Species Management Report and Plan ADF&G/DWC/SMR&P–2025–8

Moose Management Report and Plan, Game Management Unit 9:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

David W. Crowley

Amy M. Vande Voort

2025

Alaska Department of Fish and Game Division of Wildlife Conservation

Species Management Report and Plan ADF&G/DWC/SMR&P-2025-8

Moose Management Report and Plan, Game Management Unit 9:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

PREPARED BY:

David W. Crowley
Area Wildlife Biologist

Amy M. Vande Voort
Area Wildlife Biologist

APPROVED BY:

Todd A. Rinaldi
Management Coordinator

PUBLISHED BY:

Susan G. Erben
Technical Reports Editor

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

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 pay state hunting license and tag fees. These taxes and fees fund the federal Wildlife Restoration Program and the State of Alaska's Fish and Game Fund, which provided funding for the work reported on in this publication.

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.

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). To subscribe to email announcements regarding new technical publications from the Alaska Department of Fish and Game, Division of Wildlife Conservation please use the following link: http://list.state.ak.us/mailman/listinfo/adfgwildlifereport.

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

Crowley, D. W., and A. M. Vande Voort. 2025. Moose management report and plan, Game Management Unit 9: Report period 1 July 2015–30 June 2020, and plan period 1 July 2020–30 June 2025. Alaska Department of Fish and Game, Species Management Report and Plan ADF&G/DWC/SMR&P-2025-8, Juneau.

Please contact the authors or the Division of Wildlife Conservation at (907) 465-4190 if you have questions about the content of this report.

Contents

Purpose of this Report 1
I. RY15–RY19 Management Report 1
Management Area 1
Summary of Status, Trend, Management Activities, and History of Moose in Unit 9 1
  Population size and distribution 1
  Harvest Mortality 3
Management Direction 4
  Existing Wildlife Management Plans 4
  Goals 5
  Codified Objectives 5
    Amounts Reasonably Necessary for Subsistence Uses 5
    Intensive Management 5
  Management Objectives 5
  Management Activities 6
    1. Population Status and Trend 6
    2. Mortality-Harvest Monitoring and Regulations 12
    3. Habitat Assessment Enhancement 15
  Nonregulatory Management Problems or Needs 15
    Data Recording and Archiving 15
    Agreements 15
    Permitting 16
Conclusions and Management Recommendations 16
II. Project Review and RY20–RY24 Plan 16
Review of Management Direction 16
  Management Direction 16
  Goals 16
  Codified Objectives 17
    Amounts Reasonably Necessary for Subsistence Uses 17
    Intensive Management 17
  Management Objectives 17
  Review of Management Activities 17
    1. Population Status and Trend 17
    2. Mortality-Harvest Monitoring 18
    3. Habitat Assessment Enhancement 18
  Nonregulatory Management Problems or Needs 18
    Data Recording and Archiving 18
    Agreements 19
    Permitting 19
References Cited 19

List of Figures

Figure 1. Unit 9 on the Alaska Peninsula in Southwest Alaska..... 2

Figure 2. Moose harvest and hunters, Unit 9, regulatory years 1983–2019, Alaska Peninsula. .. 14

Figure 3. Percent of successful moose hunters by conveyance, Unit 9, regulatory years 2015–2019, Alaska Peninsula. 15

List of Tables

Table 1. Moose composition counts, Unit 9, regulatory years 2010–2020, Alaska Peninsula..... 8

Table 2. Units 9B–9E calf mortality study results, regulatory years 2017–2019, Alaska Peninsula. 11

Table 3. Moose harvest by hunters, residency, and success, Unit 9, regulatory years 2015–2019, Alaska Peninsula. 13

Purpose of this Report

This report provides a record of survey and inventory management activities for moose [*Alces alces*] in Game Management Unit 9 for the 5 regulatory years 2015–2019 and plans for survey and inventory management activities in the next 5 regulatory years, 2020–2024. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY15 = 1 July 2015–30 June 2016). This report is produced primarily to provide agency staff with data and analysis to help guide and record agency efforts but is also provided to the public to inform it of wildlife management activities. In 2016 the Alaska Department of Fish and Game's (ADF&G, the department) Division of Wildlife Conservation (DWC) launched this 5-year report to report more efficiently on trends and to describe potential changes in data collection activities over the next 5 years. It replaces the moose management report of survey and inventory activities that was previously produced every 2 years.

I. RY15–RY19 Management Report

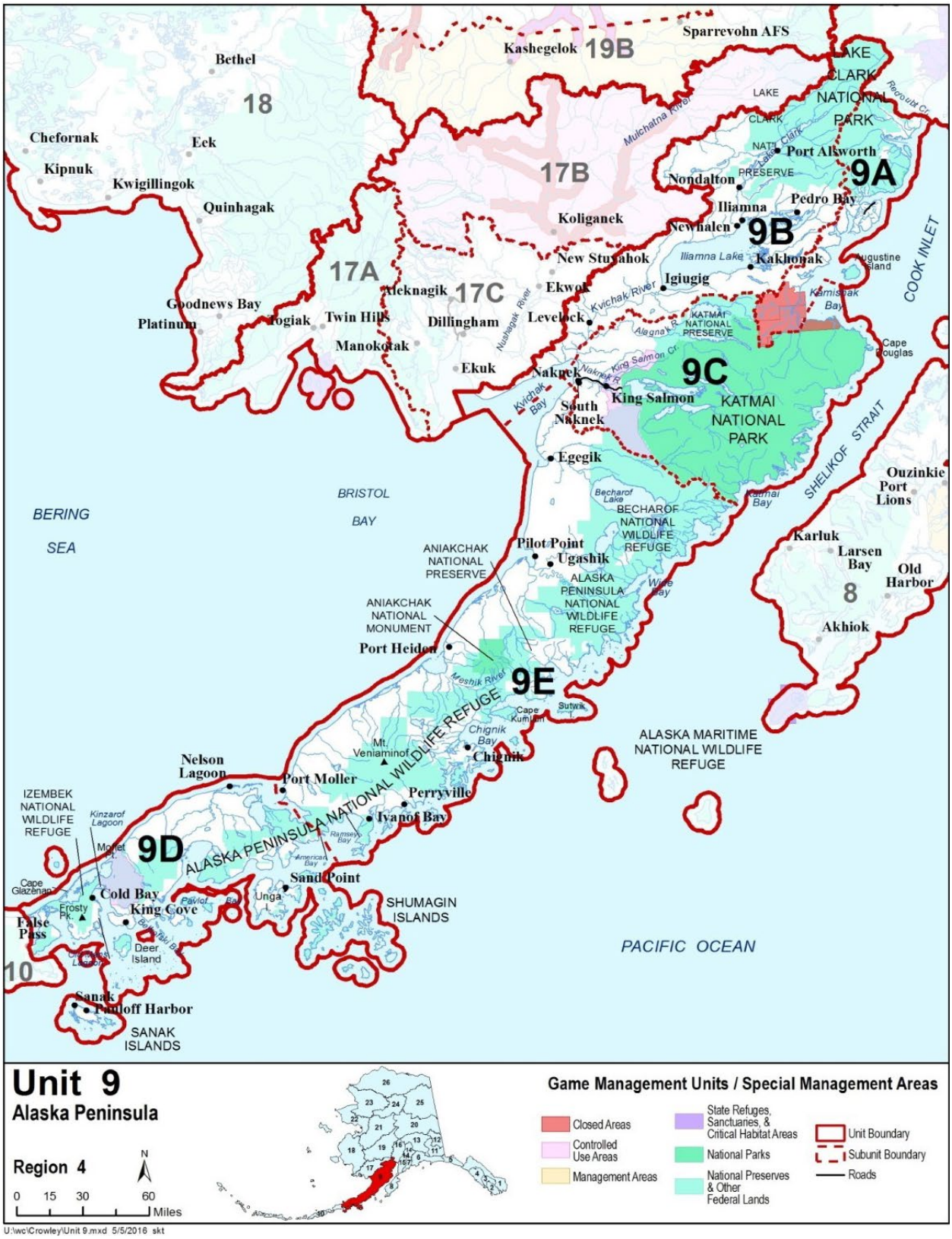
Management Area

Unit 9 (33,600 mi^2) consists of the Alaska Peninsula of Southwest Alaska, bounded in the north by the drainages of Lake Clark (Unit 9B) and Tuxedni Bay on Cook Inlet (Unit 9A), on the west by the Kvichak River drainage and Bering Sea, and extending southwest to Isanotski Strait near Cold Bay and Izembek National Wildlife Refuge (Unit 9D; Fig. 1). Mountains of the Aleutian Range extend down the Pacific coast of the peninsula providing cool, maritime conditions, alpine tundra, heavy precipitation, high winds, and active volcanoes. Boreal forest occurs over much of the northern and central portions of Unit 9 at lower elevations, and coastal plains of rolling tundra extend down the western slope of the peninsula along the Bering Sea. Many of the rivers originating in Unit 9 are spawning habitat for anadromous salmon returning through Bristol Bay. Most of the Alaska Peninsula is better suited to caribou and brown bears than moose. Moose habitat is limited to relatively narrow riparian habitat and boreal forest along river and stream corridors, extending upward into subalpine slopes during snow-free months. Although moose inhabit all 5 subunits, in reality they are only monitored and managed in Units 9B, 9C, and 9E—a large westcentral swath of the Alaska Peninsula—where most of the population and harvest occurs.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 9

POPULATION SIZE AND DISTRIBUTION

There is no prehistoric evidence of moose on the Alaska Peninsula, but by 1900, moose were present in the northern area of Unit 9 (Morris 1985). Moose occupied drainages of Unit 9 south to Ugashik Lakes by the early 1900s in low numbers and patchy distribution (Osgood 1904). As a colonizing species, moose increased in population size and distribution into range previously occupied by only caribou and domestic reindeer. Moose began increasing in the 1930s and rapidly expanded southwest, reaching the Black Lake area by the 1940s and occupying nearly all



U:\wc\Crowley\Unit 9.mxd 5/5/2016 skt

Figure 1. Unit 9 on the Alaska Peninsula in Southwest Alaska.

suitable habitat in Unit 9E by the early 1950s. The geographic barrier of Port Moller and steeply-rising Aleutian Range probably delayed colonization southwestward into Unit 9D, and lack of habitat on the southern Alaska Peninsula limited population growth. Presumably there was limited subsistence hunting as the population took hold, and eventually population size in Unit 9D allowed a limited bull-only hunt beginning in RY98.

The moose population of Unit 9 peaked in the mid-1960s, and in Unit 9E was deliberately reduced in population size through harvest during the 1960s and 1970s because of concern over range damage from overbrowsing, apparent nutritional stress, and low calf:cow ratios (Sellers and McNay 1983). By the early 1980s, moose densities in Unit 9E were 60% below peak levels and calf:cow ratios were very low despite evidence from browse analysis that range conditions had improved (Sellers and McNay 1983). A 1983 Gasaway survey in the central portion of Unit 9E resulted in an estimate of 1,148 (90% CI = 964−1,332), or 0.9 moose/mi^2, which was extrapolated to a population size of 2,500 moose in Unit 9E (Sellers and McNay 1984). Estimates for other units during this time were 800 moose in Unit 9C outside Katmai National Park and Preserve (KNP); 2,000 in Unit 9B; 300 in Unit 9A; and 600 in Unit 9D. During the 1990s and early 2000s, the Unit 9 moose population was considered stable to declining in localized areas. A geo-statistical population estimate (GSPE) conducted in Unit 9B in 2012 resulted in a population estimate of 1,160 (90% CI = 882−1,438) moose or 0.3 moose/mi^2 (Crowley and Peterson 2014). Recently the Unit 9 population is considered stable at low density.

Brown bear predation on neonatal moose is considered the primary limiting factor of moose on the Alaska Peninsula from the 1990s through the present, and widely fluctuating calf:cow ratios are normal for Unit 9 (Sellers 1990, Butler 2008). Wolves also prey on moose— a year-round food source—but the effects may not be as significant because wolves occur at much lower densities than bears. Like brown bears, wolves consume seasonally available marine resources (e.g., salmon and beached marine mammal carcasses) on the Alaska Peninsula as alternative foods to ungulate prey (Watts and Newsome 2016, Watts et al. 2010).

HARVEST MORTALITY

Reported average moose harvest during RY68–RY75 was 61 in Unit 9B and 54 in Unit 9C, compared to 312 in Unit 9E, where most of the moose population and hunting effort occurred during those years (Sellers and McNay 1983). Moose harvest was stable during the 1980s and 1990s, then declined during the 2000s to lows of 37, 31, and 78 moose in Units 9B, 9C, and 9E, respectively.

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 in Unit 9E to allow the habitat to recover. Once the Unit 9E population declined to the desired objective, the Board of Game enacted a series of hunting restrictions. An experimental selective harvest strategy was implemented in 1976. The selective harvest strategy consisted of a bag limit for bulls having 50-inch antlers or antlers with 3 brow tines on at least 1 antler (Sellers and McNay 1983). This regulation was designed, among other objectives, to protect bulls <5 years of age, increase bull:cow ratios, and evaluate hunters' ability to judge legal bulls by antler size. Smith et al. (1979) and Smith (1981) evaluated the regulation for bulls with antlers of 50 inches or 3 brow tines on 1 side and concluded the following after 5 years: 1) because of rapid antler growth on

Alaska Peninsula bulls, ages 1–3 years were protected, but not ages 4–5 years; 2) hunters could indeed judge legal bulls by antler size; and 3) the bull:cow ratio stabilized but failed to increase because of heavy harvest and poor calf survival during the first 5 years of the selective harvest strategy. By 1983, however, bull:cow ratios began to increase, and larger bulls were increasingly observed during composition surveys (Sellers and McNay 1984), indicating that the selective harvest strategy was working as intended. The Board of Game passed a spike-fork allowance for resident hunters in 1999.

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 the harvest in Unit 9E in 1983, reduced and eventually eliminated the cow harvest in Unit 9B in 1991 and in Unit 9C in 2002, shortened seasons in Units 9E and 9C (1987–1988), and expanded the bull bag limit of 50-inch antlers or antlers with 3 brow tines on 1 side to Units 9B and 9C in 1992 (Sellers 1990). Also during this period, federal agencies agreed to a moratorium on permitting additional guiding outfits on federal lands. The average number of hunters decreased to 569 hunters during the 1990s, 414 during the 2000s, and 351 during the 2010s. Declining hunter participation more recently can be attributed to rapidly declining caribou populations on the Alaska Peninsula that reduced and then eliminated the possibility of people hunting moose and caribou at the same time (Butler 2006).

Illegal moose harvest, and particularly the harvest of cows, has contributed to local population declines in areas accessible to rural communities (Butler 2008). High moose demand increased tension between subsistence, resident, and nonresident hunters with the decline of caribou populations throughout Unit 9 during the 2000s (Butler 2008). At the Board of Game's suggestion, 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 that included transitioning to registration permit hunts—which the Board of Game passed for the 2011 season—and providing educational outreach to Unit 9 residents on moose conservation and wolf trapping.

Management Direction

Existing Wildlife Management Plans

Alaska Wildlife Management Plans, Southwestern Alaska (ADF&G 1976) includes moose management plans for the following areas: Kvichak-Nushagak, Becharof Lake-Cinder River, Meshik-Pacific, Port Moller-Black Lake, Ivanof-Perryville, and southwestern Alaska Peninsula. Moose management strategies have been modified over the years based on public comments, department recommendations, and Board of Game actions. A record of these changes can be found in the division's management report series. The plan portion of this report contains the current (RY20–RY24) management plan for moose in Unit 9.

GOALS

1. Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
2. Provide the greatest sustained opportunity to participate in hunting moose.
3. Provide an opportunity to view and photograph moose.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

Portions of the Unit 9 moose population—Units 9A, 9B, 9C, and 9E— have a positive customary and traditional use determination finding. The amount reasonably necessary for subsistence (ANS) in those units combined is 100–140 bull moose per year.

Intensive Management

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 (IM) law. There have been no IM programs initiated for moose in these units. The IM objectives (Alaska Administrative Code 5AAC 92.108) for moose in Unit 9 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	–	–

MANAGEMENT OBJECTIVES

Population objectives for moose in Unit 9 are as follows:

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. During the RY15–RY19 report period, this applied to Unit 9E only.
2. Increase low density populations (where habitat conditions are not limiting) to 0.5 moose/mi^2. During RY15–RY19, this applied to Unit 9 remainder.
3. Maintain sex ratios of at least 25 bulls:100 cows in medium- to high-density populations (Unit 9E) and at least 40 bulls:100 cows in low density areas (Unit 9 remainder).

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct aerial sex and age composition surveys in trend count areas of all units to determine status, trend, productivity, and mortality of moose.

Data Needs

ADF&G staff used fall composition surveys to monitor bull-to-cow ratios and number of bulls in the population to assist in determining trends, harvest quota, and to provide maximum hunting opportunity. Calf parameters are used to monitor productivity and survival. Ratios and proportions are also used in population simulation models to help monitor population dynamics.

Methods

Staff from ADF&G, the Becharof National Wildlife Refuge (BNWR), and Katmai National Park and Preserve conducted sex and age composition surveys within established trend count areas in Units 9B, 9C, and 9E during November through early December before most bulls have dropped antlers, and when adequate snow cover was available. Six new trend count areas were mapped and flown in an effort to sample more moose. Two of these were added to our flight schedule (Lower Alagnak River and the King Salmon River corridor) because moose were consistently abundant, and survey times were short with a total added area of 117 mi^2. The Big Creek and Park Border count areas were redesigned to eliminate overlap, double-counting, and tundra habitat, reducing the survey area by about 150 mi^2. We flew surveys using Piper PA-12 aircraft on traditional trend count areas with search intensities of approximately 2–4 minutes/mi^2, which varied with the number of moose encountered. Pilots circled each moose, moose group, or fresh tracks to search for moose and to determine sex and age of individuals. We used the total number of moose counted in trend areas to estimate moose densities within units. We used these densities to determine the achievement of bull objectives (relative to density) and population trend.

November snowfall has not been reliable in recent years; we therefore began flying snowless surveys during RY16 in Unit 9E to test for biases and the required survey intensity. Snowless surveys continued during RY18 and were discontinued as a viable technique in RY19.

Results and Discussion

Trend count surveys are summarized in Table 1. During RY15–RY19, we flew 11 sets of surveys including 2 in Unit 9B, 4 in 9C, and 5 in 9E. Lack of snow allowed us to fly moose surveys with no snow on the ground for comparison to standard survey conditions.

Staff flew a snowless survey in Unit 9B in 2018. Much of Unit 9B is boreal forest habitat, versus tundra and riparian habitat to the south, causing very poor moose visibility without snow on the ground. Lack of snow resulted in upwardly biased bull:cow ratios and low moose/hour counts (Table 1); those visibility issues occurred in all snowless surveys that were attempted in boreal forest habitat. Even though bulls' shiny, pale antlers made them far more visible than cows and calves at any distance in snowless conditions, overall moose counted per hour declined. In a comparison of a Unit 9B survey flown in 2016 with snow on the ground to the same survey in 2018 without snow, the 2018 survey shows a 68% decline in moose counted per hour, a 75%

decline in observed moose density, and a 60% increase in bull:cow ratio observed (Table 1). We attempted snowless surveys in Unit 9C during 2018 and 2019, and in Unit 9E during 2016 (our first attempt at a survey without snow) and 2018.

Snowless surveys required high-intensity coverage, and even though a lot of time was wasted over habitat where moose rarely occur, those areas had to be flown because without snow, moose visibility was low even in open country. Observer fatigue was high for snowless surveys. Moose occur in forested habitats, but adequate survey coverage was practically impossible without snow. Snowless balsam popular (*Populus balsamifera*) stands were the most difficult habitat type to spot moose, even without leaves. Dense silver tree trunks and closed canopies caused much glare and mottled shade in the sun, and dark, mottled conditions under overcast skies. Poplar and spruce stands were identified and mapped in an attempt to simply avoid flying over them, but trend count areas became too complex with multiple polygons to avoid flying over. After several years of conducting snowless surveys and comparing them to normal survey conditions, we abandoned snowless surveys during 2019. Working with a local contract pilot has allowed more flexibility in scheduling moose surveys in short weather windows.

In Unit 9C, both bull:cow and calf:cow ratios improved considerably during RY15–RY19 (Table 1). RY18 and RY19 have the highest bull:cow ratios on record for Unit 9C, although bull:cow ratios were biased high those years. The bull:cow ratio also remained relatively high for the RY20 survey flown in normal conditions in Unit 9C. Similarly in Unit 9E, bull:cow and calf:cow ratios were relatively high during RY15–RY19. Composition surveys suggested that calf survival to 6 months of age was adequate, and that bulls were increasing in the population.

Densities observed in trend count areas of Units 9C and 9E were above or near the lower management objective of 0.5 moose/mi^2 during RY15–RY19, with the bull:cow ratio greater than 25 bulls:100 cows (Table 1). During RY18, observed moose density was low in Unit 9B, but the bull:cow ratio was probably between 35 and 45 based on previous years. High bull:cow ratios in Unit 9 suggest that additional harvest is available, probably by increasing season lengths for resident hunters. Moose surveys were not conducted in Units 9A or 9D, which have minimal populations and harvest, and consequently are the lowest priority for population monitoring.

Recommendations for Activity 1.1

Continue to survey trend count areas as snow conditions in November and early December allow. Careful monitoring of composition and harvest has been adequate for management data needs. Discontinue snowless surveys. The calf mortality project ended in 2019 and will not be continued.

ACTIVITY 1.2. Conduct a geospatial population estimate (GSPE) survey in Units 9B, 9C, or 9E every 2–5 years when snow conditions allow, February–March.

Data Needs

Determine moose population size by area for management purposes, including determining bull harvest quota.

Table 1. Moose composition counts, Unit 9, regulatory years 2010–2020, Alaska Peninsula.

Regulatory year	Unit	Survey Area (mi²)	Survey Hours	Adults	Total	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Percent calves	Moose/hour	Density/mi²
2011	9B	400	9.6	117	131	33	5	16	11	14	0.3
2013	9B	402	7.0	76	89	43	6	25	15	13	0.2
2016	9B	359	8.4	118	132	37	11	16	11	16	0.4
2018	9B	333	6.1	29	32	93[a]	7	20	9	5	0.1
2011	9C	582	12.3	217	232	27	4	9	6	19	0.4
2016	9C	935	15.6	243	314	46	10	43	23	20	0.5
2018	9C	1,077	24.2	332	405	75[a]	13	38	18	17	0.4
2019	9C	521	14.2	183	211	87[b]	20	29	13	15	0.4
2020	9C	220	6.1	127	148	67	12	28	14	24	0.7
2010	9E	321	–	172	197	62	18	24	13	–	0.6
2016	9E	1,458	32.4	145	193	92[c]	7	62	24	6	0.1
2017	9E	757	24.3	147	173	44	6	25	15	7	0.2
2018	9E	984	26.4	316	374	77[d]	12	32	16	14	0.4
2019	9E	604	20.3	318	380	69	15	33	16	19	0.6
2020	9E	67	16.9	294	367	72	5	43	20	22	0.5

[a] Snowless surveys conducted in all survey units resulted in upwardly biased bull:cow ratios and low moose/hour counts.
[b] Snowless surveys in 2 of 4 survey units flown resulted in upwardly biased bull:cow ratios and low moose/hour counts.
[c] First attempt surveying in snowless conditions plus incomplete leaf senescence resulted in a very difficult survey.
[d] Five of the 8 survey units flown in Unit 9E in 2018 were in snowless conditions, which made it difficult to spot moose, especially cows and calves.

Methods

Biologists prepared for GSPE surveys as recommended in the previous moose SMR&P (Crowley 2017) for Units 9C and 9E, following methods as outlined in Kellie and DeLong 2006.

Results and Discussion

No GSPE surveys were completed during RY15–RY19 due to poor snow conditions and logistical limitations in narrow weather windows. Biologists question the efficacy of this method in Units 9C and 9E because moose distribution tends to be patchy and linear with large swaths of unoccupied tundra between moose, however, there is not a better alternative for obtaining a moose population estimate.

Recommendations for Activity 1.2

Continue.

ACTIVITY 1.3. Maintain a minimum sample of 20 cow moose with VHF and satellite collars in Unit 9B.

Data Needs

Locate collared cows before or during composition surveys, monitor productivity, survival, and twinning rate in Unit 9B.

Methods

Personnel located cow moose using 2 fixed-wing aircraft (Piper Super Cubs). Airplane pilots reported Global Positioning System (GPS) locations and moose group size to the helicopter crew. We used a Robinson R-44 helicopter to pursue and dart moose using 4.5 mg carfentanil citrate or 1.5 mg etorphine, and 100 mg xylazine. Moose were fitted with very-high frequency (VHF) radio collars (Telonics MOD 600-3) with coded, visual sleeves (Alaska Tent & Tarp) for individual identification. Darts were carefully removed with a scalpel, wounds flushed with povidone-iodine solution, then instilled with 0.2% nitrofurazone ointment. Anesthetized moose received 35 ml Oxybiotic (200 mg/ml), and were reversed with 400 mg tolazoline and 420 mg naltrexone (100 mg/mg carfentanil). Blood samples for cows captured in 2017 were analyzed for pregnancy. (BioPRYN PSPB [pregnancy-specific protein B]: BioTracking Inc., Moscow, Idaho). Cows were evaluated for body condition using the Franzmann method (Franzmann et al. 1976).

Results and Discussion

Cow moose in Unit 9B were collared as part of the calf mortality study. Maintaining collared moose in Unit 9B became problematic when cows captured along the Kvichak River and Yellow Creek moved west into Unit 17 to drop calves. There were 5–6 collared cows in Unit 9B at the end of the calf survival project.

Recommendations for Activity 1.3

Discontinue.

ACTIVITY 1.4. Conduct a calf mortality study to estimate the relative importance of various forms of mortality.

Data Needs

Define the limiting factors on moose calf survival. We know that bears are significant calf predators but we do not know the relative importance of wolves, or if increasing wolf harvest benefits calf survival.

Methods

Biologists monitored collared cows from Activity 1.3 for survival, parturition, calf survival, and cause of calf mortalities. We relocated each radiocollared cow and visually monitored them daily for 2 weeks from parturition, then monthly throughout the summer and fall seasons, or until the death of calf, whichever occurred first, and also determined the survival of cows and their yearlings from the previous year when possible. We conducted parturition monitoring and twinning observations from 12 May through 16 June each year.

Results and Discussion

Adult moose cows were captured through the southern half of Unit 9B into Unit 9C, across the Naknek River south along the west-southwest boundary of and within Katmai National Park. In April 2017, we captured and radiocollared 24 cows. An additional 18 collared cows, which were previously captured for BNWR biologists in Unit 9E, were adopted into the project in spring 2018, and in spring 2019 biologists captured an additional 10 cows in Units 9B and 9C.

A total of 52 cows were collared and monitored for calf production, twinning rates, and pregnancy rates during 2017–2019 in southern Unit 9B, and Units 9C and 9E (Table 2). Twenty-two collared cows were monitored in 2017; 34 cows (18 ADF&G collars and 16 BNWR collars) were available in 2018. In spring 2019, we monitored 35 marked cows remaining in the project, their 11 short yearlings (10 to 12 months), and 55 calves born in spring 2019. Each year 1–2 collared cows disappeared or died and 1–3 cows per year moved far northwest into the Tikchik Mountains of Unit 17 and were unavailable for monitoring. Five cows exhibited long-range movements immediately prior to parturition. These cows suddenly traveled 30–70 miles, generally in a day or 2, and then dropped their calf(s). Three of these locations were in extremely dense cover that enabled only 1–2 visual observations despite continued intensive effort.

Calves were born from 12 May through 2 June over the 3 years. Neonatal survival (2 weeks) ranged from 38–51% (Table 2). Annual survival rate to yearling age was 23–26%. We were unable to get a spring 2020 survival rate due to the pandemic. We obtained one survival rate to October of 29% (Table 2) but were precluded by poor weather in October 2019. Most calf mortalities observed from the air were not accessible for onsite evaluation, but most were attributed to brown bears. Numerous observations of brown bears traveling through the area of parturition, the presence of brown bears near or on dead calves, and bears actively hunting in near proximity to a cow with new calves suggest brown bear predation as the main cause of death. The area is also known to have multiple wolf packs. Only 2 wolves were observed in the study area, however it is certainly possible that some mortalities were due to predation by wolves. Not all mortalities were a result of predation. Based on cow behavior and daily movements, such as crossing rivers, remaining at the current location or traveling 8–12 miles

overnight, an estimated 4–6 calf mortalities were probably nonpredation causes (i.e., accident, injury, or drowning).

Twining rates ranged from 56% in 2017 to 86% in 2019 for collared cows (Table 2). The twinning rate in 2015 was approximately 65% in Units 9C and 9E (Dom Watts, wildlife biologist, USFWS, King Salmon), indicating that cows were not nutritionally stressed. Upon capture in 2017, all but 2 cows were in excellent body condition. In spring 2019, the body condition of 10 captured cows was 50% excellent, 30% good, and 20 % poor, suggesting a more difficult winter. Blood sample analyses for cows captured in 2017 returned a 100% pregnancy rate. The annual survival of collared cows was 100% for those captured in 2017 and 90% for 2017 captures plus the adopted BNWR cows in spring 2019 (Table 2). The BNWR cows were mostly older cows than those captured in 2017; a higher mortality observed in 2019 was probably associated with the older cows in the sample.

Because of very dense foliage and ground vegetation, monitoring flights scheduled monthly through the summer of 2017 had decreasing visibility. It was not possible in all cases to see a cow or determine if a calf was present. Only one of these flights, on 6 July 2017, was completed; it had indeterminate results for 5 calves, 2 sets of twins, and 1 single, but with 4 live calves observed. It is recommended that these monthly flights not be conducted until fall foliage permits increased visibility.

Table 2. Units 9B–9E calf mortality study results, regulatory years 2017–2019, Alaska Peninsula.

Calf project parameters	Spring 2017	Spring 2018	Spring 2019
Available radiocollared cows	22	34	35
Percent cows observed[a]	95% (21)	100% (34)	100% (35)
First day of parturition	17 May	12 May	12 May
Latest day of parturition	23 May	2 June	27 May
Percent cows with calves[a]	76% (16)	91% (31)	80% (28)
Percent twinning rate[a]	56% (9)	68% (21)	86% (24)
Calves produced	26	53	55
Percent calf survival 2 weeks[b]	38% (10)	51% (27)	42% (22)
Percent calf survival to fall (October)[b, c]		29% (12/41)	
Percent 1-year calf survival (May)[b, c]		23% (6/26)	26% (11/43)
Cow annual survival (May)[a, c]		100% (20)	90% (28/31)

[a] The number in parentheses is the number of cows.
[b] The number in parentheses is the number of calves.
[c] The numbers separated by slashes are the number of animals alive/number of animals in sample size.

Recommendations for Activity 1.4

Discontinue.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor the moose harvest through field observations, harvest reports, and contact with hunters.

Data Needs

Monitoring, collecting, and analyzing harvest data are critical for sustained yield management, and determining if the opportunity to harvest ANS has been provided.

Methods

All moose hunts held in Unit 9 were by registration permit with mandatory reporting. Hunters were required to report within 5 days of harvest or 15 days of season closure. There were no subsistence household surveys conducted by ADF&G-Division of Subsistence during RY15–RY19.

Season and Bag Limit

Regulations for hunting moose are available on the ADF&G website: http://www.adfg.alaska.gov.

Results and Discussion

Harvest by Hunters

Harvest by hunters is summarized by year and unit in Table 3. The bag limit for all units was bull moose only. The average annual harvest for RY15–RY19 was 125 bulls (range 106 to 150 bulls); they were harvested by an average of 405 hunters. Annual moose harvest increased slightly from RY15 to RY19 with a spike in harvest in RY18 (Fig. 2). Hunter participation declined overall by 18% from RY15 to RY19. Causes for the decline in participation are unknown, but are generally a result of bad weather, poor economy, or high fuel costs. Annual harvest in Unit 9A was double the typical harvest with 13 in RY18, driven by a higher number of nonlocal residents, and returned to a typical level of 7 in RY19 (Table 3). In Unit 9B, harvest is influenced by local resident hunters and success (Table 3). Probably as a result of fewer hunters, hunter success increased by approximately 14% in Units 9C and 9E from RY15 to RY19. In Unit 9D, 13 hunters harvested 5 moose during RY15–RY19, which was within the normal ranges.

The average hunter success rate for Unit 9 during RY15–RY19 was 31%; nonresidents were 11% successful and local residents were 13%. The least-successful group was nonlocal residents at 7%. Nonlocal residents are least likely to hunt during the winter season.

Harvest Chronology

Most moose in Unit 9 were harvested during the September season (80–90%) during RY15–RY19. The peak of harvest each year occurred during 11–15 September.

Table 3. Moose harvest by hunters, residency, and success, Unit 9, regulatory years 2015–2019, Alaska Peninsula.

		Successful hunters						Unsuccessful hunters						
Unit	Regulatory year	Local resident[a]	Nonlocal resident	Non-resident	Unknown	Total	Percent	Local resident[a]	Nonlocal resident	Non-resident	Unknown	Total	Percent	Total hunters
9A	2015	0	2	4	0	6	46	0	4	3	0	7	54	13
9A	2016	0	1	0	0	1	10	0	7	2	0	9	90	10
9A	2017	0	3	2	0	5	33	0	7	3	0	10	67	15
9A	2018	0	10	3	0	13	39	0	10	10	0	20	61	33
9A	2019	0	5	2	0	7	50	0	5	2	0	7	50	14
9B	2015	19	6	5	0	30	19	78	37	17	0	132	81	162
9B	2016	36	15	11	0	62	35	79	18	16	0	113	65	175
9B	2017	26	11	5	0	42	27	64	30	18	0	112	73	154
9B	2018	32	21	4	0	57	32	66	34	19	0	119	68	176
9B	2019	15	15	7	0	37	23	62	42	18	0	122	77	159
9C	2015	20	6	4	0	30	21	92	14	7	0	113	79	143
9C	2016	22	8	5	0	35	26	71	14	13	0	98	74	133
9C	2017	17	5	2	0	24	19	79	18	8	0	105	81	129
9C	2018	19	6	9	0	34	27	61	13	19	0	93	73	127
9C	2019	13	6	13	0	32	34	48	10	5	0	63	66	95
9D	2015	1	2	0	0	3	50	1	2	0	0	3	50	6
9D	2016	0	0	0	0	0	0	1	0	0	0	1	100	1
9D	2017	0	0	0	0	0	0	1	0	0	0	1	100	1
9D	2018	0	0	0	0	0	0	0	1	0	0	1	100	1
9D	2019	1	1	0	0	2	50	1	1	0	0	2	50	4
9E	2015	11	4	29	1	45	42	21	13	27	0	61	58	106
9E	2016	8	2	24	0	34	40	19	14	18	0	51	60	85
9E	2017	8	3	23	0	34	41	15	12	22	0	49	59	83
9E	2018	9	6	31	0	46	46	14	12	29	0	55	54	101
9E	2019	5	5	32	0	42	58	10	14	7	0	31	42	73
Unitwide														
9[b]	2015	51	20	42	1	114	26	192	71	55	0	318	74	432
9[b]	2016	66	26	40	0	132	33	171	53	50	0	274	67	406
9[b]	2017	51	22	33	0	106	27	161	67	52	0	280	73	386
9[b]	2018	60	43	47	0	150	34	141	70	77	0	288	66	438
9[b]	2019	35	33	56	0	124	35	121	74	35	0	230	65	354

[a] Residents of Unit 9.

[b] Also includes moose harvested in Unit 9 where the subunit is unknown.

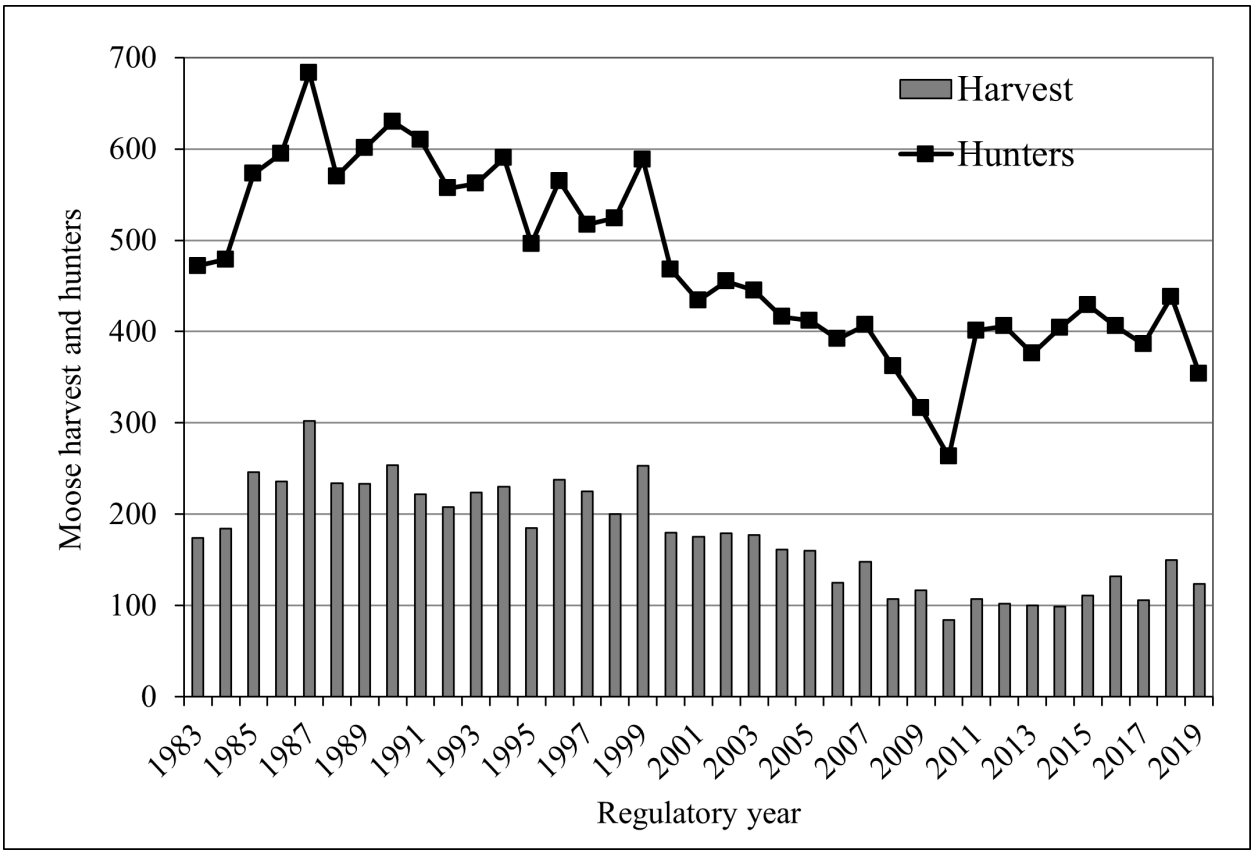


Figure 2. Moose harvest and hunters, Unit 9, regulatory years 1983–2019, Alaska Peninsula.

Note: Registration permits were required for all hunts beginning in RY11 for bull moose only.

Transport Methods

During the previous 2 decades, airplane transportation ranged from 51% to 69% for successful moose hunters in Unit 9. During RY15–RY19, airplane transport dropped to 35%, which is a drop of 20%–30% from RY10–RY14 (Fig. 3). Boat and ATV (3- and 4-wheelers) transport each increased by 8%. This was likely in response to the increasingly higher cost of air transport.

Other Mortality

No moose vehicle collisions were reported. One cow moose was illegally taken in Unit 9D near King Cove in RY18.

Alaska Board of Game Actions and Emergency Orders

In 2018, the Board of Game lengthened the fall any-bull registration hunt RM272 Unit 9B by 5 days; season dates are now 1–20 September. No emergency orders (EOs) were issued during RY15–RY19.

Recommendations for Activity 2.1

Continue monitoring the moose harvest using registration permits.

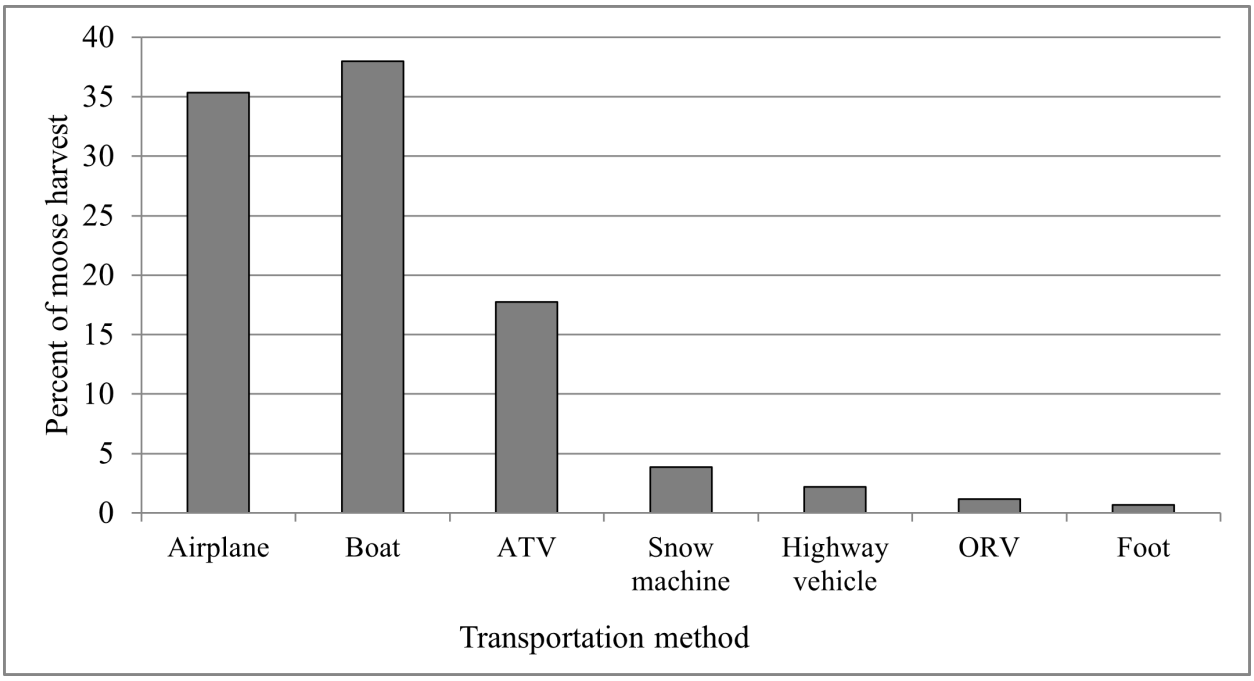


Figure 3. Percent of successful moose hunters by conveyance, Unit 9, regulatory years 2015–2019, Alaska Peninsula.

Note: ATV stands for all-terrain vehicle; it includes 3- and 4-wheelers. ORV stands for off-road vehicle; it includes side by sides.

3. Habitat Assessment Enhancement

No activities for moose habitat assessment or enhancement are included in Unit 9 moose management.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

No nonregulatory issues regarding moose have been identified in Unit 9.

Data Recording and Archiving

Data is digitized and backed up daily on an in-house server (O:\WC-DIV). Paper records are stored in file cabinets and on shelves in the area biologist and assistant area biologist offices. Archived records are stored in indexed and labeled boxes on the second floor of new warehouse (O:\WC-DIV\Admin King Salmon Area Office\Filing system\archived filing system index).

Agreements

There were no agreements with other agencies pertaining to moose management during RY15–RY19.

Permitting

Moose captures in 2017 and 2019 required the following permits:
NPS IACUC Project Name: AKR_KATM_Crowley_Moose_2017.A2
ADFG IACUC Protocol No. 2016-38
ADFG IACUC Protocol No. 0051-2018-01

Conclusions and Management Recommendations

Moose density in trend count areas was low to medium (0.1–0.7 moose/mi^2). Survey data, bull:cow ratios, and calf survival indicate a stable population. Careful monitoring of composition and harvest has been adequate for management data needs. Continue to survey trend count areas as snow conditions in November and early December allow in cooperation with BNWR and KNP staff.

Calf mortality research indicated a survival rate to yearling age of 23–26%, twinning rate of 59–86%, nearly 100% parturition rate, and brown bears as the primary source of calf mortality. High twinning rate and excellent female body condition in spring suggests that habitat is adequate to sustain the current population level.

Annual moose harvest increased slightly from RY15 until RY19, when the number of hunters decreased by about 33%. Harvest ranged from 112 to 149 bull moose. We recommend 1) no changes to harvest monitoring, and 2) to consider increasing the season length in Units 9B and 9C if bull:cow ratios remain high or increase.

II. Project Review and RY20–RY24 Plan

Review of Management Direction

MANAGEMENT DIRECTION

GOALS

1. Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.

2. Provide the greatest sustained opportunity to participate in hunting moose.

3. Provide an opportunity to view and photograph moose.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

Portions of the Unit 9 moose population—Units 9A, 9B, 9C, and 9E—have a positive customary and traditional use determination finding. The amount reasonably necessary for subsistence in Units 9A, 9B, 9C, and 9E combined is 100–140 bull moose per year.

Intensive Management

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 IM law. There were no IM programs initiated for moose, but there were for caribou in Units 9D and 9E. IM 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	–	–

Harvest objectives are set very high. The highest harvest reported for all of Unit 9 was 302 moose in 1987. These objectives can only be changed by the Board of Game.

MANAGEMENT OBJECTIVES

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. This applies to only Unit 9E during RY20–RY24.

2. Increase low density populations (where habitat conditions are not limiting) to 0.5 moose/mi^2. This applies to Unit 9 remainder during RY20–RY24.

3. Maintain sex ratios of at least 25 bulls:100 cows in medium- to high-density populations (Unit 9E) and at least 40 bulls:100 cows in low density areas (Unit 9 remainder).

No changes are recommended; however, it should be recognized that densities are not estimated but rather calculated from samples of moose observed during annual trend count surveys.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct aerial sex and age composition surveys in trend count areas of all units to determine status, trend, productivity, and mortality of moose.

Data Needs

We use fall composition surveys to monitor bull:cow ratio and number of bulls in the population to assist in determining trends, harvest quota, and to provide maximum hunting opportunity. Calf parameters are used to monitor productivity and survival. Ratios and proportions are also used in population simulation models used to help monitor population dynamics.

Methods

Continue with efforts to maximize annual composition counts in cooperation with BNWR and KNP.

ACTIVITY 1.2. Conduct a GSPE survey in Units 9B, 9C, or 9E every 2–5 years when snow conditions allow, February through March.

Data Needs

Determine moose population size by area to determine if management objectives are being met.

Methods

Follow methods as outlined in Kellie and DeLong 2006.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor the moose harvest through field observations, harvest reports, and contact with hunters.

Data Needs

Monitoring, collecting, and analyzing harvest data are critical for sustained-yield management, and determining if the opportunity to harvest ANS has been provided.

Methods

Continue hunter contacts and required harvest reporting.

3. Habitat Assessment Enhancement

No activities for moose assessment or enhancement are expected in Unit 9 moose management.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

No nonregulatory issues regarding moose have been identified in Unit 9.

Data Recording and Archiving

Digital data are backed up daily on an in-house server (O:\WC-DIV). Paper records are stored in file cabinets and on shelves in the area biologist and assistant area biologist offices. Archived

records are stored in indexed and labeled boxes on the second floor of new warehouse (O:\WC-DIV\Admin King Salmon Area Office\Filing system\archived filing system index).

Agreements

Maintain required flight certifications.

Permitting

No permits are expected in this period.

References Cited

Alaska Department of Fish and Game. 1976. Alaska wildlife management plans: A public proposal for the management of Alaska's wildlife: Southwestern Alaska. Draft proposal subsequently approved by the Alaska Board of Game. Division of Game, Federal Aid in Wildlife Restoration Project W-17-R, Juneau.

Butler, L. G. 2006. Unit 9 moose. Pages 107–115 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Butler, L. G. 2008. Unit 9 moose. Pages 116–124 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Crowley, D. W. 2017. Moose management report and plan, Game Management Unit 9: 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-2017-5, Juneau.

Crowley, D. W., and C. Peterson. 2014. Unit 9 moose. Chapter 9, Pages 9-1 through 9-12 [*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. https://www.adfg.alaska.gov/index.cfm?adfg=wildliferesearch.smr20146

Franzmann, A. W., R. E. LeResche, P. D. Arneson, and J. L. Davis. 1976. Moose productivity and physiology. Alaska Department of Fish and Game, Division of Game, Federal Aid Final Report 1 July 1969–30 June 1976, Federal Aid in Wildlife Restoration Job 1.1R, Juneau.

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

Morris, J. M. 1985. The use of fish and wildlife resources by residents of the Bristol Bay Borough, Alaska. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 123. Juneau.

Osgood, W. H. 1904. A biological reconnaissance of the base of the Alaska Peninsula. North American Fauna No. 24, U.S. Department of Agriculture, Division of Biological Survey, Washington, D.C. https://doi.org/10.5962/bhl.title.86981

Sellers, R. A. 1990. Unit 9 moose. Pages 68–77 [*In*] S. O. Morgan, editor. Moose annual management report of survey-inventory activities 1 July 1988–30 June 1989: Part VIII – moose. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

Sellers, R. A., and M. E. McNay. 1983. Unit 9 moose. Pages 36–42 [*In*] J. A. Barnett, editor. Moose annual management report of survey-inventory activities 1 July 1981–30 June 1982: Part III – moose. Alaska Department of Fish and Game, Division of Game, Federal Aid in Wildlife Restoration Job 1.0, Juneau.

Sellers, R. A., and M. E. McNay. 1984. Report to the Board of Game: Population status and management considerations of brown bear, caribou, moose and wolves on the Alaska Peninsula. Alaska Department of Fish and Game, Division of Game, King Salmon.

Smith, C. A. 1981. Final report on Unit 9E moose management experiment. Alaska Department of Fish and Game, Division of Game, King Salmon.

Smith, C. A., J. B. Faro, and N. C. Steen. 1979. An evaluation of trophy moose management on the Alaska Peninsula. Pages 280–302 [*In*] H. G. Cumming, M. Crete, E. S. Telfer, P. Jordan, A. W. Franzmann, M. Lankester, A. Bubenik, W. L. Reglin, and V. Crichton, editors. Proceedings of 15th North American Moose Conference and Workshop, 12–16 March 1979, Soldotna-Kenai.

Watts, D. E., L. G. Butler, B. W. Dale, and R. D. Cox. 2010. The Ilnik wolf Canis lupus pack: Use of marine mammals and offshore sea ice. Wildlife Biology 16(2):144-149. https://doi.org/10.2981/109-040

Watts, D. E., and S. Newsome. 2016. Exploitation of marine resources by wolves in southwestern Alaska. Journal of Mammalogy 98:66–76. https://doi.org/10.1093/jmammal/gyw153


ALASKA
DEPARTMENT OF FISH AND GAME