Species Management Report and Plan ADF&G/DWC/SMR&P-2018-18

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

Report Period 1 July 2010–30 June 2015, and

Plan Period 1 July 2015–30 June 2020

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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 area, 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 website.

This species management report and plan was reviewed and approved for publication by Doreen I. Parker McNeill, Management Coordinator for the Division of Wildlife Conservation, Fairbanks.

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Cover photo: Bull moose during the summer in Unit 20E. ©2010 ADF&G Photo by Torsten Bentzen

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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 20E for the previous 5 regulatory years (RY; RY10–RY14) and plans for survey and inventory management activities in the 5 years following the end of that period (RY15–RY19). A regulatory year begins 1 July and ends 30 June (e.g., RY10 = 1 July 2010–30 June 2011). This report is produced primarily to provide agency staff with data and analysis to help guide and record its own efforts but is also provided to the public to inform them of wildlife management activities. In 2016 the Alaska Department of Fish and Game's (ADF&G) Division of Wildlife Conservation launched this 5-year report to more efficiently report on trends and describe potential changes in data collection activities over the next 5 years. It replaces the moose management reports of survey and inventory activities that were previously produced every 2 years and supersedes the 1976 draft Alaska wildlife management plans (ADF&G 1976).

I. RY10–RY14 MANAGEMENT REPORT

Management Area

Unit 20E is in east-central Alaska bounded by the Canada border on the east and is centered on 64°16′N latitude, 142°20′W longitude. Major drainages within the unit include the Fortymile, Charley, Ladue, and Seventymile river drainages. Unit 20E encompasses 10,680 mi^2, of which 9,750 mi^2, or that portion at or below 4,000 feet in elevation, is generally considered suitable moose habitat. The unit was described in detail by Gasaway et al. (1992) and generally consists of hills with elevations ranging from 1,000 feet to 5,000 feet. However, more mountainous areas, with elevations exceeding 6,000 feet, are found in the northwestern portion of the unit, and lowland areas (2,000–2,500 feet; Mosquito Flats) are found in the southwestern portion of the unit. Vegetation types include lowland shrub and sedge meadows, mature black spruce (*Picea mariana*) forest, recently burned areas dominated by shrubs and early successional forest species, subalpine shrub, and alpine tundra. 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 20E

Similar to other areas within Alaska, the Unit 20E moose population experienced wide fluctuations in size from the 1950s to present time. Gasaway et al. (1992) summarized the history of the Unit 20E moose population from the 1950s through the 1980s, which included a rapid population increase during the 1950s through early 1960s and a rapid population decline during the mid-1960s through mid-1970s. Although the moose population has increased in some areas since the 1980s, it has generally remained at relatively low densities, with current density estimates ranging from 0.25 moose/mi^2 along the Yukon River in the northern portion of the unit (Burch 2012) to 0.9 moose/mi^2 in the southern portion of the unit (Wells 2014).

Since the early 1980s ADF&G has initiated several predator management programs targeted at reducing wolf (*Canis lupus*) and grizzly bear (*Ursus arctos*) numbers in order to increase the

moose population in Unit 20E, with the most recent program in place during RY04–RY13. The response of the Unit 20E moose population during this predator control program was summarized in Gross (2008, 2010, 2012) and Wells (2014). In addition to potentially benefiting from the predator management program, Unit 20E moose also likely benefited from large wildfires during 2004–2005, which burned approximately 1,958 mi^2 mostly within the southern portion of Unit 20E.

Unit 20E has had a 15-day bulls-only fall moose season since RY91, although in RY01 most of Unit 20E was changed to a registration moose hunt with a split season divided into a 5-day late August season and a 10-day September season. Total harvest and numbers of hunters generally increased between RY00 and RY09, although fewer hunters were present and lower harvest occurred during RY04 following the very active wildlife season.

Management Direction

EXISTING WILDLIFE MANAGEMENT PLANS

- None presently specific to Unit 20E moose. Direction in the Yukon–Tanana, Charley River, and Sixtymile Butte moose management plans (ADF&G 1976) has been modified by Alaska Board of Game (BOG) regulatory actions and ADF&G moose management reports over the years.
- Upper Yukon–Tanana intensive management plan (included moose during RY10–RY13; Alaska Fish and Game Laws and Regulations Annotated, 2013–2014: 5 AAC 92.113[b]).

GOALS

During RY10–RY14 (and since RY89) the Unit 20E moose management goals were as follows: 1) protect, maintain, and enhance the moose population in concert with other components of the ecosystem; 2) continue sustained opportunity for subsistence use of moose; 3) maximize sustained opportunities to participate in hunting moose; and 4) maximize opportunities for nonconsumptive use of moose.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

The Unit 20E moose population has a positive customary and traditional use finding, as determined by BOG, with an amount necessary for subsistence uses of between 50 and 75 moose.

Intensive Management

The Unit 20E moose population is identified by BOG as important for providing high levels of harvest for human consumptive use and has the following intensive management (IM) objectives:

1. Maintain a population of 8,000–10,000 moose.
2. Maintain a harvest of 500–1,000 moose annually.

MANAGEMENT OBJECTIVES

1. Maintain a posthunting ratio of at least 40 bulls:100 cows in all survey areas.

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Geospatial population estimation (GSPE) surveys: Population abundance and composition.

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, 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 (adult bull:cow ratio). In addition, bull:cow ratio estimates are necessary to compare to the bull:cow ratio management objective of 40 bulls:100 cows. Furthermore, the composition data are used to assess recruitment (calf:adult cow ratio), which accounts for a combination of parturition and calf mortality during the first 5–6 months.

Methods

Moose abundance and composition were estimated in portions of Unit 20E during RY10–RY14 using the GSPE method (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Areas surveyed included the 2,452 mi^2 Tok West and 2,178 mi^2 Tok Central (called Tok East during 1998–2003) survey areas during RY10–RY12, the 924 mi^2 Tok Northeast survey area in RY13, and the 2,241 mi^2 Taylor Corridor survey area in RY14 (Figure 1). In addition, the National Park Service (NPS) surveyed a portion of northwest Unit 20E within Yukon–Charley Rivers National Preserve (YCNP) in RY12. Approximately 4,030 mi^2, or 38%, of Unit 20E was not surveyed during RY10–RY14.

Sample units (SU) in all survey areas were stratified as high density if they were likely to contain >3 moose, and survey conditions for each SU 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. Population and ratio estimates (along with 90% confidence intervals) were calculated using

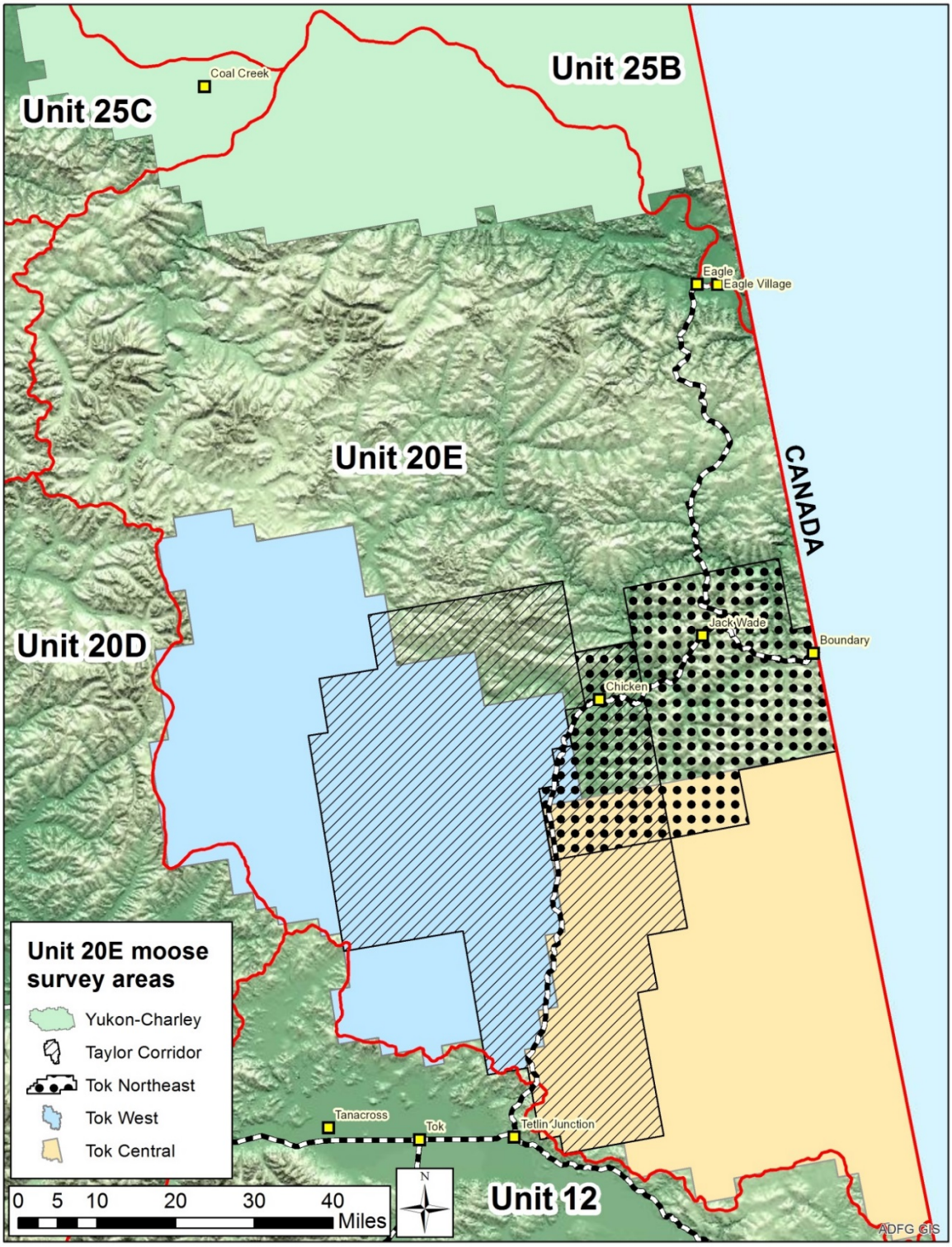

Figure 1. Moose survey areas in Unit 20E, Interior Alaska, regulatory years[a] 2010–2014.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

ADF&G's Wildlife Information Network (WinfoNet) GSPE software (DeLong 2006), and all population estimates were reported as an "observed" estimate due to the lack of a survey-specific sightability correction factor (SCF).

RY10

The GSPE method was used to survey 82 (49 high density and 33 low density; 480 mi^2) of 419 SUs in the Tok West survey area and 79 (46 high density and 33 low density; 470 mi^2) of 366 SUs in the Tok Central survey area during 8 November–5 December. Survey conditions were not recorded for the majority of SUs in both of the survey areas (conditions were not recorded for 58 of 82 and 54 of 79 SUs in the Tok West and Tok Central survey areas, respectively). For SUs in which survey conditions were recorded, 9 and 15 were recorded as good or excellent, respectively, in the Tok West survey area, and 7, 17, and 1 were recorded as fair, good, and excellent, respectively, in the Tok Central survey area. In general, snow cover was complete, although fog, turbulence, icing conditions, and lack of snow on some spruce trees affected survey quality in some areas.

In the Tok West survey area, search time per SU with 100% moose habitat averaged 5.5 min/mi^2 (n = 63), while overall search time, when taking into account the estimated proportion of moose habitat in each SU (e.g., if a SU was estimated to have 80% moose habitat, it was assumed that 20% of the SU was not flown), averaged 5.7 min/mi^2. In the Tok Central survey area, search time per SU with 100% moose habitat averaged 5.4 min/mi^2 (n = 75), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 5.7 min/mi^2. Total flight time, including ferry time, was 133.8 hours.

RY11

The GSPE method was used to survey 81 (49 high density and 32 low density; 474 mi^2) of 419 sample units in the Tok West survey area and 77 (45 high density and 32 low density; 458 mi^2) of 366 sample units in the Tok Central survey area during 25 October–2 November. Survey conditions were not recorded for the majority of the SUs in both of the survey areas (conditions were not recorded for 44 of 81 and 40 of 77 SUs in the Tok West and Tok Central survey areas, respectively). For SUs in which survey conditions were recorded, 16, 3, 15, and 3 were recorded as poor, fair, good and excellent, respectively, in the Tok West survey area, and 1, 4, and 32 were recorded as poor, fair, and good, respectively, in the Tok Central survey area. Poor survey conditions were largely recorded due to low snow cover, particularly in low elevation areas during the beginning of the survey.

In the Tok West survey area, search time per SU with 100% moose habitat averaged 5.5 min/mi^2 (n = 70), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 5.6 min/mi^2. In the Tok Central survey area, search time per SU with 100% moose habitat averaged 5.6 min/mi^2 (n = 70), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 5.7 min/mi^2. Total flight time, including ferry time, was 99.6 hours.

RY12

The GSPE method was used to survey 80 (48 high density and 32 low density; 468 mi^2) of 419 SUs in the Tok West survey area and 81 (50 high density and 31 low density; 482 mi^2) of 366 SUs in the Tok Central survey area during 31 October–6 November. Survey conditions were not recorded for the majority of SUs in both of the survey areas (conditions were not recorded for 47 of 80 and 42 of 81 SUs in the Tok West and Tok Central survey areas, respectively). For the SUs in which survey conditions were recorded, 2, 5, and 26 were recorded as fair, good, and excellent, respectively, in the Tok West survey area, and 3, 16, and 20 were recorded as fair, good, and excellent, respectively, in the Tok Central survey area.

In the Tok West survey area, search time per SU with 100% moose habitat averaged 6.9 min/mi^2 (n = 59), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 7.1 min/mi^2. In the Tok Central survey area, search time per SU with 100% moose habitat averaged 7.0 min/mi^2 (n = 72), while overall search time, when taking into account the estimated proportion of moose habitat in each SU, averaged 7.1 min/mi^2. Total flight time, including ferry time, was 143.3 hours.

A GSPE moose survey was also conducted in RY12 in northwest Unit 20E within YCNP by the NPS (Burch 2012). The NPS estimated the moose density in the entire 3,096 mi^2 YCNP survey area, and this density estimate was applied to the approximately 1,044 mi^2 portion of the survey area located within Unit 20E to estimate the observable moose population.

RY13

The GSPE method was used to survey 80 (50 high density and 30 low density; 468 mi^2) of 158 SUs in the Tok Northeast survey area during 28 November–7 December. This area was surveyed in response to a proposal submitted by the Upper Tanana–Fortymile Fish and Game Advisory Committee to BOG to reimplement the grizzly bear portion of the Upper Yukon–Tanana Predator Control Program (UYTPCP) within a 900 mi^2 area encompassed within the Tok Northeast survey area. Of the 158 SUs in the survey area, 128 had not been surveyed in the past using the GSPE method. These units were stratified using a Cessna 185 with 2 observers in addition to the pilot. For SUs in which survey conditions were recorded (49 of 80), 1, 19, and 29 were recorded as fair, good, and excellent, respectively. In general, snow cover was complete in most areas, but the snow was not fresh (>1-week old), and poor light prevailed on some days. Search time per SU with 100% moose habitat (n = 75) and overall search time averaged 7.5 min/mi^2. Total flight time, including ferry time and 4.6 hours for stratification, was 91.5 hours.

RY14

The GSPE method was used to survey 81 (49 high density and 32 low density; 476 mi^2) of 381 SUs in the Taylor Corridor survey area during 4–8 November. This survey area, which was established in RY14, overlaps portions of the Tok West/Central and Tok Northeast survey areas and was established to focus survey efforts in the areas where the majority of the moose harvest occurs in Unit 20E. Of 381 SUs in the survey area, 43 had not been surveyed in the past using the GSPE method. These units were stratified using a Cessna 185 with 2 observers in addition to

the pilot. A simple random sample of 64 SUs (40 high density and 24 low density) were selected using Microsoft Excel® software (Microsoft, Redmond, Washington), and an additional 16 SUs (10 high density and 6 low density) were selected to fill gaps in randomized coverage. However, fog in several SUs during the survey resulted in the selection of alternate SUs while in the field, which resulted in a final sample size of 81 SUs. All survey conditions were reported as excellent (52%; $n = 42$) or good (48%; $n = 39$). Search time per SU with 100% moose habitat ($n = 71$) averaged 6.9 min/mi^2 and overall search time averaged 7.0 min/mi^2. Total flight time, including ferry time and 2.5 hours for stratification, was 79.1 hours.

Unitwide Population Estimate

In order to compare population estimates to the Unit 20E intensive management population objective, the following equation was used to estimate a probable population range for all of Unit 20E during this report period:

$$Pop_{20E} = Pop_{west/central} + Pop_{YCNP} + POP_{Taylor} + POP_{NE} + Pop_{REM}$$

Where

Pop_{20E} = Observable moose population estimate for Unit 20E during RY10–RY14.

$Pop_{west/central}$ = Upper or lower 90% confidence interval (CI) of the observable moose population estimate for the combined Tok West and Tok Central survey areas (4,630 mi^2) during 2012.

Pop_{YCNP} = Estimated number of observable moose in the 1,044 mi^2 portion of the YCNP survey area that is located within Unit 20E, calculated by applying the upper or lower 90% CI of the YCNP moose density estimate from 2012 (Burch 2012) to the 1,044 mi^2 area.

POP_{Taylor} = Estimated number of observable moose in the 420 mi^2 portion of the Taylor Corridor survey area that does not overlap with the Tok West/Central survey areas, calculated by applying the upper or lower 90% CI of the Taylor Corridor moose density estimate from 2014 to the 420 mi^2 area.

POP_{NE} = Estimated number of observable moose in the 553 mi^2 portion of the Tok Northeast survey area that does not overlap with the Tok West/Central or Taylor Corridor survey areas, calculated by applying the upper or lower 90% CI of the Tok Northeast moose density estimate from 2013 to the 553 mi^2 area.

Pop_{REM} = Estimated number of observable moose in the remainder of Unit 20E, calculated by applying the upper or lower 90% CI of the YCNP moose density estimate to the 4,030 mi^2 area of northern Unit 20E outside the Tok Central, Tok West, Taylor Corridor, Tok Northeast, and YCNP survey areas.

Results and Discussion

The Unit 20E moose population was likely lower than the IM population objective of 8,000–10,000 moose during RY10–RY14. The unitwide observable November moose population estimate during RY10–RY14 was 5,246–7,364 moose; however, it is important to stress that this estimate, as described above in the methods section, includes extrapolating nearby survey areas to estimate population size for approximately 40% of the unit. Furthermore, a Unit 20E SCF is

not available. Therefore, although it is likely that the unitwide population was less than the IM population objective, it is difficult to assess without a survey-specific SCF and unitwide population survey.

The Unit 20E moose population was likely stable during RY10–RY14. The combined Tok West/Central observable moose population estimate varied little during RY10–RY12 (Table 1). In addition, the population estimate for the area of overlap between the Tok West/Central and Taylor Corridor survey areas (1,821 mi^2) during RY10–RY12 and RY14 was relatively stable, and 90% confidence intervals overlapped (estimates ranged from 1,619 [±17%, 90% CI] in 2010 to 2,032 [±15%, 90% CI] in 2014). It is important to note that search time during RY12 and RY14 (6.9–7.0 min/mi^2) was higher than during RY10–RY11 (5.4–5.6 min/mi^2), which means that sightability could have been higher during RY12 and RY14 than during RY10–RY11. With the exception of RY10, the ratio of 5-month-old-calves:100 cows (calf:cow ratio) was lower than that observed during RY04–RY09, when the southern Unit 20E moose population increased (Wells 2014). While calf:cow ratios generally exceeded 25 calves:100 cows during RY04–RY09, especially in the Tok West survey area, calf:cow ratios were lower than 25 calves:100 cows in all survey areas during RY11–RY14. Gasaway et al. (1992) summarized data collected from 36 different sites in Alaska and Yukon and concluded that calf:cow ratios ≤25 calves:100 cows were generally observed in moose populations with a stable to declining trend, while populations with fall calf:cow ratios ≥30 calves:100 cows were generally observed in moose populations with an increasing trend.

Bull:cow ratios were greater than the management objective of 40 bulls:100 cows in the Tok West/Central survey areas and were less than or close to the management objective in the more heavily hunted and accessible Tok Northeast and Taylor Corridor survey areas (Table 1). Bull:cow ratios have consistently been ≥40 bulls:100 cows in the Tok West/Central survey areas, which include both portions of the unit that are relatively inaccessible and lightly hunted in addition to areas close to the Taylor Highway that are more heavily hunted. The majority of moose harvest in Unit 20E occurs within or close to the Taylor Corridor survey area, where it appears that the bull:cow ratio is very close to the management objective. It is possible that the bull:cow ratio estimate for the Tok Northeast survey area, which was a relatively small survey area, was not an accurate estimate for the area. At times, bulls are found in relatively large concentrations during surveys in Unit 20E; therefore, since the survey area was relatively small, it is possible that such concentrations existed just outside of the survey area and were missed. However, due to this low bull:cow ratio estimate, another survey should be conducted in northern Unit 20E to verify whether bull:cow ratios are in fact below the objective or not.

Table 1. Moose composition and population estimates in the Tok West, Tok Central, Tok Northeast, and Taylor Corridor moose survey areas in Unit 20E, Interior Alaska, fall 2010–2014[a].

Survey area	Year	Size of survey area (mi^2)	Bulls:100 cows[b]		Calves:100 cows[b]		Yearling bulls:100 cows[b]		Total moose observed	Observable moose density estimate[b]		Observable moose population estimate[b]	
Tok West	2010	2,452	83	(18.3)	37	(12.2)	6	(3.4)	618	1.03	(0.21)	2,519	(504)
	2011	2,452	66	(23.8)	17	(4.1)	5	(3.4)	803	1.28	(0.26)	3,148	(630)
	2012	2,452	50	(12.5)	18	(6.3)	3	(2.2)	629	1.12	(0.25)	2,748	(605)
Tok Central	2010	2,178	54	(20.0)	15	(5.6)	14	(6.0)	369	0.63	(0.14)	1,379	(317)
	2011	2,178	61	(17.1)	5	(2.5)	8	(3.4)	272	0.47	(0.12)	1,024	(266)
	2012	2,178	67	(18.1)	9	(3.1)	3	(1.2)	425	0.59	(0.09)	1,299	(208)
Combined Tok	2010	4,630	70	(11.9)	28	(7.0)	11	(3.7)	987	0.84	(0.13)	3,894	(584)
West/Central	2011	4,630	66	(13.2)	14	(2.8)	7	(2.3)	1,075	0.90	(0.14)	4,192	(671)
	2012	4,630	53	(9.5)	17	(2.6)	3	(1.0)	1,054	0.90	(0.14)	4,164	(666)
Tok Northeast	2013	924	19	(4.8)	17	(3.1)	2	(1.0)	402	0.75	(0.11)	694	(104)
Taylor Corridor	2014	2,241	37	(9.6)	19	(3.4)	10	(2.7)	580	1.07	(0.15)	2,389	(334)

[a] Sampled using the geospatial population estimator (GSPE) sampling method (Ver Hoef 2001, 2008; Kellie and DeLong 2006).
[b] Ninety percent confidence interval, plus and minus the estimate, in parentheses.

Recommendations for Activity 1.1

- Continue GPSE surveys but survey the Taylor Corridor survey area annually and the Tok West/Central survey areas every 3 years.

- Incorporate SCF trials, using the radiocollared moose in southern Unit 20E, into the GPSE surveys to improve the accuracy of population estimates.
    - Survey the remaining portion of northern Unit 20E that has not been previously surveyed using GPSE techniques in order to improve the unitwide population estimate and more accurately compare population estimates to IM objectives and to estimate composition to evaluate the management objective.

- Utilize memos to archive details of future abundance and composition surveys to reduce detail in methods and results text of management reports.

ACTIVITY 1.2. Twinning surveys.

Data Needs

An important part of the Unit 20E management goal of protecting, maintaining, and enhancing the moose population in concert with other components of the ecosystem is to ensure moose nutritional condition is maintained over time and is not reduced due to density-dependent effects. Given that wolf numbers were likely reduced in portions of southern Unit 20E during RY10–RY14 through UYTPCP, it was especially important to measure moose nutritional condition during this report period, and estimates of twinning rates provide an index to nutritional condition (Boertje et al. 2007).

Methods

Twinning rates were estimated during RY10–RY14 from spring surveys conducted in southern Unit 20E and a small number of observations in immediately adjacent northern Unit 12. During RY10–RY13 reconnaissance-style twinning rate surveys were flown in late May during or within a few days of the median calving date (Boertje et al. 2007) in areas historically used as moose calving areas. Roughly parallel contour-transects were flown at approximately ½-mile intervals ≤500 feet above ground level in PA-18 aircraft by experienced contract pilots and ADF&G observers. All moose observed were classified as bull; yearling cow; adult cow without a calf; or adult cow with single, twin, or triplet calves. During RY14 the twinning rate was estimated from observations of radiocollared cows (n = 24) and random cows observed with calves both during radiotracking and reconnaissance-style flights. Although a minimum sample size of 50 cows with calves is preferable for accurate estimation of twinning rates, the minimum desired sample size for Unit 20E was set at 30 cows with calves due to relatively low moose densities and a limited budget for conducting twinning surveys. Twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows observed with newborn calves. To account for variability that can exist between consecutive years and with the relatively low sample size of approximately 30 cows with calves, the 3-year average twinning rate was used to evaluate nutritional condition of the moose population (Boertje et al. 2007).

Results and Discussion

Twinning rates averaged 28% during RY10–RY14 (Table 2), while 3-year average twinning rates (e.g., 3-year average twinning rate for RY10 would include RY08–RY10) ranged from 24% (±6.7%, 90% CI) in RY11 to 30% (±8.2%, 90% CI) in RY13. Three-year mean twinning rates have been relatively stable since twinning surveys began in RY03 and have ranged from 34% (±7.8%, 90% CI) in RY05 to 24% (±6.7%, 90% CI) in RY11. All of these twinning rates are above those rates observed in nutritionally stressed populations (Boertje et al. 2007); therefore, habitat was likely not a major limiting factor in southern Unit 20E during this report period.

Recommendations for Activity 1.2

- Continue spring twinning rate surveys; however, modify by increasing the desired sample size to a minimum of 40 cows with calves. This should be achievable through a combination of observations of radiocollared and random cows.

- Adopt the following guidelines, which will be based upon the mean 3-year midpoint twinning rate estimate:
  - Twinning rate ≥20%: Conclude moose population has moderate to high nutritional status and is not habitat-limited.
  - Twinning rate <20% for 2 consecutive 3-year means: Conclude moose population has low to moderate nutritional status, and initiate secondary measure to estimate nutritional condition (Boertje et al. 2007).

Table 2. Southern Unit 20E moose twinning rates, Interior Alaska, 2011–2015.

		Cows observed					
Year	Date(s)	w/Single calf	w/Twins	w/Triplets	Total	% Twins[a]	
2011	26–27 May	42	11	0	53	21	(9.2)
2012	30 May	17	9	0	26[b]	35	(15.4)
2013	30 May	17	8	0	25	32	(15.4)
2014	29 May	25	8	0	33	24	(12.3)
2015	22–29 May	26	10	0	36[c]	28	(12.3)

[a] Percentage of cows with calves that had twins or triplets (90% confidence interval, plus and minus the estimate).
[b] Desired minimum sample size of 30 not achieved likely due to sightability issues associated with early green up.
[c] Included 17 collared cows observed with calves.

ACTIVITY 1.3. Deploy radio collars on adult cows.

Data Needs

Radio collars were deployed on adult cows in southern Unit 20E in order to 1) increase the efficiency and samples sizes obtained during twinning surveys, 2) estimate an SCF during fall moose surveys, 3) refine moose survey areas according to the movement of collared animals between the hunting season and November, and 4) identify important calving areas.

Methods

During 31 March–10 April 2015, 25 adult cows and 1 adult bull (captured by mistake) were captured and fitted with a VHF radio collar (other than the bull) within the Taylor Corridor survey area by darting from a helicopter using Palmer darts (3 cc with 1 1/8″ needles) projected from a Pneu-Dart rifle using brown charges on power setting #5 with 1.5 ml (4.5 mg) Carfentanil and 1.2 ml (120 mg) Xylazine (J. Wells, Wildlife Biologist, ADF&G, memorandum 4 May 2015, Tok). The moose were reversed with 9 ml (450 mg) Naltrexone and 2 ml (400 mg) Tolazoline. A canine tooth to determine age was collected from 23 of the 25 cows, and blood was collected to determine pregnancy from 24 of the 25 cows.

During 11–16 March 2016, 26 adult cows were captured using the same methods described above, with the exception that Pneu-Dart darts were used instead of Palmer darts (J. Wells, Wildlife Biologist, ADF&G, memorandum 7 April 2016, Tok). A canine tooth was collected from 25 of the cows, and blood was collected from all 26 moose.

Results and Discussion

The radiocollared cows captured during 2015 were utilized during the spring 2015 twinning survey. Of the 24 cows in which pregnancy was determined through pregnancy-specific protein B (PSPB) analysis, 20 (83%) were determined to be pregnant. All 4 which were not pregnant were 2-year olds (born during 2013). Of the 26 cows captured during 2016, 24 (92%) were determined to be pregnant; ages will not be available until late-summer 2016. All of the collared cows will be used for twinning surveys during spring 2016 as well as during fall 2016 moose surveys to estimate an SCF and to analyze movement between the hunting season and November.

Recommendations for Activity 1.3

- Continue by maintaining a sample size of 50 collared cows during the next report period.

2. Mortality–Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor and analyze harvest data and other mortality.

Data Needs

Harvest data are a necessary component to ensure 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 RY10–RY14 this included data from the registration hunt RM865 in most of Unit 20E, the general season hunt in the upper Middle Fork Fortymile River drainage, and drawing hunts DM794 and DM796 during November–December in the Ladue River Controlled Use Area. If timely harvest reports were not received, general season hunters received 1 reminder letter, and permitted hunters received 2 reminder letters, an e-mail (if an email address was provided by the hunter), and in some situations, a telephone call.

Results and Discussion

Harvest by Hunters

Total reported annual harvest during RY10–RY14 averaged 180 moose per year (Table 3), which is well below the IM harvest objective of 500–1,000 moose per year. With the exception of RY13, annual moose harvest increased during this report period, and the reported harvest of 222 moose during RY14 was the highest reported harvest during the last 25 years. Similar to other areas of Interior Alaska, harvest was low during RY13, likely due at least in part to a very warm fall hunting season. Unreported and illegal harvest was not estimated during this report period.

Hunter Residency and Success

With the exception of RY13, success rates during RY10–RY14 were relatively stable and ranged 22–27% (Table 4). The total number of moose hunters that reported hunting in Unit 20E increased from RY10–RY11 and were stable during RY11–RY14.

Transport Methods

Similar to prior reporting periods, the type of transportation used by most successful hunters during RY10–RY14 was 4-wheelers ($\bar{x}$ = 46%; Table 5).

Alaska Board of Game Actions and Emergency Orders

During the March 2012 meeting BOG extended the season of the moose draw hunts (DM794 and DM796) in southern Unit 20E from 1–30 November to 1 November–10 December. This was intended to allow hunters additional time to hunt when snow conditions are more favorable for using snowmachines.

During the February 2014 meeting BOG reauthorized UYTPCP; however, moose were removed from the intensive management plan because it did not include any predator control efforts specifically intended to benefit moose. Furthermore, BOG failed to adopt a proposal to reimplement the grizzly bear control portion of UYTPCP (Appendix A).

Other Mortality

No new information was gathered on natural or human-caused mortality outside of harvest during this reporting period. Historic information on Unit 20E moose mortality is summarized in Gasaway et al. (1992).

Recommendations for Activity 2.1

- Continue to monitor total harvest for comparison with the IM harvest objective.
- Recommend to BOG to lower the IM harvest objective from 500–1,000 to 240–500 (3–5% of the IM population objective).
- Monitor and estimate mortality rates of calves and adult cows via monitoring of the radiocollared cows.

3. Habitat Assessment–Enhancement

ACTIVITY 3.1. Assess habitat condition.

Data Needs

Twinning rates are the primary metric used to assess nutritional health of the Unit 20E moose population. However, if twinning rates decreased to levels suggesting that the nutritional status may be low, a habitat assessment of forage plants could help determine if the moose were limited by habitat, and/or if moose were having an adverse impact on the landscape. This would be necessary in order to achieve the goal of managing the moose population in concert with other components of the ecosystem.

Methods

No habitat assessment surveys or enhancement were completed during this report period.

Results and Discussion

None this reporting period.

Recommendations for Activity 3.1

As described in activity 1.2, if twinning rates declined to <20%, a browse survey could be initiated to serve as a secondary measure of nutritional status.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

There were no nonregulatory management needs during this reporting period.

Data Recording and Archiving

- All GSPE and harvest data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm).

- 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 found in the file cabinet in the conference room in the Tok office.

Agreements

None.

Table 3. Unit 20E reported moose harvest, Interior Alaska, regulatory years[a] 2010–2014.

Regulatory year	General and registration reported harvest				Drawing permit harvest		Total reported harvest
	Male	Female	Unk	Total	DM794	DM796	
2010	164	0	0	164	0	1	165
2011	186	1	0	187	0	0	187
2012	182	1	0	183	0	0	183
2013	138	1	0	139	1	0	140
2014	222	0	0	222	0	0	222

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

Table 4. Unit 20E moose hunter residency and success, Interior Alaska, regulatory years[a] 2010–2014.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
2010	27	119	19	0	165 (26)	98	326	49	3	476 (74)	641
2011	30	134	23	0	187 (22)	127	462	59	4	652 (78)	839
2012	29	131	22	1	183 (22)	129	446	70	2	647 (78)	830
2013	16	111	13	0	140 (16)	102	527	86	2	717 (84)	857
2014	26	170	26	0	222 (27)	102	432	65	1	600 (73)	822

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).
[b] Residents of Unit 12, Unit 20E, and eastern Unit 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

Table 5. Unit 20E moose harvest and percent by transport method, Interior Alaska, regulatory years[a] 2010–2014.

Regulatory year	Harvest and percent (%) by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV[b]	Highway vehicle	Unknown	*n*
2010	33 (20)	1 (1)	20 (12)	72 (44)	0 (0)	14 (8)	18 (11)	7 (4)	165
2011	34 (18)	0 (0)	19 (10)	77 (41)	0 (0)	23 (13)	30 (16)	4 (2)	187
2012	29 (16)	0 (0)	19 (10)	88 (48)	0 (0)	20 (11)	26 (14)	1 (1)	183
2013	17 (12)	0 (0)	12 (9)	65 (46)	1 (1)	32 (23)	9 (6)	4 (3)	140
2014	41 (18)	0 (0)	19 (9)	108 (49)	0 (0)	27 (12)	18 (8)	9 (4)	222

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).
[b] ORV = off-road vehicle.

Permits

None.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Population estimates during RY10–RY14 indicate that the Unit 20E moose population was likely stable and lower than the IM population objective of 8,000–10,000 moose. However, the Unit 20E population estimates did not include an SCF, and approximately 40% of the unit was estimated via extrapolation. Therefore, it is difficult to accurately assess whether the IM population objective was met. Regardless, the population was likely below the objective, and it may be difficult to achieve the objective without further reductions in wolf and grizzly bear numbers in portions of the unit. In addition, twinning rates remained above those levels observed in nutritionally stressed populations, suggesting habitat was not a limiting factor during this reporting period.

Reported harvest during RY10–RY14 did not meet the IM harvest objective of 500–1,000 moose. Limited hunter access in much of the unit will make it difficult to achieve the harvest objective even if the IM population objective is achieved. Furthermore, harvest of 500–1,000 moose would represent a 5–12% harvest rate if the population was between 8,000–10,000 moose. Based upon research conducted in Unit 20A, where reproduction and predation (especially by bears) are relatively low compared to most of the rest of Interior Alaska, sustainable harvest rates were estimated at 5% during the late 1990s and early 2000s (Boertje et al. 2009). In addition, Gasaway et al. (1992) estimated that in low-density areas where bear and wolf predation is significant, sustainable harvest likely ranges from 2% to 5%. Therefore, harvest rates in excess of 5% in Unit 20E would likely be unsustainable unless there were significant reductions in predator populations. Furthermore, given the difficult access to much of the unit and the fact that the majority of harvest occurs in areas accessible from the Taylor Highway, the unitwide sustainable harvest rate is likely less than 5%. Therefore, a proposal should be submitted to BOG to change the IM harvest objective to 240–500 moose, which would represent a 3–5% harvest rate (based upon a 3% harvest rate of the lower population objective and 5% harvest rate of the higher population objective).

Bull:cow ratios were greater than or close to the management objective of 40 bulls:100 cows in southern Unit 20E, and the objective was not met in the Tok Northeast survey area in central Unit 20E. It is possible that the estimated low bull:cow ratio in the Tok Northeast survey area was the result of sampling error and does not accurately represent the bull:cow ratio in that portion of the unit. However, a second survey should be conducted in a larger portion of northern Unit 20E to both estimate the bull:cow ratio and obtain a population estimate for the portion of the unit which has not previously been surveyed using the GSPE technique. After a discussion with local advisory committees and an investigation into bull:cow ratios in adjacent units, it was determined that the unitwide bull:cow ratio of 40:100 was likely unnecessarily high and did not match the management goal to maximize sustained opportunity to hunt moose or the IM harvest objective of 500–1,000 moose. Therefore, the bull:cow ratio objective will be modified for the next reporting period.

II. PROJECT REVIEW AND RY15–RY19 PLAN

Review of Management Direction

MANAGEMENT DIRECTION

The current management direction and goals for Unit 20E moose are appropriate and will remain unchanged.

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.

G4. Maximize opportunities for nonconsumptive use of moose.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

C1. Unit 20E has a customary and traditional use finding for moose, with amounts necessary for subsistence uses (ANS) of 50–75 moose. New: 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 RY15–RY19 Plan | 1. Population Status and Trend | Methods" this document) is greater than or equal to the lower threshold of ANS (currently 50 moose).

Intensive Management

C2. Population objective: 8,000–10,000 moose. New: 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 RY15–RY19 Plan | 1. Population Status and Trend | Methods" this document) is greater than or equal to lower threshold of the IM population objective (currently 8,000 moose).

C3. Harvest objective: 500–1,000 moose available for harvest. New: This objective will be considered to be met if 3-year mean reported harvest or 4% of the midpoint of the unitwide prehunt moose population estimate (estimated once during the 5-year report period: see "II. Project Review and RY15–RY19 Plan | 1. Population Status and Trend | Methods" this document) is greater than or equal to lower threshold of the IM harvest objective (currently 500 moose). We will consider recommending to BOG (at the spring 2020 meeting) to reduce the harvest objective to 240–500 moose (3–5% harvest rate).

MANAGEMENT OBJECTIVES

M1. Maintain a posthunting ratio of ≥30 bulls:100 cows within the Taylor Corridor survey area and ≥40 bulls:100 cows in all other survey areas. This objective will be considered to be met if the midpoint bull:cow ratio estimate (determined annually for each area surveyed) falls above the objective.

- Management action will be considered if the midpoint estimate falls below the objective for 2 consecutive surveys, or conversely, if the midpoint estimate falls above the objective for 2 consecutive surveys. Examples of possible management actions, if the bull:cow ratio falls below the objective, include shortening the season or instituting an antler restriction.

This is revised for RY15–RY19 and is a change from the previous objective of a posthunting ratio of 40 bulls:100 cows in all survey areas. Schwartz (1998) suggested that higher density populations may not require as high of bull:cow ratios as lower density populations to maintain pregnancy rates, and previous research found that pregnancy rates of moose in Alaska and British Columbia were not affected when bull:cow ratios ranged 4–29 bulls:100 cows (Bishop and Rausch 1974; Thomson 1991; Schwartz et al. 1992). With the management goal to maximize sustained opportunity to participate in hunting moose and the IM harvest objective of 500–1,000 moose, the bull:cow ratio of 40:100 was not biologically justified, particularly in the southern portion of Unit 20E where moose densities are considerably higher than in northern Unit 20E. Therefore, the objective was changed to that listed above, and the change was discussed with the Eagle and Upper Tanana–Fortymile Fish and Game Advisory Committees during February–March 2016.

M2. Allow for population growth in southern Unit 20E (within the Taylor Corridor, Tok West, and Tok Central survey areas) when the 3-year mean twinning rate is >20% and manage for population stability or reduction when the 3-year mean twinning rate is ≤20%, contingent on a secondary measure of nutritional status.

- Management action, including the option to begin measuring a secondary index of nutritional status, will be triggered if the mean 3-year twinning rate is ≤20% for 2 consecutive 3-year means.

This is a new objective for RY15–RY19 and was added to address the management goal to protect, maintain, and enhance the moose population in concert with other components of the ecosystem. By adding this objective, it allows for a clear link between nutritional condition and population growth or reduction, both of which are critical components to maintaining the population within carrying capacity.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. GSPE surveys: Population abundance and composition (objectives C1, C2, M1).

Data Needs

Data needs are the same as those described during the prior reporting period, with the addition that other than abundance and composition estimates are desired for the northern portion of Unit 20E which has not been previously surveyed using GSPE techniques.

Methods

Input from biometric staff will be sought to verify and, if needed, refine the following methods prior to conducting the following portions of this activity to ensure that high scientific standards are retained in methods and interpretation of results.

The GSPE technique will be used to complete all population and composition surveys (see "I. RY10–RY14 Management Report | 1. Population Status and Trend | Methods" this document; Kellie and DeLong 2006).

RY15

Complete a GSPE survey within the Taylor Corridor survey area by surveying 50 high density and 30 low density SUs. Deploy additional radio collars on adult cows to bring the total sample size to approximately 50 radiocollared cows, which will be used for future sightability trials (Note: Both of these had been completed by the time this plan was written).

The desired relative precision (RP) for the Taylor Corridor and the combined Tok West/Central survey areas for observable moose population estimates will be investigated and refined in collaboration with regional biometricians. As a starting point, the desired RP is within 15–20% of the mean at the 90% CI, and for composition estimates (calf:cow and bull:cow ratios) within 20–30% of the mean at the 90% CI. For the uncombined Tok West and Tok Central survey areas, as well as any new survey areas, the desired RP for observable moose population estimates is within 15–25% of the mean at the 90% CI, and for composition estimates within 20–35% of the mean at the 90% CI. When corrected for sightability, the desired RP for the Taylor Corridor and combined Tok West/Central survey areas for population estimates is within 20–25% of the mean at the 90% CI and for the uncombined Tok West/Central survey areas within 25–30% of the mean at the 90% CI.

RY16

To determine sample allocation for the RY16 GSPE survey, estimated sample variances from the RY12, RY14, and RY15 moose surveys were used to optimally allocate sampled SUs between strata and estimate a sample size sufficient for attaining an estimate of observable moose with a RP of 15% at the 90% CI. Using data from the RY12 survey (Tok West/Central survey areas), a sample size of 177 SUs was estimated as necessary to attain a RP of 15% at the 90% CI at an optimal allocation of 63% high:37% low SUs. Using data from the RY14 survey (Taylor

Corridor), a sample size of 93 SUs was estimated as necessary to attain a RP of 15% at the 90% CI at an optimal allocation of 62% high:38% low SUs. Using data from the RY15 survey (Taylor Corridor), a sample size of 80 SUs was estimated as necessary to attain a RP of 15% at the 90% CI at an optimal allocation of 59% high:41% low SUs. Finally, using the data from the combined RY12 Tok West/Central survey and the RY15 Taylor Corridor survey, a sample size of 134 SUs was estimated as necessary to attain a RP of 15% at the 90% CI at an optimal allocation of 60% high:40% low SUs. Since this combined estimate most closely matches the area to be surveyed and includes the most recent data collected, sample size and allocation will be based off of this.

Therefore, during RY16, the plan goal will be to complete a GSPE survey within the Taylor Corridor, Tok West, and Tok Central survey areas by surveying a minimum of 140 SUs (split between high density and low density SUs by a proportion of 60:40) distributed throughout the survey area. In addition, an SCF will be estimated using the radiocollared cows, with the goal of completing 20 sightability trials in both high and low density SUs for a total of 40 sightability trials. Biometric assistance will be used during the survey to compare precision of the total moose abundance estimate (with and without SCF) to the precision objectives.

If funding is not available to complete the entire Taylor Corridor, Tok West, and Tok Central survey areas as described above, the plan will be to complete a GSPE survey within the Taylor Corridor by surveying 80 SUs (split between low and high density SUs by a proportion of 60:40). The methods used to estimate an SCF will follow those described in the previous paragraph.

RY17–RY18

If funding is not available to complete the entire Taylor Corridor, Tok West, and Tok Central survey areas during RY16, complete a GSPE survey within this area during RY17 (using methods described in RY16). If this area is successfully surveyed during RY16, complete a GSPE survey within the Taylor Corridor survey area during RY17. In addition, complete a GSPE survey within the Taylor Corridor survey area during RY18. The total number of SUs sampled and allocation will likely be close to 80 total SUs with a ratio of 60% high:40% low; however, the final sample size and allocation will be determined based upon biometric assistance using the most up-to-date survey and variance data. In addition, estimate an SCF using the radiocollared cows using methods similar to those described in RY16. Biometric assistance will be used to finalize the methods for the SCF trials.

During either RY17 or RY18, if funding sources are available, complete a GSPE survey within the 3,150 mi^2 in northern Unit 20E outside of Yukon–Charley Rivers National Preserve not included in the Tok West, Tok Central, or Taylor Corridor survey areas.

RY19

Complete a GSPE survey within the Taylor Corridor, Tok West, and Tok Central survey areas using methods similar to RY16 (including estimating an SCF using the radiocollared cows). Similar to RY17–RY18, biometric assistance will be used to determine the sample size and allocation of SUs as well as final methods for the SCF trials.

Unitwide Population Estimate

Similar to the previous 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 20E, making annual estimates infeasible and likely inaccurate. The unitwide population estimate will be determined using a similar formula to that used during the previous reporting period, with the exception that the estimate will change from a posthunt to a prehunt estimate by adding the average annual reported harvest to the estimate. This change is being made to allow for more accurate estimates of moose available for harvest to evaluate whether the ANS and IM harvest objectives were met. In addition, the prehunt unitwide estimate will be compared to the IM population objective.

Analyze Population and Composition Trend

- With biometric assistance, population trend will be analyzed for the Taylor Corridor survey area and the combined Tok West and Tok Central survey areas using linear mixed effects models (DeLong and Taras 2009): https://winfonet.alaska.gov/sandi/trend/pdf/moose_trend_analysis.pdf

- With biometric assistance, composition (specifically bull:cow ratios) trend will be analyzed for the Taylor Corridor survey area and the combined Tok West/Central survey areas using linear mixed-effects models.

ACTIVITY 1.2. Twinning surveys (objective M2).

Data Needs

No change from prior reporting period.

Methods

Input from biometric staff will be sought to verify and, if needed, refine the following methods prior to conducting the following portions of this activity to ensure that high scientific standards are retained in methods and interpretation of results.

Methods will follow those described during the previous reporting period for spring 2015 when the twinning rate was estimated from a combination of radiocollared and randomly observed cows. However, the desired minimum sample size will increase from 30 to 40 cows with calves. With an annual sample size of 40 (or a 3-year sample size of 120), a power analysis indicated an 80% chance of detecting a change in twinning rate of ±10% at alpha equal to 0.1 (Figure 2). In other words, there would be an 80% probability of detecting a change of 10% from the trigger point of a 20% twinning rate. This is compared to an annual sample size of 30 (or a 3-year sample size of 90), for which the power analysis indicated an 80% chance of detecting a change in twinning rate of ±11% at alpha equal to 0.1. In addition, the desired precision for the 3-year mean twinning rate will be 5–8% of the mean at the 90% CI. The following guidelines, which will be based upon 3-year mean midpoint twinning rate estimates, will also be adopted:

- Twinning rate ≥20%: Conclude moose population has moderate to high nutritional status and is not habitat limited.

- Twinning rate <20% for 2 consecutive 3-year means: Conclude moose population has low to moderate nutritional status, and initiate a secondary measure to estimate nutritional condition (Boertje et al. 2007). The most feasible secondary index of nutritional status for Unit 20E would most likely be either a browse survey or weighing short-yearlings.

- With biometric assistance, estimate trend in twinning rates using logistic regression.

ACTIVITY 1.3. Deploy radio collars on adult cows (objectives C1, C2, M2).

Data Needs

Same as those described during the prior reporting period, with the addition that maintaining a sample size of approximately 50 radiocollared cows will allow for adequate sample sizes to be achieved during twinning surveys and SCF trials.

Methods

Captures and collaring will occur as needed (i.e., annually or biennially) following the same methods as described during the prior reporting period (RY10–RY14) to maintain a sample size of approximately 50 radiocollared cows during this report period (RY15–RY19).

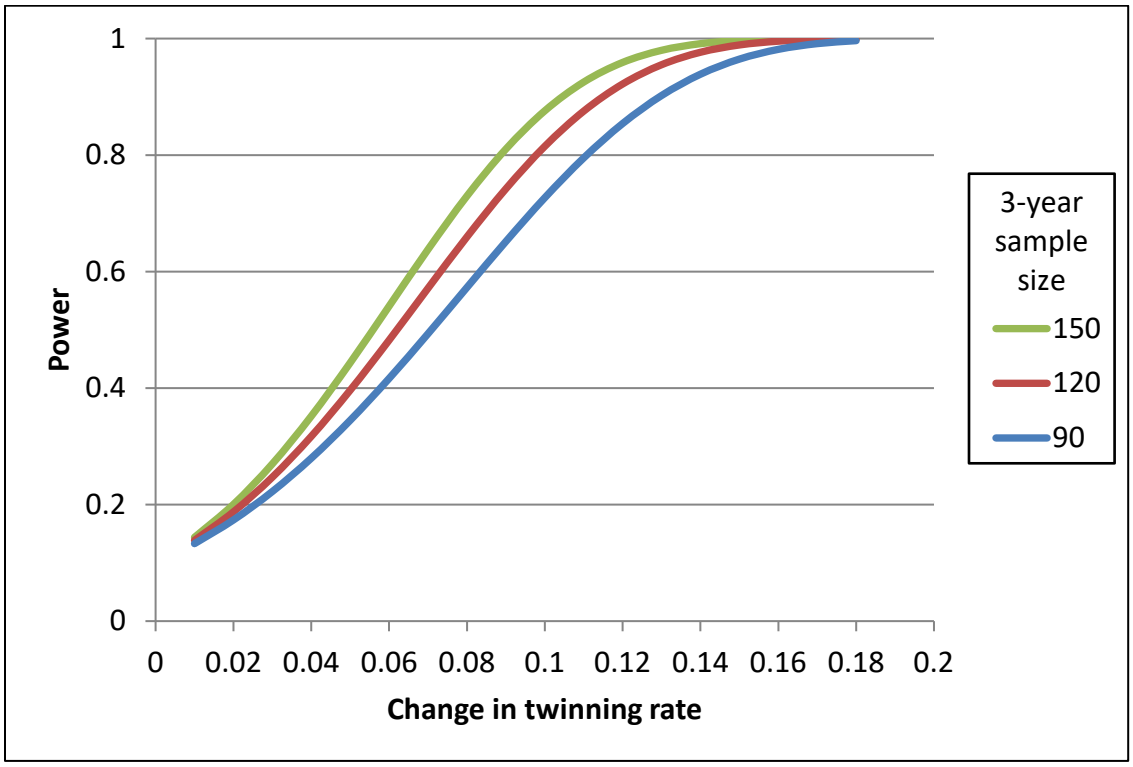

Figure 2. Estimated power to detect a change in moose twinning rates in southern Unit 20E, Interior Alaska, based on 3-year samples sizes of 90, 120, and 150 (colored lines; alpha = 0.1).

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 prior reporting period, other than the items listed below. In addition, input from biometric staff will be sought to verify and, if needed, refine the following methods prior to conducting the following portions of this activity to ensure that high scientific standards are retained in methods and interpretation of results.

- Total reported harvest, using a 3-year running mean to account for annual variation, will be compared to the IM harvest objective to determine whether the objective was met (the IM harvest objective will also be assessed using the unitwide population estimate - see "II. Project Review and RY15–RY19 Plan | Codified Objectives | Intensive Management" this report).
- Harvest rate will be estimated by dividing the mean annual harvest for the 5-year report period by the midpoint unitwide population estimate.
- With biometrician, review use of linear regression models to evaluate harvest trends.

Mortality rates of calves and adult cows will be estimated via monitoring of the radiocollared cows. Review mortality estimates for calves and adult cows with biometric and research staff.

3. Habitat Assessment–Enhancement

ACTIVITY 3.1. Assess habitat condition (goal to protect, maintain, and enhance the moose population in concert with other components of the ecosystem).

Data Needs

If the 3-year mean twinning rate <20% for 2 consecutive 3-year periods, a secondary measure of nutritional condition will be initiated. A browse survey is one option for a secondary measure of nutritional status (the other feasible option being weighing short-yearlings).

Methods

If a browse survey is initiated, methods will follow methods described in Seaton et al. (2011) and sampling design reviewed by biometric. Input from biometric staff will be sought to verify and, if needed, refine the methods prior to conducting this activity to ensure that high scientific standards are retained in methods and interpretation of results.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

No new issues have been identified.

Data Recording and Archiving

RECORDING

- GSPE Moose Survey Form (archived in (http://winfonet.alaska.gov/index.cfm) *WinfoNet* under *Data Archive* (folder *Unit 20E moose*) (Appendix B).
- Moose Twinning Survey Form (archived in *WinfoNet* (http://winfonet.alaska.gov/index.cfm) under *Data Archive* (folder *Unit 20E moose*) (Appendix C).
- ArcGIS version 10.3 (store and analyze spatial data).

ARCHIVING

- Harvest data and GSPE survey data will be 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 will be located on the Tok server (S:\Wells\moose and S:\Wells\MAPS). All hard copy data sheets, paper files, etc. are found in the file cabinet in the conference room in the Tok office.
- In addition, survey memos and other pertinent electronic survey information (e.g., survey maps) will be archived in *WinfoNet* under *Data Archive* (folders *Region III Memos* and *Unit 20E moose captures*).

Agreements

None.

Permitting

Institutional Animal Care and Use Committee (IACUC) Unit 20E moose 2015-12 and 2016-05.

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Appendix A. Moose radiocollaring proposal for southern Unit 20E, Interior Alaska.

Moose Radiocollaring Proposal for Southern Unit 20E

Spring, 2015
Alaska Department of Fish and Game
Tok, Alaska

Location: Southern Unit 20E.

Need:

1 Statement

Predation is the primary factor limiting moose population size and growth in Unit 20E (Gasaway et al. 1992), but continued monitoring of the nutritional status of 20E moose is important in light of an increasing population and changing habitat conditions. Moose twinning rates are the most widely available index to nutritional status in Alaska (Boertje et al. 2007), and twinning rates have been estimated in Unit 20E with transect surveys since 2004. This project will continue monitoring Unit 20E moose twinning rates, but larger samples sizes and more efficient surveys will be achieved through following radiocollared cows and secondarily through observations of parturient cows randomly found during radiotracking flights. Furthermore, this project will also allow us to 1) estimate a sightability correction factor, 2) refine moose survey areas according to the movement of collared animals between the hunting season and November, 3) identify important calving areas, and 4) estimate adult parturition and survival rates.

2 Background and Justification

The intensive management moose objectives established in Unit 20E are for a population of 8,000–10,000 moose, with a harvest of 500–1,000 annually. The 2012 Unit 20E moose population estimate was 4,500–6,400 observable moose, with an estimated density of 0.47–0.65 moose/mi^2 of moose habitat (9,750 mi^2). Based on surveys conducted within 4,630 mi^2 in southern Unit 20E during 2004–2012, the observable moose population increased from an estimated 2,268 moose (0.49 moose/mi^2) in 2004 to 4,165 moose (0.90 moose/mi^2) in 2012. Although southern Unit 20E currently appears to have a large amount of high quality moose habitat due to wildfires during 1998–1999 (≥400,000 acres) and 2004–2005 (≥1,000,000 acres), monitoring the nutritional status of this population is important to ensure the population does not become nutritionally stressed as the population increases and/or habitat conditions change.

Twinning rates were estimated in southern Unit 20E during 2004–2013 using transect surveys in areas historically used as moose calving areas. Although a minimum sample size of 50 cows with calves is preferable for statistical reasons, a minimum sample size of 30 was established for southern Unit 20E due to low moose densities and a limited budget for conducting twinning surveys. During 2004–2010 and 2012–2013, an average of 32 parturient cows was observed in 15.1 hours of survey time per year. Twinning rates ranged 17–47% ($\bar{x}$ = 31%) and an average of 2.1 parturient cows were observed per hour of survey time. The majority of cows with calves were observed in the vicinity of Mosquito Flats in southwest Unit 20E, and although some time was spent surveying east

of the Taylor Highway, few parturient cows were observed due to thick cover and low moose densities.

By collaring adult cows in southern Unit 20E, this project will allow for twinning surveys to be conducted in a more efficient manner, thereby allowing for larger samples sizes to be achieved with little or no additional flight time as compared to surveys conducted during 2004–2013. A larger sample size will allow us to more quickly detect a change in twinning rates, which would otherwise require more years of sampling to detect with a smaller sample size. Furthermore, following collared cows will allow us to estimate twinning rates from a wider swath of southern Unit 20E, including areas where transact surveys have been unsuccessful in the past. Therefore, twinning rates estimated from a combination of collared and randomly-located parturient cows will be attained in a more efficient manner and will be a more accurate representation of the twinning rate of southern 20E moose than the transect surveys conducted during 2004–2013.

In addition to collaring cows, we will collect data during the capture process that will aid in future twinning surveys and data analysis. Age will be determined by counting cementum annuli from a pulled canine tooth (aging will be completed by Matson's Laboratory). Known-age animals will be useful in order to partially account for bias that can result from estimating twinning rates from radiocollared moose due to underrepresentation of younger cohorts (Boertje et al. 2007). Secondly, pregnancy will be determined by collecting and analyzing blood sera for pregnancy-specific protein B (PSPB; Sasser et al. 1986). Known pregnancies will be useful in order to assess the efficiency of early, middle, and late twinning survey flights (e.g. what proportion and when are pregnant cows first seen with a calf).

Although twinning surveys would be the primary goal of collaring adult cows in southern Unit 20E, we could gain a multitude of additional information, if budgets allowed. First, a sightability correction factor (SCF) could be estimated for Unit 20E. Currently, moose population estimates for 20E are reported as observable moose. A SCF would allow for more accurate comparisons of population estimates to intensive management objectives and more precise estimates of sustainable yield. Second, moose survey areas could be refined according to movements of marked animals between the hunting season and November, when moose surveys are typically conducted in Unit 20E. Approximately 70% of the total Unit 20E moose harvest occurs in the southern portion of the unit along the Taylor Highway, but movement data of moose available to hunters (e.g. in areas along the Taylor Highway or trail systems) between the hunting season and surveys is unknown. Third, important calving areas could be identified. Little is known on calving areas in Unit 20E, and this information could be used to conduct twinning surveys in the future if collared cows are not available, guide land use decisions in order to protect important areas from human disturbance, and focus future intensive management. Fourth, this project would allow for estimates of parturition and survival rates. This would enhance our knowledge of the population dynamics of southern Unit 20E moose and allow for more accurate population modeling. Lastly, all of the above information could be used to guide future intensive management actions.

Approach:

Objective 1: Estimate twinning rates in southern Unit 20E from radiocollared cows and secondarily through observations of parturient cows randomly found during radiotracking flights.

> **Procedure:** Capture 25 adult cows each year during March–April 2015 and 2016. Each cow will be fitted with a VHF collar, a tooth will be pulled to determine age, and blood will be drawn to determine pregnancy rates. Twinning surveys using collared cows will begin in May 2015. Randomly observed cows will be recorded and will make up the remainder of the survey with an overall goal of a sample size of 50 parturient cows.

Objective 2: Identify Unit 20E moose calving areas.

> **Procedure:** Moose calving areas will be identified during twinning surveys using the collared cows.

Objective 3: Increase the accuracy of Unit 20E moose population estimates by determining a sightability correction factor.

> **Procedure:** Following captures, moose surveys will be conducted during November and a sightability correction factor using the collared cows will be estimated during the survey.

Objective 4: Determine seasonal movements of moose in southern Unit 20E.

> **Procedure:** Captures will occur in southern Unit 20E along the Taylor Highway, where the highest concentration of hunters and harvest in Unit 20E occurs. Periodic radiotracking flights will determine seasonal movements, but an emphasis will be placed on determining movements between the hunting season and November, when moose surveys are conducted.

Objective 5: Estimate parturition and survival rates of adult cows in southern Unit 20E.

> **Procedure:** If budgets allow, parturition rates of collared cows will be estimated using methods described in Boertje et al. (2007).

Budget:

	Estimated operating costs x 1000	
Objective 1 and 2: Captures and twinning surveys	**FY15**	**FY16**
Moose adult VHF collars ($325 each) n=25/year OR refurbish collars ($225 each = 5.7)	8.3	8.3
Visibility flags for collars ($50 each) n=25/year	1.3	1.3
Adult moose captures n=25/year		
R44 18 hours @ $700/hr	12.6	12.6
PA18 35 hours @ $235/hr	8.2	8.2

Post-capture flight PA18 4 hours @ $235/hr	1.0	1.0
Capture drugs for 25 adult cows	9.8	9.8
Age determination ($10.25/tooth) n=25/year	0.3	0.3
PSPB analysis ($25/sample) n=25/year (Biotracking)	0.5	0.5
Twinning surveys		
PA18 25 hours @ $235/hr	6.0	6.0
TOTAL	**48**	**48**

*Total amount remaining in the FY15 moose budget = $44k

Objective 3: Sightability Correction Factor	**FY15**	**FY16**
PA18 ?? Hours @ $235/hr	As budgets allow	

Objective 4: Seasonal movements	**FY15**	**FY16**
3 radiotracking flights: PA18 12 hours @ $235/hr	As budgets allow	

Objective 5: Parturition and survival rates	**FY15**	**FY16**
Parturition flights: PA18 55 hours @ $235/hr 18 flights @ 3 hrs/flight	As budgets allow	

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Appendix B. Spatial moose survey form.

SPATIAL MOOSE SURVEY FORM

Page ___ of ___ Form CTS 12/15/04

SEARCH IDENTIFICATION

Date: _____ SU #: _____
GMU: _____
Location: _____
Observer: _____
Pilot: _____
Aircraft Type: _____ Temp (F) _____

SEARCH TYPE (check one or both)

☐ Standard ~8-9 min/mi^2
☐ Composition ~ 4 min/mi^2
Strata pre-survey: _____
Strata post-survey: _____

Lat
Lon

SEARCH TIMES (in minutes)

Stop@ _____
Start@ _____
Elapsed _____

OVERALL SURVEY RATING: ☐ Excellent ☐ Good ☐ Fair ☐ Poor

SEARCH CONDITIONS

SNOW AGE
☐ 1. Fresh
☐ 2. < 1 week
☐ 3. >1 week

LIGHT TYPE
☐ 1. Bright
☐ 2. Flat

SNOW COVER
☐ 1. Complete
☐ 2. Some Low veg Showing
☐ 3. Bare Ground Showing

LIGHT INTENSITY
☐ 1. High
☐ 2. Medium
☐ 3. Low

% PREDOMINANT HABITAT TYPE IN SU
___1. Open lower elevation, predom shrub, riparian, or wetland
___2. Mixed Open Forest with some shrub understory
___3. Dense Spruce Forest
___4. Dense Deciduous Forest Birch, Aspen, etc. Few Shrubs
___5. Subalpine Shrub
___6. Burn- take a guess at the year burned _____
___7. Other (describe):
___8. Non search habitat (rock, ice, alpine, etc)

CHECK ADDITIONAL CONDITIONS THAT MAY HAVE AFFECTED THE QUALITY OF THE SEARCH

☐ Classification Errors
☐ Uncooperative Pilot
☐ Inadequate Search Effort
☐ Short on Fuel
☐ Windy/Turbulent
☐ Other (Explain):
☐ Inadequate Snow Cover
☐ Inexperienced Pilot
☐ Movement In/Out Of Intensive
☐ Movement In/Out of SU
☐ Improper Aircraft
☐ Poor Light
☐ Inexperienced Observer
☐ Too Many Moose in Intensive (>15)
☐ Observer Airsick
☐ Low Clouds or Fog
☐ Poor Visibility/Snow on Trees
☐ Problems finding SU Boundaries
☐ Observer Sleeping

OTHER SPECIES----- _____# of Ptarmigan seen in unit

Group No.	Bulls					Cows				MISC		Total Moose	Remarks/Waypoint/Lat-Lon
	Yearling		Medium		Lrg	Cow w/0	Cow w/1	Cow w/2	Cow w/3	Lone Calf	Unk		
	=SF	>SF	31-40	41-50	>50								
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													
11.													
12.													

Additional Lines on Back of Sheet if Needed

Survey Summary (Do not add calves to cows in column totals)													
1-12													Survey Unit Summary:
13-46													# Moose in SU Search:
Total													% Potential search habitat in SU:

Appendix C. Moose twinning survey form.

PAGE ____ OF ____

MOOSE TWINNING SURVEY

GMU_____ DATE_____ PILOT_____ OBSERVER_____

WEATHER START (temp, cloud cover, wind)_____

WEATHER END (temp, cloud cover, wind)_____

TIME LEAVE TOK_____ TIME START SURVEY_____ TIME END SURVEY_____ TIME BACK TO TOK_____

% LEAF-OUT (shrubs/trees)_____COMMENTS_____

Group #	BULL	Yearling COW	Cow w/0	Cow w/1	Cow w/2	Cow w/3	Location / Remarks
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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