

## **Moose Management Report and Plan, Game Management Unit 20B:**

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

**Jeffrey Wells**





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Plan Period 1 July 2020–30 June 2025

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This species management report and plan was reviewed and approved for publication by Jason R. Caikoski, Management Coordinator for Region III for the Division of Wildlife Conservation.

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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 20B 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 20B encompasses 9,196 mi<sup>2</sup> in Central Alaska. For moose management purposes, it is divided into 3 geographic zones: 1) western Unit 20B (2,942 mi<sup>2</sup>), which includes Minto Flats, Tatalina Creek drainage, Tolovana River drainage, and areas farther west; 2) eastern Unit 20B (2,425 mi<sup>2</sup>), which includes the Little Salcha and Salcha river drainages; and 3) central Unit 20B (3,829 mi<sup>2</sup>), the remainder of the unit (Fig. 1).

Unit 20B includes all drainages into the north bank of the Tanana River between Banner Creek to the east and Hot Springs Slough to the west. The unit includes the urban Fairbanks and North Pole areas, as well as multiple smaller towns, including Nenana, Minto, and Manley Hot Springs. Elevations within Unit 20B range from approximately 300 to 5,900 ft, with most of the unit below 4,000 ft, the cutoff generally considered suitable moose habitat in this portion of Interior Alaska. The area of estimated suitable habitat encompasses 8,883 mi<sup>2</sup>. Terrain varies greatly within the unit, ranging from flat, lowland areas to rolling hills and mountains. Habitat types include lowland riparian and grassland, mature black spruce (*Picea mariana*) and white spruce (*Picea glauca*) forest, deciduous forest, alpine and subalpine habitat, and burns of various ages. The climate in Unit 20B is typical of Interior Alaska, where temperatures frequently reach 80°F in summer and –40°F in winter. Snow depths in most years do not reach levels that substantially impact moose population dynamics. However, snow depth varies greatly with elevation, generally increasing at higher elevations.

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

As in other areas of Alaska, the Unit 20B moose population experienced wide fluctuations in size from the 1950s to the 2010s. Moose numbers increased from the 1950s through the early 1960s, likely related to improved habitat from extensive wildfires and federal wolf (*Canis lupus*) control (McNay 1993). The population then declined from the mid-1960s through the mid-1970s following severe winters, increased wolf predation, and liberal either-sex hunting seasons. Moose numbers again increased following wolf control within portions of the unit during 1982–1986, and the unitwide population was estimated at 9,800 moose in 1990. Following 1990, the

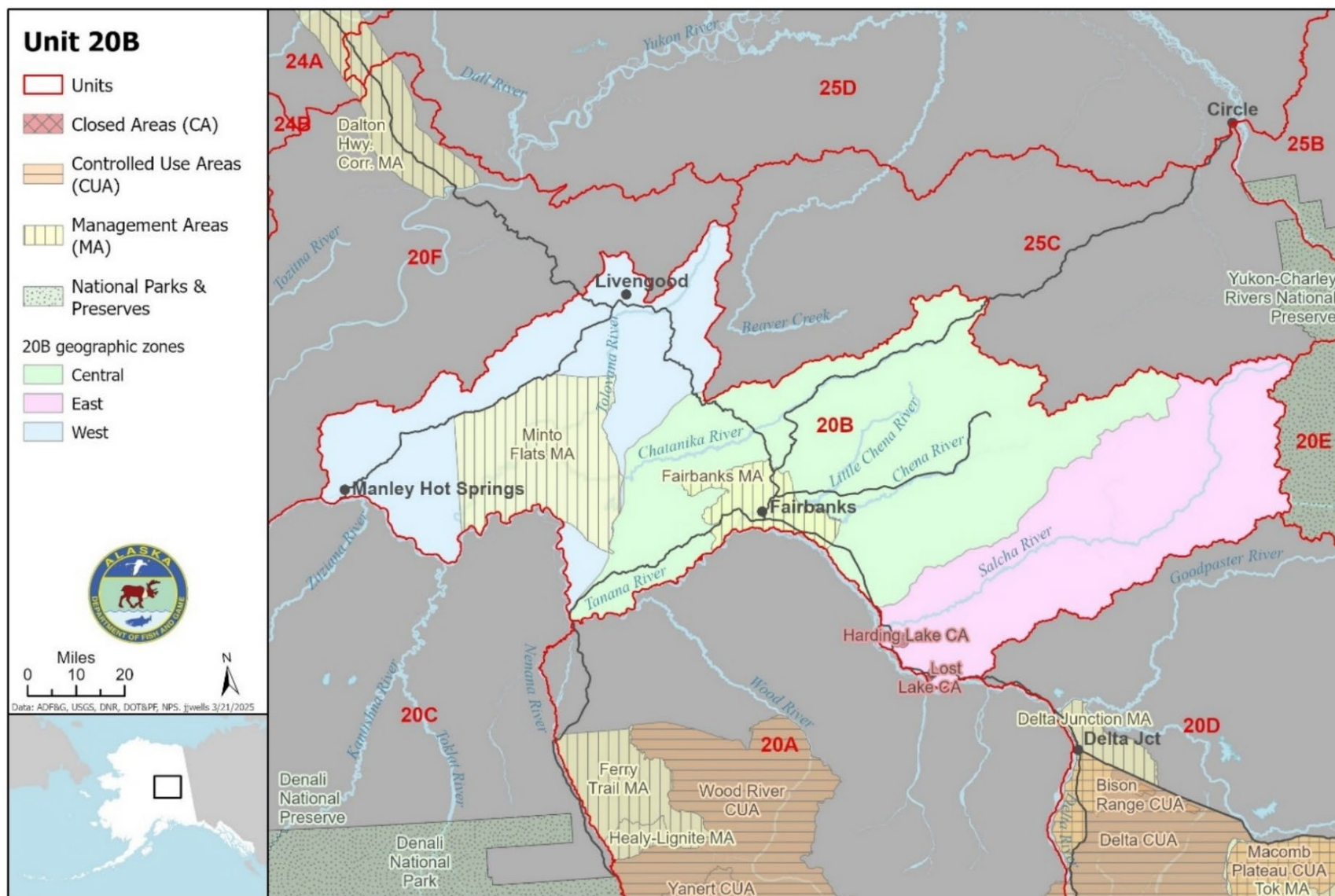


Figure 1. Map of Unit 20B, including moose management geographic zones and management areas, Interior Alaska, regulatory years 2015–2019.

next unitwide population estimate was 10,261 moose in 2001 (Young 2002). The unitwide population then steadily increased through 2009, when it was estimated to be 20,173 moose (Hollis 2012). Following intentionally high cow harvest levels during RY09–RY13, intended to decrease the population, and an extremely late spring in 2013, the unitwide population was estimated at 14,057 moose in 2012–2013 (Hollis 2018), which was within the intensive management (IM) population objective of 12,000–15,000 moose.

Demand for moose hunting opportunities in Unit 20B is high, and seasons and bag limits have been altered over time in response to changes in the moose population. Hunter access is high throughout much of the unit, with extensive road and trail systems providing overland access and numerous waterways (e.g., Tanana, Chena, Salcha, and Chatanika rivers) providing boat access. Bull moose hunting opportunity throughout much of the road-accessible portion of the unit included a 10-day season in the 1970s and early 1980s, a 15-day season during the 1990s and 2000s, and a 20-day season in the late 1980s and a portion of the 2010s. In conjunction with the increasing moose population and the extended season length beginning in RY11 (i.e., 20-day versus 15-day), bull moose harvest increased through the 2000s and 2010s and averaged >600 bulls harvested annually during RY08–RY12 (Hollis 2018). Antlerless harvest opportunity was also expanded in conjunction with the increasing moose population, provided through a combination of registration and drawing permits. Through these permits, antlerless harvest peaked at 441 moose in RY11 and 426 moose in RY12 (Hollis 2018). Through the combination of bull and antlerless moose harvest, total reported annual moose harvest during RY10–RY14 exceeded the lower IM harvest objective of 600 moose (Hollis 2018).

Two management areas in Unit 20B were established for moose management. The first is the 913 mi<sup>2</sup> Minto Flats Management Area (MFMA; Fig. 1), established in 1979 to restrict harvest in a low-density moose population. In 1988, the Alaska State Legislature established the Minto Flats State Game Refuge, related to the MFMA, to 1) ensure the protection and enhancement of habitat and the conservation of fish and wildlife, and 2) guarantee the continuation of hunting, fishing, trapping, and other compatible public uses within approximately 800 mi<sup>2</sup> of the Minto Flats area. The second management area is the Fairbanks Management Area (FMA; Fig. 1), established in 1983 to provide moose hunting opportunity around the Fairbanks and North Pole urban areas by bow and arrow only. Since RY02, the FMA boundary has encompassed 300 mi<sup>2</sup>, and this management area has been used not only to provide moose hunting opportunity but also to reduce roadkill and nuisance moose reports.

## **Management Direction**

### **EXISTING WILDLIFE MANAGEMENT PLANS**

Directions for moose management in Unit 20B have been reviewed and modified through public comments, staff recommendations, and Alaska Board of Game actions over the years. A record of these changes can be found in the division's moose management report series. Unit 20B plans for moose survey and inventory management activities for RY15–RY19 were outlined in Hollis (2018), and the plan section of this document contains the current management plan for Unit 20B moose.

## GOALS

During RY15–RY19 (and since RY93), the Unit 20B moose management goals were as follows:

- G1. Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- G2. Provide for the continued subsistence use of moose by Alaska residents who have customarily and traditionally used the population.
- G3. Provide the greatest sustained opportunity to participate in hunting moose.
- G4. Provide an opportunity to view and photograph moose.
- G5. Protect human life and property in human–moose interactions.

## CODIFIED OBJECTIVES

### Amounts Reasonably Necessary for Subsistence Uses

The Unit 20B moose population outside the Fairbanks nonsubsistence area has a positive customary and traditional use finding, as determined by the Board of Game, for amounts reasonably necessary for subsistence (ANS) uses:

- C1. Unit 20B, that portion outside the MFMA: 75–100 moose.
- C2. Unit 20B, that portion within the MFMA: 20–40 moose.

### Intensive Management

The Unit 20B moose population is identified by the Board of Game as important for providing high levels of harvest for human consumptive use and has the following IM objectives:

- C3. Population objective of 12,000–15,000 moose.
- C4. Harvest objective of 600–1,500 moose.

## MANAGEMENT OBJECTIVES

During RY15–RY19, the Unit 20B moose management objective was:

- M1. Manage for posthunting bull-to-cow sex ratios of  $\geq 30:100$  unitwide and  $\geq 20:100$  in each count area (i.e., eastern Unit 20B, central Unit 20B, western Unit 20B, and the MFMA).

## MANAGEMENT ACTIVITIES

### 1. Population Status and Trend

ACTIVITY 1.1. Conduct Geospatial Population Estimator surveys to estimate population abundance and composition (objectives C1, C2, C3, C4, and M1).

#### *Data Needs*

Population abundance and composition estimates are important components of moose management. Population abundance estimates are necessary to assess the IM population objective, estimate sustainable yield, and monitor the population in response to different management actions. Composition estimates are used to assess the influence of harvest on the male component of the population (bull-to-cow ratio) and to assess the bull-to-cow ratio management objective. Furthermore, composition data are used to assess calf recruitment to fall (calf-to-cow ratio), which can be an indication of predation pressure when production is also measured.

#### *Methods*

ADF&G staff estimated moose abundance and composition in Unit 20B during RY15–RY19 using the Geospatial Population Estimator (GSPE) method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Hollis (2018) suggested completing an annual Unit 20B GSPE survey during this period, alternating between high- and low-intensity surveys. However, due to various constraints, we did not conduct annual Unit 20B GSPE surveys during RY15–RY19. Instead, we conducted unitwide surveys in RY15 and RY17, and a survey within MFMA in RY19. We did not conduct a survey in RY16 due to poor survey conditions, and we did not conduct one in RY18 because our efforts were focused on completing a Unit 20A survey.

We stratified sample units (SUs) as high-stratum if they were likely to contain  $>4$  moose and as low-stratum if they were likely to contain  $\leq 4$  moose. After selecting SUs, we surveyed them at altitudes of approximately 300–800 ft above ground level, depending on vegetative cover, and at speeds typically varying 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. Rather than conducting transects in hilly or mountainous terrain, our flight path followed terrain contours within the SU boundaries.

We rated survey conditions for each completed SU as poor, fair, good, or excellent, based on snow (age and cover), light (intensity and type), and wind (strength and turbulence). Unless otherwise noted, all surveys were completed using a PA-18 Piper Super Cub and a Bellanca Scout aircraft. The target search intensity was 8 min/mi<sup>2</sup>, or approximately 45 minutes of survey time, in SUs with 100% moose habitat. We calculated population and ratio estimates (with 90% confidence intervals [CIs]) using ADF&G's Wildlife Information Network (WinfoNet) GSPE software (DeLong 2006).

To correct the observable (or raw) moose estimate for sightability, we used a sightability correction factor (SCF) estimated for Unit 20A, since a Unit 20B-specific SCF has not been estimated. The Unit 20A SCF, a composite SCF derived from proportions of radiocollared

moose observed during 2003–2006 Unit 20A surveys (Boertje et al. 2007, 2009), was 1.21 (standard error [SE] = 0.067). Using the Delta method, we applied the SCF and its associated SE separately to the high- and low-stratum estimates and their associated SEs, then combined them to estimate the total population size and associated variance, accounting for sightability.

The following includes more specific information by regulatory year for each survey conducted.

#### Regulatory Year 2015

ADF&G staff used the GSPE method to survey 100 SUs (70 high stratum and 30 low stratum) of the 1,628 SUs in Unit 20B from 20 November to 5 December. Survey conditions were reported as excellent (47%), good (39%), fair (12%), and poor (1%; conditions were not reported for 1 SU). For SUs with 100% moose habitat ( $n = 74$ ), average search time was 7.6 min/mi<sup>2</sup>. Overall search time, accounting for the estimated proportion of moose habitat in each SU, averaged 8.0 min/mi<sup>2</sup>.

#### Regulatory Year 2017

ADF&G staff used the GSPE method to survey 185 SUs (132 high stratum and 53 low stratum) of 1,628 SUs in Unit 20B from 14 November to 8 December. We selected a simple random sample of 170 SUs (120 high stratum and 50 low stratum) using Microsoft Excel, and an additional 15 SUs (12 high stratum and 3 low stratum) to fill gaps in randomized coverage. Survey conditions were reported as excellent (57%), good (40%), and fair (3%; conditions were not reported for 18 SUs). For SUs with 100% moose habitat for which search time was recorded ( $n = 85$ ), average search time was 7.4 min/mi<sup>2</sup>. Overall search time, accounting for the estimated proportion of moose habitat in each SU where search time was recorded ( $n = 100$ ), averaged 7.6 min/mi<sup>2</sup>.

#### Regulatory Year 2019

ADF&G staff used the GSPE method to survey 52 SUs (36 high stratum and 16 low stratum) of 169 SUs in MFMA during 21–26 November. Survey conditions were reported as excellent (21%), good (74%), and fair (4%; conditions were not reported for 2 SUs). For SUs with 100% moose habitat ( $n = 39$ ), average search time was 7.1 min/mi<sup>2</sup>. Overall search time, accounting for the estimated proportion of moose habitat in each SU, averaged 7.4 min/mi<sup>2</sup>. Total flight time, including ferry time, was 45.9 hours.

#### *Results and Discussion*

The RY15 midpoint unitwide population estimate of 11,064 moose (1.2 moose/mi<sup>2</sup>) was below the IM objective, whereas the RY17 estimate of 12,871 moose (1.4 moose/mi<sup>2</sup>) was within the IM objective (Table 1). The 90% CIs for both estimates overlapped. Also, both estimates were lower than the combined RY12–RY13 unitwide estimate of 14,057 moose (Hollis 2018) and the RY09 unitwide estimate of 20,173 moose (Hollis 2012). The population decrease between RY09 and RY15 reflects the management strategy during that period, which used antlerless moose harvest to reduce population growth and abundance to within the IM population objective (Hollis 2012).

**Table 1. Aerial moose fall composition counts and estimated population size, Unit 20B, Interior Alaska, regulatory years 2015–2019. The 90% confidence intervals, plus and minus the estimate, are shown in parentheses.**

| Count area        | Size of count area (mi <sup>2</sup> ) | Year              | Moose observed | Bulls:100 cows |      | Yearling bulls:100 cows |     | Calves:100 cows |      | Estimated population <sup>a</sup> |         | Estimated population with SCF <sup>b</sup> |         | Estimated density with SCF <sup>b</sup> |        |
|-------------------|---------------------------------------|-------------------|----------------|----------------|------|-------------------------|-----|-----------------|------|-----------------------------------|---------|--------------------------------------------|---------|-----------------------------------------|--------|
| Unit 20B          | 9,196                                 | 2015              | 572            | 24             | (7)  | 10                      | (4) | 45              | (9)  | 9,144                             | (1,646) | 11,064                                     | (2,116) | 1.20                                    | (0.42) |
|                   |                                       | 2017              | 1,274          | 18             | (4)  | 7                       | (2) | 38              | (6)  | 10,637                            | (1,489) | 12,871                                     | (1,976) | 1.40                                    | (0.39) |
| Eastern           | 2,425                                 | 2015              | 73             | 20             | (11) | 9                       | (7) | 39              | (13) | 2,060                             | (577)   | 2,494                                      | (710)   | 1.03                                    | (0.29) |
|                   |                                       | 2017              | 127            | 23             | (11) | 8                       | (3) | 39              | (15) | 1,982                             | (667)   | 2,399                                      | (820)   | 0.99                                    | (0.34) |
| Central           | 3,829                                 | 2015              | 254            | 24             | (8)  | 11                      | (4) | 45              | (10) | 3,909                             | (747)   | 4,730                                      | (958)   | 1.24                                    | (0.25) |
|                   |                                       | 2017              | 717            | 16             | (4)  | 7                       | (2) | 37              | (6)  | 5,235                             | (769)   | 6,336                                      | (1,019) | 1.65                                    | (0.27) |
| Western           | 2,942                                 | 2015              | 245            | 27             | (9)  | 10                      | (5) | 50              | (11) | 3,174                             | (606)   | 3,841                                      | (780)   | 1.31                                    | (0.27) |
|                   |                                       | 2017              | 430            | 19             | (6)  | 7                       | (2) | 40              | (9)  | 3,419                             | (674)   | 4,138                                      | (868)   | 1.41                                    | (0.29) |
| MFMA <sup>c</sup> | 951                                   | 2015              | 144            | 33             | (11) | 12                      | (5) | 62              | (15) | 1,259                             | (257)   | 1,523                                      | (331)   | 1.60                                    | (0.35) |
|                   |                                       | 2017              | 173            | 16             | (7)  | 7                       | (2) | 40              | (9)  | 1,367                             | (323)   | 1,654                                      | (413)   | 1.74                                    | (0.43) |
|                   |                                       | 2019 <sup>d</sup> | 434            | 19             | (5)  | 8                       | (3) | 32              | (8)  | 1,449                             | (319)   | 1,753                                      | (397)   | 1.84                                    | (0.42) |

*Note:* Data sampled using the Geospatial Population Estimator (GSPE) sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006).

<sup>a</sup> Population estimate uncorrected for sightability.

<sup>b</sup> Estimate corrected for sightability using a sightability correction factor (SCF) of 1.21 with a standard error of 0.067.

<sup>c</sup> Minto Flats Management Area (MFMA) within western Unit 20B.

<sup>d</sup> Population size could not be estimated using the GSPE method due to inadequate sample sizes within each stratum; therefore, the method described in Gasaway et al. (1986) was used to estimate population size.

Similarly, moose population estimates for each of the 3 geographic zones and MFMA appeared stable during RY15–RY19, at levels below peak estimates from past reporting periods. Average density estimates during this reporting period were highest in the MFMA (1.7 moose/mi<sup>2</sup>; Table 1), which is encompassed within western Unit 20B, where the average density estimate was 1.4 moose/mi<sup>2</sup>. The average density estimate for central Unit 20B was similar at 1.5 moose/mi<sup>2</sup> and slightly lower in eastern Unit 20B) at 1.0 moose/mi<sup>2</sup>. These density estimates are lower than the peak density estimates recorded during 2008–2009, which were 6.0 moose/mi<sup>2</sup> in the MFMA, 3.3 moose/mi<sup>2</sup> in western Unit 20B, 1.9 moose/mi<sup>2</sup> in central Unit 20B, and 1.5 moose/mi<sup>2</sup> in eastern Unit 20B (Hollis 2012).

Unitwide bull-to-cow ratio estimates of 24:100 in RY15 and 18:100 in RY17 (Table 1) did not meet the unitwide management objective of  $\geq 30:100$ . Conversely, bull-to-cow ratio estimates within each count area in RY15 (Table 1) met the count area management objective of  $\geq 20:100$ . However, the count-area bull-to-cow ratio objective in RY17 was met only in eastern Unit 20B. In contrast, bull-to-cow ratio estimates in western Unit 20B, central Unit 20B, and the MFMA were below the objective, with midpoint estimates ranging from 16:100 to 19:100. Similarly, the midpoint bull-to-cow ratio estimate for the MFMA in RY19 was below the objective. These bull-to-cow ratio estimates are well below those from previous reporting periods. During RY05–RY14, unitwide bull-to-cow ratio estimates averaged 31:100 ( $n = 3$  surveys; Hollis 2018). During the same period, bull-to-cow ratios averaged 37:100 in eastern Unit 20B, 27:100 in central Unit 20B, and 31:100 in western Unit 20B ( $n = 4$  surveys for eastern and western,  $n = 5$  surveys for central). The bull-to-cow ratio in MFMA during the same period averaged 26:100 ( $n = 6$  surveys).

The low bull-to-cow ratio estimates observed during RY15–RY19 were likely the result of high bull harvest levels in conjunction with a lower overall population abundance compared with previous reporting periods. Following the high population abundance and bull-to-cow ratio estimate in RY09, the bull hunting season in much of Unit 20B was extended by 5 days, from a closing date of 15 September to 20 September, beginning in RY11. As the overall population declined between RY09 and RY15, the additional bull harvest from the 5-day extension became unsustainable for maintaining the bull-to-cow ratio management objectives. Beginning in RY18, the bull season was shortened by 5 days to address the low bull-to-cow ratios.

Unlike bull-to-cow ratio estimates, calf-to-cow ratio estimates during RY15–RY19 were above average. The RY15–RY19 unitwide calf-to-cow ratio averaged 42:100 (Table 1), compared with the RY05–RY14 unitwide average of 38:100. Within the count areas, the highest and lowest calf-to-cow ratio estimates were both in the MFMA, with the highest in RY15 at 62:100 and the lowest in RY19 at 32:100.

### *Recommendations for Activity 1.1*

Continue.

## ACTIVITY 1.2. Spring twinning surveys (G1).

### *Data Needs*

Estimates of moose nutritional condition and productivity are integral to management goal G1, which is to protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem. Twinning rate estimates provide a relatively inexpensive and obtainable index of nutritional condition (Boertje et al. 2007).

### *Methods*

ADF&G staff estimated twinning rates during RY15–RY19 from annual spring surveys conducted in the MFMA. Additionally, we attempted a twinning rate survey in RY16 in central Unit 20B within the Little Chena River drainage, but we did not obtain an adequate sample size of parturient moose. Twinning rates were estimated from observations of random cows with calves, with a target minimum annual sample size for the MFMA of 50 cows observed with calves. With an annual sample size of 50 cows observed with calves, or a 3-year combined sample size of 150, the power analysis presented in Wells (2018) indicates an 80% chance of detecting a change in the 3-year average twinning rate of  $\pm 8\%$  at alpha equal to 0.1.

Twinning rate surveys consisted of roughly parallel transects flown at approximately 0.5–1 mile intervals at  $\leq 500$  ft above ground level in a PA-18 or Scout aircraft by experienced pilots with observers (except for RY19, when no observers were used). Within the MFMA, these transects were flown in a northwest-southeast direction, bounded on the north by lat  $65^{\circ}10'N$ , on the west by the Tolovana River–Swanneck Slough, on the east by the Dunbar Trail, and on the south by the MFMA boundary. We classified all observed moose as bull, yearling cow, adult cow without a calf, or adult cow with a single calf, twin, or triplet calves. We flew twinning rate surveys in late May, during or within a few days of the median calving date as determined by concurrent parturition surveys of collared cow moose in Unit 20A. The twinning rate was calculated as the proportion of cows with twins or triplets in the sample of all cows with calves. To account for variability that can exist between consecutive years, we used the 3-year average twinning rate to evaluate the nutritional condition of the moose population based on the thresholds described in Boertje et al. (2007).

### *Results and Discussion*

We met the target sample size of 50 cows observed with calves in the MFMA each year during RY15–RY18 (spring 2016–2019; Table 2), but not in RY19 (spring 2020). Snowfall was higher than normal throughout the Minto Flats during winter 2019–2020, and as a result, the flats were flooded well above normal levels during the twinning survey. This flooding may have displaced moose from the survey area, as we observed very few moose during the survey and did not observe enough cows with calves to obtain an adequate sample size.

Annual twinning rates during RY15–RY18 averaged 17% and ranged from 10% to 27% (Table 2). The 3-year running average twinning rates (e.g., 3-year average twinning rate for RY15 would include RY13–RY15) ranged from 16% (90% CI = 11–21%) in RY18 to 24% (90% CI = 19–29%) in RY16. These rates hovered around the 20% cautionary threshold suggested by Boertje et al. (2007), at which nutrition might be a limiting factor.

**Table 2. Moose twinning rates from transect surveys in the Minto Flats Management Area, Unit 20B, Interior Alaska, calendar years 2016–2020.**

| Calendar year     | Date   | Cows observed with |       | Twinning rate <sup>a</sup> |                        | Total parturient |
|-------------------|--------|--------------------|-------|----------------------------|------------------------|------------------|
|                   |        | Single calf        | Twins | Rate                       | (90% CI <sup>b</sup> ) |                  |
| 2016              | 20 May | 51                 | 11    | 18                         | (10–26)                | 62               |
| 2017              | 25 May | 38                 | 14    | 27                         | (17–37)                | 52               |
| 2018              | 30 May | 44                 | 6     | 12                         | (4–20)                 | 50               |
| 2019              | 23 May | 45                 | 5     | 10                         | (3–17)                 | 50               |
| 2020 <sup>c</sup> | 20 May | —                  | —     | —                          | —                      | —                |

<sup>a</sup> Proportion of cows with calves that had twins.

<sup>b</sup> CI stands for confidence interval.

<sup>c</sup> A survey was attempted in spring 2020, but an adequate sample size of cows with calves could not be obtained.

### *Recommendations for Activity 1.2*

Continue.

### ACTIVITY 1.3. Short-yearling mass estimates (G1).

#### *Data Needs*

Estimates of moose nutritional condition and productivity are integral to management goal G1, which is to protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem. Short-yearling mass is an index of moose nutritional condition and can substantiate nutritional condition based on twinning rate estimates (Boertje et al. 2007). Our goal during RY15–RY19 was to compare the average short-yearling mass in the MFMA and central Unit 20B with the 385 lb threshold identified by Boertje et al. (2007) as indicative of low nutrition. Our secondary goal was to compare average mass within each location (MFMA and central 20B) with the average mass during 2009–2010, the previous period when short-yearling weights were assessed. Because moose densities decreased between 2009–2010 and 2017–2018, we expected that moose nutrition would improve and, in turn, that short-yearling mass would increase.

#### *Methods*

Our goal was to capture 120 short-yearling moose (60 males, 60 females), split evenly between March 2017 and 2018 and between central Unit 20B and the MFMA. We captured short yearlings via chemical immobilization by darting from a helicopter and weighed them using a dynamometer suspended from a tripod hoist.

For the 2017–2018 data, we assessed the MFMA separately from central Unit 20B because these areas had been subject to different management schemes. To assess whether average mass differed between males and females during 2017–2018, we used a two-sample *t*-test, and to assess whether average mass differed from the 385 lb threshold, we used a one-sample *t*-test. For both tests, we based statistical significance on  $\alpha = 0.05$ . We assessed the *t*-test assumption of normality via visual inspection of the normal probability plots and the two-sample *t*-test assumption of equal variance across groups via Levene’s test of homogeneity of variance using the R package car (Fox and Weisberg 2019).

To compare the average mass between 2009–2010 and 2017–2018, we compared 95% CIs around the average between each period at each location (MFMA and central 20B). However, we did not perform a statistical test because only 1 year of data was collected at each location during the earlier period, and Boertje et al. (2007) recommended >1 year of data to assess nutritional status, given substantial annual variation in short-yearling mass, especially with relatively small sample sizes.

### *Results and Discussion*

During March 2017 and 2018, we captured 116 short-yearling moose (60 in 2017 and 56 in 2018), including 60 in the MFMA and 56 in central Unit 20B (Table 3). MFMA captures were distributed throughout the MFMA, whereas central Unit 20B captures were distributed along the Elliot and Steese highways within the Washington, Chatanika, and Little Chena river drainages. On average, males were heavier than females in both locations (Table 3), but the difference was not significant in either the MFMA ( $t = -1.74$ ,  $df = 58$ ,  $p = 0.09$ ) or central Unit 20B ( $t = -1.05$ ,  $df = 54$ ,  $p = 0.30$ ). Because mass did not vary significantly by sex, we combined male and female masses to compare the overall average to the 385 lb threshold.

**Table 3. Short-yearling (10-month-old) moose average weight (pounds) by sex and location, Unit 20B, Interior Alaska, March 2017 and 2018.**

| Location          | Male     |         |                 | Female   |         |                 | Combined |         |                 |
|-------------------|----------|---------|-----------------|----------|---------|-----------------|----------|---------|-----------------|
|                   | <i>n</i> | Average | SE <sup>a</sup> | <i>n</i> | Average | SE <sup>a</sup> | <i>n</i> | Average | SE <sup>a</sup> |
| MFMA <sup>b</sup> | 32       | 377     | 9.0             | 28       | 357     | 7.0             | 60       | 367     | 5.9             |
| Central Unit 20B  | 31       | 398     | 8.8             | 25       | 383     | 11.5            | 56       | 392     | 7.1             |

*Note:* Weights were collected during March 2017 and 2018.

<sup>a</sup> Standard error.

<sup>b</sup> Minto Flats Management Area.

Average mass in the MFMA was 367 lb (95% CI = 356–379), which was significantly different from the 385 lb threshold ( $t = -2.976$ ,  $df = 59$ ,  $p = 0.004$ ). However, this mass was similar to the average mass of 364 lb (95% CI = 351–375) in 2010. Because the average mass during 2017–2018 was significantly below the 385 lb threshold, the MFMA moose population was likely at a relatively low nutritional level during that period.

Average mass in central Unit 20B was 392 lb (95% CI = 377–406), which was not significantly different from the 385 lb threshold ( $t = 0.93$ ,  $df = 55$ ,  $p = 0.36$ ) and was similar to the 2009 average mass of 373 lb (95% CI = 359–387). Because the average mass during 2017–2018 was not significantly different from the 385 lb threshold, the central Unit 20B moose population was likely at a relatively low to moderate nutritional level during that period. This conclusion is further supported by the fact that the upper end of the 95% CI was below the 410 lb threshold identified by Boertje et al. (2007) as indicative of high nutrition.

### *Recommendations for Activity 1.3*

Continue periodically weighing short yearlings in portions of Unit 20B as an additional nutritional index alongside twinning rates.

## 2. Mortality-Harvest Monitoring and Regulations

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

#### *Data Needs*

Harvest data are needed to ensure that harvest remains within sustainable yield and to determine whether the IM harvest objective has been met.

#### *Methods*

We estimated moose harvest by regulatory year using mandatory harvest report cards and reported potlatch harvest. Data from the harvest report cards were archived in databases on ADF&G's WinfoNet server. During RY15–RY19, this report's data came from general season harvest ticket hunts, the MFMA registration permit hunt, and FMA, Creamer's Field Migratory Waterfowl Refuge, and central and western Unit 20B antlerless drawing permit hunts. If timely harvest reports were not received, hunters received reminder letters (1 for general season hunters and 2 for permitted hunters), an e-mail (if the hunter provided an e-mail address), and, in some cases, a telephone call. Potlatch permittees received 1 or more reminder telephone calls. To assess harvest relative to the IM harvest objective, we compared the total annual reported harvest to the lower limit of the IM harvest objective.

We estimated accidental mortality from motor vehicles using records from the Alaska Department of Public Safety (Wendy Harris, Administrative Assistant, Department of Public Safety, Fairbanks, personal communication). These records likely underestimate mortality from motor vehicles because they include only animals that are documented as killed and reported to the Department of Public Safety. We estimated moose fatalities from train strikes using data from the Alaska Railroad (Beth Fleischer, Director Info Technology, Alaska Railroad, Anchorage, personal communication). Moose strikes that occurred between railroad mileposts 411.8 and 470 were located in Unit 20B.

#### *Results and Discussion*

##### Harvest by Hunters

During RY15–RY19, the total reported annual harvest, including potlatch harvest, averaged 613 moose (Table 4), below the previous 5-year average of 934 reported moose harvested annually. Of the reported moose harvested during the reporting period, 85% were bulls and 15% were cows. Reported harvest during the reporting period was within the IM harvest objective of 600–1,000 moose during RY15–RY17 but fell below the objective during RY18–RY19. Harvest declined during RY18–RY19, likely due to the shorter bull season in most of Unit 20B, which shifted from 1–20 September to 1–15 September beginning in RY18. Reported bull harvest (excluding potlatch harvest) averaged 589 bulls per year during RY15–RY17 and declined to an average of 401 bulls per year during RY18–RY19. Reported potlatch harvest remained relatively stable during the reporting period, averaging 11 per year, with an average of 47% females.

Within the FMA, general harvest averaged 22 bulls per year (Table 5), compared with the previous 5-year average of 21 bulls per year. Within the MFMA, general harvest averaged 56 bulls per year (Table 6), which was lower than the previous 5-year average of 65 bulls per year.

**Table 4. Reported moose mortality from hunter harvest, potlatch harvest, roadkill, and train strikes, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Regulatory year | Hunter harvest |        |     |       | Potlatch harvest |        |     |       | Total reported harvest | Reported roadkill <sup>a</sup> | Reported train fatalities |
|-----------------|----------------|--------|-----|-------|------------------|--------|-----|-------|------------------------|--------------------------------|---------------------------|
|                 | Male           | Female | Unk | Total | Male             | Female | Unk | Total |                        |                                |                           |
| 2015            | 635            | 139    | 1   | 775   | 2                | 8      | 0   | 10    | 785                    | 102                            | 0                         |
| 2016            | 610            | 91     | 0   | 701   | 7                | 7      | 1   | 15    | 716                    | 120                            | 6                         |
| 2017            | 522            | 82     | 1   | 605   | 6                | 1      | 1   | 8     | 613                    | –                              | 8                         |
| 2018            | 352            | 60     | 1   | 413   | 7                | 3      | 1   | 11    | 424                    | –                              | 3                         |
| 2019            | 450            | 65     | 0   | 515   | 4                | 7      | 0   | 11    | 526                    | 99                             | 5                         |

*Source:* Reported roadkill data obtained from the Alaska Department of Public Safety (Wendy Harris, Administrative Assistant, Department of Public Safety, Fairbanks, personal communication), and reported train fatality data obtained from the Alaska Railroad (Beth Fleischer, Director Info Technology, Alaska Railroad, Anchorage, personal communication).

<sup>a</sup> En dashes indicate that reported roadkill is not available for regulatory years 2017 and 2018.

**Table 5. Reported moose harvest and roadkill within the Fairbanks Management Area, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Regulatory year | General harvest |  | Draw permit |        |       | Total reported harvest | Reported roadkill |
|-----------------|-----------------|--|-------------|--------|-------|------------------------|-------------------|
|                 | Male            |  | Male        | Female | Total |                        |                   |
| 2015            | 18              |  | 3           | 30     | 33    | 51                     | 45                |
| 2016            | 24              |  | 2           | 13     | 15    | 39                     | 64                |
| 2017            | 24              |  | 2           | 44     | 46    | 70                     | –                 |
| 2018            | 17              |  | 2           | 31     | 33    | 50                     | –                 |
| 2019            | 25              |  | 3           | 33     | 36    | 61                     | 57                |

*Source:* Reported roadkill data obtained from the Alaska Department of Public Safety (Wendy Harris, Administrative Assistant, Department of Public Safety, Fairbanks, personal communication).

<sup>a</sup> En dashes indicate that reported roadkill is not available for regulatory years 2017 and 2018.

**Table 6. Reported moose harvest within the Minto Flats Management Area, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Regulatory year | General harvest |  | Draw permit |  | Registration permit |        | Total reported harvest |
|-----------------|-----------------|--|-------------|--|---------------------|--------|------------------------|
|                 | Male            |  | Male        |  | Male                | Female |                        |
| 2015            | 89              |  | 3           |  | 3                   | 35     | 130                    |
| 2016            | 61              |  | 1           |  | 5                   | 30     | 97                     |
| 2017            | 44              |  | 3           |  | 2                   | 27     | 76                     |
| 2018            | 46              |  | 2           |  | 1                   | 19     | 68                     |
| 2019            | 42              |  | 0           |  | 5                   | 21     | 68                     |

## Permit Hunts

### REGISTRATION HUNTS

An average of 404 moose registration permits was issued annually in Unit 20B during RY15–RY19 (Table 7). Of the registration permits issued during this reporting period, most (94%) were antlerless permits specific to the MFMA, while the remainder were bull muzzleloader permits (RM782) for the Middle Fork of the Chena River and upper Salcha River drainages. However, no moose were reported harvested under the RM782 permit. Harvest from the MFMA registration permits averaged 30 moose per year but decreased over the reporting period due to decreased harvest quotas. Of the reported total harvest, 89% were females (Table 7). The number of registration permits issued for the MFMA increased substantially beginning in RY12, when the permit switched from a limited to an unlimited registration.

### DRAWING HUNTS

An average of 300 drawing permits were issued annually in Unit 20B during RY15–RY19, but the number issued declined from 499 in RY15 to 199–218 per year in RY17–RY19 (Table 7). The number of permits issued declined after RY15 because the fall 2015 and 2017 unitwide population estimates were within or close to the IM population objective. The number of draw permits issued annually during RY15–RY19 was far below the average of 1,053 permits issued annually during RY10–RY14, a period when the population was above the IM population objective.

Of the draw permits issued during RY15–RY19, 139–161 draw permits were issued annually for the FMA, 50 for the Richardson Highway hunt (DM783), and 8 for the nonresident MFMA permit. For the remainder of Unit 20B, 280 antlerless draw permits were issued in RY15, 168 in RY16, and 0 in RY17–RY19. Annual harvest from draw permits averaged 33 moose in the FMA (Table 5), 2 in the MFMA (Table 6), 11 in the Richardson Highway hunt area, and 55 in the remainder of Unit 20B (specific to RY15–RY16, the years draw permits were issued within the Unit 20B remainder). These harvests correspond to average success rates of 30% in the FMA, 28% in the MFMA, 30% in the Richardson Highway hunt area, and 33% in the remainder of Unit 20B.

### TARGETED HUNTS

The Board of Game authorized a targeted moose hunt in Unit 20B beginning in RY14 to target injured moose and those near roadways. During RY15–RY19, 3 targeted permits were issued, resulting in 3 harvested moose (Table 7).

## Hunter Residency and Success

The number of Unit 20B general season hunters averaged 3,071 during RY15–RY17 and declined to an average of 2,368 during RY18–RY19 (Table 8). This decrease corresponded with the 5-day reduction in the September bull moose season across most of Unit 20B. Residents harvested 89% of the total moose harvested, and resident success rates averaged 17%, compared with a nonresident average of 32% (Table 8). The overall success rate was lowest in RY18, at 14%. RY18 had an extremely rainy September, which led to poor moose hunting success across many areas of Interior Alaska.

**Table 7. Moose harvest data by hunt type, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Hunt               | Regulatory year | Permits issued | Successful hunters (%) |       | Unsuccessful hunters (%) |      | Did not hunt (%) |      | Did not report | Bulls (%) |       | Cows (%) |       | Harvest          |
|--------------------|-----------------|----------------|------------------------|-------|--------------------------|------|------------------|------|----------------|-----------|-------|----------|-------|------------------|
| Drawing hunts      | 2015            | 499            | 113                    | (32)  | 242                      | (68) | 143              | (29) | 1              | 10        | (9)   | 103      | (91)  | 113              |
|                    | 2016            | 365            | 68                     | (26)  | 195                      | (74) | 101              | (28) | 1              | 9         | (13)  | 59       | (87)  | 68               |
|                    | 2017            | 199            | 60                     | (40)  | 89                       | (60) | 49               | (25) | 1              | 5         | (8)   | 55       | (92)  | 60               |
|                    | 2018            | 218            | 45                     | (30)  | 106                      | (70) | 67               | (31) | 0              | 5         | (11)  | 40       | (89)  | 45               |
|                    | 2019            | 218            | 49                     | (33)  | 101                      | (67) | 67               | (31) | 1              | 5         | (10)  | 44       | (90)  | 49               |
| General hunts      | 2015            | 3,215          | 624                    | (19)  | 2,591                    | (81) | –                | –    | –              | 622       | (100) | 1        | (<1)  | 624 <sup>a</sup> |
|                    | 2016            | 3,068          | 596                    | (19)  | 2,472                    | (81) | –                | –    | –              | 595       | (100) | 1        | (<1)  | 596              |
|                    | 2017            | 2,929          | 516                    | (18)  | 2,413                    | (82) | –                | –    | –              | 515       | (100) | 0        | (0)   | 516 <sup>a</sup> |
|                    | 2018            | 2,417          | 347                    | (14)  | 2,070                    | (86) | –                | –    | –              | 346       | (100) | 0        | (0)   | 347 <sup>a</sup> |
|                    | 2019            | 2,319          | 440                    | (19)  | 1,879                    | (81) | –                | –    | –              | 440       | (100) | 0        | (0)   | 440              |
| Registration hunts | 2015            | 471            | 38                     | (19)  | 157                      | (81) | 264              | (56) | 12             | 3         | (8)   | 35       | (92)  | 38               |
|                    | 2016            | 561            | 35                     | (13)  | 242                      | (87) | 270              | (48) | 14             | 5         | (14)  | 30       | (86)  | 35               |
|                    | 2017            | 375            | 29                     | (19)  | 120                      | (81) | 223              | (59) | 3              | 2         | (7)   | 27       | (93)  | 29               |
|                    | 2018            | 301            | 20                     | (15)  | 112                      | (85) | 166              | (55) | 3              | 1         | (5)   | 19       | (95)  | 20               |
|                    | 2019            | 312            | 26                     | (19)  | 113                      | (81) | 171              | (55) | 2              | 5         | (19)  | 21       | (81)  | 26               |
| Targeted hunts     | 2015            | 0              | –                      | –     | –                        | –    | –                | –    | –              | –         | –     | –        | –     | 0                |
|                    | 2016            | 2              | 2                      | (100) | 0                        | (0)  | 0                | (0)  | 0              | 1         | (50)  | 1        | (50)  | 2                |
|                    | 2017            | 0              | –                      | –     | –                        | –    | –                | –    | –              | –         | –     | –        | –     | 0                |
|                    | 2018            | 1              | 1                      | (100) | 0                        | (0)  | 0                | (0)  | 0              | 0         | (0)   | 1        | (100) | 1                |
|                    | 2019            | 0              | –                      | –     | –                        | –    | –                | –    | –              | –         | –     | –        | –     | 0                |

*Note:* En dashes indicate no data available.

<sup>a</sup> Harvest includes 1 moose of unknown sex.

**Table 8. Moose hunter residency and success, general season, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Regulatory year | Successful |             |         |       | Unsuccessful |             |         |       | Total hunters |
|-----------------|------------|-------------|---------|-------|--------------|-------------|---------|-------|---------------|
|                 | Resident   | Nonresident | Unknown | Total | Resident     | Nonresident | Unknown | Total |               |
| 2015            | 549        | 74          | 1       | 624   | 2,458        | 124         | 9       | 2,591 | 3,215         |
| 2016            | 529        | 66          | 1       | 596   | 2,321        | 144         | 7       | 2,472 | 3,068         |
| 2017            | 456        | 60          | 0       | 516   | 2,269        | 132         | 12      | 2,413 | 2,929         |
| 2018            | 315        | 32          | 0       | 347   | 1,970        | 96          | 4       | 2,070 | 2,417         |
| 2019            | 400        | 38          | 2       | 440   | 1,794        | 85          | 0       | 1,879 | 2,319         |

*Note:* Table excludes ceremonial harvest and harvest by drawing, registration, and target-permit hunters.

### Harvest Chronology

Harvest chronology for moose harvested under the general season varied during RY15–RY19 because the bull season was shortened by 5 days in portions of Unit 20B beginning in RY18. During RY15–RY17, an average of 24% of the harvest occurred during 11–15 September, and an average of 27% occurred during 16–20 September (Table 9). However, during RY18–RY19, the harvest peak shifted earlier, with an average of 26% occurring during 6–10 September and 32% during 11–15 September. Between 3–4% of the unitwide general harvest was taken during the August MFMA hunt, while 5–7% of the unitwide harvest occurred during the last 5 days of the season in areas open until 25 September.

**Table 9. Moose harvest chronology percentage by month and day, Unit 20B, Interior Alaska, regulatory years 2015–2019.**

| Regulatory year | Aug 21–27 | Sep 1–5 | Sep 6–10 | Sep 11–15 | Sep 16–20 | Sep 21–25 | Unknown and other | <i>n</i> |
|-----------------|-----------|---------|----------|-----------|-----------|-----------|-------------------|----------|
| 2015            | 4         | 17      | 18       | 25        | 27        | 5         | 3                 | 624      |
| 2016            | 3         | 17      | 19       | 24        | 28        | 7         | 2                 | 596      |
| 2017            | 3         | 23      | 16       | 22        | 27        | 6         | 3                 | 516      |
| 2018            | 4         | 22      | 26       | 32        | 8         | 5         | 3                 | 347      |
| 2019            | 4         | 19      | 26       | 31        | 10        | 7         | 3                 | 440      |

*Note:* Table excludes ceremonial, drawing, registration, and target hunt harvest. Percentages may not total 100% due to rounding.

### Transport Methods

As in prior reporting periods, the most commonly used transportation method among successful general-season moose hunters in Unit 20B during RY15–RY19 was 4-wheelers (36%), followed by boats (25%) and highway vehicles (22%).

### *Other Mortality*

Due to the relatively high human population, moose densities, and road densities in Unit 20B, substantial numbers of moose are reported killed by motor vehicle collisions. Roadkill data were incomplete for RY17–RY18, but reported unitwide roadkill averaged 107 per year during RY15,

RY16, and RY19 (Table 4). Over half of this roadkill was reported within the FMA, which averaged 55 roadkill per year during the same 3 regulatory years (Table 5). This was similar to the previous 5-year average of 61 roadkill per year within the FMA. The reported FMA roadkill during RY15, RY16, and RY19 was greater than the reported average harvest during the same period, which was 50 moose per year. Reported moose kills from train strikes remained relatively low during RY15–RY19 and averaged 4 per year (Table 4).

#### *Alaska Board of Game Actions and Emergency Orders*

Other than annual antlerless hunt reauthorizations, the Board of Game took no action to change Unit 20B moose hunting regulations during RY15–RY19. However, in spring 2020, the Board of Game adopted several proposals that affected Unit 20B moose hunting regulations beginning in RY20. First, the Board of Game adopted a proposal that shortened the general bull moose season in the Unit 20B remainder by 5 days, from 1–20 September to 1–15 September. Second, the Board of Game changed the nonresident bag limit within the Unit 20B remainder from 1 bull to 1 bull with 50-inch antlers or 4 or more brow tines on at least 1 side. Finally, the Board of Game eliminated the RM782 muzzleloader registration permit.

ADF&G issued several emergency orders (EOs) during RY15–RY19 that affected Unit 20B moose hunting regulations. We issued annual EOs to close the MFMA antlerless moose registration hunt (RM785) once the quota was met. In addition, based on low bull-to-cow ratio estimates from the fall 2017 Unit 20B moose survey, we issued EOs before the RY18 and RY19 fall moose seasons to shorten the bull moose season in the Unit 20B remainder by 5 days, from 1–20 to 1–15 September.

#### *Recommendations for Activity 2.1*

Continue.

### 3. Habitat Assessment-Enhancement

#### ACTIVITY 3.1. Assess habitat condition (G1).

##### *Data Needs*

Estimates of moose nutritional condition and productivity are integral to management goal G1, which is to protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem. Moose browse removal is an index of moose nutritional condition and can substantiate nutritional condition based on twinning rate estimates (Boertje et al. 2007).

##### *Methods*

No moose browse removal surveys were conducted during RY15–RY19. The plan, as described in Hollis (2018), was to conduct a browse study in the MFMA if the IM population objective had been met for several years and twinning rates had fallen below 20% for 3 consecutive years.

### *Results and Discussion*

Although the unitwide population estimate was close to or within the IM population objective in RY15 and RY17, MFMA twinning rates did not remain below 20% for 3 consecutive years. Therefore, we did not conduct a browse survey during RY15–RY19.

#### *Recommendations for Activity 3.1*

Continue to retain this activity as a potential additional index to substantiate twinning rate estimates of moose nutritional condition.

## **NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS**

As in past reporting periods, moose management within the FMA remained a challenge during RY15–RY19. The number of moose reported killed by motor vehicles continued to be as high as or higher than the number reported harvested by hunters. Furthermore, moose-human conflicts were common; ADF&G often received complaints from the public about aggressive moose in urban areas, moose in gardens or fenced yards, and injured moose. During the next reporting period, managers should focus on additional ways to reduce moose-vehicle collisions and mitigate moose-human conflicts.

Ceremonial and potlatch moose harvest remains an important cultural practice for some residents of Unit 20B and the surrounding area, and it is important to account for this harvest when assessing harvestable surplus. Although poor reporting rates among potlatch permittees have been an issue in previous reporting periods, they improved in this period, especially during RY16–RY19. During RY15–RY19, a total of 211 potlatch permits were issued for moose, and the specified hunting area included Unit 20B (many included additional units as well). Of these, 190 (90%) were reported. The reporting rate increased from 76% in RY15 to 93% during RY16–RY19.

### Data Recording and Archiving

Harvest data and GSPE survey data are stored in WinfoNet. Survey memos and other pertinent electronic survey information (e.g., survey maps) are also archived in WinfoNet. All other electronic files, including survey memos, reports, and maps, are stored on the Fairbanks server. All hard copy data sheets, paper files, and other physical files are stored in the Fairbanks Area Biologist's or Assistant Area Biologist's office.

### Agreements

There were no agreements with other agencies that pertained to Unit 20B moose management.

### Permitting

ADF&G Animal Care and Use Committee Unit 20B moose capture protocols 0011-2017-11 and 0011-2018-18 were in effect during RY15–RY19.

## **Conclusions and Management Recommendations**

ADF&G met the IM population and harvest objectives (C1–C4) during portions of RY15–RY19. Although the RY15 unitwide midpoint population estimate was just below the lower bounds of the IM population objective, the RY17 estimate was within the IM objective. We did not conduct unitwide surveys during RY16 or RY18–RY19, so we could not assess population size relative to the IM population objective in those years. Reported moose harvest met the IM harvest objective during RY15–RY17 but not during RY18–RY19, when antlerless and bull harvest opportunities were reduced compared with RY15–RY17. It is unlikely we can achieve the IM harvest objective while maintaining bull-to-cow ratios above management objectives unless we provide additional antlerless harvest opportunity.

The unitwide bull-to-cow ratio management objective (M1) was not met in RY15, and neither the unitwide nor the count area (except eastern 20B) management objectives were met in RY17 or RY19 (the MFMA was the only area surveyed in RY19). In response to the RY17 survey results, we shortened the bull moose season throughout most of Unit 20B by 5 days, beginning in RY18. In conjunction with this change, reported bull moose harvest declined in RY18 and RY19; thus, we expect improvement in bull-to-cow ratios by the next unitwide survey.

Despite the reduction in the unitwide population from the peak of >20,000 moose in RY09 to approximately 11,000–13,000 moose during RY15–RY19, moose nutritional levels remain a concern in portions of Unit 20B. Twinning rates and short-yearling weights collected in the MFMA, along with short-yearling weights collected in central Unit 20B, suggest that both areas have low to moderate moose nutritional levels. Continued conservative antlerless moose harvest of  $\leq 1\%$  of the prehunt moose population will be important to maintain the population within the IM population objective and, hopefully, improve nutritional indices. Furthermore, a limited antlerless harvest provides additional harvest opportunity and can help achieve the IM harvest objective.

## **II. Project Review and RY20–RY24 Plan**

### **Review of Management Direction**

#### **MANAGEMENT DIRECTION**

There are no changes to the management direction for Unit 20B moose during RY20–RY24.

#### **GOALS**

No change from the RY15–RY19 reporting period.

## **CODIFIED OBJECTIVES**

### Amounts Reasonably Necessary for Subsistence Uses

The Unit 20B moose population outside of the Fairbanks nonsubsistence area has a positive customary and traditional use finding, as determined by the Board of Game, for the following ANS uses.

- C1. Unit 20B, that portion outside the MFMA: 75–100 moose.

This objective will be considered met if 4% of the midpoint-estimated population size within this portion of Unit 20B is greater than or equal to the lower threshold of 75 moose. This objective will be assessed following every unitwide population survey.

- C2. Unit 20B, that portion within the MFMA: 20–40 moose.

This objective will be considered met if 4% of the midpoint-estimated population size within this portion of Unit 20B is greater than or equal to the lower threshold of 20 moose. This objective will be assessed following every MFMA population survey.

### Intensive Management

The Unit 20B moose population is identified by the Board of Game as important for providing high levels of harvest for human consumptive use and has the following IM objectives.

- C3. Population objective of 12,000–15,000 moose.

This objective will be considered met if the midpoint of the unitwide moose population estimate falls between 12,000 and 15,000 moose. This objective will be assessed after each unitwide survey.

- C4. Harvest objective of 600–1,500 moose.

This objective will be considered met if the reported harvest (including the reported potlatch harvest) is between 600 and 1,500 moose. This objective will be assessed annually.

## **MANAGEMENT OBJECTIVES**

- M1. Manage for a posthunting sex ratio of  $\geq 30$  bulls:100 cows unitwide and  $\geq 20$  bulls:100 cows in each count area (i.e., eastern Unit 20B, central Unit 20B, western Unit 20B, and the MFMA).

This objective will be considered met if the midpoint bull-to-cow ratio estimate (determined annually for each surveyed area) exceeds the target post-hunting ratio.

- M2. Manage for population stability or growth when the 3-year average twinning rate is  $>20\%$  and manage for population stability or reduction when the 3-year average twinning rate is  $\leq 20\%$ , contingent on a secondary measure of nutritional status.

The following signals could be used to substantiate low twinning-based 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).

This is a new objective for RY20–RY24 and is intended to serve as a measurable objective to meet goal G1, which relates to the moose population and its habitat.

## **REVIEW OF MANAGEMENT ACTIVITIES**

### **1. Population Status and Trend**

ACTIVITY 1.1. Conduct Geospatial Population Estimator surveys to estimate population abundance and composition (objectives C1, C2, C3, C4, and M1).

#### *Data Needs*

No change from the RY15–RY19 reporting period.

#### *Methods*

Methods will follow those described during RY15–RY19, with some additions. First, our goal will be to complete unitwide population surveys every other year (alternating with Unit 20A population surveys), or at least 2 unitwide population surveys during RY20–RY24. Depending on management needs, we may conduct additional surveys of subsections of Unit 20B (e.g., the MFMA or FMA) between unitwide surveys. Second, we will attempt to measure sightability via sightability trials. Third, our relative precision (RP) goal for the unitwide observable moose population estimate will be within 10–15% of the average at the 90% CI, and for composition estimates (calf-to-cow and bull-to-cow ratios) within 20–30% of the average at the 90% CI. When corrected for sightability, our desired RP for the unitwide moose population estimate will be within 15–20% of the average at the 90% CI. We will use biometric assistance to evaluate both the sample size and the proportion of SUs allocated to high strata before each survey.

ACTIVITY 1.2. Spring twinning surveys (objective M2).

#### *Data Needs*

No change from the RY15–RY19 reporting period.

#### *Methods*

No change from the RY15–RY19 reporting period, except that we will also attempt twinning surveys in central Unit 20B.

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

#### *Data Needs*

Estimates of moose nutritional condition and productivity are integral to management goal G1, which is to protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem. Short-yearling mass is an index of moose nutritional

condition and can substantiate nutritional condition based on twinning rate estimates (Boertje et al. 2007).

Twinning rate estimates in the MFMA remained at relatively low to moderate levels during RY15–RY19, and short-yearling mass estimates remained below the 385 lb threshold identified by Boertje et al. (2007) as indicative of low nutrition. Therefore, additional short-yearling mass samples in the MFMA should be collected during RY20–RY24 to substantiate twinning rate estimates of nutritional condition. Furthermore, if twinning rate estimates in central Unit 20B indicate low to moderate nutrition, short-yearling mass estimates in that portion of Unit 20B would also be helpful in assessing nutritional condition. Alternatively, if we cannot obtain adequate twinning survey sample sizes in central Unit 20B, short-yearling mass estimates would be another option for estimating nutritional condition.

### *Methods*

ADF&G staff will collect multi-year (minimum of 2 years) short-yearling weights in the MFMA and, if needed (i.e., for low-to-moderate twinning rate estimates), in central Unit 20B as well. We will consult biometric staff before conducting captures to determine appropriate sample sizes. To assess nutritional status, we will compare the multi-year mean short-yearling mass (with 95% CI) to the 385 lb and 410 lb thresholds identified by Boertje et al. (2007). We will also compare the multi-year mean mass with the mean mass from previous data collection periods to assess changes between periods.

## 2. Mortality-Harvest Monitoring

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

### *Data Needs*

No change from the RY15–RY19 reporting period.

### *Methods*

No change from the RY15–RY19 reporting period.

## 3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Assess habitat condition (objective M2).

### *Data Needs*

No change from the RY15–RY19 reporting period.

We will consider conducting a browse survey in portions of Unit 20B 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 ADF&G biometricians will review sampling design. We will solicit input from biometricians to verify and, if needed, refine the methods before conducting this activity, ensuring that high scientific standards are maintained in both the methods and the interpretation of results.

## **NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS**

To track nonhunting human-caused mortality, we will continue to work with the Alaska Department of Public Safety to collect roadkill reports and with the Alaska Railroad to collect train strike reports. Furthermore, to aid moose management in the FMA and the broader Unit 20B, we will conduct an analysis assessing the effects of moose harvest, specifically harvest from antlerless draw hunts in the FMA and along the Richardson Highway, on reported roadkill. Additionally, we will focus on other measures, such as habitat management, to reduce moose-vehicle collisions and mitigate moose-human conflicts. Finally, we will continue to work on maintaining and improving ceremonial and potlatch harvest reporting to accurately account for this harvest when assessing sustainable yield.

## Data Recording and Archiving

No change from the RY15–RY19 reporting period.

## Agreements

None.

## Permitting

None identified, except the required approved Institutional Animal Care and Use Committee permits for conducting captures.

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