Species Management Report ADF&G/DWC/SMR-2014-6

Moose management report of survey-inventory activities, 1 July 2011–30 June 2013

Patricia Harper and Laura A. McCarthy, editors

2014 Set

Alaska Department of Fish and Game Division of Wildlife Conservation

Species Management Report ADF&G/DWC/SMR-2014-6

Moose management report of survey-inventory activities, 1 July 2011–30 June 2013

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

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Species management reports provide information about species that are hunted or trapped and management actions, goals, and recommendations for those species. Detailed information is prepared for each species every two or three years, depending on the species, by the area management biologist for game management units in their areas. Reports are not produced for species that are not managed for hunting or trapping or for areas where there is no current or anticipated activity. The individual unit reports are compiled in this statewide report. Unit reports are reviewed and approved for publication by regional management coordinators.

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If this report is referenced in its entirety, please reference as follows:

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Cover Photo: A bull moose in Chugach State Park, Alaska. ©2010 Ken Marsh.

MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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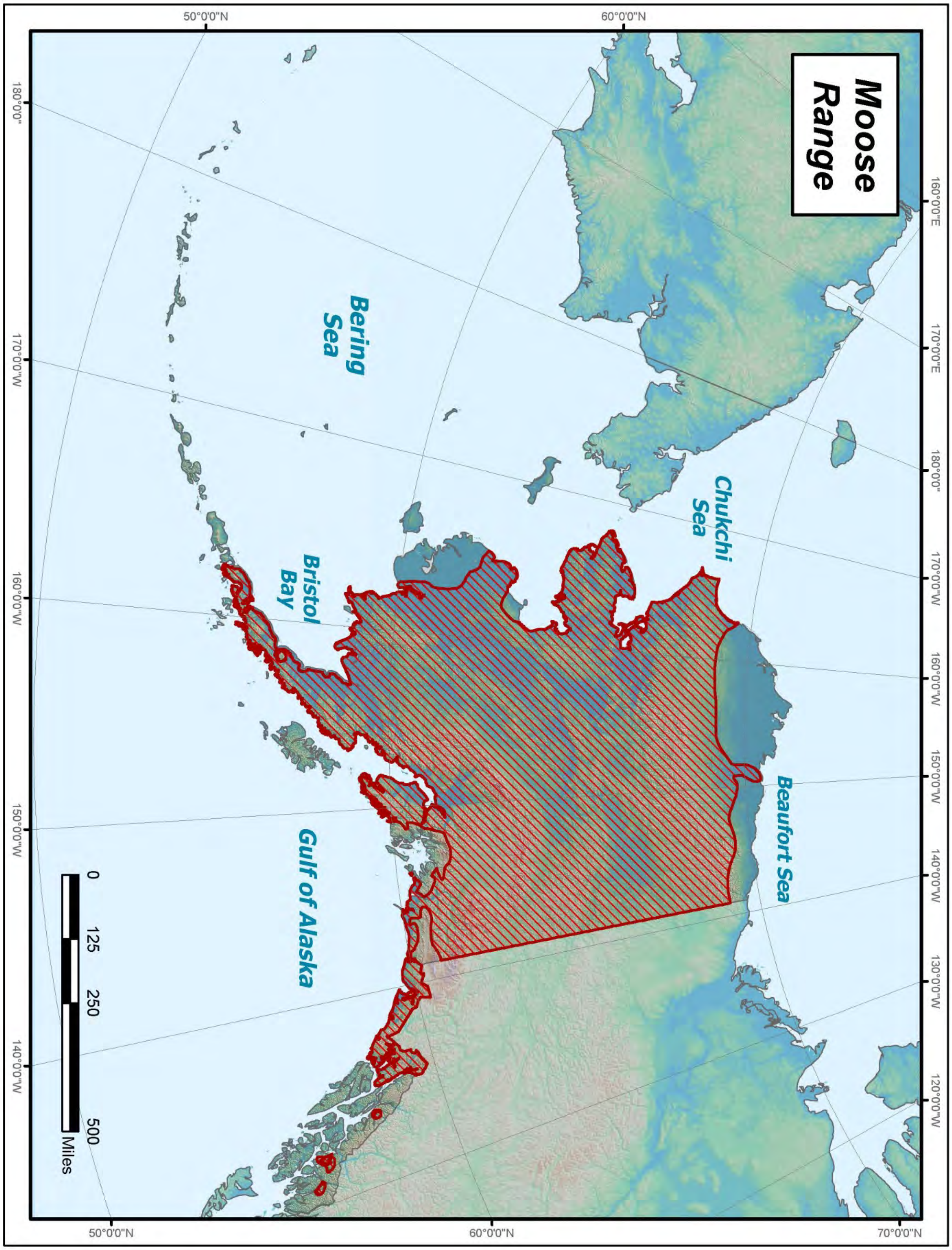
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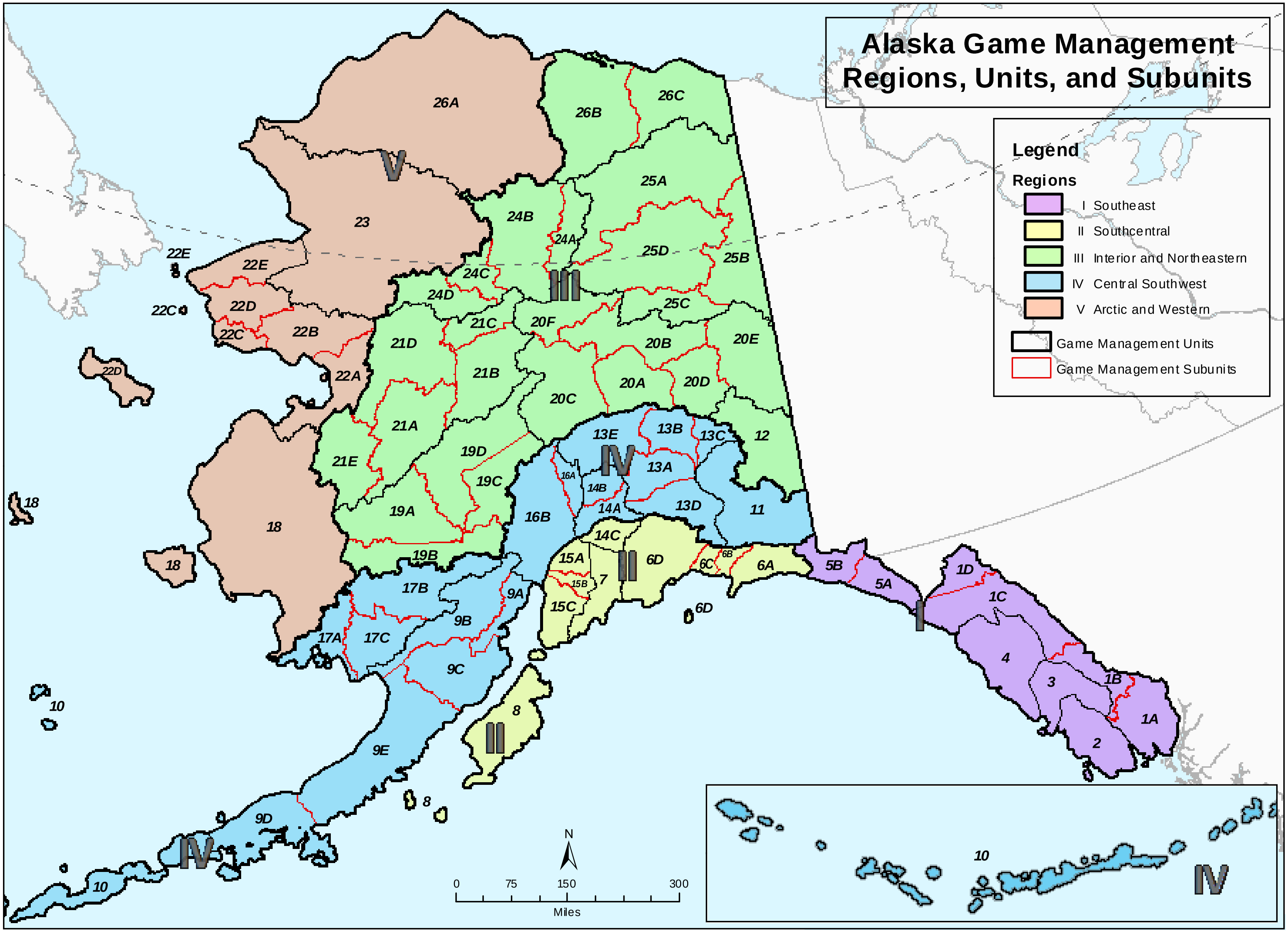
Alaska Game Management
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CHAPTER 1: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

LOCATION

GAME MANAGEMENT UNITS: 1A (5,300 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.

BACKGROUND

The status and state management of moose in these units has been relatively unchanged for the past decade. 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 surveys 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 0–5 per year. Unit 1A moose are believed to be entirely subspecies *Alces alces andersonii*, and likely emigrated from interior British Columbia via the Unuk River valley. Moose sightings are occasionally reported from other parts of Unit 1A including the lower mainland, Revillagigedo Island, the Cleveland Peninsula, and on Prince of Wales Island in Unit 2.

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 non-consumptive 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, hunt timing, mode of transport, and hunter success. Effort is also made to obtain federal registration permit hunt information prior to compiling this report. Harvest data are organized by regulatory year (RY). A regulatory year runs from 1 July through 30 June (e.g., RY11 = 1 July 2011–30 June 2012).

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 likely account for substantial mortality in this area, particularly on moose calves.

After more than 2 decades of no moose observations along the mainland Chickamin River located south of the Unuk River, the Alaska Fish and Game sport fish tagging crew observed fresh moose tracks and pellets in this area representing at least 1 adult moose during the summers of 2010 and 2011. This area once held a small, introduced moose population during the 1970s and we will watch for more signs of moose in the future.

Population Composition

Current population estimates for the Unuk River within the Alaska portion of the drainage are between 35–50 moose. We try 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. No aerial surveys were completed during this reporting period.

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 radiocollared 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.

MORTALITY

Harvest

<u>Season and bag limit</u>	<u>Resident and nonresident hunters</u>
Unit 1A	15 September–15 October
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 did we issue any emergency orders in relation to Unit 1A moose management.

Hunter Harvest. The Unit 1A 10-year mean annual harvest (RY03–RY12) is 2 bulls. During RY11 hunters reported 4 bulls taken under state registration permit and no additional harvest was reported from the federal permit. During RY12, 2 bulls were taken by state permit and 1 bull was reported under the federal permit (Table 1).

Permit Hunts. During RY11, 22 individuals obtained a Unit 1A state moose registration permit for RM022 and 11 hunted. During the RY12 season 45 hunters registered and 31 reported hunting. This is the highest level of participation in this hunt over the past decade (Table 1).

Hunter Residency and Success. Unit 1A moose hunters are primarily from Ketchikan, Metlakatla, and Prince of Wales Island. All successful hunters during the past 10 years were residents of 1 of these 3 communities. The success rate for hunters who participate has averaged 13% over the last 10 years. During RY11 36% of hunters were successful, and in RY12 6% were successful (Table 2). The higher level of success during the 2011 season is likely a function of fewer hunters in the field and focused effort by the few active hunters during that season. Weather during the 2011 hunting season was extremely poor and consequently fewer hunters were able to reach the remote hunt area.

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 (September 5–October 15) federal season in 6 of the last 10 years. Of the 9 additional moose reported under the Federal permit over the past 10 years, 6 were harvested prior to the opening of the State hunt, 2 during the state season, and 1 harvest date is unknown. Most hunters using federal permits continue to hunt under federal regulations after the state season opens. A few hunters who were federally qualified obtained both state and the federal permits that allowed them to hunt on state and private lands near the Unuk River. When hunters obtain both permits we make an effort to cross reference harvest report data and avoid counting the same hunter twice.

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 that 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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Management Coordinator

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

Porter, B. 2015. Unit 1A moose management report. Chapter 1, pages 1-1 through 1-8 [In] P. Harper and L. A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.

Table 1. Unit 1A moose harvest data for permit hunt (RM022) for regulatory years 2003 through 2012.

Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Males	(%)	Females	(%)	Total harvest
2003	30	20	8	2	2[a]	(100)	0	(0)	2[a]
2004	38	12	23	3	3[b]	(100)	0	(0)	3[b]
2005	41	24	17	0	0	(100)	0	(0)	0
2006	23	13	9	1	1[c]	(100)	0	(0)	1[c]
2007	33	16	15	2	2	(100)	0	(0)	2
2008	20	5	13	2	2[b]	(100)	0	(0)	2[b]
2009	33	16	14	3	3	(100)	0	(0)	3
2010	24	11	12	1	1[b]	(100)	0	(0)	1[b]
2011	22	11	7	4	4	(100)	0	(0)	4
2012	45	14	29	2	2[b]	(100)	0	(0)	2[b]
Average	30.9	14.3	14.6	2.0	2.0	(100)	0	(0)	2.0

[a] Three additional bulls harvested under federal regulations.

[b] One additional bull harvested under federal regulations.

[c] Two additional bulls harvested under federal regulations.

Table 2. Unit 1A moose hunter residency and success for regulatory years 2003 through 2012.

Year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Total	(%)	Local resident	Nonlocal resident	Nonresident	Total	(%)	
2003	2	0	0	2[a]	(20)	8	0	0	8	(80)	10
2004	2	1	0	3[b]	(12)	23	0	0	23	(88)	26
2005	0	0	0	0	(0)	16	1	0	17	(100)	17
2006	1	0	0	1[c]	(10)	6	3	0	9	(90)	10
2007	2	0	0	2	(12)	14	1	0	15	(88)	17
2008	2	0	0	2[b]	(13)	13	0	0	13	(87)	15
2009	3	0	0	3	(18)	13	1	0	14	(82)	17
2010	1	0	0	1[b]	(8)	11	0	1	12	(92)	13
2011	4	0	0	4	(36)	6	0	1	7	(64)	11
2012	2	0	0	2[b]	(6)	26	2	1	29	(94)	31
Average	2.0	0.1	0	2.0	(13)	12	1.0	0.3	14	(87)	16

[a] Three additional bulls harvested under federal regulations.

[b] One additional bull harvested under federal regulations.

[c] Two additional bulls harvested under federal regulations.

Table 3. Unit 1A moose harvest chronology for regulatory years 2003 through 2012.

Year	15–21 Sep	(%)	22–28 Sep	(%)	29 Sep–5 Oct	(%)	6–15 Oct	(%)	*n*
2003	0	(0)	1	(50)	1	(50)	0	(0)	2 [a]
2004	1	(33)	0	(0)	1	(33)	1	(33)	3 [b]
2005	0	(0)	0	(0)	0	(0)	0	(0)	0
2006	0	(0)	0	(0)	0	(0)	1	(100)	1[c]
2007	0	(0)	0	(0)	0	(0)	2	(100)	2
2008	0	(0)	0	(0)	2	(100)	0	(0)	2 [b]
2009	0	(0)	0	(0)	1	(33)	2	(66)	3
2010	0	(0)	0	(0)	1	(100)	0	(0)	1[b]
2011	0	(0)	0	(0)	1	(25)	3	(75)	4
2012	1	(50)	1	(50)	0	(0)	0	(0)	2[b]
Average	0.2	(10)	0.2	(10)	0.7	(35)	0.9	(45)	

[a] Three additional bulls harvested under federal regulations.

[b] One additional bull harvested under federal regulations.

[c] Two additional bulls harvested during early federal season.

Table 4. Unit 1A moose harvest percent by transport method for regulatory years 2003 through 2012.

Year	Harvest percent by transport method										
	Airplane	(%)	Boat	(%)	Highway vehicle	(%)	Off-road vehicle	(%)	Unk	(%)	*n*
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)	0	(0)	0	(0)	0	(0)	0	(0)	0
2006	1	(100)	0	(0)	0	(0)	0	(0)	0	(0)	1[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 [b]
2009	0	(0)	3	(100)	0	(0)	0	(0)	0	(0)	3
2010	0	(0)	1	(100)	0	(0)	0	(0)	0	(0)	1[b]
2011	0	(0)	4	(100)	0	(0)	0	(0)	0	(0)	4
2012	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2[b]
Average	0.1	(5)	1.9	(95)	0	(0)	0	(0)	0	(0)	

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

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CHAPTER 2: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 twentieth 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-twentieth 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 1984 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 Alaska Board of Game (BOG) 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 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-inch 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 regionwide (Division of Wildlife Conservation, Region I, Southeast Alaska) 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 might 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 was 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 6 October 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. 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. From 2000 to 2010 the harvest of Stikine River moose averaged 20 bulls, and ranged from 11 to 34 moose annually.

The average annual harvest of bulls from Thomas Bay rose steadily through the decades from 5 during the 1950s to 21 during 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 northward, 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	2011	2012
Post-hunt numbers	300	N/A	N/A
Annual hunter kill	30	19	20
Number of hunters	250	164	198
Hunter-days of effort	1,750	1,247	1,532
Hunter success	12%	12%	10%

Thomas Bay

	Plan Objective	2011	2012
Post-hunt numbers	200	N/A	N/A
Annual hunter kill	20	10	10
Number of hunters	160	70	61
Hunter-days of effort	675	608	386
Hunter success	12%	14%	16%

METHODS

We flew late winter population surveys along the Stikine River valley to count moose and to gather composition data (calves and adults). Of the 3 surveys conducted during the report period, 2 were conducted prior to antler drop, thereby allowing us to identify the sex of adult moose observed and calculate bull:cow ratios. 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. 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. RY11 = 1 July 2011–30 June 2012).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Three aerial surveys were conducted during this report period, 1 in 2011 (80 moose observed) and 2 in 2012 (86 and 65 moose observed). Without a sample of radio-marked moose, 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 1996. 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.

Three surveys were conducted during this report period (Table 1). We had early winter snowfall and good survey conditions in December 2011 and 2012 that allowed us to get bull:cow ratios prior to antler drop during both years. In December 2011 a total of 80 moose were counted, including 6 bulls, 61 cows, 12 calves and 1 moose that could not be identified to sex, for a bull:cow ratio of 10:100 and a calf:cow ratio of 20:100. In March 2012, a total of 86 moose were counted; however, because of the late survey date it was not possible to reliably distinguish the sex and age of moose seen. In December 2012 a total of 65 moose were counted, including 8 bulls, 49 cows and 16 calves, for a bull:cow ratio of 20:100 and a calf:cow ratio of 39:100.

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 2011 a total of 234 RM038 hunters reported seeing a total of 1,325 moose in Unit 1B, including 458 bulls, 627 cows, and 240 calves, for a bull-to-cow ratio of 73:100, and a calf-to-cow ratio of 38:100. In 2012, 259 RM038 hunters reported seeing a total of 1,478 moose, including 495 bulls, 669 cows, and 314 calves, for a bull-to-cow ratio of 74:100, and a calf-to-cow ratio of 47:100.

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	

Alaska Board of Game Actions and Emergency Orders. No Board of Game actions took place, and no emergency orders were issued during the report period.

Hunter Harvest. For the Stikine River portion of Unit 1B, in 2011, 164 hunters harvested 19 moose, including 1 illegal kill. In 2012, 198 hunters harvested 20 moose, including 2 illegal kills (Tables 2 and 4). For the Thomas Bay/Farragut Bay portion of Unit 1B, in 2011, 70 hunters harvested 10 moose in the general vicinity of Thomas Bay, including 4 from Farragut Bay (Tables 3 and 5). Three additional moose 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 2012, 61 hunters harvested 10 moose in the Thomas Bay vicinity, including 6 from Farragut Bay. Two additional moose were harvested at Port Houghton in southern Unit 1C.

Hunter Residency and Success. Most Unit 1B moose hunters are local residents and participation by nonlocal residents and nonresidents is typically low. In both 2011 and 2012, local residents of Wrangell and Petersburg represented 95% of successful hunters on the Stikine River, and nonlocal hunters represented 5% (Table 4). The overall success rate for Stikine River moose hunters was 12% in RY11 and 10% in RY12.

Petersburg residents continued to dominate the Thomas Bay and Farragut Bay moose hunts (Table 5). In 2011, local residents of Petersburg and Wrangell represented 90% of successful hunters in the vicinity of Thomas Bay and Farragut Bay, and nonlocal hunters represented 10%. In 2012, local residents of Petersburg represented 80% of successful hunters in the vicinity of Thomas Bay and Farragut Bay, and nonlocal residents represented 20%. The overall success rate for Thomas Bay and Farragut Bay moose hunters was 14% and 16%, respectively, in 2011 and 2012.

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 2011, the largest percentage of the annual harvest in the Thomas Bay area occurred during the third week of the season, followed by the second and fourth weeks. The largest percentages of the annual harvest on the Stikine River, in order beginning with the highest, occurred during the first, fourth and second weeks of the season. In 2012 the largest percentages of the annual harvest at Thomas Bay occurred during the third, second, and fourth weeks of the season. The largest percentages of the annual harvest on the Stikine occurred during the first and second weeks of the season followed by the third and fourth weeks, each with identical harvests. 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 WAAs. During the report period, moose harvest was reported in 5 Unit 1B WAAs and 1 Unit 1C WAA. In 2011 the highest percentage of the annual harvest occurred in WAA # 1708 (52%) on the Stikine River and in WAA # 1605 (21%) at Thomas Bay, respectively. In 2012 the highest percentage of the annual harvest occurred in WAA # 1708 (53%) on the Stikine River and in WAA # 1602 (20%) at Farragut Bay.

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–LeConte 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 14 years indicate that moose use has increased in these thinned units.

CONCLUSIONS AND RECOMMENDATIONS

During this report period, the only Stikine management objective met was that of hunter success in 2011. The success rate of 12% in 2011 and 10% in 2012 was equal to and below, respectively, the management objective of 12%. While the total number of hunters increased by 5% from the previous report period, and the actual days of effort increased by 7%, both remained well below the management objectives of 250 hunters and 1,750 days of effort. The harvest of 19 moose on the Stikine River in 2011 and 20 moose in 2012 were both below the management objective of 30 moose per year. We believe the Stikine moose population was at low levels during the late 1990s and early 2000s, but the population 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, which occurred in both 2011 and 2012. The success rate of 14% in 2011, and 16% in RY12, were both above the management objective of 12% success. The number of hunters has been steadily declining in recent years, and that trend continued during the report period. During the report period, the total number of hunters decreased by 29% from the previous report period. During the same period, the days of effort decreased by nearly 19%. The Thomas Bay moose population currently appears to be in decline and is thought to be at 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 have rebounded in recent years. The Unit 1B total harvests of 29 bulls in 2011, and 30 bulls in 2012, were both above the long-term average annual harvest of 26 moose during the period 1952 to 2010. An aerial moose survey in December 2006 documented 199 moose on the United State side of the international boundary, which is the highest count since 1960. The relatively sudden appearance of moose in high numbers on the U.S. side of the international boundary implies that there may be considerable transboundary movement of moose between the U.S. and Canada. During this report period, however, the number of moose observed during aerial surveys of the Stikine River valley steadily declined from the high of 199 in 2006, to 80 in 2011 and 86 in 2012.

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 2011, 9 (31%) of the 29 bulls harvested in Unit 1B had 2 brow tines on both antlers. In 2012, 9 (30%) of the 30 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 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 15 September 15 through 15 October with a bag limit of 1 bull with spike-fork or 50-inch antlers or 3 or more brow tines on 1 antler, or 2 or more brow tines on both antlers.

REFERENCES 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.

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Lowell, R. E. 2014. Unit 1B moose management report. Pages 2-1 through 2-15 [*In*] P. Harper and L. A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013, Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.

While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Product names used in this publication are included for completeness but do not constitute product endorsement.

Table 1. Unit 1B Stikine area aerial moose surveys, regulatory years 1996 through 2012.

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[a]	54	11	(17)	0	65	30
2009						
2/18 [a]	82	21	(20)	39	142	53
2010						
12/14 [a]	96	26	(21)	3	125	49
2011						
12/07[a]	67	12	(15)	1	80	24
2012						
3/21[a]	NA	NA	NA	NA	86	34
12/12[a]	49	16	(25)	0	65	27

[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 2012.

	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
2011	18	(100)	0	(0)	1	0	19
2012	18	(100)	0	(0)	2	0	20

[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 2012.

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
2011	8	(100)	0	(0)	2	0	10
2012	10	(100)	0	(0)	0	0	10

[a] Includes RM038 and DM033 harvest.

Table 4. Unit 1B (Stikine[a]) moose hunter residency and success by permit hunt, regulatory years 1999 through 2012.

	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
2011	18	1	0	0	19	(12)	130	15	0	0	145	(88)	164
2012	19	1	0	0	20	(10)	173	3	2	0	178	(90)	198

[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 2012.

	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
2011	9	1	0	10	(14)	54	6	0	60	(86)	70
2012	8	2	0	10	(16)	42	9	0	51	(84)	61

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

Table 6. Unit 1B moose harvest chronology, regulatory years 1999 through 2012.

Area	Year	15–21 Sep	22–28 Sep	29 Sep–5 Oct	6–15 Oct
Thomas and Farragut bays					
	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
	2011	1	3	4	2
	2012	2	1	5	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
	2011	8	3	2	6
	2012	12	4	2	2

[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 2012.

Area	Year	Airplane	Boat	Highway vehicle	3- or 4-wheeler	Horse	Other	Total
Thomas and Farragut bays								
	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
	2011	0	10	0	0	0	0	10
	2012	0	10	0	0	0	0	10
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
	2011	0	19	0	0	0	0	19
	2012	0	20	0	0	0	0	20

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

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CHAPTER 3: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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. Moose in this area of Unit 1C have been managed since 1995 as part of the 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 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. Couverden 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 1968. 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 overutilization. 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 4 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. 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 the 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, 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 calculate sightability during aerial surveys, 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. RY11 = 1 July 2011–30 June 2012)

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Berners Bay: Aerial surveys conducted in Berners Bay in RY11 enumerated 73 moose, and 2 surveys were conducted in RY12, which resulted in 85 and 102 total moose observed, respectively (Table 1). The survey total for RY11 was below our management objective of 80–90 moose counted post hunt; however, in RY12 numbers were within or exceeded the parameters. The Berners Bay moose population was depressed during the previous report period, likely because of 3 successive years (2006–2009) of severe winter weather. During RY11, 134 inches of snow fell at the Juneau airport and 360 inches fell in Haines, Alaska which might suggest that moose numbers may drop again. However, after 2 aerial surveys in RY12 the total number of moose was the highest they have been since 1999. Careful monitoring of the herd should be maintained to ensure sufficient time to determine lags in population effects of severe weather events.

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. Couverden.

Taku River: We have very little information regarding the number of moose in the Taku River drainage. The last survey conducted by the department in the Taku River was in the winter of RY00, when 37 moose were counted (Table 1). In response to a 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, B.Sc, Redfern Resources, 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 RY11 and RY12 counted 136 and 274 moose, respectively (Table 1). Radiocollared 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 and the Gustavus moose population 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 areas. 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 December or January, when 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: Between RY11 and RY12, we conducted 3 aerial surveys which allowed us to gather reliable composition data for this population. We observed ratios of 54 bulls:100 cows, and 24 calves:100 cows in RY11, and 43 and 31 bulls: 100 cows, respectively, and 17 and 21 calves: 100 cows, respectively for the 2 surveys conducted in RY12. The bull:100 cow ratio is higher than our objective of 25:100 in both years due to no harvest since the season was closed in 2006. The increased number of calf moose detected in RY11 is likely related to mild-moderate winter severity in RY10; however, heavy snowfall in RY11 resulted in a lower calf:100 cow ratio in RY12. 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 3.7 years, lower than the previous report period. However, during the report period 7 of 31 bull moose taken were yearlings (23%), suggesting there is a slight increase in recruitment within the population (Table 3). 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 a portion of the older mean age of harvested bulls in previous report periods, 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 RY11, we observed 136 moose with a bull:cow ratio of 17 bulls:100 cows, and a calf:cow ratio of 28 calves:100 cows. In RY12, we observed 274 moose with a bull:cow ratio of 16 bulls:100 cows, and a calf: cow ratio of 20 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. Implementation of an antler restriction bull moose hunt on the Gustavus Forelands starting in RY08 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 3.5 and 2.4 years for RY11 and RY12, 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 2011, 4 of the 8 bulls taken were >4.5 years of age resulting in a slightly higher average age at harvest. In 2012, a higher proportion of yearling bulls were taken (63%) and the age of the remaining harvest was skewed to the younger side of the age classes. Overall, it appears there are older bulls available for harvest, which is a product of the antler restricted hunt strategy that protects some bulls from harvest based on antler configuration. Prior to the antler restricted bull moose hunt in Gustavus a high proportion of young bulls were harvested before attaining older age. No antlerless moose hunts were held in Gustavus during the report period.

Taku River: No aerial surveys were conducted in this area during the report period. 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 2.7 years during both RY11 and RY12, respectively (Table 3). During the report period 57% 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 6 of the 30 (20%) bulls taken were older than 3.5 years; 1 bull taken was 10.5 years old.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 1(C), Berners Bay Drainages:	15 Sep–15 Oct (General hunt only)
1 moose by drawing permit only; up to 30 permits may be issued	
Unit 1(C), that portion south of Point Hobart, including all Port Houghton drainages:	15 Sep–15 Oct (General hunt only)
1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on one side or 2 or more brown times on both sides by registration permit only	
Unit 1(C), that portion west of Excursion Inlet and north of Icy Passage:	
1 moose per regulatory year, only as follows:	
1 bull by registration permit only or	15 Sep–15 Oct (General hunt only)
1 antlerless moose by drawing permit only; up to 100 permits may be issued	15 Nov–30 Nov (General hunt only)
Remainder of Unit 1(C) 1 bull by registration permit only	15 Sep–15 Oct (General hunt only)

Game Board Actions and Emergency Orders. There were no Board of Game actions taken for moose in 1C during the 2010 Alaska meeting. We did not issue any emergency orders closing moose hunts during RY11 or RY12.

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 16 moose, similar to the previous report period, and slightly less than the average of 18 bulls taken between 2003 and 2012 (Table 4).

Gustavus: During this report period, the antler restricted hunt at Gustavus was managed for a guideline harvest of 8 bulls in RY11 and 11 bulls in RY12. Hunters harvested 8 bulls in each regulatory year of this report period (Table 4). 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 continued to provide a community training event for moose hunters in Gustavus in both RY11 and RY12 at which time antler architecture was discussed. Four bulls not meeting legal antler requirements were taken in each year (50%), which emphasizes the need to continue with public education prior to the moose hunt. 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 16 taken in RY11 and 14 in RY12. The mean harvest for the report period is equal to the mean annual harvest of 15 moose during 2003–2012 (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 use 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 327 permits were issued in RY11, followed by 321 in RY12. Although we cannot determine the destination the permittees will hunt within Unit 1C when they acquire their permit (for RM046), the resulting reporting data (Table 4) indicate that of those actually hunting 50% hunted the Chilkat Range and 50% hunted the Taku River.

For RM049 at Gustavus, 153 permits were issued in RY11, and 147 in RY12. 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 of the permittees actually participated in a hunt. Combining both years of the report period, 71% of the permittees hunted. Overall, during the report period, the Gustavus bull moose hunt accounted for 36% 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 60 of 77 harvested moose, other Alaska residents took 15, and nonresidents took 2 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. Thirteen percent of hunters pursuing bull moose in Unit 1C were successful during the report period. Gustavus moose hunters had a success rate of 8%, 16% of the Taku River hunters were successful, and Chilkat Range hunters had a success rate of 16%.

Harvest Chronology. Similar to recent years, the RY11 and RY12 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 1 December–10 December. Even then, most 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 both boats and ORVs were used by 37% of the hunters (Table 7). Generally, most airplane access (20%) to this area is in the upper Endicott River, and most boat access takes place at St. James Bay, Howard Bay, and Point Couverden/Swanson Harbor. Off-road-vehicle (ORV) use in the Couverden 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. Two successful moose hunters reported using a highway vehicle for transportation and one hunter was successful on foot. The vehicle is likely being used on logging roads in the Homeshore/Couverden area.

Gustavus Forelands: Successful Gustavus Forelands hunters use a variety of access methods. During the report period an average of 81% used highway vehicles, and 19% used a boat; no hunters reported using ORVs, airplanes, or walking 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. In general hunters who list walking as their mode of access are residents of Gustavus who have access to hunting areas on or near their property. ATV access for hunting moose at Gustavus is restricted to “constructed road surfaces” only, thus, the limited use of that access type.

Taku: Of the successful Taku River moose hunters, boat access in the area was the most widely used (93%) during the report period, with the remainder using ORVs (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 of 2006–2007 and subsequent greater than average snowfall winters of 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 radiocollared female moose in Berners Bay continued to improve; survival rates in 2011 and 2012 were 96% and 90%, respectively (White et al. 2012). Calf moose survival for Berners Bay also improved during the report period. In 2011 calf survival was estimated at 29%, and in 2012 survival was estimated at 32% (White et al. 2012). We believe severe winter weather with resulting snow depths in Berners Bay is the likely cause of adult moose mortality. The combination of low calf survival and adult mortality in Berners Bay has negatively impacted this herd’s 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 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 RY11 and RY12 bull:cow ratios exceeded the management objective of 25:100 during both years. Aerial survey data met the objective of 80–90 moose as listed in the Berners Bay management objectives in RY11; the number of moose observed exceeded the management objectives in RY12. During the report period, moderate winters in RY11 suggested that moose numbers would dip, however in RY12 survey results were as high as they have been since 1999 suggesting that the Berners Bay moose population is increasing. There is potential that a lag effect may occur and population numbers may be lower in the next reporting period. 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 the previous report period, but less than in RY06, which had the highest harvest (28 moose) in the last 10 years. The age structure of the harvest during the current report period is younger than has been seen in recent years, suggesting there is good recruitment within the population. The mean number of days hunted is consistent with previous report periods suggesting that hunters are spending the same amount of time in the field from year to year. With decreasing opportunity in Gustavus, the Chilkat Range moose population continues to gain popularity with hunters in Unit 1C. ATVs and other vehicles can be used on the logging roads in the Homeshore-Couverden area to access moose hunting areas. 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 Couverden, 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 difficult to determine 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 try to acquire survey data for 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, 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 current registration permit system should help meet population objectives throughout Unit 1C by allowing opportunity for harvest in areas where moose are present and ensuring populations do not exceed their habitat capacity. In addition, 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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While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Table 1. Unit 1C aerial moose survey data, regulatory years 1995 through 2012.

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						
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
2011	22	41	10	0	73	NA	54	24	14	NA
2012	23	53	9	0	85	4.2	43	17	11	20
2012	21	67	14	0	102	4.0	31	21	14	26
				Chilkat Range1998–2012						
1998	6	15	16	35	72	1.1	---	---	22	65
1999					No Survey					
2000	---	6	6	113	125	1.7	---	---	---	74
2001–2012					No Survey					
				Taku River 1998–2012						
1998	6	15	16	35	72	1.1	---	---	22	65
1999				No Survey						
2000	---	5	7	25	37	2.1	---	---	19	18
2001–2012				No Survey						
				Gustavus Forelands 1998–2012						
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
2011	16	94	26	0	136	3.9	17	28	19	35
2012	33	201	40	0	274	5.0	16	20	15	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 2012.

								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
2007-2012											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
2003–2005											HUNT CLOSED								
2006	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100	2.5
2007–2012											HUNT CLOSED								

Table 3. Unit 1C moose age at harvest, excluding Berners Bay, regulatory years 2003 through 2012.

								Age	Class								Total	%	Mean
Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	kill	Aged	Age
									Chilkat Range										
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
2011	0	6	6	0	3	2	0	1	1	0	1	0	0	0	0	0	20	100	3.8
2012	0	1	1	5	2	1	0	0	0	0	0	0	0	0	0	0	11	91	3.6
									Gustavus Forelands										
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
2011	0	4	0	0	2	1	0	1	0	0	0	0	0	0	0	0	8	100	3.5
2012	0	5	2	0	0	0	1	0	0	0	0	0	0	0	0	0	8	100	2.4

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																			
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
2011	0	10	1	1	0	0	3	0	0	0	0	0	0	0	0	0	16	94	2.7
2012	0	7	4	2	0	0	0	0	0	0	1	0	0	0	0	0	14	100	2.7

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
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
2009-2012	HUNT CLOSED																		

Table 4. Unit 1C moose historical harvests, number of hunters, and percent success, regulatory years 2003 through 2012.

Year	No. males	No. females	No. unknown	Total kill	No. hunters	% success[b]
			Berners Bay			
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
2007–2012		HUNT CLOSED				
			Chilkat Range			
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
2011	20	0	0	20	103	19
2012	11	0	0	11	86	13
			Gustavus Forelands			
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
2011	8	0	0	8	108	7
2012	8	0	0	8	104	8
			Taku River			
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
2011	16	0	0	16	98	16
2012	14	0	0	14	90	16

Year	No. males	No. females	No. unknown	Total kill	No. hunters	% success[b]
		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
2009–2012		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 2003 through 2012.

		Successful hunters			Unsuccessful hunters			Total Hunters		
Year	Permits Issued[a]	No. hunters	Total days	Avg days	No. hunters	Total days	Avg days	No. hunters	Total days	Avg days
					Berners Bay-DM041 and DM042					
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
2007–2012					HUNT CLOSED					
					Chilkat Range					
2003	516	22	61	2.8	75	244	3.3	97	305	3.1
2004	474	18	49	2.7	80	282	3.5	98	331	3.4
2005	313	17	53	3.1	98	364	3.7	115	417	3.6
2006	337	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
2011	327	20	67	3.4	83	412	5.0	103	479	4.7
2012	321	11	83	7.5	75	370	4.9	86	453	5.3
					Gustavus Forelands					
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
2011	153	8	80	10.0	100	762	7.6	108	842	7.8
2012	147	8	66	8.3	96	638	6.6	104	704	6.8
					Taku River					
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
2011	---	16	42	2.6	82	389	4.7	98	431	4.4
2012	---	14	59	4.2	76	417	5.5	90	476	5.2

Year	Permits Issued[a]	Successful hunters No. hunters	Successful hunters Total days	Successful hunters Avg days	Unsuccessful hunters No. hunters	Unsuccessful hunters Total days	Unsuccessful hunters Avg days	Total Hunters No. hunters	Total Hunters Total days	Total Hunters Avg days
Gustavus Forelands (Antlerless Harvest)—DM043, DM044, DM045										
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
2009–2012	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 2003 through 2012.

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
			Berners Bay						
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
2007-2012			HUNT CLOSED						
			Chilkat Range						
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
2011	20	0	12	3	0	0	0	4	1
2012	11	0	6	4	0	0	0	1	0
			Gustavus Forelands						
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
2011	8	6	1	0	0	0	0	0	1
2012	8	5	2	1	0	0	0	0	0
			Taku River						
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
2011	16	0	14	1	0	0	0	1	0
2012	14	0	14	0	0	0	0	0	0

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
			Gustavus Forelands (Cow Harvest)						
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
2009-2012			HUNT CLOSED						

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

Table 7. Unit 1C successful moose hunters transport methods, regulatory years 2003 through 2012.

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										
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	---
2007-2012	HUNT CLOSED									
Chilkat Range										
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	---
2011	5	(25)	6	(30)	7	(35)	1	(5)	1	(5)
2012	1	(9)	5	(46)	4	(36)	1	(9)	0	---
Gustavus Forelands										
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	(14)
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	---
2011	0	---	1	(12)	0	---	7	(88)	0	---
2012	0	---	2	(25)	0	---	6	(75)	0	---
Taku River										
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	---
2011	0	---	15	(94)	1	(6)	0	---	0	---
2012	0	---	13	(93)	1	(7)	0	---	0	---
Gustavus Forelands (Cow Harvest)										
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	---
2009-2012	HUNT CLOSED									

Table 8. Unit 1C moose hunters commercial services use, regulatory years 2003 through 2012.

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
2007–2012					HUNT CLOSED						
					Chilkat Range						
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
2011	76	6	16	2	3	0	95	8	7	1	0
2012	62	6	16	1	1	0	79	7	7	0	0
					Gustavus Forelands						
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	1	1	0	107	1	1	0	0
2010	89	1	4	0	2	0	95	1	1	0	0
2011	93	4	8	0	3	0	104	4	1	0	3
2012	97	3	4	0	0	0	101	3	1	0	2
					Taku River						
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
2011	88	0	10	0	0	0	98	0	0	0	0
2012	82	0	8	0	0	0	90	0	0	0	0

Year	Unit residents		Other AK residents		Non-residents		Total use		Transport	Non-guided services	Other services
	No	Yes	No	Yes	No	Yes	No	Yes			
Gustavus Forelands (Cow Harvest)											
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
2009–2012	HUNT CLOSED										

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CHAPTER 4: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 (ADF&G 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 Alaska 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 RY11 and RY12 (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., RY11 = 1 July 2011–30 June 2012).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We conducted aerial surveys in the fall of 2011 and fall of 2012. In fall 2011 we counted 212 moose and in fall 2012 we counted 177 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 2011 survey were adequate to classify animals that were observed (212 total) as bulls, cows, or calves. We classified 28 (13%) of the moose seen on this survey as calves, which is slightly lower than the 15% and 14% of calves seen in the fall 2009 and fall 2010 surveys, respectively (Table 1). The bull:cow ratio was determined to be 45:100 and the calf:cow ratio was 22:100. Survey conditions in fall 2012 were also adequate to collect reliable herd composition, and we were able to classify 175 animals as bulls, cows or calves. We classified 24 (14%) of the moose seen as calves, while the bull:cow and calf:cow ratios were determined to be 38:100 and 22:100 respectively. The high bull:cow ratio during the R11 and RY12 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 16% 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 10 years were recorded in RY06 and RY11 (Table 1).

The harvest age structure has remained consistent between the current and past reporting periods (RY07–RY10). Mean age at harvest during this report period was 3.8 years, which was similar to the mean age of 3.7 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 Sep–7 Oct (Subsistence hunt only)	No open season.

Alaska Board of Game 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 22 moose, an increase from the 16 reported during the previous report period. In RY11, 21 bull moose were taken, and in RY12, 22 bull moose were harvested. The RY08 harvest had been the highest harvest during the past 10 years (n=30), and 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. 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 RY11 and RY12 seasons.

Hunter Residency and Success: During the report period local residents were the primary Unit 1D moose hunters even though all Alaska residents are eligible to apply for this or any other Tier II hunt. Residents of Haines and Klukwan (Table 4) took 42 of the 43 moose harvested during the report period. Hunter success was 11% in each of RY11 and RY12. Success rates during this report period are similar to those over the past decade (Table 5). Successful hunters took an average of 4.0 days in RY11 and 7.0 days in RY12 to harvest a bull moose (Table 3). Hunter days were 1,501 in RY11 and 1,590 in RY12 (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 57% and 36% of the harvest in the first week of the season in RY11 and RY12, 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 11 bulls (27% of the total harvest) harvested the first week had spike/fork configuration, 3 bulls had 3 or more brow tines on at least one side, and 3 bulls with a more than a 50 inch spread were taken during this period in RY11. Three sublegal moose in RY11 were taken with 2 bulls having fewer than 3 brow tines, and 1 illegal bull being left unsalvaged in the field. In RY12 four bulls with spike/fork antlers, 2 bulls with 3 brow tines (9% of the total harvest), and 1 bull with more than a 50 inch spread was taken in the first week. Three sublegal bulls were taken after the first week in RY12 with 2 bulls harvested having less than 3 brow tines, and 1 bull with less than a 50 inch spread.

Transport Methods: Most Unit 1D moose hunters use boats or highway vehicles during the harvest (Table 6). During the RY11 and RY12 hunting seasons, 57% and 73% of successful hunters used boats, respectively. Many of the remaining successful hunters used highway vehicles (29% in RY11 and 18% in RY12; Table 6).

Commercial Services: No resident or nonresident 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/accepting moose for cultural education and traditional funeral ceremonies. A sublegal bull moose was donated in both RY11 and RY12 for cultural education and another bull was harvested in RY11 for a potlatch ceremony. These types of harvests/donations 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 inch, or 3-brow-tine bull moose).

Unit 1D residents have suggested that local brown bear and wolf populations continue to predate 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–RY09 (range 7–18; Bethune 2011), 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; Sell 2012). Wolf data are not currently available for this reporting period; however, 7 and 11 wolves were taken in RY09 and RY10, respectively. Wolf harvest data are 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 these data, the percentage of calves in the herd during RY11 and RY12 (13% and 14% respectively) is on par or just above the 10-year average of 14% calves. In some years deep snow may contribute to calf mortality and this may have been the case during the heavy snow winters in 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 we hope to examine 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 one unreported hunter kill was discovered in either year of the report period. It appears that preseason education and a systematic approach for addressing moose that do not meet the antler requirements (enforcement action and meat distribution) has reinforced a positive working relationship with area moose hunters. Sublegal bull harvest does not appear to be a significant problem in Unit 1D although it is inherent with some populations managed under the spike-fork, 3-brow-tine, or 50-inch hunts.

HABITAT

Nearly all moose habitat in this subunit lies within the Haines State Forest, managed under multiple-use guidelines of the 2002 Haines State Forest Management Plan (Alaska Department of Natural Resources 2002). Increased browse production may occur in logged areas, though the extent, duration, and value of deciduous reproduction in these areas has not been determined. The long-term usefulness of recently logged areas to moose will be reduced if timber harvest occurs in high-value wintering areas, and if those 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, selecting coniferous forest habitats where snow accumulates to a lesser degree than open habitats. These habitats may also play an important role in predator avoidance.

Habitat changes within nonforested portions of the area are also of concern, although only anecdotally documented in recent years. Research in the early 1980s showed a low proportion of young willow plants in shrub stands in the Chilkat River valley, and it is suspected that post glacial land uplift (isostatic rebound) is causing permanent habitat change. In May 2007 and 2008 department staff conducted moose browse surveys in three areas of the Unit 1D moose range. The department has interest in continuing browse surveys in the future; however, time constraints and staff availability prevented a survey from occurring during both this and the previous report period. Winter weather is an important factor to consider when reviewing these data. Current browse surveys are intended to provide general browsing information and to identify locations that can be surveyed long term. Browse surveys are scheduled to continue in the next report period.

CONCLUSIONS AND RECOMMENDATIONS

The management objectives at the beginning of this report were adapted from the Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94 (ADF&G 1990b). Based on existing aerial survey data and the lack of correction or sightability data, we believe it is practical to use a minimum population level of 200 moose, post hunt, as a management objective. The harvest objective of 20–25 bulls was met in RY11 (21) and RY12 (22). We were close to meeting the objective of a 12% hunter success rate in RY11 (11%) and in RY12 (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 predator-prey relationships have not been investigated in the Chilkat River valley. Winter wolf predation does not appear to be a serious problem, except when moose movements are restricted by extremely deep snow. However, the active trapping populace likely maintains a check on this source of predation.

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

Aerial surveys conducted the last few years suggest that moose numbers in Unit 1D have remained relatively stable over the past 20 years. During this report period, the harvest of yearling and 2.5 year age classes were well represented (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 for regular surveys to better understand the status and trend of the population.

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While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Table 1. Unit 1D (Chilkat Valley) moose aerial survey data, regulatory years 1998 through 2012[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	33
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
2011	57	127	28	0	212	6.0	45	22	13	35
2012	42	109	24	2	177	4.4	38	22	14	40

[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 2012.

	Age Class																		
Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% aged	Mean age
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[a]	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	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
2011	0	10	1	2	3	0	1	2	0	0	1	0	1	0	0	0	21	100	3.9
2012	0	7	4	4	2	2	0	0	2	1	0	0	0	0	0	0	22	100	3.7

[a] Does not include 1 unsalvaged illegal harvest.

Table 3. Unit 1D moose hunter effort and success, regulatory years 2001 through 2012.

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits Issued	No. hunters	Total No. days	Avg No. days	No. hunters	Total No. days	Avg No. days	No. hunters	Total No. days	Avg No. days
2001	200	17	68	4.0	137	963	7.0	154	1,031	6.7
2002	200	22	78	3.5	135	971	7.2	157	1,049	6.7
2003	222	21	80	3.8	140	895	6.4	161	975	6.1
2004	202	19	86	4.5	142	1,029	7.2	161	1,115	6.9
2005	220	18	87	4.8	148	934	6.3	166	1,021	6.2
2006	220	27	77	2.9	150	934	6.2	177	1,011	5.7
2007	220	22	104	4.7	156	1,430	9.2	178	1,534	8.6
2008	220	30	203	6.8	155	1,365	8.8	185	1,568	8.5
2009	251	15	75	5.0	199	1,876	9.4	214	1,951	9.1
2010	250	16	85	5.3	174	1,470	8.4	190	1,555	8.2
2011	250	21	84	4.0	172	1,417	8.2	193	1,501	7.8
2012	250	22	154	7.0	177	1,436	8.1	199	1,590	8.0

Table 4. Unit 1D annual moose kill by community of residence, regulatory years 2001 through2012.

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	15	14	0	1	0	0	0
2010	16	15	0	0	1	0	0
2011	21[b]	20	0	1	0	0	0
2012	22	22	0	0	0	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 2012.

Regulatory year	No. males	No. females	No. unknown	Total kill	No. 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	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	15	0	0	15	214	7
2010	16	0	0	16	190	8
2011	21[a]	0	0	21	193	11
2012	22	0	0	22	199	11

[a] Does not include 1 unsalvaged illegal harvest.

Table 6. Unit 1D transport methods used by successful moose hunters, regulatory years 2001 through 2012.

	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	(67)	3	(17)	2	(11)	0	---
2010	1	(5)	8	(50)	3	(19)	4	(25)	0	---
2011	0	---	12	(57)	3	(14)	6	(29)	0	---
2012	0	---	16	(73)	0	---	4	(18)	2	(9)

Table 7. Unit 1D commercial services[a] used by moose hunters, regulatory years 2001 through 2012.

	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	202	1	11	0	213	1	0
2010	181	0	9	0	190	0	0
2011	182	0	11	0	193	0	0
2012	187	0	12	0	199	0	0

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

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CHAPTER 5: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 Alaska Board of Game (BOG) 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 Regionwide regulation stating that a broken, damaged or altered antler does not satisfy the spike-fork requirement in antler restricted moose hunts. This regulation resulted from a steadily increasing number of bulls being checked in annually that 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 2007, the Board of Game removed the broken antler requirement from Unit 1D (the only other unit at the time with the regulation) leaving RM038 as the only hunt with this specific regulation.

In the Petersburg Management Area (Units 1B and 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 1 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. During the 10-year period 2001–2010, the average annual harvest increased to 42 bulls. While the increased harvest was in part due to the any-bull drawing permit hunts held during 2005–2008, and liberalization of antler restrictions starting in 2009, moose distribution and abundance does appear to be increasing throughout Unit 3.

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 (Southeast Alaska) moose plan in the late 1980s (Alaska Department of Fish and Game 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	2011	2012
Post hunt numbers	400	N/A	N/A
Annual hunter kill	40	56	36
Number of hunters	470	490	493
Hunter-days of effort	2,300	3,393	3,111
Hunter success	10%	11%	7%

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. RY11 = 1 July 2011–30 June 2012).

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 sublegal 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 increasing in both distribution and abundance. 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 2011, 490 RM038 moose hunters reported observing 1,553 moose in Unit 3, including 545 bulls, 670 cows, and 338 calves, for a bull-to-cow ratio of 81:100 and a calf-to-cow ratio of 50:100. In 2012, 493 RM038 moose hunters reported observing 1,108 moose, including 484 bulls, 421 cows, and 203 calves, for a bull-to-cow ratio of 115:100 and a calf-to-cow ratio of 48:100.

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.

MORTALITY

Harvest

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

Alaska Board of Game Actions and Emergency Orders. No Board of Game actions took place, and no emergency orders were issued regarding Unit 3 moose during the report period.

Hunter Harvest. In 2011, 490 hunters harvested 56 moose, including 7 illegal kills, in Unit 3 (Tables 1 and 2). The harvest of 56 moose in 2011 was the third highest unitwide harvest on record. In 2012, 493 hunters harvested 36 moose, including 3 illegals. The unitwide harvest of 36 moose in 2012 represents the lowest harvest since 2008.

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 11% in 2011 and 7% in 2012; these rates were above and below, respectively, the preceding 10-year average (RY01–RY10) of 8% success. Just 10 and 13 nonresident hunters participated in the Unit 3 moose hunt in 2011 and 2012, respectively, and only 3 were 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 2011 most of the annual harvest occurred during the fourth and second weeks of the season. In 2012 most of the annual harvest occurred during the third and second weeks of the season (Table 3).

Harvest in Wildlife Analysis Areas (WAAs). During the report period hunters reported harvesting moose in 17 Unit 3 WAAs. In 2011 the largest percentage of the annual harvest occurred in WAA # 5132 (27%) on northwest Kupreanof Island, followed by WAA # 2007 (21%) on Mitkof Island. In 2012 the largest percentage of the harvest also occurred in WAAs # 5132 (42%), followed by # 2007, #5131 and #5134 each with 11% percentage of the harvest.

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

Transport Methods. During both years of the reporting 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 2011, but was below the objective in 2012. The number of hunters was also above the management objective of 470 hunters during both years of the report period. Hunter days of effort was well above the management objective of 2,300 days during both years. Success rates of 11% in 2011 and 7% in 2012 were above and below, respectively, the management objective of 10% annually. The harvest of 56 moose in 2011, the third year the harvest of bulls with 2 or more brow tines on both antlers was allowed, represents the third highest Unit 3 moose harvest since the inception of the moose hunt in 1993. The harvest of 36 moose in 2012 was the lowest harvest since 2008. In 2011, 16 (29%) of the 56 bulls harvested in Unit 3 had 2 brow tines on both antlers. In 2012, 14 (39%) of the 36 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 liberalized antler restrictions on the moose herd.

The Unit 3 moose population is believed to be below carrying capacity and predation by wolves and black bears is thought to be the primary factor limiting the population. Although moose density varies from island to island, the Unit 3 moose population appears to be expanding in both distribution and abundance. 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 15 September through 15 October with a 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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Alaska Department of Fish and Game (ADF&G). 1990. Strategic plan for management of moose in Region I, Southeast Alaska 1990–1994. Division of Wildlife Conservation, Juneau.

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Table 1. Unit 3 moose harvest, regulatory years 1999 through 2012.

	Hunter harvest reported							
Year	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
2011	49	(100)	0	(0)	0	49	7	56
2012	33	(100)	0	(0)	0	33	3	36

[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 2012.

	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
2011	43	12	1	56	(11)	365	60	9	434	(86)	490
2012	26	8	2	36	(7)	386	60	11	457	(93)	493

[a] Residents of Kake, Petersburg, and Wrangell

Table 3. Unit 3 moose harvest chronology in, regulatory years 1999 through 2012.

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
2011	4	17	14	21	56
2012	4	8	17	7	36

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

Table 4. Unit 3 successful moose hunter transport methods, regulatory years 1999 through 2012.

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
2011	3	12	34	7	0	0	56
2012	1	12	21	2	0	0	36

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CHAPTER 6: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 2,000 animals. The population began declining toward a more realistic carrying capacity (thought to be substantially lower than 2,000) 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 rates, indicative of healthy moose with good habitat. Predation appears to be a 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, a main source of browse for moose. Following the retreat of the Hubbard Glacier and subsidence of the waters of Russell Fjord in the fall of 1986, moose slowly recolonized this area over the next 7 years. Based on 1994 aerial survey counts, the Alaska Board of Game (BOG) reopened moose hunting in this area, beginning with the 1995 season. However, the Hubbard Glacier blocked off Russell Fjord 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 that time 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 1 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 2011– RY 2012)	Plan objective
Unit 5A Yakutat Forelands		
Post-hunt moose numbers (estimated)	600–800	1000
Annual hunter kill (average)	39	70
Number of hunters (annual average)	138	250
Hunter-days of effort (annual average)	533	1025
Hunter success (annual average)	28%	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)	4	25
Number of hunters (annual average)	12	50
Hunter-days of effort (annual average)	52	200
Hunter success (annual average)	30%	50%

METHODS

We conducted aerial surveys on the Yakutat Forelands of Unit 5A during both regulatory years and surveyed Nunatak Bench only in RY12 (Table 1); no surveys were conducted on the Malaspina Forelands. All surveys were flown with a Cessna 185 or 206 aircraft because better-suited survey aircraft (super cub) are not available in Yakutat.

Two state hunts and 1 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 harvested 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 harvested moose.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g. RY11 = 1 July 2011–30 June 2012).

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 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 from year to year (Table 1). The Yakutat Forelands in Unit 5A are generally surveyed annually, although in some years we attempt surveys only to acquire a sample of moose for composition analysis. We try to survey Nunatak Bench every other year because the population has declined dramatically due to recent flooding of prime habitat by rising water levels of Russell Fjord. 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 RY11 and RY12, we counted 229 and 197 moose on the forelands, respectively (Table 1). Both surveys were conducted towards the end of the calendar year and had excellent snow conditions covering 100% of the ground and adequate snow on vegetation for sightability. In RY11 bad weather forecasts limited the amount of flight time available for the survey, however compositional data resulted in a high number of moose seen with relatively little effort. The RY12 survey occurred in December when antler drop had already began so positively identifying bulls was unsuccessful which resulted in 168 unidentified adult moose. In addition moose on the Yakutat forelands had begun moving inland and to dense spruce forests where it is difficult to detect them; this likely contributed to the lower number of moose observed during this report period.

Unit 5(A) Nunatak Bench: Aerial surveys of the Nunatak Bench area were completed only during RY12. In February 2012, 12 moose were observed with only 2 calves. This moose herd continues to suffer the effects of habitat depletion from the 2002 flooding. Managers will attempt to survey this area every other year until a sufficient number of moose are present to support a hunt.

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

Population Composition

Unit 5A, Yakutat Forelands: During this report period the RY12 aerial survey was conducted after antler drop began so we were unable to collect reliable composition data. Therefore, survey data lists cows, calves, bulls, and adult moose of unknown sex (Table 1). The minimal bull:100 cow ratio in RY11 and RY12 was 20:100 and 2:100, respectively, with a minimum calf:100 cow ratio of 46:100 and 8:100, respectively. The minimum percent calves observed was 26% in RY11 and 7% in RY12.

In addition to sex composition data, age structure of harvested bull moose provides valuable population information (Table 2). 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. Mean age at harvest during this report period was 2.8 years. The number of yearling and 2-year-old bulls was 31 and 25, respectively, during this report period, an increase from the previous report period. The number of 3- and 4-year-old bulls decreased slightly as did the number of 5 and 6 year old bulls, however overall harvest was on average with previous years (Table 2). Based on the strong representation in the harvest, the calf cohort from previous years has had good survival levels that continue to contribute to the herd. The age range of bulls harvested each year suggests the age classes are well represented in the population. The number of yearling bulls in both RY11 and RY12 (Table 2) 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 RY12 survey did not provide reliable composition data (Table 1), however it indicates the population is still struggling. No moose were harvested during the report period.

Malaspina Forelands: In contrast to the relatively consistent age of moose harvested in Unit 5A, the mean age of harvested Malaspina Forelands moose has been erratic, ranging between 3.0 and 7.5 years since 1999. The mean age of 3.7 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 (1 and 0, respectively) is similar to 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 is limited.

MORTALITY

Harvest

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

Unit 5B 1 bull by registration permit Only; up to 25 bulls may be taken	15 Sep–15 Dec

Game Board Actions and Emergency Orders. No Emergency Orders for Unit 5 moose hunts during the reporting period. In RY11 and RY12, 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 RY01–RY10, with a mean of 38. The average harvest for this report period was 39 moose/year. The number of moose harvested annually since RY03 has increased with RY04, RY07 and RY12 harvests of 40 or more moose. The yearling and 2.5 year old bull component of the harvest was very strong in all 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 (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 substantially from the previous report period to 3 in RY11, and 4 in RY12 (Table 3). Total harvest for the report period (7 moose) is similar to harvests in the mid-2000s. The number of hunters and days hunted (Table 4) decreased again during this report period, 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 RY11–RY12 totaled 188 and 166 respectively. The number of permittees who actually hunted in RY11–RY12 was similar to the previous report period with 147 and 128 hunters respectively (Table 4).

The number of permits issued for the Unit 5B hunt (RM062) vary year-to-year. In RY11 and RY12, 33 and 28 permits, respectively, were issued; and 14 and 9 hunters, respectively, hunted (Table 4). The mean number of permits issued for the period RY01–RY10 was 42; and the mean number of hunters for the same period was 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 registration permits and monitoring these hunts.

Enforcement personnel from the USFS also helped monitor the Unit 5A hunt during the report period. We used reminder emails and multiple reminder 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 52 of 78 bulls (67%) harvested in 5A during the report period (Table 5). The majority of moose taken by local hunters were taken during the first 2 weeks of the season. Later in the season, use increased by nonlocal hunters in areas farther from Yakutat (especially east of the Dangerous River) and in those areas accessible only by airplane. Nonlocal Alaskans residents hunting but not living in Unit 5 took 21 moose (27%) during the report period. Nonresidents took only 5 moose during the report period, lower than the mean of 3.0 moose harvested per 2-year period for the past 5 report periods (Table 5). Since RY01 the overall success of Unit 5A hunters has ranged from 22% to 32% (Table 3). Hunter success was 26% in RY11 and 31% in RY12.

The Malaspina Forelands hunt is dominated less 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 29% of the Unit 5B moose harvest, nonresidents took 43%, and other Alaska residents took the remaining 29% of the harvest (Table 5). Unit 5 residents generally take the majority of moose in Unit 5B because they are positioned to take advantage of weather breaks to cross Yakutat Bay.

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, 5 moose (71%) were taken in October and 2 in September. 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 October 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 decreased to 26% from 33% during R09–RY10; and the use of boats remained similar to the previous report period at 24% (Table 6). The use of 3 or 4 wheelers and other off-road vehicles (ORVs) and highway vehicles was slightly higher than the previous report period at 50%. 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, ORV, or highway vehicles, while most nonresident hunters charter aircraft for access. The use of aircraft generally increases later in the season as nonlocal hunters begin hunting where there are no roads.

Commercial Services. Commercial services were used by 22% 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 (65%) than Unit 5A hunters (19%). This difference in commercial services used can be attributed to the difficulty in accessing Unit 5B.

Other Mortality

The winter of RY11 was one of the most severe on record in many parts of Southeast Alaska, with above average snowfall in Yakutat. The winters of RY07–RY08 were only slightly less extreme. Snowfall amounts were slightly below average during the winter of RY12 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 foreland moose herds have not indicated a significant change in number 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 but the factors contributing to low numbers of moose are not known. 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 2003 through 2012[1].

Year	MM	FF	Calves	Unk	Total	Count time (hrs)	MM Per 100 FF	Calves per 100 FF	Percent calves in herd	Moose per hour
					5A Yakutat Forelands					
2003	11	46	48	262	367	10.3	NA	NA	13	36
2004						No survey				
2005	41	71	75	445	632	12.1	NA	NA	12	52
2006[2]	10	119	11	0	140	3.4	9	11	8	42
2007	79	70	74	462	685	9.0	15	13	11	76
2008	47	266	44	0	360	5.0	18	17	12	72
2009	NA	NA	25	276	301	8.5	NA	NA	8	35
2010						No survey				
2011	28	141	60	0	229	2.1	20	43	26	110
2012	3	12	14	168	197	2.3	NA	NA	7	88
					5A Nunatak Bench					
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
2010-2011						No survey				
2012	NA	2	2	8	12	.8	NA	NA	17	15
					5B Malaspina Forelands					
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
2008-2012						No survey				

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

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

Table 2. Unit 5 age structure of harvested moose, regulatory years 2003 through 2012.

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																			
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
2011	0	18	9	4	1	2	4	0	0	0	0	0	0	0	0	0	38	100	2.8
2012	0	13	16	6	1	1	0	0	2	0	0	0	0	0	0	0	40	98	2.8
5A Nunatak Bench																			
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	---	---
2006-2012	No Harvest																		
5B Malaspina Forelands																			
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
2011	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	33	3.5
2012	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	4	100	3.8

Table 3. Unit 5 historical harvests, hunters, and success, regulatory years 2003 through 2012.

Year	Nr MM	Nr FF	Nr unk.	Total kill	Nr hunters	Percent success
			5A Yakutat Forelands			
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
2011	38	0	0	38	147	26
2012	40	0	0	40	128	31
			5A Nunatak Bench			
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			
2007-2012				---		
			5B Malaspina Forelands			
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
2011	3	0	0	3	14	21
2012	4	0	0	4	9	44

Includes moose harvested under federal ceremonial permit

Table 4. Unit 5 hunter effort and success, regulatory years 2003 through 2012[1].

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										
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
2011	188	38	107	2.8	109	489	4.5	147	596	4.1
2012	166	40	114	2.9	88	356	4.0	128	470	3.7
5A Nunatak Bench										
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					
2007-2012						---				
5B Malaspina Forelands										
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
2011	33	3	8	2.7	11	70	6.4	14	78	5.6
2012	28	4	18	4.5	5	7	1.4	9	25	2.8

[1] Includes data from both federal and state moose permits. Not all information is available for each hunter; calculations for any given field may only include a subset of hunters.

Table 5. Unit 5 annual moose kill by community of residence, regulatory years 2003 through 2012.

Year	Total kill	Yakutat	Juneau	Ketchikan	Sitka	Pelican	Hoonah	Petersburg	Haines	Wrangell	Other AK	Non-resident
5A Yakutat Forelands												
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
2011	38	25	5	0	1	0	0	0	0	0	4	3
2012	40	27	9	0	0	0	0	0	0	0	2	2
5A Nunatak Bench												
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											
2007-2012	---											
5B Malaspina Forelands												
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
2011	3	2	0	0	1	0	0	0	0	0	0	0
2012	4	0	0	0	0	0	0	0	0	0	1	3

Table 6. Unit 5 transport methods used by successful hunters, regulatory years 2003 through 2012[1].

Year	Airplane Total	(%)	Boat Total	(%)	3 or 4 wheeler Total	(%)	ORV Total	(%)	Highway vehicle Total	(%)	Foot Total	(%)
5A Yakutat Forelands												
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	---
2011	12	(32)	6	(16)	10	(26)	0	---	10	(26)	0	---
2012	8	(20)	13	(33)	10	(25)	0	---	9	(22)	0	---
5A Nunatak Bench												
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											
2007-2012	---											
5B Malaspina Forelands												
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	---
2011	2	(67)	0	---	1	(33)	0	---	0	---	0	---
2012	1	(25)	0	---	3	(75)	0	---	0	---	0	---

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

Table 7. Unit 5 commercial services used by hunters, regulatory years 2003 through 2012[1].

Year	Unit residents No	Unit residents Yes	Other AK residents No	Other AK residents Yes	Nonresidents No	Nonresidents Yes	Total use No	Total use Yes	Transport	Registered guide	Other Services
5A Yakutat Forelands											
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
2011	93	6	23	14	3	8	119	28	27	0	1
2012	88	4	12	16	1	3	101	23	21	1	1
5A Nunatak Bench											
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										
2007-2012	---										
5B Malaspina Forelands											
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
2011	2	1	2	4	0	5	4	10	7	3	0
2012	4	0	0	2	0	3	4	5	2	0	3

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

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CHAPTER 7: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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, which probably number about 40 animals total. Until recently, glaciers isolated the Copper River Delta (CRD) from moose populations in other parts of the state. Many people recognized the CRD contained good moose habitat.

During 1949–1958, Cordova residents successfully raised 24 captive moose calves and released them on the western CRD (Unit 6C). This small population grew rapidly and expanded eastward across the Copper River and into the Martin River Valley (Unit 6B) by the early 1960s. Eastward expansion continued into the Bering River area (Unit 6A) by the late 1960s and to Cape Yakataga by the mid-1970s. Meanwhile, the 1964 Good Friday Earthquake led to uplift of as much as 11.5 meters (38 feet) in areas of Unit 6. The CRD itself uplifted 1.8–3.4 meters (5.9–11.2 feet), effectively changing the habitat from a subtidal estuary to intertidal and supertidal wetlands that are gradually transitioning to alder dominated. Habitat has been mechanically altered nearly annually since 2007 by the U.S. Forest Service (USFS) and the Native Village of Eyak (NVE) through hydroaxing alder stands to reinitiate habitat succession.

The CRD was evaluated in the early 1990s for nutritional carrying capacity (MacCracken 1992, MacCracken et. al 1997). The carrying capacity estimate encompassed a wide range (380–1,424 moose, depending on winter snow depths). In the early 1990s, population estimation techniques transitioned from minimum count techniques to the Gasaway estimation technique (Gasaway, 1986). Nowlin (1995) revised harvest objectives in 1994 using this new information about carrying capacity of the winter ranges and better estimates of population size.

The population reached a high of approximately 1,600 in 1988 as the population came out of its irruptive period (Griese 1990). 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).

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. In 1977, moose in Unit 6A were designated as 2 populations (east and west of Suckling Hills) and have been managed separately since then.

By 1994, harvest was liberalized to accommodate the interest in increased harvest opportunities (Nowlin 1998). Cow hunts were permitted to prevent post-irruptive collapse. However, since that time, the populations in Units 6B and 6A have declined and stabilized at low numbers that are incompatible with cow harvest. The last year of cow harvest in Unit 6B was in 1998 and the last year in Unit 6A was in 2005. Now cow hunts are only used in Unit 6C where moose populations are higher than publicly vetted population objectives.

Hunters harvested more than 5,000 moose from 1965 to 2013 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. Clearly, moose were introduced into a highly productive area by comparison. The 10 and 20 year average annual harvest in the rest of the Unit was 110 (Standard Deviation [SD] = 32) and 106 (SD = 33) moose respectively.

The harvest allocation for cow moose in Unit 6C was moved into federal subsistence hunting in 2000, as was 75% of the bull harvest quota in 2002. 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.

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 is to maintain a population of 400–500 moose and minimum bull:cow ratios of 25:100 to provide for improved viewing opportunities along the Cordova road system.

METHODS

During this reporting period, we conducted aerial surveys to determine population size in Units 6B and Unit 6C. Composition surveys and twinning surveys were also conducted in Unit 6C. We flew surveys in a Piper Super Cub (PA-18) and a Bellanca Scout aircraft, with the exception of stratification surveys which were flown in a Cessna 185.

Population Estimation

Population estimates are conducted between mid-January and mid-March. Surveys are dependent on adequate snow cover and an acceptable weather window for survey completion. Study design was based on stratified random sampling with the Gasaway technique from 1991 to 2012 when it transitioned to the Geospatial Population Estimate (GSPE) in 2013. Sample units are flown at altitudes of 800–1500 feet above ground level at an intensity of approximately 4–6 minutes per square mile. Sightability Correction Factors (SCFs) were also generated using more intensive surveys (9–12 minutes per square mile.) SCFs were applied to moose observed to give an estimate of total moose.

Data collected in the Gasaway technique utilized the DOS (Disk Operating System) program MoosePop whereas the transition to the GSPE utilized a combination of the GSPE analysis tool in WinfoNet for the high strata and a standard Gasaway analysis for the low strata (25 March 2014 memo from C. Westing, Area Management Biologist, to G. Del Frate, Management Coordinator, ADF&G Anchorage). WinfoNet is the Division of Wildlife Conservation's intranet data system.

Fall Composition

Composition surveys are flown to examine any potential effects of selective hunting pressure. We conduct aerial surveys to estimate fall moose population composition in November when 6–8 inches of snow increases sightability (Crowley 2010). In some years, requisite snow does not occur by the time antlers begin to shed in early December. Surveys are flown between 300 and 800 feet above ground level. Surveys prior to 2013 were done using an unstandardized approach that focused on maximizing moose observations but can be vulnerable to bias. Survey techniques in 2013 used a random sample of units (approximately 6.5 square miles) within the Geospatial Population Estimate (GSPE) survey protocol, which is less biased but can also be less efficient. Moose were classified as yearling (spike/fork), medium (<50 inch antler spread), and large (>50 inch antler spread). Cows were classified as either a cow without calf, cow with one calf, or cow with 2 calves. Prior to 2009 bulls were only classified as either yearling or >2 year old.

Data were analyzed using the GSPE analysis tool in WinfoNet. In the 2013 survey, universal stratification was applied to all units due to the high likelihood of moose presence. The web interface for GSPE analysis is not designed to run using a single stratification scheme. A "dummy" stratification was created to allow for the analysis. This was done by selecting units outside the survey area for consideration in the survey but designating them as a separate analysis area as per the advice of the analyst/programmer responsible for the WinfoNet tool.

Twinning rates

Twinning surveys are used as an indicator of habitat quality. We conducted moose twinning surveys at low level (200–600 feet above ground level), searching brush lines bordering large meadows and stream braids on the west CRD (Unit 6C). We flew surveys in Unit 6C generally in the last week of May. The objective of each survey was to see as many parturient cows as possible. Radio collars were used for surveys in 2012; however, in 2013 collars were simply noted when seen. Each moose observed was classified based on sex and parturition status, e.g. bull, yearling, and cow with 0, 1, or 2 calves.

Twinning rates were calculated based on peak calving, which takes multiple flights to determine, and were also calculated cumulatively. Surveys were flown in the morning or evening when there were calm winds and limited precipitation, which were the most likely conditions for cows with calves to be active and visible. Our sample goal was 30 parturient cows in one survey; however, data can also be considered cumulatively since it is proportional. Twinning rates were calculated as: 100* (cows with 2 calves / all cows with calves).

In all surveys, waypoints were taken for groups of animals to record distribution, gauge sightability, and determine inclusion in analysis. Observations of other wildlife, such as coyotes or wolves, were opportunistically recorded.

Harvest data come from hunt reports, a mandatory condition of drawing and registration permits. These data are summarized by subunit, 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., RY10 = 1 July 2010–30 June 2011).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During and since this reporting period, surveys were conducted west of the CRD (Unit 6C) and east of the CRD including the Martin River Valley (Unit 6B.) No surveys were conducted in RY12 due to weather. Surveys will be conducted in Unit 6A during the next reporting cycle.

The RY13 point estimate for Unit 6B, east of the Copper River Delta and including the Martin River Valley, is 227 (90% CI; 177–278; Table 1). All of the results for the last 5 surveys fall within the confidence intervals for this survey. The RY13 estimate is slightly lower than the RY11 estimate of 271 although confidence intervals for these surveys overlap. This population has been below the management objective of 300–350 for 15 years (Fig. 1).

The point estimate for Unit 6C, west of the Copper River Delta is 609 (90% CI; 483–734; Table 1). This is virtually identical to the previous estimate in RY12 of 601 and is above management objectives (400–500 moose; Fig. 2). Now that 2 surveys estimate a population over 600 moose, suspicions that the RY11 estimate was elevated have been largely alleviated.

Population Composition

From 2006 to 2009, the bull harvest may have been too liberal with Bulls:100 Cows (B:C) ratios documented as low as 14 B:C in 2009 (Crowley 2010). Anecdotal evidence confirmed a drop in the number of bulls in the population and antler spread data also reflected that perhaps fewer large bulls were available for harvest (Milo Burcham, personal communication, USFS, Cordova). As a result of these data, adjustments were made in quotas to allow for growth in the bull component of the population. In 2009 and 2010, when bulls were classified into the 3 categories also used in the 2013 survey, there was a preponderance of yearling bulls (Table 3). However in 2013, 54% of observed bulls were medium, 25% were large, and 21% were yearling bulls (Fig. 3).

Calves observed in fall composition surveys support a high and increasing population. Calves:100 Cows (c:C) ratios were the highest observed (49 c:C) since the late 1970s when the population was coming out of its irruptive period. More recently the c:C ratios were 15–19 c:C except in RY05 (29 c:C; Table 2). The high value in RY05 corresponds with a higher population estimate the following year (560 moose; Table 1) suggesting that many young animals recruited into the population. Of the cows with calves at heel during fall composition surveys, 19% had twins compared with 6% in 2010 and 12% in 2009. The most likely factor influencing the high B:C and c:C ratios is the high harvest of cows this hunting season (50 cows taken thus far.) Future adjustments to allow for more bull harvest should take pre-hunting as well as post-hunting numbers into consideration to avoid overharvest of the bull segment of the population.

MORTALITY

Harvest

Reported moose harvest for Units 6A of 32 and 19 for RY11 and RY12 (Table 4), respectively, were below both the 10-year average of 33 moose and the 20-year average of 41 moose. This may be an indication of population levels but is likely related to weather and commercial operator dynamics. Harvest in Unit 6B was also lower during this reporting period, with 32 and 19 moose taken in RY11 and RY12, respectively, compared with the 10-year average of 33 moose and the 20-year average of 41 moose. In Unit 6C, the harvest of 25 moose in RY11 was lower than the 10-year average of 49 moose and the 20-year average of 38 moose. However, the maximum allowable harvest (MAH) in RY12 was increased in response to the population exceeding its management objectives. The 6C harvest for RY12 was 56 moose. Harvest in Unit 6D was typical with only a few animals taken each year.

<u>Seasons and Bag Limits.</u>

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY11 and RY12		
Unit 6(A), all drainages into the Gulf of Alaska from Cape Suckling to Palm Point		
One bull moose	1 Sep–30 Nov (registration hunt)	1 Sep–30 Nov (drawing permit only)
Remainder of Unit 6(A)		
One bull with spike-fork antlers or 50 inch antlers or with 3 or more brow tines on one side	1 Sep–30 Nov (General hunt)	
One bull with 50-inch antlers or antlers with 3 or more brow tines on one side		1 Sep–30 Nov (General hunt)
Unit 6(B)		
One antlered moose by registration permit only	27 Aug–31 Oct (registration hunt)	No open season
Unit 6(C)		

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
One moose	1 Sep-31 Oct	No open season
Unit 6(D)		
1 bull moose	1 Sep-30 Sep	1 Sep-30 Sep

Unit 6B is a controlled use area. No motorized vehicles are 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 cannot 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 are required to display an Alaska Department of Fish and Game identification number.

Board of Game Actions and Emergency Orders. The resident MAH for the portion of Unit 6A West was up to 20 bulls by registration permit, and nonresident MAH was up to 5 bulls by drawing permit. The MAH has not been met for this area since RY05.

The season in Unit 6B was 1 September–30 November (unless the MAH is met) for resident hunters only with a bag limit of 1 moose. The MAH of 25 bulls by registration permit has not been met since RY10. No emergency orders were issued during this reporting period.

In 2013 the Board of Game reauthorized antlerless moose hunts in Unit 6C during the reporting period. However, the antlerless season was allowed to lapse in Units 6A and 6B since they have not been used for many years and will likely not be used in the foreseeable future. An additional hunt was established, RM169, a late season hunt (1 November–31 December) that could be used if harvest in the existing federal and state MAH was not taken and there was concern about habitat stress.

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 5).

Hunter Residency and Success. Local residents composed 67% in RY11 and 81% in RY12 of successful moose hunters in Unit 6 during this reporting period (Table 6). Since 2001 all of the cow harvest and three-quarters of the bull harvest in Unit 6C have been administered through the federal system by the U.S. Forest Service, Cordova Ranger District, which requires Cordova residency. This provided a 80–93% rural allocation for Cordova residents during the reporting period. Resident-only seasons and difficult access on the Copper and Bering River deltas discouraged nonlocal hunters from participating in hunts in Units 6B and 6A West. Almost all nonresident hunting occurs in Unit 6A East. Most nonlocal Alaska residents either successfully draw for a permit in Unit 6C or they hunt in the Unit 6B registration hunt.

Harvest Chronology. Harvest is protracted in Unit 6A and Unit 6C, occurring between September and mid-October. In Unit 6B, most harvest is concentrated in early September. It is difficult to draw conclusions from Unit 6D harvest data because of the very small sample size but most harvest occurs in September. Unitwide during this reporting period more than 60% of the harvest occurred in the first 15 days of September (Table 7).

Transport Methods. Unit 6A is the only area where a significant proportion of the harvest is airplane supported (Table 8). Airboats, boats, and ORVs (including 3- and 4-wheelers) are also utilized, particularly in the Bering River portion (Unit 6A West). Local hunters use larger boats (seiners or tenders) to transport smaller vessels for use in the hunt. Harvest in Unit 6B predominantly utilizes airboats. Unit 6C has good road access from Cordova, allowing both highway vehicle and airboat access to moose. Unit 6D harvest occurs by boat or highway vehicles; however, small sample size limits inference. These patterns of use have not changed over the past 5 years.

Other Mortality

Brown bears and black bears undoubtedly prey upon moose calves and, to a lesser degree, adult moose. However, the magnitude of these events is poorly understood. 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 (Dave Crowley, former Cordova ADF&G Area Management Biologist, personal communication). Estimates Carnes (2004) made of moose kill rates for wolves in Unit 6 were low compared to other areas of Alaska. However, calf survival, measured by the percent calves seen on spring surveys, is lowest in Unit 6A where predator populations are likely highest. The percent of calves observed may indicate that young cohorts are not recruiting into the adult population in adequate numbers. Calf survival is highest in Unit 6C where predator populations are more regulated by hunting pressure (Table 1).

Moose are known to be more susceptible to predation during deep snow winters. Unit 6 can experience deep snow events with variable persistence. The winter of RY11 was a 100-year weather event with 10 feet of snowfall in 2 weeks, which was persistent well into the spring. Despite this weather event, calf recruitment in Unit 6B and Unit 6C in RY11 surveys fell within normal ranges. The nature of the snow pack may have influenced the effect on the moose population. The snow contained numerous hard layers that prevented moose from “punching through” and being limited by its full depth.

HABITAT

Assessment

Twinning surveys were flown in RY11 and RY12 to continue to assess habitat status in Unit 6C as the population has exceeded its population objective. Daily surveys in this reporting period indicated a twinning rate of 41–54% for cows with calves at heel. The pooled estimate for RY11 is a twinning rate of 46% (95% CI of 30–62 assuming normal binomial distribution). The pooled estimate for RY12 is a twinning rate of 50% (95% CI of 35–65 assuming normal binomial distribution). Peak twinning rates in 2013 are quite comparable to those observed in previous years (Table 9). Moose twinning rates in the west CRD are among some of the highest observed in Alaska, implying excellent nutritional status of both moose and habitat. Although this seems to support the argument for increasing herd size in Unit 6C, the threshold level at which moose may begin impacting habitat is unknown for coastal populations. When moose density in Unit 20A (Tanana Flats) increased above approximately 1,000 moose/1,000 km^2 during the last decade, twinning rates decreased to 3–10% (Boertje et al. 2007). Managers are currently struggling to reduce herd size in the area to protect habitat. In contrast, moose density in Unit 6C has ranged 1,250–1,900 moose/1,000 km^2 since 2005 with as yet little or no indication of nutritional stress.

Enhancement

Habitat modification began experimentally in the 1990s and has been conducted regularly since 2007 by USFS and NVE to address concerns that habitat was converting from willow to alder dominated stands that are less suitable for moose. Mechanical habitat alteration using hydroaxe has been utilized annually. At this time, an estimated 616 acres have been cut.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations in Units 6A and 6B have been below management objectives for many years. These objectives were set in the absence of habitat data. These populations may be stabilized at low densities and may be influenced by high predation compared to moose in Unit 6C where wolves and bears are more aggressively pursued by hunters.

Twinning surveys should be conducted in Unit 6B to evaluate habitat. If twinning rates are as high in Unit 6B, a compelling case could be made that predation is inhibiting the growth of this population. However, if the habitat is simply not as productive it may be indicative that the population objectives that have been set are not appropriate. In fact, only 4 times in the entire history of monitoring moose in this area has the population estimate fallen within its objective (1991, 1992, 1996, and 1998). Twinning surveys should also continue in Unit 6C as the population continues to grow and has exceeded population objectives despite aggressive harvest rates (including on cows). Rump fat depth and/or short yearling weights may also be used to evaluate resource constraints.

A revised carrying capacity estimate is being generated for Unit 6C (the west CRD) that should be used to evaluate the appropriateness of existing management objectives (Smythe 2015). These data will be available in the autumn of 2014 and will be presented and discussed as part of a public process. An analysis is also being performed on the use and efficacy of hydroaxed plots by moose in Unit 6C.

Fall composition surveys should continue to rotate between survey areas to monitor for the potential effects of selective harvest pressure. Unit 6B fall composition should be examined with the highest priority. It is likely that the inability of this population to increase into the range of the management objective is related to lower recruitment but fall composition surveys and habitat data will help clarify what is driving this population.

The MAH for the hunt in Unit 6B (locally referred to as the Martin River hunt) will be adjusted downward since the population is below management objectives, the current harvest rate on the population is high (around 10%) and the existing MAH has not been met since RY10.

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Table 1. Unit 6 moose population estimates, RY04–RY13.

Unit	Year	Survey date	Calves (%)	Adult Estimate	Population Estimate	90% C.I	Moose Observed
6A East	RY07	29 Jan 08	7	213	230	212–247	203
	RY09 [a]	02 Feb 10	-	44	280	-	49
6A West	RY05	31 Jan 06	15	233	275	238–311	206
	RY07	31 Jan 08	7	257	276	249–301	232
	RY08	14 Feb 09	3	187	245	212–279	194
6B	RY07	18 Jan 07	9	179	242	225–258	195
	RY09	17 Mar 10	16	144	172	116–227	122
	RY11	29 Jan 12	16	204	271	236–307	174
	RY13	19 Feb 14	16	165	196	117–274	106
6C	RY05	01 Feb 06	10	438	488	423–553	361
	RY06	18 Jan 07	20	310	560	453–667	409
	RY07	14 Jan 08	15	273	430	389–471	361
	RY08	14 Feb 09	19	314	388	304–403	269
	RY09	16 Mar 10	17	200	296	164–426	251
	RY10	23 Feb 11	17	248	398	324–471	308
	RY11	25 Jan 12	22	361	601	536–666	535
	RY13	19 Feb 14	25	232	609	483–734	291

[a] Brief survey between Cape Yakataga and Icy Bay east of established survey, colonized by moose and now hunted regularly. These data were added to the survey results for RY08 for the RY09 estimate.

Table 2. Unit 6 moose composition estimates, RY04–RY13.

Unit	Year	Survey date	Number observed: Bulls> 2 yrs	Cows	Calves	Bulls: 100 cows	Calves: 100 cows	Calves (%)	Moose observed
6A West[a]	RY05	04 Dec 05	20	143	18	18	13	10	187
	RY09	17 Nov 09	20	129	19	20	15	11	174
6B	RY05	02 Dec 05	26	77	19	45	25	15	129
6C	RY05	1 Dec 05	32	151	44	30	29	18	240
	RY07	30 Nov 07	16	83	14	36	17	11	129
	RY09	16 Nov 09	15	230	34	14	15	11	298
	RY10	02 Dec 10	12	183	35	22	19	14	258
	RY13[b]	02 Dec 13	50	129	63	49	49	25	255

[a] Composition data not collected in 6A East.

Table 3. Unit 6C composition survey detail RY09–RY13.

Survey date	Yrlg bulls	Medium bulls	Large bulls	Bulls >2 yrs	Cows	Calves	Unk	B:C	c: C	Calves (%)	Total
11/16/09	18	9	6	15	230	34	1	14	15	11	298
12/2/10	28	9	3	12	183	35	0	22	19	14	258
12/2/13[a]	13	34	16	50	129	63	0	49	49	25	255

[a] Data collected using a Modified Geospatial Population estimate (GSPE) for Bulls was 64 Bulls:100 Cows (95% CI of 30–97). The GSPE found 50 Calves:100 Cows (95% CI of 17–83)

Table 4. Unit 6 moose harvest RY08-RY12

		Reported Harvest				
Unit	Year	Males	(%)	Females	(%)	Total[a]
6A East	RY08	12	(100)	0	(0)	12
	RY09	13	(100)	0	(0)	13
	RY10	18	(100)	0	(0)	18
	RY11	19	(100)	0	(0)	19
	RY12	7	(100)	0	(0)	7
6A West	RY08	16	(100)	0	(0)	16
	RY09	14	(100)	0	(0)	14
	RY10	12	(100)	0	(0)	12
	RY11	13	(100)	0	(0)	13
	RY12	12	(100)	0	(0)	12
6B	RY08	26	(100)	0	(0)	26
	RY09	29	(100)	0	(0)	29
	RY10	25	(100)	0	(0)	25
	RY11	16	(100)	0	(0)	16
	RY12	17	(100)	0	(0)	17
6C	RY08	48	(69)	22	(31)	70
	RY09	43	(81)	10	(19)	53
	RY10	18	(58)	13	(42)	31
	RY11	15	(60)	10	(40)	25
	RY12	22	(39)	34	(61)	56
6D	RY08	7	(100)	0	(0)	7
	RY09	5	(100)	0	(0)	5
	RY10	4	(100)	0	(0)	4
	RY11	6	(100)	0	(0)	6
	RY12	4	(100)	0	(0)	4
Unit 6	RY08	109	(83)	22	(17)	131
	RY09	104	(91)	10	(9)	114
	RY10	77	(86)	13	(14)	90
	RY11	69	(87)	10	(13)	79
	RY12	62	(65)	34	(35)	96

[a] Unreported, illegal, or accidental kill combined are probably less than 5 animals in each area each year.

Table 5. Unit 6 moose harvest data by permit hunt, RY08–RY12.

Unit/ Hunt number[a]	Year	Legal moose	Permits issued	Percent did not hunt	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6A/RM160	RY08	Bull	47	60	63	12	(100)	0	(0)	12
	RY09	Bull	59	51	41	11	(100)	0	(0)	11
	RY10	Bull	70	61	41	11	(100)	0	(0)	11
	RY11	Bull	53	60	57	12	(100)	0	(0)	12
	RY12	Bull	46	67	53	8	(100)	0	(0)	8
6A/DM160	RY08	Bull	5	40	67	2	(100)	0	(0)	2
	RY09	Bull	5	0	80	3	(100)	0	(0)	3
	RY10	Bull	5	40	33	1	(100)	0	(0)	1
	RY11	Bull	5	60	50	1	(100)	0	(0)	1
	RY12	Bull	5	20	100	4	(100)	0	(0)	4
6B/RM164	RY08	Bull	183	28	20	26	(100)	0	(0)	26
	RY09	Bull	264	22	14	29	(100)	0	(0)	29
	RY10	Bull	233	37	17	25	(100)	0	(0)	25
	RY11	Bull	197	36	13	16	(100)	0	(0)	16
	RY12	Bull	177	41	16	17	(100)	0	(0)	17
6C/DM167	RY08	Bull	13	0	92	12	(100)	0	(0)	12
	RY09	Bull	13	15	100	11	(100)	0	(0)	11
	RY10	Bull	6	17	80	4	(100)	0	(0)	4
	RY11	Bull	7	31	67	6	(100)	0	(0)	6
	RY12	Bull	7	0	86	6	(100)	0	(0)	6
6C/ Federal subsistence[b]	RY08	Both	70	11	98	36	(62)	22	(38)	58
	RY09	Both	65	20	93	32	(76)	10	(24)	42
	RY10	Both	40	7	82	14	(52)	13	(48)	27
	RY11	Both	29	7	86	9	(47)	10	(53)	19
	RY12	Both	66	12	93	16	(32)	34	(68)	50

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

Table 6. Unit 6 moose hunter residency and success, RY08–RY12.

		Successful					Unsuccessful					
Unit	Year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
6A East	RY08	0	0	14	14	(42)	1	1	17	19	(58)	33
	RY09	1	1	11	13	(43)	3	4	9	17[b]	(57)	30
	RY10	0	0	18	18	(62)	1	0	10	11	(38)	29
	RY11	1	0	17	19[b]	(56)	0	2	13	15	(44)	34
	RY12	0	1	6	7	(41)	0	4	6	10	(59)	17
6A West	RY08	10	2	2	14	(64)	6	1	1	8	(36)	22
	RY09	9	2	3	14	(50)	10	4	0	14	(50)	28
	RY10	9	2	1	12	(39)	12	4	3	19	(61)	31
	RY11	12	0	1	13	(57)	7	2	1	10	(43)	23
	RY12	7	1	4	12	(63)	7	0	0	7	(37)	19
6A TOTAL	RY08	10	2	16	28	(44)	7	2	28	37	(59)	65
	RY09	10	3	14	27	(46)	13	8	9	31[b]	(53)	58
	RY10	9	2	19	30	(50)	13	4	13	30	(50)	60
	RY11	13	0	18	32[b]	(56)	7	4	14	25	(44)	57
	RY12	7	2	10	19	(53)	7	4	6	17	(47)	36
6B	RY08	23	3	0	26	(20)	93	13	0	106	(80)	132
	RY09	22	7	0	29	(14)	139	36	0	175	(86)	204
	RY10	19	6	0	25	(17)	108	14	0	122	(83)	147
	RY11	15	1	0	16	(13)	93	17	0	110	(87)	126
	RY12	16	1	0	17	(16)	81	7	0	88	(84)	105

Table 6, continued.

		Successful					Unsuccessful					
Unit	Regulatory year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
6C	RY08	67	3	-	70	(97)	1	1	-	2	(3)	72
	RY09	48	5	-	53	(95)	3	0	-	3	(5)	56
	RY10	30	1	-	31	(82)	6	0	-	6	(18)	38
	RY11	20	5	-	25	(81)	3	3	-	6	(19)	31
	RY12	52	4	-	56	(92)	4	0	-	4	(8)	61
6D	RY08	5	0	2	7	(21)	24	3	0	27	(79)	34
	RY09	4	1	0	5	(9)	38	8	7	53	(91)	58
	RY10	3	1	0	4	(13)	24	3	1	28	(88)	32
	RY11	5	1	0	6	(19)	18	6	1	25	(81)	31
	RY12	3	1	0	4	(13)	21	3	3	27	(87)	31
Unit 6 TOTAL	RY08	105	8	18	131	(44)	125	19	28	172	(57)	301
	RY09	84	16	14	114	(30)	193	52	16	262	(69)	377
	RY10	61	10	19	90	(32)	151	21	14	186	(67)	277
	RY11	53	7	18	79[b]	(32)	121	30	15	166	(68)	245
	RY12	78	8	10	96	(41)	113	14	9	136	(58)	233

[a] Residents of Unit 6.
[b] Includes 1 hunter with unknown residency.

Table 7. Unit 6 moose harvest percent by time period, RY08–RY12.

		Harvest periods (%)							
		August	September		October		November	December	
Unit	Year	20–31	1–15	16–30	1–15	16–31	1–30	1–31	*n*
6A	RY08	0	21	46	25	7	0	0	28
	RY09	0	37	30	26	4	4	0	27
	RY10	0	30	20	17	33	0	0	30
	RY11	0	47	28	25	0	0	0	32
	RY12	0	47	26	26	0	0	0	19
6B	RY08	0	69	31	0	0	0	0	26
	RY09	0	69	10	3	17	0	0	29
	RY10	0	48	44	8	0	0	0	25
	RY11	0	56	31	6	6	0	0	16
	RY12	0	47	6	47	0	0	0	17
6C [a]	RY08	0	39	20	17	16	3	6	70
	RY09	0	25	36	13	11	4	11	53
	RY10	0	32	39	6	13	3	6	31
	RY11	0	52	8	28	4	4	4	25
	RY12	0	54	17	13	6	4	7	54
6D	RY08	0	38	50	13	0	0	0	7
	RY09	0	40	60	0	0	0	0	5
	RY10	0	50	50	0	0	0	0	4
	RY11	0	17	83	0	0	0	0	6
	RY12	0	25	75	0	0	0	0	4
Unit 6 TOTAL	RY08	0	41	30	15	10	2	3	131
	RY09	0	39	29	13	11	3	5	114
	RY10	0	37	34	10	16	1	2	90
	RY11	0	48	27	20	3	1	1	79
	RY12	0	50	19	21	3	2	4	94

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

Table 8. Unit 6 moose harvest percent by transport method, RY08–RY12.

Unit	Regulatory year	Airplane	Boat	Airboat	3 or 4 ORV	Highway Vehicle	*n*
6A	RY08	36	14	32	18	0	28
	RY09	48	30	15	7	0	27
	RY10	40	20	17	23	0	30
	RY11	43	10	30	20	0	31
	RY12	65	12	29	0	0	18
6B	RY08	0	13	52	0	35	23
	RY09	22	19	41	0	19	27
	RY10	22	22	48	0	9	23
	RY11	13	0	80	14	7	15
	RY12	0	21	57	0	7	14
6C[a]	RY08	0	10	57	12	21	68
	RY09	4	9	42	9	36	53
	RY10	0	3	45	19	32	31
	RY11	0	4	50	13	33	24
	RY12	0	2	30	11	57	56
6D	RY08	0	17	0	17	67	6
	RY09	0	60	0	0	40	5
	RY10	0	75	0	25	0	4
	RY11	17	33	0	17	33	6
	RY12	0	25	0	0	75	4
Unit 6 TOTAL	RY08	8	12	48	11	21	125
	RY09	19	19	33	6	23	112
	RY10	19	17	34	16	14	88
	RY11	21	8	43	13	14	76
	RY12	12	8	33	9	39	92

[a] Number of moose harvested (*n*) in 6C does not include all federal subsistence harvest because hunter transportation is not always recorded.

Table 9. Unit 6C twinning survey results RY07–RY12.

Date	Cows			Total	%	Hours	Twinning
	0 calf[a]	1 calf	2 calf	moose[b]	calves	searched	rate
5/21/2013	61	5	5	93	16	4	50.0
5/23/2013	102	5	6	146	12	7	54.5
5/29/2013	57	11	10	108	29	7	47.6
5/23/2012	46	7	5	78	22	6.4	41.7
5/28/2012	66	13	12	142	26	3.75	48.0
5/26/2009	21	2	4	45	22	2.5	66.7
5/28/2009	40	8	7	82	27	2.7	46.7
5/29/2008	46	8	11	103	29	3.75	57.9
6/7/2008	13	3	3	41	22	3	50.0
5/26/2007	41	4	8	91	22	3.5	66.7
6/12/2007	50	3	5	84	15	3.3	62.5

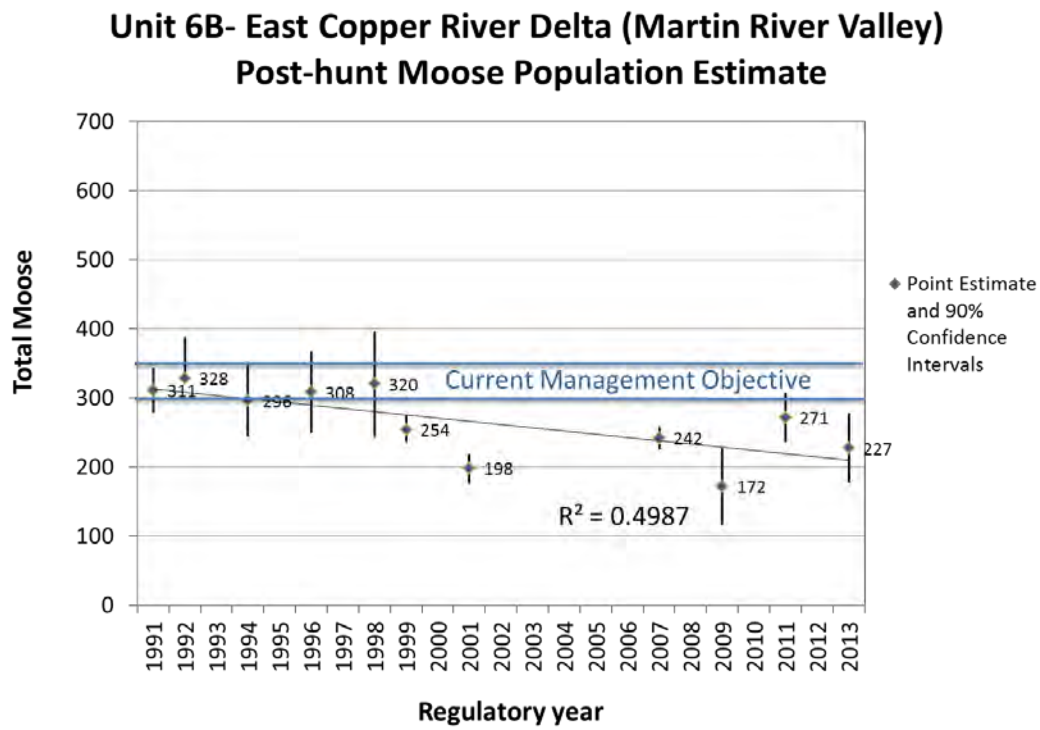

Figure 1. Post-hunt moose population estiamte, Unit 6B, RY91–RY13.

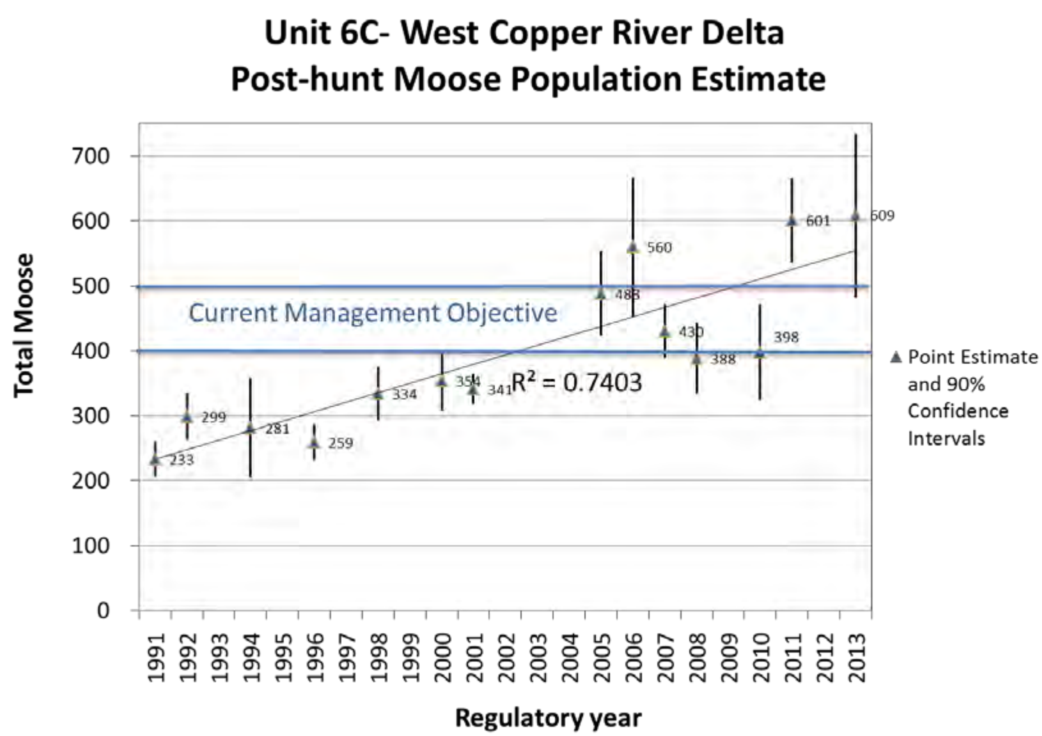

Figure 2. Post-hunt moose population estimates in Unit 6C, RY91–RY13.

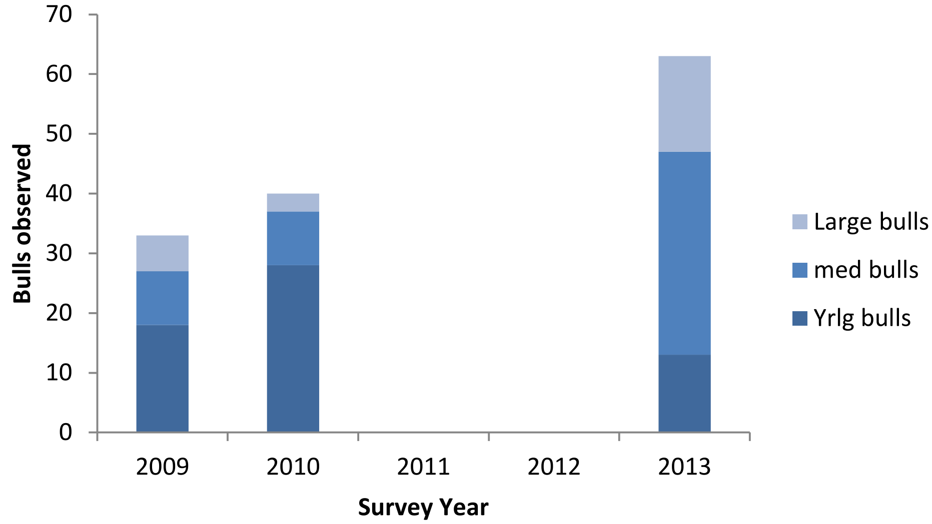

Figure 3. Size distribution of bulls in Unit 6C observed during fall composition surveys

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CHAPTER 8: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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/Juneau Creek count areas counted every other year. From 2000 through 2011 these two areas were counted 5 times. The two most recent counts were 2010 and 2011, during which 76 and 95 moose were counted, respectively. No population estimate survey has ever been conducted in Unit 7.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

1. Maintain a healthy population of moose with a minimum bull-to-cow ratio of 20–25:100.

2. 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.

METHODS

Composition surveys are flown in traditional count areas as funding allows. Harvest data come from hunter information taken from harvest ticket reports. This report reflects updated data from ADF&G's Web-based database called WinfoNet; therefore, information in the tables may differ slightly from past reports.

Harvest data are summarized by regulatory year (RY). A regulatory year runs from 1 July through 30 June (e.g., RY11 = 1 July 2011–30 June 2012).

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 all 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 10 calves:100 cows, and a total of 76 moose observed. The same count areas flown in November of 2011 produced count ratios of 12 bulls:100 cows and 18 calves:100 cows with 95 moose observed. Recent bull:cow and calf:cow ratios have declined significantly compared to the historical 5-year averages in these 2 count areas from the 1980s of 36 bulls:100 cows and 27 calves:100 cows, suggesting a significant population decline. No surveys were conducted in 2012.

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 one bull with a spike or fork on at least one antler, or 50-inch antlers, or antlers with 3 or more brow tines on at least one side. In 2011, the bag limit was further restricted to 50-inch antlers, or antlers with 4 or more brow tines on at least one side (50-4bt).

The average reported harvest from 2008 through 2012 in Unit 7 was 19 moose (Table 2). Harvest rates declined significantly in 2011 and 2012 due to the increased bag limit restrictions.

Permit Hunts. Information for permit hunts DM210 and DM211, which encompass both Unit 7 and Unit 14C, are reported in the Unit 14C management report. Permit hunt DM522, which encompassed portions of Units 7 and 15A has been suspended since 2008 due to low moose numbers.

Board of Game Action and Emergency Orders. During the March 2013 meeting, The Board of Game reauthorized the antlerless moose permit hunt for the Placer River area (DM211). Other actions taken at the March 2013 meeting included changing the antler requirements for a legal bull from 50-4bt only to 50-4bt and spike 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 3). The 5 year average of the annual success rates was 8% over the past 5 seasons (Table 3).

Harvest Chronology. Moose were harvested throughout the season, but in somewhat larger proportions at the start and end of the season (Table 4). The chronology of the harvest depends on weather conditions and other factors unrelated to moose abundance.

Transport Methods. Highway vehicles remain the main transportation method used by successful hunters in Unit 7 even with the recent minimal harvest (Table 5).

Other Mortality

Highway vehicles killed an average of 17 moose per year during the past 5 seasons in Unit 7 (Table 2). This is a decrease from the previous 5-year average of 25 and likely reflects decreasing population numbers. The effect of wolf and bear predation on moose and the degree of illegal take are unknown. In addition, 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 apparent decline in moose numbers. Anecdotal reports from local residents and hunters suggest the population has declined from populations in the 1980s. Moose vehicle collisions, long-term harvest trends and composition counts all support this 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 to generate a long-term plan to address habitat concerns.

Moose densities in Unit 7 are chronically low and according to our limited data it appears we are meeting only a portion of our management objectives. Roadkill and human conflicts with moose have significantly decreased in Unit 7 but this appears to be due to low moose numbers rather than good land management practices. We expect bull/cow ratios to come back within management objectives due to the harvest restrictions imposed in 2011. Unfortunately population numbers are not likely to increase until large scale habitat manipulation occurs or a natural improvement in moose habitat occurs. In spite of conservation concerns raised by ADF&G and hunting seasons that 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 Unit 7 on Federal Lands. 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.

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

Herreman, J. 2012. Unit 7 moose management report. Chapter 8, pages 8-1 through 8-6 [*In*] P. Harper and L. A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.

Table 1. Unit 7 moose aerial composition counts and estimated population size, 2008–2012.

Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
2008	No Surveys Conducted					
2009	No Surveys Conducted					
2010	17	10	8	70	76	no survey
2011	12	18	14	82	95	no survey
2012	No Surveys Conducted					

Table 2. Unit 7 reported general season moose harvest and accidental death, 2008–2012.

Regulatory	Reported Hunter Harvest				Accidental death			Total Reported
Year	Bull	Cow	Unk	Total	Road	Train	Total	Mortality
2008	31	0	1	32	23	14	37	69
2009	25	0	2	27	18	8	26	53
2010	23	0	1	24	15	1	16	40
2011	9	0	0	9	21	23	44	53
2012	2	0	0	2	9	4	13	15

Table 3. Unit 7 residency and success of moose hunters for the general season, 2008–2012.

	Successful				Unsuccessful				
Regulatory Year	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b] (%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	Total Hunters
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
2011	0	2	0	2 (2)	49	47	5	102	104
2012	3	4	2	9 (6)	57	74	7	144	153

[a] Local = residents of Unit 7.

[b] Includes unspecified residency.

Table 4. Unit 7 moose general season harvest chronology (percent of harvest), 2008–2012.

	Harvest Periods							
Regulatory Year	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
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
2011	22	11	11	22	33	0	0	9
2012	50	0	0	0	50	0	0	2

Table 5. Unit 7 general season transport methods for successful moose hunters (percent of harvest), 2008–2012.

	Percent of Harvest							
Regulatory Year	3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/ Dogteam	ORV	Unknown	Harvest
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
2011	0	0	0	67	33	0	0	9
2012	0	0	50	50	0	0	0	2

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CHAPTER 9: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Alaska Peninsula

BACKGROUND

Moose were present in the northern area of the Alaska Peninsula by 1900 but more recently colonized the southern portion of the peninsula, demonstrating fairly typical dynamics of a colonizing ungulate: rapid increase, overbrowsing, and long-term decline. Moose occupied drainages of Cook Inlet (Unit 9A), Lake Clark and Iliamna Lake (Unit 9B), Naknek River (Unit 9C), and King Salmon River and Ugashik Lakes in (Unit 9E) in the early 1900s in very low numbers and patchy distribution (Osgood 1904). Moose populations began increasing in the 1930s and rapidly colonized southwest along the Alaska Peninsula, reaching the Black Lake area by the 1940s and occupying nearly all suitable habitat in Unit 9E by the early 1950s. The geographic barrier of Port Moller delayed colonization of Unit 9D, and lack of habitat south of Port Moller limited population growth, but eventually a limited hunt was permitted in Unit 9D. The Unit 9E population peaked in the mid-1960s, followed by a deliberate reduction in numbers to protect habitat (Sellers and McNay 1983). In response to range damage in Unit 9E from overbrowsing, nutritional stress, and low calf:cow ratios, the Alaska Board of Game adopted liberalized regulations from 1964 to 1973, first to slow population growth and later (during the early 1970s) to reduce the population to allow recovery of the habitat. Once the population declined to the desired objective, a series of hunting restrictions began after 1973, including an experimental bag limit of bulls having 50-inch antlers or 3 brow tines in Unit 9E, and reducing the bull season by 10 days in 1981 (Sellers and McNay 1983). The population, however, continued to decline because of poor recruitment. By the early 1980s, moose densities in Unit 9E were 60% below peak levels, and calf:cow ratios were very low despite evidence that range conditions had improved. A 1983 census in the central portion of Unit 9E resulted in a rough estimate of 2,500 moose. Estimates for moose in other units during this time were: Unit 9C outside of Katmai National Park - 800; Unit 9B - 2,000; Unit 9A – 300; and Unit 9D - 600. During the 1990s and early 2000s, the Unit 9 moose population was considered stable to declining in localized areas. Recently the Unit 9 population is thought to be slowly decreasing with the possible exception of Unit 9E which appeared to finally stabilize.

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

In response to increasing hunting pressure in the 1980s when moose were declining in Unit 9E and stable in other areas, the Board of Game eliminated cow harvest in Unit 9E (1983), reduced and eventually eliminated cow harvest in Units 9B and 9C (1984, 1991), shortened nonsubsistence hunting seasons in Units 9E and 9C (1987–1988), and expanded the 50″/3 bull bag limit to Units 9B and 9C (1991) (Sellers 1990). Also during this period, federal agencies agreed to a moratorium on permitting additional guides and outfitters on federal lands. Average number of hunters decreased to 569 hunters during the 1990s, 414 hunters during the 2000s, and 337 during the last reporting period. Declining hunter participation more recently can be attributed to crashing caribou populations on the Alaska Peninsula that reduced and then eliminated the possibility of simultaneously hunting caribou (Butler 2006).

Brown bear predation on neonatal moose was considered the primary limiting factor of moose on the Alaska Peninsula from the 1990s through the present, and widely fluctuating calf:cow ratios were normal for Unit 9 (Sellers 1990, Butler 2008). Illegal cow harvest contributed to population declines in areas accessible to villages (Butler 2008). Household surveys conducted by the Division of Subsistence of Unit 9 communities and testimonies of village residents indicated that many moose harvests were not reported by hunters or were illegally harvested. For example, the villages of Igiugig, Kokhanok, and Nondalton reported a combined harvest of 1 moose during 2001, whereas household surveys by the Division of Subsistence estimated a combined harvest of 123 moose for the 3 villages (Community Subsistence Harvest Information System, http://www.adfg.alaska.gov/sb/CSIS). In 2005, Igiugig and Kokhanok reported harvesting 3 moose under state hunts, but Krieg et al. (2008) estimated a harvest of 29 moose for the 2 villages. Much of the unreported harvest occurred during closed seasons and a significant proportion of the animals taken were cow moose according to village residents.

Tensions between subsistence, resident, and nonresident hunters increased with the decline of caribou populations throughout Unit 9 during the 2000s (Butler 2008). At the suggestion of the Board of Game, a working group of stakeholders was formed to address user group conflicts. The Unit 9 Moose Working Group met in 2010 and drafted recommendations for moose management including a transition to registration permit hunts, and providing educational outreach on moose conservation and wolf trapping to Unit 9 residents.

MANAGEMENT DIRECTION

POPULATION OBJECTIVES

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

In March 1999 the Board of Game found that moose in Units 9B, 9C, and 9E met the criteria to be considered "important for providing high levels of human consumptive use" under the state's intensive management law. Intensive management objectives (Alaska Administrative Code 5AAC 92.108) are as follows:

Population	Finding	Population objective	Harvest objective
Unit 9A	negative		
Unit 9B	positive	2,000–2,500	100–250
Units 9C and 9E	positive	3,000–3,700	165–320
Unit 9D	negative		

METHODS

We conducted 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. Staff conducted a geospatial population estimator (GSPE) survey in Unit 9B in March 2012, the first attempt to use this technique in Unit 9.

Under the new registration permit hunts, hunters were required to report hunting activities to the department. We used that hunt data to monitor harvest during the reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Low moose density and patchy distribution, linear habitat over very large landscapes, inadequate knowledge of moose movements, poor weather conditions, and inadequate snow cover hinder our attempts to estimate moose abundance on the Alaska Peninsula. Most trend areas are surveyed irregularly and incompletely from year to year.

The 2012 GSPE survey flown in Unit 9B resulted in a population estimate of 1,160 ± 278 (90% CI) and density of 0.3 moose per mi^2, outside of national park boundaries. This was a low density population based on our management objectives. Lake Clark National Park reported approximately 540 moose present inside the park in 2010 for an approximate total of 1,700 moose in Unit 9B. Moose densities presumably remained low in Units 9A, 9B, 9D, and the southern portion of Unit 9E during the reporting period. Hunter success rate in Unit 9C decreased from an average of 34% in the 1990s to 22% during the 2010s, suggesting a decrease in moose density, unlike the other subunits where hunter success was stable. Coincidently, from 1990 to 2013, the human population of Unit 9C (which is roughly the same as Bristol Bay Borough) also declined by 34% (Williams 2000, Alaska Department of Labor and Workforce Development 2015), which may have contributed to declining moose harvest.

Population Composition

The same problems apply to composition surveys for moose in Unit 9, particularly the lack of snow before December (when bulls shed antlers) in the central and southern portions of the peninsula. In 2011 a composition count in Unit 9B outside of Lake Clark National Park indicated 16 calves:100 cows, and 33 bulls:100 cows (Table 1). In Unit 9C a composition count yielded 27 bulls:100 cows and 9 calves:100 cows in 2011. A 2012 survey was abandoned after only 42 moose were observed. The bull management objective was exceeded in Units 9C and 9E in 2010, and was below in Unit 9B in 2011 assuming low moose density (<0.5 moose/mi^2) (Table 1).

MORTALITY

Harvest

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

The nonresident season dates in Unit 9C were the same as for Unit 9B; however, the nonresident bag limit was 1 bull with ≥50-inch antlers or ≥3 brow tines on at least one side. The resident fall season was 1–15 September throughout Unit 9C, but resident winter season dates were different between the Naknek River drainage and the remainder of Unit 9C. Within the Naknek drainage the state hunting season was open 1–31 December, while the remainder of Unit 9C was open 15 December–15 January. The bag limit was 1 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 Units 9A, 9B, 9C, and 9E.

The nonresident season in Unit 9E was 10–20 September, and the bag limit was 1 bull with an antler spread of ≥50 inches or ≥3 brow tines on at least one side. The resident season was 10–20 September and 1 December–20 January in Unit 9E. The resident bag limit in Unit 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 Unit 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.

Unit 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 Unit 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.

Alaska Board of Game Actions and Emergency Orders. 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 Unit 9C and 9E composition surveys in recent years.

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

Harvest by Hunters. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY11 = 1 July 2011–30 June 2012). Reported moose harvests ranged between 84 and 177 moose annually since RY03 (Table 2). Although hunters were concerned when the Board of Game changed the winter season bag limit from 1 bull to 1 antlered bull in 2009 for Units 9B, 9C and 9E, reported participation and harvest increased during the reporting period from a record low in RY10, possibly stabilizing a downward trend that began in the 1990s; however, it is also probable that the recent switch to registration permit hunts has resulted in better reporting of hunting activity.

Hunter Residency and Success. Participation in the Unit 9 moose hunt decreased to 260 hunters in 2010 but increased to an average of 400 during this reporting period (Table 3). Local hunter success in Unit 9E increased from a low of 7% in RY10, to 29% in RY12; and in Unit 9C increased from 10% in RY09 to approximately 20% during the reporting period. Local hunter success was stable in Unit 9B at about 30%. Nonresident hunter success decreased in Units 9B and 9C during the reporting period to less than resident success, probably because the Board of Game gave resident hunters a 4-day head start on the season beginning in RY11. As usual, nonresident hunter success remained lower than that of residents in Unit 9A. Nonresidents had a higher success rate in Unit 9E (47% and 58% for reporting period) because most were guided and flew out to hunt, and season dates were the same as for residents. Only 2 moose were killed in Unit 9D during the reporting period, both by nonlocal residents.

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 Unit 9C. Participation in these hunts is low.

Harvest Chronology. Since RY03 the majority of the reported moose harvest occurred in September (Table 4). Reported harvest levels during the winter season remained low and ranged from 4% to 16% of the total harvest. However, the total winter harvests exceed reported values according to many sources.

Transportation Methods. No major change in transportation type occurred during this reporting period. Aircraft continue 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 be good, 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 were much higher than predator:prey ratios within the indigenous range of moose in Alaska (Sellers 2002).

CONCLUSIONS AND RECOMMENDATIONS

GSPE surveys should be added as an activity to, and planned for, Units 9B, 9C and 9E to be conducted during years when snow is abnormally abundant. We do not have adequate data to assess if moose density objectives have been achieved. Bull:cow ratio in Unit 9C apparently declined below the desired objective of 40 bulls:100 cows. An unknown number of unreported moose are taken each year, many of which are cows. These illegal practices primarily occur in specific geographic areas and are not pervasive enough to impact the overall Unit 9 moose population.

Brown bear predation on neonate moose is the major factor 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 local, detrimental effects of illegal moose 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 travel to Unit 9 villages to issue hunting licenses and permits. These visits 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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Table 1. Moose composition counts in Unit 9, Alaska, 2003–2012.

Unit	Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calf %	Adults	Total moose	Moose/hour
9B	2003	14	3	26	19	74	91	30
	2005	23	6	19	13	158	182	20
	2007	39	4	4	3	71	73	
	2011	33	7	16	11	117	131	
9C	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
	2011	27	13	9	7	217	232	
9E	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 National Park Service staff.
[b] Surveys conducted by U.S. Fish and Wildlife Service staff.

Table 2. Unit 9 annual moose harvest, Alaska, regulatory years[a] 2003–2012.

Regulatory	Reported				Estimated	
year	Male	Female	Unknown	Total	Unreported	Total
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
2011	104	0	1	105	100	205
2012	102	0	0	102	100	202

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.

Table 3. Unit 9 moose hunter residency and success, Alaska, regulatory years[a] 2008–2012.

Unit/ Regulatory year	Successful hunters						Unsuccessful hunters						Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total	(%)	
Unit 9B													
2008	17	9	5	1	32	(25)	40	44	14	0	98	(75)	130
2009	10	12	6	0	28	(31)	27	26	9	1	63	(69)	91
2010	14	8	4	0	26	(35)	23	23	2	0	48	(65)	74
2011	29	6	4	1	40	(23)	78	33	19	5	135	(77)	175
2012	14	16	5	0	35	(21)	74	38	19	4	135	(79)	170
Unit 9C													
2008	12	5	4	0	21	(23)	50	13	7	0	70	(77)	91
2009	6	5	5	1	17	(19)	59	13	2	0	74	(81)	91
2010	16	3	0	0	19	(21)	56	10	5	0	71	(79)	90
2011	16	6	0	1	23	(21)	70	8	9	0	87	(79)	110
2012	12	5	2	0	19	(16)	78	11	8	0	97	(84)	116
Unit 9E													
2008	4	2	41	0	47	(39)	15	12	46	0	73	(61)	120
2009	4	7	46	6	63	(53)	12	17	26	2	57	(47)	120
2010	1	3	28	1	33	(42)	14	10	18	3	45	(58)	78
2011	4	3	30	0	37	(37)	20	8	34	0	62	(63)	99
2012	6	1	37	2	46	(45)	18	13	25	0	56	(55)	102
Unit 9 Total[c]													
2008	33	17	54	1	105	(29)	105	79	77	0	261	(71)	366
2009	20	30	62	7	119	(37)	98	58	39	4	199	(63)	318
2010	31	17	35	1	84	(32)	93	51	29	3	176	(68)	260
2011	49	18	38	2	107	(27)	168	54	63	6	291	(73)	396
2012	32	24	44	2	102	(25)	170	75	54	4	303	(75)	405

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] Residents of Unit 9
[c] Also includes moose harvested in Units 9A and 9D.

Table 4. Unit 9 reported moose harvest chronology percent by period, Alaska, regulatory years[a] 2003–2012

Regulatory	Harvest chronology (%) by period									
year	20–31 Aug	1–5 Sep	6–10 Sep	11–15 Sep	16–20 Sep	16–20 Sep	1–15 Dec	16–31 Dec	1–20 Jan	Other
2003	1	7	26	41	15	0	5	4	1	1
2004	0	9	22	45	13	0	6	3	1	1
2005	0	11	20	38	19	0	3	4	4	1
2006	0	12	16	35	25	0	2	4	4	2
2007	1	3	19	44	19	0	6	5	3	0
2008	0	10	15	44	14	0	2	12	2	1
2009	2	7	27	41	18	0	1	2	1	1
2010	1	10	18	39	17	0	5	9	1	0
2011	1	13	12	27	15	10	3	10	4	4
2012	0	3	19	46	14	9	2	3	3	2

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.

Table 5. Unit 9 successful moose hunter percent by transport methods, regulatory years[a] 2003–2012

Regulatory year	Transport methods (%)							
	Airplane	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unspecified
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
2011	42	33	8	12	1	1	0	2
2012	52	28	13	2	2	2	0	1

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.

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CHAPTER 10: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

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. The National Park Service (NPS) closely manages hunting on park lands by controlling access based on hunter residency.

The existing state season dates of 20 August–20 September have been in place since 1993. The bag limit has been 1 bull with spike-fork 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 2000 a federal subsistence season for local residents was opened with a bag limit of 1 bull. In regulatory year (RY) 2012 (regulatory year begins 1 July and ends 30 June, e.g., RY12 = 1 July 2012–30 June 2013) a registration moose hunt (RM291) was implemented with a bag limit of 1 bull with spike-fork antlers, or 50-inch antlers, or 3 or more brow tines on at least one side for residents, or 1 bull with 50-inch antlers with 3 or more brow tines on at least one side for nonresidents. Currently, the community hunt (CM300) allows for harvest of up to 10 antlered bulls of any size by community harvest participants in possession of “any bull” locking tags in Unit 11.

MANAGEMENT DIRECTION

POPULATION OBJECTIVES

- Allow the population to fluctuate as dictated by available habitat and predation rates.
- Maintain a population with a posthunt minimum of 30 bulls:100 cows.

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-early winter to determine moose population trends and sex and age composition. In some years surveys are not possible due to a lack of snow or funding.

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

An additional count area in the upper Copper River drainage has also been counted in some years by NPS. Harvests and hunting pressure were monitored through state and federal harvest ticket reporting systems.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

The moose population has been considered low density across Unit 11 for many years, but counts in Count Area 11 tend to cycle between very low periods (0.1 moose/mi^2 in 1979 and 1992) and considerably higher periods (1.0 moose/mi^2 in 1969 and 2012; 0.7 moose/mi^2 from 1987 to 1990). For this reporting period, observed moose densities were relatively high in Count Area 11, with 0.9 moose/mi^2 observed in 2011 and 1.0 moose/mi^2 observed in 2012.

Population Composition

During this reporting period, bull:cow ratios were lower than the long-term average for the area of 98 bulls:100 cows (1990–2008), but ratios were still well above the current management goal of maintaining no less than 30 total bulls:100 cows (Table 1).

Calf:cow ratios during this reporting period remained in the typical range of the 9–25 calves:100 cows for this area, with 21 calves:100 cows observed in 2011 and 13.3 calves:100 cows observed in 2012.

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 Mount Sanford, Mount Drum, and Mount 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

<u>Seasons and Bag Limits</u>. The state general season is 20 August–20 September with a bag limit of 1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on at least one side. The federal subsistence season has a bag limit of 1 bull, though season dates are the same as for the state general season. In RY09 a community subsistence harvest (CSH) hunt (CM300) was held in Units 11 and 13 with season dates of 10 August–20 September with a bag limit of 1 bull under general season antler restrictions, or any bull if the hunter is in possession of an “any bull” locking tag. The CSH hunt was not held in RY10, but began again in RY11. In RY12, a joint state-federal registration hunt (RM291) began with hunt dates of 20 August–17 September with a bag limit of 1 bull with spike-fork or 50-inch antlers or 3 or more brow tines on at least one side

for residents, or 1 bull with 50-inch antlers with 3 or more brow tines on at least one side for nonresidents.

Alaska Board of Game Actions and Emergency Orders. During the March 2009 meeting, the Board of Game (BOG) opened Unit 11 to a CSH moose hunt for the 8 Ahtna communities: Chitina, Kluti kaah, Tazlina, Gakona, Gulkana, Chistochina, Mentasta, and Cantwell. Other Alaskan 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. They were allowed to take up to 15 'any' bulls, and an unlimited number of bulls meeting the state general hunt antler restrictions. For purposes of the CSH hunt, an 'any' bull was a bull that did not meet the state general hunt antler restrictions. Due to a court ruling, BOG eliminated the CSH hunt for the RY10 season. The CSH hunt was reinstated in RY11. Since then, it has been open to any group of Alaska residents that with 25 or more individuals registered to participate in the hunt. The extensive hunt conditions can be found online at http://www.adfg.alaska.gov/index.cfm?adfg=huntlicense.cultural.

In March 2011, BOG decreased the "any bull" moose quota for the community harvest hunt from 100 to 70 for Units 11 and 13, effective 1 July 2011.

In March 2012, BOG replaced the general season hunt for that portion in Unit 11 east of the east bank of the Copper River upstream from and including the Slana River drainage and Unit 12, that portion within the Nabesna River drainage west of the east bank of the Nabesna River upstream from the southern boundary of the Tetlin National Wildlife Refuge, with a registration hunt (RM291) for both residents and nonresidents. The RM291 hunt has a resident bag limit of 1 moose with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on one side, nonresident bag limit of 1 bull with 50-inch antlers or antlers with 3 or more brow tines on one side, season 20 August–17 September, effective 1 July 2012.

Harvest and Success by Hunters. The combined harvest in Unit 11 from all hunts during this reporting period ranged from 65 to 49 bulls (Table 2). Hunters participating in the general state moose hunt typically show higher success rates than those participating in the federal, registration, or community hunts, presumably because general state hunters in Unit 11 are more likely to utilize commercial services than are other Unit 11 hunters. Out of 173 Unit 11 hunters that reported on the use of commercial services in 2012, 40% of general season hunters used commercial services, 1% of registration hunters used commercial services, and 1 out of 6 community hunters used commercial services.

Harvest Chronology. Chronology data for the state general hunt indicate most moose are taken late in the season in Unit 11 (Table 3). Bull moose are more vulnerable towards 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. In addition, many hunters time their efforts later in the season as a result of these factors.

Transportation Methods. Unit 11 moose hunters typically use aircraft, 3- or 4-wheelers, horses, 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 were the result of trail closures imposed by NPS in response to legal issues. Most of the transportation restrictions were removed in RY10, just prior to hunting season. Aircraft can be used for hunter transportation in the preserve, but not in the park.

Natural Mortality

Wolves and bears are present in the area and contribute to moose predation year-round. 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.

HABITAT

Assessment

Fires occurred throughout much of Unit 11 prior to the mid-1940s, when the Bureau of Land Management 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 Mount Drum and covered 13,000 acres (20 mi^2). No substantial fires 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 the next 20 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.

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.

Enhancement

Habitat manipulation to benefit moose is not currently an option in Unit 11 because most of the area is included in Wrangell–Saint Elias National Park and Preserve, where habitat manipulation is prohibited.

Unit 11 is covered by the *Copper River Fire Management Plan* which was designed to bring natural wildfire back onto the landscape. Given recent changes in land management policies, large tracts of private Native corporation land, even though remote, are now listed under the full protection category. This will have substantial impacts on fire management throughout Unit 11. In addition to full fire suppression on private corporation lands, NPS is expected to suppress fires on any adjacent lands, if there is any chance the fire could spread to corporation land.

CONCLUSIONS AND RECOMMENDATIONS

An increase in the number of moose counted, the moose per hour figures, and the moose per square mile figures lead to the conclusion that moose numbers in the western portion of Unit 11 may have increased slightly over the past decade. Regardless, densities remain at or below 1 moose/mi^2 and are still considered relatively low density. Recent winters have been mild and snow depths have been average. Given the relatively high numbers of bears and wolves in Unit 11, the moose population is expected to remain at a relative low density. Annual fluctuations may occur with changing winter severity. The Chakina fire should provide substantial new early succession browse near McCarthy in the next 3–10 years. Without a reciprocal decline in predation, the response in the moose population is expected to be minimal.

Moose hunting patterns have not changed considerably in Unit 11 during this reporting period for either the state general hunt or the federal subsistence hunt. Few Community Hunt participants utilize Unit 11 for moose, presumably because ease of access and moose densities are greater in neighboring Unit 13. 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 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 Mount Drum) fall aerial moose composition counts, Alaska, 2008–2012.

Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calf	Total moose	Moose/ hour	Density moose/mi^2
2008	73.3	7.0	17.4	9.1	164	38.1	0.6
2011	71.0	3.6	21.0	10.9	265	45.7	0.9
2012	83.9	11.2	13.3	6.7	282	45.5	1.0

Table 2. Unit 11 moose harvest by permit type, Alaska, regulatory years[a] 2008–2012.

	General state harvest ticket		RM291 (started in 2012)		CM300		Federal permit		
Regulatory year	Successful hunters	Success rate (%)	Successful hunters	Success rate (%)	Successful hunters	Success rate (%)	Successful hunters	Success rate (%)	Total harvest
2008	25	20					29	16	54
2009	35	32			1	17	20	15	56
2010	19	17					19	13	38
2011	35	38			3	33	27	20	65
2012	23	26	16	15	1	17	9	12	49

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.

Table 3. Unit 11 moose harvest (%) chronology for general state harvest tickets, Alaska, regulatory years[a] 2008–2012.

Regulatory		Week of season (%)				
year	Season dates	1st	2nd	3rd	4th	5th
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	47	21
2011	20 Aug–20 Sep	13	9	34	19	25
2012	20 Aug–20 Sep	9	14	14	45	18

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.

Table 4. Unit 11 successful moose hunter transport methods (%) for general state harvest ticket hunt, Alaska, regulatory years[a] 2008 – 2012.

	Transport methods (%)						
Regulatory year	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV[b]	Highway vehicle
2008	58	8	4	8	0	8	13
2009	38	18	9	9	0	9	18
2010	67	11	6	11	0	0	6
2011	49	23	0	14	0	3	11
2012	52	22	0	13	0	4	9

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] ORV = off-road vehicle.

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CHAPTER 11: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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 late 1960s and 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 (Gardner 1998).

In response to the declining moose populations, antlerless seasons were closed beginning in 1975 and wolf control programs were conducted in adjacent Unit 20D (1980), Unit 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. Bulldozer 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; Kelleyhouse 1989).

Based on data collected during October–November aerial composition surveys and area-specific population estimation surveys from 1989 through 2010, 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 1998–2010. During the growth phase of 1994–1997, the most apparent increase occurred in northwestern Unit 12 within the area affected by the 1990 Tok wildfire (155 mi^2). Population estimates indicate this area supported 0.19 moose/mi^2 in 1989 (Kelleyhouse 1990), 0.6 moose/mi^2 by 1994 (Gardner 1996), and about 1.0 moose/mi^2 in 1997 (Gardner 1998).

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

Unit 12 has traditionally been an important moose hunting area for local residents, hunters from Southcentral Alaska, and guided nonresidents. It is also an important wildlife viewing area for tourists driving the Alaska Highway. 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. With the exception of portions of southeastern Unit 12 where a 30-day season has been in place for over 25 years, restrictive season length and bag limits have continued since 1991, including antler restrictions within the Tok River drainage since 2006.

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

In 2011 we developed a 1,602 mi^2 moose survey area in the portions of Units 11 and 12 accessible from the Nabesna Road and adjacent trail system. We estimated moose population size and composition in the survey area using the geospatial population estimator (GSPE) method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). To determine the survey area, we used moose distribution and movement patterns between the rut in October and survey season in late November from 22 adult moose (11 cows and 11 bulls) collared in the Nabesna Road area in October 2011. We surveyed 81 (50 high density and 31 low density; 499 mi^2) of 260 survey units in cooperation with the National Park Service 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, Wildlife Biologist, ADF&G, memorandum 17 January 2012, Tok).

During November 2012 we conducted a GSPE moose survey in the northern portion of Unit 12, including the Tetlin National Wildlife Refuge (Tetlin NWR) and northwestern Unit 12 but excluding Wrangell–St. Elias National Park and Preserve. We surveyed 160 (94 high density and 66 low density; 973 mi^2) of 915 survey units and survey conditions were good to excellent on each day that surveys were conducted. U.S. Fish and Wildlife Service (FWS), Tetlin NWR staff collected survey data on federal and private lands in eastern and southern Unit 12, and ADF&G staff collected survey data on state and private lands in northwestern Unit 12 (T. Bentzen, memorandum 13 December 2012, Tok).

We have not obtained a sightability correction factor (SCF) specific to Unit 12 GSPE surveys. 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 (search intensity of 4.0 to 5.0 min/mi^2). Because average search intensity was higher during the 2008 and 2012 moose surveys (search intensity of 7.0 to 8.5 min/mi^2) we applied an SCF of 1.2 to the estimate of observable moose for these years.

Data collected during the 2011 and 2012 GSPE surveys were also used to determine moose population trends and sex and age composition within the survey areas, and to infer composition within Unit 12. During GSPE surveys, moose were classified as large bulls (antlers ≥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.

In November 2013 we surveyed a trend count area in portions of Units 12 and 20D within the Robertson River drainage upstream of the confluence of the east and west fork. We surveyed all 24 of the high density GSPE sample units within the survey area and a random sample of the low density sample units (4 of 22), and survey conditions were fair to excellent in all survey units (J. Wells, Wildlife Biologist, ADF&G, memorandum 20 December 2013, Tok). Data collected during the survey was used to estimate sex and age composition within the survey area, and surveying a proportion of the low density sample units as opposed to only high density units allowed for more accurate and precise estimates.

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 from potlatch harvest reports and by interviewing residents and public safety officers of villages where potlatches took place.

HABITAT

We continued work with the Alaska Department of Natural Resources-Division of Forestry on an 880-acre timber sale in the lower Tok River drainage designed to increase deciduous browse and cover for wildlife while providing nursery structure for spruce regeneration. Timber harvest began in 2008 and scarification began in 2010. A total of 88 acres were scarified using a disk-trencher or blade during spring and summer 2010–2012. In 2001 we completed a burn plan with the Alaska Department of Natural Resources-Division of Forestry to create early seral habitat in the Robertson River drainage. The plan was in review during RY13 and may be implemented when prescription conditions and funding allow.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population estimate derived from the 2011 survey in the 1,602 mi^2 Nabesna Road moose survey area was 1,261 observable moose (±17%, 90% CI; 0.79 moose/mi^2). Using an SCF of 1.20, similar to all Unit 12 surveys since 2008, the total estimated number of moose in the area was 1,249–1,777 (0.8–1.1 moose/mi^2).

The 2012 combined ADF&G and Tetlin NWR GSPE moose surveys produced an estimate of 4,773 (±15%, 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 4,883–6,571 (0.8–1.1 moose/mi^2). The highest moose densities (1.36 moose/mi^2) were in northwestern Unit 12. Similar density estimates of 0.9–1.1 moose/mi^2 in 2008 (unitwide) and 0.94, 1.07, and 1.43 moose/mi^2 in northwestern Unit 12 in 2005, 2006, and 2008, respectively, suggest a stable population trend (Table 1).

Population Composition

In 2011 we estimated a bull:cow ratio of 34:100 and a calf:cow ratio of 27:100 within the Nabesna Road area of Units 11 and 12. This is similar to the estimated 29 bulls:100 cows and 27 calves:100 cows in northwestern Unit 12 in 2012 (Table 2). However, the 2012 bull:cow and calf:cow ratios were a decrease from the 46 bulls:100 cows and 35 calves:100 cows estimated in 2008. Although the decrease in bull:cow ratios between 2008 and 2012 was not statistically significant (90% confidence intervals overlapped), the decrease warrants continued monitoring.

Based on a sample of 140 moose observed in the upper Tok River drainage during the northwestern Unit 12 moose survey in 2012, we estimated a bull:cow ratio of 30:100 and a calf:cow ratio of 27:100 within the Tok River drainage. This is similar to the 34 bulls:100 cows and 23 calves:100 cows observed in the upper Tok River trend count area in 2010. Conservative antler restrictions implemented in RY06 have been effective at maintaining bull:cow ratios at or above 30:100 within the Tok River drainage.

Based on a sample of 240 moose observed in the Robertson River trend count survey in 2013, we estimated a bull:cow ratio of 33:100 and a calf:cow ratio of 24:100. This survey was conducted in part to address concerns that hunting pressure had increased in recent years and the low bull:cow ratio (24:100) estimated in the area during the northwestern Unit 12 survey in 2012. However, our confidence in the 2012 estimate is low due to a low sample size. The estimated bull:cow ratio from the 2013 survey is comparable to the bull:cow ratio in all of northwestern Unit 12 of 29 bulls:100 cows in 2012 and in southeastern Unit 20D (all of Unit 20D east of the Johnson River, including the West Fork Robertson River) of 31 bulls:100 cows in 2011.

Distribution and Movements

Moose generally occur below 4,500 feet throughout Unit 12 and do not occupy the large portions of Unit 12 composed of rock and ice at high elevation in the Alaska, Wrangell, and Nutzotin mountains. Based on this criterion, 6,000 mi^2 (15,540 km^2) of Unit 12 is suitable moose habitat. The 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.

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 from the Tok River area migrate to areas 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; Kelleyhouse 1983). 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 were also reported along the Slana and Chistochina river drainages in Unit 13C during December 2011.

In October and November 2011, National Park Service 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, 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 2 cows and a 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 radio collar 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 March 2012 the Alaska Board of Game (board) replaced the general season hunt for the portion of Unit 12 within the Nabesna River drainage west of the east bank of the Nabesna River upstream from the southern boundary of the Tetlin NWR with a registration hunt (RM291) for residents and nonresidents. The change to a registration hunt also included that portion of Unit 11 east of the east bank of the Copper River upstream from and including the Slana River drainage; therefore, season dates and antler restrictions were aligned for Units 11 and 12 along the Nabesna Road.

Harvest by Hunters. Reported harvest in Unit 12 was 110 bulls and 1 moose of unknown sex in RY11 and 127 bulls and 1 moose of unknown sex in RY12 (Table 4). Harvest during RY06–RY10 was similar, averaging 130 bulls annually (range: 107–159).

Total unitwide harvest was ≤4% of the estimated prehunt population in recent years and has likely had little impact on unitwide population dynamics. During RY11 and RY12, the annual out-of-season take was estimated at 25–40 moose, mostly cows. However, this is highly speculative and more data are needed to refine this estimate. During RY11 and RY12, reported potlatch moose harvest totaled 8 moose (75% cows), but reporting is poor and each year a large portion of the potlatch harvest remains undocumented. During RY11 and RY12, 81% (21 of 26) of potlatch permits issued for moose within Unit 12 remained unreported. This is a lower reporting rate than during RY05–RY10, when 47% (27 of 57) of permits remained unreported. During RY05–RY10, total reported potlatch harvest was 22 bulls, 14 cows, and 16 moose of unknown sex (52 total moose, $\bar{x}$ = 9 moose/year). Most of the potlatch harvest occurred near the communities of Tok, Tanacross, Tetlin, and Northway, and along the road system between these communities. Although potlatch harvest likely has little influence on unitwide population dynamics, localized harvest of cows near communities and along the road system might hinder population growth in these areas.

Hunter Residency and Success. The number of people who reported hunting moose in Unit 12 was 482 in RY11 and 577 in RY12 (Table 5). Hunter numbers were the lowest in RY11 compared to the previous 10 years (range: 506–616) and were similar in RY12 to the previous 5-year average of 576 hunters. The success rate in RY11 (23%) and RY12 (22%) was similar to the previous 5-year average of 23%.

During RY11 and RY12, local residents accounted for an average of 46% of moose hunters, nonlocal residents averaged 42%, and nonresidents averaged 12%. The number of local resident and nonresident hunters has remained relatively constant since RY94 and, other than an increase in RY12, the number of nonlocal resident hunters has remained relatively constant since RY02. Local hunters took 40% and 30% of the reported harvested bulls in RY11 and RY12 respectively, nonlocals took 37% and 43%, and nonresidents took 23% and 26% (Table 5). Although harvest by nonlocal Alaska residents increased during RY01–RY04, it has remained relatively constant since then.

Since the community harvest hunt (CM300) was implemented, 3 hunters harvested 1 moose in Unit 12 in RY09 and 2 hunters were unsuccessful in Unit 12 in RY11. No CM300 permittees reported hunting in Unit 12 in RY10 or RY12.

Harvest Chronology. Beginning in RY01 the hunting season in most of Unit 12 was split into 2 periods: 24–28 August and 8–17 September. This attempt to maintain harvest within sustainable levels eliminated the large influx of hunters during the Labor Day holiday weekend but retained overall season length (15 days). During the early portion of the season in RY01–RY08 (24–28 August) harvest was reduced 36% ($\bar{x}$ = 12 bulls) compared to RY93–RY00 (1–6 September, $\bar{x}$ = 33 bulls) (Table 6). However, harvest increased during the 10-day September season, but the unitwide harvest remained within sustainable levels. Since RY01, an average of 11% of the total harvest occurred during the August portion of the season. Overall there has been little change in the harvest chronology since the change of season dates in RY01.

Transport Methods. During RY11 and RY12, the type of transportation used most by successful hunters was 4-wheelers ($\bar{x}$ = 30%), followed by highway vehicle ($\bar{x}$ = 24%), airplane ($\bar{x}$ = 15%), boat ($\bar{x}$ = 12%), horse ($\bar{x}$ = 11%), and other off-road vehicles (ORV) ($\bar{x}$ = 9%; Table 7). Other than a slightly lower use of boats by successful hunters in RY11 and RY12, there were no other deviations from the previous 10 years.

Other Mortality

No estimates of natural mortality were calculated during RY11 and RY12. However, 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. During RY11 and RY12, an estimated 10–15 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 (Gardner 2000). 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 RY11 and RY12. 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, the 1990 Tok burn in Unit 12 (Gardner 2000), and the Teslin burn in Yukon, Canada (Boertje et al. 1995). Boertje et al. (1995) hypothesized that early seral stages also reduce predation efficiency in a variety of ways.

Enhancement

In 1990 a wildfire burned approximately 155 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 within the burned area increased rapidly from an estimated 0.19 moose/mi^2 in 1989 to an estimated 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, 28 mi^2, and 112 mi^2 in Unit 12 during 2004, 2010, and 2013, respectively, improving habitat quality for moose in the area. No prescribed burns were conducted during RY11 or RY12.

Since 1998 we have been working in cooperation with the Alaska Department of Natural Resources-Division of Forestry to determine suitable timber harvest sites within a proposed 880-acre timber sale area in the Tok River valley. Potential areas to be harvested were selected based on numbers of marketable trees, historic winter moose use, and the potential to regenerate quality moose browse species. Timber harvest began in 2008 and 528 acres had been harvested by spring 2013. Twenty- to 80-acre harvest units were 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 but several issues were encountered, including the inaccessibility of the harvest units during spring–fall; as a result, only 88 acres have been scarified. We will continue to work with the Division of Forestry to initiate scarification on accessible sites as they are harvested.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

ADF&G has worked with local communities during village council meetings and traditional knowledge workshops to improve potlatch reporting and reduce harvest of cow moose, but few corrective steps have been taken. Potlatches are culturally important and should be maintained; however, reporting must improve in order to better assess the influence of cow harvest on localized populations. 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 to work with the village council concerning moose management on tribal lands.

CONCLUSIONS AND RECOMMENDATIONS

Population surveys in fall 2012 indicate the unitwide population is likely stable at 4,883–6,571 moose (0.8–1.1 moose/mi^2 of suitable moose habitat), which met the intensive management population objective of 4,000–6,000 moose. The moose population in Unit 12 is likely to remain at low to moderate density if there is no change in the density of wolves and grizzly bears or number of medium- to large-scale wildfires. Furthermore, local moose numbers near some communities and along the road system may also be limited by the harvest of cows.

During RY11 and RY12 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 at or above 30:100 due to moderate harvest rates and low yearling bull recruitment. The bull:cow ratio in northwestern Unit 12 decreased from an estimated 46 bulls:100 cows in 2008 to an estimated 29 bulls:100 cows in 2012, though the decrease was not statistically significant (based on 90% confidence intervals). The northwestern Unit 12 population estimate and the unitwide harvest, hunters, and harvest distribution remained stable; therefore, if the bull:cow ratio is truly declining, the mechanism for the decrease is unknown. Expanding the area with moose antler restrictions into the upper Tok River drainage in RY06 successfully increased the bull:cow ratio while allowing maximum hunter opportunity. Since fall 2008 the bull:cow ratio in the upper Tok River drainage has ranged 30–39 bulls:100 cows. Similar harvest restrictions may be needed in other areas of high harvest to maintain a bull:cow ratio adequate to meet our management objectives.

Since RY08, harvest has averaged 130 moose (range 107–159). With a bulls-only harvest, this harvest rate is within sustainable levels (based on a 3–4% harvest rate). However, continued harvest of cows may be unsustainable in localized areas (causing decline or hindering population growth). During the next report period, additional effort will be placed on increasing the potlatch reporting rate in order to more accurately track overall cow harvest within the unit.

Harvest of 111 moose in RY11 and 126 in RY12 did not meet the intensive management harvest objective of 250–450 moose. Difficult hunter access, especially on the Tetlin NWR and on private lands, combined with low moose recruitment make it unlikely we will achieve the intensive management 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 RY11 and RY12. 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, 2003–2012.

Survey area	Year	Survey size (mi^2)	Number of sample units surveyed	Population estimate (±90% CI)	Population estimate with SCF	Moose/mi^2 w/SCF
Northwestern Unit 12[a]	2003	2,845	69	3,064 (±35%)	3,830[b]	1.35[b]
	2005	2,845	48	2,129 (±15%)	2,661[b]	0.94[b]
	2006	2,702	89	2,317 (±18%)	2,896[b]	1.07[b]
	2008	2,702	92	3,225 (±18%)	3,870[c]	1.43[c]
	2012	2,702	80	3,058 (±12%)	3,670[c]	1.36[c]
Southeastern Unit 12[d]	2003	2,954	80	1,317 (±19%)	1,646[b]	0.56[b]
	2004	2,954	80	1,272 (±20%)	1,590[b]	0.54[b]
	2008	2,954	80	1,843 (±20%)	2,212[c]	0.75[c]
	2012	2,954	80	1,613 (±17%)	1,936[c]	0.66[c]
Nabesna Road[e]	2011	1,602	81	1,272 (±17%)	1,526[c]	0.95[c]

[a] Survey area includes state and private lands in northwestern Unit 12. Survey conducted by Alaska Department of Fish and Game.
[b] Sightability correction factor of 1.25 used in estimate.
[c] Sightability correction factor of 1.20 used in estimate.
[d] Survey area includes federal and private lands in eastern and southern Unit 12. Survey conducted by Fish and Wildlife Service, Tetlin National Wildlife Refuge.
[e] Survey area includes portions of Unit 11 and 12 mostly within the Wrangell-St. Elias National Park and Preserve.

Table 2. Unit 12 aerial moose composition counts, fall 2003–2012.

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Percent calves	Calves observed	Adults observed	Moose observed
Northwestern Unit 12[a]							
2003	25	7	32	19	111	464	575
2005	22	11	30	18	69	315	384
2006	37	7	41	21	185	688	873
2008	46	15	35	20	218	899	1,117
2012	29	6	27	16	133	650	819
Southeastern Unit 12[b]							
2003	89	15	33	16	89	475	564
2004	70	16	48	20	89	351	440
2008	62	14	24	13	81	552	633
2012	52	9	18	9	65	634	699
Nabesna Road[c]							
2011	34	3	27	14	75	476	551

[a] Survey area includes state and private lands in northwestern Unit 12. Survey conducted by Alaska Department of Fish and Game.

[b] Survey area includes federal and private lands in eastern and southern Unit 12. Survey conducted by U.S. Fish and Wildlife Service, Tetlin National Wildlife Refuge.

[c] Survey area includes portions of Unit 11 and 12 mostly within the Wrangell-St. Elias National Park and Preserve.

Table 3. Unit 12 moose hunting seasons and bag limits, regulatory years[a] 2011 and 2012.

Regulatory year	Area	Season		Bag limit[b]
2011	Unit 12, that portion in the Tok River drainage upstream from the Tok Cutoff Bridge, including the Little Tok River drainage.[c]	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.
2012	Unit 12, that portion in the Tok River drainage upstream from the Tok Cutoff Bridge, including the Little Tok River drainage.[c]	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.
	Unit 12, that portion in the Nabesna River drainage west of the east bank of the Nabesna River upstream from the southern boundary of Tetlin National Wildlife Refuge	RESIDENT:	20 Aug–17 Sep	1 bull with spike–fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least one side by registration permit.
		NONRESIDENT:	20 Aug–17 Sep	1 bull with 50-inch antlers or antlers with 3 or more brow tines on at least one side by registration permit.
	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] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2011 = 1 July 2011–30 June 2012).
[b] 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.
[c] This 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[a] 2003–2012.

Regulatory year	Harvest by hunters: Reported				Harvest by hunters: Estimated			Accidental death		
	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	Road	Total	Total
2003	132 (99)	1 (1)	1	134	20–50	3–10	23–60	3–5	3–5	160–199
2004	137 (100)	0 (0)	0	137	20–50	3–10	23–60	3–5	3–5	163–202
2005	134 (100)	0 (0)	2	136	20–30[b]	5–10	25–40	3–5	3–5	164–181
2006	118 (100)	0 (0)	0	118	20–30[b]	5–10	25–40	3–5	3–5	146–163
2007	121 (100)	0 (0)	1	122	20–30[b]	5–10	25–40	3–5	3–5	150–167
2008	159 (100)	0 (0)	0	159	20–30[b]	5–10	25–40	3–5	3–5	187–204
2009	143 (99)	1 (1)	2	146	20–30[b]	5–10	25–40	14	14	185–200
2010	105 (100)	0 (0)	2	107	20–30[b]	5–10	25–40	13	13	145–160
2011	110 (100)	0 (0)	1	111	20–30[b]	5–10	25–40	10–15	10–15	146–166
2012	127 (100)	0 (0)	1	128	20–30[b]	5–10	25–40	10–15	10–15	163–183

[a] Regulatory year (RY) begins 1 July and ends 30 June (e.g., RY03 = 1 July 2003–30 June 2004).

[b] Includes reported ceremonial potlatch harvest of 9, 2, 7, 15, 19, 0, 3, and 5 moose during RY05–RY12.

Table 5. Unit 12 moose hunter residency and success, regulatory years[a] 2003–2012.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
2003	54	44	36	0	134 (24)	230	164	35	4	433 (76)	567
2004	49	53	34	1	137 (25)	204	167	30	0	401 (75)	538
2005	53	51	30	2	136 (24)	234	167	35	2	438 (76)	574
2006	48	42	26	2	118 (20)	255	178	40	3	476 (80)	594
2007	61	38	23	0	122 (20)	256	189	45	3	493 (80)	615
2008	53	57	49	0	159 (26)	251	160	42	4	457 (74)	616
2009	60[b]	57	26	3	146 (27)	217[c]	162	23	0	402 (73)	548
2010	44	47	16	0	107 (21)	215	151	28	5	399 (79)	506
2011	44	41	26	0	111 (23)	193[c]	149	27	2	371 (77)	482
2012	38	54	33	1	126 (22)	211	199	39	2	451 (78)	577

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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.
[c] Includes hunters hunting under the CM300 community harvest permit.

Table 6. Unit 12 moose harvest chronology by month/day, regulatory years[a] 2003–2012.

Regulatory	Harvest chronology by month/day (%)							
year	8/15–8/28	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	Unknown	*n*
2003	12 (9)	2 (1)	63 (47)	40 (30)	12 (9)	2 (1)	3 (2)	134
2004	7 (5)	3 (2)	68 (50)	43 (32)	10 (7)	4 (3)	0 (0)	135
2005	12 (9)	0 (0)	58 (46)	43 (34)	7 (6)	7 (6)	0 (0)	127
2006	15 (13)	2 (2)	60 (51)	31 (26)	4 (3)	4 (3)	2 (2)	118
2007	15 (12)	0 (0)	58 (48)	36 (30)	5 (4)	3 (2)	5 (4)	122
2008	16 (10)	3 (2)	82 (52)	42 (26)	12 (8)	3 (2)	1 (1)	159
2009	22 (15)	2 (1)	71 (49)	42 (29)	6 (4)	2 (1)	1 (1)	146
2010	8 (8)	1 (1)	55 (51)	39 (36)	3 (3)	1 (1)	0 (0)	107
2011	15 (13)	3 (3)	43 (39)	43 (39)	6 (5)	0 (0)	1 (1)	111
2012	16 (13)	3 (2)	61 (48)	35 (28)	7 (6)	1 (1)	3 (2)	126

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

Table 7. Unit 12 moose harvest percent by transport method, regulatory years[a] 2003–2012.

	Harvest percent by transport method								
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
2003	12	13	16	31	0	10	16	1	134
2004	15	11	15	36	0	7	15	1	137
2005	13	10	13	36	0	7	19	1	136
2006	24	3	16	37	0	9	9	1	118
2007	17	8	13	30	0	10	18	3	122
2008	18	11	18	32	0	8	11	3	159
2009	17	6	13	38	0	6	19	1	146
2010	15	4	21	34	0	6	20	0	107
2011	17	9	14	28	0	8	22	2	111
2012	13	12	9	31	0	9	25	1	126

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

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CHAPTER 12: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

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. Annual harvests were large during the late 1960s and early 1970s, averaging more than 1,200 bulls and 200 cows. Hunting seasons were long, with both fall and winter hunts. As moose numbers declined, 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 antler spreads 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 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 (TCA), and the harvest peaked 1 year later when 1,259 moose were taken.

The population declined 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. A regulatory year begins 1 July and ends 30 June, e.g., RY90 = 1 July 1990–30 June 1991. During fall 1999 and 2000, unitwide wolf estimates peaked at more than 500 wolves (>12 wolves/1,000 km^2) and were the highest in more than 25 years. Snow depths during winters 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

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

near objective levels since spring 2010 (Schwanke 2012), the moose population has grown steadily.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Population Objectives

- 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, 13D, 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 TCAs has been surveyed annually, as budget and conditions allow, for more than 40 years (TCAs 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 global positioning system (GPS) units in the 1990s, area coverage and data quality during these surveys have increased.

Additional surveys, using techniques developed by Gasaway et al. (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.

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 TCAs each year (Table 1). The number of moose counted in the continuous TCAs 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. During this reporting period, the observed unitwide moose density within continuous count areas reached 1.6 moose/mi^2 in 2011, though dropped slightly to 1.5 moose/mi^2 in 2012 (Table 1).

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 (TCA 5), the number of moose observed increased from 1,051 to 1,783 (70%) between 2002 and 2012. For the foothills of the eastern Talkeetna Mountains in Subunit 13A (TCAs 13 and 14), the number of moose observed increased from 917 to 1,580 (72%) during the same period. While these data are from trend counts, and some movement is captured annually, the increases were relatively consistent through time.

While the Unit 13 intensive management predator control program has expanded since inception (Schwanke 2012), 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 (TCA 15) 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 2012 by subunit were: 3,650 in Subunit 13A, 5,350 in Subunit 13B, 1,680 in Subunit 13C, 1,950 in Subunit 13D, and 5,630 in Subunit 13E. The unitwide estimate was 18,260 moose. With the exception of Subunit 13C all appear to be within population objectives.

Population Composition

Composition data collected during fall trend counts are presented in Table 1, with data by subunit presented in Table 2 for 2012. 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, and has remained at or above 30 bulls:100 cows since. 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 were observed in 2011 and 7 yearling bulls:100 cows in 2012 (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 1,163 bulls were observed annually 2011–2012 in continuous count areas. An average of 25% of bulls were classified as yearlings (spike, fork, or paddle bulls), while the 30- to 39-inch class accounted for 34%. Bulls in this size class are typically 2–4 years of age. Bulls in the 40- to 49-inch class accounted for 24%, and are typically 3–5 years of age. The >50-inch class accounted for the remaining 17%.

Of the bulls observed, very few had 4 or more brow tines (6%). In the 30- to 39-inch class, less than 1% had 4 or more brow tines. The majority had 2 brow tines. Within the 40- to 49-inch class, an average of 5% had 4 or more brow tines. Of this class, 58% had 2 brow tines, and 35% had 3 brow tines. Of the bulls with antlers >50 inches, 28%, 45%, and 27% had 2, 3, and 4 brow tines respectively. Of all the bulls observed, an average of 25% had 3 or more brow tines.

An average of 40% of the bulls observed during surveys 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 age classes protected during hunting season.

For purposes of estimating 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 19 calves:100 cows. During this reporting period the calf ratio also averaged 19 calves:100 cows.

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 have the lowest densities unitwide. Historically, moose numbers in Subunits 13B, 13C, and western 13A have fluctuated more than the lower density areas of Subunits 13D and eastern 13A.

Fall rutting and post-rutting 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. 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

Harvest

Seasons and Bag Limits. 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.

In RY09, 5 remote drawing hunt areas were offered (DM330–DM334) 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–DM339), with a bag limit of 1 bull with 4 or more brow tines on one side, or a spread of 50 inches or more. In RY12 a resident antlerless moose hunt (DM325) was offered in Subunit 13A, with a bag limit of 1 antlerless moose. Ten DM325 permits were issued.

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 spike-fork 50-inch bulls could also be taken, not to exceed the total number of hunt participants).

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.

Alaska Board of Game Actions and Emergency Orders. 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 spike-fork 50-inch bulls could also be taken).

Total Harvest. The total Unit 13 reported bull harvest has increased from a low of 468 in 2001. Over this reporting period harvests were 953 in RY11 to 704 in RY12 (Table 3).

General Hunt. The Unit 13 general hunt has had increasing participation since RY02, when the moose population started to rebound. During this reporting period there was an average of 4,031 general season hunters. The 4,254 general season hunters in Unit 13 during RY12 was the highest reported since RY99 (Table 4).

During this reporting period the general season moose harvest averaged 614 (Table 4). Somewhat less than the 756 moose harvested in RY10.

Permit Hunts. Five any bull resident drawing hunts (DM330–334) were offered, with a total of 225 permits issued for RY11. Permit numbers decreased to 104 for RY12. Permit success was relatively high despite the remote location of the hunt areas. In RY11, a total of 118 permittees reported hunting (53%), taking 49 bulls (42% hunt success). In RY12, 104 permittees reported hunting (53%), taking 33 bulls (60% hunt success).

In RY12 a resident drawing antlerless hunt (DM325) was held, the first antlerless hunt in Unit 13 since RY94. A total of 10 permits were issued, and 10 permittees reported hunting (100%). The harvest was 4 cows (40% hunt success).

During this reporting period 5 nonresident drawing hunts (DM335–339) were offered. A total of 65 nonresident permits were issued for RY11, resulting in a harvest of 16 bulls. Permit numbers were increased to 105 for RY12, in which a total of 9 bulls were harvested.

A total of 753 hunters participated in the CSH moose hunt in RY11. Of those, 310 reported hunting (some utilized designated hunters). A total of 86 bulls were taken, with 64 qualifying as "any bulls" (Table 5). Of the 961 participating CSH hunters in RY12, 357 reported hunting. Of the 98 bulls harvested, 76 were classified as "any bulls."

<u>Illegal Harvests</u>. Unreported, accidental, and illegal harvest estimates are presented in Table 3.

<u>Hunter Residency and Effort</u>. Local residents (residents of Unit 13) harvested 7% of the moose under the general season this reporting period (Table 4). The success rate for general season moose hunters has been stable over time, averaging 17% from RY94 through RY10. Success decreased to 15% during this reporting period as a result of the below average success rate in RY12 (12%). Successful hunters spent an average of 7.2 days in the field during this reporting period, an increase from the 6.8 days during the previous reporting period. Unsuccessful hunter effort also increased to 8.4 days per hunter compared to 7.4 days in the previous period.

Resident any-bull drawing hunters on average spent 6.3 days in the field per successful hunter for the 5 hunts during this reporting period, and unsuccessful drawing hunters 5.6 days in the field. Successful resident community hunters spent an average of 4.6 days in the field during this reporting period, while unsuccessful hunters spent an average 8.0 days in the field. Nonresident drawing hunters on average spent 5.7 days to take a bull, while unsuccessful nonresidents spent 7.9 days in the field.

<u>Harvest Chronology</u>. Chronology data for the general hunt are presented in Table 6. Moose become increasingly vulnerable throughout September, and harvest typically increases as the season progresses. Leaf fall starts occurring, bull movements increase, and onset of the rut increases the effectiveness of calling.

For the resident any-bull drawing hunts, the majority of the harvest (72%) occurred during the first 14 days of the season. The nonresident drawing hunters harvested bulls throughout the season.

Because the CSH hunt began 10 August during this reporting period, 22 days prior to the other moose hunts in the unit, the harvest chronology is somewhat different. Most (56%) of the harvest occurred before 1 September.

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 took 70% 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 airplane in the DM332 hunt (eastern Alphabet Hills). Nonresident drawing hunters primarily used 4-wheelers, off-road vehicles, and highway vehicles. 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) had shown increased 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 to reduce the population and increase calf survival unitwide. However, even though bear harvests have doubled under the more liberal regulations, calf recruitment has not increased.

Wolf numbers in Unit 13 peaked in fall 1999 and 2000, with unitwide estimates exceeding 500 wolves (>12 wolves/1,000 km^2). Snow depths during winters 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 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 293 wolves and spring estimates averaged 191 wolves. This was an increase over the average of 254 and 166 during the previous reporting period.

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 (Coady 1974). 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. During RY11 the winter severity index for Unit 13 was classified as severe, with a unitwide average of 34.1 inches of snow. In RY12 the unitwide snow depth average was 27.6 inches, and the winter was classified as moderate.

HABITAT

Assessment

Unit 13 has several 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, 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 2002). There are indications that browse quality in Subunit 13A may not be as good as in other portions of the state. Bill Collins (Wildlife Physiologist, ADF&G, Palmer, personal communication) has found higher levels of tannins and lower nitrogen in Subunit 13A browse than in nearby study areas in Denali National Park.

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 landownership 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 Bureau of Land Management and Alaska Department of Natural Resources 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 around Kelly Lake on the south slopes of the Alphabet Hills in Subunit 13B. 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, 109 in 2011, and 136 in 2012.

Habitat improvement by mechanical methods, such as crushing, is an alternative to burning. To be effective, mechanical treatment have focused 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.

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 significantly 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.

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. 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 should 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 trend count areas 3, 5, 6, 10, 13, 14, 15, and 16, Alaska, calendar years 2008–2012.

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)
2008[a]	35	12	19	13	3,918	4,481	54	1.3 (0.5–2.0)
2009	34	9	23	15	4,326	5,061	50	1.4 (0.5–2.0)
2010[a]	30	10	21	14	4,558	5,313	53	1.5 (0.6–2.2)
2011	33	10	23	15	4,777	5,604	53	1.6 (0.5–2.2)
2012	32	7	16	11	4,821	5,404	50	1.5 (0.5–2.2)

[a] Trend count area 15 was not flown, data were estimated.

Table 2. Unit 13 fall composition estimates by subunit for moose in trend count areas 3, 5, 6, 10, 13, 14, 15, and 16, Alaska, calendar year 2012.

Subunit	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Calves %	Total moose observed	Moose/hour	Density moose /mi^2
13A	26	7	15	11	1,580	58	1.6
13B	34	7	18	12	2,685	49	1.8
13C	30	6	12	9	506	50	1.7
13D	67	2	14	8	174	26	0.5
13E	31	9	24	10	1,525	42	1.2

Table 3. Unit 13 moose harvest[a] and accidental death, Alaska, regulatory years[b] 2008–2012.

Regulatory	Reported				Estimated			Accidental			Grand
year	M	F	Unk	Total[c]	Unreported	Illegal	Total	Road	Train[d]	Total	total
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	1,101
2011	953	1	0	954	25	25	50	36	32	68	1,072
2012	704	5	2	711	25	25	50	27	27	54	815

[a] Includes permit hunt harvest, harvest tickets, and federal subsistence hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[c] Includes unknown sex.
[d] Subunit 13E – the Alaska Railroad.

Table 4. Unit 13 moose hunter residency and success for general harvest ticket hunt only, Alaska, regulatory years[a] 2008–2012.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total[c]	Local[b] resident	Nonlocal resident	Nonresident	Total[c]	Total hunters
2008	51	560	1	616	363	2,592	3	2,970	3,586
2009	38	584	0	627	277	2,383	11	2,690	3,317
2010	67	677	0	756	428	2,858	16	3,332	4,088
2011	49	669	4	724	249	2,808	9	3,084	3,808
2012	39	465	0	505	282	3,442	17	3,749	4,254

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] Residents of Unit 13
[c] Includes unspecified residency.

Table 5. Unit 13 moose harvest data for state permit hunts, Alaska, regulatory years[a] 2008–2012.

Hunt number	Regulatory year	Permits[b] issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Harvest
Tier II TM300	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	2011	225	47	59	42	49	0	0	49
	2012	104	47	40	60	33	0	0	33
Resident Antlerless DM325	2012	10	0	60	40	0	4	0	4
Nonresident	2009	50	34	64	36	12	0	0	12
Antler restricted	2010	115	43	78	22	13	0	0	13
DM335–339	2011	65	46	54	46	16	0	0	16
	2012	105	44	84	16	9	0	0	9
Community	2009	377	23	66	34	100	0	0	100
Subsistence	2010	No hunt							
Harvest Hunt	2011	753	58	72	28	86	0	0	86
CM300	2012	961	62	73	27	98	0	0	98

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] 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, Alaska, regulatory years[a] 2008–2012.

Regulatory year	Season dates	Week of harvest[b] 1st	2nd	3rd	4th
2008	1–20 Sep	9	25	36	30
2009	1–20 Sep	8	31	34	27
2010[c]	1–20 Sep	3	22	32	24
2011	1–20 Sep	7	32	35	27
2012	1–20 Sep	8	33	39	21

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] For the conventional moose season, weeks end 1 September, 8 September, 15 September, and 22 September.
[c] An additional 20% (146 moose) were harvested during an early August hunt period 15 August–25 August.

Table 7. Unit 13 successful moose hunter transport methods (%) for general state harvest ticket hunt only, Alaska, regulatory years[a] 2008–2012.

	Transport method (%)							
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV[b]	Highway vehicle	Airboat
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
2011	7	1	5	59	0	17	10	1
2012	5	1	4	55	0	22	12	1

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2008 = 1 July 2008–30 June 2009.
[b] ORV = off-road vehicles.

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CHAPTER 13: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Matanuska Valley

BACKGROUND

The moose population and the human population in Game Management Unit 14A has grown significantly since the area was settled by relocated farmers of the 1930s. Moose were described as scarce during the 1930s. The moose population likely 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. 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 contributed to an increase in moose browse. As the area continues to grow, much of the early seral moose habitat has been replaced with homes, roads, and associated industry (Peltier 2012).

Between statehood (1959) and 1971, harvests ranged from 20 to 1,300 (Griese 2000). The harvest was predominantly bulls, 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., RY62 = 1 July 1962–30 June 1963). Following several severe winters, antlerless moose seasons were discontinued from RY72 to RY77 and the mean annual harvest of bulls declined, ranging between 167 and 346. Antlerless seasons began again in RY78. 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” (Schwartz et al. 1992). Between RY93 and RY10, the average general season harvest averaged 363 (range 226–498).

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 human-caused fire occurred in the Big Lake area termed the Miller’s Reach Fire (Griese and Masteller 1998).

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

Even though the habitat enhancement from this fire substantially enhanced moose forage and habitat in Unit 14A, politically it restricted future prescribed burn opportunities. Since 2001, the Ruffed Grouse Society, and the State of Alaska's Division of Forestry and Department of Fish and Game (ADF&G) have been cooperating on mechanical habitat enhancement efforts in the Matanuska Valley Moose Range to benefit both moose and ruffed grouse. In addition, ADF&G staff in Palmer have been cooperating regularly with Division of Forestry staff on proposed timber sales in an effort to enhance moose habitat in lieu of prescribed fires (Kavalok 2008).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

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

METHODS

Moose populations were surveyed 14–19 November 2011 using the geospatial population estimator (GSPE) technique (Kellie and DeLong 2006). Winter 2011 was exceptionally snowy, and we recorded an increase in the number of moose-vehicle collisions, moose-rail collisions, nuisance moose reports, and moose mortality reports during that winter and spring. Concern for a possible population decline led us to attempt to repeat the GSPE survey the following year, however conditions in fall 2012 precluded a full GSPE survey. We completed a sex and age composition survey on 26–27 November 2012. Previous sex and age composition surveys were completed by having pilot-observer teams fly to areas of known winter moose concentrations until a minimum of 1,000 moose were counted. In order to reduce the potential for bias that could occur by concentrating our efforts in the post-rut wintering aggregation areas, we subdivided the unit into equal parts and sent pilot-observer teams to each area. This approach is believed to result in estimates that more accurately reflect the composition of Unit 14A.

Harvest was monitored with general harvest and draw 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. After several years of difficulty getting accurate information from MATCOM dispatch regarding road kills, moose killed illegally, or in defense of life or property, the Alaska Department of Public Safety once again provided those numbers during this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In 2011 the population was estimated at 7,993 ± 1,167 (80% CI; Table 1). The results of this survey indicate that the population has increased from the 2008 survey of 6,613 ± 727 (Peltier 2010). Both surveys included a sightability correction factor calculated from additional intensive surveys of a randomly selected subsample of the survey units.

Population Composition

The results of the 2011 GSPE survey showed a bull:100 cow ratio of 17.4 and a calf:100 cow ratio of 43.5 (Table 1). The bull:cow ratios for 2011 showed a decrease from the previous estimates of 23 bulls:100 cows for the 2008 GSPE survey and 24.7 for the 2009 composition survey. The results of the 2012 sex and age composition survey was a bull:100 cow ratio of 26–29 and a calf:100 cow ratio of 27.8–30.8. The range of values is the result of the methodology used and subsequently may not be directly comparable to previous information.

MORTALITY

Harvest

Seasons and Bag Limits. 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.

The department issued 400 drawing permits for antlerless moose for the 25 August–25 September period in 2011 (Table 2). Concern about excessive winter kill during winter 2011 led to the cancellation of the antlerless draw hunts for RY12.

Alaska Board of Game Actions and Emergency Orders. During the spring 2011 meeting, the Board of Game added a winter antlerless draw hunt to the other draw hunts available from 1 January to 25 February. The area selected for the hunt was the central portion of the unit. The board also added a new type of hunt that was designed specifically to address nuisance moose issues and areas where moose-vehicle collisions are likely to occur. This hunt, initially labelled RM and now AM415, provided up to 200 permits. Under the permit conditions, hunters were required to possess a valid hunter education card, and had to register during October. Those that signed-up were randomly drawn as either nuisance moose were identified, or were assigned to a predetermined area along road corridors where a high number of moose-vehicle collisions were known to occur. During the spring 2012 meeting the board shifted the dates for the winter antlerless draw hunt from 1 November to 25 December to address concerns about the possibility of taking bulls in the midwinter hunt, and increased the total number of permits available to 1,000 permits.

Harvest by Hunters. Harvest by hunters was highest for the past 10 years in RY11 (788) followed by one of the lowest years in RY12 (457; Table 3). Some of the reduction in harvest was due to the cancellation of the draw permits. Nevertheless it was still within the harvest objectives. The number of moose taken during the archery-only season of 10–17 August has increased in the past few years.

Permit Hunts. In order to help keep the population in Unit 14A in check, the department is authorized to issue up to 400 antlerless drawing permits in several hunt areas. In RY11 all available permits were issued; however, due to the hard winter of 2011, no permits were issued for RY12. Hunters took 235 moose from the draw hunt in RY11 (Table 2).

Beginning in RY11, a new type of permit hunt was established (AM415) where up to 200 permits may be issued. In RY11, 50 permits were issued and 42 moose taken, in RY12, 189 permits were issued and 143 moose were taken (Table 2).

Hunter Residency and Success. Fewer people hunted bulls during the general season this reporting period than the previous reporting (2,729 vs. 3,213 during RY09–RY10; Table 4). Local residents of Unit 14 consistently make up the majority of the hunter composition, harvesting 96–98% percent of all moose taken in Unit 14A. Hunter success increased slightly to 15% compared to the average of 13.4% during the previous 5 years; however this increase is due to the good hunting in RY11. Hunter participation and success rates were down throughout Southcentral Alaska in RY12. 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 Unit 14A may lead a lot of hunters into the field at the start of the season. Further analysis of the harvest data showed a trend toward the percentage of bulls greater than the spike-fork component decreasing during the hunting season, while the percentage of the spike-fork component increases as the season progresses. This may be the result of the decrease in availability of the larger age classes of bulls, a decrease in the selectivity of hunters as the season progresses, or a combination of the 2 factors.

Transport Methods. All-terrain vehicles, such as 4-wheelers, and highway vehicles combined have accounted for a majority of the transportation types used by successful hunters for well over the past 10 seasons (Table 6). Access throughout Unit 14A is good relative to the surrounding units and continues to improve each year.

Accidental and Illegal Mortality

The snowy winter of 2011 led to a very high mortality of moose from both vehicle and railroad collisions (Table 3). Improved reporting of vehicle collisions by the Department of Public Safety has greatly increased our confidence in the accuracy of the numbers reported.

Other Mortality

Winter of RY11 had an exceptional amount of snow which began early in the season and persisted well into April. The impact of the winter on the moose population was noted through the increase in the amount of road and rail kill, the number of nuisance or weakened moose reports received in the Palmer office, and the anecdotal reports of dead or emaciated moose which began to increase in late December. As a result, the department cancelled the antlerless permits for RY12, and the Alaska Moose Federation developed plans for a supplemental feeding program. However, subsequent twinning and GSPE surveys conducted in spring 2012 and fall 2013, respectively, indicated that the impact of winter RY11 was not as severe as originally feared.

HABITAT

Enhancement

Since 2001, ADF&G in cooperation with the Ruffed Grouse Society, and occasionally Rocky Mountain Elk Foundation and the Division of Forestry, contracted aspen cutting in the Matanuska Valley Moose Range to produce early successional growth to benefit grouse, moose, and other species. During RY11, 32 acres of aspen were treated and another 38 acres were treated in RY12. Since the start of the project, 559 acres have been treated. However, large mature contiguous stands of aspen are becoming scarce in the Matanuska Valley Moose Range and other projects for habitat enhancement should be explored.

CONCLUSIONS AND RECOMMENDATIONS

The fact that the moose population has continued to increase beyond the population objective in spite of increased harvest is concerning. Harvest objectives have been consistently met or exceeded since 2001. While the harvest of antlerless moose has helped keep the population in check, harvests will need to continue and the population should be closely monitored to ensure that it has not been overharvested or grown to the point that nutritional limitations could start to have an effect.

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 area, the 1996 Big Lake burn and other areas, will reveal the proportion of moose that are migratory and where these individuals spend the non-winter months. The Point MacKenzie winter population exceeds 10 moose/mi^2. These areas are critical to moose in the unit and may be used by moose summering within adjacent units. Movement and previous habitat studies may help us understand how many moose the unit can hold from a biological and a social perspective. As the Matanuska Valley continues to grow, human development will result in increased conflicts with a growing moose population. Movement data may also help demarcate travel corridors and ameliorate conflicts arising from future road expansion.

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Wildlife Biologist III

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Table 1. Unit 14A, fall aerial moose composition surveys and censuses, Alaska, regulatory years[a] 2003–2012.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Adults observed	Moose observed	Moose observed /mi^2	Estimated population size[b]
2003[c]	21	9	29	19	1,498	1,869	4.1	6,564 ± 748
2004[d]								
2005[d]								
2006[d]								
2007[e]	33		32	19	540	665		
2008[f]	23	8	42	25	1,498	2,158	4.1	6,613 ± 727
2009[f]	25		49	28	546	761		
2010[d]								
2011	17	6.5	44	27	1,384	1,863	3.5	7,993 ± 1167
2012	26–29		28–31		1,190	1,474		

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] At an 80% confidence interval.
[c] Ver Hoef spatial estimator survey method (Ver Hoef 2001).
[d] No surveys completed.
[e] Composition count of known wintering areas.
[f] Geospatial population estimator.

Table 2. Moose harvest data by permit hunts in Unit 14A, Alaska, regulatory years[a] 2006–2012.

Hunt/Unit /Location	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
DM400, Unit 14A, Susitna River, Redshirt Lake										
	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
	2011	1,211	25	8	30	70	0	11	0	11
	2012	967	0							
DM401, Unit 14A, Susitna River, Figure Eight Lake										
	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
	2011	429	10	30	29	71	0	4	0	4
	2012	332	0							
DM402, Unit 14A, Point Mackenzie										
	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
	2011	2,727	50	8	24	76	2	31	0	33
	2012	2,336	0							
DM403, Unit 14A, Big Lake										
	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

Hunt/Unit /Location	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
	2009	1,846	30	7	14	86	1	23	0	24
	2010	2,199	30	9	26	74	0	20	0	20
	2011	2,144	40	15	18	82	1	27	0	28
	2012	2,224	0							
DM406, Unit 14A, Bald Mountain Ridge										
	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
	2011	2,215	50	20	35	65	2	24	0	26
	2012	1,906	0							
DM407, Unit 14A, Matanuska River, North										
	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
	2011	3,468	85	12	33	67	1	56	0	57
	2012	2,983	0							
DM408, Unit 14A, Matanuska River, South										
	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	56	4	0	20	1	21
	2011	1,466	75	15	44	56	2	34	0	36
	2012	1,246	0							

Hunt/Unit /Location	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Total
DM410, Unit 14A, Knik River										
	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
	2011	2,438	50	12	27	73	1	31	0	32
	2012	1,924	0							
DM412, Unit 14A, Point MacKenzie[b]										
	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
	2011	428	15	13	38	62	1	7	0	8
	2012	394	0							
RM/AM415, Unit 14A, Targeted Hunt[c]										
	2011	432	50	4	9	91	10	32	0	42
	2012	205	189	6	25	75	22	121	0	143

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2006 = 1 July 2006–30 June 2007.
[b] DM412 added in 2007, boundaries are the same as DM402.
[c] RM415 renamed AM415 in regulatory year 2012.

Table 3. Unit 14A, moose harvest[a] and accidental death, Alaska, regulatory years[b] 2003–2012.

Regulatory	Harvest										Grand
	Reported				Estimated			Accidental deaths[c]			
year	M	F	Unk	Total[d]	Unreported[e]	Illegal[f]	Total	Road	Train	Total	total
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[g]	14	214	842
2006	397	131	3	531	28	60	88	200[g]	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	1,055
2010	504	209	0	713	35	60	95	229[h]	41	270	1,078
2011	525	261	2	788	37	60	97	300[i]	71	371	1,256
2012	339	122	1	462	24	60	84	179[i]	21	200	746

[a] Includes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] Road and train kills are minimum numbers.
[d] Includes moose of unknown sex.
[e] Derived by taking 7% of the reported harvest of bulls.
[f] Includes moose taken in defense of life or property, enforcement cases, and an estimate of out of season take.
[g] Road kill estimates for 2005–2006 and 2006–2007 are minimum estimates based on reported numbers which were known to be incomplete.
[h] Roadkill estimate is based on the number of heads turned in to the Palmer office.
[i] Roadkill estimate is based on location data provided from Department of Public Safety.

Table 4. Unit 14A, moose hunter residency and success[a], Alaska, regulatory years[b] 2003–2012.

	Successful					Unsuccessful					
Regulatory year	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
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)	2,535	60	64	16	2,675 (84)	3,180
2011	469	25	21	3	518 (18)	2,298	71	46	8	2,423 (82)	2,941
2012	288	15	9	2	314 (12)	2,098	60	42	3	2,203 (88)	2,517

[a] Does not include drawing permit hunters.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] Unit 14 residents.

Table 5. Unit 14A moose harvest chronology[a], Alaska, regulatory years[b] 2003–2012.

Regulatory	August			September						
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	Unk	Total
2003[c]	13	87	34	57	41	67	54	50	12	415
2004[c]	11	73	17	48	36	62	45	53	15	360
2005[c]	9	70	21	43	50	62	57	57	13	382
2006[c]	10	65	22	47	34	74	50	78	15	395
2007[d]	13	65	22	26	51	83			6	266
2008[d]	19	108	38	43	71	100			14	393
2009[e]	32	64	68	62	71	94	72		14	477
2010[e]	33	68	73	73	68	76	98		16	505
2011[e]	41	82	71	64	65	92	91		12	518
2012[e]	23	48	35	56	45	48	52		7	314

[a] Does not include drawing permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] Open season = 10–17 August (archery only), 20 August–30 September (General, spike fork 50).
[d] Open season = 10–17 August (archery only), 20 August–20 September (General, spike fork 50).
[e] Open season = 10–17 August (archery only), 25 August–25 September (General, spike fork 50).

Table 6. Unit 14A, transport methods (%) of successful moose hunters[a], Alaska, regulatory years[b] 2003–2012.

Regulatory year	Transport methods (%)									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Airboat	*n*
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	7	45	0	7	30	4	1	505
2011	4	3	8	41	0	5	34	5	0	518
2012	4	3	11	38	0	4	32	7	1	314

[a] Does not include drawing permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.

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CHAPTER 14: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Western Talkeetna Mountains

BACKGROUND

The first survey of moose in Unit 14B was conducted in fall 1987 with estimated moose numbers at 2,814 ± 248 (Masteller 1994). Deep snow winters in 1989–1990 and 1994–1995 likely contributed to declining populations reflected in the 1999 survey estimate of 1,687 ± 244 (Masteller 1994, 1998). Surveys completed in 2005 showed a further decline to 1,413 ± 215 (Table 1; Peltier 2006). Surveys in 2009 showed an improving trend (1,662 ± 220; Table 1; Peltier 2012) although a deep snow winter in 2011 may have slowed the trend.

Moose harvest has decreased over the last 30 years in Unit 14B. Harvest averaged 259 moose during the 1980s, and liberal cow seasons allowed peak harvests to reach 534 in regulatory year (RY) 1984 (regulatory year begins 1 July and ends 30 June, e.g., RY84 = 1 July 1984 through 30 June 1985) (Griese 1993). With the decline in moose population, the annual harvest during the 1990s fell to 58 moose and has remained, on average, at that level. 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" (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.

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

METHODS

Alaska Department of Fish and Game staff compiled population estimates and sex and age composition data from a geospatial population estimation (GSPE) survey conducted in fall 2009 (Kellie and DeLong 2006, Ver Hoef 2001).

Department staff monitored harvest using harvest reports from Unit 14B hunters. All harvest data were reviewed for accuracy and updated as necessary; therefore, 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, by highway vehicles, or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The moose population was not surveyed during this reporting period. The last survey was conducted in November 2009 using the GSPE technique (Kellie and DeLong 2006). The population is believed to be 1,662 ± 220 (80% CI).

Population Composition

The ratio of bulls:100 cows for the 2009 GSPE survey was 34 and the ratio of calves:100 cows was 18.

Trends in the population and calf:cow ratios indicate an increasing population. Surveys completed after the reporting period also indicate that the population has recovered from the low levels of the 1990s and early 2000s.

MORTALITY

Harvest

<u>Seasons and Bag Limits</u>. The fall general open season was 10–17 August (for archery-only hunters) and 25 August–25 September for all resident and nonresident hunters. The bag limit was 1 spike-fork 50-inch or 3 brow tines bull.

<u>Alaska Board of Game Actions and Emergency Orders</u>. There were no changes to the moose hunting regulations during this reporting period.

<u>Harvest by Hunters</u>. The average harvest declined during the reporting period (66 vs. 84 for RY09–RY10; Table 2). This decrease is mainly the result of the RY12 hunting season. Overall, total participation was also down (Table 3). Fall 2012 was very wet and cool throughout much of Southcentral Alaska and there was reduced participation in moose hunting in several units.

<u>Hunter Residency and Success</u>. Local residents of Unit 14 consistently make up the majority of the hunter composition (Table 3). In spite of changes to the moose population over the past decade there has been little fluctuation in the number of hunters in the unit or the percentage of successful hunters.

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 (Table 4).

Transport Methods. All-terrain vehicles and highway vehicles account for the majority of the transportation types used by successful hunters in the past 10 seasons (Table 5).

Other Mortality

Moose killed by train collisions numbered 129 and 7 in RY11 and RY12, respectively (Table 2). RY11 was a record snowfall year in the valley and subsequently moose mortality was high throughout the railroad corridor. Moose mortality by vehicle collision during this reporting period was provided by the Department of Public Safety (Table 2). Previous reports estimated the amount of road-killed moose because reporting by dispatch was inconsistent. Nonetheless because the number reported killed on the roads or rail corridors is the number of moose actually observed, it does not account for moose that may have wandered away from an accident and died later. Thus, this number should be considered a minimum estimate of mortality.

HABITAT

Enhancement

Most of the unit has mature stands of forest and very little early stage willow components. Small clear cuts along near the Willow Fishhook Road has resulted in a few stands of deciduous trees being converted to an earlier successional stage; however, larger habitat projects in the area would benefit the moose population by increasing available forage. Browse surveys should be completed to aid in determining biological carrying capacity and to identify potential areas for treatment.

CONCLUSIONS AND RECOMMENDATIONS

The average annual harvest by hunters has increased in recent years (excluding RY12) and may reach the lower end of the objective of 100–200 moose. However, hunters are limited by access in the unit and by the demography. Increased access would allow more hunters into remote portions of the unit.

Annual movements often carry moose across borders of Units 13E, 16A, 14A, and 14B (Modafferi 1999). Therefore, management decisions for Unit 14B should be made with consideration to neighboring units.

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Table 1. Unit 14B fall aerial moose composition surveys, Alaska, regulatory years[a] 1999–2009.

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Percent calves	Adults observed	Moose observed	Observable moose/mi^2	Population estimate (±80% CI[b])
1999[c]	40.2	12.3	21.3	13.2	616	699	1.6	1,687 ± 244
2005[d]	29.8	5.4	15.5	10.7	582	646		1,413 ± 215
2009[d]	34.0	11.7	19.1	12.2	653	744	2.2	1,662 ± 220

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1999 = 1 July 1999–30 June 2000.
[b] Confidence interval.
[c] Data from "Gasaway surveys" conducted in late October-early November. Sightability correction factor estimated at 1.20, 1.33, 1.15 and 1.03 for low, medium, high, and super-high density strata, respectively.
[d] Data from geospatial population estimator surveys.

Table 2. Unit 14B moose harvest and accidental death, Alaska, regulatory years[a] 2003–2012.

Regulatory	Reported				Estimated			Accidental deaths[b]			Grand
year	M	F	Unknown	Total	Unreported[c]	Illegal[d]	Total	Road	Train	Total	total
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[e]	19	39	112
2006	57	0	0	57	6	20	26	20[e]	6	26	109
2007	49	0	0	49	5	20	25	20[e]	19	39	113
2008	57	0	1	58	6	20	26	20[e]	36	56	140
2009	78	0	2	80	8	20	28	20[e]	30	50	158
2010	91	1	0	92	9	20	29	20[e]	39	59	180
2011	83	0	1	84	8	20	28	28	129	157	269
2012	46	0	0	46	5	20	25	16	7	23	94

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Road and train deaths are minimum numbers. Roadkills do not include unsalvageable animals.
[c] Derived by taking 10% of the total reported kill.
[d] Includes moose taken in defense of life or property.
[e] Estimated minimum based on the previous years as data was missing for this period.

Table 3. Unit 14B moose hunter residency and success, Alaska, regulatory years[a] 2003–2012.

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2003	54	1	1	0	56 (12)	372	15	17	1	405 (88)	461
2004	52	1	2	1	56 (13)	355	13	13	6	387 (87)	443
2005	46	1	1	0	48 (11)	345	16	18	3	382 (89)	430
2006	43	6	8	0	57 (13)	343	16	11	4	374 (87)	431
2007	43	4	2	0	49 (12)	340	13	17	0	370 (88)	419
2008	49	2	7	0	58 (13)	370	20	12	0	402 (87)	460
2009	62	8	10	0	80 (14)	466	17	19	8	510 (86)	590
2010	84	2	6	0	92 (17)	422	11	17	1	451 (83)	543
2011	75	1	7	1	84 (16)	412	12	11	1	436 (84)	520
2012	41	2	4	0	47 (11)	370	11	8	1	390 (89)	437

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Unit 14 residents.

Table 4. Unit 14B moose harvest chronology, Alaska, regulatory years[a] 2003–2012.

Regulatory	August			September						
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	Unknown	Total[b]
2003[c]	0	5	2	5	4	12	12	16		56
2004[c]	0	8	1	6	7	12	9	13		56
2005[c]	0	3	6	2	5	8	6	16	2	48
2006[c]	1	7	3	7	9	12	4	13		56
2007[d]	1	4	1	6	9	26				47
2008[d]	0	17	5	2	10	21			3	58
2009[e]	4	5	8	9	14	23	13		4	80
2010[e]	3	4	7	12	23	23	17		3	92
2011[e]	1	6	8	13	16	14	25		1	84
2012[e]	3	5	2	4	13	8	12			47

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Chronology does not include moose taken out of season.
[c] Open season =10–17 August (archery only), 10 August–30 September (general, spike-fork 50).
[d] Open season =10–17 August (archery only), 20 August–20 September (general, spike-fork 50).
[e] Open season = 10–17 August (archery only), 25 August–25 September (general, spike-fork 50).

Table 5. Unit 14B percent transport methods of successful moose hunters, Alaska, regulatory years[a] 2003–2012.

Regulatory year	Transport method (%)									No. moose harvested
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV[b]	Highway vehicle	Unknown	Airboat	
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
2011	4	0	4	59	0	8	20	5	0	84
2012	7	0	6	45	0	21	11	10	0	47

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] ORV = off-road vehicle.

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CHAPTER 15: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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

In Unit 14C the department management objectives for population and harvest are the same as Intensive Management objectives adopted by the Board of Game.

- Maintain a population of 1,500–1,800 moose and an annual harvest of 90–270 moose.

- Maintain a post-hunting sex ratio of no fewer than 25 bulls:100 cows.

- Maintain the moose population at a level to promote public safety by reducing conflicts with Anchorage residents.

METHODS

Every fall, we attempt to conduct both population and composition surveys for moose in most 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 modified Gasaway census 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 are summarized by regulatory year (RY). A regulatory year runs from 1 July through 30 June (e.g., RY11 = 1 July 2011–30 June 2012).

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 1994–1995 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 1,800 moose. Another severe winter in 1998–1999 reduced the population to an estimated 1,650. The population rebounded to an estimated 2,200 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 2003–2004 was one of the worst in recent years for moose mortality. From 2005 to 2008, the population rose to 1,800, but has declined since, and is now at the low end of the population objective.

During this reporting period we attempted to conduct aerial surveys annually in some hunt areas to estimate sex and age composition during fall and early winter. In 2011, surveys were conducted on JBER and in the upper Ship Creek drainage, Peters Creek, Eklutna, Thunderbird, and the Twentymile/Portage/Placer area. Fall surveys were not flown in 2012 because there was inadequate snow cover until late December, after most bulls had shed antlers.

The winter of 2011–2012 was characterized by the deepest snowfall on record. While we were not able to fly surveys in fall 2012, available evidence (e.g., few reported winterkills, average number of highway collisions) 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 are used to estimate the moose population in GMU 14C. A modified Gasaway census was conducted only once (2011) during this reporting period. From that census we estimated 335 moose on JBER and in the upper Ship Creek valley. In addition, composition counts were conducted in 2011 in the Twentymile, Portage, and Placer River valleys, as well as in Peters Creek, Eklutna, and Thunderbird valleys (Table 1). During those composition counts, 178 moose were counted in the Twentymile/Portage/Placer area, 48 moose were counted in Peters Creek, and 80 moose were counted in Eklutna and Thunderbird valleys. We estimated a fall 2011 population of 1,540 moose in Unit 14C.

Population Composition

In the composition survey conducted in the Twentymile area in 2010, the bull:cow ratio was estimated to be 30 bulls:100 cows and the calf:cow ratio was 68 calves:100 cows. In 2011 the bull:cow ratio was estimated to be 21 bulls:100 cows and the calf:cow ratio was 29 calves:100 cows. Fluctuations such as these are seen regularly in the Twentymile area, which is known for population crashes following severe winters. In 2011, the total bull:cow ratio for GMU 14C was estimated to be 32 bulls:100 cows (Table 1), which was nearly the same as the last reporting period (31:100 in 2010). The overall calf:cow ratio decreased since the last reporting period (37:100 in 2010 vs. 20:100 in 2011). In both 2010 and 2011, the unit had 9 yearling bulls per 100 cows.

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). Recently, a project intended to delineate movement corridors used by moose on JBER was conducted by ADF&G and JBER Natural Resources staff. Once data analysis is finished, this research may provide more evidence for the need for habitat linkages and 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.

Drawing permit hunts on JBER included DM421–430, and were open to resident and nonresident hunters. Hunts DM421–427 are located on JBER-Richardson, 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 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 101 archery permits and 27 muzzleloader permits in 2011 and 92 archery permits and 27 muzzleloader permits in 2012 in this portion of the JBER management area (Table 4).

Moose harvest on JBER-Elmendorf 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. We issued a total of 13 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 front and rear sights and slugs, by drawing permit only, from 1–30 November (DM666). Ten drawing permits total were issued for 2 separate hunt areas (6 for upper Campbell Creek and 4 for McHugh Creek) during both RY11 and RY12 (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 (DM448). 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, 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 (RM445).

The open season for the Twentymile River area was 20 August—30 September by drawing permit for bull moose (DM210) and 20 August—10 October by drawing permit for antlerless moose (DM211). The bag limit was 1 moose by drawing permit with 40 bull permits and 30 antlerless permits issued in RY11. Due to record snowfalls in the winter of 2011–2012, permit numbers were reduced to 25 bull permits and 20 antlerless permits for RY12.

Moose harvest in the Ship Creek area is managed with drawing (DM446 and DM447) and registration permit (RM435) hunts. Drawing hunts occur the day after Labor Day—30 September. Twenty drawing permits were issued in each of RY11 and RY12. In previous years drawing permits have been issued for either sex in this area, but since 2009 the bag limit has been 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.

In 2011, 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 October 20—November 15 (DM444). Two permits were issued for this hunt in 2012.

Board of Game Actions and Emergency Orders. The Board of Game reauthorized all antlerless moose hunts annually during this reporting period.

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

Hunter Harvest. During RY11 and RY12, 137 and 100 moose were harvested, respectively, with a 2-year mean of 89 bulls and 29 cows (Table 2). Approximately 17% of the bulls were taken during the general season harvest.

Permit Hunts. During RY11, we issued 636 permits to hunt moose in Unit 14C. Of those who hunted, 22% were successful (121 hunters). In RY12, 623 permits were issued and 18% of those who hunted were successful (86 hunters) (Table 4).

Drawing permit hunts are very popular. In 2011, 7,444 applications were received for 256 drawing permits (3,191 applications were for the 70 permits for the Placer/Twentymile hunts). In 2012, 6,899 applications were received for 224 drawing permits (3,016 of the applications were for the 45 permits for the Placer/Twentymile hunts). While permit numbers were reduced during the last 2 years due to population size and record snowfall during the winter of 2011–2012, the overall number of drawing permits has increased substantially over the years (e.g., 140 permits were issued in 2003). In addition to those receiving drawing permits, 279 bow hunters in RY11 and 299 bow hunters in RY12 registered for a permit for the Eklutna Lake archery hunt, and 101 and 100 hunters registered for a permit for the Ship Creek registration hunt in RY11 and RY12, 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 63% and 59% of the moose harvested in Unit 14C in RY10 and RY11, respectively (Table 3), which is a slight decrease from RY09 (65%) and RY10 (68%). Nonlocal resident harvest slightly increased since the last reporting period at 34% and 35% of the moose harvest in Unit 14C in RY10 and RY11, respectively, compared to 30% in RY09 and 26% in RY10. Nonresidents accounted for 3% and 6% of the total harvest in Unit 14C in RY10 and RY11, respectively.

Harvest Chronology. In the general-season, spike-fork/50-inch hunts it is difficult to compare annual harvests for the first week in September (Table 5) because season opening dates are variable (i.e., the day after Labor Day). However, other than in 2012, when 43% of the harvest came in the first week, recent years have shown a continued decline in harvest during the first week of the season (Table 5). The day after Labor Day was 5 September in 2011 and 3 September in 2012.

Most moose in Unit 14C are harvested during 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 66% of all successful hunters used a highway vehicle for transportation to their hunting area during this reporting period (Table 6). This is roughly the same as the previous reporting period. 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. Between 70 and 185 (average of 120) moose per year were killed in vehicle collisions during 2004–2012 (Table 2). These are conservative figures because not all collisions are reported and some moose, never found, die from injuries. Important factors which influence collision rates are the moose population level and snow depths.

An additional 10–20 moose have died from unknown causes each year. Most of these deaths occur during winter. Necropsy results revealed that at least 4 (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 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 only found when the snow melted. Causes of these mortalities include starvation, disease, ingesting toxic substances, and accidents such as falling off a cliff or getting a leg caught in the crotch of a tree. Approximately 5–8 moose are reported dead and salvaged for nonconsumptive use 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 has reclaimed some areas denuded of vegetation with small willow plantings, usually in conjunction with fish habitat projects (Jessica Ilse, USFS, personal communication). Limited habitat enhancement projects (primarily conducted with hydro-axe) have also taken place on JBER lands. Winter habitat has decreased and will inevitably continue to 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 2011 surveys estimated the population at 1,540 moose (an increase of less than 3% since 2010), with a bull:cow ratio of greater than 25 bulls:100 cows, indicating that the population is remaining at the lower end of our objective while maintaining desired sex ratios. 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. Almost 20 years ago, the DOT&PF estimated rural moose-vehicle collisions cost an average of $15,150 for vehicle repairs; emergency, medical, and legal services; and lost wages (Alaska Department of Transportation and Public Facilities 1995). Considering inflation, moose-vehicle collisions probably cost Anchorage residents at least $3 million/year, based on the number of moose-vehicle collisions reported between 2004 and 2013. 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. In general, ADF&G recommends the construction of dedicated wildlife crossing structures coupled with fencing to help mitigate negative impacts on moose. Based on research in other areas of North America and Europe (Clevenger and Waltho 2005, Seiler et. al. 2003), we recommend overpass structures for moose be at least 14 feet in height. Area biologists need to be involved early in planning of roads and long fences and must have information on moose distribution and movement corridors. With this in mind, in 2013 ADF&G entered into a Memorandum of Understanding (MOU) with the Alaska Department of Transportation (DOT). This new agreement was designed to promote human safety, efficient transportation, and economical ways to design, construct, and manage Alaska's highways while reducing negative impacts to wildlife populations by bringing wildlife experts into cooperation with transportation engineers in planning efforts.

During this reporting period, wildlife staff participated in planning for a number of transportation infrastructure projects. 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, possibly transferring moose-vehicle collisions to other portions of the road corridor. We recommended against fencing in this area and for additional lighting, clearing, and a reduced speed limit. We will monitor the effects of this and report in future documents.

Currently, DOT&PF is in the planning stage of new road access from the north to the Anchorage University and Medical District (U-Med). ADF&G area staff have participated in scoping meetings and provided comments. There are no data on specific movement corridors used by moose in that area, but we have been able to offer input on typical moose use of habitat in the urban landscape.

Moose are also considered residential pests in Unit 14C by many homeowners. 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, and in some cases, enforcing the regulation prohibiting feeding of 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 during the 2003–2004 school year by Mirror Lake Middle School students in cooperation with Anchorage area biologists, Division of Wildlife Conservation Region II education staff, the University of Alaska Anchorage, and the Anchorage School District. Copies were distributed to all Anchorage elementary schools. The target audience was all third- through fifth-graders in the Anchorage School District; however, second-graders are also watching the video. Pre- and post-tests show a substantial increase in knowledge of how to avoid moose attacks or injuries in the event of an attack. The movie continues to be shown in Anchorage and statewide. It is available on the ADF&G website and if an educator or anyone from the public wants a free copy, they can send in a website request to the Anchorage area education specialist. The DVD is also distributed to teachers who request a bear and moose safety presentation. During the 2011-2012 school year, education staff conducted approximately 240 wildlife safety presentations to 11,000 students in Anchorage. During the 2012–2013 school year, education staff conducted approximately 200 wildlife safety presentations to 9,000 students in Anchorage.

In the fall of 2011, more than 8 miles of single track mountain bike trails were constructed in Kincaid Park, and in the summer/fall of 2013 an additional 6.6 miles of single track trails were constructed in Kincaid. These trails traverse moose calving areas and likely overlap 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 Track 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 have been made to notify the public of this issue, many bikers have continued to use these trails, and additional injuries have been sustained. Since biking has increased dramatically in popularity 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 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 1 had Cryptosporidium when captured. In 2012, no calves from Unit 14C were delivered to AMF. In 2013, 2 calves from Unit 14C were delivered to AMF, and were successfully released near Cordova, but both succumbed to wolf predation in their first winter (T. Kavalok, ADF&G, personal communication). In addition to calves delivered to AMF, 3 calves in 2011, 1 calf in 2012, and 3 calves in 2013 were placed in captive facilities, some in Alaska and some in facilities outside the state.

We recommend maintaining the population at the low end of the current objective due to the high amount of moose–human conflict within Unit 14C, and the fact that maintaining moose numbers at a lower level will most likely result in a healthier population due to the reduction of browsing pressure, resulting in decreased nutritional stress. 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 may be feasible, although currently not permissible under municipal regulations. We recommend continued discussion with the municipality and with concerned user groups regarding limited moose hunting opportunities in city parks at a future date.

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Table 1. Unit 14C fall aerial moose composition counts and estimated population size, regulatory years 2004–2013.

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
	2011	21	6	29	19	178	61	178
	2012	--	--	--	--	--	--	
Hillside	2004 [c]	28	11	40	24	99 [d]	30	120
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	140 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	155 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	129 [e]
	2011	--	--	--	--	--	--	133 [e]
	2012	--	--	--	--	--	--	
Anchorage Bowl	2004	--	--	--	--	--	--	
(except Hillside)	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	250 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	280 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	242 [e]
	2011	--	--	--	--	--	--	248 [e]
	2012	--	--	--	--	--	--	

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
	2011	37	8	14	9	280	22	335
	2012	--	--	--	--	--	--	
Eagle River [g]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	120 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	135 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	122 [e]
	2011	--	--	--	--	--	--	125 [e]
	2012	--	--	--	--	--	--	
Peters Creek [h]	2004	--	--	--	--	--	--	
	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	65 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	73 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	48 [e]
	2011	33	10	27	17	48	16	48
	2012	--	--	--	--	--	--	

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	2004	--	--	--	--	--	--	
Thunderbird Cr.	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	45 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	58	--	37	15	48	12	58
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	78 [e]
	2011	36	16	24	15	80	17	80
	2012	--	--	--	--	--	--	
Bird Creek	2004	--	--	--	--	--	--	
Indian River [i]	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	110 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	124 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	
	2011	--	--	--	--	--	--	103 [e]
	2012	--	--	--	--	--	--	
Hunter Creek [h]	2004	--	--	--	--	--	--	
Knik River	2005	--	--	--	--	--	--	
	2006	--	--	--	--	--	--	150 [e]
	2007 [b]	--	--	--	--	--	--	
	2008	--	--	--	--	--	--	165 [e]
	2009	--	--	--	--	--	--	
	2010	--	--	--	--	--	--	148 [e]
	2011	--	--	--	--	--	--	152 [e]
	2012	--	--	--	--	--	--	

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]
	2011	--	--	--	--	--	--	129 [e]
	2012	--	--	--	--	--	--	
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	24	1500
	2011	32	9	20	15	586	25	1540
	2012	--	--	--	--	--		

[a] Estimates based on sightability correction factors (SCF) of 1.12 (2006), 1.41 (2008), 1.49 (2010), and 1.18 (2011) 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 2004–2013.

	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	185	7	192	295
2005	68 (67)	34 (33)	104	10	10	20	116	9	125	249
2006	80 (71)	33 (29)	113	10	10	20	119	11	130	263
2007	84 (69)	38 (31)	123	10	10	20	111	10	121	264
2008	96 (72)	38 (28)	134	10	10	20	112	7	119	273
2009	102 (69)	46 (31)	149	10	10	20	140	14	154	323
2010	86 (64)	47 (35)	135	10	10	20	119	7	126	281
2011	104 (76)	33 (24)	137	10	10	20	110	15	125	282
2012	74 (75)	25 (25)	100	10	10	20	70	3	73	193

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

Table 3. Unit 14C moose hunter residency and success, regulatory years 2004–2013.

	Successful				Unsuccessful				
Regulatory year	Local resident[a]	Nonlocal resident	Nonresident	Total[b] (%)	Local resident[a]	Nonlocal resident	Nonresident	Total[b] (%)	Total hunters[b]
2004	55	22	3	80 (17)	260	106	13	380 (83)	460
2005	72	23	4	99 (20)	281	108	11	401 (80)	500
2006	79	24	8	113 (21)	303	96	19	423 (79)	536
2007	79	28	7	114 (16)	421	163	16	602 (84)	716
2008	81	36	5	122 (19)	364	156	8	528 (81)	650
2009	82	38	6	127 (18)	384	185	15	590 (82)	717
2010	82	31	7	120 (18)	347	179	19	549 (82)	669
2011	80	44	4	128 (24)	263	131	6	403 (76)	531
2012	51	30	5	86 (16)	292	135	20	449 (84)	535

[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, 2004–2013.

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	16	57	43	89	11	9
	2005	20	5	37	63	100	0	12
	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	9	32	68	60	40	42
	2010	70	4	52	48	50	50	30
	2011	70	13	55	45	70	30	27
	2012	45	13	51	49	63	37	19
DM421,422,423 JBER (muzzleloader)	2004	25	12	73	27	83	17	6
	2005	25	8	48	52	75	25	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
	2011	27	15	48	52	75	25	12
	2012	27	11	74	26	83	17	6
DM424,425,426, 427 JBER (archery)	2004	100	13	67	33	55	45	29
	2005	100	16	60	40	58	42	33
	2006	100	16	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

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	% Bulls	% Cows	Total harvest [a]
	2010	99	20	54	46	39	61	36
	2011	101	17	37	63	66	34	53
	2012	92	16	51	49	64	36	36
DM428,429,430 JBER (archery)	2004	20	5	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
	2011	13	8	64	36	100	0	4
	2012	13	15	62	38	100	0	3
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	67	33	0	100	1
	2011	5	0	80	20	0	100	1
	2012	5	40	67	33	0	100	1
DM442 Ship (antlerless)	2004	40	30	93	7	0	100	2
	2005	0	--	--	--	--	--	--
	2006	0	--	--	--	--	--	--

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	% Bulls	% Cows	Total harvest [a]
	2007	0	--	--	--	--	--	--
	2008	0	--	--	--	--	--	--
	2009	0	--	--	--	--	--	--
	2010	0	--	--	--	--	--	--
	2011	0	--	--	--	--	--	--
	2012	0	--	--	--	--	--	--
DM443 Peters and Little Peters	2004	10	20	100	0	0	0	0
	2005	10	40	67	33	0	100	2
	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	40	100	0	0	0	0
	2010	5	0	80	20	0	100	1
	2011	5	0	80	20	0	100	1
	2012	5	0	80	20	0	100	1
DM444 Edmonds and Mirror Lake Parks	2005	--	--	--	--	--	--	--
	2006	--	--	--	--	--	--	--
	2007	--	--	--	--	--	--	--
	2008	--	--	--	--	--	--	--
	2009	--	--	--	--	--	--	--
	2010	--	--	--	--	--	--	--
	2011	--	--	--	--	--	--	--
	2012	2	0	100	0	0	0	0
DM446, 447 Ship Creek	2005	40	28	66	34	70	30	10
	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	22	62	38	67	33	15
	2010	40	30	68	32	89	11	9

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	% Bulls	% Cows	Total harvest [a]
	2011	20	15	65	35	100	0	6
	2012	20	10	61	39	100	0	7
DM448, 449 Birchwood (archery only)	2004–05	15	20	83	17	100	0	2
	2005–06	15	15	100	0	0	0	0
	2006–07	15	53	100	0	0	0	0
	2007–08	15	47	88	13	100	0	1
	2008–09	5	60	100	0	0	0	0
	2009–10	5	60	0	100	100	0	2
	2010–11	5	40	67	33	100	0	1
	2011–12	5	60	0	100	0	0	0
	2012–13	5	40	100	0	0	0	0
DM666 Anchorage (muzzleloader, shotgun only)	2005–06	4	0	0	100	0	100	4
	2006–07	4	0	25	75	0	100	3
	2007–08	8	0	37	63	0	100	5
	2008–09	8	25	17	83	0	100	5
	2009–10	10	30	29	71	0	100	5
	2010–11	10	20	25	75	17	83	6
	2011–12	10	40	67	33	0	100	2
	2012–13	10	50	60	40	0	100	2
RM435 [c] Ship	2007-08	355	55	89	11	94	6	18
	2008-09	139	30	89	11	100	0	11
	2009–10	102	25	90	10	100	0	7
	2010–11	100	28	91	9	100	0	6
	2011–12	101	42	83	17	100	0	10
	2012–13	100	27	89	11	100	0	8

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	% Bulls	% Cows	Total harvest [a]
RM445 [c] Eklutna (archery only)	2004–05	218	58	96	4	100	0	4
	2005–06	257	32	98	2	100	0	3
	2006–07	249	31	99	1	100	0	2
	2007–08	298	37	100	0	0	0	0
	2008–09	325	36	99	1	100	0	2
	2009–10	363	34	99	1	100	0	2
	2010–11	346	33	99	1	100	0	3
	2011–12	279	50	96	4	100	0	5
	2012–13	299	42	99	1	100	0	2
Totals for all permit hunts[d]	2004–05	463	16	79	21	66	34	62
	2005–06	506	26	76	24	64	36	92
	2006–07	508	24	77	23	62	38	87
	2007–08	906	39	81	19	64	36	107
	2008–09	707	29	79	21	66	34	107
	2009–10	748	27	77	23	63	37	125
	2010–11	725	28	79	21	56	44	111
	2011–12	636	35	78	22	73	27	121
	2012–13	623	30	82	18	70	29	86

[a]Includes permittees who did not report; [b]Includes moose with unspecified sex; [c]Registration hunt; [d]Includes all DM210 hunt area.

Table 5. Unit 14C moose harvest [a] chronology, regulatory years 2004–2013.

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*
2004–05 [b]	0	21	26	26	26	0	19
2005–06 [c]	0	10	20	10	50	10	10
2006–07 [d]	4	20	24	28	20	4	25
2007–08 [e]	0	13	27	27	27	0	15
2008–09 [f]	0	13	17	21	50	0	24
2009–10 [g]	0	10	5	35	45	5	20
2010–11 [h]	0	0	33	21	42	4	24
2011–12 [i]	0	13	13	20	33	20	15
2012–13 [j]	0	43	14	7	36	0	14

[a] Does not include permit hunt harvests.
[b] Season 9/7–9/30
[c] Season 9/6–9/30
[d] Season 9/5–9/30
[e] Season 9/4–9/30
[f] Season 9/2–9/30
[g] Season 9/8–9/30
[h] Season 9/7–9/30
[i] Season 9/6–9/30
[j] Season 9/4–9/30

Table 6. Unit 14C moose harvest[a] percent by transport method, regulatory years 2004–2013

Regulatory year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown/ Other	*n*
2004	3	4	8	6	0	0	79	1	80
2005	2	3	9	1	0	1	77	6	99
2006	4	6	8	4	0	2	66	11	113
2007	4	10	7	4	0	0	73	1	114
2008	4	7	7	3	0	0	74	4	122
2009	3	5	17	2	0	1	64	7	127
2010	1	9	11	4	0	0	67	7	120
2011	4	8	14	2	0	0	66	6	128
2012	0	8	7	2	0	1	67	13	86

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

SPECIES

MANAGEMENT REPORT

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

CHAPTER 16: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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. Recent population peaks occurred in 1971, 1982, and 1991; the 1971 peak was the highest. 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. Unit 15A represents 75% of these estimates, and saw a decline from 5,900 to 2,500 moose. By 1982, following a 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 has continually declined since 1991.

From 1947 to 1969, wildfires that occurred in Unit 15A encompassed an area with a perimeter of about 388,000 acres. From 1970 to 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 the moose population size ensued.

The department works with a variety of agencies and landholders. 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 and cooperative management of Skilak Loop as a wildlife viewing area. There is a need to focus on addressing habitat concerns now that most of the habitat in Unit 15A is past the early successional stage.

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 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 (Schwartz et. al., 1992). A 10-year evaluation was conducted in 1999 (Hundertmark et al. 1999). In 2011, the Peninsula harvest strategy was restricted to harvesting 50-inch or 4 brow tines moose due to declines in bull:cow ratios in 15C.

Unit 15B. The moose population in Unit 15B is believed to have been relatively stable from 1990 through 2001, with an estimated population of around 1,000, which has since declined. Composition counts in 15B West suggest a decline from 1994 to 2009. Because these were not censuses, it is difficult to determine the extent of the decline, but the total moose counted in 2009 were less than one half of the 1994 count for similar survey areas. 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 n.d.). Since 2001, infestation rates have decreased as the number of unaffected trees becomes scarce (U.S. Forest Service and Alaska Department of Natural Resources 2002). Salvage logging efforts are limited because most of the area in 15B is within the Kenai National Wildlife Refuge which limits many motorized and mechanical activities.

Hunting within 15B is by drawing permit only in 15B East, which is designated as a “trophy” area, and by general harvest ticket in 15B West. During this reporting period (1 July 2011–30 June 2013) the quality (antler size) and quantity of moose harvested continued to remain low along with hunter satisfaction.

From 2003–2009 fire perimeters have encompassed about 34,025 acres in Unit 15B. No additional significant fires have occurred in recent years. The above fires should provide areas with improved moose habitat, but benefit to the moose population has been limited to date.

Unit 15C. Available habitat on the Lower Peninsula can be limiting in winters with heavy snow accumulations. Important winter habitat includes the drainages of 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 and continues to slowly increase. Community development continues, increasing interactions of human residents and moose.

Widespread spruce bark beetle infestations have also affected this region of the Peninsula. Portions of the affected forest outside of designated wilderness have been salvage logged. Spruce mortality and salvage logging efforts have significantly altered moose habitat in this area. Moose browse species did regenerate in logged areas that were scarified after tree removal, but in areas that were not scarified, *Calamagrostis canadensis*, which has poor nutritional value for moose, became the dominant ground cover. Some logged areas were replanted with conifers rather than species beneficial for moose browse such as birch. This area could have produced more high quality moose browse if specific treatments were applied during the salvage logging operations.

Unit 15C has the most potential for good moose habitat in the future as browse recovers in new burns. Since 2004, the perimeter of wildfires has encompassed over 87,000 acres in this unit. We have not evaluated the quality of moose habitat regenerated from these fires, but relative to Units 15A and 15B, Unit 15C has more potential for large areas of quality moose habitat in the near (by 2015) future. Our main concern for moose management in this unit is maintaining an adequate bull:cow ratio. Hunting restrictions imposed in 2011 increased the bull:cow ratio from 9 bulls:100 cows in 2010 to 22 bulls:100 cows in 2012. Future regulation changes however, may affect overall bull numbers and whether we stay within management objectives.

A census conducted north of Kachemak Bay in February of 2013 resulted in a point estimate of 3,204 (Sightability Correction Factor [SCF] 1.296) which equates to approximately 2.7 moose/mi^2 (survey area = 1,171mi^2).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Maintain moose populations at a level to promote public safety through directed harvest, and participate in land management decisions that affect moose movements in an effort to direct moose into areas with lower vehicle traffic.

Unit 15A. Maintain a healthy population of moose with a posthunting bull-to-cow ratio of at least 20–25:100 in Unit 15A, except for the Skilak Loop Wildlife Management Area (SLWMA).

Primary moose management objectives in the SLWMA are to:

- Provide opportunities to view moose in a natural setting throughout the year.
- Provide opportunities to view all components of the moose community, including their behavior and habitat.
- Provide opportunities to harvest moose when a reduction in numbers is desirable to achieve other objectives.
- Achieve and maintain the resident population at 130 animals or a density of 1.8 to 2.0 moose per mi^2. Resident moose in excess of 130 will be available for harvest.
- Maintain a bull-to-cow ratio of 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 20–25:100.
- 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 bull-to-cow ratio of 20–25:100.
- Maintain a healthy and productive population.

Intensive Management

The Intensive Management law was passed in 1994. Units 15A and 15C fall under intensive management; Unit 15B was excluded.

- IM objectives Unit 15A
  - Population objective: 3,000–3,500 moose.
  - Harvest objective: 180–350 moose.
- IM objectives Unit 15C
  - Population objective: 2,500–3,500 moose.
  - Harvest objective: 200–350 moose.

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; however, we surveyed all of our desired count areas during 2010–2013.

Population estimates for Subunit 15A were developed from data collected with a geospatial survey (Kellie and Delong 2006) in February 2001, February 2008, and February 2013. Sightability correction factors for moose were assumed in 2001 and 2008 but calculated during 2013 efforts.

Unit 15B. Composition surveys were flown in November of 2009 and 2010. This was the first time composition surveys had been conducted since November 1996.

Unit 15C. Fall composition surveys were conducted during 2010–2013. Two additional count areas were added to these surveys compared to previous years. A geospatial census was conducted in February 2013.

Harvest data are provided by hunter reports of harvest and are summarized by regulatory year. A regulatory year runs from 1 July through 30 June (e.g., RY10 = 1 July 2010–30 June 2011).

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] 95%: 2,921–3,943, SCF 1.21). The February 2001 point estimate for moose was 1,942 (95% CI: 1,555–2,329, assumed SCF 1.25), while the February 2008 census resulted in a population point estimate of 1,670 (95% CI: 1,405–1,934, assumed SCF 1.25). The February 2013 census provided a point estimate of 1,569 (95% CI: 1,296–1,843, SCI 1.27). These data indicate that the population was approximately 54 percent lower in 2013 compared to the most recent peak in 1991.

The bull:cow ratio calculated from the November 2012 composition surveys was 30 bulls:100 cows (Table 1). Information for 2009 includes only one count area in the eastern portion of the unit and should not be compared to other years. The fall calf:cow ratio has fluctuated since 2008 with a low of 16 calves:100 cows to 2012 levels of 25 calves:100 cows (Table 1).

Unit 15A is currently outside its intensive management objectives in both population size and harvest. Harvest objectives are currently unmet due to population size, composition, and harvest restrictions. The current population objective is unattainable due to habitat limitation and will remain so until habitat improvements occur either through direct manipulation such as mechanical treatment and prescribed fire or from natural causes (wildfire). Direct habitat manipulation is currently unlikely to dramatically improve habitat conditions due to management limitations. Controlled burning has not been implemented to date due to resource limitations and burn conditions. Mechanical treatment is costly and only very limited amounts of habitat can be treated by this means.

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) and 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 in the fall) indicates there were more than twice the number of moose in 1994 (N=275, count areas 903–905; N=65, count areas 906 and 907) compared to counts in 2009 (N=164, count areas 903–905) and 2010 (N=65, count areas 906 and 907) under similar conditions and flying similar coverage. Because these were composition surveys they only indicate a possible trend. Comparing the bull:cow ratio, which decreased from 57 bulls:100 cows in 1994 to 35 bulls:100 cows in 2009–2010, we see a similar trend. 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 3,964 moose (95% CI: 3,491–4,438, assumed SCF 1.33). The 2001-2002 survey however, 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 2,195 moose (95% CI: 1,918–2,473) assuming a sightability correction factor of 1.33 (Table 1). In February 2013 (RY12), we conducted a geospatial census that produced a population estimate of 3,204 (95% CI: 2,554–3,855) with a calculated sightability correction factor of 1.3.

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 observed during the 2010 surveys (Table 1) indicated a unitwide issue and management actions were taken to address it. These actions of reducing the bull harvest increased the bull:cow ratio to 22 bulls:100 cows by 2012.

Unit 15A is currently below Intensive Management population and harvest objectives. These objectives were based on the peak moose population that existed following the 1969 burn. With no large scale habitat alteration since that time, 15A can no longer support enough moose to realize population or harvest objectives identified under Intensive Management. We continue to work with the Kenai National Wildlife Refuge and other private and public organizations to identify areas where we can improve the habitat in 15A so it is more favorable to moose. In addition to addressing habitat concerns, the department will also consider implementing a wolf control program on lands outside the Kenai National Wildlife Refuge.

Unit 15C is currently within its population objective set under Intensive Management but outside of the harvest objective. This is due to a previous overharvest of the bull segment of the population leading to implementation of harvest restrictions to recover adequate bull to cow ratios. Harvest objectives could be met in the future with an increase in cow harvest and additional bull harvest as bull numbers recover under the current restrictive harvest regulations. When bull ratios are adequately recovered, new regulations can be set to limit the chance of future overharvest but still allow adequate harvest opportunity.

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. From 1987 to 2010, the bag limit was 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 (SF-50-3bt). Harvest statistics are shown in Tables 2 and 3. In 2011, the bag limit was restricted to 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side (50-4bt).

Board of Game Actions. In 2010, the Board of Game provided additional hunting opportunity (15–19 October) for TM549 due to poor hunting conditions during the regularly scheduled dates and hardships caused by poor salmon returns.

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 SF-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 and 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. In March of 2013, the Board of Game directed the department to implement wolf control in Unit 15A.

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 and harvest large-antlered bulls through a drawing permit system. Permittees reported harvesting 3 bulls in 2011 and 5 in 2012 (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 3 bulls have been taken during this season in the last 5 years (Table 3). 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% from 2008 to 2010 and then declined dramatically due to increased harvest restrictions in 2011 and 2012 (1% and 2%, respectively, Table 4). During all years, local residents (people living in Unit 15) accounted for the majority (82–100%) of successful moose hunters.

Unit 15B-West. Hunter success ranged 7–19% during the last 5 years (Table 4). The reduction in success during 2011 and 2012 is most likely due to increased harvest restrictions. During all years, local residents (people living in Unit 15) accounted for the majority (81–100%) of successful moose hunters.

Unit 15C. Hunter success ranged 6–19% during the last 5 years (Table 4). The lower success rates in 2011 and 2012 were most likely due to increased harvest restrictions. During all years, local residents (people living in Unit 15) accounted for the majority (78–96%) of successful moose hunters.

During this reporting period (1 July 2011–30 June 2013) 14% of the reported moose harvest came from Unit 15A, 16% from 15B, and 70% 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

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 declined for a short time, collisions have again increased, which is likely due to animals seeking forage near roadways as browse species away from roadways in 15A have continued to mature and become unavailable to moose.

"Winter kill" deaths appear to be increasing in 15A. The number of known moose that died from causes other than predation during the late winter of 2012–2013 was twice as high in Unit 15A (69) as either Units 15B (36) or C (28). Interestingly, the winter of 2012–2013 was relatively mild with moderate snowfall compared to previous winters.

Unit 15A. Crippling loss by hunters and loss to predation was unknown. During the last 5 years (RY08–RY12), the yearly average of moose killed in 15A by motor vehicles increased to 94 from the previous 5-year average of 83 (Table 2). Most of the 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.

Unit 15B. Crippling loss by hunters and loss to predation was unknown. During the last 5 years (RY08–RY12), a yearly average of 51 moose have been killed by motor vehicles in Unit 15B (Table 2).

Unit 15C. Crippling loss by hunters and loss to predation was unknown. During the last 5 years (RY08–RY12), a yearly average of 48 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, it only benefited 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. With the forage benefits for moose lasting 20–25 years post burn, 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 left untreated (unburned) as scattered islands for wildlife cover and as a seed source for revegetation.

In March and April 2013, 85 acres of mature mixed hardwoods were mechanically treated through clearcutting and replanting on Kenai Natives Association land north of the Sterling Highway and east of the Swanson River Road. This treatment was conducted by Evergreen Alaska, Inc. The total cost of the project was $93,137, funded with an appropriation from the Alaska Legislature for the 2013 fiscal year.

Additional interagency habitat improvement projects coordinated by ADF&G are planned for coming years in Unit 15A. ADF&G has requested a long-term funding commitment of $1 million over the course of 5 years from the Alaska Legislature to facilitate habitat enhancement. This funding is to be directed toward private contractors operating on public and private lands along with wildland firefighters to support interagency burn operations, both natural and prescribed. Building on the work of the Spruce Beetle Task Force and associated community outreach, additional fuel breaks are expected to be developed to protect communities and infrastructure to support the use of fire for habitat enhancement. Through partnerships with the Alaska Division of Forestry, the Kenai Peninsula Borough, U.S. Forest Service and the Kenai National Wildlife Refuge, ADF&G hopes to return fire to the landscape for the benefit of wildlife and ecosystem processes; this will also reduce the likelihood for high intensity wildland fires prone to result in damaging impacts to the landscape.

15B

Assessment

From 1890 (when a wildfire burned most of the unit) to 2003, no significant wildfires occurred in this unit. However, from 2004 to 2009, fires have encompassed about 34,000 acres. Quality assessment 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. Development continues to occur in prime moose habitat, particularly in important wintering areas for moose, increasing the probability of permanent habitat loss. Concerns over future property loss from such development will likely hamper future use of natural and prescribed fires for habitat enhancement.

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 benefits for moose habitat production from these fires are unknown at this time.

CONCLUSIONS AND RECOMMENDATIONS

Unit 15A. ADF&G (Hundertmark et al. 1999) 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 1991–1992. In RY94 the ratio rebounded to 24:100, and it increased to 30:100 in RY12. The calf to cow ratio has declined significantly from 34:100 in the 1990s to the current average of 25:100.

Currently, the largest impacts on the 15A moose population are declining habitat quality 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 board's March 2009 meeting it 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 and began 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) wild fire or other habitat events, it is unlikely we can maintain a moose population of 3,000–3,500 moose (the IM population objective) in 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 through 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 and complaints from hunters who had difficulty locating and harvesting animals in conjunction with supporting 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 have been issued since 2009.

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, natural or prescribed. 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 previous objective range of 15–20 bulls:100 cows in 2007. 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 Unit 15C, 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 began in late 2011.

Results from the February 2013 census indicate we are within and likely in the upper 1/3 of our Intensive Management population objectives (census range 2,554–3,855 with a point estimate of 3,204, intensive management objective 2,500–3,500). The point estimate equates to a density of approximately 2.7 moose/mi^2 over the entire census area (1,171.3 mi^2.), but likely 4 or more moose/mi^2 on winter range (below 1,000 ft. elevation during an average snowfall winter, T. McDonough, Wildlife Biologist, ADF&G, Homer, personal communication). Given we are still below Intensive Management harvest objectives, and have a relatively high moose density, we should be looking to increase harvest opportunities in the near future.

The expansion of federal subsistence hunting opportunities, the increased effort associated with these new opportunities, and the inconsistency between state and federal regulations and season dates have confounded the issues surrounding moose management. 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, 2008–2012.

Unit	Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	%Calves	Adults	Total Moose Observed	Estimated Population Size
15A	2008	11	21	16	171	204	1,405–1,934[a]
	2009	84	16	8	79	86	no survey
	2010	20	23	16	288	345	no survey
	2011	36	29	17	402	487	no survey
	2012	30	25	16	312	372	1,269–1,843[a]
15B	2008	No Surveys Conducted					
	2009	51	11	7	153	164	no survey
	2010	33	9	6	61	65	no survey
	2011	No Surveys Conducted					
	2012	No Surveys Conducted					
15C	2008	13	10	8	492	537	no survey
	2009	13	18	14	368	426	no survey
	2010	9	19	15	625	735	1,918–2,473[a]
	2011	14	26	19	877	1077	no survey
	2012	22	15	11	580	650	2,554–3,855[a]

[a] Estimates from geospatial census method, estimated population size shown = 95% CI.

Table 2. Unit 15 Reported general season moose harvest and accidental death, 2008–2012.

Unit	Regulatory Year	Reported Hunter Harvest: Bull	Cow	Unk	Total	Accidental death: Road	Train	Total	Total Reported Mortality
15A	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
	2011	4	0	0	4	103	0	103	107
	2012	7	0	0	7	84	0	84	91
15B	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
	2011	7	0	0	7	49	0	49	56
	2012	3	0	0	3	41	0	41	44
15C	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
	2011	26	0	0	26	53	0	53	79
	2012	27	0	0	27	52	0	52	79

Table 3. Unit 15 harvest data for drawing permit hunts, regulatory years 2008–2012.

	Hunt No.	Regulatory Year	Permits Issued	Permittees that hunted	Percent Success	Harvest Bulls	Harvest Cows	Harvest Unk.	Harvest Total
15B	DM530-539	2008[a]	60	42	5	2	0	0	2
	(combined	2009	50	31	6	2	0	0	2
	totals)	2010	50	19	16	3	0	0	3
		2011	50	17	18	3	0	0	3
		2012	49	18	28	5	0	0	5
15C	DM549	2008	50	40	58	0	23	0	23
		2009	50	43	60	0	26	0	26
		2010	50	43	44	0	19	0	19
		2011	50	35	86	0	19	0	19
		2012	50	42	45	0	19	0	19
	TM549	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
		2011	4	4	50	3	0	0	3
		2012	4	4	50	2	0	0	2

[a] Only 10 permits were issued for the 26 September–15 October season.

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

Table 4. Unit 15 residency and success of moose hunters for the general season, 2008–2012.

		Successful				Unsuccessful				
Unit	Regulatory Year	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b](%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	Total Hunters
15A	2008	97	12	4	115 (10)	827	162	24	1,020	1,135
	2009	91	11	7	110 (11)	763	137	17	928	1,038
	2010	98	12	4	119 (13)	642	124	14	789	908
	2011	4	0	0	4 (1.4)	227	47	0	286	290
	2012	7	0	0	7 (2.4)	237	33	0	281	288
15B	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
	2011	6	1	0	6 (7)	64	8	0	77	83
	2012	6	0	0	6 (8)	62	5	1	68	74
15C	2008	165	21	5	195 (14)	999	128	23	1,153	1,348
	2009	209	24	12	248 (19)	909	126	21	1,071	1,319
	2010	186	24	7	220 (18)	819	131	17	986	1,206
	2011	22	3	0	26 (6)	352	38	1	399	425
	2012	24	1	0	27 (6)	366	37	0	417	444

[a] Local = residents of Unit 15.

[b] Includes unspecified residency.

Table 5. Unit 15 moose general season harvest chronology (percent of harvest), 2008–2012.

		Harvest Periods								
Unit	Regulatory Year	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	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
	2011	25	0	0	0	0	25	50	0	4
	2012	14	14	0	0	0	29	43	0	7
15B	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
	2011	0	0	0	0	0	0	71	29	7
	2012	17	0	0	0	33	50	0	0	6
15C	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
	2011	0	4	8	12	4	35	31	8	26
	2012	0	7	7	0	11	22	41	11	27

[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), 2008–2012.

		Percent of Harvest							
Unit	Regulatory Year	3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/ Dogteam	ORV	Unknown	Harvest
15A	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
	2011	0	0	25	75	0	0	0	4
	2012	0	0	14	57	14	0	14	7
15B	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
	2011	0	14	29	43	0	14	0	7
	2012	0	0	0	67	0	0	33	6
15C	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
	2011	54	0	8	12	23	0	4	26
	2012	48	0	0	11	22	4	15	27

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CHAPTER 17: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Westside Susitna River (Kahiltna River to Chulitna River)

BACKGROUND

The Unit 16A moose population has historically experienced large fluctuations in population size as a result of die-offs during severe winters. Die-offs have occurred at least once every decade (Griese 1996). A population high was noted in 1997 of 3,636 moose and a low of 1,619 was recorded in 2005. Recovery of the moose population after a severe winter can be hampered by predation (Peltier 2010).

The predator control program implemented to reduce the wolf population in Unit 16B was expanded in 2006 to include the non-roaded portions of Unit 16A. In 2007 a black bear control program began on the same lands which included provisions for an unlimited take of black bears, the taking of sows with cubs, and the taking of cubs, among others (Peltier 2008). While the initial control efforts were designed to improve the moose population in Unit 16B, it is possible that predator reductions in the unit may have led to an increase in calf recruitment and the moose population in Unit 16A as well.

Unit 16A is mostly a roadless area. Access is limited to a few points from the Parks Highway, Petersville Road or Oil Well Road. Boats, airboats, all-terrain vehicles, and airplanes are used to access more remote portions of the unit for moose hunting. Annual harvest has fluctuated as a result of variable moose densities, availability of cow moose hunts, and improved hunter access (Griese 1996). Harvest numbers have ranged from a high of 309 (1984) to a low of 37 (1990) (Del Frate 2004).

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.

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

- 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

The moose population in Unit 16A is surveyed using the geospatial population estimator (GSPE) technique (Kellie and DeLong 2006) on a triennial basis. This estimate provides data on sex and age composition and aids in developing trend information that is used to develop recommendations for season and bag limits.

Harvest in Unit 16A was monitored through general season harvest reports from hunters. All harvest data were reviewed for accuracy and adjusted as necessary. Thus, 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 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

No surveys were conducted during the reporting period due to time and weather constraints. Population composition and trends were examined from the previous surveys conducted in 2000, 2005, and 2009 (Peltier 2012). The 2009 GSPE estimate was 2,574 ± 294 (80% CI; Table 1) moose.

Population Composition

The ratio of bulls:100 cows for the 2009 survey was 26 and the ratio of calves:100 cows was 29 (Table 1).

MORTALITY

Harvest

<u>Seasons and Bag Limits</u>. The fall general open season was 20 August–25 September for all resident and nonresident hunters, 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 (Schwartz et al. 1992).

<u>Alaska Board of Game Actions and Emergency Orders</u>. There were no changes to the moose hunting regulations during this reporting period.

<u>Harvest by Hunters</u>. There was a decrease in harvest during the reporting period (Table 2). The 5-year average (RY08–RY12) was 112 moose, which was less than the previous 5-year average

(RY03–RY07) of 123 moose and below the harvest objective minimum (190). The lower level of harvest is likely due to lower moose densities.

Hunter Residency and Success. Hunter participation and success rate decreased in RY12 (Table 3). RY12 was a very wet and cool autumn in the Matanuska Valley and as a result interest in hunting was down in several units. The majority of hunters were not considered local residents (i.e., residents of Unit 16). The 10-year average of hunter success was 14.6%.

Harvest Chronology. The majority of the moose were taken in the last 2 weeks of the season (Table 4). Hunters prefer to take moose when they are more vulnerable as the rut approaches and where hunting competition for moose is light.

Transport Methods. All-terrain vehicles and boats account for most of the transportation used by successful hunters in the past 10 seasons (Table 5). Given the wet, swampy habitat of much of the unit, airboats are also popular.

HABITAT

Enhancement

An 18,000-acre area east of the lower end of Kroto Creek (Deshka River) was prepared for a planned prescribed burn in 1994 (W. Collins, Wildlife Biologist, ADF&G, Palmer, personal communication). During spring and summer 2007, a 10,000-acre wildfire burned over major portions of the same prescription area (G. Holt, Forester, Division of Forestry, Palmer, personal communication). This was expected to result in improved habitat and forage for moose. Currently ADF&G is working with the Division of Forestry on a proposal for a prescribed burn adjacent to the area proposed by Collins in 1994. This burn would affect approximately 4,940 acres.

CONCLUSIONS AND RECOMMENDATIONS

At this time it appears that the current season and bag limits are adequate for increasing the moose population. The survey trend between 2005 and 2009 indicates a growing moose population and there has been no significant change to either the number of hunters in the unit or the success rate of the hunters. However, current information about the size of the population is lacking. Triennial surveys with a consistent methodology will effectively capture accurate population trends and help managers to be more responsive to fluctuations in populations as well as sex and age components. Providing that a positive trend in the population continues, additional harvest opportunity could be provided through either an any bull draw hunt or an increase in season length.

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Table 1. Unit 16A fall aerial moose composition surveys and censuses, Alaska, regulatory years[a] 2000–2009.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults observed	Moose observed	Moose /mi^2	Population size[b]
2000[c]	28	6	22	15	661	787	1.4	2,420 ± 528
2005[d]	22	3	19	14	510	590	1.1	1,619 ± 197
2009[e]	26	6	29	19	691	853	1.9	2,574 ± 294

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2000 = 1 July 2000–30 June 2001.
[b] Population estimate and 80% confidence interval.
[c] Becker and Reed (1990) survey methodology.
[d] Ver Hoef (2001) survey methodology.
[e] Geospatial population estimator technique (Kellie and DeLong 2006).

Table 2. Unit 16A moose harvest and accidental death, Alaska, regulatory years[a] 2003–2012

Regulatory	Reported				Estimated			Accidental deaths[b]			Grand
year	M	F	Unk	Total	Unreported[c]	Illegal[d]	Total	Road	Other	Total	total
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[e]	0	10	147
2006	115	0	0	115	8	20	28	10[e]	0	10	153
2007	85	0	1	86	6	20	26	10[e]	0	10	122
2008	103	0	0	103	7	20	27	10[e]	0	10	140
2009	116	0	1	117	8	20	28	10[e]	0	10	155
2010	125	0	1	126	9	20	29	10[e]	0	10	165
2011	135	0	0	135	9	20	29	5	0	5	169
2012	77	0	1	78	5	20	25	7	0	7	110

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Roadkill is minimum number and does not reflect moose hit and lost or not salvaged.
[c] Derived by taking 7% of the reported harvest.
[d] Includes moose taken in defense of life or property.
[e] Estimated minimum based on the previous years as data was missing for this period.

Table 3. Unit 16A moose hunter residency and success, Alaska, regulatory years[a] 2003–2012

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total	Total hunters
2003	12	144	11	1	168 (18)	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)	41	547	30	3	621	747
2011	9	109	16	1	135 (18)	31	566	22	5	624	759
2012	1	70	7	0	78 (12)	43	518	36	6	603	681

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Unit 16 residents.

Table 4. Unit 16A moose harvest chronology, Alaska, regulatory years[a] 2003–2012.

Regulatory	August			September						
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	Unknown	Total
2003[b]	0	13	6	10	15	34	34	47	9	168
2004[b]	0	8	4	9	20	35	37	21	5	139
2005[b]	1	5	2	8	11	19	24	36	3	109
2006[b]	0	4	5	6	14	33	24	25	4	115
2007[c]	0	1	3	11	22	48			1	86
2008[c]	1	13	2	8	25	52			2	103
2009[c]	2	11	6	12	28	55	3		0	117
2010[c]	2	10	6	14	39	53	1		1	126
2011	0	10	5	8	24	50	37		0	134
2012	0	7	2	10	19	21	19		0	78

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Open season = 10–17 August (archery only), 20 August–30 September (spike-fork 50).
[c] Open season = 10–17 August (archery only), 20 August–20 September (spike-fork 50).

Table 5. Unit 16A percent transport methods of successful moose hunters, Alaska, regulatory years[a] 2003–2012.

Regulatory year	Transport method (%)									n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat	Unk	
2003	11	0	21	40	0	8	14	5	1	168
2004	9	1	15	52	0	6	15	0	2	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	4	0	86
2008	9	0	28	32	0	12	14	5	0	103
2009	10	0	22	51	0	9	6	2	0	117
2010	7	0	30	29	0	14	15	3	2	126
2011	13	1	30	35	0	7	12	2	0	135
2012	14	1	18	41	0	9	12	5	0	78

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.

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CHAPTER 18: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: West Side of Cook Inlet and Kalgin Island

BACKGROUND

Moose populations fluctuate greatly in Unit 16B due to heavy snow years that seem to occur once or twice every decade. Moose in this unit likely numbered in excess of 10,000 during the early 1980s (Griese 1996). Before the severe winter of 1989–1990, there likely were 8,500–9,500 moose (Harkness 1993). Following a 15–20% decline after winter 1989–1990, moose numbers in the unit continued to decline in response to deep snow winters and growing predation (Griese 2000).

Prior to 1989, moose hunting in Unit 16B was by permits with long season dates and had either any-moose or antlerless-moose bag limits. Tier II permits were issued beginning in regulatory year (RY) 1990 to ensure local residents have an opportunity to meet subsistence needs. A regulatory year begins 1 July and ends 30 June, e.g., RY90 = 1 July 1990–30 June 1991. Beginning 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" (Schwartz et al. 1992). The general season was closed in both RY01 and RY02 and then again during RY06–RY08 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).

For most of the post-statehood history of the unit, predation was not considered a significant factor limiting the moose population. Predation by wolves was not thought to influence the moose population until around 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 fall 1998 estimated a population of 120–140 wolves (Masteller 2000), and Del Frate (2003) reported an estimate of 160–245 wolves for all of Unit 16 in winter 2001. 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

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

2006). Additionally, studies in Unit 16B suggest that bear predation also has a strong influence on calf recruitment (Faro 1989, Peltier 2012). Bear surveys were conducted in spring 2007 and indicated high densities of black bears (182 bears/1,000 km^2) and brown bears (63 bears/1,000 km^2) in the unit (Peltier 2008). Brown bear seasons and bag limits were liberalized and a black bear control program began in fall 2007 (Peltier 2008, 2010).

The establishment of the Kalgin Island moose population is the result of a translocation of calves during 1957–1959. Numbers grew to a density of 6 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 1–2 moose/mi^2 while vegetation recovered (Faro 1989). In 1999 the Board of Game adopted an any-moose registration hunt to reduce the population to the management objectives.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Maintain and enhance the moose population to provide for high levels of human consumptive use.

MANAGEMENT OBJECTIVES

Mainland Unit 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 3 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 defined 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) in each of these units as funding and priorities allow (Table 1).

A geospatial population estimator (GSPE; Kellie and DeLong 2006) survey was conducted in Unit 16B Middle. Minimum count surveys were conducted on Kalgin Island in 2011 and 2012. 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 Unit 16B Middle was estimated at 3,458 ± 539 (Table 1). This estimate includes a sightability correction factor derived from intensive sampling. The previous estimate was 2,446 ± 322 moose which indicates a growing moose population. Based on this survey, as well as the 2010 survey of Unit 16B South of 2,372 ± 778 and Unit 16B North at 1,042 ± 235, the estimated population for mainland Unit 16B (excluding Kalgin Island) is 6,782 ± 1,562. The moose population on Kalgin Island was estimated to be 60–70 moose in November 2011 and 110–120 in 2012. Given that the population could not possibly double in one year, the most likely explanation for the increase was poor sightability in the 2011 survey.

Population Composition

Based on the GSPE survey of Unit 16B Middle in 2011, the bull:100 cow ratio was 45.7 and the calf:100 cow ratio was 23.7 (Table 1). In Unit 16B South the 2010 GSPE survey indicated a bull:100 cow ratio of 52 and a calf:100 cow ratio of 18 indicating a potential lag in recruitment in Unit 16B South. However, these numbers should be considered with caution. Results of a multi-year calf recruitment study in the area indicate that calf:100 cow ratios can vary greatly (ADF&G, unpublished data, Palmer, Alaska); survey results may reflect this.

MORTALITY

Harvest

<u>Seasons and Bag Limits</u>. The general resident hunting season for RY11 and RY12 was 20 August–25 September (Table 2). The general nonresident hunting season was 25 August–15 September. Tier II (TM565, TM567, and TM569) hunting was open for any bull 15 November–28 February for RY11 and shifted to 15 December–31 March for RY12. There were 260 Tier II permits issued for RY11 and 261 permits issued for RY12 (Table 3). Kalgin Island was open to registration hunting (RM572) 20 August–20 September in RY11 (any moose) and from 20 August to 10 September in RY12.

<u>Alaska Board of Game Actions and Emergency Orders</u>. During the Board of Game meeting in spring 2011, the board passed a nonresident hunting season for the unit which was implemented in fall 2011. The board also reauthorized the predation control intensive management plan and approved a brown bear control program in a 960 mi^2 subsection of Unit 16B between the McArthur and Beluga rivers to aid the recovery of the moose population. They also changed the winter Tier II dates to 15 December–31 March. This regulation was to be implemented in RY12.

Due to a low population estimate in winter 2011, the RM572 Kalgin Island moose hunt was closed by emergency order, ending the RY12 hunting season 10 days early.

<u>Harvest by Hunters</u>. Harvest decreased slightly during RY11–RY12 over the previous reporting period (208 vs. 217 for RY09–RY10; Table 2). This is due mostly to the reduced harvest and participation in RY12. RY12 was a particularly wet and cool fall and hunter effort was reduced throughout Southcentral Alaska. The Tier II harvest which occurs midwinter was not noticeably

different than the previous reporting period (Table 3). The harvest on Kalgin Island was reduced during the reporting period, due to the fact that RM572 was closed by emergency order.

Hunter Residency and Success. The general season was opened to nonresidents during the RY11 hunting season for the first time since RY03 (Table 4). The general resident season was 10 days longer during this reporting period. The majority of resident hunters were nonlocal residents.

Harvest Chronology. In areas such as Unit 16B where competition among hunters is low, harvest of bulls is concentrated in the last 2 weeks of the season (Table 5). This is due to the fact that bulls become more vulnerable to hunters as they approach the rut.

Transport Methods. The lack of road accessibility to the unit is reflected by the dominance of aircraft and boat 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 Unit 16B in 2011. At this time the effects of these programs are not clear (Peltier 2012). Calf recruitment is still relatively low compared with other moose populations; however, recruitment appears to be improving slightly. Overall survey numbers appear to be increasing, and anecdotal information from the field is that hunters are seeing more calves and more moose in general.

CONCLUSIONS AND RECOMMENDATIONS

At this time it appears that with a population estimate of 6,782 ± 1,562, we are within the population objective of 6,500–7,500 moose for mainland Unit 16B (excluding Kalgin Island). The unit is still below the harvest objective of 310–600; however, with the recent return of nonresident hunting, along with some other changes in the regulations that will take place in the future, it is likely that we will be achieving our harvest objectives relatively soon.

As long as Unit 16B remains under intensive management additional information is needed to better understand the predator-prey dynamics of the unit. Current research plans include looking at calf recruitment 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 RY14 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. Spatial analysis of predators and moose in the unit could be used to develop geographic information system layers that could assist managers in deciding where to expect faster moose population recovery and where to concentrate predator control efforts.

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Table 1. Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, Alaska, regulatory years[a] 2001–2012.

Regulatory year	Area	Date(s)	Bulls: 100 cows	Yearling bulls:100 cows	Calves: 100 cows	Percent calves	Adults	Total moose observed	Moose observed/ mi^2	Population estimate[b]
2001	Northern[c]	5–7 Nov	40	7	14	9	393	438	0.8	1,187 ± 182
	Middle[c]	8–11 Nov	32	4	10	7	494	537	0.7	1,836 ± 267
	South[d]	30 Oct–4 Nov	31	3	13	9	539	594		700–850
	Kalgin Island[e]	22 Oct				33	64	96	4.2	110–140
2002[f]										
2003	North[g]	24 Nov–6 Dec	35	7	17	9	292	326		898 ± 163
	South[d]	1 Dec	46	17	23	14	133	154		700–850
	Kalgin Island[e]	25 Nov	38	25	89	39	76	125		179
2004	South[d]	5–9 Dec	23	10	23	16	509	604		960
2005	Middle[h]	26 Nov–1 Dec	29	4	14	13	582	628	0.8	1,714 ± 343
	Kalgin Island[e]	17 Jan 2006	17	3	47	29	69	97	4.2	100–120
2006	Kalgin Island[e]	9 Feb 2007				30	26	37	1.6	50–70
2007	Kalgin Island[e]	19 Nov 2007	26	13	67	37	77	118	5.2	120-140
2008	North[h]	29–30 Oct	58	16	12	7	318	340	1.9	1,042 ± 245[i]
	Middle[h]	15–17 Nov	54	11	21	12	600	678	0.9	2,446 ± 322[i]
	South[d]	2 Dec 2008	78	13	18	9	224	247		
2009	Middle[d]	15–17 Nov	39		19	12	315	359		
2010	South[h]	13–18 Nov	52	15	18	11	628	703	1.1	2,372 ± 778[i]
	Kalgin Island[e]	7 Dec				43	40	70	3.1	80–90
2011	Middle[h]	20–26 Nov	46	9	24	15	698	825	1.1	3,458 ± 539
	Kalgin Island[e]	13 Dec				28	38	53	3.1	60–70
2012	Kalgin Island[e]	17 Dec				38	65	104	4.6	110–120

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2001 = 1 July 2001–30 June 2002.
[b] Includes 80% confidence intervals where appropriate.
[c] Becker survey (Becker and Reed 1990).
[d] Trend area composition survey (2–4 min/mi^2).
[e] Trend area composition survey (6–8 min./mi^2).
[f] No surveys completed.
[g] J. Ver Hoef's regression sampling method (Ver Hoef 2001) for one-third of area (612 ± 151 [80% CI]), plus 350–550 estimated for remainder of area.
[h] Geospatial population estimator (Kellie and DeLong 2006).
[i] Includes a sightability correction factor.

Table 2. Unit 16B moose harvest and accidental deaths, Alaska, regulatory years[a] 2003–2012.

Regulatory	Reported				Estimated			Accidental deaths			Grand
year	M	F	Unk	Total[b]	Unreported[c]	Illegal	Total	Road	Other	Total	total
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
2011	206	13	0	219	15	25	40	0	0	0	259
2012	176	9	0	185	15	25	40	0	0	0	225

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] Includes all reported harvest including federal subsistence.
[c] Includes moose taken in defense of life or property.
[d] Season is Resident Harvest, 1 September–20 September (spike fork 50), Tier II 15 November–28 February (any bull); Kalgin Island 20 August–20 September.
[e] Season is Tier II only, 1 September–20 September (spike fork 50) and 15 November–28 February (any bull); Kalgin Island 20 August–20 September.
[f] Season is Resident Harvest, 20 August–20 September (spike fork 50), Tier II 15 November–28 February (any bull); Kalgin Island 20 August–20 September.

Table 3. Unit 16B moose harvest data by permit hunt, Alaska, regulatory years[a] 2003–2012.

Hunt number[b]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest Bulls	Harvest Cows	Harvest Unk	Harvest Total
TM565	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
	2011	100	37	41	59	36	0	1	37
	2012	101	29	47	53	38	0	0	38
TM567	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
	2011	80	28	42	58	32	1	0	33
	2012	80	26	41	59	35	0	0	35
TM569	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

Hunt number[b]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest			
						Bulls	Cows	Unk	Total
	2011	80	41	57	43	19	0	1	20
	2012	80	40	60	40	19	0	0	19
DM571/ RM572	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
	2011	138	36	72	28	10	12	0	22
	2012[c]	111	30	84	16	4	8	0	12

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[b] TM = Tier II permit, RM = registration permit, DM = drawing permit.
[c] Closed by emergency order 10 September.

Table 4. Unit 16B moose hunter[a] residency and success, Alaska, regulatory years[b] 2003–2012.

	Successful						Unsuccessful					
Regulatory year	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total	Total hunters
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[e]												
2007[e]												
2008[e]												
2009[d]	7	91	0	2	100	(23)	22	305	0	6	333	433
2010[d]	8	89	0	0	97	(25)	23	270	2	3	298	395
2011	3	93	9	4	109	(22)	16	355	7	5	383	492
2012	4	64	17	0	85	(20)	26	284	35	0	345	430

[a] Does not include individuals participating in permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] Unit 16 residents.
[d] No general nonresident open season.
[e] No general open season.

Table 5. Unit 16B moose harvest chronology[a] by month, Alaska, regulatory years[b] 2003–2012.

Regulatory	August		September						
year	20–26	27–31	1–7	8–14	15–20	21–25	26–30	Unknown	Total
2003[c]			15	28	47	1	2	6	99
2004[c]			12	22	47	1	1	2	85
2005[c]			7	21	32	1		1	62
2006[d]									
2007[d]									
2008[d]									
2009[e]	2	4	11	24	58			1	100
2010[e]	4	2	8	39	43			1	97
2011[f]	2	5	8	24	37	29		3	108
2012[f]	5	1	5	30	16	23		5	85

[a] Does not include harvest from permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] Open season = 1 September–20 September (spike fork 50).
[d] No general open season.
[e] Open season = 20 August–20 September (spike fork 50).
[f] Open season = Residents: 20 August–25 September (spike fork 50); Nonresidents: 25 August–15 September (spike fork 50).

Table 6. Unit 16B percent transport methods of successful moose hunters[a], Alaska, regulatory years[b] 2003–2012.

Regulatory year	Transport method (%)									*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat	Unk	
2003	56	1	16	14	1	1	5	1	5	99
2004	63	0	15	12	0	1	5	0	4	85
2005	63		19	13			1	1	1	62
2006[c]										
2007[c]										
2008[c]										
2009	59	3	19	12	0	2	4	0	1	100
2010	56	1	27	7	1	3	3	0	2	97
2011	62	6	19	4	0	3	5	0	1	109
2012	64	5	19	7	0	1	1	2	1	85

[a] Does not include harvest from permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2003 = 1 July 2003–30 June 2004.
[c] No general open season.

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CHAPTER 19: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

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 or 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. Information from pilots Tom Tucker and Bo Darden, both long time locals who were flying this country in 1970, suggests much of the lower Mulchatna River and Stuyahok River were void of timber at that time (Tom Tucker and Bo Darden, personal communication, 2015). Today these areas have abundant willow and alder communities as well as coniferous forests.

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 were suspected to be the principal factor contributing to low densities of moose in the unit (Taylor 1990).

In the last 3 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 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 Unit 17A, where a viable population has become established.

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

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Unit 17A

- Manage for a minimum population of 300 moose and a target population of 1,100–1,750 moose.

Unit 17B

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

Unit 17C

- Maintain a minimum density of 0.5 moose/mi^2.
  - Intensive Management Objective: Manage for a population of 2,800–3,500 moose with a harvest objective of 165–350 moose.

METHODS

Moose populations in Unit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Movements along the border of Units 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994. In March 1998, 36 moose were radiocollared in Unit 17A to study movements and population parameters (Aderman et al. 1999). Additional moose in Unit 17A are periodically radiocollared to continue this study.

Late winter aerial surveys of Unit 17A were conducted during this reporting period, but no surveys were conducted in Units 17B or 17C. Aerial surveys of trend count areas in Units 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 demographic trends, but have not been conducted since 1998.

Moose population estimation surveys have been conducted in various portions of Units 17B and 17C in the past. In 1983 a portion of Unit 17C, in 1987 a portion of Unit 17B that included the upper Mulchatna River area, and in 1995 western Unit 17C and most of Unit 17A were surveyed using the Gasaway population estimation technique (Gasaway et al. 1986). Beginning in March 1999, a geospatial population estimator technique (DeLong 2006, Kellie and DeLong 2006) has been used for population estimation surveys in Units 17B and 17C.

We collected harvest data by means of harvest ticket reports and registration permit reports. Hunters who did not report were sent reminder letters and eventually put on the failure to report list if they failed to comply with the permit reporting requirements. 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

In 1995, Aderman et al. (1995) estimated there were approximately 100 moose in Units 17A and a portion of 17C surveyed at that time. Each year during late winter, department staff and TNWR staff attempt to survey Unit 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 Unit 17A (A. Aderman, Wildlife Biologist, TNWR, Dillingham, personal communication, 2014). Lack of snow prevented surveys during this reporting period. The present population size in Unit 17A probably exceeds 1,200 moose given that the trajectory of the population leading up to the most recent survey in regulatory year (RY) 2010, which begins 1 July and ends 30 June (e.g., RY10 = 1 July 2010–30 June 2011), was of an increasing population.

The moose population in Unit 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 Unit 17B is good moose habitat, we established the intensive management population objective for Unit 17B as a minimum of 4,900 moose. In March 2001, 2006, and 2010, moose population estimation surveys were completed in the western portion of Unit 17B using the geospatial survey technique. These estimates indicate the Unit 17B moose population is stable, but below the intensive management population objective (Table 1). Surveys were not conducted during this reporting period.

The moose population in Unit 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 intensive 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 Unit 17C north of the Igushik River using the geospatial survey technique. These estimates indicate the Unit 17C moose population is above the minimum intensive management population objective (Table 1). Surveys were not conducted during this reporting period.

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 or since 1998. Calf production and survival appear to fluctuate between areas and years based on the percentages of calves seen during aerial surveys. In 1997–1998, late winter survey data indicated minimum calf percentages of 19.4% in the Mulchatna drainages (Nushagak-Red Veils, including the Mosquito, Old Man, and Stuyahok Rivers), and 24.9% in the upper Nushagak River drainages from Big Bend to Koliganek. These surveys included only the river corridors as listed. Minimum calf percentages obtained during the most recent population estimation surveys conducted in Unit 17 indicate percentages are generally lower in Unit 17B (4–8%) than in Unit 17C (11–15%) but are generally overall low (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 moose 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 Unit 17C stayed in that area, but there was some movement into Unit 17A. One collared moose and her calf moved from Weary River to Kulukak River (Jemison 1994), which is at least 24 miles straight-line distance. During the February 1995 population estimation survey, 29 moose were observed moving into Unit 17A from the upper Sunshine Valley in Unit 17C (Aderman et al. 1995). Aderman et al. (2000) found that in Unit 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 Unit 17A have moved into western Unit 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

Seasons and Bag Limits. Harvest data were summarized by regulatory year.

The fall resident-only registration hunt in Unit 17A was open 25 August–20 September. The winter resident-only 2-week registration hunt in Unit 17A (RM575) during RY11 was 10–23 December, while in RY12 it was 18–31 December. The department uses its discretion to open this hunt when snow conditions are sufficient to allow snowmachines to be used for hunting. Registration permit holders could take 1 bull in a regulatory year. There was no general hunt or nonresident hunting season for moose in Unit 17A.

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

The fall Alaska resident-only registration hunt in Units 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 Unit 17B nonresident corridor (RM587) was 5–15 September. Nonresident registration permit holders could take 1 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 Units 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 Unit 17A and were available 5 August–20 September to any Alaska resident who applied in person at Togiak or Dillingham. Registration hunt RM575 permits were valid only in Unit 17A and were available (throughout the open season) to any Alaska resident who applied in person at Togiak or Dillingham. Permits for registration hunts RM583 and RM585 were valid for both Units 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. Only a single day is designated for issuing permits in each of Koliganek, New Stuyahok, and Ekwok.

Alaska Board of Game Actions and Emergency Orders. No regulatory changes due to Board of Game action took place for moose hunting in Unit 17 during this reporting period. Emergency orders during this reporting period consisted of the opening of registration hunt RM575 each winter.

Harvest by Hunters. 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).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the 5 seasons previous to this reporting period, at least 42% of the completed harvest reports included moose with antler spreads of 50″ or greater. This trend continued with 47% and 44% of the moose antlers ≥50″ for RY11 and RY12 respectively. The largest antlers reported for each season since RY92 has been at least 69″ with many years exceeding 70″ (Table 3).

General Hunt. The general moose hunt in Units 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). This is because local residents take advantage of the registration permit hunts that are less restrictive and have an earlier starting date than the general season. Unit 17A has not had an open general moose hunting season since RY80. The reported harvest during the 5 years prior to this reporting period for the general moose season in Unit 17B ranged from 18 to 53, with a mean annual harvest of 39 moose (Table 5). During this reporting period the harvest ranged from 30 to 40, with a mean annual harvest of 35. In Unit 17C, the previous 5-year mean annual harvest for the general hunt was 19 moose, with a range of 11 to 25 (Table 6). During this reporting period the harvest was 13 moose each year.

Permit Hunts. Longer seasons and more liberal bag limits have enticed many resident hunters to participate in the registration hunts (RM573, RM575, RM583, and RM585). In fall and winter RY11, 1,427 resident permits were issued for Unit 17 registration moose hunts, and 1,121 permittees reported they hunted, killing 306 moose. In fall RY11, 35 nonresidents were issued permits for registration hunt RM587, all permittees hunted, and 13 killed a moose. In fall and winter RY12, 1,376 resident permits were issued for Unit 17 registration moose hunts, and 1,091 hunters reported hunting, killing 248 moose. In fall RY11, 39 nonresidents were issued permits for registration hunt RM587, 35 permittees reported they hunted, killing 13 moose. In RY12, 45 permits were issued for RM587, 38 permittees hunted and they harvested 12 moose. Each year 15–20% of those receiving registration moose hunting permits for Unit 17 reported that they did not hunt (Tables 7, 8, 9, and 10).

Hunter Residency and Success. The mean number of moose hunters participating each year in the general moose hunting season in Unit 17 during the 5 years prior to this report period was 226, and declined to 141 during this reporting period. This pattern of decreasing general season hunters has been evident since the late 1990s (Table 4). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. Decline by nonresident hunters has followed a statewide decline in nonresident moose hunters, as well as a decline in moose in Unit 17B. Unitwide success during the general hunt for this reporting period averaged 25%, similar to that of the previous 5 years. During this reporting period, nonresidents accounted for 32% of the reporting hunters in the general hunt, residents of Unit 17 accounted for 28%, and other residents from Alaska made up the remaining 40%. During the previous 5 years this distribution was quite different, with 46% of the hunters being nonresidents and only 16% being residents of Unit 17 (Table 4).

The mean number of resident moose hunters participating in registration moose hunts in Unit 17 during this reporting period was 1,128, well above the previous 5-year average of 943. Success during the registration hunts in Unit 17 for Alaska residents ranged from 26% to 38% during the 5 years prior to this reporting period, with a mean annual hunter success rate of 32%. During this reporting period, success for resident hunters ranged from 23% in RY12 to 27% in RY11. Residents of Unit 17 composed 90% and other residents of Alaska made up 10% of hunters in the resident registration hunts during this reporting period. This is similar to the 5 years prior to this reporting period when local residents made up 89% and nonlocal residents 11% of resident hunters (Table 10).

Harvest Chronology. An interesting aspect of the fall harvest chronology for both the permit hunts and the general season is the comparison between the periods of 1–10 September and 11–20 September. All the fall moose hunts in Unit 17 (except RM573 in Unit 17A) close on 15 September, yet hunters get as many or more moose during the 6-day period of 10–15 September as they do during the first 10 days of September. The main reason for this is the approach of the rutting period near mid-September that makes bull moose much more vulnerable than during the earlier part of the season (Tables 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, with 81% of the hunters using this form of access (Table 13). This differs dramatically from hunters in the registration hunts who primarily used boats (62% during reporting period) or snowmachines (24% during reporting period) for access (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. The use of boats during the permit hunts is largely from people hunting the Tikchik Lake system, and the Nushagak, Mulchatna, and Togiak rivers. These waterways provide direct access to moose hunting, and many local hunters are outfitted with the necessary boats and equipment to take advantage of this opportunity.

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

No formal habitat-monitoring programs were conducted in the remainder of Unit 17. Moose winter ranges along the Nushagak and Mulchatna rivers, and along the lower reaches of the major tributaries to those rivers, are probably in good condition. Although there is evidence of heavy browsing 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 USDA Natural Resources Conservation Service (NRCS) was conducted during winters 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 herd through the mid-1990s impacted the moose population in this unit, though there was little direct competition between these ungulates. Short-term impacts of large caribou populations include decreased illegal moose harvest by local residents and increased hunting pressure by other residents and nonresidents interested in combination hunts for moose and caribou. The most significant long-term impact on moose may be the response of predator populations to abundant prey resources. Wolf numbers appeared to increase in the unit during this reporting period. There were few instances of wolves following the caribou herd, so when the herd moved out of a pack's territory, moose became the primary source of meat for wolves. The same prey shift probably happened over a larger area of the unit as the caribou herd declined (Woolington 2005). As the Mulchatna herd has declined, reduction in nonresident hunting opportunity for caribou has likely affected the number of nonresident hunters hunting moose in Unit 17.

CONCLUSIONS AND RECOMMENDATIONS

Predation by wolves and bears, and reported harvests of moose increased in recent years. Good browse conditions and a continuing series of average winters resulted in stable to increasing moose populations in Units 17A and 17C during this reporting period. The moose population exceeded the minimum goal in Unit 17A and continued to increase. Population estimation surveys during the previous and present reporting period indicate the moose population in Unit 17B is below management objectives. Population estimation surveys during previous reporting periods indicate the moose population in Unit 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 Unit 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.

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 Unit 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, Alaska, regulatory years[a] 1998–2009.

Survey area	Regulatory year	Population estimate	Moose/mi^2	Total survey (mi^2)	Moose habitat (mi^2)	Moose/mi^2	Min. % calves
Unit 17B (west)[b]	2000	1,202 (± 141)	0.22	5,524	2,932	0.41	5
	2005	1,210 (± 120)	0.22	5,524	3,140	0.39	12.5
	2009	1,137 (± 159)	0.21	5,510	3,146	0.36	8
Unit 17B (east)[c]	2001	1,953 (± 254)	0.46	4,269	2,914	0.67	4
	2008[d]	1,466 (± 424)	0.37	3,981	2,913	0.50	8
Unit 17C	1998	2,955 (± 488)	0.54	5,447	3,795	0.78	15
	2003	3,670 (± 542)	0.67	5,447	4,096	0.90	11
	2007	3,235 (± 354)	0.59	5,447	4,280	0.76	12

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1998 = 1 July 1998–30 June 1999.

[b] That area of the Nushagak River drainage upstream of the confluence of the Nushagak and Mulchatna rivers.

[c] 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.

[d] 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, Alaska, regulatory years[a] 1978–2012.

Regulatory year	Reported harvest	Hunters afield	Percent success	Unit[b]			
				17A	17B	17C	Unk
1978	65	160	41				
1979	33	68	49				
1980	89	212	42				
1981	76	209	36				
1982	49	149	33				
1983	127	293	43	0	72	48	7
1984	158	344	46	0	86	70	2
1985	148	401	37	0	94	52	2
1986	202	486	42	0	122	73	7
1987	207	499	41	0	152	42	13
1988	187	457	41	0	157	28	2
1989	175	438	40	0	122	48	5
1990	225	489	46	0	178	44	3
1991	268	590	45	0	172	85	11
1992	263	705	37	0	160	90	13
1993	249	705	35	1	150	78	20
1994	296	800	37	0	167	94	35
1995	336	881	38	0	192	109	35
1996	373	913	41	0	207	113	53
1997	347	956[c]	36	15	168	126	38
1998	389	1,048[c]	37	10	168	171	40
1999	425	1,116[c]	38	10	170	192	53
2000	373	1,112[c]	34	10	226	136	1
2001	419	1,175[c]	36	7	186	222	4
2002	404	1,147[c]	35	8	183	210	3
2003	426	1,168[c]	36	11	163	251	1
2004	383	1,204[c]	32	20	168	193	2
2005	380	1,182[c]	32	25	117	232	6
2006	384	1,103[c]	35	36	113	233	2
2007	388	1,142[c]	34	40	113	213	22
2008	353	1,230[c]	29	45	79	229	0
2009	322	1,231	26	31	81	206	4
2010	343	1,289	27	37	75	151	80
2011	349	1,279	27	50	63	236	0
2012	301	1,281	23	46	55	200	1

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1978 = 1 July 1978–30 June 1979.
[b] Harvest data not broken down by unit before regulatory year 1983.
[c] Included hunters who registered for both fall and winter registration hunts.

Table 3. Unit 17 moose antler sizes (%) in the reported harvest, Alaska, regulatory years[a] 1992–2012.

Regulatory	Antler size (%)[b]			Largest
year	<30″	30–50″	>50″	antlers (inches)
1992	6	36	57	80
1993	3	30	68	73
1994	9	29	62	73
1995	7	35	57	78
1996	9	26	65	75
1997	6	36	57	73
1998	9	35	56	74
1999	7	37	56	71
2000	8	27	65	80
2001	19	28	53	72
2002	20	35	46	69
2003	13	33	54	78
2004	15	33	52	72
2005	18	30	52	73
2006	17	38	45	76
2007	13	41	46	77
2008	5	35	59	73
2009	6	33	61	72
2010	5	38	57	70
2011	15	39	46	69
2012	12	44	44	72

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[b] Includes only those with antler size reported on harvest card.

Table 4. Unit 17 general season[a] moose hunter residency and success, Alaska, regulatory years[b] 1992–2012.

	Successful				Unsuccessful				
Regulatory year	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1992	61	79	64	212 (41)[c]	65	114	124[c]	310 (59)[c]	522
1993	21	28	93	144 (33)[d]	27	117	142[d]	292 (67)[d]	436
1994	22	41	91	161 (33)[e]	24	117	180[e]	329 (67)[e]	490
1995	23	30	115	171 (35)[f]	28	103	177[f]	314 (65)[f]	485
1996	16	35	144	196 (40)[g]	33	82	174[g]	291 (60)[g]	487
1997	13	33	100	150 (35)[h]	29	79	161	277 (65)[h]	427
1998	15	34	120	169 (32)	27	111	220	359 (68)[i]	528
1999	16	26	99	146 (29)[j]	20	91	235	358 (71)[j]	504
2000	4	41	139	184 (34)	18	98	236	353 (66)[k]	537
2001	11	27	125	169 (36)[l]	14	97	191	304 (64)[l]	473
2002	12	25	77	120 (25)[m]	19	115	217	351 (75)	471
2003	6	38	97	141 (36)	27	96	127	253 (64)[n]	394
2004	4	26	97	129 (31)[o]	20	92	169	283 (69)[p]	412
2005	12	27	61	100 (29)	21	93	130	245 (71)[q]	345
2006	12	25	38	76 (27)[r]	31	60	115	209 (73)[r]	285
2007	9	28	40	78 (28)[s]	23	70	108	205 (72)[s]	283
2008	3	23	24	51 (20)[t]	37	82	76	199 (80)[t]	250
2009	3	15	14	33 (21)[u]	29	48	39	119 (78)[u]	153
2010	3	15	29	47 (29)	29	49	36	114 (71)	161
2011	5	9	14	28 (25)	33	34	18	85 (75)[v]	113
2012	6	18	16	40 (24)	34	53	42	129 (76)[w]	169

[a] Excludes hunters in permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[c] Includes 8 successful and 7 unsuccessful hunters of unknown residency.
[d] Includes 2 successful and 6 unsuccessful hunters of unknown residency.
[e] Includes 7 successful and 8 unsuccessful hunters of unknown residency.
[f] Includes 3 successful and 6 unsuccessful hunters of unknown residency.
[g] Includes 1 successful and 2 unsuccessful hunters of unknown residency.
[h] Includes 4 successful and 8 unsuccessful hunters of unknown residency.
[i] Includes 1 unsuccessful hunter of unknown residency.
[j] Includes 5 successful and 12 unsuccessful hunters of unknown residency.
[k] Includes 1 unsuccessful hunter of unknown residency.
[l] Includes 6 successful and 2 unsuccessful hunters of unknown residency.
[m] Includes 6 successful hunters of unknown residency.
[n] Includes 3 unsuccessful hunters of unknown residency.
[o] Includes 2 successful hunters of unknown residency.
[p] Includes 2 unsuccessful hunters of unknown residency.
[q] Includes 1 unsuccessful hunter of unknown residency.
[r] Includes 1 successful and 3 unsuccessful hunter of unknown residency.
[s] Includes 1 successful and 4 unsuccessful hunters of unknown residency.
[t] Includes 1 successful and 4 unsuccessful hunters of unknown residency.
[u] Includes 1 successful and 3 unsuccessful hunters of unknown residency.
[v] Does not include 4 unsuccessful and 2 successful hunters of unknown residency.
[w] Does not include 1 successful hunter of unknown residency.

Table 5. Unit 17B general season reported moose harvest, Alaska, regulatory years[a] 1992–2012.

Regulatory year	Reported harvest M (%)		F (%)		Unk	Total
1992	152	(100)	0	(0)	0	152
1993	125	(100)	0	(0)	1	126
1994	132	(100)	0	(0)	0	132
1995	148	(100)	0	(0)	0	148
1996	171	(100)	0	(0)	0	171
1997	127	(100)	0	(0)	0	127
1998	139	(100)	0	(0)	0	139
1999	122	(100)	0	(0)	0	122
2000	165	(100)	0	(0)	0	165
2001	141	(100)	0	(0)	0	141
2002	96	(100)	0	(0)	0	96
2003	114	(100)	0	(0)	0	114
2004	107	(100)	0	(0)	0	107
2005	68	(100)	0	(0)	0	68
2006	53	(100)	0	(0)	0	53
2007	53	(100)	0	(0)	0	53
2008	34	(100)	0	(0)	0	34
2009	18	(100)	0	(0)	0	18
2010	35	(100)	0	(0)	0	35
2011	30	(100)	0	(0)	0	30
2012	39	(100)	0	(0)	1	40

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.

Table 6. Unit 17C general season[a] reported moose harvest and accidental death, Alaska, regulatory years[b] 1992–2012.

Regulatory	Harvest by hunters								Accidental	Grand
	Reported					Estimated[c]				
year	M (%)		F (%)	Unk	Total	Unreported	Illegal	Total	death	total
1992	56	(100)	0 (0)	0	56[d]	0	0	0	0	56
1993	18	(100)	0 (0)	0	18	0	0	0	0	18
1994	28	(100)	0 (0)	0	28[e]	0	0	0	1[f]	29
1995	32	(100)	0 (0)	0	32[g]	0	0	0	0	32
1996	23	(100)	0 (0)	0	23[h]	0	0	0	2[i]	25
1997	21	(100)	0 (0)	0	21[j]	0	0	0	0	21
1998	27	(100)	0 (0)	0	27[k]	0	0	0	1	28
1999	23	(100)	0 (0)	0	23[l]	0	0	0	0	23
2000	18	(100)	0 (0)	0	18[m]	0	0	0	1	19
2001	26	(100)	0 (0)	0	26[n]	0	0	0	2	28
2002	21	(100)	0 (0)	0	21[o]	0	0	0	0	21
2003	26	(100)	0 (0)	0	26[p]	0	0	0	0	26
2004	21	(100)	0 (0)	0	21[q]	0	0	0	0	21
2005	32	(100)	0 (0)	0	32	0	0	0	0	32
2006	21	(100)	0 (0)	0	21[r]	0	0	0	0	21
2007	25	(100)	0 (0)	0	25	0	0	0	0	25
2008	17	(100)	0 (0)	0	17	0	0	0	0	17
2009	15	(100)	0 (0)	0	15	0	0	0	0	15
2010	11	(100)	0 (0)	0	11	0	0	0	0	11
2011	13	(100)	0 (0)	0	13	0	0	0	0	13
2012	13	(100)	0 (0)	0	13	0	0	0	0	13

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[c] No estimates of unreported/illegal harvests have been made for this unit.
[d] Does not include 3 bulls from an unspecified portion of Unit 17.
[e] Does not include 1 bull from an unspecified portion of Unit 17.
[f] Includes 1 bull killed in defense of life or property.
[g] Does not include 3 bulls from an unspecified portion of Unit 17.
[h] Does not include 11 bulls from an unspecified portion of Unit 17.
[i] Does not include 1 cow and 1 bull killed in motor vehicle accidents.
[j] Does not include 2 bulls from an unspecified portion of Unit 17.
[k] Does not include 3 bulls from an unspecified portion of Unit 17.
[l] Does not include 1 bull from an unspecified portion of Unit 17.
[m] Does not include 1 bull from an unspecified portion of Unit 17.
[n] Does not include 2 bulls from an unspecified portion of Unit 17.
[o] Does not include 3 bulls from an unspecified portion of Unit 17.
[p] Does not include 1 bulls from an unspecified portion of Unit 17.
[q] Does not include 1 bull from an unspecified portion of Unit 17.
[r] Does not include 2 bulls from an unspecified portion of Unit 17.

Table 7. Unit 17A reported moose harvest data by permit hunt, Alaska, regulatory years[a] 1997–2012.

Hunt no.	Regulatory year	Permits issued[b]	Percent did not hunt	Percent unsuccessful hunters[c]	Percent successful hunters[c]	Bulls (%)	Cows (%)	Unk	Total harvest
RM573	1997	44	11	62	38	15 (100)	0 (0)	0	15
	1998	48	10	77	23	10 (100)	0 (0)	0	10
	1999	57	28	76	24	10 (100)	0 (0)	0	10
	2000	56	13	80	20	10 (100)	0 (0)	0	10
	2001	56	16	87	15	7 (100)	0 (0)	0	7
	2002	40	10	78	22	8 (100)	0 (0)	0	8
RM573	2003	77	21	82	18	11 (100)	0 (0)	0	11
& RM575[d]	2004	97	20	74	26	20 (100)	0 (0)	0	20
	2005	149	30	75	25	25 (100)	0 (0)	0	25
	2006	121	24	61	39	36 (100)	0 (0)	0	36
	2007[e]	181	38	64	36	40 (100)	0 (0)	0	40
	2008	213	26	72	28	45 (100)	0 (0)	0	45
	2009[f]	155	17	76	24	31 (100)	0 (0)	0	31
	2010	144	13	70	30	37 (100)	0 (0)	0	37
	2011	181	10	68	32	49 (94)	0 (0)	3	52
	2012	212	23	71	29	44 (96)	0 (0)	2	46

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1997 = 1 July 1997–30 June 1998.
[b] Registration permits were valid for only Unit 17A.
[c] Includes only those permittees reporting that they hunted.
[d] Registration hunt RM575 established beginning winter 2003–2004.
[e] Beginning regulatory year 2007, RM575 winter hunt included western portion of Unit 17C.
[f] Beginning regulatory year 2009, western portion of Unit 17C deleted from RM575 winter hunt.

Table 8. Unit 17B reported moose harvest data by permit hunt, Alaska, regulatory years[a] 1992–2012.

Hunt no.	Regulatory year	Permits issued[b]	Percent did not hunt	Percent unsuccessful hunters[c]	Percent successful hunters[c]	Bulls (%)	Cows (%)	Unk	Total harvest
RM983	1992	277	30	63	27	8 (100)	0 (0)	0	8
RM583	1993	433	19	61	39	23 (100)	0 (0)	1	24
	1994	438	18	56	44	35 (100)	0 (0)	0	35
	1995	521	21	56	44	44 (100)	0 (0)	0	44
	1996	546	20	63	37	36 (100)	0 (0)	0	36
RM583	1997[d]	629	25	63	37	41 (100)	0 (0)	0	41
& RM585	1998	634	25	69	31	29 (100)	0 (0)	0	29
	1999	749	24	53	47	48 (100)	0 (0)	0	48
	2000	685	23	61	39	61 (100)	0 (0)	0	61
	2001	814	20	72	28	41 (100)	0 (0)	0	41
	2002	794	19	66	34	83 (100)	0 (0)	0	83
	2003	880	20	69	31	47 (100)	0 (0)	0	47
	2004	878	20	75	25	60 (100)	0 (0)	0	60
RM583,	2005[e]	887	22	74	26	39 (100)	0 (0)	0	39
RM585, &	2006	841	19	61	39	54 (100)	0 (0)	0	54
RM587	2007	953	22	62	38	60 (100)	0 (0)	0	60
	2008	1,037	21	69	31	45 (100)	0 (0)	0	45
	2009	1,209	21	69	31	63 (100)	0 (0)	0	63
	2010	1,203	17	76	24	45 (100)	0 (0)	0	45
	2011	1,285	20	74	26	45 (98)	0 (0)	1	46
	2012	1,209	20	81	19	27 (96)	0 (0)	1	28

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[b] Registration permit valid for both Units 17B and 17C. Permit data are for both areas combined; harvest data are specific to Unit 17B.
[c] Of those permittees that reported hunting in Unit 17B.
[d] Beginning regulatory year 1997, includes permits issued and harvest for both fall (20 August–15 September) and winter (1–31 December) permit hunts.
[e] Beginning regulatory year 2005, includes resident (RM583 and RM585) and nonresident (RM587) registration hunts.

Table 9. Unit 17C reported moose harvest data by permit hunt, Alaska, regulatory years[a] 1992–2012.

Hunt no.	Regulatory year	Permits issued[b]	Percent did not hunt	Percent unsuccessful hunters[c]	Percent successful hunters[c]	Bulls	(%)	Cows	(%)	Unk	Total harvest
RM983	1992	277[c]	30	63	27	31[d]	(100)	0	(0)	3	34
RM583	1993	433	19	61	39	59[e]	(100)	1	(0)	0	60
	1994	438	18	56	44	65[f]	(100)	0	(0)	1	66
	1995	521	21	59	41	87[g]	(100)	0	(0)	0	87
	1996	546	20	54	46	89[h]	(99)	0	(0)	1	90
RM583 &	1997[i]	629	25	60	40	105[j]	(100)	0	(0)	0	105
RM585	1998	634	25	48	52	144[k]	(100)	0	(0)	0	144
	1999	749	24	49	51	169[l]	(100)	0	(0)	0	169
	2000	685	23	68	32	118[m]	(100)	0	(0)	0	118
	2001	814	20	60	40	200[n]	(100)	0	(0)	0	200
	2002	794	19	51	49	193	(100)	0	(0)	0	193
	2003	880	20	56	44	227	(100)	0	(0)	0	227
	2004	878	20	65	35	173	(100)	0	(0)	0	173
RM583 &	2005[o]	887	22	63	37	199[p]	(100)	0	(0)	0	199
RM585	2006	841	19	61	39	211	(100)	0	(0)	0	211
	2007	953	22	60	40	188	(100)	0	(0)	0	188
	2008	1,037	21	69	31	212	(100)	0	(0)	0	212
	2009	1,209	21	73	27	190	(97)	0	(0)	5	195
	2010	1,203	17	75	25	189	(97)	0	(0)	5	194
	2011	1,285	20	73	27	220	(99)	0	(0)	3	223
	2012	1,209	20	76	24	184	(98)	0	(0)	3	187

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[b] Registration permits valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17C.
[c] Of those permittees who reported hunting in Unit 17C.
[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] Includes permits issued and harvest for both fall (20 Aug–15 Sep) and winter (1–31 Dec) permit hunts.
[j] Not included are 36 bulls from an unspecified portion of Unit 17.
[k] Not included are 37 bulls from an unspecified portion of Unit 17.
[l] Not included are 52 bulls from an unspecified portion of Unit 17.
[m] Not included are 51 bulls from an unspecified portion of Unit 17.
[n] Not included are 2 bulls from an unspecified portion of Unit 17.
[o] Beginning regulatory year 2005, includes resident (RM583 and RM585) but not (RM587) registration hunts.
[p] 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, Alaska, regulatory years[b] 1992–2012.

	Successful				Unsuccessful				
Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Total(%)	Total hunters
1992	43	7	0	50 (27)	122	11	0	133 (73)	183
1993	84	21	0	105 (39)	130	33	0	164 (61)	269[d]
1994	106	29	0	135 (44)	128	45	0	175 (56)	310[e]
1995	117	48	0	165 (42)	131	100	0	231 (58)	396
1996	117	60	0	177 (42)	157	92	0	249 (58)	426
1997	164	33	0	197 (37)	272	60	0	332 (63)	529
1998	183	37	0	220 (42)	251	54	0	305 (58)	525
1999	221	58	0	279 (46)	262	71	0	333 (54)	612
2000	144	45	0	189 (33)	304	82	0	386 (67)	575
2001	193	57	0	250 (36)	370	82	0	452 (64)	702
2002	228	56	0	284 (42)	323	69	0	392 (58)	676
2003	214	71	0	285 (37)	407	82	0	489 (63)	774
2004	204	50	0	254 (32)	446	92	0	538 (68)	792
2005	224	45	10	279 (34)	451	80	10	541 (66)	820
2006	254	47	6	307 (38)	405	68	36	509 (62)	816
2007	260	39	11	310 (36)	469	65	15	549 (64)	859
2008	257	38	7	302 (31)	596	70	12	678 (69)	980
2009	238	41	10	289 (27)	712	62	15	789 (73)	1,078
2010	248	40	9	297 (26)	751	53	27	931 (74)	1,128
2011	268	36	13	317 (28)	735	73	22	830 (72)	1,147[f]
2012	214	35	12	261 (24)	742	74	24	840 (76)	1,101[g]

[a] Includes only permittees who reported hunting.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[c] Unit 17 residents.
[d] Includes 0 successful and 1 unsuccessful hunter of unknown residency.
[e] Includes 0 successful and 2 unsuccessful hunters of unknown residency.
[f] Does not include 1 successful and 1 unsuccessful hunters of unknown residency.
[g] Does not include 1 successful and 4 unsuccessful hunters of unknown residency.

Table 11. Unit 17 reported general season moose harvest[a] chronology percent by month, Alaska, regulatory years[b] 1992–2012.

Regulatory	Harvest periods (%)									
year	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep	21–30 Sep	1–10 Dec	11–20 Dec	21–31 Dec	Unk	*n*[c]
1992[d]	0	3	44	41	0	2	2	4	3	212
1993[e]	1	2	54	35	0	0	1	1	6	144
1994	1	3	47	37	3	1	2	3	5	161
1995	1	2	55	32	0	0	1	1	9	171
1996	1	2	63	27	0	1	0	2	6	196
1997	0	1	55	36	0	1	1	1	5	150
1998	0	2	60	35	0	0	0	0	2	169
1999	0	3	51	42	0	2	0	1	1	146
2000	0	0	55	40	0	0	0	0	5	184
2001	0	3	57	38	0	1	1	0	1	169
2002	0	2	55	38	0	0	1	0	3	120
2003	0	0	57	39	0	0	0	0	4	141
2004	0	0	50	46	0	0	0	0	4	129
2005	0	0	56	41	0	0	0	0	9	100
2006	0	0	42	53	0	0	0	0	5	76
2007	0	0	40	56	0	0	0	0	4	78
2008	0	0	37	57	0	0	0	0	6	51
2009	0	0	43	55	0	0	0	0	3	33
2010	0	0	43	57	0	0	0	0	0	47
2011	0	0	53	47	0	0	0	0	0	30
2012	0	5	59	30	0	0	0	3	3	40[f]

[a] Excludes permit hunt harvest.

[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.

[c] Reported harvest.

[d] Regulatory year 1992 general season dates: Unit 17B (upstream): 1–20 September; Unit 17B (remainder): Residents 1–20 September and 1–31 December, Nonresidents 5–15 September; Unit 17C (Iowithla, etc.): Residents 1–15 September; Unit 17C (remainder): Residents 1–15 September and 1–31 December.

[e] Regulatory year 1993 to present general season dates: Unit 17B Residents: 1–15 September, Nonresidents: 5–15 September; Unit 17C Residents: 1–15 September.

[f] Includes 1 bear of unknown harvest date.

Table 12. Unit 17 reported moose harvest chronology percent for permit hunts, Alaska, regulatory years[a] 1992–2012.

Regulatory year	Harvest chronology for permit hunts (%)									
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep	21–30 Sep	1–10 Dec	11–20 Dec	21–31 Dec	Other/ Unk	n[b]
1992[c]	20	72	2	0	0	0	0	0	6	50
1993[d]	9	40	19	10	2	3	6	5	8	105
1994[d]	7	30	29	10	1	2	7	8	6	135
1995[d]	15	33	26	14	1	2	1	4	6	165
1996[d]	7	33	23	20	1	2	5	3	5	177
1997[e]	6	35	16	21	0	2	4	11	5	197
1998[e]	10	44	22	14	0	1	1	6	2	220
1999	13	44	16	13	0	1	4	4	6	279
2000	17	32	24	19	0	2	1	1	5	189
2001	11	46	21	10	0	2	2	7	1	250
2002	12	41	20	15	0	6	1	1	3	284
2003	14	44	20	13	0	1	2	4	2	285
2004	8	33	16	22	0	5	5	5	5	254
2005	6	42	23	20	0	1	1	1	5	277
2006	15	34	19	17	0	1	4	10	1	306
2007	13	26	20	24	0	1	3	8	5[f]	310
2008	11	22	15	25	0	1	6	13	8[g]	302
2009	6	24	21	29	0	5	5	6	4	289
2010	12	22	21	25	0	5	4	9	4[h]	297
2011	9	23	17	21	0	7	8	12	10	319
2012	4	19	28	25	0	2	5	8	5	261[i]

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.
[b] Reported harvest.
[c] Registration permits valid for 20–31 August.
[d] Registration permits valid for any bull, 20 August–15 September and 1–31 December.
[e] Registration permits valid for any bull; Unit 17A: 25 August–20 September; Unit 17B and 17C: 20 August–15 September and 1–31 December.
[f] Includes 8 bulls taken 2–15 January in Units 17A and western 17C.
[g] Includes 21 bulls taken 5–18 January in Units 17A and western 17C.
[h] Includes 5 bulls taken 1–10 January in Unit 17A.
[i] Includes 11 moose taken in January that do not appear in this table.

Table 13. Unit 17 reported general season moose harvest[a] percent by transport method, Alaska, regulatory years[b] 1992–2012.

Regulatory year	Harvest percent by transport method								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1992	64	0	29	0	2	0	1	3	212
1993	71	0	26	0	9	0	0	1	144
1994	71	0	22	0	2	0	1	3	161
1995	64	0	33	1	1	0	1	1	171
1996	68	0	29	0	2	0	1	1	196
1997	65	0	30	1	3	0	1	0	150
1998	67	0	32	0	1	1	0	1	169
1999	61	0	36	0	3	0	0	0	146
2000	75	0	23	0	0	0	0	2	184
2001	64	0	34	1	0	0	0	1	169
2002	61	0	38	1	0	0	0	1	120
2003	70	0	29	1	0	0	0	0	141
2004	75	0	23	1	0	0	0	1	129
2005	66	0	28	3	0	0	0	3	100
2006	63	0	33	0	0	0	0	4	76
2007	62	0	32	3	0	1	0	3	78
2008	63	0	35	0	0	0	0	2	51
2009	58	0	42	0	0	0	0	0	33
2010	75	0	23	2	0	0	0	0	47
2011	100	0	0	0	0	0	0	0	30
2012	61	0	30	2	0	0	2	5	40

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.

Table 14. Unit 17 reported moose harvest by permit hunt, percent by transport method, Alaska, regulatory years[a] 1992–2012.

Regulatory year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Total moose
1992	9	0	83	1	0	1	1	5	50
1993	15	0	73	0	6	0	4	3	105
1994	18	0	59	0	12	0	3	8	135
1995	25	0	68	0	4	0	1	2	165
1996	26	0	63	0	6	0	2	3	177
1997	8	1	73	0	16	0	1	2	197
1998	5	0	81	3	6	0	0	5	220
1999	11	0	74	1	9	0	2	2	279
2000	13	0	78	1	3	0	1	4	189
2001	10	0	74	1	10	0	1	4	250
2002	12	0	82	1	1	1	2	2	284
2003	11	0	79	1	7	1	1	1	285
2004	6	0	72	3	16	0	0	2	254
2005	12	0	79	1	3	0	1	3	277
2006	4	0	76	2	14	1	2	1	307
2007	5	0	75	2	14	1	2	1	310
2008	8	0	59	2	27	0	2	1	302
2009	10	0	66	4	15	0	2	3	303
2010	6	0	68	1	21	0	1	3	298
2011	6	0	61	1	28	0	1	2	319
2012	7	0	62	0.5	20	0	0.5	10	262

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 1992 = 1 July 1992–30 June 1993.

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CHAPTER 20: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

LOCATION

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Moose are thought to have begun moving into 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 to moderate and growing in the lower Kuskokwim River drainage. Low numbers are also reported in the southwestern portions of the unit (Aderman and Woolington 2001). 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 had 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 Alaska Department of Fish and Game has been working cooperatively with local leaders and other agencies for more than a decade on strategies to increase the moose population within the Kuskokwim River drainage. Acting on a cooperative strategy that focused on a 5-year moratorium on hunting, the Lower Kuskokwim Fish and Game Advisory Committee (LKAC) voted unanimously to submit a proposal to the Board of Game to initiate the moratorium beginning in the fall of 2004. Anecdotal evidence later suggested that the population had increased and surveys conducted in January and February of 2008 estimated a minimum of 668 moose on the Kuskokwim drainage. In November of 2008, the LKAC made an Agenda Change Request (ACR) to the BOG to open the season on the Kuskokwim Drainage within Unit 18 to a short 10-day season in fall of 2009. The Board approved a registration hunt for September 1–10.

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 refuge and we regularly cooperate during surveys, field projects, and public meetings.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Allow the Unit 18 moose populations to increase to the levels the habitat can support.
- Maintain healthy age and sex structures for moose populations within the Yukon and Kuskokwim River drainages.
- Determine population size, trend, and composition of Unit 18 moose populations.
- Achieve a continual harvest of bulls without hindering population growth.
- Improve harvest reporting and compliance with hunting regulations.
- Minimize conflicts among user groups interested in moose within and adjacent to Unit 18.

MANAGEMENT OBJECTIVES

- Allow the lower Yukon River moose population to increase above its estimated size of 2,500–3,500 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 each of 2012 and 2013, we conducted a moose population survey in January and February in the Andreafsky (Middle Yukon) and Paimiut count areas using the Geospatial Population Estimator (GSPE) method developed by Ver Hoef (2001), also described by Kellie and DeLong (2006). 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 (Middle Yukon) 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.

These survey areas are small compared to other areas in the state. This was done to achieve cost savings, safety, and other efficiencies and to allow us to conduct a census in more than one area per year. Table 1 lists the size of the areas surveyed during each census and Figure 1 depicts the larger survey areas. Table 1 also lists the methods used to assess moose abundance in Unit 18, spatial methods during the reporting period, and 'minimum count' or 'Gasaway methods' in previous periods (Gasaway et al. 1986). We plan to conduct GSPE surveys in 2 areas per year and alternate with the remaining 2 areas in the following year.

We continued the cooperative strategy to establish and expand the moose population along the Lower Kuskokwim River, working 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 (USFWS). This began with a LKAC proposal to the BOG to close moose hunting in the Lower Kuskokwim for 5 years starting the fall of 2004, followed by a 5-year hunting closure during 2004–2008, and continued with management of quota-based registration permit hunts during the reporting period.

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 in Bethel and Aniak.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In January and February 2012 and 2013, we conducted moose population estimates in the Middle Yukon (Andreafsky) and Paimiut count areas, respectively (Table 1). Unless otherwise noted, the following results are reported at the 95% confidence interval (CI).

The moose population in Middle Yukon count area grew from an estimate of 418 ± 22.4% in 2002 to 2,748 ± 16.6% moose in 2012. The density of this moose population has changed from 0.4 moose/mi^2 in 2002 to 2.4 moose/mi^2 in 2012.

The moose population in Paimiut count area grew from an estimate of 3,614 ± 18.1% in 2006 to 5,597 ± 14.9% moose in 2013. The density of this moose population has changed from 2.3 moose/mi^2 in 2006 to 3.6 moose/mi^2 in 2013.

Population Composition

In November 2013 we were able to classify bulls, cows, and calves in the Lowest Yukon and Lower Kuskokwim count areas (Table 2). Adequate survey conditions are present only every 3 or 4 years so these surveys are not conducted on an annual basis, only as conditions allow. Moose calf survival was extremely high in the Lower Kuskokwim count area. This area also had a high bull to cow ratio, probably due to the fact that it had not been hunted 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 (Eric Wald, Yukon Delta NWR Biologist, USFWS, personal communication, 2010).

We have some radiotelemetry data which show that moose are entering Unit 18 from adjacent Unit 17. These moose appear to be colonizing the southern drainages of Unit 18, including the Goodnews and Kanektok river drainages where TNWR staff observed 204 moose in March 2011. We also have reports from local residents of increasing numbers of moose in this area. (Andy Aderman, Togiak NWR Biologist, 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. RY11 = 1 July 2011–30 June 2012). The bag limit in most of 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 have been 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 *RY11* Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18 Kuskokwim Area, east of a line from the mouth of the lshkowik River to Dall Lake, then to the Johnson River at its entrance into Nunavakanukakslak Lake (N 60° 59.41 ' Lat; W 162° 22.14' Long), then upstream 1/2 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 by registration permit only (RM615)	1 Sep – 10 Sep	No open season
Unit 18, that portion south of and including the Goodnews River drainage		
1 antlered bull by registration permit only (RM620)	1 Sep – 30 Sep	No open season
Unit 18, that portion south of the Eek River drainage and north of the Goodnews River drainage:		

Regulatory year *RY11* Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 antlered bull	1 Sep – 30 Sep	No open season
Unit 18, Lower Yukon Area, that portion north and west of the Kashunuk River including the north bank from the mouth of the river upstream to the old village of Chakaktolik, west of a line from Chakaktolik to Mountain Village, excluding all Yukon River drainages upriver from Mountain Village		
1 antlered bull; or	10 Aug – 30 Sep	1 Sep – 30 Sep
1 moose	20 Dec – 28 Feb	No open season
Remainder of Unit 18		
1 antlered bull; or	10 Aug – 30 Sep	1 Sep – 30 Sep
1 antlered bull	20 Dec – 10 Jan	No open season

Regulatory year *RY12* Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit **18** Kuskokwim Area, east of a line from the mouth of the lshkowik River to Dall Lake, then to the Johnson River at its entrance into Nunavakanukakslak Lake (N 60° 59.41 ' Lat; W 162° 22.14' Long), then upstream 1/2 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 by registration permit (RM615)	1 Sep – 10 Sep	No open season
Unit 18 that portion south of and including the Goodnews River drainage		
1 antlered bull by registration permit (RM620)	1 Sep – 30 Sep	No open season
Unit 18, that portion south of the Eek River drainage and north of the Goodnews River		

Regulatory year *RY11* Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 antlered bull	1 Sep – 30 Sep	No open season
Unit 18, Lower Yukon Area, that portion north and west of the Kashunuk River including the north bank from the mouth of the river upstream to the old village of Chakaktolik, west of a line from Chakaktolik to Mountain Village, excluding all Yukon River drainages upriver from Mountain Village		
2 moose; only one of which may be an antlered bull, taking of cows accompanied by calves or calves is prohibited; or	1 Aug – 30 Sep	No open season
2 antlerless moose	1 Oct – 28 Feb	No open season
1 antlered bull		1 Sep – 30 Sep
Unit 18, Remainder		
1 antlered bull; or	10 Aug – 30 Sep	No open season
1 moose	20 Dec – 28 Feb	No open season
1 antlered bull		1 Sep – 30 Sep

Board of Game Actions and Emergency Orders. At the November 2010 BOG meeting effective in RY11, the board changed the hunt area boundaries of the Kuskokwim Area and Lower Yukon Area, and added a registration permit requirement for residents hunting in the Kuskokwim Area (RM615) and that portion south of and including the Goodnews River drainage (RM620). At the November 2011 BOG meeting the board extended the seasons and liberalized the bag limits in both the Lower Yukon Area and Unit 18 Remainder hunt areas. The department issued two EOs in early February 2012 that made these changes effective for the remaining portion of the RY11 season. In one EO we increased the bag limit in the Lower Yukon Area from 1 to 2 moose. In the hunt that is described as the Remainder of Unit 18, we changed the bag limit from an antlered bull to any moose and added additional hunting opportunity from 11 February to 29 February. .

Human-Induced Harvest.

General Season Harvest. During the RY11 general season, 861hunters reported a harvest of 546 moose**.** For RY12, 909 hunters reported a harvest of 527 moose. This shows a stabilized trend in hunting with slightly fewer general season hunters taking similar numbers of moose compared to RY09–RY10 (Table 3). The hunt statistics for the permits 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/reports, the willingness of most hunters to harvest only bulls, and the successful cooperative effort that resulted in both a huntable moose population below Mt. Village and greater public confidence in the regulatory system. However, there are hunters who do not report; consequently, reported moose harvests from Unit 18 should be regarded as minimum estimates.

The majority of the reported Unit 18 moose harvest comes from the Yukon River drainage, which accounted for approximately 80% (545 moose) of the reported harvest in RY11 and 82% (509 moose) in RY12. The other moose reported harvested were either in the new Kuskokwim River drainage hunt (116 moose in RY11 and 101 in RY12) or in the Goodnews drainage where 17 and 13 were harvested.

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-six and 53 hunters obtained RM620 registration permits in RY11 and RY12, respectively. In RY11, 5 reported that they did not hunt, 18 were successful, and 19 hunted but were not successful. In RY12, 10 reported that they did not hunt, 13 were successful, and 24 were not successful. Almost all hunters used boats to access the area.

For the RM615 permit, 1,573 and 1,455 potential hunters obtained registration permits in RY11 and RY12, respectively. In RY11, 292 did not hunt, 1,171 reported that they did hunt, and 117 harvested moose. In RY12, 241 did not hunt, 1,130 reported hunting, and 102 harvested moose (Table 4). The success rate in RY11 was 10% and 9 % in RY12.

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 861 hunters who participated in the general season hunts during the RY11 season, 31 were nonresidents. Of 909 hunters who participated during the RY12 season, 42 were nonresidents.

This is a higher number than in the past and is due to federal refuge lands becoming open to residents and nonresidents of the state in the Yukon drainage. 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 63% for RY11 and 58% for the RY12 seasons. Registration permit hunt success rates were 10% in RY11 and 9 % in RY12. . Successful hunters spent an average of 4.9 days hunting in RY11 and 5.1 days in RY12.

On the Kuskokwim River, many of the residents who hunted moose between Kalskag and McGrath (in Unit 19) have been 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 subsistence permits. On the Yukon River, Unit 18 residents had 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. Winter harvest has increased to approximately 25% of annual harvest (Table 5).

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 probably remained stable in the northern part of the unit and increased during this reporting period on the Kuskokwim drainage. 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 and moose are the main prey item for wolves and wolf distribution is not exclusively 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

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 five 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). Hunting and harvests have continued at similar levels and 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 priorities 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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While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

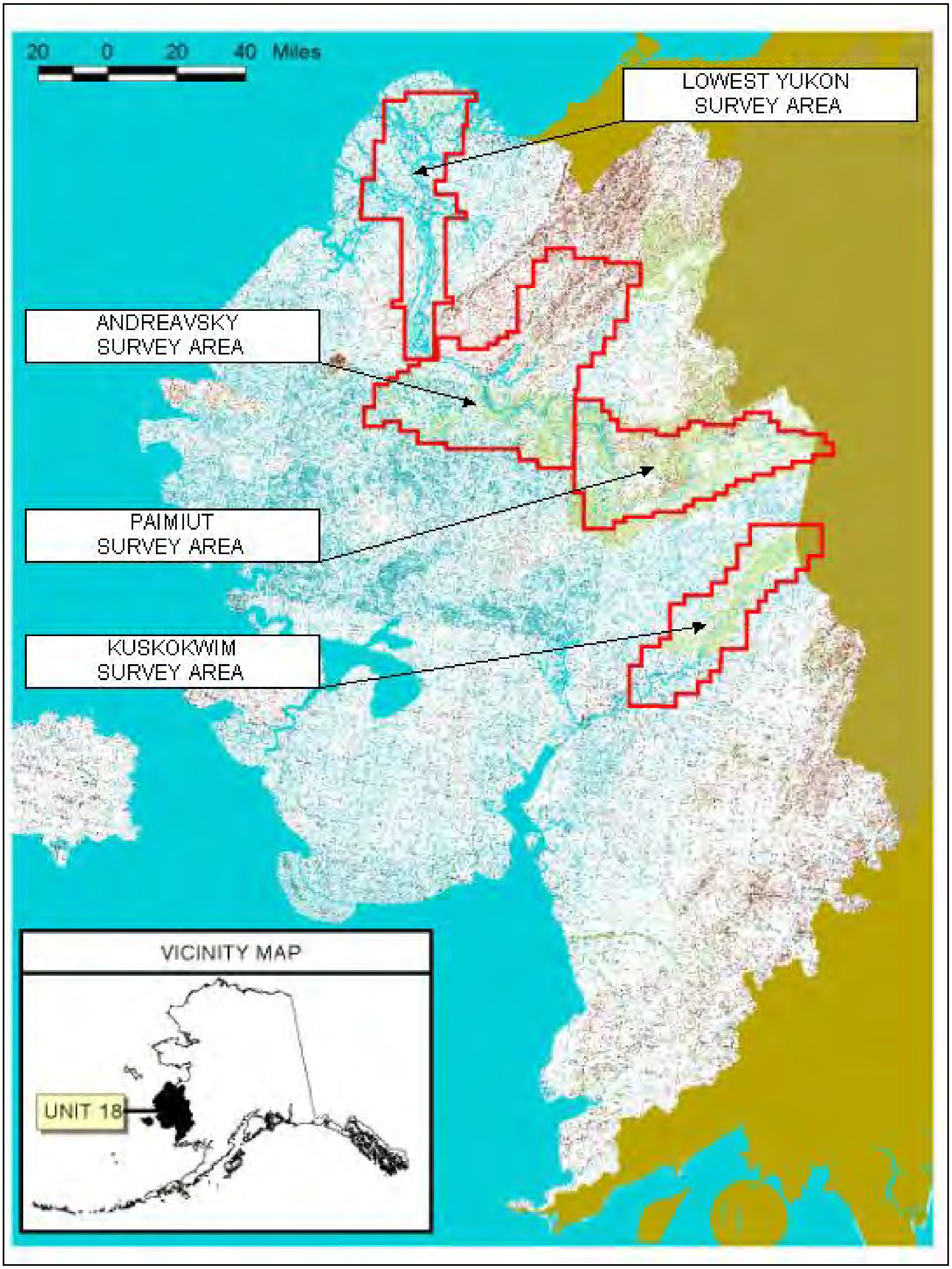

Figure 1. Unit 18 showing geostatistical population survey areas (Ver Hoef style survey areas).

Table 1. Unit 18 moose population estimate history, 1988 through 2013.

Survey Area	Year	Area (mi^2)	Estimate at 95%CI	Density ($moose/mi^2$)	Census Technique
Lowest Yukon	1988	1703	0	NA	Minimum count
	1992	1703	28	< 0.1	Minimum count
	1994	1703	65	< 0.1	Minimum count
	2002	1151	674 ± 21.9%	0.7	Spatial method
	2005	1193	1341±21.0%	1.1	Spatial method
	2008	1193	2827±11.9%	2.5	Spatial method
	2008	1193	3230±21.0%	2.7	Spatial with SCF [a]
Andreafsky	1995	1393	52 ± 74.0%	< 0.1	Gasaway method
	1999	2279	524 ± 29.8%	0.2	Spatial method
	2002	1150	418 ± 22.4%	0.4	Spatial method
	2012	1150	2748±16.6%	2.4	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
	2013	1571	5597± 14.9%	3.6	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.

Table 2. Moose composition surveys, Unit 18, November 2013.

Survey Area	Calves:100 Cows	Bulls:100 Cows
Lower Kuskokwim	72	41
Lowest Yukon	48	40

Table 3. Number of hunters and reported general season harvest in Unit 18, RY93 through RY12.

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
RY 11	861	546
RY 12	909	527

Table 4. Unit 18 Moose registration permit hunts, RY08 through RY12.

	RM615			RM620		
RY	Permits issued	Hunted	Harvested	Permits issued	Hunted	Harvested
RY08	NA	NA	NA	40	35	13
RY09	1,397	1,042	110	45	33	10
RY10	1,527	1,149	102	48	44	11
RY11	1,573	1,171	116	46	36	17
RY12	1,455	1,130	101	53	37	13

Table 5. Fall and winter moose harvests for Unit 18, all hunts RY85 through RY12.

	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]
RY 11	469	69	166	24	43	6	678[b]
RY 12	401	64	146	23	76	12	623[b]

[a]Total general season harvest plus RM620 Registration permit harvests

[b]Total General season harvests plus RM620 and RM615 Registration permit harvests.

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CHAPTER 21: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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 20th 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 same means. Nonresident closed areas established within 2 miles of most major rivers in

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

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 lead to the creation of the Central Kuskokwim Working Group, made up of representatives of multiple user groups, and the development the *Central Kuskokwim Moose Management Plan* (CKMMP), which was finalized in June 2004 and still guides moose management decisions in Units 19A and 19B. Similar public input has been accomplished in Unit 19D, largely through the McGrath Fish and Game Advisory Committee, and since 1995 much of this input focused on predator control.

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 micromanagement area (EMMA), a 528 mi^2 area of eastern Unit 19D, was established within an approximately 20 mile radius of McGrath. This area, renamed the bear control area (BCA) in 2009 and the bear control focus area (BCFA) in 2014, 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 (BOG) adopted a wolf control implementation plan for Unit 19D East. BOG updated and/or reauthorized the plan in January 2000, March 2001, March 2003, January 2006, May 2006, and March 2009 when the upper Kuskokwim villages moose management area was established (UKVMMA; Fig. 2).

Similarly, in Unit 19A, BOG adopted a wolf predation control implementation plan in March 2004 with updates and/or reauthorizations in January 2006, May 2006, and March 2009, when the central Kuskokwim villages moose management area (CKVMMA) was established (Fig. 3).

Wolf, black bear, and grizzly bear 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; research efforts undertaken; and despite wide local support for predator control, legal challenges to these programs remain. Efforts to increase the moose populations in Unit 19 characterize the most important management responsibilities in the McGrath office.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Work toward achieving the intensive management moose population and harvest objectives for Units 19A, 19B and 19D.
- Maintain population indices in Unit 19C consistent with stable or increasing moose numbers.
- In Unit 19A and Unit 19D East, reduce predation on moose through predation control activities.

MANAGEMENT OBJECTIVES

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 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 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 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 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, 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 (Unit 19A West [Aniak]); and during March 2008 and 2011 in the eastern 3,874 mi^2 of this area (Unit 19A East [Holitna]; Fig. 4). All survey units (SU) 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 (SCF) were not obtained for these surveys except during the March 2011 survey in Unit 19A East (Holitna) (Paragi and Kellie 2011a). To estimate sightability for the March 2011 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 were 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 BCFA; 2) the 1,118 mi^2 UKVMMA; and 3) the 5,313 mi^2 moose survey area (Fig. 2). With the exception of the 2003 EMMA (now called BCFA) estimate, all estimates of moose numbers in Unit 19D are based upon GSPE techniques. The 2-strata Gasaway method (Gasaway et al. 1986) was used for estimating moose numbers in the EMMA during 2003. Estimates of total numbers of moose in Unit 19D generally include yearly 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, including the BCFA, which overlaps this drainage (Holitna trend count area [TCA]); 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 TCA); and in Unit 19C in the Farewell area, generally from the Farewell airport east to the South Fork Kuskokwim River then northerly approximately 12 miles to the second moraine, then back to the Farewell airport (Farewell TCA). 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 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.

To determine twinning rates in Unit 19A in May 2013, we recorded opportunistic sightings of cows with calves on one day during our bear control effort within BCFA in Unit 19A (Fig. 3). This included a systematic search similar to that described above but involved 4 PA-18 type aircraft and over 25 aircraft hours of search time.

We estimated annual harvest using data from mandatory harvest report cards. This included data from report cards from general season harvest tickets, and registration, federal permits, 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., RY12 = 1 July 2012–30 June 2013). 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 conducted aerial 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

Units 19A and 19B. Moose population estimation surveys using GSPE techniques have been conducted in portions of Unit 19A 5 times since February 2005 (Table 1a). 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 the within Unit 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.

Moose population abundance has not been measured in Unit 19B, but densities are likely at or below those found in Unit 19A.

Unit 19D. Moose numbers were estimated using GSPE techniques in November 2011 and 2012 within BCFA and UKVMMA (Tables 1b and 1c). Within BCFA, we estimated 835 (±21%; 90% CI) moose in 2011 and 612 (±19%; 90% CI) in 2012 and within UKVMMA, we estimated 1,647 (±18%; 90% CI) in 2011 and 1,337 (±15%; 90% CI) in 2012. Confidence intervals overlap and no trend between these years is detected.

Unit 19C. GSPE moose population estimation surveys have not been 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. In November 2013 during a composition survey in the Aniak TCA we classified 147 moose including 82 cows, 31 bulls, and 34 calves (Table 2b).

In the November 2013 moose composition surveys in the Holitna TCA we observed 244 moose; ratios were 55 bulls:100 cows; 25 yearling bulls:100 cows; and 50 calves:100 cows (Table 2c). The ratio of 50 calves:100 cows in 2013 is the highest ratio recorded since 1996. We speculate that the higher calf:cow ratio is a result of reduced bear numbers following our bear control effort in May 3013.

Unit 19C. No composition surveys were conducted in the Farewell TCA during 2011 or 2012 due to unfavorable weather and other priorities. Results from previous surveys are in Table 2a.

Unit 19D. Within BCFA in 2011 among 335 moose classified, there were 31 bulls:100 cows; 12 yearling bulls:100 cows; and 49 calves:100 cows and in 2012 among 308 moose classified, there were 28 bulls:100 cows; 6 yearling bull:100 cows; and 47 calves:100 cows. These ratios are similar to those observed since 2001 (Table 1b). Similar composition data were obtained in the UKVMMA (Table 1c) except that in 2012, among 650 moose classified, there were 38 bulls:100 cows which was higher than the 28 bulls:100 cows ratio in BCFA and there were 35 calves:100

cows which was lower than the 47 calves:100 cows in BCFA. Moose population composition in moose survey area 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 2001–2013. Twinning rates of radiocollared cows are reported separately from randomly observed cows because our radiocollared sample is biased toward higher reproductive age classes. The twinning rate in – was 34% and in RY12 it was 22% with a 2-year average of 28% suggesting that the habitat is capable of supporting higher moose populations (Boertje et al. 2007). However, the 22% twinning rate observed in RY12 was the lowest observed.

Moose Movements

Radiotelemetry locations during 2003–2005 in Units 19A and 19B showed that most moose did not move great distances from their capture locations. The few moose that moved considerable distances moved south and wintered in Unit 17. In Unit 19C fewer moose are found in the Farewell TCA 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 BCFA as part of mortality research generally remained within 25–30 miles of their capture location and were nonmigratory.

Cow moose radiocollared in the spring 2013 within or near BCFA in Unit 19A generally remained within this area. However, of 22 cows with calves that were relocated in late October through early November, 9 were found as far as 10 miles outside this area, including 5 of 6 moose radiocollared along the main stem of the Kuskokwim between Sleetmute and Stony River which were relocated in the fall in burned areas of the hills north of the Kuskokwim River.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 19 for RY12 through RY13 were:

Units and Bag Limits	Open Seasons
Unit 19A, Lime Village management area, that portion drained by the Stony River from the mouth of the Stink River, including the Stink River drainage upstream to, but not including the Can Creek drainage.	
RESIDENT HUNTERS: 2 antlered bulls by Tier II permit TM684; or	10 Aug–25 Sep
2 antlered bulls by Tier II permit TM684.	20 Nov–31 Mar
NONRESIDENT HUNTERS:	No open season
Unit 19A, Kuskokwim River drainage downstream of and including the George River drainage and downstream of and excluding the Downey Creek drainage.	
RESIDENT HUNTERS: 1 antlered bull by Tier II permit TM680	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season

Units and Bag Limits	Open Seasons
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; or	1 Sep–20 Sep
1 bull by registration permit RM655.	1 Feb–28 Feb
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.	1 Sep–20 Sep
Unit 19D, that portion 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
Unit 19D, 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
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 Feb. 1–Feb. 28, a season may be announced by emergency order.	(to be announced)
NONRESIDENT HUNTERS:	No open season

Alaska Board of Game Actions and Emergency Orders. Moose hunting regulations did not change during RY11 and RY12. However, in RY13, after discussions with the McGrath Fish and Game Advisory Committee, we chose not to request reauthorization of the winter registration permit moose hunt which could have been announced if the need for additional harvest were to arise.

In February 2014 the wolf control implementation plan for Unit 19D East was updated and adopted as the operational plan for intensive management of moose in Unit 19D East (RY14–RY19) as BOG established a moose density objective for BCFA of 2.0 moose/mi^2 and a harvest objective of 180 for the wolf control focus area (WCFA; Fig. 1). They also eliminated UKVMMA (Fig. 2) and reauthorized the plan through June 2020.

Also in February 2014 the wolf predation control implementation plan for Unit 19A was updated and adopted as the operational plan for intensive management of moose in Unit 19A (RY14–RY19) as BOG established a moose density objective for BCFA of 2.0 moose/mi^2 and a harvest objective of 120 moose for WCFA (Fig. 3). CKVMMA was eliminated as a management area but retained as WCFA where aerial wolf control was permitted, and the plan was reauthorized through June 2020.

Harvest by Hunters. The overall reported harvests in Unit 19 were 321 and 357 moose in RY11 and RY12, respectively (Table 4a). Moose harvest increased (49%) from RY11 to RY12 in Unit 19A. In Unit 19B harvest was steady, but remained low. Harvest increased by 28% in Unit 19C but fell by 20% in Unit 19D (Tables 4b–4e). A few moose were reported taken in Unit 19, but reported location information is missing or does not allow identification of subunit (Table 4f). Nearly all moose reported taken were bulls, consistent with bulls-only bag limits. Some cows were likely taken illegally, but the number is difficult to estimate.

Permit Hunts. The 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 RY11 and RY12, a total of 4 moose were taken under TM684 and 5 bulls were taken under RM655.

In western Unit 19A, TM680 permittees reported taking 65 moose in RY11 and 93 in RY12. A federal permit hunt (FM019) for local rural resident hunters is also held on federal public lands within the TM680 hunt area. Harvest federal data are taken partly from a database using ADF&G's Wildlife Information Network, and partly from personal communication with refuge staff; harvest reporting for FM019 is incomplete and these data should be considered minimums. 12 bulls were reported on this federal permit in RY11 and 22 in RY12 (Table 5).

In Unit 19D during RY08–RY12, an annual average of 303 permittees took an average of 107 bulls using the RM650 permit (Table 5). Hunters reported taking 128 moose in RY11 and 103 in RY12.

Hunter Residency and Success. Hunter residency and success during RY08–RY12 were subdivided by local resident, nonlocal resident, and nonresident hunters (Tables 6a–6e). Hunter success in Unit 19 was 45% in RY11 and 46% in RY12, up from 35% in RY08 and RY09 (Table 6a).

Hunter success in Unit 19A improved from a low of 25% in RY08 and RY09, to 34% in RY11 and 50% in RY12 (Table 6b). Increased hunter success, especially in RY12 may be due to an increase in moose numbers, but speculation should be reserved pending additional survey data.

In Unit 19B, success rates were 31% in RY11 and 41% in RY12 compared with 27% in RY08 (Table 6c). Also, the number of hunters declined from 107 in RY08 to 48 in RY11 and 44 in RY12. Moose antler restrictions and a much smaller caribou herd, which drew fewer hunters seeking combination moose and caribou hunts, may explain much of this decline.

In Unit 19C, success rates improved from 43% in RY08 to 59% in RY12 and 73% in RY12. Total number of moose taken also increased from 53 in RY08 to 76 in RY11 and 97 in RY12. The number of hunters also increased from 120 hunters in RY08 to 128 in RY11 and 171 in RY12 (Table 6d).

Success rates in Unit 19D varied within the last 5 years from a low of 38% in RY12 to a high of 49% in RY11. Total moose taken was at its highest during this period in RY11 with 149 moose reported (Table 6e).

In Units 19A and 19D, residency restrictions eliminated or reduced nonresident hunting. In Unit 19A, nonresidents reported taking 1 moose in RY12 even though nonresident seasons were closed and this report, as well as reports from RY09 and RY10, are likely misreported (Table 6b). In Unit 19D, 6 nonresidents reported taking moose in RY11 and 4 in RY12 (Table 6e).

Nonresidents continued to take a substantial portion of the harvest in Units 19B and 19C. In Unit 19B, 22 of 33 moose reported taken during RY11 and RY12 were taken by nonresidents (Table 6c). In Unit 19C, 69 of 173 moose taken during RY11 and RY12 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 historically been dominant and remained so throughout RY11 and RY12.

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 RY11, 6 bulls and 8 cows were taken and 7 unsuccessful hunts were reported in Unit 19A, and 1 cow was taken in 1 reported hunt in Unit 19D. During RY12, 10 bulls and 6 cows were taken and 5 unsuccessful hunts were reported in Unit 19A, and 2 cows and 1 unsuccessful hunt were reported in Unit 19D.

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.

Other known mortality includes an unusual report of a moose killed in defense of life and property as the homeowner was attempting to scare the moose away from his fish drying rack where the moose was eating the hanging fish. After other hazing attempts failed, the homeowner shot at the moose with light shot from a small bore shotgun, which is typically not thought to be lethal but in this case, it was.

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 2011b). 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 41 inches in April 2012, and 26 inches in April 2013 (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). The 28% 2-year average twinning rate during RY11 and RY12 suggests that habitat is not limiting. However, the RY12 twinning rate was the lowest recorded but it followed the deep snow winter of RY11 (Fig. 5) and the deep snow explains the lower twinning rate better than changing habitat.

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 occur regularly over large areas of diverse vegetation types in Unit 19.

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 possible exception of Unit 19D near McGrath, the available browse is generally underutilized, particularly in Unit 19A.

CONCLUSIONS AND RECOMMENDATIONS

The combined Units 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 harvest of 96 moose in RY11 and 139 in RY12 in Units 19A and 19B (Tables 4b and 4c) are well below the intensive management harvest objective of 750–950 moose.

We could not detect a change in moose numbers in Unit 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). However, harvest in western Unit 19A has increased (Table 5) and our population data is becoming outdated. We recommend obtaining an estimate of moose numbers within this area as soon as resources become available.

We also could not detect a change in moose numbers in Unit 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.

Persistent low moose densities in Unit 19A East (Holitna), even though aerial wolf control is being applied, prompted BOG to authorize lethal removal of black and grizzly bears during May 2013 and 2014. Documenting a numerical response to predator removal is a priority and we recommend maintaining radio collars on moose within the Holitna River drainage to obtain sightability estimates to better evaluate moose numbers.

We met our objective of at least 20–30 bulls:100 cows in Unit 19A. The November 2013 bull:cow ratio was 38 bulls:100 cows in the Aniak TCA (Table 2b) and 55 bulls:100 cows within the Holitna TCA (Table 2c).

We achieved our fall calf composition objective of a minimum of 30–40 calves:100 cows in Unit 19A in November 2013 with 41 calves:100 cows in the Aniak TCA (Table 2b) and 50 calves:100 cows in the Holitna TCA (Table 2c).

We did not complete late winter surveys in Unit 19A during RY11 and RY12; therefore we do not know whether we achieved our objective of no fewer than 20% calves. During our most recent survey in March 2011, we did not achieve this objective in the Unit 19A East (Holitna) survey area where we estimated 15% calves.

No composition data have 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 not achieved in RY10 (29 bulls:100 cows), which was the last time we conducted a composition survey. Even though we did not achieve this objective, the difference is small. Additionally, harvest and success rates have increased (Table 6d) suggesting higher moose numbers 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. The moose population is likely below the objective of 4,000–6,000 within the remainder of Unit 19D, as well. Reported harvests of 149 and 119 moose in Unit 19D during RY11 and RY12 (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.

BOG 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 128 in RY11 and 103 in RY12 (Table 5) and we harvested slightly below the amount of moose needed locally.

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 2012 population estimate for this area is 1,337 moose which is below this objective. Harvest is difficult to assess from within this area because the boundaries do not follow our uniform coding unit boundaries which are used to record harvest. However, we believe harvest from within this area is below this objective.

For the next reporting period, consistent with BOG action on the Unit 19A and 19D East operational plans, we will eliminate CKVMMA and UKVMMA as management areas because the management area designations did not provide additional management benefits, and within UKVMMA, harvest is difficult to assess because the boundaries do not follow our uniform coding unit boundaries which are used to record harvest. We will also establish moose population density objectives within the Unit 19A and Unit 19D East BCFAs of 2.0 moose/mi^2 and harvest objectives of 120 moose from within WCFA in Unit 19A and 180 moose from within WCFA in Unit 19D (Figs. 2 and 3). Department resources are inadequate to conduct multiple GSPE surveys in Unit 19 each year. Generally, we have sufficient resources to conduct one population estimate (or a subset of one) per year; 3–6 fall composition surveys, dependent upon weather; and 1–5 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 Unit 19A East (Holitna), the eastern two-thirds of Unit 21E (not included in this report), and the moose survey area in Unit 19D, with an emphasis on the 1,118 mi^2 area surrounding BCFA that made up UKVMMA, as this area remains valuable for assessing moose numbers. If the opportunity presents itself to conduct a survey in Unit 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.

For the next reporting period we will establish an area within WCFA in Unit 19A, where moose numbers can be more intensively evaluated similar to those conducted in Unit 19D. The Unit 19A BCFA (Fig. 3) was recently established by BOG and is a logical choice.

To summarize, management objectives for the next reporting period, including these changes, are as follows below.

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 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 CKMMP and are approximately 10-month-old calves.

Objectives for Units 19A defined in the operational plan:

- Achieve a moose density of 2.0 moose/mi^2 within BCFA.

- Achieve a harvest of 120 moose from within WCFA.

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).

Objectives for Units 19D East defined in the operational plan:

- Achieve a moose density of 2.0 moose/mi^2 within BCFA.

- Achieve a harvest of 180 moose from within WCFA.

When evaluating populations, survey–specific sightability estimates are important because sightability correction values can vary from survey to survey. We recommend obtaining these using radiocollared moose 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 Farewell TCA, a high priority during the next reporting period.

Twinning rates are a sensitive indicator of moose nutritional status (Boertje et al. 2009). We recommend monitoring twinning rates within BCFAs in Units 19A and 19D and using them as follows: If the 2-year average twinning rate is >20% we will continue to promote growth. At a rate of 15–20% the number will be stabilized through harvest. If the 2-year average twinning rate is <15% number of moose will be reduced through harvest. Predator control will be suspended if harvest alone is insufficient to reduce moose numbers. Our current 2-year average twinning rate is 28% and we will continue to promote growth.

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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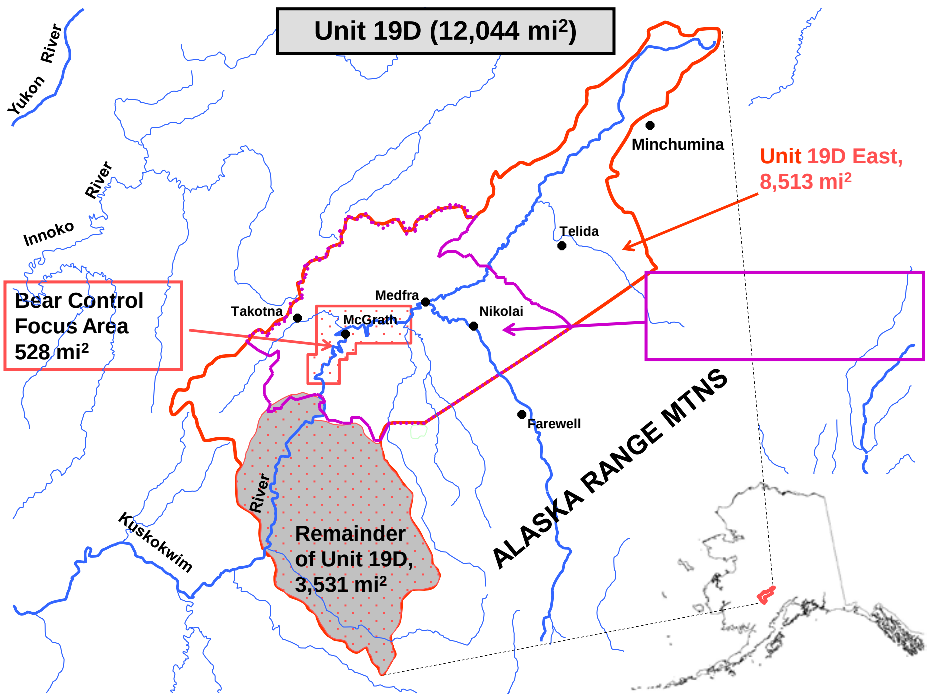

Figure 1. Unit 19D East (8,513 mi^2), the Unit 19D East wolf control focus area (4,484 mi^2), and the bear control focus area (528 mi^2) in effect during RY11 and RY12.

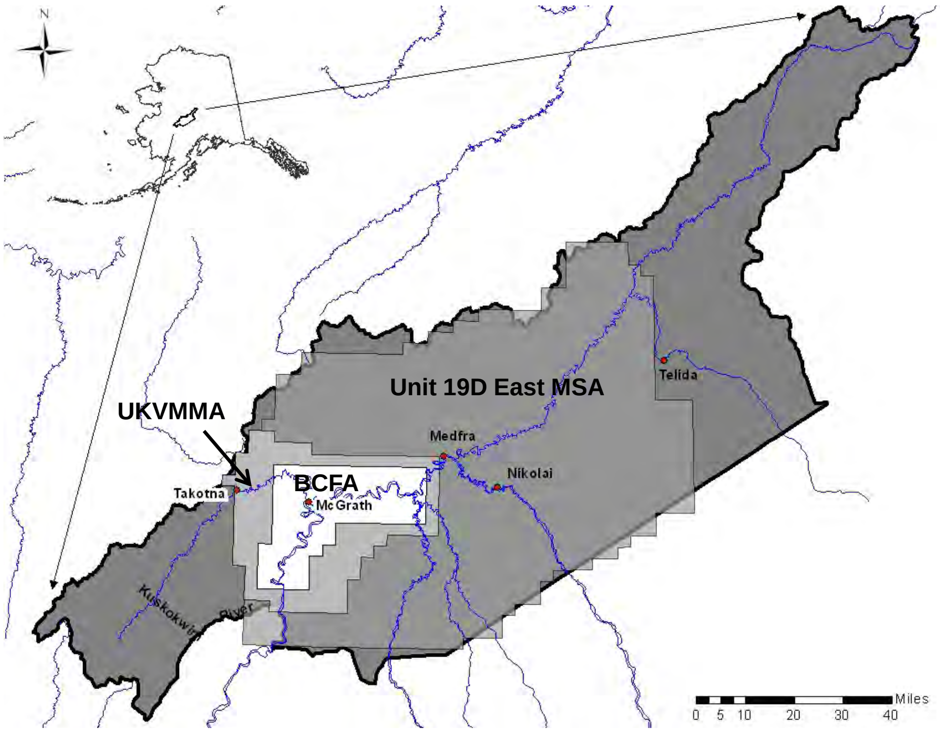

Figure 2. Unit 19D East (8,513 mi^2) showing the 3 Unit 19D moose survey areas (MSA) that have been surveyed since 2001 including the bear control focus area (BCFA; 528 mi^2); the upper Kuskokwim villages moose management area (UKVMMA; 1,118 mi^2); and the Unit 19D East moose survey area (5,313 mi^2).

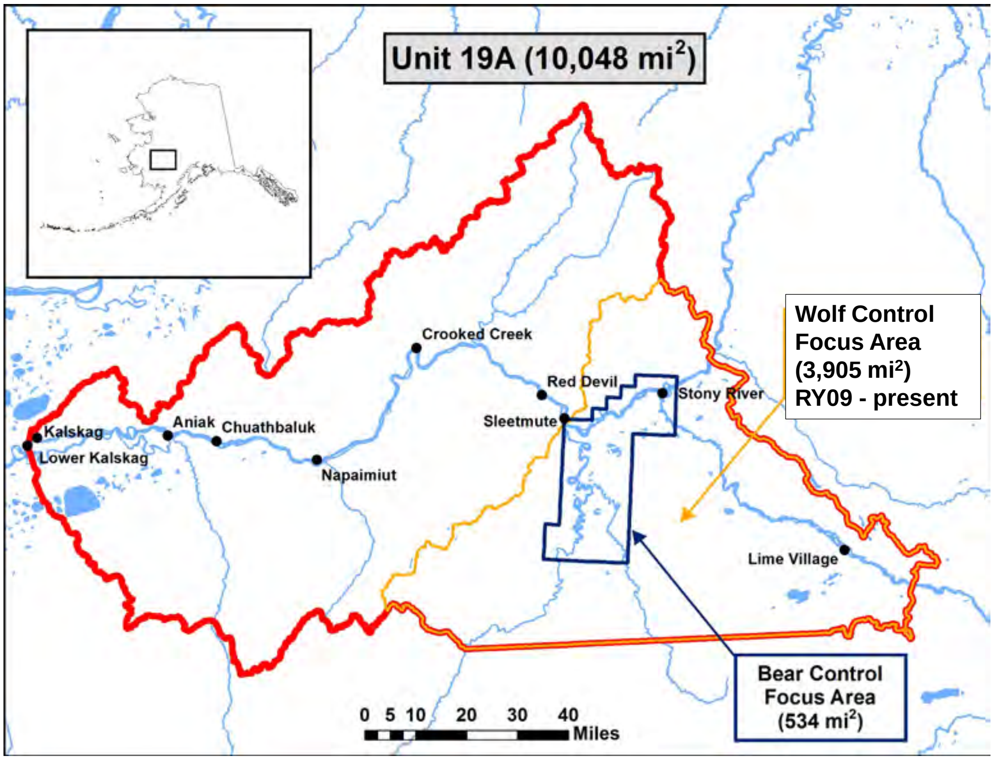

Figure 3. Unit 19A aerial wolf control area permitted throughout Unit 19A during RY04–RY08. Beginning in RY09, aerial wolf control was limited to the wolf control focus area. Both areas are defined as those portions of Unit 19A within those drainages upriver of Sleetmute. The bear control focus area is also shown.

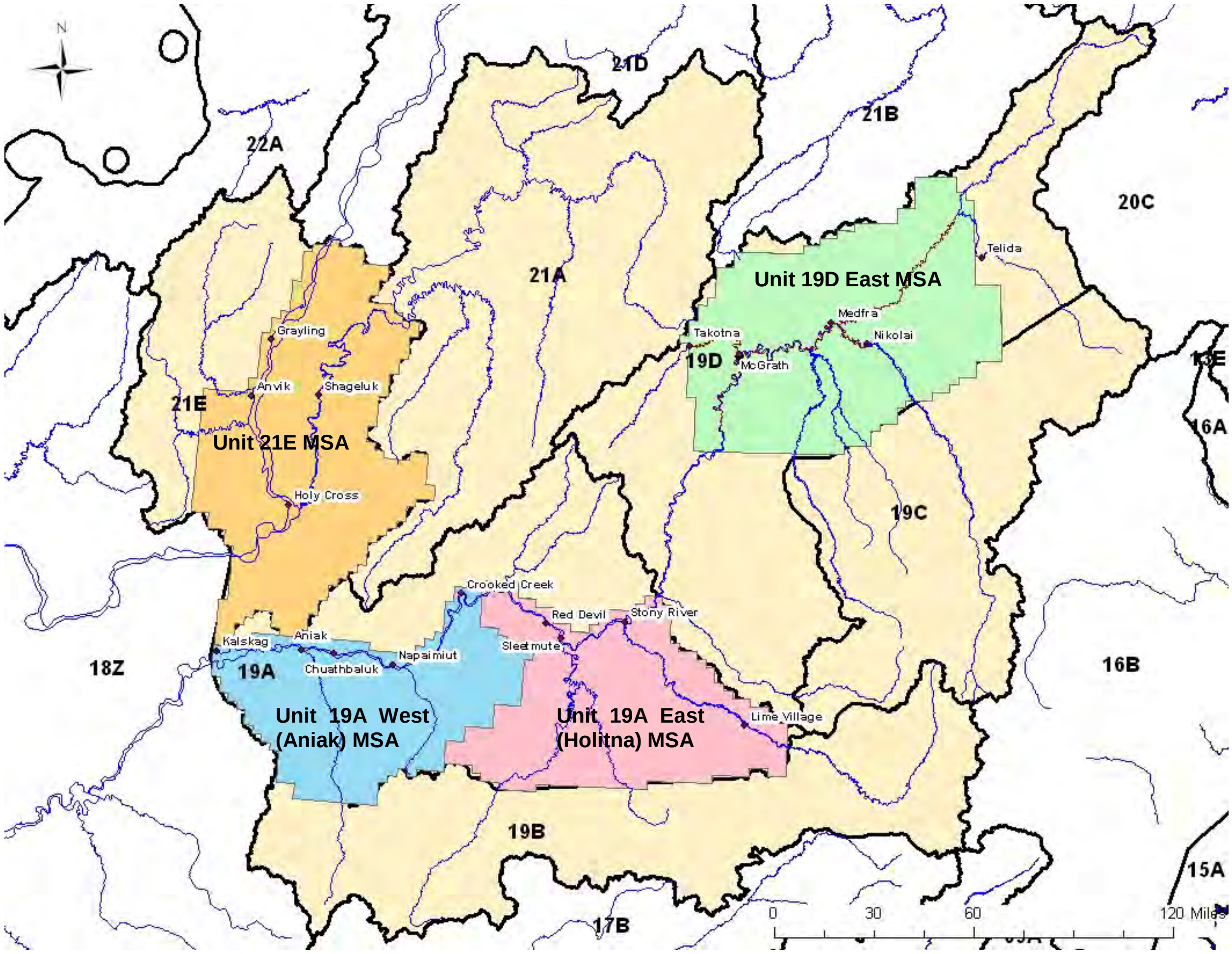

Figure 4. Units 19, 21A, and 21E showing the 3 scheduled moose survey areas (MSA): Unit 19D East moose survey area, Unit 19A East (Holitna), and Unit 21E moose survey area. Also shown is the Unit 19A West (Aniak) moose survey area which is surveyed opportunistically. The area south of the Kuskokwim River includes both the Unit 19A East (Holitna) and Unit 19A West (Aniak) survey areas.

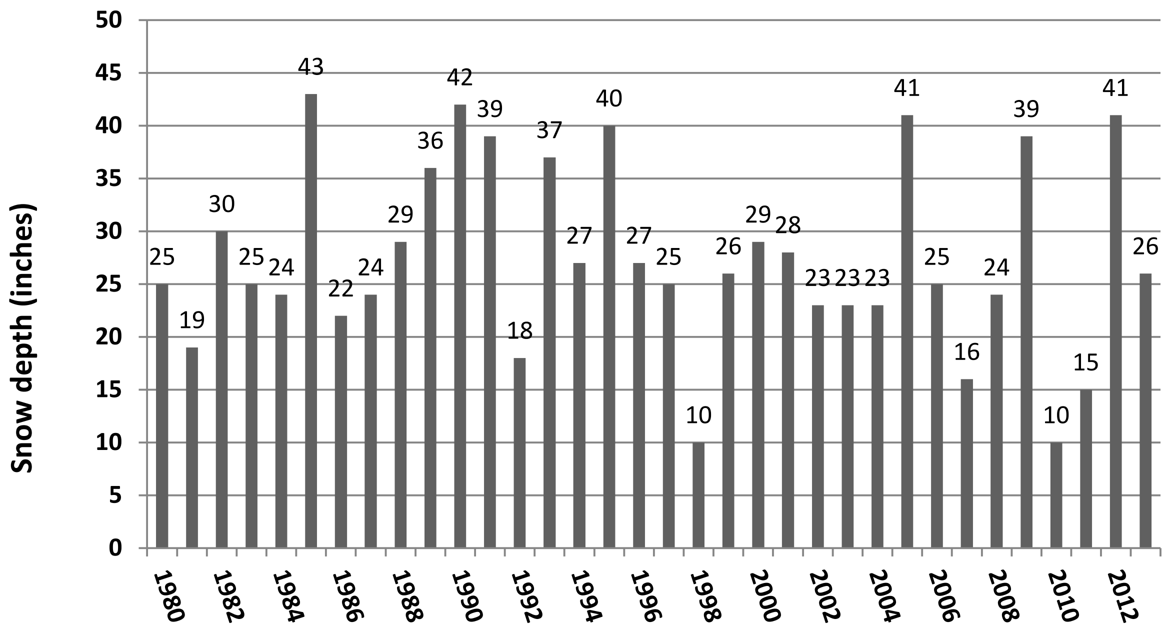

Figure 5. Snow depth in inches at McGrath as reported on 1 April from 1980 through 2013.

Table 1a. Summary of geospatial population estimates[a] for moose in Unit 19A, 2005–2011.

Location and survey year	Survey area (mi²)	Strata size (mi²) Low	Strata size (mi²) High	Area searched (mi²) Low	Area searched (mi²) High	Total search area (mi²)	No. of moose estimated by strata and 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
Unit 19A West (Aniak)											
March 2006	3,444	2,404	1,040	192	408	600	–[b]	–[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
Unit 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%[c,d]	0.43[c]	135

[a] Population estimates are of observable moose and do not include a sightability correction factor.
[b] Data lost in December 2006 office fire.
[c] Estimate includes a sightability correction factor 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 bear control focus area, 2001–2012.

Year	Moose observed	Estimated population (90% CI)[b]	SCF[a] ($n_{observed}$, $n_{available}$)[c]	Estimated population w/SCF	Bulls:100 cows[d]	Yearlings:100 cows[d,e]	Calves:100 cows[d]	Moose/mi^2 w/SCF[f]
2001	440	440 (±0)	1.19 (32,38)	525 (±12%)	18	16	34	1.0
2003	237	424 (±19)	1.35 (21,28)	573 (±24%)	18	10	56	1.1
2004	531	531 (±0)	1.27[g]	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[g]	830 (±21%)	31	14	44	1.6
2010	311	625 (±12)	1.27[g]	793 (±19%)	38	30	43	1.5
2011	335	658 (±14)	1.27[g]	835 (±21%)	31	24	49	1.6
2012[h]	308	474 (±10)	1.29 (23,30)	612 (±19%)	28	12	47	1.2

[a] Sightability correction factor.
[b] All survey units were sampled during 2001 and 2004–2007, estimates/counts of observable moose have no variance or confidence intervals.
[c] Radiocollared moose.
[d] Ratios based on estimates rather than counts of sex and age classes.
[e] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[f] Based on an estimated 528 mi^2 of moose habitat in the bear control area.
[g] No SCF data collected, an average based on 2001, 2003–2008 SCFs was applied. Variability of SCF was based upon the largest observed SCF variation (Keech 2012).
[h] Preliminary data.

Table 1c. Unit 19D, aerial moose fall composition counts and estimated population size within the upper Kuskokwim villages moose management area, 2001–2012.

Year	Moose observed	Estimated population (90% CI)	SCF ($n_{observed}$, $n_{available}$)[a]	Estimated population w/SCF	Bulls:100 cows[b]	Yearlings:100 cows[b,c]	Calves:100 cows[b]	Moose/mi^2 w/SCF[d]
2001	455	727 (±12)	1.19 (32,38)	868 (±17%)	21	16	36	0.8
2004	578	940 (±11)	1.27[e]	1,192 (±19%)	18	16	66	1.1
2006	762	1,117 (±9)	1.17 (42,49)	1,308 (±13%)	30	24	55	1.2
2007	844	1,290 (±10)	1.33 (31,41)	1,720 (±20%)	36	30	53	1.5
2008	678	1,356 (±9)	1.27 (16,20)	1,718 (±20%)	40	28	44	1.5
2009	711	1,435 (±9)	1.27[e]	1,820 (±18%)	40	22	38	1.6
2010	712	1,416 (±8)	1.27[e]	1,796 (±17%)	49	32	43	1.6
2011	639	1,298 (±9)	1.27[e]	1,647 (±18%)	33	20	42	1.5
2012[f]	650	1,036 (±9)	1.29 (23,30)	1,337 (±15%)	38	14	35	1.2

[a] Radiocollared moose.
[b] Ratios based on estimates rather than counts of sex and age classes.
[c] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[d] Based on an estimated 1,118 mi^2 of moose habitat in the upper Kuskokwim villages moose management area.
[e] No SCF data collected, an average based on 2001, 2003–2008 SCFs was applied. Variability of SCF was based upon the largest observed SCF variation (Keech 2012).
[f] Preliminary data.

Table 1d. Unit 19D aerial moose fall composition counts and estimated population size within the moose survey area, 2001–2008.

Year	Moose observed	Estimated population (90% CI)	SCF ($n_{observed}$, $n_{available}$)[a]	Estimated population w/SCF	Bulls:100 cows[b]	Yearlings:100 cows[b,c]	Calves:100 cows[b]	Moose/mi^2 w/SCF[d]
2001	743	2,148 (±26)	1.19 (32,38)	2,564 (±28%)	34	14	25	0.5
2004	764	2,163 (±19)	1.27	2,744 (±24%)	31	24	54	0.5
2008	982	3,071 (±16)	1.27 (16,20)	3,889 (±25%)	55	34	41	0.7

[a] Radiocollared moose.
[b] Ratios based on estimates rather than counts of sex and age classes.
[c] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[d] Based on an estimated 5,313 mi^2 of moose habitat in the Unit 19D East moose survey area.

Table 2a. Unit 19C Farewell Burn trend count area fall aerial moose composition counts, regulatory years[a] 1987–2010.

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Total moose	Moose/hr
1987	53	10	19	32	13	207	242[b]	115
1988	58	20	34	47	18	218	265	126
1989	47	15	22	55	13	361	416	194
1990	43	8	26	58	16	315	373	159
1991	44	8	29	59	17	293	352	156
1992	46	8	38	58	21	220	278	100
1994	52	10	19	45	11	353	404[b]	170
1996	46	11	15	43	9	411	454	158
1997	30	10	27	75	17	368	443	174
1999[c]	33	11	27	42	17	206	248	86
2001	25	3	25	76	17	377	454[b]	81
2003	25	8	34	65	21	240	305	110
2006[d]	46		41				279	85
2007[e]	105[e]	42[e]	68	26	25	78	104	83
2009	53	23	25	34	14	211	245	134
2010	29	20	27	54	17	258	312	110

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1987 = 1 July 1987–30 June 1988).
[b] Calves plus adults do not add to match the total, which probably includes unknown moose, but records were lost in office fire.
[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[a] 2004–2013.

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Calves	Percent calves	Adults	Total moose	Moose/ hr
2004	20	6	23	66	16	344	410	18
2007	28	9	52	35	29	87	122	41
2008	42	6	23	7	14	44	51	26
2013	38	10	41	34	23	113	147	28

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).

Table 2c. Unit 19A Holitna trend count area fall aerial moose composition counts, regulatory years[a] 1987–2013.

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Calves	Percent calves	Adults	Total moose	Moose/hr
1987	22	4	72	50	36	84	140[b]	85
1988	31	16	56	103	30	240	343	95
1989	24	13	55	160	30	361	528[b]	163
1990	26	10	52	139	29	336	475	162
1992	31	15	63	172	32	360	542[b]	169
1994	14	2	42	209	27	568	778[b]	251
1996	22	10	50	146	29	355	502[b]	152
1997	14	11	34	85	23	286	371	169
2001	6	3	8	13	7	183	196	59
2007	35	21	45	50	25	150	200	65
2008	34	12	27	21	18	103	124	35
2009	51	6	36	25	19	104	129	20
2010	61	10	19	24	11	188	212	55
2013	55	25	50	59	24	185	244	54

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1987 = 1 July 1987–30 June 1988).
[b] Calves plus adults do not add to total which probably includes unknown moose, but records were lost in office fire.

Table 3. Twinning rates for moose in Unit 19D East, regulatory years[a] 2000–2012.

Regulatory year	Percent observed rate of twinning for radiocollared cows >2 yr old (*n*)	Percent observed rate of twinning for uncollared cows (*n*)
2000	25 (16)	
2001	59 (22)	39 (46)
2002	24 (25)	36 (39)
2003	32 (31)	39 (31)
2004	44 (45)	50 (40)
2005	40 (60)	35 (29)
2006	52 (56)	50 (30)
2007	55 (51)	
2008	33 (43)	26 (87)
2009	33 (40)	29 (45)
2010		37 (38)
2011		34 (47)
2012		22 (55)

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2000 = 1 July 2000–30 June 2001).

Table 4a. Unit 19 reported moose harvest, regulatory years[a] 2008–2012.

Regulatory	Reported harvest			
year	M (%)	F (%)	Unk	Total
2008	277 (100)	0 (0)	1	278
2009	268 (100)	0 (0)	0	268
2010	302 (100)	0 (0)	0	302
2011	318 (100)	0 (0)	3	321
2012	355 (100)	0 (0)	2	357

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4b. Unit 19A moose harvest, regulatory years[a] 2008–2012.

Regulatory	Moose harvest				Hunt type			
year	M	F	Unk	Total	General[b]	TM684	TM680	FM019[c]
2008	76	0	0	76	8	1	56	11
2009	70	0	0	70	4	1	52	13
2010	84	0	0	84	9	3	72	0[d]
2011	79	0	2	81	2	2	65	12
2012	120	0	1	121	4	2	93	22

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Incorrect permit for this hunt area.
[c] 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.
[d] FM019 data unavailable.

Table 4c. Unit 19B moose harvest, regulatory years[a] 2008–2012.

Regulatory	Moose harvest			
year	M	F	Unk	Total
2008	26	0	0	26
2009	20	0	0	20
2010	20	0	0	20
2011	15	0	0	15
2012	18	0	0	18

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4d. Unit 19C moose harvest, regulatory years[a] 2008–2012.

Regulatory	Moose harvest				Hunt type	
year	M	F	Unk	Total	General	RM655
2008	54	0	0	54	51	3
2009	57	0	0	57	56	1
2010	70	0	0	70	68	2
2011	76	0	0	76	73	3
2012	96	0	1	97	95	2

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4e. Unit 19D moose harvest, regulatory years[a] 2008–2012.

Regulatory	Moose harvest				Hunt type	
year	M	F	Unk	Total	General	RM650
2008	120	0	1	121	18	103
2009	119	0	0	119	27	92
2010	126	0	0	126	19	107
2011	148	0	1	149	21	128
2012	119	0	0	119	16	103

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4f. Moose harvest from Unit 19 where specific harvest location was not reported, regulatory years[a] 2008–2012.

Regulatory	Moose harvest			
year	M	F	Unk	Total
2008	1	0	0	1
2009	2	0	0	2
2010	2	0	0	2
2011	0	0	0	0
2012	2	0	0	2

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

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[b] 2008–2012.

Permit hunt	Regulatory year	Permits issued	Successful hunters (%)	Unsuccessful hunters (%)	Did not hunt (%)	Male (%)	Female (%)	Unk	Total harvest
Unit 19A, TM684[c]	2008	14	1 (7)	8 (57)	5 (36)	1 (100)	0 (0)	0	1
	2009	14	1 (7)	6 (43)	7 (50)	1 (100)	0 (0)	0	2
	2010	15	3 (20)	6 (40)	6 (40)	3 (100)	0 (0)	0	3
	2011	16	2 (13)	7 (44)	7 (44)	0 (0)	0 (0)	2	2
	2012	14	2 (14)	3 (21)	9 (64)	2 (100)	0 (0)	0	2
Unit 19A, TM680	2008	230	56 (24)	141 (61)	33 (14)	56 (100)	0 (0)	0	56
	2009	231	52 (23)	132 (57)	47 (20)	52 (100)	0 (0)	0	52
	2010	200	72 (36)	105 (53)	23 (11)	72 (100)	0 (0)	0	72
	2011	200	65 (33)	102 (51)	33 (17)	65 (100)	0 (0)	0	65
	2012	200	93 (47)	72 (36)	35 (18)	92 (100)	0 (0)	1	93
Unit 19A, FM019[a]	2008		11	66		11 (100)	0 (0)	0	11
	2009		13	1		13 (100)	0 (0)	0	13
	2010		0			0 (0)	0 (0)	0	0
	2011	72	12 (17)	30 (42)	30 (42)	12 (100)	0 (0)	0	12
	2012	82	22 (27)	29 (35)	31 (38)	22 (100)	0 (0)	0	22
Unit 19C, RM655	2008	10	3 (30)	2 (20)	5 (50)	3 (100)	0 (0)	0	3
	2009	14	1 (7)	8 (57)	5 (36)	1 (100)	0 (0)	0	1
	2010	2	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	0	2
	2011	9	3 (33)	0 (0)	6 (67)	3 (100)	0 (0)	0	3
	2012	8	2 (25)	2 (25)	4 (50)	2 (100)	0 (0)	0	2
Unit19D, RM650	2008	291	103 (35)	114 (39)	74 (25)	103 (100)	0 (0)	0	103
	2009	294	92 (31)	130 (44)	72 (24)	92 (100)	0 (0)	0	92
	2010	300	107 (36)	116 (39)	77 (26)	107 (100)	0 (0)	0	107
	2011	303	128 (43)	112 (37)	63 (21)	128 (100)	0 (0)	0	128
	2012	328	103 (31)	148 (45)	77 (23)	103 (100)	0 (0)	0	103

[a] Includes data not available using ADF&G's Wildlife Information Network.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[c] Successful hunters for TM684 may not equal the number of moose taken. The bag limit is 2 antlered bulls.

Table 6a. Unit 19 moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters[c]
2008	136	80	43	0	259 (35)	237	187	67	0	491 (65)	750
2009	112	97	36	10	255 (35)	240	178	44	13	475 (65)	730
2010	140	110	48	4	302 (42)	210	149	50	2	411 (58)	713
2011	166	106	49	0	321 (45)	213	145	37	5	400 (55)	721
2012	168	130	55	4	357 (46)	227	155	39	5	426 (54)	783

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local residents reside in Unit 19.
[c] Total hunters for Unit 19 may not equal sum of hunters from all subunits due to hunters not reporting locations or unidentifiable reported locations. Includes federal data from FM019 not available using ADF&G's Wildlife Information Network.

Table 6b. Unit 19A moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2008	43	18	0	0	61 (25)	113	65	5[c]	0	183 (75)	244
2009	33	22	1[c]	1	57 (25)	98	64	3[c]	4	169 (75)	226
2010	50	32	2[c]	0	84 (38)	88	50	0	0	138 (62)	222
2011	62	17	0	0	79 (34)	109	40	0	4	153 (66)	232
2012	85	35	1[c]	0	121 (50)	99	18	1[c]	2	120 (50)	241

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local residents reside in Unit 19A. Includes federal data from FM019 not available using ADF&G's Wildlife Information Network.
[c] Incorrect permit for this hunt area.

Table 6c Unit 19B moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2008	1	8	14	0	23 (27)	1	32	29	0	62 (73)	85
2009	0	3	16	1	20 (31)	2	21	17	5	45 (69)	65
2010	1	6	11	2	20 (33)	4	15	18	3	40 (67)	60
2011	1	4	10	0	15 (31)	4	13	16	0	33 (69)	48
2012	0	6	12	0	18 (41)	6	9	10	1	26 (59)	44

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local residents reside in Units 19A or 19B.

Table 6d. Unit 19C moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2008	3	26	24	0	53 (43)	5	39	26	0	70 (57)	123
2009	1	36	13	7	57 (45)	7	46	15	1	69 (55)	126
2010	2	36	32	0	70 (53)	0	37	26	0	63 (47)	133
2011	3	41	32	0	76 (59)	1	37	14	0	52 (41)	128
2012	4	52	37	4	97 (73)	1	50	22	1	74 (27)	171

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local residents reside in Units 19C or 19D.

Table 6e. Unit 19D moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2008	87	29	5	0	121 (42)	104	56	7	0	167 (58)	288
2009	76	37	5	1	119 (39)	126	49	6	2	183 (61)	302
2010	86	36	3	1	126 (44)	99	58	3	0	160 (56)	286
2011	101	42	6	0	149 (49)	101	51	4	2	158 (51)	307
2012	78	36	4	1	119 (38)	120	65	7	2	194 (62)	313

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local residents reside in Unit 19D.

Table 7a. Unit 19[a] moose harvest percent by transport method, regulatory years[b] 2008–2012.

Regulatory year	Harvest percent by transport method[c]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk[d]	Airboat	*n*
2008	23	1	66	5	2	<1	2	1	0	189
2009	26	3	58	9	<1	1	2	1	0	263
2010	22	1	66	9	1	0	1	<1	0	277
2011	21	<1	65	9	2	<1	1	1	0	309
2112	22	<1	61	12	<1	<1	<1	2	0	335

[a] Total for Unit 19 may not equal sum of hunters from all subunits due to hunters not reporting errors or omissions.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[c] Successful hunters only. Unit 19A federal hunt transport data is not available, though most use boats.
[d] Includes transportation method "on foot."

Table 7b. Unit 19A moose harvest percent by transport method, regulatory years[a] 2008–2012.

Regulatory year	Harvest percent by transport method[b]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk[c]	Airboat	*n*
2008	0	0	95	5	0	0	0	0	0	76
2009	2	0	84	12	0	0	0	2	0	57
2010	5	0	94	1	0	0	0	0	0	84
2011	0	1	96	0	3	0	0	0	0	69
2012	1	0	92	4	1	0	0	2	0	99

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Successful hunters only. Unit 19A federal hunt transport data is not available, though most use boats.
[c] Includes transportation method "on foot."

Table 7c. Unit 19B moose harvest percent by transport method, regulatory years[a] 2008–2012.

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*
2008	76	0	12	4	8	0	0	0	0	28
2009	80	0	20	0	0	0	0	0	0	20
2010	80	0	20	0	0	0	0	0	0	26
2011	53	0	33	7	0	0	0	7	0	15
2012	78	0	17	0	0	0	0	6	0	18

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Successful hunters only.

Table 7d. Unit 19C moose harvest percent by transport method, regulatory years[a] 2008–2012.

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*
2008	74	4	0	9	6	0	0	7	0	54
2009	68	11	0	18	2	2	0	0	0	57
2010	60	3	0	34	3	0	0	0	0	70
2011	63	1	0	32	4	0	0	0	0	76
2012	56	1	1	36	2	0	0	4	0	97

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Successful hunters only.

Table 7e. Unit 19D moose harvest percent by transport method, regulatory years[a] 2008–2012.

Regulatory year	Harvest percent by transport method[b]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk[c]	Airboat	*n*
2008	4	0	88	2	0	<1	4	0	0	82
2009	8	1	80	4	0	2	5	1	0	114
2010	3	0	90	2	0	0	3	1	0	121
2011	6	0	87	2	0	<1	3	2	0	149
2012	3	0	92	<1	0	<1	2	<1	0	119

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Successful hunters only.
[c] Includes transportation method "on foot."

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CHAPTER 22: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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 1992). During 1969–1974, reported harvest increased to an average of 617 moose per year. Cow moose compose 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, reported harvests averaged 226 bulls per year (McNay 1992). During 1983–1993 the mean

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

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 2004–2007 to reduce the moose population (Young et al. 2006, Boertje et al. 2007, Young and Boertje 2011). During 2008–2013, antlerless harvests were scaled back to moderate levels to stabilize the population at approximately 12,000 moose via a combination of drawing and registration permits. In 2014, antlerless harvest was suspended because the fall 2013 population estimate fell below the low end of the intensive management of 12,000 moose.

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 2004–2013), drawing permit hunts for “any bull” moose (2006–2013) concurrent with the antler restricted general season hunt, and antlerless moose hunts by drawing (1996–1998, 2001–2003, 2009–2013) and registration permits (2004–2013) 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 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 multi-year short yearling mass is <385 lb (175 kg), or >35% of annual browse biomass is removed by moose (Boertje et al. 2007):

- <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.

METHODS

POPULATION STATUS AND TREND

2011 Geospatial Population Estimation Survey

We used the geospatial population estimation (GSPE) method (Kellie and DeLong 2006) to survey 138 survey units (SU; 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® 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).

2012 Geospatial Population Estimation Survey

We used the GSPE method (Kellie and DeLong 2006) and surveyed 111 SUs (77 high density and 34 low density; 646 mi^2) of 987 SUs (5,747 mi^2) during 7–13 November. A simple random sample of 100 SUs (70 high density and 30 low density) was selected from each stratum using Microsoft Excel software. An additional 10 SUs (7 high density and 3 low density) were selected to fill gaps in the randomized coverage and 1 SU (low density) was done by mistake.

Search time per SU with 100% moose habitat averaged 8.5 min/mi^2 (n = 73 SUs). Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were mostly good (55%) and excellent (41%) with the remainder being fair (4%) (n = 111).

2013 Geospatial Population Estimation Survey

We used the GSPE method (Kellie and DeLong 2006) and surveyed 122 SUs (84 high density and 38 low density; 710 mi^2) of 987 SUs (5,747 mi^2) during 29 November–8 December. A simple random sample of 104 SUs (73 high density and 31 low density) was selected from each stratum using Microsoft Excel software. An additional 18 SUs (11 high density and 7 low density) were selected to fill gaps in the randomized coverage. We eliminated 1 SU (no. 80), a posteriori, from the analysis because it was 100% non-moose habitat.

Search time per SU with 100% moose habitat averaged 7.8 min/mi^2 (n = 85 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 (46%) and good (44%) with the remainder being fair (8%) and poor (2%) (n = 122).

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.

HARVEST

We estimated annual harvest from mandatory harvest report cards. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY11 = 1 July 2011–30 June 2012). 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 [RY11], DM628–DM679 [RY12–RY13], 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.

We estimated total take (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. 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 2.4–2.5 moose/mi^2 during RY11–RY12 (Table 1). The Unit 20A moose population increased between 1999 and 2003, peaking at about 15,000–20,000 moose (Young 2008). Lower population estimates in 2011 and 2012 (Table 1) in conjunction with poor productivity, particularly in 2001, 2003, 2007, and 2010 (ADF&G files, Fairbanks), and liberal antlerless harvests during RY04–RY07 indicate a measurable population decline between 2003 and 2012. A trend model of the cow segment of the population (i.e., that segment of the population with the least annual variability) that declined from an estimated (with SCF = 1.21) 9,483 cows in 2004 to 8,059 cows in 2011 resulted in 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 1). 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 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, 752 in RY11, and 800 in RY12) 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 33:100 (range 32–34) during 2009–2012.

Sex ratios exceeded 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 during 2003–2006 and 2008 (Young 2010). This trend continued during 2009–2011 (Young 2012) and 2012 (2012: Tanana Flats 31:100, western foothills–mountains 35:100, and eastern foothills–mountains 35:100).

Yearling recruitment (i.e., yearlings:100 cows) was relatively strong during 2003–2012, averaging 20:100 (range = 17–25:100; Table 1). 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 2003–2012 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 classified known-age, 27-month-old bulls during those surveys. 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

2012 Twinning Surveys. Surveys were flown afternoons and evenings (13:28–19:13 ADT; Fig. 1). Leaf-out was nearly complete. Weather, turbulence, and airsickness were not factors. Total flight time (including ferry time) was 17.5 hours ($3,938) and total survey time was 14.8 hours. We observed 683 moose ≥1 year (46 moose/hour); 128 (19%) parturient moose; and 9 parturient moose/hour. Mean (northcentral, western Tanana Flats, and eastern Tanana Flats–foothills) observed twinning rate was 12% (Table 2). We observed 2 independent black bears, both in the northcentral Tanana Flats.

Northcentral Tanana Flats — Surveys were conducted on 25 May south of the Tanana River, east of the Wood River, west of the Blair Lakes Impact Area Trail, and north of approximately N64°22.5′ (Fig.1). Total flight time was 5.5 hours ($1,238) and actual survey time was 5.1 hours. We observed 279 moose (≥1 year old) or 55 moose/hour; 54 (19%) parturient moose; and 11 parturient moose/hour. The observed twinning rate was 22% (12/54; Table 2).

Western Tanana Flats — Surveys were conducted on 26 May south of the Tanana River, west of Tatlanika Creek, east of the George Parks Highway, and north of the Rex Trail (Fig. 1). Total flight time was 6.2 hours ($1,395) and actual survey time was 5.3 hours. We observed 205 moose (≥1 year old) or 39 moose/hour; 42 (21%) parturient moose; and 8 parturient moose/hour. The observed twinning rate was 10% (4/42; Table 2).

Eastern Tanana Flats-Foothills — Surveys were conducted on 27 May south of the Tanana River, east of Delta Creek, west of the Delta River, and north of N63°53.5′ (Fig.1). Total flight time was 5.8 hours ($1,305) and actual survey time was 4.4 hours. We observed 199 moose (≥1 year old) or 45 moose/hour; 32 (16%) parturient moose; and 7 parturient moose/hour. The observed twinning rate was 3% (1/32; Table 2).

2013 Twinning Surveys. Surveys were flown afternoons and evenings (13:25–21:10 ADT; Fig. 2). Leaf-out was nearly complete. Weather, turbulence, and airsickness were not factors. Total flight time (including ferry time) was 16.4 hours ($3,690) and total survey time was 13.35 hours. We observed 629 moose ≥1 year (47 moose/hour); 123 (20%) parturient moose; and 9 parturient moose/hour. Mean (northcentral, western Tanana Flats, and eastern Tanana Flats–foothills) observed twinning rate was 12% (Table 2). We observed 3 independent grizzly bears (a breeding pair and a female with 2 dependent cubs) both in the 2009 Rex Burn in the western Tanana Flats. We observed no black bears.

Northcentral Tanana Flats — Surveys were conducted on 29 May south of the Tanana River, east of the Wood River, west of the Blair Lakes Impact Area Trail, and north of approximately N64°22.22′ (Fig. 2). Total flight time was 5.0 hours ($1,125) and actual survey time was

4.78 hours. We observed 261 moose (≥1 year old) or 55 moose/hour; 48 (18%) parturient moose; and 10 parturient moose/hour. The observed twinning rate was 10% (5/48; Table 2).

Western Tanana Flats — Surveys were conducted on 30 May south of the Tanana River, west of Tatlanika Creek, east of the George Parks Highway, and north of the Rex Trail (Fig. 2). Total flight time was 5.9 hours ($1,327.50) and actual survey time was 4.97 hours. We observed 208 moose (≥1 year old) or 42 moose/hour; 41 (20%) parturient moose; and 8 parturient moose/hour. The observed twinning rate was 12% (5/41; Table 2).

Eastern Tanana Flats–Foothills — Surveys were conducted on 1 June south of the Tanana River, east of Delta Creek, west of the Delta River, and north of N63°46.0′ (Fig. 2). Total flight time was 5.5 hours ($1,237.50) and actual survey time was 3.6 hours. We observed 160 moose (≥1 year old) or 44 moose/hour; 34 (21%) parturient moose; and 9 parturient moose/hour. The observed twinning rate was 15% (5/34; Table 2).

Average twinning rates, 2006–2013, were lowest in the northcentral Tanana Flats (10%) followed by the eastern Tanana Flats–foothills (13%) and the western Tanana Flats (17%) (Table 2). Overall twinning rates (i.e., northcentral Tanana Flats, western Tanana Flats, and eastern Tanana Flats–foothills) during this same period averaged 13% (Table 2; Young 2012). Based on these twinning rates, which fall between 10% and 20%, we are managing the Unit 20A moose population for zero growth.

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 the seasonal migrants probably increase the spring density of moose on the Tanana Flats 2- to 4-fold over the density of resident Unit 20A moose. Boertje et al. (2009) estimated that in the 1,807 mi^2 Tanana Flats portion of their central study area, calving and summer density was 1.85 times the November (1996) density.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY11 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 2,000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; 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	1 Oct–28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1,000 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 2,000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; 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	1 Oct–28 Feb (General hunt only)	
1 bull by drawing permit only; up to 1,000 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 (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
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

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY12 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 2,000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; or	15 Aug–15 Nov (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	1 Oct–30 Nov (General hunt only)	
1 bull by drawing permit only; up to 1,000 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
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	1 Sep–25 Sep (General hunt only)	

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
one side; or		
1 antlerless moose by drawing permit only, up to 2,000 permits may be issued; a person may not take a calf or a cow accompanied by a calf; or	15 Aug–15 Nov (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 1,000 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

Alaska Board of Game Actions and Emergency Orders.

March 2011 — The board took the following actions for moose in Unit 20A:

- Extended the antlerless drawing permit hunts from 25 August–31 October to 15 August–15 November and "up to" language from 1,000 to 2,000 permits.
- Extended the antlerless registration permit season from 10 January–28 February to 1 October–28 February.
- Reauthorized antlerless moose hunts.

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 the take of 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.
- 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).
- Reauthorized antlerless moose hunts.

March 2013 — The board took no actions for moose in Unit 20A.

- Reauthorized antlerless moose hunts.

March 2014 — The board took the following actions for moose in Unit 20A:

- Established targeted moose hunts to address public safety and nuisance moose concerns in very small areas along the road system. Targeted hunts would be implemented by selecting hunters at random from an applicant pool. They will be required to respond quickly to harvest moose from specifically defined "targeted" moose–vehicle collision or nuisance areas, using either shotgun or bow and arrow.
- Limit proxy hunters to only taking 1 moose/year by proxy.
- Reauthorized antlerless moose hunts.

Harvest by Hunters. Reported harvests of 799 moose in RY11 and 695 in RY12 (Table 3) fell short of the intensive management harvest objective of 900–1,100 adopted by the board in 2012, 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 63% between RY90–RY91 ($\bar{x}$ = 376 bulls) and RY96–RY97 ($\bar{x}$ = 613 bulls), and remained relatively stable through RY99. Liberalizing the general season from 20 to 25 days in Unit 20A in RY95 likely contributed to the increased harvest. Average annual reported harvest RY00–RY01 declined to 540 bulls (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) was likely the result of a drawing permit hunt initiated for "any bull" moose that ran concurrent with the September general season hunt. 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 spike-fork-50 regulation were reported as being taken under the permit hunt regulation). An increase in total reported harvest of bulls from 452 in RY05 to 621 in RY08 and 607 in RY09, supports this assertion (Tables 4 and 5). A decline in the reported harvest of bulls (i.e., the general hunt and total take) during RY09–RY12 is likely due to the decline in the moose population during that time period (Table 1).

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; Fig. 3) 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 (n = 300) through RY09 (n = 1,000) and harvest increased commensurately (Table 5) and bull:cow ratios declined to 32:100 by 2009 (Table 1). Beginning in 2010, we reduced the number of "any bull" drawing permits (896 in RY10, 752 in RY11, and 800 in RY12) 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 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 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 to obtain as much of the antlerless harvest as possible during the fall (versus the winter registration hunt) in order to reduce the take of antlerless bulls and reduce hunter conflict with trappers. That year, 372 drawing (Fig. 4) and 685 registration permits were issued and resulted in a reported harvest of 66 (27%) by drawing permit and 176 (73%) by registration permit (Table 5). During RY10–RY13, 44% (116/269), 58% (156/271), 57% (107/188), and 61% (56/92) of the antlerless moose were harvested during drawing permit hunts held during fall. Many modifications to antlerless drawing and registration hunt areas were made during RY09–RY13 to address biological, harvest, and social issues (Figs. 5–9).

<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 and hunters often obtained harvest tickets for both general and antlerless hunts. 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), then declined to 1,608 general season hunters in RY06, apparently as participation in the antlerless hunts waned (n = 2,057 hunters). This trend continued during RY09–RY10 (Young 2012), RY11–RY12 (1,184 general season hunters; 665 antlerless moose hunters), and RY12–RY13 (1,146 general season hunters; 453 antlerless moose hunters).

Harvest Chronology. Moose harvest in Unit 20A has traditionally been well distributed throughout the season and consistent across years with no deviations apparent during RY11–RY12 (Table 6).

Transport Methods. All-terrain vehicles (3- or 4-wheeler and other ORV) and airplanes remain the primary modes of transportation used by successful hunters, and no deviations from their use in recent years were apparent during RY11–RY12 (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 approximately 25–30% between 2004 and 2012, 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. 2007). 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, and the extent to which moose use that burn is being investigated. During summers 2006 and 2007, 46,000 acres burned in the east central Tanana Flats (Little Delta burn). In 2009, there were 2 additional large wildfires: 1) 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 2) 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. In 2011, 24,000 acres burned (Coal Creek burn) in the southwestern mountains. During September 2012, 47,000 acres burned in the northcentral Tanana Flats (a re-burn of the 1957 Bear and McDonald Creeks burn). Finally, in 2013, 67,000 acres burned in the northeastern Tanana Flats (re-burned most of the 1998 Carla Lake burn). Thus, roughly

700,000–800,000 acres burned in Unit 20A during 2001–2013, which should result in significantly greater browse production and higher carrying capacity of the range for moose. 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 Comments 2011 (Office of the Commissioner, July 9, 2012, Juneau) regarding the military's proposed Joint Pacific Alaska Range Complex (JPARC) Modernization and Enhancement Draft Environmental Impact Statement 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, on-going research projects, increase costs due to the need to circumvent airspace, schedule additional flights and cause researchers to reduce, abandon or not undertake future projects to monitor moose or other species if predictable, adequate access to airspace cannot be assured. Without the continued ability to free access to the airspace in the region, particularly below 7,000 feet above ground level, necessary fish and wildlife population management in this area could be reduced. 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 of 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 12,000 moose (i.e., intensive management population objective's upper limit through 2011 and lower limit beginning in 2012) through November 2012. 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 intensive management 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., roughly 700,000–800,000 acres burned during 2001–2013). 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–RY13, 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 RY14 and RY15, 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 intensive management harvest objective of 1,400–1,600 moose annually in RY11 or 900–1,100 moose in RY12. 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.

MANAGEMENT OBJECTIVES

For the next reporting period, management objectives will be adjusted to the following:

- Manage for a November population of between 12,000 and 15,000 moose.

- Manage population levels based on 3-year mean (change from 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 multi-year short yearling mass is <385 lb (175 kg), or >35% of annual browse biomass is removed by moose (Boertje et al. 2007):

- o <10% twinning rate — reduce the moose population.
- o 10–20% twinning rate — maintain a stable moose population.
- o >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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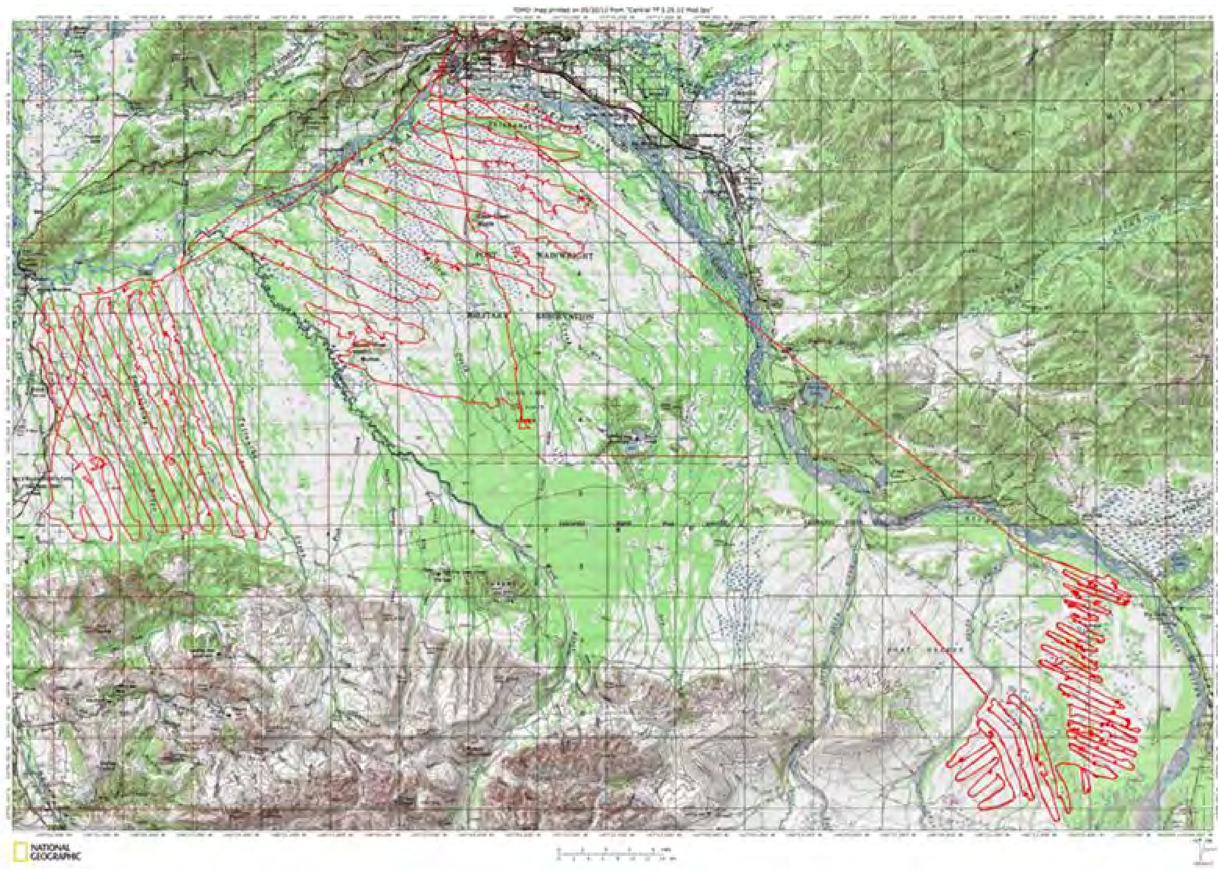

Figure 1. Northcentral Tanana Flats, western Tanana Flats, and eastern Tanana Flats-foothills twinning survey areas and flight paths, Unit 20A, 2012.

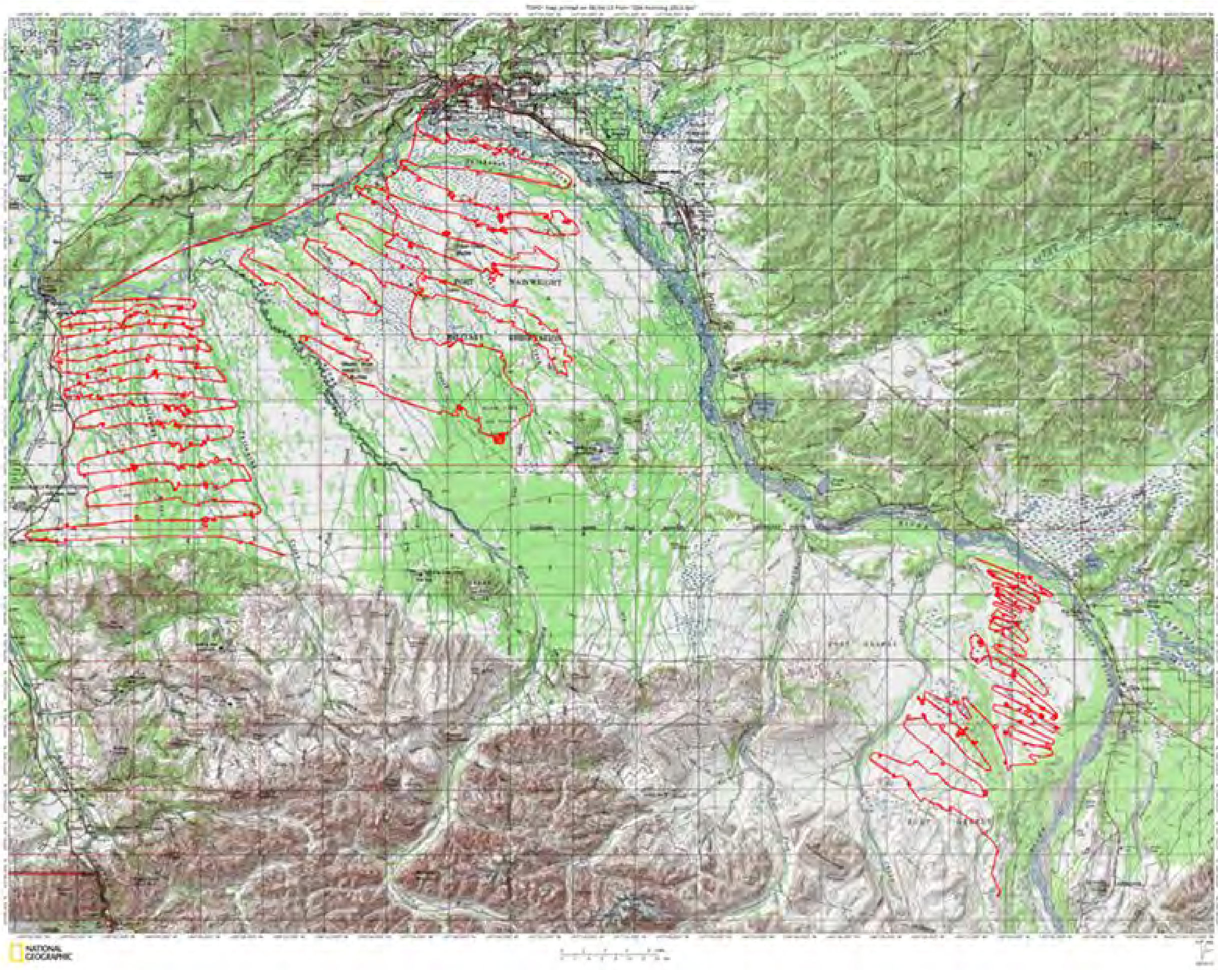

Figure 2. Northcentral Tanana Flats, western Tanana Flats, and eastern Tanana Flats-foothills twinning survey areas and flight paths, Unit 20A, 2013.

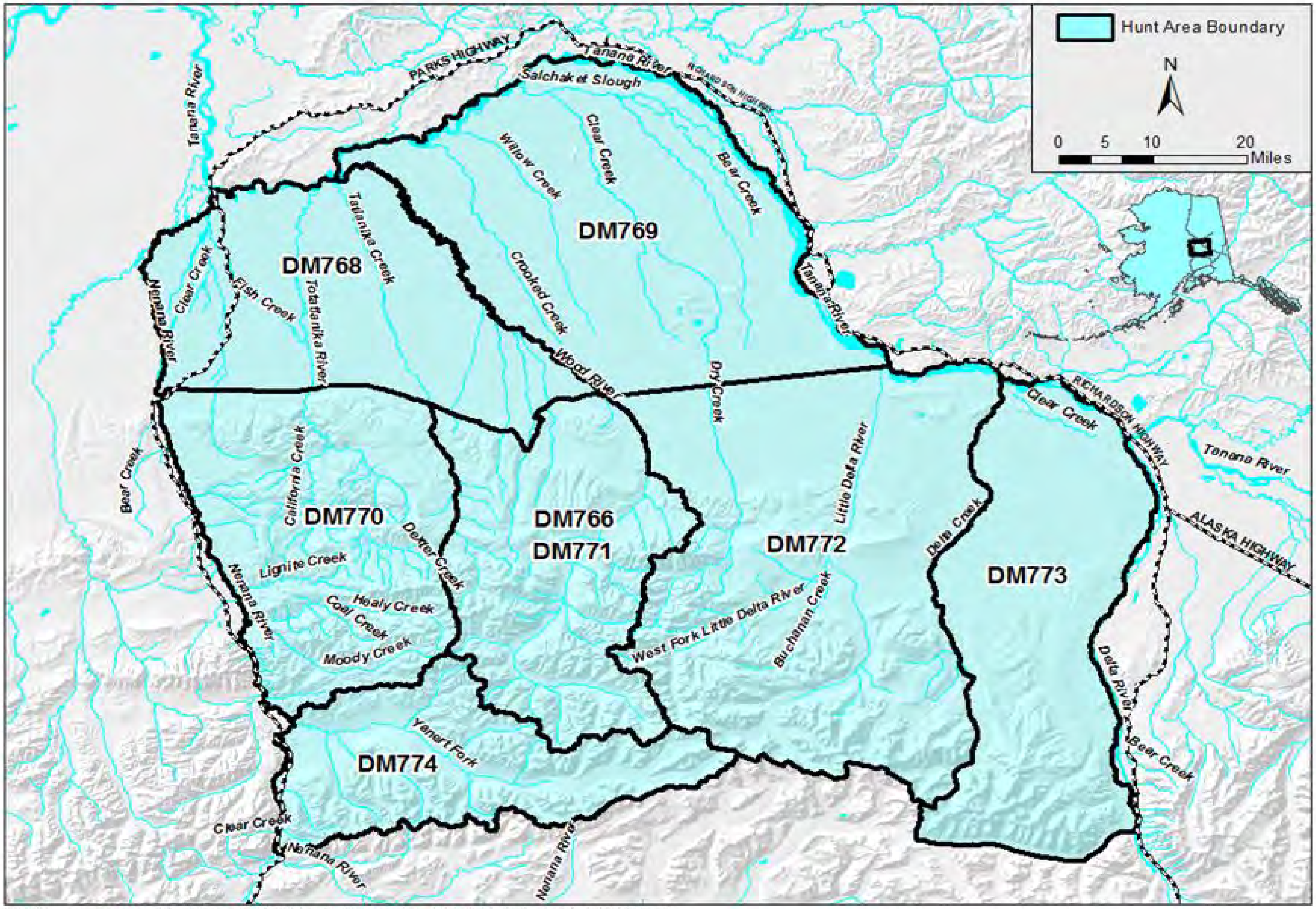

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Figure 3. Bull drawing permit hunts DM768–DM774, regulatory years[a] 2008–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

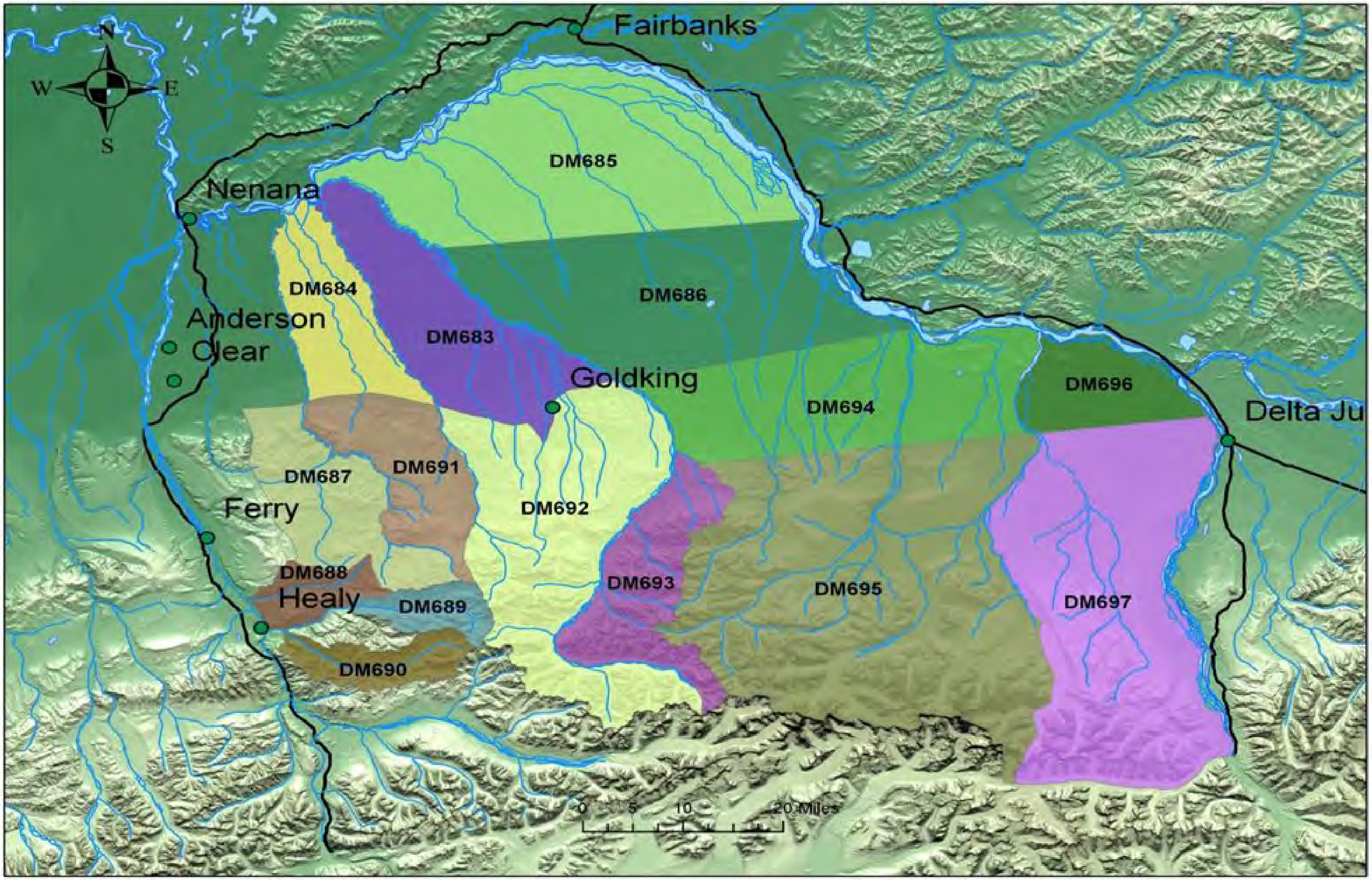

Figure 4. Antlerless drawing permit hunts DM683–DM697 hunt areas, regulatory years[a] 2009–2011.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2009 = 1 July 2009–30 June 2010).

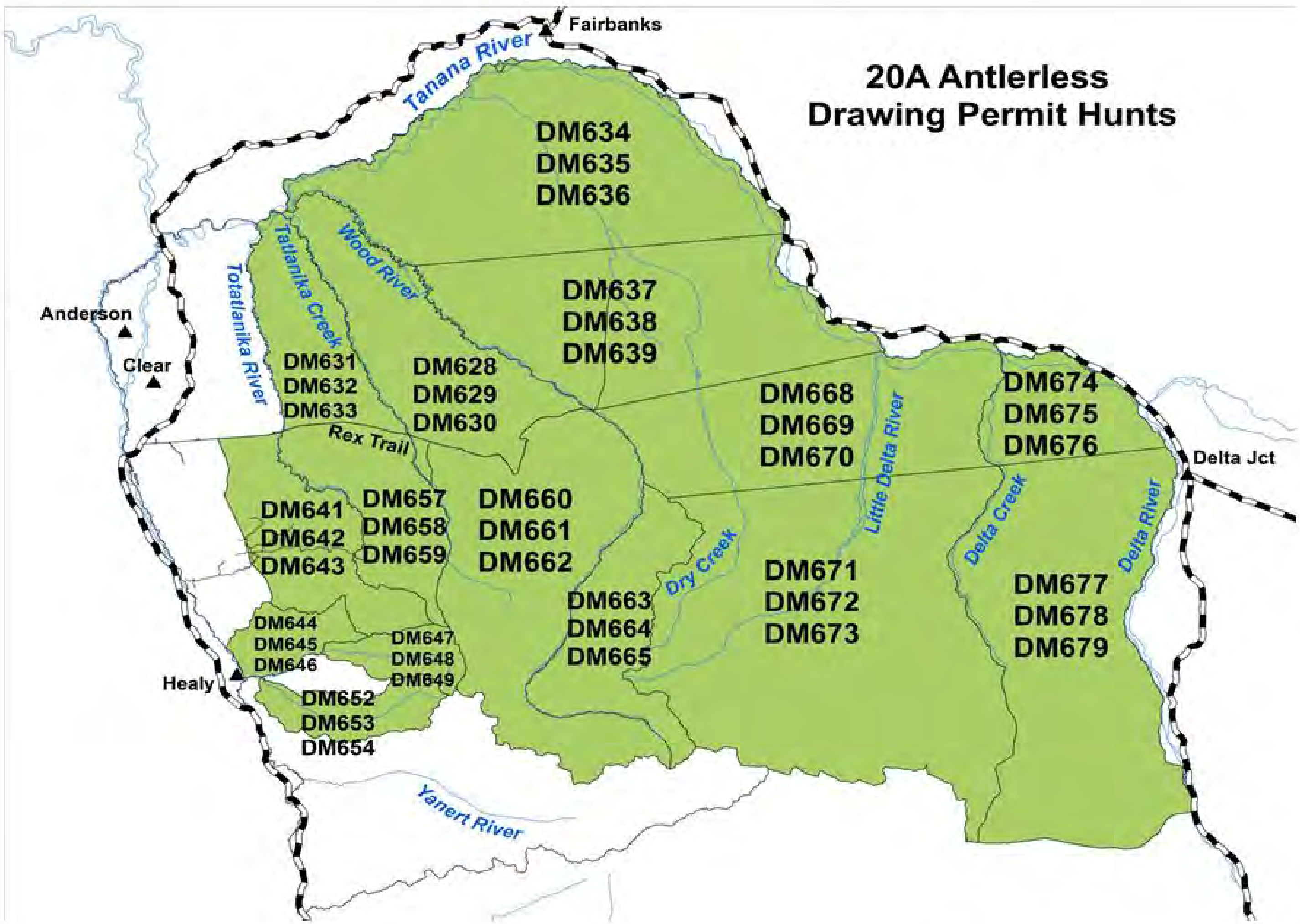

Figure 5. Antlerless drawing permit hunts DM628–DM679 hunt areas, regulatory years[a] 2012 and 2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2012 = 1 July 2012–30 June 2013).

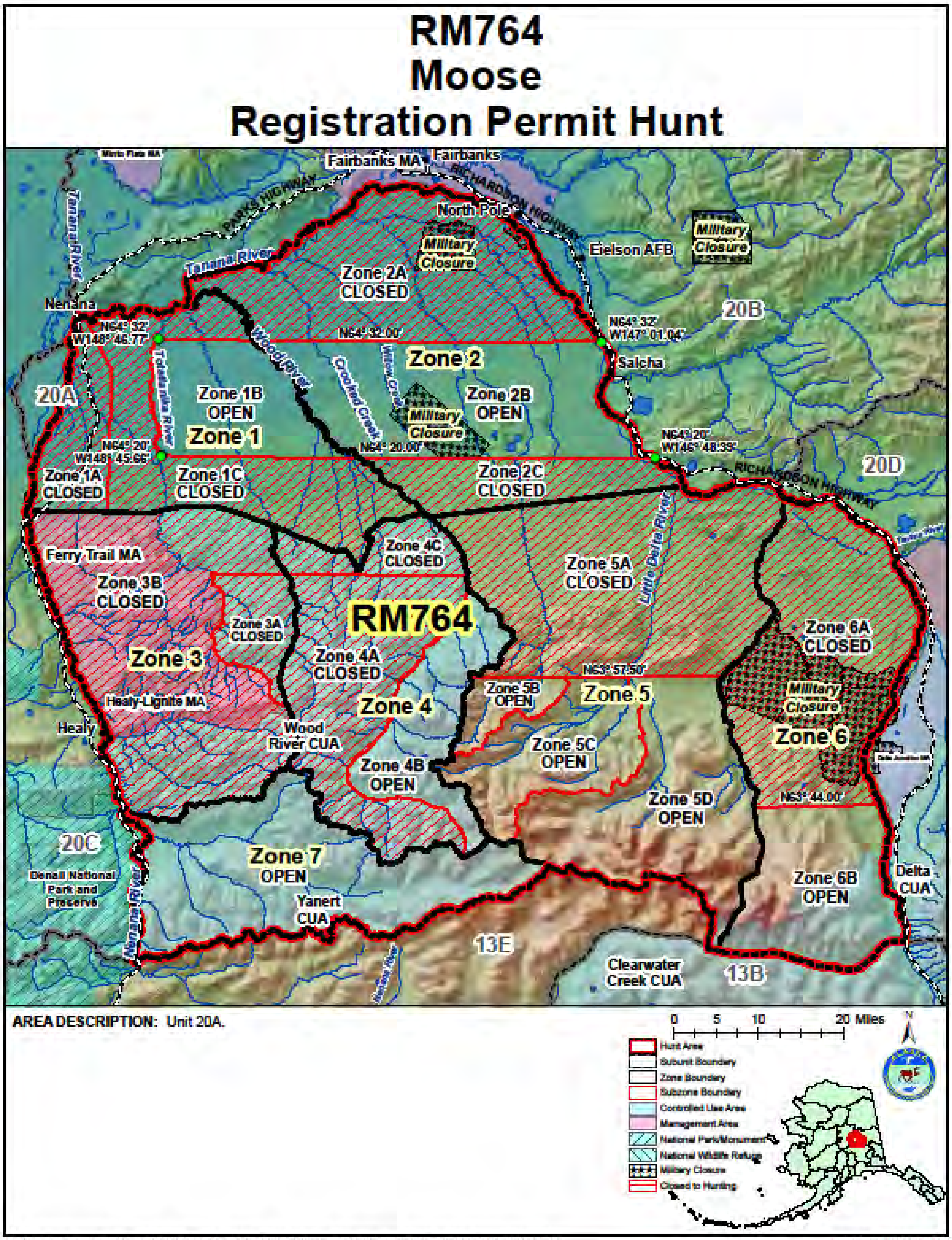

Figure 6. Antlerless moose registration hunt RM764 hunt areas, regulatory year[a] 2011.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2011 = 1 July 2011–30 June 2012).

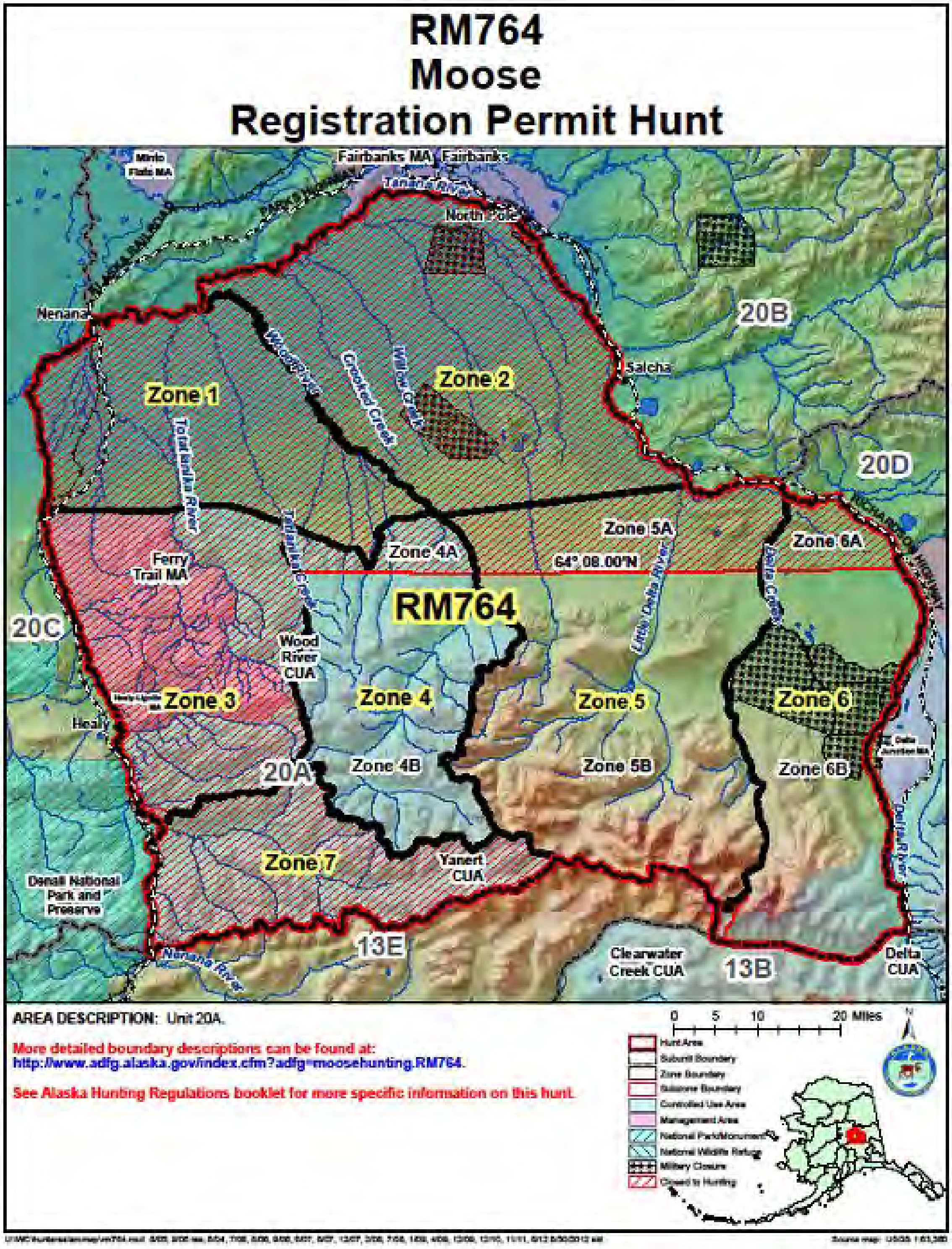

Figure 7. Antlerless moose registration hunt RM764 hunt areas, regulatory year[a] 2012.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2012 = 1 July 2012–30 June 2013).

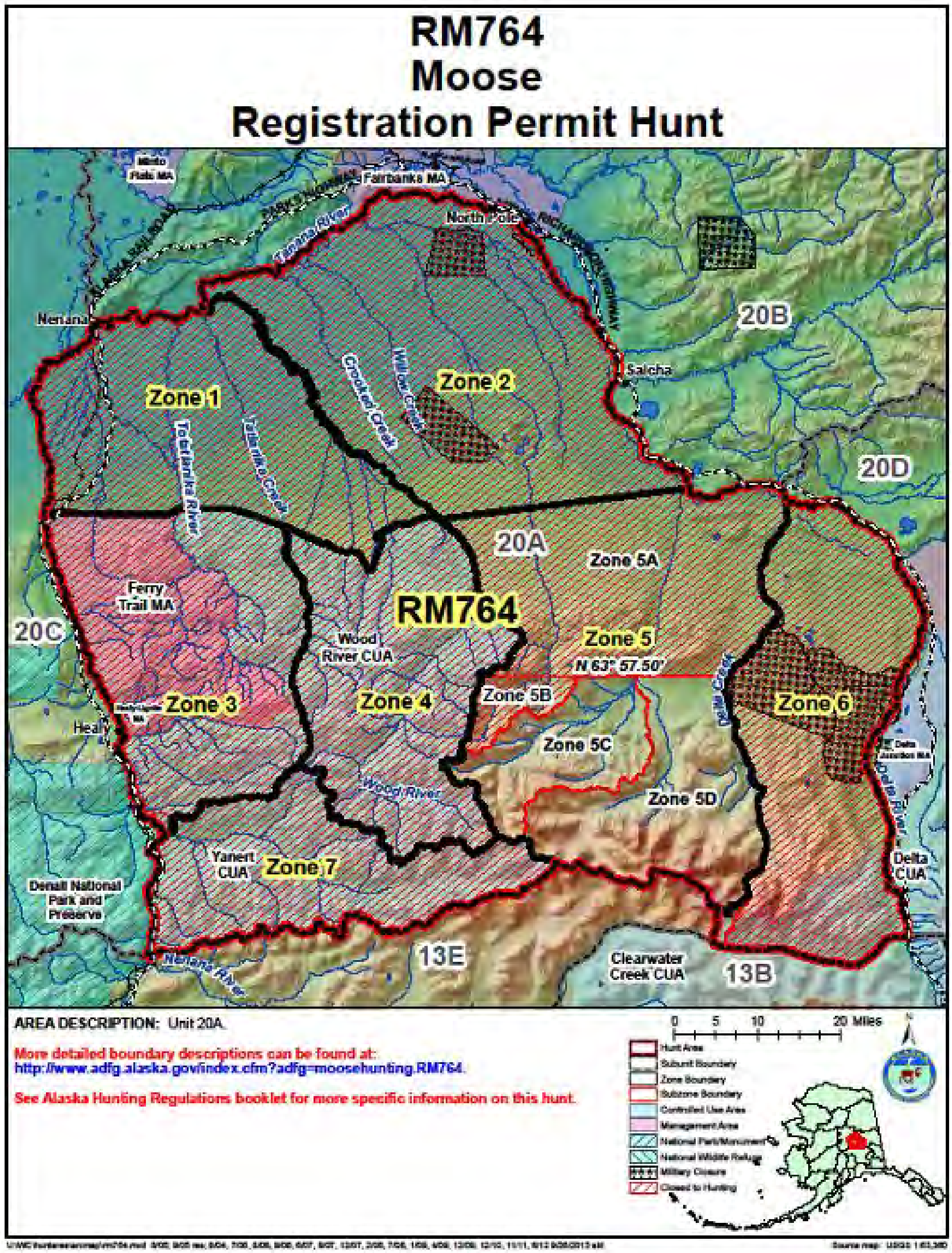

Figure 8. Antlerless moose registration hunt RM764 hunt areas, regulatory year[a] 2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2013 = 1 July 2013–30 June 2014).

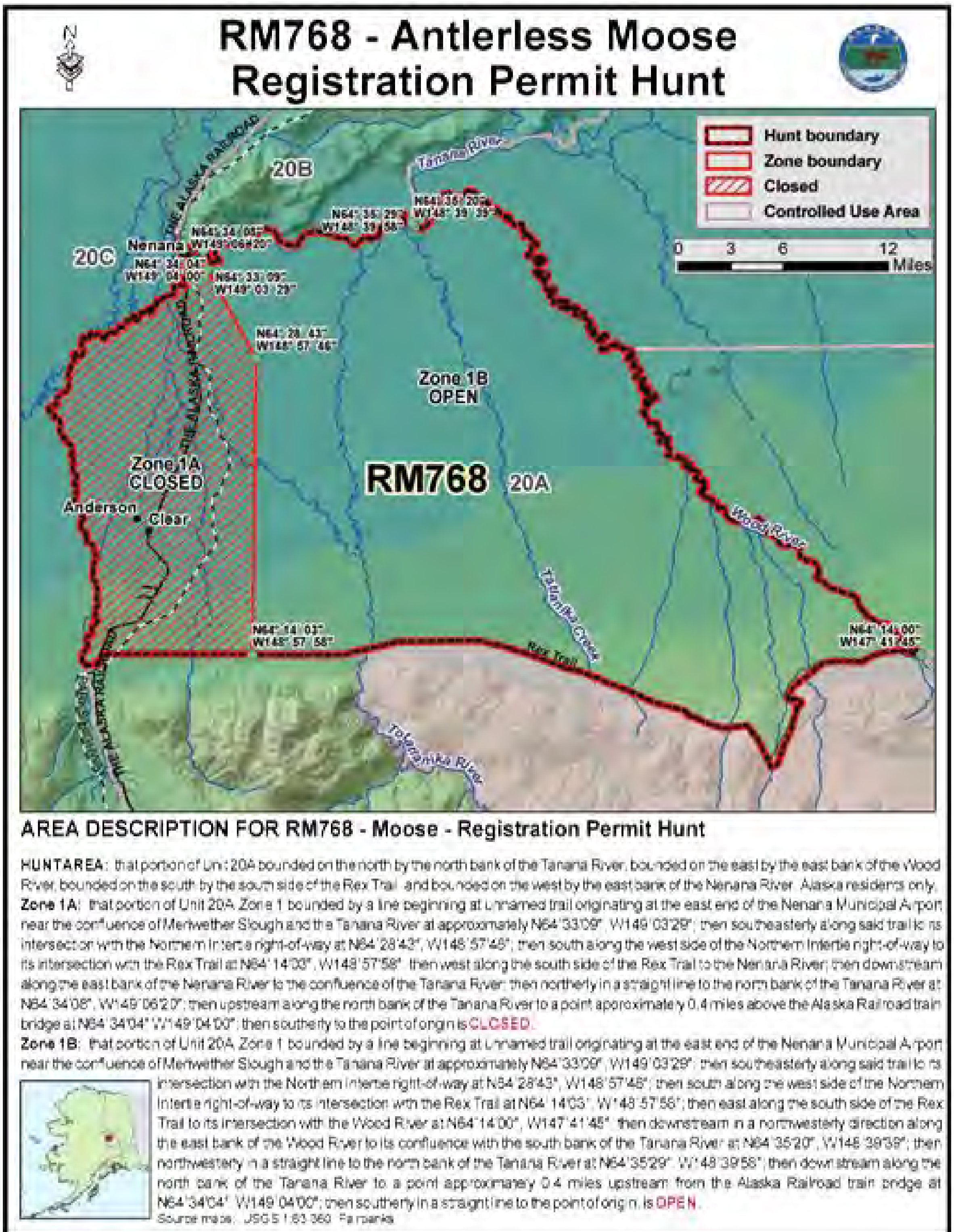

Figure 9. Antlerless moose registration hunt RM768 hunt area, regulatory years[a] 2009–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2009 = 1 July 2009–30 June 2010).

Table 1. Unit 20A aerial moose fall composition counts and estimated population size, 1999–2013.

Year	Bulls:100 Cows	Yearlings: 100 Cows[b]	Calves: 100 Cows	Percent calves	Adults	Moose observed	Estimated population[a] w/SCF = 1.21[c] (90% CI)	Moose/mi^{2}[d]
1999	23	13	33	21	760	965	13,558 (±16.8%)	2.7
2000	23	10	33	21	1,089	1,377	13,565 (±23.0%)	2.5
2001	26	18	26	17	737	887	13,928 (±17.4%)	2.8
2002[e]								
2003	32	22	28	18	1,212	1,483	17,768 (±15.7%)	3.5
2004	35	21	36	21	1,512	1,922	16,415 (±17.1%)	3.3
2005	38	18	30	19	1,370	1,684	16,151 (±17.3%)	3.2
2006	36	22	34	20	1,232	1,536	15,455 (±18.4%)	3.1
2007[e]								
2008	37	25	35	20	1,335	1,672	12,537 (±14.6%)	2.5
2009	32	18	30	19	1,411	1,740	15,667 (±15.3%)	3.1
2010	32	17	32	20	1,196	1,486	14,497 (±16.2%)	2.9
2011	33	17	28	21	1,363	1,651	12,723 (±15.3%)	2.5
2012	34	18	31	18	1,014	1,244	12,193 (±15.8%)	2.4
2013	28	14	31	19	875	1,085	10,156 (±14.5%)	2.0

[a] Geospatial population estimation (GSPE) method.
[b] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[c] Sightability correction factor (Boertje et al. 2009).
[d] Based on an estimated 5,040 mi^{2} of moose habitat in Unit 20A.
[e] Surveys were not conducted due to lack of snow.

Table 2. Unit 20A moose twinning rates from transect surveys, 2006–2013.

Year	Date	Cows w/Single calf	Cows w/Twins	Cows Total	% Twins[a]	Mean[b]
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	
2012[c]	25 May	42	12	54	22	
2012[d]	26 May	38	4	42	10	12
2012[e]	27 May	31	1	32	3	
2013[c]	29 May	43	5	48	10	
2013[d]	30 May	36	5	41	12	12
2013[e]	1 Jun	29	5	34	15	

[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 3. Estimate of Unit 20A moose harvest[a] and accidental death, regulatory years[b] 2001–2012.

Regulatory	Human take					Accidental death			Grand
	Reported hunter harvest				Estimated	Reported			
year	M	F	Unk	Total	total[c]	Road[d]	Train[e]	Total	total
2001	541	70	4	615	830	3	4	7	837
2002	363	115	1	479	647	7	6	13	660
2003	347	159	0	506	683	0	6	6	689
2004	431	557	0	988	1,334	0	11	11	1,345
2005	497	634	0	1,131	1,527	0	6	6	1,533
2006	558	493	0	1,051	1,419	2	8	10	1,429
2007	538	417	7	962	1,299	0	8	8	1,307
2008	643	171	8	822	1,110	1	11	12	1,122
2009	643	202	0	845	1,141	1[f]	9[f]	10	1,151
2010	593	231	0	824	1,112	1[f]	9[f]	10	1,122
2011	545	254	0	799	1,079	1[f]	9[f]	10	1,089
2012	518	177	0	695	938	1[f]	9[f]	10	948

[a] Includes general and permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).
[c] Reported total harvest times 1.35 (Boertje et al. 2009); includes all other types of reported (e.g., defense of life or property, dispatched, potlatch, stickdance) and unreported (e.g., illegal, snaring, other, and wounding loss), except train and roadkill.
[d] Documented kills; actual number killed by vehicles is certainly greater.
[e] 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.
[f] Average reported killed regulatory years 2003–2008.

Table 4. Unit 20A general season moose hunter[a] residency and success, regulatory years[b] 2001–2012.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
2001	350	131	56	2	539 (35)	705	219	81	7	1,012 (65)	1,551
2002	190	77	85	1	353 (30)	567	190	70	1	828 (70)	1,181
2003	185	68	78	0	331 (28)	551	202	99	6	858 (72)	1,189
2004	191	95	92	15	393 (24)	815	320	85	15	1,235 (76)	1,628
2005	211	112	119	2	444 (24)	892	385	86	9	1,372 (76)	1,816
2006	177	107	123	1	408 (25)	755	327	108	10	1,200 (75)	1,608
2007	176	90	116	2	384 (24)	694	374	132	1	1,201 (76)	1,585
2008	197	113	136	5	451 (30)	596	304	116	22	1,038 (70)	1,489
2009	173	104	111	10	398 (27)	623	322	97	21	1,063 (73)	1,461
2010	135	80	103	30	348 (26)	563	277	101	51	992 (74)	1,340
2011	136	97	74	8	315 (27)	470	298	80	21	869 (73)	1,184
2012	126	81	70	11	288 (25)	429	325	78	26	858 (75)	1,146

[a] Excludes hunters in permit hunts.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).
[c] Residents of Unit 20.

Table 5. Unit 20A moose harvest data by permit hunt, regulatory years[a] 2004–2012.

Permit hunt	Regulatory year	Permits issued	Successful hunters (%)	Unsuccessful hunters (%)	Did not hunt (%)	Male (%)	Female (%)	Unk	Harvest
Totals for antlerless permit hunts	2004	5,430	595 (25)	1,766 (75)	3,069 (57)	37 (6)	553 (94)	5	595
	2005	5,114	679 (25)	2,038 (75)	2,397 (47)	47 (7)	629 (93)	3	679
	2006	3,737	559 (27)	1,498 (73)	1,680 (45)	66 (12)	484 (88)	9	559
	2007	3,721	469 (25)	1,419 (75)	1,833 (49)	44 (9)	421 (91)	4	469
	2008	1,852	197 (31)	447 (69)	1,208 (65)	24 (12)	171 (88)	2	197
	2009	1,057	242 (32)	522 (68)	293 (28)	33 (15)	189 (85)	20	242
	2010	1,355	269 (38)	436 (62)	650 (48)	39 (15)	225 (85)	5	269
	2011	1,383	271 (41)	394 (59)	718 (52)	14 (5)	253 (95)	4	271
	2012	1,129	188 (42)	265 (58)	676 (60)	11 (6)	177 (94)	0	188
Totals for antlered permit hunts	2004	0	0 (0)	0 (0)	0 (0)	0 0	0 (0)	0	0
	2005	75	8 (23)	27 (77)	40 (53)	8 (100)	0 (0)	0	8
	2006	375	85 (40)	126 (60)	164 (44)	85 (100)	0 (0)	0	85
	2007	576	113 (34)	223 (66)	240 (42)	113 (100)	0 (0)	0	113
	2008	825	170 (41)	242 (59)	413 (50)	170 (100)	0 (0)	0	170
	2009	1,040	210 (39)	332 (61)	498 (48)	209 (100)	0 (0)	1	210
	2010	936	208 (40)	307 (60)	421 (45)	208 (100)	0 (0)	0	208
	2011	827	216 (47)	242 (53)	369 (45)	216 (100)	0 (0)	0	216
	2012	871	219 (46)	261 (54)	391 (45)	219 (100)	0 (0)	0	219
Totals for all permit hunts	2004	5,430	595 (25)	1,766 (75)	3,069 (57)	37 (6)	553 (94)	5	595
	2005	5,189	687 (25)	2,065 (75)	2,437 (47)	55 (8)	629 (92)	3	687
	2006	4,112	644 (28)	1,624 (72)	1,844 (45)	151 (24)	484 (76)	9	644
	2007	4,297	582 (26)	1,642 (74)	2,073 (48)	157 (27)	421 (73)	4	582
	2008	2,677	367 (35)	689 (65)	1,621 (61)	194 (53)	171 (47)	2	367
	2009	2,097	452 (35)	854 (65)	791 (38)	242 (56)	189 (44)	21	452
	2010	2,291	477 (39)	743 (61)	1,071 (47)	247 (52)	225 (48)	5	477
	2011	2,210	487 (43)	636 (57)	1,087 (49)	230 (48)	253 (52)	4	487
	2012	2,000	407 (44)	526 (56)	1,067 (53)	230 (57)	177 (43)	0	407

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).

Table 6. Unit 20A moose harvest[a] chronology percent by month/day, regulatory years[b] 2007–2012.

Regulatory year	Harvest chronology percent by month/day						
	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25	Unk/Other	*n*
2007	18	11	23	26	20	2	384
2008	14	15	20	25	23	3	454
2009	16	15	26	23	18	2	398
2010	16	12	23	23	24	2	348
2011	18	15	17	29	21	1	315
2012	14	16	23	21	22	4	288

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2007 = 1 July 2007–30 June 2008).

Table 7. Unit 20A moose harvest[a] percent by transport method, regulatory years[b] 2001–2012.

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
2001	34	5	19	20	0	10	3	7	1	539
2002	36	5	14	23	0	8	3	8	2	353
2003	32	5	13	26	0	10	3	9	2	331
2004	33	5	14	29	0	10	3	4	2	393
2005	37	3	15	25	0	11	3	4	0	395
2006	38	7	13	28	0	7	2	4	1	408
2007	32	5	15	25	1	12	2	5	2	387
2008	38	5	15	30	0	6	2	4	1	455
2009	30	8	12	32	0	9	3	3	2	398
2010	32	7	12	31	0	9	3	3	2	348
2011	29	9	8	41	0	10	1	3	1	315
2012	30	7	10	35	0	11	1	3	3	288

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).

Table 8. Unit 20A short-yearling weights, 2009, 2010, and 2012.

Area	Year	Avg weight (lb)	*n*	Variance	SE	Dates
Central Unit 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 Unit 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

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CHAPTER 23: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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 1992). 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 a peak of about 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 permit hunts are available only to resident hunters. Fifty-eight permit hunts were available to hunt moose in Unit 20B during RY11 and RY12: 2 hunts for "any moose" and 56 hunts for "antlerless moose" (i.e., 1 in the Fairbanks management area [FMA] by

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

bow and arrow, 1 in the Creamer's Field Migratory Waterfowl Refuge [Creamer's Refuge] within FMA by muzzleloader, and 56 in central and western Unit 20B outside FMA).

The Minto Flats management area (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.

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 FMA changed numerous times. The most recent changes went into effect in July 2004. FMA currently encompasses about 300 mi^2, about 50 mi^2 of which have 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

Weather and snow conditions were not adequate in 2011 to allow us to complete a unitwide survey. In November 2012, we completed the survey in eastern Unit 20B, but conditions deteriorated and the remainder of Unit 20B was not completed. We used the geospatial population estimator (GSPE) method to conduct the survey (Ver Hoef 2001, 2008; Kellie and DeLong 2006). 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 (SU; Kellie and DeLong 2006). We selected a simple random sample of SUs (n = 164) from each stratum using Microsoft Excel® 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 November 2013, snow conditions were adequate in central and western Unit 20B to complete a GSPE survey. We used the same sampling and sightability methodology used in 2012. We surveyed 145 of 425 SUs from eastern and western Unit 20B of which 101 were high density SUs and 44 were low density. To evaluate management objectives, we obtained a unitwide estimate of moose abundance by combining the 2012 population estimate from eastern Unit 20B with the 2013 population estimate for central and western Unit 20B.

Twinning Rate Surveys

Twinning rates were estimated from surveys conducted in traditional twinning survey trend count areas in Minto Flats and areas surveyed in central Unit 20B since 2006. Surveys in MFMA consisted of parallel transects flown at approximately ½-mile intervals at ≤500 feet above ground level in PA-18 or Bellanca Scout aircraft by experienced pilots. This method is most effective in 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 above ground level in a Bellanca Scout or PA-18. 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. Twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

2012 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 24 May between the Tolovana River and Swanneck Slough to the west and Dunbar Trail to the east beginning at 65°02.9′N and working south until a sample of 50 parturient moose were found or we reached a latitude of 64°55.0′N. The survey was flown with a PA-18 Super Cub. Leaf-out was approximately 80%. Weather, turbulence, and airsickness were not factors. Survey flight time was 2.75 hours.

Central Unit 20B. On 30 May, we used a Bellanca Scout aircraft to search from Fairbanks down Goldstream Creek to Standard Creek road, over Luck Dome to Murphy Dome, up the Chatanika River to the Steese Highway, over Fort Knox gold mine to the Little Chena River, down the Little Chena River to the Chena River, up the Chena River to the flood control project and in the vicinity of Eielson Air Force Base and then down the north side of the Tanana River to Fairbanks. Weather, turbulence and airsickness were not factors in the survey. Total survey time was 4.7 hours.

2013 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 24 May between the Tolovana River and Swanneck Slough to the west and Dunbar Trail to the east beginning at 65°02.9′N and working south until a sample of 50 parturient moose were found or we reached a latitude of 64°55.0′N. The survey was flown with a PA-18 Super Cub. Leaf-out was approximately 50%. Turbulence and airsickness were not factors, but unseasonable warm temperatures (75–89°F) made it hard to locate moose. Many of the moose were found in the more shaded and dense forest or shrubs, likely escaping the heat; therefore they were more difficult to see from the air. Survey flight time was 4.9 hours.

Central Unit 20B. On 30 May, a PA-18 Super Cub aircraft was used to search from Fairbanks down Goldstream Creek to Standard Creek road, over Luck Dome to Murphy Dome, up the Chatanika River to the Steese Highway, over Fort Knox gold mine to the Little Chena River, down the Little Chena River to the Chena River, up the Chena River to the flood control project and in the vicinity of Eielson Air Force Base and then down the north side of the Tanana River to Fairbanks. Weather was 75–80°F, so moose were likely in shaded areas and more difficult to see. Turbulence and airsickness were not factors. Total survey time was 5.0 hours.

MORTALITY

We estimated harvest based on harvest reports. This included report 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 nonreporting general season hunters, and up to 2 letters and an e-mail were sent to permit holders who failed to report. When antler size of bulls was reported, we considered bulls with antler spreads of <30 inches to be yearlings. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY12 = 1 July 2012–30 June 2013).

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 Alaska Department of Fish and Game [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

The most recent browse removal surveys were conducted in March 2010 in MFMA. Data on browse production and removal were estimated using plant sampling methods described by Seaton (2002). No browse removal surveys were conducted in RY11 or RY12.

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 1992). The population was estimated at 12,499 moose (1.3 moose/mi^2) by 2001 and 16,214 moose (1.7 moose/mi^2) in 2003 (Table 1). The population then appeared to stabilize during 2004–2006. In 2008, the population estimate increased again to 17,954 (1.9 moose/mi^2) moose. In 2009, the population estimate was 20,173, and the lower end of the 90% confidence interval was above the intensive management population objective of 15,000 moose. During 2000–2009, we measured relatively high productivity and recruitment, as well as low snow winters and high predator (black bear, brown bear, and wolf) harvests in Unit 20B, which further indicated a period of population growth (Seaton 2010). Unitwide surveys were not completed during RY11 or RY12. We combined data collected in 2012 in eastern Unit 20B and 2013 in central and western Unit 20B to obtain a unitwide estimate of 14,057 moose (1.5 moose/mi^2). The extremely late spring in 2013 and intentionally high harvest of cow moose likely contributed to the lower population estimate during 2012 and 2013.

Within the 3 geographic zones in Unit 20B, moose numbers in central and western Unit 20B (including MFMA) showed similar increasing trends through 2009 and then a decrease in 2012 and 2013 (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) and then decreased to 5,841 (1.5 moose/mi^2) in 2013. In western Unit 20B moose numbers increased from 4,562 (1.6 moose/mi^2) to 9,742 (3.3 moose/mi^2) during 2001–2009 and then decreased to 5,419 (1.8 moose/mi^2) in 2013. Population estimates in eastern Unit 20B, however, increased slightly during 2001–2006 and remained stable during 2006–2009 (Table 1). It appears that there might be a slight decrease in the eastern Unit 20B population from 2009 through 2012.

During 2001–2010 the MFMA estimate increased from 2,252 (2.4 moose/mi^2) to 4,181 (4.4 moose/mi^2) and then decreased to 2,455 (2.6 moose/mi^2) in 2013. However, annual estimates of moose densities in MFMA during 2003–2013 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 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 wildlife biologists, personal communication to J. Selinger, 2000).

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 MFMA in western Unit 20B have had relatively intensive wolf trapping efforts compared with most of Interior Alaska, including eastern Unit 20B. 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, however, we lack wolf and bear population estimates for this area.

Population Composition

Bull:Cow Ratios. The 2012 survey indicated post hunting bull:cow ratios of 40 bulls:100 cows in eastern Unit 20B. The 2013 central and western Unit 20B bull:cow ratios were 24 and 33 bulls:100 cows, respectively (Table 1). The estimated bull:cow ratio was 23:100 in MFMA in 2013.

Historically, bull:cow ratios in most of Unit 20B have exceeded the lower limit of the management objective of ≥30:100, but varied spatially by harvest intensity within the unit. For example, the overall Unit 20B bull:cow ratio averaged 40:100 through the early 1990s (McNay 1992). The less intensively harvested Salcha River drainage had bull:cow ratios of 44:100 (1990) and MFMA had 49:100 (1989) and 47:100 (1994). In contrast, the more intensively harvested central Unit 20B ratio was 28:100 (1990), and the most intensively harvested FMA had 9–14 bulls:100 cows (1989–1994).

Calf:Cow Ratios. Calf:cow ratios were high during 2001–2013 (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). This wasn't the case in the 2012 eastern Unit 20B survey where calf:cow ratio was higher than the ratios found in central and western Unit 20B during 2013. It is unclear whether differences in calf:cow ratios between central-western Unit 20A and eastern Unit 20A reflect actual differences in calf survival or are a spurious result of conducting the moose surveys during different years.

Twinning Rates. Twinning rates in MFMA were relatively stable during 2002–2013 ($\bar{x}$ = 24%; range = 13–34%) (Table 2). The MFMA twinning rate was 13% in 2012, but rebounded to 22% in 2013.

The central Unit 20B twinning rate was 4% in 2012, and 6% in 2013. Twinning surveys have been conducted in central Unit 20B since 2006 and have been consistently lower ($\bar{x}$ = 7%, range = 2–18) than in MFMA during 2006–2013.

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 RY11 and RY12 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Creamer's Field Migratory Waterfowl Refuge		
1 bull with spike–fork or greater antlers by bow and arrow only; 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 FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in 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 FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in FMA.	21–27 Nov (RY11) 1 Dec–31 Jan (RY12)	21–27 Nov (RY11) 1 Dec–31 Jan (RY12)
Remainder of 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 FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in FMA.	1 Sep–27 Nov	1 Sep–27 Nov

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Minto Flats management area (RY11)		
1 moose by registration permit only	1 Sep–25 Sep or 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 one side.	11 Sep–25 Sep	No open season
Minto Flats management area (RY12)		
1 bull, or	21 Aug–27 Aug	No open season
1 bull with spike–fork or 50-inch antlers, or antlers with ≥4 brow tines on one side; or	8 Sep–25 Sep	No open season
1 antlerless moose by registration permit.	15 Oct–28 Feb	No open season
Middle fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull; or	1 Sep–20 Sep	1 Sep–20 Sep
1 bull by bow and arrow only; 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; or	15 Aug–15 Nov	No open season
1 moose (RY11) or 1 bull (RY12) by muzzleloader permit.	1 Nov–30 Nov	No open season
Southeast of the Moose Creek dike within a half-mile of each side of the Richardson highway except Birch, Harding, and Lost Lake closed areas.		
1 bull; or	1 Sep–20 Sep	5 Sep–20 Sep
1 moose by bow and arrow or muzzleloader.	21 Sep–28 Feb	

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Remainder of Unit 20B		
1 bull; or	1 Sep–20 Sep	5 Sep–20 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.

Emergency Orders — In January 2013, we issued an emergency order to close the registration permit hunt (RM785) for antlerless moose in MFMA because the harvest quota of approximately 100 antlerless moose had been met.

Board of Game Actions Effective 1 July 2011 — At the spring 2010 meeting, the Alaska Board of Game (board) adopted a proposal to have a drawing permit muzzleloader hunt (DM782) for any moose in the middle fork of the Chena River and the Salcha River upstream of Goose Creek. This proposal was intended to add hunting opportunity in an area where the moose population was being underutilized. The board also adopted a proposal to implement a drawing permit hunt (DM783) for muzzleloader or archery within a half-mile of the Richardson Highway from the Moose Creek dike to the boundary with Unit 20D. The bag limit is 1 moose and the intention of the permit is to reduce the number of moose-vehicle collisions. Because the application period for drawing permits is in November and December (prior to the board passing these new hunts), both DM782 and DM783 were first available to hunters during the RY11 hunting season. Also during this meeting, the board adopted an ADF&G proposal to extend the general moose season 5 days in the remainder of Unit 20B. The intent of this proposal was to allow opportunity to hunt this high moose population with a harvestable surplus of bulls that could sustain a 5-day longer season. The season was lengthened from 1–15 September to 1–20 September. Also 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 FMA.

Board of Game Actions Effective 1 July 2012 — At the spring 2012 meeting, the board authorized a 21–27 August general season hunt for any bull in the MFMA area and lengthened the September general season to begin 8 September instead of 11 September. The board also authorized a registration permit for a 15 October–28 February antlerless moose season in MFMA. These changes were in response to a proposal that sought to address the limited registration hunts and the process to obtain those permits.

Earlier board actions are summarized by Hollis (2012), Seaton (2010), and Young (2006).

Harvest by Hunters.

General Season — Reported harvest of 605 bulls in RY11 and 652 bulls in RY12 ($\bar{x}$ = 629) was higher than the average reported harvest of 546 bulls during RY03–RY10 (Table 3). Most harvest during RY11–RY12 was in central Unit 20B, followed by western Unit 20B, then eastern Unit 20B (Table 3).

Reported harvest in FMA was 30 moose in RY11 and 25 in RY12 ($\bar{x}$ = 28; Table 3), a decrease from the RY03–RY10 average of 34. Relatively high harvest in FMA is likely the result of high densities and survival rates of moose in FMA.

Permit Hunts — There were no apparent trends in harvest, effort, or success rates in permit hunts during RY03–RY12 (Table 4). Harvest of antlerless moose increased in drawing permit hunts due to a substantial increase in the number of permits issued. Despite increases in the number of permits issued, success rates in those hunts remained relatively stable. Success rates drastically decreased in the registration hunts in RY12 because the hunt was changed to an unlimited registration permit and the number of permits issued drastically increased.

Hunter Residency and Success. Primarily local residents hunted moose in Unit 20B (Table 3). Participation by nonlocal Alaska residents and nonresidents was relatively low, but has increased most years since RY04. Nonlocal resident (n = 515) and nonresident (n = 192) hunters peaked in RY12.

The average success rate of 21% during RY11 and RY12 was similar to the average (20%) reported during RY03–RY10. During RY11 and RY12, central Unit 20B had the lowest success rates ($\bar{x}$ = 19%), followed by eastern Unit 20B ($\bar{x}$ = 26%) and then western ($\bar{x}$ = 29%). By comparison, success rates during RY03–RY10 were similar in central ($\bar{x}$ = 19%), eastern ($\bar{x}$ = 23%), and western Unit 20B ($\bar{x}$ = 24%). 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 RY03–RY12, 18–23% ($\bar{x}$ = 20%) of general season 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 16–20 September ($\bar{x}$ = 29%) in RY11 and 11–15 September and 16–20 September ($\bar{x}$ = 25% each) in RY12 (Table 5). Between RY03 and RY10, more bull moose were killed during 1–5 September or during 11–15 September. However, the season was lengthened for the RY11 season, therefore a good portion of the harvest now occurs during the 16–20 of September when the bull moose are more susceptible due to rutting activities.

Transport Methods. Three- or 4-wheelers, followed by highway vehicles, then boats were the primary methods of transportation used by successful hunters (Table 6). Methods of transportation used by successful hunters were relatively consistent during RY03–RY12.

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 72 animals during RY08–RY12 compared to 84 animals during RY03–RY07. This is an indication that the increased antlerless hunts in the FMA may be helping to reduce roadkill. An additional 57 and 48 moose were reported killed on roads in the remainder of Unit 20B during RY11 and RY12. 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–RY12.

HABITAT

Assessment and Enhancement

A 2010 browse removal study in MFMA estimated browse biomass removal at 29.5% (27–32%, 95% CI), a moderately high removal rate (Paragi and Kellie, *In prep*). 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 during RY09–RY12. Since no browse survey was conducted during RY11 and RY12, and the 2013 population indicates that moose are within the intensive management population objective, it will be prudent to conduct another survey to determine if moose in Unit 20B are utilizing the browse at the same levels or if the levels have changed.

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 AND NEEDS

During RY11–RY12 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

Since no population estimates were available during RY11 and RY12, it is unknown if we met the intensive management population objective of 12,000–15,000 moose. However, the unitwide 2012–2013 estimate falls within the objective so it was met during RY13. Reported harvests reached the intensive management objective's lower limit of 600 moose during RY05–RY12, therefore we met this objective in RY11 and RY12. Because the 2012–2013 population estimate remains high relative to our population objective, I recommend continuing a conservative antlerless moose harvest (1% of the prehunt moose population) in central Unit 20B and in the MFMA of western Unit 20B to limit population growth, maintain the population within the intensive management population objective, and increase yield to meet the intensive management harvest objective. If unitwide surveys indicate population growth or decline, more aggressive or restrictive antlerless harvest may be necessary to maintain this population level.

During RY11 and RY12 it is unknown if 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), however we did meet this objective in 2013. This is consistent with surveys conducted during 2001–2009 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 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 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 because we have antlerless hunts in most of western and central Unit 20B, as well as in MFMA and FMA. I recommend continued twinning rate surveys in 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 FMA or 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, 2001–2013.

Count area	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	12,499 (±19)[d]	12,499	1.3
Unit 20B	2003	33	23	39	22	399	514	16,214 (±24)[d]	16,214	1.7
Unit 20B	2004	32	18	42	25	551	730	16,710 (±30)[d]	16,710	1.7
Unit 20B	2006	29	22	43	26	838	1,127	16,118 (±23)[d]	16,118	1.6
Unit 20B	2008	28	20	36	24	1,177	1,558	17,954 (±18)[d]	17,954	1.9
Unit 20B	2009	37	16	36	21	891	1,128	20,173 (±22)[d]	20,173	2.2
Unit 20B[e]	2012 and 2013							14,057 (±14)[d]	14,057	1.5
Eastern[f]	2001	47	15	24	11	271	305	2,454 (±22)	2,945	1.2
Eastern[f]	2006	36	24	46	24	180	236	2,728 (±34)	3,274	1.4
Eastern[f]	2008	31	13	26	20	106	132	3,126 (±31)	3,751	1.5
Eastern[f]	2009	40	16	27	18	155	189	2,954 (±41)	3,574	1.5
Eastern[f]	2012	40	15	36	21	439	566	2,310 (±19)	2,795	1.2
Central[g]	2001	27	13	34	*26*	205	278	4,005 (±25)	4,806	1.3
Central[g]	2003	26	21	35	21	191	242	3,995 (±37)	4,794	1.3
Central[g]	2004	33	22	46	27	158	216	5,276 (±41)	6,331	1.7
Central[g]	2005	26	26	40	24	493	645	5,881 (±18)	7,057	1.8
Central[g]	2006	28	22	41	17	328	397	5,451 (±29)	6,541	1.7
Central[g]	2008	26	24	36	26	627	852	6,197 (±20)	7,436	1.9
Central[g]	2009	32	16	33	21	258	328	5,666 (±38)	6,856	1.8
Central[g]	2013	24	12	30	19	472	584	4,828 (±17)	5,841	1.5
Western[h]	2001	30	16	29	17	274	331	3,802 (±22)	4,562	1.6
Western[h]	2006	27	20	44	22	384	494	5,142 (±24)	6,170	2.1
Western[h]	2008	27	22	44	23	444	574	5,515 (±19)	6,618	2.2
Western[h]	2009	39	16	41	22	478	611	8,051 (±19)	9,742	3.3
Western[h]	2013	33	12	33	20	386	485	4,479 (±17)	5,419	1.8
MFMA[i,j]	2001	30	16	28	17	191	230	1,877 (±21)	2,252	2.4
MFMA[j]	2003	44	20	36	23	89	116	1,352 (±63)	1,622	1.7
MFMA[j]	2004	26	11	47	24	302	399	3,447 (±19)	4,136	4.3
MFMA[j]	2005	12	12	40	26	296	400	2,937 (±17)	3,524	3.7
MFMA[j]	2006	19	15	45	28	243	337	2,724 (±23)	3,269	3.4

Count area	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[j]	2008	30	23	37	18	309	375	2,487 (±20)	2,984	3.1
MFMA[j]	2009	40	12	40	21	235	298	4,749 (±19)	5,746	6.0
MFMA[j]	2010	34	20	41	23	1,309	1,709	3,455 (±9)	4,181	4.4
MFMA[j]	2013	23	8	41	24	189	250	2,029 (±18)	2,455	2.6
FMA[k,l]	2001	12	13	39	29	70	99	461 (±34)	553	1.7
FMA[k,m]	2008	25	26	56	31	288	417	417[n]	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] Estimated population and confidence interval are calculated with the SCF.
[e] The 2013 Unit 20B estimate is a combination of data from the 2012 survey from eastern Unit 20B and 2013 survey in central and western Unit 20B. Unitwide composition data are not available for combined data.
[f] Survey area = 2,425 mi^2.
[g] Survey area = 3,829 mi^2.
[h] Survey area = 2,942 mi^2.
[i] Minto Flats management area (MFMA) within western Unit 20B.
[j] Count area = 951 mi^2.
[k] Fairbanks management area (FMA).
[l] Survey area = 318 mi^2.
[m] Survey area = 293 mi^2.
[n] 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), 2002–2013.

		Cows			
Year	Date(s)	w/Single calf	w/Twins	Total	% Twins[a]
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
2012[b]	24 May	55	8	63	13
2012[c]	30 May	26	1	27	4
2013[b]	29 May	39	11	50	22
2013[c]	30 May	16	1	17	6

[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[b] 2003–2012.

	Successful						Unsuccessful					
Area/ Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	Total hunters
Eastern Unit 20B — Uniform Coding Units[d] (UCUs) 600, 601, 602, 603, 604, 605, 684)												
2003	58	1	10	0	69	20	235	22	15	0	272	341
2004	49	6	11	3	69	22	205	10	20	4	239	308
2005	77	11	8	0	96	25	243	13	24	1	281	377
2006	76	6	7	0	89	24	235	29	15	5	284	373
2007	60	14	8	4	86	24	222	24	22	2	270	356
2008	65	13	6	4	88	26	206	20	12	10	248	336
2009	54	15	6	1	76	23	208	36	7	4	255	331
2010	54	14	6	2	76	22	204	38	15	11	268	344
2011	68	7	9	2	86	25	200	39	11	9	259	345
2012	72	13	11	4	100	27	211	35	17	1	264	364
Central Unit 20B — (UCUs 207, 208, 209, 211, 212, 213, 301, 401, 402, 403, 404, 405, 406, 484, 485,486,487, 501, 583, 584)												
2003	232	33	23	0	288	19	1,099	94	55	5	1,253	1,541
2004	203	18	25	5	251	19	916	56	57	22	1,051	1,302
2005	211	21	29	0	261	17	1,070	97	70	8	1,245	1,506
2006	239	25	28	2	294	18	1,110	109	76	8	1,303	1,597
2007	216	31	33	0	280	18	1,072	118	63	14	1,267	1,547
2008	276	45	20	19	360	23	1,005	100	44	62	1,211	1,571
2009	261	42	25	1	329	21	1,093	106	48	26	1,273	1,602
2010	183	21	18	4	226	17	937	118	48	21	1,124	1,350
2011	227	37	23	4	291	21	838	130	48	27	1,043	1,334
2012	203	36	39	7	285	17	1,088	159	82	49	1,378	1,663
Western Unit 20B — (UCUs 101, 201, 202, 203, 204, 205, 206, 210)												
2003	65	19	3	0	87	21	244	69	17	1	331	418
2004	56	16	6	2	80	22	214	51	13	4	282	362
2005	53	15	8	0	76	20	233	47	15	1	296	372
2006	57	16	5	0	78	20	241	63	8	4	316	394
2007	67	20	8	1	96	23	247	62	12	1	322	418
2008	91	23	6	1	121	28	216	78	12	8	314	435
2009	83	35	11	1	130	29	245	58	15	5	323	453
2010	80	29	4	3	116	25	246	98	7	5	356	472
2011	69	45	10	4	128	30	196	74	9	10	289	417
2012	107	48	4	4	163	28	295	111	10	4	420	583

Area/ Regulatory year	Successful Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Unsuccessful Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	Total hunters
FMA[e] — general archery hunt[f] (UCUs 0212, 0213, 0300, 0301, 0401, 0402, 0403, 0501; archery only)												
2003	54	5	1	0	60							
2004	31	0	2	0	33							
2005	18	2	1	0	21							
2006	21	1	1	0	23							
2007	21	2	0	0	23							
2008	26	1	0	0	27							
2009	48	2	0	0	50							
2010	33	1	2	0	36							
2011	28	2	0	0	30							
2012	24	1	0	0	25							
MFMA[g] — general hunt (UCUs 0201, 0205, 0210; Nonresident hunters and antlerless harvest censored)												
2003	39	10	0	0	49	30	96	19	0	0	115	164
2004	28	8	0	0	36	25	90	16	0	0	106	142
2005	28	10	0	0	38	25	100	17	0	0	117	155
2006	33	11	0	0	44	25	102	30	0	1	133	177
2007	43	8	0	0	51	28	108	25	0	0	133	184
2008	45	11	0	0	56	30	102	26	0	0	128	184
2009	36	14	0	1	51	29	107	16	0	3	126	177
2010	39	15	0	2	56	25	121	45	0	3	169	225
2011	36	13	0	2	51							
2012	51	15	0	3	69							
Unit 20B remainder, general hunt (Includes FMA general archery hunt, but excludes MFMA)												
2003	358	47	38	0	443	18	1,775	198	99	8	2,080	2,523
2004	324	41	45	13	423	20	1,479	129	101	35	1,744	2,167
2005	368	43	47	0	458	19	1,690	170	114	14	1,988	2,446
2006	394	45	42	2	483	19	1,784	203	109	17	2,113	2,596
2007	350	67	54	1	472	18	1,772	241	118	19	2,150	2,622
2008	440	93	33	24	590	22	1,653	221	81	90	2,045	2,635
2009	451	116	54	3	624	22	1,835	262	87	44	2,228	2,852
2010	364	71	44	8	487	19	1,684	301	84	47	2,116	2,603
2011	403	95	48	8	554	22	1,557	285	84	52	1,978	2,532
2012	410	99	48	16	573	19	1,866	348	134	73	2,421	2,994

	Successful						Unsuccessful					
Area/ Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	Total hunters
All general hunts												
2003	397	57	38	0	492	18	1,871	217	99	8	2,195	2,687
2004	352	49	45	13	459	20	1,569	145	101	35	1,850	2,309
2005	396	53	47	0	496	19	1,790	187	114	14	2,105	2,601
2006	427	56	42	2	527	19	1,886	233	109	18	2,246	2,773
2007	394	75	57	2	528	19	1,879	265	119	19	2,282	2,810
2008	486	104	33	25	648	23	1,755	247	82	91	2,175	2,823
2009	487	130	54	4	675	22	1,942	278	87	47	2,354	3,029
2010	403	86	44	10	543	19	1,805	346	84	50	2,285	2,828
2011	439	108	48	10	605	22	1,640	318	84	55	2,097	2,702
2012	461	114	58	19	652	20	2,025	401	134	76	2,636	3,288

[a] Excludes drawing, registration, and Tier II permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[c] Residents of Unit 20.
[d] Uniform coding units (UCU) are a numbering system used to differentiate drainages in a game management unit.
[e] Fairbanks management area (FMA), 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.
[f] Subtracted number of bulls reported harvested by bow and arrow on Eielson Air Force Base (in UCU 0501, but outside FMA).
[g] Minto Flats management area (MFMA).

Table 4. Unit 20B moose harvest data by permit hunt, regulatory years[a] 2003–2012.

Hunt	Regulatory year	Permits issued	Successful hunters (%)	Unsuccessful hunters (%)	Did not hunt (%)	Did not report (%)	Bulls (%)	Cows (%)	Harvest
Drawing hunts	2003	100	28 (35)	53 (65)	17 (17)	2 (2)	0 (0)	28 (100)	28
	2004	160	50 (38)	80 (62)	24 (16)	6 (4)	1 (2)	49 (98)	50
	2005	159	38 (32)	81 (68)	39 (25)	1 (1)	2 (5)	39 (95)	41
	2006	360	158 (53)	142 (47)	55 (15)	5 (1)	11 (7)	147 (93)	158
	2007	361	127 (42)	169 (58)	65 (18)	0 (0)	8 (6)	119 (94)	127
	2008	185	63 (40)	93 (60)	29 (16)	0 (0)	0 (0)	63 (100)	63
	2009	867	254 (41)	362 (59)	247 (29)	4 (1)	1 (0)	253 (100)	254
	2010	851	209 (33)	422 (67)	216 (26)	4 (1)	8 (4)	201 (96)	209
	2011	1,276	309 (32)	645 (68)	318 (25)	4 (1)	15 (5)	294 (95)	309
	2012	1,250	286 (33)	593 (67)	369 (30)	2 (1)	15 (5)	271 (95)	286
Registration hunts	2003	0							
	2004	110	62 (76)	20 (24)	2 (2)	26 (24)	30 (48)	32 (52)	62
	2005	115	64 (65)	35 (35)	16 (14)	0 (0)	26 (41)	38 (60)	64
	2006	193	104 (64)	59 (36)	21 (11)	9 (5)	45 (43)	59 (57)	104
	2007	197	107 (64)	60 (36)	29 (15)	1 (1)	46 (43)	61 (57)	107
	2008	211	140 (77)	43 (23)	26 (12)	2 (1)	69 (49)	71 (51)	140
	2009	210	142 (77)	43 (23)	22 (11)	3 (1)	65 (46)	77 (54)	142
	2010	230	150 (75)	50 (25)	25 (11)	5 (2)	78 (52)	72 (48)	150
	2011	237	132 (71)	54 (29)	42 (18)	9 (4)	54 (41)	78 (59)	132
	2012	825	140 (39)	217 (61)	441 (55)	27 (3)	18 (13)	122 (87)	140
Tier II hunts	2003	100	46 (58)	30 (38)	21 (22)	3 (3)	23 (50)	23 (50)	46
Total for all permit hunts	2003	200	74 (47)	83 (53)	38 (19)	5 (3)	23 (31)	51 (69)	74
	2004	270	112 (47)	100 (53)	26 (11)	32 (12)	31 (28)	81 (72)	112
	2005	274	105 (48)	113 (52)	55 (20)	1 (1)	28 (27)	77 (73)	105
	2006	553	262 (56)	201 (44)	76 (14)	14 (3)	56 (21)	206 (79)	262
	2007	558	234 (51)	229 (49)	94 (17)	1 (1)	54 (23)	180 (77)	234
	2008	396	203 (60)	136 (40)	55 (14)	2 (1)	69 (34)	134 (66)	203
	2009	1,077	396 (48)	405 (52)	269 (25)	7 (1)	66 (17)	330 (83)	396
	2010	1,081	359 (43)	472 (57)	241 (22)	9 (1)	86 (24)	273 (76)	359
	2011	1,513	441 (39)	699 (61)	360 (24)	13 (1)	69 (16)	372 (84)	441
	2012	2,075	426 (34)	810 (66)	810 (40)	29 (1)	33 (8)	393 (92)	426

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

Table 5. Unit 20B moose harvest[a] chronology percent by month/day, regulatory years[b] 2003–2012.

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*
2003	24	26	35	8	1	7	492
2004	33	27	29	6	2	4	459
2005	38	22	27	6	2	4	496
2006	35	20	31	5	2	6	527
2007	27	24	36	8	2	4	528
2008	37	25	29	5	2	3	648
2009	33	29	27	8	2	2	664
2010	29	22	35	8	3	3	543
2011	21	17	24	29	5	4	605
2012	22	20	25	25	4	4	652

[a] Excludes drawing, registration, and Tier II permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

Table 6. Unit 20B moose harvest[a] percent by transport method, regulatory years[b] 2003–2012.

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Other/ Unknown	*n*
2003	4	0	20	28	0	4	36	3	5	492
2004	4	0	16	30	0	3	39	3	4	459
2005	4	0	21	31	2	5	34	2	3	496
2006	3	1	19	38	1	2	31	3	4	527
2007	3	1	17	35	0	4	33	3	2	528
2008	3	0	17	37	0	6	33	2	2	655
2009	2	0	20	40	0	4	28	1	2	675
2010	3	0	21	40	0	5	26	3	2	543
2011	3	0	19	39	0	5	26	3	5	605
2012	5	0	22	35	0	5	27	3	3	652

[a] Excludes drawing, registration, and Tier II permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

Table 7. Estimate of Unit 20B moose harvest[a] and accidental death, regulatory years[b] 2001–2012.

	Harvest by hunters							Accidental death					
	Reported				Estimated			Road[c]					
Regulatory year	M	F	Unk	Total	Unreported[d]	Illegal/ Other	Total	FMA[e]	Unit 20B remainder	Total	Train[f]	Total	Combined total
2001	531	53	6	590	104	37[g]	141	72	50	122	9	131	862
2002	725	61	2	788	139	47[g]	186	118	71	189	12	201	1,175
2003	549	52	2	603	107	50[g]	157	87	64	151	13	164	924
2004	488	84	1	573	101	56[g]	157	95	62	157	30	187	917
2005	519	77	4	600	106	109[h]	215	79	57	136	6	142	957
2006	571	212	7	790	140	105[h]	245	88	68	156	8	164	1,199
2007	581	183	5	769	136	93[h]	229	73	56	129	12	141	1,139
2008	718	135	4	857	152	112[h]	264	79	67	146	6	152	1,273
2009	664	264	7	935	165	90	255	79	72	151	0[i]	151	1,341
2010	558	278	1	837	148	80	228	78	59	137	0[i]	137	1,202
2011	672	373	2	1,047	185	101	286	60	57	117	0[i]	117	1,450
2012	681	396	2	1,079	191	104	295	65	48	113	0[i]	113	1,487

[a] Includes general, registration and permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).
[c] Documented kills; actual number killed by vehicles is certainly greater.
[d] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[e] Fairbanks management area.
[f] Confirmed dead between Alaska Railroad mileposts 411.8 and 470.0; "Missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[g] Includes illegal, defense of life or property, dispatched, potlatch, stickdance, and other reported deaths.
[h] Includes illegal, defense of life or property, dispatched, potlatch, stickdance, and other reported deaths, plus an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).
[i] No data available for these years.

SPECIES MANAGEMENT REPORT

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CHAPTER 24: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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). Wolf and bear populations are lightly harvested in these units. The high proportion of large bulls in the harvest suggests that harvest of bull moose is low. Thus, we consider harvest to be a minor factor affecting population dynamics relative to predation. Low densities do not appear to be related to habitat limitation. Although these units contain tracts of mature black spruce that are poor quality moose habitat, there appears to be a substantial amount of riparian area, subalpine hills, and recently burned habitat capable of sustaining moose densities higher than the current levels.

Trends in moose populations have been difficult to identify due to infrequent surveying and low moose density. 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 20F and 25C during RY11 and RY12, but we did conduct a moose population survey in Unit 20C during RY11. Methods used in years outside the report period to estimate the RY11 and RY12 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 2,962 mi^2 survey area is north of DNPP, south of the Tanana River, west of the Nenana River, and east of the Kantishna River drainages. We first stratified the area on 1–2 November and classified each survey unit (SU) 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® 2010 software. We then surveyed 100 (60 high density and 40 low density; 577 mi^2) of 514 SUs (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). We then extrapolated the mean moose density estimated in this area to all of Unit 20C outside DNPP. 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 of observable moose in Unit 20C to calculate total moose population size for comparison with intensive management population and harvest objectives (Boertje et al. 2009).

Unit 20F. No recent surveys have been conducted in Unit 20F.

Unit 25C. No recent surveys have been conducted in Unit 25C. The last survey was conducted in 2007 by Bureau of Land Management (BLM) with support from the Alaska Department of Fish and Game (ADF&G; Hollis 2010).

Nutritional Status

Calf Weights. To evaluate moose nutritional status east of the Kantishna River in Unit 20C, we captured and weighed 20 short-yearlings (11 male, 9 female) on 17–18 March 2011 and radiocollared the 9 female calves to assess seasonal movements.

Pregnancy Rate. During 10–11 March 2012 we captured and radiocollared 26 adult female moose in Unit 20C to evaluate use of the 2009 Railbelt Complex Burn. We used the presence of placental-derived pregnancy-specific protein B (PSPB) in blood obtained from these moose to measure the 2012 pregnancy rate.

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 determine if habitat may be a limiting factor preventing growth to 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. A detailed description of the survey methods, sampling design, and results can be found in an upcoming research report (Paragi and Kellie, *In prep*).

Twinning Surveys

We conducted twinning surveys in Unit 20C in June 2012 and 2013. 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. Since past attempts at twinning surveys have not been effective in obtaining an adequate sample size, we changed our technique in the area. Twinning rate surveys were to be flown in June 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 was conducted by radiotracking 30 adult females that were fitted with VHF radio collars in March 2012. While radiotracking these moose from the air we also looked for random cow-calf groups to include in the sample. The survey area was bounded by the Tanana River to the north, the DNPP boundary to the south, the Nenana River on the east, and the Kantishna River on the west. All moose observed during the survey were classified as bull; yearling cow; adult cow without a calf; or adult cow with single, twin, or triplet calves.

MORTALITY

Harvest

We estimated annual harvest and mortality in all units from 1) data from mandatory harvest reports, 2) our records of telephone calls from the public concerning nonhunting mortality,

3) Alaska Wildlife Trooper records of moose–motor vehicle collisions, and 4) Alaska Railroad records of moose–train collisions between railroad mileposts 327 and 371 in Unit 20C. To estimate unreported harvest by residents of Tanana, we used a 1987 study conducted by ADF&G-Division of Subsistence (Andersen and Alexander 1992). We summarized data regarding hunter residency and 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., RY11 = 1 July 2011–30 June 2012).

Other Mortality

We located radiocollared adult female moose in Unit 20C once per month from September 2012 through March 2013. During each observation, we recorded the presence of a calf or yearling at heel. We approximated oversummer calf mortality as the number of adult females with a calf at heel divided by the number of females that were pregnant during capture in March 2012. We approximated overwinter calf mortality as the number of adult females with a calf at heel in March 2013 divided by the number of females with a calf at heel in September 2012. A calf was assumed dead when an adult female previously seen with a calf at heel was subsequently seen without a calf at heel during ≥2 consecutive observations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Unit 20C. We estimate 3,800 moose inhabited Unit 20C outside DNPP during RY11 and RY12, based on the November 2011 GSPE survey in eastern Unit 20C (1,460 moose; 90% CI = 1,189–1,731). Because Unit 20C is similar in habitat type to Unit 20A, we applied an SCF of 1.21 to obtain a sightability corrected estimate of 1,767 moose (0.6 moose/mi^2). We then extrapolated this density to all of Unit 20C outside of DNPP (6,476 mi^2) to attain an estimated population of 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. We assume population density in Unit 25C during RY11 and RY12 remained similar to the estimate obtained during the 2007 GSPE survey (Hollis 2010). We estimate 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. 2007). Applying an 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 ≥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–RY07 the percentage of large bulls in the reported harvest averaged 34% in Unit 20C and 38% in Unit 20F. During RY08–RY12 the percentage of large bulls in the harvest averaged 29% in Unit 20C and 31% in Unit 20F. These data suggest that there has been a decrease in the number of large bulls in the harvest. However, these percentages are above our management goal of 20% large bulls for Units 20C and 20F.

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); and, 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.

Pregnancy Rate. Twenty-three of 26 adult females (88%) captured in March 2012 were pregnant based on PSPB protein analysis.

Browse Surveys. We determined that eastern Unit 20C had a low to moderate browse removal rate of 19% in spring 2011 (Paragi and Kellie, *In prep*). In comparison, adjacent Units 20A and 20B, where moose density and nutritional stress is higher, have removal rates of 40% and 28% respectively. With 81% of the available forage unbrowsed annually, it is likely that habitat is not a factor limiting population growth.

Twinning Surveys. During June 2012 twinning surveys, we located 25 of the 30 radiocollared moose in Unit 20C. Of these, 23 were observed; 15 were parturient and 4 of the parturient cows had twins. The observed twinning rate in 2012 was 27%.

During the June 2013 twinning survey, 28 radiocollared moose were located. A total of 12 cows were parturient and 3 had sets of twins. We also encountered 3 random cow-calf pairs during the survey in which all calves were singletons. The observed twinning rate in 2013 was 20%.

MORTALITY

Harvest

Season and Bag Limit. The hunting seasons and bag limits remained the same in Units 25C and 20F during RY11 and RY12; however, in Unit 20C during RY12 the season was lengthened to end 25 September for residents and 20 September for nonresidents and antler restrictions were added to the nonresident bag limit.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY11		
Unit 20C		
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep	
NONRESIDENT HUNTERS: 1 bull.		5 Sep–15 Sep
RY12		
Unit 20C		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50 inch antlers or 4 brow tines.		1 Sep–20 Sep
RY11 and RY12		
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 2012 meeting, in an attempt to increase harvest in Unit 20C to meet the intensive management harvest objective, the

Alaska Board of Game increased the length of the season for moose by 5 days for residents and 10 days for nonresidents and added antler restrictions for nonresidents. We recommended this change after completing an intensive management feasibility assessment and determining that increasing the season length would be the appropriate action to increase harvest in the area. No Alaska Board of Game actions were taken and no emergency orders were issued during RY11 and RY12 in Units 25C and 20F.

Harvest by Hunters. During RY03–RY12 reported moose harvest was stable in Unit 20C and increased in Units 20F and 25C (Table 2). During RY11 and RY12, reported moose harvest averaged 140 in Unit 20C, 49 in Unit 20F, and 88 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 reports 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 (Andersen 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 for RY11 and RY12, therefore we have no estimates for those years.

Hunter Residency and Success. During RY11 and RY12, total number of hunters in Unit 20C averaged 480, this is compared to the RY06–RY10 average of 487. In Unit 20F, the average number of hunters in RY11 and RY12 was 149, this is compared to the average of 153 during RY06–RY10. The average number of hunters in Unit 25C was 311 during RY11 and RY12 compared to 346 during RY06–RY10 (Table 2). The number of moose harvested during RY11 and RY12 remained stable in Units 20F and 25C (Table 2). In Unit 20C, the moose harvest was stable during RY11, but increased during RY12. This was likely due to the increase in season length by 5 days.

During RY03–RY12, as many as 2 nonresident hunters annually reported hunting in Unit 20F (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 RY03–RY12 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). The fourth week of the season in Unit 20C first occurred in RY12 and will likely continue to have a high proportion of the harvest because the onset of the moose breeding season makes bulls more vulnerable to harvest. Few moose were reported harvested during the December season in Unit 20F.

Transport Methods. The most successful hunters in Unit 20C use boats, 3- or 4-wheelers, and airplanes for transportation (Table 5). Extensive river systems, many lakes, and an expanding trail system make these transport methods most successful. In Unit 20F, boats and 3- or 4-wheelers are the primary modes of transportation for successful hunters. In Unit 25C, successful moose hunters use highway vehicles, 3- or 4-wheelers, or boats. Transportation methods used throughout this area reflect access opportunities.

Other Mortality

In Unit 20C, 3 of 9 radiocollared yearlings (33%) died within 1 year of capture and all were killed by wolves. Of 26 radiocollared adult females, only 1 died within a year of capture (4%). Cause of death was unknown. Twenty-two adult females survived until the May 2013 calving season and 14 (64%) were observed with calves at heel on 7 August 2013. By March 2013, only 6 of the original 22 pregnant females (27%) were observed with a calf at heel.

HABITAT

In remote country such as Units 20C, 20F, and 25C, the most effective means of habitat improvement is wildfire, although moose densities in these remote areas are generally limited by predation rather than forage (Gasaway et al. 1992, Boertje et al. 2009). 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, Wildlife Biologist, 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 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 an 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 is low, especially from people who live in remote villages. We recommend contacting more people in these 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.

Periodic wildfire is an integral part of Interior Alaska ecosystems and is essential to producing early-successional moose habitat in the boreal forest. We should continue to coordinate wildlife needs with the Department of Natural Resources and BLM and encourage maintaining a limited suppression burn response policy to allow wildfire to burn.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations in Units 20C, 20F, and 25C are at low densities. Hunting pressure was relatively low. During RY11 and RY12, we met our goal to promote natural fires to enhance moose habitat through our efforts on an interagency fire management team. We also met our goal to provide 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 (33% in Unit 20F) in areas without aerial surveys.

No regulatory changes are recommended at this time in Units 20F and 25C. During the 2012 Alaska 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 Alaska Administrative Code 5 AAC 92.108. It appears that the longer season increased harvest to within the range of the intensive management harvest objective.

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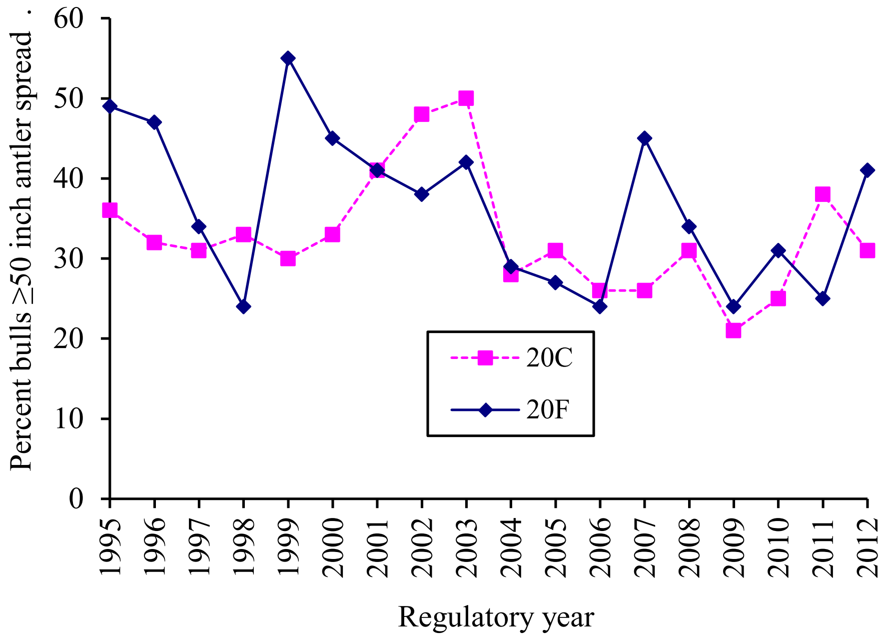

Figure 1. Percent of bull moose in the reported fall harvest with an antler spread ≥50 inches in Units 20C and 20F, regulatory years[a] 1995–2012.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1995 = 1 July 1995–30 June 1996).

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[c]	45	14	14	4	9	42	46
2007[d]	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 (Kellie and DeLong 2006).
[d] Spatial trend survey.

Table 2. Units 20C, 20F, and 25C reported moose hunter residency and success, regulatory years[a] 2003–2012.

Unit and Regulatory year	Successful hunters				Unsuccessful hunters				Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Total[c] (%)	Local[b] resident	Nonlocal resident	Nonresident	Total[c] (%)	
Unit 20C									
2003	59	36	10	105 (21)	252	116	26	394 (79)	499
2004	66	23	8	97 (21)	228	108	19	355 (79)	452
2005	86	36	7	129 (30)	204	81	19	304 (70)	433
2006	92	35	16	143 (28)	218	124	35	377 (73)	520
2007	90	34	16	140 (28)	219	130	18	367 (72)	507
2008	86	40	13	142 (30)	178	136	14	328 (70)	470
2009	77	49	14	140 (29)	213	105	22	340 (70)	480
2010	53	39	7	101 (23)	178	135	18	331 (75)	432
2011	71	42	9	124 (30)	172	102	11	285 (69)	409
2012	79	68	1	155 (28)	219	153	12	384 (70)	539
Unit 20F									
2003	12	8	0	20 (15)	85	29	0	114 (85)	134
2004	18	7	0	25 (22)	60	26	1	87 (78)	112
2005	27	8	1	36 (29)	64	23	2	89 (71)	125
2006	27	12	1	40 (33)	58	22	2	82 (67)	122
2007	23	6	0	29 (20)	83	29	1	113 (80)	142
2008	31	19	2	52 (31)	72	41	1	114 (69)	166
2009	38	19	2	59 (32)	90	35	2	127 (68)	186
2010	24	18	0	42 (28)	78	31	0	109 (72)	151
2011	30	19	0	49 (37)	48	36	0	84 (63)	133
2012	36	12	1	49 (30)	77	36	2	115 (70)	164
Unit 25C									
2003	3	43	6	52 (17)	20	210	19	249 (83)	301
2004	4	41	6	51 (21)	15	164	15	194 (79)	245
2005	3	56	4	63 (17)	17	248	39	304 (83)	367
2006	3	53	6	62 (18)	18	226	41	285 (82)	347
2007	4	55	9	68 (19)	9	247	32	288 (81)	356
2008	6	64	10	80 (25)	16	191	32	239 (75)	319
2009	1	95	15	111 (33)	11	183	22	216 (64)	327
2010	7	77	8	92 (26)	16	222	21	259 (72)	351
2011	9	62	19	90 (32)	10	156	17	183 (66)	273
2012	12	55	15	86 (25)	12	204	34	257 (75)	343

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Hunters who live within the unit in which they reported hunting were considered local.
[c] 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[a] 2003–2012.

Unit and Regulatory year	Harvest by hunters										Combined total
	Reported[b]				Estimated			Accidental death			
	M	F	Unk	Total	Unreported[c]	Illegal/Other[d]	Total	Road[e]	Train[f]	Total	
Unit 20C											
2003	105	0	0	105	19	0	19	0	0	0	124
2004	99	0	0	99	18	1	19	0	0	0	118
2005	131	1	2	134	23	0	23	0	1	1	158
2006	141	0	2	143	25	0	25	0	3	3	171
2007	140	0	0	140	25	0	25	0	0	0	165
2008	142	0	0	142	25	0	25	0	0	0	167
2009	139	0	1	140	25	0	25	0	0	0	165
2010	101	0	0	101	18	0	18	0	0	0	119
2011	122	0	2	124	22	0	22	0	0	0	146
2012	150	1	4	155	27	0	27	0	0	0	182
Unit 20F											
2003	20	0	0	20	4	1	5	0		0	25
2004	27	0	0	27	5	0	5	0		0	32
2005	35	0	1	36	6	0	6	0		0	42
2006	39	0	0	39	7	0	7	0		0	46
2007	29	0	0	29	5	0	5	0		0	34
2008	53	0	1	54	9	0	9	0		0	63
2009	56	2	3	61	10	0	10	0		0	71
2010	43	0	0	43	8	0	8	0		0	51
2011	48	0	1	49	8	0	8	0		0	57
2012	49	0	3	52	9	0	9	0		0	61
Unit 25C											
2003	52	0	0	52	9	0	9	0		0	61
2004	52	0	0	52	9	1	10	1		1	63
2005	63	0	0	63	11	0	11	0		0	74
2006	62	0	0	62	11	0	11	0		0	73
2007	68	0	0	68	12	0	12	0		0	80

Unit and Regulatory year	Harvest by hunters							Accidental death			Combined total
	Reported[b]				Estimated						
	M	F	Unk	Total	Unreported[c]	Illegal/Other[d]	Total	Road[e]	Train[f]	Total	
2008	79	1	0	80	14	0	14	0		0	94
2009	114	0	0	114	20	0	20	0		0	134
2010	95	0	0	95	17	0	17	0		0	112
2011	91	0	0	91	16	0	16	0		0	107
2012	84	0	2	86	15	0	15	0		0	101

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Data from moose harvest ticket reports in moose harvest database using ADF&G's Wildlife Information Network (WinfoNet).
[c] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[d] Data from Fairbanks Alaska Wildlife Troopers wildlife mortality logs and ADF&G records.
[e] Documented kills from Fairbanks Alaska Wildlife Troopers wildlife mortality logs.
[f] 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[a] 2003–2012.

Regulatory	Harvest percent chronology by month/day[b]					
year	9/1–9/7	9/8–9/15	9/16–9/20	9/21–9/25	12/1–12/10	*n*
Unit 20C						
2003	21	54	25			102
2004	32	28	39			92
2005	25	40	35			124
2006	37	35	28			134
2007	31	47	22			137
2008	22	44	33			142
2009	31	39	30			137
2010	31	40	29			101
2011	27	40	33			122
2012[c]	17	30	28	25		151
Unit 20F						
2003	26	32	37		5	19
2004	26	41	30		4	27
2005	26	40	31		3	35
2006	31	46	23		0	39
2007	14	59	24		3	29
2008	23	53	23		2	53
2009	25	34	36		5	59
2010	16	49	26		9	43
2011	28	39	27		6	47
2012	16	56	24		4	51
Unit 25C						
2003	45	55				49
2004	44	56				52
2005	39	61				59
2006	43	56				57
2007	44	56				66
2008	44	56				75
2009	49	51				113
2010	45	55				95
2011	35	65				90
2012	41	59				82

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Does not include kills reported outside open hunting seasons or hunters who did not report date of kill.
[c] The season was lengthened 5 days in Unit 20C beginning in regulatory year 2012.

Table 5. Units 20C, 20F, and 25C reported moose harvest percent by transport method, regulatory years[a] 2003–2012.

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									
2003	27	5	24	24	0	12	7	2	105
2004	30	1	27	22	0	14	5	0	99
2005	21	1	32	25	1	13	3	3	134
2006	29	1	27	27	0	10	3	3	143
2007	24	1	28	28	0	11	7	1	140
2008	37	1	30	18	0	12	2	0	142
2009	20	1	32	26	0	14	6	1	140
2010	19	0	31	30	0	13	7	0	101
2011	23	0	31	35	0	7	4	0	122
2012	15	1	37	28	0	12	5	2	155
Unit 20F									
2003	0	0	50	30	5	10	5	0	20
2004	0	0	37	22	4	11	26	0	27
2005	6	0	28	31	3	5	25	2	36
2006	5	0	33	31	0	18	13	0	39
2007	3	0	31	38	7	7	14	0	29
2008	3	2	31	39	4	9	12	0	54
2009	0	0	36	46	7	2	8	2	61
2010	6	2	33	34	9	7	7	2	43
2011	2	0	35	37	6	6	14	0	49
2012	6	0	35	24	4	6	19	6	52
Unit 25C									
2003	6	0	29	44	0	8	12	2	52
2004	4	0	17	46	0	4	27	2	52
2005	0	0	30	48	0	6	14	2	63
2006	6	0	21	53	0	6	13	0	62
2007	1	0	22	53	0	0	25	0	68
2008	4	0	23	51	1	1	19	1	80
2009	5	0	21	51	0	6	15	2	114
2010	2	0	28	55	0	2	12	1	95
2011	1	0	26	51	0	2	20	0	91
2012	5	0	18	49	0	2	24	2	86

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).

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CHAPTER 25: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

GAME MANAGEMENT UNIT: 20D (5,637 mi^2, 5028 mi^2 of moose habitat)

GEOGRAPHIC DESCRIPTION: Central Tanana Valley near Delta Junction

BACKGROUND

Unit 20D was created in 1971 from a portion of Unit 20C. During 1962–1970, the moose hunting season in the area that is currently Unit 20D consisted of a 70- to 72-day bull season and a 1- to 8-day antlerless moose season. Most (51–74%) of the harvest during 1964–1970 came from the highly accessible areas near Delta Junction (Clearwater Lake, Donnelly Dome, and the Delta farming area). However, several severe winters in the mid-1960s and early 1970s killed many moose throughout this unit and other portions of Interior Alaska and set the stage for predation and hunting to compound and aggravate already widespread population declines. Poor recruitment of yearlings to the population in combination with intense bulls-only hunting depressed the bull:cow ratio to only 4:100 in the more accessible portions of the unit. The moose hunting season was closed during 1971–1973 because the depressed moose population could no longer support any significant harvest (McIlroy 1974).

Despite restrictions on hunting, the moose population in Unit 20D continued to decline because of chronically high moose mortality from other causes. In 1973 the moose population 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 DJCA was reduced in size to provide more hunting opportunity in the area. In 1996 DJCA was renamed 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.

To regulate moose hunting in the fields of the Delta Junction Bison Range (hereinafter referred to as Bison Range), the Bison Range youth hunt management area was created in 2002. 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. The goals of the antlerless hunts were to stabilize population growth in the unit and to address concerns about range degradation, reduced nutritional conditions, and reduced reproductive success. Antlerless moose hunting in southwestern Unit 20D continued through fall 2009.

The southwestern Unit 20D moose density was reduced by the antlerless hunts. Three indices of density-dependent moose nutritional conditions — biomass removal of current annual growth on winter browse, proportion of females with twin calves, and late-winter calf weights — were evaluated in relation to changes in density. The post-antlerless hunt evaluation of these 3 indices was compared to prehunt data and data collected during the hunts. The comparison detected a decrease in winter browse removal, an increase in twinning rate, and an increase in the average weight of 9-month-old calves. There have been no antlerless hunts since the 2009 season, with the exception that an antlerless moose (except a cow accompanied by a calf or a calf) is part of the legal bag limit in the Bison Range youth moose hunt.

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

- 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 a decreasing population as described in the population objective. Antlerless harvest will not be implemented on a declining population even if the 2-year prior twinning rate averages >20%.

METHODS

POPULATION ESTIMATES

We used the geospatial population method (GSPE; Ver Hoef 2001, Ver Hoef 2008) to conduct moose population estimation surveys in southern and northern 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 southern Unit 20D sample units (SU) as high or low density of moose based on previous stratifications and existing knowledge of the area. In general, SUs were stratified low if we expected to count <5 moose in them and stratified high if we expected to count ≥5 moose. In an attempt to keep variance as small as possible, we placed borderline SUs in the high stratum to minimize variance in the population estimate for the low stratum.

Northern Unit 20D GSPE SUs were stratified using a Piper PA–18 Super Cub. We stratified by flying north–south transects through the midpoint of each SU. The proportion of moose habitat in each SU was estimated and classified as low shrub (generally *Salix* species), tall shrub, deciduous forest, sparse spruce forest, spruce forest, or nonhabitat. The presence of moose tracks and number of moose seen in the SU were recorded. Before exiting the SU, it was stratified as either high or low density.

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 within blocks of similar habitat distributed somewhat evenly, rather than randomly, throughout the survey area. The number of SU pairs that could be surveyed was based on funding. First, the number of SUs to be surveyed in each stratum was divided by 2 to determine the number of SU pairs in each stratum. Next, the number of SU pairs to be surveyed per stratum was divided into the total number of SUs in the survey area to determine the number of survey blocks. I then grouped SUs in our survey area into blocks with similar anticipated moose densities, habitat types, and topographic features. Blocks of SUs were grouped within strata. Within each block of SUs, pairs of SUs were selected by randomly selecting the first SU, and then randomly selecting an adjacent SU to form the pair. Ten percent of available SUs were not allocated to pairs, but held in reserve and placed singly, rather than as pairs, within the survey area where selected SU pairs were >50 km apart. 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 feet 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 nonhabitat (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 the Alaska Department of Fish and Game's (ADF&G) GSPE application software (DeLong 2006) to calculate a population estimate and composition of observable moose.

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; Keech et al. 2011; R. Boertje, ADF&G, unpublished data, Fairbanks). An SCF of 1.21 was applied to estimates for southern Unit 20D and an SCF of 1.25 was applied to estimates for northern Unit 20D.

Population estimates in southern and northern Unit 20D were combined in some years to estimate a total unitwide estimate following the methods described in Gasaway et al. (1986). We applied the area-specific SCFs to the area population estimates.

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 totaling approximately 90 mi^2 south of the Tanana River between the Gerstle and Delta rivers (southwestern Unit 20D). The SUs surveyed include 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., RY11 = 1 July 2011–30 June 2012). 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 permit reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

2011. The GSPE survey in southern Unit 20D during 2–23 November 2011 cost $9,490. 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 64 SUs including 44 high-density (73%) and 20 low-density (31%), meeting the objective of surveying 60% high-density SUs. Search effort during this survey did not meet the objective. Search effort averaged 42.7 min/SU (7.1 min/mi^2) in high density SUs and 39.7 min/SU (6.60 min/mi^2) in low density SUs.

The southern Unit 20D population estimate was 4,134 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 3,162–5,106. Applying a 1.21 SCF to the estimate resulted in an SCF-corrected estimate of 5,002 moose (2.6 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, south of the Tanana River and east of the Johnson River; and 2) southwestern Unit 20D, south of the Tanana River and west of the Johnson River.

The southeastern Unit 20D analysis area had a population estimate of 791 observable moose (Table 2) and 957 with a 1.21 SCF applied, resulting in 1.6 moose/mi^2.

The southwestern Unit 20D population estimate was 3,343 observable moose (Table 3) and 4,045 with a 1.21 SCF applied, resulting in a density of 2.7 moose/mi^2.

Aerial twinning surveys in southwestern Unit 20D were flown during 28 May–2 June 2012 in 14.1 hours of survey time and cost $4,900. We spotted 20.5 moose/hr, with 300 moose observed including 59 cow–calf groups with 8 (13.6%) being cows with twins (Table 4).

2012. The southern Unit 20D (south of the Tanana River) GSPE survey was flown during 5 November–12 December 2012 and cost $8,960. 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. Fifty SUs were searched including 30 high-density (60%) and 20 low-density (43%), meeting the objective of surveying 60% high density SUs. Search effort during this survey met the objective in high density SUs and averaged 46.1 min/SU (7.7 min/mi^2) but did not meet the objective in low density SUs that averaged 44.1 min/SU (7.4 min/mi^2).

The population estimate was 4,450 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 3,618–5,284 moose. Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 5,385 moose for a density of 2.8 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, south of the Tanana River and east of the Johnson River; and 2) southwestern Unit 20D, south of the Tanana River and west of the Johnson River.

The southeastern Unit 20D analysis area had a population estimate of 1,164 observable moose (Table 2) and 1,408 moose with a 1.21 SCF applied, resulting in 2.3 moose/mi^2.

The southwestern Unit 20D analysis area had a population estimate of 3,286 observable moose (Table 3) and 3,976 with a 1.21 SCF applied, resulting in a density of 3.2 moose/mi^2.

Aerial twinning surveys in southwestern Unit 20D were flown during 28–30 May 2013 for a total of 9.1 hours of survey time and cost $2,580. We saw 26.0 moose/hr, with 246 moose observed including 54 cow-calf groups with 14 (25.9%) being cows with twins (Table 4).

Northern Unit 20D — Habitat stratification and GSPE surveys were flown in northern Unit 20D in 2012. The last stratification survey in northern Unit 20D prior to this occurred in the late 1990s, and the last northern Unit 20D GSPE survey was flown in 2004.

The northern Unit 20D (north of the Tanana River) stratification survey occurred during 1–12 November. Two hundred fifty-eight SUs were stratified as high density and 288 were stratified as low density.

The northern Unit 20D GSPE survey was flown during 17 November–11 December 2012 and cost $13,360. This survey area included 546 SUs and covered 3,174 mi^2 averaging 5.8 mi^2/SU. The high-density stratum had 262 SUs totaling approximately 1,520 mi^2 and the low density stratum had 284 SUs totaling 1,653 mi^2. Fifty-three SUs were searched including 32 high-density (60%) and 21 low-density (40%), meeting the objective of surveying 60% high-density SUs. Search effort during this survey met the objective in high density SUs and averaged 45.4 min/SU (7.8 min/mi^2) but did not meet the objective in low density SUs that averaged 43.8 min/SU (7.6 min/mi^2).

The population estimate was 2,406 observable moose (without an SCF applied, Table 5) with a 90% confidence interval of 1,811–3,001 moose. Applying an SCF of 1.25 to the estimate resulted in a sightability-corrected estimate of 3,008 moose for a density of 0.9 moose/mi^2.

Unitwide Population Estimate — The 2012 southern and northern Unit 20D population estimates were combined to calculate a Unit 20D total population estimate of 6,856 observable moose.

Population Composition

2011. The southern Unit 20D population composition from the fall 2011 GSPE survey was 35 calves:100 cows (range = 31–40) and 30 bulls:100 cows (range = 22–38; Table 1).

The southeastern Unit 20D analysis area had composition of 35 calves:100 cows (range = 31–40) and 31 bulls:100 cows (range = 16–46; Table 2).

The southwestern Unit 20D analysis area had composition of 37 calves:100 cows (range = 32–41) and 30 bulls:100 cows (range = 22–38; Table 3).

2012. The southern Unit 20D population composition from the fall 2012 GSPE survey was 30 calves:100 cows (range = 24–38) and 37 bulls:100 cows (range = 27–47; Table 1).

The southeastern Unit 20D analysis area had composition of 30 calves:100 cows (range = 24–38) and 39 bulls:100 cows (range = 21–56; Table 2).

The southwestern Unit 20D analysis area had composition of 34 calves:100 cows (range = 28–40) and 36 bulls:100 cows (range = 27–45; Table 3).

The northern Unit 20D population composition from the fall 2012 GSPE survey was 13 calves:100 cows (range = 8–19) and 59 bulls:100 cows (range = 35–84; Table 5).

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. A. K. Seaton, Wildlife Research Biologist, ADF&G, unpublished data, Fairbanks). This project continued through this reporting period.

MORTALITY

Harvest

Season and Bag Limit. Hunting seasons and bag limits during RY11–RY12 are listed in Table 6.

Alaska Board of Game Actions and Emergency Orders.

2012 — In March 2012 the Alaska Board of Game adopted proposal 201 to reauthorize antlerless moose hunting in southwestern Unit 20D. No emergency orders were issued in RY11 or RY12.

Harvest by Hunters.

RY11 — Estimated moose mortality from all human causes in RY11 was 376 moose (Table 7). This total included 279 moose reported killed by hunters in fall 2011, an estimated unreported harvest of 49 moose, no estimate for illegal harvest, and an estimated 48 moose killed in vehicle collisions (the average of the last 2 years of known vehicle collision mortality). Illegal harvest is undocumented. The total reported hunting mortality of 279 did not meet the harvest objective for Unit 20D.

RY12 — Estimated moose mortality from all human causes in RY12 was 360 moose (Table 7); however this did not include an estimate of illegally taken moose, which is thought to be high but is undocumented. This total included 265 moose reported killed by hunters in fall 2012, an estimated unreported harvest of 47 moose, and an estimated 48 moose killed by highway vehicles (the average of the last 2 years of known vehicle collision mortality). The total reported hunting mortality of 265 did not meet the harvest objective for Unit 20D.

Southwestern Unit 20D Harvest — In RY11, reported harvest totaled 169 moose. Hunters reported taking 148 moose during the general season (Table 8), 11 during Delta Junction management area hunt DM790, 2 during the Delta Junction management area hunt DM795 for qualified disabled veterans (Table 9), and 8 during the Bison Range youth hunt DM792 (Table 10). Hunter success was 29% during the general season, 69% for DM790 (Table 9), 50% for DM795 (Table 9), and 89% for DM792 (Table 10).

In RY12, reported harvest in southwestern Unit 20D totaled 152 moose. Hunters reported taking 135 moose during the general season (Table 8), 10 during the Delta Junction management area hunt DM790, 0 during the Delta Junction management area hunt DM795 for qualified disabled veterans (Table 9), and 7 in the Delta Junction Bison Range youth hunt DM792 (Table 10). Hunter success was 24% for the general season, 71% for DM790, 0% for DM795, and 70% for DM792.

Southeastern Unit 20D Harvest — Moose harvest in southeastern Unit 20D continued to be low, with a 2-year average harvest for RY11 and RY12 of 33 moose/year (35 in RY11 and 31 moose in RY12; Table 8). The 2-year average hunter success was 38%.

Northwestern Unit 20D Harvest — During RY11, harvest was 49 moose, with a success rate of 27%. In RY12, reported harvest by hunters totaled 53 moose (Table 8) and hunter success was 29%. 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 RY11 and RY12 general seasons. In RY11, reported harvest by hunters totaled 18 moose (Table 8), with a success rate of 35%. In RY12, hunters reported taking 20 moose, with a success rate of 34%.

In RY11 and RY12, no moose were reported to be harvested during the August hunting season in the Healy River drainage (Table 11).

Hunter Residency. Based on harvest reports, the majority of Unit 20D hunters were Alaska residents who resided outside of Unit 20D (Table 12). The proportion of nonresident hunters continued to be low.

Hunter Effort. Successful hunters averaged 5.4 hunting days in RY11 and 5.7 days in RY12 (Table 13).

Permit Hunts. Permit hunt DM790 (DJMA) had 19 drawing permits issued in RY11 and RY12 (Table 9). The number of applicants for DM790 was 686 in RY11 and 1,132 in RY12.

Permit hunt DM792 (Bison Range youth hunt management area) had 10 permits in RY11 and in RY12 (Table 10). The number of applicants for DM792 was 206 in RY11 and 300 in RY12.

Drawing permits for hunt DM795 were issued to 6 (65 applicants) qualifying disabled veterans in RY11 and RY12. Permit hunts DM795 and DM790 had the same hunt area, season dates, and bag limit in RY11 and RY12.

Harvest Chronology. In RY11 and RY12, general season harvest chronology remained similar to previous years, with most harvest occurring during the first 5 days of the general season (Table 14).

Transport Methods. In RY11 and RY12, 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 in RY11 or RY12. However, predation by wolves, grizzly bears, and black bears is believed to be significant in Unit 20D.

HABITAT

Assessment

No habitat assessment was conducted in RY11 or RY12. However, the relationship between biomass removal estimates and the nutritional condition of moose in southwestern Unit 20D is being analyzed. This analysis is based on biomass removal estimates from Unit 20D browse sampling in RY99, RY00, RY06, and RY09 (T. Paragi, ADF&G, unpublished data, Fairbanks).

Enhancement

No habitat enhancement was conducted in RY11 or RY12.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates from the 2012 GSPE survey indicated the northern Unit 20D moose population increased since 2004. The calf:cow ratio was low, suggesting increased calf mortality compared to 2004. However, the calf:cow ratio is likely not an indicator of long-term population trend. We need to collect northern Unit 20D population data on an annual basis to assess population trend.

Northwestern Unit 20D continued to have the second highest harvest in the unit (after southwestern Unit 20D). Reported harvest and the number of hunters were stable during the reporting period.

In northeastern Unit 20D the number of hunters and harvest remained low during the RY11 and RY12 general seasons. 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. The number of hunters and harvest is likely to remain low in northeastern Unit 20D.

The 2012 northern Unit 20D population estimate and the stability of the reported harvest in RY11 and RY12 suggest hunting opportunity is being sustained in this portion of the unit. No changes to northern Unit 20D hunting season or bag limits are recommended.

Harvest in southeastern Unit 20D during the general hunting season remained low, primarily because motorized access restrictions in the Macomb Plateau controlled use area make moose hunting difficult, and motorized access to the remainder of the area is limited.

In southwestern Unit 20D, the general bull season moose harvest and the number of hunters has continued to increase since the mid-1990s (DuBois 2004), although bull harvest has stabilized since RY07 and RY08 (Table 8). Additional harvest in southwestern Unit 20D occurred with implementation of cow moose permit hunts in RY06 which continued through RY09 (Table 16).

Antlerless moose hunts during RY06–RY09 contributed to a decreased moose density in southwestern Unit 20D. The goals of these hunts were to stabilize population growth, and to address concerns about range degradation and reduced nutritional condition and reduced reproductive success of moose. By the end of RY12, most of these goals had been met. Moose density was reduced from 5.6 moose/mi^2 (pre-antlerless hunts) to 3.2 moose/mi^2 (post-antlerless hunts). Overwinter browse utilization decreased from 25% in 2007 to 15% in 2010. The average weight of 9-month-old calves increased from 340 lb in 2010 to 366 lb in 2012 (K. A. K. Seaton, unpublished data, Fairbanks).

Twinning rates increased in 2011, but decreased in 2012. A spike in twinning rates was documented throughout a significant portion of Interior Alaska in 2011 (K. A. K. Seaton, personal communication), and may not have been indicative of a trend in Unit 20D. I recommend continued aerial twinning surveys to determine trend in this measurement of population status.

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: biomass removal of current annual growth on winter browse; proportion of females with twin calves; and 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 RY11 and RY12 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. To meet this harvest objective it will be necessary to harvest moose at a rate that cannot be sustained with the current population. We are currently managing for a stable population, as indicated by an average of 20% twinning rate during spring 2012 and 2013, and no additional harvest is warranted. No changes are planned for the general season hunt. Antlerless moose hunts will not be recommended for RY13, other than retaining a cow (not accompanied by a calf) in the bag limit for DM792 in the Bison Range youth hunt management area.

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Table 1. Results of population estimates of observed moose for southern Unit 20D using geospatial population estimator (GSPE) surveys, 2005–2012.

Year/Method	Total population estimate	Total cows	Total calves	Total bulls	Calves: 100 cows	Bulls:100 cows
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
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	4,633	2,823	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
2011	4,134	2,497	888	757	35	30
(LCI–UCI)[a]	3,162–5,106	1,940–3,055	686–1,091	497–1,016	31–40	22–38
2012	4,450	2,640	805	975	30	37
(LCI–UCI)[a]	3,618–5,284	2,112–3,167	590–1,019	708–1,242	24–38	27–47

[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 Unit 20D using geospatial population estimator (GSPE) surveys, 2005–2012.

	Year						
Parameter	2005	2006	2008	2009	2010	2011	2012
East of Johnson River (southeastern Unit 20D)							
Total pop estimate	690	998	602	997	976	791	1,164
LCI[a]	290	328	408	632	594	374	816
UCI[b]	1,090	1,668	795	1,360	1,357	1,208	1,512
Total cows	402	625	542	575	608	494	687
LCI	130	198	288	348	346	254	442
UCI	676	1,051	796	802	869	734	932
Total calves	97	267	152	224	165	155	150
LCI	6	90	67	153	100	67	46
UCI	189	443	237	296	231	243	255
Total bulls	205	128	229	186	220	159	267
LCI	117	36	167	99	132	62	167
UCI	292	225	292	118	307	257	368
Bulls:100 Cows	51	20	42	32	35	31	39
LCI	19	10	19	12	15	16	21
UCI	84	30	65	51	55	46	56
Calves:100 Cows	24	41	28	40	28	35	30
LCI	10	28	8	26	8	31	24
UCI	38	54	49	53	49	40	38

[a] LCI = Lower confidence interval.
[b] UCI = Upper confidence interval.

Table 3. Results of population estimates of observed moose for southwestern Unit 20D using geospatial population estimator (GSPE) surveys, 2005–2012

	Year							
Parameter	2005	2006	2007	2008	2009	2010	2011	2012
West of Johnson River (southwestern Unit 20D)								
Total pop estimate	4,863	6,245	5,926	4,065	3,637	3,599	3,343	3,286
LCI[a]	3,933	4,931	4,525	3,189	2,986	2,957	2,559	2,690
UCI[b]	5,792	7,559	7,327	4,940	4,286	4,239	4,127	3,882
Total cows	3,070	3,869	3,767	2,530	2,248	2,280	2,003	1,952
LCI	2,432	3,033	2,697	1,936	1,838	1,838	1,555	1,586
UCI	3,708	4,705	4,837	3,123	2,657	2,722	2,452	2,310
Total calves	1,121	1,549	1,128	897	741	589	733	654
LCI	913	1,195	805	709	620	478	571	498
UCI	1,330	1,902	1,450	1,086	862	699	896	810
Total bulls	613	801	1,351	686	676	748	597	707
LCI	396	608	940	529	501	583	392	514
UCI	829	994	1,762	844	851	912	802	901
Bulls:100 Cows	20	21	36	27	30	32	30	36
LCI	13	17	21	18	20	23	22	27
UCI	27	24	51	36	39	42	38	45
Calves:100 Cows	34	41	30	35	33	25	37	34
LCI	29	36	18	24	28	19	32	28
UCI	39	45	42	47	97	32	41	40

[a] LCI = Lower confidence interval.
[b] UCI = Upper confidence interval.

Table 4. Results of moose twinning surveys in southwest Unit 20D, 2005–2013.

Year	Cows w/single calves	Cows w/twin calves	% Cows w/twins	Moose per hour	Total moose
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
2012	51	8	13.6	20.5	300
2013	40	14	25.9	26.0	246

Table 5. Results of northern Unit 20D moose geospatial population estimation surveys, 2004 and 2012.

Parameter	2004 GSPE[a]	2012 GSPE[a]
Total estimate	1,929	2,406
LCI[b]	1,443	1,811
UCI[c]	2,415	3,001
Total bulls	515	828
LCI	351	524
UCI	679	1,133
Total cows	1,202	1,393
LCI	776	1,052
UCI	1,426	1,733
Total calves	338	184
LCI	189	114
UCI	486	255
Bulls:100 cows	47	59
LCI	28	35
UCI	66	84
Calves:100 cows	31	13
LCI	19	8
UCI	43	19

[a] GSPE is a geospatial population estimator survey conducted with a higher search intensity than the Gasaway method, but without a sightability correction factor applied to the observable moose estimate. Northern Unit 20D was surveyed in its entirety each GSPE survey.
[b] LCI = Lower confidence interval.
[c] UCI = Upper confidence interval.

Table 6. Unit 20D moose hunting seasons and bag limits, regulatory years[a] 2011 and 2012.

Regulatory year	Area	Season		Bag limit
2011 and 2012	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 one side.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on at least one side.
	Within Delta Junction management area.	RESIDENT:	1 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on one side by drawing permit DM790.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on one side by drawing permit DM790.
	Within Delta Junction management area.	RESIDENT QUALIFIED DISABLED VETERANS ONLY:	1 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on one side by drawing permit DM795.
		NONRESIDENT QUALIFIED DISABLED VETERANS ONLY:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on one side by drawing permit DM795.
	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.

Regulatory year	Area	Season		Bag limit
	South of Tanana River and east of Johnson River except within the Robertson River drainage south of the confluence of east and west fork, and within 1 mile west of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least one side.
	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.
	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 (north of Tanana River).	RESIDENT AND NONRESIDENT:	1 Sep–15 Sep	1 bull.
2012 and 2013	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 one side.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on at least one side.

Regulatory year	Area	Season		Bag limit
	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 on at least one side by drawing permit DM790.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on one side by drawing permit DM790.
	Within Delta Junction management area	RESIDENT QUALIFIED DISABLED VETERANS ONLY:	1 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines by drawing permit DM795.
		NONRESIDENT QUALIFIED DISABLED VETERANS ONLY:	5 Sep–15 Sep	1 bull with 50-inch antlers or 4 or more brow tines on at least one 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 one 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	

Regulatory year	Area	Season		Bag limit
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least one side.
	Within the Healy River drainage.	RESIDENT:	15 Aug–28 Aug	1 bull with spike-fork antlers.
			1 Sep–20 Sep	1 bull.
		NONRESIDENT:	1 Sep–20 Sep	1 bull.
	North of the north bank of the Tanana River and draining into the Volkmar River east to and including the Billy Creek drainage, excluding the Healy River drainage	RESIDENT AND NONRESIDENT:	1 Sep–20 Sep	1 bull.
	Remainder of Unit 20D (north of Tanana River)	RESIDENT AND NONRESIDENT:	1 Sep–15 Sep	1 bull.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2012 = 1 July 2012–30 June 2013).

Table 7. Unit 20D moose harvest and accidental death, regulatory years[a] 2005–2012.

	Harvest by hunters									
Regulatory	Reported				Estimated			Accidental death		Combined
year	M	F	Unk	Total	Unreported[b]	Illegal	Total	Road	Total	total
2005	232	0	0	232	41	14	55	52	52	339
2006	296	58	2	356	63	15	78	66	66	500
2007	284	514	2	800	142	Unk	142	54[c]	54	996
2008	297	386	1	684	120	Unk	120	37	37	841
2009	299	117	0	416	73	Unk	73	52[c]	52	541
2010	239	6	0	245	43	Unk	43	52[c]	52	340
2011	272	7	0	279	49	Unk	49	48[d]	48	376
2012	257	8	0	265	47	Unk	47	48[d]	48	360

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[b] Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).
[c] Three-year average of the last 3 known years.
[d] Two-year average of the last 2 known years.

Table 8. Southwestern (SW), southeastern (SE), northwestern (NW), and northeastern (NE) Unit 20D reported moose harvest and number of hunters during general seasons, regulatory years[a] 2005–2012.

Regulatory	Moose harvest						Hunters					
year	SW	SE	NW	NE	Unk	Total	SW	SE	NW	NE	Unk	Total
2005	126[b]	19[c]	61[c]	13[d]	0	219	407[b]	56[c]	206[c]	30[d]	22	721
2006	155[b]	26[c]	82[c]	19[d]	4	286	517[b]	49[c]	279[c]	44[d]	26	915
2007	164[b]	23[c]	68[c]	12[d]	6	273	553[b]	63[c]	305[c]	39[d]	35	995
2008	149[b]	22[c]	62[c]	20[e]	2	255	425[b]	59[c]	221[c]	36[e]	20	761
2009	153[b]	21[c]	63[c]	15[e]	0	252	543[b]	67[c]	252[c]	44[e]	114	1,020
2010	130[b]	28[c]	51[c]	17[e]	7	233	515[b]	78[c]	215[c]	34[e]	72	914
2011	148[b]	35[c]	49[c]	18[e]	8	258	502[b]	78[c]	184[c]	52[e]	63	879
2012	135[b]	31[c]	53[c]	20[e]	9	248	556[b]	105[c]	185[c]	58[e]	57	961

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[b] 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.
[c] Season 1–15 Sep; 1 bull.
[d] Resident season 1–15 Sep; 1 bull. Within Healy River drainage: resident season 15–28 Aug, 1 bull with spike-fork antlers; 1–15 Sep, 1 bull; nonresident season, 1–15 Sep; 1 bull. Remainder area is resident and nonresident 1–15 Sep, 1 bull.
[e] Resident season 1–15 Sep; 1 bull. Within Healy River drainage: resident season 15–28 Aug, 1 bull with spike-fork antlers; 1–20 Sep, 1 bull; nonresident season, 1–20 Sep; 1 bull. Remainder area is resident and nonresident 1–15 Sep, 1 bull.

Table 9. Unit 20D Delta Junction management area moose drawing permit harvest, regulatory years[a] 2005–2012.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Percent bulls	Percent cows	Unk	Harvest
DM790	2005	10	89	11	10	100	0	0	8
DM790	2006	10	88	13	20	100	0	0	7
DM790	2007	10	60	40	0	100	0	0	6
DM790	2008	27	50	50	25	50	50	0	10
DM790	2009	25	57	43	8	100	0	0	13
DM790	2010	18	46	54	28	100	0	0	6
DM795	2010	6	40	60	17	100	0	0	2
DM790	2011	19	69	31	16	100	0	0	11
DM795	2011	6	50	50	33	100	0	0	2
DM790	2012	19	71	29	26	90	10	0	10
DM795	2012	6	0	100	50	0	0	0	0

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).

Table 10. Unit 20D Delta Junction Bison Range youth hunt management area moose drawing permit harvest, regulatory years[a] 2005–2012.

Hunt	Regulatory year	Permits issued	Successful hunters (%)	Unsuccessful hunters (%)	Did not hunt (%)	Percent bulls	Percent cows	Unk	Harvest
DM792	2005	24	25	75	17	100	0	0	5
DM792	2006	10	80	20	0	0	100	0	8
DM792	2007	10	70	30	0	14	86	0	7
DM792	2008	10	100	0	0	20	80	0	10
DM792	2009	10	80	20	0	50	50	0	8
DM792	2010	10	60	40	0	0	100	0	6
DM792	2011	10	89	11	10	13	87	0	8
DM792	2012	10	70	30	0	14	86	0	7

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).

Table 11. Unit 20D Healy River (Uniform Coding Unit 501) reported moose harvest, regulatory years[a] 2005–2012.

	Unit 20D Healy River			
		Harvest month		
Regulatory year	Hunters	Aug	Sep	Jan
2005[b]	14	0	6	n/a
2006[b]	22	0	8	n/a
2007[b]	16	0	5	n/a
2008[c]	19	0	9	n/a
2009[c]	17	0	5	n/a
2010[c]	15	1	5	n/a
2011[c]	25	0	11	n/a
2012[c]	23	0	6	0

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[b] Resident moose hunting season: 15–28 Aug, 1 spike-fork bull; 1–15 Sep, 1 bull.
[c] Resident moose hunting season: 15–28 Aug, 1 spike-fork bull; 1–20 Sep, 1 bull.

Table 12. Unit 20D general hunting season moose hunter residency and success[a], regulatory years[b] 2005–2012.

	Successful					Unsuccessful					Total hunters
Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
2005	73	138	21	2	234 (26)	233	381	46	4	664 (74)	898
2006	84	176	27	2	289 (31)	236	364	45	7	652 (69)	941
2007	81	164	24	11	280 (27)	250	420	46	33	749 (73)	1,029
2008	159	104	13	6	282 (27)	447	241	48	16	752 (73)	1,034
2009	78	144	28	2	252 (27)	214	440	35	79	768 (75)	1,020
2010	66	159	15	2	242 (27)	192	428	33	13	666 (73)	908
2011	69	166	18	5	258 (30)	156	408	29	12	605 (70)	863
2012	67	153	23	5	248 (26)	184	472	34	20	710 (74)	958

[a] Excludes hunters in permit hunts.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[c] Local means reside in Unit 20D.

Table 13. Southwestern (SW), southeastern (SE), northwestern (NW), and northeastern (NE) Unit 20D general season moose and mean days hunted[a], regulatory years[b] 2005–2012.

Regulatory	Successful hunters					Unsuccessful hunters				
year	SW	SE	NW	NE	Total	SW	SE	NW	NE	Total
2005	5.3	3.8	5.9	4.9	5.3	6.4	6.3	7.0	6.1	6.5
2006	5.3	7.4	5.3	4.3	5.4	6.4	5.4	6.8	3.4	6.6
2007	5.0	6.5	5.7	4.9	5.3	6.4	6.6	7.0	4.9	6.7
2008	4.8	4.6	5.1	5.6	4.9	6.6	6.4	7.4	5.3	6.8
2009	5.2	6.0	6.3	6.9	5.9	6.7	6.1	6.6	6.1	6.6
2010	5.7	5.7	5.9	5.1	5.7	6.8	5.5	7.3	7.6	6.9
2011	5.1	5.5	6.0	8.5	5.4	7.0	6.2	7.6	7.7	7.1
2012	5.8	6.3	5.8	4.7	5.7	6.7	6.5	7.4	8.1	6.8

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).

Table 14. Unit 20D general season moose harvest[a] chronology percent by month/day, regulatory years[b] 2005–2012.

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*
2005	50	21	27	0	2	230
2006	45	27	23	0	4	288
2007	43	26	27	0	4	275
2008	44	26	25	3	2	282
2009	45	25	27	1	2	252
2010	42	26	28	2	2	232
2011	41	32	21	3	2	258
2012	43	28	27	1	1	244

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).

Table 15. Unit 20D moose harvest percent[a] by transport method, regulatory years[b] 2005–2012.

Regulatory year	Harvest percent by transport method: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboats	Unknown	*n*
2005	5	2	18	45	0	4	22	0	5	235
2006	7	2	20	37	0	4	27	1	1	289
2007	5	3	16	49	1	4	19	0	3	280
2008	5	2	18	39	0	5	26	3	2	282
2009	5	2	20	44	0	4	23	0	2	252
2010	5	2	19	42	0	4	25	1	2	232
2011	5	2	17	44	0	4	21	3	4	258
2012	6	2	18	45	0	4	19	3	3	248

[a] Excludes permit hunt harvest.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).

Table 16. Unit 20D antlerless moose hunt harvest, regulatory years[a] 2006–2009.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Percent bulls	Percent cows	Unk	Harvest
DM793	2006	75	87	13	20	4	96	0	52
DM797	2007	541	77	23	23	3	97	0	321
DM798	2007	180	74	26	30	0	100	0	93
DM799	2007	180	70	30	26	2	98	0	93
RM797	2008	725	25	75	58	1	99	0	73
DM798	2008	390	65	35	20	2	98	0	201
DM799	2008	200	76	25	28	4	96	0	108
DM797	2009	50	70	30	24	4	96	0	26
DM798	2009	100	81	19	20	3	97	0	64
DM799	2009	50	87	13	40	0	100	0	26

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).

SPECIES MANAGEMENT REPORT

Alaska Department of Fish and Game
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CHAPTER 26: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

GAME MANAGEMENT UNIT: 20E (10,680 mi^2 total area, 9,750 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 1976–2010, the moose population in Unit 20E increased in some areas but remained at low densities, fluctuating at an estimated 2,200–5,300 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 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, ADF&G conducted the Fortymile Nonlethal Wolf Control Program (nonlethal program), designed to benefit the Fortymile caribou herd, 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, 2008; Kellie and DeLong 2006). Although surveys indicated that the moose population increased in some areas during 1976–2010, 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 (board) implemented the Upper Yukon–Tanana Predation

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

Control Program (UYTPCP), encompassing portions of Unit 20E, to allow the moose population to increase. The control program was expanded by the board in May 2006 to include all of Unit 20E and parts of surrounding units and was ongoing during regulatory year (RY) 2011 (RY = 1 July through 30 June, e.g., RY11 = 1 July 2011–30 June 2012) through RY12.

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 densities due to predation and have proposed various predator control programs to increase moose numbers and moose harvest. Improved moose density prompted the board to approve a 10-day bulls-only season in 1982, which continued through 1990. In response to further moose population improvement, the board lengthened the moose season to 15 days during 1991–2000.

The primary moose hunters in Unit 20E through 1991 were local residents and residents from Fairbanks and Southeast Alaska. During 1992–2010, 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. The fall moose season was split in 2001 into a 5-day late August season and a 10-day September season, closing during Labor Day weekend. In response to increased moose harvest due to increasing numbers of caribou hunters, the moose hunting season was managed under a registration permit in most of Unit 20E. Moose and caribou permit conditions stipulated that a hunter could not hold a registration permit for both species at the same time. Remote portions of the upper Middle Fork Fortymile River remained a general season hunt, with the same season dates as the moose registration permit hunt. These actions appeared to stabilize moose harvest during 2001–2007, and although harvest increased during 2008–2010, bull:cow ratios did not decrease below the management objective and the season structure remained 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

During late October and November 2011 and 2012 we estimated moose population size in southern Unit 20E within the 2,452 mi^2 Tok West and 2,178 mi^2 Tok Central (called Tok East during 1998–2003) survey areas using the GSPE method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). The Tok West and Tok Central moose survey areas include 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. Survey units (SU) in both the Tok West and Tok Central survey areas were stratified as high density if they were likely to contain >3 moose. In 2011 we selected 83 (49 high density and 34 low density; 486 mi^2) of 419 SUs in the Tok West survey area and 77 (45 high density and 32 low density; 458 mi^2) of 366 SUs in the Tok Central survey area. During 2012, we selected 80 (48 high density and 32 low density; 468 mi^2) SUs in the Tok West survey area and 81 (50 high density and 31 low density; 482 mi^2) SUs in the Tok Central survey area. Population and ratio estimates for the 2 separate survey areas and the combined area were calculated using the WinfoNet GSPE software (DeLong 2006).

A GSPE moose survey was also conducted in northwest Unit 20E within the Yukon–Charley Rivers National Preserve (YCNP) in 2012 by the National Park Service (NPS; Burch 2012). NPS estimated the moose density in the entire 3,096 mi^2 YCNP survey area. We applied this density estimate to the approximately 1,200 mi^2 portion of the YCNP survey area located within Unit 20E to obtain an estimate of observable moose. No other formal surveys were conducted in the remaining 3,960 mi^2 of moose habitat in northern Unit 20E during RY11–RY12. Because habitat is similar, I estimated the moose population in this area by extrapolating the moose density estimated for YCNP in 2012.

We used the following equation to estimate a probable population range for all of Unit 20E in RY11 and RY12:

$Pop_{20E} = Pop_{west/central} + Pop_{YCNP} + Pop_{REM}$

where

Pop_{20E} = Lower or upper range of observable moose estimated within Unit 20E.

$Pop_{west/central}$ = Upper or lower 90% CI of observable moose population estimate for the combined Tok West and Tok Central survey areas

Pop_{YCNP} = 2012 observable moose population estimate for the 1,200 mi^2 portion of the YCNP survey area that is located within Unit 20E

Pop_{REM} = Estimated number of observable moose in the remainder of Unit 20E, calculated by applying the YCNP moose density estimate to the 3,960 mi^2 area of northern Unit 20E outside the Tok Central, Tok West, and YCNP survey areas.

All GSPE surveys during 2004–2012 used a search intensity of 5.5–7 min/mi^2 with no sightability correction factor. We use low-to-medium search intensities with the understanding that lower search intensities likely underestimate populations and introduce additional, unmeasured variation among survey years because of differences in survey conditions. However, because the unitwide population estimate remains far below objectives, 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 the accuracy of our estimates.

Data collected during the 2004–2012 GSPE surveys were also used to examine changes in sex and age composition within the survey areas. During GSPE surveys, moose were classified as large bulls (antlers ≥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.

Twinning Surveys

Twinning rates were estimated during 2011–2012 from spring surveys conducted in southern Unit 20E. Reconnaissance-style twinning rate surveys were flown in late May during or within a few days of the median calving date (Boertje et al. 2007) in areas historically used as moose calving areas. Roughly parallel contour-transects were flown at approximately ½-mile intervals ≤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. A minimum sample size of 50 cows with calves is preferable for accurate estimation of twinning rates. However, 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. 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 2011–2012, this included data from the registration hunt RM865 in most of Unit 20E, the general season hunt in the upper Middle Fork Fortymile River drainage, and drawing hunts DM794 and DM796 during November–December in the Ladue River controlled use area. General season hunters received 1 reminder letter and permitted hunters 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.

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 RY11–RY12.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In 2011, survey conditions ranged from poor to good, with the poorest conditions occurring during the beginning of the survey in the lower elevation SUs where complete snow cover was lacking. Search time averaged 5.7 min/mi^2. The estimated number of observable moose in the Tok West survey area was 3,082 moose (±19%, 90% CI; 1.26 moose/mi^2; Table 1), and the estimated number of observable moose in the Tok Central survey area was 1,025 moose (±26%, 90% CI; 0.47 moose/mi^2). The combined Tok West and Tok Central observable moose population estimate was 4,148 moose (±16%, 90% CI; 0.90 moose/mi^2). The 2011 unitwide observable moose population estimate for Unit 20E was 4,530–6,340 observable moose, with an estimated density of 0.46–0.65 moose/mi^2 of moose habitat (9,750 mi^2).

In 2012, survey conditions ranged from good to excellent. Search time averaged 7.0 min/mi^2. The estimated number of observable moose in the Tok West survey area was 2,748 moose (±22%, 90% CI; 1.12 moose/mi^2; Table 1), and the estimated number of observable moose in the Tok Central survey area was 1,299 moose (±16%, 90% CI; 0.59 moose/mi^2). The combined Tok West and Tok Central observable moose population estimate was 4,165 moose (±16%, 90% CI; 0.91 moose/mi^2). NPS estimated the moose density in the entire 3,096 mi^2 YCNP survey area (including 1,200 mi^2 in Unit 20E) at 0.25 moose/mi^2 (±20%, 90% CI) in 2012 (Burch 2012). The 2012 unitwide observable moose population estimate was 4,540–6,370 observable moose, with an estimated density of 0.47–0.65 moose/mi^2 of moose habitat.

The southern Unit 20E moose population likely increased during 2004–2009 and remained stable during 2009–2012. Both the 2011 and 2012 population estimates for the combined Tok West and Tok Central areas are similar to the 2009 and 2010 estimates of 3,968 (±15%, 90% CI) and 3,894 (±12%, 90% CI) moose, respectively, whereas the 2009 population estimate of 3,968 observable moose was 75% greater than the 2004 estimate of 2,267 moose (±17%, 90% CI; 0.49 moose/mi^2), and 90% confidence intervals do not overlap. Nevertheless, the unitwide estimates from 2011 and 2012 remain far below the intensive management population objective of 8,000–10,000 moose.

Population Composition

During 1998–2012, bull:cow ratios in both the Tok West and Tok Central survey areas exceeded the management objective of 40 bulls:100 cows every year except 2006 (39 bulls:100 cows in the Tok West survey area; Table 1).

During RY98–RY04, ratios of 5-month-old calves:100 cows were consistently below 25 calves:100 cows and did not equal or exceed 30 calves:100 cows during any year in the southern Unit 20E survey areas (Tok West and Tok Central; Table 1). Gasaway (1992) summarized data collected from 36 different sites in Alaska and Yukon and concluded that 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 every year except 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 primary 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–RY12, calf:cow ratios were low in both the Tok West ($\bar{x}$ = 18 calves:100 cows) and Tok Central ($\bar{x}$ = 7 calves:100 cows) survey areas. The combined Tok West and Tok Central calf:cow ratio averaged 16:100 during RY11–RY12 compared to 28:100 during RY05–RY10. Although incomplete snow cover during portions of the 2011 survey may have resulted in sightability problems (especially of lone cow-calf pairs), multiple years of low calf:cow ratios indicates low recruitment into the population. Although the mechanism for the decreased recruitment is unknown, it is likely primarily due to grizzly bear predation (Gasaway et al. 1992), and it is unlikely to increase substantially without reductions in grizzly bear numbers. Low calf:cow ratios did not result in a decreased estimated population size, which remained stable during RY11–RY12.

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 2012–2014 was 30% (Table 2), 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). In the future we may consider deploying radio collars on cows in southern Unit 20E in order to achieve a larger sample size during twinning surveys, which would allow us to more quickly detect a change in twinning rates.

Distribution and Movements

Moose generally occur throughout Unit 20E below elevations of 4,000 feet. Based on this criterion, 9,750 mi^2 (25,252 km^2) of Unit 20E is suitable moose habitat. This is a significant change from the 8,000 mi^2 of moose habitat used in previous reports, which was based on the exclusion of habitat clearly not suitable for moose (Gross 2012). However, it is unclear how the 8,000 mi^2 area was calculated, and it is likely that the 9,750 mi^2 area more accurately represents available moose habitat in Unit 20E. The LANDFIRE vegetation classification based on 2001 Landsat™ imagery was used to estimate 8,938 mi^2 (23,149 km^2) of available winter moose habitat (deciduous woody browse ≥0.5 m tall) and 10,323 mi^2 (26,736 km^2) of summer range (winter range plus all other vegetated types; Paragi and Kellie 2011:Table 2). I chose to use the more general 9,750 mi^2 of moose habitat for this report because the LANDFIRE classification system has not yet been validated. 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–RY13 are summarized in Table 3.

Alaska Board of Game Actions and Emergency Orders.

Predator Control Actions — During the February 2014 meeting, the board reauthorized the UYTPCP through 30 June 2020; however, moose were removed from the intensive management plan because it did not include any predator control efforts specifically intended to benefit moose. Furthermore, the board failed to adopt a proposal to re-implement the grizzly bear control portion of UYTPCP.

Other Board of Game Actions — In March 2012 the board extended the season of the 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 snowmachines.

Harvest by Hunters. Reported harvest in Unit 20E was 186 bulls and 1 moose of unknown sex in RY11 and 182 bulls and 1 moose of unknown sex in RY12 (Table 4). Harvest during RY08–RY10 was similar, averaging 172 bulls annually (range 165–179). This is an increase from the average harvest of 137 bulls annually (range 130–144) during RY05–RY07. This increase is likely a result of both increased moose numbers since 2004 in areas along the trail systems off the Taylor Highway in southern Unit 20E and an overall increase in moose hunters, especially in southern Unit 20E. Total unitwide harvest was 3.5–4% of the estimated prehunt population in recent years and has likely had little impact on unitwide population dynamics.

Permit Hunts. Two winter drawing permit hunts (DM794 and DM796) occurred within portions of the Ladue River controlled use area. These hunts allowed greater hunting opportunity in remote areas that supported a high proportion of bulls (>60 bulls:100 cows) but were rarely hunted in the fall due to difficult access caused by access restrictions during 24 August–20 September in the controlled use area.

During RY11–RY12, we issued 3 DM794 and 7 DM796 permits annually, but no moose were harvested (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 (e.g. during RY11–RY12, 45% of permit holders did not hunt). A longer season in 2012 (1 November–10 December) did not result in additional harvest or participation.

Hunter Residency and Success. The number of people who reported hunting moose in Unit 20E was 839 in RY11 and 830 in RY12. This is the highest number of hunters compared to the previous 10 years (range 484–822) and is much higher than the previous 5-year average of 699. Of the 183–187 bulls harvested annually in RY11–RY12, 72% were taken by nonlocal Alaska residents (Table 5). Furthermore, nonlocal resident hunters made up 70–71% of the hunters. Local residents represented 19% of the hunters and took 16% of the harvest, while nonresidents represented 10–11% of the hunters and took 12% of the harvest. This is similar to RY98–RY10 when nonresidents represented 11% of the hunters and averaged 13% 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 23% (range 20–26%) during RY08–RY12, likely a result of increased moose numbers along the trail systems off the Taylor Highway in southern Unit 20E. The success rate in RY12 (20%) was the lowest since RY07 (20%).

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–RY10, 2–11 bulls ($\bar{x}$ = 7) were harvested during 24–28 August, a 77% reduction in the average harvest during the first 5 days of the general season (Table 6). August harvest during RY11–RY12 remained at similar levels (9–11 bulls; $\bar{x}$ = 10) as reported during RY01–RY10.

Transport Methods. During RY11–RY12, the type of transportation used most by successful hunters was 4-wheelers ($\bar{x}$ = 45%), followed by airplanes ($\bar{x}$ = 17%), highway vehicles ($\bar{x}$ = 15%), other off-road vehicles (ORV, $\bar{x}$ = 12%), and boats ($\bar{x}$ = 10%). No deviations from the previous 10 years were apparent during RY11–RY12 (Table 7).

Although the proportion of successful hunters using 4-wheelers and ORVs (primarily 8-wheeled vehicles equipped with tracks, such as ARGO®[2] [Ontario Drive and Gear Ltd., Ontario, Canada]) has remained relatively constant since RY01, increasing quality and dependability of these machines 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.

Several other concerns about the increasing trail systems have been voiced by members of the public. 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 in southern Unit 20E has resulted in proposals and testimony to the board, and requests from local advisory committees to the department, to implement 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). Boertje et al. (2009) summarized cause of death postcalving in 4 moose populations in Alaska and Yukon; 31% of the southern Unit 20E postcalving moose population was killed by wolves and bears in the early 1980s, compared with 41% in the

[2] Use of the product name does not constitute endorsement of the product.

southwestern Yukon, 34% near McGrath prior to predator control, and 19% south of Fairbanks after predator control. Predator-prey relationships between moose, wolves, and grizzly bears in Unit 20E during RY81–RY08 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 UYTPCP in Unit 20E can be found in the March 2012–2014 *Upper Yukon-Tanana Predation Control Implementation Plan and Activities* annual reports from ADF&G to the Alaska Board of Game (J. Gross, ADF&G, unpublished report, Tok).

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 13.75% (95% CI ± 4.24%) 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. These results illustrate that Unit 20E likely has moderate habitat potential and browse utilization compared to other Interior Alaska units.

Currently, southern Unit 20E appears to have a large amount of high quality moose habitat associated with 2 large mid-1960s wildfires (>1,000,000 acres), 1998–1999 prescribed and wild fires (≥400,000 acres), and the 2004–2005 wildfires (>1,000,000 acres). The 2004–2005 wildfires 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 355 acres burned in 2011, while 9,670 and 36,423 acres burned in 2012 and 2013 respectively (Alaska Interagency Coordination Center, http://fire.ak.blm.gov [Accessed 17 June 2014]).

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.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates during RY11–RY12 indicated we did not meet the Unit 20E intensive management objective of 8,000–10,000 moose. The population likely increased slowly during RY04–RY09 and was stable during RY09–RY12. The RY12 unitwide population estimate was 4,540–6,370 observable moose with an estimated density of 0.47–0.65 moose/mi^2 of moose habitat (9,750 mi^2).

Predation by wolves and grizzly bears appears to be the primary factor limiting the moose population. Wolf numbers were periodically reduced in portions of Unit 20E during RY98–RY13. Although moose are no longer included in the UYTPCP intensive management plan, the 6-year reauthorization (1 July 2014–30 June 2020) of UYTPCP by the board will likely benefit the Unit 20E moose population through continued suppression of wolf numbers in portions of the unit. However, it is unlikely that the Unit 20E moose population objective will be achieved without further reductions of wolf and grizzly bear numbers.

We continued to meet the management objective of maintaining a posthunting sex ratio of at least 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. Although the total number of moose hunters in Unit 20E continues to increase, the annual unitwide harvest remained at 3.5–4% of the estimated prehunt population during RY09–RY12. If moose numbers continue to increase in southern Unit 20E, it may be possible to consider more liberal hunting regulations in portions of the unit. Continued monitoring of the moose population will be critical in determining the feasibility of more liberal hunting regulations.

Unitwide harvests of 187 moose in RY11 and 183 moose in RY12 were well below the intensive management harvest objective of 500–1,000 moose. Limited hunter access to much of the Unit 20E moose population will make it difficult to achieve the intensive management harvest objective even if the intensive management population objective is reached.

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. Under leadership of the Department of Natural Resources-Division of Forestry and the Bureau of Land Management, guidelines developed in the interagency fire management plan should implement fire management activities that have a greater chance of benefiting the moose population.

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Table 1. Moose population estimates in Tok West and Tok Central moose survey areas in southern Unit 20E, fall 1998–2012[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 (90% CI)	Population estimate (90% CI)
Tok West	1998	64	18	19	10	278	1,932	0.56 (±44%)	1,086 (±44%)
	1999	80	16	22	10	365	1,932	0.47 (±20%)	901 (±20%)
	2000	60	11	14	8	561	1,932	0.58 (±19%)	1,115 (±23%)
	2001	76	9	14	7	531	1,932	0.47 (±19%)	915 (±17%)
	2002	59	10	25	14	364	1,932	0.60 (±19%)	1,166 (±27%)
	2003	64	9	15	9	355	1,944	0.58 (±25%)	1,128 (±25%)
	2004	61	11	26	14	283	2,452	0.59 (±22%)	1,435 (±22%)
	2005	55	13	30	16	543	2,452	0.73 (±17%)	1,801 (±17%)
	2006	39	9	37	20	584	2,452	0.98 (±19%)	2,398 (±19%)
	2007	50	11	30	16	503	2,452	0.86 (±18%)	2,098 (±18%)
	2008	47	11	27	16	509	2,452	0.83 (±15%)	2,040 (±15%)
	2009	63	18	34	18	585	2,452	1.00 (±16%)	2,445 (±16%)
	2010	83	14	37	17	618	2,452	1.03 (±20%)	2,519 (±20%)
	2011	67	8	17	9	799	2,452	1.26 (±19%)	3,082 (±19%)
	2012	50	3	18	10	629	2,452	1.12 (±22%)	2,748 (±22%)
Tok Central	1998	59	14	23	14	450	2,750	0.62 (±25%)	1,694 (±25%)
	2000	49	11	21	13	347	1,821	0.70 (±24%)	1,272 (±24%)
	2001	51	6	10	6	624	2,703	0.75 (±23%)	2,026 (±23%)
	2002	71	8	20	10	396	2,703	0.63 (±28%)	1,707 (±28%)
	2003	53	5	11	6	297	2,703	0.51 (±23%)	1,379 (±23%)
	2004	48	11	23	14	233	2,178	0.37 (±19%)	802 (±19%)
	2005	48	8	16	10	344	2,178	0.50 (±19%)	1,097 (±19%)
	2006	46	3	24	14	520	2,178	0.45 (±19%)	979 (±19%)
	2007	46	11	22	13	440	2,178	0.62 (±22%)	1,348 (±22%)
	2008	82	19	28	13	356	2,178	0.53 (±16%)	1,162 (±16%)
	2009	51	11	25	14	461	2,178	0.68 (±15%)	1,471 (±15%)
	2010	54	6	15	9	369	2,178	0.63 (±23%)	1,379 (±23%)
	2011	61	5	5	3	272	2,178	0.47 (±26%)	1,025 (±26%)
	2012	67	3	9	6	425	2,178	0.59 (±16%)	1,299 (±16%)

[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 Unit 20E, 2004–2014.

Year	Date	Cows				% Twins[a]
		w/Single calf	w/Twins	w/Triplets	Total	
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
2013	30 May	17	8	0	25	32
2014	29 May	25	8	0	33	24

[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[a] 2003–2013.

Regulatory year	Area		Season	Bag limit[b]
2003	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.
2004–2013	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] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Fifty-inch antlers are defined as having a spread of at least 50 inches at the widest point or at least 4 brow tines on at least one side.

Table 4. Unit 20E moose harvest and accidental death, regulatory years[a] 1998–2012.

Regulatory year	General and registration harvest							Drawing permit harvest		Accidental death		Total
	Reported				Estimated							
	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	DM794	DM796	Road	Total	
1998	145 (100)	0 (0)	5	150	0–5	5–10	5–15	1	10	0	0	166–176
1999	127 (100)	0 (0)	4	131	0–5	5–10	5–15	2	6	0	0	144–154
2000	135 (100)	0 (0)	0	135	0–5	5–10	5–15	3	9	0	0	152–162
2001	137 (100)	0 (0)	1	138	0–5	5–10	5–15	5	3	0	0	151–161
2002	154 (100)	0 (0)	1	155	0–5	5–10	5–15	1	3	0	0	164–174
2003	119 (100)	0 (0)	0	119	0–5	5–10	5–15	0	0	0	0	124–134
2004	93 (100)	0 (0)	1	94	0–5	5–10	5–15	1	0	0	0	100–110
2005	137 (100)	0 (0)	0	137	0–5	5–10	5–15	1	0	0	0	143–153
2006	129 (99)	1 (1)	0	130	0–5	5–10	5–15	0	0	0	0	135–145
2007	144 (100)	0 (0)	0	144	0–5	5–10	5–15	0	0	0	0	149–159
2008	176 (100)	0 (0)	0	176	0–5	5–10	5–15	1	2	0	0	184–194
2009	169 (100)	0 (0)	0	169	0–5	5–10	5–15	0	3	0	0	177–187
2010	164 (100)	0 (0)	0	164	0–5	5–10	5–15	0	1	0	0	170–180
2011	186 (99)	1 (1)	0	187	0–5	5–10	5–15	0	0	0	0	192–202
2012	182 (99)	1 (1)	0	183	0–5	5–10	5–15	0	0	0	0	188–198

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).

Table 5. Unit 20E moose hunter residency and success, regulatory years[a] 1998–2012.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1998	51	98	12	0	161 (32)	78	217	39	2	336 (68)	497
1999	37	84	17	1	139 (24)	100	311	30	4	445 (76)	584
2000	41	91	15	0	147 (27)	101	258	33	1	393 (73)	540
2001	33	96	16	1	146 (19)	222	327	58	4	611 (81)	757
2002	40	101	16	1	158 (19)	173	417	72	2	664 (81)	822
2003	22	76	21	0	119 (16)	130	411	62	0	603 (84)	722
2004	21	55	19	0	95 (20)	97	243	47	2	389 (80)	484
2005	27	78	33	0	138 (22)	126	305	56	1	488 (78)	626
2006	27	85	18	0	130 (19)	127	362	72	0	561 (81)	691
2007	24	108	12	0	144 (20)	128	356	74	2	560 (80)	704
2008	25	130	23	1	179 (25)	115	347	67	0	529 (75)	708
2009	22	129	21	0	172 (23)	118	407	50	3	578 (77)	750
2010	27	119	19	0	165 (26)	98	326	49	3	476 (74)	641
2011	30	134	23	0	187 (22)	127	462	59	4	652 (78)	839
2012	29	131	22	1	183 (22)	129	446	70	2	647 (78)	830

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).
[b] Residents of Unit 12 and Unit 20E and eastern Unit 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

Table 6. Unit 20E moose harvest chronology percent by month/day, regulatory years[a] 1998–2012.

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	Unk	*n*
1998	0	23	50	15	4	1	7	6	155
1999	0	22	41	20	9	0	6	3	136
2000	1	15	41	28	5	0	8	3	144
2001	10	0	49	29	5	0	5	3	143
2002	5	0	62	29	1	0	3	0	153
2003	7	3	61	28	0	1	0	0	110
2004	2	2	61	32	1	0	1	1	92
2005	9	3	54	32	1	0	1	0	136
2006	8	0	55	33	2	0	0	3	127
2007	6	1	60	31	1	0	0	1	143
2008	8	2	59	27	1	0	2	2	177
2009	8	1	57	33	0	0	2	0	169
2010	6	1	55	36	1	0	1	0	165
2011	5	0	59	33	2	0	0	1	187
2012	6	1	61	28	4	0	0	0	183

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).

Table 7. Unit 20E moose harvest and percent by transport method, regulatory years[a] 1998–2012.

	Harvest and percent (%) by transport method								
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1998	32 (20)	0 (0)	23 (14)	40 (25)	12 (7)	12 (7)	41 (26)	1 (1)	161
1999	31 (22)	1 (1)	26 (18)	37 (27)	8 (6)	19 (14)	15 (11)	2 (1)	139
2000	29 (20)	2 (1)	28 (19)	40 (27)	12 (8)	14 (10)	20 (14)	2 (1)	147
2001	23 (16)	0 (0)	14 (10)	68 (46)	4 (3)	15 (10)	18 (12)	4 (3)	146
2002	36 (23)	1 (1)	17 (11)	58 (37)	4 (2)	19 (12)	16 (10)	7 (4)	158
2003	32 (27)	2 (2)	6 (5)	51 (43)	0 (0)	13 (11)	12 (10)	3 (2)	119
2004	20 (21)	1 (1)	8 (8)	32 (34)	1 (1)	15 (16)	17 (18)	1 (1)	95
2005	27 (20)	1 (1)	15 (11)	48 (35)	1 (1)	27 (20)	17 (12)	2 (1)	138
2006	27 (21)	0 (0)	13 (10)	46 (35)	0 (0)	20 (15)	23 (18)	1 (1)	130
2007	23 (16)	1 (1)	20 (14)	52 (36)	0 (0)	21 (15)	24 (16)	3 (2)	144
2008	22 (12)	0 (0)	21 (12)	77 (43)	3 (2)	29 (16)	24 (13)	3 (2)	179
2009	30 (17)	0 (0)	12 (7)	80 (47)	2 (1)	27 (16)	19 (11)	2 (1)	172
2010	33 (20)	1 (1)	20 (12)	72 (44)	0 (0)	14 (8)	18 (11)	7 (4)	165
2011	34 (18)	0 (0)	19 (10)	77 (41)	0 (0)	23 (13)	30 (16)	4 (2)	187
2012	29 (16)	0 (0)	19 (10)	88 (48)	0 (0)	20 (11)	26 (14)	1 (1)	183

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).

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CHAPTER 27: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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 Grayling, Anvik, Shageluk, and Holy Cross are located in Unit 21E and the lower Innoko and Yukon rivers are easily accessible by boat.

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 including the transportation of moose hunters and their gear. This restricts access in the CUA primarily to residents with boats.

The Alaska Department of Fish and Game (ADF&G) has limited information available on the moose population in Unit 21A; however survey work has increased since 2007. In Units 21A and 21E, aerial composition surveys as well as geospatial population estimator (GSPE) surveys (Ver Hoef 2001, 2008) have been the primary means of assessing the population status.

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

Long-term historical moose survey data are limited. In Unit 21E we began collecting population and composition data in 2000. In Unit 21A, regular fall composition surveys began in 2007 and the first GSPE survey was conducted in March 2013. We have worked in close cooperation with Innoko National Wildlife Refuge (INWR) and the Bureau of Land Management (BLM) to complete these surveys.

MANAGEMENT DIRECTION

The *Yukon–Innoko Moose Management Plan* (YIMMP; ADF&G 2006) guides moose management in Units 21A and 21E. 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 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 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 INWR in cooperation with INWR staff whenever possible.
- Conduct a GSPE moose population estimation survey in Unit 21E every 3 years.

METHODS

The current estimate of moose numbers in Unit 21A was derived from a GSPE survey (Kellie and DeLong 2006) conducted in March 2013 by INWR, with support from ADF&G, in a 3,821 mi^2 area. We surveyed 150 (97 high density and 53 low density) of 643 sample units (SU; approximately 6 mi^2 per SU). All high density SUs were sampled and the low density 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 6,976 mi^2 of Unit 21A to derive a unitwide population estimate. No sightability correction factor (SCF) was applied to this survey and all results were reported as observable moose.

We derived estimates of moose numbers in Unit 21E from an aerial survey conducted in March 2012 in a 5,070 mi^2 area of Unit 21E using the GSPE method (Kellie and DeLong 2006) as well as radiocollared moose (Fig. 1) to determine sightability (see Keech et al. 2011 for methods). We surveyed 150 (113 high density and 37 low density) of 822 SUs. These SUs were selected randomly (90%) or manually to fill gaps in the randomized coverage (10%). An SCF was determined using a sample of radiocollared bulls and cows. We extrapolated the density calculated from the GSPE population estimate of the low density strata (including SCF) to the remaining 2,925 mi^2 of Unit 21E to derive a unitwide population estimate.

During November 2008–2012, fall composition surveys were conducted annually in Unit 21A. Surveys in 2008–2009 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 2011–2012, GSPE survey units were selected by INWR in an area similar to previous composition surveys. In all years each moose or group of moose was circled to determine composition.

During November 2008–2011 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. 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.

Twinning surveys were attempted in Unit 21A in 2008–2010 and 2012, however sample sizes were low (<17 each year) and data were not analyzed.

Twinning surveys were conducted in Unit 21E during late May or early June 2008–2012 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/triplet calves. Radiocollared adult females were used to increase observations during 2010–2012. Twinning rate was calculated as the number of cows with twins/triplets divided by the number of cows with calves.

Two methods were used to determine harvest in Units 21A and 21E. First, we used mandatory harvest report cards from general season harvest tickets and drawing permits on which hunters report residency, effort, location of hunt, transportation method, commercial services used, success, sex of kill, and antler width. Second, we used household surveys conducted by ADF&G-Division of Subsistence to 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., RY11 = 1 July 2011–30 June 2012).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Unit 21A. The March 2013 GSPE survey estimated a density of 0.3 observable moose/mi^2 or 1,047 moose ±24% (90% CI) in the survey area (Table 1a) with 21% calves. The current estimate for all of Unit 21A is 2,442 observable moose. No SCF was applied to this estimate.

Unit 21E. The March 2012 GSPE survey indicated a density of 1.0 observable moose/mi^2 or 4,914 moose ±11% (90% CI) in the survey area with 19% calves. Correcting for sightability resulted in an estimate of 5,701 moose ±16% (90% CI) in the survey area. Using the 2012 GSPE low density estimate of 0.43 moose/mi^2 (with a low density SCF = 1.33) extrapolated over the 2,925 mi^2 not included in the Unit 21E moose survey area gives a unitwide population estimate of 6,959 moose. This survey was not statistically different from prior surveys, and indicates the winter moose population in Unit 21E was likely stable during 2000–2012 (Table 1b).

Population Composition

Results of fall composition surveys in Unit 21A during November 2008–2012 ranged 54–82 bulls:100 cows and 8–44 calves:100 cows (Table 2a). The number of moose observed was low in 2008; however in 2009–2012 a larger sample size was achieved.

Fall composition surveys in Unit 21E during November 2008–2011 indicated a high bull:cow ratio in all years except 2009 (Table 2b). In 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, few cows with calves were found and no inference on productivity is warranted. In Unit 21E the most recent 2-year average twinning rate was 37% (Table 3) indicating habitat was not limiting this moose population (Boertje et al. 2007).

Distribution and Movements

During the 1980s, ADF&G cooperated with INWR and BLM 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 radiocollared moose which had died. The GPS radio collars acquire up to 6 location fixes daily and will allow a more thorough analysis of movements. Distribution and movement of these moose will be summarized in 2015. In addition the radio collars were used to obtain an SCF for the 2012 GSPE survey. These collars are scheduled to be removed and replaced with VHF collars in March 2014.

MORTALITY

Harvest

Seasons and Bag Limits. Bag limits and season dates by regulatory year.

Unit and bag limits	Open season
RY11–RY12	
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. In 2010 the board adopted an intensive management plan (Title 5 Alaska Administrative Code 92.124) 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.

Harvest by Hunters. General season harvest by hunters during RY08–RY12 is reported in tables 4a and 4b, this report. During this period, annual harvest in Unit 21A was lowest in RY09, and has since remained fairly stable (Table 4a). In Unit 21E, annual harvest averaged 106 moose during RY08–RY12 (Table 4b).

Beginning in RY10 a federal permit (FM2104) was issued for the Unit 21E winter hunt. This permit was available only to residents of Unit 21E and Russian Mission. Beginning in RY12, residents of Kalskag, Lower Kalskag, Aniak and Chuathbaluk were also granted a customary and traditional use determination on federal lands and a new hunt was created (FM2105). The season for this hunt overlaps with FM2104, however hunters with a FM2105 permit may only hunt in southern Unit 21E. Prior to implementing these permits a state general season harvest ticket was required for the federal winter hunt. Participation in these hunts appears to be low and on average only 8 moose have been harvested annually since the hunts began (Table 4c).

No mortuary moose (defined in 5 AAC 92.019) were reported taken in Unit 21A during RY11–RY12. Twenty-three mortuary moose (19 cows and 4 bulls) were taken in Unit 21E during RY11–RY12.

Hunter Residency and Success. There are few local hunters in Unit 21A and most hunting pressure was from nonresidents and nonlocal residents (Table 5a). In Unit 21E a large number of hunters were local residents from Anvik, Grayling, Holy Cross, and Shageluk (Table 5b), though more hunters were nonlocal Alaskans. During RY08–RY12, average reported success was 37% in Unit 21A (range = 24–46%) and 63% in Unit 21E (range = 52–69%).

Permit Hunts. Beginning in RY07, nonresident hunters in Unit 21E were required to apply for a drawing permit instead of obtaining a general season harvest ticket. Initially 60 permits were offered (48 unguided DM837 and 12 guided DM839) with the intent to take up to 30 moose. After the nonresident season was extended to 25 September in RY10, the number of permits offered was reduced to 50 (40 unguided and 10 guided). Both hunts were undersubscribed during RY07–RY11. In RY12 and RY13, DM839 was fully subscribed. Harvest by nonresidents remains well below 30 moose (Table 5b) which was identified in YIMMP as the maximum desired nonresident harvest.

Antler Size. During RY11–RY12 the average antler size of harvested bulls in Unit 21A (50.5 inches) remained larger than in Unit 21E (42.2 inches). However, Unit 21A had a high proportion of nonresident hunters, who were required to take bulls with a minimum antler size of 50 inches or at least 4 brow tines on one side. During RY11–RY12, 17 bulls ≥50 inches, 16 ≥60 inches and 1 ≥70 inches were taken in Unit 21A. During the same period in Unit 21E, 33 bulls ≥50 inches, 19 ≥60 inches, and 2 ≥70 inches were taken.

Transport Methods. During RY08–RY12, aircraft and boats were the most common methods of hunter transportation in Unit 21A (Table 6a). In Unit 21E, boats, followed by aircraft, were the most commonly used methods of transportation (Table 6b). 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).

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. We also noted abundant felt leaf willow on the islands and floodplain of the middle Yukon River and diamond leaf willow in extensive meadows adjacent to the Yukon and lower Innoko rivers. Browse removal was estimated at 21%, a moderate level for Interior Alaska (Paragi et al. 2008). During RY10–RY12 there were no major ice scouring events or fires.

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 Yukon–Innoko Moose Management Working Group convened to develop a plan to proactively manage moose populations in the area. YIMMP was the result of this process (ADF&G 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 may be conducted; however twinning surveys, an index of population nutrition, will be our primary metric of habitat quality.

In 2011, ADF&G staff placed 10 snow stakes in Unit 21E to assess snow depth. Nine of the stakes fell that first winter and all were repaired in summer 2012. Seven more fell again and only 3 snow stakes remain, so we have inadequate data to report. Repairs were again made in summer 2014.

Land management in Units 21A and 21E is complex, with a mix of federal, state, and 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. The current population estimate for Unit 21A is 2,442 observable moose. Because this estimate is not corrected for sightability it is a conservative estimate. The current population estimate for all of Unit 21E is 6,959 moose. This is below the Unit 21E intensive management objective of at least 9,000 moose (9,000–11,000).

The objectives to maintain a minimum posthunt bull:cow ratio of 25–30 bulls:100 cows in Units 21A and 21E was met during RY11–RY12. The objective to maintain a minimum posthunt calf:cow ratio of 30–40 calves:100 cows in Unit 21E was met in RY11 and no composition data were collected in RY12. Unit 21A has a negative finding for intensive management and there are no management actions we can take to improve calf:cow ratios in years when the objective is not met. The objective to maintain at least 20% calves in the late winter moose population in Unit 21E was not met when measured in 2012. We found 19% calves in the population during that survey.

The objective to maintain harvest of ≤4% of the estimated population in both Units 21A and 21E was met in RY11 and RY12. 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 Unit 21E does not exist. The current estimate of harvestable surplus is 278 moose. Actual harvest appears to be well below this level; however, harvest is difficult to assess because of poor reporting.

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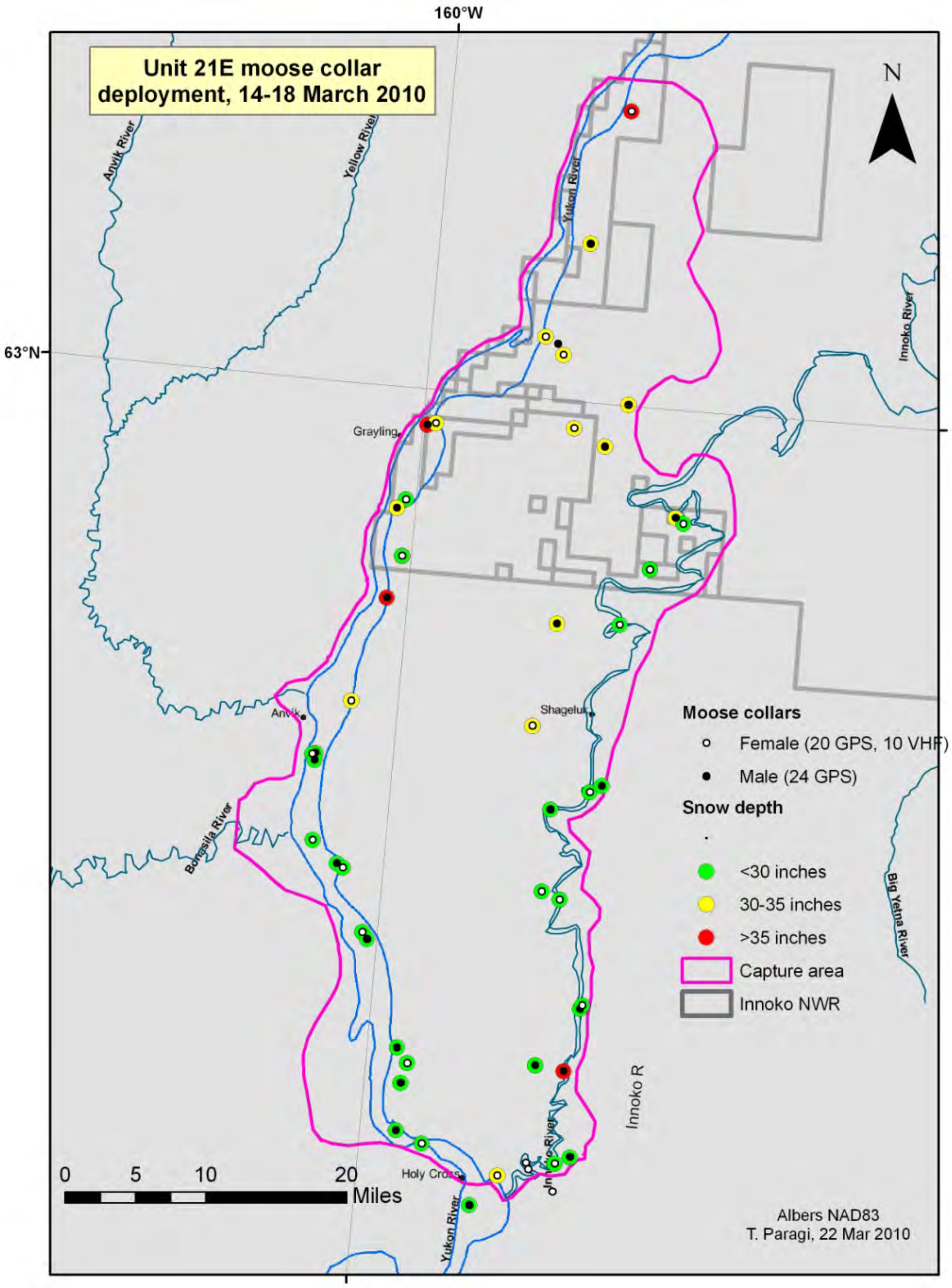

Figure 1. Locations of radio collar deployments on Unit 21E moose, 14–18 March 2010.

Table 1a. Summary of geospatial moose population estimates (GSPE) in Unit 21A.

Survey year and method[a]	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				
2013 GSPE	3,821	3,244	577	315	577	892	681	(0.2)	366	(0.3)	1,047±24%	0.3	150

[a] Population estimates are of observable moose and do not include a sightability correction factor.

Table 1b. Summary of geospatial moose population estimates (GSPE) in Unit 21E, 2000–2012.

Survey year and method[a]	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 Gasaway[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
2012 GSPE[c]	5,070	4,104	966	229	696	925	1,331	(0.3)	3,583	(3.7)	4,914±11%	1.0	150

[a] Population estimates are of observable moose and do not include a sightability correction factor.
[b] The 2000 survey was calculated using 3 strata (high, medium, low) and the Gasaway et al. (1986) technique.
[c] Corrected estimate for 5,070 mi^2 survey area in 2012 is 5,701±16% at 90% CI.

Table 2a. Unit 21A fall aerial moose composition counts, regulatory years[a] 2008–2012.

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total moose	Survey date
2008	54	21	8	2	5	37	39	18 Nov
2009	64	10	40	23	19	95	118	17 Nov
2011	82	21	44	32	20	131	163	29 Nov
2012	69	12	28	23	14	137	160	27 Nov

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 2b. Unit 21E fall aerial moose composition counts, regulatory years[a] 2008–2011.

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Total moose	Survey date
2008	62	29	37	35	19	151	186	4 Nov
2009[b]	32	21	18	18	12	135	153	17 Nov
2010	61	15	51	69	24	218	287	16 Nov
2011	64	22	47	45	22	156	201	16 Nov

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Partial survey.

Table 3. Unit 21E moose aerial twinning surveys, regulatory years[a] 2008–2012.

Regulatory year	Total moose	Cows with 1 calf	Cows with 2–3 calves	Percent twinning[b]	Survey date
2008	194	17	15	47	29 May
2009	182	12	12	50	27 May
2010	143	15	18	55	28 May
2011	256	32	22[b]	41	2 Jun
2012	339	38	18	32	30 May

[a] Percent of cows with calves that had twins.
[b] Two of these cows had triplets.

Table 4a. Unit 21A moose harvest, regulatory years[a] 2008–2012.

Regulatory year	Reported harvest Male	(%)	Female	(%)	Unknown	Total
2008	29	(100)	0	(0)	0	29
2009	18	(100)	0	(0)	0	18
2010	35	(100)	0	(0)	0	35
2011	34	(100)	0	(0)	0	34
2012	36	(100)	0	(0)	0	36

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4b. Unit 21E moose harvest, regulatory years[a] 2008–2012.

Regulatory year	Reported harvest Male	(%)	Female	(%)	Unknown	Total
2008	103	(90)	10	(9)	1	114
2009	102	(96)	3	(3)	1	106
2010	107	(99)	1	(1)	0	108
2011	105	(100)	0	(0)	0	105
2012	97	(100)	0	(0)	0	97

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 4c. Unit 21E moose harvest for federal permits FM2104[a] and FM2105[b] regulatory years[c] 2010–2013.

Regulatory year	Permits issued	Hunted	Reported harvest Male	(%)	Female	(%)	Unknown	Total
2010		25	2	(33)	4	(67)	0	6
2011	48	25	2	(33)	4	(67)	0	6
2012	46	20	3	(38)	5	(63)	1	9
2013[d]	48	21	7	(64)	4	(36)	0	11

[a] Hunt only open to residents of Grayling, Anvik, Shageluk, Holy Cross and Russian Mission.
[b] Hunt only open to residents of Kalskag, Lower Kalskag, Aniak and Chuathbaluk.
[c] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).
[d] Preliminary data.

Table 5a. Unit 21A moose hunter residency and success, regulatory years[a] 2008–2012.

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2008	1	19	9	0	29 (31)	2	32	27	3	64 (69)	93
2009	0	14	4	0	18 (24)	7	30	20	0	57 (76)	75
2010	3	24	7	1	35 (40)	3	33	15	1	52 (60)	87
2011	2	19	12	1	34 (43)	2	29	14	1	46 (58)	80
2012	2	17	15	2	36 (46)	3	29	9	2	43 (54)	79

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Local resident from Anvik, Grayling, Holy Cross, Shageluk, McGrath, or Takotna.

Table 5b. Unit 21E moose hunter residency and success, regulatory years[a] 2008–2012[b].

	Successful					Unsuccessful					
Regulatory year	Local resident[c]	Nonlocal resident	Nonresident[d]	Unk	Total (%)	Local resident[c]	Nonlocal resident	Nonresident[d]	Unk	Total (%)	Total hunters
2008	29	57	10	18	114 (52)	25	44	32	5	106 (48)	220
2009	34	64	7	1	106 (62)	14	32	19	0	65 (38)	171
2010	47	50	10	1	108 (64)	17	29	14	1	61 (36)	169
2011	39	56	9	1	105 (69)	10	24	14	0	48 (31)	153
2012	33	52	12	0	97 (69)	10	21	11	2	44 (31)	141

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Does not include data from federal hunts.
[c] Local resident from Anvik, Grayling, Holy Cross or Shageluk.
[d] Drawing permits DM837 and DM839.

Table 6a. Unit 21A moose harvest percent by transport method of successful hunters, regulatory years[a] 2008–2012.

Regulatory year	Harvest percent by transport method									*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
2008	21 (72)	0 (0)	6 (21)	0 (0)	0 (0)	0 (0)	2 (7)	0 (0)	0 (0)	29
2009	18 (90)	0 (0)	2 (10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	20
2010	25 (71)	0 (0)	6 (17)	2 (6)	0 (0)	1 (3)	1 (3)	0 (0)	0 (0)	35
2011	19 (56)	0 (0)	7 (21)	2 (6)	1 (3)	1 (3)	3 (9)	0 (0)	1 (3)	34
2012	22 (61)	0 (0)	13 (36)	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	36

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

Table 6b. Unit 21E moose harvest percent by transport method of successful hunters, regulatory years[a] 2008–2012.

Regulatory year	Harvest percent by transport method[b]									*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
2008	11 (10)	1 (1)	88 (77)	0 (0)	11 (10)	0 (0)	0 (0)	0 (0)	3 (3)	114
2009	9 (8)	0 (0)	93 (88)	1 (1)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	106
2010	12 (11)	0 (0)	93 (86)	0 (0)	2 (2)	0 (0)	0 (0)	0 (0)	1 (1)	108
2011	10 (10)	0 (0)	91 (87)	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)	1 (1)	105
2012	10 (10)	0 (0)	85 (88)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	97

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).
[b] Does not include data from federal hunts.

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
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CHAPTER 28: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

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 community with meat. 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 20th century. The 1982 *Alaska Interagency Fire Management Plan: Tanana–Minchumina Planning Area*, and more recently 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, the Blind River, and the Boney River drainages. The Alaska Board of Game (BOG) 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 BOG adopted regulations to implement 3 drawing hunts and a registration hunt for the entire unit. In 2006 BOG added the upper Nowitna drainage (formerly part of

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

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 substantial differences in data analysis from subsequent management reports and are described in Stout (2008).

MANAGEMENT DIRECTION

MANAGEMENT GOAL, OBJECTIVES, AND ACTIVITY

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 posthunt 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 4,000–6,000.

Activity — Conduct population estimation surveys when funding is available and monitor harvest through hunt reports.

METHODS

No unitwide population surveys were conducted during RY11–RY12. Methods for geospatial population estimator (GSPE) surveys conducted in 2001 and 2008 in Unit 21B are described in Pamperin (2012a).

During 31 October–1 November 2011, the U.S. Fish and Wildlife Service (FWS) surveyed 2 established trend count areas (TCA) to assess population composition in a small portion of 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 4–8 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 adequate 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.

Harvest information was monitored through mandatory registration and drawing permit harvest reports, general season harvest reports, 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., RY11 = 1 July 2011–30 June 2012).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

No unitwide GSPE surveys were conducted in Unit 21B during RY11–RY12 (Table 1). The Nowitna mouth and Nowitna–Sulatna confluence TCAs surveyed by FWS in 2011 and 2012 represent the only new population and composition data gathered in Unit 21B for RY11–RY12. Because of inadequate survey conditions, we did not include the results of the 2012 trend count survey data in this report.

TCA data from RY11 indicate that moose densities along the riparian corridor were relatively constant and within the range of past surveys (Tables 2 and 3). Data from TCAs (Tables 2–4) are not broadly representative of the unitwide moose population, the majority of which has lower moose densities than the riparian areas where TCAs are located.

Unit 21B Total Area. The most recent unitwide population estimate survey for Unit 21B was conducted in 2008 and indicated 2,317 observable moose (±18% relative error = 1,899–2,736 observable moose, 90% CI) in the survey area (Table 1). This resulted in an overall density of 0.27 moose/mi^2.

Population Composition

No unitwide population composition surveys have been conducted in Unit 21B since 2008. The 2011 TCA surveys conducted by FWS at the Nowitna mouth and Nowitna–Sulatna confluence produced similar results to past surveys and no significant trend is apparent (Fig. 1). The yearling bull:cow ratios were low in 2010 and likely a carryover from poor production and survival of the calf cohort after the severe winter of 2008–2009 (Fig. 1). Bull:cow ratios from the TCAs (Tables 2 and 3) are consistently lower than the unitwide estimate of 50 bulls:100 cows from the 2008 GSPE survey (Table 1). This is not surprising, given that areas accessible from the Nowitna River corridor experience higher hunting pressure than most other areas in the unit.

Distribution and Movements

No recent studies have been done on moose distribution and movement in Unit 21B. Limited information on moose movements from radiocollared cow–calf pairs is available in Woolington (1998).

MORTALITY

Harvest

Season and Bag Limit.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY11–RY12		
Unit 21B, that portion within the Nowitna River drainage upstream from the Little Mud River drainage and outside a corridor extending 2 miles on either side of and including the Nowitna River.		
RESIDENT HUNTERS: 1 bull.	22 Aug–31 Aug 5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Remainder of Unit 21B.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	22 Aug–31 Aug 5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 300 permits may be issued in Unit 21B.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 300 permits may be issued in Unit 21B.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. No regulatory changes were adopted and no emergency orders were issued during RY11–RY12.

Harvest by Hunters. Reported harvest during RY11–RY12 in Unit 21B averaged 71 moose annually, consistent with average reported harvest during RY01–RY10 ($\bar{x}$ = 76, range = 64–86) (Table 5; including harvest in 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 (Stout 2010). During RY11 and RY12, harvest from the lower Nowitna River corridor accounted for 26% of the reported harvest for Unit 21B, suggesting that regulations adopted in 2004 to improve harvest distribution remained successful in moving hunters away from the Nowitna River corridor. Prior to 2004 harvest from the lower Nowitna River corridor comprised 61% of total Unit 21B harvest (RY97–RY03, Tables 6 and 7).

Checkstation Results. A hunter checkstation located at the mouth of the Nowitna River has been in place since RY88 and historical patterns in success and numbers of hunters through the checkstation are outlined in Pamperin (2012a). During RY11 and RY12 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 annual success rate for all hunters during RY99–RY10 was 37% (range = 26–48%). The annual success rate was 44% (range = 38–48%) in RY99–RY03, dropped to 31% (range = 26–39%) during RY04–RY10, and increased slightly to 36% and 37% in RY11 and RY12 (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 RY11 and RY12, hunter reports indicated that most moose were shot during 15–25 September ($\bar{x}$ = 64%; Table 8). This was probably due to relatively little movement of bulls in the earlier part of the season compared to later, when bulls actively engage in rutting behavior.

Winter harvest was not reported on harvest or permit report cards, but was probably about 20% of the annual kill. Winter harvest likely occurred during October–March (Andersen et al. 2001).

Transportation Methods. Consistent with past harvest methods, the majority of hunters (RY11–RY12; $\bar{x}$ = 82%) used boats to hunt moose (Table 9). Most airplane access was by commercial transporters. Highway vehicle transportation occurred exclusively on the Poorman Road south of Ruby. Snowmachines were used during winter to hunt, but winter reporting rates were low because there was no open moose hunting season, and therefore snowmachine use was underrepresented in the data.

Other Mortality

Predation mortality on moose calves was previously found to be 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 (Pamperin 2012b).

HABITAT

Assessment

No new habitat data were collected in RY11 or RY12. One significant wildfire on the Nowitna River burned ~22,000 acres in 2012 (Alaska Interagency Coordination Center-Alaska Fire Service, fire.ak.blm.gov/incinfo/aklgfire.php).

CONCLUSIONS AND RECOMMENDATIONS

Classification data from the Nowitna TCAs indicated slightly higher total moose numbers in 2011 within the riparian zone of the lower Nowitna River compared to data from RY00 through RY10. Composition data varied within the range of values observed within the TCAs in the previous 8 years, with slight increases in yearling bull:cow and total bull:cow ratios. 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 surveys are conducted. 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.

In RY11 and RY12 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 98 moose in RY11 and 94 in RY12, approximately 4.2% of the Unit 21B observable moose population (2008 GSPE survey; Table 1).

The objective to implement at least 2 habitat enhancement projects every 5 years in combination with Unit 21C was not met.

The third management objective to maintain a moose population of 4,000–6,000 was likely not met during RY11–RY12. 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), and it is unlikely that the population could have grown enough from 2008 to 2012 to fall within the population objective. The positive intensive management finding for Unit 21B moose adopted by BOG in 2010 allows for a wider range of management options, including strategies to improve recruitment to achieve this population objective. Despite the positive finding, intensive management activities are improbable due to federal landownership in areas most frequented by moose hunters.

Predators likely remained relatively abundant and continued to be the primary factor limiting moose abundance in Unit 21B. Harvest of wolves (≤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

The second management objective will be removed in the next reporting period. There have been no habitat enhancement projects in Units 21B or 21C and it is unlikely that resources will be available to do so in the foreseeable future.

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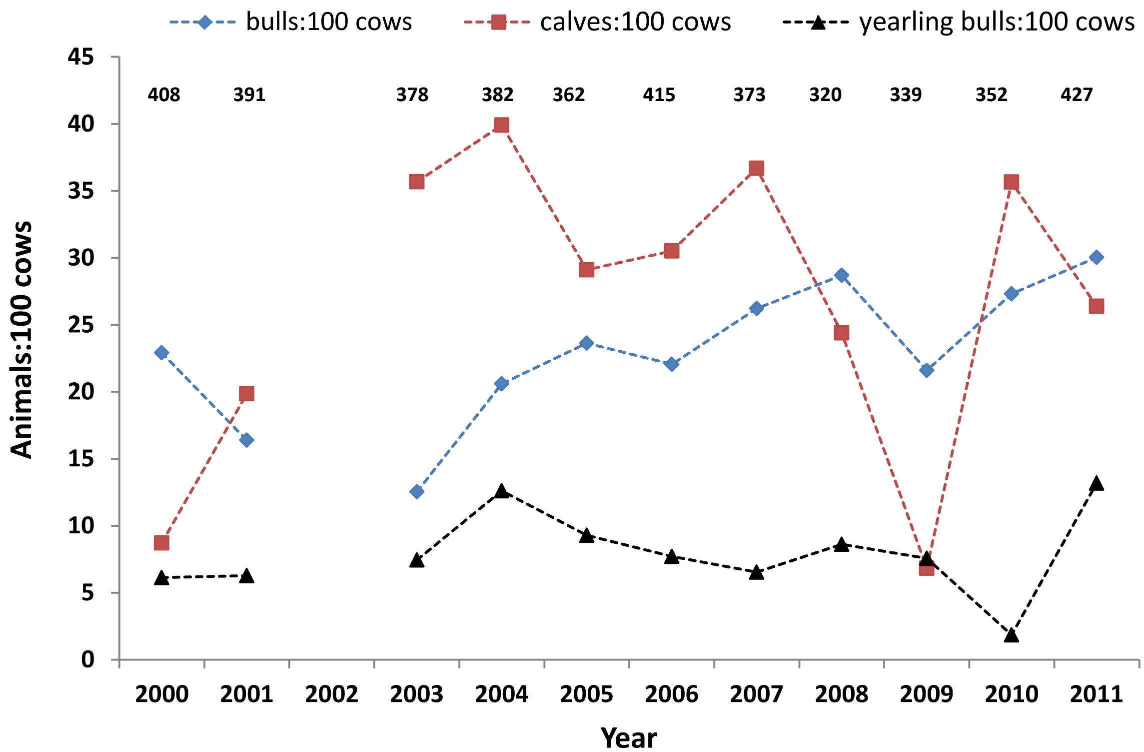

Figure 1. Ratios of calves, bulls, and yearling bulls per 100 cows in Nowitna mouth and Nowitna–Sulatna confluence trend count areas. The number of moose counted during each survey is provided at the top of the figure.

Table 1. Unit 21B moose population estimates, regulatory years[a] 1980–2008.

Area/Regulatory year	Area mi^2	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Percent calves	Adults	Population estimate (90% CI[b])	Density
21B–Nowitna West								
1980[c]	1,556	53	35	25	19	1,125	1,389 (±27%)	0.89
1986[c]	1,596	37	39	12	22	685	878 (±24%)	0.55
1990[c]	1,560	40	39	10	22	948	1,214 (±18%)	0.78
1995[d]	1,338	34	30	14	19	856	1,052 (±20%)	0.79
2001[e,f]	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[e,f]	4,754	39	18	9	12	2,772	3,201 (±45%)	0.67
2008[e]	4,754	45	43	12	23	1,110	1,438 (±15%)	0.30
Total Area								
2008[e]	8,565	50	49	12	25	1,747	2,317 (±18%)	0.27

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1980 = 1 July 1980–30 June 1981).
[b] Confidence interval (% ±).
[c] MOOSEPOP analysis of Gasaway et al. (1986) survey with sightability correction factor (SCF).
[d] MOOSEPOP analysis (regression design) of Gasaway et al. (1986) survey with SCF.
[e] Geospatial population estimator (GSPE) analysis without SCF (observable moose).
[f] 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[a], regulatory years[b] 1991–2011.

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[c]	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[c]	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
2011	149	28	14	38	8	23	224	1.5

[a] Conducted by the U.S. Fish and Wildlife Service.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1991 = 1 July 1991–30 June 1992).
[c] Low snow conditions during survey.

Table 3. Unit 21B Nowitna mouth aerial moose composition counts[a], regulatory years[b] 1992–2011.

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[c]	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[c]	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
2011	102	32	12	14	0	10	203	1.9

[a] Conducted by the U.S. Fish and Wildlife Service.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1992 = 1 July 1992–30 June 1993).
[c] Low snow conditions during survey.

Table 4. Unit 21B Deep Creek aerial moose composition counts, regulatory years[a] 1982–2008.

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

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1982 = 1 July 1982–30 June 1983).

Table 5. Unit 21B[a] moose harvest, regulatory years[b] 1996–2012.

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
2011	73	0	0	73	25	98
2012	69	0	0	69	25	94

[a] All years include the Nowitna River drainage above the Little Mud River, which was added to Unit 21B in 2006.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1996 = 1 July 1996–30 June 1997).

Table 6. Unit 21B Nowitna River checkstation hunters (R), harvest (H), and percent success (%S), regulatory years[a] 1997–2012[b].

Regulatory	Local villages[c]			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	31
2011	12	4	33	36	15	42	39	17	44	1	0	0	88	36	41
2012	17	5	29	23	8	35	32	14	44	4	2	50	76	29	38

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] U.S. Fish and Wildlife Service.
[c] Local residents reside in Tanana, Ruby, and Galena.

Table 7. Unit 21B moose hunter residency and success, regulatory years[a] 1996–2012[b].

	Successful					Unsuccessful					
Regulatory year	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[c]	Nonlocal Resident	Nonresident	Unk	Total	Total hunters
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
2011	17	44	12	0	73 (36)	37	80	15	0	132	205
2012	19	34	16	0	69 (37)	42	65	13	0	120	189

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1996 = 1 July 1996–30 June 1997).
[b] Some hunters had multiple permits.
[c] Local residents reside in Tanana, Ruby, and Galena.

Table 8. Unit 21B moose harvest chronology percent by month/day, regulatory years[a] 1996–2012.

Regulatory year	Harvest chronology percent by month/day 8/22–8/31[b]	9/1–9/14	9/15–9/25	*n*
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
2011	1	27	71	73
2012	1	42	57	69

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1996 = 1 July 1996–30 June 1997).
[b] August season started in 2006.

Table 9. Unit 21B moose harvest percent by transport method, regulatory years[a] 1996 through 2012.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat[b]	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
2011	7	0	82	3	0	3	3	3	73
2012	10	0	81	3	0	0	4	1	69

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1996 = 1 July 1996–30 June 1997).
[b] Includes airboats.

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CHAPTER 29: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

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

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.

Moose have been present in Unit 21C throughout the recent history of Interior Alaska (S. Huntington, personal communication to Glenn Stout, Alaska Department of Fish and Game [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 hunter numbers and harvest have been low, there has been little need to extensively monitor the moose population in this area. Given this, management activities in Unit 21C are restricted to monitoring reported harvest. A more active management approach in Unit 21C is not likely in the near future given the number of higher priority management activities currently ongoing in other subunits in the Galena management area.

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.

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

MANAGEMENT OBJECTIVE

- Maintain ≥20% large bulls (bulls with antlers 60 inches or greater) in the harvest.

METHODS

POPULATION STATUS AND TREND

No unitwide population estimates have been conducted in Unit 21C. 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 Unit 21D (Stout 2012). Using the geospatial population estimator (GSPE) technique (Ver Hoef 2001, 2008; Kellie and DeLong 2006), 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 1 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 were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY11 = 1 July 2011–30 June 2012).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During the November 2010 GSPE survey in the 700 mi^2 portion of western Unit 21C, we observed 98 moose, 0.46 moose/mi^2 (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 Unit 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.

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

Seasons and Bag Limits during RY11–RY12.

Unit 21C, the Dulbi River drainage — The hunting season was 5–25 September. Resident bag limit was 1 bull for registration permit RM834 (trophy value of antlers must be destroyed) or drawing permit DM812 (no trophy destruction required). Nonresidents were allowed 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side, by permit DM812.

Remainder of Unit 21C — Residents and nonresidents hunted under general harvest ticket during 5–25 September. Resident bag limit was 1 bull and nonresident bag limit was 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.

Alaska Board of Game Actions and Emergency Orders. No regulation changes were adopted during RY11–RY12.

Harvest by Hunters. Harvest in Unit 21C averaged 17 moose/year during RY11–RY12 compared to the long-term average of 21.3 moose/year ±2.13 ($\bar{x}$ ±SE) during RY96–RY12 (Table 2). The average number of hunters during RY11–RY12 (43.5 hunters/year) was similar to the long-term average (44.1 hunters/year, RY96–RY12).

Thirty-three moose have been reported harvested on drawing hunt permit DM812 since RY04 (Table 3). During RY04–RY12, only 3 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–RY12 (Fig. 1), however the percentage of large bulls (>60 inches) in the harvest has been below 20% (0–18%) during RY09–RY12. Since there is a lack of survey data from the portions of Unit 21C where most hunting pressure occurs, it is difficult to determine whether the apparent decrease of large bulls in the harvest is due to real declines in the population, a change in harvest, or simply coincidental given the small number of bulls harvested.

Hunter Residency and Success. Alaska residents composed 48% of the 87 hunters who hunted moose in Unit 21C during RY11–RY12 (Table 2). On average, 7.5 residents per year were successful during this period, whereas 8.8 resident hunters per year successfully harvested moose during RY96–RY10. Success for all hunters was 49% during RY96–RY10 and averaged 39% during RY11–RY12. Overall, success rates were typical for Interior Alaska and probably due to relatively low hunter numbers and concentrations of moose along the river corridors in September.

Harvest Chronology. Moose were harvested throughout the season, and most harvest consistently occurred during the second half of September (Table 4).

Transport Methods. While boats were used by moose hunters in Unit 21C, 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. Predation has probably influenced moose population status in the past (Gasaway et al. 1992) and is likely still a factor in maintaining low moose densities. Wolf and bear harvests were low (<5 annually) because hunter access is limited.

CONCLUSIONS AND RECOMMENDATIONS

Human use of moose has remained low, and recent harvest levels can likely be sustained.

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 largely within the limited option for fire management, allowing 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 a unitwide population estimate to serve as reference point for future analyses of harvest and population status.

During RY11 and RY12, the management objective to maintain ≥20% large bulls (bulls with antlers 60 inches wide or greater) in the harvest was not met. 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.

Management goals and objective are not consistent with the level of management focus that Unit 21C receives, given current priorities in the Galena management area. Therefore, the management goal and objective for the next reporting period will be adjusted to the following.

MANAGEMENT GOAL

- Provide a sustained opportunity to participate in hunting moose.

MANAGEMENT OBJECTIVE

- Maintain a 5-year running average harvest of ≥15 bulls/year.

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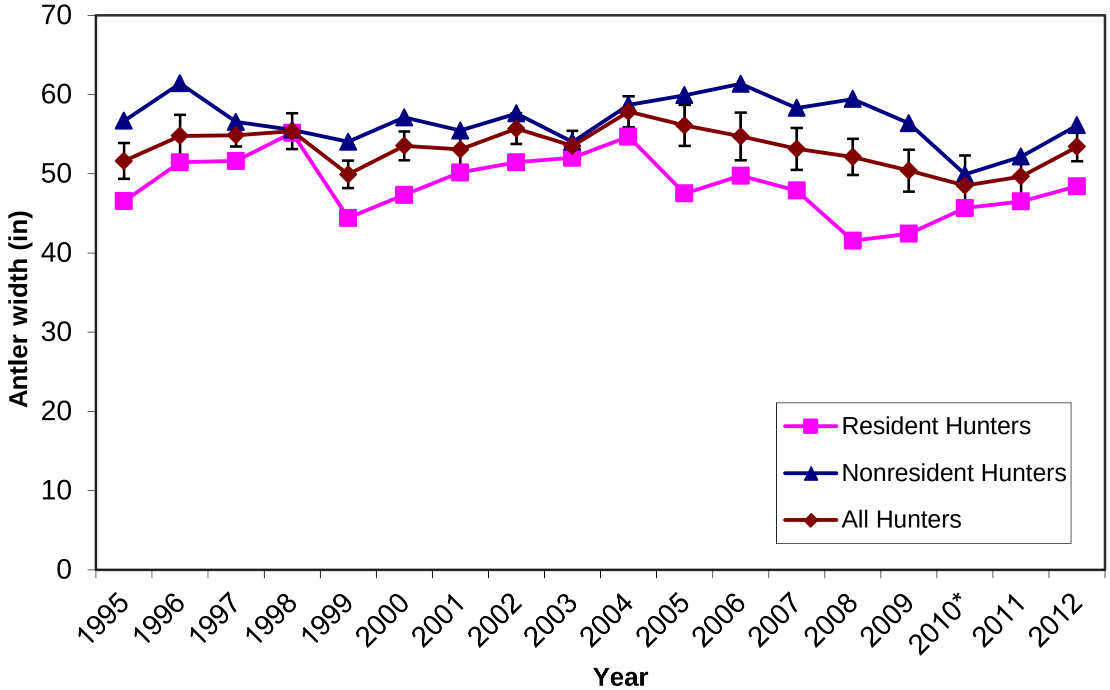

Figure 1. Average bull moose antler spread by hunter residency, Unit 21C, Alaska, fall 1995–fall 2012. Error bars represent ± one standard error.

* = Sublegal bull included in nonresident harvest.

Table 1. Unit 21C, Cottonwood Creek and Dulbi River portion, moose population estimate, Alaska, regulatory year[a] 2010.

Unit/Regulatory year	Area mi^2	Bulls:100 Cows	Calves:100 Cows	Yearling bulls:100 Cows	Percent calves	Adults	Population estimate (90% CI[b])	Density ($moose/mi^2$)
Unit 21C – partial area								
2010[c]	700	92	31	13	13	277	323 (±27%)	0.46

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory 2010 = 1 July 2010–30 June 2011).
[b] Confidence interval (% ±).
[c] Geospatial population estimator analysis without sightability correction factor (observable moose).

Table 2. Unit 21C moose hunter residency and success, Alaska, regulatory years[a] 1996–2012.

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total	Total hunters
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
2011	0	7	7	0	14 (37)	0	15	7	2	24	38
2012	1	7	12	0	20 (41)	0	12	17	0	29	49

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1996 = 1 July 1996–30 June 1997).
[b] Local resident resides in Units 21C or 21B.

Table 3. Unit 21C, outside Koyukuk controlled use area, moose harvest by permit hunt, Alaska, regulatory years[a] 2004–2012.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM812	2004	20	67	33	70	4 (100)	0 (0)	0	4
	2005	20	50	50	80	2 (100)	0 (0)	0	2
	2006	20	0	100	95	0 (0)	0 (0)	0	0
	2007	29	0	100	97	0 (0)	0 (0)	0	0
	2008	31	60	40	68	6 (100)	0 (0)	0	6
	2009	26	60	40	62	6 (100)	0 (0)	0	6
	2010	28	100	0	86	4 (100)	0 (0)	0	4
	2011	25	33	67	60	3 (100)	0 (0)	0	3
	2012	44	67	33	73	8 (100)	0 (0)	0	8
RM834	2004	4	0	100	0	0 (0)	0 (0)	0	0
	2005	0							
	2006	2	0	100	0	0 (0)	0 (0)	0	0
	2007	4	25	75	0	1 (100)	0 (0)	0	1
	2008	3	33	67	0	1 (100)	0 (0)	0	1
	2009	2	0	100	0	0 (0)	0 (0)	0	0
	2010	0							
	2011	0							
	2012	1	100	0	0	1 (100)	0 (0)	0	1

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).

Table 4. Unit 21C moose harvest chronology percent by month/day, Alaska, regulatory years[a] 1995–2012.

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
2011	36	29	21	14	14
2012	20	30	35	15	20

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1995 = 1 July 1995–30 June 1996).

Table 5. Unit 21C moose harvest percent by transport method, Alaska, regulatory years[a] 1995–2012.

Regulatory year	Harvest percent by transport method							
	Airplane	Horse	Boat[b]	3- or 4-wheeler	Snowmachine	ORV	Unknown	*n*
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
2011	57	0	43	0	0	0	0	14
2012	70	0	25	0	0	5	0	20

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1995 = 1 July 1995–30 June 1996).
[b] Includes airboats.

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CHAPTER 30: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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, Alaska Department of Fish and Game [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 (TCA) 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 may contain 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. Since 2001 there were fluctuations in the abundance of moose, due to stochastic changes in productivity and survival, but no clear trend in the recent trajectory of the population is apparent.

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. Those local residents often traveled as much as 100 miles up the Koyukuk River in the 1980s–2000s, until fuel prices began to restrict travel in the 2000s–2010s. Nonlocal hunters using Unit 21D mostly concentrated their hunting activities within 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 the logistics of accessing the area.

Since 1983, the department has operated a hunter checkstation on the Koyukuk River, 15 miles upstream from the village of Koyukuk. In 1990 the Koyukuk River checkstation became a mandatory stop for all hunters. The checkstation enables accurate determination of the number of hunters using the river to access the Koyukuk controlled use area (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. In 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 destruction disincentives or limited drawing permit hunts.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Management was directed according to the following management goals and objectives during this reporting period.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

OBJECTIVE 1: Maintain a moose population of 9,000–10,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

OBJECTIVE 2: Provide for a harvest of moose not to exceed 700 moose or 7% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 21D.

OBJECTIVE 3: Provide for moose hunting opportunity not to exceed 950 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

OBJECTIVE 1: In combination with Unit 24, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

OBJECTIVE 1: 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) 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 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).

No new population estimation surveys were completed in Unit 21D since the 2012 management report (Stout 2012a).

The regulatory year (RY) 2011 (RY begins 1 July and ends 30 June; e.g., RY11 = 1 July 2011 through 30 June 2012) and RY12 moose population estimates are based on previously reported values (Stout 2012a), RY11–RY13 trend count surveys, and RY10–RY11 GSPE surveys. I developed the RY13 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 2004–2013 TCA data (Stout 2010). For those areas that did not have survey data, I used recent density estimates from GSPE 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 included results of GSPE surveys and TCA surveys. Moose in 6 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). TCA surveys were not conducted in RY12 due to poor survey conditions.

Guidelines reported by Franzmann and Schwartz (1998) were used to interpret sex and age indices as reported in Stout (2010).

Twinning Surveys

Beginning in 1990, 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. Our goal was to observe at least 50 cows with calves (Boertje et al. 2007), 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 registration and drawing permit reports, door-to-door subsistence surveys, and a hunter checkstation on the Koyukuk River. 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, sex of animal harvested, method and location of harvest, harvest chronology, and transportation used. Harvest reports were collected from most hunters at the checkstation. Additional data collected at the checkstation included time in the field, hunting party size, age structure of harvest (tooth extraction), department-measured antler size, a more precise location of harvest (when needed), and caliber of firearm used. Moose ages were determined by counting cementum annuli of the lower incisors from hunter harvested bull moose (Gasaway et al. 1978, Matson et al. 1993). Harvest data were summarized by regulatory year.

We evaluated meat salvage to measure success in meeting objectives under goals 3 and 4 (Stout 2012a). 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Overall, the moose population trend counts during RY11–RY12 showed a generally stable index to abundance in Unit 21D over recent years (Tables 1–6) as previously described (Stout 2010). Density estimates in the western Galena GSPE analysis area 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 estimates for individual drawing hunt areas in Unit 21D, I estimated a Unit 21D population of 8,611 observable moose in RY11 (Table 8). This estimate did not change for RY13 because no GSPE surveys were conducted. 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 ($P = 0.08$; 95% CI, 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. TCA surveys were not conducted in RY12 due to poor survey conditions. Most TCAs had moderate calf:cow ratios in RY11 but low ratios in RY13. The decline to 10–21 calves:100 cow in RY09 followed the severe winter of 2008–2009.

The 2011 GSPE survey data indicated 32 bulls:100 cows, well above the minimum needed for adequate productivity. TCA data in RY11 also indicated stable bull:cow ratios; however, yearling bull:cow ratios were low in some areas. Bull:cow ratios continue to vary widely among TCAs (Tables 1–6). Most TCAs indicated stable parameters through the 2000s, but a decline in RY13 (Fig. 2), particularly in the northern TCAs of Unit 21D. The Koyukuk controlled use area "Core-5" dropped below 30 bulls:100 cows in RY13, for the first time since RY06, likely due to the poor cohorts of 2008 and 2009. Only in the Kaiyuh Slough TCA were calf:cow and yearling bull:cow ratios high and stable in RY11 and RY13.

Moose twinning rates in 2011–2012 (33% Three Day Slough, 41% Pilot Mountain and Kaiyuh Slough) suggest above average nutritional status (Boertje et al. 2007) and productivity in the Three Day Slough, Pilot Mountain Slough and Kaiyuh Slough 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, 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. Seasons and bag limits in Unit 21D during RY11 and RY12 were as follows:

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 21D, that portion within the Koyukuk controlled use area		
RESIDENT HUNTERS:		
1 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

Alaska Board of Game Actions and Emergency Orders. No changes were adopted by the Alaska Board of Game (board) during RY09–RY12 and no emergency orders were issued.

Unit 21D has a positive finding for intensive management (IM). The Unit 21D objectives in Title 5 Alaska Administrative Code, regulation 92.108 during RY11–RY12 were as follows:

Population Objective	Harvest Objective
7,000–10,000 moose	450–1,000

Harvest by Hunters. Harvest of moose in Unit 21D during RY09–RY12 was stable (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 relative to harvestable surplus in the Koyukuk River mouth and Pilot Mountain Slough areas was still high and likely suppressed bull:cow ratios in those areas. No cows were reported harvested during RY11–RY12, due to elimination of all antlerless moose seasons in the Unit 21D. However, illegal cow harvest continued to occur during winter. Potlatch, stickdance, and ceremonial moose harvest also included cows.

During RY09–RY13, most harvest in Unit 21D ($\bar{x}$ = 70%) was in the Koyukuk River drainage (northern Unit 21D, Table 14). In contrast, during RY05–RY07 harvest in the Koyukuk River drainage averaged 58%, with a low of 53% in RY06.

Koyukuk River Checkstation Results. 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 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 hunter contact at the checkstation.

Total success rates in the Koyukuk CUA were stable at $\bar{x}$ = 52% during RY11–RY12. Harvest success in the fall hunt during RY02–RY12 was high for nonlocal residents ($\bar{x}$ = 55%) and nonresidents ($\bar{x}$ = 71%), but local resident success was lower ($\bar{x}$ = 38%). 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 RY02–RY06 due to low bull:cow ratios compared to the recent (RY07–RY13) average ($\bar{x}$ = 51%; Table 13).

The Koyukuk CUA area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. During RY11 and RY12, 54% and 52% of the harvested bulls measured were large, respectively and 40% of the bulls counted in TCAs were large in RY11. Of the bulls observed in the Koyukuk CUA TCAs completed during RY03–RY13, 31% had large antlers (Table 15). During RY03–RY13, 48% of the harvested bulls measured in Koyukuk CUA permit hunts had large antlers.

Meat evaluation surveys conducted at the checkstation indicated meat care was generally very good with an average overall score of 4.9 in RY11 and 4.7 in RY12 (Table 16), with little change since RY05. In RY11 and RY12, 0 hunters were given average overall scores of less than 3. In general, meat scores stabilized at a high level. The number of days hunters kept their meat in the field increased to 2.9 days in RY12 and 3.0 days in RY13.

Permit Hunts. The subsistence registration permit (RM832) was the permit used most by resident Alaskans to hunt within the Koyukuk CUA and antler destruction was required. The number of RM832 permits issued during RY02–RY13 varied less than 19% of average (Table 17). Registration permit use among local residents was relatively stable, while use of the permit by other Alaska residents declined during RY99–RY07 then gradually increased from RY09 through RY13. With implementation of drawing hunts in the remainder of Unit 21D, hunter numbers were better regulated and distribution of hunters improved (Table 18). 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 19; Stout 2012a). Harvest and hunter participation by Unit 21D residents during RY96–RY02 was relatively constant (Andersen et al. 1998).

Unit 21D local hunter success rates were 31% in RY11 and 33% in RY12. Local hunter success rates were low (RY02–RY12; $\bar{x}$ = 32%; Table 19) compared to RY90–RY99, when success rates averaged 59% (Stout 2010). Success rates for nonlocal resident (RY90–RY99; $\bar{x}$ = 67% vs. RY01–RY10; $\bar{x}$ = 44%) and nonresident (RY90–RY99; $\bar{x}$ = 68% vs. RY01–RY10; $\bar{x}$ = 45%) hunters followed similar trends.

Harvest Chronology. There were no apparent changes in harvest chronology during RY11–RY12 (Table 20). 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 (Andersen et al. 1998).

Transportation Methods. The presence of the Koyukuk CUA and the area's extensive river system made boats the primary transportation method during RY11–RY12 (Table 21). Snowmachines were the main transportation 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 assessments were conducted during RY11–RY12. 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 did not change the 2012 estimate of 8,611 (with 15% presumed relative error of ±1,300 moose) observable moose in Unit 21D from the previous reporting period. During this reporting period, the Unit 21D population may have increased slightly south of the Yukon River, but numbers were stable in northern Unit 21D based on GSPE and TCA surveys. 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, shows that low intensity surveys conducted in the intervening years of infrequent, high-intensity surveys provides accurate composition and population estimates, yet the confidence intervals for all survey years were improved (Stout 2012b). This strategy provided managers with better decision-making information for the overall population than TCA composition data alone. Since 2003, high productivity as a result of increased twinning rates was likely an important factor in stabilizing the population in Unit 21D.

The key management issues facing Unit 21D during RY11–RY12 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 objectives of 9,000–10,000 observable 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 observable moose (±1,300) in Unit 21D did not likely meet our management objective of 9,000–10,000 observable moose. However, the IM population objective of 7,000–10,000 moose was likely achieved. Analysis of RY11 and RY13 TCA data indicated poor recruitment in northern Unit 21D, but good recruitment in the southern Unit 21D. 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 RY12 at 406 moose including the estimate of unreported harvest (4.1–5.6% of the estimated population of 8,611). However, the IM annual harvest objective of 450–1,000 moose was not achieved in RY11 or RY12. The objective to provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year, was achieved with a total of 739 hunters in RY11 and 721 hunters in RY12.

The long-term objective to implement at least 2 habitat enhancement activities was not achieved during RY08–RY12. We will continue to encourage land managers to liberalize fire management options and implement habitat enhancement activities.

In RY11 and RY12 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 (0.0% in RY11, 0.0% in RY12), and the average number of days hunters stayed in the field with their meat was less than 2.9 days. Therefore, the meat care objective was met.

Finally, we discontinued our program to monitor and evaluate the number of people engaged in nonconsumptive activities due to poor public participation.

MANAGEMENT OBJECTIVES

Activity 2 of Goal 1, Objective 2 will be removed in the next reporting period. Funding and methods to accomplish monitoring social and environmental impacts on private lands are unlikely to be available in the foreseeable future.

Objective 1 of Goal 2 will be removed in the next reporting period. There have been no habitat enhancement projects in Units 21D or 24 and it is unlikely that resources will be available to do so in the foreseeable future.

Objective 1 of Goal 4 will be removed in the next reporting period due to poor public participation and interest.

Therefore, management goals, objectives, and activities for the next reporting period are as follows:

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

OBJECTIVE 1: Maintain a moose population of 9,000–10,000 observable moose.

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: Develop programs to improve moose population and harvest data in Unit 21D.

OBJECTIVE 3: Provide for moose hunting opportunity not to exceed 950 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

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.

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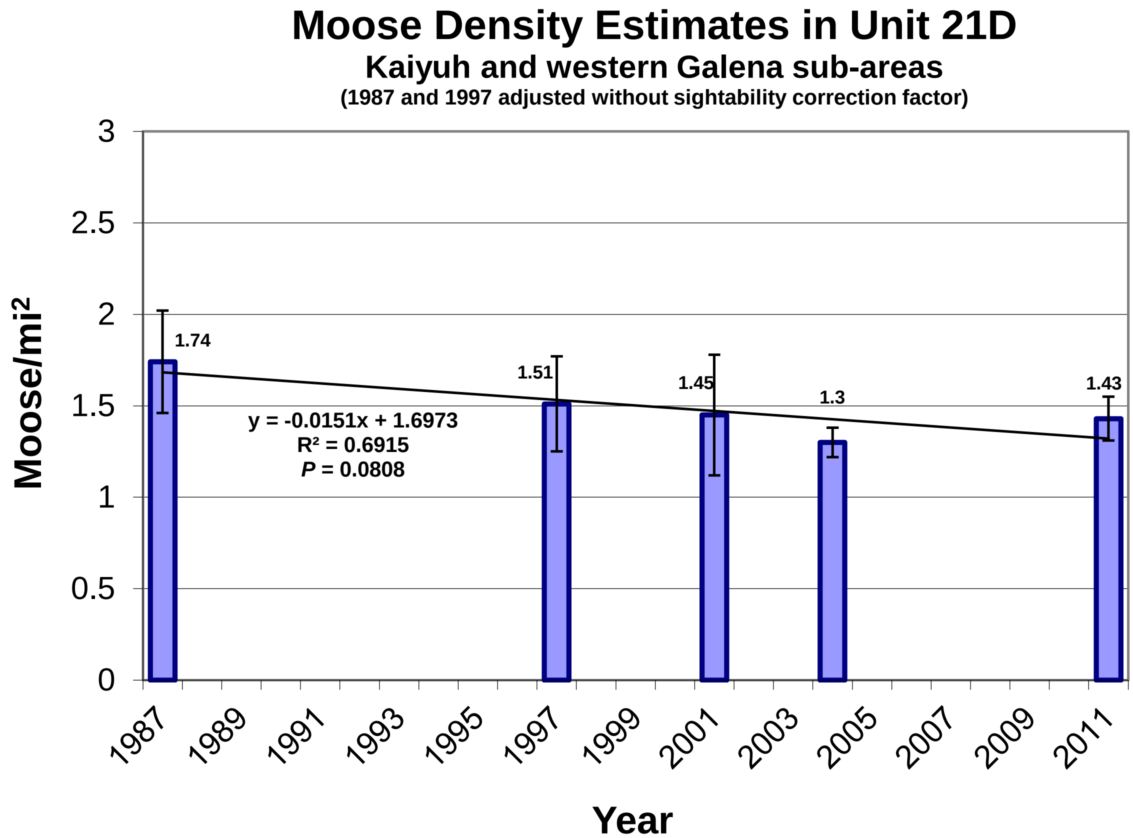

Figure 1. Moose density estimates and regression analysis based on 5 population estimation surveys. The 1987 estimate was calculated using MOOSEPOP; 1997 was a regression analysis estimate; and 2001, 2004, and 2011 were geospatial population estimates. All values presented do not include sightability 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. Error bars are 90% CI, regression equation 95% CI.

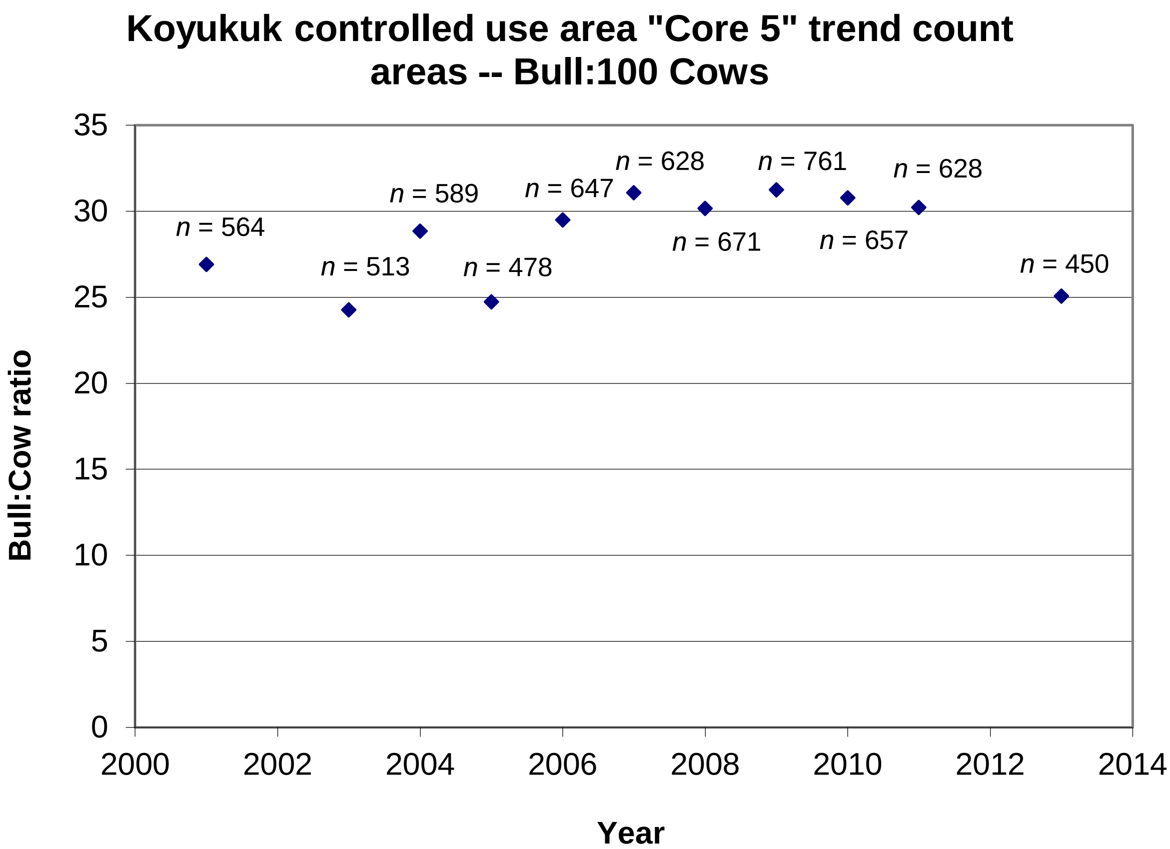

Figure 2. Cumulative bull:100 cow ratio for the Koyukuk controlled use area that includes the 5 aerial trend count survey areas surveyed each year since 2001. These "Core 5" trend count areas are the Three Day Slough, Dulbi River mouth, and Koyukuk River mouth trend count areas in Unit 21D, and the Treat Island and Huslia Flats trend count areas in Unit 24 (Stout 2014, *In prep*).

Table 1. Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years[a] 2003–2013[b].

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
2003[c]	160.4	17	7	21	8	15	846	5.3
2004[c]	193.6	22	9	23	8	16	935	4.8
2005[c]	193.6	21	5	21	6	15	863	4.5
2006[d]	193.6	25	5	40	12	24	1177	6.1
2007[c]	193.6	30	10	34	7	21	967	5.0
2008	193.6	28	8	19	5	13	1270	6.6
2009[c]	193.6	26	8	13	2	9	1151	5.9
2010	193.6	31	4	26	3	17	1148	5.9
2011	193.6	31	11	23	5	15	921	4.8
2013	193.6	21	4	17	3	12	794	4.1

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Beginning in regulatory year 2001, geospatial population estimator sample units replaced Gasaway units (Stout 2004).
[c] Late survey (after 21 November).
[d] Low snow year.

Table 2. Unit 21D Dulbi River mouth trend count area aerial moose composition counts, regulatory years[a] 2003–2013[b].

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
2003	116.7	17	6	23	5	17	411	3.5
2004	122.0	21	6	40	7	25	406	3.3
2005	122.0	18	8	23	4	16	333	2.7
2006	116.7	24	6	32	8	21	403	3.5
2007	116.7	36	13	47	11	26	454	3.9
2008	116.7	33	12	32	5	19	505	4.3
2009	116.7	36	11	16	6	11	534	4.6
2010	116.7	24	2	32	8	19	414	3.6
2011	111.1	24	7	29	3	19	506	4.4
2013	111.1	25	7	13	0	10	365	3.3

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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[a] 2003–2013[b].

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
2003	118.8	25	11	35	6	22	521	4.4
2004	118.8	33	15	47	12	24	551	4.6
2005	118.8	24	10	38	7	24	443	3.7
2006	118.8	21	7	25	8	17	457	3.9
2007	118.8	23	7	46	9	27	528	4.5
2008	118.8	32	16	38	7	22	427	3.6
2009	118.8	32	14	13	0	9	478	4.0
2010	118.8	23	3	27	10	18	493	4.2
2011	118.8	20	5	24	1	17	503	4.2
2013	118.8	23	9	11	0	8	450	3.8

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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[a] 2003–2013[b].

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
2003	96.6	32	8	25	23	16	242	2.5
2004	102.3	44	14	45	9	24	248	2.4
2005	90.9	32	7	23	9	15	252	2.8
2006	90.9	35	4	35	3	21	164	1.8
2007	96.6	45	17	29	11	17	248	2.6
2008	96.6	45	14	20	7	12	252	2.6
2009	90.9	34	10	17	0	12	278	2.9
2010	90.9	25	5	42	18	25	289	3.2
2011	96.6	24	7	37	12	23	288	3.0
2013	96.6	39	11	30	3	18	205	2.1

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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[a] 2003–2013[b].

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
2003	91.0	13	10	48	11	30	342	3.8
2004	91.0	10	3	41	12	27	377	4.1
2005	102.4	19	7	54	11	31	365	3.6
2006	91.0	16	8	31	15	21	326	3.6
2007	91.0	15	7	40	9	26	409	4.5
2008	91.0	15	7	31	7	21	354	3.9
2009	91.0	12	3	21	6	16	345	3.8
2010	91.0	17	2	48	5	29	466	5.1
2011	91.0	18	9	30	9	25	563	6.2
2013	91.0	23	8	23	12	16	472	5.2

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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[a] 2003–2013[b].

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
2003	178.0	55	19	38	14	20	204	1.2
2004	229.8	53	18	52	25	25	252	1.1
2005	229.8	66	18	29	0	15	180	0.8
2006	126.3	42	5	21	5	13	171	1.4
2007	126.3	45	7	27	7	16	190	1.5
2008	126.3	59	8	47	19	23	136	1.1
2009	126.3	50	12	10	0	6	180	1.4
2010	126.3	44	11	52	9	26	190	1.5
2011	126.3	45	19	56	20	28	261	2.1
2013	126.3	51	19	43	15	22	274	2.2

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] 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[a] 1987–2011.

Area/Regulatory year	Area mi^2	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Percent calves	Adults	Population estimate (90% CI[b])	Density (moose/mi^2)
Unit 21D–Kaiyuh Flats								
1987[b]	1,582	60.6	46.4	15.0	22.4	1,389	1,790±18%	1.13
1997[c]	1,582	42.3	28.4	13.0	16.6	1,113	1,335±17%	0.84
2001[d]	1,843	44.5	22.1	8.8	13.4	1,558	1,800±32%	0.98
2004[d]	1,843	35.1	43.3	12.2	24.7	1,119	1,487±10%	0.81
2011[d]	1,843	30.5	38.6	10.4	22.9	1,463	1,897±11%	1.03
Unit 21D–Western Galena								
1987[b]	1,508	36.7	38.2	12.4	21.8	3,220	4,118±14%	2.73
1997[c]	1,508	31.3	32.1	8.0	19.6	2,612	3,250±12%	2.15
2001[d]	1,734	26.6	17.1	6.4	12.0	2,995	3,403±19%	1.96
2004[d]	1,841	26.2	36.2	10.5	22.3	2,564	3,299±5%	1.79
2011[d]	1,841	29.0	25.0	8.8	16.3	2,811	3,360±7%	1.83
Unit 21D–Yuki River–Bear Creek								
2010[d]	3,516	64.3	27.4	9.9	14.5	1,477	1,727±14%	0.49
Unit 24D–Upper Koyukuk								
2001[d]	1,949	35.0	17.6	6.1	11.4	3,228	3,642±16%	1.87
2004[d]	1,843	32.7	33.9	12.6	20.4	2,531	3,181±5%	1.73
2011[d]	1,843	38.4	23.4	9.2	14.4	2,249	2,627±8%	1.43
Total Area								
1987[b]	3,090	43.1	40.4	13.1	6.7	4,609	5,908±15%	1.91
1997[c]	3,090	34.4	31.1	9.4	17.8	3,725	4,585±14%	1.48
2001[d]	5,526	33.4	18.3	6.7	12.0	7,849	8,924±13%	1.62
2004[d]	5,527	30.4	36.5	11.6	18.2	6,514	7,967±4%	1.44
2011[d]	5,527	32.4	27.6	9.3	17.3	6,524	7,885±4%	1.43

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1987 = 1 July 1987–30 June 1988).
[b] Gasaway survey, MOOSEPOP analysis estimate (Woolington 1998), with sightability correction factor.
[c] Gasaway survey, regression analysis estimate, with sightability correction factor.
[d] Geospatial population estimation survey, without sightability correction factor.

Table 8. Unit 21D moose population estimate by drawing hunt areas, regulatory year[a] 2013[b].

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)[c]

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2013 = 1 July 2013–30 June 2014).
[b] Population estimates for each permit area were a combination of population estimation survey data, trend count survey data, and extrapolation data to varying degrees.
[c] 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[a] 2002–2011.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Dates in May
2002	18	37	14	27	21	27,28
2003	44	35	25	42	31	26,27
2004[c]	77	27	16[d]	37	25	24–27
2005	118	26	24	48	62	25–27
2006	65	33	12	27	33	25–27
2007	49	40	23	37	43	25–27
2008	119	39	10	20	29	26–28
2009	69	32	19	37	26	26–28,30
2010	59	33	17	34	34	25–27
2011	74	39	19	33	28	26–28

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Percent of cows with calves that had 2 or more calves.
[c] Extensive flooding and early leaf-out, survey conditions difficult.
[d] Including 1 cow with 3 calves.

Table 10. Unit 21D moose aerial twinning surveys in the Pilot Mountain Slough to Kaiyuh Slough trend count areas, regulatory years[a] 2003–2011[b].

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[c]	Yearlings	Dates in May
2003	52	32	18	36	28	24,25
2004	63	26	31	54	12	24–26
2005	86	32	20	38	29	25,26
2006	69	29	18	38	35	22–26
2007	76	30	22	42[d]	7	23,24,29
2008	69	27	20	43	14	26–28
2009	60	34	19	36	18	28,29
2010	50	39	17	30	13	27
2011	94	30	21	41	13	24–26, 29

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] U.S. Fish and Wildlife Service data.
[c] Percent of cows with calves that had twins.
[d] Including 1 cow with 3 calves.

Table 11. Unit 21D moose harvest, regulatory years[a] 2002–2013.

Regulatory year	Harvest by hunters				Unreported harvest[b]	Potlatch/ Stickdance[c]	Total
	Bull	Cow	Unk	Total			
2002	316	10	0	326	150	13	489
2003	310	9	1	320	150	14	484
2004	227	0	0	227	150	12	389
2005	218	0	0	218	150	13	381
2006	211	0	0	211	150	17	378
2007	204	1	0	205	150	25	380
2008	263	0	0	263	150	9	422
2009	244	0	0	244	150	17	411
2010	286	0	0	286	125	12	423
2011	285	0	2	287	125	15	427
2012	267	0	0	267	125	14	406
2013[d]	274	0	1	275	125	13	413

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Unreported harvest based on ADF&G-Division of Subsistence door-to-door survey and other sources.
[c] Includes all potlatch, stickdance, ceremonial and cultural permit harvest.
[d] Preliminary data.

Table 12. Koyukuk River checkstation moose harvest, regulatory years[a] 2002–2013[b].

Regulatory year	Bull	Cow	% Cow	Total
2002	217	0	0	217
2003	248	0	0	248
2004	153	0	0	153
2005	147	0	0	147
2006	164	1	1	167[c]
2007	157	1	1	158
2008	201	0	0	201
2009	223	0	0	223
2010	237	0	0	238[c]
2011	242	0	0	242
2012	230	0	0	230
2013	261	0	0	261

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Moose harvested in Units 21D and 24.
[c] Includes moose of unknown sex.

Table 13. Koyukuk River checkstation[a,b] moose hunter residency and success, regulatory years[c] 2002–2013.

Regulatory	Local resident[d]		Nonlocal resident[e]		Nonresident		Total	
year	Hunter	Moose	Hunter	Moose	Hunter	Moose	Hunter	Moose
2002	215	70	219	130	24	18	458	218
2003	230	80	274	148	40	20	544	248
2004	255	74	158	75	7	4	420	153
2005	261	73	174	68	7	6	442	147
2006	265	92	139	67	9	8	413	167
2007	212	78	122	70	8	8	342	156
2008	209	98	138	92	14	11	361	201
2009	247	110	181	104	14	9	442	223
2010	255	100	203	120	26	13	484	233
2011	204	95	211	134	21	13	436	242
2012	249	110	199	104	22	16	470	230
2013	276	101	227	144	18	16	521	261

[a] Includes hunters reporting in both Units 21D and 24.
[b] Includes hunters reporting at Huslia.
[c] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[d] Local residents of Units 21B, 21D and 24
[e] 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, regulatory years[a] 2002–2013.

Regulatory year	Percent harvest: Northern Unit 21D	Percent harvest: Southern Unit 21D	Total harvest
2002	68	32	318
2003	79	21	313
2004	70	30	192
2005	59	41	218
2006	53	47	211
2007	63	37	201
2008	66	34	258
2009	71	29	238
2010	69	31	283
2011	70	30	283
2012	68	32	260
2013[b]	72	28	274

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] 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[b] 2002–2013.

Regulatory year	% Harvested (Sep)	Number measured (Sep)	% Counted (Nov)[c]	Number counted (Nov)[c]
2002	46	97	–[d]	–[d]
2003	58	108	25	513
2004	42	138	19	589
2005	46	120	33	478
2006	53	125	27	647
2007	47	115	30	628
2008	41	156	25	671
2009	38	180	28	761
2010	50	205	36	657
2011	54	204	40	628
2012	52	190	–[d]	–[d]
2013	51	208	42	450

[a] Fifty-inch or greater antler spread.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[c] Data includes Huslia Flats and Treat Island trend count areas (Stout 2012b).
[d] No survey.

Table 16. Overall scores for meat evaluation at Koyukuk River checkstation, regulatory years[a] 2002–2013.

Regulatory year	Avg no. days hanging	Avg clean score[b]	Avg dry score[b]	Avg smell score[b]	Avg overall score[b]	% Hunters scoring <3	Sample size (n)
2002	3.3	4.3	4.3	n/a	4.3	4.4	184
2003	3.3	4.2	4.4	4.8	4.2	4.5	199
2004	2.6	4.3	4.8	4.8	4.6	1.1	96
2005	2.7	4.8	4.8	4.8	4.8	0.0	95
2006	2.6	4.8	4.8	4.8	4.8	0.0	90
2007	2.4	4.4	4.5	4.8	4.6	0.0	84
2008	2.6	4.6	4.9	5.0	4.9	0.0	118
2009	2.6	4.6	4.8	4.9	4.8	0.7	140
2010	2.7	4.6	4.8	4.8	4.7	2.0	148
2011	2.6	4.4	4.8	4.9	4.7	0.0	158
2012	3.0	4.5	4.6	4.8	4.7	0.7	140
2013	2.9	4.6	4.8	4.9	4.9	0.0	164

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Subjective ranking scale of 1–5, with a score of 1 being lowest.

Table 17. Units 21D and 24 Koyukuk controlled use area moose harvest by permit hunt, regulatory years[a] 2002–2013[b].

Hunt	Regulatory year	Permits issued	Percent successful hunters[c]	Percent unsuccessful hunters[c]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	2002	359	49	51	17	145 (100)	0 (0)	0	145
	2003	401	45	55	12	155 (99)	0 (0)	2	157
	2004	399	38	62	8	141 (100)	0 (0)	0	141
	2005	411	37	63	9	132 (100)	0 (0)	0	132
	2006	382	42	58	7	142 (99)	0 (0)	1	143
	2007	349	41	59	8	131 (100)	0 (0)	0	131
	2008	341	53	47	6	168 (99)	1 (1)	0	169
	2009	429	48	52	9	187 (100)	0 (0)	0	187
	2010	418	47	53	7	181 (100)	0 (0)	1	182
	2011	405	47	53	9	174 (100)	0 (0)	0	174
	2012	394	48	52	7	174 (100)	0 (0)	1	175
	2013[d]	469	46	54	6	204 (100)	0 (0)	0	204
DM823	2005	2	100	0	0	2 (100)	0 (0)	0	2
	2006	2	50	50	0	1 (100)	0 (0)	0	1
	2007	2	100	0	0	2 (100)	0 (0)	0	2
	2008	4	75	25	0	3 (100)	0 (0)	0	3
	2009	4	100	0	0	4 (100)	0 (0)	0	4
	2010	7	29	71	0	2 (100)	0 (0)	0	2
	2011	7	43	57	0	3 (100)	0 (0)	0	3
	2012	6	100	0	17	5 (100)	0 (0)	0	5
	2013[d]	6	83	17	0	5 (100)	0 (0)	0	5
DM825	2005	3	100	0	33	2 (100)	0 (0)	0	2
	2006	4	100	0	0	4 (100)	0 (0)	0	4
	2007	4	100	0	0	4 (100)	0 (0)	0	4
	2008	6	100	0	33	4 (100)	0 (0)	0	4
	2009	4	50	50	0	2 (100)	0 (0)	0	2
	2010	7	86	14	0	6 (100)	0 (0)	0	6
	2011	7	83	17	0	5 (100)	0 (0)	0	5
	2012	6	100	0	0	6 (100)	0 (0)	0	6
	2013[d]	6	100	0	17	5 (100)	0 (0)	0	5

Hunt	Regulatory year	Permits issued	Percent successful hunters[c]	Percent unsuccessful hunters[c]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM827	2002	20	69	31	35	9 (100)	0 (0)	0	9
	2003	26	37	63	19	7 (100)	0 (0)	0	7
	2004	5	75	25	20	3 (100)	0 (0)	0	3
	2005	3	100	0	33	2 (100)	0 (0)	0	2
	2006	3	100	0	66	1 (100)	0 (0)	0	1
	2007	3	100	0	66	1 (100)	0 (0)	0	1
	2008	4	50	50	50	1 (100)	0 (0)	0	1
	2009	4	50	50	50	1 (100)	0 (0)	0	1
	2010	7	17	83	14	1 (100)	0 (0)	0	1
	2011	7	75	25	43	3 (100)	0 (0)	0	3
	2012	6	17	83	0	1 (100)	0 (0)	0	1
	2013[d]	6	75	25	33	3 (100)	0 (0)	0	3
DM828	2002	79	55	45	56	17 (100)	0 (0)	0	17
	2003	103	60	40	48	27 (100)	0 (0)	0	27
	2004	20	57	43	55	4 (100)	0 (0)	0	4
	2005	20	44	56	55	4 (100)	0 (0)	0	4
	2006	20	60	40	50	6 (100)	0 (0)	0	6
	2007	20	80	20	75	3 (75)	1 (25)	0	4
	2008	32	56	44	50	9 (100)	0 (0)	0	9
	2009	32	69	31	50	11 (100)	0 (0)	0	11
	2010	54	65	35	43	20 (100)	0 (0)	0	20
	2011	54	75	25	48	21 (100)	0 (0)	0	21
	2012	47	60	40	36	18 (100)	0 (0)	0	18
	2013[d]	48	52	48	52	12 (100)	0 (0)	0	12
DM829	2002	20	100	0	45	11 (100)	0 (0)	0	11
	2003	26	62	38	12	13 (100)	0 (0)	0	13
	2004	5	33	67	40	1 (100)	0 (0)	0	1
	2005	2	0	100	50	0 (0)	0 (0)	0	0
	2006	2	100	0	0	2 (100)	0 (0)	0	2
	2007	2	100	0	0	2 (100)	0 (0)	0	2
	2008	4	75	25	0	3 (100)	0 (0)	0	3
	2009	4	50	50	0	2 (100)	0 (0)	0	2
	2010	7	67	33	14	4 (100)	0 (0)	0	4

Hunt	Regulatory year	Permits issued	Percent successful hunters[c]	Percent unsuccessful hunters[c]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2011	7	50	50	43	2 (100)	0 (0)	0	2
	2012	6	75	25	33	3 (100)	0 (0)	0	3
	2013[d]	6	100	0	50	3 (100)	0 (0)	0	3
DM830	2002	79	84	16	38	41 (100)	0 (0)	0	41
	2003	103	76	24	36	44 (100)	0 (0)	0	44
	2004	20	57	43	60	4 (100)	0 (0)	0	4
	2005	20	73	27	45	8 (100)	0 (0)	0	8
	2006	20	47	53	32	9 (100)	0 (0)	0	9
	2007	20	100	0	30	14 (100)	0 (0)	0	14
	2008	32	86	14	56	12 (100)	0 (0)	0	12
	2009	32	70	30	25	16 (100)	0 (0)	0	16
	2010	54	73	27	39	24 (100)	0 (0)	0	24
	2011	54	89	11	31	33 (100)	0 (0)	0	33
	2012	47	78	22	43	21 (100)	0 (0)	0	21
	2013[d]	47	88	12	32	28 (100)	0 (0)	0	28
Total	2002	557	54	46	27	223 (100)	0 (0)	0	223
	2003	659	50	50	22	246 (100)	0 (0)	2	248
	2004	449	38	62	13	153 (100)	0 (0)	0	153
	2005	461	40	60	15	150 (100)	0 (0)	0	150
	2006	433	44	56	12	165 (100)	0 (0)	1	166
	2007	400	46	54	13	157 (99)	1 (1)	0	158
	2008	423	56	44	14	200 (99)	1 (1)	0	201
	2009	511	51	49	13	223 (100)	0 (0)	0	223
	2010	557	50	50	14	238 (100)	0 (0)	1	239
	2011	541	53	47	16	241 (100)	0 (0)	0	241
	2012	512	51	49	13	228 (100)	0 (0)	1	229
	2013[d]	588	51	49	13	260 (100)	0 (0)	0	260

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] RM830 ended in regulatory year 2000 and was replaced by drawing hunts DM827, 828, 829, and 830.
[c] 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.
[d] Preliminary data.

Table 18. Unit 21D outside Koyukuk controlled use area moose harvest by permit hunt, regulatory years[a] 2004–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM814	2004	15	33	67	13	4 (100)	0 (0)	0	4
	2005	15	33	67	53	2 (100)	0 (0)	0	2
	2006	15	67	33	40	6 (100)	0 (0)	0	6
	2007	16	21	79	13	3 (100)	0 (0)	0	3
	2008	16	56	44	44	5 (100)	0 (0)	0	5
	2009	16	57	43	56	4 (100)	0 (0)	0	4
	2010	15	75	25	20	9 (100)	0 (0)	0	9
	2011	9	83	17	33	5 (100)	0 (0)	0	5
	2012	16	50	50	25	6 (100)	0 (0)	0	6
	2013[b]	18	63	38	55	5 (100)	0 (0)	0	5
DM815	2004	3	50	50	33	1 (100)	0 (0)	0	1
	2005	3	50	50	33	1 (100)	0 (0)	0	1
	2006	3	67	33	0	2 (100)	0 (0)	0	2
	2007	2	0	100	0	0 (0)	0 (0)	0	0
	2008	2	50	50	0	1 (100)	0 (0)	0	1
	2009	2	100	0	0	2 (100)	0 (0)	0	2
	2010	2	100	0	0	1 (100)	0 (0)	0	1
	2011	2	100	0	50	1 (100)	0 (0)	0	1
	2012	2	0	0	100	0 (100)	0 (0)	0	0
	2013[b]	2	100	0	0	2 (100)	0 (0)	0	2
DM816	2006	25	50	50	12	11 (100)	0 (0)	0	11
	2007	25	64	36	36	9 (100)	0 (0)	0	9
	2008	25	62	38	48	8 (100)	0 (0)	0	8
	2009	25	39	61	28	7 (100)	0 (0)	0	7
	2010	25	47	53	32	8 (100)	0 (0)	0	8
	2011	25	73	27	40	11 (100)	0 (0)	0	11
	2012	25	54	46	48	7 (100)	0 (0)	0	7
	2013[b]	25	64	36	44	9 (100)	0 (0)	0	9

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM817	2006	16	75	25	25	9 (100)	0 (0)	0	9
	2007	31	25	75	36	5 (100)	0 (0)	0	5
	2008	31	50	50	55	7 (100)	0 (0)	0	7
	2009	28	42	58	57	5 (100)	0 (0)	0	5
	2010	31	39	61	40	7 (100)	0 (0)	0	7
	2011	26	60	40	81	3 (100)	0 (0)	0	3
	2012	25	50	50	52	6 (100)	0 (0)	0	6
	2013[b]	15	17	83	60	1 (100)	0 (0)	0	1
DM818	2006	4	50	50	25	1 (100)	0 (0)	0	1
	2007	18	0	100	89	0 (0)	0 (0)	0	0
	2008	25	40	60	80	2 (100)	0 (0)	0	2
	2009	17	0	100	35	0 (0)	0 (0)	0	0
	2010	9	50	50	56	2 (100)	0 (0)	0	2
	2011	5	0	0	100	0 (0)	0 (0)	0	0
	2012	14	43	57	50	3 (0)	0 (0)	0	3
	2013[b]	8	75	25	0	6 (0)	0 (0)	0	6
DM819	2007	1	0	100	0	0 (0)	0 (0)	0	0
	2008	1	0	0	100	0 (0)	0 (0)	0	0
	2009	0	0	0	0	0 (0)	0 (0)	0	0
	2010	1	0	0	100	0 (0)	0 (0)	0	0
	2011	0	0	0	0	0 (0)	0 (0)	0	0
	2012	0	0	0	0	0 (0)	0 (0)	0	0
	2013[b]	0	0	0	0	0 (0)	0 (0)	0	0
DM820	2004	22	0	100	55	0 (0)	0 (0)	0	0
	2005	22	88	13	59	7 (100)	0 (0)	0	7
	2006	22	40	60	73	2 (100)	0 (0)	0	2
	2007	34	53	47	44	10 (100)	0 (0)	0	10
	2008	34	18	82	50	3 (100)	0 (0)	0	3
	2009	34	29	71	59	4 (100)	0 (0)	0	4
	2010	34	50	50	59	7 (100)	0 (0)	0	7
	2011	34	32	68	35	7 (100)	0 (0)	0	7

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2012	34	32	68	26	8 (100)	0 (0)	0	8
	2013[b]	34	41	59	50	7 (100)	0 (0)	0	7

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).
[b] Preliminary data.

Table 19. Unit 21D moose hunter residency and success, regulatory years[a] 2002–2013.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	
2002	108	171	47	0	326	133	171	19	1	324	650
2003	115	159	45	3	322	222	169	49	5	445	767
2004	127	88	11	1	227	334	166	44	1	545	772
2005	109	92	15	2	218	288	170	29	9	496	714
2006	114	82	15	0	211	252	129	10	1	392	603
2007	112	79	13	1	205	274	126	22	0	422	627
2008	141	112	10	0	263	268	106	18	1	393	656
2009	121	114	9	0	244	315	156	30	0	501	745
2010	126	143	17	0	286	297	146	24	0	467	754[c]
2011	117	155	16	0	288	256	180	14	1	451	740[c]
2012	116	137	20	0	273	239	181	28	0	448	721
2013[d]	99	161	17	0	277	288	163	7	2	460	739[c]

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Unit 21D and Ruby residents only.
[c] Includes unknown success hunters.
[d] Preliminary data.

Table 20. Unit 21D moose harvest chronology percent by month/day, regulatory years[a] 2002–2013.

Regulatory year	Harvest chronology percent by month/day 8/22–8/31	9/1–9/14	9/15–9/25	2/1–2/10	*n*
2002	4	30	61	5	313
2003	4	43	47	6	313
2004	2	40	58	0	212
2005	1	37	61	0	209
2006	10	32	58	0	204
2007	7	37	56	0	199
2008	7	36	58	0	259
2009	3	45	52	0	242
2010	4	31	65	0	279
2011	3	35	62	0	285
2012	1	46	52	0	271
2013[b]	1	35	63	0	267

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Preliminary data.

Table 21. Unit 21D moose harvest percent by transport method, regulatory years[a] 2002–2013.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
2002	5	0	87	0	4	1	1	2	326
2003	4	0	88	0	6	0	1	1	322
2004	3	0	81	2	3	2	6	3	227
2005	1	1	92	1	1	2	1	1	209
2006	5	0	90	2	0	1	1	1	211
2007	6	0	88	4	0	1	2	1	201
2008	3	0	92	4	0	1	1	0	261
2009	4	0	90	4	0	1	1	0	239
2010	4	0	90	3	0	0	2	0	284
2011	4	0	89	4	0	1	1	0	285
2012	3	0	91	3	0	0	2	1	266
2013[b]	2	0	90	1	0	2	1	4	275

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Preliminary data.

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CHAPTER 31: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 have now stabilized at lower densities. 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). Beginning in 2001, declining moose populations prompted the Board of Game to implement restrictions intended to reduce harvest in many parts of Unit 22, and the most accessible portions of Unit 22 now have 14-day fall hunting seasons with harvest quotas, adjusted based on current population survey data to prevent overharvest of bull moose. Unit residents account for most of the annual reported harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The following population objectives and bull:cow ratios are the current management goals for Unit 22:

- Unit 22 unitwide: maintain a combined population of 5,100–6,800 moose.
  - Unit 22A: maintain a population of 600–800 moose.

- Unit 22B West: increase and stabilize the population at 1,000–1,200 moose.

- Unit 22B East: insufficient data exists to develop a specific management goal; however, increased recruitment rates and population growth are desired.

- Unit 22C: maintain a population of 450–525 moose.

- Unit 22D: maintain a population of 2,000–2,500 moose.

- Unit 22E: increase and stabilize the population at 200–250 moose.

➢ Maintain a minimum bull:cow ratio of 30:100 in Units 22A, 22B, 22D, and 22E.

➢ Maintain a minimum bull:cow ratio of 20:100 in Unit 22C.

The Unit 22 population objective (5,100–6,800 moose) recommended by the Alaska Department of Fish and Game (ADF&G, the department) was adopted by the Board of Game in November 2001. This objective was revised downward slightly from our previous management goal of 5,700–7,300 moose, which may be slightly larger than habitat can support. In Units 22A, 22B, and 22D, our goal is to increase and stabilize the population from a period of steady decline in moose numbers. In Unit 22C, the goal was revised slightly upward (from reduce and maintain a population of 450–475 moose) based on results of a 2004 habitat survey, with the revised goal 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. However, understanding precise population potential in Unit 22 is difficult due to the lack of data related to both habitat quantity and quality. 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 as follows:

➢ In selected areas of the unit, make annual estimates of moose abundance, sex and age composition, and yearling recruitment, and determine trends in population size and composition.

- Complete censuses in the 5 subunits of Unit 22 on a 3-year rotational basis to estimate moose abundance.

- Complete late fall and/or early spring aerial surveys in selected portions of the unit to provide an index of moose population status and trends, sex and age composition, and yearling recruitment.

➢ Monitor human and natural mortality factors affecting the population.

- Evaluate hunting mortality by analyzing all moose harvest data.

- Improve harvest reporting through public education, vendor support, and improved communication, and by conducting community-based harvest assessment surveys in selected villages.

- Evaluate hunting regulations and recommend changes if necessary for conservation purposes.

- Improve public understanding of hunting regulations and the reasons they are necessary.

METHODS

During the reporting 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 Super Cub type aircraft (Piper PA-12, PA-18, Scout). Geospatial population estimation (GSPE) techniques were used in February and March 2012 and 2013 to estimate moose abundance in Unit 22A, Unit 22B, west of the Darby Mountains, and Unit 22C (J. VerHoef, ADF&G, personal communication). Population estimates from this reporting period are comparable to previous geospatial census efforts completed in the same areas of Unit 22A (February and March 2003, 2005, and 2008) and Unit 22C and 22B (February and March 2001, 2004, 2007, and 2010). 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Summary results for population censuses completed in Units 22A, 22B, and 22C are discussed below, and are presented in Figures 1–3, Appendix 1, and Table 2.

Population Size

Both of the GSPE moose population surveys (Unit 22A and Unit 22C) completed during the reporting period found observable moose point estimates outside of previous population survey confidence intervals (Fig. 1–3, Table 2). We used a C-185 with 4 occupants (pilot and three observers) to stratify survey areas into "high" and "low" boxes. Super Cub type aircraft were used to intensively search boxes for moose.

In Unit 22A, the 2012 GSPE survey estimated 545 observable moose (90% CI: 452–638), 0.23 moose/mi², 24 calves:100 adults, and a 19% recruitment rate. Low level intensive searches were conducted in 154 of 406 (38%) sample units to locate and count moose (Fig. 1, Table 2).

In Unit 22B, west of the Darby Mountains, and Unit 22C, the 2013 GSPE survey estimated 1,047 observable moose (90% CI: 900–1,194) in the total survey area.

The GSPE technique estimated 618 observable moose, 0.25 moose/mi², 10 calves:100 adults, and 9% recruitment in the Unit 22B survey area. A Sightability Correction Factor (SCF) of 1.26 (SE = 0.180) was estimated for Unit 22B, west of the Darby Mountains, by resurveying a random sample of surveyed SUs at a greater search intensity. Applying this SCF to the estimate of observable moose yields an estimate of total moose abundance in Unit 22B. The estimate of total moose abundance was 767 (90% CI: 545–989) as compared to the observable moose estimate of 618 observable moose (90% CI: 500–735). The decrease in the relative precision of the total moose abundance estimate is due to the additional variance associated with the SCF estimate, which was greater than expected partly because of a sample size less than planned and partly because of low moose counts in the high stratum SUs surveyed (Fig. 2, Appendix 1).

The GSPE technique estimated 429 observable moose (90% CI: 356–502), 0.27 moose/mi^2, 15 calves:100 adults, and 13% recruitment in the Unit 22C survey area (Fig. 3). Please see Appendix 1 for additional information related to 2013 moose population survey methodology and results.

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 2011 and 2012 we completed composition surveys in Unit 22C. In 2013 composition surveys were completed in the Unit 22D Kuzitrin River drainage.

Unit 22C. The 2011 moose composition survey classified 194 moose and found 13 bulls:100 cows, 15 calves:100 cows, and 12% calves. The 2012 composition survey classified 237 moose and found 17 bulls:100 cows, 17 calves:100 cows, and 13% calves (Table 3). Annual composition surveys completed in Unit 22C since 2006 have found bull:cow ratios below 20 bulls:100 cows, suggesting hunt management should continue to protect bulls in the population.

Unit 22D. In 2012, we completed a composition survey in the Kuzitrin drainage, classified 295 moose and found 23 bulls:100 cows, 16 calves:100 cows, and 12% calves (Table 3).

Spring. We did not complete spring recruitment surveys during the reporting period. We attempted to classify moose during March 2013 in the southern portion of Unit 22A, but weather allowed for only one short day of flying, and did not produce reportable data. Results from spring surveys completed prior to the reporting period can be 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; however, a 10-month old moose captured and weighed in 2009 was harvested by a hunter in the Crater Creek drainage, located approximately 30 miles to the northeast of the original capture location.

MORTALITY

Harvest

Seasons and Bag Limits. A regulatory year (RY) begins on 1 July and ends on 30 June (e g., RY11 = 1 July 2011–30 June 2012). No changes were implemented in Unit 22 during the reporting period.

Regulatory years RY11 and RY12 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 years RY11 and RY12 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 years RY11 and RY12 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Nonresidents:		No open season
Unit 22D Kuzitrin River drainage (includes Kougarok and Pilgrim rivers),and Southwest area located west of Tisuk River drainage, west of the west bank of Canyon Creek beginning at McAdam's Creek continuing to Tuksuk Channel.		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 bull by registration permit only.	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Remainder of Unit 22D		
Residents: 1 antlered bull or	10 Aug–14 Sep	
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.	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: 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

Alaska 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 2011. Several emergency orders were issued by the department, as follows:

In September 2011, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22B, west of the Darby Mountains, and Unit 22C. The Unit 22B registration hunt area had a harvest quota of 15 bull moose, and the Unit 22C hunt area had a harvest quota of 13 bull moose that was anticipated to be met by 6 September. The EO was issued to prevent overharvest.

In September 2011, the department issued an EO that extended fall registration permit hunt RM841 in the central portion of Unit 22A. The harvest quota of 14 antlered bulls in the hunt area was unmet on 14 September, and the EO was issued to provide additional opportunity.

In September 2011, the department issued an EO that closed fall registration permit hunt RM841 in the central portion of Unit 22A. The harvest quota of 14 antlered bulls was anticipated to be met by 17 September, and the EO was issued to prevent overharvest.

In December 2011, 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 54 bulls during fall registration hunt RM840 was not met which left a surplus of 10 antlered bulls available for harvest during the winter hunt.

In November 2012, the department issued an EO that opened winter registration permit hunt RM844 in the central portion of Unit 22A. The fall harvest quota of 22 bulls during fall registration hunt RM841 was not met which left a surplus of 6 antlered bulls available for harvest during the winter hunt.

In February 2012, the department issued an EO that opened a winter moose hunt in the remainder of Unit 22A with the bag limit of one antlered bull. The EO was issued to provide additional opportunity based on low fall harvest and inclement weather during the regular winter 1 January – 31 January season.

Hunter Harvest. During RY11, harvest report data show that 607 hunters harvested 196 moose (168 males, 26 females, and 2 unknown). A harvest of 178 moose (153 males and 25 females) was reported taken by 651 hunters during the RY12 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 some village residents has always been incomplete.

Resident 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 RY11, 13 cows were harvested in RM850, and 11 cows were harvested in RM852. In RY12, 12 cows were taken in RM850 and 11 moose (10 cows, 1 unknown) were harvested in RM852 (Table 5).

Registration moose hunts with harvest quotas are in place in the heavily hunted portions of Units 22B, 22C and 22D along the Nome road system (RM840) and in the central portion of Unit 22A near Unalakleet (RM841). In RY11 a total of 411 people reported hunting in RM840 and 85 bull moose were harvested (Table 5). In Unit 22B, west of the Darby Mountains, hunters harvested 14 bulls (93% of 15 bull quota). In Unit 22C hunters harvested 26 bulls (96% of 27 bull quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 45 bulls (83% of 54 bull quota). Registration moose hunt RM841 was administered in the central portion of Unit 22A, 64 hunters harvested 15 moose (14 bulls, 1 unknown; 107% of 14 bull quota).

In RY11, winter registration moose hunt RM843 was administered in Unit 22B, west of the Darby Mountains, and 9 hunters harvested 2 antlered bulls (25% of quota). The winter hunt utilizes a portion of the total harvest quota from Unit 22B, west of the Darby Mountains, as recommended by the Northern Norton Sound Advisory Committee. Winter registration hunt RM849 was administered in Unit 22D Kuzitrin and 22D Southwest where 5 hunters harvested 1 antlered bull (10% of quota). The RM849 hunt utilizes unfilled quota from the fall RM840 hunt.

In RY12, a total of 413 people reported hunting in RM840 and 85 moose (82 bulls, 2 cows, 1 unknown) were harvested (Table 5). In Unit 22B West hunters harvested 20 bulls out of the 15 bull quota (133% of 14 bull quota). In Unit 22C, hunters harvested 14 bulls (108% of 13 bull quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 51 bulls (94% of 54 bull quota). Registration moose hunt RM841 was administered in the central portion of Unit 22A; 52 hunters harvested 15 bulls (68% of 22 bull quota).

In RY12, winter registration moose hunt RM843 was administered in Unit 22B, west of the Darby Mountains, and 12 hunters harvested 2 antlered bulls (40% of quota). Winter registration hunt RM844 also occurred in the central portion of Unit 22A and 1 hunter reported hunting; however no moose were harvested. The RM844 winter hunt utilized unfilled quota from the fall RM841 hunt.

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.

Nonresident Permit Hunts. In RY11, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Twenty one hunters reported in RM842, 16 nonresidents hunted, and 9 bulls were taken. In RY12, nonresident registration hunt RM842 was administered in Unit 22D Remainder, and 8 hunters reported. Eight nonresident hunters hunted and 6 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 RY11, 6 permits were issued and 6 hunters hunted, of which 5 hunters harvested bull moose. In RY12, 4 permits were issued, 3 hunters hunted, and 3 hunters harvested bull moose.

Hunter Residency and Success. Unit 22 residents accounted for 73% of the harvest in RY11 and 76% of the harvest in RY12 (Table 6). From 1994 through 2004 the proportion of harvest attributable to local residents ranged 69−74%; however, since 2005 local resident harvest has been higher, 73–90%. Nonresidents accounted for 9% of the harvest in RY11 and 7% of the harvest in RY12. Alaska residents residing outside of Unit 22 accounted for 15% of the harvest in RY11 and 11% of the harvest in RY12. Eight (8%) percent of harvest residency during the reporting period is unknown because of incomplete harvest ticket information.

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. Most of the hunter effort and reported harvest occurred during September (80%), August (5%) and October (5%) during the reporting period. Hunters harvested 90% of Unit 22 moose during the months of August, September, and October during the reporting period.

Transport Methods. During this reporting period 36% of successful moose hunters used 3- or 4-wheelers, 32% used boats, 10% used off-road vehicles, 7% used highway vehicles, 7% used snowmachines, and 1% of the harvest was by hunters using airplanes. One percent (1%) of hunters used other methods, airboats, or hunted on foot, and 6% of hunters used an unknown method of transportation because of incomplete harvest ticket information (Table 8).

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 their 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 data 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 moose densities with less competition for browse, yielding higher 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 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. 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 completed during this reporting period show the population in Unit 22B, west of the Darby Mountains, continues to be stable and is likely not growing because of low recruitment rates at or below 10% since 1999. The Unit 22B, west of the Darby Mountains, 2013 population estimate of 618 observable moose indicates a 3% annual rate of increase between 2010 and 2013. The 767 moose estimate reported in Appendix 1 and Figure 2 includes a sightability correction factor not collected during 1999, 2004, and 2010 surveys, which only reported the estimated number of observable moose. 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 only be sustainable if populations remain below the pre-crash population level in this area. However, densities in Unit 22B (west of the Darby Mountains) could likely double before they approach the levels of the late 1980s.

The moose population in Unit 22C declined during the reporting period, likely in part due to antlerless moose hunts administered in the area since 2000, and is now near our population objective of 450–525 moose. Between 2000 and 2010 realized antlerless moose harvest rates fluctuated 2%–4%, but managers increased antlerless hunt quotas in 2011 and 2012 due to concerns over increased population levels and habitat limitations and realized harvest rates for those 2 years were 6% and 7% respectively. The GSPE population survey completed during the reporting period found a 9% annual decline between 2010 and 2013, and the antlerless hunt first authorized in 1999 by the Board of Game has been cancelled. Current harvest management is structured to maintain densities near current levels (0.27 moose/mi^2) and increase bull: cow ratios in the area. The department will estimate moose in Unit 22C again in 2016 (see below).

The Unit 22A moose population survey completed during the reporting period showed a 14% rate of increase between 2008 and 2012, and current densities (0.23 moose/ mi^2) are above what was found in the area during the late 1980s. It is important that staff continues to work with local residents on the importance of harvest reporting, ensures conservative harvest continues in the local area, and monitors the area's recovering moose population.

A stratified moose census is completed in each of the units once every 3 years and future censuses are scheduled as follows: 2014−Units 22D/E, 2015−Unit 22A, 2016−Units 22B/C, 2017−Units 22D/E, 2018−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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While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Product names used in this publication are included for completeness but do not constitute product endorsement.

Table 1. Unit 22 historical moose harvest by sex, hunter effort, and success rate RY69–RY12.

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	1,292	31
RY84	298	91	6	395	1,086	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
RY11	168	26	2	196	607	32
RY12	153	25	0	178	651	27

[a] Minimum known number of hunters.

Table 2. Summary of Unit 22 spring moose censuses, 1987–2012.

Area	Year	Size (mi^2)	Census estimate (No.)			Density (No../mi^2)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22A Unalakleet Drainage	1989	1,124	273	52	325	0.24	0.29	19	16	Gasaway
Unit 22A Unalakleet Drainage	2003	2,000	71	11	75	0.04	0.04	15	15	Geostatistical
Unit 22A Unalakleet Drainage	2005	2,400	113	10	123	0.05	0.05	9	8	Geostatistical
Unit 22A Unalakleet Drainage	2008	2,400	282	60	339	0.12	0.14	21	18	Geostatistical
Unit 22A Unalakleet Drainage	2012	2,400	440	106	545	0.18	0.23	24	19	Geostatistical
Unit 22B West	1987	2,105	1,676	218	1,894	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	2,105	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	2,400	529	53	586	0.22	0.24	10	9	Geostatistical
Unit 22B West	2010	2,400	512	58	570	0.21	0.24	11	10	Geostatistical
Unit 22B West[b]	2013	2,400	698	69	767	0.29	0.32	10	9	Geostatistical
Unit 22C	1990	1,368	322	85	407	0.24	0.30	26	21	Gasaway
Unit 22C	1995	1,368	394	85	479	0.29	0.35	22	18	Mod. Gasaway
Unit 22C	2001	1,368	413	139	558	0.30	0.41	34	25	Geostatistical
Unit 22C	2004	1,368	442	102	530	0.32	0.39	23	19	Geostatistical
Unit 22C	2007	1,368	533	87	620	0.39	0.45	16	14	Geostatistical
Unit 22C	2010	1,368	533	130	663	0.39	0.48	24	20	Geostatistical
Unit 22C	2013	1,368	373	56	429	0.22	0.27	15	13	Geostatistical

Area	Year	Size (mi^2)	Census estimate (No.)			Density(No../mi^2)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22D Kuzitrin Drainange	2011	1,610	810	90	900	0.50	0.56	11	10	Geostatistical
Unit 22D Kuzitrin Drainage	2006	1,610	821	145	966	0.51	0.60	18	15	Geostatistical
Unit 22D Kuzitrin Drainage	2002	1,456	911	114	1,028	0.63	0.71	13	11	Geostatistical
Unit 22D Kuzitrin Drainage	1988	1,456	1,673	278	1,951	1.14	1.34	17	14	Gasaway
Unit 22D Kuzitrin Drainage Reduced	1993	856	943	153	1,096	1.10	1.28	16	14	Mod. Gasaway
Unit 22D Kuzitrin Drainage	1997	1,456	1,019	232	1,251	0.70	0.86	23	19	Mod. Gasaway
Unit 22D Agiapuk Drainage	1988	1,041	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	1,041	451	127	578	0.43	0.56	28	22	Mod. Gasaway
Unit 22D Agiapuk Drainage	2002	1,041	485	82	567	0.47	0.54	17	14	Geostatistical
Unit 22D Agiapuk Drainage	2006	1,271	443	156	599	0.35	0.47	35	26	Geostatistical
Unit 22D Agiapuk Drainage	2011	1,271	687	94	781	0.54	0.61	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	4,500	408	96	504	0.09	0.11	23	19	Geostatistical
Unit 22E	2006	4,500	481	106	587	0.11	0.13	22	18	Geostatistical
Unit 22E	2011	4,500	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.
[b]Estimate of total moose abundance.

Table 3. Unit 22 aerial moose composition surveys, fall of 1992, 1994, and 2000–2013.

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[1]	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
	2012	17	17	30	13	207	237

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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
	2013	23	16	34	12	261	295
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 1991–2011.

Survey area and survey year	No. calves	No. 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[a]				
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

[a] Includes Cripple, Sinuk, Penny, Snake, Nome, Flambeau, and Eldorado rivers.

Table 5. Unit 22 Registration moose hunt statistics for RY11 and RY12.

RY	Hunt	Total moose killed	Males killed	Females killed	Unknown killed	Total permittees reporting	Hunted	Did not hunt
RY11	RM840	85	85	0	0	514	411	103
RY11	RM841	15	14	0	1	67	64	3
RY11	RM842	9	9	0	0	21	16	5
RY11	RM843	2	2	0	0	9	9	0
RY11	RM849	1	1	0	0	17	5	12
RY11	RM850	13	0	13	0	15	15	0
RY11	RM852	11	0	11	0	24	18	6
RY11	RM853	2	2	0	0	18	8	10
RY12	RM840	85	82	2	1	507	413	94
RY12	RM841	15	15	0	0	57	52	5
RY12	RM842	6	6	0	0	8	8	0
RY12	RM843	2	2	0	0	13	12	1
RY12	RM844	0	0	0	0	1	0	1
RY12	RM849	0	0	0	0	1	0	1
RY12	RM850	12	0	12	0	18	18	0
RY12	RM852	11	0	10	1	29	23	6
RY12	RM853	1	1	0	0	9	3	6

Table 6. Residency and success of moose hunters in Unit 22, RY11 and RY12.

Regulatory	Residency of successful hunters					Residency of unsuccessful hunters				
Year/Unit	Unit[a]	State[b]	Nonresident	Unknown	Total	Unit[a]	State[b]	Nonresident	Unknown	Total
RY11										
22A	24	0	1	0	25	54	3	0	0	57
22B	19	5	5	1	30	52	6	2	1	61
22C	47	4	0	0	51	130	13	5	0	148
22D	50	18	9	1	78	103	15	9	0	127
22E	4	3	2	3	12	5	4	6	3	18
22 unk	0	0	0	0	0	0	0	0	0	0
Total	144	30	17	5	196	344	41	22	4	411
RY12										
22A	21	2	3	1	27	32	7	1	2	42
22B	24	3	3	0	30	58	8	2	2	70
22C	35	2	0	0	37	140	5	0	0	145
22D	51	12	6	1	70	164	27	3	1	195
22E	5	1	1	7	14	4	3	2	2	11
22 unk	0	0	0	0	0	10	0	0	0	10
Total	136	20	13	9	178	408	50	8	7	473

[a] Resident of Unit 22.

[b] Other Alaska resident.

Table 7. Chronology of Unit 22 moose harvest, RY11 and RY12.

Regulatory year/	Month of harvest									
Unit	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
RY11										
22A	3	20	0	0	0	1	1	0	0	25
22B	2	20	0	6	0	2	0	0	0	30
22C	0	51	0	0	0	0	0	0	0	51
22D	3	56	16	0	2	1	0	0	0	78
22E	1	9	0	0	0	1	0	0	1	12
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	9	156	16	6	2	5	1	0	1	196
RY12										
22A	2	22	0	0	0	3	0	0	0	27
22B	3	21	0	3	0	2	0	0	1	30
22C	0	37	0	0	0	0	0	0	0	37
22D	0	58	9	0	2	0	0	0	1	70
22E	4	6	1	0	0	3	0	0	0	14
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	9	144	10	3	2	8	0	0	2	178

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
RY09										
22A	1	0	15	2	2	1	1	0	3	25
22B	1	0	14	5	8	0	0	0	2	30
22C	0	0	4	34	0	5	7	0	1	51
22D	2	0	21	40	3	6	3	1	2	78
22E	0	0	2	4	1	4	1	0	0	12
Total	4	0	56	85	14	16	12	1	8	196
RY10										
22A	0	0	11	1	3	5	1	0	6	27
22B	0	0	18	3	5	0	0	0	4	30
22C	0	0	3	20	0	3	10	0	1	37
22D	1	0	25	22	2	11	1	0	8	70
22E	0	0	6	4	3	1	0	0	0	14
Total	1	0	63	50	13	20	12	0	19	178

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 No. 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	No.	Mean weight, lb	No.	Mean weight, lb	No.	Mean weight, lb
2006	15	417	14	411		
2007			14	419	16	379
2008			5	374	24	393
2009			16	371	14	372

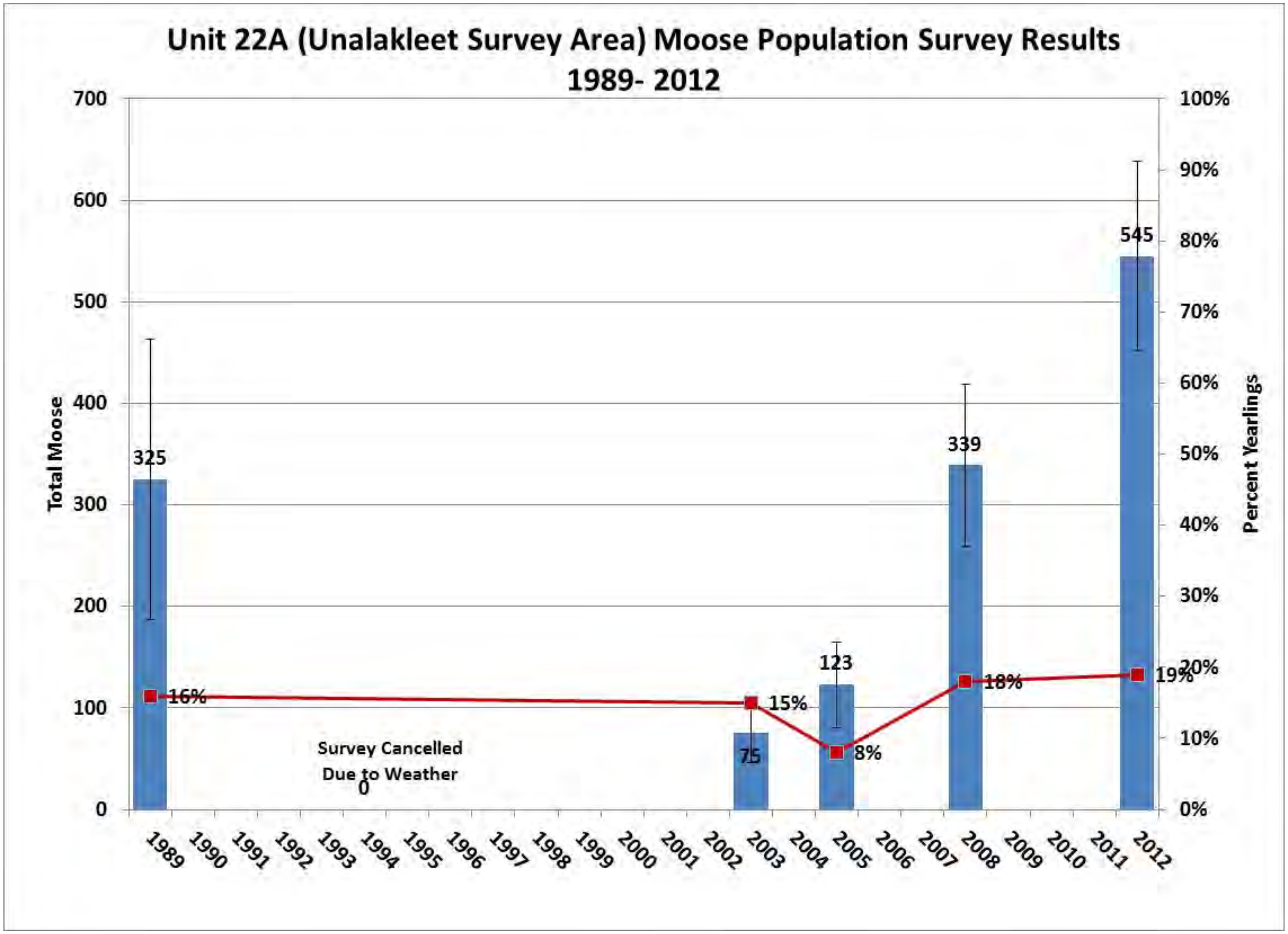

Figure 1. Unit 22A (Unalakleet Survey Area) moose population survey results.

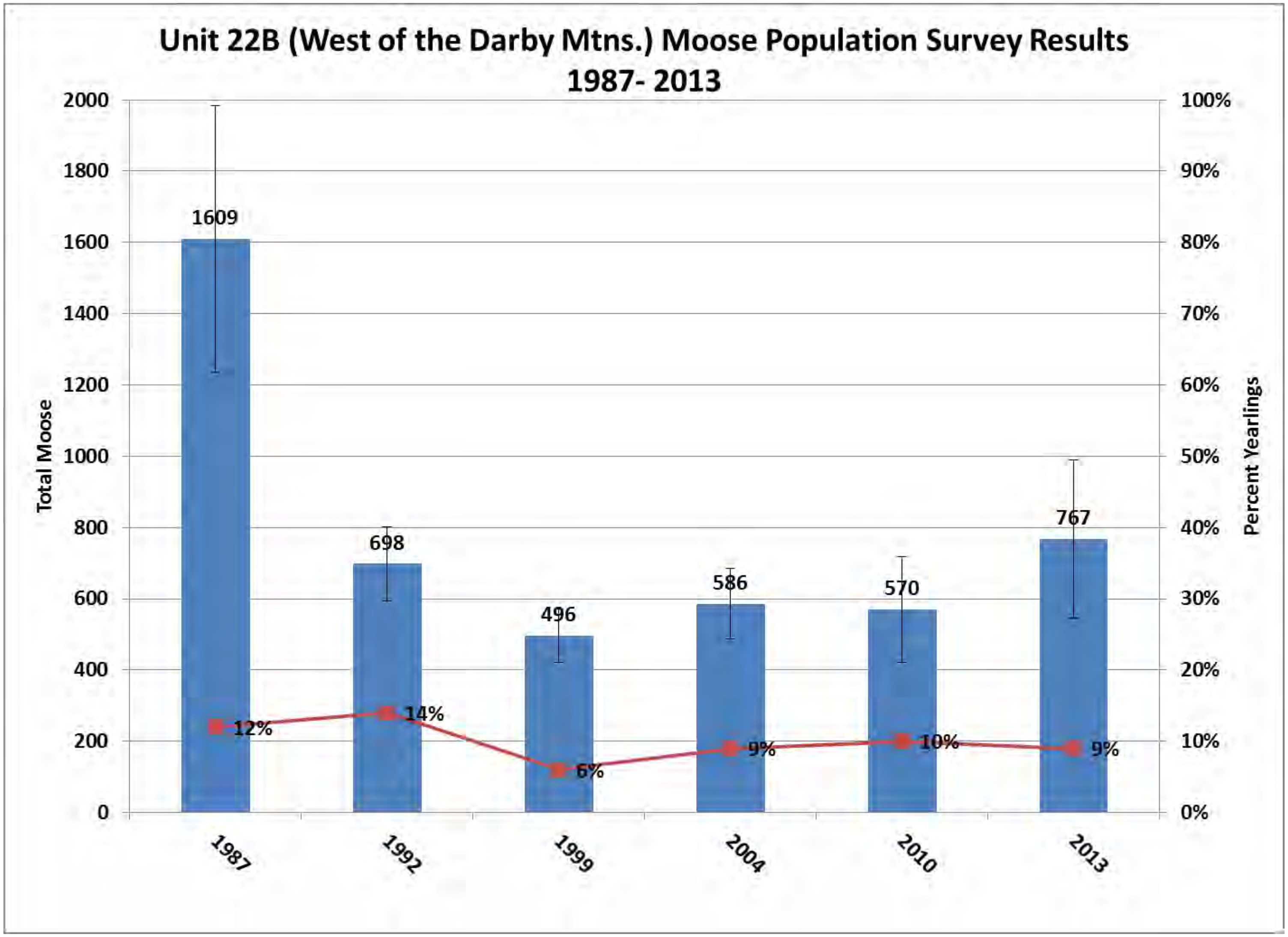

Figure 2. Unit 22B (West of the Darby Mountains) moose population survey results.

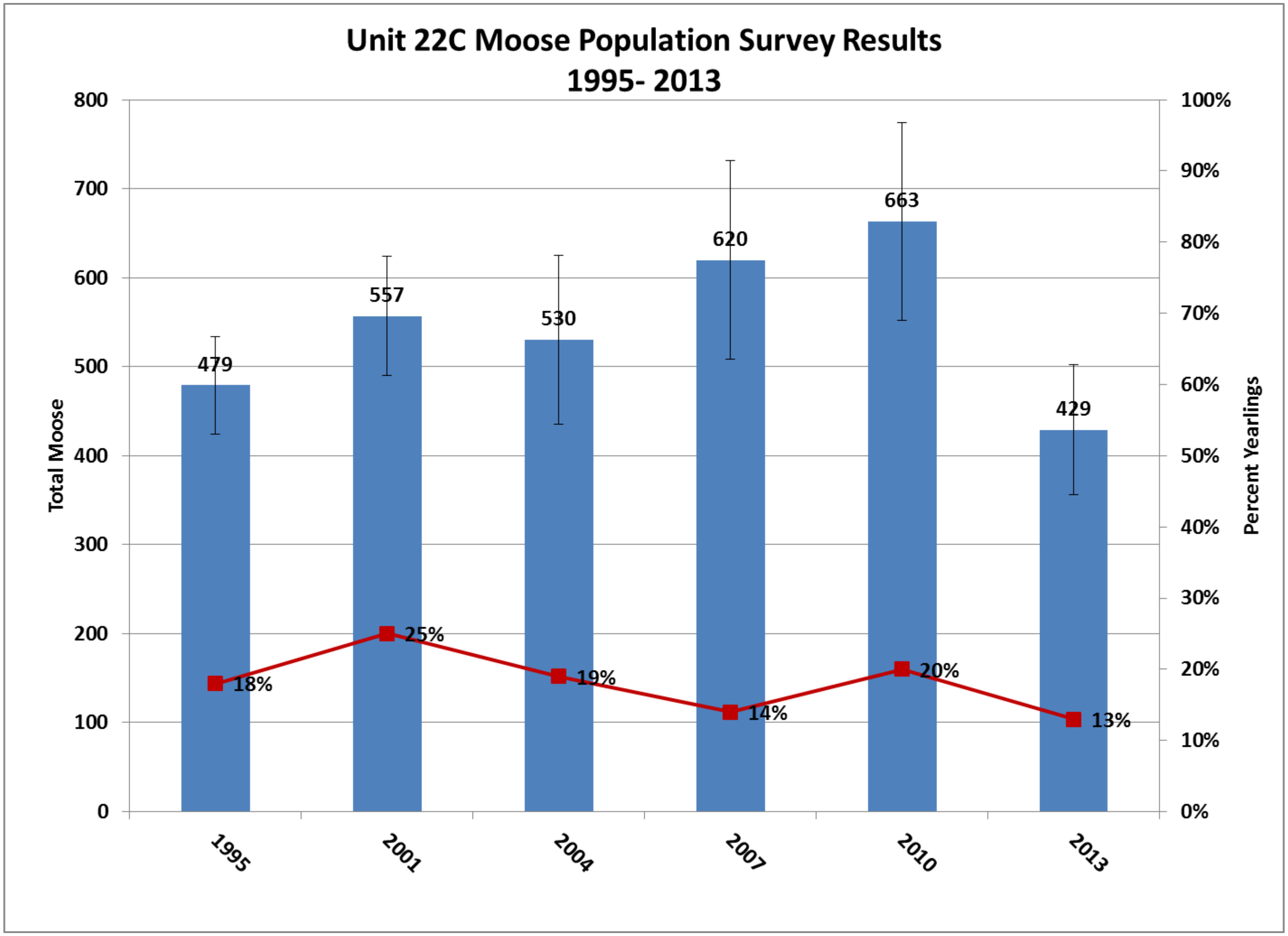

Figure 3. Unit 22C moose population survey results.

Appendix 1. 2013 Unit 22B and Unit 22C moose population survey results.

THE STATE of ALASKA

GOVERNOR SEAN PARNELL

Department of Fish and Game

DIVISION OF WILDLIFE CONSERVATION
Northwest

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TO: R5 Staff

DATE: March 21, 2013

PHONE NO: 907-443-8189

FROM: Tony Gorn, Unit 22AB
Bill Dunker, FWT Tech III

SUBJECT: Unit 22 spring moose population survey results

THRU: Brian Taras, Biometrician

2013 Unit 22B and 22C Moose Population Survey Summary

ADF&G staff completed a moose population survey of Unit 22B West of the Darby Mountains (Unit 22B West) and Unit 22C between February 16- 23, 2013. The crew was grounded for 3 days (Feb. 19- 21) because of high winds. Survey participants included ADF&G staff: Tony Gorn, Jim Dau, Letty Hughes, Bill Dunker, Kate Persons, and Pete Rob. Austin Ahmasuk (Nome) was a volunteer for the project. Bruce Seppi represented the Bureau of Land Management. Charter pilots were Andy Greenblatt, Lance Williams, and Marty Webb.

METHODS

Stratification: We did not stratify the survey area using the C-185 during the 2013 population survey because of scheduling conflicts between survey participants. Nome staff desk-topped the stratification using stratification notes from previously completed surveys from years with similar snow cover (2004 and 2010). The desk-top stratification appeared to be accurate, as we only found 12 moose in 60 low stratum survey units (SU) during the survey (0.2 moose per SU). Six of the twelve moose observed in low stratum SU were observed in one low SU adjacent to a high stratum SU in the Sawtooth Mountains, which in retrospect could have been classified as a high using the "paint with a broad brush" rule often associated with stratification. For comparison, we found 24 moose in 88 low stratum SU during the 2010 survey when snow conditions were thought to be ideal, and we were able to complete in-survey stratification flights using the C-185

Standard Survey: We used five Piper Cub type aircraft to conduct searches in SU. Pilot observer teams all had prior experience conducting GSPE moose surveys. We followed the recommendation from Brian Taras (biometrician) to increase the number of high stratum SU searched from 60% to 70% of the total sample. This recommendation was based on an optimal allocation analysis (Gasaway et al. (1986:43)) using 2004 and 2010 survey results for Unit22B, which indicated a consistent trend of pure lows (few boxes with >0 moose), which indicated the optimal allocation called for searching 85% highs (Figure 1). We chose to be less aggressive, since in-survey stratification flights were not completed. This guarded against the possibility of observing more moose in low stratum SUs while still increasing the possibility of achieving the precision objectives with a lower sample size. Also, we needed to ensure a sufficient number of low SUs were surveyed in both subunits. We planned to survey 175 high SUs and 50 low SUs and reserve an additional 25 low SUs to fill holes.

Sightability Correction Factor (SCF) Surveys: This is the first effort since beginning GSPE surveys in unit 22 (i.e., since Gasaway surveys) to estimate sightability. Recognizing resource constraints and a lack of experience in conducting SCF surveys we opted to focus our efforts in Unit 22B to gain experience and obtain a useful SCF in an area of management concern with the potential for lower sightability. We concentrated on high stratum SUs in Unit 22B. We omitted low stratum SUs due to resource constraints and because previous surveys found very few moose in the low stratum which would impose a negative bias on the estimate of total moose and its variance assuming the SCF for the low stratum would be very small compared to the overall uncertainties. Simulations were performed for a number of possible scenarios to assess the robustness of this approach.

We largely followed recommendations from a similar SCF survey in Unit 19A and guidance in The Geospatial Survey Operations Manual (Kellie and Delong 2006; ADF&G). Our survey objective was to conduct SCF surveys in 20-25 (preferably 25, if possible) surveyed high stratum search units.

Thirty (30) SUs were randomly selected from surveyed high stratum search units to conduct SCF surveys. The north or south half section (3.19 mi^2)of each selected SU was randomly selected prior to the survey. SCF surveys were to be initiated within 2 hours of completing the standard survey and the pilot/observer team planned to allot between 9 and 12 min/mi^2 during these surveys.

RESULTS and DISCUSSION

Observable Moose Abundance for the Entire Survey Area: The population survey estimate for the entire survey area is 1047 observable moose (+/-14% at 90% C.I.). Re-allocation of sampling effort from the low stratum to the high stratum appears to have increased the precision of this survey (nearly the same relative precision as in 2004 during which 242 SUs were sampled). This represents a 5% annual rate of decrease between 2010 and 2013, though inference to the population is confounded due to the lack of sightability correction and by not evaluating the statistical significance of the difference. The recruitment rate (% short ylgs) was 11%, which represents a decline since 2010 when recruitment was 15%. Survey conditions were generally good, despite high winds during the middle of the survey that prevented standard and SCF surveys for three days. Bright light and recent snow fall in Unit 22C provided very good sightability in stringers of riparian moose habitat, but the same bright light cast long shadows in many of the tree covered boxes in Unit 22B West. Pilot and observer teams were able to search 220 SUs effectively of which 73% (160 of 220 SUs) were in the high stratum. We observed 389 moose (0.43 moose/mi^2) in high stratum SUs and 12 moose (0.04 moose/mi^2) in low stratum SUs. The stratification seemed accurate as evident by the low number of moose found in low strata SUs. For comparison, we observed 388 moose (0.56 moose/mi²) in high stratum SUs and 24 moose (0.05 moose/mi²) in low stratum SUs during the 2010 survey.

The survey ended on February 24, 2013 due to high winds, charter plane schedules, and aircraft maintenance schedules (100 hr inspections). We intended to complete standard surveys in an additional 25 to 30 SUs in Unit 22B if given the opportunity, however, winds remained high in the survey area for several days. During this time staff generated an estimate and it was determined the completion of additional surveys was unnecessary. The habitat in the last 25 to 30 SUs was similar to habitat surveyed in previous SUs, and there was no expectation that higher moose density existed in this small area that would significantly change the overall estimate. These factors combined with the precision (+/-14% at 90% C.I.) of the estimate led to the decision to end the 2013 GSPE survey.

Observable Moose Abundance for the Unit22C: The Unit 22C (1674 mi²) population survey estimate is 429 observable moose (+/-17% at 90% C.I.), and 13% recruitment (Table 1). The density (0.27/mi²) represents a point estimate decline when compared to surveys completed in 2007 and 2010 when densities were ~0.40/mi². We administered an antlerless hunt between 2001 and 2012 in Unit 22C to reduce the local moose population to our management goal of 450-525 moose because of concerns regarding available winter habitat and potential resource limitation during years of high snowfall. We found weights from Unit 22C short yearlings weighed in 2008 and 2009 averaged 374lbs and 371lbs respectively when snow depth was above 110 inches per year. Average weights from Unit 22C short yearlings weighed in 2006 and 2010 were 411lbs and 398lbs respectively when snow depth was less than 97 inches per year. The lower weights implied nutritional limitation in heavy snow years (Boertje et al 2007) suggesting antlerless hunts be used to slowly reduce the Unit 22C moose population to reduce competition, avoid chronically low weights, and decrease susceptibility to a weather related population decline. Local hunters harvested an average of 22 antlerless moose per year between 2010 and 2013 which is approximately 3% of the 2010 population survey point estimate. We plan to issue an emergency order to cancel the 2013 (15 Sept – 30 Sept) antlerless hunt in Unit 22C. I included results of populations surveys with confidence limits from previous Unit 22C population surveys to provide a long term perspective of the population in Unit 22C (Figure 1).

Table 1 compares Unit 22C census results.

Area	Year	Estimated Number of Moose	Calves/ 100 Adults	Census Technique
Unit 22C	1990	407	26	Gasaway
Unit 22C	1995	479	22	Gasaway
Unit 22C	2001	557	34	GSPE
Unit 22C	2004	530	23	GSPE
Unit 22C	2007	620	16	GSPE

Unit 22C	2010	639	20	GSPE
Unit 22C	2013	429	15	GSPE

Observable Moose Abundance for the Unit22B: The Unit 22B West (2510 mi.^{2}) population survey estimate was 618 observable moose (+/-19% at 90% C.I.), and 9% recruitment (Table 2). The density (0.25/ mi.^{2}) remained relatively unchanged since 1992 when four population surveys found densities between 0.20/ mi.^{2} and 0.27/ mi.^{2}. Our limited knowledge of habitat availablity and quality in Unit 22B and our population objective (increase and stabilize the population at 1000-1200 moose) suggest the area can sustain a higher density moose population. The 2013 estimate suggests the Unit 22B West moose population has stabilized at a lower density since the decrease in moose numbers found in Table 2. Census and spring recruitment survey efforts found chronically low calf numbers over the last decade. I included results of populations surveys with confidence limits from previous Unit 22B population surveys to provide a long term perspective of the population and evaluate the survey technique's ability to detect change in Unit 22B (Figure 3).

Table 2 compares Unit 22B West census results.

Area	Year	Estimated Number of Moose	Calves/ 100 Adults	Census Technique
Unit 22B W Darby Mtn.	1987	1894	13	Gasaway
Unit 22B W Darby Mtn.	1992	698	16	Gasaway
Unit 22B W Darby Mtn.	1999	476	6	GSPE
Unit 22B W Darby Mtn.	2004	586	10	GSPE
Unit 22B W Darby Mtn.	2010	597	10	GSPE
Unit 22B W Darby Mtn.	2013	618	10	GSPE

SCF estimate and Total Moose Abundance for the Unit22B:
A Sightability Correction Factor (SCF) of 1.26 (SE = 0.180) was estimated for Unit 22B (west of the Darby Mountains) by resurveying a random sample of surveyed SUs at a greater search intensity. Applying this SCF to the estimate of observable moose yields an estimate of total moose in 22B. Two results will be provided. First, we will assume perfect detection in the low stratum of 22B. The estimate of total abundance in this case is 767 (+/-29% at 90% C.I.) as compared to the observable moose estimate of 618 observable moose (+/-19% at 90% C.I.). The increase in relative precision from 19% to 29% is due to the uncertainty in the SCF, which was greater than expected partly because of a sample size less than planned and partly because of low moose counts in the high stratum SUs surveyed. Both the point estimate and its variance are biased low. A reasonable worst case

would be to assume that the sightability in the low stratum was as poor as that in the high straum. The resulting estimate of total moose was 777 (+/-29% at 90% C.I.) leading to an increase of 10 in the abundance and virtually no change in precision. A number of more likely (less extreme) scenarios were evaluate and the bottom line was that negative bias in the point estimate and its precision was negligible, particularly when compared with the overall uncertainties.

A total of 19 SCF surveys were completed in Unit 22B during the survey period. Standard surveys were conducted by 5 pilot/observer teams participating in the GSPE survey, and all SCF surveys were conducted by the same pilot/observer team (Jim Dau/Bill Dunker). All pilot/observer teams conducting standard surveys in Unit 22B west of the Darby Mountains were incorporated into the estimate of sightability for the unit with a range of 2-6 SCF surveys flown per pilot/observer team.

SUs selected to resurvey had an average search intensity of 4.34 min/mi^2 (range: 2.35 to 8.93 min/mi^2). SCF surveys completed in the same SUs had an average search intensity of 9.24 min/mi^2 (range: 4.39 to 14.12 min/mi^2). SCF surveys began an average of 31 min after the completion of the standard surveys. The longest elapsed time between the end of the standard survey and the start of the SCF survey was 1hr 48min.

We reviewed daily track logs from survey flights, data sheet comments, and discussed survey results with pilot and observer teams to determine that 26 moose were observed during the SCF surveys that were observable during the intensive surveys. In comparison, 20 moose were observed during the standard surveys. No moose were observed in 63% of the SU selected for SCF surveys. The standard surveys found zero moose in every SU where zero moose were observed during the SCF survey.

In two cases where habitat was not homogenous throughout the selected SU, the north or south half section containing the majority of the habitat in the SU was selected for SCF survey. In both instances no moose were observed. Brian Taras cautioned against doing so as a general approach because of the potential to bias the SCF estimate. Specific circumstances may warrant further discussion.

RECOMMENDATIONS

Although the desktop method held for this survey, I recommend that we continue stratification flights in the future due to the variability in snow cover and habitat availability along the southern Seward Peninsula coast. Further, I recommend that we conduct stratification flights prior to beginning intensive surveys. Stratification and intensive survey flights were conducted simultaneously during surveys completed during 2004-2010. We should consider change to this approach for future surveys because knowing stratification of the survey area in 2013 allowed us to be more efficient with intensive searches.

SCF survey recommendations:

•To facilitate interpretation of moose observed during the SCF surveys, all pairs should pay attention to moose in a "buffer" surrounding unit and half unit boundaries.

•Moose outside of a unit or subunit section should not be used in estimating the SCF. Using data from areas not flown with specified intensity (opportunistic sightings) can lead to bias. For example, both teams saw two moose to the SE of a corner but if intensively searched as specified for the unit the SCF crew may have found additional moose. A possible exception warranting further consideration is when moose are observed so close to the boundary that they are subjected to the specified search intensity by each team and they are not known as "in" or "out" until plotting their locations.

•Future SCF survey protocol should re-consider change to allow individual pilot/observer crews to fly their own SCFS. This change would likely provide larger sample sizes and more robust SCF estimates given the logistical constraints, large proportion of high strata SU containing zero moose, and brief weather windows suitable for wildlife surveys found in Unit 22. Additional considerations include aircrew safety (not all crews may be capable of flying intensive SCF surveys), the potential for correcting to different extents (i.e., variable SCFc, (Gasaway et al. (1986:31)), and the potential for the same pilot/observer team to miss moose repeatedly because they have previously processed/interpreted a particular search image.

LITERATURE CITED

Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys; Biological Papers of the University of Alaska, Number 22

Kellie, K.A., and R.A. DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Fairbanks.

Boertje et al. 2007. Ranking Alaska Moose Nutrition: Signals to Begin Liberal Antlerless Harvests. Journal of Wildlife Management 71(5): 1494-1506

Figure 1 – Estimated sample sizes to achieve an estimate of observable moose with a relative precision of 0.15 at the 95% confidence and the optimal allocation of surveyed samples units (SUs) between the low and high strata.

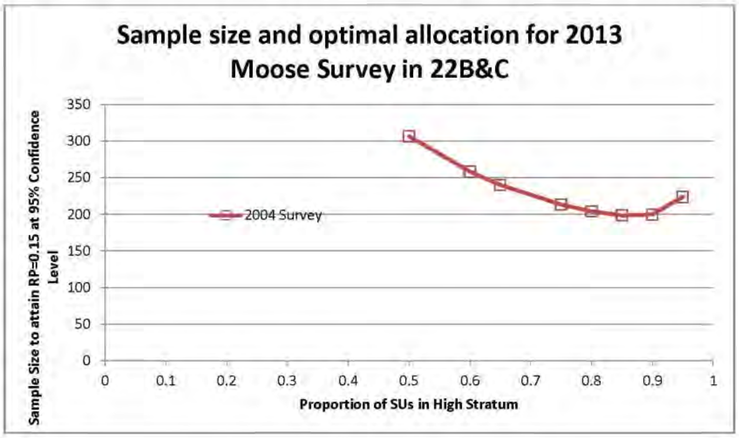


Figure 2 - Unit 22C Moose population survey results from Unit 22C, 1995-2013

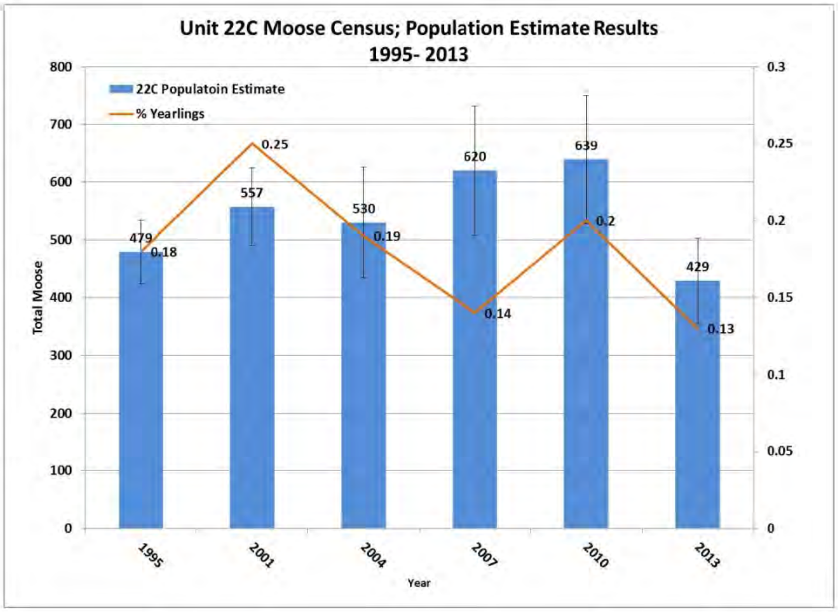
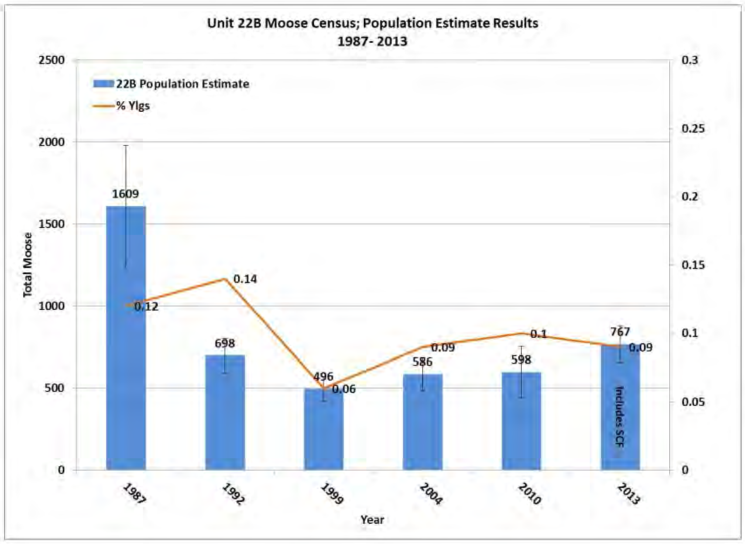


Figure 3 - Unit 22B Moose population survey results from Unit 22B, 1987-2013



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CHAPTER 32: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

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 appeared 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 during 1988–1991caused starvation among adult moose and weakened calf cohorts in at least 2 years. 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; Westing 2012).

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, Selawik, and 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 fall 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 objective is higher than the standard ratio of 20–30 bulls:100 cows used in most areas of Alaska 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; Kellie 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 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. Lower Kobuk River drainage (March 2012; cooperative project with NPS, USFWS). In 2012, stratification involved 1 aircraft, a Cessna 185 with a 4-person crew (pilot, navigator and 2 observers) surveying 30–31 March. Sample units (n = 250) received aerial intensive coverage from 3 aircraft during the period 2–11 April.

2. Lower Noatak River drainage expanded to include Wulik River, Kivalina River, Cape Krusenstern National Monument (CKNM), and excluding the Upper Squirrel River

drainage (March 2013; cooperative project with NPS, USFWS, and BLM). This survey area is referred to as the 'Lower Noatak (new)'. In 2013, stratification involved 2 aircraft, a Cessna 185 with a 4-person crew (pilot, navigator and 2 observers) surveying 19–26 March, and a Cessna 206 with a 3-person crew surveying 25–26 March. Sample units (n = 259) received aerial intensive coverage from 4 aircraft during the period 19–22 March and 2 planes continued intensive surveys until 26 March. Sightability surveys (replicate intensive survey flights, n = 30) were completed by a second aircraft team immediately after initial intensive surveys were completed.

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, quantitative GIS-based exclusion criteria were generated. Despite these exclusions, large areas of open tundra, as well as the headwaters of rivers and creeks, were surveyed even though such areas were often poor quality moose habitat. These marginal areas have been included in GPSE surveys because they were utilized when moose densities were higher in the late 1980s. Even now, at lower densities, a few moose still use these areas of poor, marginal habitat. Using broad, inclusive GSPE surveys 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 'adjustments' to 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 spring abundance surveys, moose were classified during fall geospatial composition surveys in cooperation with federal partners (USFWS, NPS) using methods described by Westing (2012). The technique during fall surveys is a 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. Two fall moose surveys were conducted in Unit 23 since the last report was prepared:

1. Lower Kobuk River drainage (October 2011; cooperative project with NPS, USFWS). In 2012, Sample units (n = 153) received aerial intensive coverage from 4 aircraft during the period 29 October–17 November.
2. Lower Noatak River (new) drainage (November 2012; cooperative project with NPS, USFWS). In 2012, sample units (n = 217) received aerial intensive coverage from 3 aircraft during the period 9–16 November.

Harvest information was derived from harvest reports. Community-based harvest assessments were also used to estimate moose harvests by Unit 23 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.

Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY11 = 1 July 2011–30 June 2012). 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

Spring geospatial population estimates 2000–2013 indicate Unit 23 adult moose densities ranged from 0.03 to 0.59 adult moose/mi^2 (Table 1).

The 2013 total moose estimate of the Lower Noatak survey area (excluding Upper Squirrel River) was 1,478 ± 19% (90% CI). This is a 32% decline from the 2008 estimate of the same area when the population was 2,273 ± 18%. The spring 2013 GPSE population estimate is consistent with the 2012 GSPE fall composition survey estimate of 1,289 moose, which helps confirm a substantial population decline since 2008.

Because sightability (e. g., through use of a sightability correction factor, SCF) has not been uniformly applied to Unit 23 geospatial population estimates, we likely underestimate the population. 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, using these slightly conservative estimates for management purposes affords a small measure of additional protection for these populations.

Sightability analysis in 2013 showed that of 30 units sampled, 5 sample units were ‘low’ strata determined by real time stratification. The remaining 25 sample units were classified as ‘high’ strata, with 14 containing moose. The sightability surveys found 2 additional moose, so the preliminary SCF is expected to be less than 1.10.

Population Composition

Spring (March–April) calf:adult ratios were 8–11:100 during this reporting period (Table 1). Due to conflicts with other projects, 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 2012 geospatial composition estimate for the Lower Noatak River drainage resulted in a bull:cow ratio of 45:100. The fall 2011 geospatial composition estimate for the Lower Kobuk River Drainage resulted in a bull:cow ratio of 49:100 (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 Lower Noatak drainage in 2004–2007 and 2012 (13:100 and 12:100 respectively) but the Lower Kobuk drainage estimates in 2004–2007 and 2011 differ by half (34:100 and 17:100 respectively. Calf:cow ratios can fluctuate greatly 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 the proportion of moose sampled and variation in group size.

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. RY11 = 1 July 2011–30 June 2012).

Regulatory year *RY11 and RY12* 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	1 Aug–31 Dec	

Regulatory year *RY11 and RY12* Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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.	(registration hunt)	

Board of Game Actions and Emergency Orders. The board reauthorized antlerless moose seasons for RY11 and RY12. No emergency orders were issued during RY11 and RY12.

Hunter Harvest. Community-based harvest assessments indicate approximately 350–450 moose are harvested annually by residents of Unit 23. 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 72 and 75 moose unit residents indicated on harvest reports in RY11 and RY12, respectively. Although establishment of registration permit hunt RM880 appears to have improved compliance with licensing and reporting requirements for local moose hunters, community harvest data 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 (82 moose in RY11 and 81 moose in RY12) with community harvest assessments for local hunters (mean harvest of 342 moose annually, Table 3) indicates the total annual moose harvest in Unit 23 was roughly 400–425 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.

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 has 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 RY11 and RY12 in terms of absolute numbers (11 and 10 taken respectively; Table 5), and in relation to total harvest (8% and 6%, 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. Community based harvest estimates provide only total numbers of moose, and could not be used to ascertain this conclusion.

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 until late fall (October) during most recent years and the desire of many hunters to conduct a multi-species hunt. However, this may also have 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 = 91%) participated in RM880 (Table 6). In contrast, approximately half of nonlocal Alaskan moose hunters (mean = 56%) 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.

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.

Harvest Chronology: As in the past, most 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 RY11, 75% of the reported harvest occurred during September, and in RY12, this percentage was 80%. Nine and 11% of the total harvest was taken during August during these regulatory years, respectively. Similar to RY10, the harvest in December was 7% and 9%, respectively, in RY11 and RY12. Increased harvest of moose in December is likely due to the absence of caribou in 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). As participation in registration hunt RM880 by local residents has increased since it was initiated in RY04, the number of boat hunters has exceeded numbers of airplane hunters in each year since RY04. 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

There were no habitat assessment activities for moose in Unit 23 during the reporting period.

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, previously reported by Dau 2002 and Westing 2012, are ongoing at less than peak levels reported in 2002. User conflicts are still perceived by some, but may have decreased for the following reasons:

- Annual meetings of the Unit 23 User Conflict Workgroup (formed in 2008 to address conflicts among users in Unit 23).

- Outreach materials created and distributed by ADF&G that help identify ways to mitigate and minimize conflicts among user groups.

- Economic factors that have reduced the number of hunters visiting the area.

- Regulatory changes have influenced the number of nonresidents and nonlocal Alaska residents using the area.

- Continuation of the pilot orientation requirement for all individuals transporting hunters or their gear in Unit 23.

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.

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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While this unit report was actually published in 2017, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Product names used in this publication are included for completeness but do not constitute product endorsement.

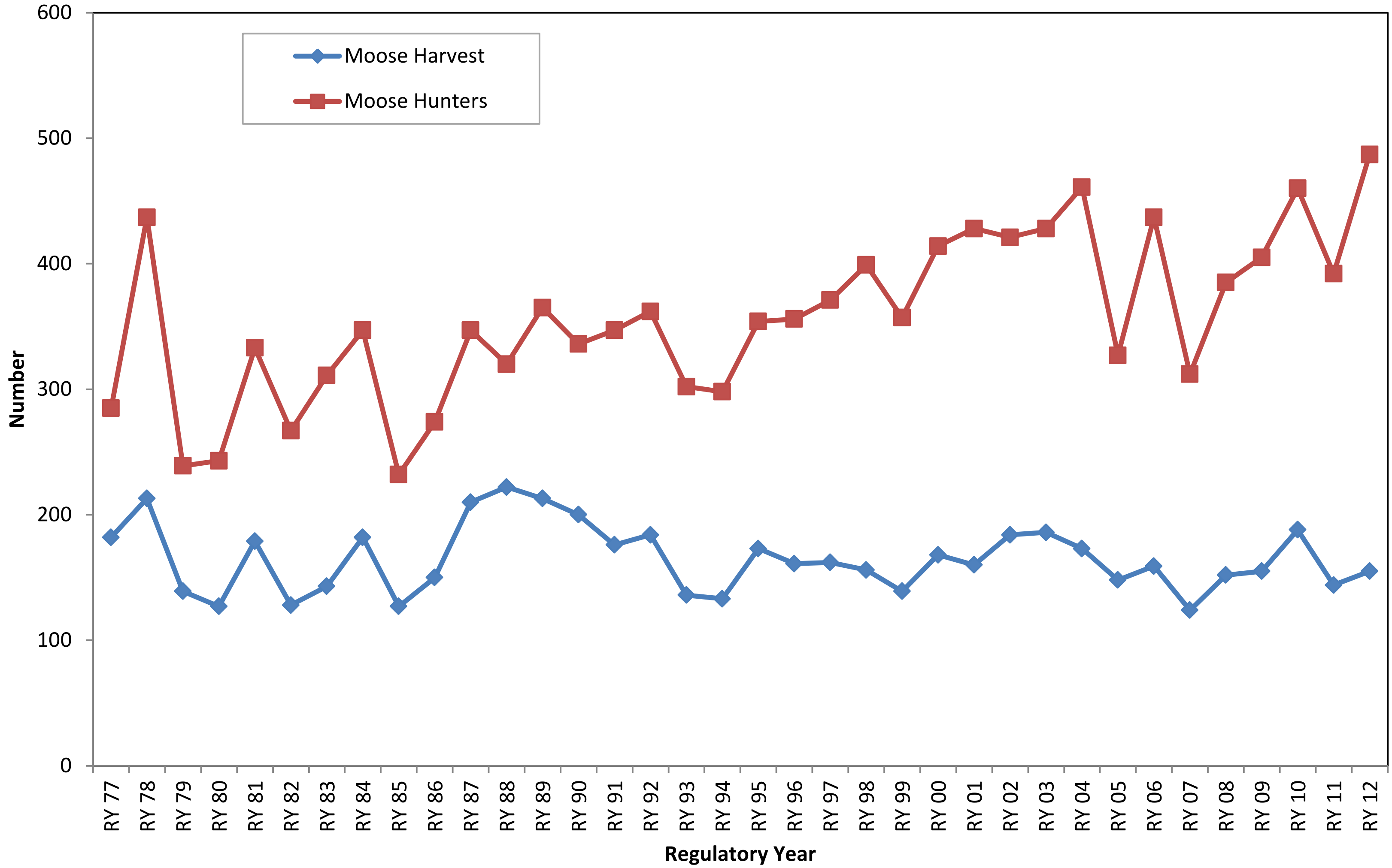

Figure 1. Unit 23 moose hunters and harvests (harvest and registration report data), RY77 through RY12.

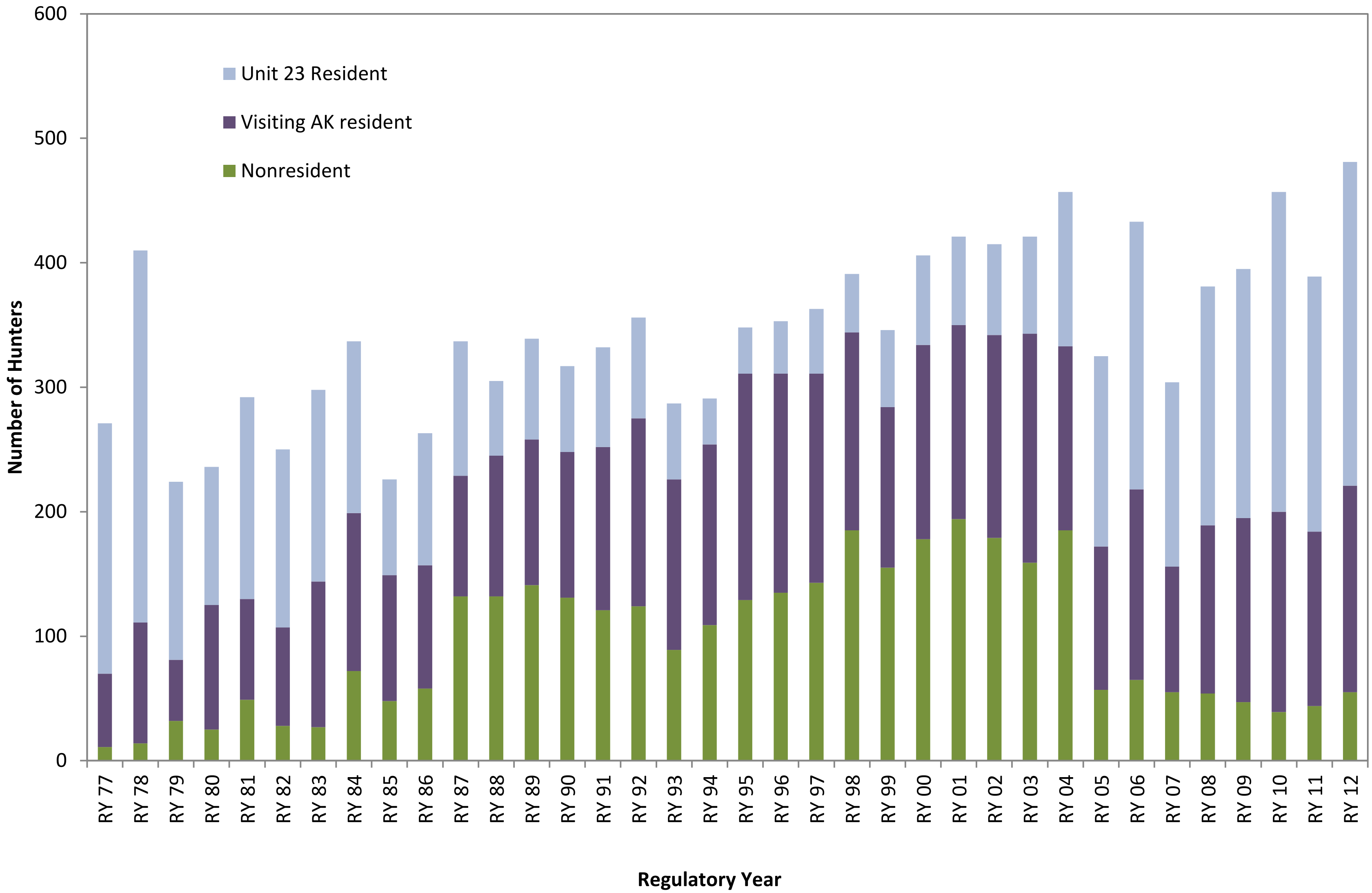

Figure 2. Numbers of moose hunters in Unit 23 by residency (harvest and registration report data), RY77 through RY12.

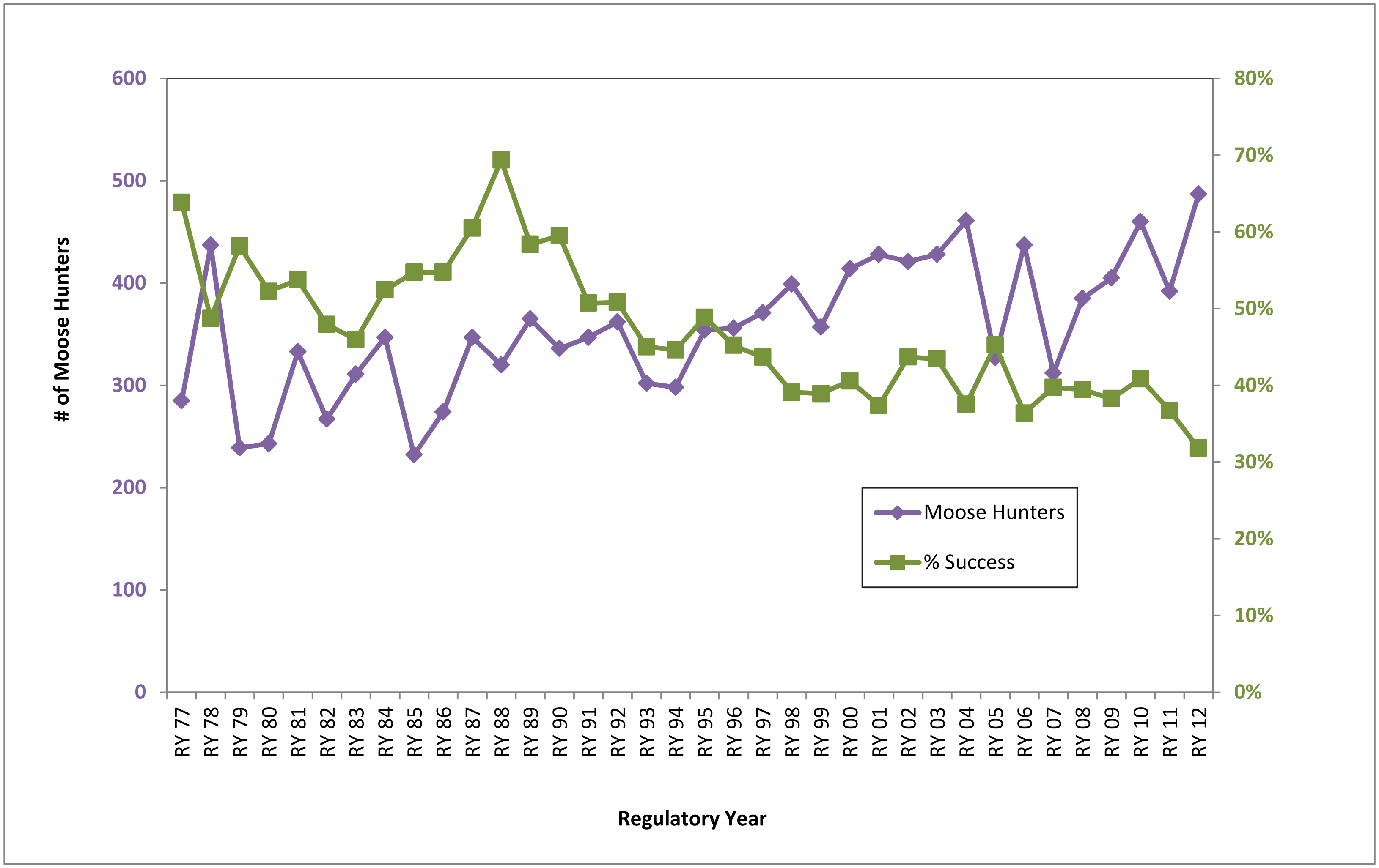

Figure 3. Unit 23 moose hunter effort and success (harvest and registration report data), RY77 through RY12.

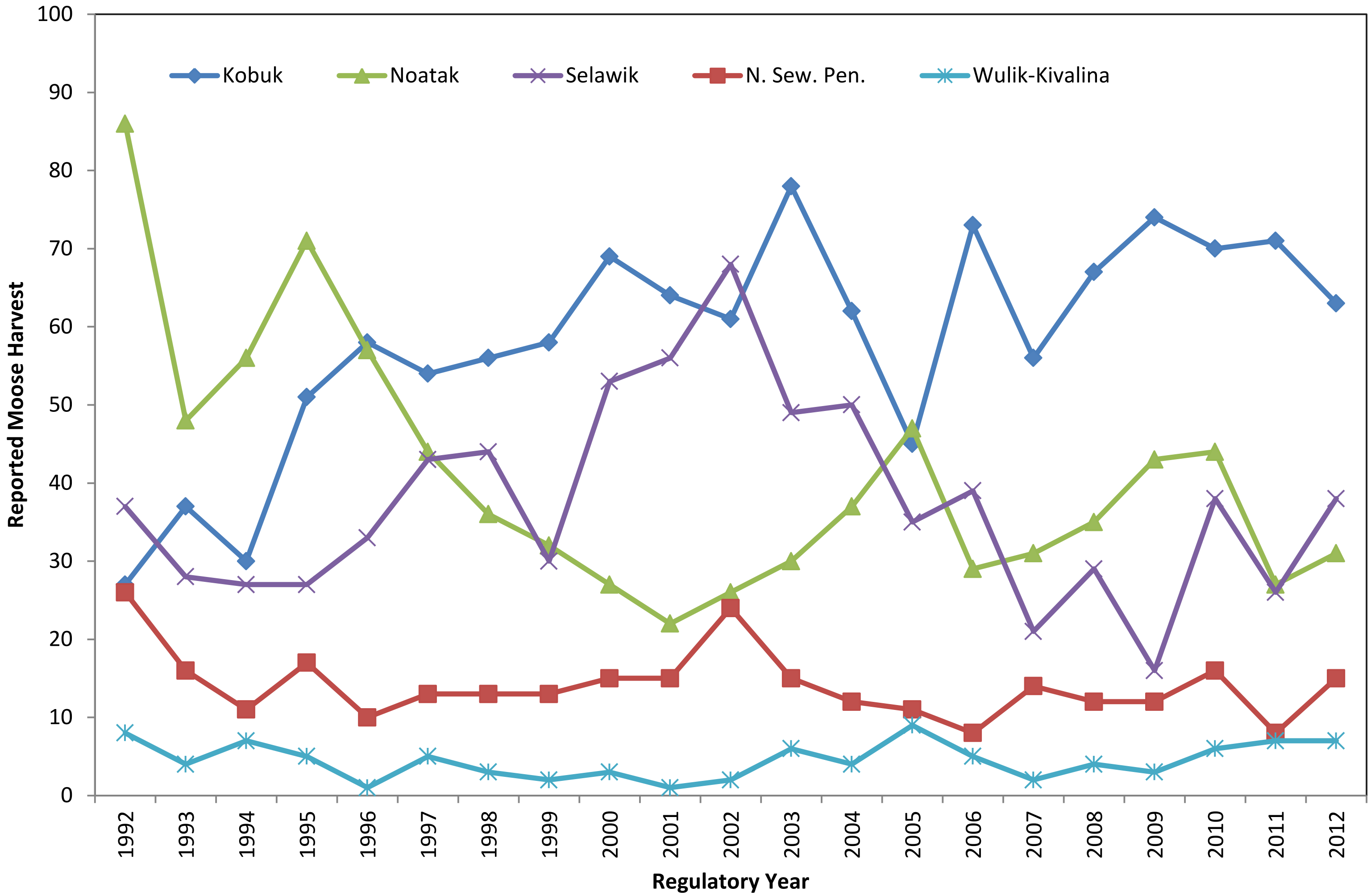

Figure 4. Unit 23 moose harvest by drainage (harvest and registration report data), RY83 through RY12.

Table 1. Unit 23 spring geospatial moose survey results, 2000–2013 (all surveys conducted cooperatively by ADF&G, NPS, USFWS and BLM, except as noted).

Area	Year	Size (mi^2)	Survey estimate (No.) Adults	Survey estimate (No.) Calves	Survey estimate (No.) Total[a]	90% CI[b]	Density ($No./mi^2$) Adult	Density ($No./mi^2$) Total	Calves:100 Adults
Selawik	2007	6,580.1	2,114	208	2,319	±16	0.35	0.32	10
Selawik	2011	6,559.0	1,569	170	1,739	±18	0.24	0.27	11
Lower Noatak	2000	2,111.2	710	59	779	±19	0.34	0.37	8
Lower Noatak	2001	2,111.2	1,325	130	1,453	±18	0.63	0.69	10
Lower Noatak-Upper Squirrel	2001	5,230.2	1,580	151	1,731	±18	0.30	0.33	10
Lower Noatak-Upper Squirrel	2005	5,349.7	1,630	208	1,838	±19	0.30	0.34	12
Lower Noatak (prev), includes-Upper Squirrel-Wulik-Kivalina-Cape Krusenstern	2008	7,161.6	2,094	297	2,388	±19	0.29	0.33	15
Lower Noatak (new), includes Wulik, Kivalina, Cape Krusenstern	2013	6,404.5	1,349	143	1,478	±19	0.21	0.23	11
Upper Noatak	2010	4,485.6	136	16	152	±18	0.03	0.03	12
N. Seward Peninsula[c]	2002	5,888.5	575	38	612	±14	0.10	0.10	7
N. Seward Peninsula[c]	2004	5,882.9	728	86	810	±9	0.12	0.14	12
N. Seward Peninsula	2009	5,773.2	904	74	966	±27	0.16	0.17	8
Upper Kobuk	2003	4,001.5	760	91	856	±19	0.19	0.21	12
Upper Kobuk	2006	4,001.5	653	96	737	±22	0.16	0.18	15
Lower Kobuk-Lower Squirrel	2006	4,870.5	2,891	511	3,398	±15	0.59	0.70	18
Lower Kobuk- Squirrel	2012	5,338	2,363	181	2,546	±17	0.44	0.48	8

[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, 2008–2012. (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)	1,838 (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)	3,398 (2006)	26		34	
Selawik	20	52	34	222	41	4	0	0	558(24)	2,319 (2007)	40		18	
Total	69	221	187	1,007	210	21	0	2			39		21	
Geospatial Composition Estimate [bc]														
Selawik (2008)	131	452	375	1,455	230	34	0	0	464 (20)	2,319(2007)	54	±19%	18	±31%
N. Seward Peninsula (2009)	23	98	85	380	17	0	0	0	152 (16)	966 (2009)	53	±54%	4	±73%
Selawik (2010)	42	475	335	1,492	286	32	0	0	474 (20)	2,319 (2007)	47	±29%	19	±23%
Lower Kobuk (2011)	24	538	562	1,917	340	17	0	1	685 (27)	2,546 (2012)	49	±24%	17	±25%
Lower Noatak (2012)	11	189	200	786	91	11	0	0	199 (14)	1,478 (2013)	45	±30%	12	±42%

[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 1991–2013 (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 2012	Estimated annual moose harvest in 2012–2013
Ambler	2002, 2009, 2012	271	10	0.04	283	11
Buckland	2003, 2009	421	13	0.03	421	13
Deering	1994, 2007	159	8	0.05	153	8
Kiana	1999, 2006, 2009	387	13	0.03	378	13
Kivalina	1992, 2007, 2010	380	11	0.03	367	11
Kobuk	2004, 2009, 2012	135	6	0.04	164	7
Kotzebue	1991, 2013	3,362	154	0.05	3,076	154
Noatak	1994, 1999, 2001, 2007, 2010, 2011	481	7	0.02	545	11
Noorvik	2002, 2008, 2012	621	35	0.06	585	35
Point Hope[a]	1992	685	14	0.02	674	14
Selawik	1999, 2006, 2011	797	50	0.06	856	51
Shungnak	1998, 2002, 2008, 2012	258	12	0.05	275	14
Unit 23 Total					**7,777**	**342**

[a] North Slope Borough, unpublished data.

Table 4. Numbers of moose hunters (effort) and harvest by residency (harvest and registration report data), RY91 through RY12.

	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	62	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
RY11	43	139	31	25	43	58	73	204	36	3	144	393	37
RY12	59	176	34	22	48	44	75	262	29	3	156	489	32

Table 5. Sex of moose harvested (harvest and registration report data), RY91 through RY12.

	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
RY11	133	11	0
RY12	146	10	0

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 RY12.

	General Hunt				RM880			
Regulatory	Nonlocal AK		Unit 23 Res		Nonlocal AK		Unit 23 Res	
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
RY11	19	72	7	16	24	67	66	188
RY12	28	106	4	27	31	70	71	235
Total	**241**	**886**	**81**	**253**	**175**	**390**	**569**	**1,502**

Table 7. Percent of moose hunters by transportation type in Unit 23 (harvest and registration report data), RY91 through RY12.

	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
RY11	38	44	6	0	2	0	1	0	9
RY12	35	54	3	1	4	1	0	0	2

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SPECIES MANAGEMENT REPORT

CHAPTER 33: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

GAME MANAGEMENT UNITS: 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, 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 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.

[1] At the discretion of the reporting biologist, this unit report may contain 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 state and federal regulations from December through April 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 Dalton Highway corridor management area 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 fall 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 in the fall according to methods and in areas described in Stout (2010).

In 2010, Koyukuk National Wildlife Refuge (NWR) staff conducted a survey of 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 Unit 24D that overlapped the area conducted in 2004 described by Stout (2010). Methods and results of the 2011 survey are described in the Unit 21D report (Stout 2012a).

In 2010, 2011, and 2013 we completed GSPE surveys on the Kanuti NWR in Unit 24B covering 2,715 mi^2 and a 1,021 mi^2 area west of the Kanuti NWR referred to as the upper Koyukuk management area. The Kanuti NWR portion of the survey area overlapped with surveys conducted during 1999–2008. Stratification of sample units (SU) for the 2010 survey was conducted using a Cessna 207. Intensively surveyed SUs were flown from small fixed-wing aircraft (PA-18 or similar aircraft) described by Stout (2010). 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; T. Craig, U.S. Fish and Wildlife Service, and G. Stout, Alaska Department of Fish and Game [ADF&G], unpublished survey report, February 2011, Fairbanks). In 2011 we intensively surveyed 151 SUs (75 high density, 76 low density; 805 mi^2) of 701 SUs (3,736 mi^2; Craig and Stout, unpublished survey report, February 2012). In 2013 we intensively surveyed 129 SUs (74 high density, 55 low density; 687 mi^2) of 701 SUs (3,736 mi^2; Craig and Stout, unpublished survey report, February 2014). Due to limited funding, the 2011 and 2013 surveys used stratification data from the regulatory year (RY; regulatory year begins 1 July and ends 30 June [e.g., RY08 = 1 July 2008–30 June 2009] RY08, RY10, and RY11 surveys (75 high density SUs, 627 low density SUs). Using radiocollared moose present in the survey area, we estimated a sightability correction factor (SCF; Boertje et al. 2009) for the 2010 survey. We used the Bayesian method for trend analysis described by Ver Hoef (2001), and applied a multiplicative mixed effects model for the 1999–2011 Kanuti surveys. For that trend analysis, we applied SCFs of 1.27 and 1.05 to the 2008 and 2010 results, respectively. The average of those 2 years (SCF = 1.16), was applied to the remaining Kanuti NWR GSPE estimates conducted during 1999–2011.

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. Range approximations were variable based on knowledge of the area. 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 fall trend count area (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 staff from the Koyukuk NWR, Kanuti NWR, and the Bureau of Land Management. Due to low snow and poor survey conditions, no TCA or GSPE surveys were conducted by ADF&G in RY12.

Twinning Surveys

Twinning surveys were flown in late May and early June to determine the proportion of moose cows with twin calves among all cows with calves in the Huslia Flats and Kanuti Flats areas. Observation 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 and early June 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

ADF&G initiated a cooperative moose distribution and movements study in Units 24A and 24B in 2008 (Stout 2010) and continued participation during RY09–RY12. 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 through March 2013, when the study was terminated.

HARVEST AND OTHER MORTALITY

Hunting mortality and harvest distribution were monitored through the statewide harvest reporting system using general season harvest tickets, registration 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 drawing and registration permits and did not report were sent an e-mail notification if they provided an e-mail address, 2 reminder letters, and called via telephone between letters. Names of hunters who possessed drawing and registration permits were withdrawn from the following year's drawing and registration permit hunts if they did not report their hunt activity. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were archived using ADF&G's Wildlife Information Network (WinfoNet) and accessed 27 March 2014. These data were summarized by regulatory year. Meat salvage assessment was previously described in Stout 2012a.

Predation was evaluated using interviews with trappers, field observations, and aerial wolf reconnaissance surveys conducted in cooperation with U.S. Fish and Wildlife Service during RY09–RY11 (Stout 2012b).

HABITAT

No habitat assessment or enhancement was conducted during RY09–RY13.

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

Units 24A and 24B. The RY10, RY11, and RY13 estimates were not significantly different from the RY07 or RY08 estimates (Table 1). In the RY10 Kanuti GSPE survey, we classified 409 moose, and estimated a total of 1,068 moose (±11.5%; 90% confidence interval [CI]; 0.39 moose/mi^2) on the Kanuti NWR in Unit 24B, not including an SCF. In the 2011 GSPE survey, we classified 316 moose, and estimated 797 moose (±19.3%; 90% CI; 0.29 moose/mi^2) in the same area, not including an SCF. In the 2013 GSPE survey, we classified 259 moose, and estimated 551 moose (±25.7%; 90% CI; 0.20 moose/mi^2) in the same area, not including an SCF. Results from the RY13 survey were not evaluated using the Bayesian method for trend analysis at the time of this report. However, the unbiased estimate of 551 moose (±25.7%; 90% CI) in RY13 was not significantly different from the RY11 estimate. The RY13 survey had lower precision due to low sample size, and survey conditions were subjectively rated low by observers. Therefore, I interpreted the Unit 24B population estimate, with the RY13 survey included, to be unchanged from the 2010 estimate (Stout 2010). I estimated the RY12 moose population in Units 24A and 24B to be 3,567 observable moose (±980) based on the RY10, RY11, and RY13 GSPE surveys in Unit 24B and data reported in Stout (2010).

The multiplicative mixed effects model for 1999–2011 indicated the population was stable (λ = 1.00; Fig. 1; B. Taras, ADF&G Biometrician, memorandum, 21 March 2012, Fairbanks) for the Kanuti survey area. In the Middle Fork TCA, moose density without a sightability correction factor (SCF) was relatively unchanged at 0.87 moose/mi^2 in RY08 and 0.81 in RY11 (Table 2).

The upper Koyukuk management area estimates in Unit 24B did not change significantly during RY10–RY13 (Table 3).

Unit 24C. I estimated the RY12 moose population to be 562 observable moose (±130) based on the 2007 GSPE data (Tables 4 and 5; Stout 2012a).

Unit 24D. During RY11–RY12, moose were numerous, based on previous surveys and inference from TCAs in the Koyukuk River lowlands in Unit 24D (1.5–4.3 moose/mi^2, Tables 6–8). Based on recruitment parameters, the population probably began to stabilize beginning around 2003–

2004 (Stout 2010). I estimated the RY12 moose population to be 4,380 moose (±477; Table 5) based on the 2010 and 2011 GSPE surveys and estimates reported in Stout (2012a).

All of Unit 24. Surveys through RY11 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, based on the addition of extrapolated population estimates previously reported (Stout 2010) and estimates reported for each subunit (Table 5). Because the RY13 survey indicated no change in the Kanuti moose population estimate, no change will be made to the Unit 24B estimate. Because no other surveys were conducted, the Unit 24 population estimate of 8,509 observable moose ±1,587 (6,922–10,096) at the end of RY12 was the same as the estimate at the end of RY10.

Population Composition

Population composition from TCA (Tables 2 and 6–8) and GSPE surveys (Tables 1, 3, and 4) conducted during RY11–RY13 throughout Unit 24 were highly variable. Generally, moose density trends in TCAs corroborated GSPE 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 RY11–RY13 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. GSPE 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 2). 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 RY11–RY13. 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 6, 7, and 8) bull:cow ratios were typically lower than the GSPE composition data (Tables 1 and 3–5). This can likely be explained by the influence of accessibility and higher hunting pressure in higher density moose areas in Unit 24D compared to lower hunting pressure in Units 24A and 24B (Tables 1 and 3–5). 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. Combined averages for Huslia Flats and Treat Island TCAs in Unit 24D indicated calf recruitment to 5 months of age had dropped in the 4 surveys of RY09–RY13 $\bar{x}$ = 20.5 calves:100 cows; compared to the 4 surveys of RY04–RY07 $\bar{x}$ = 27.8 calves:100 cows. Yearling recruitment in 2011 and 2013 (2-yr $\bar{x}$ = 9 yearling bulls:100 cows) appeared lower compared to 2004–2006 (3-yr $\bar{x}$ = 11 yearling bulls:100 cows). Because yearling bull:cow ratios were low in RY10 and RY13, it indicated that overwinter survival of the remaining calves was poor. 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 survey on the Kanuti NWR in Unit 24B in RY08, RY10, RY11, and RY13 indicated that recruitment to 5 months of age averaged 41.8 calves:100 cows and recruitment to 17 months of age averaged 10.6 yearling bulls:100 cows.

Twinning Surveys. Radio collars deployed in March 2008 in the upper Koyukuk River drainage in Units 24A and 24B combined, allowed us to obtain adequate sample sizes in 2008–2012. Results indicated high twinning rates (6-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–RY12. 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 during RY11 and RY12 and reflected various moose densities and consumptive use patterns.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24B all drainages of the Koyukuk river upstream from the Henshaw Creek drainage, excluding the North Fork Koyukuk River drainage.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Remainder Unit 24B.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep 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

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Remainder of Unit 24C.		
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
Remainder of Unit 24D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull by drawing permit only; up to 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 Koyukuk CUA 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 during RY02–RY08 were reported in Stout (2010).

At the 2010 spring meeting, the Board of Game adopted a 15 December–15 April season in portions of Unit 24B and 24C, eliminated the 1–10 December season in those areas, and reduced the size of the Kanuti controlled use area by 298 mi^2. At the 2012 spring meeting, the board adopted a wolf predation control plan for Unit 24B to improve moose survival.

Intensive Management — All of Unit 24 has a positive finding for intensive management (IM) and the objectives in regulation [5AAC 92.108] for RY11–RY12 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

An IM plan [5AAC 92.124(c)] was adopted by the Alaska Board of Game at the 2012 meeting which prescribed wolf predation control to increase moose calf and yearling survival in a 1,360 mi^2 portion of Unit 24B. The IM plan for moose in Unit 24B was developed based on the recommendation of Koyukuk River Fish and Game Advisory Committee and at the request of the board. The IM plan and the operational plan (ADF&G 2012) included information and recommendations from a feasibility assessment prepared by the Alaska Department of Fish and Game (Alaska Department of Fish and Game 2011) and recommendations by the board following public comment at the March 2011 board meeting. The Unit 24B wolf predation control activities are an experimental treatment to evaluate whether 1) wolf control in a focused area can allow reallocation of moose mortality from predators to humans and 2) whether moose harvest per unit effort is a feasible response metric at low moose density. Under the IM plan, wolf predation control to improve moose survival was initiated in spring 2013. Implementation of the IM plan [5AAC 92.124(c)] is directed by the IM operational plan (ADF&G 2012). An annual report was submitted to the board at the spring 2014 meeting (ADF&G 2014).

Harvest by Hunters. Annual reported harvest during RY03–RY12 averaged 168 moose (128–202, Table 13). Harvest reported under potlatch, ceremonial, and cultural and education permits averaged 5.3 moose/year during RY03–RY12. Unreported harvest and 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 RY11–RY12 Unit 21D moose management report (Stout 2014).

Federal harvest during RY00–RY03 averaged 4.8 moose/year, increased to 13.6 moose/year during RY04–RY08, 11 moose in RY09, and 0 moose in RY10. At the time of this report no federal harvest data from Unit 24 were available for RY11–RY13. There were 4 federal moose hunts in Unit 24 (FM2402, FM2403, FM2405, and FM2406). 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 — There were 6 drawing hunts in the Koyukuk CUA (DM823, DM825, DM827, DM828, DM829 and DM830), 2 outside the Koyukuk CUA in Unit 24D (DM892 and DM896), and 2 registration permits (RM832 and RM834) (Tables 14–16). Results of the RM834 permit are reported in the Unit 21D report (Stout 2014). There were 2 drawing hunts in Unit 24A (DM920 and DM922). Average rates for successfully drawing a Dalton Highway corridor management area permit were relatively high during RY11–RY13, at 11% for DM920 and 31% for DM922. However, hunting success rates were low at 9% north of Slate Creek (DM920) and 13% 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 RY03–RY12 $\bar{x}$ = 44% of harvest was in the first half of September and $\bar{x}$ = 55% was in the second half of September.

Hunter Residency and Success. Assessing harvest success rate trends has become increasingly problematic in Unit 24 since RY04. Based on harvest reports, the average annual number of moose hunters was 415 during RY03–RY12; 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 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.

Transportation Methods. During RY11–RY12, boats continued to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 19). Highway vehicles were used only on the Dalton Highway where it crosses eastern Unit 24. Snowmachines were the main transportation method used during winter, but were likely underreported because most of the unreported harvest occurs during winter.

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 Units 24B and 24C (Stout 2010). No monitoring activity occurred during RY11–RY12.

CONCLUSIONS AND RECOMMENDATIONS

The development and initiation of the IM program in Unit 24B was the focus of management activities in Unit 24 during RY11–RY13. The response of the Unit 24B moose population to wolf removal will be monitored by calf and yearling survival of radiocollared moose and GSPE moose surveys. Moose were radiocollared in spring 2012, fall 2012, and fall 2013. Harvest and hunter effort in the communities of Alatna and Allakaket will be monitored through household surveys conducted by ADF&G-Division of Subsistence, and general harvest will continue to be monitored through the statewide harvest monitoring program. Household surveys were conducted after the September moose seasons in fall RY11, RY12, and RY13. The wolf predation control program will continue through RY17.

Without current ADF&G-Division of Subsistence survey data in the remainder of Unit 24, it was not certain 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).

Completion of the moose telemetry study in Units 24A and 24B was an important accomplishment in RY12 and data from that study has improved our understanding of population dynamics and distribution in this low-density portion of Unit 24. Analysis and reporting of that telemetry data will continue in RY13 and RY14.

During RY11–RY13 we completed population estimates for the Koyukuk NWR in central Unit 24D, the upper Koyukuk management area, 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 of infrequent high intensity surveys provided accurate composition and population estimates, and improved the confidence intervals for all survey years when estimates were smoothed. This strategy provided 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 once every 5 years on the Kanuti NWR.

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 seventh consecutive reporting period. We achieved the objective to provide for an adequate moose harvest without exceeding 360 moose or a 5% harvest rate (RY12 estimated harvest rate = 4.0%). We also achieved the objective to provide for hunting opportunity that did not exceed 500 hunters.

The long-term objective to implement at least 2 habitat enhancement activities was not achieved during RY06–RY12. We will continue to encourage land managers to liberalize fire management options and implement habitat enhancement activities, but habitat manipulation will be removed from our objectives because it is unlikely to be accomplished.

In RY11 and RY12 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 (0.0% in RY11, 0.0% in RY12), and the average number of days hunters stayed in the field with their meat was less than 2.9 days. Therefore, the meat care objective was met.

Finally, we discontinued our program to monitor and evaluate the number of people engaged in nonconsumptive activities due to poor public participation and interest.

In RY11 and RY12, we did not meet IM population objectives for any of the subunits in Unit 24 (Table 5). In RY11–RY12, our total harvest including estimated unreported harvest for Unit 24 also failed to meet the combined Unit 24 IM harvest objective of 500 moose (RY11 = 304 moose, RY12 = 339 moose).

MANAGEMENT OBJECTIVES

Activity 2 of Goal 1, Objective 2 will be removed in the next reporting period. Funding and methods to accomplish monitoring social and environmental impacts on private lands are unlikely to be available in the foreseeable future.

Goal 2 will be removed in the next reporting period. There have been no habitat enhancement projects in Units 21D or 24 and it is unlikely that resources will be available to do so in the foreseeable future.

Goal 4 will be removed in the next reporting period, due to poor public participation and interest.

Therefore, management goals, objectives, and activities for the next reporting period are as follows:

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: 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: 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.

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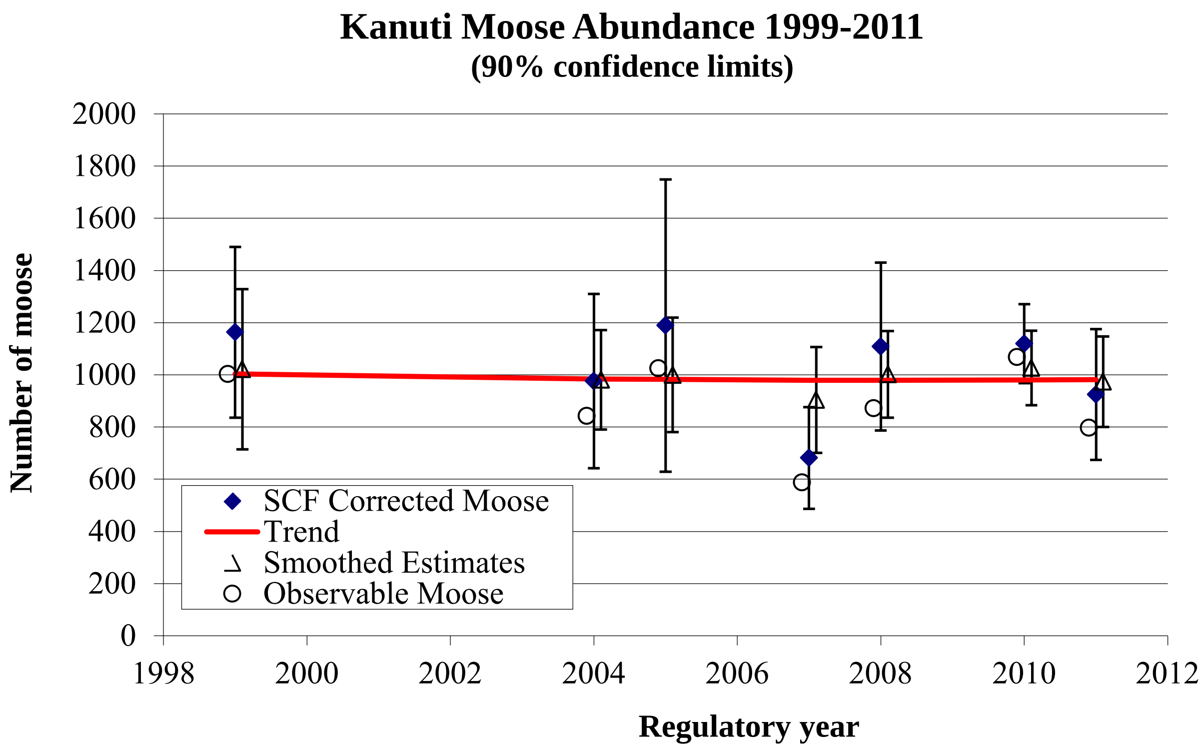

Figure 1. Unit 24 Kanuti National Wildlife Refuge moose density estimates from GSPE surveys and smoothed estimates fitted to the modeled regression line, indicating a stable population for regulatory years[a] 1999–2011. The 2008 (1.272) and 2010 (1.048) sightability correction factors (SCF) were based 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.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1999 = 1 July 1999–30 June 2000).

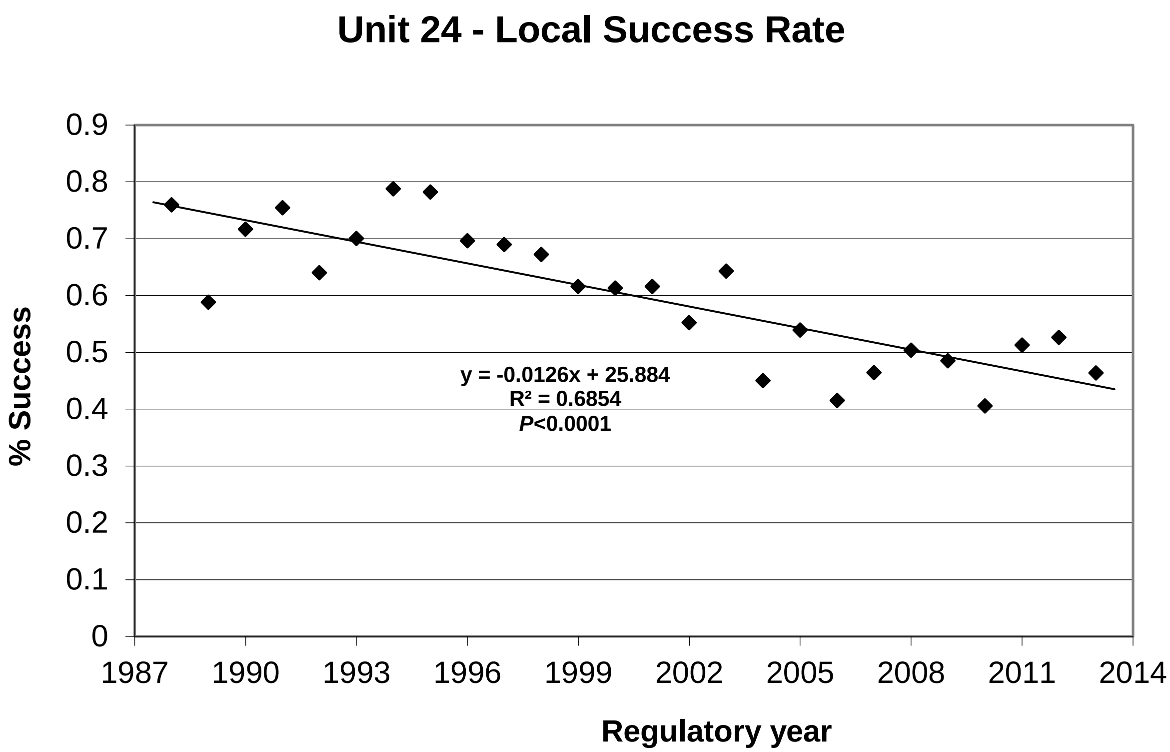

Figure 2. Unit 24 moose harvest success rate by Unit 24 local resident hunters, regulatory years[a] 1988–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1988 = 1 July 1988–30 June 1989).

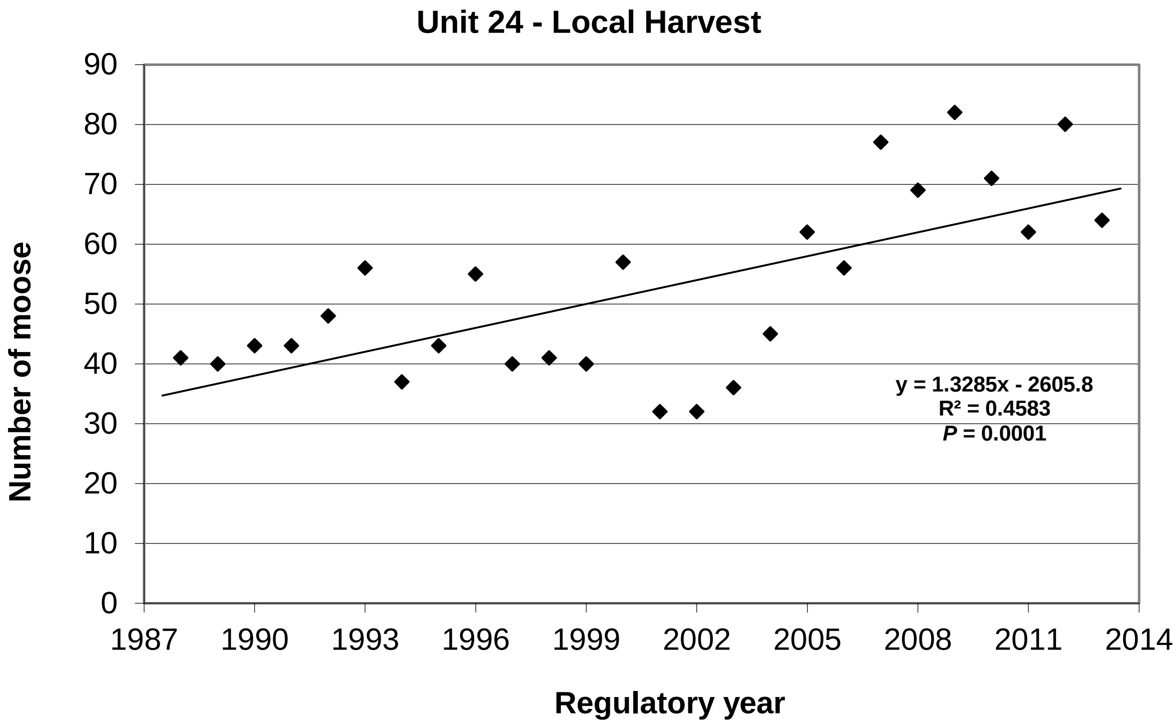

Figure 3. Unit 24 moose harvest reported by Unit 24 local residents, regulatory years[a] 1988–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1988 = 1 July 1988–30 June 1989).

Table 1. Unit 24B Kanuti National Wildlife Refuge population estimation surveys, regulatory years[a] 1989–2013.

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[b])	Moose/mi^2
1989[c]	2,615	64	17	4	9.2		1,172 (±25.1%)	0.45
1993[c]	2,644	61	33	8	17.0		2,010 (±22.0%)	0.76
1999[c]	2,714	61	28	4	14.7	858	1,003 (±20.8%)	0.37
2004[c]	2,710	62	46	9	20.7	650	842 (±28.6%)	0.31
2005[d,e]	2,710	70	43	20	19.7	810	1026 (±43.3%)	0.38
2007[d]	2,715	60	53	13	24.7	451	588 (±21.4%)	0.22
2008[d]	2,715	46	58	14	28.5	624	872 (±23.3%)	0.32
2010[d]	2,715	51	33	8	17.5	861	1,068 (±11.5%)	0.39
2011[d]	2,715	69	41	10	19.9	656	797 (±19.3%)	0.29
2013	2,715	65	36	11	19.6	466	551 (±25.7%)	0.20

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1989 = 1 July 1989–30 June 1990).
[b] Confidence interval (% ±).
[c] Martin and Zirkle (1996), Gasaway (1986) survey estimate with sightability correction factor (1.00 in 1989; 1.17 in 1993).
[d] GSPE survey estimate, without sightability correction factor.
[e] Lawler et al. (2006).

Table 2. Unit 24A Middle Fork trend count area aerial moose composition counts, regulatory years[a] 1987–2011.

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	78	49	5	21	0	13	104	1.33
2000	77	13	0	43	10	27	62	0.81
2001	77	36	9	18	0	12	34	0.44
2002	77	0	0	33	0	25	24	0.31
2003	113	23	9	24	0	16	104	0.92
2004	113	38	6	22	0	14	110	0.97
2005	113	33	5	14	0	11	86	0.76
2007	113	41	5	25	15	15	101	0.89
2008	113	40	13	18	0	11	99	0.87
2011	113	21	5	30	6	20	92	0.81

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1987 = 1 July 1987–30 June 1988).

Table 3. Unit 24B upper Koyukuk management area[a] geospatial population estimation surveys, regulatory years[b] 2010–2013.

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[c])	Moose/mi^2
2010[d]	1,340	52	34	8	18.3	328	405 (±23.9%)	0.30
2011[d]	1,340	103	49	8	18.8	250	324 (±29.0%)	0.24
2013	1,340	67	37	11	17.4	243	300 (±31.4%)	0.22

[a] Area partially overlaps Kanuti National Wildlife Refuge survey area.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).
[c] Confidence interval (% ±).
[d] Without sightability correction factor.

Table 4. Units 24C and 24D geospatial population estimation (GSPE) survey, regulatory year 2007[a].

Area	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[b])	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
GSPE calculated total	4,295	75	43	14	19.4	1,239	1,545 (±10.6%)	0.36

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2007 = 1 July 2007–30 June 2008).
[b] Confidence interval (% ±).

Table 5. Unit 24 total population estimation summary, regulatory years[a] 2004–2011.

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate without sightability correction factor[b]
Units 24A and 24B[c]					
2008 Estimated	8,779				1,929±550
2004–2011 Survey block avg, (Kanuti NWR)[d]	2,715	508	60:100	46:100	885±130
Moose habitat Unit 24, North[e]	3,402				595±200
Remainder Unit 24, North[f]	3,150				158±100
Subtotal (2004–2011)	18,046				3,567±980
Unit 24C[c]					
2007 Survey block (Hogatza River)	2,672	498	70:100	45:100	562±129 (90% CI)
Subtotal (2007)[d]	2,672				562±130
Unit 24D[g]					
2011 Survey block (lower Koyukuk)[d]	1,843	336	38:100	23:100	2,627±210 (90% CI)
2007 Survey block (eastern Koyukuk refuge)[d]	1,623	296	78:100	42:100	983±93 (90% CI)
2010 Survey block (western Koyukuk refuge)[d,h]	1,361	249	79:100	28:100	640±139 (90% CI)
Remainder Unit 24D	523				130±35
Subtotal (2007–2011)	5,350				4,380±477
Unit 24 – Total	26,068				8,509±1,587

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).
[b] Values following (±) symbol without a 90% CI designation are range approximations and are not statistically derived confidence intervals.
[c] 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).
[d] GSPE survey.
[e] The estimated area of Units 24A and 24B that could potentially support moose year-round, based primarily on occurrence of rocky slopes, altitude, and deciduous canopy.
[f] The area remaining in Units 24A and 24B with very little year-round moose habitat, primarily the high altitude mountainous portion within Gates of the Arctic National Park.
[g] Unit 24D (5,350 mi^2) was formerly defined as Management Zone 1 (Stout 2006).
[h] Survey results provided by Koyukuk National Wildlife Refuge.

Table 6. Unit 24D Dulbi Slough trend count area aerial moose composition counts, regulatory years[a] 1982–2011[b].

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	35.0	45	5	7	0	4.5	111	3.2
1983	39.0	17	8	33	14	22.5	113	2.9
1984	48.1	19	8	20	6	14.6	130	2.7
1985	54.2	19	9	10	0	7.7	170	3.1
1989	48.7	53	7	23	18	13.1	298	6.1
1996	86.4	24	8	37	1	23.0	443	5.1
1999	89.0	11	3	22	5	16.1	411	4.6
2001	132.8	24	8	28	0	18.2	280	2.1
2004	132.8	28	16	40	11	23.7	389	2.9
2006[c]	149.4	23	7	53	15	30.1	436	2.9
2011	132.8	47	10	32	9	17.6	204	1.5

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1982 = 1 July 1982–30 June 1983).
[b] 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).
[c] Low snow year.

Table 7. Unit 24D Huslia River flats trend count area aerial moose composition counts, regulatory years[a] 1983–2013[b].

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	80.0	36	7	23	3	14.6	212	2.7
1985	64.5	45	17	10	25	6.7	254	3.9
1989	38.2	50	2	30	7	16.7	90	2.4
1993	80.2	81	15	24	8	11.8	483	6.0
1997	80.2	58	15	24	9	13.2	438	5.5
2000	80.2	35	3	17	4	11.2	259	3.2
2001	125.9	38	9	16	0	10.0	603	4.8
2003	136.8	36	10	29	4	17.7	623	4.6
2004	142.3	38	16	33	7	19.1	768	5.4
2005	142.3	31	14	23	4	15.0	752	5.3
2006[c]	142.3	40	12	37	11	20.8	811	5.7
2007	142.3	38	13	33	5	19.4	684	4.8
2008	142.3	35	11	29	7	14.5	509	3.6
2009	142.3	34	13	19	6	12.4	693	4.9
2010	142.3	33	8	30	4	18.2	632	4.4
2011	125.9	42	15	24	3	14.6	541	4.3
2013	125.9	31	6	21	2	13.6	433	3.4

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1983 = 1 July 1983–30 June 1984).
[b] 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).
[c] Low snow year.

Table 8. Unit 24D Treat Island trend count area aerial moose composition counts, regulatory years[a] 1985–2013[b].

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	41.0	35	13	17	5	10.9	192	4.7
1993	40.3	39	11	25	7	15.1	317	7.9
1998	67.1	25	6	19	2	13.5	379	5.7
1999	67.1	21	5	15	11	10.8	279	4.2
2000	67.1	16	4	13	5	10.0	430	6.4
2001	163.3	23	4	9	2	7.1	604	3.7
2003	174.1	27	9	21	4	14.3	762	4.4
2004	168.7	29	7	30	9	18.9	800	4.7
2005	168.7	25	9	14	9	10.2	566	3.4
2006[c]	168.7	35	8	30	5	18.2	740	4.4
2007	163.3	29	11	22	10	14.4	711	4.4
2008	163.3	29	13	20	4	13.1	724	4.4
2009	163.3	34	11	11	11	7.7	689	4.2
2010	163.3	39	7	21	5	12.7	688	4.2
2011	163.3	36	7	18	3	11.8	601	3.7
2013	163.3	29	5	20	3	13.5	496	3.0

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1985 = 1 July 1985–30 June 1986).
[b] 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).
[c] Low snow year.

Table 9. Unit 24D moose aerial twinning surveys in the combined areas of Huslia Flats and Treat Island areas, regulatory years[a] 2001–2011.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date(s)
2001		17	2	11	3	29 May–1 Jun
2002	144	53	22	29	41	28–30 May
2003	58	55	23	29	34	29 and 30 May
2004[c]	30	21	12	36	13	27 May
2005	36	40	27	40	32	28 and 29 May
2006	31	40	8	17	21	28 and 29 May
2007	47	38	18	32	22	28 and 29 May
2008	97	37	13	26	29	28–30 May
2009[d]	51	41	10	20	12	29 and 30 May
2010	34	38	15	28	24	28 and 29 May
2011	74	47	13	22	14	29 and 30 May

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).
[b] Percent of cows with calves that had twins.
[c] Extensive flooding and early leaf-out, so survey flight path was "high-graded" to maximize observations.
[d] Early leaf-out.

Table 10. Unit 24D moose aerial twinning surveys in the Dulbi Slough area, regulatory year[a] 2005.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date
2005	16	18	16	47	10	29 May

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[b] Percent of cows with calves that had twins.

Table 11. Unit 24C moose aerial twinning surveys in the Hogatza River, regulatory year[a] 2006.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date
2006	7	1	2	n/a	1	30 May–1 Jun

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).
[b] Percent of cows with calves that had twins.

Table 12. Units 24A and 24B combined moose aerial twinning surveys in the Kanuti–Alatna–Middle Fork Koyukuk rivers, regulatory years[a] 2006–2012.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date(s)
2006	4	3	1	n/a	0	30–31 May
2007[c]	n/a	32	17	35	n/a	27–31 May
2008[c]	n/a	19	28	60	n/a	29–31 May
2009[c,d]	n/a	15	21	58	n/a	28–30 May
2010[c,e]	n/a	34	20	37	n/a	31 May–2 Jun
2011[c]	n/a	25	27	52	n/a	31 May–2 Jun
2012[c]	27	28	21	43	n/a	30 May–1 Jun

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).
[b] Percent of cows with calves that had twins.
[c] Sample from radiocollared cows.
[d] Early leaf-out.
[e] Including 1 cow with 3 calves.

Table 13. Unit 24 moose hunter harvest, regulatory years[a] 1997–2013.

Regulatory year	Harvest by hunters				Unreported harvest[b]	Potlatch/ Stickdance[c]	Total
	Bull	Cow	Unk	Total			
1997	168	10	2	180	100	n/a	280
1998	213	17	0	230	100	n/a	330
1999	228	10	2	240	100	n/a	340
2000	211	7	1	219	100	n/a	319
2001	183	5	1	189	96	4	289
2002	186	4	0	190	99	1	290
2003	149	5	1	155	90	10	255
2004	127	1	0	128	99	1	228
2005	162	0	0	162	95	5	262
2006	141	0	0	141	140	5	286
2007	199	3	0	202	135	10	347
2008	168	1	0	169	136	9	314
2009	183	3	3	189	144	1	334
2010	179	0	2	181	143	2	326
2011	158	0	1	159	141	4	304
2012	190	0	4	194	139	6	339
2013[d]	154	0	0	154	141	4	299

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Unreported harvest based on ADF&G-Subsistence Division's door-to-door survey and other sources.
[c] Includes reported potlatch, stickdance, ceremonial, and cultural permit harvest.
[d] Preliminary data.

Table 14. Units 21D and 24 Koyukuk controlled use area moose harvest by permit hunt, regulatory years[a] 2002–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls	(%)	Cows	(%)	Unk	Total harvest
RM832	2002	359	49	51	17	145	(100)	0	(0)	0	145
	2003	401	45	55	12	155	(99)	0	(0)	2	157
	2004	399	38	62	8	141	(100)	0	(0)	0	141
	2005	411	37	63	9	132	(100)	0	(0)	0	132
	2006	382	42	58	7	142	(99)	0	(0)	1	143
	2007	349	41	59	8	131	(100)	0	(0)	0	131
	2008	341	53	47	6	168	(99)	1	(1)	0	169
	2009	429	48	52	9	187	(100)	0	(0)	0	187
	2010	418	47	53	7	181	(100)	0	(0)	1	182
	2011	405	47	53	9	174	(100)	0	(0)	0	174
	2012	394	48	52	7	174	(100)	0	(0)	1	175
	2013[c]	469	46	54	6	204	(100)	0	(0)	0	204
DM823	2005	2	100	0	0	2	(100)	0	(0)	0	2
	2006	2	50	50	0	1	(100)	0	(0)	0	1
	2007	2	100	0	0	2	(100)	0	(0)	0	2
	2008	4	75	25	0	3	(100)	0	(0)	0	3
	2009	4	100	0	0	4	(100)	0	(0)	0	4
	2010	7	29	71	0	2	(100)	0	(0)	0	2
	2011	7	43	57	0	3	(100)	0	(0)	0	3
	2012	6	100	0	17	5	(100)	0	(0)	0	5
	2013[c]	6	83	17	0	5	(100)	0	(0)	0	5
DM825	2005	3	100	0	33	2	(100)	0	(0)	0	2
	2006	4	100	0	0	4	(100)	0	(0)	0	4
	2007	4	100	0	0	4	(100)	0	(0)	0	4
	2008	6	100	0	33	4	(100)	0	(0)	0	4
	2009	4	50	50	0	2	(100)	0	(0)	0	2
	2010	7	86	14	0	6	(100)	0	(0)	0	6
	2011	7	83	17	0	5	(100)	0	(0)	0	5

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2012	6	100	0	0	6 (100)	0 (0)	0	6
	2013[c]	6	100	0	17	5 (100)	0 (0)	0	5
DM827	2002	20	69	31	35	9 (100)	0 (0)	0	9
	2003	26	37	63	19	7 (100)	0 (0)	0	7
	2004	5	75	25	20	3 (100)	0 (0)	0	3
	2005	3	100	0	33	2 (100)	0 (0)	0	2
	2006	3	100	0	66	1 (100)	0 (0)	0	1
	2007	3	100	0	66	1 (100)	0 (0)	0	1
	2008	4	50	50	50	1 (100)	0 (0)	0	1
	2009	4	50	50	50	1 (100)	0 (0)	0	1
	2010	7	17	83	14	1 (100)	0 (0)	0	1
	2011	7	75	25	43	3 (100)	0 (0)	0	3
	2012	6	17	83	0	1 (100)	0 (0)	0	1
	2013[c]	6	75	25	33	3 (100)	0 (0)	0	3
DM828	2002	79	55	45	56	17 (100)	0 (0)	0	17
	2003	103	60	40	48	27 (100)	0 (0)	0	27
	2004	20	57	43	55	4 (100)	0 (0)	0	4
	2005	20	44	56	55	4 (100)	0 (0)	0	4
	2006	20	60	40	50	6 (100)	0 (0)	0	6
	2007	20	80	20	75	3 (75)	1 (25)	0	4
	2008	32	56	44	50	9 (100)	0 (0)	0	9
	2009	32	69	31	50	11 (100)	0 (0)	0	11
	2010	54	65	35	43	20 (100)	0 (0)	0	20
	2011	54	75	25	48	21 (100)	0 (0)	0	21
	2012	47	60	40	36	18 (100)	0 (0)	0	18
	2013[c]	48	52	48	52	12 (100)	0 (0)	0	12
DM829	2002	20	100	0	45	11 (100)	0 (0)	0	11
	2003	26	62	38	12	13 (100)	0 (0)	0	13
	2004	5	33	67	40	1 (100)	0 (0)	0	1

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls	(%)	Cows	(%)	Unk	Total harvest
	2005	2	0	100	50	0	(0)	0	(0)	0	0
	2006	2	100	0	0	2	(100)	0	(0)	0	2
	2007	2	100	0	0	2	(100)	0	(0)	0	2
	2008	4	75	25	0	3	(100)	0	(0)	0	3
	2009	4	50	50	0	2	(100)	0	(0)	0	2
	2010	7	67	33	14	4	(100)	0	(0)	0	4
	2011	7	50	50	43	2	(100)	0	(0)	0	2
	2012	6	75	25	33	3	(100)	0	(0)	0	3
	2013[c]	6	100	0	50	3	(100)	0	(0)	0	3
DM830	2002	79	84	16	38	41	(100)	0	(0)	0	41
	2003	103	76	24	36	44	(100)	0	(0)	0	44
	2004	20	57	43	60	4	(100)	0	(0)	0	4
	2005	20	73	27	45	8	(100)	0	(0)	0	8
	2006	20	47	53	32	9	(100)	0	(0)	0	9
	2007	20	100	0	30	14	(100)	0	(0)	0	14
	2008	32	86	14	56	12	(100)	0	(0)	0	12
	2009	32	70	30	25	16	(100)	0	(0)	0	16
	2010	54	73	27	39	24	(100)	0	(0)	0	24
	2011	54	89	11	31	33	(100)	0	(0)	0	33
	2012	47	78	22	43	21	(100)	0	(0)	0	21
	2013[c]	47	88	12	32	28	(100)	0	(0)	0	28
Total	2002	557	54	46	27	223	(100)	0	(0)	0	223
	2003	659	50	50	22	246	(100)	0	(0)	2	248
	2004	449	38	62	13	153	(100)	0	(0)	0	153
	2005	461	40	60	15	150	(100)	0	(0)	0	150
	2006	433	44	56	12	165	(100)	0	(0)	1	166
	2007	400	46	54	13	157	(99)	1	(1)	0	158
	2008	423	56	44	14	200	(99)	1	(1)	0	201
	2009	509	51	49	13	223	(100)	0	(0)	0	223

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2010	554	50	50	14	238 (100)	0 (0)	1	239
	2011	541	53	47	16	241 (100)	0 (0)	0	241
	2012	512	51	49	13	228 (100)	0 (0)	1	229
	2013[c]	588	51	49	13	260 (100)	0 (0)	0	260

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).

[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] Preliminary data.

Table 15. Units 24C and 24D Huslia River and Hogatza River drainages moose harvest by permit hunt, regulatory years[a] 2004–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM892	2004	32	89	11	72	8 (100)	0 (0)	0	8
	2005	32	64	36	31	14 (100)	0 (0)	0	14
	2006	32	60	40	53	9 (100)	0 (0)	0	9
	2007	35	73	27	26	19 (100)	0 (0)	0	19
	2008	35	39	61	34	9 (100)	0 (0)	0	9
	2009	35	62	38	40	13 (100)	0 (0)	0	13
	2010	35	29	71	20	8 (100)	0 (0)	0	8
	2011	28	56	44	43	9 (100)	0 (0)	0	9
	2012	22	38	62	41	5 (100)	0 (0)	0	5
	2013[b]	35	38	62	63	5 (100)	0 (0)	0	5
DM896	2004	54	35	65	31	13 (100)	0 (0)	0	13
	2005	54	48	52	57	11 (100)	0 (0)	0	11
	2006	54	18	82	80	2 (100)	0 (0)	0	2
	2007	60	43	57	63	9 (100)	0 (0)	0	9
	2008	31	44	56	39	8 (100)	0 (0)	0	8
	2009	48	43	57	48	10 (100)	0 (0)	0	10
	2010	47	56	44	47	14 (100)	0 (0)	0	14
	2011	60	52	48	58	12 (100)	0 (0)	0	12
	2012	60	45	55	33	18 (100)	0 (0)	0	18
	2013[b]	39	50	50	49	10 (100)	0 (0)	0	10

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).
[b] Preliminary data.

Table 16. Unit 24A Dalton Highway corridor management area moose harvest by permit hunt, regulatory years[a] 2002–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM920	2002	20	0	100	30	0 (0)	0 (0)	0	0
	2003	20	0	100	40	0 (0)	0 (0)	0	0
	2004	20	9	91	45	1 (100)	0 (0)	0	1
	2005	20	6	94	20	1 (100)	0 (0)	0	1
	2006	20	33	67	55	3 (100)	0 (0)	0	3
	2007	20	15	85	35	2 (100)	0 (0)	0	2
	2008	20	0	100	20	0 (100)	0 (0)	0	0
	2009	20	13	87	25	2 (100)	0 (0)	0	2
	2010	20	36	64	45	4 (100)	0 (0)	0	4
	2011	20	19	81	20	3 (100)	0 (0)	0	3
	2012	20	8	92	35	1 (100)	0 (0)	0	1
	2013[b]	20	0	100	20	0 (100)	0 (0)	0	0
DM922	2002	50	12	88	29	4 (100)	0 (0)	0	4
	2003	50	14	86	54	3 (100)	0 (0)	0	3
	2004	50	8	92	46	2 (100)	0 (0)	0	2
	2005	50	21	79	42	6 (100)	0 (0)	0	6
	2006	50	12	88	32	4 (100)	0 (0)	0	4
	2007	50	3	97	24	1 (100)	0 (0)	0	1
	2008	50	6	94	30	2 (100)	0 (0)	0	2
	2009	50	9	91	30	3 (100)	0 (0)	0	3
	2010	51	8	92	49	2 (100)	0 (0)	0	2
	2011	50	3	97	30	1 (100)	0 (0)	0	1
	2012	50	33	67	46	9 (100)	0 (0)	0	9
	2013[b]	50	3	97	38	1 (100)	0 (0)	0	1

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Preliminary data.

Table 17. Unit 24 moose harvest chronology percent by month/day, regulatory years[a] 1997–2013.

Regulatory	Harvest chronology percent by month/day				
year	9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	*n*
1997	49	46	1	4	170
1998	49	47	0	5	219
1999	43	52	0	4	231
2000	46	49	0	4	205
2001	37	60	2	2	179
2002	43	55	0	2	174
2003	48	48	0	5	145
2004	46	54	0	1	123
2005	34	66	0	0	152
2006	44	56	0	1	128
2007	36	60	0	4	191
2008	44	56	0	0	159
2009	44	53	0	3	184
2010	42	58	0	0	178
2011	46	54	0	0	158
2012	51	49	0	0	192
2013[b]	41	59	0	0	150

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Preliminary data.

Table 18. Unit 24 moose hunter residency and success, regulatory years[a] 1997–2013[b].

Regulatory year	Successful: Local[c] resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Unk	Successful: Total	Unsuccessful: Local[c] resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Unk	Unsuccessful: Total	Total hunters
1997	40	97	41	2	180	18	81	20	0	119	299
1998	41	125	59	5	230	20	120	25	2	167	397
1999	40	119	77	4	240	25	143	39	3	210	450
2000	57	124	38	1	220	36	141	55	0	232	452
2001	32	101	48	1	182	20	181	57	0	258	440
2002	32	90	68	0	190	26	130	56	2	214	404
2003	36	76	35	8	155	20	104	50	10	184	339
2004	45	51	29	2	127	55	139	35	1	230	357
2005	62	73	24	2	161	53	145	38	1	237	398
2006	56	66	20	0	142	79	152	32	1	264	406
2007	77	89	36	0	202	89	170	30	0	289	491
2008	69	69	30	1	169	68	151	40	0	259	428
2009	82	82	24	0	188	87	142	41	5	275	463
2010	71	84	26	0	181	104	118	50	1	273	454
2011	62	68	27	2	159	59	109	29	0	197	356
2012	80	76	35	3	194	72	143	43	1	259	453
2013[d]	64	60	30	0	154	74	106	30	5	215	369

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] 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.
[c] Unit resident only.
[d] Preliminary data.

Table 19. Unit 24 moose harvest percent by transport method, regulatory years[a] 1997–2013.

Regulatory year	Harvest percent by transport method								n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1997	19	1	51	7	6	1	11	6	178
1998	17	0	62	2	4	0	10	5	230
1999	17	1	56	3	4	0	18	1	240
2000	16	0	61	3	4	1	14	2	220
2001	19	1	62	2	3	0	14	0	182
2002	18	1	69	1	2	0	7	2	190
2003	19	1	69	1	5	0	5	1	155
2004	19	0	59	2	1	0	17	2	127
2005	7	1	75	1	0	0	13	4	161
2006	9	3	69	1	1	2	11	4	142
2007	15	1	70	2	4	2	7	0	201
2008	16	1	70	2	1	1	8	1	167
2009	12	0	72	5	0	0	4	7	185
2010	14	1	74	4	0	0	6	1	180
2011	16	1	69	5	0	1	5	3	159
2012	16	1	72	3	0	1	7	1	191
2013[b]	12	1	82	3	0	1	1	0	153

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Preliminary data.

SPECIES
MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
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CHAPTER 34 MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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, ADF&G Area Wildlife Biologist, circa 1998). However, moose density continues to be low compared with many other areas of Interior Alaska. Recent population trends in Units 25A and 25B are not well understood. 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, and have been stable at lower densities since then.

In Unit 25D, a few population surveys were conducted in the late 1970s, and more extensive surveys began in 1981 when the Alaska Department of Fish and Game (ADF&G) established a Fort Yukon area office. In the 1980s and 1990s trend count surveys and stratified random sampling were used by ADF&G and the U.S. Fish and Wildlife Service (FWS) to estimate population density. Estimates ranged from a low of 0.1 moose/mi^2 in the western Yukon Flats in 1984 to a high of 0.64 moose/mi^2 in the eastern Yukon Flats in 1989.

State regulations for moose hunting have changed little over the past decade in Units 25A and 25B. In Unit 25A, seasons were either 1–20 September or 5–25 September with an any bull bag limit for residents and an antler restricted bag limit (50-inch antlers or at least 4 brow tines on one side) for nonresidents. For most of Unit 25B, the resident moose hunting season was 5–25 September and 1–15 December with an any-bull bag limit. The nonresidents season was 5–25 September with an antler restricted bag limit (50-inch antlers or at least 4 brow tines on one side). In the upper Porcupine River drainage, the season was changed in 2003 from 20–30 September for residents and nonresidents to 10–25 September. A community harvest permit hunt (CM001) was established in 2003 for most of Unit 25B with a bag limit of any bull and a season during 5–25 September and 1–15 December.

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

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 status 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 = 1 July 1990 through 30 June 1991) a Tier II permit hunt was established because the harvestable surplus was deemed insufficient to support all subsistence uses, and restrictions were thought to be necessary. During most of the 1990s, 125 permits and 3 hunting seasons were 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–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 and implemented in 1990–1991. In 2000 the board also approved a regulation that established a community harvest permit program for part of Unit 25D East. The board established the Chalkyitsik Community Harvest Area (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.

Separate survey areas have been conducted in Units 25D East and 25D West by ADF&G and FWS, respectively. Since 1999, population surveys were conducted by ADF&G and FWS using geospatial population estimators (GSPE) described by Ver Hoef (2001, 2008) and Kellie and DeLong (2006). From 1999 to 2009, estimated densities from fall surveys have ranged from 0.18 to 0.41 moose/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).

MANAGEMENT DIRECTION

Unit 25D has 7 communities (Beaver, Birch Creek, Chalkyitsik, Circle, Fort Yukon, Stevens Village, and Venetie). Residents of those communities have historically and continue to harvest moose as their primary wild food resource (Van Lanen et al. 2012). The importance of moose to those communities and other Alaska residents, despite historically low moose densities, resulted in moose being identified as an intensive management (IM) species for Unit 25D. Therefore, management goals and objectives for Unit 25D and eastern Unit 25B reflect harvest needs for those subunits and most of the Unit 25 moose funding is allocated to monitor or research moose populations in Unit 25D.

During the early to mid-1990s, cooperative effort among ADF&G, FWS, and local residents of Unit 25D resulted in 2 educational videos on moose management in the Yukon Flats emphasizing the adverse effects of shooting cow moose. During this period it also became evident that there was substantial local concern about the status of moose populations; opposition to the taking of cow moose; and support for increased enforcement, biological studies, predator control, and local involvement in moose management. As a result, ADF&G initiated a cooperative effort in 2001 to develop a moose management plan for the Yukon Flats. By 2002 the *Yukon Flats Cooperative Moose Management Plan* (YFCMMP) was completed and endorsed by the Board of Game (ADF&G 2002). The plan was developed under the sponsorship of ADF&G–Division of Wildlife Conservation, in cooperation with the Yukon Flats Fish and Game Advisory Committee through the Yukon Flats Moose Management Planning Committee, an advisory group created specifically for the planning project. Other involved stakeholders included the Council of Athabascan Tribal Governments (CATG), individual tribal governments, FWS–Yukon Flats National Wildlife Refuge, FWS–Office of Subsistence Management, and other interested users of the Yukon Flats moose resource. This effort focused on community and agency initiatives that together could maintain or increase moose abundance, especially in key hunting areas near local communities, as well as the interest of nonlocal hunters and other interested parties. 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 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 FWS lands and focused on the feasibility of increased wolf and bear harvest on smaller private lands surrounding villages in order to increase moose survival. 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 YFCMMP.

During 2008–2011, ADF&G conducted an IM feasibility assessment to evaluate the efficacy of implementing an IM plan in western Unit 25D. The assessment used data from existing monitoring programs conducted by ADF&G and FWS and implementation of new programs in coordination with the Beaver Tribal Council 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) eliminate illegal and potlatch harvest of cow moose. The results of the feasibility assessment concluded that public-based efforts to reduce black bear, brown bear, and wolf abundance to levels sufficient to improve moose survival was not currently possible. In addition, department-based predator control was not permitted on federal land which accounts for most of western Unit 25D. As a result, current management direction focuses on monitoring moose population status and improving harvest reporting rates to provide for maximum sustained harvest. Caikoski (2012) provides a more comprehensive description of the results of the feasibility assessment.

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 from 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 25B since the late 1980s. Composition surveys have occasionally been conducted in a small portion of eastern Unit 25A since 1991. The survey area consists of the riparian habitat upstream of Bear Mountain in the Coleen drainage and the riparian habitat upstream of Double Mountain in the Sheenjek drainage. Survey methods have varied slightly between years, especially with respect to search time and aircraft type, but generally consist of surveying most of the available moose habitat, counting the total number of moose observed, and classifying observed moose as adult bull, yearling bull, calf, or cow. Most surveys were conducted by the FWS, with the exception of 2012 when ADF&G conducted the Coleen portion of the survey and FWS conducted the Sheenjek portion of the survey.

Unit 25D East Survey Area and Methods

No population estimation or composition surveys were conducted in Unit 25D East during RY11 or RY12 due to poor survey conditions. However, surveys of Unit 25D East have been regularly conducted over the past decade. Caikoski (2008, 2010) provide survey area descriptions and methods for surveys conducted in prior years.

Unit 25D West Survey Area and Methods

FWS conducted a moose population survey in fall 2010 and in spring 2013 in the western portion of Unit 25D using GSPE described by Ver Hoef (2001, 2008) and Kellie and DeLong (2006). Survey area descriptions and methods for both surveys are described by Lake (2010, 2013).

Unit 25D Extrapolated Population Estimate Methods

The estimated moose population size for all of Unit 25D was obtained by extrapolating the estimated density range from the Unit 25D East survey area across the remainder of Unit 25D East (10,750 mi^2) and by extrapolating the estimated density range from the Unit 25D West survey area across the remainder of Unit 25D West (6,750 mi^2). The extrapolated densities for Units 25D East and 25D West were then converted to total moose for each respective area and summed to obtain the total observable moose population for Unit 25D. The observable moose population estimate was expanded upward to account for sightability. For Unit 25D East, the most recent fall survey results occurred in 2007 and were used. For Unit 25D West, the 2008 fall survey was used because a high proportion of survey units were surveyed and precision was good compared to the most recent survey which occurred in 2010.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Units 25A and 25B. No population surveys were conducted in Unit 25A or Unit 25B in RY11 or RY12. The total number of moose observed while conducting composition surveys suggest that moose abundance may have declined in the upper Sheenjek and Coleen river drainages in eastern Unit 25A during the late 1980s and early 2000s and have stabilized at lower numbers since the early 2000s (Table 1). However, these surveys were not designed to estimate moose abundance. 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 during RY11 or RY12. 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, 2012).

Unit 25D West – FWS Survey. No population estimation surveys were conducted during RY11 or RY12. 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 FWS is described by Lake (2008, 2010).

Unit 25D Totals. Based on the most current estimated moose density range (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 estimated moose density range (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 Units 25D East and 25D 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, memorandum 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 composition surveys were conducted in Unit 25B in RY11 or RY12. ADF&G and FWS conducted a composition survey in a small portion of eastern Unit 25A in fall 2012. The composition survey resulted in a high bull:cow ratio (122 bulls:100 cows) and moderate summer calf survival and yearling recruitment (Table 1). Moderate to low harvests related to logistic limitations in this remote area suggest that hunting has had a minor effect on bull:cow ratios.

Unit 25D. No composition surveys were conducted during RY11 or RY12. 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 result 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, FWS 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 ongoing study of moose radiocollared in the Old Crow Flats by the Yukon Department of Environment 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 RY11–RY12.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25A, within the DHCMA.		
RESIDENT HUNTERS: 1 bull by bow and arrow only, by drawing permit.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by bow and arrow only, by drawing permit.		1 Sep–25 Sep
Unit 25A, remainder.		
RESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		5 Sep–25 Sep
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

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25D West.		
RESIDENT 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 or emergency orders during RY11 and RY12.

Harvest by Hunters. The annual reported moose harvest in Unit 25A was 43 in RY11 and 45 in RY12, similar to previous years (Table 4). Slightly fewer moose were reported harvested in Unit 25B (32 and 25 moose) but harvest was similar to prior years for that unit (Table 5).

In Unit 25D East, reported moose harvest was 24 in RY11 and 25 in RY12, including 1 cow reported taken in RY11 (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 (Van Lanen et al. 2012). 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 25B. Subsistence household surveys were not conducted in RY11 or RY12; however, we assume harvest levels by residents of Unit 25D during RY11 and RY12 were similar to those estimated by ADF&G in 2008 and 2009.

Permit Hunts. Seventy-five permits were available annually in Unit 25D West for TM940; however, this permit hunt is often undersubscribed. In RY11, 75 permits were issued and in RY12 only 32 permits were issued. Reported harvests were 7 moose in RY11 and 4 in RY12 (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.

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 in Unit 25B.

Hunter Residency and Success. In Unit 25A, Alaska residents composed 56% of moose hunters during RY11 and RY12, consistent with prior years (Table 8). Total hunters and success rates remained similar to prior years with 95 and 97 hunters in RY11 and RY12, respectively, with success rates of 45% in RY11 and 46% in RY12. In Unit 25B, residents composed ≥86% of hunters during RY11 and RY12, consistent with prior years (Table 9). Total hunters in RY11 and RY12 were 77 and 76, respectively, and represent a decline of 15–25% compared to the previous 10 years (Table 9). However, success rates for hunters in Unit 25B remained similar to previous years at 33–42% (Table 9). The total number of hunters in Unit 25D East during RY11 and RY12 were 93 and 100 hunters, respectively, and success rate was 30% in both regulatory years. Both the number of hunters and success rates increased during the past 4 regulatory years compared to the early and mid-2000s (Table 10). However, it is likely that both increases are a result of an improvement in reporting by local residents of the unit.

Harvest Chronology. Most moose harvest in Unit 25A, Unit 25B, and Unit 25D occurred during the second and third weeks of September during RY11 and RY12 and remained consistent with previous years (Tables 11, 12, and 13). Because the hunting season opens on 5 September (Unit 25A and 25B) or 10 September (Unit 25D) and closes on 25 September (Units 25A and Unit 25B) or 20 September (Unit 25D), few moose are harvested during the first week or fourth week of September. Too few moose were reported in Unit 25D West to determine harvest chronology.

Transport Methods. Aircraft were the most common transport method in Unit 25A, used by 86% of successful hunters in RY11 and 68% in RY12. Boats were used by most of the remaining successful hunters (Table 14). Transport methods remained consistent in Unit 25A during RY11 and RY12 compared to RY02–RY10 and reflect difficulty in accessing this unit due to the absence of roads. Boats were used by 86% and 85% of successful hunters in Units 25B and 25D East, respectively, during RY11 and RY12, consistent with prior years (Tables 15 and 16). Too few moose were reported in Unit 25D West to determine transport methods, but boats were likely the most common method.

HABITAT

Assessment and Enhancement

Empirical observations and habitat surveys indicated that the upper Yukon River valley provides excellent moose habitat in Units 25A, 25B, and 25D. Moose in Unit 25D appear to be well below carrying capacity and are in excellent nutritional condition as indexed by relatively high pregnancy and twinning rates (Bertram and Vivion 2002, Boertje et al. 2007).

Habitat surveys in 2000 indicated that moose browsing intensity is low in both riparian and upland sites and 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 2 fires in excess of 150,000 acres combined occurred in 2009. During 2010–2013, wildfires burned approximately 375,000 acres.

CONCLUSIONS AND RECOMMENDATIONS

UNITS 25A AND 25B

Although few moose surveys have been conducted 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 and has stabilized at lower densities since 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.

UNIT 25D

Moose densities in the Yukon Flats have been historically low and are among the lowest population densities found among low density moose–bear–wolf systems (Gasaway et al. 1992). Sources and extent of adult moose mortality is poorly documented in the Yukon Flats. However, Bertram and Vivion (2002) observed 87% annual survival rates for radiocollared adult cows from 1998 to 2000. These estimates are similar to or lower than other studies of moose populations in Interior Alaska (Keech and Boudreau 2006, Boertje et al. 2009). Predation accounted for most sources of the mortality in all Interior Alaska studies. Survey data for the Yukon Flats indicate adult cow mortality remains higher than would be expected from predation alone (ADF&G 2002). Efforts by local hunters, tribal and village governments, and state and federal agencies resulted in development and implementation of 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. 2013). 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 management actions that are expected to result in moderate changes in population size (Kellie 2011).

UNITS 25A, 25B, AND 25D MANAGEMENT OBJECTIVES

We likely did not 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 did not conduct a systematic household harvest survey in coordination with ADF&G-Division of Subsistence for communities in Unit 25D in RY11 or RY12. However, estimates of harvest in 2008 and 2009 were obtained and are considered representative of current harvest rates.

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 during RY11 or RY12, 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. Unit 25A winter aerial composition counts, 1989–2012.

Year	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Moose observed
1989[a]	n/a	n/a	n/a	367
1991[a]	90	16	36	314
2000[a]	100	25	38	150
2002[a]	88	6	48	124
2012[b]	122	15	34	105

[a] Unpublished data from U.S. Fish and Wildlife Service.
[b] Unpublished data from U.S. Fish and Wildlife Service and ADF&G (Fairbanks).

Table 2a. Summary of moose geospatial population estimates (GSPE)[a] in Unit 25D, 1999–2013.

Location and survey year	Survey area (mi²)	Strata size (mi²)		Area searched (mi²)		Total search area (mi²)	No. of moose estimated by stratum and density (moose/mi²)		Population estimate ±90% CI	Average density (moose/mi²)	No. of sample units counted
		Low	High	Low	High		Low	High			
Unit 25D East											
1999 GSPE	2,936	1,828	1,108	175	366	541	229/0.13	596/0.54	829±20%	0.28	102
2000 GSPE	2,936	1,639	1,297	218	375	594	368/0.22	359/0.28	726±25%	0.25	112
2001 GSPE	2,936	1,612	1,324	186	419	605	52/0.03	487/0.37	514±27%	0.18	115
Mar 2004 GSPE	2,936	1,649	1,286	187	413	600	53/0.03	324/0.25	382±20%	0.13	113
2004 GSPE	2,936	1,607	1,329	175	424	599	138/0.08	648/0.49	773±17%	0.26	113
2005 GSPE	2,936	1,548	1,388	202	440	642	428/0.27	552/0.38	1008±20%	0.34	121
2006 GSPE	2,936	1,548	1,388	181	440	620	206/0.13	593/0.43	799±17%	0.27	117
2007 GSPE	2,936	1,538	1,398	181	403	584	178/0.12	408/0.29	585±23%	0.20	110
Birch Creek Survey[b]											
2006 GSPE	3,630	2,295	1,335	195	277	472	495/0.21	237/0.18	732±33%	0.20	87
Venetie Survey[b]											
2004 GSPE	2,858	1,623	1,235	109	204	313	105/0.06	413/0.33	551±60%	0.19	60
2005 GSPE	2,858	1,638	1,219	115	418	533	71/0.04	280/0.23	423±32%	0.15	101
Unit 25D West[c]											
Mar 1999 GSPE	2,269	1,714	554	253	264	517	318/0.19	422/0.76	735±17%	0.32	96
1999 GSPE	2,269	1,444	825	156	345	501	295/0.20	567/0.69	862±19%	0.38	93
2000 GSPE	2,269	1,281	987	124	371	495	124/0.10	553/0.56	670±24%	0.30	
2001 GSPE	2,269	1,374	865	205	334	539	161/0.12	506/0.56	668±24%	0.29	100
Mar 2003 GSPE	2,269	1,682	587	194	264	458	156/0.09	383/0.65	508±29%	0.22	85
Mar 2004 GSPE	2,269	1,720	548	216	274	490	310/0.19	319/0.57	632±20%	0.28	91
2004 GSPE	2,299	1,569	700	151	350	501	198/0.13	298/0.43	511±25%	0.29	93
2006 GSPE	2,269	1,612	656	172	350	522	n/a	n/a	417±21%	0.18	97
2008 GSPE	2,269	1,493	776	393	544	937	n/a	n/a	490±13%	0.22	174
2010 GSPE	2,269	1,326	943	178	340	518	n/a	n/a	440±28%	0.19	96
Mar 2013 GSPE	2,269	1,294	976	178	367	545	n/a	n/a	460±21%	0.20	101

[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 U.S. Fish and Wildlife Service–Yukon Flats National Wildlife Refuge (Bertram and Vivion, FWS–YFNWR, 1999–2004 unpublished moose survey reports; Bertram 2007, unpublished moose survey report; and Lake 2008, unpublished moose survey report).

Table 2b. Summary of moose geospatial 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 Mgmt Area Survey								
2008	536	268	182±15%	0.34	54	7	35	50
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 geospatial population estimate (GSPE) surveys in Unit 25D, 1999–2010.

Survey year and area (mi²)	Bulls:100 cows	Yearling 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
2010 (2,269)	35	5	32
Beaver Survey			
2008 (536)	54	7	35
2009 (536)	33	5	37

Table 4. Unit 25A reported moose harvest, regulatory years[a] 2002–2012.

Regulatory year	Reported[b] harvest			
	M	F	Unk	Total
2002	49	0	0	49
2003	36	0	0	36
2004	29	0	0	29
2005	52	0	1	53
2006	44	0	0	44
2007	32	0	0	32
2008	47	0	0	47
2009	45	0	1	46
2010	42	0	1	43
2011	43	0	0	43
2012	45	0	0	45

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25A moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).

Table 5. Unit 25B reported moose harvest, regulatory years[a] 2002–2012.

Regulatory year	Reported harvest[b]			
	M	F	Unk	Total
2002[c]	34	0	0	34
2003[d]	23	0	0	23
2004	26	0	0	26
2005	26	0	0	26
2006	35	0	0	35
2007	37	0	0	37
2008	36	0	0	36
2009	38	0	0	38
2010	26	0	0	26
2011	32	0	0	32
2012	25	0	0	25

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25B moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[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[a] 2002–2012.

Regulatory year	Reported harvest[b]			
	M	F	Unk	Total
2002[c]	24	0	0	24
2003[d]	12	0	0	12
2004	8	0	0	8
2005	23	0	0	23
2006	16	0	0	16
2007	15	0	0	15
2008	18	1	0	19
2009	23	1	0	24
2010	25	0	0	25
2011	23	1	0	24
2012	25	0	0	25

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25D East moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[c] Includes 11 moose taken in Chalkyitsik community harvest permit hunt.
[d] 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[a] 2002–2012.

	Tier II permit hunt (TM940)								
Regulatory year	Permits issued	Successful hunters (%)	Unsuccessful hunters (%)	Did not hunt (%)	Did not report (%)	Bulls (%)	Cows (%)	Total harvest	Federal harvest permit
2002	49	4 (20)	16 (80)	23 (47)	6 (12)	4 (100)	0 (0)	4	7[b]
2003	51	4 (29)	10 (71)	30 (59)	7 (14)	4 (100)	0 (0)	4	–[b]
2003	51	3 (23)	10 (77)	31 (61)	7 (14)	3 (100)	0 (0)	3	26[c]
2004	72	1 (6)	15 (94)	29 (40)	27 (38)	1 (100)	0 (0)	1	15[d]
2005	53	7 (24)	22 (76)	22 (42)	2 (4)	7 (100)	0 (0)	7	14
2006	75	2 (11)	17 (89)	56 (75)	0 (0)	2 (100)	0 (0)	2	10
2007	75	2 (11)	16 (89)	57 (76)	0 (0)	2 (100)	0 (0)	2	10
2008	75	0 (0)	20 (100)	55 (73)	0 (0)	0 (0)	0 (0)	0	5
2009	55	2 (9)	20 (91)	29 (53)	4 (7)	2 (100)	0 (0)	2	1
2010	73	11 (37)	19 (63)	32 (44)	11 (15)	11 (100)	0 (0)	11	0
2011	75	7 (25)	21 (75)	37 (49)	10 (13)	7 (100)	0 (0)	7	–[e]
2012	32	4 (25)	12 (75)	15 (47)	1 (3)	4 (100)	0 (0)	4	–[e]

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] No federal harvest reports were received from Stevens Village.
[c] Includes 6 cows reported taken by Stevens Village hunters.
[d] Includes 5 cows reported taken by Stevens Village hunters.
[e] Federal harvest reports unavailable.

Table 8. Unit 25A moose hunter residency and success, regulatory years[a] 2002–2012[b].

	Successful					Unsuccessful					
Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2002	2	20	27	0	49 (43)	3	33	29	0	65 (57)	114
2003	2	9	25	0	36 (39)	5	24	27	0	56 (61)	92
2004	2	7	17	2	28 (33)	3	26	27	1	57 (67)	85
2005	3	24	26	0	53 (56)	3	24	15	0	42 (44)	95
2006	3	20	21	0	44 (37)	3	34	38	0	75 (63)	119
2007	2	16	14	0	32 (27)	1	45	41	0	87 (73)	119
2008	1	17	27	2	47 (42)	0	32	34	0	66 (58)	113
2009	2	29	14	0	45 (43)	3	27	30	0	60 (57)	105
2010	2	22	19	0	43 (39)	1	35	28	2	66 (61)	109
2011	1	17	25	0	43 (45)	3	27	22	0	52 (55)	95
2012	2	24	19	0	45 (46)	0	34	18	0	52 (54)	97

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25A moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[c] Resident of Units 25A, 25B, or 25D.

Table 9. Unit 25B moose hunter residency and success, regulatory years[a] 2002–2012[b].

	Successful					Unsuccessful					
Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2002	1	29	3	0	33 (33)	4	60	2	0	66 (67)	99
2003	5	16	1	1	23 (25)	6	54	9	0	69 (75)	92
2004	3	18	5	0	26 (29)	6	48	10	0	64 (71)	90
2005	12	13	1	0	26 (35)	9	29	10	0	48 (65)	74
2006	13	14	8	0	35 (35)	11	42	11	1	65 (65)	100
2007	4	28	5	0	37 (37)	1	50	11	0	62 (63)	99
2008	6	26	4	0	36 (40)	1	43	10	0	54 (60)	90
2009	7	29	1	1	38 (38)	3	50	5	3	61 (62)	99
2010	4	19	3	0	26 (34)	1	44	5	0	50 (66)	76
2011	4	23	5	0	32 (42)	1	38	4	2	45 (58)	77
2012	1	22	2	0	25 (33)	2	41	7	1	51 (67)	76

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25B moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet); does not include moose taken under the Chalkyitsik community harvest permit during regulatory years 2000–2001 through 2006–2007.
[c] Resident of Units 25A, 25B, or 25D.

Table 10. Unit 25D East moose hunter residency and success, regulatory years[a] 2002–2012[b].

	Successful					Unsuccessful					
Regulatory year	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2002	5	6	1	1	13 (16)	22	32	12	0	66 (84)	79
2003	6	3	3	0	12 (16)	22	34	7	0	63 (84)	75
2004	4	4	0	0	8 (15)	14	25	7	0	46 (85)	54
2005	16	5	1	1	23 (33)	17	23	6	0	46 (67)	69
2006	12	4	0	0	16 (26)	17	21	8	0	46 (74)	62
2007	9	6	0	0	15 (18)	22	39	4	3	68 (82)	83
2008	10	6	3	0	19 (28)	20	24	5	0	49 (72)	68
2009	13	8	4	2	27 (27)	21	43	8	2	74 (73)	101
2010	21	15	0	0	36 (35)	24	37	4	3	68 (65)	104
2011	20	5	1	2	28 (30)	31	31	2	1	65 (70)	93
2012	17	12	0	1	30 (30)	27	35	7	1	70 (70)	100

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25D East moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet); does not include moose taken under the Chalkyitsik community harvest permit during regulatory years 2000–2001 through 2006–2007.
[c] Resident of Unit 25.

Table 11. Unit 25A reported moose harvest chronology percent by month/day, regulatory years[a] 2002–2012[b].

Regulatory year	Harvest chronology percent by month/day						
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5[c]	Unk	*n*
2002	16	47	31	4	0	2	49
2003	0	26	44	24	6	0	34
2004	0	14	55	28	3	0	29
2005	8	40	40	8	0	6	53
2006	0	41	48	9	0	2	44
2007	3	9	50	31	6	0	32
2008	0	15	46	35	4	0	46
2009	7	31	51	9	0	2	45
2010	12	36	45	2	0	5	42
2011	9	47	41	2	0	0	43
2012	14	45	34	5	0	2	44

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25A moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[c] No open season.

Table 12. Unit 25B reported moose harvest chronology percent by month/day, regulatory years[a] 2002–2012[b].

Regulatory	Harvest chronology percent by month/day								
year	Aug[c]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
2002	0	12	36	36	15	0	0	0	33
2003	0	9	36	18	14	9	14	0	22
2004	0	0	12	23	50	15	0	0	26
2005	4	4	38	27	23	0	4	0	26
2006	3	3	23	43	23	3	3	0	35
2007	3	3	22	44	24	0	3	0	36
2008	3	3	31	49	14	0	0	0	35
2009	5	3	49	35	8	0	0	0	37
2010	4	4	8	69	8	0	4	4	26
2011	0	10	29	48	3	3	3	4	31
2012	0	20	32	36	8	0	4	0	25

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25B moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[c] No open season.

Table 13. Unit 25D East reported moose harvest chronology percent by month/day, regulatory years[a] 2002–2012[b].

Regulatory	Harvest chronology percent by month/day							
year	Aug[c]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Unk	*n*
2002	0	0	31	46	15	0	8	13
2003	0	0	0	50	42	8	0	12
2004	0	0	14	57	28	0	0	7
2005	4	9	43	35	9	0	0	23
2006	6	13	19	63	0	0	0	16
2007	0	13	33	40	13	0	0	15
2008	0	5	42	42	11	0	0	19
2009	4	7	37	37	15	0	0	27
2010	6	6	40	37	6	0	5	35
2011	4	11	33	41	7	0	0	27
2012	3	10	40	33	0	10	0	30

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25D East moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).
[c] No open season.

Table 14. Unit 25A moose harvest percent by transport method, regulatory years[a] 2002–2012[b].

Regulatory year	Harvest percent by transport method: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
2002	71	10	18	0	0	0	0	0	0	49
2003	83	8	8	0	0	0	0	0	0	36
2004	69	17	10	0	0	0	0	0	3	29
2005	66	15	11	2	0	0	0	2	4	53
2006	77	2	14	2	0	0	0	0	5	44
2007	69	6	22	0	0	0	0	0	3	32
2008	66	4	21	2	0	0	0	0	6	47
2009	74	2	20	2	0	0	0	0	2	46
2010	67	2	23	2	0	0	0	0	5	43
2011	86	5	7	0	2	0	0	0	0	43
2012	68	5	25	0	0	0	0	0	2	44

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25A moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).

Table 15. Unit 25B moose harvest percent by transport method, regulatory years[a] 2002–2012[b].

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
2002	12	0	82	6	0	0	0	0	0	33
2003	9	3	83	3	0	0	0	0	0	23
2004	15	0	69	4	0	0	0	0	12	26
2005	12	0	85	0	4	0	0	0	0	26
2006	20	0	71	6	3	0	0	0	0	35
2007	19	0	73	3	3	0	0	0	3	37
2008	14	0	81	3	0	0	0	0	3	36
2009	13	0	84	0	0	0	3	0	0	38
2010	27	0	62	0	4	0	4	0	4	26
2011	6	0	91	0	3	0	0	0	0	32
2012	12	0	80	0	0	0	0	0	8	25

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25B moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).

Table 16. Unit 25D East moose harvest percent by transport method, regulatory years[a] 2002–2012[b].

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
2002	15	0	77	0	0	0	8	0	0	13
2003	17	0	83	0	0	0	0	0	0	12
2004	25	0	50	12	0	0	0	0	12	8
2005	9	0	83	4	0	0	0	4	0	23
2006	6	0	75	13	0	0	6	0	0	16
2007	6	0	80	13	0	0	0	0	0	15
2008	11	0	84	5	0	0	0	0	0	19
2009	26	0	67	4	0	0	0	0	4	27
2010	6	6	69	11	3	0	0	0	6	36
2011	7	0	82	0	4	0	4	0	4	28
2012	10	0	87	0	0	3	0	0	0	30

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Source: Unit 25D East moose harvest ticket reports from moose harvest database on ADF&G's Wildlife Information Network (WinfoNet).

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CHAPTER 35: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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, 2008, and 2011. 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), increased to 1,180 in 2008, and declined to 609 moose in 2011 (Trent 1989; Carroll 2012). In trend area counts the number of moose declined from 610 in 2007 to 265 in 2010. In 2011 and 2012 we counted 282 and 284 moose, respectively, indicating that the declining trend may have ended (Carroll 2012).

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, respectively. 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 were marginally deficient

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

in copper. Some of the cows captured in 1996 and 1997 tested positive for antibodies to the bacteria *Brucella suis biovar 4* (8 of 43) and *Leptospira interrogans serovar pomona* (6 of 30). Both diseases cause abortions and weak calves. Relatively high moose populations in the 1980s and early 1990s may have led to 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, resulting in an increase from 152 moose in 1996 to 610 moose in the trend count area in 2007 (Carroll 2008). Recruitment rates declined drastically to 2% in both 2009 and 2010, resulting in a reduction in the trend area count to 265 moose. There was a modest increase in 2011 and 2012 to 11% and 18% and the number in the trend count area slowly increased to 284 (Carroll 2012).

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 1995–1996 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 2002–2010, hunters harvested from 5 to 13 moose annually (Carroll 2012).

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 unitwide 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; we 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.

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.

We are working with another department employee to collect browse samples to assess the quality of moose browse in Unit 26A. Browse samples were 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 summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY11 = 1 July 2011–30 June 2012). 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 6–9 April 2014 and counted a total of 294 moose, including 290 adults and 4 short yearlings (10-month-old calves) for a 1% recruitment rate. This was a 75% decrease from the 2008 census, when we counted 1,180 moose (Table 1, Fig. 1).

Trend area counts were conducted 11–12 April 2012, 2–3 April 2013, and 6–9 April 2014. In 2012, we counted 284 moose, including 233 adults and 51 calves (18% recruitment rate). In 2013, we counted 308 moose, including 260 adults and 48 short yearlings (16% recruitment rate). In 2014, we counted 165 moose, including 164 adults and only 1 calf (1% recruitment rate). These counts indicate that, after declining to 265 moose within the trend count area in

2010, the number slowly grew to 308 moose in 2013, but crashed again to 165 moose in 2014 (Table 2, Figure 2). There was a very late spring in 2013, which resulted in malnourishment, very poor calf survival, and a 47% decline between 2013 and 2014.

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), and declined to 265 moose in 2010 (Table 2, Figure 2).

Population Composition

The percentage of short yearlings counted in spring surveys was very low in 2009 and 2010 (2% both years), but improved to 11% in 2011, 18% in 2012, and 16% in 2013. In 2014 it dropped to 1% (Table 2, Fig. 2).

On spring calving surveys during 9–12 June 2012 we observed 25 collared cows and 9 had no calf, 10 had 1 calf, and 6 had twins (88 calves:100 cows and 38% twins). During 8–12 June 2013 we observed 20 collared cows and 7 had no calf, 11 had 1 calf, and 2 had twins (65 calves:100 cows and 15% twins). The calculated number of calves:100 cows was relatively high in 2012 and midrange in 2013. The percentage of twins was midrange in 2012 and fairly low in 2013 (Table 3).

Fall composition surveys were flown in 2001, 2012, and 2013 (Table 4). During 11–14 Nov 2011 we observed 131 moose within the trend count area, including 43 bulls (67 bulls:100 cows), 64 cows, and 24 calves (38 calves:100 cows, 18% calves). During 3–5 Nov 2012 we observed 168 moose, including 57 bulls (69 bulls:100 cows), 83 cows, and 28 calves (34 calves:100 cows, 17% calves). During the fall of 2013 we surveyed from 8–12 November, but there was very little snow cover and many moose had not moved into the river bottoms. We saw only 58 moose, including 17 bulls (42 bulls:100 cows), 41 cows, and 0 calves (0 calves:100 cows, 0% calves). We also radiotracked and found 14 collared cows. Seven of these were dead and 7 had no calves. All of these moose were alive the previous June and most of them had calves. There was a serious mortality event during the summer of 2013.

Antler widths were estimated for all bulls sighted during fall composition surveys and are summarized in Table 5. With improved calf survival beginning in 2011 there was a modest increase in the percentage of bulls in the smaller antler size age groups.

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.

MORTALITY

Harvest

Season and Bag Limit.

Regulatory year RY11 and RY12	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 Sep (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, except for permit holders under DM980/981, may not use aircraft to transport hunters, hunting equipment, or parts of moose. Aircraft cannot be used to hunt moose in the Anaktuvuk Pass Controlled Use Area.

Board of Game Actions and Emergency Orders (EO). During its January 2014 meeting the Board of Game adopted regulations to lengthen the season for the harvest ticket hunt in the Colville River drainage up-stream from and including the Anaktuvuk River drainage and in Unit 26A Remainder (the rest of the Colville River Drainage and Ikpikpuk River drainage). The season was changed from 1 August–14 September to 1 August–30 September. The board also changed the drawing permit regulation so that 20% of permits would go to nonresident hunters rather than up to 20% going to nonresidents. In response to low moose populations the department issued an EO for RY14 that closed the drawing permit hunts, all nonresident hunts, and the winter hunt. It also shortened the fall harvest ticket hunts on the Colville and Ikpikpuk River drainages to 1 August–14 September.

Hunter Harvest. Hunter harvest and antler size for general season harvest are summarized in Tables 6 and 7. During the reporting period only one cow was harvested and most bulls harvested were over 50 inches.

Permit Hunts. In RY11 for DM980 5 permits were issued but no people hunted. For DM981 5 permits were issued, 4 people hunted, and 4 bull moose were harvested.

In RY12 for DM980 5 permits were issued, 3 people hunted, and 2 bull moose were harvested and for DM981 5 permits were issued, 3 people hunted, and 3 bull moose were harvested.

In RY13 for DM980 5 permits were issued but no people hunted and for DM981 5 permits were issued, 4 people hunted, and 3 bull moose were harvested.

Hunter Residency and Success. Hunter residency is summarized in Table 8. The number of nonlocal resident and nonresident hunters declined because of a reduction in the number of drawing permits issued and due to land access restrictions enforced by the landowner, Arctic Slope Regional Corporation.

Harvest Chronology. Harvest chronology is summarized in Table 9. As in past years, most moose were harvested during the first week of September, with the next highest harvests occurring in the second week of September (RY12) and in August (RY13). One moose was taken during the winter hunt.

Transport Methods. Transportation methods are summarized in Table 10. Most local residents used boats. Nonlocal residents and nonresidents used aircraft. Winter hunters used snow machines.

Other Mortality

After 3 years of slow growth from 265 moose counted in the trend count area in 2010 to 308 in 2013, the number crashed to 165 in 2014. Fall surveys indicated that much of the mortality occurred during the summer of 2013. Winter conditions persisted for 2–3 weeks longer than normal during the spring of 2013 and that was probably a major factor in the die-off.

Wolf predation is often a major factor in moose population fluctuations in Unit 26A. 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 0.1 per hr in 2002 to 3.1 per hr in 2009. The moose population declined during this period of higher wolf density. The wolf sighting rate was 0.5 per hr in 2011, 2.6 wolves per hr in 2012, and 0.8 per hr in 2013.

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 appeared to be a factor in the 2008–2010 population decline. 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 after 3 years.

Thus far, analyses of blood, hair, and fecal samples have not identified causes for increased mortality during the population decline of 2008–2010. 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 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 was 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. Analysis is still in progress but preliminary results indicate that digestible protein quality of *Salix alaxensis* gathered during the winters of 2009 and 2010 along the Colville River was very low compared to other areas of the state (Bill Collins, ADF&G unpublished data).

One factor that could affect browse plants is that there are a large number of snowshoe hares in the area, which also consume willows. Hares often eat bark as well as branch ends from the willows, which may stress the plants causing them to produce more tannins or other substances that may make them difficult to digest and 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 has a large influence on how we manage hunts in this area.

CONCLUSIONS AND RECOMMENDATIONS

After several years of increasing population numbers, riparian zone minimum population censuses indicated that the Unit 26A moose population declined from 1,180 moose in 2008 to 294 moose 2014 (a 75% decline since 2008). Trend area counts completed each year along the Colville, Anaktuvuk, and Chandler rivers in the core area of the moose range indicated that the number of moose in the trend count area grew slowly from 265 moose in 2010 to 308 moose in 2013. However, the population again crashed during 2013–2014 and 165 moose (including only 1 short yearling) were counted in April 2014. A fall composition survey in November 2013 indicated that much of the mortality occurred during the summer of 2013. Winter conditions persisted for 2 to 3 weeks longer than normal during the spring of 2013 and that was probably a major factor in the die-off.

Malnourishment was apparently an issue in the decline from 2008 to 2010. Samples collected in 2008 showed short yearlings were small and malnourished. In 2009 and 2010 samples of blood, hair, and fecal content showed no indication of bacterial diseases contaminants, or parasites that would lead to increased mortality. Nearly all of the samples showed moose 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 have led to mortality.

Browse quantity and/or quality have been examined for sources of malnourishment. Browse removal rates (12%) were similar to other areas in the state with moderate browsing and twinning rates, and the quantity of browse seemed to be adequate to support the population. Preliminary analysis of browse quality from Colville River samples collected in 2009–2010 suggests that digestible protein quality of *Salix alaxensis* was very low compared to other areas of the state, probably leading to malnourishment. 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.

Wolf predation continues to be an important factor in moose population fluctuations. The increasing number of wolves in the area coincided with the declining number of moose and low recruitment from 2008 to 2010. The number of wolves seen during moose surveys began to decline in 2010 and the recruitment number increased, causing the moose population to slowly grow. 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.

Due to the substantial decline in moose numbers, the department issued an EO for RY14 that closed the drawing permit hunts, all nonresident hunts, and the winter hunt. It also shortened the fall harvest ticket hunts on the Colville and Ikpikpuk River drainages to 1 August–14 September. A very limited summer moose hunt in western Unit 26A from 1 July–14 August remains open because very few moose are harvested in this hunt. The situation will be reassessed at the 2016 Board of Game meeting and regulations will be adjusted.

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While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

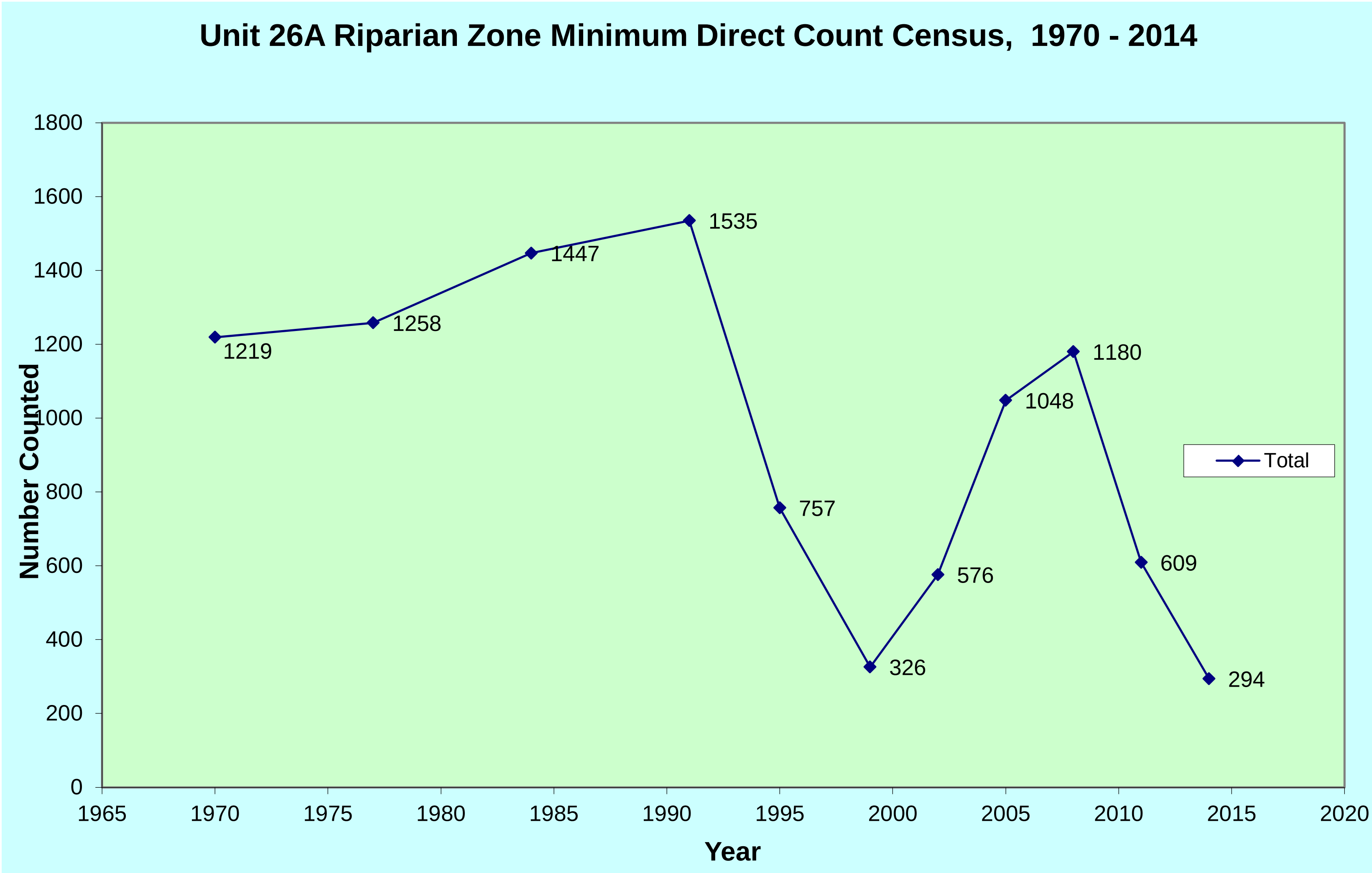

Figure 1. Unit 26A riparian zone minimum direct count census 1970–2014.

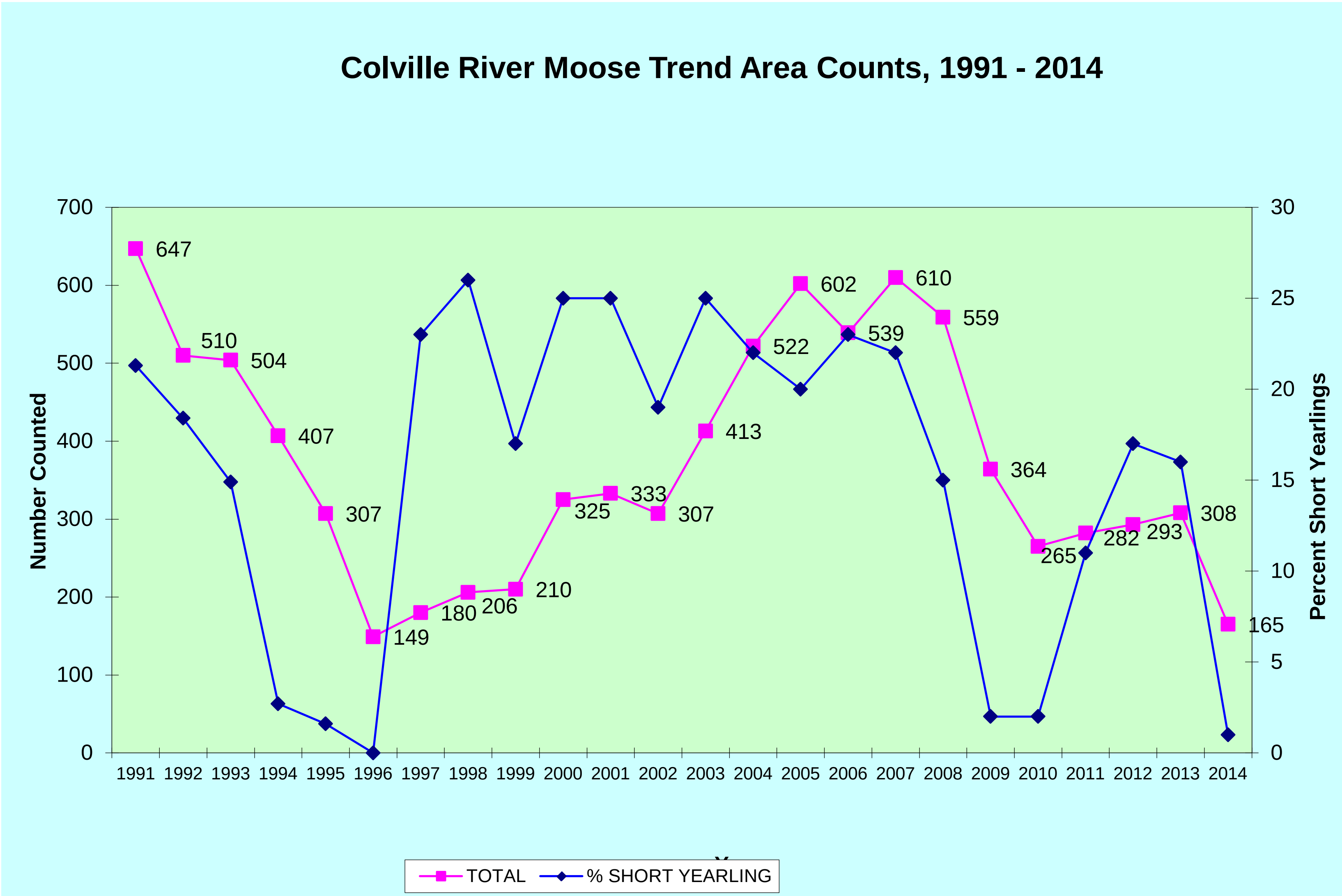

Figure 2. Unit 26A moose trend counts and percentage of short yearlings: Colville River between the mouths of Anaktuvuk and Killik rivers, Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, 1991–2014.

Table 1. Number of adult and 10-month-old calf moose from Unit 26A censuses during April, 1970–2014.

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
2014	290	4	294	1

[a] Includes moose counted on the Itkillik River which is part of the Colville River drainage in Unit 26B. In 2014, there were 14 moose, including 0 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, 1980–1981, and 1983–2014.

Year	Total moose	Adults	Short yearlings	Short yearling (%)
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
2013	308	260	48	16
2014	165	164	1	1

Table 3. Calving surveys of radiocollared cows with twinning rate, June, 1996–2013.

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%
2012	25	88	6	24	38%
2013	20	65	2	10	15%

[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, 1990–2013.

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[a]	70	0	0	34	34
1996	60	44	22	126	161
1997	46	40	22	80	102
1998	64	35	18	131	159
1999	49	52	26	155	209
2001	69	30	15	258	304
2002	52	49	24	253	334
2003	75	57	25	217	288
2004	60	37	19	255	313
2005	66	37	18	188	230
2006	59	40	20	252	316
2007	63	37	18	239	293
2008	69	12	7	231	247
2009	71	13	7	204	219
2010	97	25	11	136	153
2011	67	38	18	107	131
2012	69	34	17	140	168
2013[a]	42	0	0	58	58

[a] Survey incomplete due to late fall conditions.

Table 5. Percent bull moose observed by antler width categories (inches) during fall composition surveys, Unit 26A, 1996–2013.

	Antler width category, percent observed					
Year	<30 in	30–39 in	40–49 in	50–59 in	≥60 in	*N*
1996	0	0	38	45	17	47
1997	4	8	16	48	24	25
1998	13	22	14	31	20	51
1999	18	16	12	28	26	51
2001	13	18	17	32	20	105
2002	15	12	16	25	32	91
2003	10	18	17	29	26	93
2004	24	18	10	38	10	99
2005	19	15	19	25	22	75
2006	18	16	19	26	21	93
2007	21	14	17	25	23	92
2008	20	18	22	29	11	94
2009	8	5	34	41	12	85
2010	10	5	10	51	24	67
2011	5	7	23	46	19	43
2012	12	12	11	37	28	57
2013[a]	18	12	18	28	24	17

[a] Survey incomplete due to late fall conditions.

Table 6. Unit 26A moose harvest, RY90 through RY13.

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
RY11	6	0	6
RY12	8	1	9
RY13	5	0	5

Table 7. Number of bull moose harvested in antler width categories (inches) in Unit 26A, RY96 through RY13.

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
RY11		0	1	0	1	1	3	6
RY12		1	0	0	2	0	5	8
RY13				2	0	3	0	5

[a] Antler size was inadvertently excluded from hunter report cards for the drawing hunt.

Table 8. Moose hunter residency and success, Unit 26A, RY90 through RY13.

	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	UNK[d]	UNK	UNK	UNK	UNK
RY01	4	0	0	0	4	UNK	UNK	UNK	UNK	UNK	UNK
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
RY11	2	3	1	0	6	100	2	3	1	0	6
RY12	4	5	0	0	9	90	4	6	0	0	10
RY13	2	2	1	0	5	50	6	3	1	0	10

[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 (UNK) number of total hunters. Moose population was low and the hunt was restricted.

Table 9. Percent chronology of moose harvest, Unit 26A, RY96 through RY13.

Regulatory year	Harvest periods						
	July	Aug	1–7 Sep	8–14 Sep	15 Feb–15 Apr	Unknown	*N*
RY96[a]	–	–	–	–	–	–	0
RY97[a]		100	–	–	–	–	2
RY98[a]		100	–	–	–	–	5
RY99[a]		100	–	–	–	–	2
RY00[a]	–	–	–	–	–	–	–
RY01[a]		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
RY11			83	17			6
RY12		0	67	22	11		9
RY13		40	60				5

[a] Season open only in August.

Table 10. Percent transport methods for moose harvest in Unit 26A, RY94 through RY13.

	Percent method of transportation					
Regulatory year	Airplane	Boat	3 or 4 wheeler	Snowmachine	ORV	*N*
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
RY11	67	33				6
RY12	56	33		11		9
RY13	60	40				5

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CHAPTER 36: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[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. Predation, as well as hunting, probably contributed to the historical scarcity of moose. During the 1940s to 1950s, populations expanded and became more common and in some places, even abundant, along the limited riparian habitat of major drainages (LeResche et al. 1973). The reduction in wolf numbers by federal control programs during that time period and the movement of Nunamiut people from inland/foothills to coastal locations were 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 total number of moose in Units 26B and 26C probably peaked during the late 1980s at approximately 1,400 moose (Martin and Garner 1984; Mauer and Akaran 1994; Lenart 2004, 2008). 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). Although surveys were not conducted in Unit 26C during the 1990s, we suspected moose numbers were also very low, based on anecdotal observations from residents, biologists, and hunters. Historical survey data for trend count 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. 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 Unit 26C in the Brooks Range in the early 2000s.

[1] At the discretion of the reporting biologist, this unit report may contain 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 regulatory year (RY) 2006 (e.g., RY06 = 1 July 2006–30 June 2007) 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; a 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.

  Activities:

  - Conduct annual surveys during April.
  - 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

A total count in trend count areas, rather than random sampling, is the most effective population survey method on the North Slope due to the limited and relatively open nature of winter moose habitat with its sparse, low vegetation. Moose are limited almost entirely to riparian shrub habitat during winter.

<u>Unit 26B</u>. During RY01–RY13, all surveys in Unit 26B were conducted in April by Alaska Department of Fish and Game (ADF&G) staff using a Piper PA-18 flown at 70–90 mph and/or a

Cessna 185 flown at 95–120 mph, at altitudes of 300–700 feet above ground level. During RY98–RY00, surveys in Unit 26B were conducted during April or May by Arctic National Wildlife Refuge (ANWR) staff in Unit 26B East (see below) and by ADF&G staff in Unit 26B West (see below) using a Cessna 185.

Moose were classified as short yearlings (11-month-old calves) and adults in surveys conducted by ADF&G staff. In 2002, spring surveys were conducted in early May when early antler development on males had initiated. Moose in this year were classified as bulls, cows, and short yearlings. Identification of bulls was likely conservative because we probably misclassified young bulls with little early antler development.

Survey data are reported as Unit 26B East, Unit 26B West (excluding the Itkillik River), Unit 26B West, 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. The geographic areas for each trend count areas and drainages included in the survey are described below:

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). Moose in Unit 26B East are found primarily in the northern foothills of the Brooks Range. The following drainages were surveyed as weather permitted: Sagavanirktok River from Happy Valley to Sagwon, Accomplishment Creek, Lupine River, Saviukviayak River, Flood Creek, Ivishak River, Gilead Creek, Echooka River, Shaviovik River, Juniper–Fin Creek, Kavik River, and Canning River. All of these drainages were surveyed during this report period (RY11 and RY12) and in RY13.

Unit 26B West, excluding the Itkillik River — This area encompasses Unit 26B west of the east bank of the Sagavanirktok River. 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 or as moose habitat disappeared. All of these drainages were surveyed during this report period (RY11 and RY12) and in RY13.

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 in April or May during RY98–RY03. In RY98 a portion of the upper Itkillik (upstream of Itkillik Lake) was also surveyed. Beginning in RY04, we surveyed the Itkillik River in April from its mouth upstream to the headwaters. This area was also surveyed during this report period (RY11 and RY12) and in RY13.

Additional Areas in Unit 26B — During RY05–RY13, we surveyed additional drainages in some years. These included a portion of the upper Canning River upstream of Eagle Creek

(RY05 and RY11–RY13), the upper Sagavanirktok River upstream of Happy Valley to the extent of moose habitat in the upper Sagavanirktok (RY05, RY08–RY13), Oksrukuyik Creek (RY07–RY13), Ribdon River (RY11–RY13), and the Shaviovik River (RY12 and RY13). During this report period (RY11 and RY12) and in RY13, all of the additional areas listed above were surveyed.

Unit 26C. Surveys in Unit 26C were conducted using a Cessna 185 or 206 flown at 95–120 mph, at altitudes of 300–700 feet above ground level. Moose were not classified during the April surveys. Moose were classified as cow, bull, yearling bull, and calf during the early winter surveys.

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, 2011 and 2014. Moose were not classified. 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 River (upstream of and including Drain Creek) and Firth River–Mancha Creek were surveyed by ANWR staff during early winter 1991, 2000, and 2002 and by ADF&G staff in 2011.

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. Twinning surveys were not conducted during this report period (RY11 and RY12).

HARVEST

Harvest and hunting pressure were monitored using harvest and drawing permit reports. One or 2 reminder letters were sent to hunters who did not report. 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.

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.

Unit 26B.

Unit 26B East — During RY11 and RY12, 242 and 176 moose were observed during April surveys, respectively (Table 1). By RY13 the number of moose observed declined to only 41 moose during April surveys. The highest concentrations of moose were found along the Echooka, Ivishak, Kavik, and Canning rivers. Moose numbers had been slowly declining following the peak observed during the mid- to late 2000s when numbers were slightly above 300 moose (Table 1). The peak was preceded by a population decline that occurred in the late 1990s when the lowest numbers of moose observed during April surveys was 146 moose in RY00 (Lenart 2006).

Unit 26B West, excluding the Itkillik River — During RY11 and RY12, 79 and 56 moose were observed during April surveys, respectively (Table 2). By RY13 the number of moose observed declined to only 19 moose during April surveys. Most of the moose observed in Unit 26B West were in the Kuparuk River drainage. Moose numbers peaked during the mid- to late 2000s to 175 moose (Table 2). However, during RY08–RY11 we estimated approximately a 50% decline in observable moose compared to the previous 4 years when the peak had occurred ($\bar{x}$ = 71 moose; Table 2), indicating that the decline was more marked in Unit 26B West. Similar to Unit 26B East, moose in Unit 26B West had experienced a population decline in the early 1990s and recovered during the 2000s (Lenart 2006), until this most recent decline.

Unit 26B West, Itkillik River — During RY11 and RY12, 61 and 57 moose were observed during April surveys, respectively (Table 3). By RY13 the number of moose observed declined to 14 moose during April surveys. Prior to RY13, the number of moose observed in the Itkillik River drainage had remained relatively stable (range: 50–73 moose) during RY04–RY12 (Table 3).

All Unit 26B — During RY11 and RY12, 464 and 396 moose were observed during April surveys, respectively (Table 4). By RY13 the number of moose observed declined to 109 moose during April surveys. Moose numbers peaked during the mid- to late 2000s to 606 moose (Table 4) and gradually declined beginning in RY09 (Table 4). This trend follows the same trends observed in the separate trend count areas analyzed in Unit 26B, with the exception of the Itkillik River drainage. Additionally, moose numbers and recruitment declined in Unit 26A beginning in RY08 (L. S. Parrett, Wildlife Biologist, ADF&G, personal communication, 2011).

Unit 26C.

Central Unit 26C — No surveys were completed during RY11 and RY12. In RY13 only 22 moose were observed in central Unit 26C, indicating the population declined by approximately 50% compared to moose observed during RY02–RY10 when moose numbers were relatively stable ranging 47–61. ANWR staff observed 52 moose in RY02, 47 in RY04, 59 in RY06, 61 in RY07, and 48 in RY10 (E. Wald, USFWS, personal communication, 2014).

Eastern Unit 26C — During this report period, moose were surveyed in RY11 only. A total of 339 moose were observed in eastern Unit 26C in RY11 during an early winter survey in the upper Kongakut River (upstream of and including Drain Creek) and Firth River–Mancha Creek drainages. Results of the 339 moose observed in 2011 included 118 bulls (15 yearling bulls), 169 cows, and 52 calves (Table 5). In the upper Kongakut River, 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 River–Mancha Creek 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 River–Mancha Creek drainage in early winter 2010 to determine if moose numbers increased since the 2002 survey (227 moose) and a complete survey was warranted. A total of 109 moose were observed including 43 bulls (2 yearling bulls), 53 cows, and 13 calves and survey time was 3 hours, 25 minutes. Results of this partial survey indicated there was likely more moose in the eastern Unit 26C in 2010–2011 compared to the early 2000s (Table 5).

No surveys were conducted in eastern Unit 26C during 2003–2009. ANWR staff observed 406 in 1991, 157 in 2000, and 227 in 2002 (Table 5). Direct comparisons between surveys before and after 2010 are problematic due to differences in search time, area searched, survey airplanes, and moose classification protocol; therefore some caution should be taken in interpreting the extent of increase in population size between 2002 and 2011.

Population Composition

Unit 26B.

Unit 26B East — During RY11 and RY12, the proportion of 11-month-old calves (short yearlings) in the population was 7% and 10%, respectively (Table 1). In RY13, no short yearlings were observed. The proportion of short yearlings during RY11 and RY12 was similar to previous years beginning RY08, just before the population began to decline. During RY99–RY07, the proportion of short yearlings was moderately good, ranging 13–22%, except in RY03 when it was 6% (Table 1). During this time period, the population increased and peaked (Table 1).

Bull:cow ratios were not available during RY03–RY12 because surveys were conducted after bulls had shed antlers and prior to early antler development. However, based on surveys conducted prior to 1998 (Mauer 1997, Lenart 2006), bull:cow ratios are likely high (≤60:100). In addition, we observed a high bull:cow ratio of 72:100 during a spring survey in May 2002. This is likely conservative because we probably misclassified young bulls with little early antler development.

Unit 26B West, excluding the Itkillik River — During RY11 and RY12, the proportion of 11-month-old calves (short yearlings) in the population was 21% and 9%, respectively (Table 2). In RY13, no short yearlings were observed. Short-yearling proportions were substantially higher in RY11 (21%) in contrast to proportions observed in Unit 26B East (7%). Otherwise, proportions observed in Unit 26 West were similar to Unit 26B East (Tables 1 and 2).

Bull:cow ratios were not available in Unit 26B West during RY03–RY12 because surveys were conducted after bulls had shed antlers and prior to early antler development. During the May 2002 survey in Unit 26B West, 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.

Unit 26B West, Itkillik River — During RY11 and RY12, the proportion of 11-month-old calves (short yearlings) in the population was 25% and 5%, respectively (Table 3). In RY13 no short yearlings were observed. In RY11 the proportion of short yearlings (24%) was the highest observed since RY03 (Table 3). This was similar to the proportions observed in Unit 26B West.

All Unit 26B — During RY11 and RY12, the proportion of 11-month-old calves (short yearlings) in the population was for the combined survey areas of Unit 26B East, Unit 26B West, Itkillik River drainage, and miscellaneous survey areas was 13% and 9%, respectively (Table 4). In RY13 no short yearlings were observed. These numbers were similar to proportions observed when the areas were analyzed separately. The overall bull:cow ratio in the Unit 26B survey areas in May 2002 was 57:100.

Unit 26C

Central Unit 26C— No data were available on the proportion of short yearlings in central Unit 26C during RY02–RY13 because moose were not classified during spring surveys.

Eastern Unit 26C — During RY11 the bull:cow ratio was 70 bulls:100 cows and the calf:cow ratio was 13 calves:100 cows in the upper Kongakut (upstream from Drain Creek) and the Firth River–Mancha Creek drainages of eastern Unit 26C, indicating bull:cow ratios were good (Table 5). The yearling bull:cow ratio was 11 yearling bulls:100 cows (Table 5). These are lower than ratios observed in 2000 and 2002 when >100 bulls:100 cows and 35 and 24 calves:100 cows and 26 and 21 yearling bulls:100 cows were observed in the population (Table 5). As noted previously, detection of trends in moose composition over time is difficult due to differences in search time, area searched, survey airplanes, and moose classification protocol.

Twinning Rates

No twinning surveys were conducted during RY11 and RY12. 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–RY12 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 a 14-day season during 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 (board) determined that a harvest of 60–80 moose was necessary to satisfy subsistence needs in Unit 26. In March 2006 the board 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 opportunity (ANS) in Unit 26 to 21–48, including 15–30 in Unit 26A, leaving 6–18 moose available to satisfy the ANS in Units 26B and 26C combined. No board actions occurred during December 2007–February 2011.

During the board 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 River–Mancha Creek. The bag limit is 1 bull for residents and 1 bull with 50-inch antlers or 4 or more brow tines on one side for nonresidents. The season for both residents and nonresidents is 1–25 September. This area is on federal land and is currently closed to non-federally qualified hunters. The department requested a federal closure review by the Federal Subsistence Board for the upper Kongakut River and Firth River–Mancha Creek drainages due to new biological information. The Federal Subsistence Board did not lift the closure during their review in 2013. The drawing hunt will be implemented when or if the federal closure is removed.

Emergency orders to open the general moose season in Unit 26B were issued during RY06–RY12. The 14-day season during RY06–RY10 ranged 1–15 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. In RY12 the Federal Subsistence Board granted an emergency special action request and extended the moose season to 14 April and increased the moose harvest quota to 4 by allowing the take of 1 additional moose in Unit 26B remainder.

Harvest by Hunters.

Unit 26B — Moose were reported harvested or hunted under the general hunting season in Unit 26B during RY06–RY12, 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–RY12 ranged 2–11 moose harvested by 4–20 hunters (Table 7). During RY06–RY12, 10 to 25 permits were issued (Table 7).

Hunter Residency and Success. The moose season in Unit 26B was open only to Alaska residents during RY06–RY12. Success rates ranged 25–69% (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−RY12, 67−100% 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 during most years (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).

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). Since RY06, 0–2 moose were harvested annually by federally qualified hunters using federal permits.

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 have also been relatively low in Units 26B and 26C during the same time period.

CONCLUSIONS AND RECOMMENDATIONS

Moose on the eastern North Slope in Unit 26B and central Unit 26C experienced a severe population crash in spring 2014. The population declined by approximately 75% during 2013 to 2014 in Unit 26B with no short yearlings observed in spring 2014. Similarly, the population in central Unit 26C declined by approximately 50% with no short yearlings observed. Moose numbers in eastern Unit 26A also experienced a severe decline in RY13 (G. Carroll, ADF&G, personal communication, 2014). The severe decline from 2013 to 2014 may have been a result of poor nutrition related to a very late spring in 2013, resulting in high adult mortality and little or no recruitment. Predation by wolves on weakened moose may have also contributed as few alternate prey inhabit Unit 26B and central Unit 26C during winter. Some Teshekpuk caribou winter in eastern Unit 26A and western Unit 26B, but most of the Central Arctic caribou herd winters south of the Brooks Range. Moose in Units 26B and 26C inhabit the most northern extent of their range in Alaska, potentially making them more vulnerable to climatic or nutritional stresses. The population began to decline in spring 2010 in both population size and recruitment, indicating that either some nutritional, disease, or climatic factor had initiated a decline. A substantial population decline had occurred previously during the mid- to late 1990s, but not as markedly as this most recent crash (Lenart 2008).

MEETING GOALS AND OBJECTIVES

During RY11 and RY12, we met our first goal of maintaining viable populations of moose in their historic range throughout the region. We met our second goal by continuing to provide an opportunity to harvest moose. Moose were also available for viewing and photographing during RY11 and RY12, our third goal.

We met a portion of our first objective in Unit 26B during RY11 and RY12, 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 10% during RY10–RY12 (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 RY11 and RY12. We do not know if we met the 3-year mean (RY10–RY12) 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 during RY11 and RY12. Based on the high bull:cow ratios observed in early May 2002 (57:100), and little hunting pressure during RY06–RY12, we believe our bull:cow ratios exceeded 35:100 in Units 26B.

RECOMMENDATIONS

The population exceeded 300 moose in the Unit 26B population during the report period; although we did not maintain a 3-year mean proportion of ≥15% short yearlings. For RY13 we initially determined that even during years of low recruitment there is likely a small harvestable surplus and issued 12 drawing permits to Alaska residents for the fall hunt in RY14. Issuance of drawing permits occurred prior to the survey we conducted in April 2014. Because the population experienced a severe decline, we closed all moose seasons in Unit 26B for RY14. We recommend keeping the seasons closed until the population recovers to 300 moose and a harvestable surplus.

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Table 1. Unit 26B East (east of the Sagavanirktok River, including Canning River) aerial moose composition counts[a,b], regulatory years 1998–2013.

Regulatory year	Adults	Short yearlings[c] (%)	Unknown	Moose observed	Search time (hr:min)
1998	129	20 (13)	0	149	
1999[d]	151	14 (8)	0	165	
2000			146	146	
2001	148	22 (13)	0	170	
2002	183	41 (18)	0	224	8:19
2003	219	15 (6)	0	234	8:30
2004	226	62 (22)	0	288	9:12
2005	275	60 (18)	0	335	11:08
2006	267	41 (13)	0	308	10:07
2007[e]	262	47 (15)	0	309	13:50
2008	304	35 (10)	0	339	10:18
2009[e]	234	20 (8)	0	254	12:58
2010	209	12 (5)	0	221	10:44
2011[e]	224	18 (7)	0	242	11:59
2012	159	17 (10)	0	176	10:42
2013	57	0 (0)	0	41	10:19

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).
[b] Data source for regulatory years 1998–2000: F. Mauer, U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.
[c] Short yearlings are 11-month-old calves.
[d] Moose were not circled and examined closely, so some short yearlings may have been identified as adults.
[e] 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[a] 1998–2013.

Regulatory year	Adults	Short yearlings[b] (%)	Unknown	Moose observed	Search time (hr:min)
1998	50	6 (11)	0	56	n/a
1999	34	10 (23)	0	44	n/a
2000	65	5 (7)	0	70	2:35
2001[c]	56	11 (16)	0	67	n/a
2002	119	40 (25)	1	160	2:59
2003	96	21 (18)	0	117	3:30
2004	133	19 (13)	0	152	3:04
2005	125	25 (17)	0	150	3:12
2006	136	39 (22)	0	175	3:55
2007[d]	119	21 (15)	0	140	6:00
2008	77	1 (1)	0	78	3:41
2009	66	4 (6)	0	70	4:18
2010	55	3 (5)	0	58	3:47
2011	62	17 (21)	0	79	3:46
2012	51	5 (9)	0	56	3:04
2013	19	0 (0)	0	19	3:02

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).
[b] Short yearlings are 11-month-old calves.
[c] The Sagavanirktok River was not surveyed.
[d] Longer search time because sightability was poor due to low snow cover.

Table 3. Unit 26B, Itkillik River drainage[a,b] spring aerial moose surveys, regulatory years 1998–2013.

Regulatory year	Adults	Short yearlings[c] (%)	Moose observed	Search time (hr:min)
1998	26	1 (4)	27	2:01
1999	3	0 (0)	3	n/a
2000	3	0 (0)	3	1:05
2001	6	3 (33)	9	n/a
2002	11	2 (15)	13	1:07
2003	19	8 (30)	27	1:03
2004	44	6 (12)	50	1:39
2005	60	6 (9)	66	2:25
2006	47	5 (10)	52	2:05
2007[d]	59	4 (6)	63	3:06
2008	71	2 (3)	73	2:35
2009[d]	66	4 (6)	70	3:38
2010	56	8 (12)	64	2:43
2011	46	15 (25)	61	2:44
2012	54	3 (5)	57	2:44
2013	14	0 (0)	14	2:18

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1998 = 1 July 1998–30 June 1999).
[b] Regulatory years 1998–2003 included the portion below Itkillik Lake to the mouth. Beginning in regulatory year 2004, the area includes the headwaters of the Itkillik River to the mouth.
[c] Short yearlings are 11-month-old calves.
[d] 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[a] 2003–2013.

Regulatory year	Adults	Short yearlings[b] (%)	Moose observed	Search time (hr:min)[c]
2003	334	44 (12)	378	13:03
2004	403	87 (18)	490	13:55
2005[d]	505	101 (17)	606	18:40
2006[e]	477	92 (16)	569	16:19
2007[f]	491	79 (14)	570	25:01
2008[f]	517	47 (8)	564	18:58
2009[f]	421	33 (7)	454	23:54
2010[g]	414	35 (8)	449	20:51
2011[h]	403	61 (13)	464	23:55
2012[i]	360	36 (9)	396	20:52
2013	109	0 (0)	109	20:04

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2003 = 1 July 2003–30 June 2004).
[b] Short yearlings are 11-month-old calves.
[c] Beginning in regulatory year 2005, search time in the upper Itkillik drainage increased. In regulatory year 2007, search time increased because sightability was not good due to low snow cover.
[d] Upper Sagavanirktok and upper Canning rivers surveyed.
[e] Oksrukuyik Creek, small portion of upper Sagavanirktok surveyed.
[f] Upper Sagavanirktok River, and Oksrukuyik Creek surveyed.
[g] Upper Sagavanirktok River, Oksrukuyik Creek, and Ribdon River surveyed.
[h] Upper Sagavanirktok River, Oksrukuyik Creek, Ribdon and upper Canning rivers surveyed.
[i] Upper Sagavanirktok River, Oksrukuyik Creek, Ribdon River, upper Canning and Shaviovik rivers surveyed.

Table 5. Eastern 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[a] 1991–2011.

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[c]	26–27 Oct	105 (176)	21 (36)	38 (167)	63	15	343	406	
2000[c]		118 (73)	26 (16)	35 (62)	22	14	135	157	
2002[c]	21–23 Oct	113 (108)	21 (20)	24 (96)	23	10	204	227	
2011	27 Oct, 7 Nov	70 (118)	11 (15)	31 (169)	52	15	287	339	10:12

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1991 = 1 July 1991–30 June 1992).
[b] First date represents the survey for Firth River–Mancha Creek; second date represents survey for upper Kongakut River.
[c] *Data Source*: Compiled from U.S. Fish and Wildlife Service data.

Table 6. Unit 26B reported general season moose harvest, regulatory years[a] 2006–2012.

Regulatory	Reported harvest				Hunters	Illegal hunters
year	M (%)	F (%)	Unk	Total	(% success)	(harvest)
2006	0 (0)	0 (0)	0	0	0 (0)	1 (0)
2007	0 (0)	0 (0)	0	0	0 (0)	2 (1)
2008	0 (0)	0 (0)	0	0	2 (0)	6 (0)
2009	0 (0)	0 (0)	0	0	0 (0)	1 (0)
2010	1 (100)	0 (0)	0	1	1 (100)	4 (0)
2011	0 (0)	0 (0)	0	0	3 (0)	3 (0)
2012	0 (0)	0 (0)	0	0	4 (0)	2 (0)

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).

Table 7. Unit 26B DM996 permit moose harvest, regulatory years[a] 2006–2013.

Regulatory	No.	DM996 harvest				No. hunters
year	permits	M (%)	F (%)	Unk	Total	(% success)
2006	15	7 (100)	0 (0)	0	7	13 (54)
2007	15	3 (100)	0 (0)	0	3	11 (27)
2008	20	6 (100)	0 (0)	0	6	12 (50)
2009	20	3 (100)	0 (0)	0	3	12 (25)
2010	25	8 (100)	0 (0)	0	8	20 (40)
2011	10	4 (100)	0 (0)	0	4	7 (57)
2012	20	11 (100)	0 (0)	0	11	12 (92)
2013	12	2 (100)	0 (0)	0	2	4 (50)

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).

Table 8. Unit 26B moose hunter residency and success, regulatory years[a] 2006–2012.

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
2006	0	7	n/a	0	7 (54)	0	6	n/a	0	6 (46)	13
2007	0	3	n/a	0	3 (27)	0	8	n/a	0	8 (73)	11
2008	0	6	n/a	0	6 (43)	0	8	n/a	0	8 (57)	14
2009	0	3	n/a	0	3 (25)	0	9	n/a	0	9 (75)	12
2010	0	9	n/a	0	9 (43)	0	12	n/a	0	12 (57)	21
2011	0	4	n/a	0	4 (40)	0	6	n/a	0	6 (60)	10
2012	0	11	n/a	0	11 (69)	0	5	n/a	0	5 (31)	16

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).
[b] Residents of Units 26B.

Table 9. Unit 26B moose harvest chronology percent by month/day, regulatory years[a] 2006–2012.

	Harvest chronology percent by month/day							
Regulatory year	9/1–9/8	9/9–9/15	9/16–9/22	9/23–9/28	9/29–10/5	Oct	Apr	*n*
2006	100	0	n/a	n/a	n/a	n/a	0	7
2007	100	0	n/a	n/a	n/a	n/a	0	3
2008	83	17	n/a	n/a	n/a	n/a	0	6
2009	67	33	n/a	n/a	n/a	n/a	0	3
2010	78	11	n/a	n/a	n/a	n/a	11	9
2011	100	0	n/a	n/a	n/a	n/a	0	4
2012	82	18	n/a	n/a	n/a	n/a	0	11

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).

Table 10. Unit 26B moose harvest percent by transport method, regulatory years[a] 2006–2012.

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Airboat	Highway vehicle	Unknown	*n*
2006	71	0	0	0	0	14	14	0	7
2007	33	0	0	0	0	33	33	0	3
2008	67	0	17	0	0	0	17	0	6
2009	33	0	0	0	0	67	0	0	3
2010	67	0	0	0	0	11	11	11	9
2011	75	0	25	0	0	0	0	0	4
2012	64	0	9	0	0	9	18	0	11

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).