001–2002	415	44	44	3	506	18	1,925	206	145	8	2,284	2,790
2002–2003	515	88	43	2	648	21	2,094	246	110	10	2,460	3,108
2003–2004	397	57	38	0	492	18	1,871	217	99	8	2,195	2,687
2004–2005	352	49	45	13	459	20	1,569	145	101	35	1,850	2,309
2005–2006	396	53	47	0	496	19	1,790	187	114	14	2,105	2,601
2006–2007	427	56	42	2	527	19	1,886	233	109	18	2,246	2,773
2007–2008	394	75	57	2	528	19	1,879	265	119	19	2,282	2,810
2008–2009	486	104	33	25	648	23	1,755	247	82	91	2,175	2,823
2009–2010	487	130	54	4	675	22	1,942	278	87	47	2,354	3,029
2010–2011	403	86	44	10	543	19	1,805	346	84	50	2,285	2,828

[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.

[f] Uniform Coding Units UCUs) are a numbering system used to differentiate drainages in a Game Management Unit.

Table 4. Unit 20B moose harvest data by permit hunt, regulatory years 2001–2002 through 2010–2011.

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Harvest
DM698–	2009–2010	335	59 (18)	142 (52)	133 (48)	0 (0)	133 (100)	0	133
DM748	2010–2011	673	161 (24)	338 (67)	165 (33	4 (2)	161 (98)	0	165
DM788	2001–2002	75	14 (19)	33 (54)	28 (46)	2 (7)	26 (93)	0	28
and	2002–2003	75	10 (13)	28 (43)	37 (57)	3 (8)	34 (92)	0	37
DM786	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
	2009–2010	150	27 (18)	71 (58)	52 (42)	0 (0)	52 (100)	0	52
	2010–2011	152	36 (24)	58 (59)	41 (41)	4 (10)	37 (90)	0	41
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 (12	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
	2009–2010	10	1 (10)	6 (67)	3 (33)	0 (0)	3 (100)	0	3
	2010–2011	10	3 (30)	5 (71)	1 (14)	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

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Harvest
	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
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 (79	56 (67)	28 (33)	0	84
	2009–2010	100	9 (9)	24 (27)	65 (73)	37 (57)	27 (42)	1	65
	2010–2011	100	6 (6)	24 (26)	69 (74	49 (71)	20 (29)	0	69
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
	2009–2010	110	13 (12)	19 (20)	77 (79)	28 (36)	49 (64)	0	77
	2010–2011	130	23 (18)	26 (24)	81 (76)	29 (36)	52 (64)	0	81
YM301	2002–2003	257	36 (14)	170 (77)	51 (23)	51 (100)	0 (0)	0	51
	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
	2009–2010	705	109 (15)	262 (44)	330 (55)	65 (20)	264 (80)	1	330
	2010–2011	1065	229 (22)	451 (56)	357 (44)	86 (24)	271 (76)	0	357

Table 5. Unit 20B moose harvest[a] chronology percent by month/day, regulatory years 2001–2002 through 2010–2011.

Regulatory	Harvest chronology percent by month/day						
year	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25	Unk/Other	*n*
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
2009–2010	33	29	27	8	2	2	664
2010–2011	29	22	35	8	3	3	543

[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 2010–2011.

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Other/ Unknown	*n*
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	655
2009–2010	2	0	20	40	0	4	28	1	2	675
2010–2011	3	0	21	40	0	5	26	3	2	543

[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 2010–2011.

	Harvest by hunters							Accidental death					
	Reported				Estimated			Road[b]					
Regulatory year	M	F	Unk	Total	Unreported[c]	Illegal/ Other	Total	FMA[d]	Unit 20B remainder	Total	Train[e]	Total	Total
2001–2002	531	53	6	590	104	37[f]	141	72	50	122	9	131	862
2002–2003	725	61	2	788	139	47[f]	186	118	71	189	12	201	1,175
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	1,199
2007–2008	581	183	5	769	136	93[g]	229	73	56	129	12	141	1,139
2008–2009	718	135	4	857	152	112[g]	264	79	67	146	6	152	1,273
2009–2010	664	264	7	935	165	90	255	79	72	151	0[h]	151	1,341
2010–2011	558	278	1	837	148	80	228	78	59	137	0[h]	137	1,202

[a] Includes general, registration and permit hunt harvest.
[b] Documented kills; actual number killed by vehicles is certainly greater.
[c] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[d] Fairbanks Management Area.
[e] Confirmed dead between Alaska Railroad mileposts 411.8 and 470.0; "Missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[f] Includes illegal, defense of life and property, dispatched, potlatch, stickdance, and other reported deaths.
[g] Includes illegal, defense of life and property, dispatched, potlatch, stickdance, and other reported deaths, plus an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).
[h] No data available for these years.

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNITS: 20C (11,902 mi^2), 20F (6,267 mi^2), and 25C (5,149 mi^2)

GEOGRAPHIC DESCRIPTION: Unit 20C includes drainages into the west bank of the Nenana River and into the south bank of the Tanana River west of the Nenana River. Most of Denali National Park and Preserve is within Unit 20C. Unit 20F includes drainages into the north bank of the Tanana River west of Manley Hot Springs and into the Yukon River drainage 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 densities higher than the current levels.

Trends in moose populations have been difficult to identify, but densities probably fluctuate within 0.1 and 1.1 moose/mi^2, and more likely 0.2–0.7 moose/mi^2, based on Alaska and Yukon studies in large areas (>800 mi^2) with 2 or more lightly-harvested predators (Gasaway et al. 1992).

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

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 ≥30:100 in areas with aerial surveys and ≥20% large bulls in the harvest in areas without aerial surveys.

METHODS

POPULATION STATUS AND TREND

Population Estimation Surveys

No aerial moose surveys were completed in Units 20C, 20F and 25C during RY09–RY10. Methods used in years outside the report period to estimate the RY09–RY10 moose population status in each unit are outlined below.

Unit 20C. We conducted a geospatial population estimator (GSPE) moose survey (Ver Hoef 2001, 2008; Kellie and DeLong 2006) in eastern Unit 20C during November 2011. This is the first GSPE survey conducted in Unit 20C. The area surveyed was north of DNPP, south of the Tanana River. The area includes drainages of the Kantishna River and the area west of the Nenana River, totaling 2,962 mi^2. We then extrapolated the moose density in this area to all of Unit 20C outside DNPP. We first stratified the area on 1–2 November and classified each survey unit as either high or low density moose habitat according to field stratification methods outlined by Kellie and DeLong (2006). A simple random sample of 100 SUs (60 high density and 40 low density) was selected from each stratum using Microsoft® Excel 2007 software. We then surveyed 100 (60 high density and 40 low density; 577 mi^2) of 514 survey units (SU; 2,962 mi^2) during 11–15 November. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported as excellent (24%; n = 24), good (62%; n = 62), fair (4%; n = 4), poor (1%; n = 1) or unclassified (9%; n = 9).

The GSPE method does not employ a sightability correction factor (SCF), thus does not correct for moose not seen during the survey. Rather, the GSPE method employs greater search intensity, 8–10 min/mi^2 versus 4–6 min/mi^2 (Gasaway et al. 1986), resulting in a higher level of sightability. Search time per SU in SUs with 100% moose habitat averaged 7.5 min/mi^2 (n = 100

SUs). Preliminary work with the sightability of radiocollared moose in adjacent Unit 20A indicates that an SCF of 1.16 to 1.25 may be appropriate. We applied an SCF of 1.21 to GSPE estimates in Unit 20C (Boertje et al. 2009).

Unit 20F. No recent surveys have been conducted in Unit 20F.

Unit 25C. A GSPE moose survey was conducted in Unit 25C (5,000 mi^2) during November 2007 by the Bureau of Land Management (BLM) with support from the Alaska Department of Fish and Game (ADF&G). This was the first GSPE survey conducted in Unit 25C 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 RY09–RY10.

Nutritional Status

Calf weights. To evaluate population nutrition east of the Kantishna River in Unit 20C, on 17–18 March 2011 we captured and weighed 20 short-yearlings (11 male, 9 female) and radiocollared the 9 female calves to assess seasonal movements.

Browse Survey. During March 2011 we conducted a browse survey east of the Kantishna River in Unit 20C to evaluate browse abundance relative to current levels of use by moose, and to determine if habitat may be a limiting factor preventing growth of the moose population in the area (Seaton et al. 2011). Preferred forage species were analyzed from 35 random plots throughout the area to determine the rate of consumption by moose.

Twinning Surveys

We attempted twinning surveys in Unit 20C in May 2010 and 2011; however, we were unable to obtain an adequate sample size of cow–calf groups. To increase the power of statistical comparisons between survey areas and across years, we established, a priori, a desired sample size of ≥50 cows with 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. The survey area was bounded by the Tanana River to the north, the Denali National Park and Preserve boundary to the south, the Nenana River on the east and the Kantishna River on the west. Surveys were conducted by flying roughly parallel north-south transects flown at approximately ½-mile intervals at ≤500 feet above ground level in a Bellanca Scout by experienced pilots with observers. All moose observed were classified as bull; yearling cow; adult cow without a calf; or adult cow with single, twin, or triplet calves.

HARVEST

We estimated annual harvest and mortality in all units from 1) data from mandatory harvest report cards, 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., RY09 = 1 July 2009–30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Unit 20C. During RY09–RY10 we conservatively estimated 3,500–4,500 moose inhabited Unit 20C: approximately 2,000 within Denali National Park and 1,500–2,500 outside Denali National Park (including Denali National Preserve). These estimates assumed an average density of 0.58 moose/mi^2 inside Denali National Park (Oct 1991 census; T. Meier, National Park Service [NPS], personal communication to D. Young, 2004) and 0.25 moose/mi^2 outside Denali National Park. However, after conducting the November 2011 GSPE survey in eastern Unit 20C outside of Denali National Park, we estimated 1,460 moose (90% CI =1,189–1,731) there. Because Unit 20C is similar in habitat type to Unit 20A, we used a similar SCF of 1.21. The eastern 20C population estimate with a SCF was 1,767 moose and the density equaled 0.6 moose/mi^2. We then extrapolated this density to all of Unit 20C outside of DNPP preserve and estimated the population to be 3,801 moose.

Unit 20F. McNay (1990) estimated 0.25–0.50 moose/mi^2 occurred within the roughly 4,250 mi^2 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/mi^2 to estimate 1,000–2,000 moose in Unit 20F.

Unit 25C. Based on the 2007 GSPE survey without a sightability correction factor (SCF), we estimated the Unit 25C moose density at 0.59 moose/mi^2 of moose habitat (5,149 mi^2 of moose habitat), with a total population estimate of 3,019 moose (90% CI ± 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 1.21 yields an estimated moose density of 0.66 moose/mi^2. Both estimates are within the expected range of 0.1–1.1 moose/mi^2 found in most large areas of Interior Alaska (>800 mi^2) with lightly harvested bear and wolf populations (Gasaway et al. 1992).

Population Composition

Unit 20C. Results of the 2011 GSPE survey in Unit 20C indicated ratios of 41 calves:100 cows and 49 bulls:100 cows. These ratios suggest light hunting pressure and moderate calf recruitment.

Unit 20F. 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–RY05 the percentage of large bulls in the reported harvest averaged 36% in Unit 20C and 39% in Unit 20F. During RY06–RY10 the percentage of large bulls in the harvest averaged 26% in 20C and 32% in 20F. These data suggest that there has been a decrease in the number of large bulls in the harvest. However, these percentages are greater than our management goal of 20% large bulls for both 20C and 20F, and suggest that overharvest is not occurring.

Unit 25C. 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 Nutrition

Calf weights. Short-yearlings in northern Unit 20C averaged 442 lb (200 kg) and ranged 379–487 lb (172–221 kg). Male (n = 11) calves averaged 455 lb (206 kg) and females (n = 9) 426 lb (193 kg). These short-yearling weights demonstrate a relatively high level of nutrition. By comparison, Boertje et al. (2007) reported weights of female short-yearlings in adjacent subpopulations: In a low moose density area in southern Unit 20C female short-yearlings averaged 450 lb (204 kg); in high moose density populations of Unit 20A, female short-yearlings averaged 379 lb (172 kg) in the Alaska Range foothills and 342 lb (155 kg) in the Tanana Flats.

Browse Surveys. We determined that eastern 20C had a low to moderate browse removal rate of 19% (T. Paragi, ADF&G, unpublished data, Fairbanks). As a comparison, adjacent Units 20A and 20B have removal rates of 40% and 28% respectively. With 81% of the available forage unbrowsed annually, it is likely that habitat is not the limiting factor preventing population growth.

MORTALITY

Harvest

Season and Bag Limit. The hunting seasons and bag limits remained the same in Units 25C and 20F during RY09–RY10; however, the bag limit in Unit 20C changed in RY10 to eliminate the restriction on harvest of white-phased or albino moose.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY09		
Unit 20C		
RESIDENT HUNTERS:		
1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken.	1 Sep–20 Sep	
NONRESIDENT HUNTERS:		
1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken.		5 Sep–15 Sep
RY10		
Unit 20C		

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RESIDENT HUNTERS:		
1 bull	1 Sep–20 Sep	
NONRESIDENT HUNTERS:		
1 bull		5 Sep–15 Sep
RY09–RY10		
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	
NONRESIDENT HUNTERS:		No open season
Unit 20F, drained by the Tanana River.		
RESIDENT HUNTERS:		
1 bull.	1 Sep–20 Sep	
NONRESIDENT HUNTERS:		No open season
Remainder of Unit 20F		
RESIDENT HUNTERS:		
1 bull.	1 Sep–15 Sep	
NONRESIDENT HUNTERS:		No open season
Unit 25C		
RESIDENT HUNTERS:		
1 bull.	1 Sep–15 Sep	
NONRESIDENT HUNTERS:		
1 bull.		5 Sep–15 Sep

Alaska Board of Game Actions and Emergency Orders. During the March 2010 meeting, the Alaska Board of Game changed the bag limit in Unit 20C by eliminating the restriction against harvesting white-phased or albino moose. At the same meeting, the board also requested that ADF&G conduct an intensive management feasibility assessment to be presented to the board in March 2012. The feasibility assessment was requested because of several proposals by the public and advisory committees to implement intensive management actions in Unit 20C. No board actions were taken and no emergency orders were issued during RY09–RY10 in Units 25C and 20F.

Harvest by Hunters. During RY01–RY10 the reported moose harvest trend was stable in Unit 20C and increased in Units 20F, and 25C (Table 2). During RY09 and RY10, reported moose harvest was 140 and 101 in Unit 20C, 61 and 43 in Unit 20F, and 114 and 95 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 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 unreported harvest, including wounding loss, at 17.7% (Table 3).

Illegal harvest and motor vehicle deaths were obtained from the Alaska Wildlife Troopers mortality logs. Data concerning deaths caused by train collisions in Unit 20C were obtained from the Alaska Railroad. However these 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 the Alaska Wildlife Troopers or Alaska Railroad should be considered minimum counts.

Hunter Residency and Success. During RY09–RY10, total number of hunters in Unit 20C averaged 464, a slight decline compared to the RY04–RY08 average of 480. In Unit 20F, the average number of hunters in RY09–RY10 was 169, an increase compared to the average of 135 during RY04–RY08. The average number of hunters in Unit 25C also increased to 348 during RY09–RY10 compared to 329 during RY04–RY08 (Table 2). The number of moose harvested during RY09–RY10 remained stable in Units 20C and 20F, but increased in Unit 25C (Table 2).

During RY01–RY10, as many as 6 nonresident hunters annually reported hunting in Unit 20F (including a total of 4 in RY09–RY10; Table 2), even though this unit had no open moose season for nonresidents. These nonresident harvest data may be attributed to misreporting by hunters, data management errors by ADF&G, 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 (96%) resided outside 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 RY01–RY10 the highest proportion of the harvest occurred during the second week of the fall 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 order of highest use, successful hunters in Unit 20C used boats, 3- or 4-wheelers, and airplanes 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, boats and 3- or 4- wheelers were the primary modes of transportation for successful hunters, and in Unit 25C successful moose hunters used highway vehicles, 3- or 4-wheelers, or boats. Transportation methods used throughout this area reflected access opportunities.

HABITAT

In remote country such as Units 20C, 20F and 25C, the most effective means of habitat improvement is wildfire, although 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 units over the last 25 years, including several hundred thousand acres in 2004 and 2005. Also, several large fires have occurred in Unit 20C since 2007, enhancing habitat quantity for moose. For example, in eastern Unit 20C approximately 1,240 mi^2 (42% of the area) burned during the 2009 and 2010 Railbelt Complex fires. ADF&G staff have been members of the Interagency Fire Management Team and provided input recommending limited fire suppression in areas not inhabited by residents and recreational cabins. This recommendation was made to allow poor quality habitat to be altered by fire and regenerate into quality moose forage. A map of burned areas is available from BLM in Fairbanks.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Harvest reporting in these units was low. 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 Alaska 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 to 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 goal to promote natural fires to enhance moose habitat through the our efforts on the Interagency Fire Management Team. We met our goal of providing for sustained harvest of these low-density populations by providing general season moose hunts. With ratios of 49 bulls:100 cows in Unit 20C in fall 2011, we likely met our objective to maintain a bull:cow ratio of ≥30:100 in areas with aerial surveys. We also met our objective of ≥20% large bulls in the harvest (28% in Unit 20F and 25% in Unit 25C) in areas without aerial surveys during RY09–RY10.

No regulatory changes are recommended at this time in Units 20F and 25C. During the 2012 Board of Game meeting we recommended lengthening the hunting season by 5 days in Unit 20C. We based this recommendation on the high bull:cow ratio (49 bull:100 cows in 2011) and the need to meet the intensive management harvest objective of 150–400 moose as required in the Alaska Administrative Code 5 AAC 92.108. 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.

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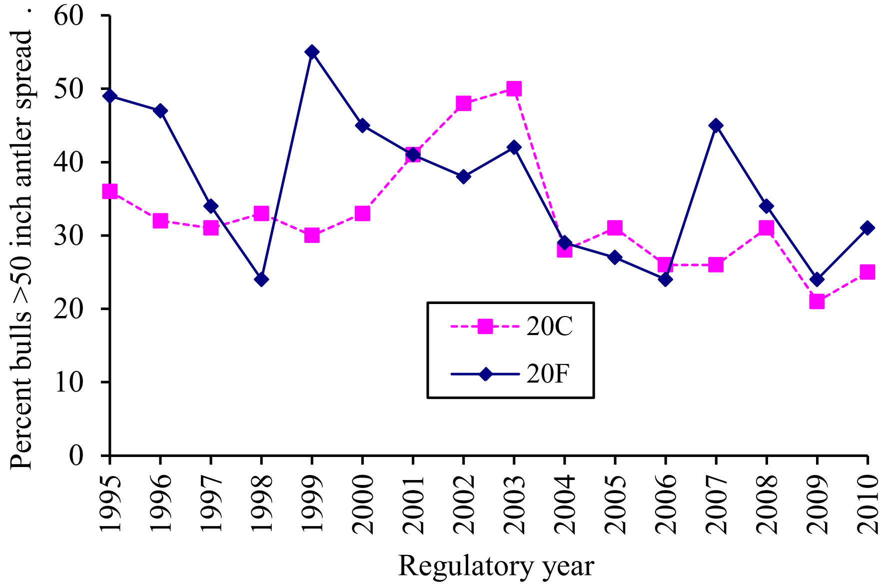

Figure 1. Percent of bull moose in the reported fall harvest with an antler spread >50 inches in Units 20C and 20F, regulatory years 1995–1996 through 2010–2011.

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 (citation).
[d] Spatial trend survey.

Table 2. Units 20C, 20F, and 25C reported moose hunter residency and success, regulatory years 2001–2002 through 2010–2011.

Unit and	Successful hunters				Unsuccessful hunters				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total[b] (%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b] (%)	Total hunters
Unit 20C									
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	86	40	13	142 (30)	178	136	14	328 (70)	470
2009–2010	77	49	14	140 (29)	213	105	22	340 (70)	480
2010–2011	53	39	7	101 (23)	178	135	18	331 (75)	432
Unit 20F									
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
2009–2010	38	19	2	59 (32)	90	35	2	127 (68)	186
2010–2011	24	18	0	42 (28)	78	31	0	109 (72)	151

Unit and Regulatory year	Successful hunters				Unsuccessful hunters				Total Hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total[b] (%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b] (%)	
Unit 25C									
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	64	10	80 (25)	16	191	32	239 (75)	319
2009–2010	1	95	15	111 (33)	11	183	22	216 (64)	327
2010–2011	7	77	8	92 (26)	16	222	21	259 (72)	351

[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, nonlocal and nonresident hunters.

Table 3. Units 20C, 20F, and 25C estimated moose harvest and accidental death, regulatory years 2001–2002 through 2010–2011.

Unit and Regulatory year	Harvest by hunters: Reported[a] M	F	Unk	Total	Estimated: Unreported[b]	Illegal/Other[c]	Total	Accidental death: Road[d]	Train[e]	Total	Total
Unit 20C											
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	25	0	25	0	0	0	165
2008–2009	142	0	0	142	25	0	25	0	0	0	167
2009–2010	139	0	1	140	25	0	25	0	0	0	165
2010–2011	101	0	0	101	18	0	18	0	0	0	119
Unit 20F											
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
2009–2010	56	2	3	61	10	0	10	0	---	0	71
2010–2011	43	0	0	43	8	0	8	0	---	0	51

Unit and Regulatory year	Harvest by hunters							Accidental death			Total
	Reported[a]				Estimated						
	M	F	Unk	Total	Unreported[b]	Illegal/Other[c]	Total	Road[d]	Train[e]	Total	
Unit 25C											
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	79	1	0	80	14	0	14	0	---	0	94
2009–2010	114	0	0	114	20	0	20	0	---	0	134
2010–2011	95	0	0	95	17	0	17	0	---	0	112

[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 2001–2002 through 2010–2011.

Regulatory	Harvest chronology by month/day[a]				
year	9/1–9/7	9/8–9/15	9/16–9/20	12/1–12/10	*n*
Unit 20C					
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	--	142
2009–2010	31	39	30	--	137
2010–2011	31	40	29	--	101
Unit 20F					
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
2009–2010	25	34	36	5	59
2010–2011	16	49	26	9	43
Unit 25C					
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
2009–2010	49	51	--	--	113
2010–2011	45	55	--	--	95

[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 2001–2002 through 2010–2011.

Unit and Regulatory year	Harvest percent by transport method: Airplane	Horse/ Dogsled	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unk/ Other	*n*
Unit 20C									
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	1	140
2008–2009	37	1	30	18	0	12	2	0	142
2009–2010	20	1	32	26	0	14	6	1	140
2010–2011	19	0	31	30	0	13	7	0	101
Unit 20F									
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	5	25	2	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	3	2	31	39	4	9	12	0	54
2009–2010	0	0	36	46	7	2	8	2	61
2010–2011	6	2	33	34	9	7	7	2	43
Unit 25C									
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	80
2009–2010	5	0	21	51	0	6	15	2	114
2010–2011	2	0	28	55	0	2	12	1	95

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 20D (5,637 mi^2, 5,028 mi^2 of moose habitat)

GEOGRAPHIC DESCRIPTION: Central Tanana Valley near Delta Junction

BACKGROUND

Unit 20D was created in 1971 from a portion of Unit 20C. During 1962–1970, the moose hunting season in the area that is currently Unit 20D consisted of a 70- to 72-day bull season and a 1- to 8-day antlerless moose season. Most (51–74%) of the harvest during 1964–1970 came from the highly accessible areas near Delta Junction (Clearwater Lake, Donnelly Dome, and the Delta farming area). However, several severe winters in the mid-1960s and early 1970s killed many moose throughout this unit and other portions of Interior Alaska and set the stage for predation and hunting to compound and aggravate already widespread population declines. Poor recruitment of yearlings to the population in combination with intense bulls-only hunting depressed the bull:cow ratio to only 4:100 in the more accessible portions of the unit. The moose hunting season was closed during 1971–1973 because the depressed moose population could no longer support any significant harvest (McIlroy 1974).

Despite restrictions on hunting, the moose population in Unit 20D continued to decline because of chronically high moose mortality from other causes. In 1973 the moose population 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 moose hunting. The moose population decline in western Unit 20D 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.

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

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

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 is 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 began in fall 2006 in southwestern 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. Antlerless moose hunting in southwestern Unit 20D continued through this reporting period.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

- Increase the fall moose population to 8,000–10,000 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, we developed the following interim population and harvest objectives for Unit 20D.

Population Objective

- Intensively manage the northern and southern Unit 20D moose populations independently (north and south of the Tanana River) for optimal population size based on indices to density-dependent nutritional limitation, to guard against eventual site-specific long-term range damage and starvation from overabundance.

Moose populations will be managed for

1) increasing population growth when the average 2-year prior twinning rate exceeds 20%, but a reduced rate of growth as this twinning rate average approaches 20%,

2) stable population size when the 2-year prior twinning rate averages 11–20%, and

3) decreasing population growth when the 2-year prior twinning rate averages ≤10%.

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

We used the geospatial population estimator method (GSPE, Ver Hoef 2001, Ver Hoef 2008) to conduct moose population estimation surveys in southern Unit 20D. We maximized accuracy and precision of GSPE surveys by allocating 60% of sampling effort to the high-density stratum and 40% of effort to the low-density stratum (Kellie and Delong 2006).

We stratified sample units (SUs) as 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 we expected to count <5 moose in them. Sample units were stratified high if we expected to count ≥5 moose in them. In an attempt to keep variance as small as possible, we placed borderline SUs in the high stratum to minimize variance in the low stratum.

GSPE SUs are a continuous grid of squares with boundaries every 2 degrees of latitude and 5 degrees of longitude. SUs varied in size from approximately 5.7 to 5.9 mi^2 in Unit 20D. Each SU is identified by the latitude and longitude of its southeastern 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/mi^2 of search effort in each SU sampled to achieve consistently high sightability of moose. However, large areas of non-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 palmate 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. In southern Unit 20D, separate population estimates were calculated for southwestern and southeastern Unit 20D for those years when GSPE surveys met the criteria. Population estimates and compositions were calculated by entering SU data into ADF&G's GSPE application software (DeLong 2006) to calculate a population estimate and composition of observable moose.

The GSPE slightly underestimates the size of a moose population because it does not account for moose missed while conducting the survey. However, the moose population objective for Unit 20D is based on actual moose population size so we applied a sightability correction factor (SCF) to GSPE estimates based on recent research by Boertje and others (Boertje et al. 2009; R. Boertje, ADF&G, unpublished data, Fairbanks; Keech et al. 2011). 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). We applied the area-specific SCFs to the area population estimates before calculating the standard error for the combined estimate.

Twinning Surveys

Surveys were flown in a Piper PA-18 at 300–700 feet above ground level at 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 SUs 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 (southwestern 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 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 and number of calves or yearling offspring, and the moose location. Twinning rates were calculated by dividing the total number of cows seen with any calves at heel (single or twins) by the number of cows seen with twins at heel.

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., RY09 = 1 July 2009–30 June 2010). One reminder letter was sent to holders of harvest tickets who did not report. Hunters who had permits received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive timely harvest reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

<u>2009 GSPE Survey</u>. The GSPE survey in southern Unit 20D during 2 November–8 December 2009 cost $12,600. This survey area included 320 SUs and covered 1,890.2 mi^2 averaging 5.9

mi^2/SU. The high-density stratum had 186 SUs totaling approximately 1,098.2 mi^2 and the low-density stratum had 134 SUs totaling 792.0 mi^2. We searched 60 SUs including 37 high-density (62%) and 23 low-density (38%), meeting the objective of surveying 60% high-density SUs. Search effort during this survey met the objective in high density SUs and averaged 48.1 min/SU (8.2 min/mi^2) but did not meet the search effort objective of 8 min/mi^2 in the low density SUs that averaged 41.2 min/SU (7.0 min/mi^2).

The southern Unit 20D population estimate was 4,633 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 3,864–5,401. The estimate was based on GSPE calculations of 4,124 moose in the high stratum and 509 moose in the low stratum. Applying a 1.21 SCF to the estimate resulted in an SCF-corrected estimate of 5,606 moose (3.0 moose/mi^2).

Southwestern and Southeastern Unit 20D — The southern Unit 20D GSPE survey results were subdivided into 2 analysis areas of 1) southeastern Unit 20D (SE) south of the Tanana River and east of the Johnson River, and 2) southwestern Unit 20D (SW) south of the Tanana River and west of the Johnson River.

The SE Unit 20D analysis area had a population estimate of 997 observable moose (Table 2) and 1,206 with a 1.21 SCF applied, resulting in 2.0 moose/mi^2.

The SW Unit 20D population estimate was 3,637 observable moose (Table 2) and 4,400 with a 1.21 SCF applied, resulting in a density of 3.5 moose/mi^2.

Twinning Survey. Aerial twinning surveys in southwestern Unit 20D were flown during 27–30 May 2010 in 12.8 hours of survey time and cost \$3,600. We spotted 23.7 moose/hr, with 303 moose observed including 59 cow–calf groups; 7 (11.8%) were cows with twins (Table 3).

2010 GSPE Survey. The southern Unit 20D (south of the Tanana River) GSPE survey was flown during 17 November–1 December 2010 and cost \$15,290. This survey area included 320 SUs and covered 1,890 mi^2 averaging 5.9 mi^2/SU. The high-density stratum had 189 SUs totaling approximately 1,116 mi^2 and the low density stratum had 131 SUs totaling 775 mi^2. Seventy-six SUs were searched including 51 high-density (67%) and 25 low density (33%), meeting the objective of surveying 60% high density SUs. Search effort during this survey met the objective in high density SUs and averaged 47 min/SU (8.0 min/mi^2) but did not meet the objective in low density SUs that averaged 41 min/SU (7.0 min/mi^2).

The population estimate was 4,574 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 3,734–5,414 moose. Applying an SCF of 1.21 to the estimate resulted in an sightability-corrected estimate of 5,534 moose for a density of 2.9 moose/mi^2.

Southwestern and Southeastern Unit 20D — The southern Unit 20D GSPE survey results were subdivided into 2 analysis areas of 1) southeastern Unit 20D (SE) south of the Tanana River and east of the Johnson River, and 2) southwestern Unit 20D (SW) south of the Tanana River and west of the Johnson River.

The SE Unit 20D analysis area had a population estimate of 976 observable moose (Table 2) and 1,180 moose with a 1.21 SCF applied, resulting in 1.9 moose/mi^2.

The SW Unit 20D analysis area had a population estimate of 3,599 observable moose (Table 2) and 4,354 with a 1.21 SCF applied, resulting in a density of 3.5 moose/mi^2.

Twinning Survey. Aerial twinning surveys in southwestern Unit 20D were flown during 27–30 May 2011 for a total of 11.2 hours of survey time and cost $3,300. We saw 29.0 moose/hr, with 325 moose observed including 66 cow–calf groups; 17 (25.8%) were cows with twins (Table 3).

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 southwestern 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

2009. The southern Unit 20D population composition from the fall 2009 GSPE survey was 34 calves:100 cows (range = 30–39) and 30 bulls:100 cows (range = 21–39; Table 1).

The SE Unit 20D analysis area had composition of 40 calves:100 cows (range = 26–53) and 32 bulls:100 cows (range = 12–51; Table 2).

The SW Unit 20D analysis area had composition of 33 calves:100 cows (range = 28–37) and 30 bulls:100 cows (range = 20–39; Table 2).

2010. The southern Unit 20D population composition from the fall 2010 GSPE survey was 26 calves:100 cows (range = 19–32) and 33 bulls:100 cows (range = 23–43; Table 1).

The SE Unit 20D analysis area had composition of 28 calves:100 cows (range = 8–49) and 35 bulls:100 cows (range = 15–55) (Table 2).

The SW Unit 20D analysis area had composition of 25 calves:100 cows (range = 19–32) and 32 bulls:100 cows (range = 23–42) (Table 2).

Distribution and Movements

In RY10 ADF&G staff initiated a project to monitor moose movements. Twenty-five moose were radiocollared in Unit 20D for this study (K. Seaton, ADF&G, unpublished data, Fairbanks).

MORTALITY

Harvest

Season and Bag Limit. Hunting seasons and bag limits are listed in Table 5.

Alaska Board of Game Actions and Emergency Orders.

2010 — In March 2010 the Alaska Board of Game adopted proposal 73 to reauthorize antlerless moose hunting in southwestern Unit 20D. No emergency orders were issued during RY09–RY10.

Harvest by Hunters.

RY09 — Estimated moose mortality from all human causes in RY09 was 541 moose (Table 6). This total included 416 moose reported killed by hunters in fall 2009, an estimated unreported harvest of 73 moose, no estimate for illegal harvest, and an estimated 52 moose killed in vehicle collisions (the average of the last 3 years of known vehicle collision mortality). Illegal harvest is thought to be high but undocumented. The total reported hunting mortality of 416 did not meet the harvest objective for Unit 20D.

RY10 — Estimated moose mortality from all human causes in RY10 was 340 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 245 moose reported killed by hunters in fall 2010, an estimated unreported harvest of 43 moose, and an estimated 52 moose killed by highway vehicles (the average of the last 3 years of known vehicle collision mortality). The total reported hunting mortality of 245 did not meet the harvest objective for Unit 20D.

Southwestern Unit 20D Harvest — General bull season moose harvest and the number of hunters in southwestern Unit 20D has continued to increase since the mid-1980s, although bull harvest stabilized in RY07–RY08 (Table 7). Additional harvest in southwestern Unit 20D occurred with implementation of cow moose permit hunts in RY06 which continued through RY09.

In RY09, reported harvest totaled 290 moose. Hunters reported taking 153 moose during the general season (Table 7), 13 during Delta Junction Management Area hunt DM790 (Table 8), 8 during Delta Junction Bison Range Youth Hunt DM792 (Table 9), 26 during antlerless hunt DM797, 64 in antlerless hunt DM798, and 26 in antlerless hunt DM799 (Table 10). Hunter success was 27% during the general season (Table 11), 57% for DM790 (Table 8), 80% for DM792 (Table 9), 70% for DM797, 81% for DM798, and 87% for DM799 (Table 10).

In RY10, reported harvest in southwestern 20D totaled 139 moose. Hunters reported taking 125 moose during the general season (Table 7), 6 during the Delta Junction Management Area hunt DM790 and 2 during the Delta Junction Management Area hunt DM795 for qualified disabled veterans (Table 8), and 6 in Delta Junction Bison Range Youth Hunt DM792 (Table 9). Hunter success was 25% for the general season, 46% for DM790, 40% for DM795, and 60% for DM792.

Southeastern Unit 20D Harvest — Moose harvest in southeastern Unit 20D continued to be low, with a 2-year average harvest for RY09–RY10 of 26 moose/year (Table 7). General season reported harvest was 21 in RY09 and 31 moose in RY10 (Table 7). The 2-year average hunter success was 50%. Harvest during the general hunting season remains low in this area primarily because motorized access restrictions in the Macomb Plateau Controlled Use Area make moose hunting difficult.

Northwestern Unit 20D Harvest — Northwestern Unit 20D consistently has the second highest harvest in the unit. During RY09, harvest was 63 moose, with a success rate of 25%. In RY10, reported harvest by hunters totaled 59 moose (Table 7) and hunter success was 24%. There were no permit hunts in northwestern Unit 20D.

Northeastern Unit 20D Harvest — The number of hunters and harvest remained low in northeastern Unit 20D during the RY09–RY10 general seasons. In RY09, reported harvest by hunters totaled 15 moose (Table 7), with a success rate of 34%. In RY10, hunters reported taking 17 moose, with a success rate of 32%. This area is difficult to access during the hunting season except along the Tanana River, a few small creeks and rivers flowing into the Tanana River, and at a few ridge top airstrips.

In RY09–RY10, 1 moose was reported harvested during the August hunting season in the Healy River drainage (Table 12).

Hunter Residency. Based on harvest reports, most Unit 20D hunters were Alaska residents who resided outside of the unit (Table 11). The proportion of nonresident hunters continued to be low.

Hunter Effort. Successful hunters averaged 5.9 hunting days in RY09 and 5.2 days in RY10 (Table 13).

Permit Hunts. Permit hunt DM790 (DJMA) had 25 drawing permits issued in RY09 and 18 in RY10 (Table 8). The number of applicants for DM790 was 665 in RY09 and 983 in RY10.

Permit hunt DM792 (BRYHMA) had 10 permits in each of RY09 and RY10 (Table 9). The number of applicants for DM792 was 212 in RY09 and 314 in RY10.

Unit 20D antlerless moose hunts were implemented in RY06 and were continued in RY09 for the taking of a cow moose not accompanied by a calf. In RY09, permit hunt DM797 had 50 permits (536 applicants), DM798 had 100 permits (1,704 applicants), and DM799 had 50 permits (1,055 applicants).

Drawing permits for hunt DM795 were issued to 6 (54 applicants) qualifying disabled veterans in RY10 in the DJMA. In RY09 6 (25 applicants) DM790 permits were reallocated to qualifying disabled veterans. Permit hunts DM795 and DM790 had the same hunt area, season dates, and bag limit in RY10.

Harvest Chronology. During RY09–RY10 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).

Transport Methods. During RY09–RY10 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 RY09–RY10. 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

Browse sampling was conducted in RY10 to estimate biomass removal by moose. Estimates of biomass removal from RY10 sampling will be compared to estimates of biomass removal in the same area of Unit 20D from browse sampling in RY99, RY00, RY06, and RY09, and will be used in analyzing the nutritional condition of moose in SW Unit 20D (T. Paragi, ADF&G, unpublished data, Fairbanks).

Enhancement

No habitat enhancement was conducted during RY09–RY10.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates were completed in southern Unit 20D in RY09–RY10. No population estimates were conducted in northern Unit 20D during RY09–RY10. Without a population estimate for northern Unit 20D, a unitwide estimate was not available.

Current population and harvest objectives include interim objectives which supplement the population and harvest objectives. The interim objectives are based on density-dependent thresholds and will be used to manage the Unit 20D moose population until a Unit 20D intensive moose management plan has been completed.

Antlerless moose hunts during RY06–RY09 have contributed to a decreasing moose density in southwestern Unit 20D. The goals of the antlerless moose hunts were to stabilize population growth in the unit and to address concerns about range degradation, reduced nutritional condition, and reduced reproductive success of moose.

The antlerless moose hunts and their effect on moose density and population growth should continue to be evaluated. Three indices of density-dependent moose nutritional condition, 1) biomass removal of current annual growth on winter browse, 2) proportion of females with twin calves, and 3) late-winter calf weights, will be evaluated in relation to changes in moose density. Future antlerless moose hunts for Unit 20D will be implemented as needed based on this evaluation.

In conclusion, during RY09–RY10 the Unit 20D moose population did not meet the population objective of 8,000–10,000 moose set by the Board of Game. The harvest objective of 500–700 moose was also not met. No changes are planned for the general season hunt. Antlerless moose hunts will not be recommended for RY11. The moose population in northern Unit 20D is likely increasing due to habitat enhancement caused by wildland fires in 2003 and 2004. I recommend a population estimate of northern Unit 20D to assess whether the Unit 20D population objective is being met.

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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, 1995–2010.

Year/Method	Total population estimate	Total cows	Total calves	Total bulls	Calves: 100 cows	Bulls:100 cows
1995 (Gasaway)	2,522	1,626	552	343	34	21
(LCI–UCI)[a]	1,979–3,065	1,271–1,981	411–693	249–437	29–39	17–25
1998	3,630	2,321	863	479	37	21
(LCI–UCI)[a]	2,533–4,727	1,570–3,072	630–1,097	305–653	32–42	16–25
2000	3,932	2,530	676	671	27	27
(LCI–UCI)[a]	3,245–4,618	2,021–3,039	498–855	530–813	22–31	19–34
2001	3,435	2,424	575	392	24	16
(LCI–UCI)[a]	2,643–4,227	1,840–3,009	453–697	281–504	16–32	10–22
2003	5,493	3,476	1,097	790	32	23
(LCI–UCI)[a]	3,924–7,061	2,363–4,588	830–1,364	462–1,118	27–37	19–26
2005	5,553	3,473	1,219	817	33	24
(LCI–UCI)[a]	4,513–6,593	2,757–4,188	984–1,453	560–1,075	28–38	17–31
2006	7,243	4,494	1,815	929	41	21
(LCI–UCI)[a]	5,659–8,827	3,485–5,501	1,386–2,244	696–1,162	36–45	17–24
2007	No data					
2008	5,006	3,071	1,049	915	34	30
(LCI–UCI)[a]	3,938–6,074	2,348–3,794	823–1,275	715–1,116	23–45	20–39
2009	4633	2823	966	862	34	30
(LCI–UCI)[a]	3,864–5,401	2,341–3,305	822–1,110	650–1,073	30–39	21–39
2010	4,574	2,888	755	968	26	33
(LCI–UCI)[a]	3,734–5,414	2,310–3,466	610–900	753–1,182	19–32	23–43

[a] LCI = lower confidence interval at 90% and UCI = upper confidence interval at 90%.

Table 2. Results of population estimates of observed moose for southeastern and southwestern Unit 20D using geospatial population estimator (GSPE) surveys, 2001–2010.

Parameter	2001	2003	2005	2006	2007	2008	2009	2010
East of Johnson River (southeastern Unit 20D)								
Total pop estimate	853	968	690	998	--	602	997	976
LCI[a]	544	321	290	328	--	408	632	594
UCI[b]	1,162	1,616	1,090	1,668	--	795	1,360	1,357
Total cows	463	356	402	625	--	542	575	608
LCI	185	139	130	198	--	288	348	346
UCI	740	573	676	1,051	--	796	802	869
Total calves	128	87	97	267	--	152	224	165
LCI	74	16	6	90	--	67	153	100
UCI	182	158	189	443	--	237	296	231
Total bulls	106	139	205	128	--	229	186	220
LCI	65	47	117	36	--	167	99	132
UCI	147	230	292	225	--	292	118	307
Bulls:100 Cows	23	39	51	20	--	42	32	35
LCI	5	29	19	10	--	19	12	15
UCI	41	49	84	30	--	65	51	55
Calves:100 Cows	28	24	24	41	--	28	40	28
LCI	5	9	10	28	--	8	26	8
UCI	50	40	38	54	--	49	53	49
West of Johnson River (southwestern Unit 20D)								
Total pop estimate	2,583	4,524	4,863	6,245	5,926	4,065	3,637	3,599
LCI	1,190	3,269	3,933	4,931	4,525	3,189	2,986	2,957
UCI	3,175	5,779	5,792	7,559	7,327	4,940	4,286	4,239
Total cows	1,962	3,229	3,070	3,869	3,767	2,530	2,248	2,280
LCI	1,507	2,137	2,432	3,033	2,697	1,936	1,838	1,838
UCI	2,416	4,320	3,708	4,705	4,837	3,123	2,657	2,722
Total calves	447	1,049	1,121	1,549	1,128	897	741	589
LCI	358	719	913	1,195	805	709	620	478
UCI	537	1,379	1,330	1,902	1,450	1,086	862	699
Total bulls	286	664	613	801	1,351	686	676	748
LCI	203	393	396	608	940	529	501	583
UCI	370	936	829	994	1,762	844	851	912
Bulls:100 Cows	15	21	20	21	36	27	30	32
LCI	9	17	13	17	21	18	20	23
UCI	20	24	27	24	51	36	39	42
Calves:100 Cows	23	32	34	41	30	35	33	25
LCI	16	27	29	36	18	24	28	19
UCI	30	38	39	45	42	47	97	32

[a] LCI = Lower confidence interval.
[b] UCI = Upper confidence interval.

Table 3. Results of moose twinning surveys in southwest Unit 20D, 2001–2011.

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
2010	52	7	11.9	23.7	303
2011	49	17	25.8	29.0	325

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	2,026	2,395	1,929
LCI[c]	1,583	2,070	1,443
UCI[d]	2,469	2,719	2,415
Total bulls	504	957	515
LCI	364	805	351
UCI	644	1,109	679
Total cows	1,255	1,181	1,101
LCI	967	979	776
UCI	1,543	1,384	1,426
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 (Gasaway 1986) 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 2009–2010 through 2010–2011.

Regulatory year	Area	Season		Bag limit
2009–2010	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 1 side.
			1 Oct–15 Nov	1 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 1 side.
	Within Delta Junction Management Area.	RESIDENT:	1 Sep–15 Sep	1 bull with spike/fork or 50-inch antlers or 4 or more brow tines by drawing permits DM790.
			1 Oct–15 Nov	1 antlerless moose (taking calves or cows accompanied by calves is prohibited) by drawing permit DM797.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers[a] by drawing permit DM790.
	Within the Bison Range Youth Hunt Management Area.	RESIDENT AND NONRESIDENT:	1 Sep–30 Sep	1 bull with spike/fork or 50-inch antlers or 4 or more brow tines on at least 1 side, or 1 antlerless moose per lifetime (taking calves or cows accompanied by calves is prohibited) by permit DM792.
	South of Tanana River and east of	RESIDENT:	1 Sep–15 Sep	1 bull.

Regulatory year	Area	Season		Bag limit
	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.	NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least 1 side.
	Within the Healy River drainage.	RESIDENT:	15 Aug–28 Aug 1 Sep–15 Sep	1 bull with spike/fork antlers. 1 bull.
		NONRESIDENT:	1 Sep–15 Sep	1 bull.
	Remainder of Unit 20D (north of Tanana River).	RESIDENT AND NONRESIDENT:	1 Sep–15 Sep	1 bull.
2010–2011	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	1 bull with spike/fork or 50-inch antlers or 4 or more brow tines on at least 1 side.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or four or more brow tines on at least 1 side.
	Within Delta Junction Management Area.	RESIDENT:	1 Sep–15 Sep	1 bull with spike/fork or 50-inch antlers or 4 or more brow tines by drawing permits DM790.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers by drawing permit DM790.

Regulatory year	Area	Season		Bag limit
	Within Delta Junction Management Area	QUALIFIED DISABLED VETERANS ONLY, RESIDENT	1 Sep–15 Sep	1 bull with spike/fork or 50-inch antlers or 4 or more brow tines by drawing permit DM795.
		QUALIFIED DISABLED VETERANS ONLY, NONRESIDENT	5 Sep–15 Sep	1 bull with 50-inch antlers or four or more brow tines on at least 1 side.
	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 1 side, or 1 antlerless moose per lifetime (taking calves or cows accompanied by calves is prohibited) by permit DM792.
	South of Tanana River and east of Johnson River except within the Robertson River drainage south of the confluence of east and west fork, and within 1 mile west of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least 1 side.
	Within the Healy River drainage.	RESIDENT:	15 Aug–28 Aug	1 bull with spike/fork antlers.
			1 Sep–20 Sep	1 bull.
		NONRESIDENT:	1 Sep–20 Sep	1 bull.

Regulatory year	Area	Season		Bag limit
	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.

Table 6. Unit 20D moose harvest and accidental death, regulatory years 1991–1992 through 2010–2011.

Regulatory year	Harvest by hunters: Reported M	F	Unk	Total	Estimated: Unreported[a]	Illegal	Total	Accidental death: Road	Total	Total
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
2009–2010	299	117	0	416	73	unk	73	52[b]	52	541
2010–2011	239	6	0	245	43	unk	43	52[b]	52	340

[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. Southwestern (SW), southeastern (SE), northwestern (NW), and northeastern (NE) Unit 20D reported moose harvest and number of hunters during general seasons, regulatory years 1991–1992 through 2010–2011.

Regulatory	Moose harvest						Hunters					
year	SW	SE	NW	NE	Unk	Total	SW	SE	NW	NE	Unk	Total
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
2009–2010	153[h]	21[c]	63[c]	15[i]	0	252	543[h]	67[c]	252[c]	44[i]	114	1,020
2010–2011	125[h]	31[c]	59[c]	17[i]	0	232	492[h]	37[c]	241[c]	53[i]	75	898

[a] Season 1–6 Sep; 1 bull.
[b] Season 1–20 Sep; 1 bull.
[c] Season 1–15 Sep; 1 bull.
[d] Season 1–10 Sep; 1 bull.
[e] Season 1–15 Sep; 1 bull with spike/fork or 50-inch antlers or 3 brow tines on 1 antler.
[f] Subsistence–resident season 1–15 Sep; 1 bull with spike/fork or 50-inch antlers or 3 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 antler.
[g] West of pipeline season 1–15 Sep; 1 bull. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 side. Remainder area 1–10 Sep; 1 bull.
[h] Resident season 1–15 Sep; 1 bull with spike/fork or 50-inch antlers or 4 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 4 brow tines on 1 antler.
[i] Resident season 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 2010–2011.

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
DM790	2009–2010	25	8	43	57	100	0	0	13
DM790	2010–2011	18	28	54	46	100	0	0	6
DM795	2010–2011	6	17	60	40	100	0	0	2

Table 9. Unit 20D Bison Range Youth Hunt Management Area moose drawing permit harvest, regulatory years 2002–2003 through 2010–2011.

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
DM792	2009–2010	10	0	20	80	50	50	0	8
DM792	2010–2011	10	0	40	60	0	100	0	6

Table 10. Unit 20D antlerless moose hunt harvest, regulatory years 2006–2007 through 2009–2010.

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
DM797	2009–2010	50	24	30	70	4	96	0	26
DM798	2009–2010	100	20	19	81	3	97	0	64
DM799	2009–2010	50	40	13	87	0	100	0	26

Table 11. Unit 20D general hunting season moose hunter residency and success[a], regulatory years 1991–1992 through 2010–2011.

Regulatory year	Successful						Unsuccessful						Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
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)	1,029
2008–2009	159	104	13	6	282	(27)	447	241	48	16	752	(73)	1,034
2009–2010	78	144	28	2	252	(25)	214	440	35	79	768	(75)	1,020
2010–2011	66	159	15	2	242	(27)	192	428	33	13	666	(73)	908

[a] Excludes hunters in permit hunts.
[b] Local means reside in Unit 20D.

Table 12. Unit 20D Healy River (Uniform Coding Unit 501) reported moose harvest, regulatory years 1993–1994 through 2010–2011.

	Unit 20D Healy River			
Regulatory		Harvest month		
year	Hunters	Aug	Sep	Jan
1993–1994[a]	9	0	2	0
1994–1995[a]	13	0	2	0
1995–1996[a]	24	0	2	0
1996–1997[a]	10	0	2	0
1997–1998[a]	14	0	3	0
1998–1999[b]	19	0	5	0
1999–2000[b]	21	0	7	0
2000–2001[b]	24	0	6	0
2001–2002[b]	23	0	5	0
2002–2003[b]	10	0	1	0
2003–2004[b]	10	0	5	1
2004–2005[c]	15	0	1	0
2005–2006[c]	14	0	6	0
2006–2007[c]	22	0	8	0
2007–2008[c]	16	0	5	0
2008–2009[c]	19	0	9	0
2009–2010[c]	17	0	5	0
2010–2011[c]	15	1	5	0

[a] Resident moose hunting season 1–15 Sep, 1 bull.
[b] Resident moose hunting season: 15–28 Aug, 1 spike/fork bull; 1–15 Sep, 1 bull; 1 Jan–15 Feb, 1 bull.
[c] Resident moose hunting season: 15–28 Aug, 1 spike/fork bull; 1–15 Sep, 1 bull.

Table 13. Southwestern, southeastern, northwestern, and northeastern Unit 20D general season moose and mean days hunted[a], regulatory years 1991–19927 through 2008–2009.

Regulatory year	Successful hunters					Unsuccessful hunters				
	SW	SE	NW	NE	Total	SW	SE	NW	NE	Total
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
2009–2010	5.2	6.0	6.3	6.9	5.9	6.7	6.1	6.6	6.1	6.6
2010–2011	5.7	5.5	5.6	5.1	5.2	6.9	6.3	7.0	7.6	7.1

[a] Excludes permit hunt harvest.

Table 14. Unit 20D general season moose harvest[a] chronology percent by month/day, regulatory years 1991–1992 through 2010–2011.

Regulatory	Harvest chronology percent by month/day					
year	9/1–9/5	9/6–9/10	9/11–9/15	9/16–20	Unk	*n*
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
2009–2010	45	25	27	1	2	252
2010–2011	42	26	28	2	2	232

[a] Excludes permit hunt harvest.

Table 15. Unit 20D moose harvest percent[a] by transport method, regulatory years 1991–1992 through 2010–2011.

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboats	Unknown	*n*
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
2009–2010	5	2	20	44	0	4	23	0	2	252
2010–2011	5	2	19	42	0	4	25	1	2	232

[a] Excludes permit hunt harvest.

SPECIES

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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 20E (10,680 mi^2 total area, 8,000 mi^2 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 2,200 moose. During 1976–2008, the moose population in Unit 20E remained at low densities, fluctuating at an estimated 2,200–5,900 moose (0.3–0.7 moose/mi^2 of moose habitat).

Gasaway et al. (1992) evaluated the roles that predation, nutrition, snow, harvest, and disease played in maintaining the moose population at low densities. They concluded that predation was the primary limiting factor and that other variables had little 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 3,800 mi^2 area of Unit 20E using a combination of aerial shooting by ADF&G and trapping by the public. 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 1998–2005 (Boertje and Gardner 1999, Boertje et al. 2008) using the geospatial population estimator method (GSPE; Ver Hoef 2001, Ver Hoef 2008, Kellie and DeLong 2006). Although surveys indicated the moose population fluctuated during 1976–2008, it did not increase beyond the ability of wolves and bears to maintain the population at low densities (≤1.0 moose/mi^2 of moose habitat). The most recent effort to increase the moose population in Unit 20E began in November 2004, when the Alaska Board of Game implemented the Upper Yukon–Tanana Predation Control Program (UYTPCP), encompassing

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

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 1 July 2009–30 June 2011.

Historically, moose harvest was low in relation to the 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 of Game to approve a 10-day bulls-only season in 1982, which continued until 1991. In response to further moose population improvement, the board lengthened the moose season to 15 days during 1991–2000.

Local residents, residents from Fairbanks, and residents from Southeast Alaska were the primary moose hunters in Unit 20E through 1991. During 1992–2008, 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 late August season and a 10-day September season managed under a registration permit. The remote portions of the upper Middle Fork Fortymile River were not included in this split season registration hunt (Gross 2008), which retained 15 days of hunting opportunity but reduced moose hunting pressure by closing the moose season during Labor Day weekend. In addition, moose and caribou permits allowed a hunter to hold a registration permit for only one species at a time. These actions appear to have stabilized moose harvest to maintain adequate bull:cow ratios and the season structure remains 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 500–1,000 moose annually.

METHODS

POPULATION STATUS AND TREND

We used the GSPE technique to conduct moose population estimation surveys in southern Unit 20E within the 2,452 mi^2 Tok West and 2,178 mi^2 Tok Central (called Tok East in 1998–2003) survey areas during 1998–2011. See unpublished survey memos in the Tok office files for further details about 1998–2011 moose surveys. These survey areas varied in size during 1998–2003, but have remained the same since 2004. In 2003, 2006, and 2009 we conducted a GSPE survey in a 1,200 mi^2 portion of northwestern 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 5.5–7 min/mi^2 with no sightability correction factor. Low–to–medium search intensities adopted in 2004 are used to provide a cost-efficient estimate with the understanding that using lower search intensities introduces additional unmeasured variation. Because the unitwide population has been far below objectives, the additional variation is less of a concern than it would be if we were close to our population objective. Results from these surveys have provided adequate results to manage this population. In the future, if the population approaches management objectives it will become necessary to increase search intensities and correct for sightability to improve precision of our estimates.

We used GSPE survey data 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 1998–2011 from data collected during the GSPE population surveys in the Tok West and Tok Central survey areas. As previously discussed, all GSPE surveys in Unit 20E used a low–to–medium search intensity of 5.5–7 min/mi^2 with no sightability correction factor, which introduces additional unmeasured variation in estimates. However, because the bull:cow ratio has remained well above the objective since we began using GSPE surveys in 1998, the additional variation has not been a concern. If we approach management objectives in the future it will become more critical to increase search intensities and correct for sightability to improve precision.

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 2004–2011 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 one-half 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. Surveys were flown in late May during or within a few days of the median calving date (Boertje et al. 2007), when approximately 50% of the cows observed had calves. 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. In addition to improving sample size, sampling close to the median calving date helps avoid early mortality factors such as predation, which could lead to underestimating twinning rates.

Although a minimum sample size of 50 cows with calves is preferable for statistical reasons, due to low moose densities in southern Unit 20E and a limited budget for conducting twinning surveys, we established, a priori, a minimum desired sample size of 30 cows with calves (Boertje et al. 2009). 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 2001–2011, this included data from the registration hunt RM865 in most of Unit 20E, the general season hunt in the Upper Middle Fork of the Fortymile River drainage, and drawing hunts DM794 and DM796 during November in the Ladue River 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 which begins 1 July and ends 30 June (e.g., RY09 = 1 July 2009 through 30 June 2010).

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 RY09–RY11.

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 2004–2011 (Table 1), the observable moose population increased from an estimated 2,268 moose (0.49 moose/mi^2) in RY04 to an estimated 4,148 moose (0.90 moose/mi^2) in RY11. 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).

The NPS estimated the moose density in the entire 3,096 mi^2 YCNP survey area (including 1,200 mi^2 in Unit 20E) at 0.20 moose/mi^2 in 2006 and 0.37 moose/mi^2 in 2009 (Burch 2006, 2009). For the unitwide population estimate during years when YCNP surveys were not conducted, I used the density estimate from their most recent survey for this area.

No formal surveys were conducted in northern Unit 20E outside YCNP (approximately 2,170 mi^2 of moose habitat) during RY09–RY11. Because habitat is similar, I estimated the moose population size in northern Unit 20E outside the YCNP survey area by extrapolating the YCNP estimate to this area. While this is not a statistical estimation, it provides a conservative estimate of the low density moose population in this area.

To develop my unitwide population estimate during RY09–RY11, I adding the estimated number of moose in the Tok West, Tok Central, and 1,200 mi^2 portion of the YCNP survey areas to the extrapolated estimate in the 2,170 mi^2 portion of northern Unit 20E outside these survey areas. Because surveys were not conducted in all years in the YCNP survey area, and estimates for the 2,170 mi^2 portion of northern Unit 20E were extrapolated from the adjacent YCNP survey area, my unitwide estimate is not statistically supported, but it provides a conservative estimate of the low density moose population.

<u>RY09</u>. The 2009 population estimate for Unit 20E was 4,300–6,000 observable moose, with an estimated density of 0.54–0.75 moose/mi^2 of moose habitat (8,000 mi^2). Only habitat clearly not suitable for moose was excluded, e.g., high portions of mountains (Gasaway et al. 1986).

<u>RY10</u>. The 2010 population estimate was 4,100–6,100 observable moose, with an estimated density of 0.51–0.77 moose/mi^2 of moose habitat (8,000 mi^2).

<u>RY11</u>. The 2011 population estimate was 4,200–6,400 observable moose, with an estimated density of 0.53–0.80 moose/mi^2 of moose habitat (8,000 mi^2).

Population Composition

The bull:cow ratio remained above the management objective of 40 bulls:100 cows each year during RY03–RY11 in the Tok Central and Tok West survey areas (Table 1).

During RY98–RY04, ratios of 5-month-old calves:100 cows were consistently at or below 25 calves:100 cows except during 2004 in Tok West (26 calves:100 cows). Ratios have not equaled or exceed 30 calves:100 cows during any year for which data exist 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.

During RY05–RY10, 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 ($\bar{x}$ = 22 calves:100 cows; range = 15–28). Wolf control in the UYTPCP may have contributed to higher calf survival in the Tok West survey area during RY05–RY10 by reducing wolf predation on calves. Although Gasaway et al. (1992) did not show wolves as the primary predator of calves ≤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).

During RY11, the fall calf:cow ratios fell to 17 and 5 calves:100 cows in Tok West and Tok Central survey areas, respectively. Because fall 2011 surveys were conducted earlier than normal (last week in October vs. November), and we did not have complete snow cover in the entire survey area, we may have experienced sightability problems, (especially of lone cow/calf pairs) that skewed the 2011 results.

Twinning Rates

To account for variability that can exist between consecutive years and with our relatively low sample size of about 30 cows with calves, we used 3-year average twinning rates to evaluate nutritional condition of the moose population (Boertje et al. 2007). The average for 2010–2012 was 26%, which is above rates observed in nutritionally stressed populations (Boertje et al. 2007). Based on this 3-year average, the population can support an increased moose population (Boertje et al. 2007).

Distribution and Movements

Moose are distributed throughout Unit 20E below elevations of 4,500 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). Early deep snowfalls (>22 inches) in fall 1988, 1992, 1999, and 2000 appeared to cause moose to move to lower elevations during November (Gardner 2002).

MORTALITY

Harvest

Seasons and Bag Limit. Season dates and bag limits during RY03–RY11 are summarized in Table 3.

Alaska Board of Game Actions and Emergency Orders.

Predator Control Actions — During the spring 2004 Board of Game 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 its 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 6,600 mi^2 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 2,700 mi^2 portion of southern Unit 20E to reduce predation on moose calves.

During its spring 2006 meeting, the board enlarged the Upper Yukon–Tanana predator control area to 18,750 mi^2 to include most of the Fortymile caribou herd's annual range largely to benefit the caribou herd. Wolf control was authorized for the entire predation control area, including all of Unit 20E. Grizzly bear control was limited to 4,050 mi^2 in southern Unit 20E to reduce grizzly bear predation on moose calves.

During its March 2009 meeting, the board reauthorized the UYTPCP but suspended grizzly bear control on 1 July 2009 because it was determined to be ineffective at removing bears. This plan was authorized for 5 years beginning 1 January 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 8,000–10,000 moose with an annual harvest objective of 500–1,000 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 8,000–10,000 moose and harvest of 500–1,000 to the entire unit.

During its 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 and the Boundary Cutoff of the Taylor Highway. This prohibited moose hunters from using a network of mining trails between Liberty Creek and the Boundary Cutoff of the Taylor Highway.

During its 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. The board also changed the ending date for motorized restrictions within the LRCUA from 30 September to 20 September. This allowed for increased motorized access in this area to hunt other species after the general moose season ended.

In March 2012 the board extended the season of the 2 moose draw hunts (DM794 and DM796) in southern Unit 20E from 1–30 November to 1 November–10 December. This was intended to allow hunters additional time to hunt when snow conditions are more favorable for using snow machines.

Harvest by Hunters. During RY08–RY11, average reported harvest during the general season increased by 27% ($\bar{x}$ = 174, range = 164–185) compared with RY05–RY07, when reported harvest during the general season averaged 137 bull moose (130–144) annually (Table 4), about 3–4% of the estimated population. This increase is likely a result of increased moose numbers since 2004 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 LRCUA. 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 caused by access restrictions during 5 August–20 September in the LRCUA.

During RY09–RY11, we issued 3 DM794 and 7 DM796 permits annually. No moose were harvested in the DM794 hunt, but 4 bulls were harvested in the DM796 hunt (3 in RY09 and 1 in RY10; Table 4). Hunting conditions, including access, were extremely difficult with unpredictable snow conditions and extreme cold. This likely accounted for the low harvest. In addition, hunters who applied for these hunts often expected an easy moose hunt. However, once they understood the remoteness and difficulty, many permit holders chose not to participate. In addition, these hunters indicated that during RY09–RY11 they were searching for large bulls. A longer season in 2012 (1 November–10 December 10) should allow hunters additional time to hunt when snow conditions are more favorable to the use of snow machines. I will continue to encourage permit holders to travel to this remote area when snow conditions allow.

Hunter Residency and Success. Of the 165–186 bulls harvested annually in RY09–RY11, 72–75% were taken by nonlocal Alaska residents (Table 5). Nonlocal resident hunters made up 69–72% of the hunters during RY09–RY11. Local hunters represented 18–20% of the hunters and took 13–16% of the harvest. Prior to 1992, most nonlocal hunters were from Interior and Southeast Alaska, but since RY92 most nonlocal hunters have been from Southcentral Alaska. During RY09–RY11, nonresidents represented an average of 10% (range = 9–11%) of the hunters and took an average of 12% (range = 11–12%) of the harvest. This is similar to RY91–RY08 when nonresidents represented 10% of the hunters and averaged 11% of the harvest.

Hunter success rate declined from an average of 28% during RY93–RY00 to an average of 19% during RY01–RY07. However, success rate increased to an average of 24% (range = 23–26%) during RY08–RY11, 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–RY08, 2–10 bulls ($\bar{x}$ = 7) were harvested during 24–28 August, a 78% reduction in the average harvest during the first 5 days of the general season (Table 6). August harvest during RY09–RY11 remained at similar levels (8–11 bulls; $\bar{x}$ = 9) as reported during RY01–RY08.

Transport Methods. Transportation methods used by successful hunters during RY09–RY10 did not appear to change from the previous report period. However, methods changed markedly in RY01–RY11 compared to RY91–RY00. During RY01–RY11, the proportion of successful moose hunters using 4–wheelers (annual average 60%, range = 32–80%) and ORVs (annual average 20%, range = 13–29%) increased substantially compared to RY91–RY00, when hunters using 4–wheelers and ORVs harvested an average of 32% (range = 10–46%) and 14% (range = 7–19%) of the moose annually (Table 7). Conversely, the proportion of moose taken by hunters using highway vehicles declined from 27% (range = 15–41%) in RY91–RY00 to 20% (range = 12–30%) in RY01–RY11.

All Terrain Vehicles (4-wheelers) and ORVs (primarily 8-wheeled vehicles equipped with tracks, such as Argos™) have gained in popularity since RY01. Increasing quality and dependability of ATVs has allowed hunters to access areas farther from roads and resulted in new trails into areas that previously served as refugia for moose. This has likely resulted in localized reductions in bull:cow ratios in areas with increasing networks of trails.

The number of successful hunters who used other transportation types (airplane, horse, boat, and snowmachine) has remained relatively constant since RY01.

Several other concerns about the increasing trail systems have been voiced by members of the public. Complaints of hunter crowding and user group conflicts in portions of Unit 20E have increased since RY05. Hunters along the Taylor Highway and trails close to the highway have complained of crowding and conflicts between hunters hunting on foot from the highway and hunters who used ATVs/ORVs. In addition, complaints of trail pioneering and habitat degradation in the Mosquito Flats of southern Unit 20E has resulted in proposals and testimony to the Board of Game, and requests from local advisory committees to the department, to implement further motorized restrictions in this wetland area.

Other Mortality

Predation by wolves and grizzly bears was identified as the greatest source of moose mortality in Unit 20E (Gasaway et al. 1992) and maintained the population at a low density (0.32–0.64 moose/mi^2). In southern Unit 20E, 31% of the 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 (Boertje et al. 2009). Predator–prey relationships between moose, wolves and grizzly bears in Unit 20E during RY81–RY06, were discussed by Boertje et al. (1987, 1988, 2009), Gasaway et al. (1992), and Gross (2004, 2008, and 2010). Additional information and analysis of predator–prey relationships related to the UYTPCP in Unit 20E can be found in the March 2010–2012 Upper Yukon Tanana Predation Control Implementation Plan and annual activity reports from ADF&G to the Alaska Board of Game (Available at http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.unit_12_20b_20d_20e_25c#anchor)

HABITAT

Assessment

Availability of browse in Unit 20E does not appear to have limited 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. In southern Unit 20E, the 2010–2012 average twinning rate of 26%, and browse removal rate ≤35%, are not indicative of nutritionally stressed Interior Alaska moose populations (Boertje et al. 2007).

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 (≥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.

In 2004 and 2005, wildfires burned >1,000,000 acres (1,890 mi^2) 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 25–35 years.

In 2009, 26,700 acres burned primarily within the Ladue River drainage. Wet conditions resulted in only 13.6 acres burned in 2010 and 355 in 2011 (Alaska Interagency Coordination Center website, http://fire.ak.blm.gov, [Accessed 25 June 2012]).

CONCLUSIONS AND RECOMMENDATIONS

Population estimates during RY09–RY11 indicated we did not meet the Unit 20E intensive management objective of 8,000–10,000 moose. During RY04–RY11 the population increased slowly to an estimated 4,200–6,400 moose, with an estimated density of 0.53–0.80 moose/mi^2 of moose habitat (8,000 mi^2).

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 during RY98–RY11. The 5-year reauthorization (1 July 2009–30 June 2014) of the UYTPCP by the Board of Game will likely result in continued suppression of wolf numbers to reduce wolf predation on moose. Authorized control efforts did not reduce grizzly bear numbers under the previous UYTPCP so grizzly bear control efforts were not included when the plan was reauthorized in 2009. To reach the Unit 20E 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 averaged 3.6% (range 3.2–4.6%) of the midpoint Unit 20E population estimate during RY07–RY11.

Unitwide harvests of 172 moose in RY09, 165 in RY10, and 186 in RY11 respectively, were well below the intensive management harvest objective of 500–1,000 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 RY11. Most additional hunters were from Southcentral Alaska. As during previous years, the preferred transportation type during RY09–RY11 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, hunter numbers in Unit 20E may plateau or decline in coming years. 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. 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, more than 1,890 mi^2 of Unit 20E moose habitat burned in wildfires. With Alaska Department of Natural Resources, Division of Forestry and Bureau of Land Management leadership, the interagency fire management plan has guidelines that should result in implementation of 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 of Game process.

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Table 1. Moose population estimates in Tok West and Tok Central Moose Survey Areas in southern Unit 20E, fall 1998–2011[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	1,932	0.56 (90% CI±44%)	1,086 (90% CI±44%)
	1999	80	16	22	10	365	1,932	0.47 (90% CI±20%)	901 (90% CI±20%)
	2000	60	11	14	8	561	1,932	0.58 (90% CI±19%)	1,115 (90% CI±23%)
	2001	76	9	14	7	531	1,932	0.47 (90% CI±19%)	915 (90% CI±17%)
	2002	59	10	25	14	364	1,932	0.60 (90% CI±19%)	1,166 (90% CI±27%)
	2003	64	9	15	9	355	1,944	0.58 (90% CI±25%)	1,128 (90% CI±25%)
	2004	61	11	26	14	283	2,452	0.59 (90% CI±22%)	1,435 (90% CI±22%)
	2005	55	13	30	16	543	2,452	0.73 (90% CI±17%)	1,801 (90% CI±17%)
	2006	39	9	37	20	584	2,452	0.98 (90% CI±19%)	2,398 (90% CI±19%)
	2007	50	11	30	16	503	2,452	0.86 (90% CI±18%)	2,098 (90% CI±18%)
	2008	47	11	27	16	509	2,452	0.83 (90% CI±15%)	2,040 (90% CI±15%)
	2009	63	18	34	18	585	2,452	1.00 (90% CI±16%)	2,445 (90% CI±16%)
	2010	83	14	37	17	618	2,452	1.03 (90% CI±20%)	2,519 (90% CI±20%)
	2011	67	8	17	9	799	2,452	1.26 (90% CI±19%)	3,082 (90% CI±19%)
Tok Central	1998	59	14	23	14	450	2,750	0.62 (90% CI±25%)	1,694 (90% CI±25%)
	2000	49	11	21	13	347	1,821	0.70 (90% CI±24%)	1,272 (90% CI±24%)
	2001	51	6	10	6	624	2,703	0.75 (90% CI±23%)	2,026 (90% CI±23%)
	2002	71	8	20	10	396	2,703	0.63 (90% CI±28%)	1,707 (90% CI±28%)
	2003	53	5	11	6	297	2,703	0.51 (90% CI±23%)	1,379 (90% CI±23%)
	2004	48	11	23	14	233	2,178	0.37 (90% CI±19%)	802 (90% CI±19%)
	2005	48	8	16	10	344	2,178	0.50 (90% CI±19%)	1,097 (90% CI±19%)
	2006	46	3	24	14	520	2,178	0.45 (90% CI±19%)	979 (90% CI±19%)
	2007	46	11	22	13	440	2,178	0.62 (90% CI±22%)	1,348 (90% CI±22%)
	2008	82	19	28	13	356	2,178	0.53 (90% CI±16%)	1,162 (90% CI±16%)
	2009	51	11	25	14	461	2,178	0.68 (90% CI±15%)	1,471 (90% CI±15%)
	2010	54	6	15	9	369	2,178	0.63 (90% CI±23%)	1,379 (90% CI±23%)
	2011	61	5	5	3	272	2,178	0.47 (90% CI±26%)	1,025 (90% CI±26%)

[a] Sampled using the geospatial population estimator (GSPE) sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006).

Table 2. Twinning rate in northern Unit 12 and southern 20E, 2004–2012.

Calendar year	Date	Cows w/single calf	Cows w/twins	Cows w/triplets	Cows Total	% Twins[a]
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
2010	27 May 1–2 June	25	7	0	32	22
2011	26–27 May	42	11	0	53	21
2012	30 May	17	9	0	26[b]	35

[a] Percentage of cows with calves that had twins or triplets.
[b] Desired minimum sample size of 30 not achieved likely due to sightability issues associated with early green up.

Table 3. Unit 20E moose hunting seasons and bag limits, regulatory years 2003–2004 through 2011–2012.

Regulatory year	Area		Season	Bag limit[a]
2003–2004	Unit 20E draining into the Middle Fork Fortymile River upstream from the drainage of the North Fork Fortymile River.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull, or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Remainder of Unit 20E.	RESIDENT:	Registration 24–28 Aug Registration 8–17 Sep Drawing 1–30 Nov	1 bull by permit RM865, or 1 bull by permit RM865, or 1 bull by permit DM794–DM796 in the Ladue River Controlled Use Area.
		NONRESIDENT:	Registration 8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by permit RM865.
2004–2005 through 2011–2012	Unit 20E drainages of the Middle Fork Fortymile River upstream from and including the Joseph Creek drainage.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull, or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side
	Remainder of Unit 20E.	RESIDENT:	Registration 24–28 Aug Registration 8–17 Sep Drawing 1–30 Nov	1 bull by permit RM865, or 1 bull by permit RM865, or 1 bull by permit DM794–DM796 in the Ladue River Controlled Use Area.
		NONRESIDENT:	Registration 8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by permit RM865.

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

Table 4. Unit 20E moose harvest and accidental death, regulatory years 1998–1999 through 2011–2012.

Regulatory	General and registration harvest							Drawing permit harvest		Accidental death		
	Reported				Estimated							
Year	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	DM794	DM796	Road	Total	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	177–187
2010–2011	164 (100)	0 (0)	0	164	0–5	5–10	5–15	0	1	0	0	170–180
2011–2012[a]	185 (99)	1 (1)	0	186	0–5	5–10	5–15	0	0	0	0	191–201

[a] Preliminary data.

Table 5. Unit 20E moose hunter residency and success, regulatory years 1998–1999 through 2011–2012.

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	22	129	21	0	172 (23)	118	407	50	3	578 (77)	750
2010–2011	27	119	19	0	165 (26)	98	326	49	3	476 (74)	641
2011–2012[b]	30	133	23	0	186 (23)	115	452	59	4	630 (77)	816

[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 2011–2012.

Regulatory Year	Percent harvest chronology by month/day 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	n
1998–1999	0	23	50	51	4	0	7	151
1999–2000	0	22	41	20	9	0	6	136
2000–2001	1	15	41	28	5	0	8	144
2001–2002	10	0	49	29	5	0	5	143
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	92
2005–2006	9	3	54	32	1	0	1	136
2006–2007	8	0	55	33	2	0	0	127
2007–2008	6	1	60	31	1	0	0	143
2008–2009	8	2	59	27	1	0	2	177
2009–2010	8	1	57	33	0	0	2	169
2010–2011	6	1	55	36	1	0	1	165
2011–2012	5	0	59	33	2	0	0	187

Table 7. Unit 20E moose harvest and percent by transport method, regulatory years 1998–1999 through 2011–2012.

Regulatory year	Harvest and percent (%) by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	n
1998–1999	32 (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	30 (17)	0 (0)	12 (7)	80 (47)	2 (1)	27 (16)	19 (11)	2 (1)	172
2010–2011	33 (20)	1 (1)	20 (12)	72 (44)	0 (0)	14 (8)	18 (11)	7 (4)	165
2011–2012[b]	34 (18)	0 (0)	19 (10)	77 (41)	0 (0)	22 (12)	30 (16)	4 (2)	186

[a] Preliminary data.

SPECIES 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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNITS: 21A (10,797 mi^2) and 21E (7,995 mi^2) (18,792 mi^2 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 river corridors. 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 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 Paradise Controlled Use Area (CUA) has existed since 1977 and was implemented to reduce conflicts between user groups. This CUA, which lies primarily in Unit 21E between the Yukon and Innoko rivers, is closed to the use of aircraft for hunting moose. This restricts access primarily to local residents with boats.

The Alaska Department of Fish and Game (ADF&G) has limited information on the moose population in Unit 21A; however, more surveys have been conducted since 2007. Density estimates derived from helicopter surveys conducted by Innoko National Wildlife Refuge (INWR) as well as extrapolated data from Unit 21E are the basis for the most recent estimate of

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

moose numbers in Unit 21A. In Unit 21E, aerial composition surveys as well as geospatial population estimator (GSPE) surveys (Ver Hoef 2001, Ver Hoef 2008) have been the primary means of assessing the population status.

Long-term historical moose survey data are limited. In Unit 21E we began collecting population and composition data in 2000. In Unit 21A, we began conducting regular fall composition surveys in cooperation with INWR in 2007.

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 moose management in the area would be proactive to maintain an abundant moose population that provides for high levels of consumptive use. The following management goals, objectives, and activities are based on recommendations in the YIMMP:

MANAGEMENT OBJECTIVES

Population Objectives

- Manage to achieve the intensive management (IM) population objective established in 2000 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 ≤4% of the estimated moose population in Unit 21A, and ≤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.

METHODS

Innoko National Wildlife Refuge (INWR) staff have conducted aerial moose density surveys since 1994 in Unit 21A using a line transect method with helicopters (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.

We derived estimates of moose numbers in Unit 21E from aerial surveys in February–March 2009 using GSPE methods (Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. The 2009 surveys were conducted in a 5,070 mi^2 area in eastern Unit 21E. We surveyed 150 (90 high density and 60 low density; 925 mi^2) of 822 sample units (SU; approximately 6.17 mi^2 per SU). SUs were selected randomly (80%) or manually to fill gaps in the randomized coverage (20%). We extrapolated the density calculated from the GSPE population estimate of the low density strata to the remaining 2,925 mi^2 of Unit 21E to derive a unitwide population estimate. Survey time averaged 35 minutes per SU (~6 min/mi^2). No sightability correction factor (SCF) exists for March GSPE surveys in 21E and all results were reported as observable moose. In March 2012 another GSPE survey was conducted (including an SCF) however results are not yet available for this report.

In November 2007–2011 we flew fall composition surveys in Unit 21E between the Innoko and Yukon Rivers. Surveys were flown in PA-18 or similar aircraft at roughly 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 2007–2011 fall composition surveys were also conducted in Unit 21A. Surveys in 2007–2009 were flown using a similar technique beginning at the INWR cabin (63°38.34'N, 158°01.84'W) on the Innoko River and proceeding to the confluence with the North Fork. In 2010 and 2011, INWR staff conducted composition surveys with similar aircraft, but different techniques. In 2010 a line transect survey was attempted in which the pilot flew precisely on predetermined transects; however effort was high and sample size was low. In 2011 GSPE survey units were selected in an area similar to previous composition surveys and the number of moose observed was the highest of any year composition has been obtained in 21A. In all years each moose or group of moose was circled to determine composition.

Twinning surveys were conducted in Unit 21E during late May or early June 2008–2011 from PA-18 or similar aircraft flown at approximately 70 mph and 500 feet above ground level. We flew 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. All moose observed were recorded; however, only cows with calves were classified as adult cow with single or twin calves. Radiocollared adult females were used to increase observations in 2010 and 2011. Twinning rate was calculated as the proportion of cows with twins from the sample of all cows with calves.

Twinning surveys were also attempted in Unit 21A in 2008 and 2009 using similar methods; however, sample sizes were extremely low and data were not analyzed.

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 estimate 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., RY09 = 1 July 2009–30 June 2010).

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, the Yukon Innoko Moose Management Working Group (YIMMWG) estimated 4,300–6,480 moose in the unit (0.4–0.6 moose/mi^2). Survey data from INWR indicate that moose densities declined in Unit 21A during 1998–2002. INWR attempted a GSPE survey in November 2010 but it was canceled due to lack of adequate snow. The survey area was stratified in March 2011 and INWR will attempt a GSPE survey in March 2013.

Unit 21E. The February 2000 GSPE survey indicated a density of 1.0 observable moose/mi^2 or 5,151 moose ±13% (90% CI) in the survey area. Results of the March 2005 survey indicated a density of 0.9 observable moose/mi^2 or 4,673 moose ±17% (90% CI) in the survey area. In 2009 we estimated moose density at 1.2 observable moose/mi^2 or 6,218±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 for all of Unit 21E is 6,205–8,747 observable moose (no SCF was applied to this estimate). Proportion of calves during these surveys was 16% of the population in 2000, 18% in 2005, and 21% in 2009.

Population Composition

Results of fall composition surveys in Unit 21A in November 2007–2011 ranged 36–79 bulls:100 cows and 8–43 calves:100 cows (Table 2a). The number of moose observed was low in both 2007 and 2008; however, in 2009 and 2011 we achieved larger sample sizes.

Fall composition surveys in Unit 21E during November 2007–2011 indicated 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 an area where high numbers of bulls were found in the past.

During twinning survey attempts in Unit 21A in 2008 and 2009, few cows with calves were found (3 in 2008 and none in 2009) and no inference on productivity is warranted. In Unit 21E, the 2-year average twinning rate of 46% (Table 3) indicates habitat was not limiting this moose population (Boertje et al. 2007).

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 large 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 summers 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 (Fig. 1). On 21 April 2011, 3 additional moose (2 bulls and 1 cow) were radiocollared to replace moose which had died since the original radiocollaring effort. The GPS radio collars acquire up to 6 location fixes daily and will allow a more thorough analysis of movements. In addition the radio collars were used to obtain an SCF for the 2012 GSPE survey.

MORTALITY

Harvest

Seasons and Bag Limits. Bag limits and season dates by regulatory year.

Unit and bag limits	Open season
RY09	
Unit 21A	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep
Unit 21E	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep
RY10	
Unit 21A	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep
Unit 21E	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. At its spring 2006 meeting, the Board of Game established a nonresident drawing permit hunt in Unit 21E. The first permit hunt occurred in RY07. In 2010 the board adopted a proposal related to this permit hunt which extended the nonresident season in 21E until September 25.

In 2010 the board adopted an intensive management plan (Title 5 Alaska Administrative Code 92.125) authorizing wolf control in Unit 21E if the moose population falls below 1.0 observable moose/mi^2. The moose population is currently above this threshold and no wolf control is planned at this time. The board also extended the nonresident season to end on September 25.

<u>Harvest by Hunters</u>. Harvest as reported by hunters during RY06–RY10 is presented in Tables 4a and 4b. During this time, annual harvest in Unit 21A declined to its lowest point in RY09, then increased in RY10 (Table 4a). In Unit 21E, annual harvest was lowest in RY09 and RY10 (Table 4b). The YIMMP suggests the nonreporting rate is 50% in Unit 21E, which is taken into consideration when assessing actual harvest levels.

No mortuary moose were reported taken in Unit 21A during RY09–RY10. Nine mortuary moose (6 cows and 3 bulls) were taken in Unit 21E during RY09–RY10.

<u>Permit Hunts</u>. 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 DM837 and 12 guided DM839) with the intent to take approximately 30 moose. After the nonresident season was extended to September 25 in RY10, the number of permits offered was reduced to 50 (40 unguided and 10 guided). Both hunts have been undersubscribed every year since RY07. Harvest remains well below 30 moose, which was identified in the YIMMP as the current level of nonresident harvest at the time of the planning process.

Beginning in RY10 a permit regulated by the federal government (FM2104) was issued for the Unit 21E winter hunt. Prior to this time a general season harvest ticket regulated by state government was required. Participation in this hunt appears to be low and only 6 moose were reported harvested in RY10 (Table 4c).

<u>Hunter Residency and Success</u>. There are few local hunters in Unit 21A and most hunting pressure has been 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 RY06 to RY10, average reported success was 30% in Unit 21A (range = 22–40%) and 56% in Unit 21E (range = 48–64%).

<u>Antler Size</u>. During RY06–RY10 the average antler size of harvested bulls in Unit 21A (48.2 in) remained larger than in Unit 21E (45.9 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 RY06–RY10, 48 bulls ≥50 in, 20 ≥60 in and 0 ≥70 in were taken in Unit 21A. During the same period in 21E, 112 bulls ≥50 in, 60 ≥60 in and 2 ≥70 in were taken.

<u>Transport Methods</u>. During RY06–RY10, aircraft and boats were the most common methods of hunter transportation in Unit 21A (Table 6a). In Unit 21E, boats and aircraft were the most commonly used methods of transportation (Table 6b). This is consistent with previous reporting periods for both units.

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 et. al 1991, Gasaway et al. 1992, Boertje et al. 2009). Anecdotal evidence from local residents, guides and transporters, suggests predation on moose has increased in recent years, and these people 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.

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. Staff recorded snow depth and age of dominant plant species at 77 sites. They also noted abundant feltleaf 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%, a moderate level for Interior Alaska (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, factors other than nutrition 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 the YIMMWG convened to develop a plan to proactively manage moose populations in the area. The YIMMP was the result of this process in December 2006.

Maintaining or improving moose habitat was recommended by the working group and habitat quality was assessed in Unit 21E in 2006. However, no habitat assessment 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.

In 2011, ADF&G staff placed 10 snow stakes in Unit 21E to assess snow depth. This winter would have been the first year of monitoring; however, 9 stakes appear to have fallen over. A repair flight is scheduled for summer 2012.

Land management in Units 21A and 21E is complex, with a mix of federal, state, and Alaska Native corporation 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.

The current population estimate for Unit 21E is 6,205–8,747 observable moose, which is below the Unit 21E intensive management objective of at least 9,000 moose (9,000–11,000). However, because the true population is probably higher than this estimate of observable moose, it is likely that the moose population is near the lower end of the intensive management objective. Therefore, this objective may have been met during RY09–RY10.

The objectives to maintain a minimum posthunt bull:cow ratio of 25–30 bulls:100 cows in Unit 21A and Unit 21E and a minimum posthunt calf:cow ratio of 30–40 calves:100 cows were met in both Units 21A and 21E. The objective to maintain at least 20% calves in the late winter moose population in 21E was met when it was measured in 2009 at 21% calves in the population.

The objective to maintain harvest of ≤4% of the estimated population in both Units 21A and 21E was met in RY09–RY10. Winter harvest under the federal permit hunt was less than 40 antlerless moose and this objective was also met. Finally, the opportunity for Alaska residents to harvest up to 310 moose in 21E exists, however harvest is below this level. Nonreporting continues to be a chronic issue in 21E and actual levels of harvest are difficult to assess.

MANAGEMENT OBJECTIVES

For the next reporting period the objective to maintain a posthunt calf:cow ratio of 30–40 calves:100 cows in Unit 21A will be deleted. Unit 21A is not designated as an intensive management area by the Board of Game and there would be no management actions which could be taken to address this if the objective was not met.

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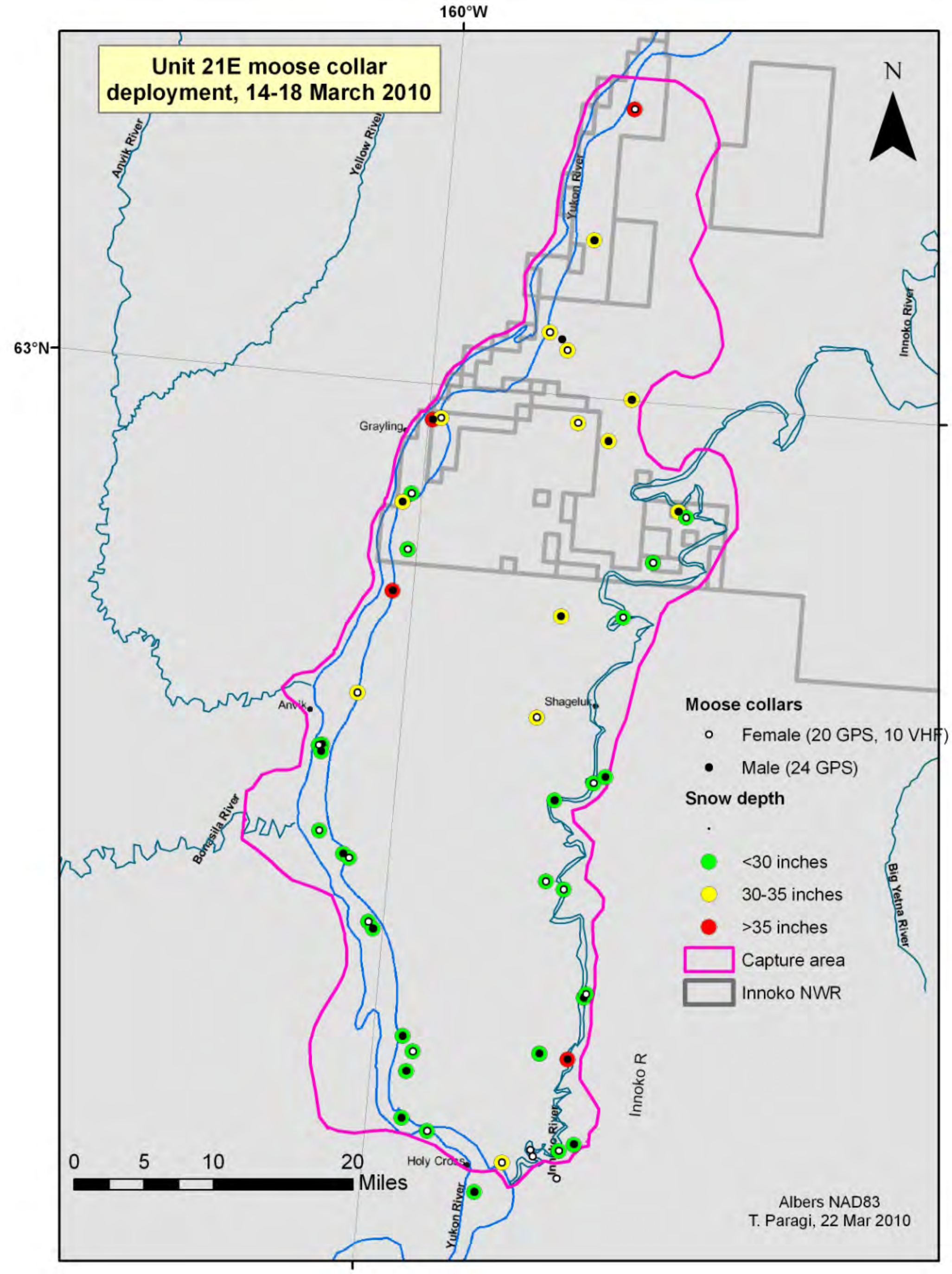

Figure 1. Locations of radio collar deployments in Unit 21E moose.

Table 1. Summary of geospatial moose population estimates (GSPE)[a] in Unit 21E, 2000–2012.

Location and survey year	Survey area (mi²)	Strata size (mi²)		Area searched (mi²)		Total search area (mi²)	No. of moose estimated by strata and density (moose/mi²)		Total estimate @ 90% CI	Average density moose/mi²	No. of sample units counted
		Low	High	Low	High		Low	High			
2000 GSPE[b]	5,070					617			5,151±13%	1.0	100
2005 GSPE	5,070	4,015	1,055	321	604	925	1,696 (0.4)	2,977 (2.8)	4,673±17%	0.9	150
2009 GSPE	5,070	4,147	923	371	554	925	1,778 (0.4)	4,439 (4.8)	6,218±17%	1.2	150

[a] Population estimates are of observable moose and do not include a sightability correction factor.
[b] The 2000 survey was calculated using a 3 strata (high, medium, low) with the Gasaway et al. (1986) technique.

Table 2a. Unit 21A fall aerial moose composition counts, regulatory years 2007–2008 through 2011–2012.

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 Nov
2010–2011								
2011–2012	79	20	43	32	19	134	166	21 Nov

Table 2b. Unit 21E fall aerial moose composition counts, regulatory years 2007–2008 through 2011–2012.

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
2010–2011	61	15	51	69	24	218	287	16 Nov
2011–2012	64	22	47	45	22	156	201	16 Nov

Table 3. Unit 21E moose aerial twinning surveys, regulatory years 2000–2001 and 2010–2011.

Regulatory year	Total moose	Cows with 1 calf	Cows with 2–3 calves	Percent 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	4 Jun
2008–2009	194	17	15	47	29 May
2009–2010	182	12	12	50	27 May
2010–2011	256	32	22[d]	41	2 Jun

[a] Percent of cows with calves that had twins.

[b] No survey.

[c] Data were lost in the McGrath Area office fire.

[d] Two of these cows had triplets.

Table 4a. Unit 21A moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Reported harvest					
Year	Male	(%)	Female	(%)	Unknown	Total
2006–2007	30	(100)	0	(0)	0	30
2007–2008	30	(100)	0	(0)	0	30
2008–2009	29	(100)	0	(0)	0	29
2009–2010	18	(100)	0	(0)	0	18
2010–2011	35	(100)	0	(0)	0	35

Table 4b. Unit 21E moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory	Reported harvest					
Year	Male	(%)	Female	(%)	Unknown	Total
2006–2007	125	(96)	5	(4)	1	131
2007–2008	107	(94)	7	(6)	1	115
2008–2009	103	(9)	10	(9)	1	114
2009–2010	102	(96)	3	(3)	1	106
2010–2011	107	(99)	1	(1)	0	108

Table 4c. Unit 21E moose harvest for Federal Permit FM2104 Regulatory Year 2010–2011.

Regulatory		Reported harvest					
Year	Hunted[a]	Male	(%)	Female	(%)	Unknown	Total
2010–2011	25	2	(33)	4	(67)	0	6

[a] Hunt only open to residents of Grayling, Anvik, Shageluk, Holy Cross and Russian Mission.

Table 5a. Unit 21A moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	
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	19	9	0	29 (31)	2	32	27	3	64 (69)	93
2009–2010	0	14	4	0	18 (24)	7	30	20	0	57 (76)	75
2010–2011	3	24	7	1	35 (40)	3	33	15	1	52 (60)	87

[a] Local resident from Anvik, Grayling, Holy Cross, Shageluk, McGrath, Takotna.

Table 5b. Unit 21E moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	
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	29	57	10	18	114 (52)	25	44	32	5	106 (48)	220
2009–2010	34	64	7	1	106 (62)	14	32	19	0	65 (38)	171
2010–2011[b]	47	50	10	1	108 (64)	17	29	14	1	61 (36)	169

[a] Local resident from Anvik, Grayling, Holy Cross or Shageluk.

[b] Does not include data from federal hunt FM2104.

Table 6a. Unit 21A moose harvest percent by transport method of successful hunters, regulatory years 2006–2007 through 2010–2011.

	Harvest (percent) by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
2006–2007	17 (57)	0 (0)	9 (30)	2 (7)	0 (0)	0 (0)	1 (3)	0 (0)	1 (3)	30
2007–2008	21 (70)	0 (0)	6 (20)	1 (3)	0 (0)	1 (3)	1 (3)	0 (0)	0 (0)	30
2008–2009	21 (72)	0 (0)	6 (21)	0 (0)	0 (0)	0 (0)	2 (7)	0 (0)	0 (0)	29
2009–2010	18 (90)	0 (0)	2 (10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	20
2010–2011	25 (71)	0 (0)	6 (17)	2 (6)	0 (0)	1 (3)	1 (3)	0 (0)	0 (0)	35

Table 6b. Unit 21E moose harvest percent by transport method of successful hunters, regulatory years 2006–2007 through 2010–2011.

	Harvest (percent) by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
2006–2007	16 (12)	0 (0)	104 (79)	1 (1)	6 (5)	2 (2)	0 (0)	0 (0)	2 (2)	131
2007–2008	8 (7)	0 (0)	98 (85)	0 (0)	7 (6)	0 (0)	1 (1)	0 (0)	1 (1)	115
2008–2009	11 (10)	1 (1)	88 (77)	0 (0)	11 (10)	0 (0)	0 (0)	0 (0)	3 (3)	114
2009–2010	9 (8)	0 (0)	93 (88)	1 (1)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	106
2010–2011	12 (11)	0 (0)	93 (86)	0 (0)	2 (2)	0 (0)	0 (0)	0 (0)	1 (1)	108

SPECIES MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 21B (9,311 mi^2)

GEOGRAPHIC DESCRIPTION: Nowitna River drainage east of Poorman Road, Yukon River drainage between Melozitna and Tozitna Rivers

BACKGROUND

The earliest accounts of this portion of Interior Alaska mentioned the presence of moose (Osborne 1990). 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 harvested 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 (>50,000 ac) periodically occur in this area, and fire was ignited by gold miners to remove overburden and create fuel for dredges south of Ruby during the early twentieth century. The *Alaska Interagency Wildland Fire Management Plan* (Alaska Wildland Fire Coordinating Group 1998), identified settlement resources needing protection from wildland fire and recognized the ecological role of fire in remote areas.

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 has been the focus of much of the management effort in Unit 21B.

In addition to the lower Nowitna River drainage, Unit 21B includes the area east of the Ruby–Poorman Road, the banks of the Yukon River from Ruby to Tanana, and the Blind and Boney river drainages. 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 added the upper Nowitna drainage (formerly part of Unit 21A) to Unit 21B, adopted an additional drawing permit and a registration permit hunt in part of the area added, and added 10 days of fall moose hunting opportunity for resident hunters.

Unit 21B management reports prior to 2010 contained 3 substantial differences in data analysis from subsequent management reports. The first change occurred 1 July 2006 when the size of Unit 21B nearly doubled from 4,871 mi^2 to 9,311 mi^2 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 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: 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 post-hunt fall 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 ≥4,000–5,000.

Activity — Conduct trend count surveys annually or population estimation surveys when funding is available, and notify relevant wildlife agencies and land managers if the population declines below 4,000–5,000 moose.

METHODS

During 19–24 November 2009 and 11–13 November 2010, the U.S. Fish and Wildlife Service (USFWS) surveyed 2 established trend count areas (TCAs) to assess population status and trend in Unit 21B. These were the 149 mi^2 Nowitna–Sulatna confluence and the 102 mi^2 Nowitna mouth TCAs. Piper PA-18 (or equivalent) aircraft were used, and contiguous survey units of approximately 6 mi^2 each were searched at a rate of about 5 min/mi^2 at 70–80 mph and 300–800 feet above ground level depending on terrain and vegetation. Surveys were conducted after sufficient snow had fallen to ensure sightability and moose were classified by sex and age with cows classified by number of calves present and bulls classified by size based on antler width and configuration.

We conducted surveys in 2001 and 2008 using the geospatial population estimator method (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. Rather, the GSPE method employs greater search intensity. For these surveys we report estimates of observable moose. Sample units were surveyed with Piper PA-18 (or equivalent) aircraft at search intensity of ~6 min/mi^2 at 70–80 mph and 300–800 feet above ground level depending on terrain and vegetation. Surveys were conducted after sufficient snow had fallen to ensure sightability and moose were classified by sex and age with cows classified by number of calves present and bulls classified by size based on antler width and configuration.

During 23 October–7 November 2001 we conducted a GSPE survey in Unit 21B below the Big Mud River, including a 1,531 mi^2 analysis area on the lower Nowitna River (Nowitna West). We surveyed 111 survey units (60 high density, 51 low density; 632 mi^2) of 834 total survey units (4,754 mi^2).

During 30 October–14 November 2008 we conducted a GSPE survey in most of Unit 21B, which encompassed the areas surveyed in 2001 (below the Big Mud River and Nowitna West) and derived population estimates for each subarea (Stout 2010). We surveyed 244 survey units (137 high density, 107 low density; 1,396 mi^2) of 1,485 total survey units (8,565 mi^2).

Harvest information was monitored through mandatory registration and drawing permit harvest reports, general season harvest reports, 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 or 2 reminder letters 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. Survey and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY09 = 1 July 2009–30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

No GSPE surveys were conducted in 21B during RY09–RY10 (Table 1). The Nowitna mouth and Nowitna–Sulatna trend count areas surveyed by the USFWS in 2009 and 2010 represent the only new population and composition data gathered in 21B for RY09–RY10.

TCA data from RY09–RY10 indicate that moose densities along the riparian corridor were relatively constant (Tables 2 and 3). Data from TCAs (Tables 2–4) are not broadly representative of the unitwide moose population; most of the unit has lower moose densities than the riparian areas where TCAs are located.

Unit 21B Total Area. The 2008 GSPE survey (8,565 mi^2) covered nearly all of Unit 21B, excluding areas of non-moose habitat. Results indicated 2,317 observable moose (±18% relative error = 1,899–2,736 observable moose, 90% CI) in the area survey area (Table 1). This was the first survey in the Nowitna River drainage above the Little Mud River drainage so there were no previous data for comparison. However, the estimate of 2,317 moose resulted in an overall density of 0.27 moose/mi^2. We expected this density, based on reconnaissance flights of the area and our familiarity with Unit 21B habitat.

Unit 21B Below the Big Mud River. Results from the November 2001 GSPE survey indicated a total of 3,201 observable moose (±45% relative error = 1,774–4,627 observable moose. 90% CI) over 4,754 mi^2 of moose habitat in Unit 21B below the Big Mud River (Table 1). However, sampling errors in the 2001 GSPE survey may have led to an overestimate. Within the survey area, 11% (84 of 754) low density survey units shared a border with a high density unit. However, among sampled low density units, 41% (21 of 51) shared a border with high density units, 6 of which contained >7 moose per unit (range 7–28 moose). Because the sampled proportion of low density units adjacent to high density units was disproportionately high compared to the proportion of low density units adjacent to high density units in the overall area, the estimate may be biased high and the low density stratum is likely overestimated. Due to these errors, population estimates from this survey may be unreliable and comparisons between other surveys should be done with caution.

Population Composition

No trend is apparent in the proportion of calves and cows observed in the TCAs during 2003–2010 (Figs. 1 and 2). The proportion of calves observed in the TCAs declined in 2009 (Fig. 2), probably a result of the severe winter of 2008–2009 which likely affected calf survival. The smaller proportion of calves observed in 2009 is likely also the reason the proportion of cows observed appeared to increase in 2009 (Fig. 1). Bull:cow ratios observed in 2009 and 2010 are consistent with ratios observed since 2000, with no discernible trends (Tables 2 and 3).

The 2008 GSPE survey data indicate 50 bulls:100 cows in Unit 21B (Table 1). Although bull:cow ratios from the TCAs around the mouth of the Nowitna River and the confluence of the Nowitna and Sulatna Rivers are consistently lower, this is expected because most harvest is in these areas, which are accessible from the river corridor.

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 cow–calf pairs move to the riparian areas, where they remain until early May. Relatively few cow moose wintered in the hills to the north and south of the Nowitna River.

MORTALITY

Harvest

Season and Bag Limit.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY09–RY10		
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		

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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. During the Board of Game meeting in March 2010, the board adopted a positive finding for intensive management (IM) of Unit 21B moose based on 1) the 2008 survey information, 2) changes to the size of the unit, and 3) increased harvest that occurs in the expanded Unit 21B. In addition, the board adopted the following intensive management (IM) objectives for Unit 21B in Title 5 Alaska Administrative Code, regulation 92.108:

- A population objective at 4,000–6,000 moose.
- A harvest objective at 200–300 moose.

No additional regulatory changes were adopted and no emergency orders were issued during RY09–RY10.

The board expanded the Unit 21B boundaries in January 2006 to include the Nowitna River drainage above the Little Mud River drainage. In March 2006, the board implemented an additional drawing permit hunt in a 4-mile wide corridor on the Nowitna River above the Little

Mud River drainage, extended the nonresident season from an ending date of 20 September to 25 September to simplify regulations, and added a 22–31 August subsistence season for resident hunters to provide additional fall hunting opportunity.

At its spring 2004 meeting, the board eliminated the general moose hunting season (harvest ticket) in the lower Nowitna River drainage and implemented a resident registration hunt that requires the destruction of trophy value. The board also implemented a drawing permit for resident and nonresident hunters in this portion of the unit. Through discretionary authority, we divided this area into 3 drawing permit areas: a 10-mile wide corridor on the Nowitna River, the lands east of the corridor, and the lands west of the corridor. 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.

Harvest by Hunters. Reported harvest during RY09–RY10 in Unit 21B averaged 74 moose annually, consistent with average reported harvest during RY01–RY10 ($\bar{x}$ = 76, range = 64–86) (Table 5; including harvest in the Nowitna River drainage above the Little Mud River). In addition, we estimated the Unit 21B annual unreported harvest to be 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 that is presented in tables 6 and 7 for RY99–RY10. However, in RY04–RY10, the proportion of harvest from the lower Nowitna River corridor averaged 43% of the total 21B harvest, compared to 61% during RY97–RY03, indicating 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 (3-year $\bar{x}$ = approximately 36 moose), less the harvest reported by those 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. Hunter numbers and success rate of hunters passing through the Nowitna checkstation have been somewhat stable (except for RY03); 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–RY10 to 116. The low of 90 hunters was in RY07 when drawing and registration hunt regulations were implemented in Unit 21B. During RY09–RY10 we observed no substantial changes in hunter residency, harvest, or success of hunters passing through the checkstation.

Hunter Residency and Success. Based on harvest reports, most Unit 21B hunters were Alaska residents who resided outside the unit, principally in Fairbanks (Table 6). Average success rate for all hunters during RY99–RY10 was 37% (range = 26–48%; Table 7). Success rate was 44% (range = 38–48%) in RY99–RY03, dropped to 31% (range = 26–39%) during RY04–RY08, and remained at 31% during RY09–RY10 (Table 7). Most of the decline can be explained by 3 changes in hunt administration. First, more hunters were forced to hunt away from the Nowitna River 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 2 outcomes were implemented by design, and improved our ability to manage moose in Unit 21B. However, because of these changes, assessing harvest success rate trends has become problematic when comparing data before and after RY04.

Harvest Chronology. During RY99–RY10, hunter reports indicated that most moose were shot during September 15–25 ($\bar{x}$ = 70%; 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 actively engage in rutting behavior.

Winter harvest was not reported on harvest or permit report cards (so is not included in Table 8), but was probably about 20% of the annual reported kill. Winter harvest likely occurred during October–March (Anderson et al. 2001).

Transportation Methods. Not surprisingly, the majority of hunters (RY99–RY10; $\bar{x}$ = 73%) used boats to hunt moose (Table 9). Most airplane access was by commercial transport. Highway vehicle transportation occurred exclusively on the Poorman Road south of Ruby. Snowmachines were used during winter to hunt, but winter reporting rates were low because there was no open hunting season for moose, 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. No direct estimates of bear abundance have been done in Unit 21B, and no change in wolf abundance has been described for this area since 1996 (Stout 2009).

HABITAT

Assessment

No new habitat data were collected during RY09–RY10.

CONCLUSIONS AND RECOMMENDATIONS

The 2008 GSPE survey established baseline information for the upper Nowitna River drainage and confirmed expectations that moose densities were low in 21B outside the Nowitna River corridor. After examining sampling errors encountered during the 2001 GSPE survey we are not confident that a population decline occurred from 2001 to 2008, as previously reported (Stout 2010). Classification data from the Nowitna River TCAs indicated stable total moose numbers in

2009 and 2010 within the riparian zone of the lower Nowitna River. Additional composition data varied within the range of values observed within the TCAs in the previous 8 years with a slight dip in proportion of calves observed in 2009, likely as a result of the severe winter of 2008–2009. Observed variability in data from the TCAs is likely a factor of their small area and increased sensitivity to changes in the timing and conditions under which these surveys are conducted relative to movements away from post-rut congregations. By transitioning to a system of larger scale GSPE surveys conducted at more frequent intervals we hope to improve the quality of composition and population data gathered in Unit 21B.

We recommend biennial or triennial GSPE moose surveys to better document unitwide moose abundance, 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.

During RY09–RY10 we met the goal to manage Unit 21B moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and 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 up to 5% of the population. Total estimated harvest was 92 moose in RY09 and 106 in RY10, with the 2-year average of 99 moose representing approximately 4.3% of the Unit 21B observable moose population.

The objective to implement at least 2 habitat enhancement projects in combination with Unit 21C was not met. Activities to meet this objective were limited to review of fire management plans and fire suppression policies. In 2009, 4 significant fires (Bering Creek 2, Little Mud, Nowitna, and Titna River) burned a total of 390,000 acres within Unit 21B. A majority of these burns did not overlap areas traditionally used by hunters, but will likely improve habitat for moose in future years.

Based on the 2008 GSPE survey, the population estimate for all of Unit 21B was 2,317 observable moose (1,899–2,736; 90% CI), therefore the third management objective to maintain a moose population of ≥4,000–5,000 was likely not met during RY09–RY10. The positive intensive management 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 improves our ability to achieve this population objective. Despite the positive finding, future intensive management activities will be challenging due to federal land ownership in areas most frequented by moose hunters.

Predators remained relatively abundant and likely continued to be the primary factor limiting moose abundance in Unit 21B. Harvest of wolves (fewer than 10 annually) and black bears within the unit was low and unlikely to reduce their abundance sufficiently to increase calf or yearling moose survival. Efforts should be made to increase the harvest of predators if more moose are desired.

MANAGEMENT OBJECTIVES

Management objectives for the next reporting period have been adjusted in light of board action in 2010, new population data, and revisions in the Unit 21B boundaries. During the next reporting period, our management objectives and activities will be:

- Provide for harvest of 50–200 moose or 5% of the post-hunt fall moose population estimate, whichever is less.

- In combination with Unit 21C, implement at least 2 habitat enhancement activities every 5 years.

- Maintain a moose population of 4,000–6,000 moose.

  Activity — Conduct population estimation surveys when funding is available and monitor harvest through hunt reports.

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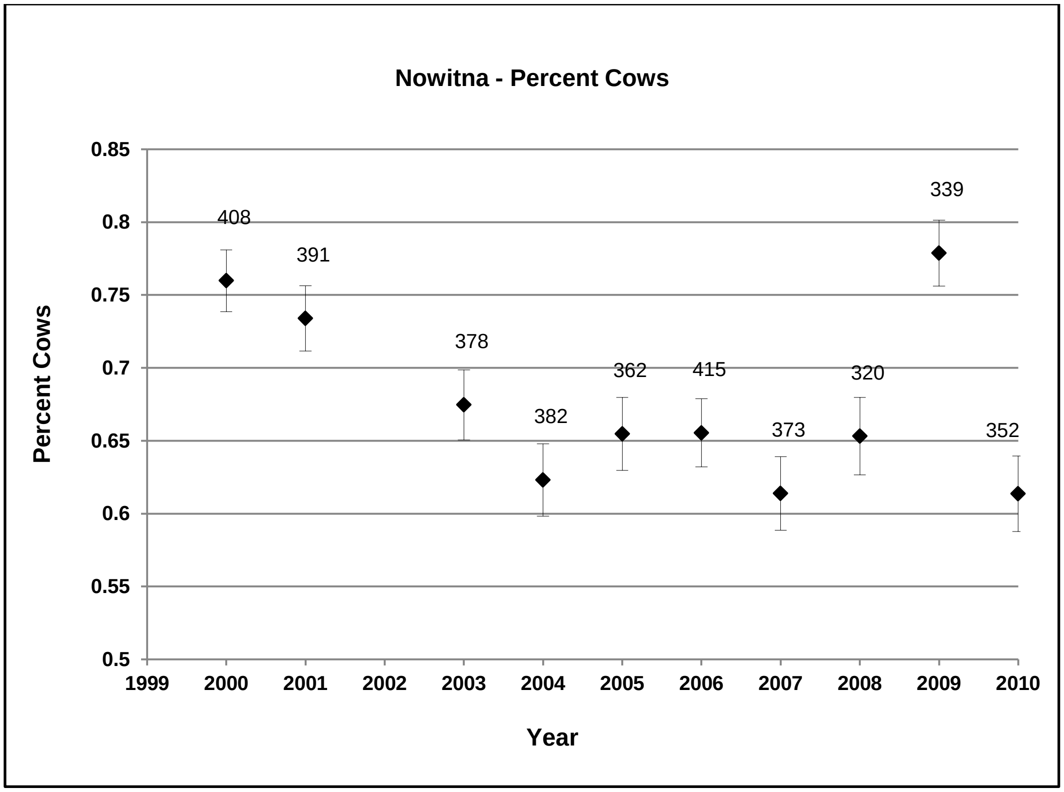

Figure 1. Percent cows in 3 trend count areas on the lower Nowitna River. Error bars represent ± 1 standard error and numbers above bars indicate total number of moose counted.

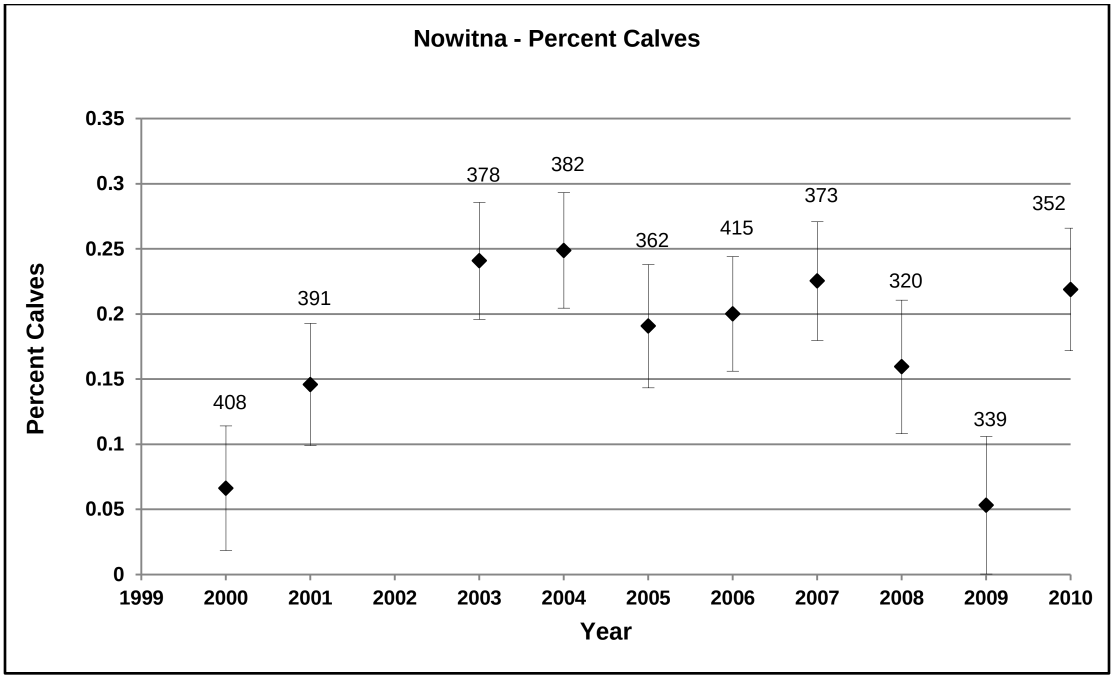

Figure 2. Percent calves in 3 trend count areas on the lower Nowitna River. Error bars represent ± 1 standard error and numbers above bars indicate total number of moose counted.

Table 1. Unit 21B moose population estimates, regulatory years 1980 through 2008.

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
21B–Nowitna West								
1980[b]	1,556	53	35	25	19	1,125	1,389 (±27%)	0.89
1986[b]	1,596	37	39	12	22	685	878 (±24%)	0.55
1990[b]	1,560	40	39	10	22	948	1,214 (±18%)	0.78
1995[c]	1,338	34	30	14	19	856	1,052 (±20%)	0.79
2001[d,e]	1,531	30	19	7	12	1,203	1,358 (±28%)	0.89
2008[d]	1,531	35	36	9	21	646	816 (±9%)	0.53
21B–Below Big Mud								
2001[d,e]	4,754	39	18	9	12	2,772	3,201 (±45%)	0.67
2008[d]	4,754	45	43	12	23	1,110	1,438 (±15%)	0.30
Total Area								
2008[d]	8,565	50	49	12	25	1,747	2,317 (±18%)	0.27

[a] Confidence interval (% ±).
[b] MOOSEPOP analysis of Gasaway survey with sightability correction factor (SCF).
[c] MOOSEPOP analysis (regression design) of Gasaway et al. (1986) survey with SCF.
[d] Geospatial population estimator (GSPE) analysis without SCF (observable moose).
[e] 2001 GSPE survey contained sampling errors and likely produced an overestimate of observable moose.

Table 2. Unit 21B Nowitna–Sulatna confluence aerial moose composition counts, regulatory years 1991 through 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	76	21	9	29	8	20	200	2.7
1992	76	18	1	48	7	29	171	2.3
1993	76	22	7	20	0	14	195	2.6
1994	76	16	6	20	4	15	191	2.5
1995	76	15	4	33	6	22	148	2.0
1996	76	18	8	23	6	13	216	2.9
1998	76	19	2	28	6	19	180	2.5
1999[b]	76	6	1	23	12	18	106	1.5
2000	149	25	7	11	0	8	202	1.4
2001	120	18	6	18	0	12	200	1.7
2003	143	15	10	28	3	20	172	1.2
2004	149	23	12	41	15	25	188	1.3
2005	149	29	10	37	12	22	167	1.1
2006	149	25	7	25	3	16	207	1.4
2007[b]	149	31	9	42	19	24	177	1.2
2008	149	29	10	24	17	16	170	1.1
2009	149	23	7	8	0	6	173	1.2
2010	149	32	3	42	5	24	185	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 through 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	59	21	0	31	0	20	138	2.9
1993	59	32	6	32	6	20	189	3.2
1994	59	19	8	23	0	22	148	2.5
1995	59	16	5	26	0	18	116	2.0
1996	59	21	7	22	0	16	185	3.1
1998	59	20	3	12	0	9	182	3.0
1999[b]	59	11	8	21	0	16	87	1.4
2000	102	21	6	7	0	5	206	2.0
2001	102	15	7	15	6	18	191	1.9
2003	102	10	5	42	10	28	206	2.0
2004	102	19	13	39	7	25	194	1.9
2005	102	20	9	24	0	16	195	1.9
2006	102	19	8	37	17	24	208	2.0
2007[b]	102	22	5	32	0	21	196	1.9
2008	102	29	7	24	9	16	150	1.5
2009	102	21	8	6	0	5	166	1.6
2010	102	23	1	29	0	19	167	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 through 2008.

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	53	90	35	42	0	18	72	1.4
1987	53	43	7	55	14	27	87	1.7
1993	53	45	15	20	0	12	66	1.3
1995	53	48	8	30	8	17	89	1.7
1996	53	29	5	24	0	16	89	1.7
2001	130	33	8	18	0	12	152	1.2
2004	130	28	10	48	14	27	152	1.1
2008	130	28	2	38	14	23	144	1.1

Table 5. Unit 21B[a] moose harvest, regulatory years 1996 through 2010.

Regulatory year	Harvest by hunters				Unreported	Total
	Bull	Cow	Unk	Total		
1996	78	0	0	78	15	93
1997	67	1	0	68	15	83
1998	74	2	0	76	15	91
1999	81	0	0	81	20	101
2000	65	1	7	73	20	93
2001	75	0	4	79	20	99
2002	77	0	0	77	20	97
2003	75	0	0	75	25	100
2004	63	1	0	64	25	89
2005	77	0	0	77	25	102
2006	70	0	0	70	25	95
2007	84	0	0	84	25	109
2008	86	0	0	86	25	111
2009	66	0	1	67	25	92
2010	81	0	0	81	25	106

[a] All years include the Nowitna River drainage above the Little Mud River.

Table 6. Unit 21B Nowitna River checkstation hunters (R), harvest (H) and percent success (%S), regulatory years 1997 through 2010.[a]

Regulatory	Local villages[b]			Fairbanks			Other residents			Nonresident			Total		
year	R	H	%S	R	H	%S	R	H	%S	R	H	%S	R	H	%S
1997	16	1	6	57	29	51	21	8	38	7	3	43	101	41	41
1998	17	4	24	57	26	46	27	17	63	22	3	14	123	50	41
1999	24	3	13	57	21	37	60	17	28	14	4	29	155	45	29
2000	11	2	18	59	21	36	56	18	32	28	6	21	154	47	31
2001	27	0	0	62	21	34	48	8	17	23	5	22	160	34	21
2002	18	3	17	56	25	45	45	20	44	15	3	20	134	51	38
2003	22	4	18	80	29	36	80	19	24	26	4	15	208	56	27
2004	19	2	11	59	13	22	60	12	20	13	0	0	151	27	18
2005	17	2	12	44	14	32	61	19	31	8	3	38	130	38	29
2006	21	2	10	66	17	26	41	14	34	5	0	0	133	33	25
2007	20	1	5	28	11	39	38	14	37	4	0	0	90	26	29
2008	16	3	19	43	19	44	48	18	38	3	1	33	110	41	37
2009	16	3	19	32	10	31	38	16	42	4	0	0	90	29	32
2010	17	2	12	35	12	34	53	20	38	5	0	0	110	34	32

[a] U.S. Fish and Wildlife Service.
[b] Local residents reside in Tanana, Ruby, and Galena.

Table 7. Unit 21B moose hunter residency and success, regulatory years 1996 through 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	1	66	10	1	78	(38)	27	78	18	2	125	203
1997	10	51	7	0	68	(38)	27	74	9	0	110	178
1998	9	57	9	1	76	(62)	11	30	6	0	47	123
1999	13	55	12	1	81	(45)	13	69	15	3	100	181
2000	8	44	18	3	73	(48)	4	54	22	0	80	153
2001	14	43	21	1	79	(43)	20	65	21	0	106	185
2002	8	56	13	0	77	(45)	10	69	16	0	95	172
2003	14	51	10	0	75	(38)	18	86	18	1	123	198
2004	15	43	5	1	64	(27)	38	108	22	1	169	233
2005	17	52	8	0	77	(31)	63	99	9	0	171	248
2006	11	50	8	1	70	(26)	39	142	22	0	203	273
2007	25	48	11	0	84	(39)	38	76	15	0	129	213
2008	16	61	9	0	86	(34)	46	109	11	0	166	252
2009	16	44	7	0	67	(31)	43	95	10	1	149	216
2010	26	47	8	0	81	(31)	58	104	15	0	177	258

[a] Some hunters had multiple permits.

[b] Local residents reside in Tanana, Ruby, and Galena.

Table 8. Unit 21B moose harvest chronology percent by month/day, regulatory years 1996 through 2010.

Regulatory year	Harvest chronology percent by month/day			*n*
	8/22–8/31[a]	9/1–9/14	9/15–9/25	
1996	n/a	40	60	73
1997	n/a	33	67	64
1998	n/a	39	61	69
1999	n/a	37	63	79
2000	n/a	35	65	68
2001	n/a	24	76	76
2002	n/a	28	72	74
2003	n/a	31	69	74
2004	n/a	33	67	62
2005	n/a	37	63	73
2006	3	15	82	67
2007	3	28	70	80
2008	2	29	68	85
2009	5	27	68	66
2010	6	21	72	80

[a] August season started in 2006.

Table 9. Unit 21B moose harvest percent by transport method, regulatory years 1996 through 2010.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat[a]	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1996	17	0	82	1	0	0	0	0	77
1997	7	0	87	0	3	0	3	0	68
1998	20	0	74	0	3	0	3	0	74
1999	15	1	74	0	0	1	8	0	78
2000	30	0	69	0	0	1	0	0	67
2001	23	0	65	0	1	0	11	0	75
2002	18	0	80	0	0	0	1	0	76
2003	15	0	75	1	3	0	5	0	73
2004	13	0	78	0	0	2	8	0	64
2005	20	0	76	1	0	0	3	0	76
2006	24	0	68	0	0	2	6	0	66
2007	15	0	69	4	0	5	8	0	84
2008	13	0	81	2	0	0	3	0	86
2009	7	0	80	1	0	6	5	1	67
2010	15	0	65	1	0	3	16	0	80

[a]Includes airboats.

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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 21C (3,660 mi^2)

GEOGRAPHIC DESCRIPTION: Melozitna River drainage upstream from Grayling Creek, and Dulbi River drainage upstream from and including the Cottonwood Creek drainage

BACKGROUND

Moose have been present in Unit 21C throughout the recent history of Interior Alaska (S. Huntington, personal communication to Glenn Stout, ADF&G, 2000). Moose densities are low presumably due largely to predation by bears and wolves (Gasaway et al. 1992, 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 Unit 21C is hilly and mountainous, with peaks as high as 5,000 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.

METHODS

POPULATION STATUS AND TREND

To classify moose habitat as having an expected high or low moose density, we conducted a moose stratification flight during 18–19 April 2000 using guidelines for the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008; Kellie and DeLong 2006). The stratification provided the basis for a rough population estimate in Unit 21C and will be used to increase the precision of future GSPE surveys. We conducted the stratification flight in a Cessna 206 flown at 95–120 mph at altitudes of 500–1,000 feet 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 (3,660 mi^2) that were approximately 5.5 mi^2. We flew on the north–south boundary between 2 sample units, and each sample unit was classified as low or high moose density, based on number of moose observed, number of moose tracks observed, and abundance of browse species (willows and young hardwoods). 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 (2,380 mi^2). Sex and age of moose were not recorded.

We surveyed a small portion of Unit 21C in November 2010 as part of a larger survey that included 3,516 mi^2 of eastern 21D (Stout 2012). Using the GSPE technique, we surveyed 36 sample units (6 high density and 30 low density; 201 mi^2) in western Unit 21C (West of 155° 25.00’) distributed across an area of 700 mi^2 that included Cottonwood Creek and a portion of the upper Dulbi River. Search intensity averaged ~6 min/mi^2 in each sample unit. Most of this area was stratified just prior to starting the GSPE survey. Sex and age of moose and size class of bulls were recorded.

HARVEST

We monitored harvest 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, harvest chronology, and transportation used to hunt. Each of these parameters was summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY09 = 1 July 2009–30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Survey conditions during the April 2000 stratification were 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, a stratification criterion. Because moose distribution may be dependent on seasonal influences, this stratification will apply best to a spring survey.

During the April 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 this area and was likely a result of reduced sightability in spring (Gasaway et al. 1986).

We estimated the unitwide moose density in Unit 21C 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 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/mi^2 or 900–1,300 total moose in all of Unit 21C (including non-moose habitat) Based on the low density of moose we observed during the April 2000 stratification and declines observed in moose numbers in similar habitat in Unit 24C to the north, the moose population in Unit 21C could be declining.

During the November 2010 GSPE survey in the 700 mi^2 portion of western Unit 21C, we observed 98 moose (38 cows, 45 bulls, 15 calves) in 36 sample units. Analysis of these survey data, as a subset of the larger survey, produced an estimate of 323 observable moose (234–411: 90% CI; Table 1. Because this survey included a large portion of Unit 21D, the resulting estimate for the Unit 21C portion was influenced by these data and we did not extrapolate to a unitwide 21C population estimate based on the small proportion of Unit 21C (19% of Unit 21C) that was sampled. Portions of Unit 21D that were surveyed, on average, contained higher quality habitat than in the remaining area of Unit 21C; therefore extrapolation would likely produce an overestimate. We estimated 0.46 moose/mi^2 in this 700 mi^2 portion of 21C. However, based on lower quality habitat in the remainder of Unit 21C, a unitwide density of ~0.25–0.35 moose/mi^2 is likely more realistic.

Population Composition

Composition data collected during the November 2010 GSPE survey were reflective of a low-density, lightly harvested moose population. Survey results indicated ratios of 92 bulls:100 cows and 31 calves:100 cows (Table 1). Low hunting pressure is likely a factor in the high bull:cow ratio because the area surveyed is more remote than areas of Unit 21C traditionally accessed by hunters. Of bulls observed in the survey, 59% were classified as large bulls, with antler spreads greater than 50 inches.

MORTALITY

Harvest

Season and Bag Limit for RY09–RY10.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 21C, the Dulbi River drainage		
RESIDENT HUNTERS: 1 bull by permit DM812; or 1 bull by permit RM834 (trophy value of antlers must be destroyed in RM834).	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side, by permit DM812.		5 Sep–25 Sep
Remainder 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 RY09–RY10.

Harvest by Hunters. Moose harvest in Unit 21C averaged 13.5 moose/year during RY09–RY10 compared to 18.9±2.4 ($\bar{x}$ ±SE) moose during RY01–RY10 (Table 2). During RY01–RY10, the number of hunters in Unit 21C averaged 44.6±3.4 ($\bar{x}$ ±SE). The average number of hunters during RY09–RY10 (39.0 per year) decreased by 15% relative to the preceding 8-year average (46.0 per year, RY01–RY08). Declining success rates suggest a reduction in the number of large bulls and possibly an overall decline in the population.

Twenty two moose have been reported harvested on drawing hunt permit DM812 since RY04 (Table 3). During RY04–RY10, 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 suggest no substantial change in the trend of the average antler widths of all harvested bulls during RY95–RY10; however, in RY10 average antler width (48.5 in) was the lowest measured during the 16 years in which these data have been collected (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 in RY99 (14%), RY09 (14%), and RY10 (11%), the percentage of large bulls (≥60 inches) in the reported harvest in Unit 21C ranged 21–47% during RY95–RY10. Because nonresidents are limited to taking moose with antler spreads ≥50 inches, excessive harvest may more readily be reflected in declines in the size of antler spreads in moose harvested by residents. Since 2008, antler width of bulls taken by resident hunters appears to be declining.

Hunter Residency and Success. Alaska residents composed 59% of the 78 hunters who hunted moose in Unit 21C during RY09–RY10 (Table 2). On average, 5 residents per year were successful during this period, whereas 7.2 resident hunters per year successfully harvested moose during RY01–RY10. As in RY07–RY08, the number of successful nonresident hunter was lower during RY09–RY10 compared to previous years; it was down 26% ($\bar{x}$ = 8.5 successful nonresidents per year) compared to 11.5 successful nonresidents per year during RY01–RY10. Success for all hunters was 41.1% during RY01–RY10, and decreased to an average of 34.5% during RY09–RY10. 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; most harvest consistently occurred during the second half of September (Table 4). During RY09–RY10, 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 this unit, hunters mainly used aircraft for transport (Table 5). 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 low water levels common in the fall.

Other Mortality

Wolves, and grizzly and black bears live throughout Unit 21C. 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 Unit 21C and a grizzly bear density of 1 bear/40 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 (<5 annually) because hunter access is limited.

CONCLUSIONS AND RECOMMENDATIONS

Total moose density in Unit 21C was estimated at 0.25–0.35 moose/mi^2 for all terrain in 2000, with an estimated 900–1,300 moose present in the unit. Human use of moose has remained low, and recent harvest can likely be sustained even though the moose 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 by monitoring moose harvest pressure and by monitoring bear and wolf harvest. Unit 21C is almost entirely within the limited option for fire management to allow for natural disturbance to maintain browse abundance on upland sites. 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 unitwide population and/or bull:cow ratio estimates to more closely monitor effects of harvest and other factors on the population.

During RY09–RY10, the management objective to maintain ≥20% large bulls (bulls with antlers 60 inches or greater) in the harvest was not met. Data indicate that we achieved this management objective during RY07–RY08 with an average of 26% of the bulls harvested with antler widths of ≥60 inches. However, during RY09–RY10 an average of 13% of harvested bulls had antler widths ≥60 inches, 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, we believe that those who hunted in Unit 21C were primarily interested in harvesting large-antlered (≥60 inches) bulls.

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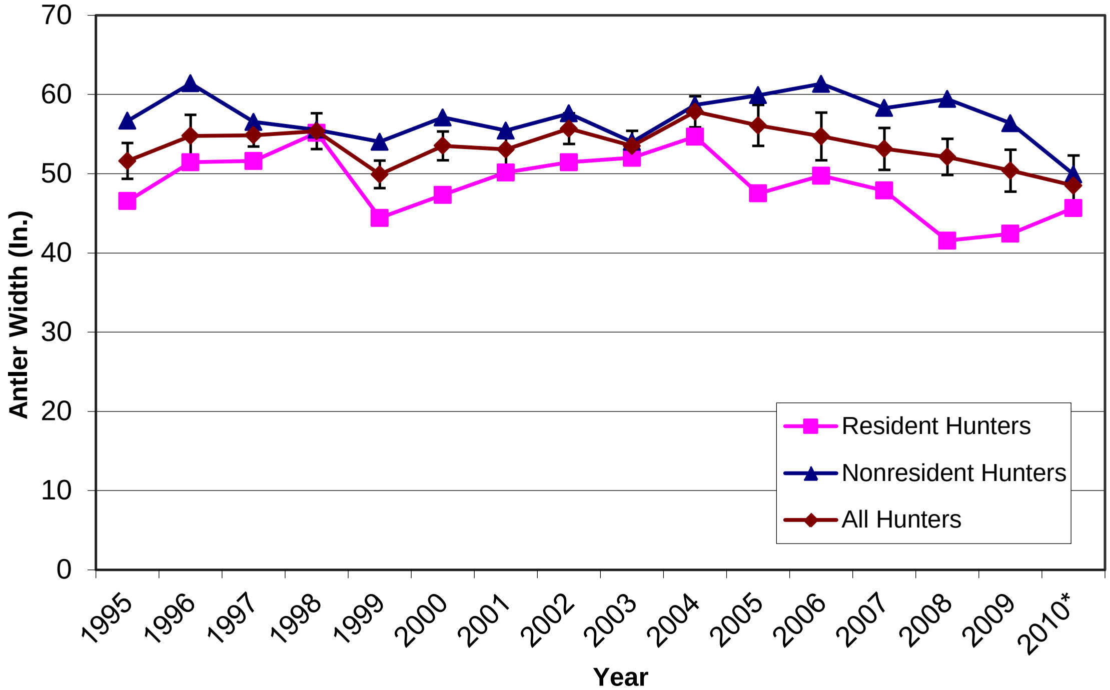

Figure 1. Average bull moose antler spread by hunter residency, Unit 21C, 1995–2010.

*sublegal bull included in nonresident harvest.

Table 1. Unit 21C, Cottonwood Creek and Dulbi River portion, moose population estimate, regulatory year 2010.

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 (moose/mi^2)
21C – partial area								
2010[b]	700	92	31	13	13	277	323 (±27%)	0.46

[a] Confidence interval (% ±).
[b] Geospatial population estimator analysis without sightability correction factor (observable moose).

Table 2. Unit 21C moose hunter residency and success, regulatory years 1996 through 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	0	10	5	0	15 (56)	0	9	3	0	12	27
1997	1	14	26	0	41 (76)	0	10	3	0	13	54
1998	1	8	12	0	21 (58)	0	9	6	0	15	36
1999	0	15	16	0	31 (63)	0	13	5	0	18	49
2000	0	11	20	0	31 (61)	0	13	7	0	20	51
2001	0	13	17	0	30 (53)	0	16	11	0	27	57
2002	0	10	20	1	31 (51)	0	18	11	1	30	61
2003	0	5	16	0	21 (46)	0	19	6	0	25	46
2004	0	3	11	1	15 (41)	0	15	7	0	22	37
2005	1	4	11	0	16 (37)	0	12	15	0	27	43
2006	0	6	3	0	9 (32)	2	10	7	0	19	28
2007	0	9	6	0	15 (39)	3	15	5	0	23	38
2008	1	10	14	0	25 (43)	1	19	13	0	33	58
2009	0	7	8	0	15 (36)	0	20	7	0	27	42
2010	0	3	9	0	12 (33)	0	16	8	0	24	36

[a] Includes total number of hunters from all hunts.
[b] Local resident resides in Units 21C or 21B.

Table 3. Unit 21C, outside Koyukuk Controlled Use Area, moose harvest by permit hunt, regulatory years 2004 through 2010.

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
DM812	2004	20	70	33	67	4 (100)	0 (0)	0	4
	2005	20	80	50	50	2 (100)	0 (0)	0	2
	2006	20	95	100	0	0 (0)	0 (0)	0	0
	2007	29	97	100	0	0 (0)	0 (0)	0	0
	2008	31	68	40	60	6 (100)	0 (0)	0	6
	2009	26	62	40	60	6 (100)	0 (0)	0	6
	2010	28	86	0	100	4 (100)	0 (0)	0	4
RM834	2004	4	0	100	0	0 (0)	0 (0)	0	0
	2005	0	0	0	0	0 (0)	0 (0)	0	0
	2006	2	0	100	0	0 (0)	0 (0)	0	0
	2007	4	0	75	25	1 (100)	0 (0)	0	1
	2008	3	0	67	33	1 (100)	0 (0)	0	1
	2009	2	0	100	0	0 (0)	0 (0)	0	0
	2010	0	–	–	–	– –	– –	–	–

Table 4. Unit 21C moose harvest chronology percent by month/day, regulatory years 1995 through 2010.

Regulatory year	Harvest chronology percent by month/day 9/5–9/10	9/11–9/15	9/16–9/20	9/21–9/25	*n*
1995	29	33	25	12	24
1996	7	33	40	20	15
1997	12	36	34	17	41
1998	25	35	30	10	20
1999	20	30	27	23	30
2000	21	25	50	4	24
2001	15	22	30	33	27
2002	7	21	43	29	28
2003	19	14	43	24	21
2004	33	7	40	20	15
2005	27	27	33	13	15
2006	0	33	67	0	9
2007	33	33	20	13	15
2008	13	38	38	13	24
2009	0	53	33	13	15
2010	0	17	33	50	12

Table 5. Unit 21C moose harvest percent by transport method, regulatory years 1995 through 2010.

Regulatory year	Harvest percent by transport method							n
	Airplane	Horse	Boat[a]	3- or 4-wheeler	Snowmachine	ORV	Unknown	
1995	84	0	4	0	0	0	12	25
1996	93	7	0	0	0	0	0	15
1997	85	0	10	0	0	0	5	41
1998	90	0	10	0	0	0	0	21
1999	74	0	23	3	0	0	0	31
2000	60	0	40	0	0	0	0	25
2001	60	0	37	0	0	3	0	30
2002	71	0	29	0	0	0	0	31
2003	76	0	14	0	0	0	10	21
2004	67	0	33	0	0	0	0	15
2005	81	0	19	0	0	0	0	16
2006	100	0	0	0	0	0	0	9
2007	71	0	29	0	0	0	0	14
2008	80	0	20	0	0	0	0	25
2009	93	0	7	0	0	0	0	15
2010	67	0	33	0	0	0	0	12

[a] Includes airboats.

SPECIES
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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 21D (12,096 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough

BACKGROUND

Moose are abundant in much of Unit 21D. 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 by the public (Regelin et al. 2005).

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 (Stout 2008). Initially, we thought this was due to better surveys, but a population estimation survey of the Kaiyuh Flats and the lower Koyukuk River in 1987 corroborated TCA data (Osborne 1996). Moose densities were high along the Yukon River floodplain (3–6 moose/mi^2) and were very high on the Koyukuk River in the Three Day Slough TCA, where densities reached 13.3 moose/mi^2 in early winter 1993 (Stout 2008). We estimated that 6,340 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.

A population estimation survey in fall 1997 in the lower Koyukuk drainage and the Kaiyuh Flats indicated moose numbers were similar to the 1993 estimate (Huntington 1998). However, a population estimation survey in 2001 suggested the population had declined marginally to

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

8,500–9,500 moose by winter 2001–2002, and declining recruitment parameters observed in the TCAs from 1997 to 2001 seemed to corroborate this. The population estimate again declined slightly for 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 the 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 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 (Woolington 1998). 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 during 1975–1981. During 1981–1996 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, resident and nonresident drawing hunts were added. 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

Management was directed according to the following management goals and objectives during the reporting period:

<u>GOAL 1</u>: 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.

<u>GOAL 2</u>: Protect and enhance moose habitat.

OBJECTIVE 1: In combination with Unit 24, implement at least 2 habitat enhancement activities every 5 years.

<u>GOAL 3</u>: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall Meat Assessment Score of less than "3" for ≤5% of the hunters each regulatory year.

<u>GOAL 4</u>: 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 ≥65% of the hunters who respond to the survey each regulatory year.

METHODS

Population Estimation

Beginning in 1999, we conducted population estimation surveys and analyzed data from all population estimation surveys using the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008; Kellie and DeLong 2006). GSPE surveys since 1999 were conducted according to methods and in areas described in Stout (2010).

We conducted population estimation surveys in different portions of Unit 21D during October and November of 2010 and 2011 using the geospatial population estimator (GSPE; Ver Hoef 2001, 2008; Kellie and DeLong 2006) method, a modification of the standard Gasaway et al. (1986) technique. In 2010 we conducted the GSPE survey in the upper Bear Creek and upper Dulbi River drainages. We intensively surveyed 176 sample units (SUs; 63 high density, 113 low density; 1,005 mi^2) of the 616 SUs (64 high density and 552 low density; 3,516 mi^2) and classified 769 moose. We based planes and their respective survey teams in Galena. Stratification of SUs for the 2010 survey was conducted using a Cessna 206. The GSPE sample units averaged 5.7 mi^2 in size, and were flown with a search intensity of ~5.5 min/mi^2.

In 2011 we conducted our GSPE survey to the west of the 2010 survey area, covering 5,526 mi^2, including 3,684 mi^2 in Unit 21D. We based planes and their respective survey teams in Galena. Stratification of SUs was conducted using a Found Bush Hawk. We intensively surveyed 332 SUs (237 high density, 95 low density; 1,861 mi^2) of 986 SUs (290 high density and 696 low density; 5,527 mi^2). GSPE sample units averaged 5.6 mi^2 in size, and were flown with a search intensity of ~6 min/mi^2.

Regulatory year (RY) 2009 and RY10 moose population estimates are based on previously reported values (Stout 2010), RY09–RY11 trend count surveys, and RY10–RY11 GSPE surveys (A regulatory year begins 1 July and ends 30 June; e.g., RY09 = 1 July 2009 through 30 June 2010).

RY09–RY11 trend count surveys, and RY10–RY11 GSPE surveys. I developed the RY11 moose population estimate for Unit 21D by individually estimating moose densities in each of the 6 drawing permit hunt areas within Unit 21D. To accomplish this, I used data from the 2001, 2004, 2010, and 2011 GSPE surveys as well as fall 2004–2011 TCA data (Stout 2010). For those areas that did not have survey data, I used density estimates of surveys in similar habitat within Unit 21D. Therefore, to varying degrees, estimates for each permit area were a combination of GSPE survey data, trend count survey data, and extrapolated data.

Population Composition

Composition data were derived from results of GSPE surveys or counts from TCA surveys. Moose in six TCAs (Dulbi River Mouth, Three Day Slough, Koyukuk Mouth, Pilot Mountain, Squirrel Creek, and Kaiyuh Slough) were classified as cows, calves, yearling bulls (<30" antler width and no brow tine definition), medium bulls (≥30" and <50" antler width), or large bulls (≥50" antler width) using methods previously described (Stout 2010).

Guidelines reported by Franzmann and Schwartz (1998) were used to interpret sex and age indices as reported in Stout (2010).

Twinning Surveys

Twinning surveys were conducted 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, Squirrel Creek, and Natlaratlen River. Aerial twinning surveys consisted of parallel transects flown at approximately ¼ mile intervals at ≤500 feet above ground level in a PA-18 or similar aircraft by experienced pilots. For statistical reasons, 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 or more calves. Timing was critical, so surveys were flown in late May within a few days of the median calving date (Boertje et al. 2007), when approximately 50% of the cows observed had calves. This avoided early mortality factors such as predation, which could lead to underestimating twinning rates.

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 or 2 reminder letters 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.

We evaluated meat to measure success in meeting our objective under goal 3. 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 low performance.

We evaluated predation by interviewing trappers and by opportunistic field observations.

Wildlife Viewing

To measure success in meeting our objective under goal 4, hunters who came through the checkstation were also given a wildlife viewing survey that consisted of a 5×7 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. Questions asked during RY02–RY11 are described in Stout (2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Overall, the moose population trend counts from RY09–RY10 showed a generally stable index to abundance in Unit 21D over recent years (Tables 1–6) as previously described (Stout 2010). Density estimates for some portions of Unit 21D also indicated a stable trend (Table 7).

In 2010 we classified 769 moose during the GSPE survey (covering 3,516 mi^2 in the upper Bear Creek and upper Dulbi River drainages). In the 2011 GSPE survey (which overlapped survey areas sampled in RY01 and RY04) we classified 5,620 moose. By combining my estimates for individual drawing hunt areas in Unit 21D, I estimated a Unit 21D population of 8,611 observable moose in RY11 (Table 8). The population estimate for the total area calculated from the 2011 survey was not significantly different (95% CI) from the 2001 or 2004 estimates; however, the 2011 point estimate was lower than 2001 and 2004. The regression analysis of the 1987–2011 survey estimates indicated a slight decline (Fig. 1).

Population Composition

From the 2011 GSPE survey, we calculated 28 calves:100 cows, which is within the range (20–40 calves:100 cows) reported by Franzmann and Schwartz (1998) for maintaining a stable or increasing population. Most TCAs also had high ratios during RY09–RY11. The 2011 GSPE survey data indicated 32 bulls:100 cows, well above the minimum needed for adequate productivity. TCA data in RY10–RY11 also indicated stable bull:cow ratios; however, yearling bull:cow ratios were low in some areas. The decline to 10–20 calves:100 cow in RY09 TCAs followed the severe winter of 2008–2009, and poor twinning (20–43%) during RY08 probably explains the low (2–5) yearling bull:cow ratios in RY10–RY11 in some TCAs.

Bull:cow ratios continue to vary widely among TCAs (Tables 1–6), but most indicated some level of decline beginning in the mid-1990s, and a more recent recovery (Fig. 2).

Although no objective measurements of habitat were conducted during RY09–RY10, I observed no dramatic changes in vegetative characteristics that would account for the apparent improvements in twinning rates since spring 2004 (Stout 2010). Moose twinning rates during 2003–2011 (20–54%) suggest above average nutritional status (Boertje et al. 2007) and productivity in the Three Day Slough, Pilot Mountain Slough, Kaiyuh Slough and Natlaratlen River areas in Unit 21D (Tables 9–10).

Distribution and Movements

Moose generally 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. In spring, bulls leave the riparian areas, followed by cows with calves (Osborne and Spindler 1993; B. Scotton, U.S. Fish and Wildlife Service biologist, Galena, personal communication, 2008). Approximately 83% of all moose appear to be migratory (Osborne and Spindler 1993). Distribution and movement patterns of moose in Unit 21D are summarized in (Stout 2010).

MORTALITY

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY09 Unit 21D, that portion within the Koyukuk Controlled Use Area		
RESIDENT HUNTERS: 1 bull by registration permit only; or	1 Sep–25 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	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 600 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep
RY10 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.	1 Sep–25 Sep (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 80 permits may be issued in combination with Unit 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	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 600 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. No changes were adopted by the Alaska Board of Game during RY09–RY10 and no emergency orders were issued. Board actions for RY03–RY08 are summarized in Stout (2010).

Unit 21D has a positive finding for intensive management (IM). The Unit 21D objectives in Title 5 Alaska Administrative Code, regulation 92.108 for RY09–RY10 were as follows:

Population Objective	Harvest Objective
7,000–10,00 moose	450–1,000

Harvest by Hunters. Harvest of moose in Unit 21D during RY09–RY10 was higher than in RY07–RY08 (Tables 11–13). Reduced harvest through restrictive hunting regulation during RY04–RY07 likely reversed the trend of declining bull:cow ratios in the Koyukuk CUA portion of Unit 21D, but hunting pressure was still high in the Koyukuk River mouth and Pilot Mountain Slough areas and likely suppressed bull:cow ratios in those areas. No cows were reported harvested during RY09–RY10, due to elimination of all antlerless moose seasons in Unit 21D. However, illegal and unreported cow harvest continued to occur during the winter. Potlatch, Stickdance, and ceremonial moose harvest also included cows.

During RY09–RY10, most of the reported harvest in Unit 21D ($\bar{x}$ = 70%) was in the Koyukuk River drainage (Northern Unit 21D, Table 14). Low water levels on the Yukon River (southern Unit 21D) during RY09–RY10 that reduced hunters' ability to access Kaiyuh Slough, along with increased bull:cow ratios that resulted in improved hunter success on the Koyukuk River were 2 factors that likely caused this change in harvest distribution. In contrast, during RY05–RY07 harvest in the Koyukuk River drainage averaged 58%, with a low of 53% in RY06.

Koyukuk River Checkstation Results. The Koyukuk River checkstation has been mandatory since RY90. The number of hunters who checked in peaked in RY99, but dropped significantly when drawing hunts were implemented in RY00. During the period of increase (RY90–RY99), the additional hunters in the Koyukuk CUA were primarily nonlocal Alaska residents and, secondarily, nonresidents (Table 13). The reported numbers of local residents (residents of Units 21B, 21D and 24) increased during RY00–RY06 due to the expanded registration hunt area and improved reporting by unsuccessful hunters.

Total success rates in the Koyukuk CUA were stable at $\bar{x}$ = 50% in RY09–RY10. Harvest success during the fall hunt in RY01–RY10 was high for nonlocal residents ($\bar{x}$ = 54%) and nonresidents ($\bar{x}$ = 69%), but local resident success was lower ($\bar{x}$ = 35%). This was likely because many local hunting parties consisted of several family members who all obtained permits, but not all permit holders intended to harvest their own moose. Success rates generally remained high except in RY04 and RY05 when weather was extremely warm during the fall hunting season. Additionally, success rates were lower ($\bar{x}$ = 40%) during RY01–RY06 due to low bull:cow ratios compared to the long-term (RY89–RY11) average ($\bar{x}$ = 51%; Table 13).

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 adopted by the Board of Game 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. At the checkstation, all hunters were notified of this regulation when we issued their permits and checked for compliance upon departure from the hunt area. 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 Koyukuk CUA area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. During RY09–RY10, 38%–50% of the harvested bulls measured were large and 28%–36% of the bulls counted in TCAs were large. Of the bulls observed in the Koyukuk CUA TCAs during RY01–RY10, 32% had large antlers (Table 15). During RY01–RY10, 46% of the harvested bulls measured in Koyukuk CUA permit hunts had large antlers. The 28-year average (RY81–RY10) percentage of harvested bulls measured with antler width of ≥60 inches was 17%.

Meat evaluation surveys conducted at the checkstation indicated meat care was generally very good with an average overall score of 4.8 in RY09 and 4.7 in RY10 (Table 16), with little change since RY05. In RY10, 3 hunters (2%) were given average overall scores of less than 3. In general, meat scores stabilized at a high level and the number of days hunters kept their meat in the field stabilized at about 2.5 days.

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 17). Only a portion of all hunters that stopped at the checkstation received the questionnaire ($\bar{x}$ =24%, RY02–RY11). There were no apparent changes in wildlife viewing during the reporting period.

Permit Hunts. The subsistence registration permit (RM832) was the permit used most by resident Alaskans to hunt within the Koyukuk CUA; antler destruction was required. The number of RM832 permits issued for RY03–RY11 varied by only 13% (Table 18). Registration permit use among local residents was relatively stable, while use of the permit by other Alaska residents declined during RY99–RY07 then stabilized in RY09–RY11 (Table 14). With implementation of drawing hunts in the remainder of Unit 21D, hunter numbers were better regulated and distribution of hunters improved (Table 19). Resident hunters who did not want to destroy the trophy value of their bull moose, and nonresidents could apply for a limited 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 20). Reported annual harvest and hunter participation by Unit 21D residents were about the same throughout RY96–RY02 (Anderson et al. 1998).

Unit 21D local hunter success rates were 33% in RY09 and 38% in RY10. Local hunter success rates were low (RY01–RY10 $\bar{x}$ = 33%; Table 20) compared to RY90–RY99, when success rates averaged 59% (Stout 2010). Success rates for nonlocal resident (RY90–RY99 $\bar{x}$ = 67% vs. RY01–RY10 $\bar{x}$ = 43%) and nonresident (RY90–RY99; $\bar{x}$ = 68% vs. RY01–RY10; $\bar{x}$ = 40%) hunters followed similar trends.

Increased reporting by unsuccessful hunters and subsequent apparent 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 changes in success rates reflect hunt conditions. Therefore, success rates in the Koyukuk CUA were not likely influenced by the RY04 changes in the hunt administration processes. Success rates appeared to decrease within the Koyukuk CUA during RY02–RY06, then stabilized in RY07–RY11 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. There were no apparent changes in harvest chronology during RY09–RY10 (Table 21) compared to previous years. 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 meant most hunters used boats to access hunting areas during RY09–RY10 (Table 22). Snowmachines were the main transportation method used during winter, although little winter harvest is reported. These patterns have changed little since 1980.

Other Mortality

Wolves and black bears were common throughout Unit 21D. 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. Hunters continued to report increased observations of grizzly bears during the fall moose season. Anecdotal reports by Unit 21D residents also suggested grizzly bears were increasing and becoming more common intruders at fish camps. Black bears were shown to kill more than 40% of moose calves annually in Unit 21D (Osborne et al. 1991).

HABITAT

Assessment

No habitat assessments were conducted during RY09–RY10. Feltleaf willow is an important browse species for moose due to its nutritional quality. In Three Day Slough this species is high in protein compared with feltleaf willow on the Tanana River and is lightly browsed (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 (Tables 13 and 14; Boertje et al. 2007) adequate to support an increasing moose population (Boertje et al. 2007). Previous habitat assessments are summarized in Stout (2010).

CONCLUSIONS AND RECOMMENDATIONS

Moose were relatively numerous in the riparian lowlands of Unit 21D. I estimated 8,611 (±1,300 at 15% presumed relative error) observable moose in Unit 21D. The Unit 21D population may have increased slightly south of the Yukon River, but numbers were stable in northern Unit 21D. Cow numbers in TCAs throughout the unit continue to be closely monitored. High calf:cow ratios and yearling bull:cow ratios in RY04, RY06, and RY07 did not appear to increase the population, based on the 2011 population estimate. We recommend annual or biennial GSPE 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 years between infrequent high intensity surveys provided accurate composition and population estimates, and the confidence intervals for all survey years were improved (Stout 2012). 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 likely has been an important factor in stabilizing the population in Unit 21D.

The key management issues facing Unit 21D during RY09–RY10 were 1) cow harvest, 2) evaluation of harvest success rates, and 3) reallocation of harvest from state-qualified hunters to local federally-qualified subsistence hunters.

Cow harvest must decrease throughout the area if we are to achieve our population management objective of 9,000–10,000 moose. To work toward that objective, we closed all fall hunting seasons for cow moose by emergency order during RY02–RY05, and in RY06 the Board of Game eliminated these antlerless seasons. Additionally, the winter season was eliminated in favor of a bulls-only season in August. However, moose harvest during the winter will likely continue, depending on the level of fall hunting success. The stable trend in bull:cow ratios within the Koyukuk CUA appeared to reflect the stable fall success rates since RY07, thereby decreasing demand for the winter harvest. 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 8,611 moose (±1,300) in 21D did not likely meet our management objective of 9,000–10,000 observable moose. However, the intensive management population objective of 7,000–10,000 moose may have been achieved. Analysis of RY09–RY10 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 or 7% of the population was met. Estimated total harvest was highest in RY10 at 423 moose, including the estimate of unreported harvest (4.3–5.8% of the estimated population of 8,611). However, the intensive management annual harvest objective of 450–1,000 moose was not achieved in RY09 or RY10. The objective to provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year, was achieved with a total of 745 hunters in RY09 and 754 hunters in RY10.

The long-term objective to implement at least 2 habitat enhancement activities was not achieved during RY06–RY10. We will continue to encourage land managers to liberalize fire management options and implement habitat enhancement activities.

In RY09 and RY10 we continued to monitor the objective to maintain an overall meat assessment score of less than "3" for ≤5% of the hunters each regulatory year at the Koyukuk River checkstation. Fewer than 5% of the hunters scored less than 3 on the overall meat care (0.7% in RY09, 2.0% in RY10), and the average number of days hunters stayed in the field with their meat was less than 2.7 days. Therefore, the meat care objective was met.

Finally, we continued our program to monitor and evaluate the number of people engaged in nonconsumptive activities. Parameters measured by the wildlife viewing survey appeared to be somewhat stable. However, the wildlife viewing objective was not achieved because less than 65% of the respondents (RY09=30%, RY10=46%, RY11=44%), reported "hunting and viewing" as the purpose of their trip. A program to increase species identification and the importance of wildlife sign by hunters may improve that measure. Friends continued to be the primary source of hunters learning about the area.

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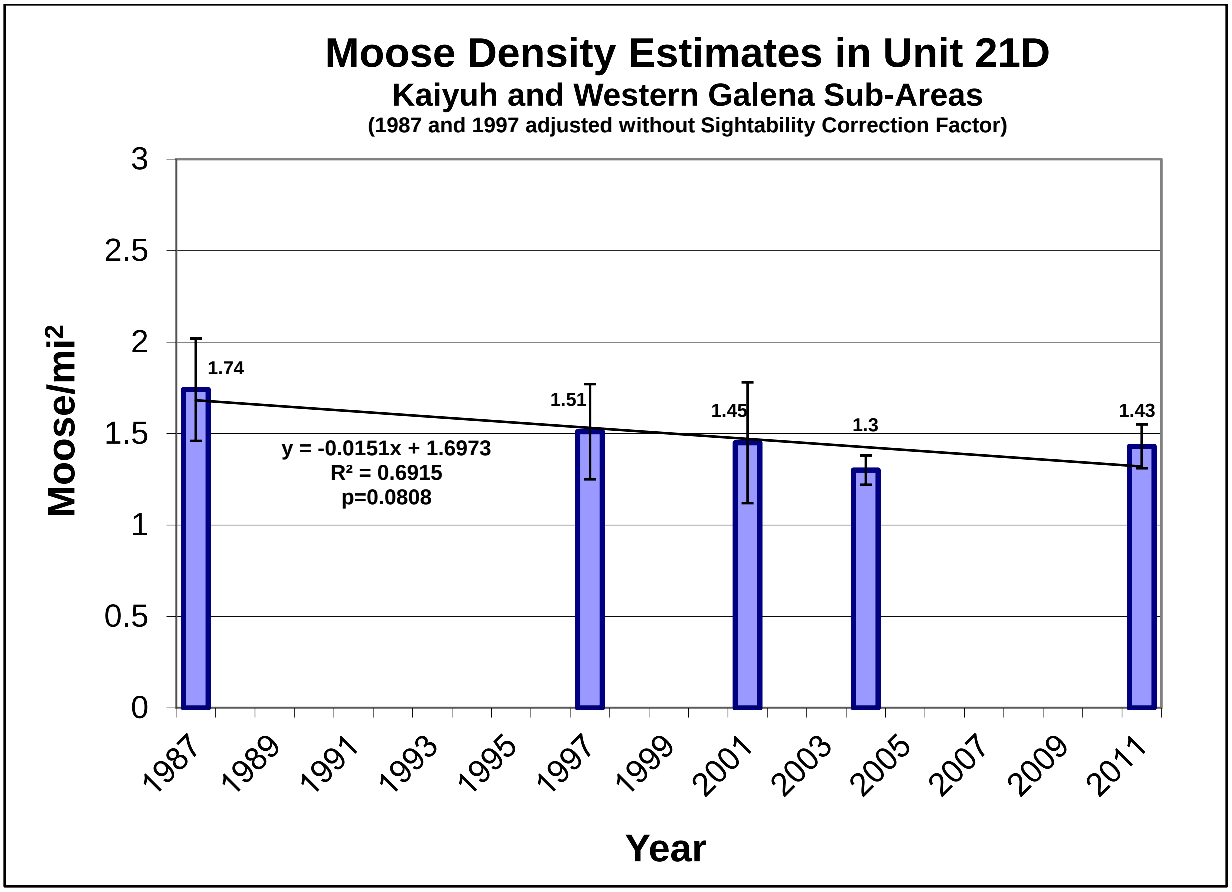

Figure 1. Moose density estimates and regression analysis based on 5 population estimation surveys. The 1987 estimate was calculated using MOOSEPOP; 1997 was a regression analysis estimate; and 2001, 2004, and 2011 were geospatial population estimates. All values presented do not include sightability correction factors and are presented as density of observable moose/mi^2. Although survey areas differed in size (see Table 7), survey areas overlapped substantially between years.

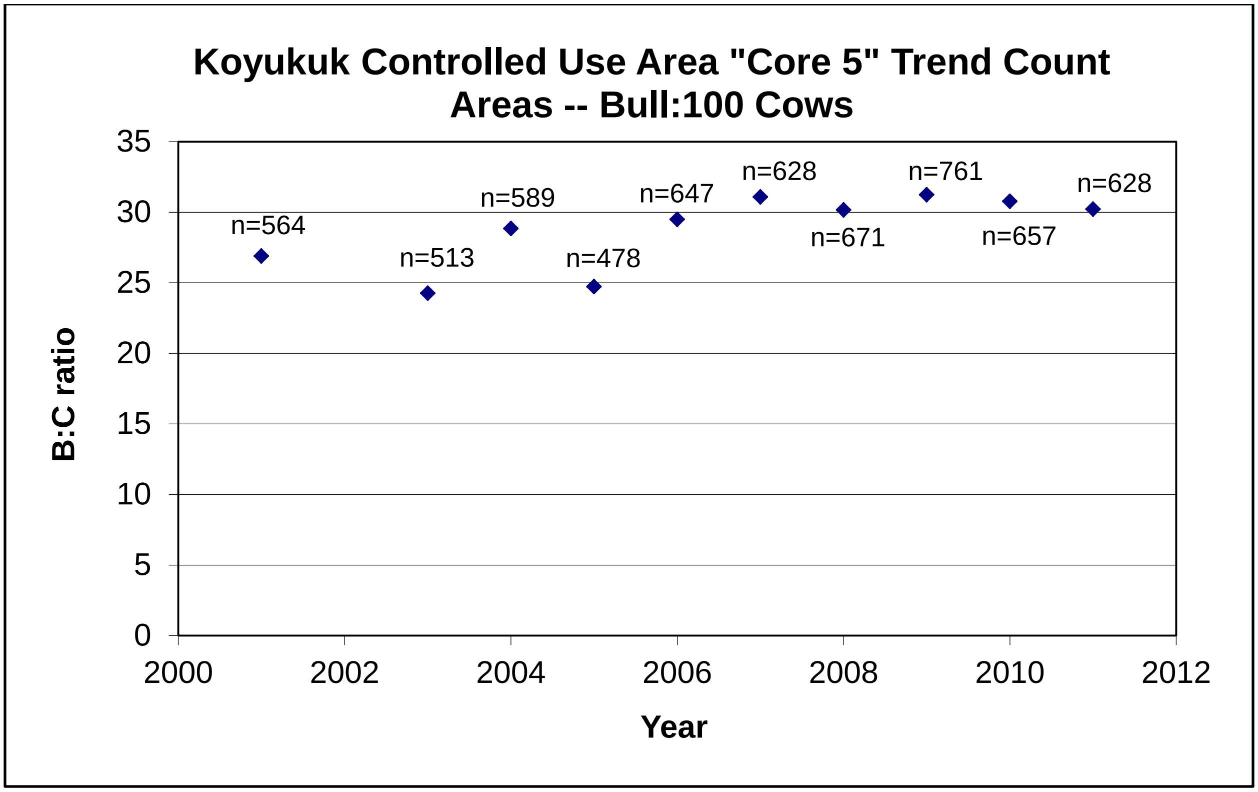

Figure 2. Cumulative bull:100 cow ratio for the Koyukuk Controlled Use Area that includes the 5 aerial trend count survey areas surveyed each year since 2001. These "Core 5" trend count areas are the Three Day Slough, Dulbi River Mouth, and Koyukuk River Mouth Trend Count Areas in Unit 21D, and the Treat Island and Huslia Flats Trend Count Areas in Unit 24 (Stout 2012).

Table 1. Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
2001–2002	177.0	20	13	13	2	10	906	5.1
2003–2004[c]	160.4	17	7	21	8	15	846	5.3
2004–2005[c]	193.6	22	9	23	8	16	935	4.8
2005–2006[c]	193.6	21	5	21	6	15	863	4.5
2006–2007[b]	193.6	25	5	40	12	24	1177	6.1
2007–2008[c]	193.6	30	10	34	7	21	967	5.0
2008–2009	193.6	28	8	19	5	13	1270	6.6
2009–2010[c]	193.6	26	8	13	2	9	1151	5.9
2010–2011	193.6	31	4	26	3	17	1148	5.9
2011–2012	193.6	31	11	23	5	15	921	4.8

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).
[b] Low snow year.
[c] Late survey (after 21 Nov).

Table 2. Unit 21D Dulbi River mouth trend count area aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
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
2010–2011	116.7	24	2	32	8	19	414	3.6
2011–2012	111.1	24	7	29	3	19	506	4.4

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).

Table 3. Unit 21D Koyukuk River mouth aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
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
2010–2011	118.8	23	3	27	10	18	493	4.2
2011–2012	118.8	20	5	24	1	17	503	4.2

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).

Table 4. Unit 21D Squirrel Creek aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
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
2010–2011	90.9	25	5	42	18	25	289	3.2
2011–2012	90.9	25	7	34	13	21	251	2.8

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).

Table 5. Unit 21D Pilot Mountain Slough aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
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
2010–2011	91.0	17	2	48	5	29	466	5.1
2011–2012	91.0	18	9	30	9	25	563	6.2

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).

Table 6. Unit 21D Kaiyuh Slough aerial moose composition counts, regulatory years 2001–2002 through 2011–2012[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
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
2010–2011	126.3	44	11	52	9	26	190	1.5
2011–2012	126.3	45	19	56	20	28	261	2.1

[a] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).

Table 7. Unit 21D aerial moose population estimates, regulatory years 1987–1988 through 2011–2012.

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 ($moose/mi^2$)
21D–Kaiyuh Flats								
1987–1988[a]	1,582	60.6	46.4	15.0	22.4	1,389	1,790±18%	1.13
1997–1998[b]	1,582	42.3	28.4	13.0	16.6	1,113	1,335±17%	0.84
2001–2002[c]	1,843	44.5	22.1	8.8	13.4	1,558	1,800±32%	0.98
2004–2005[c]	1,843	35.1	43.3	12.2	24.7	1,119	1,487±10%	0.81
2011–2012[c]	1,843	30.5	38.6	10.4	22.9	1,463	1,897±11%	1.03
21D–Western Galena								
1987–1988[a]	1,508	36.7	38.2	12.4	21.8	3,220	4,118±14%	2.73
1997–1998[b]	1,508	31.3	32.1	8.0	19.6	2,612	3,250±12%	2.15
2001–2002[c]	1,734	26.6	17.1	6.4	12.0	2,995	3,403±19%	1.96
2004–2005[c]	1,841	26.2	36.2	10.5	22.3	2,564	3,299±5%	1.79
2011–2012[c]	1,841	29.0	25.0	8.8	16.3	2,811	3,360±7%	1.83
21D–Yuki River–Bear Cr.								
2010–2011[c]	3,516	64.3	27.4	9.9	14.5	1,477	1,727±14%	0.49
24D–Upper Koyukuk								
2001–2002[c]	1,949	35.0	17.6	6.1	11.4	3,228	3,642±16%	1.87
2004–2005[c]	1,843	32.7	33.9	12.6	20.4	2,531	3,181±5%	1.73
2011–2012[c]	1,843	38.4	23.4	9.2	14.4	2,249	2,627±8%	1.43
Total Area								
1987–1988[a]	3,090	43.1	40.4	13.1	6.7	4,609	5,908±15%	1.91
1997–1998[b]	3,090	34.4	31.1	9.4	17.8	3,725	4,585±14%	1.48
2001–2002[c]	5,526	33.4	18.3	6.7	12.0	7,849	8,924±13%	1.62
2004–2005[c]	5,527	30.4	36.5	11.6	18.2	6,514	7,967±4%	1.44
2011–2012[c]	5,527	32.4	27.6	9.3	17.3	6,524	7,885±4%	1.43

[a] Gasaway survey, MOOSEPOP analysis estimate (Woolington 1998), with sightability correction factor.
[b] Gasaway survey, Regression analysis estimate, with sightability correction factor.
[c] Geospatial population estimation survey, without sightability correction factor.

Table 8. Unit 21D moose population estimate by drawing hunt areas, regulatory year 2011–2012[a].

Drawing hunt area	Density estimate	Moose estimate
(DM816) Yuki River and Bishop Creek	(545 mi^2 @ 1.44 moose/mi^2)	785
	(1,555 mi^2 @ 0.35 moose/mi^2)	575
	Subtotal	1,360
(DM817) Nulato River and Kaiyuh Flats	(612 mi^2 @ 1.03 moose/mi^2)	630
	(2,329 mi^2 @ 0.30 moose/mi^2)	1,071
	Subtotal	1,701
(DM818) Papa Willie Slough	(360 mi^2 @ 1.30 moose/mi^2)	468
	(1,096 mi^2 @ 0.35 moose/mi^2)	383
	Subtotal	851
(DM823–DM830) Koyukuk Controlled Use Area	(1,841 mi^2 @ 1.83 moose/mi^2)	3,360
	(559 mi^2 @ 0.35 moose/mi^2)	196
	Subtotal	3,556
(DM814, DM815, DM819) Bear Creek	(916 mi^2 @ 0.75 moose/mi^2)	687
(DM820) Gisasa and Kateel Rivers	(2,283 mi^2 @ 0.20 moose/mi^2)	456
Unit 21D total	(12,096 mi^2)	8,611 (±1,300)[b]

[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 of (±15%) based on my experience at being able to estimate moose numbers for this area.

Table 9. Unit 21D moose aerial twinning surveys in the Three Day Slough trend count area, regulatory years 1989–1990 through 2010–2011.

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
2009–2010	69	32	19	37	26	26–28,30
2010–2011	59	33	17	34	34	25–27

[a] Percent of cows with calves that had 2 or more calves.
[b] Including 1 cow w with 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 10. Unit 21D moose aerial twinning surveys in the Pilot Mountain Slough to Kaiyuh Slough trend count areas, regulatory years 2003–2004 through 2010–2011[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
2009–2010	60	34	19	36	18	28,29
2010–2011	50	39	17	30	13	27

[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 11. Unit 21D moose harvest, regulatory years 1995–1996 through 2011–2012.

Regulatory year	Harvest by hunters				Unreported harvest[a]	Potlatch/ Stickdance[b]	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	244	0	0	244	150	17	411
2010–2011	286	0	0	286	125	12	423
2011–2012[c]	285	0	2	287	125	7	419

[a] Unreported harvest based on ADF&G Division of Subsistence door-to-door survey and other sources.
[b] Includes all Potlatch, Stickdance, Ceremonial and Cultural permit harvest.
[c] Preliminary data.

Table 12. Koyukuk River checkstation moose harvest, regulatory years 1995–1996 through 2011–2012[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
2010–2011	237	0	0	238[b]
2011–2012	240	0	0	242[c]

[a] Contains moose harvested in Units 21D and 24.
[b] Including one moose of unknown sex.
[c] Including two moose of unknown sex.

Table 13. Koyukuk River checkstation[a,b] moose hunter residency and success, regulatory years 1991–1992 through 2011–2012.

Regulatory	Local resident[c]		Nonlocal resident[d]		Nonresident		Total	
year	Hunter	Moose	Hunter	Moose	Hunter	Moose	Hunter	Moose
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	247	110	181	104	14	9	442	223
2010–2011	250	101	200	124	26	13	476	238
2011–2012	216	96	216	133	21	13	453	242

[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 14. 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 2011–2012.

Regulatory year	Percent harvest: Northern Unit 21D	Percent harvest: Southern Unit 21D	Total Harvest
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	71	29	238
2010–2011	69	31	283
2011–2012[a]	70	30	283

[a] Preliminary data.

Table 15. Unit 21D large bull[a] moose percent harvested and number measured during the hunting season from the Koyukuk CUA hunts and percent counted during aerial surveys in the Koyukuk "Core-5" trend count areas, regulatory years 2001–2002 through 2011–2012.

Regulatory year	% Harvested (Sep)	Number measured (Sep)	% Counted (Nov)[b]	Number counted (Nov)[b]
2001–2002	40	83	30	564
2002–2003	46	97	–[c]	–[c]
2003–2004	58	108	25	513
2004–2005	42	138	19	589
2005–2006	46	120	33	478
2006–2007	53	125	27	647
2007–2008	47	115	30	628
2008–2009	41	156	25	671
2009–2010	38	180	28	761
2010–2011	50	204	36	657
2011–2012	54	205	40	628

[a] Fifty-inch or greater antler spread.
[b] Data includes Huslia Flats and Treat Island TCAs (Stout, *In prep)*.
[c] No survey.

Table 16. Overall scores for meat evaluation at Koyukuk River Checkstation, regulatory years 2002–2003 through 2011–2012.

Regulatory year	Avg. no. days hanging	Avg. clean score[a]	Avg. dry score[a]	Avg. smell score[a]	Avg. overall score[a]	% hunters scoring <3	Sample size (*n*)
2002–2003	3.3	4.3	4.3	n/a	4.3	4.4	184
2003–2004	3.3	4.2	4.4	4.8	4.2	4.5	199
2004–2005	2.6	4.3	4.8	4.8	4.6	1.1	96
2005–2006	2.7	4.8	4.8	4.8	4.8	0.0	95
2006–2007	2.6	4.8	4.8	4.8	4.8	0.0	90
2007–2008	2.4	4.4	4.5	4.8	4.6	0.0	84
2008–2009	2.6	4.6	4.9	5.0	4.9	0.0	118
2009–2010	2.6	4.6	4.8	4.9	4.8	0.7	140
2010–2011	2.7	4.6	4.8	4.8	4.7	2.0	148
2011–2012	2.6	4.4	4.8	4.9	4.7	0.0	158

[a] Subjective ranking scale of 1–5, with a score of 1 being lowest.

Table 17. Wildlife viewing survey at Koyukuk River Checkstation, regulatory years 2002–2003 through 2011–2012.

Regulatory year	Question #1		Question #2 Purpose of Trip?[a]			Question #3 Wildlife Seen?		Question #4	Question #5 Wildlife Rank?[b]								Question #6 Seeing Wildlife Important?[c]			Question #7 Wildlife Sign Important?[c]			Question #8 Source of Hunting Information?[d]				
	n	# Days viewing ($\bar{x}$)	H %	V %	B %	Yes %	No %	# Species observed	M	B	Wo	Wa	F	C	SM	So	V %	S %	N %	V %	S %	N %	Fr %	P %	Fa %	A %	O %
2002–2003	96	7.0	43	2	55	83	17	23	1	2	3	4	5	8	6	7	--	--	--	--	--	--	45	23	4	17	11
2003–2004	80	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	50	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	59	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	82	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	90	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	113	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	117	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
2010–2011	81	6.5	53	1	46	78	22	24	1	2	3	4	5	6	7	8	63	28	9	64	28	9	42	32	14	7	5
2011–2012	75	6.5	53	3	44	85	15	26	1	2	3	4	6	5	7	8	64	24	3	50	42	8	31	41	7	6	14
Average	84.3	6.6	52.8	2.7	44.4	79.5	20.5	25.2	1.0	2.0	3.0	4.2	5.5	6.0	7.0	7.3	58.0	35.9	6.2	57.9	35.8	6.6	42.2	30.9	12.5	7.7	6.9

[a] H=Hunting only, V=Viewing only, B=Both
[b] M=moose, B=Bears, Wo=Wolves, Wa=Waterfowl, 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 18. Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2002–2003 through 2011–2012[a].

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	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
	2010–2011	421	8	53	47	180 (100)	0 (0)	1	181
	2011–2012 [c]	418	8	52	48	174 (100)	0 (0)	1	175
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
	2010–2011	7	0	71	29	2 (100)	0 (0)	0	2
	2011–2012 [c]	7	0	57	43	3 (100)	0 (0)	0	3
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
	2010–2011	7	0	14	86	6 (100)	0 (0)	0	6
	2011–2012 [c]	7	0	17	83	5 (100)	0 (0)	0	5
DM827	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

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
	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
	2010–2011	7	14	83	17	1 (100)	0 (0)	0	1
	2011–2012 [c]	7	43	25	75	2 (100)	0 (0)	1	3
DM828	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
	2010–2011	54	43	35	65	20 (100)	0 (0)	0	20
	2011–2012 [c]	54	48	25	75	21 (100)	0 (0)	0	21
DM829	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
	2010–2011	7	14	33	67	4 (100)	0 (0)	0	4
	2011–2012 [c]	7	43	50	50	2 (100)	0 (0)	0	2
DM830	2002–2003	79	38	16	84	41 (100)	0 (0)	0	41
	2003–2004	103	36	24	76	44 (100)	0 (0)	0	44

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
	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
	2010–2011	54	39	27	73	24 (100)	0 (0)	0	24
	2011–2012[c]	54	31	11	89	33 (100)	0 (0)	0	33
Total	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (100)	0 (0)	2	248
	2004–2005	449	13	62	38	153 (100)	0 (0)	0	153
	2005–2006	461	15	60	40	150 (100)	0 (0)	0	150
	2006–2007	433	12	56	44	165 (100)	0 (0)	1	166
	2007–2008	400	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
	2010–2011	557	14	50	50	237 (100)	0 (0)	1	238
	2011–2012[c]	554	15	47	53	240 (100)	0 (0)	2	242

[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.

[c] Data preliminary.

Table 19. Unit 21D outside Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2004–2005 through 2011–2012.

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
	2010–2011	15	20	25	75	9 (100)	0 (0)	0	9
	2011–2012	9	33	17	83	5 (100)	0 (0)	0	5
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 (0)	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
	2010–2011	2	0	0	100	1 (100)	0 (0)	0	1
	2011–2012	2	50	0	100	1 (100)	0 (0)	0	1
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
	2010–2011	25	32	53	47	8 (100)	0 (0)	0	8
	2011–2012	25	40	27	73	11 (100)	0 (0)	0	11
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
	2010–2011	31	40	61	39	7 (100)	0 (0)	0	7

	2011–2012	26	81	40	60	3 (100)	0 (0)	0	3
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
	2010–2011	9	56	50	50	2 (100)	0 (0)	0	2
	2011–2012	5	100	0	0	0 (0)	0 (0)	0	0
DM819	2007–2008	1	0	100	0	0 (0)	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
	2010–2011	1	100	0	0	0 (0)	0 (0)	0	0
	2011–2012	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
	2010–2011	34	59	50	50	7 (100)	0 (0)	0	7
	2011–2012	34	35	68	32	7 (100)	0 (0)	0	7

Table 20. Unit 21D moose hunter residency and success, regulatory years 1992–1993 through 2011–2012.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	
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	121	114	9	0	244	315	156	30	0	501	745
2010–2011	126	143	17	0	286	297	146	24	0	467	754[b]
2011–2012[c]	118	153	16	0	287	233	138	13	1	385	672

[a] Unit 21D and Ruby residents only.
[b] Includes one unknown success hunter.
[c] Preliminary data.

Table 21. Unit 21D moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2011–2012.

Regulatory	Harvest chronology percent by month/day				
year	8/22–8/31	9/1–9/14	9/15–9/25	2/1–2/10	*n*
1996–1997	0	53	43	3	419
1997–1998	0	59	38	3	414
1998–1999	0	50	50	1	387
1999–2000	0	49	46	5	441
2000–2001	7	41	47	5	334
2001–2002	3	27	62	8	263
2002–2003	4	30	61	5	313
2003–2004	4	43	47	6	313
2004–2005	2	40	58	0	212
2005–2006	1	37	61	0	209
2006–2007	10	32	58	0	204
2007–2008	7	37	56	0	199
2008–2009	7	36	58	0	259
2009–2010	3	45	52	0	242
2010–2011	4	31	65	0	279
2011–2012[a]	3	34	63	0	282

[a] Preliminary data.

Table 22. Unit 21D moose harvest percent by transport method, regulatory years 1992–1993 through 2011–2012.

Regulatory year	Harvest percent by transport method: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
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	4	0	90	4	0	1	1	0	239
2010–2011	4	0	90	3	0	0	2	0	284
2011–2012[a]	3	0	90	4	0	1	1	0	284

[a] Preliminary data.

SPECIES

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 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi^2).

GEOGRAPHIC DESCRIPTION: Seward Peninsula and the adjacent mainland drained by all streams flowing into Norton Sound.

BACKGROUND

Before 1930 very few moose were observed on the Seward Peninsula. However, by the late 1960s much of the suitable habitat in Unit 22 contained moose. Moose populations grew rapidly in the 1960s through the early 1980s and peaked in the mid-1980s in most parts of the unit. Severe winters in 1989, 1990, and 1992 caused declines in moose densities because winter browse was insufficient to maintain such large populations in Units 22B and 22D (Nelson 1995). Populations in these areas never recovered and recent data indicate 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 higher 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 population surveys were completed using fixed-wing Piper PA12 and SuperCub type aircraft. Geospatial population estimation (GSPE) techniques were used in February and March 2010 to estimate abundance of moose in Unit 22B (west of the Darby Mountains) and Unit 22C, and in Units 22D and 22E in February and March 2011 (J. Ver Hoef, ADF&G, personal communication). Population estimates from this reporting period are comparable to previous geospatial census efforts completed in the same areas of Unit 22C and 22B (February and March 2001, 2004, and 2007) and Units 22D and 22E (2002 and 2006). 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.

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 22B, 22C, 22D, and 22E are discussed below, respectively, and are presented in Table 2.

Population Size

None of the GSPE moose censuses completed during the survey found a statistical change in the area’s population since previous censuses were completed (Table 2). We used a C-185 with 4 occupants (pilot and 3 observers) to stratify survey areas into “high” and “low” boxes. Super Cub type aircraft (PA-12, PA-18) were used to intensively search boxes for moose.

In Unit 22C, a 2010 census estimated 663 moose (90% C.I. ± 17.0%). Low level intensive searches were conducted in 92 of 293 (31%) sample units to locate and count moose. The GSPE technique found 0.48 moose/mi², 24 calves:100 adults and a 20% recruitment rate (Table 2).

In Unit 22B (west of the Darby Mountains), a 2010 census estimated 570 moose (90% C.I. ± 26.0%). Low level intensive searches were conducted in 117 of 440 (27%) sample units to locate and count moose. The GSPE technique found 0.24 moose/mi², 11 calves:100 adults and a 10% recruitment rate (Table 2).

In 2011 we generated separate estimates for Unit 22D Kuzitrin River drainage (1,610 mi^2) and Unit 22D Agiapuk River drainage (1271 mi^2) to facilitate quota based hunt management in Unit 22D Kuzitrin (Table 2). The estimate for the Kuzitrin River drainage was 902 moose (90% C.I. ± 25.8%), and we found 0.56 moose/ mi^2, 10 calves:100 adults, and a 9% recruitment rate. The estimate for the Agiapuk River drainage was 700 moose (90% C.I. ± 30.5%), and we found 0.55 moose/ mi^2, 14 calves:100 adults, and a 12% recruitment rate. Although not additive, the census results for both Unit 22D areas combined was 1601 moose (90% C.I. ± 21.8%); 0.56 moose/ mi^2; 12 calves:100 adults; and a 10% recruitment rate.

In Unit 22E, a 2011 census estimated 669 moose (90% C.I. ± 15.7%). Low level intensive searches were conducted in 189 of 727 (26%) sample units to locate and count moose. The GSPE technique found 0.15 moose/ mi^2, 11 calves:100 adults, and a 10% recruitment rate (Table 2).

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 2009, 2010, and 2011 we completed comprehensive surveys in Unit 22C. In 2011 composition surveys were completed in the Unit 22D Kuzitrin River drainage and Unit 22D Agiapuk River drainage.

Unit 22C. The 2009 moose composition survey completed in Unit 22C classified 268 moose and found 13 bulls:100 cows, 19 calves:100 cows, and 14% calves. The composition survey completed in 2010 classified 217 moose yielding summary data of 11 bulls:100 cows, 16 calves:100 cows, and 13% calves (Table 3). Staff classified 194 moose during the 2011 survey, and found 13 bulls:100 cows, 15 calves:100 cows, and 12 % calves. Annual composition surveys completed in Unit 22C since 2006 found bull:cow ratios below 20B:100C suggesting hunt management should continue to protect bulls in the population.

Unit 22D. In 2011, we completed a composition survey in a portion of the Kuzitrin drainage, classified 242 moose and found 28 bulls:100 cows, 15 calves:100 cows, and 11% calves. In 2011, we were also able to classify moose in the Agiapuk River drainage for the first time since 2003. We classified 244 moose and found 35 bulls:100 cows, 18 calves:100 adults, and 11% calves during the 2011 Agiapuk survey (Table 3).

Spring. There were no spring short yearling recruitment surveys completed in Unit 22 during the reporting period. Results from previous surveys (1991 through 2009) are found in Table 4.

Distribution and Movements

No studies were undertaken during this reporting period to evaluate distribution or movements of moose in Unit 22.

MORTALITY

Harvest

Seasons and Bag Limits. A regulatory year (RY) begins on 1 July and ends on 30 June (e g. RY09 = 1 July 2009–30 June 2010). Changes were implemented in Units 22A, 22B, and 22D during the reporting period.

Regulatory year *RY09 and RY10* Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik river drainages.		
Residents: 1 bull.	1 Aug–30 Sep	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Sep–14 Sep
Unit 22A, that portion in the Unalakleet River drainage and all drainages flowing into Norton Sound, north of the Golsovia River drainage and south of the Tagoomenik and Shaktoolik river drainages.		
Residents: 1 bull.	1 Sep–14 Sep	
Nonresidents:		No open season
Remainder of Unit 22A		
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–30 Sep

Regulatory year RY09 and RY10 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, Koyuk and Inglutalik rivers.		
Residents: 1 bull.	1 Aug–30 Sep 1 Nov–31 Dec	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Nov–31 Dec
Remainder of Unit 22B,		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only.	1 Jan–31 Jan	
Nonresidents:		No open season
Unit 22C		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 antlerless moose by registration permit.	15 Sep–30 Sep	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Sep–14 Sep
Unit 22D, that portion within the Kougarok, Kuzitrin and Pilgrim river drainages		
Residents: 1 antlered bull by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only.	1 Jan–31 Jan (Season may be announced by emergency order)	

Regulatory year RY09 and RY10 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Nonresidents:		No open season
Unit 22D Southwest, that portion west of the Tisuk River drainage, west of the west bank of the unnamed creek, originating at the unit boundary opposite the headwaters of McAdam's Creek, to its confluence with Tuksuk Channel.		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 bull by registration permit only.	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Remainder of Unit 22D		
Residents: 1 antlered bull or 1 moose; however antlerless moose may be taken only from 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
Unit 22E		
Residents: 1 bull; or	1 Aug–31 Dec	
1 antlered bull.	1 Jan– 31 Jan	
Nonresidents:		No open season

Board of Game Actions and Emergency Orders (EO).

The Board of Game made no changes to the Unit 22 moose seasons or bag limits at their meetings in 2009. Several emergency orders were issued by the department, as follows:

In September 2009, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22B, west of the Darby Mountains. The registration hunt area had a harvest quota of 18 bull moose that was anticipated to be met by 9 September. The EO was issued to prevent overharvest.

In September 2009, the department issued an EO that closed fall registration permit hunt RM850 in Unit 22C. The harvest quota of 5 antlerless moose in Unit 22C was reached, and the EO was issued to prevent overharvest.

In September 2009, the department issued an EO that closed fall registration permit hunt RM852 in Unit 22C. The harvest quota of 10 antlerless moose in Unit 22(C) was reached, and the EO was issued to prevent overharvest.

In December 2009, the department issued an EO that opened winter registration permit hunt RM849 in Unit 22D Southwest and Unit 22D Kuzitrin River Drainage. The fall harvest quota of 58 bulls during fall registration hunt RM840 was not met which left a surplus of 14 antlered bulls available for harvest during the winter hunt.

In January 2010, the department issued an EO that closed winter registration permit hunt RM849 in Unit 22B, west of the Darby Mountains. The harvest quota of 5 antlered bulls was reached, and the EO was issued to prevent overharvest.

In September 2010, 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 8, and the EO was issued to prevent overharvest.

In September 2010, the department issued an EO that closed fall registration permit hunt RM841 in Central Unit 22A. The harvest quota of 14 antlered bulls was expected to be met by September 13, and the EO was issued to prevent overharvest.

In September 2010, the department issued an EO that closed fall registration permit hunt RM850 in Unit 22C. The harvest quota of 7 antlerless moose in Unit 22C was expected to be met by September 19, and the EO was issued to prevent overharvest.

In December 2010, the department issued an EO that opened winter registration permit hunt RM849 in Unit 22D Southwest and Unit 22D Kuzitrin River Drainage. The fall harvest quota of 58 bulls during fall registration hunt RM840 was not met which left a surplus of 24 antlered bulls available for harvest during the winter hunt.

Hunter Harvest. During RY09, harvest report data shows that 655 hunters harvested 193 moose (172 males, 18 females, and 3 unknown). A harvest of 170 moose (148 males and 22 females) was reported taken by 620 hunters during the RY10 season (Table 1).

Moose harvest remained well below harvest levels seen in the 1980s. Hunters reported an annual average harvest of 343 moose 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 RY09, 5 cows were harvested in RM850, and 12 cows were harvested in RM852. In RY10, 7 cows were taken in RM850 and 13 cows were harvested in RM852 (Table 5).

Registration moose hunts with harvest quotas have been in placed in the heavily hunted portions of Units 22B, 22C, and 22D along the Nome road system. In RY09 a total of 397 people reported hunting in RM840 and 87 bull moose were harvested (Table 5). In Unit 22B West hunters harvested 23 bulls (128% of quota). In Unit 22C hunters harvested 20 bulls (50% of 40 bull quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 44 bulls (76% of 58 bull quota). In Unit 22A hunters harvested 11 bulls in RM841 in the central portion of Unit 22A.

In RY09, 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 22D Kuzitrin and 22D Southwest where hunters harvested 8 antlered bulls.

In RY10, a total of 384 people reported hunting in RM840 and 84 bull moose were harvested (Table 5). In Unit 22B West hunters harvested 22 bulls out of the 18 bull quota (122% of quota). In Unit 22C, hunters harvested 27 bulls (90% of quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 35 bulls (60% of 58 bull quota). In Unit 22A hunters harvested 6 bulls in RM841 in the central portion of Unit 22A.

In RY10, winter registration hunt RM849 was administered in Unit 22B and Unit 22D Kuzitrin and 22D. Hunters harvested 5 antlered bulls (100% of quota) in Unit 22B West, and 7 antlered bulls in the Unit 22D hunt areas.

In RY09, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Thirteen hunters reported in RM842, 10 nonresidents hunted, and 7 bulls were taken. In RY10, nonresident registration hunt RM842 was administered in Unit 22D Remainder, and 12 hunters reported. Nine nonresident hunters hunted and 4 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 RY09, 8 permits were issued and 4 hunters hunted, of which 4 hunters harvested bull moose. In RY10, 4 permits were issued and 2 hunters hunted, of which 2 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 78% of the harvest in RY09 and 76% of the harvest in RY10 (Table 6). During 1994–2004 the proportion of harvest attributable to local residents remained 69–74%; however, since 2005 local resident harvest has been higher, 78–90%. The nonresident portion of the harvest accounted for 6% of the harvest in each of RY09 and RY10.

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 8%. Hunters harvested 85% of Unit 22 moose during the months of August, September, and October during the reporting period.

Transport Methods. During this reporting period 41% of successful moose hunters used 3- or 4-wheelers, 25% used boats, 9% used highway vehicles, 10% used snowmachines, and 9% used off road vehicles (Table 8). Only 1% 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 caribou herd and muskox herds that have expanded historic range eastward.

HABITAT

Assessment

Habitat surveys were not completed during the reporting period. 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 lb were an indication moose were resource limited. During April 2006–2009 department staff weighed male and female10-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 lb and 411 lb, respectively. A sample of 30 moose weighed during April 2007 in Units 22C and 22D found average weights of 419 lb and 379 lb, respectively (Table 10). A sample of 30 moose weighed during April 2008 in Units 22C and 22D found average weights of 374 lb and 393 lb, 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 third 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 lb and 372 lb, respectively. Short yearlings weighed during 2009 were born during another deep snow year in 2008, which National Weather Service show as the second 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 lb, 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 completion 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 Units 22B (west of the Darby Mountains), 22C, and 22D.

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 numbers in Units

22B (west of the Darby Mountains) and 22D have changed little since the initial decline found in the late 1980s. The populations in both areas appear to have stabilized at lower densities. We know very little about moose habitat on the Seward Peninsula (see previous discussion), but given results of habitat surveys completed in 2004 and 2006 and results from short-yearling moose capture weights between 2006 and 2009, it seems reasonable to suggest moose densities in Unit 22D are sustainable at current levels, but densities in Unit 22B (west of the Darby Mountains) would be sustainable only if populations remain below the the pre-crash population level in this area.

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 overutilization of the limited winter habitat. Additional effort should be made to harvest antlerless moose to help slow population growth in Unit 22C. The 2010 moose census showed the population remained stable between 2007 and 2010 and is still 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: 2012–Unit 22A, 2013–Units 22B/C, 2014–Units 22D/E, 2015–Unit 22A.

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.

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Table 1. Unit 22 historical moose harvest by sex, hunter effort, and success rate for RY69 through RY10.

Regulatory year	Males	Females	Unknown sex	Total harvest	Total hunters[a]	Percent success
RY69	69	1	2	72	182	40
RY70	70	0	1	71	139	51
RY71	59	0	1	60	168	36
RY72	44	0	0	44	99	44
RY73	103	32	1	136	317	43
RY74	149	72	1	222	479	46
RY75	136	0	2	138	389	35
RY76	186	51	3	240	611	39
RY77	151	88	5	244	457	53
RY78	198	97	2	297	596	50
RY79	193	75	2	270	760	36
RY80	156	71	1	228	492	46
RY81	225	72	1	298	696	43
RY82	244	100	0	344	904	38
RY83	291	68	46	405	1292	31
RY84	298	91	6	395	1086	36
RY85	279	92	3	374	876	43
RY86	306	101	1	408	892	46
RY87	286	20	4	310	775	40
RY88	332	36	7	375	748	50
RY89	208	82	0	290	713	41
RY90	280	70	0	350	700	50
RY91	207	95	0	302	656	46
RY92	217	72	0	289	645	45
RY93	225	21	1	247	553	45
RY94	201	10	0	211	486	43
RY95	169	13	3	185	469	39
RY96	176	20	2	198	456	43
RY97	197	6	0	203	423	48
RY98	195	13	3	211	510	41
RY99	244	5	3	252	581	43
RY00	194	27	0	221	536	41
RY01	119	8	0	127	421	30
RY02	160	12	0	172	563	31
RY03	182	12	2	196	587	33
RY04	179	13	0	192	530	36
RY05	154	8	2	164	544	30
RY06	159	16	0	175	520	34
RY07	184	15	1	200	653	31
RY08	159	16	0	175	520	34
RY09	172	18	3	193	655	30
RY10	148	22	0	170	620	27

[a] Minimum known number of hunters.

Table 2. Summary of Unit 22 spring moose censuses, 1987–2011.

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	13	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	18	Geostatistical
Unit 22A Unalakleet Drainage	2012	2400	440	106	569	0.18	0.23	24	19	Geostatistical
Unit 22B West	1987	2105	1676	218	1894	0.80	0.90	13	12	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	798	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 22B West	2010	2400	512	58	570	0.21	0.24	11	10	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	558	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 22C	2010	1368	533	130	663	0.39	0.48	24	20	Geostatistical
Unit 22D Kuzitrin Drainage	1988	1456	1673	278	1951	1.14	1.34	17	14	Gasaway
Unit 22D Kuzitrin Drainage Reduced	1993	856	943	153	1096	1.10	1.28	16	14	Mod. Gasaway

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 22D Kuzitrin Drainage	1997	1456	1019	232	1251	0.70	0.86	23	19	Mod. Gasaway
Unit 22D Kuzitrin Drainage	2002	1456	911	114	1028	0.63	0.71	13	11	Geostatistical
Unit 22D Kuzitrin Drainage	2006	1610	821	145	966	0.51	0.60	18	15	Geostatistical
Unit 22D Kuzitrin Drainange	2011	1610	821	81	902	0.51	0.56	10	9	Geostatistical
Unit 22D Agiapuk Drainage	1988	1041	782	159	941	0.75	0.90	20	17	Gasaway
Unit 22D Agiapuk Drainage Reduced	1993	723	406	77	483	0.56	0.66	19	16	Mod. Gasaway
Unit 22D Agiapuk Drainage	1997	1041	451	127	578	0.43	0.56	28	22	Mod. Gasaway
Unit 22D Agiapuk Drainage	2002	1041	485	82	567	0.47	0.54	17	14	Geostatistical
Unit 22D Agiapuk Drainage	2006	1271	443	156	599	0.35	0.47	35	26	Geostatistical
Unit 22D Agiapuk Drainage	2011	1271	616	84	700	0.48	0.55	14	12	Geostatistical
Unit 22E	1991	NA	208	18	226	NA	NA	9	8	Riparian Survey
Unit 22E	1996	NA	164	32	196	NA	NA	20	16	Riparian Survey
Unit 22E	2001	NA	157	12	169	NA	NA	8	7	Riparian Survey
Unit 22E	2003	4500	408	96	504	0.09	0.11	23	19	Geostatistical
Unit 22E	2006	4500	481	106	587	0.11	0.13	22	18	Geostatistical
Unit 22E	2011	4500	602	67	669	0.13	0.15	11	10	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 2000–2011.

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
Koyuk River	2004	12	0	0	0	56	56
Unit 22C							
Snake River	1992	11	30	11	21	41	52
	1994	14	32	12	22	42	54
	2000	10	25	16	19	69	85
Snake/Stewart Rivers	2001	25	21	24	15	140	164
	2002	24	43	32	26	93	125
	2004	11	31	28	22	101	129
	2005	27	39	26	24	84	110
	2006	14	20	18	15	104	122
	2007	17	27	26	19	111	137
	2008[11]	11	10	17	8	194	211
	2009[1]	13	19	38	14	230	268
	2010	11	16	30	13	187	217
	2011	13	15	23	12	171	194

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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
	2011	28	15	26	11	216	242
Agiapuk	2000	44	23	43	14	275	318
	2001	30	6	5	4	107	112
	2003	24	27	40	18	183	223
	2011	35	18	28	11	216	244

[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
Unalakleet, main stem (Unit 22A)				
2000	7	77	84	8
2003	3	16	19	16
2006	13	37	50	26
2007	12	70	82	15
Central Portion (Unit 22A)				
2006	27	137	164	16
2007	12	82	94	13
Shaktoolik, main stem (Unit 22A)				
2000	5	40	45	11
2003	2	11	13	15
Ungalik, main stem (Unit 22A)				
2000	1	28	29	3
2003	0	1	1	0
Golsovia drainage (Unit 22A)				
2000	4	11	15	27
2003	6	23	29	21
Pikmiktalik main stem (Unit 22A)				
2000	2	4	6	33
2003	6	11	17	35
Fish River (Unit 22B)				
1991	12	202	214	6
1993	11	227	238	5
1994	15	255	270	6
1995	16	384	400	4
Niukluk River (Unit 22B)				
1991	30	319	349	9
1995	13	133	146	9
1997	6	77	83	7
2000	9	81	90	10
2003	6	59	65	9
West of Darby Mountains (Unit 22B)				
2006	19	189	208	9
2007	3	83	86	3
Koyuk River (Unit 22B)				
1999	21	208	229	9
2000	19	223	242	8
2004	12	54	66	18
2005	13	89	102	13

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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 Kougarok River (Unit 22D)				
1991	14	103	117	12
1994	33	153	186	18
1995	42	227	269	16
2000	16	168	184	9
2003	32	180	212	15
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 RY09 and RY10.

RY	Hunt	Total moose killed	Males killed	Females killed	Unknown killed	Total permittees reporting	Hunted	Did not hunt
RY09	RM840	87	87	0	0	489	397	92
RY09	RM841	11	11	0	0	96	61	35
RY09	RM842	7	7	0	0	13	10	3
RY09	RM849	13	13	0	0	64	29	35
RY09	RM850	5	0	5	0	10	10	0
RY09	RM852	12	0	12	0	20	18	2
RY09	RM853	1	1	0	0	5	4	1
RY10	RM840	84	84	0	0	506	384	122
RY10	RM841	6	6	0	0	67	36	31
RY10	RM842	4	4	0	0	12	9	3
RY10	RM849	12	12	0	0	55	41	14
RY10	RM850	7	0	7	0	8	8	0
RY10	RM852	13	0	13	0	18	18	0
RY10	RM853	2	2	0	0	14	4	10

Table 6. Residency and success of moose hunters in Unit 22, RY09 and RY10.

Regulatory Year/Unit	Residency of successful hunters Unit[a]	State[b]	Nonresident	Unknown	Total	Residency of unsuccessful hunters Unit[a]	State[b]	Nonresident	Unknown	Total
RY09										
22A	18	0	0	0	18	42	1	1	0	44
22B	35	2	4	1	42	67	11	4	1	83
22C	33	3	0	0	36	145	17	2	0	164
22D	54	15	7	0	76	121	16	3	2	142
22E	11	4	1	5	21	12	4	3	0	19
22 unk	0	0	0	0	0	6	2	0	0	8
Total	151	24	12	6	193	393	51	13	3	460
RY10										
22A	13	1	1	1	16	30	2	0	0	32
22B	29	4	2	0	35	55	9	2	6	72
22C	41	5	1	0	47	155	8	5	2	170
22D	39	12	5	2	58	107	29	7	8	151
22E	8	2	1	3	14	6	5	2	4	17
22 unk	0	0	0	0	0	6	1	0	0	7
Total	130	24	10	6	170	359	54	16	20	449

[a] Resident of Unit 22.
[b] Other Alaska resident.

Table 7. Chronology of Unit 22 moose harvest, RY09 and RY10.

Regulatory year/ Unit	Month of harvest									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
RY09										
22A	3	13	0	0	0	1	0	0	1	18
22B	4	27	0	5	0	5	0	0	1	42
22C	0	36	0	0	0	0	0	0	0	36
22D	1	54	9	0	1	8	0	0	3	76
22E	3	11	3	0	4	0	0	0	0	21
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	11	141	12	5	5	14	0	0	5	193
RY10										
22A	2	10	0	0	0	3	1	0	0	16
22B	4	24	0	2	0	4	0	0	1	35
22C	0	45	0	0	0	0	0	0	2	47
22D	0	45	5	0	0	7	0	0	1	58
22E	1	7	3	0	0	0	0	3	0	14
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	7	131	8	2	0	14	1	3	4	170

Table 8. Means of transportation reported by successful Unit 22 moose hunters, RY09 and RY10.

Regulatory Year/Unit	Aircraft	Horse	Boat	3 or 4 Wheeler	Snowmobile	Off-road vehicle	Highway vehicle	Air boat	Unknown	Total
<u>RY09</u>										
22A	0	0	11	3	1	1	1	0	1	18
22B	0	0	20	10	4	6	2	0	0	42
22C	0	0	4	22	0	4	6	0	0	36
22D	3	0	16	32	9	8	3	2	3	76
22E	0	0	2	15	4	0	0	0	0	21
Total	3	0	53	82	18	19	12	2	4	193
<u>RY10</u>										
22A	1	0	7	3	4	0	1	0	0	16
22B	0	0	16	8	6	3	2	0	0	35
22C	0	0	2	26	0	4	10	0	5	47
22D	0	0	10	24	7	4	6	1	6	58
22E	0	0	2	5	3	4	0	0	0	14
Total	1	0	37	66	20	15	19	1	11	170

Table 9. Categorization of browse shrub architecture and health of moose winter range in parts of Unit 22, 2004–2006.

Area	Date	n[a]	% unbrowsed	% browsed by moose	Broom index[b]	% browsed by hare	% none dead	% less dead	% more dead	Average Nr. dead[c]
22A Unalakleet	Aug 2005	859	24.3	55.3	19.3	6.7	3.8	90.7	5.5	0.41
22C Nome/Snake/ Flambeau	Mar 2004	960	7.6	32.6	64.7	0	1.1	87.0	11.9	0.44
22B Fish/Niukluk	Jun 2004	531	8.7	47.5	46.7	2.2	0	96.4	3.6	0
22D Kuzitrin	Jun 2004	545	4.5	29.0	69.5	0.2	0.4	92.1	7.5	0
22D Agiapuk	Sep 2006	960	1.0	29.7	70.0	0	0	98.5	1.5	0
22B Fish/Niukluk	April 2006	900	3.0	42.7	56.0	0	0.2	94.5	5.3	0.03

[a]Number of shrubs categorized along linear transect, across all transects in count area.

[b]Index is proportion of shrubs receiving any browsing that were broomed ((broomed / [browsed + broomed])* 100), by respective herbivore.

[c]Average number of dead shrubs encountered during the course of getting 30 live shrubs to evaluate.

Table 10. Short-yearling moose weight results in parts of Unit 22, 2006–2009.

	Unit 22B		Unit 22C		Unit 22D Kuzitrin drainage	
Year	Nr	Mean weight, lb	Nr	Mean weight, lb	Nr	Mean weight, lb
2006	15	417	14	411		
2007			14	419	16	379
2008			5	374	24	393
2009			16	371	14	372

SPECIES

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 2009
To: 30 June 2011

LOCATION

GAME MANAGEMENT UNIT: 23 (43,000 mi^2)

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 decline throughout the unit. From the mid-1990s through this reporting period calf recruitment throughout most of the unit has been low, and 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. This ratio is higher than the standard 20–30 bulls:100 cows used in most areas because moose populations in Unit 23 are widely distributed and occur at low densities.
- 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 the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM). Two spring moose surveys were conducted in Unit 23 since the last report was prepared:

1. That portion of the Noatak River drainage above but not including Kaluktavik Creek (March and April 2010; cooperative project with NPS, USFWS and BLM). This survey area is referred to in tables as the Upper Noatak.
2. The entire Selawik and Kauk River drainages (April 2011; cooperative project with NPS, and USFWS). This survey area is referred to in tables as the Selawik.

In defining geospatial moose survey areas we excluded areas that were obviously not moose habitat, for example, high alpine areas typical of sheep habitat and very large lakes. For most moose survey areas sample units were subjectively excluded; however, for some areas, a quantitative GIS-based exclusion criteria was generated. Despite these exclusions, large areas of open tundra, as well as the headwaters of rivers and creeks, are surveyed even though such areas are often poor moose habitat. These more marginal areas have been included in GPSE surveys because they were utilized when moose were at higher densities in the late 1980s. Even now, at lower densities, a few moose still use these poor to marginal habitats. An inclusive survey approach covering large geographic areas (e.g., >4,000 mi^2) has been effective by 1) ensuring that a broad range of moose habitat types and quality will be included, 2) reducing the effects of snow-induced movements of moose on survey results, and 3) reducing the temptation to perpetually 'adjust' survey boundaries through time to fit changing environmental conditions. Adult moose densities, rather than total moose densities, are reported as a measure of abundance to avoid natural, short-term variation associated with calf production and survival.

In addition to abundance 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.

Since 2008, ADF&G, in cooperation with USFWS, NPS, and in some years BLM have conducted fall moose geospatial composition surveys. During this reporting period, the Northern Seward Peninsula, and Selawik drainages were surveyed. The technique is a more streamlined approach to GSPE design focusing on desktop stratification to determine 'high' and 'low' strata. Additionally, 150 sample boxes are considered acceptable to adequately characterize the area, despite the understanding that confidence intervals will widen as a result.

In 2010, ADF&G conducted twinning surveys to begin to collect baseline measures of habitat quality. Our surveys focused on the Kobuk Delta in late May and early June. The objective was to see as many parturient cows as possible. Ratios were generated for the number of cows with twins per number of parturient cows.

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 any hunter, resident or nonresident, residing outside of Unit 23. "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 2000-2011 indicate Unit 23 adult moose densities ranged from 0.03 to 0.59 adult moose/mi^2 (Table 1). Adult density appears to be stable based on the 4 large sample areas that have been surveyed at least twice using the GSPE approach (Lower Noatak-Upper Squirrel; Northern Seward Peninsula; Selawik; and Upper Kobuk).

Since sightability (e. g., through use of a sightability correction factor, SCF) has not been applied to Unit 23 geospatial population estimates, we 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 2010) and their consistency here through time suggest moose density is, in fact, low and not an artifact of conservative estimates. Of course, localized densities in preferred habitat can exceed 0.6 moose/mi^2, especially when moose are seasonally aggregated. The main stem of the Kobuk River below Kiana has the highest year-round density and proportion of calves in the unit (Tables 1 and 2). The Mulgrave Hills, upper Squirrel River drainage and northern portion of the Selawik Hills also have high, localized densities of moose on a seasonal or even annual basis.

Conducting geospatial population estimates in areas with low density moose populations results in unique challenges that are important to consider. One potential source of complication is from stratification surveys. While stratification increases the efficiency of annual surveys, it may obscure detection of trends in a population sampled over multiple years. If stratification changes measurably between surveys, each stratification scenario should be compared against each dataset to help illuminate trends. However, sampling bias makes these analyses purely exploratory. Data from surveys on the Northern Seward Peninsula support this technique. Surveys done in 2002, 2004, and 2009 suggest an increasing trend when each survey is considered independently (Table 1). However, each successive survey considered more sample units as having a high likelihood of moose presence (through cumulative knowledge of previous surveys and a switch from desktop stratification). When all datasets are considered against one selected stratification scenario, they suggest that instead of increasing the population is stable or decreasing. Considering this information with the observed calf ratios, it seems the more plausible explanation of population trend in this area.

Population Composition

Spring (March–April) calf:adult ratios were 8–12:100 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 widely, 12–34:100 cows, as some areas naturally contain higher concentrations of maternal cows.

Previous reconnaissance surveys conducted 2004–2007 found a unitwide mean bull:cow ratio of 39:100 (Table 2). Bull:cow ratios ranged 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. The fall 2009 geospatial composition estimate for the Northern Seward Peninsula drainages resulted in a bull:cow ratio of 53:100. The fall 2010 geospatial composition estimate for the Selawik River drainage resulted in a bull:cow ratio of 47:100 (Table 2). These data are not comparable to reconnaissance surveys and are therefore not indicative of a change in sex and age composition. Rather, these data 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 and 2008 and 2010 (18:100 and 19:100 respectively) and a much lower calf:cow ratio of 4:100 on the Northern Seward Peninsula. Calf:cow ratios can fluctuate wildly from year to year due to poor cohort success. However, it is also important to note the extremely wide confidence intervals accompanying this survey. The two factors strongly influencing confidence intervals are sampling a high proportion of moose and variation in group size. For example, in the 2010 Selawik survey the confidence intervals are 10% wider but the number of moose observed was slightly higher than when the area was examined in 2008. There were also fewer stratification errors observed, which can greatly influence confidence intervals. However, a basic examination of these data shows higher variability in group size in 2010 and it is statistically significant (Bartlett's Test of Equal Variances Chi-Sq= 10.5, p= 0.0012). In 2008, there were only 2 groups larger than 20 whereas in 2010 there were 6 groups. These very large groups may be a product of clumpy distribution that could have a great impact on confidence intervals.

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, for example, 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. A regulatory year (RY) begins on 1 July and ends on 30 June (e g. RY09 = 1 July 2009–30 June 2010).

Regulatory year RY09 and RY10 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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.	1 Sep–20 Sep (general hunt) (harvest ticket)	1 Sep–20 Sep (drawing permit only)
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 Jul–31 Dec (registration hunt)	
Remainder of Unit 23:		
One bull with 50-inch antlers or antlers with 4 or more brow tines on one side.	1 Sep–20 Sep (general hunt) (harvest ticket)	1 Sep–20 Sep (drawing permit only)
OR		
One moose by registration permit only; however, antlerless moose may be taken only 1 Nov–31 Dec; a person may not take a calf or a cow accompanied by a calf.	1 Aug–31 Dec (registration hunt)	

Board of Game Actions and Emergency Orders. The board reauthorized antlerless moose seasons for RY09 and RY10. No emergency orders were issued during RY09 and RY10.

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 78 and 102 moose unit residents indicated on harvest reports in RY09 and RY10, respectively. However, the largest influencing factor on the community-based estimate is the Kotzebue-specific estimate which is now 20 years old and may have been biased high when data were collected. Although establishment of registration permit hunt RM880 appears to have improved compliance with licensing and reporting requirements for local moose hunters, community harvest data suggest compliance is still far from complete. However, compliance among Kotzebue hunters is likely higher than other communities and it seems unreasonable that only 20% of harvested moose are reported. 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 (72 moose in RY09 and 84 moose in RY10) with community harvest assessments for local hunters (mean harvest of 418 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. In RY10, use of moose by Unit 23 residents was higher as was the antlerless moose harvest (18 cows taken). This is likely related to the absence of caribou in the western portions of Unit 23.

Based on harvest report data, there has been a stable trend in total annual moose harvest since the late 1970s (Table 4; Fig. 1). In contrast, the total number of moose hunters generally increased since the early 1980s (Figs. 1 and 2). Prior to RY03, when regulations were restructured, most of this increase in hunters was due to nonlocal Alaskan hunters and nonresident hunters (Fig. 2). However, after RY03 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 (Fig. 3). However, in the years following establishment of nonresident drawing moose hunts (RY05 to present), success rates among that group increased.

As in the past, the reported harvest of female moose was small during RY09 and RY10 in terms of absolute numbers (10 and 17 taken respectively; Table 5), and in relation to total harvest (6% and 9%, respectively). However, the number and proportion of females in the harvest was higher than the 10-year and 20-year average. This is likely due at least in part, to the lack of caribou in the western part of the traditional fall caribou migration corridor. Hunters may have had to shift their effort to moose once it became clear that they would not have access to caribou.

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 (Fig. 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. However, this may have also been influenced by commercial service trends and authorizations within the Selawik National Wildlife Refuge.

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, disproportionate hunting pressure and user conflict issues.

Drawing permit hunts for nonresident hunters were instituted during RY05. 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 RY00 through RY04. This regulatory change markedly reduced numbers of nonresident moose hunters but only moderately reduced their harvest levels (Figs. 1 and 2).

The resident registration hunt (RM880) was instituted in RY04 and is described by Dau (2008). During this reporting period, most local resident moose hunters (mean = 87%) participated in RM880 (Table 6). In contrast, most nonlocal Alaskan moose hunters (mean = 71%) hunted under the general hunt. However, this pattern may be changing as a higher proportion of nonlocal hunters acquire RM880 permits. RM880 permits provide a longer season and allow for the take of “any bull.” Additionally, RM880 hunters may take an antlerless moose beginning 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 RY05, when the overall number of moose hunters in Unit 23 dipped below the level of previous years (Fig. 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 (Fig. 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. Participation by nonlocal Alaskan hunters has now returned to pre-RM880 levels.

Success rates among all users declined steadily beginning in 1970 and stabilized in the mid-1990s (Fig. 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 RY09, 74% of the reported harvest occurred during September, and in RY10, this percentage was 70%. Fourteen and 11% of the total harvest was taken during August during these regulatory years, respectively. In RY10, a significant spike in the harvest occurred in December when 9% of the total harvest was taken. As mentioned before, this is likely due to the unavailability of caribou in the western portions of Unit 23.

Transport Methods: Airplane was the primary mode of transportation for most hunters who reported hunting moose in Unit 23 until RY05 (Table 7). However, as numbers of local residents who reported hunting moose have increased while numbers of nonlocal hunters have decreased, since RY05, the number of boat hunters has 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, ADF&G, Fairbanks, personal communication). In summer 2006, this same individual floated the Upper Kobuk River drainage from Walker Lake to Kobuk and reported similar findings.

Twinning surveys were flown in the Lower Kobuk in 2010 as a secondary indicator of habitat quality. Data were considered cumulatively since it is proportional data (Fig. 5). We saw 62 parturient cows and observed an 18% twinning rate (95% CI 8-27). Considering just the peak flight, we saw 32 parturient cows (twinning rate of 14%). We saw 101 yearlings; however, this is the group with which we have the biggest classification error.

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.
- ADF&G 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.
- In 2009, the Board of Game passed a pilot orientation requirement for all individuals looking to transport hunters or their gear in Unit 23. This tool is currently being evaluated for its efficacy.

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 recruitment has remained low in all areas.

The department should continue with the strategy of monitoring moose abundance by conducting spring population estimates over large areas (4,000–10,000 mi^2). Covering large areas minimizes the effects of moose movements on density estimates, and ensures the full range of habitat and snow conditions are included. Snow and light conditions are optimal for observing moose during spring. Sampling areas should rotate each year so data are collected regularly 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. A study evaluating the accuracy of harvest ticket data for Kotzebue, or simply a community-based harvest survey of Kotzebue, would be very advantageous for understanding the amount of unreported harvest and how it has changed over time.

Future effort in Unit 23 should focus on habitat assessment using browse surveys, parturition surveys or twinning surveys (or some combination of these assessments.)

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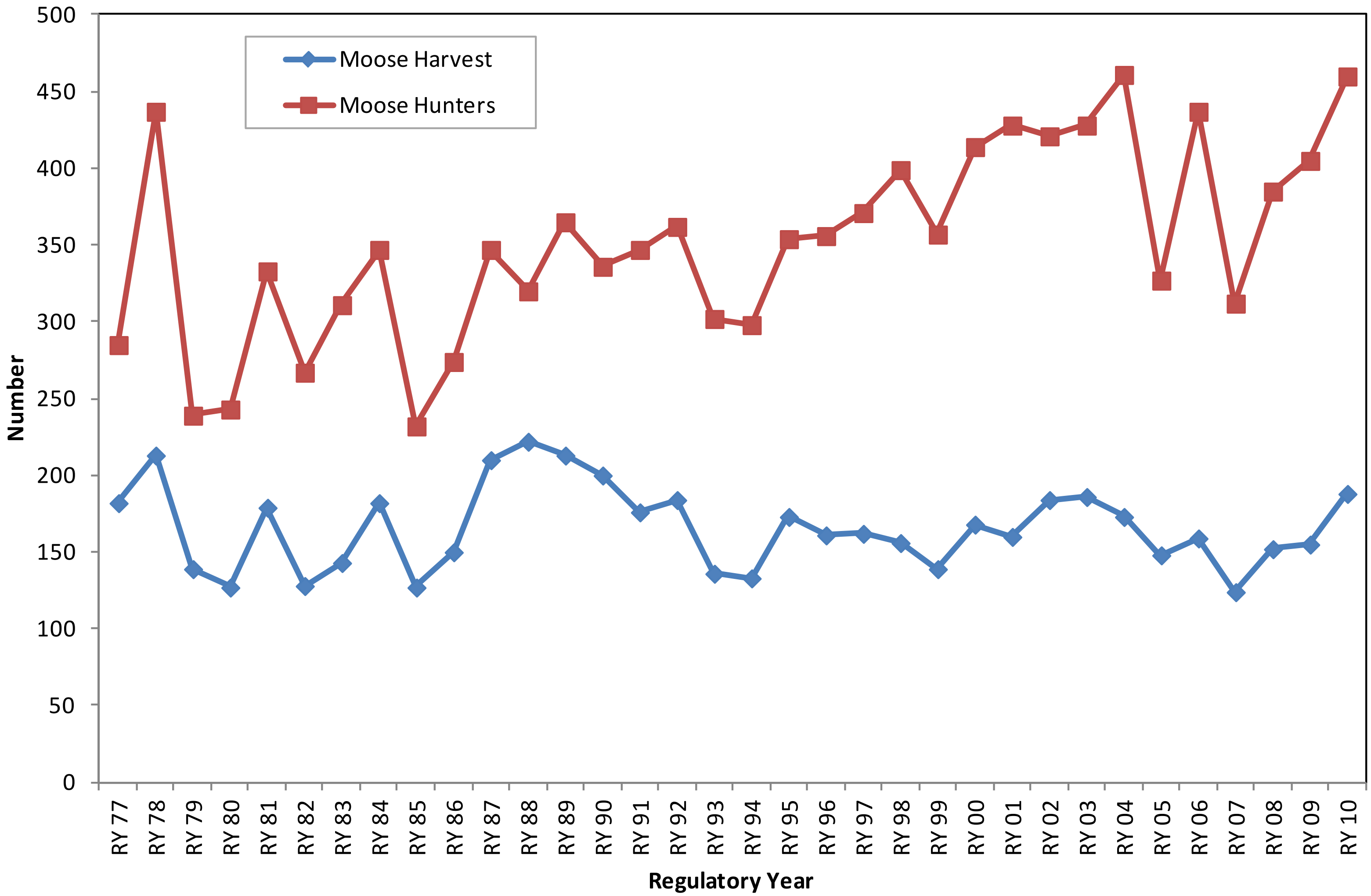

Figure 1. Unit 23 moose hunters and harvests (harvest and registration report data), RY77 through RY10.

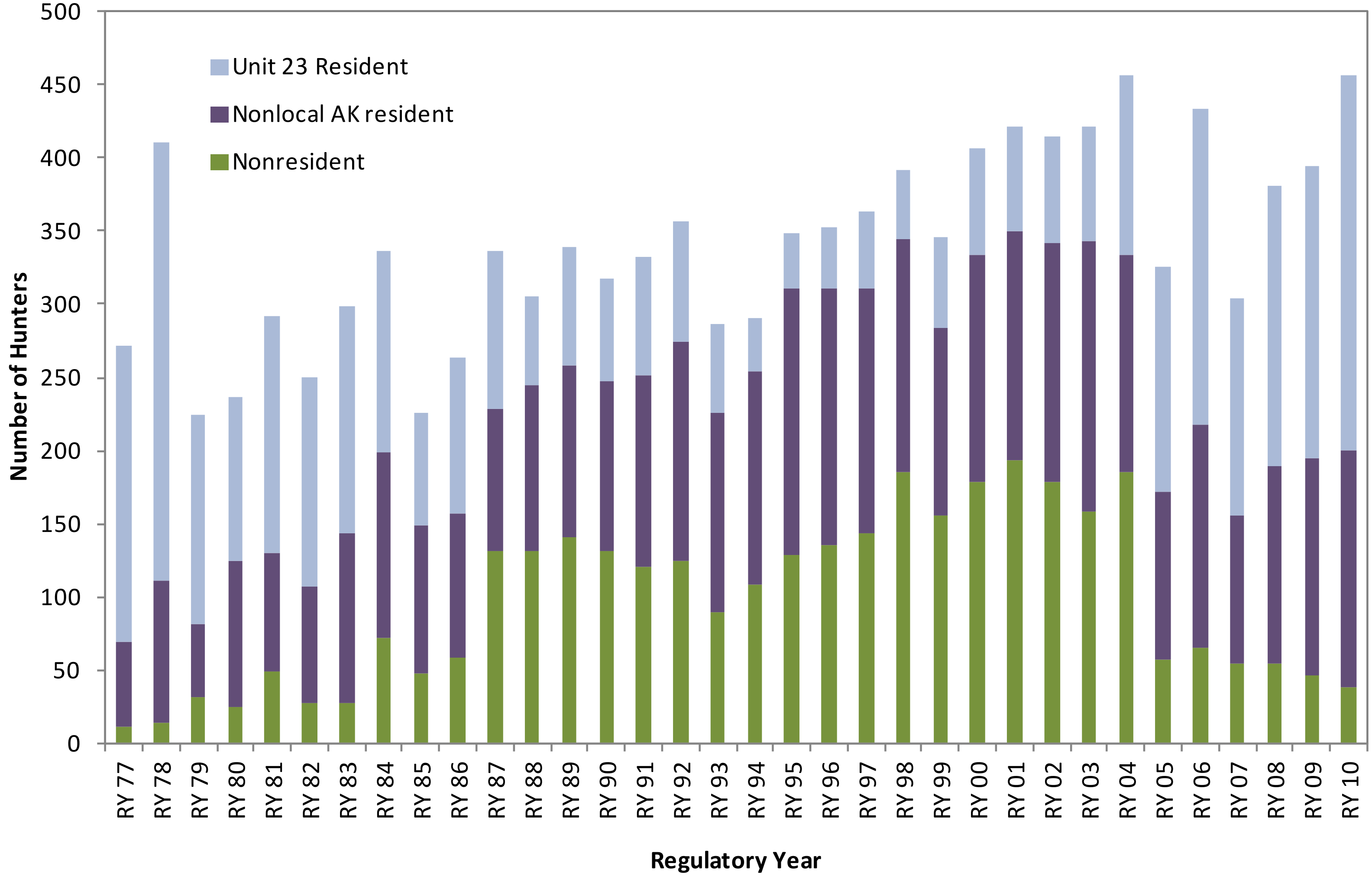

Figure 2. Numbers of moose hunters in Unit 23 by residency (harvest and registration report data), RY77 through RY10.

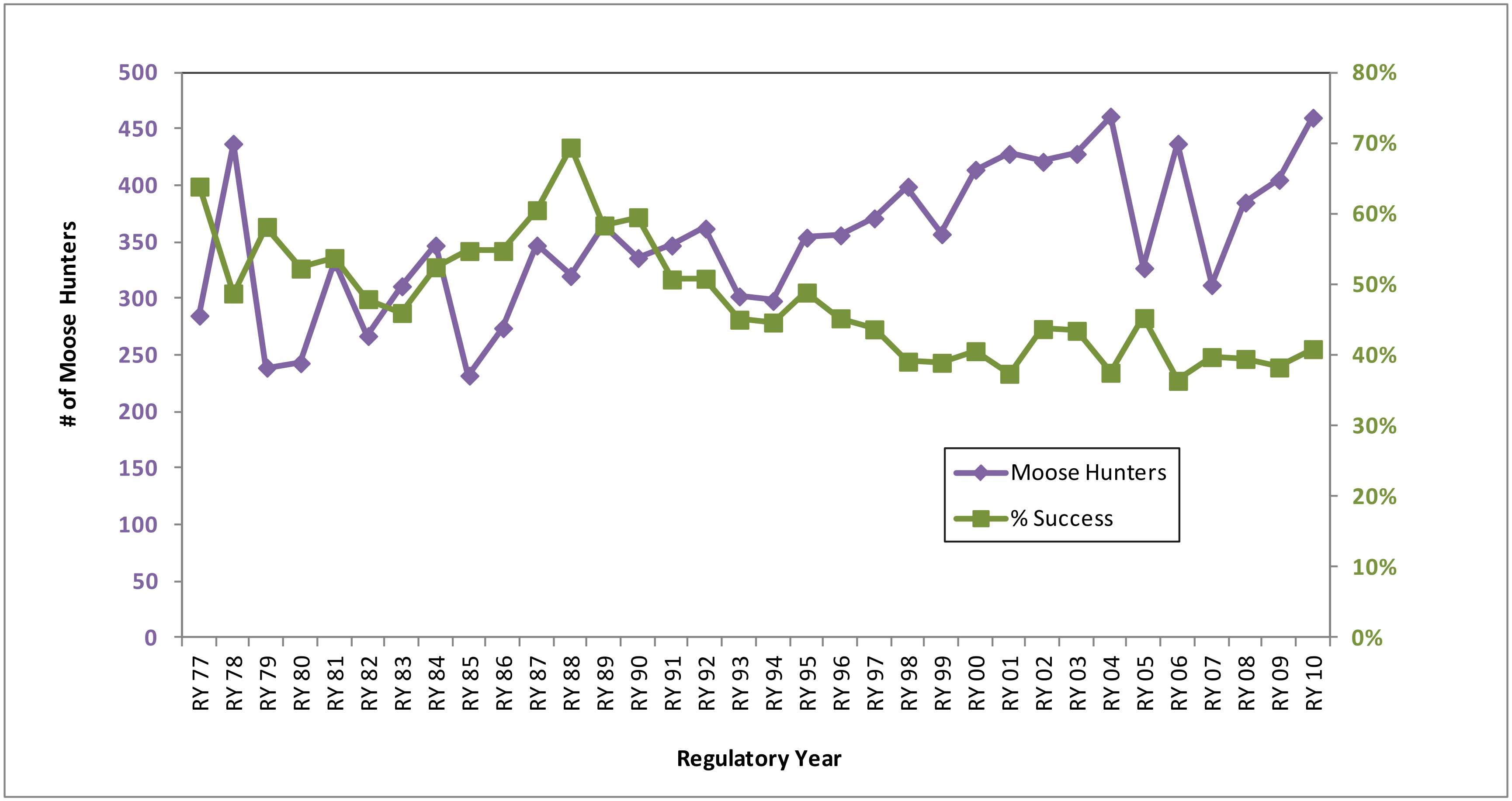

Figure 3. Unit 23 moose hunter effort and success (harvest and registration report data), RY77 through RY10.

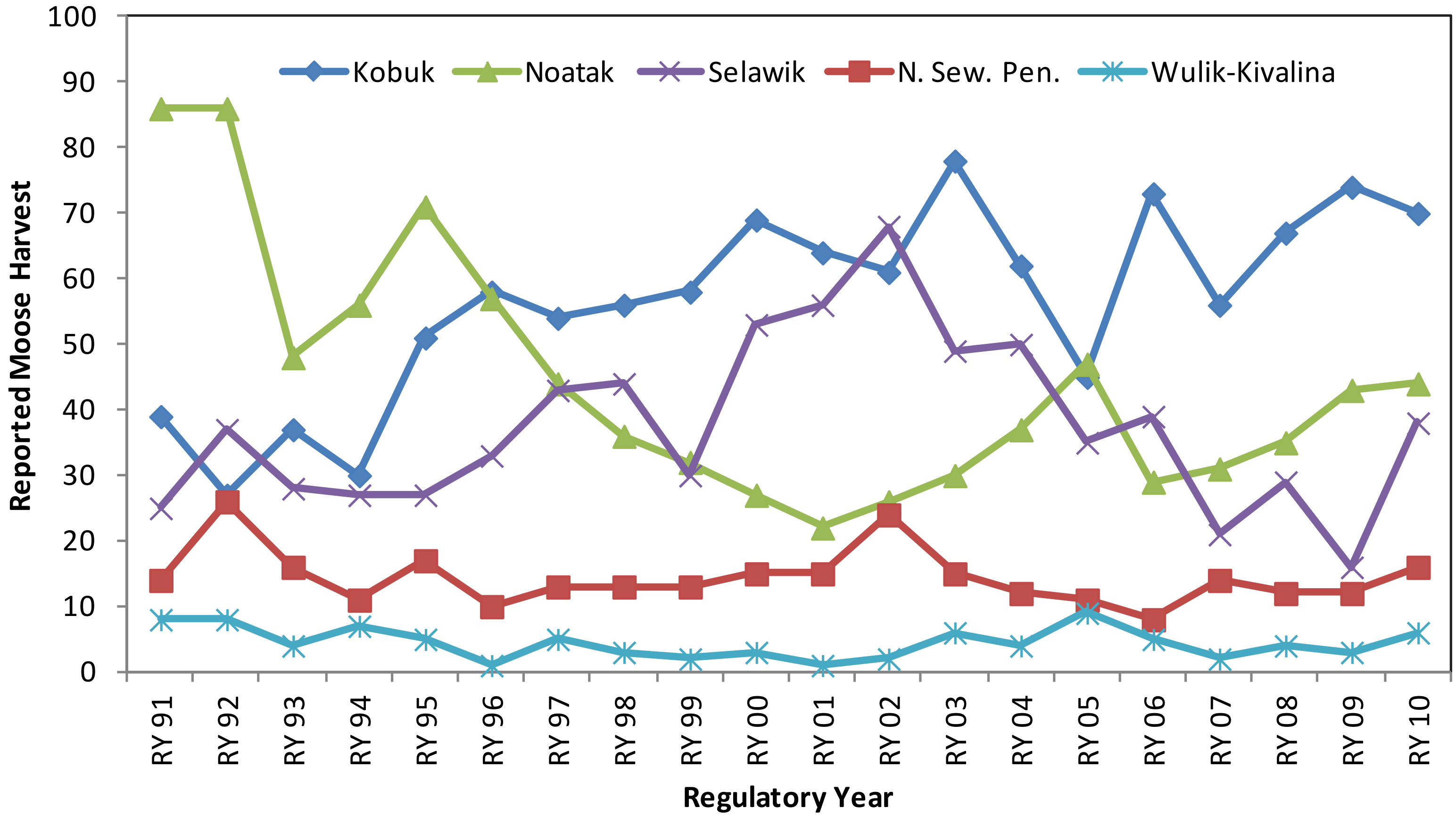

Figure 4. Unit 23 moose harvest by drainage (harvest and registration report data), RY83 through RY10.

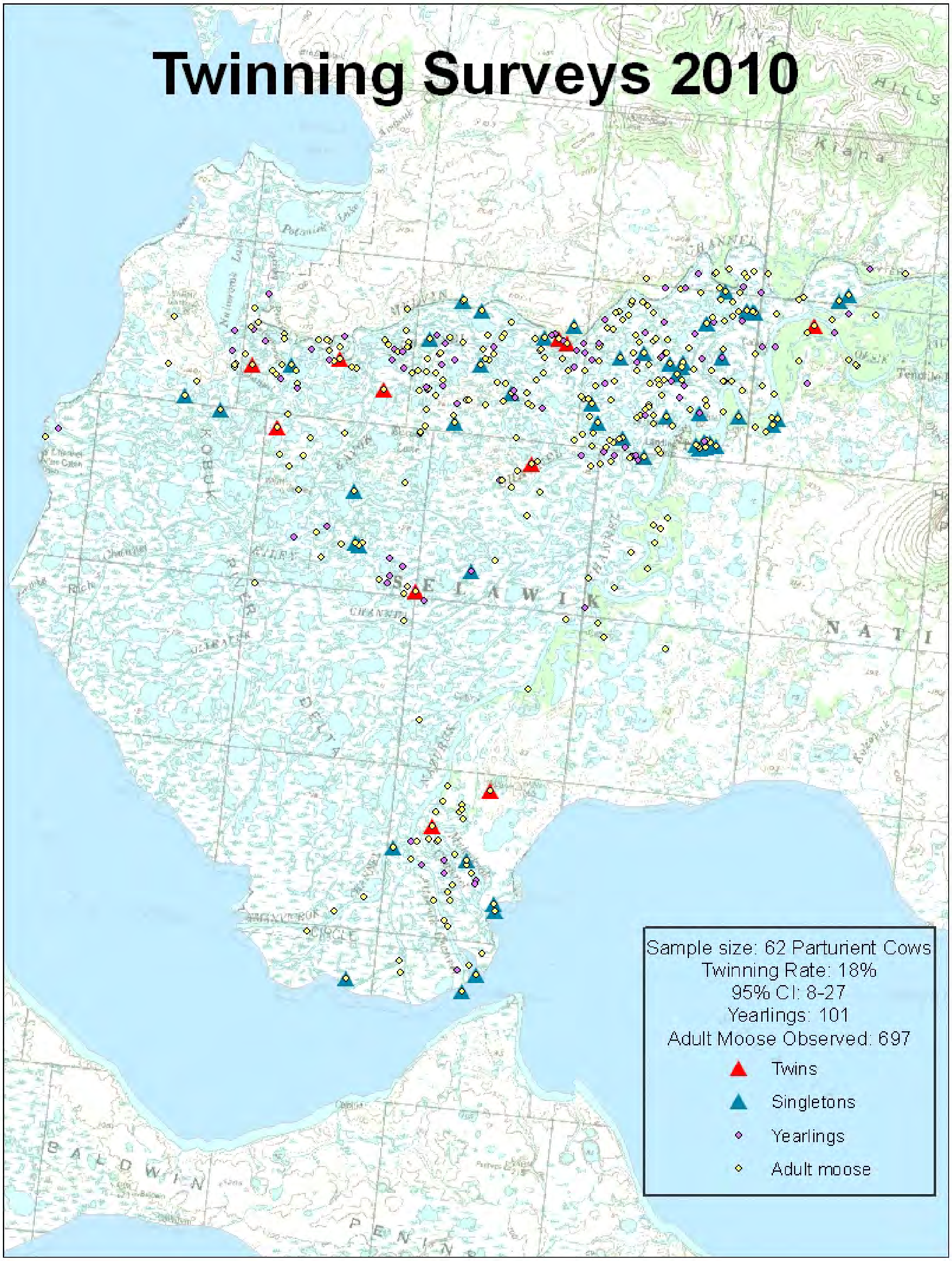

Figure 5. Results from moose twinning surveys of the Lower Kobuk Delta, May 2010.

Table 1. Unit 23 spring geospatial moose survey results, 2000–2011 (all surveys conducted cooperatively by ADF&G, NPS, USFWS and BLM, except as noted).

			Survey estimate (Nr.)				Density ($Nr./mi^2$)		
Area	Year	Size (mi^2)	Adults	Calves	Total[a]	90% CI[b]	Adult	Total	Calves:100 Adults
Selawik	2007	6580.1	2114	208	2319	±16	0.35	0.32	10
Selawik	2011	6559.0	1569	170	1739	±18	0.24	0.27	11
Lower Noatak	2000	2111.2	710	59	779	±19	0.34	0.37	8
Lower Noatak	2001	2111.2	1325	130	1453	±18	0.63	0.69	10
Lower Noatak-Upper Squirrel	2001	5230.2	1580	151	1731	±18	0.30	0.33	10
Lower Noatak-Upper Squirrel	2005	5349.7	1630	208	1838	±19	0.30	0.34	12
Lower Noatak-Upper Squirrel-Wulik-Kivalina-Cape Krusenstern	2008	7161.6	2094	297	2388	±19	0.29	0.33	15
Upper Noatak	2010	4485.6	136	16	152	±18	0.03	0.03	12
N. Seward Peninsula[c]	2002	5888.5	575	38	612	±14	0.10	0.10	7
N. Seward Peninsula[c]	2004	5882.9	728	86	810	±9	0.12	0.14	12
N. Seward Peninsula	2009	5773.2	904	74	966	±27	0.16	0.17	8
Upper Kobuk	2003	4001.5	760	91	856	±19	0.19	0.21	12
Upper Kobuk	2006	4001.5	653	96	737	±22	0.16	0.18	15
Lower Kobuk-Lower Squirrel	2006	4870.5	2891	511	3398	±15	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] Expressed as a percentage of the estimate.

[c] 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. (Data not comparable between survey methods).

	Bull antler size			Cows with calves					Total moose		Ratio (per 100 cows)			
Area	Sp-Fk	Med	Large	0 ca	1 ca	2 ca	3 ca	Lone calf	Observed (% of GSPE)	Spring GSPE (year conducted)	Bulls	90% CI	Calves	90% CI
2004–2007 Avg. Reconnaissance Surveys [a]														
Lower Noatak-Upper Squirrel	22	82	94	352	38	5	0	0	641 (35)	1838 (2005)	50		13	
N. 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	1007	210	21	0	2			39		21	
Geospatial Composition Estimate [bc]														
Selawik (2008)	131	452	375	1455	230	34	0	0	464 (20)	2319(2007)	54	±19%	18	±31%
N. Seward Peninsula (2009)	23	98	85	380	17	0	0	0	152 (15)	966 (2009)	53	±54%	4	±73%
Selawik (2010)	42	475	335	1492	286	32	0	0	474 (26)	2319(2007)	47	±29%	19	±23%

[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 1991–2010 (CSIS information from Subsistence Division, 2010 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 2010	Estimated annual moose harvest in 2010–2011
Ambler	2002, 2009	276	8	0.03	258	7
Buckland	2003, 2009	394	13	0.03	416	10
Deering	1994, 2007	145	8	0.05	122	6
Kiana	1999, 2006, 2009	380	13	0.04	361	13
Kivalina	1992, 2007, 2010	378	11	0.03	374	12
Kobuk	2004, 2009	141	7	0.05	151	7
Kotzebue	1991	3,649	235	0.06	3,201	224
Noatak	1994, 1999, 2001, 2007, 2010	450	6	0.01	514	6
Noorvik	2002, 2008	653	29	0.06	668	40
Point Hope[a]	1992	685	14	0.02	674	14
Selawik	1999, 2006	805	55	0.08	829	62
Shungnak	1998, 2008	266	16	0.06	262	17
Unit 23 Total					**7,830**	**418**

[a] North Slope Borough, unpublished data.

Table 4. Numbers of moose hunters (effort) and harvest by residency (harvest and registration report data), RY91 through RY10.

	Nonlocal AK			Nonresident			Unit 23 resident			Unknown	Total		
Regulatory year	Harvest	Effort	% Success	Harvest	Effort	% Success	Harvest	Effort	% Success	Harvest	Harvest	Effort	% Success
RY91	60	131	46	69	121	57	38	80	48	9	176	347	51
RY92	63	151	42	69	124	56	48	81	59	4	184	362	51
RY93	52	137	38	41	89	46	36	61	59	7	136	302	45
RY94	61	145	42	58	109	53	12	37	32	2	133	298	45
RY95	85	182	47	60	129	47	24	37	65	4	173	354	49
RY96	80	176	45	60	135	44	19	42	45	2	161	356	45
RY97	70	168	42	62	143	43	27	52	52	3	162	371	44
RY98	62	159	39	72	185	39	20	47	43	2	156	399	39
RY99	47	129	36	67	155	40	23	62	37	7	139	357	39
RY00	61	156	39	72	178	40	31	72	43	4	168	414	41
RY01	59	156	38	67	194	35	29	71	41	5	160	428	37
RY02	54	163	33	84	179	47	42	73	58	4	184	421	44
RY03	78	184	42	66	159	42	37	78	47	5	186	428	43
RY04	35	148	24	85	185	46	51	124	41	2	173	461	38
RY05	41	115	36	41	57	72	65	153	42	1	148	327	45
RY06	49	153	32	30	65	46	79	215	37	1	159	437	36
RY07	29	101	29	25	55	45	65	148	44	5	124	312	40
RY08	49	135	36	40	54	74	62	192	32	1	152	385	39
RY09	49	148	33	23	47	49	78	200	39	5	155	405	38
RY10	62	161	39	22	39	56	102	257	40	2	188	460	41

Table 5. Sex of moose harvested (harvest and registration report data), RY91 through RY10.

	Sex of moose harvested		
Year	Male	Female	Unknown
RY91	143	33	0
RY92	159	25	0
RY93	118	17	1
RY94	127	6	0
RY95	164	8	1
RY96	145	15	1
RY97	154	8	0
RY98	146	8	2
RY99	127	11	1
RY00	157	11	0
RY01	150	9	1
RY02	172	11	1
RY03	175	11	0
RY04	173	0	0
RY05	137	10	1
RY06	150	7	2
RY07	117	7	0
RY08	145	6	1
RY09	144	10	1
RY10	168	17	3

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), RY04 through RY10.

	General Hunt				RM880			
	Nonlocal AK		Unit 23 Res.		Nonlocal AK		Unit 23 Res	
Regulatory Year	Harvest	Effort	Harvest	Effort	Harvest	Effort	Harvest	Effort
RY04	31	128	9	15	4	20	42	109
RY05	30	89	13	36	11	26	52	117
RY06	31	115	12	32	18	38	67	183
RY07	15	72	9	35	14	29	56	113
RY08	25	85	4	31	24	50	58	161
RY09	28	107	11	33	21	41	67	167
RY10	34	112	12	28	28	49	90	229
Total	194	708	52	210	120	253	432	1079

Table 7. Percent of moose hunters by transportation type in Unit 23 (harvest and registration report data), RY91 through RY10.

	Airplane	Boat	Snow machine	Horse/Dog	3 or 4 wheeler	Off-road Vehicle	Highway Vehicle	Airboat	Unknown
RY91	67	19	8	1	2	0	1	0	3
RY92	68	17	6	0	2	0	1	0	5
RY93	64	24	6	0	3	1	1	0	2
RY94	64	25	4	1	2	0	1	0	3
RY95	68	22	3	0	5	0	0	0	3
RY96	66	22	6	0	4	0	1	0	2
RY97	67	20	5	1	4	0	1	0	3
RY98	72	19	3	0	3	0	0	0	3
RY99	69	22	5	1	3	0	1	0	0
RY00	63	28	4	1	2	0	0	0	1
RY01	66	27	3	0	2	0	0	0	1
RY02	65	28	3	0	1	0	0	1	1
RY03	59	35	2	1	1	0	0	0	2
RY04	58	36	3	0	2	0	0	0	1
RY05	42	45	5	1	3	0	0	0	2
RY06	36	51	4	1	2	0	0	1	4
RY07	43	46	4	0	2	1	0	0	4
RY08	38	51	4	1	3	0	1	0	3
RY09	37	52	5	0	4	0	0	0	1
RY10	37	50	5	0	4	0	0	0	4

SPECIES 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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 24 (26,068 mi^2); 24A = 4,146 mi^2, 24B = 13,523 mi^2, 24C = 3,049 mi^2, 24D = 5,350 mi^2

GEOGRAPHIC DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

Moose are broadly distributed throughout much of Unit 24, with local densities (0.25–2.0 observable moose/mi^2) typical of Interior Alaska. Anecdotal evidence indicates the population was low prior to the 1930s, but increased during the 1930s–1950s (Huntington 1993). The rate of increase was probably slow until predator control efforts in the 1950s allowed rapid expansion of local populations, especially in the southern third of the unit. During the early 1970s the population reached a peak 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 in spring 2007, browse production is not limiting the size of the moose population in most of Unit 24 (Paragi et al. 2008).

The Koyukuk River and major tributaries are popular moose hunting areas for Unit 24 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 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 Unit 24 increased with the opening of the highway to the public in 1981.

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

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 in state and federal regulations also provide hunting opportunity for residents of Alaska. A registration permit moose hunt was established in 1996 in the Koyukuk CUA downstream from Huslia. Drawing hunts were established in the Koyukuk CUA in 2000, the DHCMA in 2002, and drainages around the Koyukuk CUA in 2004.

Annual reported harvest did not exceed 100 moose until 1980, and was highest in 1999 at 240 moose. Unreported harvests during this period probably were 160–300 moose per year (Woolington 1998). Local residents have become more aware of the importance of harvest reporting, resulting in increased compliance with reporting requirements.

MANAGEMENT DIRECTION

Management was directed according to the following management goals and objectives during the reporting period.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

OBJECTIVE 1: Maintain a moose population of 10,000–12,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

OBJECTIVE 2: Provide for a harvest of moose not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 24.

OBJECTIVE 3: Provide for moose hunting opportunity not to exceed 500 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

OBJECTIVE 1: In combination with Unit 21D, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall Meat Assessment Score of less than "3" for ≤5% of the hunters each regulatory year.

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 ≥65% of the hunters who respond to the survey each regulatory year.

METHODS

POPULATION STATUS AND TREND

Population Size

Beginning in 1999, we conducted population estimation surveys and analyzed data from all population estimation surveys using the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008; Kellie and DeLong 2006). GSPE surveys since 1999 were conducted according to methods and in areas described in Stout (2010).

In 2010, Koyukuk National Wildlife Refuge (NWR) staff conducted a survey on a 1,361 mi^2 area on the western portion of the refuge using GSPE methods described by Stout (2010). In 2011 we completed a GSPE survey in a portion of 24D that overlapped the area conducted in 2004 (Stout 2010). Methods and results of that survey are described in the Unit 21D report (Stout 2012a).

In 2010 and 2011 we completed GSPE surveys on the Kanuti NWR in Unit 24B covering 2,715 mi^2 and in a 1,021 mi^2 area west of the Kanuti NWR referred to as the Upper Koyukuk Management Area (UKMA). The Kanuti NWR portion of the survey area overlapped with surveys conducted in 1999–2008. We based planes and their respective survey teams at the U. S. Fish and Wildlife Service (USFWS) and National Park Service (NPS) facilities in Bettles. Stratification of sample units (SUs) for the 2010 survey was conducted using a Cessna 207. In 2010 we intensively surveyed 205 SUs (69 high density, 136 low density; 1,092 mi^2) of 701 SUs (3,736 mi^2; Stout 2010). In 2011 we intensively surveyed 151 SUs (75 high density, 76 low density; 805 mi^2) of 701 SUs (3,736 mi^2). Due to limited funding, the 2011 survey used stratification data from previous years (75 high density SUs, 627 low density SUs). Using radiocollared moose present in the survey area, we estimated a sightability correction factor (Boertje et al. 2009) for the 2010 survey.

Unit 24 moose population estimates for RY11 were obtained using methods described in Stout (2010). I included range approximations for population estimates to indicate uncertainty in the estimate. Values that include a 90% confidence interval (CI) were statistically derived variances. However, values followed by a (±) symbol that do not have a 90% CI designation were based on knowledge of the area and previously conducted surveys.

Population Composition

Composition data were derived from results of GSPE surveys or counts from TCA surveys. Moose in 4 TCAs (Dulbi Slough, Huslia River Flats, Treat Island, and Middle Fork) were classified as cows, calves, yearling bulls (<30" antler width and no brow tine definition), medium bulls (≥30" and <50" antler width), or large bulls (≥50" antler width) using methods previously described (Stout 2010). 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. For statistical reasons, 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. Timing was critical, so surveys were flown in late May during or within a few days of the median calving date (Boertje et al. 2007) when approximately 50% of the cows observed had calves. This avoided early mortality factors such as predation, which could lead to underestimating twinning rates.

Moose Distribution and Movement

The Alaska Department of Fish and Game (ADF&G) initiated a cooperative moose distribution and movements study in Units 24A and 24B in 2008 (Stout 2010) and continued participation during RY09–RY10. We deployed an additional 37 collars in April 2011 (120 total; 90 VHF transmitters and 30 GPS transmitters on 94 cows and 26 bulls). Relocation flights of VHF transmitters usually occurred once a month, and GPS data were transmitted daily.

HARVEST AND OTHER MORTALITY

Hunting mortality and harvest distribution were monitored through the statewide harvest reporting system using harvest tickets, registration permits, and drawing permits; a moose hunter checkstation on the lower Koyukuk River; and door-to-door subsistence surveys. We encouraged local residents to increase their harvest reporting by providing information at public meetings, checkstations, and village meetings. 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 but did not report their hunt activity were withdrawn from the following year's drawing and registration permit hunts. 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 ADF&G's Wildlife Information Network (WinfoNet) database and accessed 23 April 2012. These data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY10 = 1 July 2010–30 June 2011).

Predation was evaluated using interviews with trappers, field observations, and aerial wolf reconnaissance surveys conducted in cooperation with USFWS during RY09–RY11 (Stout 2012b).

HABITAT

ADF&G staff conducted a browse survey in RY06 in Units 24B and 24C (Stout 2010). No habitat assessment or enhancement was conducted during RY09–RY10.

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 19,580 mi^2 of Unit 24, which is 75% of this 26,068 mi^2 game management unit.

Population Size

Unit 24D. During RY09–RY10, moose were numerous based on previous surveys and inference from TCAs in the Koyukuk River lowlands in Unit 24D (4.2–4.9 moose/mi^2, Tables 1–4). Based on recruitment parameters, the population probably began to stabilize beginning around 2003–2004 (Stout 2010). In the 1,361 mi^2 GSPE survey area completed in 2010, we classified 309 moose and estimated 640 moose (±22%; 90% CI; 0.47 moose/mi^2). In the 1,843 mi^2 GSPE survey area completed in 2011, we classified 1,946 moose and estimated 2,627 moose (±8%; 90% CI; 1.43 moose/mi^2; Stout, 2012a). I estimated the RY10 moose population to be 4,380 moose (±477; Table 5) based on the 2010 and 2011 GSPE surveys and estimates reported in Stout (2010).

Unit 24C. I estimated the RY10 moose population to be 562 observable moose (±130) based on the 2007 GSPE data (Tables 5 and 6; Stout 2010).

Units 24A and 24B. The 2010 and 2011 estimates were not significantly different from the 2007 or 2008 estimates (Table 7). In the 2010 GSPE surveys, we classified 550 moose, and estimated a total of 1,068 moose (±11.5%; 90% confidence interval [CI]; 0.39 moose/mi^2) on the Kanuti NWR (Table 7) and 405 moose (±23.9%; 90% confidence interval [CI]; 0.30 moose/mi^2) on the UKMA in Unit 24B, not including an SCF (Table 8). In the 2011 GSPE survey, we classified 351 moose, and estimated 797 moose (±19.3%; 90% CI; 0.29 moose/mi^2) on the Kanuti NWR (Table 7) and 324 moose (±29.0%; 90% confidence interval [CI]; 0.24 moose/mi^2) on the UKMA in Unit 24B (Table 8), not including an SCF. Using the GSPE analysis of these two survey blocks combined, I estimated the RY10 moose population in the Kanuti NWR and UKMA survey areas to be 3,567 observable moose (±980) based on the 2010 and 2011 GSPE surveys in 24B and data reported in Stout (2010; Table 5).

The population trend in Unit 24B appeared to be stable during RY99–RY11. Using the Bayesian method for trend analysis described by Ver Hoef (2001), the multiplicative mixed effects model for 1999–2011 indicated the population was stable (λ = 1.00; Fig. 1; Brian Taras, ADF&G Biometrician, unpublished memo, 21 March 2012, Fairbanks). For that trend analysis, we applied SCFs of 1.27 and 1.05 to the 2008 and 2010 results, respectively. The average of those two years (SCF=1.16), was applied to the remaining Kanuti NWR GSPE estimates conducted during 1999–2011. In the Middle Fork TCA, moose density using GSPE survey methodology without a sightability correction factor (SCF) was relatively unchanged at 0.87 moose/mi^2 in RY08 and 0.81 in RY11.

All of Unit 24. Recent surveys helped refine the overall estimate within Unit 24. I estimated the total Unit 24 population to be 8,509 observable moose ±1,587 (6,922–10,096) at the end of RY10. This estimate is based on the addition of extrapolated population estimates previously reported (Stout 2010) and estimates reported for each subunit (Table 5). This compares to the Unit 24 population estimate of 8,751 observable moose ±1,530 (7,221–10,281 moose) for RY08 (Stout 2010).

Population Composition

Population composition from TCA (Tables 1–4) and GSPE surveys (Tables 5–8) conducted during RY09–RY10 throughout Unit 24 were highly variable. Generally, moose density trends in

TCAs corroborated population estimation composition data, and indicated the population declined through RY03 in most of Unit 24, but began to stabilize in RY04–RY06.

Bull:cow ratios. Bull:cow ratios >30 bulls:100 cows observed in TCA and GSPE surveys (Tables 1–8) indicate the bull component of the population was not overharvested in Unit 24 during RY09–RY10 and breeding activity was unaffected, even in Unit 24D. 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 38 bulls:100 cows in Unit 24D, but ranged as high as 65–70 bulls:100 cows in Units 24B and 24C. Bull:cow ratios during RY01–RY02, and RY11 in the Middle Fork TCA (in Unit 24A) were questionable due to small sample size but were higher during RY03–RY08 (Table 4). In general, most ratios in TCAs with counts of less than 100 moose tended to have larger annual variation that made interpretation difficult.

Bull:cow ratios were generally high on the Huslia River Flats and Kanuti NWR during RY09–RY10. High bull:cow ratios in TCAs were generally consistent with bull:cow ratios in GSPE surveys (Tables 1–8). However, the Dulbi Slough, Treat Island, and Middle Fork TCA (Tables 1, 3, and 4) bull:cow ratios were typically lower than the GSPE composition data (Tables 5–8). This can likely be explained by the influence of higher hunting pressure in higher density moose areas in 24D compared to lower hunting pressure in 24A and 24B (Tables 6–8). The higher density moose areas typically attracted higher levels of hunting pressure and are generally more accessible.

Calf and yearling ratios. Ratios of calves and yearlings to 100 cows in Unit 24D were variable. During RY07–RY11, TCAs in Unit 24D indicated calf recruitment to 5 months of age had dropped, $\bar{x}$ = 20 calves:100 cows in RY09–RY11, compared to highs of 31 and 34 calves:100 cows in RY04 and RY06, respectively. Yearling recruitment in 2009–2011 (3-yr $\bar{x}$ = 10 yearling bulls:100 cows) appeared unchanged compared to 2004–2006 (3-yr $\bar{x}$ = 11 yearling bulls:100 cows). Because yearling bull to cow ratios were generally good, it indicated that overwinter survival of the remaining calves was good. High productivity, as evidenced by high twinning rates (Tables 9–12) then low fall calf ratios, suggests high mortality during summer, which is typical of high bear predation. Data available did not explain why high calf:cow ratios in 2004 and 2006 did not result in a stronger response in the yearling:cow ratios in 2005 and 2007 or a stronger positive response in the total number of moose counted. Results from the GSPE surveys on the Kanuti NWR in Unit 24B in RY08, RY10, and RY11 indicated that recruitment to 5 months of age averaged 44.0 calves:100 cows and recruitment to 17 months of age averaged 10.7 yearling bulls:100 cows.

Twinning surveys. Radio collars deployed in March 2008 in the upper Koyukuk River drainage in Units 24A and 24B allowed us to obtain adequate sample sizes in 2008–2011. Results indicated high twinning rates (4-yr $\bar{x}$ = 47.5; Table 12). Based on these twinning rates and an anticipated calving rate of 80%, an average of 115 calves:100 cows were likely produced annually during RY08–RY11. Using calf and yearling ratios along with these twinning survey results indicates that approximately 62% of a calf cohort was lost in the first 5 months and approximately 18% of that cohort was lost in the next 12 months (total mortality to 17 months = 80%).

Distribution and Movements

A comprehensive data analysis for moose radiocollared since 2008 in the upper Koyukuk River drainage was not available for this report. Prior information on movements was reviewed by Stout (2010).

MORTALITY

Harvest

Seasons and Bag Limits. Hunting seasons in Unit 24 were diverse and reflected various moose densities and consumptive use patterns.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY09		
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

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24(B) all drainages of the Koyukuk River upstream from the Henshaw Creek drainage, excluding the North Fork of the 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 CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	27 Aug–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA.		5 Sep–25 Sep
Remainder of Unit 24C.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk CUA.	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 CUA.		5 Sep–25 Sep
Unit 24D, that portion within the Koyukuk CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	27 Aug–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA.		5 Sep–25 Sep
RY10 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
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	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Remainder Unit 24B.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep 15 Dec–15 Apr (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Unit 24C, that portion within the Koyukuk CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	1 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	15 Dec–15 Apr (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA.		5 Sep–25 Sep
Remainder of Unit 24C.		

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only) 15 Dec–15 Apr (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk CUA.	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 CUA.		5 Sep–25 Sep
Unit 24D, that portion within the Koyukuk CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	1 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA.		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Remainder of Unit 24D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24C outside the Koyukuk CUA.	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 CUA.		5 Sep–25 Sep
Remainder of Unit 24D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24C outside the Koyukuk CUA.	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 CUA.		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 we attempted to manage with regulation changes were declining bull:cow ratios and uniform distribution of hunters in Unit 24D. The regulations were designed to improve distribution of hunters around the perimeter of the CUAs 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. Regulation changes adopted by the board from RY02–RY08 were reported in Stout (2010).

At the 2010 spring meeting, the board adopted a 15 December–15 April season in portions of Unit 24B and 24C, and eliminated the 1–10 December season in those areas.

All of Unit 24 has a positive finding for Intensive Management (IM) and the objectives in regulation for RY09–RY10 were as follows:

Unit	Population Objective	Harvest Objective
24A	1,200–1,500 moose	75–125
24B	4,000–4,500 moose	150–250
24C	1,000–1,500 moose	50–125
24D	5,000–6,000 moose	225–425

Harvest by Hunters. Annual reported harvest during RY01–RY10 averaged 171 moose (128–202, Table 13). Harvest reported under potlatch, ceremonial, and cultural and education permits averaged 4.8 moose/year during RY01–RY10. Unreported harvest was estimated from subsistence division reports (Brown et al. 2004), historical information, and public interviews (Table 13). Typically, 60%–70% of ceremonial and unreported harvest was cows.

Illegal and unreported harvests by local residents continued to hamper our efforts to manage moose. During some years, I estimated unreported harvest was nearly equal to the harvest reported on harvest ticket and permit hunt reports (Table 13). 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 RY09–RY11 Unit 21D moose management report (Stout 2012a).

Federal harvest during RY00–RY03 averaged 4.8 moose/year, increased to 13.6 moose/year during RY04–RY08, and was reported at 11 moose in RY09. At the time of this report no federal harvest data from Unit 24 were available for RY10–RY11. Federal harvest data we received were incomplete and reporting requirements and data entry protocols were not comparable to our 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, contradicting the current management strategy for growth of the moose population.

Permit Hunts — Since 2000, there have been 6 drawing hunts in the Koyukuk CUA (DM827, DM828, DM829 and DM830 beginning in RY00; DM823 and DM825 were added in RY05), 2 drawing permits outside the Koyukuk CUA in Unit 24D (DM892 and DM896 added in RY04), and 2 registration permits (RM832 inside the Koyukuk CUA; and RM834 added in RY04 outside the Koyukuk CUA) (Tables 14–16). Results of the RM834 permit are reported in the Unit 21D report in this issue (Stout, 2012a). There were also 2 drawing hunts in Unit 24A (DM920 and DM922). Average rates for successfully drawing a DHCMA permit were relatively high in RY09–RY11, at 15.6% for DM920 and 43.7% for DM922. However, hunting success rates were low at 22.7% north of Slate Creek (DM920) and 6.7% south of Slate Creek (DM922; Table 16).

Harvest Chronology. Over 95% of reported harvest occurred in the September hunting seasons (Table 17). However, much of the unreported harvest probably occurred during October–March (Brown et al. 2004). During RY97–RY00, timing of harvest occurred equally in the first and second half of the September season, but during RY01–RY10 there was a slight shift in percent of harvest to the second half of September ($\bar{x}$ = 57%).

Hunter Residency and Success. Based on harvest reports, the average annual number of moose hunters was 418 during RY01–RY10; most were Alaska residents (Table 18). 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 increased but apparent success rates declined (Fig. 2) despite an increase in total harvest (Fig. 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 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.

Transportation Methods. During RY09–RY10, most hunters continued to use boat to access hunting areas in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 19). Highway vehicles were used only on the Dalton Highway where it crosses eastern Unit 24. Snowmachine was the main transportation method used during winter, but use of snowmachines was likely underreported because most of the unreported harvest occurs during winter.

Other Mortality

A minimum of 374–540 wolves in 57–68 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 by wolves and bears was thought to be high, keeping the moose population low throughout much of Units 24A, 24B, and 24C. Annual adult mortality was approximately 7.8% for radiocollared moose in Units 24A and 24B during 2008–2009, higher than values reported by Boertje et al. (2009).

HABITAT

Browse removal rates were low in Unit 24B and 24C (Stout 2010). No monitoring activity occurred during RY09–RY10.

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 RY09–RY10 included the reallocation of harvest from state permitted users to federal permitted users, and the harvest of cow moose.

Without current ADF&G Division of Subsistence survey data, it was not clear if Unit 24 residents met their wild food requirements, but local public comments suggest those needs were not being met. Predation on moose by wolves and bears was likely the primary factor limiting Unit 24 moose populations. Where predators were lightly harvested for long periods, predation seemed to keep moose densities low (0.1–1.1 moose/mi^2 in areas >800 mi^2, Gasaway et al. 1992).

Continuation of the moose telemetry study in Units 24A and 24B was an important accomplishment in RY09–RY10 and data from that study has improved our understanding of population dynamics and distribution in this low-density portion of Unit 24.

During RY09–RY11 we completed population estimates for the upper Huslia River drainage in Unit 24D, for the Koyukuk NWR in central Unit 24D, and the UKMA and Kanuti NWR in Unit 24B. 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). Analysis of GSPE data collected in Unit 24B between 1999 and 2011 showed that low intensity surveys conducted in the intervening years between 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 us with better decision-making information for the Unit 24B 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 in Unit 24B 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 estimate of 8,509 moose ±1,587 (6,922–10,096), not including an SCF, probably did not achieve the objective to maintain a population of 10,000–12,000 moose for the sixth consecutive reporting period. We achieved the objective to provide for an adequate moose harvest without exceeding 360 moose or a 5% harvest rate (RY10 estimated harvest rate = 3.8%). 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 RY09–RY10. 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 RY09–RY10. We should continue to investigate opportunities to enhance habitat, so that browse species do not become a limiting factor and an abundance of early successional browse communities are available for moose.

The third goal was reducing meat spoilage by hunters. In RY09 and RY10 we monitored the objective of maintaining an overall Meat Assessment Score of less than "3" for ≤5% of the hunters each regulatory year at the Koyukuk River checkstation and at hunting camps. We met this objective. Less than 5% of the hunters scored less than 3 on the overall meat care (RY09=0.7%, RY10=2.0%), and hunters stayed in the field with their meat an average of 2.7 days. Meat spoilage was very low and was probably limited to only a few individual hunters each year.

Finally, we continued our program to monitor and evaluate the number of people engaged in nonconsumptive activities. However, the wildlife viewing objective was not achieved because less than 65% of the respondents (RY09=30%, RY10=46%, RY11=44%), reported "hunting and viewing" as the purpose of their trip.

In RY09–RY10, we did not meet IM population objectives for any of the subunits in Unit 24 (Table 5). In RY09–RY10, our total harvest, including estimated unreported harvest for Unit 24, also failed to meet the combined Unit 24 IM harvest objective of 500 moose (RY09=334 moose, RY10=326 moose).

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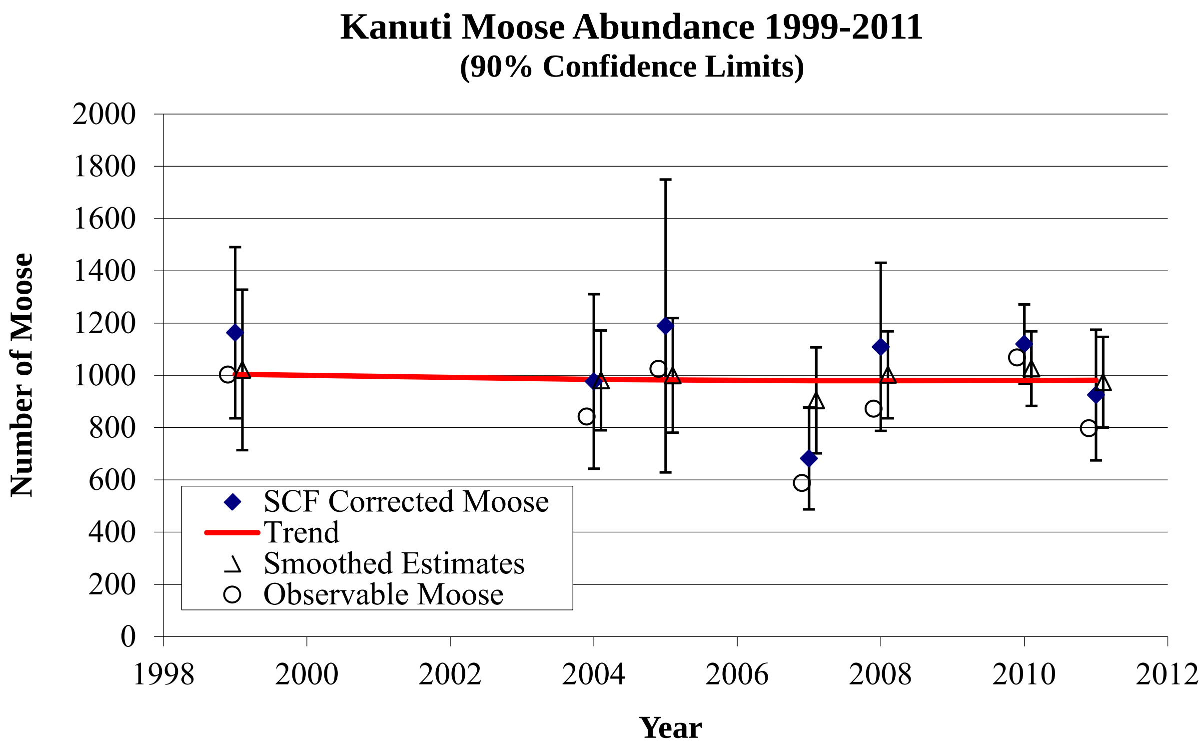

Figure 1. Unit 24 Kanuti National Wildlife Refuge moose density estimates and smoothed estimates fitted to the modeled regression line. The 2008 (1.272) and 2010 (1.048) sightability correction factors (SCF) were based on the estimate derived from radiocollared moose. The average SCF of those years (1.160) was applied as a correction factor constant for all remaining years. Lambda = 0.9996 (SE=0.024) rounded to 1.00 (SE=0.024). Lambda is not significantly different than 1.0 at the 90% confidence level.

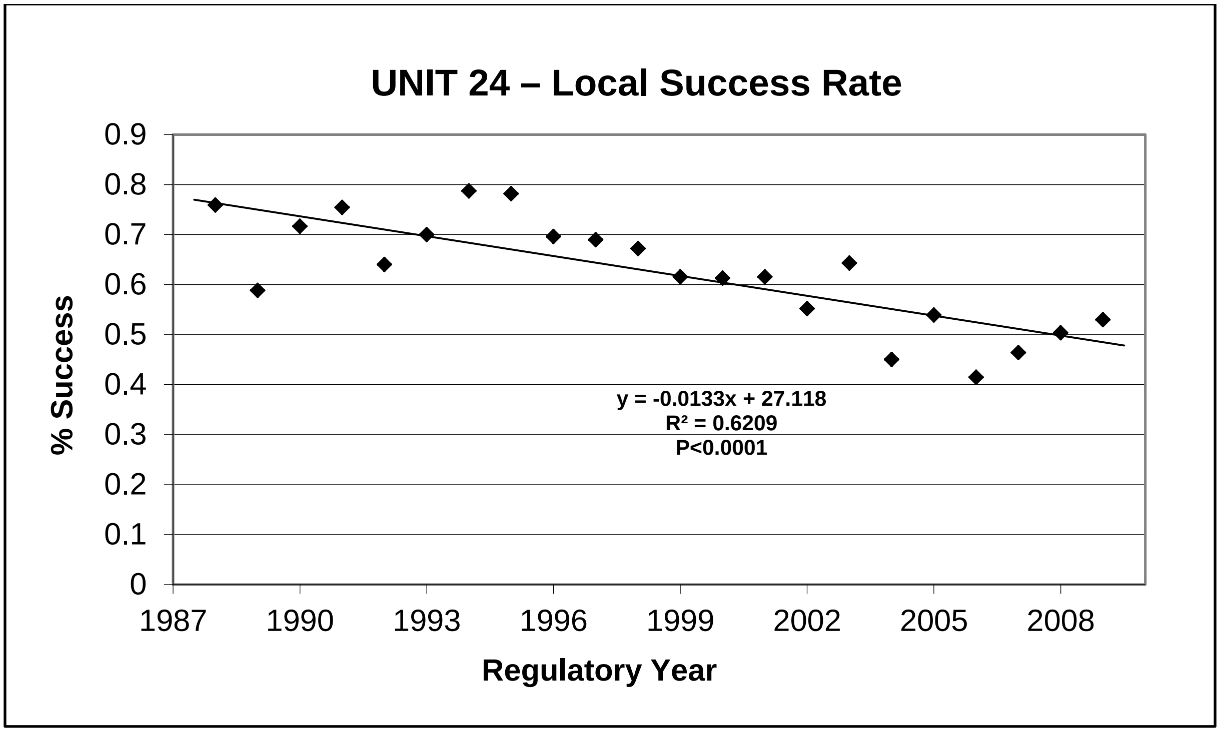

Figure 2. Unit 24 moose harvest success rate by Unit 24 local resident hunters, regulatory years 1988 through 2009[a].

[a] A regulatory year runs 1 July through 30 June(e.g. 1988 = July 1, 1988–June 30, 1989)

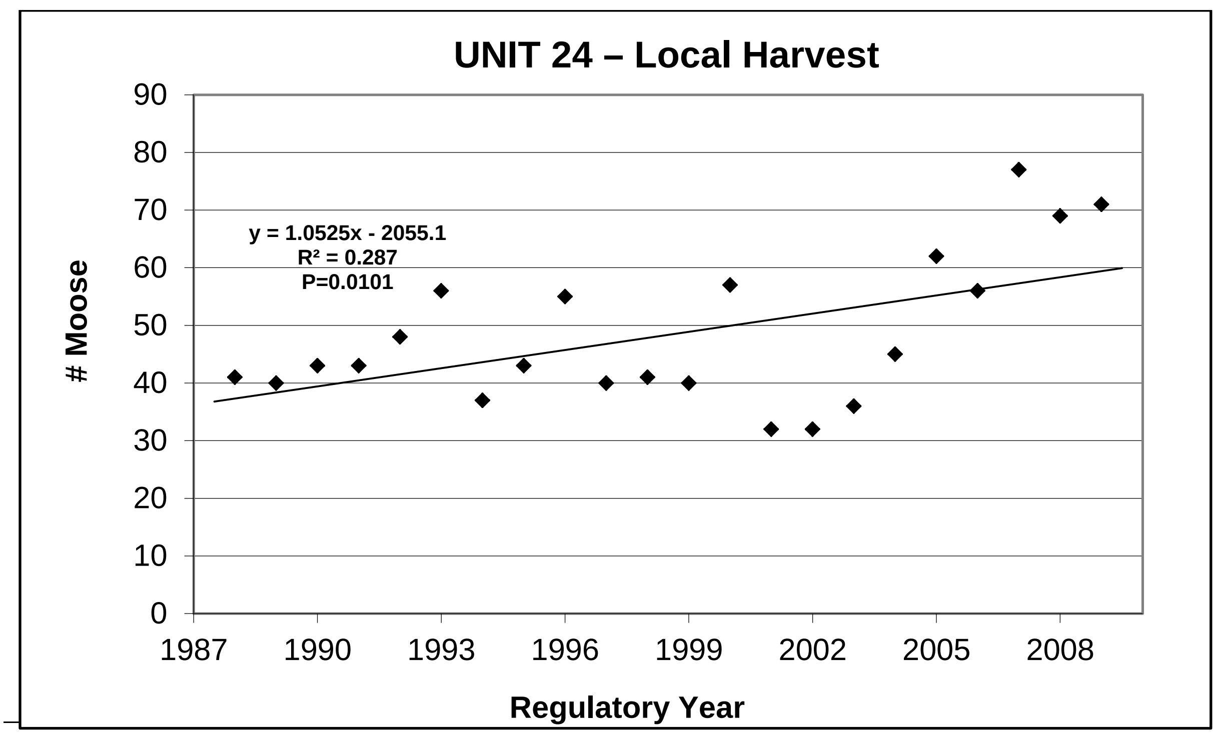

Figure 3. Unit 24 moose harvest reported by Unit 24 local residents, regulatory years 1988 through 2009.

[a] Data are reported as regulatory years (e.g. 1988 = July 1, 1988–June 30, 1989)

Table 1. Unit 24D Dulbi Slough Trend Count Area aerial moose composition counts, regulatory years 1982–1983 through 2011–2012[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
2011–2012	132.8	47	10	32	9	17.6	204	1.5

[a] Data reported prior to 2001 used Gasaway et al. (1986) sample units; beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).
[b] Low snow year.

Table 2. Unit 24D Huslia River Flats Trend Count Area aerial moose composition counts, regulatory years 1983–1984 through 2011–2012[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
2010–2011	142.3	33	8	30	4	18.2	632	4.4
2011–2012	125.9	42	15	24	3	14.6	541	4.3

[a] Data reported prior to 2001 used Gasaway et al. (1986) sample units, beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).
[b] Low snow year.

Table 3. Unit 24D Treat Island Trend Count Area aerial moose composition counts, regulatory years 1985–1986 through 2011–2012[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
2010–2011	163.3	39	7	21	5	12.7	688	4.2
2011–2012	163.3	36	7	18	3	11.8	601	3.7

[a] Data reported prior to 2001 used Gasaway et al. (1986) sample units, beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).
[b] Low snow year.

Table 4. Unit 24A Middle Fork Trend Count Area aerial moose composition counts, regulatory years 1987–1988 through 2011–2012.

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
2011–2012	113	21	5	30	6	20	92	0.81

Table 5. Unit 24 total population estimation summary, regulatory years 2004–2011.

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate without sightability correction factor[a]
Unit 24A and 24B[b]					
2008 Estimated	8,779				1,929±550
2004–2011 Survey block avg., (Kanuti NWR)	2,715	508	60:100	46:100	885±130
Moose habitat Unit 24/North[c]	3,402				595±200
Remainder Unit 24/North[d]	3,150				158±100
Subtotal (2004–2011)	18,046				3,567±980
Unit 24C[b]					
2007 Survey block (Hogatza River)	2,672	498	70:100	45:100	562±129 (90% CI)
Subtotal (2007)	2,672				562±130
Unit 24D[e]					
2011 Survey block (lower Koyukuk)	1,843	336	38:100	23:100	2,627±210 (90% CI)
2007 Survey block (eastern Koyukuk refuge)	1,623	296	78:100	42:100	983±93 (90% CI)
2010 Survey block (western Koyukuk refuge)[f]	1,361	249	79:100	28:100	640±139 (90% CI)
Remainder 24D	523				130±35
Subtotal (2007–2011)	5,350				4,380±477
Unit 24 – Total (2010)	26,068				8,509±1,587

[a] Values following (±) symbol without a 90% CI designation are range approximations and are not statistically derived confidence intervals.
[b] Cumulatively, Units 24A (4,146 mi^2), 24B (13,52 mi^2), and 24C (3,049 mi^2) were formerly defined as Management Zone 2 (Stout 2006).
[c] The estimated area of Unit 24A and 24B that could potentially support moose year-round.
[d] 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.
[e] Unit 24D (5,350 mi^2) was formerly defined as Management Zone 1 (Stout 2006).
[f] Survey results provided by Koyukuk NWR.

Table 6. 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	1,623	78	42	14	18.7	796	983 (±9.5%)	0.61
Hogatza River	2,672	70	45	16	20.7	442	562 (±23.0%)	0.21
Total Block	4,295	75	43	14	19.4	1,239	1,545 (±10.6%)	0.36

[a] Confidence interval (% ±).

Table 7. Unit 24B Kanuti National Wildlife Refuge population estimation surveys, regulatory years 1989–1990 through 2011–2012.

Regulatory year	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
1989–1990[b]	2615	64	17	4	9.2	--	1172 (±25.1%)	0.45
1993–1994[b]	2644	61	33	8	17.0	--	2010 (±22.0%)	0.76
1999–2000[c]	2714	61	28	4	14.7	858	1003 (±20.8%)	0.37
2004–2005[c]	2710	62	46	9	20.7	650	842 (±28.6%)	0.31
2005–2006[cd]	2710	70	43	20	19.7	810	1026 (±43.3%)	0.38
2007–2008[c]	2715	60	53	13	24.7	451	588 (±21.4%)	0.22
2008–2009[c]	2715	46	58	14	28.5	624	872 (±23.3%)	0.32
2010–2011[c]	2715	51	33	8	17.5	861	1068 (±11.5%)	0.39
2011–2012[c]	2715	69	41	10	19.9	656	797 (±19.3%)	0.29

[a] Confidence interval (% ±).
[b] Martin and Zirkle 1996, estimate with sightability correction factor (1.00 in 1989; 1.17 in 1993).
[c] Without sightability correction factor.
[d] Lawler et al. 2006.

Table 8. Unit 24B Upper Koyukuk Management Area[a] (UKMA) population estimation surveys, regulatory years 2010–2011 through 2011–2012.

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% C.I.[b])	Moose/mi^2
2010–2011[c]	1340	52	34	8	18.3	328	405 (±23.9%)	0.30
2011–2012[c]	1340	103	49	8	18.8	250	324 (±29.0%)	0.24

[a] Area partially overlaps Kanuti NWR survey area

[b] Confidence interval (% ±).

[c] Without sightability correction factor.

Table 9. Unit 24D moose aerial twinning surveys in the combined areas of Huslia Flats and Treat Island trend count areas, regulatory years 2001–2002 through 2010–2011.

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
2009–2010[c]	51	41	10	20	12	29 and 30 May
2010–2011	34	38	15	28	24	28 and 29 May

[a] Percent of cows with calves that had twins.
[b] Extensive flooding and early leaf-out, so survey flight path was "high-graded" to maximize observations.
[c] Early leaf-out.

Table 10. 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 11. 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 12. Unit 24B moose aerial twinning surveys in the Kanuti–Alatna–Middle Fork Koyukuk Rivers, regulatory year 2010–2011.

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
2009–2010[bc]	n/a	15	21	58	n/a	28–30 May
2010–2011[bd]	n/a	34	20	37	n/a	31 May–2 June

[a] Percent of cows with calves that had twins.
[b] Sample from radiocollared cows
[c] Early leaf-out.
[d] Including one cow with three calves.

Table 13. Unit 24 moose hunter harvest, regulatory years 1997–1998 through 2011–2012.

Regulatory year	Harvest by hunters				Unreported harvest[a]	Potlatch/ Stickdance[c]	Total
	Bull	Cow	Unk	Total			
1997–1998	168	10	2	180	100	n/a	280
1998–1999	213	17	0	230	100	n/a	330
1999–2000	228	10	2	240	100	n/a	340
2000–2001	211	7	1	219	100	n/a	319
2001–2002	183	5	1	189	96	4	289
2002–2003	186	4	0	190	99	1	290
2003–2004	149	5	1	155	90	10	255
2004–2005	127	1	0	128	99	1	228
2005–2006	162	0	0	162	95	5	262
2006–2007	141	0	0	141	140	5	286
2007–2008	199	3	0	202	135	10	347
2008–2009	168	1	0	169	136	9	314
2009–2010	183	3	3	189	144	1	334
2010–2011	179	0	2	181	143	2	326
2011–2012[b]	157	0	1	158	142	3	303

[a] Unreported harvest based on Subsistence Division's door-to-door survey and other sources.
[b] Data preliminary.
[c] Includes reported Potlatch, Stickdance, Ceremonial and Cultural permit harvest.

Table 14. Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2002–2003 through 2011–2012[a].

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	2002–2003	359	17	51	49	145 (100)	0 (0)	0	145
	2003–2004	401	12	55	45	155 (100)	0 (0)	2	157
	2004–2005	399	8	62	38	141 (100)	0 (0)	0	141
	2005–2006	411	9	63	37	132 (100)	0 (0)	0	132
	2006–2007	382	7	58	42	142 (100)	0 (0)	1	143
	2007–2008	349	8	59	41	131 (100)	0 (0)	0	131
	2008–2009	341	6	47	53	168 (99)	1 (1)	0	169
	2009–2010	431	9	52	48	187 (100)	0 (0)	0	187
	2010–2011	421	8	53	47	180 (100)	0 (0)	1	181
	2011–2012[c]	418	8	52	48	174 (100)	0 (0)	1	175
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
	2010–2011	7	0	71	29	2 (100)	0 (0)	0	2
	2011–2012[c]	7	0	57	43	3 (100)	0 (0)	0	3
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
	2010–2011	7	0	14	86	6 (100)	0 (0)	0	6
	2011–2012[c]	7	0	17	83	5 (100)	0 (0)	0	5
DM827	2002–2003	20	35	31	69	9 (100)	0 (0)	0	9
	2003–2004	26	19	63	37	7 (100)	0 (0)	0	7

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
	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
	2010–2011	7	14	83	17	1 (100)	0 (0)	0	1
	2011–2012[c]	7	43	25	75	2 (100)	0 (0)	1	3
DM828	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
	2010–2011	54	43	35	65	20 (100)	0 (0)	0	20
	2011–2012[c]	54	48	25	75	21 (100)	0 (0)	0	21
DM829	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
	2010–2011	7	14	33	67	4 (100)	0 (0)	0	4
	2011–2012[c]	7	43	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	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
	2010–2011	54	39	27	73	24 (100)	0 (0)	0	24
	2011–2012[c]	54	31	11	89	33 (100)	0 (0)	0	33
Total	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (100)	0 (0)	2	248
	2004–2005	449	13	62	38	153 (100)	0 (0)	0	153
	2005–2006	461	15	60	40	150 (100)	0 (0)	0	150
	2006–2007	433	12	56	44	165 (100)	0 (0)	1	166
	2007–2008	400	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
	2010–2011	557	14	50	50	237 (100)	0 (0)	1	238
	2011–2012[c]	554	15	47	53	240 (100)	0 (0)	2	242

[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.

[c] Data preliminary.

Table 15. Units 24C and 24D Huslia River and Hogatza River drainages moose harvest by permit hunt, regulatory years 2004–2005 through 2011–2012.

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
	2010–2011	35	20	71	29	8 (100)	0 0	0	8
	2011–2012[a]	28	43	44	56	9 (100)	0 0	0	9
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
	2010–2011	47	47	44	56	14 (100)	0 0	0	14
	2011–2012[a]	60	58	48	52	12 (100)	0 0	0	12

[a] Data preliminary.

Table 16. Unit 24A Dalton Highway Corridor Management Area moose harvest by permit hunt, regulatory years 2002–2003 through 2011–2012.

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
	2010–2011	20	45	64	36	4 (100)	0 (0)	0	4
	2011–2012[a]	20	20	81	19	3 (100)	0 (0)	0	3
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
	2010–2011	51	49	92	8	2 (100)	0 (0)	0	2
	2011–2012[a]	50	30	97	3	1 (100)	0 (0)	0	1

[a] Data preliminary.

Table 17. Unit 24 moose harvest chronology percent by month/day, regulatory years 1997–1998 through 2011–2012.

Regulatory year	Harvest chronology percent by month/day 9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	*n*
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	44	53	0	3	184
2010–2011	42	58	0	0	178
2011–2012[a]	46	55	0	0	157

[a] Data preliminary.

Table 18. Unit 24 moose hunter residency and success, regulatory years 1997–1998 through 2011–2012[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	82	82	24	0	188	87	142	41	5	275	463
2010–2011	71	84	26	0	181	104	118	50	1	273	454
2011–2012[c]	62	66	26	4	158	51	77	22	0	150	308

[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.

[c] Data preliminary.

Table 19. Unit 24 moose harvest percent by transport method, regulatory years 1997–1998 through 2011–2012.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
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	72	5	0	0	4	7	185
2010–2011	14	1	74	4	0	0	6	1	180
2011–2012[a]	16	1	69	5	0	1	5	3	158

[a] Data preliminary.

Alaska Department of Fish and Game
Division of Wildlife Conservation
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MOOSE MANAGEMENT REPORT

From: 1 July 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNITS: 25A, 25B, and 25D (47,968 mi^2)

GEOGRAPHIC DESCRIPTION: Upper Yukon River Valley

BACKGROUND

Historically, moose have been relatively scarce in the upper Yukon River valley. Long-time residents of the area report moose were hard to find in the early 1900s, but were more common in the latter half of that century (F. Thomas, H. Petersen, K. Peter, personal communication with B. Stephenson, Area Biologist, circa 1998). 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 (USFWS) to estimate population density. Estimates ranged from a low of 0.1 moose/mi^2 in the western Yukon Flats in 1984 to a high of 0.64 moose/mi^2 in the eastern Yukon Flats in 1989.

Unit 25D was divided into Unit 25D West and Unit 25D East in the early 1980s to allow the use of regulatory schemes that reflected the different statuses of these 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 was established for 35 bull moose. 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

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

seasons were available. Also, beginning in 1990, the Federal Subsistence Board promulgated regulations for subsistence use on federal lands and provided an unlimited number of permits to residents of the 3 communities in Unit 25D West to hunt bull moose on federal lands. The state Tier II permit system remained in effect and applied to both private and federal lands. However, during RY93 through RY99, state Tier II permits were not recognized on federal land. During this period, a maximum of 30 federal permits and 125 state Tier II permits were issued. In 1999, discussions with local residents helped identify 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, with 50-inch antler restrictions, implemented in RY90. 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 (CM001) 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 in 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.

Federal regulations have also influenced moose hunting in Unit 25D. Since 1990, dual management by ADF&G and federal agencies significantly affected hunting 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 season dates of 5–25 September and 1–15 December.

Separate survey areas have been conducted in Units 25D East and 25D West by ADF&G and USFWS, respectively. Since 1999, population surveys were conducted by ADF&G and USFWS 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/mi^2. 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 density for Interior Alaska (Gasaway et al. 1992).

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, USFWS, 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, USFWS–Yukon Flats National Wildlife Refuge, USFWS–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 (IM) 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 IM 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 USFWS lands and focused on the feasibility of increased wolf and bear harvest on smaller private lands surrounding villages in order to increase moose survival. IM objectives also included improved reporting by local residents and reduced illegal cow harvest. Many of the recommendations made in the IM proposal mirrored those previously identified in the YFCMMP.

During 2008–2011, ADF&G conducted an IM feasibility assessment to evaluate the efficacy of implementing an IM plan in Unit 25D. The assessment used data from existing monitoring programs conducted by ADF&G and the USFWS and implementation of new programs in coordination with the Beaver Tribal Council (BTC) and CATG. The IM assessment focused on evaluating whether the following four objectives were achievable and sustainable: 1) increase black and brown bear harvest, 2) increase wolf harvest, 3) obtain accurate harvest reporting for moose, black bears, grizzly bears, and wolves, and 4) eliminate illegal and potlatch harvest of cow moose. Results of the assessment are described in the conclusions and recommendations section below.

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 seasonally 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 25A and Unit 25B Survey Area and Methods

No population estimation or composition surveys have been conducted in Unit 25A or Unit 25B since RY02. Area descriptions and methods for moose surveys conducted by USFWS in the late 1980s through early 2000s are available in Caikoski (2010).

Unit 25D East Survey Area and Methods

No population estimation or composition surveys were conducted in Unit 25D East during RY09–RY10 due to poor survey conditions. However, surveys of Unit 25D East have been conducted regularly over the past decade. Caikoski (2008, 2010) provides survey area descriptions and methods for surveys conducted in prior years.

Unit 25D West Survey Area and Methods

No population estimation or composition surveys were conducted in Unit 25D West during RY09–RY10 due to poor survey conditions. However, surveys of Unit 25D West have been conducted regularly over the past decade. Caikoski (2008, 2010) provides survey area descriptions and methods for surveys conducted in prior years.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Units 25A and 25B. No population surveys have been conducted in Unit 25A or Unit 25B since 2002. Surveys conducted sporadically by USFWS suggest that moose abundance may have declined in the upper Sheenjek and Coleen river drainages in eastern Unit 25A during 1987–2002 (Table 1). The current trend in moose abundance in Units 25A and 25B is unknown, though moose are likely widespread at low density throughout both units.

Unit 25D East — ADF&G Survey. No population estimation surveys were conducted in RY09–RY10. However, fall density estimates for moose in Unit 25D East have been stable and consistently low (0.13–0.34 observable moose/mi^2) since GSPE surveys were implemented in 1999 (Table 2a, Table 2b). A more comprehensive description of recent survey results is described in prior reports (Caikoski 2008, 2010).

Unit 25D West — USFWS Survey. No population estimation surveys were conducted in RY09–RY10. However, fall density estimates for Unit 25D West have been low (0.18–0.30 observable moose/mi^2) since GSPE survey methods were implemented in 1999 (Table 2A). A more comprehensive description of recent survey results conducted by USFWS is described by Lake (2008).

Unit 25D Totals. Based on the most current estimated moose density (0.15–0.25 moose/mi^2) 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 mi^2) is 1,600–2,700 moose. Based on the most current estimated moose density (0.19–0.25 moose/mi^2) 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 mi^2) is 1,300–1,700 moose. Combining extrapolated estimates for Unit 25D East and West, the total observable moose population for Unit 25D (17,500 mi^2) is 2,900–4,400 moose (0.16–0.25 moose/mi^2). Assuming similar density for remaining areas of Unit 25D and an average sightability correction factor of 1.23 for GSPE surveys conducted at 7–8 min/mi^2 (R. Boertje and K. Kellie, ADF&G Fairbanks, memo 22 May 2007), we estimated the total moose population in Unit 25D at 3,500–5,400 moose (0.2–0.3 moose/mi^2).

Population Composition

Units 25A and 25B. No moose surveys have been conducted in Unit 25A or Unit 25B since 2002. Trend surveys conducted by FWS in Unit 25A in 1987, 1989, 1991, 2000, and 2002 showed high bull:cow ratios (63–91:100), moderate calf survival and low to moderate yearling recruitment (Table 1). Moderate to low harvests related to logistical limitations in this remote area suggest that hunting has had a minor effect on bull:cow ratios, although moose abundance appears to have declined during 1987–2002.

Unit 25D. No population composition surveys were conducted in RY09–RY10. However, fall bull:cow ratios have ranged from moderate to high (range: 31–95 bulls:100 cows) since 1999 (Table 3). Yearling bull:cow ratios have ranged low to moderate (range: 3–24) and calf:cow ratios have generally been moderate (range: 22–59 calves:100 cows) since 1999. 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. A more comprehensive description of past composition data is described in Caikoski (2008, 2010).

Distribution and Movements

Moose are distributed throughout Units 25A, 25B, and 25D in varying low densities. Large areas currently support densities of 0.1–0.3 moose/mi^2 and somewhat higher densities occur in localized areas in Unit 25D, particularly in late winter, when moose tend to concentrate in riparian habitat. Moose also concentrate in relatively small areas during early winter along the upper Sheenjek and Coleen rivers in Unit 25A. Telemetry studies in Units 25D East and 25D West indicate some moose are migratory, moving between higher elevation early winter range and low elevation late winter and summer ranges (Maclean and Golden 1991).

In 1995, USFWS conducted a telemetry study in northeastern Unit 25A and the upper Kongakut and Firth drainages of Unit 26C to determine seasonal movements and fidelity to winter and summer ranges. Fifty-seven moose (43 females and 14 males) were radiocollared in the Sheenjek, Coleen, Kongakut, and Firth drainages and relocated approximately once each month. Over 75% of moose that wintered in the upper Coleen, upper Kongakut, and Firth drainages 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). Less than half of the moose radiocollared in the Sheenjek migrated to the Old Crow Flats. An additional study of moose radiocollared in the Old Crow flats by the Yukon Department of Environment (YDOE) indicates moose that winter in the central portion of the Coleen exhibit a similar migratory pattern as those studied by Mauer (1998).

MORTALITY

Harvest

Seasons and Bag Limits during RY09–RY10.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25A, within the DHCMA.		
RESIDENT HUNTERS: 1 bull by bow and arrow only, by drawing permit.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by bow and arrow only, by drawing permit.		1 Sep–25 Sep
Unit 25A, remainder.		
RESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	

Units and Bag Limits	Resident Open Season	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		5 Sep–25 Sep
Unit 25B, Porcupine River drainage upstream from the Coleen River drainage.		
RESIDENT HUNTERS: 1 bull.	10 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		10 Sep–25 Sep
Remainder of Unit 25B.		
RESIDENT HUNTERS: 1 bull; or	5 Sep–25 Sep	
1 bull per community harvest report by community harvest permit in an established community harvest area.	1 Dec–15 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		5 Sep–25 Sep
Unit 25D West.		
ALL HUNTERS: 1 bull by Tier II subsistence hunting permit only; up to 75 permits will be issued.	25 Aug–28 Feb	No open season
Unit 25D East (remainder of Unit 25D).		
RESIDENT HUNTERS: 1 bull; or	10 Sep–20 Sep	
1 bull per community harvest report by community harvest permit in an established community harvest area.	18 Feb–28 Feb	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		10 Sep–20 Sep

Alaska Board of Game Actions and Emergency Orders. There were no regulatory changes during RY09–RY10.

Harvest by Hunters. The annual reported moose harvest in Unit 25A was 46 in RY09 and 43 in RY10, similar to previous years (Table 4). Slightly fewer moose were reported harvested in Unit 25B (38 in RY09 and 26 in RY10) but harvest was similar to prior years for that unit (Table 5).

In Unit 25D East, reported harvest was 24 in RY09 and 25 in RY10, including one reported cow taken in RY09 (Table 6). Reporting rates by residents of Unit 25D have historically been low when using general season harvest tickets or Tier II permits. ADF&G Division of Subsistence conducted comprehensive household surveys of Unit 25D communities in 2008 and 2009. Results of those surveys estimate local hunters harvested 104 moose in 2008 and 123 moose in 2009. The 2008 and 2009 ADF&G estimates fall within the range reported by CATG for 1993–2007 when 94–228 moose were reported harvested annually (CATG 2007). Although the household surveys conducted by ADF&G Division of Subsistence and CATG were in communities located in Unit 25D, some moose were reported to have been taken in adjacent Units 25A and Unit 25B.

Permit Hunts. Seventy-five permits were available annually in Unit 25D West for TM940; however, this permit hunt is often undersubscribed. In RY09, 55 permits were issued and 73 permits were issued in RY10. Reported harvests were 2 moose in RY09 and 11 in RY10 (Table 7). 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 were 1 moose in RY09 and 0 in RY10.

No moose have been reported taken on a Chalkyitsik community harvest permit since RY03. During RY00–RY03, annual reported harvest on a community harvest permit ranged 2–11 moose in Unit 25D and 1–9 moose in Unit 25B.

Hunter Residency and Success. In Unit 25A, Alaska residents composed 57% of moose hunters during RY09–RY10, consistent with prior years (Table 8). Total hunters and success rates remained similar to prior years with 105 and 109 hunters in RY09 and RY10, respectively, with success rates of 43% in RY09 and 39% in RY10.

In Units 25B and 25D, residents composed $\geq$87% of hunters during RY09–RY10, consistent with prior years (Tables 9 and 10). In Unit 25B, total hunters and success rates also remained similar to prior years with 99 hunters in RY09 and 76 in RY10, with success rates of 38% and 34%. The total number of hunters in Unit 25D East increased from an average of 70 hunters per year during RY00–RY08 to an average of 103 hunters per year in RY09–RY10. Local and nonlocal residents contributed to the increase in hunters while nonresidents remained similar to previous years (Table 10). Along with an increase in number of hunters in RY09–RY10, success rates increased and more moose were harvested.

Harvest Chronology. Most moose harvest in Unit 25A occurred during the second and third weeks of September in RY09–RY10 (Table 11). Because the hunting season opens on 5 September for residents and nonresidents, few moose were harvested during the first week of September. The observed trend in harvest chronology has been consistent since RY03. Prior to RY03, more moose were harvested during the first week of September. In Unit 25B, moose harvest mostly occurred during the second and third weeks of September in RY09 and during the third week of September in RY10 (Table 12). Although variable between years, since RY03, most moose were harvested during the last 3 weeks of September. Prior to RY03, more moose were harvested during the first week of September. 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. Most successful hunters used aircraft to access hunting areas in Unit 25A, 74% of successful hunters in RY09 and 67% in RY10. Boats were used by most of the remaining successful hunters (Table 14). Transport methods remained consistent in Unit 25A during RY09–RY10 compared to RY00–RY08 and reflect difficulty in accessing this unit due to the absence of roads. Boats were used by 73% and 68% of successful hunters in Units 25B and 25D East, respectively, during RY09–RY10, consistent with prior years (Tables 15 and 16). 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 most hunters probably used boats.

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 browse production for winter forage is moderately high (Paragi et al. 2008). The occurrence of broomed plants (plants with branched growth forms as a result of multi-year browsing) is low compared to the Tanana Flats and other areas with high moose densities (Paragi et al. 2008). 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 brooming.

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 combined 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 combined 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 are 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 twining rates and low browse removal rates indicate that winter forage availability and moose nutritional status are excellent (Boertje et al. 2007, Seaton et al. 2011). 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 would be expected to result in moderate changes in population size (Kellie 2011).

Unit 25D Intensive Management Activities, Results, and Evaluation

During 2008–2011, ADF&G conducted an IM feasibility assessment to evaluate the efficacy of implementing an IM plan in a 530-mi^2 area surrounding the village of Beaver in Unit 25D. The assessment used data from existing monitoring programs conducted by ADF&G and USFWS and implementation of new programs in coordination with or conducted by the Beaver Tribal Council (BTC) and CATG. The IM assessment focused on evaluating whether the following 4 objectives were achievable and sustainable: 1) increase black and brown bear harvest, 2) increase wolf harvest, 3) obtain accurate harvest reporting for moose, black bears, grizzly bears, and wolves, and 4) eliminating illegal and potlatch harvest of cow moose. A summary of activities performed and results are as follows:

<u>Activities Performed</u>.

1) BTC, CATG, ADF&G, and USFWS conducted 2 planning meetings in Beaver. BTC and CATG provided funding for travel, room, and board for local residents (IM Objectives 1, 2, 3, and 4).
2) BTC and CATG acquired grants and provided financial incentives to increase harvest of wolves and bears. Wolf hides were purchased from local trappers, black and brown bear derbies were conducted in which cash prizes were awarded for the largest bears, a black bear baiting clinic was conducted in Beaver in 2008, and fuel reimbursements were provided for wolf trappers (IM Objectives 1 and 2).

3) ADF&G conducted a wolf snaring clinic in Beaver (IM Objective 2).
4) ADF&G, CATG, and USFWS conducted household harvest surveys in the 7 communities in the Yukon Flats during RY08 and RY09 using ADF&G Division of Subsistence protocol (IM Objective 3).
5) ADF&G and USFWS determined the abundance of black bears in the IM area to assist in determining if liberalized methods for taking black bears could reasonably be expected to reduce black bear abundance (IM Objective 1).
6) ADF&G conducted a wolf abundance survey in Unit 25D West to determine the harvest rate needed for the IM area (IM Objective 2).
7) USFWS and ADF&G conducted a wolf predation rate study in Unit 25D West to determine the effect of wolf predation on moose (IM Objectives 1, 2, 3, and 4).
8) ADF&G conducted moose abundance surveys of the IM area to determine moose abundance and assess if changes in prey response could be measured with current survey methods (IM Objectives 1, 2, 3, and 4).
9) USFWS conducted moose abundance surveys of Unit 25D West to determine moose abundance and assess changes in moose population size and composition (IM Objectives 1, 2, 3, and 4).

Results.

1) Two planning meetings were conducted in Beaver which focused on increased participation by local residents to harvest bears and wolves, local participation in household harvest surveys, and eliminating illegal cow moose harvest. Between 20 and 30 local residents participated in the meetings in addition to staff from CATG, BTC, ADF&G and USFWS.

2) Financial incentives provided by CATG to local trappers and hunters did not result in a significant increase in bear or wolf harvest. In addition, long term funding to sustain the incentive programs was not obtained.

3) ADF&G conducted a wolf snaring clinic in Beaver. Twenty local residents participated in the clinic and 240 wolf snares were provided to local trappers.

4) Participation by local communities to report the harvest of moose, bears, and wolves was good, but we could not determine the accuracy of the data. Results of household surveys conducted in 2008 and 2009 indicate that 104 moose were harvested in RY08 and 123 in RY09. No cow moose were reported, including potlatch, and almost all moose were taken in September when the moose hunting season was open. However, reports by local residents indicate that some cow moose continue to be harvested and moose hunting still occurs outside the hunting seasons. Estimates of annual black bear, brown bear, and wolf harvest were 48, 14, and 20, respectively.

5) In 2010, black bear abundance within the IM area was 225 (95% CI 183–283) independent black bears (excludes cubs). This estimate corresponds to a density estimate of 425 independent black bears/1,000 mi^2. This is the highest documented density of black bears in Interior Alaska and harvest rates by local residents would not be sufficient to reduce the abundance of black bears.

6) Estimated wolf density was 11.4–13.9 wolves/1,000 mi^2 in western Unit 25D (98−120 wolves) in March 2009, similar to previous surveys conducted in the Yukon Flats. Harvest rates by local residents would not be sufficient to reduce the abundance of wolves.

7) Kill rates of moose by wolves in the Yukon Flats were similar to other populations where moose occur at higher densities and limit the recruitment of moose in this population.

8) Estimated moose density in the IM area was 0.34 moose/mi^2 in 2008 and 0.41 in 2009. Current survey techniques are not sensitive enough to detect small changes in moose abundance where densities are low, making it more difficult to assess the effect of an IM program.

9) Moose surveys conducted by the USFWS document a low density moose population (0.18–0.38 moose/mi^2) in Unit 25D West.

IM Evaluation and Recommendation

Our evaluation indicates that a community-based IM program in Unit 25D is not currently feasible. We made progress in obtaining harvest data from local communities; but were unable to determine the level of data accuracy, particularly for moose. Black bear abundance is very high and local efforts to reduce abundance through liberalized seasons, increased effort, and incentives are not reasonably achievable. Efforts by local communities to provide financial incentives to trap wolves did not result in increased harvest. Department or public-conducted predation control programs are also not feasible in Unit 25D. Predation control is not permitted on federal land, which accounts for most lands in Unit 25D.

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. We intend to conduct fall surveys in Unit 25A during RY11–RY12 to evaluate current moose abundance, composition, and distribution.

UNITS 25A, 25B, AND 25D MANAGEMENT OBJECTIVES

We did not likely meet out 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 over desired time periods. The estimated moose population for all of Unit 25D remains below the lower end of the range for the IM objective.

We met our second management objective, to implement and conduct a systematic household harvest survey in coordination with ADF&G Division of Subsistence for communities in Unit 25D in 2008 and 2009. The estimated moose harvest for Unit 25D remains below the lower end of the range for the IM objective.

We do not know whether we met our third management objective to reduce illegal and potlatch harvest of cow moose to less than 5% of total annual harvest.

Although moose population or composition surveys were not conducted in RY09–RY10, we likely met our fourth management objective to maintain a minimum of 40 bulls per 100 cows in the population based on surveys conducted in prior report periods and current estimated harvest levels.

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Table 1. Units 25A and 25B moose observed during early winter aerial composition counts, 1987–2002.

Area/ Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
Unit 25A								
1987[a]	63	9	33	25	17	124	149	
1989[b]	75	18	29	52	14	315	367	1.01
1991[c]	55		26	8	16	41	49	
1991[b]	91	13	31	44	14	270	314	0.87
1992[d]				8	15	44	52	
2000[b]	81	21	38	20	14	130	150	
2002[b]	88	4	48	24	19	100	124	0.34
Unit 25B[e]								
1987	119	6	10	6	5	105	111	

Data source: F. Mauer and T. Wertz, Arctic National Wildlife Refuge.

[a] Upper Sheenjek River only.

[b] Includes upper Sheenjek (both forks above Double Mountain) and Coleen Rivers.

[c] Observed during moose stratification flights in lower Sheenjek, Coleen, and East Fork Chandalar Rivers.

[d] March 1993 survey in East Fork Chandalar River drainage around Arctic Village.

[e] The only early winter composition count in this area during 1986–2012.

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) Low	Strata size (mi^2) High	Area searched (mi^2) Low	Area searched (mi^2) High	Total search area (mi^2)	No. of moose estimated by stratum and density (moose/mi^2) Low	No. of moose estimated by stratum and density (moose/mi^2) High	Population estimate ± 90% CI	Average density (moose/mi^2)	No. of sample units counted
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, USFWS–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

[a] Population estimates are of observable moose and do not include a sightability correction factor. Surveys conducted in fall/early winter unless otherwise indicated.

Table 3. Estimated moose population composition based on fall GSPE surveys in Unit 25D, 1999–2009.

Survey year and area (mi²)	Bulls:100 Cows	Yrlg bulls:100 Cows	Calves: 100 Cows
Unit *25D*East			
1999 (2,936)	57	24	59
2000 (2,936)	79	19	49
2001 (2,936)	95	17	43
2004 (2,936)	43	10	51
2005 (2,936)	80	22	58
2006 (2,936)	60	12	37
2007 (2,936)	64	15	39
Fort Yukon Survey			
2008 (533)	43	0	43
Venetie Survey			
2004 (2,858)	75	24	41
2005 (2,858)	44	4	58
Birch Creek Survey			
2006 (3630)	55	8	29
Unit *25D* West			
1999 (2,269)	31	6	31
2000 (2,269)	71	12	22
2001 (2,269)	52	9	27
2004 (2,269)	72	5	34
2006 (2,269)	65	18	22
2008 (2,269)	51	3	44
Beaver Survey			
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 Year	Reported[a] harvest M	F	Unk	Total
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
2009–2010	45	0	1	46
2010–2011	42	0	1	43

[a] Source: Harvest moose ticket reports from Unit 25A in ADF&G Wildlife Information Network (WinfoNet) database.

Table 5. Unit 25B reported moose harvest, regulatory years 1998–1999 through 2008–2009.

Regulatory year	Reported harvest[a] M	F	Unk	Total
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
2009–2010	38	0	0	38
2010–2011	26	0	0	26

[a] *Source:* Harvest moose ticket reports from Unit 25b in ADF&G Wildlife Information Network (WinfoNet) database.
[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	Reported harvest[a]			
year	M	F	Unk	Total
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
2009–2010	23	1	0	24
2010–2011	25	0	0	25

[a] *Source:* Harvest moose ticket reports from Unit 25D in ADF&G Wildlife Information Network (WinfoNet) database.
[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.

	Tier II permit hunt (TM940)									
Regulatory year	Permits issued	Did not hunt (%)	Did not report (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Total harvest	Federal permit harvest
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
2009–2010	55	29 (53)	4 (7)	20 (91)	2 (9)	2 (100)	0 (0)	0	2	1
2010–2011	73	32 (44)	11 (15)	19 (63)	11 (37)	11 (100)	0 (0)	0	11	0

[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].

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2009–2010	2	29	14	0	45 (43)	3	27	30	0	60 (57)	105
2010–2011	2	22	19	0	43 (39)	1	35	28	2	66 (61)	109

[a] *Source:* Harvest moose ticket reports from Unit 25A in ADF&G Wildlife Information Network (WinfoNet) database.
[b] Resident of Unit 25ABD.

Table 9. Unit 25B 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 (%)	
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
2009–2010	7	29	1	1	38 (38)	3	50	5	3	61 (62)	99
2010–2011	4	19	3	0	26 (34)	1	44	5	0	50 (66)	76

[a] *Source:* Moose harvest ticket reports from Unit 25B in ADF&G Wildlife Information Network (WinfoNet) database; 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].

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
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
2009–2010	13	8	4	2	27 (27)	21	43	8	2	74 (73)	101
2010–2011	21	15	0	0	36 (35)	24	37	4	3	68 (65)	104

[a] *Source:* Harvest moose ticket reports from eastern Unit 25D in ADF&G Wildlife Information Network (WinfoNet) database; 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	*n*
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
2009–2010	7	31	51	9	0	2	45
2010–2011	12	36	45	2	0	5	42

[a] *Source:* Harvest moose ticket reports from Unit 25A in ADF&G Wildlife Information Network (WinfoNet) database.
[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 year	Harvest chronology percent by month/day								
	Aug[b]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
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
2009–2010	5	3	49	35	8	0	0	0	37
2010–2011	4	4	8	69	8	0	4	4	26

[a] *Source:* Harvest moose ticket reports from Unit 25B in ADF&G Wildlife Information Network (WinfoNet) database.
[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 year	Harvest chronology percent by month/day							
	Aug[b]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Unk	*n*
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
2009–2010	4	7	37	37	15	0	0	27
2010–2011	6	6	40	37	6	0	5	35

[a] *Source:* Harvest moose ticket reports from eastern Unit 25D in ADF&G Wildlife Information Network (WinfoNet) database.
[b] No open season.

Table 14. Unit 25A moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009[a].

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
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
2009–2010	74	2	20	2	0	0	0	0	2	46
2010–2011	67	2	23	2	0	0	0	0	5	43

[a] *Source:* Harvest moose ticket reports from Unit 25A in ADF&G Wildlife Information Network (WinfoNet) database.

Table 15. Unit 25B moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009[a].

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
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
2009–2010	13	0	84	0	0	0	3	0	0	38
2010–2011	27	0	62	0	4	0	4	0	4	26

[a] *Source:* Harvest moose ticket reports from Unit 25B in ADF&G Wildlife Information Network (WinfoNet) database.

Table 16. Unit 25D East moose harvest percent by transport method, regulatory years 1998–1999 through 2008–2009[a].

Regulatory year	Harvest percent by transport method									n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	
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
2009–2010	26	0	67	4	0	0	0	0	4	27
2010–2011	6	6	69	11	3	0	0	0	6	36

[a] *Source:* Harvest moose ticket reports from eastern Unit 25D in ADF&G Wildlife Information Network (WinfoNet) database.

SPECIES 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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNIT: 26A (56,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Western North Slope

BACKGROUND

Archaeological evidence indicates moose have been present on the North Slope either sporadically or at low densities for many years. Since about 1940, moose populations have increased in size and have become well established in Unit 26A. Nearly all moose are confined to riparian habitat along river corridors during winter. During summer, many moose move into small tributaries and hills surrounding riparian habitat, and some disperse as far as the foothills of the Brooks Range and across the coastal plain. The largest winter concentrations of moose are found in the inland portions of the Colville River drainage.

Since 1970, late-winter surveys have been conducted annually to assess population status and short yearling (10-month-old calf) recruitment. Trend area counts were conducted each spring and complete census surveys of all major drainages in Unit 26A were completed in 1970, 1977, 1984, 1991, 1995, 1999, 2002, 2005, and 2008. Census surveys indicate that the population increased steadily from a count of 1,219 moose in 1970 to 1,535 in 1991, declined to 326 by 1999 (79% decline), then increased to 1,180 in 2008 (Trent 1989; Carroll 2010). In trend area counts the number of moose counted was 610 in 2007 and 364 in 2009, indicating another substantial decline (Carroll 2010).

The population decline of the 1990s 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 captured in 1996 and 1997 tested positive for antibodies to the bacteria *Brucella suis biovar 4* (8

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

of 43) and *Leptospira interrogans serovar pomona* (6 of 30). Both diseases cause abortions and weak calves. Relatively high moose populations in the 1980s and early 1990s may have led to overbrowsing. Snowshoe hares moved into the area in the early 1990s and irrupted, placing further stress on the browse plants. Wolf and grizzly bear numbers were at relatively high levels during the time of the decline.

Radiotracking surveys and trend area counts indicated that the population began to recover in 1996, due to increased adult and calf survival rates. The mortality rate among collared adults averaged about 7% per year 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). In 2008 and 2009 the recruitment rate dropped to 15% and 2%, respectively, resulting in a reduction in the trend area count to 364 moose (Carroll 2010).

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). For the period 2002–2008, hunters harvested from 5 to 12 moose (Carroll 2010).

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.

- 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

Piper PA–18 and Cessna 182 aircraft were used 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.

During the 2011 census we attempted to develop a missed-moose correction factor to approximate how many moose are missed and not counted during spring counts. Surveys were flown as they normally are and all riparian areas, including side drainages, were searched. For each sighting the pilot flew a circle around each moose or group of moose (to indicate on the GPS track record that we had counted those moose) and then flew directly over them so a precise location could be recorded. During the survey the radiotelemetry receiver was turned off. However, if a moose with a collar was spotted, the receiver was turned on at low volume to determine the frequency of that transmitter, then the receiver was turned off. For each drainage that we surveyed (Anaktuvuk, Chandler, and Colville River drainages), when we had completely surveyed the area where there might be collared moose, we turned on the receiver and radiotracked back through the area we had just surveyed. We went to each radiocollared moose and recorded its position. Then, by using the locations recorded during both portions of the survey along with the GPS track record, we determined whether or not each collared moose had been counted during the survey to calculate a missed-moose correction factor.

Calving success and twinning rate surveys were flown during the second week of June. We radiotracked all collared cows, obtained global positioning system locations, and recorded whether they had 0, 1, or 2 calves. Then the number of calves per 100 cows and the twinning rate (number of sets of twins divided by the number of parturient collared females) were calculated. Any cows that did not have calves early in the survey period were observed again later.

A Robinson 440 helicopter and standard chemical immobilization techniques were used to capture moose in April 2010. Moose were immobilized using carfentanil citrate and xylazine and the drugs were reversed with naltrexone and tolazoline. Moose were captured on the Colville, Anaktuvuk, and Chandler rivers. We captured 20 adult females 22–23 April; took standard measurements; collected blood, fecal, and hair samples; and attached VHF radio collars. Samples were analyzed to test for disease, mineral status, parasites, and contaminants.

We are working with another department employee to collect browse samples to assess the quality of moose browse in Unit 26A. Browse samples are being collected on a yearly basis 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. 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.

Harvest data were compiled 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 21–23 April 2011 and counted a total of 609 moose, including 545 adults and 64 short yearlings (10 month old calves) for an 11% recruitment rate. This was a 48% decrease from the 2008 census when we counted 1,180 moose (Table 1, Fig. 1).

Trend area counts were conducted 19–21 April 2010, 21–23 April 2011, and 11–12 April 2012. In 2010, we counted 265 moose, including 260 adults and only 5 short yearlings (2% recruitment rate). In 2011, we counted 282 moose, including 250 adults and 32 calves (11% recruitment rate). In 2012, we counted 284 moose, including 233 adults and 51 calves (18% recruitment rate). These counts indicate that the substantial decline seen in 2009 continued in 2010, but the population began to increase in 2011 (Table 2, Figure 1). The decline was the result of adult mortality and very poor recruitment, and was probably due to predation from wolves and bears, malnourishment, and mineral deficiency. The slight increase in numbers seen in 2011 and 2012 was due to improved recruitment.

Past trend counts indicated that the number of moose in the trend area declined during the period 1991 (647 moose) until 1996 (152 moose), then increased steadily until 2005 (602 moose), remained stable until 2007 (610 moose), declined through 2010 (265 moose), and increased again by 2012 (284 moose; all years in Table 2, Figure 2).

During the 2011 census we attempted to develop a missed-moose correction factor for spring counts by determining how many of the radiocollared moose were missed during the survey. Surprisingly, we found that every one of the collared moose had been counted. This probably does not mean that we count every moose, but it is an indication that we count a very high percentage of them when conditions are good. During this survey we had very good visibility, fresh snow, experienced observers, and skilled pilots. Under those conditions very few moose are missed.

Population Composition

The percentage of short yearlings counted in spring surveys was low, but began to improve during the reporting period. It was only 2% in each of 2009 and 2010, 11% in 2011, and 18% in 2012. This very low recruitment is very similar to what we saw in the Unit 26A moose population decline which occurred in the 1990s, when the percentage of short yearlings was 3%, 2%, and <1% from 1994 to 1996. During the time of population recovery from 1998 through 2007, recruitment was greater than 20% during most years (Table 2, Fig. 2).

During 2010 spring calving surveys, 31 collared cows were observed and 11 had no calf, 18 had 1 calf, and 2 had twins (71 calves:100 cows and 10% twins). In 2011 we observed 28 collared cows and 11 had no calf, 13 had 1 calf, and 4 had twins (75 calves:100 cows and 24% twins).

The calculated number of calves:100 cows was midrange in 2010 and 2011. The percentage of twins was the lowest of any year in 2010 and fairly low in 2011 indicating that the cows were probably in relatively poor condition (Table 3).

During 2009 fall composition surveys 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). During 2010 fall composition surveys we observed 153 moose, including 67 bulls (97 bulls:100 cows), 69 cows, and 17 calves (25 calves:100 cows, 11% calves). The 2009 and 2010 fall composition survey results indicate that part of the population decline was due to low summer calf survival (Table 4).

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 have resulted in fewer bulls in the younger age groups in 2009 and 2010.

Estimated bull antler widths in inches

Inches	<30	30–39	40–49	50–59	60+
1996	0%	0%	38%	45%	17%
1997	4%	8%	16%	48%	24%
1998	13%	22%	14%	31%	20%
1999	18%	16%	12%	28%	26%
2001	13%	18%	17%	32%	20%
2002	15%	12%	16%	25%	32%
2003	10%	18%	17%	29%	26%
2004	24%	18%	10%	38%	10%
2005	19%	15%	19%	25%	22%
2006	18%	16%	19%	26%	21%
2007	21%	14%	17%	25%	23%
2008	20%	18%	22%	29%	11%
2009	8%	5%	34%	41%	12%
2010	10%	5%	10%	51%	24%

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. A regulatory year (RY) begins on 1 July and ends on 30 June (e g. RY09 = 1 July 2009–30 June 2010).

Regulatory year RY09 and RY10	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 (harvest ticket hunt)	No open season

Unit 26A: that portion in the Colville River drainage up-stream from and including the Anaktuvuk River drainage.		
1 bull	1 Aug–14 Sep (harvest ticket hunt)	No open season
Or 1 bull by drawing permit (excludes Anaktuvuk Pass Controlled Use Area)	1 Sep–14 Sep (Permit Hunt DM980–981)	1 Sep–14 Sep (Permit Hunt DM980–981)
Or 1 moose; a person may not take a calf or a cow accompanied by a calf	15 Feb–15 Apr (harvest ticket hunt)	No open season
Remainder of Unit 26A.	1 Aug–14 Sep (harvest ticket hunt)	No open season

Moose hunters may not use aircraft to transport hunters, hunting equipment, or parts of moose except for permit holders under DM980–981. Aircraft cannot be used to hunt moose in the Anaktuvuk Pass Controlled Use Area.

Board of Game Actions and Emergency Orders (EO). The Board of Game made no changes in regulations during the reporting period. The department reduced the number of drawing permit areas from 3 to 2 (DM980 and DM981) in 2009. The department reduced the number of drawing permits given out in DM980 and DM981 from 25 to 10 in 2011. No EOs were issued during the reporting period.

Hunter Harvest. Hunter harvest and antler size for general season harvest are summarized in Tables 5 and 6. During the reporting period only one cow was harvested and most bulls harvested were over 50 inches.

Permit Hunts. In 2009 for DM980 12 permits were issued, 3 people hunted, and 1 bull moose was harvested and for DM981 13 permits were issued, 7 people hunted, and 6 bull moose were harvested.

In 2010 for DM980 12 permits were issued, 4 people hunted, and 3 bull moose were harvested and for DM981 13 permits were issued, 7 people hunted, and 6 bull moose were harvested.

Hunter Residency and Success. Hunter residency is summarized in Table 7. During the reporting period the comparative number of nonlocal residents increased over past years. Hunter success was similar to the previous years, but higher than RY05.

Harvest Chronology. Harvest Chronology is summarized in Table 8. As in past years most moose were harvested during the first week of September, followed by August and the second week in September. One or 2 moose were also taken each year during the winter hunt.

Transport Methods. Transportation methods are summarized in Table 9.

Other Mortality

The number of adult moose counted in Unit 26A declined from 1,180 in 2008 to 609 in 2011 due to mortality in adults and very poor recruitment in 2009 (2%) and 2010 (2%). Recruitment began to improve in 2011 (11%) and 2012 (18%). This decline appears to be a result of predation and malnourishment.

Wolf surveys indicated that wolf density declined from 4.1 wolves per 1,000 km^2 in 1994 to 1.6 wolves per 1,000 km^2 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 per 1,000 km^2 in the core area for the Unit 26A moose population (Carroll 2009). In addition, the number of wolves seen during moose surveys increased substantially from 0.13 per hr in 2002 to 3.10 per hr in 2009. During this reporting period the number seen declined to 1.66 per hr in 2010 and 0.45 per hr in 2011. Past survey results of observed wolves per hr have been: 0.74 in 1991; 0.46 in 1995; none in 1999; 0.13 in 2002; 0.44 in 2005; and 1.78 in 2008.

Bear predation, particularly of calves, is probably also a substantial factor. From observations during surveys for other species and hunter reports, bears appear to be plentiful in the area.

Malnourishment also appears to be a factor. In 2008, we captured 22 short yearling (10-month-old) females and most of them were small and appeared to be malnourished. The weights of the short yearlings ranged 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 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 yearlings was quite low, with only 3 still alive.

Thus far, analyses of blood, hair, and fecal samples have not identified causes for increased mortality during the current population decline. Earlier, during the mid-1990s decline, several moose 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 samples from the current decline have not indicated a prevalence of bacterial disease. In addition, 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 working all of the major drainages, which 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 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 was 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 be open only 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 declined from 1,180 moose counted in 2008 to 609 moose in the 2011 census. The percentage of yearlings was very low at 2% in 2009 and 2010, but began to increase to 11% in 2011 and 18% in 2012.

Malnourishment was apparently an issue when the current decline began. In 2008 we captured 22 short yearlings and most of them were small and malnourished. Many of the carcasses that were examined that year also indicated malnourishment. In 2009 and 2010 we captured, collared, and collected blood, hair, and fecal samples from 20 adult females. Analysis has shown no indication the bacterial diseases that were present during the population decline of the mid-1990s. 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. Weather records indicated no unusual conditions that would lead to mortality.

We also conducted studies to try to determine if the quantity and/or quality of browse plants could be the reason for malnourishment. The quantity of browse seemed to be adequate to support the population. Results are still pending on the quality of the browse. Unit 26A moose are at the northern limit of possible moose range and the vegetation they utilize has a very short growing season, which 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.

It appears that the primary reason for the continuing population decline has been predation. Wolf surveys indicated that the density of wolves in the core moose area increased from 1.6 wolves per 1,000 km^2 to 4.4 wolves per 1,000 km^2. The number of wolves seen during moose surveys also increased substantially from 0.13 per hour in 2002 to 3.1 per hour in 2009, but declined during the reporting period to 1.66 per hour in 2010 and 0.45 per hour in 2011. The increasing number of wolves in the area coincided with the declining number of moose and since the number of wolves seen during moose surveys began to decline in 2010 the moose recruitment number has increased. The reduction in wolf numbers resulted from 2 years of successful harvest by local hunters in the core moose habitat area surrounding Umiat. Bear predation, particularly of calves, has probably also been a substantial factor.

In Unit 26A there is a general season bull hunt 1 August–14 September for much of the hunt area. In addition there is a summer (1 July–14 September) hunt for moose that disperse into western Unit 26A and a winter hunt (15 February–15 April). There are also limited drawing hunts for residents and nonresidents that allow the use of aircraft. In response to the declining moose population the department reduced the number of drawing permits given out from 25 to 10 in 2011. We feel that there no need to make hunting regulations more restrictive at this time because restrictions on the use of aircraft for all general season hunts has remained; the number of moose harvested has been 13 or less per year, with only 0 to 3 per year being cows; the Arctic Slope Regional Corporation has closed access to much of the hunting area to people who are not residents of North Slope villages; and access to the area is very difficult for most hunters.

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Table 1. Number of adult and 10 month old calf moose from Unit 26A censuses during April, 1970–2011.

Year	Adults	10 month old 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
2011	545	64	609	11

[a]Includes moose counted on the Itkillik River which is part of the Colville River drainage, but is in Unit 26B. In 2011, there were 64 moose, including 8 calves, on the Itkillik River.

Table 2. Unit 26A moose trend counts during April: Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, and Colville River between the mouths of the Anaktuvuk and Killik rivers, 1970, 1974–1981, and 1983–2012.

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
2010	265	260	5	2
2011	282	250	32	11
2012	284	233	51	18

Table 3. Calving surveys of radiocollared cows with twinning rate, June, 1996–2011.

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%
2010	31	71	2	6	10%
2011	28	75	4	14	24%

[a] Number of sets of twins/number of parturient females.
[b] Incomplete survey.
[c] Survey done without radio collars.

Table 4. Unit 26A fall aerial moose composition trend area counts during November, 1990–2011.

Year	Bulls:100 cows	Calves:100 cows	Calves (%)	Adults	Total moose
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
2010	97	25	11	136	153
2011	67	38	18	107	131

Table 5. Unit 26A moose harvest, RY90 through RY10.

Regulatory year	Reported hunter harvest		
	Male	Female	Total
RY90	60	4	64
RY91	59	8	67
RY92	52	8	60
RY93	53	8	61
RY94	36	4	40
RY95	14	0	14
RY96	0	0	0
RY97	2	0	2
RY98	5	0	5
RY99	2	0	2
RY00	0	0	0
RY01	4	0	4
RY02	10	0	10
RY03	5	0	5
RY04	4	1	5
RY05	9	2	11
RY06	8	3	11
RY07	11	1	12
RY08	11	0	11
RY09	9	1	10
RY10	13	0	13

Table 6. Number of bull moose harvested in antler width categories (inches) in Unit 26A, RY96 through RY10.

Regulatory year	Unknown	<20	20–29	30–39	40–49	50–59	60+	*N*
RY96	0	0	0	0	0	0	0	0
RY97	0	1	0	0	1	0	0	2
RY98	0	1	1	1	1	0	1	5
RY99	0	1	0	1	0	0	0	2
RY00	0	0	0	0	0	0	0	0
RY01	3	1	0	0	0	0	0	4
RY02	1	0	0	1	5	3	0	10
RY03					1	2	2	5
RY04	1				1	2		4
RY05			1	1	3	3	1	9
RY06	3	2	0	1	0	2	0	8
RY07	7[a]	0	0	0	4	0	1	12
RY08	4[a]	0	0	1	0	3	3	11
RY09	2	0	0	0	1	5	2	10
RY10	5				1	5	2	13

[a] Antler size was inadvertently excluded from hunter report cards for the drawing hunt.

Table 7. Moose hunter residency and success, Unit 26A, RY90 through RY10.

	Successful hunters						Total hunters				
Regulatory year	Local res[a]	Non-local res[b]	Nonres[c]	Unknown	Total	(%)	Local res[a]	Non-local res[b]	Nonres[c]	Unknown	Total
RY90	8	19	35	2	64	65	13	40	43	3	99
RY91	9	37	29	1	76	75	13	51	37	1	102
RY92	12	16	29	3	60	57	25	35	41	4	105
RY93	7	22	29	3	61	79	11	30	32	4	77
RY94	8	7	24	1	40	74	11	14	29	0	54
RY95	4	3	6	1	14	33	13	12	15	3	43
RY96	0	0	0	0	0	0	4	2	0	0	6
RY97	2	0	0	0	2	10	20	0	0	0	20
RY98	5	0	0	0	5	25	18	2	0	0	20
RY99	2	0	0	0	2	14	12	2	0	0	14
RY00	0	0	0	0	0	0	UN[d]	UN	UN	UN	UN
RY01	4	0	0	0	4	UN	UN	UN	UN	UN	UN
RY02	8	2	0	0	10	53	11	8	0	0	19
RY03	4	1	0	0	5	56	6	3	0	0	9
RY04	5	0	0	0	5	38	9	4	0	0	13
RY05	9	2	0	0	11	79	11	3	0	0	14
RY06	8	3	0	0	11	69	10	5	1	0	16
RY07	4	7	0	1	12	57	5	15	0	1	21
RY08	4	4	3	0	11	65	4	10	3	0	17
RY09	2	5	3	0	10	67	2	10	3	0	15
RY10	4	8	1	0	13	72	6	10	2	0	18

[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, RY96 through RY10.

Regulatory year	Harvest periods						
	July	Aug	1–7 Sep	8–14 Sep	15 Feb–15 Apr	Unknown	*N*
RY96*	–	–	–	–	–	–	0
RY97*		100	–	–	–	–	2
RY98*		100	–	–	–	–	5
RY99*		100	–	–	–	–	2
RY00*	–	–	–	–	–	–	–
RY01*		100	–	–	–	–	–
RY02		20	80				
RY03		20	80				5
RY04	20	40	20	20			5
RY05		9	73	–	18		11
RY06		36	36	18	10		11
RY07	8	26	58	8	0		12
RY08	0	18	64	9	9		11
RY09	0	10	80	0	10		10
RY10	0	14	70	8	8		13

* Season open only in August.

Table 9. Percent transport methods for moose harvest in Unit 26A, RY90 through RY10.

Regulatory year	Percent method of transportation					
	Airplane	Boat	3 or 4 wheeler	Snowmachine	ORV	*N*
RY90	62	28	3	2	3	61
RY91	85	7	3	3	2	67
RY92	85	13	0	2	0	60
RY93	83	17	0	0	0	61
RY94	78	18	0	2	2	40
RY95	50	43	7	0	0	14
RY96	–	–	–	–	–	0
RY97	–	100	–	–	–	2
RY98	–	100	–	–	–	5
RY99	–	100	–	–	–	2
RY00	–	–	–	–	–	–
RY01	–	100	–	–	–	–
RY02		100				
RY03		100				5
RY04		80			20	5
RY05		82		18		
RY06	27	64	-	9		11
RY07	59	33	8	0		12
RY08	55	36		9		11
RY09	80	10		10		10
RY10	69	23		8		13

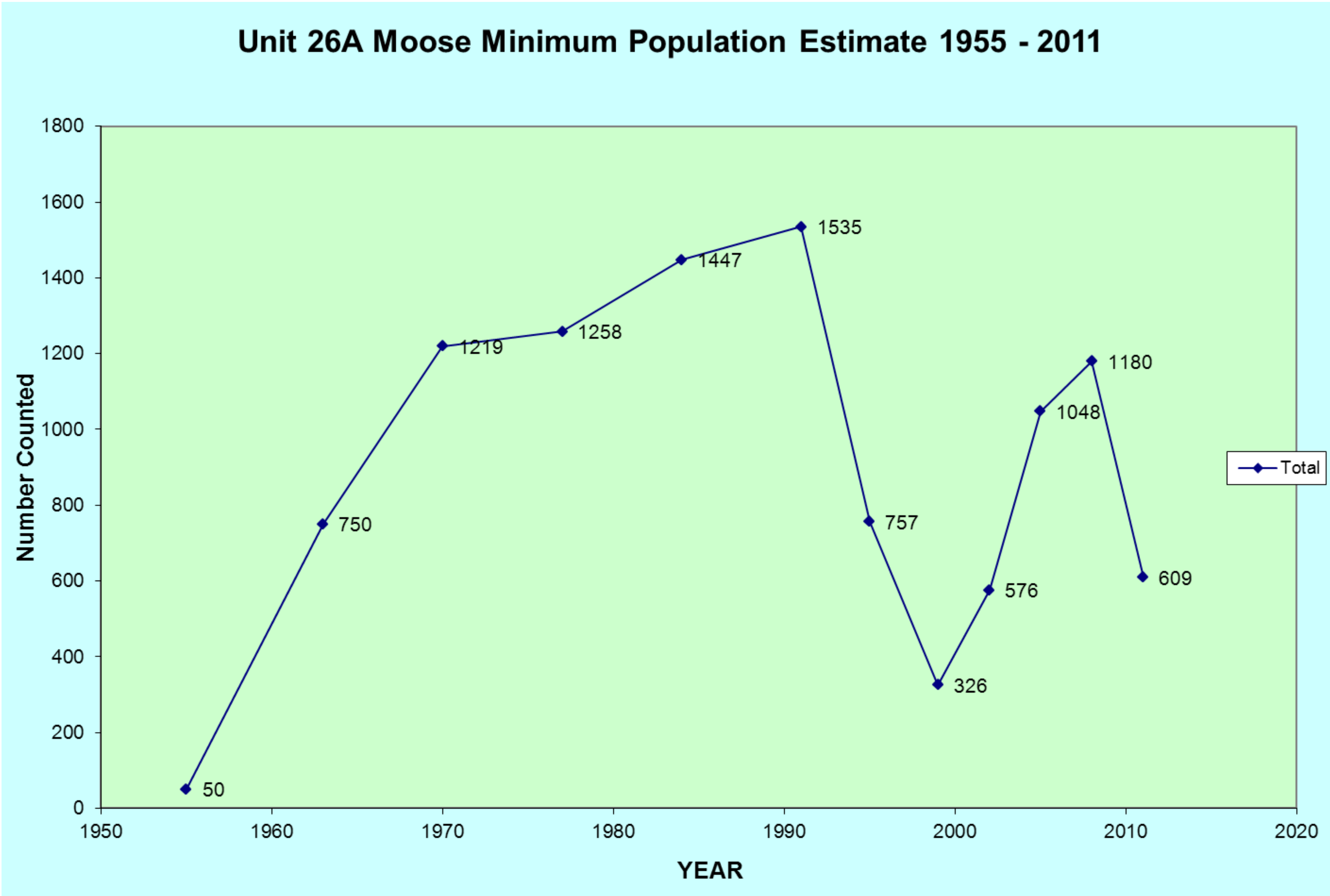

Figure 1. Unit 26A riparian zone minimum direct count census 1955–2011.

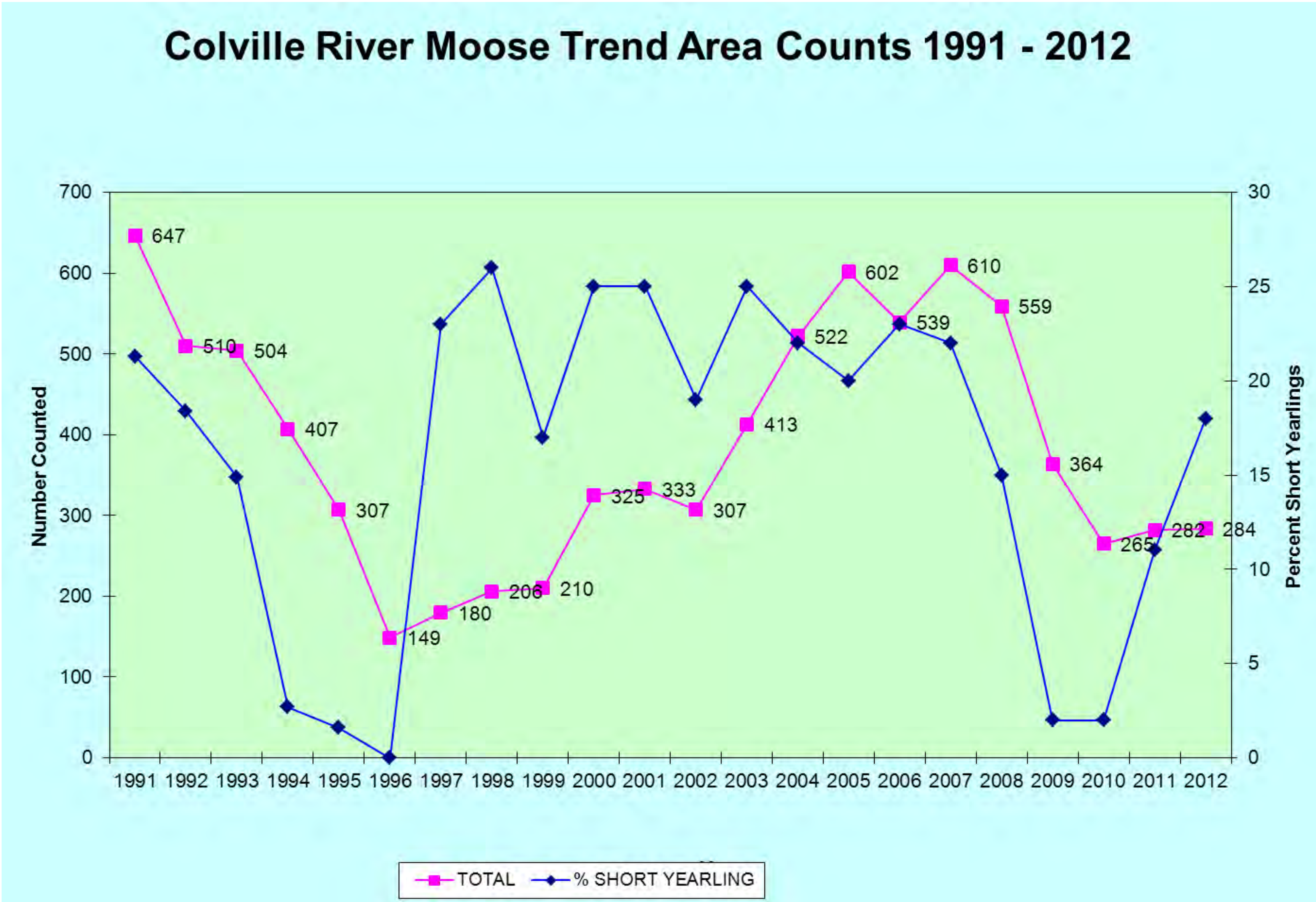

Figure 2. Unit 26A moose trend counts and percentage of short yearlings: Colville River between the mouths of Anaktuvuk and Killik rivers, Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, 1991–2012.

SPECIES 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 2009
To: 30 June 2011[1]

LOCATION

GAME MANAGEMENT UNITS: Units 26B and 26C (26,000 mi^2)

GEOGRAPHIC DESCRIPTION: North Slope of the Brooks Range and Arctic Coastal Plain east of the Itkillik River

BACKGROUND

Moose were scarce in Arctic Alaska prior to the early 1950s, when populations expanded and reached high densities in the limited riparian habitat of major drainages (LeResche et al. 1974). Predation, as well as hunting, probably contributed to the historical scarcity of moose. The reduction in wolf numbers by federal control programs during the late 1940s and early 1950s was 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 1,400 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 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. Approximately 200 moose were observed in surveys conducted in eastern 26C in the Brooks Range in the early 2000s.

[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; 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 ≥15% short yearlings in the population.

  Activity: Maintain an open moose season when the objective is met.

- In Unit 26C, maintain a population of ≥150 moose with a 3-year mean proportion of ≥15% short yearlings in the population.

  Activity: Maintain an open moose season when the objective is met.

- Maintain a bull:cow ratio of ≥35:100 when hunting seasons are open.

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, total count surveys in trend count areas 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 spring 1999, surveys in Unit 26B were conducted by Arctic National Wildlife Refuge (ANWR) staff in Unit 26B East and by Alaska Department of Fish and Game (ADF&G) staff in Unit 26B West during April or May using a 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 2002, all surveys in Unit 26B were conducted by ADF&G staff using a Piper PA-18 aircraft. Moose were classified as short yearlings (11-month-old calves) and adults. In 2002, spring surveys were conducted in early May by ADF&G staff 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.

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 Units 26B and 26C). ANWR conducted surveys during 1999–2001 and in previous years not included in this report (Lenart 2006). ADF&G has 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 (excluding the Itkillik River) — 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'N latitude to the White Hills.

Unit 26B West, Itkillik River drainage — Parts of the Itkillik River have been surveyed by ADF&G staff periodically since 1981. The lower Itkillik River (from Itkillik Lake downstream to the end of moose habitat) was surveyed during 1999–2004. In spring 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 spring 2006 and 2012, we surveyed a portion of the upper Canning River upstream of Eagle Creek. In spring 2006 and 2008–2012, we surveyed the Sagavanirktok River upstream of Happy Valley to the extent of moose habitat in the upper Sagavanirktok. Beginning in spring 2007, we surveyed Oksrukuyik Creek. In spring 2011 and 2012, we also surveyed the Ribdon River.

Unit 26C. Surveys in central Unit 26C were conducted by 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 not classified during the April surveys. Surveys in eastern Unit 26C were conducted by ANWR staff during early winter using a Cessna 185 or 206 flown at 95–120 mph, at altitudes of 300–600 feet above ground level and in 2011 by ADF&G staff using a Cessna 182 flown at 75–110 mph.

Central Unit 26C — 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, 2009, and 2011. The following drainages were surveyed as weather permitted: Itkilyariak, Sadlerochit, Hulahula, Okpilak, Jago, Aichilik, Leffingwell, Egaksrak, Ekaluakat, and lower Kongakut.

Eastern Unit 26C— In eastern Unit 26C, the upper drainages of the Kongakut (upstream of and including Drain Creek) and Firth–Mancha rivers were surveyed by ANWR staff during early winter 1991, 2000, and 2002 and by ADF&G staff in 2011.

Survey data are reported as Unit 26B East, Unit 26B West, and Itkillik River drainage and as central Unit 26C and eastern Unit 26C. 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 as total moose observed in Unit 26B. Areas were analyzed and reported separately based on historical data collection to provide comparisons over a longer period of time. Recent data were also combined for some analyses because methods were standardized across all of Unit 26B. Historical data between fall and spring surveys are not directly comparable, but both provide information on trend and recruitment (Lenart 2006).

Twinning Surveys

In early June 2007 and 2009, we conducted twinning surveys 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 who did not report received 1 or 2 reminder letters. Drawing permit holders also usually received 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., RY08 = 1 July 2008–30 June 2009).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

A moose population survey has not been conducted in the entire area of 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 1–4). In RY09, the population estimate for all survey areas combined declined by approximately 100 moose (24%) compared to the mean during RY04–RY08 (Table 4).

Unit 26B.

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 spring 2005 through spring 2009, the number of moose ranged 288–339 (Table 1). Beginning in 2010 we observed fewer moose (254). In spring 2011 and 2012, we observed 221 and 246 moose, respectively. These numbers indicated an apparent decline compared to the previous 5 years (Table 1). It is possible that some of the decline can be attributed to moose redistributing to sections of drainages not included in our surveys. The highest concentrations of moose were found along the Echooka, Ivishak, Kavik, and Canning Rivers.

Unit 26B West (excluding the Itkillik River) — During spring 1996–2002 the population was stable at 50–70 observed moose (Lenart 2006). This followed the same trend observed in Unit 26B East. However, in spring 2003 we observed approximately 100 more moose (160 total moose) in this portion of Unit 26B. This increase in number may have been related to changes in distribution or increased sightability because we began using a Piper PA-18 in 2003 compared to a Cessna 185 during 2002 and prior years. However, during this time period, we also noted 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 or sightability. During RY04–RY07 (spring 2005–spring 2008) the number of moose in Unit 26B West ranged 140–175 (Table 2). Beginning in RY08 (spring 2009), we estimated approximately a 50% decline in observable moose compared to the previous 4 years (78 moose; Table 2). We observed 70 moose in RY09 (spring 2010), 58 moose in RY10 (spring 2011), and 75 moose in RY11 (spring 2012). 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 3–27 moose. Beginning in 2005, we included the upper Itkillik River in our surveys, and during RY04–RY11 the number of moose observed ranged 50–73 moose (Table 3).

All Unit 26B — Overall, the moose population increased slowly during the 2000s in Unit 26B. Total moose observed in Unit 26B indicated a gradual increase from approximately 400 moose to 600 moose during RY03–RY08 (Table 4). Fewer moose were observed in RY09 (454), RY10 (449) and RY11 (464), indicating the moose population may be declining. This trend follows the same trends observed in the separate trend count areas analyzed in Unit 26B, with the exception of the Itkillik drainage. Additionally, moose numbers and recruitment declined in Unit 26A during RY08–RY09 (556 moose observed in spring 2009 compared with 265 in spring 2010; L. Parrett, ADF&G, personal communication, 2011).

Unit 26C.

Central Unit 26C— In central Unit 26C, moose numbers appeared to remain stable. During April, ANWR staff observed 52 moose in 2003, 47 in 2005, 59 in 2007, 61 in 2008, and 48 in 2011.

Eastern Unit 26C — In eastern Unit 26C, ADF&G staff conducted an early winter survey in the upper Kongakut (upstream of and including Drain Creek) and Firth–Mancha drainages in 2011. A total of 339 moose were observed, including 118 bulls (15 yearling bulls), 169 cows, and 52 calves (Table 5). In the upper Kongakut, search time was 2 hours, 17 minutes and 127 moose were observed in 27 groups composed of 50 bulls, 56 cows, and 21 calves. In the Firth–Mancha drainage, search time was 7 hours, 55 minutes and 212 moose were observed in 69 groups composed of 68 bulls, 113 cows, and 31 calves. We surveyed a portion of the Firth–Mancha drainage in early winter 2010 to determine if moose numbers had increased since the 2002 survey and a complete survey was warranted. Survey time was 3 hours, 25 minutes and a total of 109 moose were observed including 43 bulls (2 yearling bulls), 53 cows, and 13 calves. Results of this partial survey indicated there were likely more moose in the eastern 26C compared to the early 2000s.

No surveys were conducted in eastern Unit 26C during 2003–2009. Early winter surveys completed by ANWR indicated fewer moose (157 in 2000 and 227 in 2002) compared to 339 in 2011 and 406 in 1991 (Table 5). Direct comparisons between surveys before and after 2010 are difficult to interpret due to differences in search time, area searched, survey airplanes, and moose classification protocol. A large proportion of the moose in these areas migrate south and east to the Old Crow Flats in Yukon, Canada during spring and summer (Mauer 1998).

Population Composition

Unit 26B.

Unit 26B East — The proportion of 11-month-old calves (short yearlings) in the population during RY99–RY07 was moderately good, ranging 13–22%, except in RY03 when it was 6% (Table 1). The proportion of short yearlings declined beginning in RY08 to 10%, 8% in RY09, 5% in RY10, and 8% in RY11.

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–RY10 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 have remained high (≥50%) since the season was reopened because harvest has been low (range = 3–7 bull moose annually). However, if recruitment continues to decline and remain low for several 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). Similar to proportions observed in Unit 26B East, the proportion of short yearlings then declined to 1% in RY08, and was 6%, in RY09 and 5% in RY10 (Table 2). However, in RY11, proportions were substantially higher (21%) in contrast to proportions observed in Unit 26B East (8%).

During the May 2002 Unit 26B West survey we observed a ratio of 34 bulls:100 cows, substantially lower than the bull:cow ratio observed in Unit 26B East. Although we have no data on movements, it is possible 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–RY10 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 3–12% during RY05–RY10 (Table 3). In RY11, the proportion of short yearlings was 24%; the highest observed since RY03 (Table 3).

All Unit 26B — The proportion of short yearlings for the combined survey areas of Unit 26B East, Unit 26B West, Itkillik River drainage, and miscellaneous survey areas, was 12–18% during RY03–RY07 (Table 4). The proportion of short yearlings was 8% in RY08, 7% in RY09, and 8% in RY10, similar to proportions observed when the areas were analyzed separately. In RY11, the proportion of short yearlings was 13%. The overall bull:cow ratio in the Unit 26B survey areas in May 2002 was 57:100.

Unit 26C

Central Unit 26C— No data were available on the proportion of short yearlings in central Unit 26C during RY02–RY10 because moose were not classified during spring surveys.

Eastern Unit 26C — In the upper Kongakut (upstream from Drain Creek) and the Firth–Mancha drainages of eastern Unit 26C, early winter surveys in 2011 indicated moderate ratios of 70 bulls:100 cows and 31 calves:100 cows. The yearling bull:cow ratio (11 yearling bulls:100 cows) was also considered good (Table 5).

In 2000 and 2002 bull:cow ratios were high (>100 bulls:100 cows) and modest numbers of calves (35 and 24 calves:100 cows) and yearlings (26 and 21 yearling bulls:100 cows) were observed in the population (Table 5). As noted previously, it is difficult to directly compare and interpret survey results due to differences in search time, area searched, survey airplanes, and moose classification protocol.

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 (Boertje et al. 2007).

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 away from 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 Yukon, 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–RY11.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
RY06–RY11 Unit 26B, excluding the Canning River drainage.		
RESIDENT HUNTERS:		
1 bull by drawing permit; up to 30 permits may be issued, or	1 Sep–14 Sep	No open season
1 bull	To be announced; up to 14-day season; 15 Feb–15 Apr	

Alaska Board of Game Actions and Emergency Orders. In RY96 the hunting season was closed in Units 26B and 26C. The season was closed in Unit 26B through RY05 and remains closed in Unit 26C. During the March 2000 meeting, the Alaska Board of Game determined that a harvest of 60–80 moose was necessary to satisfy subsistence needs in Unit 26. In March 2006 the Alaska Board of Game authorized 2 moose seasons to begin 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 (ANS) in Unit 26 to 21–48, including 15–30 in Unit 26A, leaving 6–18 moose for the ANS in Units 26B and 26C combined. No board actions occurred during December 2007–February 2012.

During the Board of Game meeting in March 2012, the board authorized a drawing permit hunt of up to 30 permits for residents and nonresidents in eastern Unit 26C in the drainages of the upper Kongakut River (upstream of and including Drain Creek) and the Firth–Mancha rivers. The bag limit is 1 bull for residents and 1 bull with 50-inch antlers or 4 or more brow tines on 1 side for nonresidents. The season for both residents and nonresidents is September 1–25. This area is on federal land and is currently closed to non-federally qualified hunters. The department will request a federal closure review for the upper Kongakut and Firth–Mancha drainages, requesting the Federal Subsistence Board review the closure due to new biological information. The drawing hunt will be implemented when the federal closure is removed.

Emergency orders to open the general moose season in Unit 26B were issued during RY06–RY10. The season during RY06–RY10 was 2–15 April.

Federal Subsistence Board: In RY96, federal public lands in Units 26B and 26C were closed to the taking of moose for all hunters. In 2004 the Federal Subsistence Board established a federal registration hunt on federal public lands in Units 26B and 26C for residents of Kaktovik, with a harvest quota of 3 moose. No more than 2 bulls may be harvested from Unit 26C. Three permits were issued annually to residents of Kaktovik, with an open season of 1 July–31 March. In RY07, the federal season was opened in Unit 26B to non-federally qualified Alaska residents to coincide with state regulations which opened a season in RY06.

Harvest by Hunters

Unit 26B: Moose were reported harvested or hunted under the general hunting season in Unit 26B during RY06–RY10, which was open in April. However, most of the reported hunting on the general season harvest ticket was illegal because it took place in September when there was not a general moose hunting season (Table 6). In RY10, the first legal moose was reported harvested under the general season in April. 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).

Harvest in drawing permit hunt DM966 (Unit 26B, excluding the Canning River drainage) during RY06–RY11 ranged 3–8 moose harvested by 11–20 hunters (Table 7). Fifteen permits were available and issued annually in RY06–RY07, 20 permits were issued annually in RY08–RY09, 25 in RY10, and 10 in RY11. All hunt reports were returned.

Unit 26C. There has been no open state hunting season in Unit 26C since 1996. During RY90–RY95, harvest was low and ranged 3–6 moose taken by 5–12 hunters (Lenart 2006).

Hunter Residency and Success. The moose season in Unit 26B was open only to Alaska residents during RY06–RY10. Success rates ranged 25–54% (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. During RY06−RY10, 66−100% of moose were harvested within the first week of September (Table 9). The remaining moose were taken during the second week of September; except in RY10, when 1 moose was harvested in April.

Transport Methods. Aircraft was the most common method of transport for successful hunters in RY06 (71%), RY08 (67%), and RY10 (67%) (Table 10). In RY07, the most common method was split among airboat, aircraft, and highway vehicle (33% each). In RY09, airboat was the most common method of transport for successful hunters (67%), while highway vehicle represented the remaining 33% (Table 10).

Natural Mortality

No intensive studies of the rate or 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 also have been relatively low in Units 26B and 26C during the same time period.

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Unit 26B 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. In spring 2010 and 2011, we observed approximately 100 fewer moose compared to spring 2009 (Table 4). Lower recruitment was initially observed in spring 2009 and this trend has continued, indicating that the population in the near future will likely remain stable or decline until recruitment improves.

Moose numbers in central Unit 26C remained stable at approximately 50–60 moose during the 2000s. Moose numbers in eastern Unit 26C in early winter 2011 were higher than indicated by the early winter survey in 2000.

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 during the early to mid-2000s. Habitat in Unit 26C is more limiting than in 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.

MEETING GOALS AND OBJECTIVES

During RY09–RY11, we met our first goal of maintaining viable populations of moose in their historic range throughout the region, in part by continuing to keep the hunting season closed until the moose population recovers. We met our second goal by continuing to provide an opportunity to harvest moose during RY09–RY10. Moose were available for viewing and photographing during RY09–RY10, our third goal.

We met a portion of our first objective in Unit 26B during RY08–RY11, as the population remained ≥300 moose. We did not meet the second portion of our objective, to maintain the 3-year mean proportion of short yearlings in the Unit 26B population at ≥15%. The 3-year mean proportion of short yearlings was 7.6% during RY08–RY10 and 9.3% during RY09–RY11 (Table 4).

We likely met the portion of our second objective in Unit 26C to maintain a population of ≥150 moose. In RY10 we observed only 48 moose in spring 2011, but observed 339 in eastern Unit 26C in early winter 2012, indicating that the population was likely ≥150 moose during RY09–RY10. We do not know if we met the 3-year mean (RY08–RY10) proportion of ≥15% short yearlings in the population because moose were not classified in central Unit 26C and we classified moose in early winter in eastern Unit 26C. However, 15% of the moose observed in early winter were 5-month old calves.

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–RY10, we believe our bull:cow ratios exceeded 35:100 in Unit 26B.

RECOMMENDATIONS

We recognize that we did not meet our objective to maintain a 3-year mean proportion of ≥15% short yearlings in the Unit 26B population. However, even during years of low recruitment there is likely a small harvestable surplus. We recommend keeping the Unit 26B moose season open during RY12 because drawing permits have already been awarded, harvest is usually low (3–7 moose annually), and the population was higher (450 moose) than the objective of 300 moose. Beginning in RY13, we recommend reducing the number of permits available to ≤10 to attain a harvest of 1 to 5 bull moose during the drawing hunt and the general hunt.

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Table 1. Unit 26B East (east of the Sagavanirktok River, including Canning River) aerial moose composition counts, regulatory years 1998–1999 through 2011–2012.

Regulatory year	Adults	Short yearlings[b] (%)		Unknown	Moose observed	Search time (hr:min)
1998–1999	129	20	(13)	--	149	--
1999–2000[c]	151	14	(8)	--	165	--
2000–2001	--	--	--	146	146	--
2001–2002	148	22	(13)	--	170	--
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
2010–2011	209	12	(5)	--	221	10:44
2011–2012[d]	227	19	(8)	--	246	12:31

[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 2011–2012.

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
2010–2011	55	3	(5)	--	58	3:47
2011–2012	59	16	(21)	--	75	3:24

[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 2011–2012.

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]	66	4 (6)	--	70	3:38
2010–2011	56	8 (12)	--	64	2:43
2011–2012	47	15 (24)	--	62	2:44

[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. Total moose observed in Unit 26B East, Unit 26B West, Itkillik River drainage, and miscellaneous drainages, during spring aerial moose surveys, regulatory years 2003–2004 through 2011–2012.

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[c]	505	101 (17)	--	606	18:40
2006–2007[d]	477	92 (16)	--	569	16:19
2007–2008[e]	491	79 (14)	--	570	25:01
2008–2009[e]	517	47 (8)	--	564	18:58
2009–2010[e]	421	33 (7)	--	454	23:54
2010–2011[f]	414	35 (8)	--	449	20:51
2011–2012[g]	403	61 (13)	--	464	23:55

[a] Short yearlings are 11-month-old calves.
[b] Beginning in regulatory year 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.
[c] Upper Sagavanirktok and upper Canning surveyed.
[d] Oksrukuyik Creek, small portion of Upper Sagavanirktok surveyed.
[e] Upper Sagavanirktok, and Oksrukuyik Creek surveyed.
[f] Upper Sagavanirktok, Oksrukuyik Creek, and Ribdon River surveyed.
[g] Upper Sagavanirktok, Oksrukuyik Creek, Ribdon River, and upper Canning surveyed

Table 5. Unit 26C, Kongakut (upstream of and including Drain Creek; 199 mi^2) and Firth Rivers and Mancha Creek (372 mi^2) early winter aerial moose composition, regulatory years 1991–1992 through 2011–2012.

Regulatory year	Date[b]	Bulls: 100 Cows (*n* bulls)	Yearling bulls: 100 Cows (*n* yearling bulls)	Calves:100 Cows (*n* cows)	Calves	Percent calves	Adults	Moose observed	Search time (hr:min)
1991–1992[a]	Oct. 26–27	105 (176)	21 (36)	38 (167)	63	15	343	406	
2000–2001[a]		118 (73)	26 (16)	35 (62)	22	14	135	157	
2002–2003[a]	Oct. 21–23	113 (108)	21 (20)	24 (96)	23	10	204	227	
2011–2012	Oct. 27, Nov.7	70 (118)	11 (15)	31 (169)	52	15	287	339	10:12

[a] *Data source*: Compiled from U.S. Fish and Wildlife Service data.
[b] First date represents the survey for Firth–Mancha creeks; second date represents survey for upper Kongakut River.

Table 6. Unit 26B reported general season moose harvest, regulatory years 2006–2007 through 2010–2011.

Regulatory Year	Reported harvest M (%)	F (%)	Unk	Total	Hunters (% success)	Illegal hunters (harvest)
2006–2007	0 --	0 --	0	0	0 --	1 (0)
2007–2008	0 --	0 --	0	0	0 --	2 (1)
2008–2009	0 --	0 --	0	0	2 (0)	6 (0)
2009–2010	0 --	0 --	0	0	0 --	1 (0)
2010–2011	1 (100)	0 (0)	0	0	1 (100)	4 (0)

Table 7. Unit 26B DM996 permit moose harvest, regulatory years 2006–2007 through 2011–2012.

Regulatory Year	No. Permits	DM996 harvest M (%)	F (%)	Unk	Total	No. Hunters (% success)
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)
2010–2011	25	8 (100)	0 (0)	0	8	20 (40)
2011–2012	10	4 (100)	0 (0)	0	4	7 (57)

Table 8. Unit 26B moose hunter residency and success, regulatory years 2006–2007 through 2010–2011.

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
2010–2011	0	9	n/a	0	9 (43)	0	12	n/a	0	12 (57)	21

[a] Residents of Units 26B

Table 9. Unit 26B moose harvest chronology percent by time period, regulatory years 2006–2007 through 2010–2011.

Regulatory year	Harvest chronology percent by time period							*n*
	9/1–9/8	9/9–9/15	9/16–9/22	9/23–9/28	9/29–10/5	Oct	Apr	
2006–2007	100	0	n/a	n/a	n/a	n/a	0	7
2007–2008	100	0	n/a	n/a	n/a	n/a	0	3
2008–2009	83	17	n/a	n/a	n/a	n/a	0	6
2009–2010	66	33	n/a	n/a	n/a	n/a	0	3
2010–2011	78	11	n/a	n/a	n/a	n/a	11	9

Table 10. Unit 26B moose harvest percent by transport method, regulatory years 2006–2007 through 2009–2010.

Regulatory year	Harvest percent by transport method								*n*
	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
2010–2011	67	0	0	0	0	11	11	11	9