Moose Management Report and Plan, Game Management Units 16A and 16B:

Report Period 1 July 2010–30 June 2015, and

Plan Period 1 July 2015–30 June 2020

Tim C. Peltier

2017

Alaska Department of Fish and Game Division of Wildlife Conservation

Moose Management Report and Plan, Game Management Units 16A and 16B:

Report Period 1 July 2010–30 June 2015, and

Plan Period 1 July 2015–30 June 2020

PREPARED BY:

Tim C. Peltier
Wildlife Biologist III

APPROVED BY:

Todd A. Rinaldi
Management Coordinator

REVIEWED BY:

Michael R. Guttery
Biometrician II

Gino G. Del Frate
Regional Supervisor

Alaska Department of Fish and Game
Division of Wildlife Conservation
PO Box 115526
Juneau, AK 99811-5526

Funding for survey and inventory Project 1.0 was provided through the Federal Aid in Wildlife Restoration program. Hunters are important founders of the modern wildlife conservation movement. They, along with trappers and sport shooters, provided funding for this publication through payment of federal taxes on firearms, ammunition, and archery equipment, and through state hunting license and tag fees.

Species management reports and plans provide information about species that are hunted or trapped and management actions, goals, recommendations for those species, and plans for data collection. Detailed information is prepared for each species every 5 years by the area management biologist for game management units in their areas, who also develops a plan for data collection and species management for the next 5 years. This type of report is not produced for species that are not managed for hunting or trapping or for areas where there is no current or anticipated activity. Unit reports are reviewed and approved for publication by regional management coordinators and are available to the public via the Alaska Department of Fish and Game's public website.

This species management report and plan was reviewed and approved for publication by Todd A. Rinaldi, Management Coordinator for the Division of Wildlife Conservation, Palmer.

Species management reports and plans are available via the Alaska Department of Fish and Game's public website (www.adfg.alaska.gov) or by contacting Alaska Department of Fish and Game's Division of Wildlife Conservation, PO Box 115526, Juneau, AK 99811-5526; phone: (907) 465-4190; email: dfg.dwc.publications@alaska.gov. The report may also be accessed through most libraries, via interlibrary loan from the Alaska State Library or the Alaska Resources Library and Information Services (www.arlis.org).

This document, published in PDF format only, should be cited as:

Peltier, T. C. 2017. Moose management report and plan, Game Management Units 16A and 16B: Report period 1 July 2010–30 June 2015, and plan period 1 July 2015–30 June 2020. Alaska Department of Fish and Game, Species Management Report and Plan ADF&G/DWC/SMR&P-2017-7, Juneau.

Cover Photo: Biologists from ADF&G-Palmer conduct moose capture operations near Skwentna, Alaska. ©2017 ADF&G. Photo by Tim C. Peltier.

Contents

List of Figures

List of Tables

List of Appendices

Purpose of this Report

This report provides a record of survey and inventory management activities for moose in Unit 16 for the previous 5 regulatory years and plans for survey and inventory management activities in the 5 years following the end of that period. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY10 = 1 July 2010–30 June 2011). This report is produced primarily to provide agency staff with data and analysis to help guide and record its own efforts but is also provided to the public to inform them of wildlife management activities. In 2016 the Alaska Department of Fish and Game's Division of Wildlife Conservation launched this new type of 5-year report to more efficiently report on trends and describe potential changes in data collection activities over the next 5 years. It replaces the moose management reports of survey and inventory activities that were previously produced every 2 years.

I. RY10–RY14 Management Report

Management Area

Unit 16 is located in Southcentral Alaska, west of Anchorage. Unit 16 consists of the drainages into western Cook Inlet from Redoubt Creek and the Susitna River including the drainages of Redoubt Creek and the drainages on the west side of the Susitna River upstream from its junction with the Chulitna River and the drainages into the west side of the Chulitna River upstream of the Tokositna River including the river and drainages on the south side of the river up to the Tokositna Glacier. It is subdivided into Unit 16A which is east of the east bank of the Yentna River from its mouth upstream to the Kahiltna River, east of the east bank of the Kahiltna River and east of the Kahiltna Glacier, and Unit 16B which covers all portions south and west of Unit 16A (Figure 1). During this reporting period Unit 16B included Kalgin Island, a 23 mi^2 island approximately 7 miles east of the mainland at the southern end of the unit. Unit 16A is 1,850 mi^2 however the area of suitable moose habitat below the mean elevation of 3,500 feet is approximately 1,654 mi^2. Unit 16B is 10,405 mi^2 with approximately 6,795 mi^2 of suitable moose habitat.

Due to the size and variable weather conditions in Unit 16B the unit has been subdivided further for the purpose of surveys. This strategy allows managers to assess a proportion of the population when a unitwide effort may not be feasible. Unit 16B North consists of all portions of the unit north of the Yentna River to its confluence with the Skwentna River, following the Skwentna River upstream to its confluence with the Happy River, and upstream along the Happy River to the unit boundary. Unit 16B Middle contains the area between the border of Unit 16B north to the mouth of the Beluga River, upstream along the Beluga River to Beluga Lake, along the north shore of Beluga Lake to the base of the Triumvirate Glacier, along the northern edge of the Triumvirate Glacier and the South Twin Glacier to the western border of the unit. Unit 16B south encompasses the remainder of Unit 16B (Figure 2).

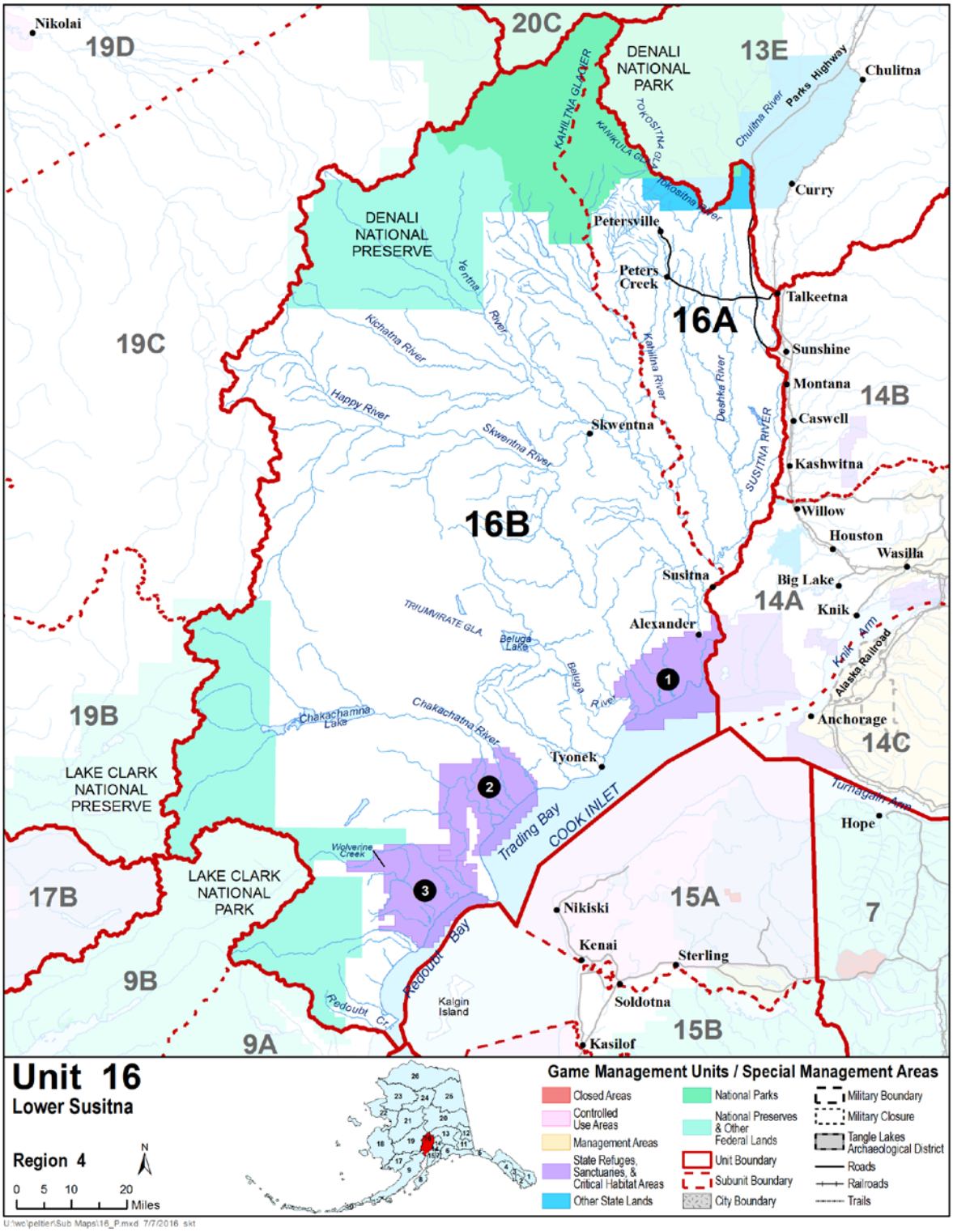

Figure 1. Unit 16 in Southcentral Alaska.

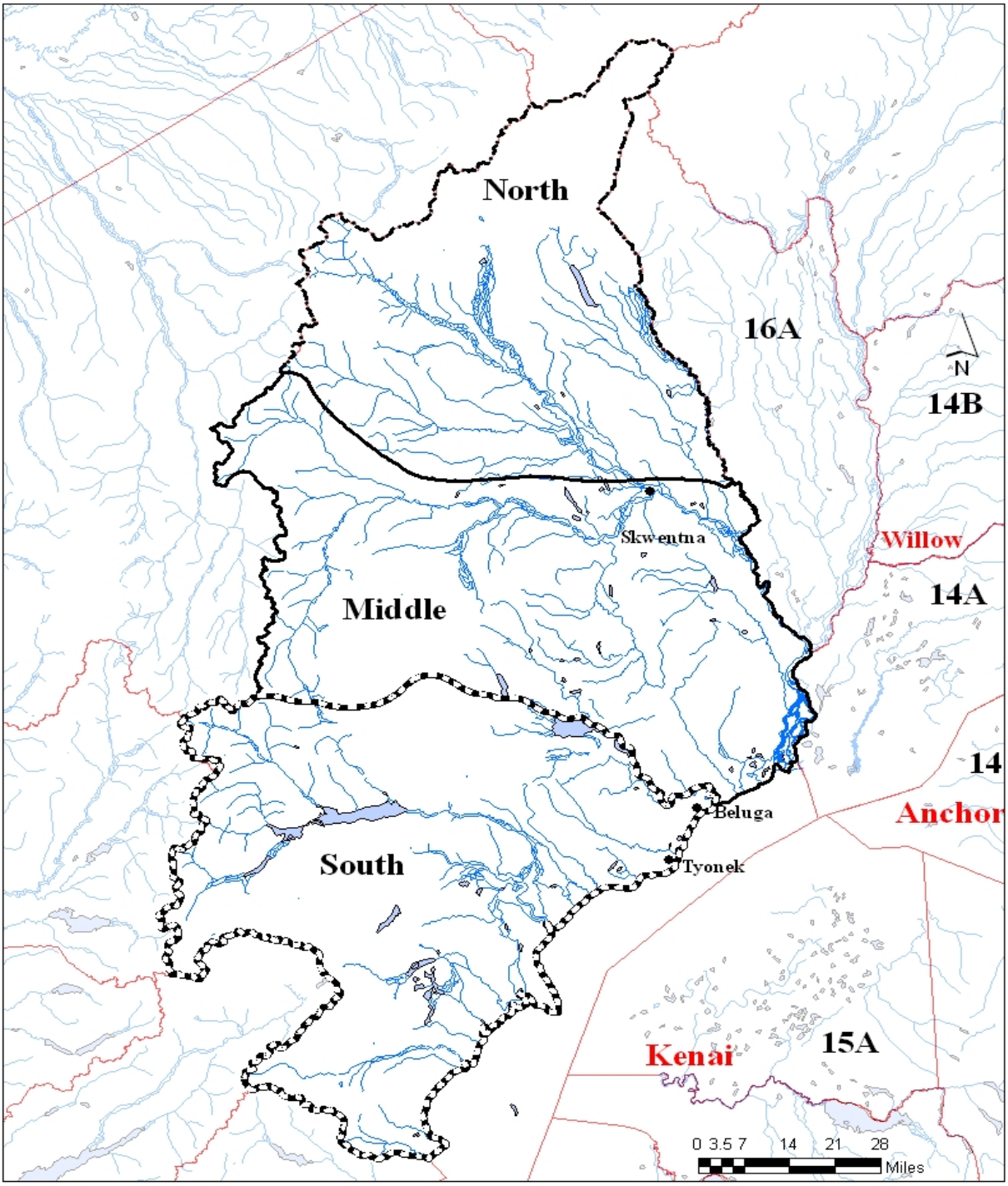

Figure 2. Unit 16B moose survey unit boundaries, Southcentral Alaska.

Summary of Status, Trend, Management Activities, and History of Moose in unit 16

UNIT 16A

Before 1940, moose persisted at low densities in Unit 16A (Griese 1995a). Thereafter the unit moose population experienced large fluctuations in population size as a result of die-offs during severe winters. These have occurred at least once every decade (Griese 1996b). 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).

An intensive management law was passed in 1994. Under this law the Alaska Board of Game (BOG) was required to identify moose, caribou, and deer populations that are important to harvest by humans and to manage predator and prey populations for sustained harvest (Alaska Department of Fish and Game [ADF&G] 2016). In 2004 BOG developed a predator control program for Unit 16B. The program was implemented to increase the moose population in Unit 16B by reducing the wolf population. This program was expanded in 2006 to include the roadless portions of Unit 16A in order to target wolves travelling between units and provide additional protection for moose on the border of the 2 units. 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 was believed that predator reductions in the unit would benefit 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, and 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 by hunters has fluctuated as a result of variable moose densities, availability of cow moose hunts, and improved hunter access (Griese 1996a). Harvest numbers have ranged from a high of 309 (1984) to a low of 37 (1990) (Del Frate 2004).

UNIT 16B

Before 1940, moose were uncommon in Unit 16B. After that time, habitat changes and federal predator control allowed the population to increase (Griese 1995b). 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 1996b). 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 increasing predation (Griese 2000).

Prior to 1989, moose hunting seasons in Unit 16B were by permit, had long openings, with any-moose or antlerless moose bag limits. Tier II permits were issued beginning in RY90 to ensure local residents an opportunity to meet subsistence needs. 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 (bt) on at least one side, or a minimum total width of 50 inches. This selective harvest strategy is referred to as "spike-fork 50-inch" (SF-50-3bt) (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 calf 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 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. Under intensive management, a control program to reduce wolf predation on moose began in 2004. At that time, the population was estimated at 175–180 wolves (ADF&G 2015). Additionally, studies in Unit 16B suggest that bear predation also has a strong influence on calf recruitment (Faro 1989; Peltier 2012). Black and brown bear surveys were conducted in spring 2007 and indicated a very high density 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 season and bag limits were liberalized and a black bear control program began in fall 2007 (Peltier 2008, 2010). A separate brown bear control program on a 960 mi^2 portion of the unit between the Beluga and McArthur rivers began in RY10 (Peltier 2013).

Moose were transplanted on Kalgin Island in the 1950s. By 1981 the population was over 140 moose and hunting was allowed on the island, first as a draw hunt and later as a registration hunt. It became part of Unit 15B in RY16.

Management Direction

EXISTING WILDLIFE MANAGEMENT PLANS

- Direction in the Peters-Dutch Hills, Chelatna Lake-Yenlo Hills, and Skwentna moose management plans (ADF&G 1976) has been reviewed and modified through public comments, staff recommendations, and BOG actions over the years. A record of these changes can be found in the division's management report series. The plan portion of this report contains the current management plan for moose in Unit 16.
- Presently moose are managed under the "Operational Plan for Intensive Management of Moose in Game Management Unit 16 during Regulatory Years 2015–2017" (ADF&G 2015).
- "Alaska Interagency Wildland Fire Management Plan 2010" (Alaska Wildland Fire Coordinating Group 2010).

GOALS

- Protect, maintain, or enhance the moose population and its habitat in concert with other components of the ecosystem to provide maximum sustained opportunity to participate in hunting moose.
- Provide and enhance wildlife viewing opportunities with special consideration for state and national parks.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Harvest

The Unit 16B moose population has a positive customary and traditional use determination. The unitwide amount reasonably necessary for subsistence is 201–229 moose. It is allocated across the unit as follows:

- Unit 16B, Kalgin Island - 2 moose.
- Unit 16B, Redoubt Bay drainages - 10 moose.
- Unit 16B, south of the Beluga River and north of Redoubt Bay - 29–37 moose.
- Unit 16B, north of the Beluga River - 160–180 moose.

Intensive Management

In 2001 the Alaska Board of Game adopted a positive finding for intensive management of moose in Unit 16. Current intensive management objectives are as follows:

SUBUNIT 16A

- Population objective: 3,500–4,000 moose.
- Harvest objective: 190–360 moose.

SUBUNIT 16B

- Population objective: 6,500–7,500 moose.
- Harvest objective: 310–600 moose.

MANAGEMENT OBJECTIVES

1. Manage moose populations at the following levels:
    - Unit 16A - maintain a population of 3,500–4,000 moose.
    - Unit 16B – maintain a population of 6,500–7,500 moose.
2. Manage for a posthunt (fall) sex ratio of 20–25 bulls:100 cows in each unit.

MANAGEMENT ACTIVITIES

Assessing population status and trends, monitoring harvest and mortality, and assessing habitat conditions are integral components of moose management in Unit 16. Survey and inventory management activities used to monitor populations in Unit 16 are described below.

1. Population Status and Trend

ACTIVITY 1.1. Conduct aerial inventory and sex and age composition survey in the unit to determine population size, composition, productivity, and trends.

Data Needs

Moose abundance is a basis from which sustainable harvest may be estimated and provides a density context for interpreting nutritional condition relative to habitat conditions. Sex and age composition information can be used to determine appropriate harvest levels and recruitment into the populations. Sex and age ratio data may also be used to model population structure and trends.

Methods

Geospatial population estimator (GSPE; Kellie and DeLong 2006) surveys are conducted on all available moose habitat in the unit below 3,500 feet. Surveys are conducted between 1 November and 6 December on a triennial basis for Units 16A, 16B-North, and 16B-South, and biennially for Unit 16B-Middle as weather and snow conditions permit. This procedure produces population estimates and statistically bound sex and age composition estimates by using a random sampling design and geostatistical models of spatial autocorrelation. It is designed for high intensity surveys of moose (8–12 min/mi^2) from a PA-18 Super Cub or equivalent aircraft to obtain a relatively unbiased estimate of moose numbers, but we correct sightability for typically lower achieved search intensity. Pilot and observer teams may fly 7 or 8 units per day collecting moose sex, age, and location data as well as conditions at the time of the survey (Appendix A).

In Unit 16, real-time stratification is generally employed with a 4-person crew at approximately 1,000 feet from a Cessna 185 prior to conducting the survey; however desktop stratification can also provide guidance. Stratification into high and low moose density is based on observed moose, moose tracks, and availability of favorable moose habitat. Using only 2 strata minimizes the impacts of moose movements among strata on the spatial estimate and allows continuity of GSPE surveys across weather breaks that do not adversely affect moose distribution during the survey. For stratification purposes, sample units that are likely to have fewer than 5 moose in the unit are considered "low" stratum and sample units that are likely to contain ≥5 moose are considered "high" stratum units. Sightability correction factors (SCF) are developed for each stratum by randomly selecting a subset of the selected units and intensively searching a quarter of the unit at 10–12 min/mi^2 and comparing the difference between the number of moose seen during the regular and intensive surveys.

In years where weather conditions, logistics, or budget limitations prevent the ability to complete a GSPE survey in Unit 16B-Middle, smaller scale sex and age composition surveys have been

completed in order to assess population trends. In a manner similar to the GSPE survey, pilot-observer teams flying at approximately 500 feet above ground level count moose of each sex and age class in areas of known winter concentrations.

Results and Discussion

The moose populations were below the population objective in Unit 16A during this reporting period, but appear to be within the population objective in Unit 16B (Table 1). All results are reported as the point estimate ± 1 standard error. The last survey of the moose population in Unit 16A was in 2009. During the survey, 26 of the 33 high strata and 47 of the 233 low strata sampling units were surveyed, which represents a survey of 27% of the available moose habitat. The resulting population estimate for Unit 16A was 2,574 ± 230 moose without an SCF. The previous population estimate for Unit 16A was 1,619 ± 154 moose from a GSPE survey without an SCF completed in 2005.

A GSPE survey of Unit 16B-South was completed for the first time in 2010. Sixty of 67 high strata (90%) and 39 of 197 (20%) low strata sampling units were surveyed, which represents 38% of available moose habitat. Using an SCF to revise the estimate, a total of 2,372 ± 584 moose were estimated to be within Unit 16B-South during the 2010 survey. This estimate is more than twice the number of moose that were thought to be in the unit in 2004 based on a trend count survey of the same area.

A GSPE survey of Unit 16B-Middle was completed in fall 2011. Thirty of 55 high strata (55%) and 90 of 469 low strata sampling units (19%) were surveyed, representing 23% of the moose habitat. Using an SCF to correct for moose that were not observed, the population was estimated to include 3,459 ± 412 moose with ratios of 42 bulls:100 cows and 26 calves:100 cows. These estimates suggest that there has been an increase in the size of the moose population and in the sex and age ratios since 2009 when a survey estimated that there were 2,446 ± 322 moose in the population with ratios of 39 bulls:100 cows and 19 calves:100 cows.

Unit 16B-North was surveyed in 2014. All 46 high strata and 54 of 242 low strata sampling units were surveyed for a total of 35% of the subunit. The resulting point estimate of 1,587 ± 152 moose was nearly twice the 2008 estimate of 834 ±121 moose, and the observed sex and age ratios of 62 bulls:100 cows and 36 calves:100 cows observed in 2014 were an improvement compared to the 60 bulls:100 cows and 11 calves:100 cows observed in 2008. A possible confounding factor in the 2014 survey was the relatively low snowfall received that year which may have allowed more moose to remain in the unit instead of migrating to lower elevations as they have been known to do before previous surveys (Appendix B).

Recommendations for Activity 1.1.

Continue-modify.

Due to the importance of the moose population in Unit 16A for Southcentral Alaska hunters, surveys should be performed on a triennial basis as weather and snow conditions permit. The need to accurately monitor the population recovery and the length of time elapsed from the 2009 survey means that this survey should be a priority for the Palmer ADF&G office.

Table 1. Unit 16 moose fall composition and estimated population from geospatial population estimates, Southcentral Alaska, 2009–2014.

Year	Area	Bulls:100 cows[a]	Yearling bulls:100 cows[a]	Calves: 100 cows[a]	Percent calves	Adults	Moose observed	Estimated population (90% CI[b])[c]	Estimated population w/SCF[d]	Moose/mi^2 w/SCF[e]
2009	16A	30 (3)	5 (2)	30 (3)	19	692	853	2,574 (± 15%)	Not calculated	
	16B Middle[f]	39 (4)	7 (3)	19 (4)	12	315	359			
2010	16B South	50 (3)	14 (2)	18 (3)	11	628	703	1,507 (± 28%)	2,372	1.4
2011	16B Middle	42 (3)	9 (2)	26 (3)	15	698	825	2,843 (± 14%)	3,459	1.0
2014	16B North	62 (3)	17 (3)	36 (3)	18	679	835	1,554 (± 16%)	1,587	0.9

[a] Ninety percent confidence interval, plus and minus the estimate, in parentheses.
[b] CI = confidence interval.
[c] Geospatial population estimation (GSPE) method.
[d] SCF = sightability correction factor.
[e] Based on habitat available as determined by the total area of the GSPE grid for each area.
[f] Sex and age composition survey.

The moose population in Unit 16B encompasses a large area that does not have uniform snow conditions that allow for a unitwide population survey. As such separate population objectives were recommended for each of the 3 subunits based on the size of each area. Achieving the midpoint of the objective for the subunits based on the whole intensive management objective would require populations of 1,960 moose in Unit 16B-North, 3,360 moose in Unit 16B-Middle, and 1,680 moose in Unit 16B-South (Table 2). The survey protocol for Unit 16B requires a biennial survey of Unit 16B-Middle, and a triennial survey of Unit 16B-North and Unit 16B-South. Given that Unit 16B-South seldom receives conditions that allow for a GSPE, this subunit should be considered for surveys any year that favorable conditions are present.

Table 2. Unit 16B moose population objectives for the 3 moose assessment areas, Southcentral Alaska (Unit 16B objective subdivided proportionately by size of assessment area).

Survey unit	Moose population objective per area (Midpoint)	
Unit 16B-North	1,820–2,100	(1,960)
Unit 16B-Middle	3,120–3,600	(3,360)
Unit 16B-South	1,560–1,800	(1,680)
Unit 16B	6,500–7,500	(7,000)

ACTIVITY 1.2. Spring parturition, twinning, and recruitment surveys in Unit 16B.

Data Needs

Determining pregnancy rates and twinning rates provides an indication of maternal condition and productivity. Trends in these indicators are very important to determining the nutritional condition of the moose population, and the habitat quality. Fall recruitment of calves indicates the level of predation on newborn calves and directly relates to the rate of growth of the moose population. Understanding these parameters is integral to management on a sustained yield basis.

Methods

Beginning in winter RY04 adult cows and short-yearlings were captured via helicopter darting. Weights and other health parameters were recorded and the animals were fit with radio collars. Beginning in spring 2015, radiocollared cows were relocated on a daily or every other day basis during the calving season to determine pregnancy and the number of calves produced. Cows were relocated in the fall (November) to determine the survival rate of calves produced through the first 6 months of life, and in late March to determine overwinter survival.

Results and Discussion

Pregnancy and twinning rates have been high throughout the length of the project (Table 3). Calf recruitment into fall (6 months of age) has been steadily increasing over the past 11 years and at this point calf recruitment is good and they appear to have escaped what is known as a “low density dynamic equilibrium” or “predator pit” (Messier 1994; National Research Council 1997).

Table 3. Unit 16B moose parturition, twinning, and survival rates from collared cows, Southcentral Alaska, 2005–2015.

Year	Cows observed	Single calves	Twins	Percent twinning[a]	Percent cows parturient[a]	Calves alive in fall	Percent recruitment to fall[a]
2005	56	20	21	51 (15)	73 (12)	5	8 (7)
2006	66	32	24	43 (13)	85 (9)	13	16 (8)
2007	89	34	37	52 (12)	80 (8)	26	24 (8)
2008	89	32	31	49 (12)	71 (9)	12	13 (7)
2009	38	10	20	67 (17)	79 (13)	8	15 (9)
2010	43	19	17	47 (16)	84 (11)	6	11 (9)
2011	88	30	35	54 (12)	74 (9)	20	20 (8)
2012	89	36	36	50 (12)	81 (8)	28	27 (9)
2013	80	22	49	69 (11)	89 (7)	54	45 (9)
2014	70	34	30	47 (12)	91 (7)	40	44 (10)
2015	80	34	34	50 (12)	85 (8)	49	51 (10)

[a] Ninety-five percent confidence interval, plus and minus the estimate, in parentheses.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor moose mortality through field observations, hunter harvest reports, contact with hunters, and reports of other causes of mortality.

Data Needs

Monitoring, collecting, and analyzing harvest data are critical for sustained yield management. Annual summaries of harvest are needed to establish quotas and to understand harvest in relation to moose population assessments (activities 1.1, 1.2, and 1.3). Analysis of harvest data will facilitate department recommendations for future BOG proposals.

Methods

Moose hunting in Unit 16 is recorded by the moose harvest report, the draw hunt report, or the Tier II harvest report submitted by hunters who participate in the different hunting opportunities in the unit. These reports note number of days hunted, location, methods of take and transportation, commercial services used, and the results of the hunter effort. Reports from Department of Public Safety provide information on additional forms of mortality.

Season and Bag Limit

During the reporting period the general season moose hunt (SF-50-3bt) in Unit 16A for residents and nonresidents was 10–17 August (archery only) and 25 August–20 September (archery, firearm, and muzzleloader) for RY10. BOG increased the season length to 25 August–25 September (archery, firearm, and muzzleloader) beginning in RY11.

In Unit 16B the general harvest (SF-50-3bt) for residents was 20 August–20 September (archery, firearm, and muzzleloader) during RY10–RY12, and 20 August–25 September (archery, firearm, and muzzleloader) in RY13 and RY14. During the reporting period nonresident hunting for

moose in Unit 16B was closed until RY11. In RY11 and RY12 the nonresident season was 25 August–15 September (archery, firearm, and muzzleloader; SF-50-3bt). The general season for nonresidents was expanded to match the resident season in RY13. Tier II moose season for any bull was 15 November–28 February during RY10 and RY11, and 15 December–31 March during RY12–RY14. Beginning in RY14, 2 new draw hunts for any bull began with DM540 for residents, and DM541 for residents ages 10–17. The season dates for DM540 were 20 August–25 September. Hunters were restricted to Unit 16B south of the Yentna, Skwentna, and Happy rivers. DM541 hunters were allowed to hunt all of Unit 16B; the season dates were 20 August–25 September and 15 November–15 December. Current season and bag limit information is available on the ADF&G website:

http://www.adfg.alaska.gov/static-f/applications/web/nocache/regulations/wildliferegulations/pdfs/regulations_complete.pdf499A7A2AE29744F260DAF8C5BA7F29FF/regulations_complete.pdf

Results and Discussion

Accurate harvest reporting is necessary for understanding patterns and levels of harvest and assisting hunt managers with their understanding of sustainable harvest rates used to manage hunts. Lack of harvest reports for moose generally stems from hunter confusion or cultural values regarding hunting. Hunt results, an estimate of unreported and illegal take, and accidental death are summarized in Tables 4A and 4B. The average annual human-caused mortality was 176 moose in Unit 16A and 251 moose in Unit 16B. These estimates remain below management objectives. However recent changes to hunt strategies should allow for hunters to take additional animals and we may achieve harvest objectives.

Harvest by Hunters

Reported harvest averaged 136 moose in Unit 16A and 211 moose in Unit 16B. Both units showed an increasing trend in the harvest with the exception of RY12. Harvest in RY12 was likely lower due to fewer hunters in the field. Winter RY11 had significant snowfall and the RY12 hunting season was wet and cool. The perception that the previous winter had a negative effect on the moose population combined with unfavorable hunting conditions may have led to decreased hunting effort in the unit.

Permit Hunts

The results of the Tier II and the draw hunts are summarized in Table 5. During the reporting period 260 permits were awarded annually for the Tier II hunt. In RY14 there were 150 permits available for DM540 and 50 permits available for DM541. Several hunters participating in DM541 complained that they were not able to access Unit 16B during the late fall (15 November–15 December) season due to unfavorable traveling conditions.

Table 4A. Unit 16A moose harvest and accidental death, Southcentral Alaska, regulatory years[a] 2010–2014.

Regulatory	Reported				Estimated			Accidental deaths[b]			Grand
year	M	F	Unk	Total	Unreported[c]	Illegal[d]	Total	Road	Other	Total	total
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
2013	160	0	0	160	11	20	31	12	0	12	203
2014	180	0	1	181	13	20	33	18	0	18	232

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[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 were missing for this period.

Table 4B. Unit 16B moose harvest and accidental deaths, Southcentral Alaska, regulatory years[a] 2010–2014.

Regulatory	Reported				Estimated			Accidental deaths			Grand
year	M	F	Unk	Total[b]	Unreported[c]	Illegal[d]	Total	Road	Other	Total	total[e]
2010	199	1	0	200	14	25	39	0	0	0	239
2011	196	1	2	199	14	25	39	0	0	0	238
2012	176	1	0	177	12	25	37	0	0	0	214
2013	232	0	0	232	16	25	41	0	0	0	273
2014	247	0	1	248	17	25	42	0	0	0	290

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[b] Includes all reported harvest including federal subsistence.
[c] Derived by taking 7% of the reported harvest.
[d] Includes moose taken in defense of life or property.
[e] Does not include moose taken on Kalgin Island.

Table 5. Unit 16B moose harvest data by permit hunt, Southcentral Alaska, regulatory years[a] 2010–2014.

Hunt number[b]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest			
						Bulls	Cows	Unk	Total
TM565	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
	2013	109	35	39	61	43	0	0	43
	2014	100	30	60	40	28	0	0	28
TM567	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
	2013	83	27	39	61	37	0	0	37
	2014	80	36	76	24	12	0	0	12
TM569	2010	81	40	55	45	22	0	0	22
	2011	80	41	57	43	19	0	1	20
	2012	80	40	60	40	19	0	0	19
	2013	86	51	74	26	11	0	0	11
	2014	80	51	77	23	9	0	0	9
DM540	2014	150	43	59	41	35	0	0	35
DM541	2014	50	54	65	35	8	0	0	8
RM572[c]	2010	131	26	70	30	18	10	0	28
	2011	138	41	72	28	10	12	0	22
	2012[d]	111	30	83	17	4	8	0	12
	2013	90	27	69	31	7	13	0	20
	2014	138	26	67	33	19	15	0	34

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[b] TM = Tier II permit; DM = drawing permit; RM = registration permit.
[c] RM572 = Kalgin Island registration permit.
[d] Closed by emergency order 10 September 2012.

Hunter Residency and Success

Average hunter success in Unit 16A was 18% during the reporting period. The average general harvest season success in Unit 16B was 23% (Tables 6A and 6B). Most hunters in Unit 16 are from Anchorage and the Matanuska-Susitna (Mat-Su) Valley. Nonresident participation was minimal with an average of 14 moose harvested annually in Unit 16A. The 4-year average harvest for nonresident hunting in Unit 16B was 22 moose.

Harvest Chronology

The majority of moose are taken in the last 2 weeks of the general harvest season when they become more vulnerable to scraping and calling as the season gets closer to the rut (Tables 7A and 7B).

Transport Methods

In Unit 16A hunters access the unit through a variety of means. The area has few roads but several points of access for all-terrain vehicles (Table 8A). Unit 16B is not connected to the road system and most hunters access the area through aircraft and boats (Table 8B).

Alaska Board of Game Actions and Emergency Orders

At the spring 2011 meeting BOG extended the general harvest moose season to 25 September for both Units 16A and 16B, and opened a nonresident season from 25 August to 15 September. They also changed the dates of the Tier II season from 15 November–28 February to 15 December–31 March.

At the spring 2013 meeting BOG added a resident drawing hunt with a bag limit of 1 bull, season dates 20 August–25 September and added a youth draw hunt for those ages 10–17 with a bag limit of 1 bull and season dates of 20 August–25 September. Those hunts began in RY14. They also aligned the nonresident and resident general harvest season (20 August–25 September).

At the spring 2015 meeting BOG reauthorized the intensive management plan for Unit 16. This reauthorization updated some information provided in the plan but did not introduce any significant changes to the plan or its implementation.

Recommendations for Activity 2.1.

Continue.

Continue to monitor harvest for comparison with current intensive management objectives. Given that both Units 16A and 16B have high bull:100 cow ratios and are below harvest objectives, additional hunting opportunities were provided and harvest is increasing. In spring 2016 BOG passed a registration hunt for any bull moose in Unit 16B that may increase the harvest; however, there are no additional hunting opportunities available in Unit 16A at this time.

Table 6A. Unit 16A moose hunter residency and success, Alaska, regulatory years[a] 2010–2014.

Regulatory year	Successful						Unsuccessful					Total hunters
	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident[b]	Nonlocal resident	Nonresident	Unk	Total	
2010	5	113	7	1	126	(17)	41	547	30	3	621	747
2011	9	109	16	1	135	(18)	33	564	22	1	620	755
2012	2	69	7	2	80	(12)	43	521	37	0	601	681
2013	14	128	18	1	161	(20)	44	553	37	0	634	795
2014	12	147	22	0	181	(20)	39	628	46	0	713	894

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[b] Unit 16 residents.

Table 6B. Unit 16B moose hunter[a] residency and success, Southcentral Alaska, regulatory years[b] 2010–2014.

Regulatory year	Successful						Unsuccessful					Total hunters
	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident[c]	Nonlocal resident	Nonresident	Unk	Total	
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
2013	4	111	26	0	141	(26)	31	324	54	1	410	551
2014	8	111	36	1	156	(24)	23	408	53	1	485	641

[a] Does not include individuals participating in permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[c] Unit 16 residents.
[d] No general nonresident open season.

Table 7A. Unit 16A moose harvest chronology, Southcentral Alaska, regulatory years[a] 2010–2014.

Regulatory	August			September					
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	Unknown	Total
2010[b]	2	10	6	14	39	53		2	126
2011[c]	0	10	5	8	24	51	37	4	139
2012[c]	0	5	4	10	19	21	19	2	80
2013[c]	2	14	4	13	22	67	35	4	161
2014[c]	0	9	12	14	38	50	52	6	181

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[b] Open season = 10–17 August (archery only), 20 August–30 September (spike-fork, 50-inch antlers with 3 brow tines [SF-50-3bt]).
[c] Open season = 10–17 August (archery only), 20 August–20 September (SF-50-3bt).

Table 7B. Unit 16B moose harvest chronology[a], Southcentral Alaska, regulatory years[b] 2010–2014.

Regulatory	August		September					
year	20–26	27–31	1–7	8–14	15–20	21–25	Unknown	Total
2010[c]	4	2	8	39	43		1	97
2011[d]	2	5	8	24	37	29	2	107
2012[d]	5	1	5	31	16	23	4	85
2013[e]	1	4	9	22	52	43	10	141
2014[e]	5	2	13	42	44	49	1	156

[a] Does not include harvest from permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[c] Open season = Residents only; 20 August–20 September (spike-fork, 50-inch antlers with 3 brow tines [SF-50-3bt]).
[d] Open season = Residents; 20 August–25 September (SF-50), Nonresidents 25 August–15 September (SF-50-3bt).
[e] Open season = Residents and nonresidents; 20 August–25 September (SF-50-3bt).

Table 8A. Unit 16A percent transport methods of successful moose hunters, Southcentral Alaska, regulatory years[a] 2010–2014.

Regulatory year	Transport method (%)									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV[b]	Highway vehicle	Unk	Airboat	Total
2010	7	0	30	29	0	14	15	2	3	126
2011	12	1	29	34	0	7	12	3	2	139
2012	14	1	17	40	0	9	11	3	5	80
2013	7	0	21	35	0	14	18	3	2	161
2014	10	1	22	39	0	11	11	2	4	181

[a] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[b] ORV = off-road vehicle.

Table 8B. Unit 16B percent transport methods of successful moose hunters[a], Southcentral Alaska, regulatory years[b] 2010–2014.

Regulatory year	Transport method (%)									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV[c]	Highway vehicle	Unk	Airboat	Total
2010	56	1	27	7	1	3	3	2	0	97
2011	63	6	19	4	0	3	5	0	0	108
2012	64	5	19	7	0	1	1	1	2	85
2013	72	4	13	4	1	3	2	2	0	141
2014	61	3	16	8	0	3	5	2	1	156

[a] Does not include harvest from permit hunts.
[b] Regulatory year begins 1 July and ends 30 June, e.g., regulatory year 2010 = 1 July 2010–30 June 2011.
[c] ORV = off-road vehicle.

ACTIVITY 2.2. Determine the causes of mortality for moose calves in Unit 16B.

Data Needs

Determining the causes of moose calf mortality can inform management decisions not only for moose but for bears, wolves, and other predators as well. Investigations of the causes and locations of calf mortality could also shed light onto other questions regarding the vulnerability of calves based on weight, the presence of siblings, age of the dam, and location of the birth relative to other geographic and terrain features. Analysis of the parameters surrounding the causes of mortality could be used to assist in determining where and what species of predators ADF&G should place reduction efforts in order to maximize the potential for increased recruitment.

Methods

Cow-calf groups were located in spring 2010 and 2012 with PA-18 Super Cubs in the southern portion of Unit 16B between the Beluga and MacArthur rivers (Appendix C). Staff used a Robinson R-44 helicopter to conduct captures. Calves that appeared to be ≤5 days old were caught, weighed, fitted with VHF radio collars around their necks, and then released. Calves were monitored daily, and when mortalities were detected staff went to the kill site to determine cause of death.

Results and Discussion

Staff captured 54 calves in 2010 and 53 calves in 2012. Survival to fall for radiocollared calves was 0.24 (SE = 0.07) in 2010 and 0.19 (SE = 0.06) in 2012. In 2010, brown bear predation was responsible for 53% of the total mortality, black bears were responsible for 21% of the total mortality, unknown predators were responsible for 15% of the total mortality, and 11% died for other reasons. In 2012, brown bears predation accounted for 53% of total mortality, black bears took 33% of the total mortality, unknown predators were responsible for 6% of total mortality, and 8% died for other reasons. These results along with the results of activity 1.2 will be reported under Wildlife Restoration Grant W-33-10, Calf Production and Survival of Moose in GMU 16.

Recommendations for Activity 2.2.

Discontinue (Wildlife Restoration Grant W-33-10 has expired).

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Habitat enhancement.

Data Needs

Identifying and treating areas of mature forest stands to return them to earlier stages of succession increases the amount of forage available for moose and enhances their nutritional condition. This in turn allows for greater productivity and improves the overall habitat condition of the unit.

Methods

Areas of potential habitat enhancement have been identified for treatment either by prescribed burning or other silvicultural treatments of mature stands. This effort is limited to state-owned lands and occurs as money, personnel, and time are available to complete the projects. Given the remoteness of Unit 16B, timber harvest of mature stands would likely be cost prohibitive.

Results and Discussion

In late winter 2013, Department of Forestry (DOF) and area staff identified a potential prescribed burn area near Trapper Creek in Unit 16A. The area proposed is approximately 4,940 acres. Budget limitations and higher priority issues prevented the burn from taking place; however the burn may be conducted in the future as time, budget, and personnel become available.

In Unit 16B, DOF and area staff identified areas where wildland fire protection status could be lessened from "full protection" or "modified protection" to modified or limited. The intent is to allow a forest fire to burn naturally instead of employing full fire suppression efforts. Forestry staff would only protect structures and would allow other areas to burn thus enhancing available moose habitat by returning it to an earlier successional stage through natural succession. ADF&G-Division of Wildlife Conservation's Region IV has sent letters requesting the modification of the local burn plans (Appendix D; Alaska Wildland Fire Coordinating Group 2010).

Recommendations for Activity 3.1.

Continue.

Continue to work with DOF foresters to identify areas in Unit 16 that would be suitable for "let it burn policies" through the development of prescribed burn plans.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

RECORDING

GSPE moose survey form (Appendix A).

ARCHIVING

- GSPE and harvest data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm). Digitized field data sheets are stored in file folders located in the Palmer Assistant Area Biologist's office.

- Field data sheets are scanned and housed on the computer server in the Palmer Area Biologist's office (O:\WC\Palmer Area Office Folder\Species\Moose\Moose Population Estimation\16A or 16B Moose Survey Data\Archived Survey Sheets) and stored in file folders located in the Palmer Assistant Area Biologist's office.

- All other electronic data and files such as copies of field data sheets, survey memos, maps, and reports are located on the in-house server (O:\\WC\Palmer Area Office Folder\)

Agreements

None.

Conclusions and Management Recommendations

At this time it appears that the current harvest seasons and bag limits are adequate for increasing the moose population within Unit 16A. 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 including 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, or the addition of an antlerless moose season.

The population estimate of 7,418 ± 2,027 moose falls within the population objective of 6,500–7,500 moose in Unit 16B. The unit was below the harvest objective of 310–600 during the reporting period; however, with the return of nonresident hunting and 2 new draw hunts for "any bull" the harvest objective was met in RY15. As long as Unit 16B remains under intensive management, additional information will be needed to better understand the predator-prey dynamics of the unit. Current research plans include investigating 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 if snow cover and weather conditions allow as well as a bear line-transect survey in RY16. 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.

II. Project Review and RY15–RY19 Plan

Review of Management Direction

MANAGEMENT DIRECTION

There are no changes in the management direction for Unit 16. However in an effort to develop a more effective management strategy within the existing framework, area staff are expanding and documenting potential improvements to the current program.

EXISTING WILDLIFE MANAGEMENT PLANS

- Direction in the Peters-Dutch Hills, Chelatna Lake-Yenlo Hills, and Skwentna moose management plans (ADF&G 1976) has been modified by BOG regulatory actions over the years.
- Presently moose are managed under the "Operational Plan for Intensive Management of Moose in Game Management Unit 16 during Regulatory Years 2015–2017" (ADF&G 2015).

GOALS

The goals for Unit 16 moose management remain unchanged. Specifically they are to:

- Protect, maintain, or enhance the moose population and its habitat in concert with other components of the ecosystem to optimize opportunity to participate in hunting moose.
- Provide and enhance wildlife viewing opportunities with special consideration for state and national parks.

CODIFIED OBJECTIVES

Intensive Management

In 2001 BOG adopted a positive finding for intensive management of moose in Unit 16. As per intensive management law, maintain:

SUBUNIT 16A

- Attain a population of 3,500–4,000 moose.
- Achieve an annual harvest of 190–360 moose.

SUBUNIT 16B

- Maintain a moose population of 6,500–7,500 moose.
- Achieve an annual harvest of 310–600 moose.

Amount Reasonably Necessary for Subsistence Uses

- Unit 16B, Redoubt Bay drainages TM569 - 10 moose.
- Unit 16B, south of the Beluga River and north of Redoubt Bay - 29–37 moose.
- Unit 16B, north of the Beluga River - 160–180 moose.

MANAGEMENT OBJECTIVES

1. Manage moose populations at the following levels:
    a. Unit 16A - maintain a population of 3,500–4,000 moose.

b. Unit 16B - maintain a population of 6,500–7,500 moose.

2. Manage for a posthunt (fall) sex ratio of 20–25 bulls:100 cows in each unit.
    a) Manage population levels based on mean spring twinning rates over a 3-year period in accordance with the recommendations of Boertje et al. (2007) <10% twinning rate (manage for population reduction).
    b) 10–20% twinning rate (manage for population stability).
    c) >20% twinning rate (manage for population growth).

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct aerial inventory and sex and age composition survey in the unit to determine population size, composition, productivity, and trends.

Conduct GSPE survey to inventory and determine sex and age composition in the unit to determine population size, productivity, and trends. The survey should be conducted with an SCF and designed to ensure that the interval proportion of the mean is ≤20% at the 90% confidence interval.

Data Needs

Area staff will continue to consult with biometric staff to ensure that methods have the necessary statistical power required to adequately sample the population.

Methods

Due to the importance of the Unit 16 moose population, surveys should be conducted on biennial basis in Unit 16B-Middle, and triennially in Unit 16A, 16B-North, and 16B-South. The lack of favorable conditions to conduct a GSPE survey during fall 2015 makes all the units a priority for fall 2016 with the highest priorities falling on Units 16A and 16B-South due to the length of time since their last surveys.

Variance in the population estimate and specifically in the SCF suggest that the total area surveyed, and the number of units selected for intensive surveys should be increased in order to gain precision in the estimate. Area staff will consult with a biometrician to determine the most effective methods to accomplish this goal.

In years where a complete GSPE survey is not completed, sex and age composition surveys should be completed in Unit 16B-Middle to detect any changes in the sex and age ratios that may augment existing data to determine trends and inform management decisions.

ACTIVITY 1.2. Spring parturition, twinning, and recruitment surveys in Unit 16B.

Manage population levels based on multi-year mean spring twinning rates over a 3-year period such that if the twinning rate is <10% additional steps will be taken. These steps will substantiate

low twinning-based nutritional status and may include determining 1) <50% of 36-month-old moose are parturient, 2) a multi-year short-yearling mass <385 lb (175 kg), and/or >35% of annual biomass is removed by moose (Boertje et al. 2007).

Data Needs

No change from report.

Methods

In order to have an adequate sample size to continue monitoring the population with the existing approach, area staff will need to maintain a number of radio collars on the air. This will require capturing cows in order to replace radio collars that are no longer functioning. We recommend focusing capture efforts on short-yearlings (~10 months) to provide moose of known ages and prevent instances of animals that may have become too old to provide relevant reproduction information. Short-yearling captures will also inform decisions regarding the nutritional status of the population.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor moose mortality through field observations, hunter harvest reports, contact with hunters, and other causes of mortality.

Data Needs

No change from report.

Methods

No change from report.

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Habitat enhancement.

Data Needs

No change from report.

Methods

No change from report.

ACTIVITY 3.2. Habitat assessment.

Data Needs

Monitoring forage utilization and forage plant condition enables an evaluation of the impact of increasing moose density on the available habitat and can serve as a signal to liberalize harvest in order to ward off the potential for severe habitat degradation and a subsequent crash in the moose population.

Methods

Staff should develop a browse survey protocol based on the work of Paragi and Kellie (2011), and Seaton et al. (2011) with a modification allowing for sampling in the roaded areas of Unit 16A.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

No new issues have been identified.

Data Recording and Archiving

- GSPE and harvest data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm). Digitized field data sheets are stored in file folders located in the Palmer Assistant Area Biologist's office.
- Field data sheets are scanned and housed on the computer server in the Palmer Area Biologist's office (O:\WC\Palmer Area Office Folder\Species\Moose\Moose Population Estimation\16A or 16B Moose Survey Data\Archived Survey Sheets) and stored in file folders located in the Palmer Assistant Area Biologist's office.
- All other electronic data and files such as copies of field data sheets, survey memos, maps, and reports are located on the in-house server (O:\\WC\Palmer Area Office Folder\).
- Historical (1990–2016) survey notes and data sheets should continue to be scanned for more secure data archive.

Agreements

None.

Permitting

None.

References Cited

ADF&G (Alaska Department of Fish and Game). 1976. Alaska wildlife management plans: Southcentral Alaska. (Draft proposal; subsequently approved by Alaska Board of Game). Division of Game, Federal Aid in Wildlife Restoration Project W-17-R, Juneau.

ADF&G (Alaska Department of Fish and Game). 2015. Operational plan for intensive management of moose in Game Management Unit 16 during regulatory years 2015–2017. Division of Wildlife Conservation, Juneau. http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.research (Accessed 25 September 2017).

ADF&G (Alaska Department of Fish and Game). 2016. Intensive management in Alaska [web page]. Division of Wildlife Conservation, Juneau. http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.main (Accessed 25 September 2017).

Alaska Wildland Fire Coordinating Group. 2010. Alaska interagency wildland fire management plan 2010. https://fire.ak.blm.gov/

Boertje, R. D., K. A. Kellie, C. T. Seaton, M. A. Keech, D. D. Young, B. W. Dale, L. G. Adams, and A. R. Aderman. 2007. Ranking Alaska moose nutrition: Signals to begin liberal antlerless harvests. Journal of Wildlife Management 71(5):1494–1506.

Del Frate, G. G. 2003. Unit 16 wolf. Pages 109–117 [*In*] C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999–30 June 2002. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 14.0, Juneau.

Del Frate, G. G. 2004. Unit 16A moose. Pages 224–232 [*In*] C. Brown, editor. Moose management report of survey-inventory activities 1 July 2001–30 June 2003. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Faro, J. B. 1989. Unit 16 moose. Pages 156–166 [*In*] S. O. Morgan, editor. Annual report of survey-inventory activities 1 July 1987–30 June 1988. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Griese, H. J. 1995a. Unit 16A moose. Pages 183–191 [*In*] M. V. Hicks, editor. Moose survey-inventory management report 1 July 1991–30 June 1993. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Griese, H. J. 1995b. Unit 16B moose. Pages 192–202 [*In*] M. V. Hicks editor. Moose survey-inventory management report 1 July 1991–30 June 1993. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Griese, H. J. 1996a. Unit 16A moose. Pages 199–207 [*In*] M. V. Hicks, editor. Moose survey-inventory management report 1 July 1993–30 June 1995. Alaska Department Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Griese, H. J. 1996b. Unit 16B moose. Pages 208–221 [*In*] M. V. Hicks, editor. Moose management report of survey-inventory activities 1 July 1993–30 June 1995. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Griese, H. J. 2000. Unit 16B moose. Pages 222–236 [*In*] M. V. Hicks, editor. Moose management report of survey-inventory activities 1 July 1997–30 June 1999. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Harkness, D. B. 1993. Unit 16B moose. Pages 182–190 [*In*] S. M. Abbott, editor. Moose management report of survey-inventory activities 1 July 1989–30 June 1991. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Kellie, K. A., and R. A. DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks.

Masteller, M. 2000. Unit 16 wolf. Pages 113–122 [*In*] M. V. Hicks, editor. Wolf management report of survey-inventory activities 1 July 1996–30 June 1999. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 14.0, Juneau.

Messier, F. 1994. Ungulate population models with predation: A case study with North American moose. Ecology 75(2):478–488.

National Research Council. 1997. Wolves, bears, and their prey in Alaska: Biological and social challenges in wildlife management. National Academy Press, Washington, D.C.

Paragi, T. F., and K. A. Kellie. 2011. Habitat evaluation techniques for moose management in Interior Alaska. Alaska Department of Fish and Game, Project Status Report 1 July 2007–30 June 2010, ADF&G/DWC/PSR-2011-R3, Juneau.

Peltier, T. C. 2008. Unit 16 black bear. Pages 187–198 [*In*] P. Harper, editor. Black bear management report of survey-inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 17.0, Juneau.

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

Peltier, T. C. 2010. Unit 16B moose. Pages 235–247 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Peltier, T. C. 2012. Unit 16B moose. Pages 232–244 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2012-5, Juneau.

Peltier, T. C. 2013. Unit 16 brown bear. Pages 168–178 [*In*] P. Harper and L. A. McCarthy editors. Brown bear management report of survey and inventory activities 1 July 2010–30 June 2012. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2013–4, Juneau.

Schwartz, C. C., K. J. Hundertmark, and T. H. Spraker. 1992. An evaluation of selective bull moose harvest on the Kenai Peninsula, Alaska. Alces 28:1–13.

Seaton, C. T., T. F. Paragi, R. D. Boertje, K. Kielland, S. DuBois, and C. L. Fleener. 2011. Browse biomass removal and nutritional condition of moose *Alces alces*. Wildlife Biology 17:55–66. doi:10.2981/10-010

♦ ♦ ♦

Appendix A. Moose survey form used in stratified surveys such as the geospatial population estimator and for composition surveys.

MOOSE SURVEY FORM

Date ___/___/___ Page ____ of ____

GMU ____ Count Area ____ Mi^2 in count area ____

Aircraft Type ____ Pilot/Observer ____/____ Cost/hr ____

WEATHER:

Cloudcover (%) ____ Precipitation ____ Temp ____

Wind Speed and Direction ____ Turbulence ____

CONDITIONS:

Light		Snow age and cover		Flight Time
Type	Intensity	Age	Cover	Depart
Bright ☐	High ☐	Fresh ☐	Complete ☐	Start Count
Flat ☐	Medium ☐	Moderate ☐	Low vegetation showing ☐	Stop Count
	Low ☐	Old ☐	Bare ground showing ☐	Return
				Flight Time
General Survey Conditions	☐ Excellent	☐ Good	☐ Fair ☐ Poor	Survey Time

	BULLS				COWS				Unk	
Group No.	Yearlings S/F I 3 pt.		Med <50"	Large ≥ 50"	w/o calf	w/1 calf	w/2 calf	Lone Calf	sex/ age	Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
Total Page 1										
Total Page 2										
Totals										

Appendix B. Moose survey report summary for Unit 16A and 16B-North, Southcentral Alaska, 2014.

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Fish and Game
DIVISION OF WILDLIFE CONSERVATION
Central/Southwest Regional Office
1800 Glenn Highway, Suite 4
Palmer, Alaska 99645-9965
Main: 907.861.2100
Fax: 907.861.2121

Memorandum

To: Lem Butler, Regional Supervisor

CC: Todd Rinaldi, Palmer Area Biologist

From: Tim Peltier, Palmer Assistant Area Biologist

Date: January 2, 2015

Subject: 2014 Moose Survey Results for GMU 16B-North &16A

In December of 2014 we completed a Geospatial Population Estimator (GSPE) moose survey in GMU16B - North and attempted to complete a survey of 16A as well, although that effort failed.

GMU 16B - North

During 6-11 December 2014, 4 pilot/observer teams in PA-18s sampled 621 mi^2 of the northern portion of GMU 16B (total survey area = 1,787 mi^2). The survey was comprised of 46 high and 54 low strata for a total of 100 of 288 available quadrats (Figure 1). Snow cover was mostly complete but many areas had low vegetation showing.

We randomly selected 27 of the sampled quadrats (14 high and 13 low) for intensive sampling. These quadrats were flown at search intensities of 3.9-4.6 min/km^2 immediately upon completion of the quadrat to calculate a sightability correction factor (SCF) following Gasaway et al. 1986.

We observed 835 moose and the moose were well distributed throughout the survey area suggesting that the snow had yet to push the moose completely out of the higher country. The GSPE population estimate was calculated at 1,554 moose (SE = 150.72). The bull to cow ratio was 60:100, which is unchanged from the last survey in 2008. The calf to cow ratio was 34:100 which is a considerable improvement over the 2008 calf to cow ratio of 11:100.

After applying the SCF (1.05 high and 1.0 low), the population in GMU16B - North was determined to be at 1,586 moose. This is an increase from the 2008 estimate of 834 moose and is consistent with the continued growth of the moose population in other portions of GMU 16B. A more precise estimate of sightability would have been derived with more units selected. For example, in the low strata only 3 units selected for SCF actually contained

moose and no moose were missed therefore the SCF was 1 and the variance was 0. Nevertheless, the low standard error for the population estimate indicates that overall the survey was conducted well. With the recent addition of this survey data the current estimate for GMU 16B is 7,418 ± 1,525 which is well within the population objective of 6,500 – 7,500 moose. This survey took 111 flight hours to complete at a cost of $27,342.

	16B North		Corrected Est. & SCF	
Parameter	Estimate	90% Interval	Estimate	90% CI or Variance
All Moose	1554	0.159	**1586**	17.1%
High Strata	647	0.0	1.05	0.0009
Low Strata	907	0.151	1.0	0.0
Bulls:100 Cow	60.4	0.203	-	-
Calves:100 Cow	34.4	0.204	-	-

GMU 16A

We attempted a survey of GMU 16A between 12 - 15 December, 2014. We flew a stratification flight with Mike Meekin in a C-185 on 12 December. At that time conditions were marginal however weather forecasts called for improving conditions with the potential for fresh snow in the immediate future. Instead we experienced warming weather with rain and increased snow melt. Do to the potential for further deteriorating conditions, unfavorable forecasts, and decreasing daylight, the decision was made to suspend the survey until more favorable conditions could be found in the spring of 2015 (?)

We selected 81 out of 261 units (50 high, and 31 low strata) and were able to complete 36 units before halting the survey. We observed 682 moose. Most of the survey units were completed in the northern portion or extreme southern portion of GMU 16A. The bull to cow ratio was 49: 100 and the calf to cow ratio was 39:100, however without a more even distribution of the survey units any comparison to the results of previous surveys would be spurious. The survey took 51 hours and cost $12,983.

Gasaway, W.C., DuBois, S.D., Reed, D.J., and Harbo, S.J. 1986. Estimating moose population parameters from aerial surveys. Biological Papers of the University of Alaska, Number 22. 108 p.

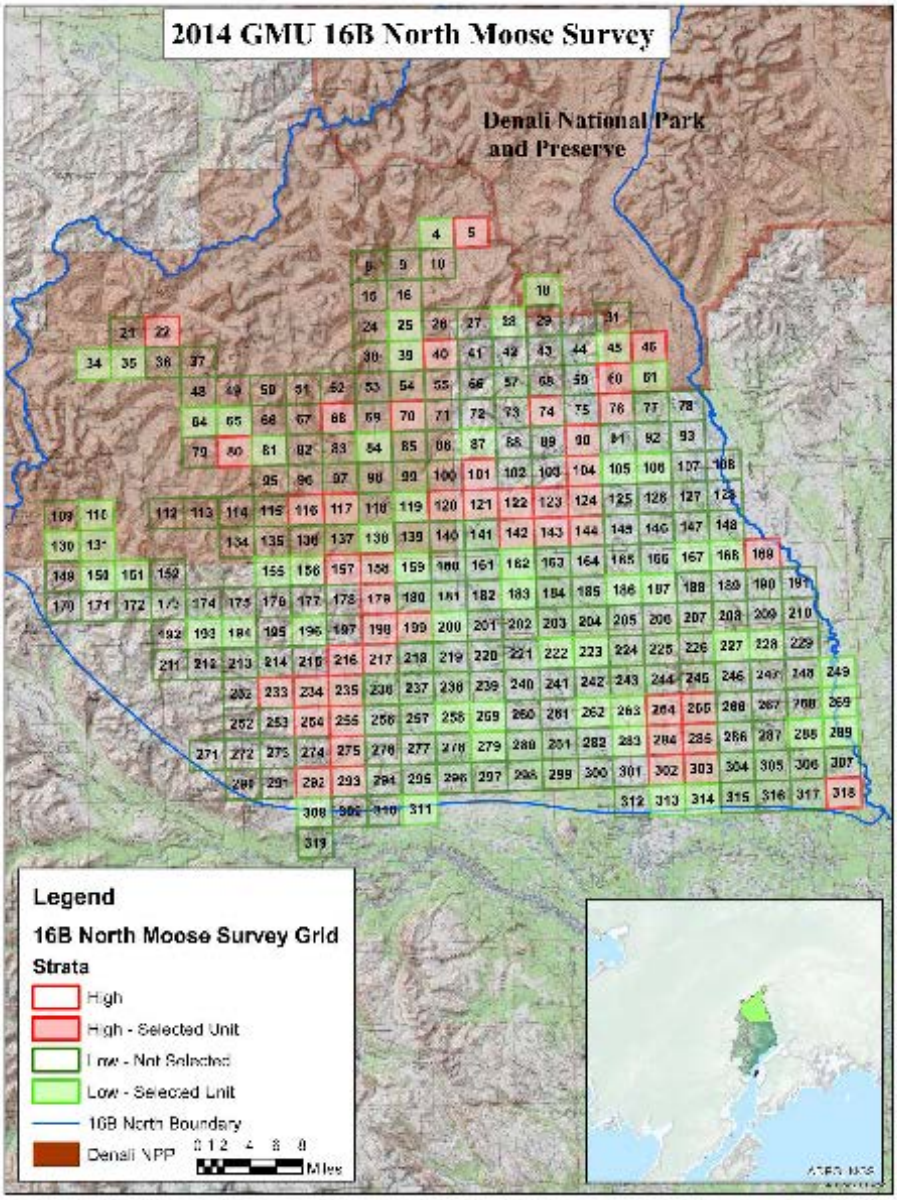

Figure 1. Survey area and stratification for the 2014 GSPE in GMU 16B-North.

Appendix C. Unit 16B moose calf mortality study memorandum, Southcentral Alaska, 2010.

THE STATE of ALASKA
GOVERNOR SEAN PARNELL

Department of Fish and Game
DIVISION OF WILDLIFE CONSERVATION
Central/Southwest Region

1800 Glenn Highway, Suite 4
Palmer, Alaska 99645-6736
Office: 907.746.6331
Fax: 907.861.2121

MEMORANDUM

TO: Bruce Dale, Regional Supervisor, Region IV

FROM: Nick Demma, Research Biologist, Region IV

DATE: 30 August 2013

SUBJECT: 2010 16B moose calf mortality study results

Background

In May 2010, Department staff initiated a moose calf mortality study in GMU 16B south. The goal of the study was to provide preliminary information on moose calf survival and mortality in an area where a black bear reduction effort was currently underway. The specific study area was chosen because of the relatively high hunting effort and number of black bears harvested there during the previous several years under the reduction program. Therefore we presumed this study area offered the maximum potential for measuring any effect of the black bear reduction on moose calf survival.

Objectives

1) Estimate seasonal survival rates of moose calves during their first year.
2) Characterize timing and cause of death for calves $\leq$ 1 month old.

Study area

GMU 16B south, from Beluga River to McArthur River (Fig. 1).

Capture and radiocollaring

During 16-28 May, we intensively searched the study area for moose daily with 1-3 fixed-wing aircraft and a Robinson R-44 helicopter. Cows with twins were observed more often than cows with singletons, and 64% of the cows we targeted for capture had twins. Close observation of cows during captures indicated they were generally in good to very good body condition.

We captured and radiocollared 52 calves that were all estimated to be $\leq$ 5 days old. Mean calf weight at capture was 18 kg (n=52). Calculated mean birth weight was 14 kg, based on a daily increase in body mass of 1.451 kg (L. Bender pers. comm.).

There were 2 capture-related mortalities. One calf was euthanized 2 days post capture after being found abandoned at its capture site and with a broken femur. The capture of that calf went smoothly and the cow reunited with both calves immediately. So the injury was apparently the

result of being stepped on or stomped after capture. Another calf was abandoned during its capture when the cow left the area with its sibling. We recaptured the calf and released it near the cow shortly afterwards and again the next day, but never saw them reunite. The calf was found killed by a black bear the following day.

An additional 2 uncollared calves (siblings) were included in the sample. They were first observed shortly after birth and still wet, so we opted to wait to collar them. When we returned the next day, we found a black bear and 2 partially consumed calves at the birth site.

Survival and mortality

The pattern of calf survival was typical for areas where ungulate neonate survival is limited by predation (Fig. 2); high mortality rate for calves during their first month then leveling off by mid-summer. The Kaplan-Meier survival rates of radiocollared calves at 16 days, 1 month, and 3 months of age were 0.48, 0.30, and 0.20 respectively. No collared calves died after 3 months of age, and all those surviving to that age (n=10) were still alive when checked the following April (Table 1).

We investigated cause of death for all radiocollared calves that died during the first month following birth (≤ 32 days of age; n=35). Predators caused 89% (n=30) of all mortalities (Fig. 3). Brown and black bears were the primary predators, and were responsible for 53% and 21% of mortalities, respectively. An additional 15% of deaths were due to predation, but those kill sites contained insufficient evidence to implicate a specific predator species. The other deaths were caused by drowning (n=2) and maternal abandonment (n=2).

Conclusions

Our observations indicated that cows in the 16B south moose population were generally healthy and productive. Survival of newborn calves is low-moderate from birth to early August. Early calf survival is limited by bears, primarily brown bears. Calf survival after late summer is high.

Kaplan-Meier Product-Limit Survival Distribution
Time Variable: DAYS
Event Variable: FATECODE

Time	Died	Cen-sored	At Risk	Lower 95% C.I.	S(t)	Upper 95% C.I.	SE S(t)	H(t)
2	3	0	50	0.8420	0.9400	0.9788	0.0336	0.0619
5	2	0	47	0.7894	0.9000	0.9558	0.0424	0.1054
6	3	0	45	0.7197	0.8400	0.9148	0.0518	0.1744
7	2	0	42	0.6731	0.8000	0.8860	0.0566	0.2231
8	1	0	40	0.6494	0.7800	0.8716	0.0586	0.2485
10	1	0	39	0.6277	0.7600	0.8560	0.0604	0.2744
11	2	0	38	0.5872	0.7200	0.8230	0.0635	0.3285
12	4	0	36	0.5094	0.6400	0.7527	0.0679	0.4463
13	1	0	32	0.4837	0.6200	0.7397	0.0686	0.4780
14	4	0	31	0.4126	0.5400	0.6623	0.0705	0.6162
15	1	0	27	0.3875	0.5200	0.6498	0.0707	0.6539
16	2	0	26	0.3528	0.4800	0.6099	0.0707	0.7340
19	2	0	24	0.3166	0.4400	0.5713	0.0702	0.8210
21	1	0	22	0.2963	0.4200	0.5546	0.0698	0.8675
23	1	0	21	0.2787	0.4000	0.5349	0.0693	0.9163
26	1	0	20	0.2613	0.3800	0.5150	0.0686	0.9676
27	1	0	19	0.2441	0.3600	0.4949	0.0679	1.0217
28	1	0	18	0.2271	0.3400	0.4745	0.0670	1.0788
32	2	0	17	0.1965	0.3000	0.4289	0.0648	1.2040
50	1	0	15	0.1776	0.2800	0.4118	0.0635	1.2730
54	1	0	14	0.1617	0.2600	0.3903	0.0620	1.3471
56	1	0	13	0.1460	0.2400	0.3685	0.0604	1.4271
74	1	0	12	0.1306	0.2200	0.3463	0.0586	1.5141
80	1	0	11	0.1155	0.2000	0.3236	0.0566	1.6094
346	0	3	10					
347	0	1	7					
349	0	1	6					
351	0	2	5					
354	0	2	3					
355	0	1	1					

Table 1. Kaplan-Meier survival results for GMU 16B south moose calves captured as neonates during May 2010.

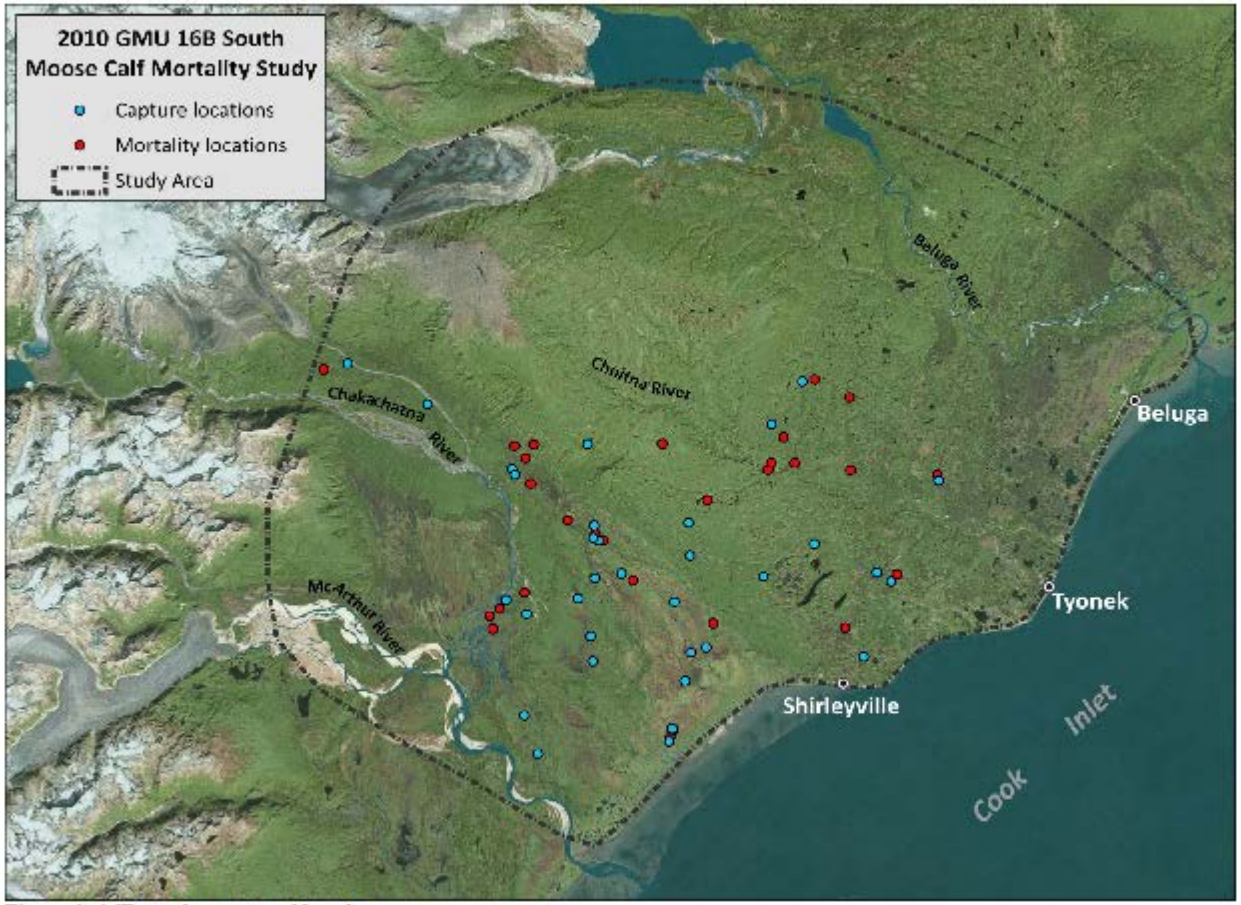

Figure 1. 16B south moose calf study area.

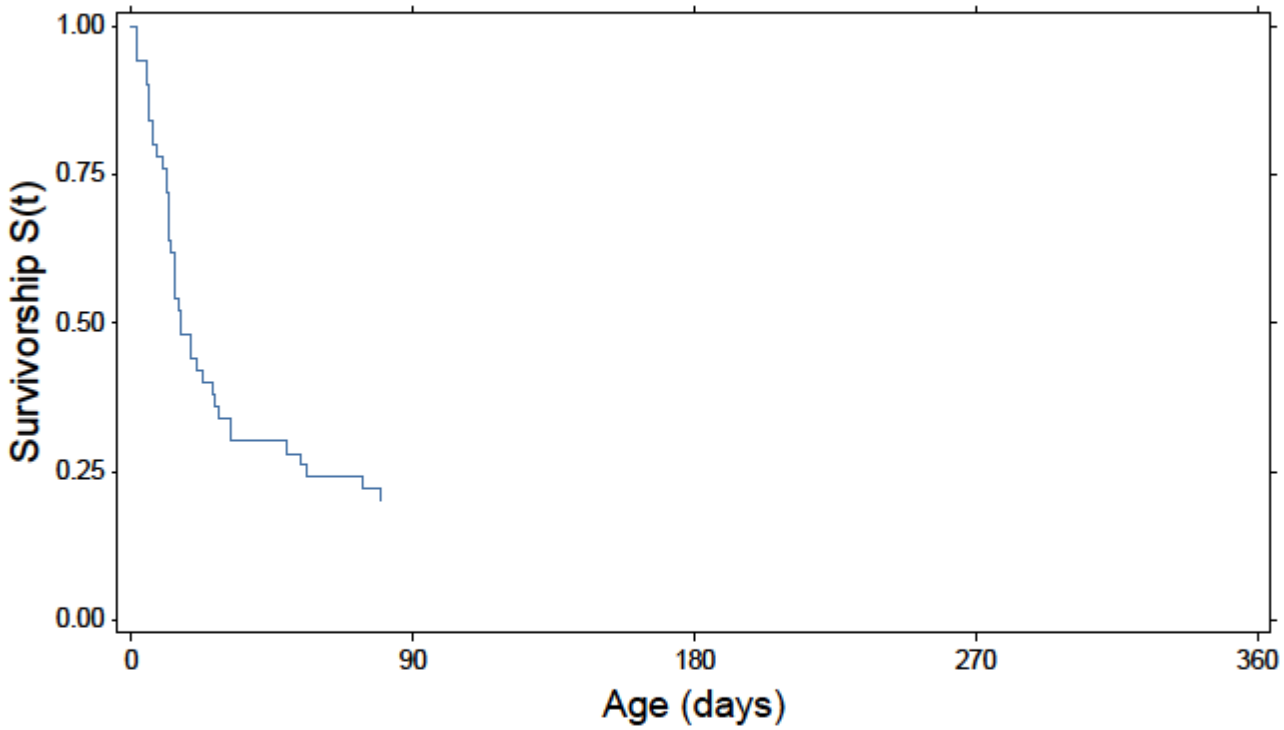

Figure 2. Kaplan-Meier survivorship function plot for 16B south moose calves captured as neonates during May 2010.

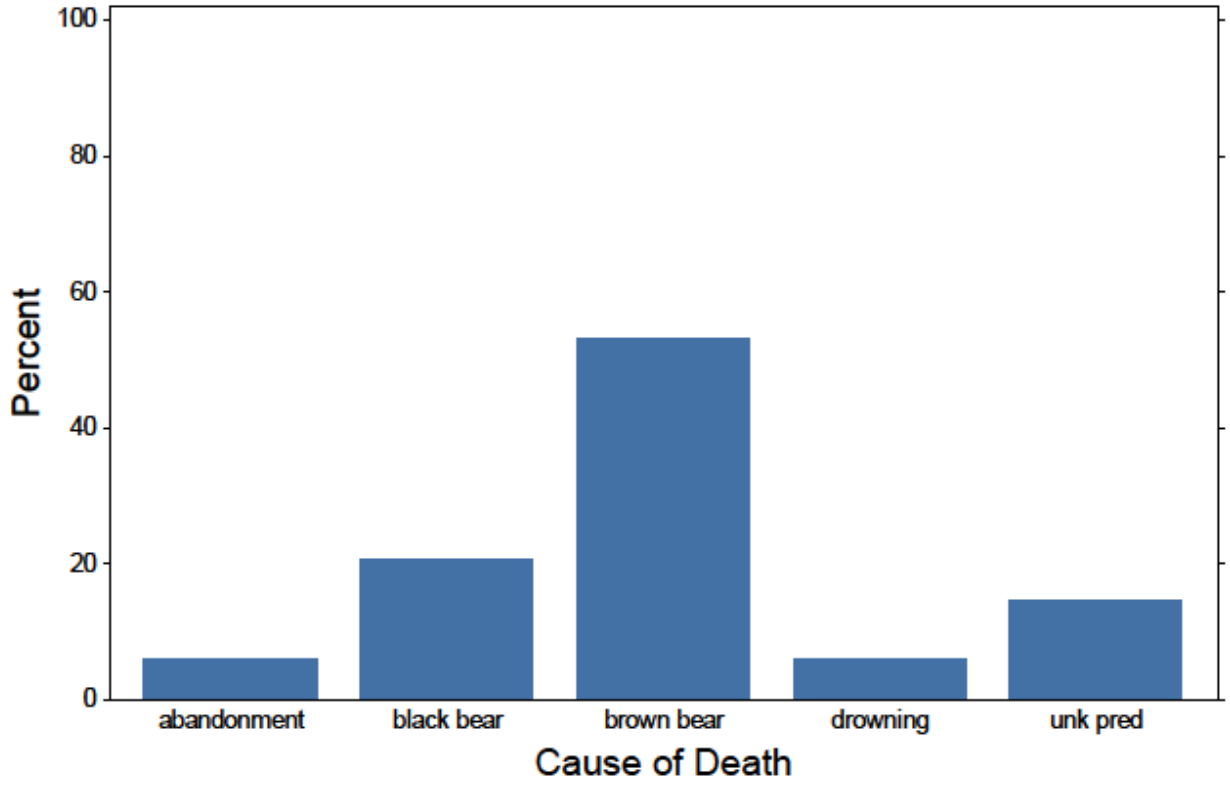

Figure 3. Cause of death during first 32 days after birth for 16B south moose calves captured as neonates in May 2010. The abandonments represented in this figure are not capture-related.

Appendix D. Letter to Alaska Division of Forestry requesting a reduction in the fire suppression levels in appropriate portions of Unit 16, Southcentral Alaska, June 2014.

THE STATE of ALASKA
GOVERNOR SEAN PARNELL

Department of Fish and Game
DIVISION OF WILDLIFE CONSERVATION
Central/Southwest Region
1800 Glenn Highway, Suite 4
Palmer, Alaska 99645-6736
Main: 907.861.2100
Fax: 907.861.2121

July 11, 2014

Norm McDonald
Alaska Division of Forestry
Mat-Su Area Fire Management Officer
101 Airport Rd
Palmer, Alaska 99645

Dear Mr. McDonald:

At our meeting on 10 July 2014 you indicated that fire suppression management options may be reconsidered in parts of Game Management Unit 14A&B and 16. We strongly encourage the Department of Natural Resources to consider reducing the fire suppression levels from full or modified to limited wherever it is prudent to do so and encourage the use of a modified suppression level where a more conservative approach is necessary. Allowing fire to play a natural role in the ecosystem leading to early successional hardwood habitats will greatly benefit moose, grouse and other wildlife species by providing essential cover and browse.

Moose populations in these management units are especially important. The Alaska Board of Game identified these moose populations as important for providing high levels of harvest for human consumptive use. Establishing and maintaining a mosaic of serial stages and forest types that mimic wildfires and natural succession would enhance the habitat and the likelihood of meeting moose population and harvest objectives in coming years.

Thank you for your consideration of this request. We will gladly consult with you and provide additional information, when necessary, as you review the wildfire designations for these areas.

Sincerely,

Lem Butler
Regional Supervisor
Division of Wildlife Conservation, Region IV


ALASKA
DEPARTMENT OF FISH AND GAME