Species Management Report and Plan ADF&G/DWC/SMR&P–2023–24

Moose Management Report and Plan, Game Management Unit 12:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

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Alaska Department of Fish and Game Division of Wildlife Conservation

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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 Caikoski, Management Coordinator 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 Unit 12 for the 5 regulatory years 2015–2019 and plans for survey and inventory management activities in the following 5 regulatory years, 2020–2024. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY15 = 1 July 2015–30 June 2016). This report is produced primarily to provide agency staff with data and analysis to help guide and record agency efforts but is also provided to the public to inform it of wildlife management activities. In 2016 the Alaska Department of Fish and Game's (ADF&G, the department) Division of Wildlife Conservation (DWC) launched this 5-year report to more efficiently report on trends and to describe potential changes in data collection activities over the next 5 years. It replaces the moose management report of survey and inventory activities that was produced every 2 years prior to 2016.

I. RY15–RY19 Management Report

Management Area

Unit 12 is in east central Alaska bounded by the Canada border on the east and is centered on lat 62°34′N, long 142°7′W. Major drainages within the unit include the Nabesna and Chisana drainages, which combine to form the Tanana River. Unit 12 encompasses 9,975 square miles, of which approximately 6,000 square miles, or that portion at or below 4,500 feet in elevation, is generally considered suitable moose habitat. Elevations within the unit range from 1,500 feet along the Tanana River to more than 12,000 feet in the Wrangell, Nutzotin, and Mentasta mountains. Much of the northeastern portion of the unit (e.g., Tetlin National Wildlife Refuge) is dominated by lowland shrub and sedge meadows, wetlands, mature black (*Picea mariana*) and white (*Picea glauca*) spruce forest, and recently burned areas dominated by shrubs and early successional forest species. The western and southern portions of the unit include more mountainous areas dominated by spruce forest in the lowland valleys transitioning to shrub communities, subalpine and alpine tundra, and glaciated areas at the higher elevations. The climate is typical of Interior Alaska, where temperatures frequently reach 80°F in summer and −40°F in winter.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 12

Similar to other areas in Alaska, the Unit 12 moose population experienced wide fluctuations in size from the 1950s to the 2020s. Moose abundance was estimated to be high in Unit 12 during the 1950s through the mid-1960s and declined rapidly during the mid-1960s through mid-1970s (Kelleyhouse 1989). The moose population increased in portions of northwest Unit 12 during the 1980s and 1990s, likely partially a result of the 155 square mile Tok River wildfire in 1990 (Gardner 1998). From the early 2000s through RY14, the Unit 12 moose population likely remained relatively stable, although moose densities varied throughout the unit. Moose density estimates during RY10–RY14, which was the first reporting period in which all areas with suitable moose habitat within the unit were surveyed, ranged from a low of 0.41 moose/mi^2 within the Chisana survey area to 1.13 moose/mi^2 within the northwestern Unit 12 survey area

(Wells 2018). The unitwide moose population estimate during RY10–RY14 was 4,492–6,444 moose, or approximately 0.75–1.07 moose/mi^2 of moose habitat (Wells 2018).

In response to low population numbers and/or low bull-to-cow ratios, portions of Unit 12 were closed to moose hunting during RY75–RY81 and RY86–RY90. All of Unit 12 was open to moose hunting beginning in RY91, when most of the unit was open for a 15-day any-bull resident season and a 10-day, antler-restricted, nonresident season. Since then, most of the unit has retained a 15-day season for residents, although it was split into a 5-day late-August season and 10-day September season in RY01, and season dates were modified along the Nabesna Road in RY12. Antler restrictions for both residents and nonresidents have been in place within portions of the Tok River drainage since RY93 and in the Nabesna Road vicinity since RY12. Finally, the southeastern portion of the unit has retained a 1–30 September season with an antler restriction for more than 30 years. The total number of hunters and harvest generally remained stable during RY01–RY14.

Since the early 1980s, ADF&G has initiated several efforts, including predator control and habitat enhancement, to increase portions of the Unit 12 moose population and/or harvest. The most recent of these efforts included wolf (*Canis lupus*) control in northern Unit 12 during RY04–RY13 as part of the upper Yukon-Tanana predator control program (ADF&G 2014), scarification in timber harvest areas to improve habitat during RY09–RY12 (Wells 2014), and roller chopping to improve habitat within the lower Tok River valley that began in RY14 (Wells 2018). In addition to potentially benefitting from these efforts, Unit 12 moose also likely benefitted from large wildfires during 2004 that burned approximately 434 square miles within northern portions of the unit.

Management Direction

Existing Wildlife Management Plans

Unit 12 plans for moose survey and inventory management activities for RY15–RY19 were outlined in Wells (2018). Other than Wells (2018), no other wildlife management plans specific to Unit 12 moose exist. Direction in the Yukon-Tanana, Sixtymile Butte, and Little Tok moose management plans (ADF&G 1976) has been modified by Alaska Board of Game regulatory actions and ADF&G moose management reports over the years.

Goals

During RY15–RY19 (and since RY89), the Unit 12 moose management goals were as follows:

G1. Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.

G2. Continue sustained opportunity for subsistence use of moose.

G3. Maximize sustained opportunities to participate in hunting moose.

G4. Maximize opportunities for nonconsumptive use of moose.

Codified Objectives

Amounts Reasonably Necessary for Subsistence Uses

C1. The Unit 12 moose population has a positive customary and traditional use finding, as determined by the Board of Game, with an amounts reasonably necessary (ANS) for subsistence uses of 60–70 moose (5 AAC 99.025 (8)).

a. During this reporting period, this objective was considered to be met if 4% of the midpoint unitwide prehunt moose population estimate (estimated once during the 5-year report period) was greater than or equal to the lower threshold of ANS (60 moose; Wells 2018).

Intensive Management

The Unit 12 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 intensive management (IM) objectives (5 AAC 92.108):

C2. Population objective: 4,000–6,000 moose.

a. This objective was considered to be met if the midpoint unitwide prehunt moose population estimate (estimated once during the 5-year report period) was greater than or equal to the lower threshold of the IM population objective (4,000 moose; Wells 2018).

C3. Harvest objective: 250–450 moose annually.

a. This objective was considered to be met if the 3-year mean reported harvest was greater than or equal to the lower threshold of the IM harvest objective (250 moose; Wells 2018).

Management Objectives

During RY15–RY19, the Unit 12 moose management objective was:

M1. Maintain a minimum posthunting sex ratio of ≥40 bulls:100 cows east of the Nabesna River and ≥25 bulls:100 cows in the remainder of the unit.

a. This objective was considered to be met if the midpoint bull-to-cow ratio estimate (determined annually for each area surveyed) was greater than or equal to the objective (Wells 2018).

Additional information on the recent history and modifications of these objectives can be found in Wells (2018).

Management Activities

1. Population Status and Trend

Activity 1.1. Conduct GeoSpatial Population Estimator (GSPE) surveys to estimate population abundance and composition (objectives C1, C2, M1).

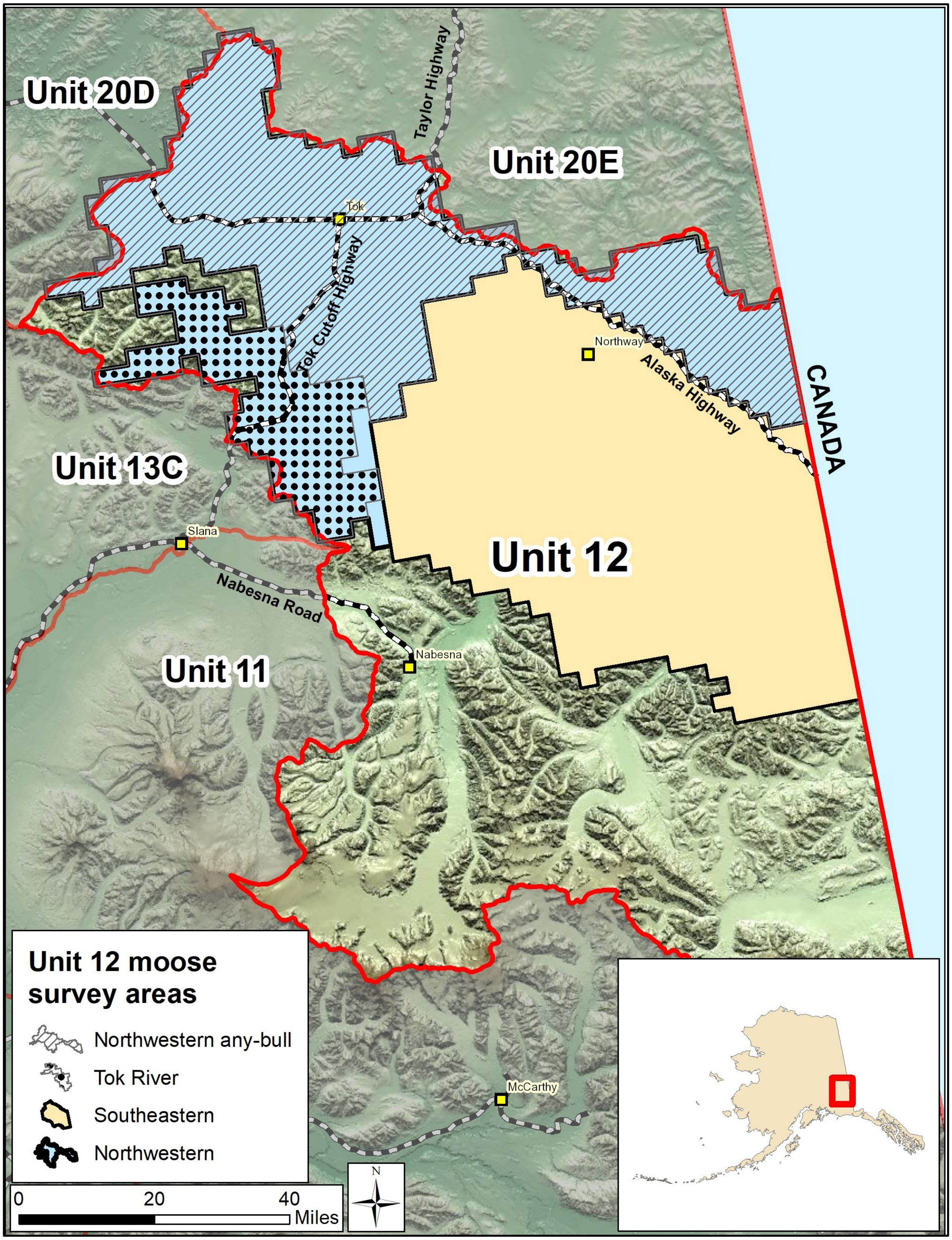
Data Needs

Estimates of population abundance and composition are important components of moose management. Population abundance estimates are necessary to track progress towards meeting IM population objectives and ANS thresholds, 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, the composition data are used to assess calf recruitment to fall (calf-to-cow ratio), which can be an indication of predation pressure if production is also measured.

Methods

Moose abundance and composition were estimated in portions of Unit 12 during RY15–RY19 using the GSPE method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). The specific areas surveyed generally followed the plan outlined in Wells (2018), which called for 2 surveys of the entire northwestern Unit 12 survey area and 2 surveys of the condensed northwestern Unit 12 survey area. However, budget constraints and changes in management priorities and issues resulted in differences between the plan and what was actually completed during RY15–RY19. Areas surveyed included the Tok River, 576-square-mile survey area in RY16; the northwestern Unit 12, 2,782-square-mile survey area in RY17; and a condensed portion of northwestern Unit 12, a 2,108-square-mile survey area in RY18 (Fig. 1). In addition, the Tetlin National Wildlife Refuge (NWR) surveyed the 2,948–2,997 square mile southeastern Unit 12 survey area in RY17 and RY19.

The desired relative precision (RP) was within 15–20% of the mean at the 90% confidence interval (CI) for all survey areas and observable moose population estimates. For composition estimates (calf-to-cow and bull-to-cow ratios), the desired RP was within 20–30% of the mean at the 90% CI. Sample units (SU) in all survey areas were stratified as high stratum if they were likely to contain >3 moose. During each survey, survey conditions for each SU completed were rated as either poor, fair, good, or excellent based upon snow (age and cover), light (intensity and type), and wind (strength and turbulence). Unless noted otherwise, all surveys were completed using PA-18 Piper Super Cub aircraft. The target search intensity was 6.7 minutes/mi^2, or approximately 40 minutes of survey time in SUs with 100% moose habitat. Survey crews recorded GPS waypoints for all groups of moose observed, and these waypoints were primarily used to assess SU stratification following the completion of each survey. Population and ratio estimates (along with 90% confidence intervals) were calculated using ADF&G's Wildlife Information Network (WinfoNet) GSPE software (DeLong 2006).



Produced by ADF&G using ArcGIS™ software (Esri, Redlands, California); base map source: ADFG, GINA (UAF), USGS.

Figure 1. Moose survey areas in Unit 12, Interior Alaska, regulatory years 2015–2019.

Population trend was analyzed using ADF&G's WinfoNet Trend Analysis software (Delong and Taras 2009). Trend was analyzed by using estimated population densities (as opposed to abundance estimates) due to slight variations in survey area size over time.

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

<u>RY15</u>

No surveys completed due to inadequate snow conditions.

<u>RY16</u>

The original plan for RY16 was to survey the entire northwestern Unit 12 survey area. However, adequate survey conditions did not exist until early December, at which point it was deemed too late to sample an adequate number of SUs within the entire northwestern Unit 12 survey area. Therefore, the survey area was refined to the upper Tok River drainage in order to obtain data related to a proposal (#89) to the Board of Game that was deliberated in February 2017.

The GSPE method was used to survey 50 (32 high stratum and 23 low stratum) of 95 SUs in the Tok River survey area during 5–7 December. A simple random sample of 30 SUs (20 high density and 10 low density) were selected using Microsoft Excel software, and an additional 5 SUs (2 high density and 3 low density) were selected to fill gaps in randomized coverage. The RP goals (for both the population and composition estimates) were not met following completion of the 35 SUs; therefore, an additional 15 SUs were selected for sampling (10 high density and 5 low density; all randomly selected).

Overall, survey conditions were good with moderate snow cover, relatively fresh snow (approximately 3–4 inches of snow fell throughout the survey area on 2–3 December), and heavy frost covering trees and brush in most of the survey area. Survey conditions were generally poorer in the southern portion of the survey area, where strong winds had created more patchy snow cover and had resulted in little frost remaining on trees and brush. Survey conditions were reported as excellent (30%), good (63%), or fair (7%; survey conditions were not reported for 2 SUs). Search time per SU with 100% moose habitat averaged 6.7 min/mi^2 (n = 5), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 7.3 min/mi^2. Total flight time (including ferry time) was 31.9 hours.

<u>RY17</u>

The GSPE method was used to survey 80 (50 high stratum and 30 low stratum) of 462 SUs in the northwestern Unit 12 survey area during 26–30 November. The survey area was slightly expanded in RY17 from the 2,702 square miles used since RY06 to fill in holes between the southeastern and northwestern Unit 12 survey areas. In addition, several SUs that contained small amounts of moose habitat in mountainous areas and were inadvertently left out of the previous survey area were added. Prior to selecting SUs, a restratification flight was conducted over a portion of upper Mansfield Creek (13 SUs) and a large portion of Gardner Creek flats (45 SUs). Portions of both of these areas burned during 2004 and 2005 wildfires, and stratification errors occurred during the 2012 survey. Upon completion of the restratification flight, a simple random sample of 68 SUs (45 high density and 23 low density) were selected using Microsoft

Excel software, and an additional 12 SUs (5 high density and 7 low density) were selected to fill gaps in randomized coverage. The ratio of high-to-low density nonrandomly selected SUs was similar to the ratio of high-to-low density SUs in the study area as a whole (42% high density and 58% low density).

Overall, survey conditions were good with high amounts of frost on trees and brush throughout much of the survey area and complete snow cover, although the snow was over 1 week old (fresh snow fell during 16–17 November). Survey conditions were reported as excellent (58%), good (39%), or fair (3% survey conditions were not reported for 4 SUs). SUs were rated as fair due to poor lighting (1 with low light and 1 with bright sunshine). Search time per SU with 100% moose habitat (n = 43) averaged 6.7 min/mi^2 and overall search time after considering the estimated proportion of moose habitat in each SU averaged 7.5 min/mi^2. Total flight time, including ferry time, was 66.1 hours, of which 5.2 hours was for the stratification flight.

Tetlin NWR staff conducted a GSPE moose survey within the southeastern Unit 12 survey area during 1–30 November (unpublished U.S. Fish and Wildlife Service Refuge Report, May 2018, obtained from Bryce Woodruff, Tetlin National Wildlife Refuge, Tok, Alaska).

RY18

The GSPE method was used to survey the 2,108 square mile portion of the northwestern Unit 12 survey area that had an any-bull resident moose bag limit because the 2017 estimated bull-to-cow ratio of 28:100 (90% CI ± 29%) within this area was close to the minimum management objective. Therefore, the primary survey objective for RY18 was to obtain another estimated bull-to-cow ratio within this area, with the secondary objective to estimate the calf-to-cow ratio and population size. Of the 351 SUs in the survey area, 80 (23%) were selected for sampling (48 high stratum and 32 low stratum SUs) and were surveyed during 27 November–7 December. Unlike previous surveys, where a portion of the SUs were selected randomly and the remainder were selected nonrandomly to fill gaps in the randomized coverage, all the RY18 SUs were selected randomly in order to enable a design-based estimate of composition with the potential for increased precision.

Overall, survey conditions were good to excellent with large amounts of frost on the brush and trees, and complete and relatively fresh snow cover. According to the National Oceanic and Atmospheric Administration (NOAA) Alaska snow depth website (National Weather Service 2018), total snow depth at the initiation of the survey on 27 November was 7 and 8 inches in Tok and Northway, respectively. An additional 3 inches fell on 29 November in both Tok and Northway. Snow cover within surveyed SUs was reported as complete (71%) or "some low vegetation showing" (29%; snow conditions were not reported for 2 SUs). Survey conditions were reported as excellent (52%), good (44%), or fair (4%; survey conditions were not reported for 10 SUs). All the SUs rated as fair were comprised of subalpine habitat with relatively low snow cover due to wind. Search time per SU with 100% moose habitat (n = 59) averaged 6.7 min/mi^2 and overall search time after considering the estimated proportion of moose habitat in each SU averaged 6.8 min/mi^2. Total flight time, including ferry time, was 70.3 hours.

RY19

ADF&G staff did not conduct any moose surveys in Unit 12 during RY19. However, Tetlin NWR staff conducted a GSPE moose survey within the southeastern Unit 12 survey area during 30 October–26 November (unpublished U.S. Fish and Wildlife Service Refuge Report, April 2020, obtained from Bryce Woodruff, Tetlin National Wildlife Refuge, Tok, Alaska).

Unitwide population estimate

In order to compare population estimates to the Unit 12 intensive management population objective, the following equation was used to estimate a probable moose population range for all of Unit 12 during this report period:

$Pop_{12} = Pop_{NW/SE} + Pop_{Nabesna} + Pop_{hisana} + MeanHarvest$

Where

Pop_{12} = Observable moose population estimate (along with an estimated plausible range) for Unit 12 during RY15–RY19.

$Pop_{NW/SE}$ = Midpoint observable moose population estimate (and 90% CI) for the combined northwestern and southeastern survey areas (5,681 mi^2) during 2017.

$Pop_{Nabesna}$ = Midpoint observable moose population estimate (and 90% CI) in the 642 mi^2 portion of the Nabesna Road survey area located within Unit 12 during 2011. Only that portion of the survey area that did not include any area of overlap with the northwestern or southeastern Unit 12 survey areas was used.

$Pop_{Chisana}$ = Midpoint observable moose population estimate (and 90% CI) in the 1,311 mi^2 portion of the Chisana survey area located within Unit 12 during 2014. Only that portion of the survey area that did not include overlap with the southeastern Unit 12 or Nabesna Road survey areas was used.

MeanHarvest = Average annual total reported moose harvest during RY15–RY19.

Although the total square mileage of these areas exceeds the estimated 6,000 square miles of moose habitat in Unit 12, portions of each survey area include nonmoose habitat.

Results and Discussion

The Unit 12 moose IM population objective was achieved during RY15–RY19. The unitwide prehunt observable moose population estimate during RY15–RY19 was 6,542 (1.09 moose/mi^2 of estimated moose habitat) with an estimated range of 5,427–7,657 moose (0.90–1.28 moose/mi^2 of estimated moose habitat). The midpoint estimate was greater than the lower bounds of the IM population objective of 4,000, which was the decision criteria used to determine whether the objective was achieved. However, it is important to note that the population estimate was also greater than the upper bounds of the objective (6,000 moose), although the plausible range of the unitwide population estimate overlaps with the range of the IM population objective. Several caveats should be noted in regard to the unitwide population estimate. First, this estimate includes information from several surveys conducted over multiple years, including years prior to this reporting period (26% of areas included in the estimate were from RY10–RY14). Furthermore, a Unit 12 sightability correction factor is not available. Therefore, this estimate should be considered a minimum approximation of the Unit 12 moose population.

Since each survey area was surveyed 0–2 times during RY15–RY19, it is not possible to determine population trend specific to this RY15–RY19 period. However, long term population trend can be assessed in the northwestern and southeastern Unit 12 survey areas, which were surveyed every 1–5 years during RY01–RY19. There was a statistically significant (*P-value* = 0.01) increasing linear trend in the northwestern Unit 12 survey area estimated moose densities between RY01–RY17 (n = 7 surveys). Moose densities during this time period increased at an average annual rate of 0.04 moose/mi^2 (95% CI = 0.01–0.07 moose/mi^2). There is also some evidence that there was an increasing linear trend in the southeastern Unit 12 survey area estimated moose densities between RY03–RY19 (n = 6 surveys). Moose densities during this time period increased at an average annual rate of 0.01 moose/mi^2 (95% CI = 0.00–0.02 moose/mi^2), although this trend was less statistically significant (p=0.06) than the northwestern Unit 12 linear trend.

Except for RY17, bull-to-cow ratios during RY15–RY19 exceeded Management Objective M1 of 40 bulls:100 cows east of the Nabesna River and 25 bulls:100 cows in the remainder of the unit. The 2017 bull-to-cow ratio estimate for that portion of southeastern Unit 12 east of the Nabesna River was 28:100 (90% CI = 18–39), slightly below the minimum management objective. However, the 2019 bull-to-cow ratio estimate from the same area was greater than the objective at 49 bulls:100 cows (90% CI = 32–67). Bull-to-cow ratios were higher within the southeastern Unit 12 survey area compared to the northwestern Unit 12 survey area (Table 1), likely reflective of the lower hunting pressure within the southeastern Unit 12 area. Bull-to-cow ratios hovered slightly above the minimum objective of 25 bulls:100 cows within the resident any-bull portion of the northwestern Unit 12 survey area, while the ratios were higher within the antler-restricted portion (i.e., upper Tok River drainage) of the survey area. Bull-to-cow ratio estimates within the upper Tok River averaged 36:100 (range 29:100–42:100) during RY08–RY17. The resident antler-restricted bag limit that was implemented within the upper Tok River drainage in RY06 has been effective at maintaining the bull-to-cow ratio above the objective; however, it may be possible to provide a small increase in hunter opportunity (e.g., a limited number of any-bull draw permits or extending the season) while still maintaining the management objective for this area.

Recommendations for Activity 1.1

Continue GSPE surveys—a suggested schedule is included in the RY20–RY24 plan portion of this document below.

Table 1. Moose composition and population estimates in Unit 12 moose survey areas, Interior Alaska, fall 2015–2019.

Survey area	Year	Size of survey area (mi^2)	Bulls:100 cows[a]	Calves:100 cows[a]	Yearling bulls:100 cows[a]	Total moose observed	Observable moose density estimate[a]	Observable moose population estimate[b]
Northwestern Unit 12	2017	2,782	27 (18–36)	29 (21–37)	4 (2–6)	914	1.5 (1.2–1.8)	4,081 (801)
	2018[c]	2,108	30 (23–37)	36 (28–44)	7 (4–10)	583	0.9 (0.9–1.1)	1,822 (292)
Southeastern Unit 12[d]	2017	2,997	35 (23–47)	25 (17–33)	14 (9–19)	459	0.6 (0.5–0.7)	1,747 (349)
	2019	2,948	54 (38–70)	27 (18–36)	7 (4–10)	589	0.6 (0.5–0.7)	1,792 (376)
Tok River[e]	2016	576	41 (29–53)	18 (16–20)	7 (5–9)	603	1.7 (1.5–2.1)	999 (180)

Note: Sampled using the geospatial population estimator (GSPE) sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006).

[a] Ninety percent confidence interval in parentheses.

[b] Ninety percent confidence interval half-width in parentheses.

[c] Only that portion of the Northwestern Unit 12 survey area with an any-bull resident bag limit was surveyed in 2018.

[d] Survey conducted by U.S. Fish and Wildlife Service, Tetlin National Wildlife Refuge.

[e] 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.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor and analyze harvest data and other mortality (objectives C3, M1).

Data Needs

Harvest data are a necessary component to ensure that harvest remains within sustainable yield and to determine whether the IM harvest objective has been achieved.

Methods

Annual harvest was estimated from mandatory harvest report cards and reported potlatch harvest. During RY15–RY19 this included data from the registration hunt RM291 in southern Unit 12 along the Nabesna Road and the general season hunt in the remainder of the unit. If timely harvest reports were not received, general season hunters received 1 reminder letter, and RM291 hunters received 2 reminder letters, an e-mail (if an e-mail address was provided by the hunter), and in some situations, a telephone call. Potlatch permittees received 1 or more reminder telephone calls. Harvest from federally qualified subsistence hunters within the FM1203 federal permit area was obtained from Tetlin NWR staff, while the remainder of federal subsistence harvest was reported on the general state moose harvest ticket or the joint state and federal registration permit RM291.

A linear regression analysis was conducted using Microsoft Excel software with RY05–RY19 harvest data to determine whether there was a linear trend in reported unitwide harvest (increasing or decreasing) during this time period.

Results and Discussion

Harvest by Hunters

Total reported annual harvest during RY15–RY19 averaged 140 moose per year, or 153 moose per year when reported potlatch harvest was included (Table 2), both of which are well below the IM harvest objective of 250–450 moose per year. Reported hunter (nonpotlatch) harvest during RY15–RY19 was comparable to RY10–RY14 (123) and RY05–RY09 (136). It has been stable in most of the unit since the Alaska resident season was split between August and September beginning in RY01. There was no evidence of a linear trend in total reported moose harvest (including potlatch harvest) during RY05–RY19 (*P-value* = 0.50).

Hunter Residency and Success

Nonlocal Alaska residents harvested the largest proportion (44%) of nonpotlatch moose during RY15–RY19 in Unit 12, followed by local Alaska residents (29%; residents of Units 12, 20E, and eastern Unit 20D), and nonresidents (27%) hunters. The proportion harvested by nonlocal residents was similar to the RY10–RY14 reporting period while the proportion taken by nonresidents was larger than the RY10–RY14 proportion of 23% and was conversely lower for locals compared to the RY10–RY14 of 35%. Reported success rates on state harvest tickets averaged 22% (range = 18–25%) during RY15–RY19, which matches the average success rate

Table 2. Unit 12 reported moose harvest, Interior Alaska, regulatory years 2015–2019.

Regulatory year	General season	Registration permit (RM291)[a]	Federal subsistence permit FM1203	Total reported hunter harvest	Potlatch reported harvest			Total reported harvest
					Male	Female	Unk	
2015	152	11	4	167	14	7	0	188
2016	133	6	2	141	12	4	0	157
2017	131	4	6	141	5	2	1	149
2018	98	6	1	105	8	3	0	116
2019	133	7	4	144	6	5	0	155

Note: Harvest is male unless notes otherwise.

[a] Although RM291 includes portions in both Units 11 and 12, only that harvest from Unit 12 is included in this table.

during the prior reporting period. The number of moose hunters who reported hunting on state harvest tickets in Unit 12 during RY15–RY19 averaged 634 annually, slightly higher than the RY05–RY09 and RY10–RY14 annual averages of 589 and 576, respectively.

Harvest Chronology

Similar to prior reporting periods, since the current split season between August and September began in most of Unit 12, the majority (93%) of moose harvested during RY15–RY19 were taken during the September portion of the fall moose season.

Transport Methods

Transportation use by successful moose hunters in Unit 12 was similar to prior reporting periods. Most successful hunters used 4-wheelers (29%) followed by highway vehicles (19%), airplanes (18%), off-road vehicles (13%), boats (12%; includes airboats), and horses (7%).

Other Mortality

Unit 12 moose mortality data from vehicle collisions was obtained from the Alaska Wildlife Troopers for RY16–RY19 (data for RY15 was not available). Annual reported moose roadkills was 12, 9, 8, and 4 for RY16–RY19, respectively, and averaged 8 per year. Most (88%) of the roadkills occurred during July–December of each year.

Alaska Board of Game Actions and Emergency Orders

The Alaska Board of Game clarified the boundary of the Unit 12 antler-restricted moose hunting area within the Tok River drainage at their February 2017 meeting. At their March 2020 meeting, the Alaska Board of Game reduced the Unit 12 IM harvest objective from 250–450 to 150–300. This reduction occurred as part of proposal 88, although the change in the objective was not an original part of the proposal. A reduction in the objective was suggested by the department as part of the proposal presentation, while the specific range of 150–300 was suggested by the Upper Tanana/Fortymile Advisory Committee (AC). No emergency orders affecting Unit 12 moose were issued during RY15–RY19.

Recommendations for Activity 2.1

Continue to monitor total harvest for comparison with the IM harvest objective.

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Habitat enhancement (goal G1).

Data Needs

The Tok river drainage is an important area for the Unit 12 moose population, both in terms of habitat and harvest. First, past research has shown that the lower Tok river valley is an important wintering area for moose (Kelleyhouse 1983). Both migratory and nonmigratory moose winter within the lower Tok River valley, with the migratory portion typically traveling to areas south of the Alaska Range (Unit 13C) to calve, and to areas within the upper Tok River to rut. Second, a considerable amount of the annual moose harvest in Unit 12 occurs within the Tok river drainage (26% of the total harvest during RY15–RY19 whereas this area represents 9% of the total Unit 12 area). Therefore, attempts to maintain or increase the moose population within the Tok river valley are important in light of achieving the IM population and harvest objectives. One habitat enhancement project was continued within the lower Tok river valley during RY15–RY19.

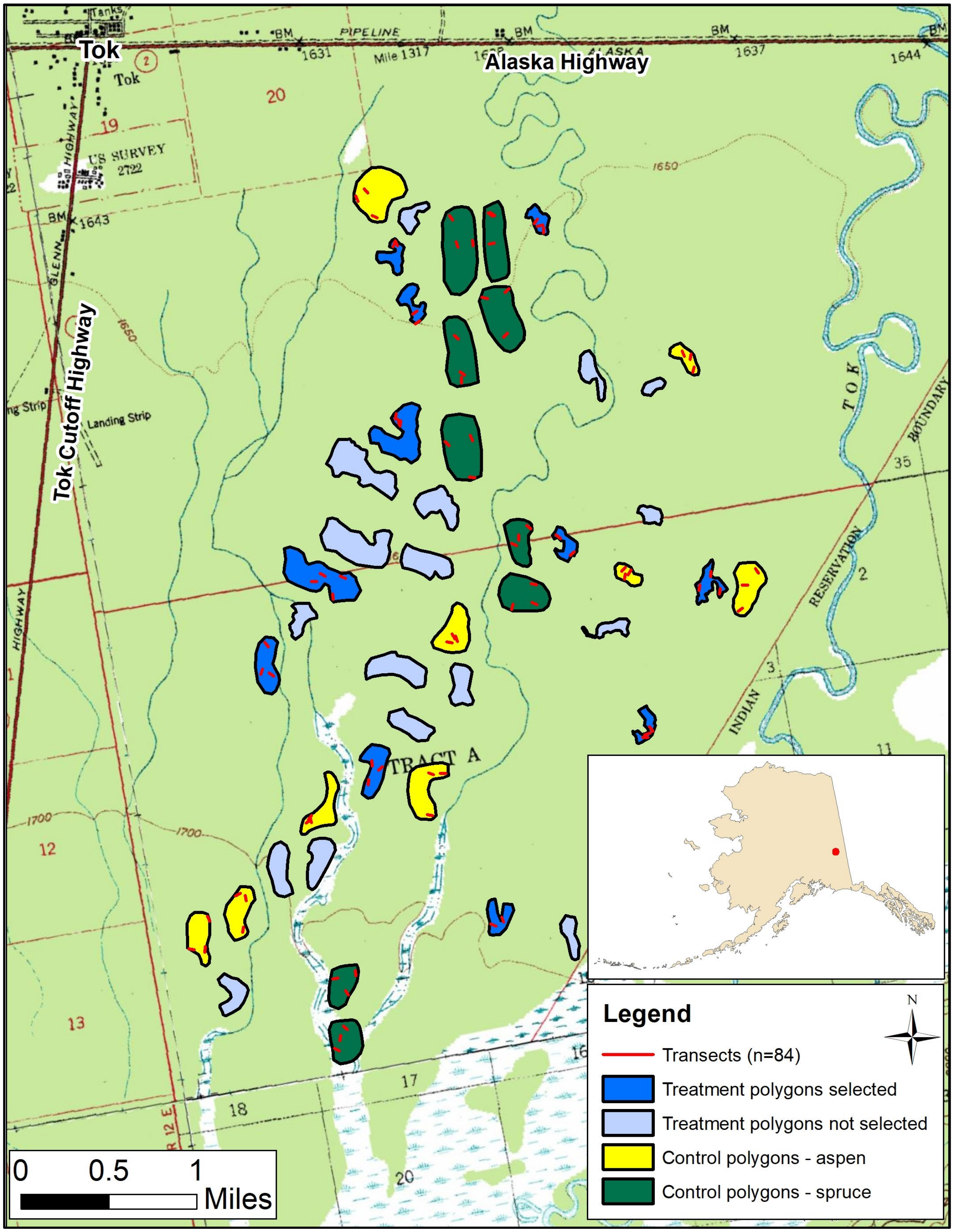
Methods

Efforts to create aspen and willow regeneration were focused within an approximately 8,000-acre area of state land southeast of Tok that burned in the 1990 Tok River fire. Aspen-dominated stands were identified through a variety of methods, including satellite imagery, aerial photos taken by a drone, observations from the air via fixed-wing and rotor aircraft, and trips on the ground. Once aspen stands were identified habitat enhancement sites ranging in size from 2 to 46 acres ($\bar{x}$ = 17 acres, n = 42 sites, 721 total acres), with a maximum width of 300 meters, were identified using ArcGIS software (Esri, Redlands, California). For sites ≥20 acres, islands of untreated forest ranging in size from 1 to 2 acres were identified within the approximate center of each site. The purpose of the islands was to both provide cover for wildlife and to reduce long shooting lanes. In addition, a minimum buffer of 100 meters was left between treatment sites. The treatment prescription was to roller chop sites during the dormant season using a D5 or D6 dozer, and roller chopping began in spring 2015. Prior to roller chopping, photos were taken in the 4 cardinal directions from the center of the site at a predetermined GPS point to allow for photo documentation post-treatment. Two sizes of roller choppers were used: one that measured 7 feet (typically pulled by the D5 dozer) and one that measured 12 feet (pulled by the D6 dozer).

Roller chopping crews were instructed to stop roller chopping any designated units with substantial heterogeneity in vegetation (black spruce with little or no aspen or willow). Furthermore, units were accessed using existing trails or roads whenever possible. When access through existing trails or roads was not possible, new access routes were created with the dozer and roller chopper. New access routes were not created in a straight line, but instead were created by weaving through the habitat both to increase the amount of area roller chopped and decrease long shooting lanes. In addition, new access routes were improved through back-blading to create easier walking, all-terrain vehicle (ATV), and snowmachine access. However, the intent was not to allow for easy access with highway vehicles.

Results and Discussion

A total of 479 acres were roller chopped during spring 2015 to early winter 2016 (Fig. 2). The total costs associated directly with roller chopping activities was $78,190 ($163/acre), which was funded through the statewide ADF&G grant AKW-5 Wildlife Habitat Enhancement. Three sites ranging in size from 37–43 acres and totaling 123 acres were roller chopped during 7 March–20 April 2015, 18 sites ranging in size from 5–34 acres and totaling 265 acres were roller chopped during 3 November 2015–16 January 2016, and 7 sites ranging in size from 8–19 acres and totaling 94 acres were roller chopped during 1–17 November 2016.



Produced by ADF&G using ArcGIS™ software (Esri, Redlands, California); base map source: ADFG, GINA (UAF), USGS.

Figure 2. Moose (and grouse) habitat enhancement project in the lower Tok River valley in Unit 12, Interior Alaska. Shown on the map are areas that were roller chopped during 2015–2016 (treatment polygons), control polygons (which includes areas burned during the 1990 Tok River fire that are currently dominated by aspen or spruce), and moose pellet transects established in 2017–2018.

Recommendations for Activity 3.1

This project was completed during RY16. The following are recommendations for future roller chopping efforts with similar objectives:

- Whenever possible, conduct roller chopping when temperatures are <20°F for proper vegetation breakage.
- Conduct adequate ground truthing of treatment areas prior to roller chopping efforts to ensure that the designated treatment areas are dominated by the vegetative species of interest (e.g., aspen or willow).

ACTIVITY 3.2. Habitat assessment (goal G1).

Data Needs

The purpose of this project was to assess moose utilization of treatment (roller chopped) and nontreatment areas and vegetation response within treatment areas within the Tok River moose habitat enhancement area (Fig. 2). Specifically, the objectives were to: 1) compare utilization of treatment and nontreatment areas and 2) compare utilization of different sized treatment polygons. This information will be used to assess the habitat enhancement project conducted during 2015–2016 (Activity 3.1), and will aid in planning potential future habitat enhancement projects. Funding for this project was provided through the statewide ADF&G grant AKW-5 Wildlife Habitat Enhancement.

Methods

Moose utilization within the treatment and nontreatment polygons was estimated using pellet counts as an index. Treatment polygons were stratified according to size into 3 categories: <10 acres (n = 8; small), ≥10 to <20 acres (n = 12; medium), and ≥20 acres (n = 8; large). Three polygons were randomly selected within each size stratification for the 2017 survey, while 1 small polygon and 1 medium polygon was added beginning in 2018. Nontreatment areas included only areas that were not roller chopped and that burned during the 1990 Tok River fire. These areas primarily regenerated as either aspen or spruce/willow (hereby referred to as "spruce"). The aspen and spruce areas were identified using a combination of satellite imagery (Google Earth), drone photographs, and ground truthing. The areas defined as "aspen" included primarily high densities of aspen with small pockets of willow, while the areas defined as "spruce" were typically slightly lower in elevation and included spruce, tussocks, and scattered willow. Nine polygons of each nontreatment habitat type (aspen and spruce/willow) were identified from within the study area (Fig. 2).

Pellet transects consisted of 2 m × 50 m (2.2 yd x 54.7 yd) belt transects that were randomly generated in ArcGIS software (Esri, Redlands, California) based on a random starting point and azimuth. Transects were eliminated and a different transect was generated if <95% of the transect fell within the polygon. In 2017, 2 transects were placed in each polygon for a total sample size of 18 in treated, untreated aspen, and untreated spruce polygons. Following data collection in 2017, biometric staff conducted a preliminary power analysis. The results of this power analysis suggested that a relatively large sample size (e.g., 80 plots per treatment/nontreatment area) would be necessary to detect a moderate (0.3 more pellet groups per transect) increase in pellet groups within the treatment versus nontreatment areas. However, a smaller sample size of 25–30 transects would result in a >80% chance in detecting a difference of 0.7 or more pellet groups per transect in the treatment versus nontreatment areas. Therefore, beginning in 2018, transect sample sizes were increased to 30 transects in treated polygons and 27 transects in untreated polygons (aspen and spruce).

The beginning and end points of the transects were marked with a wooden stake, with the distance between the points measured with a 50 m (54.7 yd) reel tape. Photographs were taken pointing along the transect from the beginning and end of each transect. The reel tape was laid on the ground between the two stakes and all pellet groups ≥50% within 1 m (1.1 yd) of each side of the tape were counted. Only pellet groups that were from the previous year were counted. For the transects conducted in 2017 and for those added in 2018, this determination was made based upon the color, texture, and amount of leaf litter on the pellets. All pellet groups were cleared from the transect and pellet groups were noted as summer (soft, misshapen, dark) or winter (hard, uniform shape, light colored).

To account for the potential effect of differences in regenerating stem densities on the utilization of different size treatment polygons, stem densities were estimated within the treatment polygons. Willow, poplar, and aspen stems were counted within 2 m^2 (2.4 yd^2; 1 m [1.1 yd] × 2 m [1.2 yd]; 1 m^2 [1.2 yd^2] plots were used during 2017) rectangular plots centered along the 50 m (54.7 yd) reel tape at 5 points along each transect (1 m [1.1 yd], 12.5 m [13.7 yd], 25 m [27.3 yd], 37.5 m [41.0 yd], and 49 m [53.6 yd]). The plot was placed such that it ran 2 m [1.2 yd] along the tape (1 m [1.1 yd] in 2017) and 0.5 m (0.5 yd) on either side of the tape. The stem counts were split into 2 height categories (≤0.5 m [0.5 yd] and >0.5 m [0.5 yd]) to account for what was likely under snow cover during the previous winter. All stems that were separate stems at the soil level were counted. Fresh browse (moose or hare) sign within plots was recorded in 2020.

Results and Discussion

The average number of moose pellet groups per transect generally increased in both the treated and untreated transects during 2017–2020, although the increase in the average number of pellet groups per transect was greatest in the treated transects (Fig. 3). The 2017–2020 combined average number of moose pellet groups per transect was 0.50 (90% CI = 0.39–0.61) for treated transects, 0.24 (90% CI = 0.16–0.32) for untreated aspen transects, and 0.38 (90% CI = 0.28–0.48) for untreated spruce transects. Most (77%) of the pellet groups observed during 2017–2020 were designated as winter pellets.

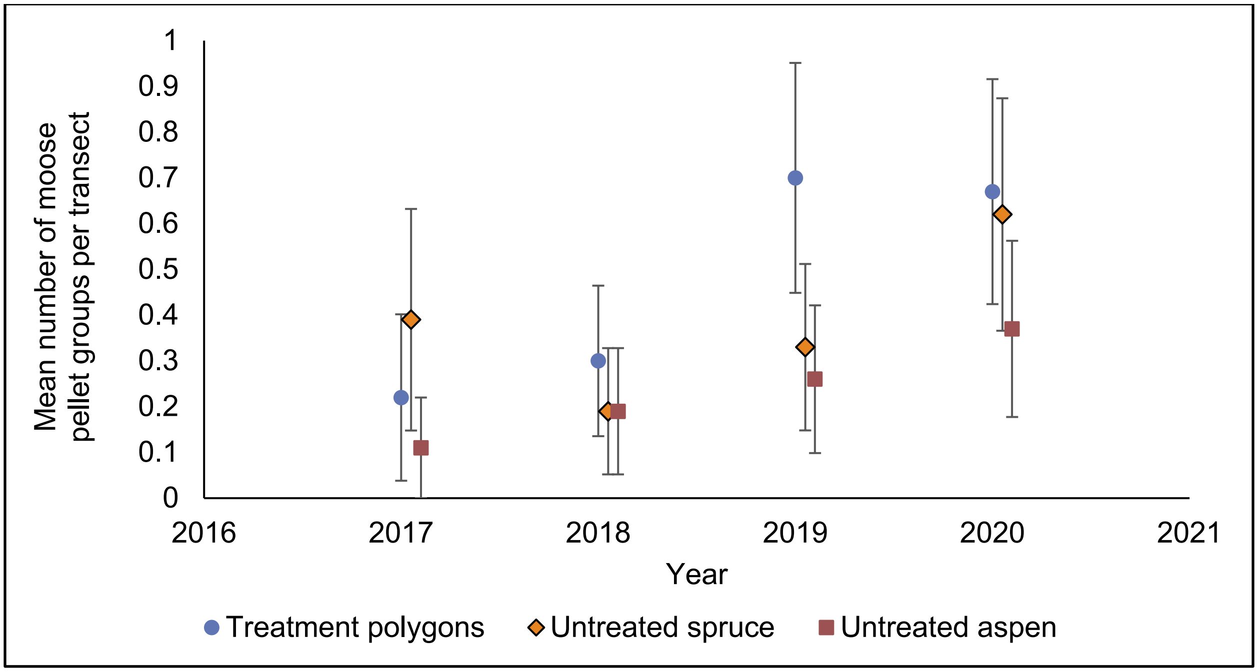


Figure 3. Average annual number of moose pellet groups per transect (and corresponding 90% confidence intervals) during 2017–2020 surveys within treated (roller chopped) and untreated polygons in the lower Tok River valley in Unit 12, Interior Alaska.

A total of 528 stem density plots were completed within treatment polygons during 2017–2020. The number of full growing seasons posttreatment (post roller chopping) varied from 1 to 5 years. The mean number of stems/m^2 (stems/1.2 yd^2) was 8.4, 2.8, and 0.2 for aspen, willow, and poplar, respectively. While the number of aspen stems varied between plots, it was much less variable than the number of willow stems. There was a reduction in the proportion of aspen and willow stems <0.5 m (0.5 yd) in height (approximate height of the average snow depth during winter) as the number of growing seasons posttreatment increases.

The proportion of aspen and willow stems <0.5 m (0.5 yd) tall decreased linearly within polygons from an average of 76% and 79%, respectively, after 1 growing season posttreatment to an average of 26% and 22%, respectively, within polygons 5 years post-treatment. Snowshoe hare numbers were at a peak during 2016–2017, and stem heights in some areas were affected by heavy hare browse. Hare browse was particularly evident during the 2018 survey and less evident during the 2019–2020 surveys, likely indicative of reduced hare numbers since winter of 2018–2019. The presence or absence of fresh hare browse sign within the vegetation plots was recorded during 2020, and fresh hare browse sign was observed in only 3 of the 149 plots (2% of plots). Conversely, fresh moose browse sign was observed in 28% (42 of 149) of plots during 2020.

The average number of pellet groups per transect during 2017–2020 was largest in the small (<10 acres) treated polygons and smallest in the large (≥20 acres) treated polygons. The 2017–2020 combined average number of moose pellet groups per transect for small, medium, and large treated polygons was 0.69 (90% CI = 0.46–0.92), 0.50 (90% CI = 0.31–0.69), and 0.31 (90% CI = 0.16–0.46), respectively. This difference was likely not due to differences in stem densities. Average aspen stem densities during 2017–2020 were 7.8, 8.6, and 7.5 per m^2 (1.2 yd^2) in small, medium, and large treated polygons, respectively. Average willow stem densities were 1.6, 3.2, and 3.6 per m^2 (1.2 yd^2) in small, medium, and large treated polygons, respectively.

Based upon the pellet count and stem density data collected during 2017–2020, there is some evidence that moose are using the treated polygons more than the untreated polygons, and that moose are using the smaller treated polygons more than the larger treated polygons. However, no statistical comparisons were made—a complete analysis of the pellet count and stem density and height data will be done upon completion of data collection in 2021. One of the ultimate goals of this habitat work was to increase moose harvest within the area; the final analysis will include an investigation into moose harvest trends within this area and Unit 12 as a whole.

Recommendations for Activity 3.2

Continue through summer of 2021 (an additional 1 year of data collection). By 2021, the areas that were roller chopped will have had 4 to 6 growing seasons posttreatment, and most of the moose browse will be >0.5 m (0.5 yd) in height, and therefore generally available to moose during the winter within the treatment areas.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Potlatches are culturally important and common in many of the communities in and near Unit 12, and moose are often the preferred species for potlatches. Reported annual potlatch harvest of moose during RY15–RY19 accounted for 9% of the total reported harvest and 100% of the reported cow harvest (Table 2). Potlatch reporting has historically been poor, but additional efforts to improve potlatch harvest reporting (e.g., additional phone calls to permittees following the potlatch if a report was not received) that were initiated in RY13 have improved reporting rates. During RY05–RY12, only 46% (37 of 81) of potlatch permits were reported on compared to 77% (58 of 75) of potlatch permits that were reported on during RY13–RY19. Although potlatch harvest likely has little influence on unitwide population dynamics, localized harvest of cows near communities and along the road system might hinder population growth in these areas. Furthermore, since potlatch harvest accounts for a portion of the annual moose harvest in Unit 12, efforts should continue to improve reporting in order to obtain accurate harvest data for the unit.

Data Recording and Archiving

RECORDING

- GSPE Moose Survey Form | WinfoNet | Data Archive | Unit 12 moose (http://winfonet.alaska.gov/index.cfm).
- ArcGIS version 10.3 (store and analyze spatial data).

ARCHIVING

- Harvest data and GSPE survey data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm) and archived in WinfoNet under Harvest Information and Survey and Inventory Tools.
- All other electronic files such as survey memoranda, reports, and maps are located on the Tok server (S:\Wells\moose and S:\Wells\MAPS). All hard copy data sheets, paper files, etc. are located in the conference room file cabinet in the ADF&G office in Tok.
- Survey memoranda and other pertinent electronic survey information (e.g., survey maps) are archived in WinfoNet under Data Archive (folders Region III Memos and Unit 12 moose).

Agreements

None.

Permitting

None.

Conclusions and Management Recommendations

The IM population objective was achieved in Unit 12 during RY15–RY19. Population trend since the early 2000s appears to be stable within portions of the unit and slightly increasing within other portions of the unit.

The IM harvest objective was not achieved in Unit 12 during RY15–RY19. The total reported harvest of 188 moose in RY15 was one of the highest annual reported moose harvests in Unit 12 in recent decades; however, this still fell far short of the lower bounds of the IM harvest objective of 250. Access to large portions of Unit 12 is challenging due to a combination of factors, including land ownership (e.g., private lands and access restrictions on National Park Service and U.S. Fish and Wildlife Service lands), and the remote nature of portions of the unit. Unless these factors changed, it is unlikely that the IM harvest objective of 250–400 could be achieved. However, beginning in RY21, the IM harvest objective for Unit 12 is 150–300 moose, and this objective will be much more attainable.

With the exception of 1 survey, bull-to-cow ratio management objectives were achieved during RY15–RY19. However, bull-to-cow ratios in accessible areas, especially those areas with an any-bull resident bag limit, were near the minimum objective during RY15–RY19. Therefore, it will be important to closely track bull-to-cow ratios during the next reporting period (RY20–RY24).

The operational portion of the roller chopping habitat enhancement project within the lower Tok River was completed during RY15–RY19 while the assessment portion of the project was ongoing. The primary goal of the habitat enhancement was to help achieve the IM objectives, while the assessment portion of the project will be useful both in evaluating the habitat work that was completed and in guiding future habitat work.

II. Project Review and RY20–RY24 Plan

Review of Management Direction

Management Direction

The current management direction and goals for Unit 12 moose are generally appropriate. However, the RY15–RY19 goal to maximize opportunities for nonconsumptive use of moose will be removed for RY20–RY24 because no codified or management objectives are tied to this goal, and no efforts have been made to assess whether the goal has been met.

Goals

G1. Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.

G2. Continue sustained opportunity for subsistence use of moose.

G3. Maximize sustained opportunities to participate in hunting moose.

Codified Objectives

Amounts Reasonably Necessary for Subsistence Uses

C1. Unit 12 has a customary and traditional use finding for moose, with amounts necessary for subsistence uses (ANS) of 60–70 moose.

- a. This objective will be considered to be met if 4% of the midpoint of the unitwide prehunt moose population estimate (estimated once during the 5-year report period: see "II. Project Review and RY20–RY24 Plan | 1. Population Status and Trend | Methods" this document) is greater than or equal to the lower threshold of ANS (currently 60 moose).

Intensive Management

C2. Population objective: 4,000–6,000 moose.

- a. This objective will be considered to be met if the midpoint of the unitwide prehunt moose population estimate (estimated once during the 5-year report period: see "II. Project Review and RY20–RY24 Plan | 1. Population Status and Trend | Methods" this document) is greater than or equal to lower threshold of the IM population objective (currently 4,000 moose).

C3. Harvest objective: 150–300 moose.

- a. This objective will be considered to be met if 3-year mean reported harvest (including reported potlatch harvest) is greater than or equal to lower threshold of the IM harvest objective (currently 150 moose). As previously stated, this objective was reduced by the Board of Game from 250–450 to 150–300 at their March 2020 meeting.

MANAGEMENT OBJECTIVES

M1. Maintain a posthunting ratio of ≥40 bulls:100 cows within the Chisana survey area and ≥25 bulls:100 cows in all other survey areas.

a. This objective will be considered to be met if the midpoint bull-to-cow ratio estimate (determined annually for each area surveyed) falls above the objective.

b. Management action will be considered if the midpoint estimate falls below the objective for 2 consecutive surveys, or conversely, if the midpoint estimate is above the objective for 2 consecutive surveys. Possible management actions could include shortening the season or instituting an antler restriction.

Except for the Chisana survey area, this objective is revised for that portion of Unit 12 east of the Nabesna River from 40 bulls:100 cows during the previous reporting period. Following a discussion with the Upper Tanana/Fortymile Advisory Committee (AC) in February 2018 regarding the Unit 12 bull-to-cow ratio management objectives, the AC recommended making this change for the following reasons. First, the bull-to-cow ratio objective of 40 bulls:100 cows east of the Nabesna River was unnecessarily high given the Unit 12 moose management goal to maximize opportunity for subsistence harvest. Second, ADF&G explained how the previous management objective was difficult to assess given that the management objective split between east versus west of the Nabesna River did not align with the moose survey area boundaries, nor was the use of the Nabesna River biologically meaningful. Therefore, this change will allow for an easier assessment and comparison of survey results to the objective. However, the AC recommended leaving the bull-to-cow ratio objective for the Chisana survey area at 40 bulls:100 cows because that area is very remote and approximately half of the harvest is by nonresidents. In addition, this area has lower densities of moose compared to the other portions of Unit 12, and bull-to-cow ratio objectives are typically larger in lower-density areas versus higher-density areas.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct GSPE surveys to estimate population abundance and composition (objectives C1, C2, M1).

Data Needs

No change from RY15–RY19 reporting period.

Methods

Overall, the methods used during RY20–RY24 will match those used during the RY15–RY19 reporting period. The GSPE technique will be used to complete all population and composition surveys. The desired relative precision (RP) for observable moose population and composition estimates will be investigated and refined in collaboration with regional biometricians. As a starting point, the desired RP for all survey areas for observable moose population estimates will be within 15–20% of the mean at 90% CI and for composition estimates (calf-to-cow and bull-to-cow ratios), within 20–30% of the mean at the 90% CI. Biometric assistance will be used to evaluate both sample size and proportion of the sample units (SUs) allocated to high-stratum SUs prior to each survey.

Survey area boundaries will be assessed in conjunction with Tetlin NWR staff prior to fall 2021 moose surveys. Moose location data collected from radiocollared (VHF and GPS) moose on the Tetlin NWR during 2003–2007 showed that moose in this area tend to have either relatively static home ranges or display north/south movements throughout the year (unpublished U.S. Fish and Wildlife Service data, Tetlin National Wildlife Refuge, Tok, Alaska). None of the locations obtained from the radiocollared moose were west of the western edge of the southeastern Unit 12 survey area. Conversely, locations of radiocollared moose were obtained north of the Alaska Highway within both the northwestern Unit 12 survey area and in Unit 20E. Furthermore, several moose switched survey areas between the fall hunting season and November when fall moose surveys are typically conducted. Therefore, although the current southeastern and northwestern Unit 12 survey area boundaries were likely largely based on land ownership boundaries, these boundaries do not make the most biological sense in terms of moose movements. The southeastern and northwestern Unit 12 moose survey boundaries will be reassessed with Tetlin NWR staff according to the available moose movement data. One potential change would be to include the section north of the Alaska Highway and east of Midway Lake in the southeastern Unit 12 survey area and the section within the Tetlin River drainage in the northwestern Unit 12 survey area (Fig. 4). This swap in areas would be approximately equal and would represent a more biologically meaningful survey area boundary. However, this change would make survey results more difficult to compare to previous surveys. These potential changes will be finalized prior to fall 2021 surveys.

Although these plans are liable to change based upon management needs, available resources, etc., the RY20–RY24 general moose survey plan for Unit 12 is to survey the northwestern (completed by ADF&G) and southeastern (completed in conjunction with Tetlin NWR) Unit 12 survey areas 2 times during RY20–RY24 (approximately every 3 years), and to survey the Nabesna Road survey area 1 time (in conjunction with Glennallen ADF&G and National Park Service [NPS]). To aid in assessing survey frequency, Region III Biometrician Carly Hammond conducted a power analysis exercise exploring the ability to detect a trend in abundance assuming an exponential rate of population change. Variables explored in the exercise included rate of change, coefficient of variation (CV), number of surveys, and survey frequency (annual, biennial, or triennial). Statistical power is the probability of a statistical test, in this case linear regression, finding an effect if there is indeed an effect to be found. And inherently, there is a tradeoff between survey frequency and the ability to detect a trend, or change, in abundance (Table 3).

The power to detect a declining trend, assuming a true exponential reduction rate of 0.05/year, before the overall decline in abundance is <20% is low unless precision is high (e.g., CV of 0.05). In addition, in order to have a power ≥80% to detect annual rates of change <0.05, the CV must be low and/or the number of years or surveys must be relatively high. It should be noted that the exponential rate of reduction of 0.05 that was used in the exercise is arbitrary, but the tradeoffs presented in the power analysis relate to the management goals and objectives (e.g., IM population objective) in that some overall change in abundance inevitably occurs prior to the detection of a linear trend. More precise and/or frequent surveys result in the ability to detect trends more quickly, which can result in earlier intervention management actions, if such actions are desired.

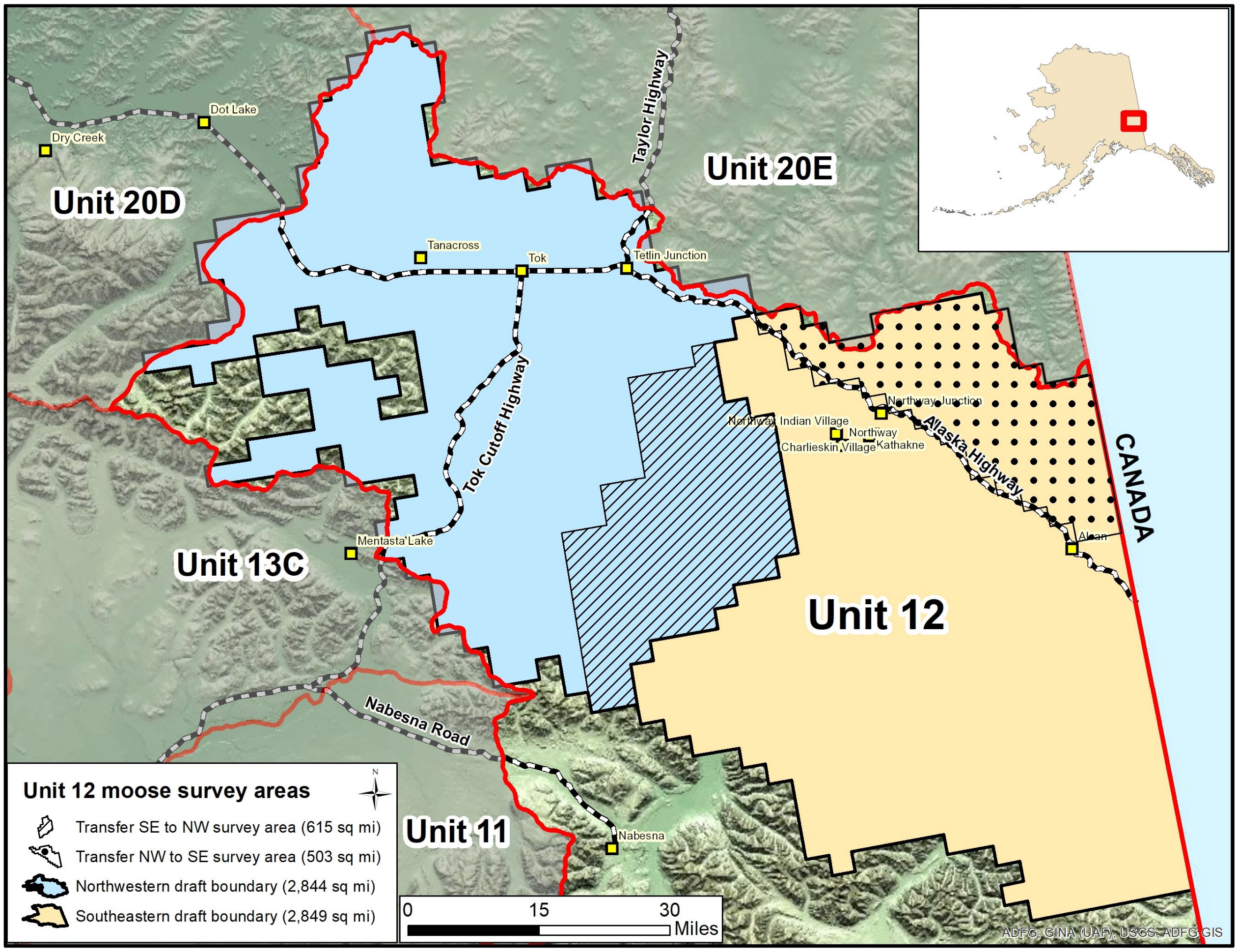


Figure 4. Draft changes to moose survey area boundaries in Unit 12, Interior Alaska, for regulatory years 2021–2024.

Table 3. Survey schedule needed to maintain at least 80% power to detect a significant linear trend, given a true annual exponential rate of reduction of 0.05 and a population estimate coefficient of variation of 0.10.

Survey frequency	Overall change in abundance[a]	Total no. of years[b]	Total no. of surveys[c]
Annual	−26%	6	7
Biennial	−34%	8	5
Triennial	−37%	9	4

[a] Estimated overall change in the population before a significant linear trend is detected.
[b] Total number of years from the initial survey before a significant linear trend is detected.
[c] Total number of surveys before a significant linear trend is detected.

Given the relatively stable trend in abundance and harvest within the northwestern and southeastern Unit 12 survey areas over the past 20 years, triennial surveys are likely adequate at this time. However, if possible, efforts should be made to increase the precision of the survey estimates. The tradeoffs presented in the power analysis[1] should be considered when changing and/or determining the frequency of surveys for Unit 12 moose survey areas in the future.

Unitwide Population Estimate

Similar to the RY15–RY19 reporting period, the unitwide population will not be estimated on an annual basis but will instead be estimated for the 5-year report period as a whole. This is because not all areas can be surveyed annually in Unit 12, making annual estimates infeasible and likely inaccurate. The unitwide population estimate will be determined using the same formula used during RY15–RY19.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor and analyze harvest data and other mortality (objectives C3, M1).

Data Needs

No change from prior reporting period.

Methods

No change from RY15–RY19 reporting period. Emphasis will be placed on the following:

- Continue to monitor total harvest for comparison with the IM harvest objective.
- Continue efforts to improve potlatch harvest reporting.

3. Habitat Assessment-Enhancement

ACTIVITY 3.1. Habitat assessment (goal G1).

Data Needs

No change from prior reporting period.

Methods

No change from prior reporting period. Habitat assessment within the Tok River moose habitat enhancement area will continue through summer 2021.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Efforts will continue to further improve potlatch reporting. In addition to reminder phone calls to permittees, additional efforts might include communicating with local communities during

[1] Carly Hammond, ADF&G Region 3 Biometrician, Moose Survey Power Analysis, unpublished report archived in WinfoNet (folder Unit 12 moose), 2021.

village council meetings, traditional knowledge workshops, etc. about the importance of accurate harvest reports and the influence of cow harvest on the moose population.

Data Recording and Archiving

RECORDING

- GSPE Moose Survey Form (archived in (http://winfonet.alaska.gov/index.cfm) WinfoNet under Data Archive (folder Unit 12 moose).
- ArcGIS version 10.3 (store and analyze spatial data).

ARCHIVING

- Harvest data and GSPE survey data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm) and archived in WinfoNet under Harvest Information and Survey and Inventory Tools.
- All other electronic files such as survey memos, reports, and maps are located on the Tok server (S:\Wells\moose and S:\Wells\MAPS). All hard copy data sheets, paper files, etc. are filed in the file cabinet in the conference room in the Tok office.
- Survey memoranda and other pertinent electronic survey information (e.g., survey maps) are archived in WinfoNet under Data Archive (folders Region III Memos and Unit 12 moose).

Agreements

Wrangell-St. Elias National Park and Preserve data sharing agreement with ADF&G dated 4 April 2016.

Permitting

None.

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