# Moose Management Report and Plan, Game Management Unit 14A:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

**Chris J. Brockman**



2025

Alaska Department of Fish and Game Division of Wildlife Conservation

# Moose Management Report and Plan, Game Management Unit 14A:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

**PREPARED BY:**

Chris J. Brockman
Area Wildlife Biologist

**APPROVED BY:**

Todd A. Rinaldi
Management Coordinator

**REVIEWED BY:**

Tim Peltier
Regional Supervisor

Manny Eichholz
Assistant Management Coordinator

**PUBLISHED BY:**

June C. Younkins
Publications Coordinator



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 grant 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 Region IV 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:

Brockman, C. J. 2025. Moose management report and plan, Game Management Unit 14A: 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-2025-20, Juneau.

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



**Cover Photo:** A cow moose with a GPS (Global Positioning System) collar that will aid in a study of moose-vehicle collisions in Unit 14A. ©2017 ADF&G. Photo by Tim 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 14A 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 Alaska Department of Fish and Game's (ADF&G) 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. RY15–RY19 Management Report

## Management Area

Unit 14A is located in Southcentral Alaska, north of Anchorage. The total area of Unit 14A is 2,685 $mi^2$; however, the area of suitable habitat below a mean height of 3,500 ft elevation is estimated at 2,131 $mi^2$. Unit 14A consists of all land from the east bank of the Susitna River beginning at the mouth of Cook Inlet heading north to the mouth of Willow Creek; then south of the north bank of the communities of Willow and Peters Creek to the headwaters, and south of the hydrologic divide separating the Susitna River and the Knik Arm drainages to the outlet creek at lake 4408. From there, the unit extends southeast in a straight line to the northernmost fork of the Chickaloon River and then south along the east bank of the Chickaloon River to the bridge on the Glenn Highway at milepost 77.7. It then follows the hydrologic divide that separates Carbon and Coal creeks to the hydrologic divide between the waters of the Matanuska River and the Knik Glacier, across the face of the glacier south to the south bank of the Knik River to Cook Inlet, and finally following along Cook Inlet to the mouth of the Susitna River (Fig. 1).

## Summary of Status, Trend, Management Activities, and History of Moose in Unit 14A

The moose population and the human population in Unit 14A have grown significantly since the area was settled by relocated farmers in the 1930s. Moose were described as scarce during the 1930s. The moose population likely grew to numbers approaching 7,000 animals during the 1960s (Griese and Masteller 1996). Moose numbers fluctuated with deep snow winters but stabilized between 5,000 and 6,000 animals in the 1990s. Surveys since 2001 have shown the population at or above the upper end of the population objective range. Managers addressed the issue by increasing the number of antlerless permits available. The human population in the Matanuska-Susitna Valley continues to be one of the fastest growing areas in the state. Land-clearing activities associated with agriculture, development, and road construction have created considerable early successional habitat and thus contributed to an increase in moose browse. As

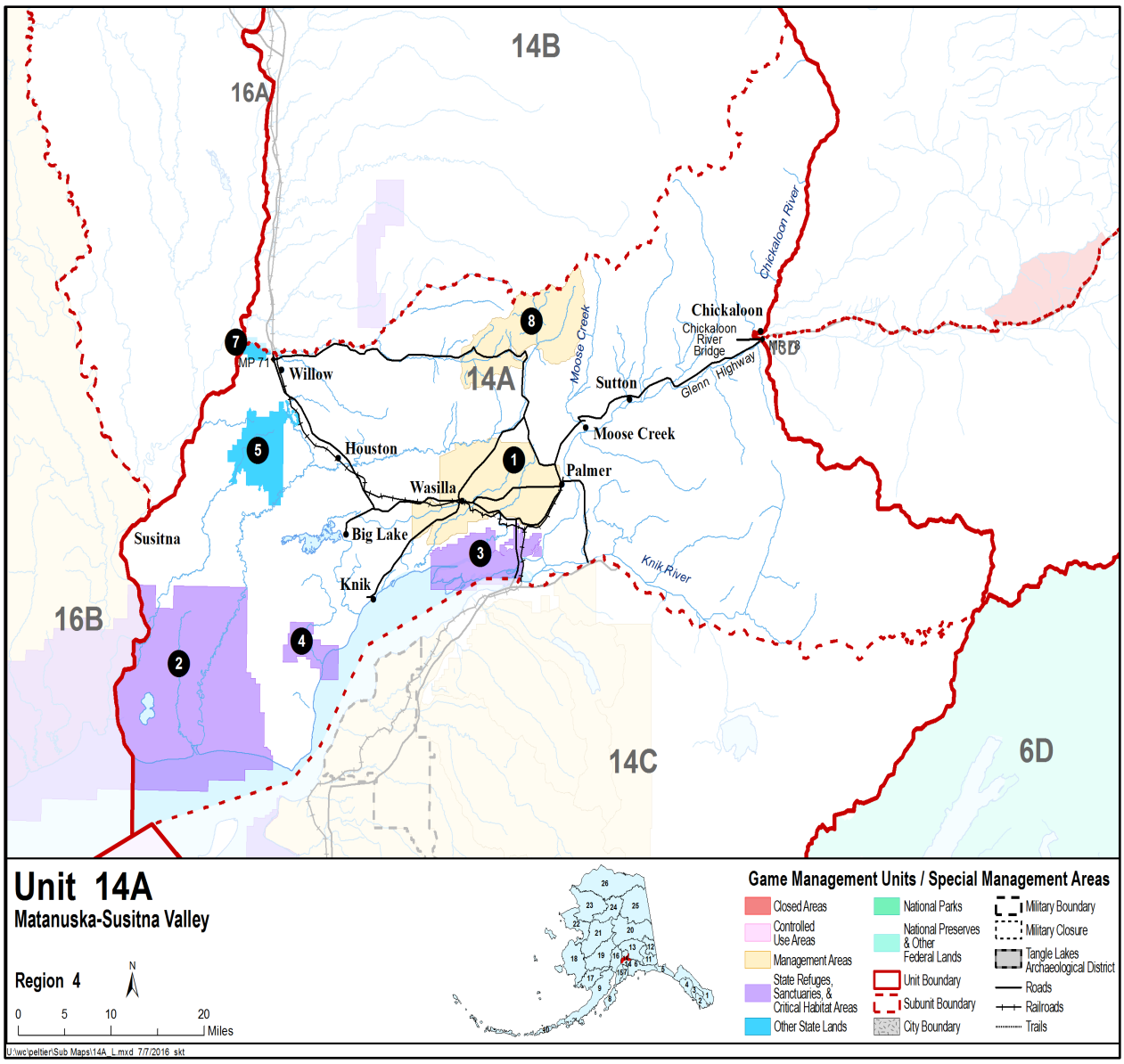



**Figure 1. Map of Unit 14A in Southcentral Alaska, regulatory years 2015–2019.**

the area continues to grow, much of the early seral moose habitat is being replaced with homes, roads, and associated industry (Peltier 2012).

Between statehood in 1959 and 1971, harvests ranged from 20 to 1,300 moose (Griese 2000). The harvest was predominantly bulls, but the harvest of antlerless moose was as high as 1,131 animals in RY62 (Griese 2000). Following several severe winters, antlerless moose seasons were discontinued during RY72–RY77, and the mean annual harvest of bulls declined, ranging between 167 and 346 bulls. Antlerless seasons began again in RY78. Starting in RY93, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least one side, a minimum of 3 brow tines on at least one side, or a minimum total width of 50 inches. This selective harvest strategy is referred to as *spike-fork 50-inch* (Schwartz et al. 1992). Between RY93 and RY10, the average general season harvest was 363 bulls (range 226–498).

Habitat enhancement efforts during the 1990s were aided by fires. In 1993, a successful cooperative effort between state agencies resulted in a 900-acre controlled burn to enhance wintering moose habitat near the community of Willow (Collins 1996). In June 1996, a 37,000-acre fire caused by humans, termed the Miller's Reach Fire, occurred in the Big Lake area (Griese and Masteller 1998). Habitat regeneration from this fire substantially enhanced moose forage and habitat in Unit 14A. Since 2001, the Ruffed Grouse Society, the Alaska Department of Natural Resources (DNR) Division of Forestry (DOF), and ADF&G have been cooperating on habitat enhancement efforts in the Matanuska Valley Moose Range (MVMR) to benefit both moose and ruffed grouse. Between 2001 and 2012, 564 acres of aspen-dominated stands were clearcut in MVMR. In addition, ADF&G staff in Palmer have been working with DOF staff on proposed timber sales in an effort to enhance moose habitat in lieu of prescribed fires.

The Alaska rail line extends from Anchorage to Fairbanks and includes 41 miles of track in Unit 14A. Moose use railroad tracks in the winter for easier traveling (i.e., energy conservation), and their use becomes more pronounced in years of high snowfall. Subsequently, annual moose mortality from trains can vary greatly and can become excessive in years with high snowfall.

The development and human population growth of the Matanuska-Susitna Valley have resulted in an increase in roads in the unit, along with road improvements and increased vehicle density and speeds. These changes have led to an increase in moose-vehicle collisions (MVCs) commensurate with the population growth. Similar to moose-railroad collisions, MVCs vary annually and are more common in years with high snowfall.

# Management Direction

## Existing Wildlife Management Plans

- Direction in the Talkeetna River, Matanuska Glacier, Matanuska Valley, and Palmer Hay Flats moose management plans (ADF&G 1976) has been reviewed and modified through public comments, staff recommendations, and Board of Game (the board) 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 14A.
- MVMR is located in the eastern portion of Unit 14A and the western portion of Unit 13A. It was created by the legislature in 1984 to maintain, improve, and enhance moose populations and other wildlife resources. MVMR encompasses 132,500 acres of habitat and is comanaged by ADF&G and DNR. It is managed under the Matanuska Valley Moose Range Management Plan (DNR and ADF&G 1986).

## Goals

- Protect, maintain, or enhance the moose population and its habitat in concert with other components of the ecosystem to provide for high levels of human consumptive use.
- Provide opportunities for nonconsumptive use (e.g., to view and photograph moose).

## CODIFIED OBJECTIVES

### Amounts Reasonably Necessary for Subsistence Uses

There is no finding for Unit 14A moose.

### Intensive Management

In 2001, the board adopted a positive finding for intensive management of moose in Unit 14A. Current intensive management objectives are as follows:

- Population objective: 6,000–6,500 moose.
- Harvest objective: 360–750 moose.

## MANAGEMENT OBJECTIVES

1. Maintain the moose population at 6,000–6,500 moose.
2. Manage for a posthunt (fall) sex ratio of 20–25 bulls to 100 cows.
3. Achieve an annual harvest of 360–750 moose.

## MANAGEMENT ACTIVITIES

Assessing population status and trends, monitoring harvest and mortality, and assessing habitat conditions are integral components of the management of moose in Unit 14A. Survey and inventory management activities used to monitor populations in Unit 14A 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 conditions relative to habitat conditions. Sex and age composition information can be used to determine appropriate harvest levels and recruitment into the population. 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 ft. Surveys are conducted between 1 November and 6 December on a biennial basis as weather and snow conditions permit. This approach produces population estimates and statistically bound sex and age composition estimates by using a stratified random sampling design and geostatistical models of autocorrelation. It is designed for high-intensity surveys of moose (8–10 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. Teams of pilots and observers record moose age and sex classes in the field for later analysis (Appendix A).

In Unit 14A, annual stratification flights are generally used and conducted with a 4-person crew at approximately 1,000 ft from a Cessna 185 prior to conducting the survey of the rest of the unit with Super Cubs. Classification of survey units as high or low moose density is based on the number of observed moose, moose tracks, and availability of favorable moose habitat, which is evaluated relative to historical data. Using only 2 stratification categories minimizes potential classification error caused by moose movements between survey units. It provides better continuity when the survey is interrupted by weather delays that could result in a change in moose distribution during the survey. For stratification purposes, sample units likely to have fewer than 5 moose in the unit are considered *low* stratum, and sample units likely to contain ≥5 moose are considered *high* stratum units. Sightability correction factors (SCFs) 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 noting 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 14A, smaller-scale sex and age composition surveys have been completed to assess population trends. In a manner similar to the GSPE survey, pilot-observer teams flying at between 300 and 500 ft above ground level (AGL) count moose of each sex and age class in areas of known winter concentrations. A GSPE survey is then conducted in the spring to get a population estimate that can be compared to the fall composition survey.

*Results and Discussion*

The Unit 14A moose population was above the population objective during the report period and appears to have increased from RY15 to RY17; then, it began to decline by RY19 (Table 1). The RY17 survey sampled 35 high strata units (10%) and 48 low strata units (14%) of the 352 units available. In total, 24% of the available moose habitat was surveyed. The RY19 survey consisted of 55 high strata units (16%) and 32 low strata units (10%) of the 336 units available, representing 26% of the total available moose habitat. The GSPE estimates for RY17 and RY19 were similar (8,756 ± 1,171 in RY17; 7,896 ± 883 for RY19; [point estimate ± standard error]); however, differences in the SCFs in the high strata (1.34 in RY17; 1.18 in RY19) and low strata (1.70 in RY17; 1.23 in RY19) result in a 10% decrease in the estimated population of moose in Unit 14A.

*Recommendations for Activity 1.1*

Continue. Due to the importance of the Unit 14A moose population for the hunters of Southcentral Alaska, GSPE surveys should be continued biennially as weather and snow conditions permit. They should remain one of the higher-priority surveys for the Palmer office. A biometrician should be consulted to determine adjustments in the sampling scheme that will address the high variance of the results. The units subsampled to develop SCFs should be increased to account for variability and absence of moose spotted in both the regular and intensive surveys.

ACTIVITY 1.2. Spring twinning surveys.

*Data Needs*

Determining the ratio of cows with twin calves to cows with singletons provides an indication of maternal condition and productivity. Trends in this indicator are integral to management on a sustained yield basis and are very important for determining the nutritional condition of the

**Table 1. Unit 14A moose fall composition and estimated population from geospatial population estimates, Southcentral Alaska, regulatory years 2015–2019.**

| Regulatory year | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Percent calves | Adults | Moose observed | Estimated population (90% CI[a])[b] | Estimated population with SCF[b,c] | Moose/mi$^2$ with SCF[d] |
|---|---|---|---|---|---|---|---|---|---|
| 2015[e] | – | – | – | – | – | – | – | – | – |
| 2016[e] | – | – | – | – | – | – | – | – | – |
| 2017[f] | – | – | – | 17 | 1,177 | 1,420 | 5,658 (±12%) | 8,756 (±23%) | 4.2 |
| 2018[g] | 34 | 7.4 | 31 | 19 | 1,467 | 1,809 | – | – | – |
| 2019[f] | – | – | – | 16 | 1,552 | 1,845 | 6,509 (±18%) | 7,896 (±19%) | 3.7 |
| 2019[g] | 34 | 9.7 | 29 | 18 | 1,650 | 2,013 | – | – | – |

[a] CI = confidence interval.
[b] The 90% confidence interval (CI) plus and minus the estimate are shown in parentheses.
[c] SCF = sightability correction factor.
[d] Based on habitat available as determined by the total area of the Geospatial Population Estimator (GSPE) grid for each area.
[e] No survey was completed.
[f] GSPE method.
[g] Sex and age composition survey of known wintering areas.

moose population and the habitat quality.

*Methods*

Twinning rate surveys are conducted from an R-44 helicopter flown at ≤500 ft AGL over a set course of known calving areas. The surveys are flown in late May within a week of the median calving date. They are repeated at least twice to account for differences in sightability due to weather and foliage condition as well as variations in calving phenology. All moose are classified as a bull, yearling cow, adult cow without calf, unknown, or adult cow with a single, twin, or triplet calves. A sample size of at least 50 cows with calves was considered sufficient. Twinning rate is calculated as the proportion of cows with 2 or more calves from the sample of all cows with calves.

*Results and Discussion*

Twinning rates have remained relatively stable at low levels for the report period, with an average of 25% across RY15–RY19 and a low of 21% in RY19 (Fig. 2). Unit 14A is experiencing a persistently low twinning rate. This is likely due to the population being significantly over the upper end of the population objective since 2011. The results of a browse survey conducted in 2016 indicate that browse removal is high compared to other areas that have been sampled throughout the state. The average twinning rate of 25% is higher than what was documented in Interior Alaska when high browse removal was documented. It is likely that the relatively mild winters and more diverse plant community of Unit 14A allow for its lower extreme of twinning rates to remain higher than that of Interior Alaska.

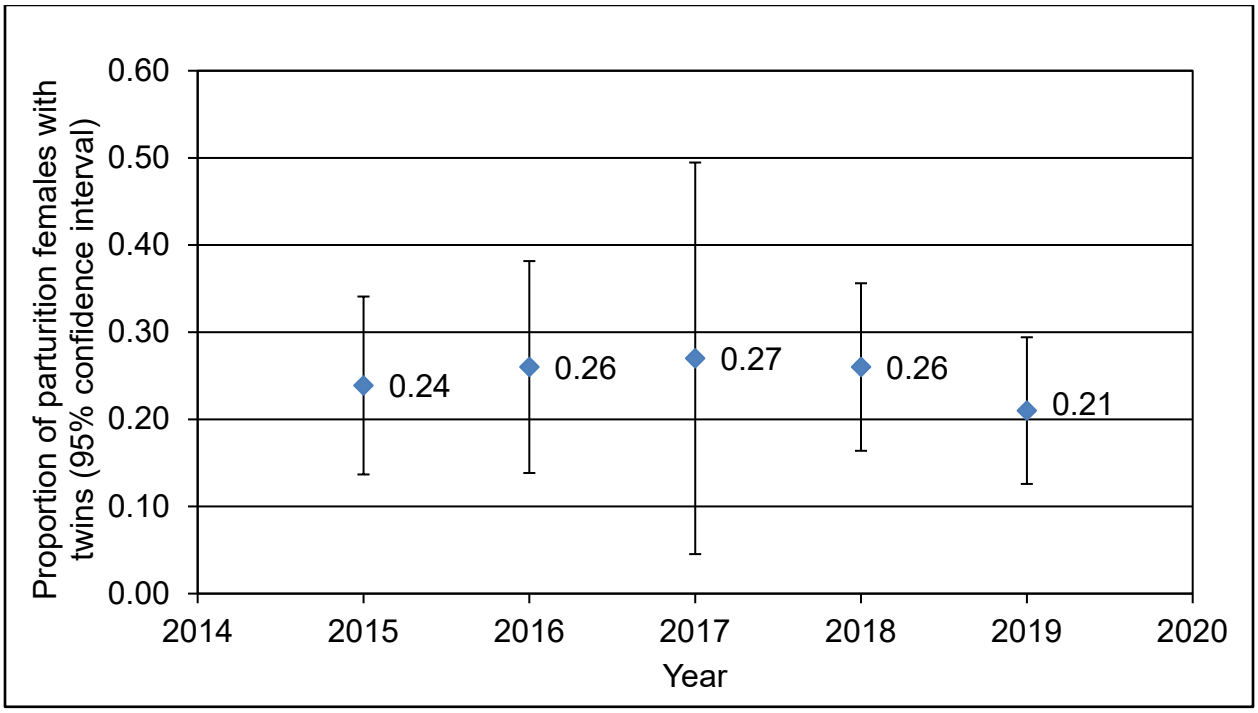



**Figure 2. Unit 14A moose spring twinning surveys, Southcentral Alaska, regulatory years 2015–2019.**

ADF&G biologists in Unit 14A would like to reduce the population to within the population objective of 6,000–6,500 moose. Reaching the population objective should result in increasing twinning rates and overall productivity. Additionally, maintaining the population within the objective will allow for resiliency in the population to the occasional deep snow winter. The combination of these factors will provide high levels of sustained yield over the long term.

*Recommendations for Activity 1.2*

Continue with spring twinning rate surveys.

## 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. Information collected on other sources of mortality helps the development of population models and is useful in ameliorating negative human-moose interactions.

*Methods*

Moose hunting effort in Unit 14A is recorded through the moose harvest report obtained and submitted by hunters that participate in hunting within the unit. This report notes the number of days hunted, location, methods of take and transportation, commercial services used, and the results of the hunter effort. Reports from the Alaska Department of Public Safety (DPS), Alaska Department of Transportation and Public Facilities, and Alaska Railroad provide information on additional forms of mortality.

*Season and Bag Limit*

During RY15–RY19, the general season for both residents and nonresidents was 10–17 August (archery only) and 25 August–25 September (archery, firearm, and muzzleloader). Hunters are limited to 1 bull with either spike or forked antlers, at least 3 brow tines on one side, or antlers ≥50 inches. In addition, resident hunters may apply for an antlerless moose drawing permit that allows them to take either a cow or a calf moose (DM400–DM410) or a cow, calf, or antlerless bull (DM413 and DM414). Season dates for the draw are 25 August–25 September (DM400–DM410), 1 November–30 November (DM413), or 1 December–25 December (DM414; Fig. 3). During the report period, the number of drawing permits available increased from a maximum of 1,000 to a maximum of 2,000. Currently, 1,005 drawing permits are issued. Resident hunters under the age of 16 may also apply for an antlerless moose draw hunt for the 25 August–25 September timeframe (YM412).

Beginning in RY11, resident hunters were allowed to register for a targeted hunt (AM415). Under the provisions of this hunt, a person who completed hunter education and registered during the month of October may be randomly drawn to hunt specific bull or cow moose. The intent of this hunt is to reduce the number of nuisance moose that may be causing property damage, injured moose, or moose that have the potential to be hurt or killed due to MVCs (Peltier 2014). In RY12, the program was expanded, and potential areas of MVCs were

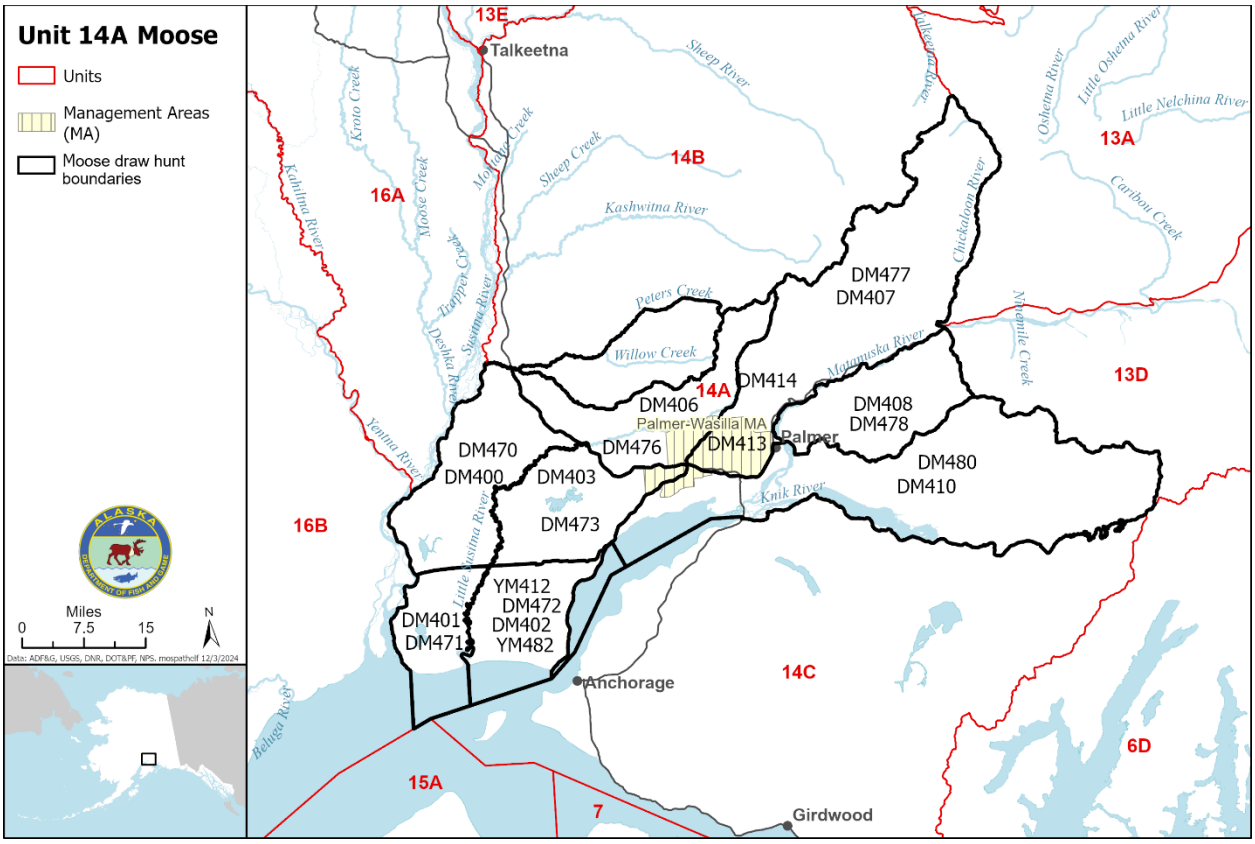



**Figure 3. Unit 14A moose antlerless drawing permit hunts DM400–DM414, Southcentral Alaska, regulatory years 2015–2019.**

identified. Also, a 2-mile buffer zone around specific roads was created to allow permitted hunters to take moose near roads during the winter, thus potentially reducing MVCs.

Season and bag limit information is available on the ADF&G website.[1]

*Results and Discussion*

Hunt results and causes of accidental death are summarized in Table 2. Average annual mortality was 1,496 moose during RY15–RY19.

Harvest by Hunters

Reported harvest averaged 1,005 moose during the report period. Harvest was well above the harvest objective of 360–750 moose. Female moose harvested under a drawing permit accounted for more than 50% of the annual harvest.

Permit Hunts

The results of the antlerless draw hunts and the targeted hunt (AM415) are available in Table 3. To reduce the population to within population objectives, the number of permits available and the subsequent harvest of antlerless moose has remained high throughout RY15–RY19.

[1] http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulations.hunting.

**Table 2. Unit 14A moose harvest and accidental death, Southcentral Alaska, regulatory years 2015–2019.**

| Regulatory year | Harvest | | | | | | | Accidental deaths[a] | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated | | | | | | |
| | M | F | Unknown | Total[b] | Unreported[c] | Illegal[d] | Total | Road | Train | Total | |
| 2015 | 545 | 569 | 5 | 1,119 | 78 | 60 | 138 | 353[e] | 9 | 362 | 1,619 |
| 2016 | 459 | 559 | 0 | 1,018 | 71 | 60 | 131 | 357[f] | 25 | 382 | 1,531 |
| 2017 | 465 | 491 | 0 | 956 | 67 | 60 | 127 | 319[f] | 26 | 345 | 1,428 |
| 2018 | 442 | 564 | 1 | 1,007 | 70 | 60 | 130 | 304[f] | 22 | 326 | 1,463 |
| 2019 | 386 | 535 | 2 | 923 | 65 | 60 | 125 | 359[f] | 34 | 393 | 1,441 |

*Note*: Includes permit hunt harvest.

[a] Road and train kills are minimum numbers.

[b] Includes moose of unknown sex.

[c] Derived by taking 7% of the reported harvest of bulls.

[d] Includes moose taken in defense of life or property, enforcement cases, and an estimate of out-of-season take.

[e] The roadkill estimate is based on the number of heads turned into the Palmer ADF&G office.

[f] The roadkill estimate is based on location data provided by the Alaska Department of Public Safety.

**Table 3. Moose harvest data by permit hunts in Unit 14A, Southcentral Alaska, regulatory years 2015–2019.**

| Regulatory year | Applicants | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls | Cows | Unknown | Total |
|---|---|---|---|---|---|---|---|---|---|
| DM400, Unit 14A, Susitna River, Redshirt Lake | | | | | | | | | |
| 2015 | 2,309 | 37 | 19 | 60 | 40 | 0 | 12 | 0 | 12 |
| 2016 | 2,035 | 37 | 24 | 50 | 50 | 1 | 13 | 0 | 14 |
| 2017 | 2,565 | 37 | 19 | 40 | 60 | 0 | 18 | 0 | 18 |
| 2018 | 2,622 | 111 | 24 | 68 | 32 | 0 | 27 | 0 | 27 |
| 2019 | 2,466 | 100 | 20 | 74 | 26 | 1 | 21 | 0 | 22 |
| DM401, Unit 14A, Susitna River, Figure Eight Lake | | | | | | | | | |
| 2015 | 850 | 15 | 20 | 58 | 42 | 0 | 5 | 0 | 5 |
| 2016 | 620 | 15 | 27 | 45 | 55 | 0 | 6 | 0 | 6 |
| 2017 | 676 | 15 | 40 | 44 | 56 | 0 | 5 | 0 | 5 |
| 2018 | 624 | 73 | 30 | 67 | 33 | 1 | 15 | 0 | 16 |
| 2019 | 764 | 70 | 37 | 77 | 23 | 0 | 10 | 0 | 10 |
| DM402, Unit 14A, Point Mackenzie | | | | | | | | | |
| 2015 | 4,555 | 75 | 16 | 48 | 52 | 1 | 32 | 0 | 33 |
| 2016 | 3,936 | 75 | 21 | 42 | 58 | 0 | 34 | 0 | 34 |
| 2017 | 4,539 | 75 | 15 | 55 | 45 | 0 | 29 | 0 | 29 |
| 2018 | 4,431 | 75 | 11 | 67 | 33 | 0 | 22 | 0 | 22 |
| 2019 | 2,969 | 75 | 21 | 63 | 37 | 0 | 22 | 0 | 22 |
| DM403, Unit 14A, Big Lake | | | | | | | | | |
| 2015 | 4,646 | 60 | 8 | 15 | 85 | 2 | 45 | 0 | 47 |
| 2016 | 4,045 | 60 | 8 | 25 | 75 | 1 | 41 | 0 | 42 |
| 2017 | 5,128 | 80 | 10 | 38 | 62 | 0 | 45 | 0 | 45 |
| 2018 | 5,927 | 100 | 15 | 36 | 64 | 2 | 52 | 0 | 54 |
| 2019 | 4,703 | 100 | 12 | 43 | 57 | 1 | 49 | 0 | 50 |
| DM406, Unit 14A, Bald Mountain Ridge | | | | | | | | | |
| 2015 | 4,497 | 75 | 19 | 41 | 59 | 0 | 36 | 0 | 36 |
| 2016 | 4,015 | 75 | 5 | 41 | 59 | 2 | 40 | 0 | 42 |
| 2017 | 4,914 | 95 | 16 | 50 | 50 | 2 | 38 | 0 | 40 |
| 2018 | 4,979 | 120 | 23 | 54 | 46 | 1 | 42 | 0 | 43 |
| 2019 | 3,739 | 120 | 7 | 62 | 38 | 1 | 42 | 0 | 43 |

-continued-

**Table 3. Moose harvest data by permit hunts in Unit 14A, Southcentral Alaska, regulatory years 2015–2019 continued.**

| Regulatory year | Applicants | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls | Cows | Unknown | Total |
|---|---|---|---|---|---|---|---|---|---|
| DM407, Unit 14A, Matanuska River, North | | | | | | | | | |
| 2015 | 5,868 | 129 | 16 | 32 | 68 | 3 | 71 | 0 | 74 |
| 2016 | 4,909 | 128 | 16 | 35 | 65 | 4 | 65 | 0 | 69 |
| 2017 | 6,829 | 158 | 8 | 44 | 56 | 3 | 78 | 0 | 81 |
| 2018 | 7,600 | 189 | 13 | 47 | 53 | 1 | 87 | 0 | 88 |
| 2019 | 6,265 | 200 | 14 | 56 | 44 | 5 | 71 | 0 | 76 |
| DM408, Unit 14A, Matanuska River, South | | | | | | | | | |
| 2015 | 3,082 | 112 | 21 | 60 | 40 | 1 | 34 | 0 | 35 |
| 2016 | 2,411 | 112 | 21 | 69 | 31 | 1 | 27 | 0 | 28 |
| 2017 | 2,538 | 112 | 23 | 76 | 24 | 0 | 21 | 0 | 21 |
| 2018 | 2,217 | 62 | 16 | 85 | 15 | 0 | 8 | 0 | 8 |
| 2019 | 1,479 | 70 | 27 | 75 | 25 | 0 | 13 | 0 | 13 |
| DM410, Unit 14A, Knik River | | | | | | | | | |
| 2015 | 4,477 | 75 | 8 | 29 | 71 | 0 | 49 | 0 | 49 |
| 2016 | 4,253 | 75 | 12 | 22 | 78 | 1 | 50 | 1 | 52 |
| 2017 | 5,928 | 105 | 12 | 38 | 62 | 0 | 57 | 0 | 57 |
| 2018 | 7,177 | 150 | 11 | 36 | 64 | 1 | 84 | 0 | 85 |
| 2019 | 5,569 | 150 | 17 | 37 | 63 | 1 | 77 | 0 | 78 |
| DM/YM412, Unit 14A, Point MacKenzie[a] | | | | | | | | | |
| 2015 | 527 | 23 | 17 | 53 | 47 | 0 | 9 | 0 | 9 |
| 2016 | 432 | 23 | 30 | 75 | 25 | 0 | 4 | 0 | 4 |
| 2017 | 857 | 23 | 13 | 55 | 45 | 0 | 9 | 0 | 9 |
| 2018 | 1,189 | 23 | 17 | 79 | 21 | 0 | 4 | 0 | 4 |
| 2019 | 1,104 | 25 | 20 | 75 | 25 | 0 | 5 | 0 | 5 |
| DM413, Unit 14A | | | | | | | | | |
| 2015 | 4,451 | 300 | 12 | 17 | 83 | 23 | 195 | 0 | 218 |
| 2016 | 5,059 | 300 | 12 | 18 | 82 | 20 | 196 | 1 | 217 |
| 2017 | 12,472 | 300 | 12 | 21 | 79 | 19 | 191 | 0 | 210 |
| 2018 | 9,917 | 399 | 12 | 22 | 78 | 55 | 220 | 0 | 275 |
| 2019 | 12,346 | 200 | 13 | 27 | 73 | 7 | 121 | 0 | 128 |
| DM414, Unit 14A[b] | | | | | | | | | |
| 2015 | – | – | – | – | – | – | – | – | – |
| 2016 | – | – | – | – | – | – | – | – | – |
| 2017 | – | – | – | – | – | – | – | – | – |
| 2018 | – | – | – | – | – | – | – | – | – |
| 2019 | 8,986 | 200 | 15 | 27 | 73 | 25 | 103 | 0 | 128 |
| RM/AM415, Unit 14A, Targeted Hunt[c] | | | | | | | | | |
| 2015 | – | 145 | 2 | 27 | 73 | 26 | 81 | 0 | 107 |
| 2016 | – | 120 | 0 | 21 | 79 | 13 | 82 | 0 | 95 |
| 2017 | – | – | – | – | – | – | – | – | – |
| 2018 | – | – | – | – | – | – | – | – | – |
| 2019 | – | – | – | – | – | – | – | – | – |

[a] DM412 was added in 2007, and boundaries are the same as DM402.
[b] DM414 was first held in 2019.
[c] RM415 was renamed AM415 in regulatory year 2012.

Hunter Residency and Success

The vast majority of hunters who report hunting Unit 14A reside in Unit 14A. Hunter success during the general harvest season averaged 17% for the report period and peaked in 2017 at 27%. The total number of hunters remained relatively constant, with a slight decline in 2018 and 2019. Success rates are much higher for hunters participating in the antlerless draw hunts and even higher for those selected to participate in the targeted hunt (Tables 3 and 4).

Harvest Chronology

Unlike a lot of other units, harvest in Unit 14A is distributed evenly throughout the open season with a slight increase in the last 2 weeks of the season (Table 5). Typically, moose become more vulnerable to hunters during the end of the season as they approach the rut; however, competition for moose in Unit 14A may lead many hunters into the field at the start of the season. Further analysis of the harvest data showed a trend toward the percentage of bulls greater than the spike-fork component decreasing during the hunting season, while the percentage of the spike-fork component increased as the season progressed. This may result from the decrease in availability of the larger age classes of bulls, a decrease in the selectivity of hunters as the season progresses, or a combination of the 2 factors (Peltier 2014).

Transport Methods

Most hunters use highway or all-terrain vehicles to access the moose-hunting areas in Unit 14A. Access throughout Unit 14A is good, and the extensive trail system created by all-terrain vehicles in the unit increases every year (Table 6).

*Other Mortality*

MVCs can be a significant source of mortality for moose in Unit 14A. MVCs accounted for an average of 338 moose killed annually during RY15–RY19. Moose killed by trains averaged 23 per year during the same period. As a result, a collaborative investigation with Utah State University has been designed to define the factors associated with MVCs and the movements of moose in the Matanuska-Susitna Valley (ADF&G 2016). Fieldwork is complete, and a report is expected in 2022.

*Alaska Board of Game Actions and Emergency Orders*

During the spring 2017 meeting, the board increased the total number of antlerless moose permits available to 2,000 permits. Antlerless moose hunts are required to stabilize or decrease the population and have been reauthorized annually at the spring board meetings. Crossbow was added as a legal method of take within the Palmer-Wasilla management area and for the targeted hunt.

*Recommendations for Activity 2.1*

Continue to monitor total harvest in comparison with current intensive management objectives. If the results of future population assessments show a continued increase in the population above the management objectives, consider options such as adjusting permit levels to reduce the population, thus avoiding the negative impact of a population that may be above biological or social carrying capacity.

**Table 4. Unit 14A moose hunter residency and success, Southcentral Alaska, regulatory years 2015–2019.**

| | Successful | | | | | | Unsuccessful | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local resident[a] | Nonlocal resident | Nonresident | Unknown | Total | (%) | Local resident[b] | Nonlocal resident | Nonresident | Unknown | Total | (%) | Total hunters |
| 2015 | 460 | 13 | 24 | 5 | 502 | (15) | 2,524 | 196 | 70 | 18 | 2,808 | (85) | 3,310 |
| 2016 | 412 | 12 | 27 | 2 | 453 | (15) | 2,494 | 51 | 75 | 8 | 2,628 | (85) | 3,081 |
| 2017 | 406 | 15 | 23 | 6 | 450 | (27) | 2,482 | 55 | 62 | 10 | 2,609 | (73) | 3,059 |
| 2018 | 347 | 16 | 25 | 1 | 389 | (13) | 2,459 | 77 | 63 | 9 | 2,608 | (87) | 2,997 |
| 2019 | 319 | 16 | 22 | 1 | 358 | (14) | 2,158 | 56 | 58 | 2 | 2,274 | (86) | 2,632 |

*Note*: Does not include drawing permit hunters.
[a] Unit 14 residents.

**Table 5. Unit 14A moose harvest chronology, Southcentral Alaska, regulatory years 2015–2019.**

| | August | | | September | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | 10–17 | 20–26 | 27–31 | 1–7 | 8–14 | 15–20 | 21–25 | Unknown | Total |
| 2015 | 52 | 54 | 65 | 52 | 86 | 93 | 93 | 7 | 502 |
| 2016 | 36 | 66 | 52 | 59 | 58 | 89 | 86 | 7 | 453 |
| 2017 | 44 | 73 | 54 | 69 | 62 | 76 | 65 | 7 | 450 |
| 2018 | 38 | 51 | 39 | 65 | 49 | 69 | 63 | 15 | 389 |
| 2019 | 24 | 42 | 51 | 50 | 53 | 43 | 82 | 13 | 358 |

*Note*: Does not include drawing permit hunts.

**Table 6. Unit 14A transport methods (percent) of successful moose hunters, Southcentral Alaska, regulatory years 2015–2019.**

| | Transport methods (percent) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Airplane | Horse | Boat | ATV | Snowmachine | ORV[a] | Highway vehicle | Unknown | Airboat | $n$[b] |
| 2015 | 5 | 2 | 7 | 41 | 0 | 8 | 27 | 9 | 1 | 502 |
| 2016 | 4 | 1 | 8 | 42 | 0 | 9 | 27 | 9 | 0 | 453 |
| 2017 | 3 | 1 | 9 | 42 | 0 | 9 | 26 | 10 | 0 | 450 |
| 2018 | 5 | 1 | 9 | 41 | 0 | 9 | 25 | 10 | 0 | 389 |
| 2019 | 6 | 2 | 11 | 40 | 0 | 8 | 23 | 9 | 1 | 358 |

*Note*: Does not include drawing permit hunts.
[a] ORV = off-road vehicle.
[b] $n$ = sample size.

Implement a research operational plan to assess factors associated with MVCs and moose movements. Work to foster communications between ADF&G, DPS, Alaska Railroad, and nongovernmental organizations to receive timely, accurate information regarding causes of mortality and ways to reduce moose mortality in Unit 14A.

ACTIVITY 2.2. Age distribution of moose harvested in draw hunts and MVCs.

*Data Needs*

Determining the age distribution of moose may lead to understanding population parameters, such as the potential for population growth. Comparisons of age and sex distribution of moose harvested and moose collected from MVCs can enhance our understanding of how different age classes are subjected to different mortality events.

*Methods*

Hunters participating in antlerless moose draw hunts (DM400–DM412 and YM413), targeted hunts (AM415), and people receiving moose from MVCs are required to submit approximately 5 inches of the lower jaw to the department for analysis. Submitted samples are examined for tooth wear and compared to teeth of known-age moose. Under the antlerless moose hunts, primarily only females are taken; however, male calves are legal for harvest, and a few antlerless bulls have been taken during the late season DM413.

*Results*

Preliminary analysis of age data demonstrates significant differences in causes of cow mortality between draw hunts and MVCs (Fig. 4). Jaws from moose taken in draw hunts were compared with jaws collected from road-killed moose for RY15, RY17, and RY19. While calves are legal to be taken in the draw hunt, they are selected against relative to availability as hunters prefer to take larger adult cows. Calves are much more susceptible to MVCs than older age classes; however, more analysis must be performed before definitive conclusions can be determined.

*Recommendations for Activity 2.2*

Continue with jaw collection and complete further analysis on age and sex distribution of moose taken in draw hunts and MVCs.

## 3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Browse Assessment.

*Data Needs*

Determining the percent off-take of preferred browse species provides an indication of habitat condition in relation to moose density. Trends in this indicator are very important to determining the nutritional condition of the moose population and are integral to management on a sustained yield basis.

*Methods*

Browse assessment surveys were conducted in Unit 14A on 31 plots over 6 days from 23 March 2016 through 31 March 2016. From roaded locations, 19 plots were accessed on foot. An R-44 helicopter was used to access 12 plots that were not road accessible.

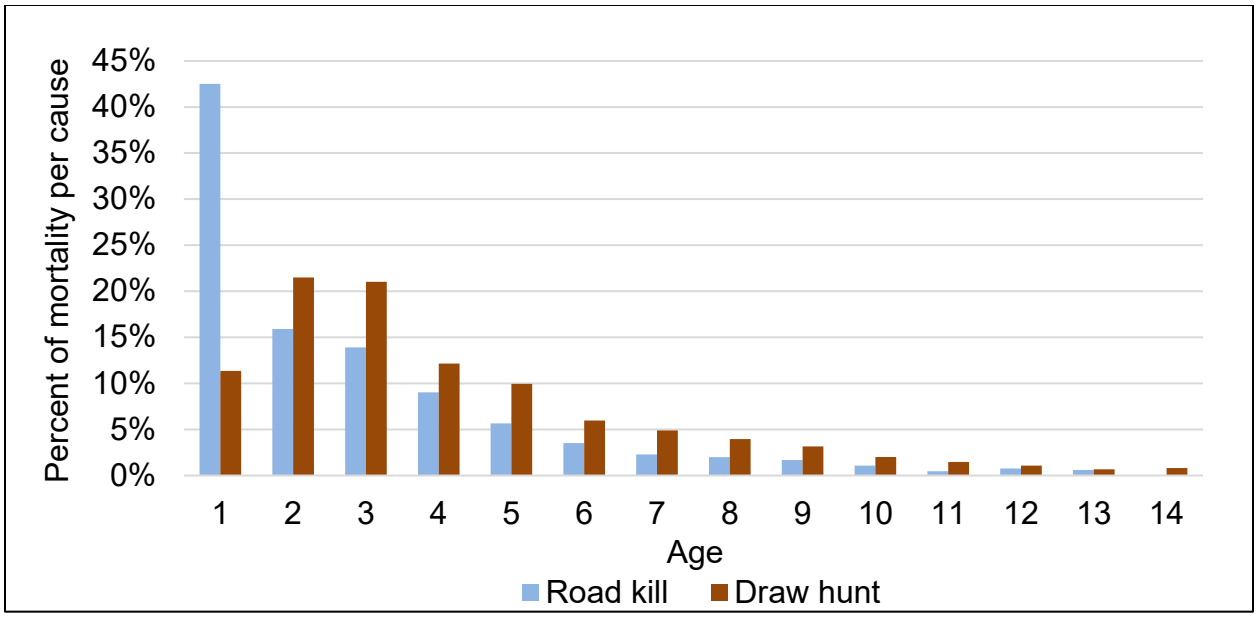



**Figure 4. Age distribution of road-killed and draw hunt moose in Unit 14A, Southcentral Alaska, regulatory years 2015–2019.**

Once a sample site was selected, biologists analyzed the proportional removal of annual browse production and utilization over the winter by examining preferred browse species. We included willow (*Salix* spp.), cottonwood (*Populus* spp.), and Alaska birch (*Betula neoalaskana*). Previous sampling in 2015 demonstrated that high bush cranberry (*Viburnum* spp.) could be a significant source of moose browse; therefore, it was also included. Other deciduous woody plants, such as alder (*Alnus* spp.), dwarf birch (*B. nana*), and American dwarf birch (*B. glandulosa*), were excluded because these plants have been identified as less important food items on moose winter range.

We established a 15 m radius circular plot for sampling, randomly selected 3 plants of the preferred species in the plot, and sampled only plants with current annual growth (CAG) between 0.5 and 3.0 m AGL. At each sampling plot, we noted slope, aspect, and snow depth. For each plant selected, we measured 10 twigs. For each twig, we recorded diameter at point of browsing, if applicable; diameter at base of current annual growth; and whether browsing occurred beyond CAG. We also counted all the number of CAG twigs between 0.5 and 3.0 m AGL on the 3 plants, dead class, total plant height, and architecture following guidance from Seaton et al. (2011). We also recorded the total number of plants that were preferred and not preferred within the plot (Appendix A).

At several sites, we collected reference plants of preferred browse species. Dry biomass of browse has an exponential relationship to diameter (Oldenmeyer 1982, Paragi et al. 2008). Following the procedures in Paragi et al. (2008), we sampled reference plants at the current annual growth and weighed them to the nearest 0.01 g. Samples were dried to a constant mass and reweighed.

A Microsoft Access database of plot counts, twig diameters, diameter-biomass pairs, and dry-weight conversions was created from the data collected and read with software written in the R language (R 2.11.1, R Development Core Team 2008).

*Results and Discussion*

The percentage of biomass removed among all species in all plots was 38.5% (±2.9% standard error [SE]). This was one of the highest percentages out of numerous browse surveys conducted in Alaska (Fig. 5). We encountered 10 different browse species in our plots and sampled a total of 197 plants. The most common species of plant encountered was paper birch (*B. papyrifera*), and on a kilogram-per-hectare basis, it also had the greatest amount of biomass removed. Moose showed a preference for Scouler's Willow (*Salix scouleriana*) when it was encountered, removing over 56% (±15% SE) of the available biomass.

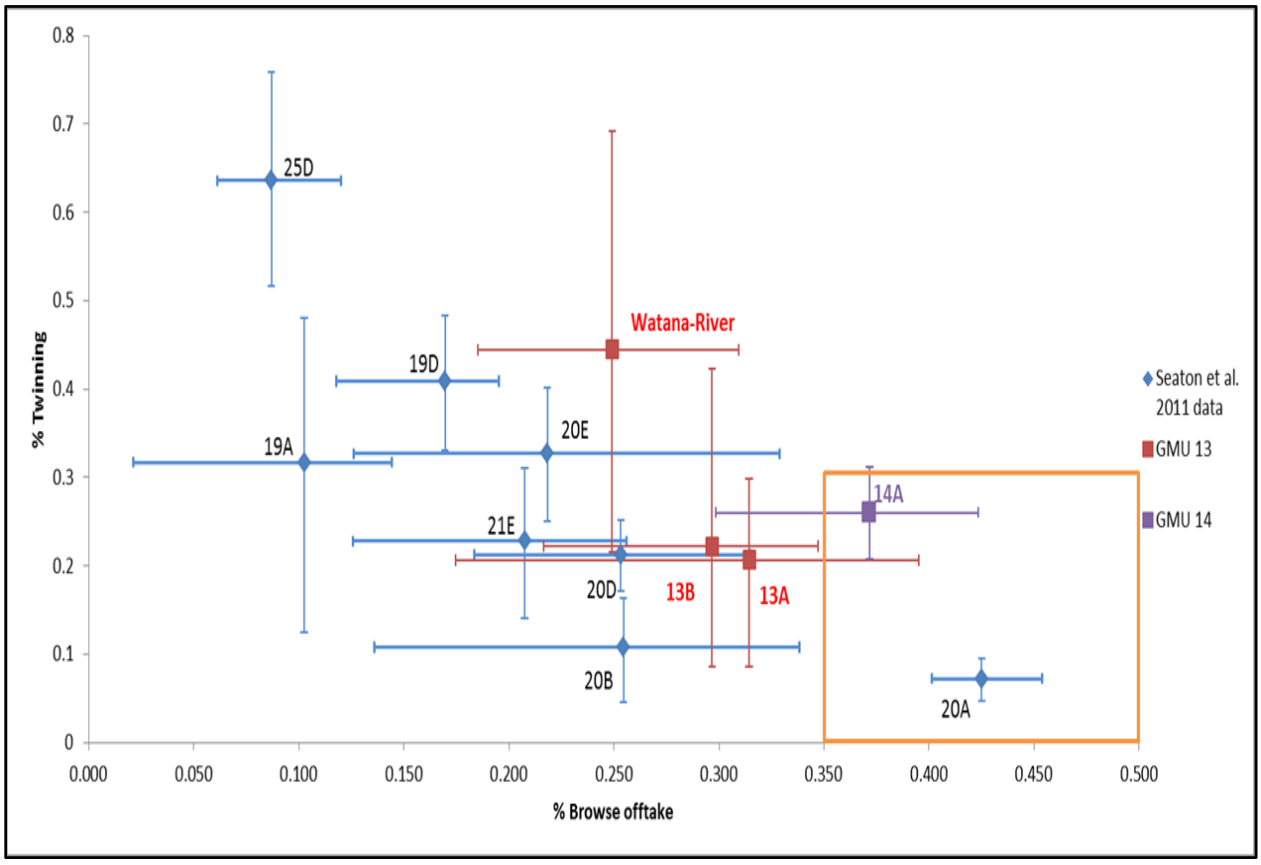



**Figure 5. Comparison of browse removal and percent twinning of moose in Alaska, regulatory years 2015–2019.**

*Recommendations for Activity 3.1*

Continue to evaluate the unit for proportional offtake and browse plant condition as a confirmatory metric when the abundance of moose changes substantially or twinning information indicates a substantial change in moose nutritional condition.

ACTIVITY 3.2. 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. In Unit 14A, this may be particularly important as the benefits provided from the Miller's Reach fire over the last 20 years provide diminishing returns as the area matures to later seral stages.

*Methods*

Areas of potential habitat enhancement have been identified for treatment either by prescribed burning or clearcutting of mature stands. This effort is limited to state-owned lands and occurs as money, personnel, and time are available to complete the projects.

*Results and Discussion*

Since 2001, ADF&G, in cooperation with the Ruffed Grouse Society and occasionally the Rocky Mountain Elk Foundation and DOF, contracted aspen cutting in MVMR to produce early successional growth to benefit grouse, moose, and other species. During RY11, 32 acres of aspen were treated, and another 38 acres were treated in RY12. Since the start of the project, 564 acres have been treated. However, large and mature contiguous stands of aspen are becoming scarce in MVMR.

Working with DOF, 310 acres of mature mixed birch spruce forest northeast of Sutton within MVMR were identified for a prescribed burn in RY14. A burn plan was developed through DOF for Granite Creek. Public outreach to discuss the goals of the prescribed burn to get buy-in from the local community was completed through the public meeting process, and opinions about the efforts were favorable. Weather and habitat conditions were not conducive to completing the project during spring 2014. The prescribed burn is planned for a future time when weather, logistics, and public sentiment are favorable.

*Recommendations for Activity 3.2*

Continue with efforts to complete the Granite Creek burn; identify other areas where habitat enhancement efforts can be successfully accomplished, given the constraints of this developed landscape; and identify potential funding sources to complete other projects in the unit.

## NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

None were identified.

Data Recording and Archiving

Recording.

- GSPE moose survey form (Appendix A).
- Browse survey form (Appendix B).

Archiving.

GSPE data are stored on an internal database housed on the Wildlife Information Network.[2] 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 office and stored in file folders located in the Palmer assistant area biologist's office.[3]

Agreements

None.

Permitting

None.

## Conclusions and Management Recommendations

The moose population has been over the population objective since at least 2001. Harvest has been high (an average of 1,005 moose) during RY15–RY19, and the population appears to be trending toward the objective of 6,000–6,500 moose. Increasing the number of antlerless permits and implementing the targeted hunt appear to be having the desired effect on growth of the moose population, but the population should be closely monitored to ensure that it has not been overharvested or grown to the point that nutritional limitations could start to have an effect.

Effective intensive management and mitigation for increased development and urban expansion in Unit 14A requires investigation into the distribution and movement of moose. Specifically, studies investigating the annual moose movement patterns into the Point MacKenzie agricultural area, the 1996 Big Lake burn, and other areas will reveal the proportion of moose that are migratory and where these individuals spend the nonwinter months. The Point MacKenzie winter population exceeds 10 moose per square mile—one of the highest densities in the state. Movement and habitat studies will help us understand how many moose the unit can hold from a biological and social perspective. Research staff have been developing a study that will look at different aspects of moose movement and seasonal distribution. This information will help demarcate travel corridors and ameliorate conflicts arising from further development. The study

[2] http://winfonet.alaska.gov/index.cfm.

[3] O:\WC\Palmer Area Office Folder\Species\Moose\Moose Population Estimation\14A Moose Survey Data\Archived Survey Sheets.

will also provide the benefit of parturition data and supplement the department's twinning information.

# II. Project Review and RY20–RY24 Plan

## Review of Management Direction

### Management Direction

There is no change in the management direction for moose in Unit 14A; 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.

### Goals

The goals for Unit 14A moose management remain unchanged for RY20–RY24.

### Codified Objectives

Amounts Reasonably Necessary for Subsistence Uses

There is no finding for Unit 14A moose.

Intensive Management

In 2001, the board adopted a positive finding for intensive management of moose in Unit 14A. As per the intensive management law, maintain:

- A population of 6,000–6,500 moose.
- Achieve an annual harvest of 360–750 moose.

### Management Objectives

In addition to the population and harvest goals, manage for a posthunt (fall) sex ratio of 20–25 bulls to 100 cows.

### Review of Management Activities

1. Population Status and Trend

Activity 1.1. Conduct GSPE surveys every other year to inventory and determine sex and age composition in the unit and to determine population size, productivity, and trends. The survey should be designed such that the interval proportion of the mean is ≤20% at the 90% confidence interval.

*Data Needs*

No change from the report period.

*Methods*

Due to the importance of the Unit 14A moose population, surveys should be conducted biennially. The next GSPE survey is scheduled for fall 2020.

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

In years where a full GSPE survey is not completed, sex and age composition surveys should be completed 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. Manage population levels based on multiyear mean spring twinning rates in conjunction with at least one of three specific signals to substantiate low twinning-based nutritional status.

*Data Needs*

Area staff should consult with a biometrician to determine the number of moose that need to be observed and which areas in the unit need to be sampled to have the statistical power required to adequately sample the population.

*Methods*

Composition surveys can be quickly conducted in areas of known moose concentrations using pilot-observer teams, similar to GSPE surveys.

The three specific signals to substantiate low twinning-based nutritional status are as follows: <50% of 36-month-old moose are parturient; the average multiyear short-yearling mass is <385 lb (175 kg); and >35% of annual browse biomass is removed by moose (Boertje et al. 2007). If the twinning rate is <10%, staff will manage for population reduction. For a twinning rate of 10–20%, staff will manage for population stability. For a twinning rate of >20%, staff will manage for population growth.

## 2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor moose harvest and mortality annually in Unit 14A.

*Data Needs*

No change from the report period.

*Methods*

No change from the report period.

ACTIVITY 2.2. Age distribution of moose harvested in draw hunts and MVCs.

*Data Needs*

No change from the report period.

*Methods*

No change from the report period.

## 3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Assess moose habitat quality and availability.

*Data Needs*

No change from the report period.

*Methods*

There will be no change from the report period except for repeating the assessment if there are large changes in the population during RY20–RY24.

ACTIVITY 3.2. Habitat enhancement.

*Data Needs*

No change from the report period.

*Methods*

No change from the report period.

# NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

## Data Recording and Archiving

GSPE data are stored on an internal database housed on the Wildlife Information Network.[4] 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 office and stored in file folders located in the Palmer assistant area biologist's office.[5]

Historical (1990–2020) survey notes and data sheets should be scanned for a more secure data archive.

[4] http://winfonet.alaska.gov/index.cfm.

[5] O:\WC\Palmer Area Office Folder\Species\Moose\Moose Population Estimation\14A Moose Survey Data\Archived Survey Sheets.

Agreements

- Alaska Department of Fish and Game and the Alaska Department of Natural Resources – Division of Forestry Little Granite Creek Prescribed Burn Plan.

Permitting

- Institutional Animal Care and Use Committee approval, moose captures. IACUC Protocol No. 0051-2019-32.

# References Cited


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

Alaska Department of Natural Resources, and Alaska Department of Fish and Game. 1986. Matanuska Valley Moose Range Management Plan. Alaska Department of Natural Resources, Division of Land and Water Management, Anchorage.

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

Collins, W. B. 1996. Wildlife habitat enhancement in the spruce-hardwood forest of the Matanuska and Susitna River valleys. Alaska Department of Fish and Game, Division of Wildlife Conservation, Final Research Report 1 July 1990–31 December 1995, Federal Aid in Wildlife Restoration Project 1.44, Juneau.

Griese, H. J. 2000. Unit 14A moose. Pages 140–154 [*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.

Griese, H. J., and M. Masteller. 1996. Unit 14A moose. Pages 128–143 [*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., and M. Masteller. 1998. Unit 14A moose. Pages 126–144 [*In*] M. V. Hicks, editor. Moose management report of survey-inventory activities 1 July 1995–30 June 1997. 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.

Oldenmeyer, J. L. 1982. Estimating production of paper birch and utilization by browsers. Canadian Journal of Forest Research 12:52–57.

Paragi, T. F., C. T. Seaton, and K. A. Kellie. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: Moose range assessment. Alaska Department of Fish and Game, Division of Wildlife Conservation, Final Research Technical Report 1 July 2005–30 June 2008, Federal Aid in Wildlife Restoration Project 5.10, Juneau.

Peltier, T. C. 2012. Unit 14A moose. Pages 158–171 [*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. 2014. Unit 14A moose. Pages 13-1 through 13-15 [*In*] P. Harper and L. A. McCarthy, editors. Moose management report of survey-inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, 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 for composition and stratified surveys (e.g., Geospatial Population Estimator surveys), Alaska, regulatory years 2015–2019.**

## MOOSE SURVEY FORM

Date ____/____/____ Page ____ of ____

GMU ____ Count Area ____ Mi² in count area ____

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

**WEATHER:**

Cloudcover (%) ____ Precipitation ____ Temp ____

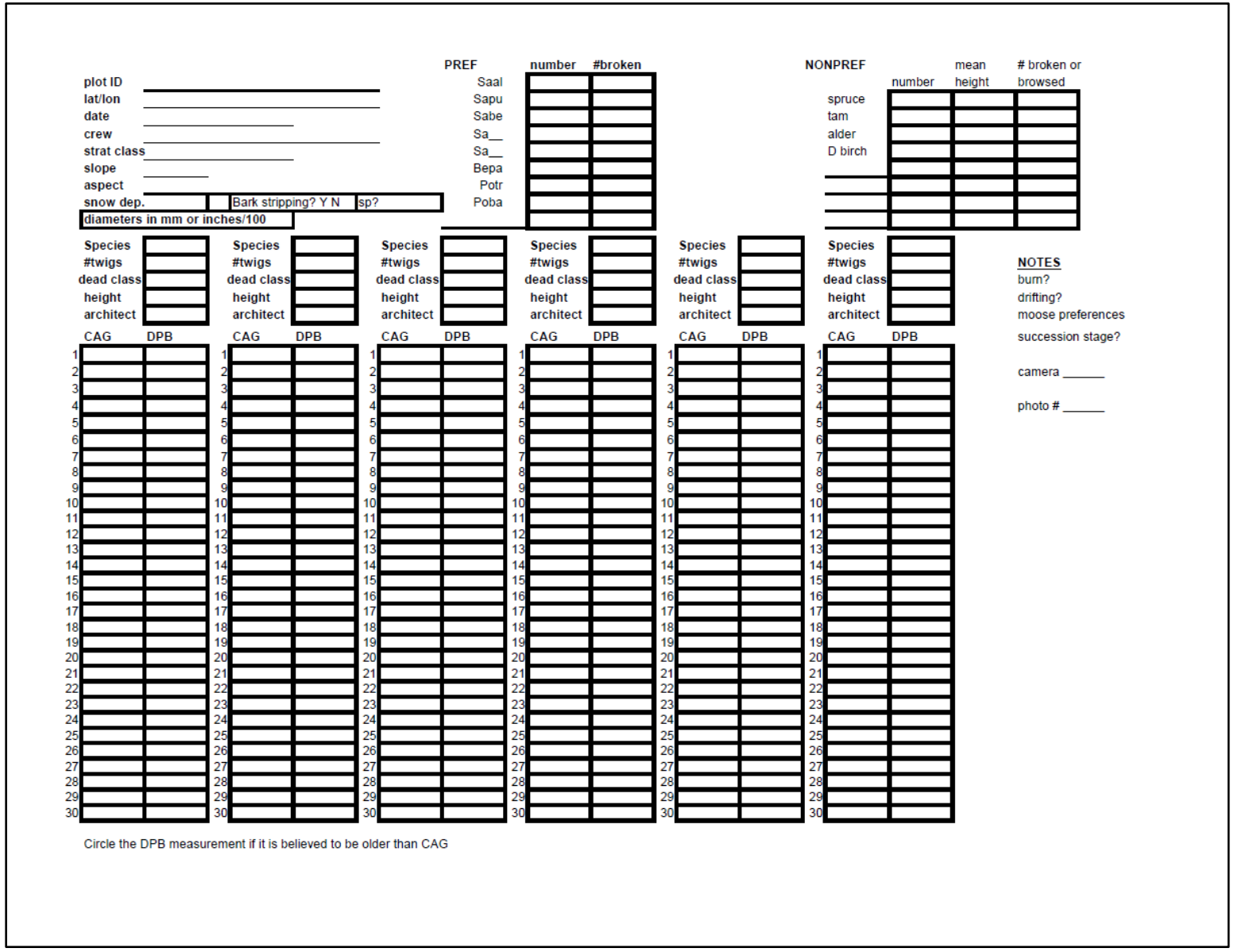
Wind Speed and Direction ____ Turbulence ____

**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 browse survey data sheet, Alaska, regulatory years 2015–2019.**



plot ID
lat/lon
date
crew
strat class
slope
aspect
snow dep.
Bark stripping? Y N
sp?
diameters in mm or inches/100

PREF: Saal, Sapu, Sabe, Sa__, Sa__, Bepa, Potr, Poba — number, #broken

NONPREF: spruce, tam, alder, D birch — number, mean height, # broken or browsed

Species
#twigs
dead class
height
architect

CAG DPB (1–30)

NOTES
burn?
drifting?
moose preferences
succession stage?
camera _____
photo # _____

Circle the DPB measurement if it is believed to be older than CAG

Architecture classes (browsing history of the plant, includes this year, and all visible evidence of past years)
broomed- more than half of the CAG twigs rise from lateral twigs that are the result of browsing
unbrowsed- no evidence of past browsing
browsed- less than half of the CAG twigs rise from lateral twigs that are the result of browsing

| Species | | | | | |
|---|---|---|---|---|---|
| #twigs | | | | | |
| dead class | | | | | |
| height | | | | | |
| architect | | | | | |

| | CAG | DPB | CAG | DPB | CAG | DPB | CAG | DPB | CAG | DPB | CAG | DPB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Dead classes (amount of dead material that comprizes a plant)
X= no dead
L= less dead than live material
M= more dead than live material

STEPS IN SURVEY
1. Locate center of plot
2. Locate boundary of plot
3. If no pref plants, pick alt
4. Snow depth
5. Choose random distance and direction from center to start measuring closest plant of each pref species
6. Turn head and grab stem on plant
7. Measure 10 twigs starting at terminal end of that stem
8. height, # twigs, spp, arch.
# stems only between 0.5m and 3.0m
9. Choose next random distance and direction from center for other plants to measure
9.5. Goal is 30 twigs/ spp
10. Estimate # of all woody browse plants by species in plot

TIPS
*Pref plant has CAG twigs between 0.5m and 3m
*Bepa, Saal, Sabe, etc., can be nonpref plants if they are too tall
*measure plant height from ground


ALASKA
DEPARTMENT OF FISH AND GAME