Species Management Report and Plan ADF&G/DWC/SMR&P–2025–12

Moose Management Report and Plan, Game Management Unit 24:

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

Glenn W. Stout

2025

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 24 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., RY19 = 1 July 2019–30 June 2020). 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 previously produced every 2 years.

I. RY15–RY19 Management Report

Management Area

Unit 24 (26,068 mi^2) is further divided into Units 24A (4,146 mi^2), 24B (13,523 mi^2), 24C (3,049 mi^2), and 24D (5,350 mi^2). It is located in western Interior Alaska and encompasses the Koyukuk River drainage upstream of the Dulbi River drainage. Portions of 4 ecoregions found in Unit 24 include the Brooks Range, Ray Mountains, Kobuk Ridges and Valleys, and Yukon River lowlands (Nowacki et al. 2001). Current maps for Unit 24 boundaries and special management areas are found at http://www.adfg.alaska.gov/index.cfm?adfg=maps.main.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 24

Moose are broadly distributed throughout much of Unit 24 with local densities (0.25–2.0 observable moose/mi^2) typical of Interior Alaska. Anecdotal evidence indicates the population was low prior to the 1930s but increased during the 1930s–1950s (Huntington 1993). The rate of increase was probably slow until predator control efforts in the 1950s allowed rapid expansion of local moose populations, especially in the southern third of the unit (Woolington 1998). During the early 1970s the population leveled off in some areas. Survey data indicate populations climbed again in the late 1980s, peaked around 1992, then fell gradually through the remainder of the 1990s (Martin and Zirkle 1996, Stout 2002).

Naturally-occurring wildfires, floods, and stream bank erosion are major forces affecting the productivity and diversity of moose habitat in this area. Habitat is excellent along most of the Koyukuk River lowlands, providing extensive areas of winter browse and aquatic vegetation in summer and fall. Lightning-caused fire is a frequent event, and large areas of the burned uplands are productive browse communities. Based on habitat surveys in spring 2007 and twinning surveys conducted in Unit 24D and 24B (Stout 2018), browse production does not appear to be limiting the size of the moose population in most of Unit 24 (Paragi et al. 2008).

The lower portion of the Koyukuk River within Unit 24 is the focus of most of the department's management effort because of the long history of use, higher moose densities, and increasing hunting activity. The Koyukuk River and major tributaries have long been popular moose hunting areas for Unit 24 residents, other Alaska residents, and nonresidents. Hunting activity increased in other portions of the unit in the early 1990s, including rivers accessible from the Dalton Highway, after the highway opened to the public in 1981. Two controlled use areas (CUA) restrict use of aircraft for moose hunting activities: the Koyukuk CUA and the Kanuti CUA, established in 1978 and 1979, respectively. The Dalton Highway Corridor Management Area prohibits use of off-road vehicles and firearms for hunting within 5 miles on either side of the Dalton Highway, except for federally qualified rural residents.

Annual reported harvest did not exceed 100 moose in Unit 24 until 1980 and was highest in 1999 at 240 moose (Stout 2014a). Unreported harvests during the 1980s and 1990s were probably 160–300 moose per year (Woolington 1998). Local residents have since become more aware of the importance of harvest reporting, resulting in increased compliance with reporting requirements.

There are several moose hunting seasons in Unit 24 that reflect the variety of moose densities and human-use patterns. In addition to the usual September hunting season, open seasons in state and federal regulations from December through April also provide hunting opportunity for residents of Alaska. A registration permit moose hunt was established in 1996 in the Koyukuk CUA downstream from Huslia. Drawing hunts were established in the Koyukuk CUA in 2000, the Dalton Highway Corridor Management area in 2002, and drainages around the Koyukuk CUA in 2004.

An intensive management program was conducted from RY12 through RY17, with the primary objective of increasing moose abundance in a 1,360 mi^2 portion of Unit 24B, referred to as the Upper Koyukuk Management Area (UKMA). The program focused on improving survival of calves and yearlings through wolf predation control. Moose abundance increased in the area following wolf control efforts, but the association between control activities and increased moose abundance is confounded by concurrent mild winters during the control period. Harvest by local hunters did not increase.

Management Direction

Existing Wildlife Management Plans

- The *Koyukuk River Moose Management Plan 2000–2005: Unit 24 and the northern portion of Unit 21D* was published in March 2001 and is still active (Koyukuk River Moose Hunters Working Group 2001). This plan identified predation on moose as significant and increasing. It stipulated an objective to provide for increased harvest of predators of moose (including wolves [*Canis lupus*]) and a recommendation to implement aerial wolf control to make progress toward intensive management objectives for moose abundance and harvest).

- The *Operational Plan for Intensive Management of Moose in Game Management Unit 24(B) during Regulatory Years 2012–2017* was published in 2012 (ADF&G 2012).

This operational plan defined an experimental program for wolf control in an area including the villages of Allakaket and Alatna to benefit moose survival for increasing sustainable harvest of moose. The operational plan complements the intensive management plan in regulation (5 AAC 92.124). The intensive management plan became inactive in RY18.

GOALS

G1. Manage moose in the Koyukuk River drainage on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

C1. Unit 24 has a positive finding for customary and traditional uses for moose and amounts reasonably necessary for subsistence uses of 170–270 available moose (5 AAC 99.025).

Intensive Management

All of Unit 24 has a positive finding for intensive management (IM). An IM plan (5AAC 92.124(c)) was adopted by the Alaska Board of Game (board) at the 2012 meeting which prescribed wolf predation control to increase moose calf and yearling survival in a 1,360 mi^2 portion of Unit 24B (ADF&G 2012).

		Moose intensive management objectives (5 AAC 92.108)	
Codified objectives	Unit	Population objective (5 AAC 92.990(63))	Harvest objective (5 AAC 92.990(35))
C2	24A	1,200–1,500	75–125
C3	24B	4,000–4,500	150–250
C4	24C	1,000–1,500	50–125
C5	24D	5,000–6,000	225–425

MANAGEMENT OBJECTIVES

M1. Maintain a moose population of 11,000 moose.

M2. Provide for an annual harvest of moose not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

M3. Provide for moose hunting opportunities not to exceed 500 hunters per regulatory year.

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct Geospatial Population Estimation surveys (objectives C1–C5, M1).

Data Needs

A statistical estimate of the moose population is needed to evaluate the status of the population and determine whether the objective to maintain a fall moose population of approximately 11,000 moose was achieved. This is derived from Geospatial Population Estimator (GSPE) surveys and a measure of precision is needed to detect change in the population. Where a GSPE cannot be conducted regularly, trend count surveys (Activity 1.2) will be conducted to monitor change in calf-to-cow, yearling bull-to-cow, and total bull-to-cow ratios. Calf-to-cow and yearling bull-to-cow ratios can be used to assess productivity and recruitment, and total bull-to-cow ratios will assess harvest effects on the population.

In cooperation with U.S. Fish and Wildlife Service (USFWS) and U.S. Bureau of Land Management (BLM), DWC wildlife biologists conduct GSPE surveys in Unit 24B (Kanuti Refuge) to estimate abundance and evaluate population status and trend. Calf-to-cow ratios and yearling bull-to-cow ratios are used to evaluate annual productivity and recruitment. Total bull-to-cow ratios are used to evaluate harvest sustainability.

To establish a baseline inventory of the moose population in Unit 24A, GSPE surveys are used to estimate abundance. Note that this is only possible if incremental funding is available and it does not compromise completion of the other activities. This is a low priority in the region and is conducted in cooperation with USFWS and BLM.

In cooperation with USFWS, GSPE surveys in Unit 24D (in combination with Unit 21D) are needed to estimate abundance to evaluate population status and trend. We need calf-to-cow ratios and yearling bull-to-cow ratios to evaluate annual productivity and recruitment. We need total bull-to-cow ratios to evaluate harvest sustainability.

Total Unit 24 moose abundance is needed to calculate harvest rate and harvestable surplus.

Methods

GSPE surveys

- Maintain a survey unit (SU) ratio of 65% high density moose SUs to 35% low density moose SUs.
- Conduct one baseline, high intensity survey in Unit 24A (<20% confidence interval [CI]; >200 SUs) that includes an aerial stratification if incremental funding is available. A Unit 24A survey would provide a baseline inventory of the population and would not be intended for repeated monitoring.
- In Unit 24B alternate high (10–20% CI; 170–200 SUs) and low intensity (20–30% CI; 100–170 SUs) surveys, with high intensity surveys once every 5 years and 2–3 low

intensity surveys during intervening years. Based on historical survey data of the Kanuti survey area, an optimum survey frequency will be evaluated by staff biometricians during RY15–RY19.

- In Unit 24D (in combination with Unit 21D), conduct a high intensity survey (<20% CI; 300–350 SUs), once every 5 years.
- Population estimates (upper range approximations; Table 1) will be compared to the minimum level of the amounts reasonably necessary for subsistence, the midpoint of the IM, and management objectives.

Beginning in 1999, we conducted fall population estimation surveys and analyzed data from all population estimation surveys using the GSPE method (Ver Hoef 2001, 2008; Kellie and DeLong 2006; Stout 2010).

In 2010 Koyukuk National Wildlife Refuge (NWR) staff conducted a survey of a 1,361 mi^2 area on the western portion of the refuge in Unit 24D using GSPE methods described by Stout (2010). In 2011 we completed a GSPE survey in a portion of Unit 24D that overlapped the area conducted in 2004 described by Stout (2010). Methods and results of the 2011 survey are described in Stout (2012a).

In 2015 and 2017 we completed GSPE surveys on the Kanuti NWR in Unit 24B covering 2,715 mi^2 and a 1,021 mi^2 area west of the Kanuti NWR referred to as the Upper Koyukuk Management Area. The Kanuti NWR portion of the survey area overlapped with surveys conducted during 1999–2008 (Stout 2018). Stratification of sample units (SU) were flown in 2015, and the 2015 stratification was used for the 2017 survey. Intensively surveyed SUs were flown from small fixed-wing aircraft (PA-18 or similar aircraft) described by Stout (2010). Results for the 2015 survey are reported in R. Churchwell (USFWS) and G. Stout (unpublished survey report, May 2016). Results for the 2017 survey are reported in E. Julianus (BLM) and S. Longson (unpublished survey report, February 2018). We used a Bayesian approach for trend analysis described by Ver Hoef (2001) and applied a multiplicative mixed-effects model for the 1999–2017 Kanuti surveys. For that trend analysis, we applied sightability correction factors (SCFs) of 1.27 and 1.05 to the 2008 and 2010 results, respectively. The average of those 2 years (SCF = 1.16) was applied to the remaining Kanuti NWR GSPE estimates during 1999–2017.

Unit 24 moose population estimates for RY19 were obtained using methods described in Stout (2010). I included range approximations for population estimates to indicate uncertainty in the estimate. Range approximations were variable based on knowledge of the area. Values that include a 90% confidence interval (CI) use statistically derived variances. However, values followed by a (±) symbol that do not have a 90% CI designation were based on knowledge of the area and previously conducted surveys but are not statistically derived.

Results and Discussion

Units 24A and 24B

GSPE surveys were completed during the prior report period in RY10, RY11, and RY13; and during this report period in RY15 and RY17 (Tables 1–5). In the 2015 GSPE survey, DWC staff classified 483 moose, and estimated 1,158 moose (±18.3%; 90% CI; 0.43 moose/mi^2) in the

same area, not including an SCF. The unbiased estimate of 1,158 moose (±18.3%; 90% CI) in RY15 was significantly different from the RY13 estimate of 551 (Table 2). However, the multiplicative mixed-effects model for 1999–2017 indicated the population trend was stable (λ = 0.99; CI ±0.96–1.03; J. Merickel, ADF&G Biometrician, memorandum, 7 March 2016, Fairbanks) for the Kanuti survey area. In the 2017 GSPE survey, we classified 437 moose, and estimated 1,311 observable moose (±19.2%; 90% CI; 0.48 moose/mi^2) in the same area. The unbiased estimate of 1,311 moose (±19%; 90% CI) in RY17 was not significantly different from the RY15 estimate. The multiplicative mixed-effects model for 2010–2017 indicated the population trend was slightly increasing (λ = 1.09 (±1.02–1.17); J. Merickel, ADF&G Biometrician, memorandum, 10 January 2018, Fairbanks) for the Kanuti survey area. The Upper Koyukuk Management Area estimates in Unit 24B increased during RY15–RY19 (Table 1).

I estimated the RY19 moose population in Units 24A and 24B to be 3,993 observable moose (±1,101) based on the RY10, RY11, RY13, RY15 and RY17 GSPE surveys in Unit 24B and data reported in Stout (2010). In the Middle Fork trend count area (TCA), observable moose density was relatively unchanged at 0.81 moose/mi^2 in RY11 and 0.88 moose/mi^2 in RY17 (Table 5).

Unit 24C

I estimated the RY19 moose population to be 562 observable moose (±130) based on the 2007 GSPE data (Tables 1 and 4; Stout 2012a).

Unit 24D

During RY15–RY19, moose were numerous based on previous surveys and inference from TCAs in the Koyukuk River lowlands in Unit 24D (1.5–4.3 moose/mi^2, Stout 2014a). Based on recruitment parameters, the population probably began to stabilize beginning around 2003–2004 (Stout 2010). I estimated the RY19 moose population to be 4,380 moose (±477; Table 1) based on the 2010 and 2011 GSPE surveys and estimates reported in Stout (2012a).

All of Unit 24

GSPE surveys indicated ratios of 38 bulls:100 cows in Unit 24D but ranged as high as 75–79 bulls:100 cows in Units 24B and 24C. Surveys through RY17 helped refine the overall estimate within Unit 24. At the end of RY10, I estimated the total Unit 24 population to be 8,509 observable moose ±1,587 (6,922–10,096), based on the addition of extrapolated population estimates previously reported (Stout 2010) and estimates reported for each subunit. At the end of RY19, including the adjustment to the Unit 24B portion, and no changes in the remainder of Unit 24, I estimated the Unit 24 population at 8,935 observable moose ±1,708 (7,227–10,643; Table 1).

Recommendations for Activity 1.1

Continue GSPE surveys annually and evaluate abundance, productivity, survival, recruitment, and sex ratios.

Table 1. Unit 24 total population estimation summary, Interior Alaska, regulatory years 2004–2019.

	Survey area	Area mi^2	Total sample units	Bulls: 100 cows	Calves: 100 cows	Population estimate without sightability correction factor[a]
Units 24A and 24B[b]	2008 estimated	8,779				1,929 ±550
	2004–2017 survey block average (Kanuti Refuge)[c]	2,715	508	75:100	40:100	1,311 ±251
	Moose habitat Unit 24, north[d]	3,402				595 ±200
	Remainder Unit 24, north[e]	3,150				158 ±100
	Subtotal (2004–2011)	18,046				3,993 ±1,101
Unit 24C[b]	2007 Survey block (Hogatza River)	2,672	498	70:100	45:100	562 ±129 (90% CI)
	Subtotal (2007)[c]	2,672				562 ±130
Unit 24D[f]	2011 Survey block (lower Koyukuk River)[c]	1,843	336	38:100	23:100	2,627 ±210 (90% CI)
	2007 Survey block (eastern Koyukuk Refuge)[c]	1,623	296	78:100	42:100	983 ±93 (90% CI)
	2010 Survey block (western Koyukuk Refuge)[c,g]	1,361	249	79:100	28:100	640 ±139 (90% CI)
	Remainder Unit 24D	523				130 ±35
	Subtotal (2007–2011)	5,350				4,380 ±477
Unit 24	Total	26,068				8,935 ±1,708

[a] Values following (±) symbol without a 90% CI designation are range approximations and are not statistically derived confidence intervals (CI).
[b] Cumulatively, Units 24A (4,146 mi^2), 24B (13,523 mi^2), and 24C (3,049 mi^2) were formerly defined as Management Zone 2 (Stout 2006).
[c] Geospatial population estimation survey.
[d] The estimated area of Units 24A and 24B that could potentially support moose year-round, based primarily on occurrence of rocky slopes, altitude, and deciduous canopy.
[e] The area remaining in Units 24A and 24B with very little year-round moose habitat, primarily the high-altitude mountainous portion within Gates of the Arctic National Park.
[f] Unit 24D (5,350 mi^2) was formerly defined as Management Zone 1 (Stout 2006).
[g] Survey results provided by Koyukuk National Wildlife Refuge.

Table 2. Unit 24B Kanuti National Wildlife Refuge population estimation surveys, Interior Alaska, regulatory years 2010–2017.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Calves: 100 cows	Yearling bulls: 100 cows	Percent calves	Adults	Population estimate (90% CI[a])	Moose/mi^2
2010	2,715	51	33	8	17.5	861	1,068 (±11.5%)	0.39
2011[b]	2,715	69	41	10	19.9	656	797 (±19.3%)	0.29
2013[b]	2,715	65	36	11	19.6	466	551 (±25.7%)	0.20
2015[b]	2,715	62	50	10	24.7	878	1,158 (±18.3%)	0.43
2017[b]	2,715	75	40	15	17.7	1067	1,311 (±19.2%)	0.48

[a] Confidence interval (% ±).
[b] GSPE survey estimate, without sightability correction factor.

Table 3. Unit 24B Upper Koyukuk Management Area Geospatial Population Estimation surveys, Interior Alaska, regulatory years 2010–2017.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Calves: 100 cows	Yearling bulls: 100 cows	Percent calves	Adults	Population estimate (90% CI[a])	Moose/mi^2
2010	1,340	52	34	8	18.3	328	405 (±23.9%)	0.30
2011[b]	1,340	103	49	8	18.8	250	324 (±29.0%)	0.24
2013[b]	1,340	67	37	11	17.4	243	300 (±31.4%)	0.22
2015[b]	1,340	78	54	13	23.1	396	509 (±26.9%)	0.38
2017[b]	1,340	84	49	18	20.9	516	631 (±22.8%)	0.47

Note: Area partially overlaps Kanuti National Wildlife Refuge survey area.
[a] Confidence interval (% ±).
[b] Without sightability correction factor.

Table 4. Units 24C and 24D Geospatial Population Estimation (GSPE) survey, Interior Alaska, regulatory year 2007.

Area	Survey area (mi^2)	Bulls: 100 cows	Calves: 100 cows	Yearling bulls: 100 cows	Percent calves	Adults	Population estimate (90% CI[a])		Moose/mi^2
Eastern Koyukuk Refuge	1,623	78	42	14	18.7	796	983	(±9.5%)	0.61
Hogatza River	2,672	70	45	16	20.7	442	562	(±23.0%)	0.21
GSPE calculated total	4,295	75	43	14	19.4	1,239	1,545	(±10.6%)	0.36

[a] Confidence interval (% ±).

Table 5. Unit 24A Middle Fork trend count area aerial moose composition counts, Interior Alaska, regulatory years 2011–2017.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2011	113.6	21	5	30	6	20	92	0.81
2015	113.6	58	4	18	2	10	88	0.77
2017	113.6	49	11	26	7	15	100	0.88

Note: Bureau of Land Management data.

ACTIVITY 1.2. Conduct trend count area (TCA) surveys (objectives C1–C5, M1).

Data Needs

In cooperation with BLM, we need to assess trend in ratio parameters and plan to conduct a TCA survey biennially in the Unit 24A Middle Fork TCA. In cooperation with USFWS, we need to assess trend in ratio parameters and plan to conduct TCA surveys annually in Unit 24D Huslia Flats and Treat Island TCAs. If USFWS or BLM are unable to continue cooperative survey efforts, we will reexamine the viability of this activity.

Methods

- In Unit 24A, in cooperation with BLM, conduct an aerial survey of the Middle Fork TCA (22 SUs; 113.6 mi^2) biennially.
- In Unit 24D, in cooperation with USFWS, conduct an aerial survey of the Huslia Flats TCA (26 SUs; 142.3 mi^2) and the Treat Island TCA (30 SUs; 163.3 mi^2) every year.

In Unit 24D, the midpoint estimate of the bull-to-cow ratio for the Koyukuk CUA was compared to the management objective of 30 bulls:100 cows (Stout 2014b). The Huslia Flats and Treat Island TCAs from Unit 24D were combined with the Koyukuk River mouth, Three Day Slough, and Dulbi River mouth TCAs from Unit 21D, and analyzed as the Koyukuk CUA Core-5 TCAs (Stout 2014b).

Composition data were derived from results of counts from fall trend count area (TCA) surveys (or GSPE surveys, Activity 1.1). Moose in 4 TCAs (Dulbi Slough, Huslia River flats, Treat Island, and Middle Fork) were classified as cows, calves, yearling bulls (<30 inch antler width and no brow tine definition), medium bulls (≥30 inch and <50 inch antler width), or large bulls (≥50 inch antler width) using methods previously described (Stout 2010). These surveys were conducted in cooperation with staff from the Koyukuk NWR, Kanuti NWR, and BLM in RY15–RY19. Due to low snow and poor survey conditions, no TCA or GSPE surveys were conducted by ADF&G in RY16.

Results and Discussion

Population composition from TCA (and GSPE) surveys conducted during RY15–RY19 throughout Unit 24 were highly variable (Tables 1–8). Generally, moose density trends in TCAs corroborated with GSPE composition data and indicated the population peaked in the mid-1990s and declined through RY03 in most of Unit 24, but began to stabilize from RY04 to RY19 except in Unit 24D where the decline appears to persist.

Bull-to-Cow Ratios

Bull-to-cow ratios of >30 bulls:100 cows observed in TCA (and GSPE surveys; Tables 1–8) indicate the bull component of the population was not overharvested in Unit 24 during RY15–RY19, and breeding activity was unaffected, even in Unit 24D. Schwartz (1998) suggested a ratio of 20–30 bulls:100 cows is needed to ensure breeding of all available cows. Bull-to-cow ratios during RY15 (58 bulls:100 cows) and RY17 (49 bulls:100 cows) in the Middle Fork TCA (in Unit 24A) were questionable due to small sample size (Table 5). In general, most ratios in TCAs with counts of less than 100 moose tended to have larger annual variation that made interpretation difficult.

Unit 24D bull-to-cow ratios during RY15–RY19 were generally stable in Dulbi Slough (32 bulls:100 cows; Table 6), Huslia River flats (29–40 bulls:100cows; Table 7), and Treat Island (24–40 bulls:100 cows; Table 8) and were typically lower than the GSPE composition data (Tables 1–4). This can likely be explained by higher hunting pressure in higher density moose areas near riparian areas. The higher density moose areas typically attracted higher levels of hunting pressure because they are more accessible by boat.

Calf and Yearling Ratios

Ratios of calves and yearling bulls to 100 cows in Unit 24D were variable. Combined averages for Huslia Flats and Treat Island TCAs in Unit 24D indicated calf recruitment to 5 months of age was low (average 25.1 calves:100 cows) in the 5 surveys conducted during RY15–RY20. Yearling recruitment during RY15–RY20 (average 9.4 yearling bulls:100 cows) appeared only slightly below normal. Results from the GSPE survey on the Kanuti NWR in Unit 24B in RY15 and RY17 indicated that recruitment to 5 months of age averaged 45.0 calves:100 cows, and recruitment to 17 months of age averaged 12.3 yearling bulls:100 cows.

Recommendations for Activity 1.2

Continue TCA surveys annually and evaluate abundance, productivity, survival, recruitment, and sex ratios.

Table 6. Unit 24D Dulbi Slough trend count area aerial moose composition counts, Interior Alaska, regulatory years 2011–2015.

Regulatory year	Survey area (mi^2)	Bulls: 100 Cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2011	132.8	47	10	32	9	17.6	204	1.5
2014	138.3	30	3	18	0	12.4	177	1.3
2015	132.8	32	4	18	5	12.0	167	1.3

Note: U.S. Fish and Wildlife Service data. Surveys used Geospatial Population Estimator sample units (Kellie and DeLong 2006).

Table 7. Unit 24D Huslia River flats trend count area aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	142.3	29	8	38	11	22.7	555	3.9
2017	142.3	40	14	31	11	17.9	665	4.7
2018	142.3	39	12	23	7	14.3	666	4.7
2019	142.3	36	7	19	17	12.3	618	4.3
2020	142.3	38	5	25	8	15.5	632	4.4

Note: U.S. Fish and Wildlife Service data. Surveys used Geospatial Population Estimator sample units (Kellie and DeLong 2006).

Table 8. Unit 24D Treat Island trend count area aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	163.3	37	10	34	14	19.8	626	3.8
2017	163.3	24	9	33	11	20.9	599	3.7
2018	163.3	35	8	21	10	13.1	579	3.6
2019	163.3	37	7	12	5	8.0	525	3.2
2020	163.3	40	6	15	7	9.7	503	3.1

Note: U.S. Fish and Wildlife Service data. Surveys used Geospatial Population Estimator sample units (Kellie and DeLong 2006).

ACTIVITY 1.3. Conduct spring twinning surveys in Unit 24D (objectives C1–C5, M1).

Data Needs

Twinning surveys need to be conducted to collect twinning rate data which serve as indicators for body condition and productivity for cows. An assessment of body condition and productivity are integral to management on a sustained yield basis and to protect moose habitat.

Methods

In Unit 24D, observe a minimum of 50 cows with calves in the Treat Island, Huslia Flats, and Dulbi Slough areas (90% CI ± <40%).

Twinning surveys were flown in late May and early June in RY15 through RY19 to determine the proportion of moose cows with twin calves among all cows with calves in the Huslia Flats, Treat Island and Dulbi Slough areas of Unit 24D. Observation of 50 cows with calves was the desired minimum to increase the power of statistical comparisons between survey areas and across years, but funding and weather sometimes prevented us from achieving that goal. Surveys consisted of non-overlapping transects at <500 feet above ground level in PA-18 or similar aircraft with experienced pilots and observers. Moose were classified as bull, yearling, calf, cow, cow with 1 calf, or cow with 2 calves. Timing was critical, so surveys were flown in late May and early June during or within a few days of the presumed median calving date (Boertje et al. 2007) when approximately 50% of the cows observed had calves. This avoided early mortality factors such as predation, which could lead to underestimating twinning rates. Twinning rate was calculated as the proportion of cows with more than 1 calf from a sample of all cows with calves.

In Units 24A and 24B an assessment of annual calf productivity and potential mortality factors was completed using reported parturition rates (Boertje et al. 2007) and the ratio of fall calves per 100 cows.

Results and Discussion

During RY15–RY19, twinning rates in the lower Koyukuk drainage in Unit 24D were high (5-year average 39.4%; Table 9) and suggests density dependent nutritional limitations are not occurring that would negatively impact habitat, or limit population growth (Boertje et al. 2007).

Recommendations for Activity 1.3.

Continue twinning surveys in Unit 24D annually and evaluate abundance, body condition, and productivity. Document survey details in memoranda and archive in ADF&G's Wildlife Information Network (WinfoNet).

Table 9. Unit 24D moose aerial twinning surveys in the combined areas of Huslia Flats, Treat Island, and Dulbi Slough areas, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Cows w/o calves	Cows w/ 1 calf	Cows w/ twins	Twinning[a] %	Yearlings	Dates
2015	32	34	17	33	25	26 May
2016	46	25	27	52	18	26 May
2017	72	36	16	31	36	27 May
2018	69	41	26	39	19	26 May
2019	36	29	21	42	12	27 May

[a] Percent of cows with calves that had twins.

ACTIVITY 1.4. Conduct an age structure analysis in Unit 24D, in combination with Unit 21D (Koyukuk CUA; objectives C1–C5, M1).

Data Needs

Using moose teeth ages from hunter-harvested moose and aerial survey data, we need to construct an age structure analysis of the moose population to evaluate annual contribution of individual cohorts to the harvestable surplus. An age structure analysis may supplement a lack of aerial survey data in years of fiscal constraints or refine our assessment of aerial moose surveys that were conducted.

Methods

Research age structure modeling techniques and analyze moose age data from hunter-killed moose in cooperation with biometric staff. Investigate funding options and contracting services to complete this analysis.

Results and Discussion

No progress was made on developing an age structure population estimate during the reporting period. However, a preliminary effort was initiated to collect genetic materials from archived teeth, to determine if a close-kin mark–recapture population estimate could be modeled. That effort is ongoing.

Moose age data was used to explain to hunters that there was a temporary shift within the population age structure to a greater proportion of younger animals. Fall aerial survey and ages of harvested moose data corroborated one another, demonstrating this shift. Although the RY16–RY18 large bull age-class abundances were below the RY01–RY20 average, the strong cohorts of yearling and medium bulls during RY16–RY18 that were recruited into the large-sized age-classes by RY19, reversed the trend of reduced proportion of large bulls. Large bulls are those bulls we estimate to have overall antler widths greater than 50 inches; medium bulls are the remaining bulls less than 50 inches not including yearlings.

Recommendations for Activity 1.4

Continue this activity.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor hunter use levels in the Koyukuk River drainage (objectives C1–C5, M2, and M3).

Data Needs

Harvest estimates are needed to establish that the population is not being harvested in excess of sustained yield. Harvest data from a moose database in ADF&G's Wildlife Information Network (WinfoNet) are needed annually to assess trends in harvest. Moose harvested, harvest location, and hunter effort are critical elements needed to assess harvest trends and corroborate aerial survey observations.

Methods

The harvest objective is an annual objective; therefore the estimated harvest will be compared on an annual basis. The estimated harvest will include the reported harvest plus an additional 145 moose (minus reported ceremonial or potlatch harvest) to adjust for the unreported harvest. The estimated unreported harvest is based on ADF&G Subsistence Division household surveys, historical survey and inventory reports. The 145 moose adjustment is robust to ensure the population is managed conservatively. The annual estimated harvest will be compared to the lower range of the IM objectives and the point values of the management objectives.

Using the Unit 24 moose population estimate and the estimated total harvest, we will assess harvest rate and harvestable surplus. Bull-to-cow ratios will complement the assessment and decision framework. Management decisions will be assessed conservatively due to the lack of broad population estimates and low harvest reporting. In general, if harvestable surplus calculations suggest additional opportunity, but the bull-to-cow ratio 5-year trend is simultaneously declining, conservative harvest will be adopted, and deference will be given to the bull-to-cow ratios. Furthermore, if harvestable surplus calculations suggest decreasing opportunity but the bull-to-cow ratio 5-year trend is increasing, deference will be given to the harvestable surplus calculation.

Harvest was monitored through mandatory hunter report cards. Hunters received up to 2 reminder letters if we did not receive timely harvest reports. Hunters with registration or drawing permits were also reminded to report by email or telephone. Harvest is reported by regulatory year. Information recorded for each moose included date of kill, name of hunter, specific location of kill, method of take and transportation, sex of the moose, and antler measurements. Ages of harvested moose primarily come from hunters passing through the Koyukuk checkstation, as determined by counting cementum annuli of a tooth extracted from those moose (Matson et al. 1993). We summarized data on hunter residency, hunter success, harvest chronology, and transport methods.

Results and Discussion

Harvest by Hunters

Annual reported harvest during RY15–RY19 averaged 167 moose (range = 151–178, Table 10). Harvest reported under potlatch, ceremonial, and cultural, and education permits averaged

3.6 moose/year during RY15–RY19. Typically, 60–70% of ceremonial and unreported harvest were cows.

Illegal and unreported harvests by local residents continued to hamper our efforts to manage moose. During some years, the estimated unreported harvest was nearly equal to the harvest reported on harvest ticket and permit hunt reports (Table 10). Moose taken during winter were rarely reported, even when the season was open. Some villages have never had a license vendor, which contributed to the problem of people hunting without licenses, harvest tickets, or permits.

The unreported harvest is an estimate that was calculated proportionally, using subsistence harvest underreporting percentage estimates (Brown et al. 2004) and report card numbers from the same years. (Estimated 5-year averages for unreported harvest by local residents in RY97–RY99, RY01, and RY02 were 72% in Huslia, 81% in Allakaket, and 76% for Unit 24 combined. All other hunter unreported harvest was estimated at 17.7% [Gasaway et al. 1992]). On an annual basis, additional unreported harvest was also obtained incidentally through hunter contacts, phone interviews, state trooper reporting, or late harvest reports. In Stout (2006) the total unreported harvest was estimated at 145 moose. Because no new information was available to change that estimate, a constant of 145 unreported moose continues to be used. The calculation includes some level of ceremonial and potlatch harvest; known harvest for those uses was subtracted from the 145 moose for the annual unreported harvest estimate in RY15–RY19.

Table 10. Number of moose harvested, Unit 24, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Harvest by hunters				Unreported harvest[a]	Potlatch/ stickdance[b]	Total
	Bull	Cow	Unknown	Total			
2015	178	0	0	178	142	3	323
2016	169	0	0	169	144	1	314
2017	177	0	0	177	141	4	322
2018	151	0	0	151	140	5	296
2019	160	0	0	160	140	5	305

[a] Unreported harvest based on ADF&G Subsistence Division's door-to-door survey and other sources.
[b] Includes reported potlatch, stickdance, ceremonial, and cultural permit harvest.

Federal harvest during RY00–RY03 averaged 4.8 moose/year and increased to 13.6 moose/year during RY04–RY08; the harvest total was 11 moose in RY09, and 0 moose in RY10 (Stout 2014a). At the time of this report no federal harvest data from Unit 24 were available for RY15–RY19. There were 4 federal moose hunts in Unit 24 (FM2402, FM2403, FM2405, and FM2406). Federal harvest data we received prior to RY11 were incomplete, and reporting requirements and data entry protocols were not comparable to our methods.

Permit Hunts

There were 6 drawing hunts in the Koyukuk CUA (DM823, DM825, DM827, DM828, DM829 and DM830; Table 11), 2 outside the Koyukuk CUA in Unit 24C and 24D (DM892 and DM896; Table 12), and 3 registration permits (RM832, RM834, and RM838). Results of the RM834 permit are reported in the Unit 21D report (Stout 2025). Results of the RM833 winter

registration hunt and RM838 are reported in Table 13. The results of the 2 drawing hunts in Unit 24A (DM920 and DM922) are reported in Table 14. Hunter success rates for the 2 Dalton Highway Corridor hunts were low, 29% north of Slate Creek (DM920) and 12% south of Slate Creek (DM922). Success rates were low because these are archery-only, restricted-use hunts (Table 14).

Hunter Residency and Success

Assessing harvest success rate trends has become increasingly problematic in Unit 24 since RY04 because hunters may obtain and submit reports on multiple reporting mechanisms. Some individual hunters have up to 3 reporting mechanisms (1 harvest permit and 2 registration permits); in terms of hunter effort, each permit is counted as 1 *hunter*. Based on harvest reports, the average annual number of moose hunters during RY15–RY19 was 386 and most were Alaska residents (Table 15). Prior to RY04, the number of hunters was probably underreported because Unit 24 residents often did not report unsuccessful hunt information; this became especially apparent when failure-to-report regulations were implemented in RY04. According to the failure-to-report regulations, hunters who failed to report were cited and barred from obtaining any drawing or registration permits during the following regulatory year.

Harvest Chronology

One hundred percent of reported harvest occurred in the September hunting seasons (Table 16). During RY15–RY19 reported harvest averaged 42% in the first half of September and averaged 58% in the second half of September. However, much of the unreported harvest probably occurred during October–March (Brown et al. 2004).

Transport Methods

During RY15–RY19, boats continued to be the primary transportation method in Unit 24 (5-year average 77%; Table 17) because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the two CUAs. Highway vehicles were used only on the Dalton Highway where it crosses eastern Unit 24. Snowmachines were the main transportation method used during winter, but were likely underreported because most of the unreported harvest occurs during winter.

Table 11. Units 21D and 24 Koyukuk controlled use area moose harvest by permit hunt, Interior Alaska, regulatory years 2015–2019.

Hunt	Regulatory year	Permits issued	Percent successful hunters[a]	Percent unsuccessful hunters[a]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	2015	427	54	46	7	216 (100)	1 (0)	0	217
	2016	392	55	45	10	193 (100)	0 (0)	0	193
	2017	396	59	41	5	220 (100)	0 (0)	0	220
	2018	374	54	46	10	183 (100)	0 (0)	0	183
	2019	334	46	54	9	141 (100)	0 (0)	0	141
DM823	2015	2	50	50	0	1 (100)	0 (0)	0	1
	2016	2	100	0	0	2 (100)	0 (0)	0	2
	2017	2	50	50	0	1 (100)	0 (0)	0	1
	2018	2	100	0	0	2 (100)	0 (0)	0	2
	2019	1	0	100	0	0 (100)	0 (0)	0	0
DM825	2015	3	100	0	33	2 (100)	0 (0)	0	2
	2016	3	66	33	0	2 (100)	0 (0)	0	2
	2017	3	100	0	0	3 (100)	0 (0)	0	3
	2018	3	100	0	0	3 (100)	0 (0)	0	3
	2019	1	100	0	0	1 (100)	0 (0)	0	1
DM827	2015	3	33	67	0	1 (100)	0 (0)	0	1
	2016	3	67	33	0	2 (100)	0 (0)	0	2
	2017	3	33	67	0	1 (100)	0 (0)	0	1
	2018	3	67	33	0	2 (100)	0 (0)	0	2
	2019	1	0	0	100	0 (100)	0 (0)	0	0
DM828	2015	20	63	37	60	5 (100)	0 (0)	0	5
	2016	20	62	38	35	8 (100)	0 (0)	0	8
	2017	20	67	33	40	8 (100)	0 (0)	0	8
	2018	20	44	56	55	4 (100)	0 (0)	0	4
	2019	10	100	0	60	4 (100)	0 (0)	0	4

Hunt	Regulatory year	Permits issued	Percent successful hunters[a]	Percent unsuccessful hunters[a]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM829	2015	2	100	0	0	2 (100)	0 (0)	0	2
	2016	2	0	100	50	0 (100)	0 (0)	0	0
	2017	2	0	100	50	0 (100)	0 (0)	0	0
	2018	2	100	0	50	1 (100)	0 (0)	0	1
	2019	1	0	0	100	0 (100)	0 (0)	0	0
DM830	2015	20	67	33	25	10 (100)	0 (0)	0	10
	2016	20	64	36	30	9 (100)	0 (0)	0	9
	2017	20	81	19	20	13 (100)	0 (0)	0	13
	2018	20	59	41	15	10 (100)	0 (0)	0	10
	2019	10	50	50	60	2 (100)	0 (0)	0	2
Total	2015	477	55	45	10	237 (100)	1 (0)	0	238
	2016	442	56	44	12	216 (100)	0 (0)	0	216
	2017	446	60	40	8	246 (100)	0 (0)	0	246
	2018	424	55	45	12	205 (100)	0 (0)	0	205
	2019	358	47	53	12	148 (100)	0 (0)	0	148

[a] Percent successful and percent unsuccessful were calculated using the total number of hunters who completed their report cards with enough information to determine whether they harvested a moose.

Table 12. Units 24C and 24D Huslia River and Hogatza River drainages moose harvest by permit hunt, Interior Alaska, regulatory years 2015–2019.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM892	2015	35	74	26	46	14 (100)	0 (0)	0	14
	2016	35	80	20	57	12 (100)	0 (0)	0	12
	2017	24	67	33	50	8 (100)	0 (0)	0	8
	2018	25	70	30	60	7 (100)	0 (0)	0	7
	2019	25	45	55	56	5 (100)	0 (0)	0	5
DM896	2015	60	48	52	58	12 (100)	0 (0)	0	12
	2016	60	30	70	45	10 (100)	0 (0)	0	10
	2017	52	58	42	50	15 (100)	0 (0)	0	15
	2018[a]	0	0	0	0	0 0	0 0	0	0
	2019	0	0	0	0	0 0	0 0	0	0

[a] DM896 ended in RY18.

Table 13. Units 24B and 24C moose harvest by permit hunt, Interior Alaska, regulatory years 2015–2019.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
RM833	2015	19	0	100	63	0 (100)	0 (0)	0	0
	2016	15	0	100	80	0 (100)	0 (0)	0	0
	2017	10	50	50	60	2 (100)	0 (0)	0	2
	2018	9	25	75	56	1 (100)	0 (0)	0	1
	2019	15	33	67	80	1 (100)	0 (0)	0	1
RM838[ab]	2015	0	0	0	0	0 (100)	0 (0)	0	0
	2016	0	0	0	0	0 (100)	0 (0)	0	0
	2017	0	0	0	0	0 (100)	0 (0)	0	0
	2018	80	35	65	43	16 (100)	0 (0)	0	16
	2019	77	37	63	40	17 (100)	0 (0)	0	17

[a] Includes portions of Unit 21C and 24D.

[b] RM838 initiated in RY18.

Table 14. Unit 24A Dalton Highway corridor management area moose harvest by permit hunt, Interior Alaska, regulatory years 2015–2019.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM920	2015	20	17	83	40	2 (100)	0 (0)	0	2
	2016	20	31	69	35	4 (100)	0 (0)	0	4
	2017	20	31	69	35	4 (100)	0 (0)	0	4
	2018	20	38	63	20	6 (100)	0 (0)	0	6
	2019	20	29	71	15	5 (100)	0 (0)	0	5
DM922	2015	51	9	91	36	3 (100)	0 (0)	0	3
	2016	50	10	90	40	3 (100)	0 (0)	0	3
	2017	50	14	86	42	4 (100)	0 (0)	0	4
	2018	51	15	85	34	5 (100)	0 (0)	0	5
	2019	50	14	86	28	5 (100)	0 (0)	0	5

Table 15. Unit 24 moose hunter residency and success, Interior Alaska, regulatory years 2015–2019.

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Total hunters
2015	73	71	32	1	177	60	105	44	0	209	386
2016	73	54	42	0	169	74	124	44	0	242	411
2017	71	68	38	0	177	63	104	51	0	218	395
2018	67	58	33	0	158	65	97	43	0	205	363
2019[b]	61	69	30	0	160	61	104	50	0	217	377

Note: Some hunters have up to 3 reporting mechanisms (1 harvest permit and 2 registration permits). Data presented here count each reporting mechanism as 1 "hunter," in terms of effort.

[a] Unit resident only.

[b] Preliminary data.

Table 16. Unit 24 moose harvest chronology percent by date, Interior Alaska, regulatory years 2015–2019.

	Harvest chronology percent by date				
Regulatory year	1–14 September	15–25 September	1–10 December	1–10 March	*n*
2015	45	55	0	0	173
2016	45	55	0	0	166
2017	50	50	0	0	174
2018	41	59	0	0	157
2019	28	72	0	0	155

Table 17. Unit 24 moose harvest percent by transport method, Interior Alaska, regulatory years 2015–2019.

	Harvest percent by transport method								
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV[a]	Highway vehicle	Unknown	*n*
2015	13	1	81	1	0	1	3	1	176
2016	13	2	77	2	0	0	5	1	167
2017	10	1	81	1	1	1	5	1	175
2018	11	1	77	3	0	0	6	2	156
2019	14	0	70	4	1	1	10	1	159

[a] ORV = off-road vehicle

Other Mortality

A minimum of 374–540 wolves in 57–68 packs (Stout 2012b) and a large population of black bears (*Ursus americanus*) inhabit the middle and southern portions of Unit 24. Grizzly bears (*U. arctos*) are common throughout the montane areas. Predation on moose by wolves and bears was thought to be high, keeping the moose population low throughout much of Units 24A, 24B, and 24C. Annual adult mortality was approximately 7.8% for radiocollared moose in Units 24A and 24B during 2008–2009, higher than values reported by Boertje et al. (2009) in a high-density population with relatively low brown bear predation.

Alaska Board of Game Actions and Emergency Orders

Drawing and registration permit hunts continue to be the predominant regulatory feature of Unit 24. Key issues we attempted to manage with regulation changes were declining bull-to-cow ratios and uniform distribution of hunters in Unit 24D. The regulations were designed to improve distribution of hunters around the perimeter of the Koyukuk CUA and to improve success rates of local hunters. It is important for local hunters to have high success rates during the fall hunting seasons so they can be less dependent on winter hunts when a higher percentage of cows are generally harvested. Regulation changes adopted by the Alaska Board of Game (board) during RY10–RY14 were reported in Stout (2018).

At the 2017 spring meeting, the board adopted the RM838 registration permit hunt in Unit 24C and portions of Units 24D and 21C. The registration hunt replaces the DM812 and DM896 drawing permits and the RM834 registration permit for those areas. Residents and nonresidents qualify for the RM838 permit, and the antler destruction requirement was repealed. The board also expanded the RM833 winter hunt to include the remainder of Unit 24B.

Recommendations for Activity 2.1

Continue this activity, but apply our decision framework that assesses harvest rates, harvestable surplus, and incorporates bull-to-cow ratios. The decision framework would likely result in a conservative strategy due to the lack of population estimates throughout Unit 24 and the generally poor harvest reporting rates.

As the sustainable harvest of moose in Unit 24 is reallocated to federal hunts, the number of moose available to state permitted hunts will continue to be reduced.

ACTIVITY 2.2. In combination with Unit 21D, improve harvest reporting for moose in Koyukuk River drainage (objectives C1–C5, M2, and M3).

Data Needs

Annual moose harvest data is needed to assess trends in harvest. However, because reporting by hunters among rural communities is lower than urban hunters, additional effort is needed to collect that data.

Methods

DWC staff operate the Koyukuk River moose hunter checkstation and coordinate with community permit vendors in Huslia, Hughes, and Allakaket to distribute and collect harvest

reports. Permit hunts in the Koyukuk CUA require checking in at the department-operated checkstation, the Huslia permit vendor, or the Hughes permit vendor. Moose teeth are collected at the checkstation and aged according to published methodology (Matson et al. 1993). Hunt information and hunter education opportunities are also provided at the checkstation (e.g., meat care, land ownership, moose biology, predator-prey interactions, reporting procedures).

Results and Discussion

Checkstation results are found in the RY15–RY19 Unit 21D moose management report (Stout 2025).

Recommendations for Activity 2.2

Continue this activity.

3. Habitat Assessment-Enhancement

No change from prior reporting period. Browse removal rates were low (5.3% [95% CI: 4.3–6.3%, n = 231 shrubs]) in Units 24B and 24C (Stout 2010). No activities are anticipated or recommended for RY20–RY24.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

- GSPE/TCA Moose Survey Form (Appendix A).
- Stratification Flight Survey Form (Appendix B).
- Moose Twinning Survey Form (Appendix C).

Potlatch, ceremonial, cultural, and education permit harvest data are recorded and stored in the office file cabinets of the Galena area biologist, and electronic copies of those memoranda are stored on the hard drive of the Galena area biologist in the moose harvest files, and backed up on the Fairbanks H:\ drive and WinfoNet database.

Global Position System (GPS) location data will be logged using WGS 84 datum. GPS files will be stored weekly on the Galena area biologist hard drive D:/Moose/Surveys/[year]. Files will be saved using MapSource (Garmin Ltd., 2008, Ver. 6.13.7) as *.gpx files. Alternatively, location data for analysis and mapping will use ArcGIS (Esri 2013. ArcGIS Desktop: Release 10.2.2. Redlands, California: Environmental Systems Research Institute) and will be stored on the Fairbanks Regional DWC network drive, S:/Stout/Moose/[year]. The Galena area biologist's hard drive will be backed up weekly onto the area biologist's home network drive.

Hardcopies of species wildlife management reports and plans and the intensive management operational plan for Moose – Unit 24 will be stored in the Fairbanks regional office library and online at http://www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement. Memoranda, data forms, and additional hard copies will be stored in the Galena area biologist files in Fairbanks and Galena offices.

Electronic copies of data, memoranda, and reports will be stored in the WinfoNet – Data Archive. Project Title: Moose Management Program. Project ID: GMU 24. Primary Region: Region III.

Agreements

None.

Permitting

The Animal Care and Use Committee authorization – 2015 renewal is found on Galena office hard drive in the Veterinary Records file, and backed-up on the Fairbanks H:\ drive and WinfoNet database.

Conclusions and Management Recommendations

During RY15–RY19 no population estimate surveys in Unit 24D were completed due to budget limitations, although composition surveys were completed in the Huslia Flats and Treat Island TCAs. We recommend a high intensity GSPE moose survey in the high density portions of Unit 24D at least once every 5 years to monitor status (Kellie and DeLong 2006; Ver Hoef 2008). Analysis of GSPE data collected in Unit 24B between 1999 and 2017 showed that low intensity surveys conducted in the years between infrequent high intensity surveys provided accurate composition and population estimates and improved the confidence intervals for all survey years when estimates were smoothed. This strategy provided us with better decision-making information for the Unit 24B population than TCA composition and density data alone, and we believe it will also work effectively in Unit 24D. TCA surveys and twinning surveys should be outlined as independent activities in the operational plan.

A baseline population estimate for all of Unit 24A should be conducted in cooperation with BLM, and low intensity (100–170 SUs) population estimates of the Kanuti NWR in Unit 24B should be conducted up to 3 of 5 years in lieu of trend count surveys. High intensity population estimation surveys (170–200 SUs) should continue to be conducted once every 5 years on the Kanuti NWR.

My RY19 estimate of 8,935 observable moose ±1,676 (6,925–10,277) was lower than but close to the management objective to maintain a population of approximately 11,000 moose. We achieved the objective to provide for moose harvest without exceeding 360 moose (RY15–RY19 average = 312 moose) or a 5% harvest rate (5% harvest rate = 447 moose; RY19 estimated harvest rate = 3.4%). We also achieved the management objective to provide for hunting opportunity that did not exceed 500 hunters (5-year average = 386 hunters; Table 15).

In RY15 through RY19 we did not meet IM population objectives for any of the subunits in Unit 24 (Table 1). The total IM harvest objective, which prescribed at least 500 moose must be harvested, was not achieved because the 5-year average estimated harvest was only 312 moose. Additionally, at a 5% harvest rate, a harvestable surplus of only 447 moose was available in RY19.

Completion of the IM program in Unit 24B was an important accomplishment in Unit 24 during RY15–RY19. The response of the Unit 24B moose population to wolf removal was monitored by calf and yearling survival of radiocollared moose and GSPE moose surveys. Moose were radiocollared in spring 2012 and each fall during 2012–2015. Harvest and hunter effort in the communities of Alatna and Allakaket were monitored through household surveys conducted by ADF&G Division of Subsistence. Household surveys were conducted after the September moose seasons in fall RY11–RY17. Additionally, harvest by hunters using permits and harvest tickets was monitored through the statewide harvest monitoring program. The wolf predation control program was authorized through RY17 and became inactive in RY18.

Without current ADF&G Division of Subsistence survey data in the remainder of Unit 24, we are not certain if Unit 24 residents met their wild food requirements, but local public comments often suggest those needs were not met.

Moose density data and predator harvest data were compared with those established in Gasaway et al (1992). Where the total predator harvest was less than 25% of the predator population estimate for long periods, predation seemed to keep moose densities low (0.1–1.1 moose/mi^2 in areas >800 mi^2; Gasaway et al. 1992). Predation on moose by wolves and bears was likely the primary factor limiting Unit 24 moose populations during RY15–RY19.

II. Project Review and RY20–RY24 Plan

Review of Management Direction

MANAGEMENT DIRECTION

GOALS

G1. Manage moose in the Koyukuk River drainage on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses (5 AAC 99.025)

C1. Unit 24 has a positive finding for customary and traditional uses for moose and amounts reasonably necessary for subsistence uses of 170–270 available moose.

Intensive Management

Codified objectives	Unit	Moose intensive management objectives (5 AAC 92.108)	
		Population objective (5 AAC 92.990(63))	Harvest objective (5 AAC 92.990(35))
C2	24A	1,200–1,500	75–125
C3	24B	4,000–4,500	150–250
C4	24C	1,000–1,500	50–125
C5	24D	5,000–6,000	225–425

MANAGEMENT OBJECTIVES

M1. Maintain a moose population of approximately 11,000 moose.
M2. Provide for an annual harvest of moose not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.
M3. Provide for moose hunting opportunities not to exceed 500 hunters per regulatory year.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Conduct Geospatial Population Estimation (GSPE) surveys (objectives C1–C5, M1).

Data Needs

In cooperation with USFWS and BLM, we plan to conduct GSPE surveys in Unit 24B (Kanuti Refuge), and we need to estimate abundance (90% CI ± 10–30%) to evaluate population status and trend. We need calf-to-cow ratios (90% CI ± 20–40%) and yearling bull-to-cow ratios (90% CI ± 20–40%) to evaluate annual productivity and recruitment. We need total bull-to-cow ratios (90% CI ± 20–40%) to evaluate harvest sustainability.

We need to establish a baseline inventory of the moose population in Unit 24A. We will conduct a GSPE survey to estimate abundance (90% CI ± <20%) during the reporting period if incremental funding is available and it does not compromise completion of the other activities. This is a low priority contingency activity that we will conduct in cooperation with USFWS and BLM.

In cooperation with USFWS, we plan to conduct GSPE surveys in Unit 24D (in combination with Unit 21D), and we need to estimate abundance (90% CI ± <20%) to evaluate population status and trend. We need calf-to-cow ratios (90% CI ± 15–30%) and yearling bull-to-cow ratios (90% CI ± 15–30%) to evaluate annual productivity and recruitment. We need total bull-to-cow ratios (90% CI ± 15–30%) to evaluate harvest sustainability.

Using the subunit estimates, we need to estimate the total Unit 24 moose abundance to calculate harvest rate and harvestable surplus.

Methods

See this document "RY15–RY19 Management Report | Population Status and Trend | Activity 1.1 | Methods" for description of GSPE surveys (Kellie and DeLong 2006). Maintain SU ratio of 65% high density to 35% low density.

- In Unit 24A conduct a high intensity survey (<20% CI; >200 SUs) that includes an aerial stratification if incremental funding is available.
- In Unit 24B alternate high (10–20% CI; 170–200 SUs) and low intensity (20–30% CI; 100–170 SUs) surveys with high intensity surveys once every 5 years and 2–3 low intensity surveys during intervening years. Based on historical survey data of the Kanuti survey area, an optimum survey frequency will be evaluated by staff biometricians during RY20–RY24.
- In Unit 24D (in combination with Unit 21D), conduct a high intensity survey (<20% CI; 300–350 SUs), once every 5 years.
- Population estimate (upper range approximations) will be compared to the minimum level of the amounts reasonably necessary for subsistence, the midpoint of the IM, and management objectives.

ACTIVITY 1.2. Conduct trend count area (TCA) surveys (objectives C1–C5, M1).

Data Needs

In cooperation with BLM, we need to assess trend in ratio parameters and plan to conduct a TCA survey biennially in the Unit 24A Middle Fork TCA. In cooperation with USFWS, we need to assess trend in ratio parameters and plan to conduct TCA surveys annually in Unit 24D Huslia Flats and Treat Island TCAs. We need calf-to-cow ratios and yearling bull-to-cow ratios to evaluate annual productivity and recruitment. We need total bull-to-cow ratios to evaluate harvest sustainability. If USFWS or BLM are unable to continue cooperative survey efforts, we will reexamine the viability of this activity.

Methods

TCA survey methods (see this report "RY15–RY19 Management Report | Population Status and Trend | Methods").

- In Unit 24A, in cooperation with BLM, conduct an aerial survey of the Middle Fork TCA (22 SUs; 113.6 mi^2) biennially.
- In Unit 24D, in cooperation with USFWS, conduct an aerial survey of the Huslia Flats TCA (26 SUs; 142.3 mi^2) and the Treat Island TCA (30 SUs; 163.3 mi^2) every year.
    - In Unit 24D, the midpoint estimate of the bull-to-cow ratio for the Koyukuk CUA will be compared to the management objective of 30 bulls:100 cows (Stout 2014b). The Huslia Flats and Treat Island TCAs will be combined with the

Koyukuk River mouth, Three Day Slough and Dulbi River mouth TCAs in Unit 21D, and analyzed as the Koyukuk CUA Core-5 TCAs (Stout 2014b).

ACTIVITY 1.3. Conduct spring twinning surveys in Unit 24D (objectives C1–C5, M1).

Data Needs

Twinning surveys need to be conducted to collect twinning rate data which serve as indicators for body condition and productivity for cows. An assessment of body condition and productivity are integral to management on a long-term sustained yield basis and to protect moose habitat.

Methods

See this report "RY15–RY19 Management Report | Population Status and Trend | Activity 1.3 | Methods |" for description of twinning surveys. Input from biometric staff will be sought to verify, and if needed, refine the following methods prior to conducting this activity to ensure that high scientific standards are retained in methods and interpretation of results.

- In Unit 24B, observe a minimum of 50 cows with calves in the Treat Island/Huslia Flats/Dulbi Slough areas (90% CI ± <40%).

ACTIVITY 1.4. Conduct an age structure analysis in Unit 24D, in combination with Unit 21D (Koyukuk CUA; objectives C1–C5, M1).

Data Needs

Using moose teeth ages from hunter-harvested moose and aerial survey data, we need to construct an age structure analysis of the moose population to evaluate annual contribution of individual cohorts to the harvestable surplus. An age structure analysis may supplement a lack of aerial survey data in years of fiscal constraints or refine our assessment of aerial moose surveys that were conducted.

Methods

Research age structure modeling techniques and analyze moose age data from hunter-killed moose in cooperation with biometric staff. Investigate funding options and contracting services to complete this analysis (see this report "RY15–RY19 Management Report | Population Status and Trend | Methods | Activity 1.4").

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor hunter use levels in the Koyukuk River drainage (objectives C1–C5, M2, and M3).

Data Needs

Harvest estimates are needed in order to establish that the population is not being harvested in excess of sustained yield. Harvest data from a moose database in WinfoNet are needed annually to assess trends in harvest. Moose harvested, harvest location, and hunter effort are critical elements needed to assess harvest trends and corroborate aerial survey observations.

Methods

Harvest data collection and data management are described in this report "RY15–RY19 Management Report | Mortality-Harvest Monitoring and Regulations | Activity 2.1 | Methods". The harvest objective is an annual objective, therefore the estimated harvest will be compared on an annual basis. The estimated harvest will include the reported harvest plus an additional 145 moose (minus reported ceremonial or potlatch harvest) to adjust for the unreported harvest. The estimated unreported harvest is based on ADF&G Subsistence Division household surveys, historical survey and inventory reports. The 145 moose adjustment is robust to ensure the population is managed conservatively. The annual estimated harvest will be compared to the lower range of the IM objectives and the point values of the management objectives.

Using the Unit 24 moose population estimate and the estimated total harvest, we will assess harvest rate and harvestable surplus. Bull:100 cow ratios will complement the assessment and decision framework. Management decisions will be assessed conservatively due to the lack of broad population estimates and low harvest reporting. In general, if harvestable surplus calculations suggest additional opportunity, but the bull:100 cow ratio 5-year trend is simultaneously declining, conservative harvest will be adopted, and deference will be given to the bull:100 cow ratios. Furthermore, if harvestable surplus calculations suggest decreasing opportunity but the bull:100 cow ratio 5-year trend is increasing, deference will be given to the harvestable surplus calculation.

ACTIVITY 2.2. In combination with 21D, develop programs to improve population and harvest data for moose in Koyukuk River Drainage (objectives C1–C5, M2, and M3).

Data Needs

Annual moose harvest data to assess trends in harvest. However, because reporting by hunters among rural communities is lower than urban hunters, additional effort is needed to collect that data.

Methods

No change from previous reporting period. We will continue to operate the Koyukuk River moose hunter checkstation. We will cooperate with Huslia, Hughes, and Allakaket community permit vendors to distribute and collect harvest report cards.

3. Habitat Assessment-Enhancement

No change from RY15–RY19 reporting period. Browse removal rates were low in Units 24B and 24C (Stout 2010). No activities are anticipated or recommended for RY20-RY24.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

- GSPE/TCA Moose Survey Form (Appendix A).
- Stratification Flight Survey Form (Appendix B).

- Moose Twinning Survey Form (Appendix C).

Global Position System (GPS) location data will be logged using WGS 84 datum. GPS files will be stored weekly on the Galena area biologist hard drive D:/Moose/Surveys/[year]. Files will be saved using MapSource (Garmin Ltd., 2008, Ver. 6.13.7) as *.gpx files. Alternatively, location data for analysis and mapping will use ArcGIS (Esri 2013. ArcGIS Pro: Release 10.2.2. Redlands, California: Environmental Systems Research Institute.) and will be stored on the Fairbanks Regional DWC network drive, S:/Stout/Moose/[year]. The "D" drive of the Galena area biologist's hard drive will be backed up weekly onto the area biologist's network (H) drive.

Hardcopies of species wildlife management reports and plans and the intensive management operational plan for Moose – Unit 24 will be stored in the Fairbanks Regional Office Library and online at http://www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement. Memoranda, data forms, and additional hard copies will be stored in the Galena area biologist files in Fairbanks and Galena offices.

Electronic copies of data, memoranda, and reports will be stored in the WinfoNet – Data Archive. Project Title: Moose Management Program. Project ID: GMU 24. Primary Region: Region III.

Agreements

None.

Permitting

None.

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Appendix A. Geospatial population estimation and trend count area moose survey form, Alaska.

MOOSE SURVEY FORM

Page ___ of ___ Form MC2 10/31/11

SEARCH IDENTIFICATION

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

SEARCH TYPE

☐ Standard ~8 min/mi^2 (depends on terrain)

Strata: _____
Area (mi^2): _____

SEARCH TIMES (in minutes)

Standard
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
☐ 7. Other (describe):

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

Group No.	Bulls			Cows				MISC		Total Moose	Remarks/Waypoint/Lat-Lon
	Yrlg	Med	Lrg	Cow w/0	Cow w/1	Cow w/2	Cow w/3	Lone Calf	Unk		
1.											
2.											
3.											
4.											
5.											

Group No.	Bulls			Cows				MISC		Total Moose	Remarks/Waypoint/Lat-Lon
	Yrlg	Med	Lrg	Cow w/0	Cow w/1	Cow w/2	Cow w/3	Lone Calf	Unk		
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Appendix B. Moose survey form.

Moose Survey - GMU_____ **STRATIFICATION FLIGHT**
Observers_____
Pilot_____ Date_____ Time_____
Conditions_____

Int ID	STRAT	Tracks	Habitat	Moose	Comments

Appendix C. Moose twinning survey form.

Moose Twinning Survey Form

Page____of____

GMU_____ Area_____ Date:_____
Stop:_____

Pilot:_____ Observer:_____
Start:_____

Survey Conditions: Clear:_____ Overcast:_____ Broken:_____
Time:_____

Wind:_____ Turbulence: None Light Moderate

Lake Ice Present: None Some Most Snow Patches: None
Other_____

Leaf-out Condition: Willow_____(%) Birch_____(%) Cottonwood_____(%)
Larch_____(%)

River Water Level: High Medium Low Flood Conditions: Yes No

Obs. #	Wpt	Cow + 1 calf	Cow + 2 calf	Other		Talley/Comments
1					COWS	
2						
3						
4					YEARLINGS	
5						
6						
7					BULLS	
8						
9						
10						
11						
12						
13						
14						
15					Gr. Bears	
16						
17					Bl. Bears	
18						
19					Wolves	
20						
21					Other	
22						
TOTAL						


ALASKA
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