

Moose Management Report and Plan, Game Management Unit 20D:

Report Period 1 July 2015–30 June 2020, and
Plan Period 1 July 2020–30 June 2025

Robert W. Schmidt



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2026

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Plan Period 1 July 2020–30 June 2025

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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. 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 Jason R. Caikoski, Management Coordinator of Region III for the Division of Wildlife Conservation.

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

Schmidt, R. W. 2026. Moose management report and plan, Game Management Unit 20D: 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-2026-34, Juneau.

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Cover Photo: Moose in the southwest portion of Unit 20D, near Donnelly Dome. ©2016 ADF&G. Photo by Mike Taras.

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Purpose of this Report

This report provides a record of survey and inventory management activities for moose (*Alces alces*) in Game Management Unit 20D during the 5 regulatory years 2015–2019, along with plans for the next 5 regulatory years 2020–2024. A regulatory year (RY) begins on 1 July and ends on 30 June (e.g., RY15 = 1 July 2015–30 June 2016). This report is primarily produced to provide agency staff with data and analysis to help guide and record agency efforts. It is also made available to the public to inform them about wildlife management activities. The Alaska Department of Fish and Game's (ADF&G, the department) Division of Wildlife Conservation (DWC, the division) publishes these reports on a 5-year cycle to document trends and describe potential changes in data collection activities for moose.

I. RY15–RY19 Management Report

Management Area

Unit 20D is in Interior Alaska, in the Central Tanana River Valley near Delta Junction. It encompasses 5,637 mi², of which 5,028 mi² contains topography and vegetation characteristic of moose habitat. The northern portion of Unit 20D consists of the Goodpaster, Volkmar, and Healy river valleys and the Tanana Highlands, with elevations ranging from 851 to 6,444 ft. The southern portion consists of the Tanana River floodplain, the lower Delta River floodplain, the Delta Agricultural Project, the drainages of the Robertson, Johnson, and Gerstle rivers, and the northern foothills and mountains of the Alaska Range, with elevations varying up to 10,278 ft. Lowland vegetation in Unit 20D is a mosaic of shrub- and young-forest-dominated seres, climax bogs, and mature black spruce (*Picea mariana*) forest. Vegetation in the hills, foothills, and mountains grades from taiga at lower elevations to shrub-dominated communities and alpine tundra at higher elevations. The climate in Unit 20D is typical of Interior Alaska, where temperatures frequently reach 80°F in summer and –40°F in winter. Snow depths are generally below 32 inches.

For moose management purposes, Unit 20D is subdivided into 4 areas: 1) southwestern Unit 20D, the area south of the Tanana River from the Johnson River to the Delta River; 2) southeastern Unit 20D, the area south of the Tanana River from the Robertson River to the Johnson River; 3) northwestern Unit 20D, the area north of the Tanana River from Banner Creek to and including the Volkmar River; and 4) northeastern Unit 20D, the area north of the Tanana River and east of the Volkmar River.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 20D

Unit 20D was created in 1971 from a portion of Unit 20C. During 1962–1970, the moose hunting season in this area consisted of a 70- to 72-day bull season and a 1- to 8-day antlerless moose season. Most of the harvest (51–74%) during 1964–1970 came from the highly accessible areas near Delta Junction (Clearwater Lake, Donnelly Dome, and the Delta farming area). However, several severe winters in the mid-1960s and early 1970s killed many moose throughout the area and other portions of Interior Alaska, setting the stage for predation and hunting to compound

and aggravate already widespread population declines. Poor recruitment of yearlings into the population, combined with intense bull-only hunting, depressed the bull-to-cow ratio to only 4:100 in the more accessible portions of Unit 20D. The moose hunting season was closed during 1971–1973 because the depressed moose population could no longer sustain this level of harvest (McIlroy 1974).

Despite hunting restrictions, the moose population in Unit 20D continued to decline because of chronically high moose mortality from other causes. In 1973, the moose population south of the Tanana River and between the Johnson and Delta rivers was estimated at only 600 moose. When limited moose hunting resumed in 1974, it was conducted under a registration permit system for the entire unit, except for a specific area around Delta Junction, which was closed to moose hunting. The moose population decline in western Unit 20D was gradually reversed by a combination of continued hunting restrictions, mild winters, and wolf control in adjacent Unit 20A (1976–1982) and western Unit 20D (1980–1983).

In 1978, Unit 20D was enlarged by moving the eastern boundary from the Johnson River to the Robertson River. It was further enlarged in 1981 to include all drainages north of the Tanana River, from the mouth of the Robertson River to Banner Creek.

In 1983, the area around Delta Junction that had been closed to hunting since 1974 was formally named the Delta Junction Management Area (DJMA). In 1990, the DJMA was renamed the Delta Junction Closed Area (DJCA) to more accurately reflect its status as an area closed to hunting. In 1991, the DJCA was reduced in size to provide more hunting opportunity in the area. In 1996, it was renamed the DJMA because a drawing permit hunt was established in the area.

As moose populations recovered during the mid-1970s and early 1980s, hunting opportunities in southwestern Unit 20D were expanded by first eliminating the registration permit requirement and then lengthening the season. In southeastern and northern Unit 20D, the seasons were also extended. In 1988, antler restrictions were implemented in southwestern Unit 20D to stabilize the increasing harvest and improve the age structure of the bull segment of the population. In March 1995, the Alaska Board of Game (BOG) determined that the preferred use of moose in Unit 20D was for human consumption and established a moose population objective of 8,000–10,000 and an annual harvest objective of 240–500. In 2000, the harvest objective was increased to 500–700.

The Bison Range Youth Hunt Management Area was created in 2002 and renamed the Bison Range Controlled Use Area in 2015 to regulate moose hunting in the fields of the Delta Junction Bison Range. This drawing permit hunt was implemented primarily to reduce the effect of moose hunting on bison management within the bison range.

In southwestern Unit 20D, antlerless moose hunting began in fall 2006 in response to a high-density population, moderate overwinter browse removal, and moderately low twinning rates. The goals of the antlerless hunts were to initially reduce the population, subsequently stabilize population growth, and address concerns about range degradation, reduced nutritional conditions, and reduced reproductive success. Large-scale antlerless moose hunting in southwestern Unit 20D concluded in 2009, but a small level of antlerless hunting has continued through fall 2019.

The southwestern Unit 20D moose density was reduced to a more appropriate level by the antlerless hunts. Three indices of density-dependent moose nutritional conditions were evaluated in relation to changes in density: 1) biomass removal of current annual growth on winter browse, 2) proportion of females with twin calves, and 3) late-winter calf weights. After the hunts ended in 2009, the indices were evaluated by comparing them with prehunt data (before 2006) and with data collected during the hunts. The comparison detected a decrease in winter browse removal, an increase in twinning rate, and an increase in the average weight of 9-month-old calves.

Entry to some military land that overlaps with Unit 20D is prohibited or restricted. This is especially controversial in those portions of Unit 20D accessible from highways and with a highly visible moose presence.

Management Direction

EXISTING WILDLIFE MANAGEMENT PLANS

The department has no formal wildlife management plans for moose in Unit 20D with other agencies or working groups.

GOALS

- G1. Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- G2. Provide the greatest sustained opportunity to participate in hunting moose.
- G3. Provide an opportunity to view and photograph moose.

CODIFIED OBJECTIVES

Amount Reasonably Necessary for Subsistence Uses

The following portions of Unit 20D have customary and traditional use findings for moose, with amounts reasonably necessary for subsistence uses as follows:

- C1. Unit 20D, that portion north of the Tanana River and outside the boundaries of the Fairbanks Nonsubsistence Area: 5–15 moose.
- C2. Unit 20D, that portion south of the Tanana River: 5 moose.

Intensive Management

- C3. Population objective: 8,000–10,000 moose.
- C4. Harvest objective: 500–700 moose.

MANAGEMENT OBJECTIVES

- M1. Manage for a posthunting bull-to-cow sex ratio of $\geq 30:100$. The bull bag limit will be liberal in any large portion of Unit 20D where the bull-to-cow ratio is $\geq 30:100$ for >2 consecutive years. If, in any portion, the bull-to-cow ratio decreases to $<30:100$ for >2 consecutive years, regulations will be adopted to restrict bull harvest sufficiently to maintain a bull-to-cow ratio of $>20:100$.
- M2. Manage the northern and southern Unit 20D moose populations independently (north and south of the Tanana River) to maintain optimal population size, based on indices of density-dependent nutritional limitation, and to guard against eventual site-specific, long-term range damage and starvation from overabundance. Moose population levels will be managed based on multiyear mean spring twinning rates in conjunction with at least one of the following indices that signal low twinning-based nutritional status: $<50\%$ of 36-month-old moose are parturient, average multiyear short-yearling mass (females) is <385 lb (175 kg), or $>35\%$ of annual browse biomass is removed by moose (Boertje et al. 2007). Twining management trigger points are as follows:
- Manage for increasing population growth when the average 2-year prior twinning rate exceeds 20%, but a reduced rate of growth as the twinning rate average approaches 20%.
 - Manage for a stable population size when the 2-year prior twinning rate averages 11–20%.
 - Manage for decreasing population growth when the 2-year prior twinning rate averages $\leq 10\%$.

Note that the management objectives planned for RY15–RY19 were revised during the reporting period, in part due to staff transitions and changes in the structure of these reports.

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Geospatial population estimation surveys (M1).

Data Needs

Population status and trends are integral components of management, and Geospatial Population Estimator (GSPE) surveys are the preferred method for application.

Methods

We used the GSPE method (Ver Hoef 2001, 2008; Kellie and DeLong 2006) to conduct moose population estimation surveys in southern and northern Unit 20D (south and north of the Tanana River). We maximized the accuracy and precision of the GSPE surveys by allocating 60% of sampling effort to the high-density stratum and 40% to the low-density stratum (Kellie and DeLong 2006).

SU selection was optimized for the GSPE spatial sampling design by selecting adjacent pairs of SUs that were distributed somewhat evenly, rather than randomly, throughout the survey area. The number of SUs to be surveyed in each stratum was divided by 2 to determine the number of SU pairs in each stratum. These pairs were formed by randomly selecting an initial SU, then randomly selecting an adjacent SU. Second, we determined the number of SU pairs that could be surveyed based on available funding. Third, to determine the number of survey blocks represented by a pair of SUs, the number of SU pairs to be surveyed per stratum was divided into the total number of SU pairs. We grouped SUs with similar anticipated moose densities, habitat types, and topographic features into blocks. Initially, 10% of the available SUs were not allocated but held in reserve and placed in the survey area where SUs had a separation of >50 km (31 mi). If SUs are separated by >50 km, autocorrelation cannot be calculated for the population estimate (Kellie and DeLong 2006).

SUs were surveyed using a Piper PA-18 Super Cub flying at altitudes of approximately 300–800 ft above ground level, depending on vegetative cover. Flight speed ranged from 60 to 70 mph. When terrain permitted, east–west linear transects were flown every 0.15 degrees of latitude, or north–south every 0.25 degrees of longitude. A GPS receiver was used to follow transect headings. In hilly or mountainous terrain, the flight path followed terrain contours within SU boundaries, rather than transects. Our objective was to spend 8–10 min/mi² of search effort in each SU sampled to achieve consistently high sightability of moose; however, large areas of nonhabitat, such as lakes and ice-covered areas, within SUs were not surveyed. Information recorded for each SU included survey start and stop times; snow (age and cover), light (intensity and type), and wind (strength and turbulence) conditions; major habitat type; location; and survey rating from excellent to poor, all based on the observer’s general impression.

We circled all observed moose to look for additional ones and to classify them as bulls, cows, or calves. Bulls were further classified into 5 categories based on antler size and morphology: 1) yearlings with spike–fork antlers, 2) yearlings with palmate antlers, 3) medium bulls with antler spread of 31–40 inches, 4) medium bulls with antler spread of 41–49 inches, and 5) large bulls with antler spread of ≥50 inches. We estimated antler spread for all medium and large bulls. Yearling bulls were identified as those with antler spread <30 inches and no antler brow palm development.

The GSPE method allows survey areas to be subdivided into smaller analysis areas, with separate population estimates calculated for each. In southern Unit 20D, separate population estimates were calculated for southeastern Unit 20D (south of the Tanana River and east of the Johnson River), and southwestern Unit 20D (south of the Tanana River and west of the Johnson River, between the Delta and Johnson rivers) for those years when GSPE surveys met the criteria. Population estimates and compositions were calculated by entering SU data into the department’s GSPE application software (DeLong 2006) to calculate a population estimate and composition of observable moose.

The GSPE method slightly underestimates the size of a moose population because it does not account for moose missed while conducting the survey. To correct the observable (or raw) moose estimate for sightability, we used a sightability correction factor (SCF) of 1.21 and an SCF standard error (SE) estimate of 0.067. This SCF (and associated SE estimate) was a composite SCF derived from proportions of radiocollared moose observed from Unit 20A

surveys during 2003–2006 (Boertje et al. 2007; Boertje et al. 2009). An SCF of 1.21 was applied to estimates for southern Unit 20D, and an SCF of 1.25 was applied to estimates for northern Unit 20D.

Population estimates for southern and northern Unit 20D were combined in some years to obtain a total unitwide estimate following the methods described by Gasaway et al. (1986). We applied SCFs to the population estimates. We calculated 90% binomial confidence intervals (CIs) around population estimates and composition ratios using GSPE tools on the department's Wildlife Information Network (WinfoNet) server (Kellie and DeLong 2006) for comparison with management objective thresholds (i.e., 8,000–10,000 moose and a bull-to-cow ratio of 30:100).

Fall 2015

SOUTHERN UNIT 20D

A GSPE survey of southern Unit 20D was not conducted in 2015, due to time and funding constraints.

NORTHERN UNIT 20D

A GSPE survey of northern Unit 20D was conducted from 22 November through 9 December 2015. The survey area included 546 SUs and covered 3,174 mi², averaging 5.8 mi² per SU. The high-density stratum contained 262 SUs totaling approximately 1,520 mi², while the low-density stratum contained 284 SUs totaling approximately 1,653 mi². Of the 63 SUs searched, 38 (60%) were high-density and 25 (40%) were low-density, meeting the objective of surveying at least 60% high-density SUs. We met the objective of search effort in high-density SUs, averaging 45 minutes per SU (7.7 min/mi²), but did not meet the objective in low-density SUs, averaging 42 minutes per SU (7.2 min/mi²). Survey conditions for snow, light, and wind were mostly good (63%) and excellent (32%), with the remainder being fair (5%) and poor (2%; $n = 63$).

Fall 2016

No GSPE surveys were conducted in Unit 20D in 2016 due to a lack of snow.

Fall 2017

SOUTHERN UNIT 20D

A GSPE survey of southern Unit 20D was conducted from 7 November through 2 December 2017. The survey area included 320 SUs and covered 1,890 mi², averaging 5.9 mi² per SU. The high-density stratum contained 189 SUs totaling approximately 1,116 mi², while the low-density stratum contained 131 SUs totaling approximately 775 mi². Of the 101 SUs selected for the search, 71 were high-density and 30 were low-density; however, poor weather and survey conditions (high wind and low visibility) prevented us from surveying 4 high-density SUs. Consequently, a total of 67 (69%) high-density SUs and 30 (31%) low-density SUs were surveyed, meeting the objective of surveying at least 60% high-density SUs. Search effort averaged 47.8 minutes per SU (8.2 min/mi²), meeting the objective of 45 minutes per SU.

Survey conditions for snow, light, and wind were good on the 12 days we were able to survey. However, due to high winds and low clouds, there were many gaps between actual survey days during the 7 November–2 December survey period. Temperatures ranged from -30°F to 30°F .

NORTHERN UNIT 20D

A GSPE survey of northern Unit 20D was not conducted in 2017 due to time and funding constraints.

Fall 2018

No GSPE surveys were conducted in Unit 20D in 2018 due to a lack of snow.

Fall 2019

SOUTHERN UNIT 20D

A GSPE survey of southwestern Unit 20D was conducted from 21 October through 11 November 2019. The southeastern part of the unit was not surveyed. Due to small sample sizes, a GSPE analysis could only be conducted to estimate total population size and estimates of age and sex classes were excluded. However, a Gasaway analysis was performed to estimate numbers by age and sex class, as this method requires lower sample intensity (Gasaway et al. 1986).

The survey area included 214 SUs and covered $1,260\text{ mi}^2$, averaging 5.9 mi^2 per SU. The high-density stratum contained 142 SUs totaling approximately 838 mi^2 , while the low-density stratum contained 72 SUs totaling approximately 425 mi^2 . Of the 35 SUs selected for surveying, 25 (71%) were high-density and 10 (29%) were low-density, meeting the objective of surveying at least 60% high-density SUs. Search time in SUs with 100% moose habitat averaged 7.6 min/mi^2 or 45.1 minutes of survey time, meeting the target search intensity of 45 minutes per SU.

Survey conditions for snow, light, and wind were good on the 7 days we were able to survey. However, due to high winds and low clouds, there were many gaps between actual survey days during the 21 October–11 November survey period. Temperatures ranged from 20°F to 37°F .

NORTHERN UNIT 20D

The northern Unit 20D GSPE survey was flown from 15 November through 5 December 2019. The survey area included 546 SUs and covered $3,174\text{ mi}^2$, averaging 5.8 mi^2 per SU. The high-density stratum contained 262 SUs totaling approximately $1,520\text{ mi}^2$, while the low-density stratum contained 284 SUs totaling approximately $1,653\text{ mi}^2$. Of the 66 SUs searched, 46 (70%) were high-density and 20 (30%) were low-density, meeting the objective of surveying at least 60% high-density SUs. Search effort averaged 7.6 min/mi^2 (44 minutes of survey time per SU), which was near but did not meet the target search intensity of 45 minutes per SU.

Survey conditions for snow, light, and wind were good to excellent on the days we were able to survey. However, there were many days when we could not survey due to high winds and poor

visibility. Only 9 days had weather conditions adequate for flights. Snow age ranged from fresh to <1 week old on all survey days. Temperatures ranged from -20°F to 35°F.

Results and Discussion

2015

NORTHERN UNIT 20D

In 2015, the population estimate for northern Unit 20D was 3,187 observable moose (without an SCF applied), with a 90% CI of 2,550–3,824 moose (Table 1). Applying an SCF of 1.25 to the estimate resulted in a sightability-corrected estimate of 3,984 moose, equating to a density of 1.26 moose/mi². The northern Unit 20D population composition had a calf-to-cow ratio of 23:100 (range = 17–30 calves) and a bull-to-cow ratio of 41:100 (range = 26–55 bulls; Table 1).

Table 1. Results of population estimates of observed moose using Geospatial Population Estimator surveys, 2015–2019, northern Unit 20D, Interior Alaska.

Year	Total population estimate	Total cows	Total calves	Total bulls	Calves:100 cows	Bulls:100 cows
2015	3,187 (2,550–3,824)	1,980 (1,549–2,411)	458 (336–580)	803 (534–1,071)	23 (17–30)	41 (26–55)
2019	3,162 (2,372–3,952)	2,152 (1,602–2,701)	327 (207–446)	743 (544–942)	15 (9–21)	35 (24–44)

Note: Sampled using the Geospatial Population Estimator sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Parentheses contain 90% confidence intervals.

SOUTHERN UNIT 20D

No GSPE survey was conducted in southern Unit 20D in 2015 due to time and funding constraints.

2016

No moose surveys were conducted in Unit 20D in 2016 due to a lack of snow.

2017

NORTHERN UNIT 20D

No moose survey was conducted in northern Unit 20D in 2017 due to time and funding constraints.

SOUTHERN UNIT 20D

In 2017, the population estimate for southern Unit 20D was 4,500 observable moose (without an SCF applied), with a 90% CI of 3,866–5,135 moose (Table 2). Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 5,445 moose, equating to a density of 2.9 moose/mi². The southern Unit 20D population composition had a calf-to-cow ratio of 38:100 (range = 34–43 calves) and a bull-to-cow ratio of 23:100 (range = 17–28 bulls; Table 2). The southern Unit 20D GSPE survey results were also divided into the southeastern and southwestern analysis areas (Tables 3 and 4).

Table 2. Results of population estimates of observed moose using Geospatial Population Estimator surveys, 2015–2019, southern Unit 20D, Interior Alaska.

Year	Total population estimate	Total cows	Total calves	Total bulls	Calves:100 cows	Bulls:100 cows
2015	—	—	—	—	—	—
2016	—	—	—	—	—	—
2017	4,500 (3,866–5,135)	2,796 (2,392–3,199)	1,064 (904–1,224)	646 (514–778)	38 (34–43)	23 (17–28)
2018	—	—	—	—	—	—
2019	—	—	—	—	—	—

Note: Sampled using the Geospatial Population Estimator sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Parentheses contain 90% confidence intervals. No survey was conducted in 2015, 2016, 2018, and 2019; En dashes indicate that no data are available.

Table 3. Results of population estimates of observed moose using Geospatial Population Estimator surveys, 2015–2019, southeastern Unit 20D (east of the Johnson River), Interior Alaska.

Year	Total population estimate	Total cows	Total calves	Total bulls	Calves:100 cows	Bulls:100 cows
2015	—	—	—	—	—	—
2016	—	—	—	—	—	—
2017	736 (429–1,044)	474 (279–669)	144 (65–222)	131 (71–190)	31 (18–44)	27 (10–44)
2018	—	—	—	—	—	—
2019	—	—	—	—	—	—

Note: Sampled using the Geospatial Population Estimator sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Parentheses contain 90% confidence intervals. No survey was conducted in 2015, 2016, 2018, and 2019; en dashes indicate that no data are available.

SOUTHEASTERN UNIT 20D

In 2017, the southeastern Unit 20D analysis area had a population estimate of 736 observable moose (without an SCF applied), with a 90% CI of 429–1,044 moose (Table 3). Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 891 moose, equating to a density of 1.5 moose/mi². The southeastern Unit 20D analysis area had a calf-to-cow ratio of 31:100 (range = 18–44 calves) and a bull-to-cow ratio of 27:100 (range = 10–44 bulls; Table 3).

SOUTHWESTERN UNIT 20D

In 2017, the southwestern Unit 20D survey area had a population estimate of 3,763 observable moose (without an SCF applied), with a 90% CI of 3,253–4,274 moose (Table 4). Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 4,553 moose, equating to a density of 3.6 moose/mi². The southwestern Unit 20D survey area had a calf-to-cow ratio of 40:100 (range = 36–44 calves) and a bull-to-cow ratio of 22:100 (range = 16–27 bulls; Table 4).

Table 4. Results of population estimates of observed moose using Geospatial Population Estimator surveys, 2015–2019, southwestern Unit 20D (west of Johnson River), Interior Alaska.

Year	Total population estimate	Total cows	Total calves	Total bulls	Calves:100 cows	Bulls:100 cows
2015	–	–	–	–	–	–
2016	–	–	–	–	–	–
2017	3,763 (3,253–4,274)	2,321 (1,997–2,646)	920 (792–1,048)	514 (412–617)	40 (36–44)	22 (16–27)
2018	–	–	–	–	–	–
2019 ^a	3,014 (2,407–3,622)	–	–	–	30 (21–39)	27 (17–37)
2019 ^b	2,929 (2,288–3,570)	1,847 (1,447–2,247)	586 (428–708)	513 (350–677)	31 (26–36)	28 (22–34)

Note: Sampled using the Geospatial Population Estimator (GSPE) sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Parentheses contain 90% confidence intervals. No survey was conducted in 2015, 2016, and 2018; En dashes indicate that no data are available.

^a A full GSPE analysis was not possible in 2019 due to the low number of survey units sampled. This row represents the results of the limited GSPE analysis conducted in 2019.

^b Gasaway analysis was performed in 2019 because this year had a limited GSPE survey. This row represents the results of the Gasaway analysis.

2018

No moose surveys were conducted in Unit 20D in 2018 due to a lack of snow (Tables 1–2).

2019

NORTHERN UNIT 20D

In 2019, the northern Unit 20D population estimate was 3,162 observable moose (without an SCF applied), with a 90% CI of 2,372–3,952 moose (Table 1). Applying an SCF of 1.25 to the estimate resulted in a sightability-corrected estimate of 3,953 moose, equating to a density of 1.25 moose/mi². The northern Unit 20D population composition had a calf-to-cow ratio of 15:100 (range = 9–21 calves) and a bull-to-cow ratio of 35:100 (range = 24–44 bulls; Table 1).

SOUTHERN UNIT 20D

The entirety of southern Unit 20D was not surveyed in 2019; therefore, no population estimate was generated for this area (Table 2).

SOUTHEASTERN UNIT 20D

No moose survey was conducted in southeastern Unit 20D in 2019 (Table 3).

SOUTHWESTERN UNIT 20D

Because only a small number of SUs were surveyed in southwestern Unit 20D in 2019, a full GSPE analysis was not feasible. Therefore, Gasaway analysis, which requires a lower sample

intensity than GSPE analysis (Gasaway et al. 1986), was also conducted to assess similarities between the 2 methods. The results of both methods were similar (Table 4).

Using the Gasaway method, the southwestern Unit 20D population estimate in 2019 was 2,929 observable moose (without an SCF applied), with a 90% CI of 2,288–3,570 moose (Table 4). Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 3,544 moose, equating to a density of 2.8 moose/mi². Based on the fall 2019 Gasaway analysis, the southwestern Unit 20D population composition had a calf-to-cow ratio of 31:100 (range = 26–36 calves) and bull-to-cow ratio of 28:100 (range = 22–34 bulls; Table 4).

Using the GSPE method, the southwestern Unit 20D population estimate in 2019 was 3,014 observable moose (without an SCF applied), with a 90% CI of 2,407–3,622 moose (Table 4). Applying an SCF of 1.21 to the estimate resulted in a sightability-corrected estimate of 3,647 moose, equating to a density of 2.9 moose/mi². Based on the fall 2019 GSPE analysis, the southwestern Unit 20D population composition had a calf-to-cow ratio of 30:100 (range = 21–39 calves) and a bull-to-cow ratio of 27:100 (range = 17–37 bulls; Table 4).

Recommendations for Activity 1.1

Continue.

ACTIVITY 1.2. Spring twinning surveys (M2).

Data Needs

Estimates of the moose population's nutritional condition and productivity are integral to long-term management on a sustained-yield basis. Twinning rates are an index of density-dependent moose nutritional condition.

Methods

Spring twinning surveys were conducted in a Piper PA-18 Super Cub at 300–700 ft above ground level, flying at approximately 60–70 mph along linear transects spaced approximately 0.25 mi apart. The survey objective was to observe a sample of 50 cows with calves. Large areas where spotting a moose was unlikely, such as large agricultural grain fields and areas of dense spruce, were not surveyed.

SUs were drawn on 1:63,360-scale U.S. Geological Survey topographic maps, using topographic features as boundaries. Twinning surveys were conducted in 8 SUs totaling approximately 139.5 mi² south of the Tanana River, between the Gerstle and Delta rivers (southwestern Unit 20D). The surveyed SUs included Big Lake (19.5 mi²), Butch Lake (17.5 mi²), Clearwater Lake (12.5 mi²), Donnelly (17.5 mi²), Gerstle (15.5 mi²), Ober Creek (34 mi²), Pump Station #9 (16.5 mi²), and Sawmill Creek North (6.5 mi²). In addition to surveying these SUs, we classified and recorded moose observed while flying en route to the SUs.

When moose were spotted, we conducted a low pass to determine their sex and to search for newborn calves. Moose ≥ 1 year old with visible antlers were classified as bulls; all others were classified as cows. If no calves were observed with cows, 2–4 additional low passes were made over the cows to improve sightability of calves if they were present. Data recorded for each

observation included the sex of the moose, the presence or absence and number of calves or yearling offspring, and the moose location. Twinning rates were calculated by dividing the total number of cows seen with any calves at heel (singleton or twins) by the number of cows seen with twins at heel.

Results and Discussion

Spring 2016

Aerial twinning surveys in southwestern Unit 20D were conducted during 23–29 May 2016 for a total of 14.8 hours of survey time. We observed 19 moose per hour and a total of 274 moose, including 62 cow–calf groups, of which 9 (15%) were cows with twins (Table 5).

Table 5. Results of moose twinning surveys, 2016–2020, southwestern Unit 20D, Interior Alaska.

Year	Cows with single calves	Cows with twin calves	Percent of cows with twins (%)	Moose per hour	Total moose
2016	53	9	(15)	19	274
2017	52	11	(18)	26	281
2018	65	7	(10)	27	328
2019	45	7	(14)	19	242
2020	45	5	(10)	23	216

Spring 2017

Aerial twinning surveys in southwestern Unit 20D were conducted during 25–28 May 2017 for a total of 11 hours of survey time. We observed 26 moose per hour and a total of 281 moose, including 63 cow–calf groups, of which 11 (18%) were cows with twins (Table 5).

Spring 2018

Aerial twinning surveys in southwestern Unit 20D were conducted during 28–31 May 2018 for a total of 12.5 hours of survey time. We observed 27 moose per hour and a total of 328 moose, including 72 cow–calf groups, of which 7 (10%) were cows with twins (Table 5).

Spring 2019

Aerial twinning surveys in southwestern Unit 20D were flown during 29–31 May 2019 for a total of 12.2 hours of survey time. We observed 19 moose per hour and a total of 242 moose, including 52 cow–calf groups, of which 7 (14%) were cows with twins (Table 5).

Spring 2020

Aerial twinning surveys in southwestern Unit 20D were flown on 27 and 28 May 2020 for a total of 9.5 hours of survey time. We observed 23 moose per hour and a total of 216 moose, including 50 cow–calf groups, of which 5 (10%) were cows with twins (Table 5).

Recommendations for Activity 1.2

Continue spring twinning rate surveys.

ACTIVITY 1.3. Short-yearling mass estimates (M2).

Data Needs

Estimates of moose nutritional condition and productivity are integral to management on a long-term, sustained-yield basis and to the goal of protecting moose health and habitat. Short-yearling mass is used as an index of moose nutritional condition and can substantiate twinning rates (Boertje et al. 2007).

Methods

We captured and weighed female short-yearling moose in 2019 and 2020. The moose were darted from an R44 helicopter using an X-Caliber Pneu-Dart rifle. They were then weighed while suspended in a net from a tripod using a 1,000 lb dial scale with 10 lb increments, although weight was estimated to the nearest 1 lb. The first half of the captures in 2019 used a carfentanil and xylazine mixture (1.5 mg carfentanil and 50 mg xylazine). This drug combination was made by adding 0.5 mL of carfentanil and 0.5 mL of xylazine to a 1 mL Pneu-Dart with a 3/4-inch needle. The remaining moose captured in 2019 and those captured in 2020 were captured using 5 mg thiafentanil and 50 mg xylazine. This combination was made by adding 0.5 mL of thiafentanil and 0.5 mL of xylazine to a 1 mL dart. The same dart-and-projector system used in the first half of 2019 was used for delivery throughout the rest of 2019 and 2020. To reverse the effects of carfentanil and thiafentanil, we used naltrexone dosed at 100 mg per 1 mg of carfentanil and 10 mg per 1 mg of thiafentanil. The xylazine was reversed using 1 mg of atipamezole per 10 mg xylazine. There was 1 known capture-related mortality.

Results and Discussion

2019

We captured and weighed 47 female short yearlings between 21 and 24 February 2019. We did not reach our target of weighing 60 moose due to weather and helicopter constraints. To ensure our 2019 results are directly comparable to those of 2010 and 2012, we captured and weighed only females, as in those years. Other studies have shown that male short yearlings weigh more than females (Boertje et al. 2007). The average weight of short yearlings in 2019 was 368 lb. In comparison, the 2010 average was 341 lb, and the 2012 average was 366 lb.

2020

We captured and weighed 35 female short yearlings and 2 males, for a total of 37 moose, between 14 and 16 March 2020. This met the recommendation of Boertje et al. (2007) to use multiyear averages when evaluating the nutritional status of a moose population using short-yearling mass. Two years of data help account for annual variation resulting from differences in environmental conditions (e.g., weather, snow conditions). Our goal was to weigh only females, as in 2010, 2012, and 2019, to obtain directly comparable results. In 2020, 2 males were caught by mistake and weighed, but were not included in the dataset. The average weight of short yearlings in 2020 was 344 lb. Notably, winter 2020 had much deeper snow than winter 2019,

which could have resulted in poorer moose nutrition and lighter weights. The 2-year average weight for 2019 and 2020 was 356 lb.

Recommendations for Activity 1.3

Additional antlerless moose harvest will be needed to stop population growth because short-yearling weight and twinning data both indicate nutritional stress. Conduct a browse survey within the next 1–2 years to measure annual browse removal by moose and further evaluate moose nutritional stress.

Continue to collect short-yearling weight data at least once every 5 years, preferably twice, or after a large change in the moose population (growth or reduction), to obtain multiyear averages or validate twinning data that may indicate nutritional stress.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor and analyze harvest data (C4).

Data Needs

Harvest data are needed to ensure that harvest remains within sustainable yield and determine whether the IM harvest objective has been met. Unit 20D was identified by the BOG for intensive management (IM) of moose with a harvest objective of 500–700 moose annually.

Methods

Annual harvest was estimated from mandatory harvest report cards. Harvest data were summarized by regulatory year and included information from the harvest ticket hunt and drawing permit hunts (i.e., DM790, the disabled veteran hunt DM795, and the Bison Range Controlled Use Area youth hunt YM792). Hunters received 1 or 2 reminder letters, usually accompanied by emails and phone calls, when we did not receive timely harvest reports. We also summarized hunter residency and success data.

We estimated total take by hunting, including unreported harvest (Gasaway et al. 1992) and other types of nonhunting mortality (i.e., defense of life or property, dispatched, potlatch, and vehicle collision). Unreported harvest was estimated based on the 17.7% unreported harvest estimated by Gasaway et al. (1992).

Season and Bag Limit

During RY15–RY19 in southern Unit 20D, the general moose hunting season for residents was September 1–15, with a bag limit of 1 bull with spike-fork antlers, 50-inch antlers, or antlers with 4 or more brow tines on at least 1 side. The nonresident season was 5–15 September, and the bag limit was 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side. In northern Unit 20D, season dates were the same as in southern Unit 20D, except for the Healy and Volkmar drainages (September 1–20), but the bag limit was any bull. There were 4 drawing permit moose hunts in Unit 20D (DM790, DM795, DM791, and YM792). Current Unit 20D moose season dates and bag limits are available on the ADF&G website.¹

¹ <https://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulations.hunting>.

Results and Discussion

Harvest by Hunters

REGULATORY YEAR 2015

Estimated moose mortality from all human causes in RY15 was 365 moose (Table 6). This total included 279 harvested moose reported by hunters in fall 2015, an estimated unreported harvest of 49 moose, and 37 moose reported killed in vehicle collisions and other accidental deaths. Illegal harvest was undocumented. The total reported hunting mortality of 279 moose did not meet the IM harvest objective for Unit 20D.

Table 6. Moose harvest and accidental death, regulatory years 2015–2019, Unit 20D, Interior Alaska.

Regulatory year	Harvest by hunters							Accidental death			
	Reported				Estimated						
	Male	Female	Unk	Total	Unreported ^a	Illegal	Total	Road	Other	Total	Total
2015	269	9	1	279	49	Unk	49	Unk	37	37	365
2016	276	17	0	293	53	10	63	52	23	75	436
2017	250	18	0	268	47	9	56	68	13	81	405
2018	211	18	0	229	41	Unk	41	Unk	19	19	290
2019	302	17	0	319	56	13	69	60	17	77	465

^a Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).

REGULATORY YEAR 2016

Estimated moose mortality from all human causes in RY16 was 436 moose (Table 6). This total included 298 harvested moose reported by hunters in fall 2016, an estimated unreported harvest of 53 moose, an estimated illegal harvest of 10 moose, and an estimated 75 moose killed in vehicle collisions and other accidental deaths. The total reported hunting mortality of 298 moose did not meet the IM harvest objective for Unit 20D.

REGULATORY YEAR 2017

Estimated moose mortality from all human causes in RY17 was 405 moose (Table 6). This total included 268 moose reported harvested by hunters in fall 2017, an estimated unreported harvest of 47 moose, an estimated illegal harvest of 9 moose, and an estimated 81 moose killed in vehicle collisions and other accidental deaths. The total reported hunting mortality of 268 moose did not meet the IM harvest objective for Unit 20D.

REGULATORY YEAR 2018

Estimated moose mortality from all human causes in RY18 was 290 moose (Table 6). This total included 230 moose reported harvested by hunters in fall 2018, an estimated unreported harvest of 41 moose, and an estimated 19 moose mortalities attributed to other accidental deaths (the number of moose killed in vehicle collisions for RY18 is unknown). The estimated illegal harvest for RY18 is unknown. The total reported hunting mortality of 230 moose did not meet the IM harvest objective for Unit 20D.

REGULATORY YEAR 2019

Estimated moose mortality from all human causes in RY19 was 465 moose (Table 6). This total included 319 moose reported harvested by hunters in fall 2019, an estimated unreported harvest of 56 moose, an estimated illegal harvest of 13 moose, and an estimated 77 moose killed in vehicle collisions and other accidental means of death. The total reported hunting mortality of 319 moose did not meet the IM harvest objective for Unit 20D.

Permit Hunts

Drawing permit hunts DM790, DM795, and YM792 contributed minimal additional harvests of bulls ($n = 73$; Tables 7–9) and antlerless moose ($n = 36$) annually during RY15–RY19. DM791 contributed a harvest of 41 antlerless moose (Table 9).

Table 7. Delta Junction Management Area moose drawing permit harvest, regulatory years 2015–2019, Unit 20D, Interior Alaska.

Hunt	Regulatory year	Permits issued	Did not hunt	Percent of unsuccessful hunters	Percent of successful hunters	Percent bulls	Percent cows	Total harvest
DM790	2015	19	3	31	69	100	0	11
	2016	19	2	35	65	100	0	11
	2017	19	4	33	67	100	0	10
	2018	19	1	35	61	100	0	11
	2019	19	2	37	59	100	0	10
DM795	2015	8	4	25	75	67	33	3
	2016	6	4	0	100	100	0	2
	2017	6	0	0	100	100	0	6
	2018	6	4	0	100	100	0	2
	2019	6	2	0	100	100	0	4

Table 8. Bison Range Youth Hunt Management Area moose drawing permit harvest (YM792), regulatory years 2015–2019, Unit 20D, Interior Alaska.

Regulatory year	Permits issued	Did not hunt	Percent of unsuccessful hunters	Percent of successful hunters	Bulls harvest	Cows harvested	Total harvest
2015	10	1	11	89	0	8	8
2016	10	1	11	89	1	7	8
2017	10	1	11	89	1	7	8
2018	10	1	0	100	0	9	9
2019	10	0	40	60	2	4	6

Table 9. DM791 antlerless moose drawing permit harvest, regulatory years 2015–2019, Unit 20D, Interior Alaska.

Regulatory year	Permits issued	Did not hunt	Percent of unsuccessful hunters	Percent of successful hunters	Bulls harvested	Cows harvested	Total harvest
2015 ^a	0	—	—	—	—	—	—
2016	12	1	9	91	0	10	10
2017	12	1	18	82	0	9	9
2018	14	3	18	82	0	9	9
2019	15	0	13	87	0	13	13

^a No permits were issued in regulatory year 2015.

Hunter Residency and Success

Based on harvest reports, the majority of hunters in Unit 20D during RY15–RY19 were Alaska residents who resided outside the unit. The proportion of nonresident hunters remained low. During RY15–RY19, general season success rates were stable. Nonresidents had higher success rates than residents (Table 10).

Table 10. Harvest ticket hunting season moose hunter residency and success, regulatory years 2015–2020, Unit 20D, Interior Alaska.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident ^a	Nonlocal resident ^b	Nonresident ^c	Total (%)	Local resident ^a	Nonlocal resident ^b	Nonresident ^c	Total (%)	
2015	56	171	30	257 (25)	223	511	43	777 (75)	1,034
2016	63	182	22	267 (28)	188	455	44	687 (72)	954
2017	49	163	21	233 (25)	182	481	41	704 (75)	937
2018	46	134	19	199 (23)	164	460	40	664 (77)	863
2019	66	196	24	286 (31)	168	447	28	643 (69)	929

Note: Table excludes permit hunters.

^a Hunters who reside in Unit 20D.

^b Hunters who reside in Alaska outside Unit 20D.

^c Hunters who reside outside Alaska.

Other Mortality

Nonhunting mortality is categorized into road mortalities and other mortalities (Table 6).

Alaska Board of Game Actions and Emergency Orders

The only BOG action regarding moose in Unit 20D during RY15–RY19 was an annual reauthorization of the antlerless moose hunting regulations.

Recommendations for Activity 2.1

Continue. Monitor total harvest for comparison with harvest objectives for IM and amounts reasonably necessary for subsistence uses.

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Enhance availability and nutritional value of moose forage (C2 and M1).

Data Needs

Twinning rates are the primary metric used to assess nutritional health of moose populations. However, if twinning rates decreased to levels suggesting that the nutritional status may be low, a habitat assessment of forage plants could help determine if the moose were limited by habitat.

Methods

Survey areas in southwestern Unit 20D to identify and assess potential treatment areas and determine feasibility of conducting treatments to improve the availability and nutritional value of winter forage for moose. Conduct surveys on biomass removal of current annual growth on winter browse (Paragi et al. 2008) a minimum of once every 4 years.

Results and Discussion

During RY15–RY19, no habitat work was conducted specifically for moose. However, habitat enhancement projects (prescribed burns and rolling chopping) conducted on the Delta Junction Bison Range, designed to improve forage for bison and habitat for grouse, may also benefit moose in the area.

Recommendations for Activity 3.1

Continue with modifications.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

The U.S. Army Garrison Fort Greely continues to seek guidance on hazards posed by the presence of moose within fenced portions of Fort Greely, particularly in areas near the missile defense field. ADF&G made multiple site visits to Fort Greely during RY15–RY19 and provided an assessment of the situation and technical assistance to the U.S. Army. The primary issue identified was incomplete fencing around the entire perimeter of Fort Greely, with gates left open on interior fences where traffic and personnel transition between different fenced facilities during the workday. Since 2014, Fort Greely has been modifying and constructing fences to keep moose out of sensitive areas such as the missile field. They have also installed some automatic gates that close behind personnel and gate guards at select locations during working hours when gates are left open. We will continue assisting the U.S. Army in hazing and excluding moose from areas deemed practical. The department has also discussed the need for water sources in the interior of Fort Greely and the installation of “moose escape hatches” at key fence-line locations on the perimeter. The issue is likely to persist until the entirety of Fort Greely is fenced, although it remains uncertain if or when the entire perimeter will be enclosed.

U.S. Army, Fort Wainwright Donnelly Training Area (DTA) East is located in southwestern Unit 20D. DTA has a high moose density and very good access for hunters. At times, closure of the DTA for military use has conflicted with moose hunting seasons. We will continue to coordinate with Fort Wainwright to inform southwestern Unit 20D moose hunters about DTA closures during moose hunting seasons.

Fencing on private lands within the Delta Agricultural Project has also become an issue, particularly when it separates cows and calves. In these situations, either the cow can get over or through the fence while the calf cannot, or the calf can get under while the cow cannot. We work with local landowners, the local Natural Resources Conservation Service office, and the Salcha-Delta Soil and Water Conservation office to help landowners build the most wildlife-friendly fences possible while still serving their purpose of keeping bison out of crop fields.

Moose in southwestern Unit 20D live proximate to domestic animals, including nontraditional livestock such as elk, in the Delta Junction area. Additionally, some livestock from the Delta Junction area become feral or escape for periods of time within Unit 20D. Livestock pose potential health risks to moose due to the potential for transmission of pathogens and endo- and ectoparasites harmful to moose. ADF&G has no control over the health of domestic livestock and limited control over the consequences of contact between moose and livestock. Monitoring moose health in Unit 20D is an essential part of understanding potential health risks to the entire Alaska moose population. Opportunistic and targeted health surveillance should be a routine part of moose management in Unit 20D.

Data Recording and Archiving

GSPE data are stored on WinfoNet. Field data sheets, paper files, and hard copies are stored in a file cabinet at the Delta Area office. All other electronic data are stored on a computer at the Delta Area office.

Agreements

U.S. Army Fort Wainwright Cooperative Agreement dated 30 June 2012.

Permitting

ADF&G Animal Care and Use Committee: Moose nutritional status in Unit 20D 0077-209-02.

Conclusions and Management Recommendations

Moose densities in southwestern Unit 20D were at an estimated 2.9–3.6 moose/mi² during RY15–RY19 but are still lower than the densities observed before the moose population was reduced through antlerless moose hunting in RY06–RY09 (DuBois 2010). After antlerless moose hunts reduced the population, 3 indices of density-dependent moose nutritional conditions—biomass removal of current annual growth on winter browse, proportion of females with twin calves, and late-winter calf weights—were evaluated in relation to changes in density. This evaluation was compared with data collected before and during the reduction. The comparison detected a decrease in winter browse removal (Paragi et al 2015), an overall increase in twinning rate, and an increase in the average weight of 9-month-old calves (K. A. K. Seaton, Wildlife Biologist, ADF&G, Fairbanks, unpublished data). However, the nutritional indices again degraded toward the end of this reporting period (low twinning rates and low short-yearling weights), indicating that more antlerless hunting may be needed to stop population growth and possibly decrease the moose population. We recommend managing for population stability and starting to transition to population reduction until nutritional indices improve (M1). We also plan

to conduct a browse survey in the next 1–2 years to measure annual browse offtake relative to observed nutritional indices.

Antlerless moose hunting in Unit 20D has recently occurred only within the southwestern portion of the unit, which has the highest moose densities. Existing Unit 20D hunts YM792, DM791, and DM795 have an antlerless moose (except a calf or a cow accompanied by a calf) as part of the legal bag limit and allow for the combined maximum potential harvest of <30 antlerless moose. Based on the analysis of population status and trends of the southwestern Unit 20D moose population, the potential harvest from these 3 hunts, combined with the antlerless take of ceremonial harvest and the mortalities of antlerless moose caused by vehicle collisions and other mortality factors, appears to be at a rate of mortality that contributes to stability of the southwestern Unit 20D moose population. However, without any habitat succession in the southwestern portion of the unit, additional harvest of antlerless moose will likely be needed to improve nutritional indices. The harvest of antlerless moose remains a controversial subject between the Delta Fish and Game Advisory Committee and the local community. ADF&G will continue gathering all available data to confirm nutritional stress and will educate the local community with this information to gain their support for antlerless hunting, especially as the need for more antlerless hunting increases. We recommend continuing a conservative antlerless moose harvest and increasing antlerless harvest in southwestern Unit 20D. There are no plans for antlerless hunting in any other portions of Unit 20D.

The southwestern Unit 20D moose population was stable during RY15–RY19, with a peak of about 3,763 observable moose in fall 2017 (Table 4). Bull-to-cow ratios in southwestern Unit 20D were also stable, and minimum bull-to-cow ratio objective of >20:100 in southwestern Unit 20D was met (M1; Table 4).

Twinning rates in southwestern Unit 20D ranged between 9.7% and 17.5% during 2015–2020 (Table 5). Based on the average twinning rate of 13%, we are managing the Unit 20D moose population for stability (M2). We will periodically capture and compare the mass of short yearlings to substantiate nutritional status in southwestern Unit 20D.

The moose population is stable in northern Unit 20D (Table 4). This area continues to experience large wildfires, which have changed a large portion of the plant community to earlier successional stages that provide increased nutritional value of forage available to moose. Therefore, the moose population is likely to respond positively to improvements in habitat in this area.

During RY15–RY19, the observable moose population in Unit 20D was below the population objective (C3) of 8,000–10,000 moose; however, the peak nearly reached the lower end of this objective, with 7,687 observable moose (2015 Unit 20D north estimate + 2017 Unit 20D south estimate; Tables 1–2). The stable, bull-to-cow and calf-to-cow ratios in southwestern Unit 20D (the area of Unit 20D with the highest moose density) during RY15–RY19 suggest the population may not be able to increase to the IM population objective without negatively affecting habitat and moose production. Toward the end of RY15–RY19, low twinning rates and low short-yearling weights indicated that the southwestern moose population is showing nutritional stress and that population growth is not warranted in this area. However, due to wildfire in northern Unit 20D within the last 20 years, it is possible the moose population there

could continue to grow. An increase in moose numbers in northern Unit 20D would contribute to increasing the overall Unit 20D moose population, but it is unlikely that the overall Unit 20D moose population will reach the lower IM population objective unless there is widespread plant community successional setback throughout the unit.

The harvest objective of 500–700 moose (C4) was not met in any year during RY15–RY19. To meet this harvest objective, it will be necessary to harvest moose at a rate that cannot be sustained by the current population. Currently, we are managing for a stable population. Based on the stability of the bull harvest, the overall positive feedback from the Delta Fish and Game Advisory Committee, and anecdotal reports of hunting satisfaction from the general public, the structure of Unit 20D moose hunts appears to be maximizing a significant and acceptable portion of the harvestable moose surplus. No changes are planned for the general season hunt. However, a proposal should be considered for the next BOG cycle to adjust the IM population and harvest objectives to numbers that the habitat can sustain.

We recommend working with the U.S. Army Fort Wainwright to mitigate conflicts between training and fall hunting seasons for moose, caribou (*Rangifer tarandus*), and Dall sheep (*Ovis dalli*). Also, we recommend working with the U.S. Army Fort Greely to address concerns about the restriction of moose ingress and egress on Fort Greely lands.

II. Project Review and RY20–RY24 Plan

Review of Management Direction

MANAGEMENT DIRECTION

The RY15–RY19 management direction for moose in Unit 20D is appropriate to continue in RY20–RY24.

GOALS

No change in goals from the RY15–RY19 report.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

No change expected from the RY15–RY19 report.

Intensive Management

No change expected from the RY15–RY19 report.

MANAGEMENT OBJECTIVES

The management objectives for RY20–RY24 will change to the following:

- M1. Manage population levels based on 2-year average spring twinning rates in conjunction with at least one of the following signals to substantiate low twinning based on nutritional status: 1) <50% of 36-month-old moose are parturient; 2) average multi-year short-yearling mass is <385 pounds; or 3) >35% of annual browse biomass is removed by moose (Boertje et al. 2007):
- Manage for population reduction when the 2-year average twinning rate is <10%.
 - Manage for population stability when the 2-year average twinning rate is 10–20%.
 - Manage for population growth when the 2-year average twinning rate is >20%.
- M2. Manage for a pothunting bull-to-cow sex ratio of $\geq 30:100$.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Geospatial Population Estimator surveys (M1).

Data Needs

No change from the RY15–RY19 report.

Methods

No change from the RY15–RY19 report.

ACTIVITY 1.2. Spring twinning surveys (M2).

Data Needs

No change from the RY15–RY19 report.

Methods

No change from the RY15–RY19 report.

ACTIVITY 1.3. Short-yearling mass estimates (M2).

Data Needs

No change from the RY15–RY19 report.

Methods

No change from the RY15–RY19 report.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor and analyze harvest data (C4, M1, and M3).

Data Needs

No change from the RY15–RY19 report.

Methods

No change from the RY15–RY19 report.

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Assess habitat condition (G1 and M2).

Data Needs

We will consider conducting a browse survey in portions of Unit 20D to substantiate twinning-rate estimates of nutritional condition, especially if multi-year twinning rates are $\leq 20\%$. Furthermore, browse survey data can be useful for estimating nutritional condition in areas where twinning rates are difficult to estimate because, for example, adequate sample sizes cannot reasonably be obtained.

Methods

Browse survey methods will generally follow those described in Seaton et al. (2011), and the department will review the sampling design. We will verify and, if needed, refine the methods before conducting this activity, ensuring high scientific standards are maintained in both the methods and the interpretation of results.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Conduct opportunistic and targeted health surveillance of moose in Unit 20D, with an emphasis on moose from southwestern Unit 20D. Sample moose carcasses to test for the presence of chronic wasting disease, meningeal worm, Johne's disease, brucellosis, *Mycoplasma* spp., and adenovirus. Perform opportunistic inspections of moose carcasses for ectoparasites; if ectoparasites are found, collect them for laboratory identification.

Work with the U.S. Army Fort Greely to address concerns about restrictions on moose ingress and egress on Fort Greely lands, especially those that are in proximity to the missile field.

High-tensile game fences and other fences on the Delta Agricultural Project (east of Delta Junction) impede daily and seasonal moose movements, cause moose injuries and mortalities, and bring about separation of dams and calves. ADF&G will continue to provide technical guidance to landowners and agencies working with landowners (i.e., Delta Soil and Water

Conservation District and the U.S. Department of Agriculture–Natural Resources Conservation Service) on fence design and gate locations to mitigate the negative impacts of fences on moose.

Data Recording and Archiving

No change from the RY15–RY19 report.

Agreements

U.S. Army Fort Wainwright Cooperative Agreement dated 30 June 2012.

Permitting

ADF&G Animal Care and Use Committee: Moose nutritional status in Unit 20D 0077-209-02.

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