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CHAPTER 33: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013[1]

LOCATION

GAME MANAGEMENT UNITS: 24 (26,068 mi^2); 24A = 4,146 mi^2, 24B = 13,523 mi^2, 24C = 3,049 mi^2, 24D = 5,350 mi^2

GEOGRAPHIC DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

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 populations, especially in the southern third of the unit. During the early 1970s the population reached a peak in some areas. Populations apparently climbed again in the late 1980s, peaked around 1992, then fell gradually through the remainder of the 1990s.

Naturally occurring wildfires and floods 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, browse production is not limiting the size of the moose population in most of Unit 24 (Paragi et al. 2008).

The Koyukuk River and major tributaries are popular moose hunting areas for Unit 24 residents, other Alaska residents, and nonresidents. The lower portion of the Koyukuk River within Unit 24 has been the focus of most of our management effort because of the long history of use, higher moose densities, and increasing hunting activity. Hunting activity was also increasing in other areas of the unit, including rivers accessible from the Dalton Highway. Two controlled use areas (CUA), the Koyukuk CUA and the Kanuti CUA, restrict use of aircraft for moose hunting activities. 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. Access to portions of Unit 24 increased with the opening of the highway to the public in 1981.

[1] At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

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.

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

MANAGEMENT DIRECTION

Management was directed according to the following management goals and objectives during the reporting period.

GOAL 1: Manage Koyukuk River drainage moose 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.

OBJECTIVE 1: Maintain a moose population of 10,000–12,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

OBJECTIVE 2: Provide for a harvest of moose not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 24.

OBJECTIVE 3: Provide for moose hunting opportunity not to exceed 500 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

OBJECTIVE 1: In combination with Unit 21D, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall meat assessment score of less than "3" for ≤5% of the hunters each regulatory year.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

OBJECTIVE 1: Maintain "hunting and viewing" as the response to question #2 (Purpose of Trip) for ≥65% of the hunters who respond to the survey each regulatory year.

METHODS

POPULATION STATUS AND TREND

Population Size

Beginning in 1999, we conducted fall population estimation surveys and analyzed data from all population estimation surveys using the geospatial population estimator method (GSPE; Ver Hoef 2001, 2008; Kellie and DeLong 2006). GSPE surveys since 1999 were conducted in the fall according to methods and in areas described in 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 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 the Unit 21D report (Stout 2012a).

In 2010, 2011, and 2013 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. Stratification of sample units (SU) for the 2010 survey was conducted using a Cessna 207. Intensively surveyed SUs were flown from small fixed-wing aircraft (PA-18 or similar aircraft) described by Stout (2010). In 2010 we intensively surveyed 205 SUs (69 high density, 136 low density; 1,092 mi^2) of 701 SUs (3,736 mi^2; Stout 2010; T. Craig, U.S. Fish and Wildlife Service, and G. Stout, Alaska Department of Fish and Game [ADF&G], unpublished survey report, February 2011, Fairbanks). In 2011 we intensively surveyed 151 SUs (75 high density, 76 low density; 805 mi^2) of 701 SUs (3,736 mi^2; Craig and Stout, unpublished survey report, February 2012). In 2013 we intensively surveyed 129 SUs (74 high density, 55 low density; 687 mi^2) of 701 SUs (3,736 mi^2; Craig and Stout, unpublished survey report, February 2014). Due to limited funding, the 2011 and 2013 surveys used stratification data from the regulatory year (RY; regulatory year begins 1 July and ends 30 June [e.g., RY08 = 1 July 2008–30 June 2009] RY08, RY10, and RY11 surveys (75 high density SUs, 627 low density SUs). Using radiocollared moose present in the survey area, we estimated a sightability correction factor (SCF; Boertje et al. 2009) for the 2010 survey. We used the Bayesian method for trend analysis described by Ver Hoef (2001), and applied a multiplicative mixed effects model for the 1999–2011 Kanuti surveys. For that trend analysis, we applied 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 conducted during 1999–2011.

Unit 24 moose population estimates for RY11 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) were 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.

Population Composition

Composition data were derived from results of GSPE surveys or counts from fall trend count area (TCA) surveys. Moose in 4 TCAs (Dulbi Slough, Huslia River flats, Treat Island, and Middle Fork) were classified as cows, calves, yearling bulls (<30″ antler width and no brow tine definition), medium bulls (≥30″ and <50″ antler width), or large bulls (≥50″ antler width) using methods previously described (Stout 2010). These surveys were conducted in cooperation with staff from the Koyukuk NWR, Kanuti NWR, and the Bureau of Land Management. Due to low snow and poor survey conditions, no TCA or GSPE surveys were conducted by ADF&G in RY12.

Twinning Surveys

Twinning surveys were flown in late May and early June to determine the proportion of moose cows with twin calves among all cows with calves in the Huslia Flats and Kanuti Flats areas. Observation of 50 cows with calves was the desired minimum, but funding and weather sometimes prevented us from achieving that goal. 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 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.

Moose Distribution and Movement

ADF&G initiated a cooperative moose distribution and movements study in Units 24A and 24B in 2008 (Stout 2010) and continued participation during RY09–RY12. We deployed an additional 37 collars in April 2011 (120 total; 90 VHF transmitters and 30 GPS transmitters on 94 cows and 26 bulls). Relocation flights of VHF transmitters usually occurred once a month, and GPS data were transmitted daily through March 2013, when the study was terminated.

HARVEST AND OTHER MORTALITY

Hunting mortality and harvest distribution were monitored through the statewide harvest reporting system using general season harvest tickets, registration and drawing permits, a moose hunter checkstation on the lower Koyukuk River, and door-to-door subsistence surveys. We encouraged local residents to increase their harvest reporting by providing information at public meetings, checkstations, and village meetings. General season hunters were sent 1 reminder letter to return their harvest reports. Hunters who had drawing and registration permits and did not report were sent an e-mail notification if they provided an e-mail address, 2 reminder letters, and called via telephone between letters. Names of hunters who possessed drawing and registration permits were withdrawn from the following year's drawing and registration permit hunts if they did not report their hunt activity. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were archived using ADF&G's Wildlife Information Network (WinfoNet) and accessed 27 March 2014. These data were summarized by regulatory year. Meat salvage assessment was previously described in Stout 2012a.

Predation was evaluated using interviews with trappers, field observations, and aerial wolf reconnaissance surveys conducted in cooperation with U.S. Fish and Wildlife Service during RY09–RY11 (Stout 2012b).

HABITAT

No habitat assessment or enhancement was conducted during RY09–RY13.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Status and trends of the moose population in an area as large and diverse as Unit 24 are difficult to determine. Most often, population size is described using generalities, and trends are discernible only for the few areas surveyed. However, since 2004 we have completed GSPE aerial surveys on 19,580 mi^2 of Unit 24, which is 75% of this 26,068 mi^2 game management unit.

Population Size

Units 24A and 24B. The RY10, RY11, and RY13 estimates were not significantly different from the RY07 or RY08 estimates (Table 1). In the RY10 Kanuti GSPE survey, we classified 409 moose, and estimated a total of 1,068 moose (±11.5%; 90% confidence interval [CI]; 0.39 moose/mi^2) on the Kanuti NWR in Unit 24B, not including an SCF. In the 2011 GSPE survey, we classified 316 moose, and estimated 797 moose (±19.3%; 90% CI; 0.29 moose/mi^2) in the same area, not including an SCF. In the 2013 GSPE survey, we classified 259 moose, and estimated 551 moose (±25.7%; 90% CI; 0.20 moose/mi^2) in the same area, not including an SCF. Results from the RY13 survey were not evaluated using the Bayesian method for trend analysis at the time of this report. However, the unbiased estimate of 551 moose (±25.7%; 90% CI) in RY13 was not significantly different from the RY11 estimate. The RY13 survey had lower precision due to low sample size, and survey conditions were subjectively rated low by observers. Therefore, I interpreted the Unit 24B population estimate, with the RY13 survey included, to be unchanged from the 2010 estimate (Stout 2010). I estimated the RY12 moose population in Units 24A and 24B to be 3,567 observable moose (±980) based on the RY10, RY11, and RY13 GSPE surveys in Unit 24B and data reported in Stout (2010).

The multiplicative mixed effects model for 1999–2011 indicated the population was stable (λ = 1.00; Fig. 1; B. Taras, ADF&G Biometrician, memorandum, 21 March 2012, Fairbanks) for the Kanuti survey area. In the Middle Fork TCA, moose density without a sightability correction factor (SCF) was relatively unchanged at 0.87 moose/mi^2 in RY08 and 0.81 in RY11 (Table 2).

The upper Koyukuk management area estimates in Unit 24B did not change significantly during RY10–RY13 (Table 3).

Unit 24C. I estimated the RY12 moose population to be 562 observable moose (±130) based on the 2007 GSPE data (Tables 4 and 5; Stout 2012a).

Unit 24D. During RY11–RY12, 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, Tables 6–8). Based on recruitment parameters, the population probably began to stabilize beginning around 2003–

2004 (Stout 2010). I estimated the RY12 moose population to be 4,380 moose (±477; Table 5) based on the 2010 and 2011 GSPE surveys and estimates reported in Stout (2012a).

All of Unit 24. Surveys through RY11 helped refine the overall estimate within Unit 24. I estimated the total Unit 24 population to be 8,509 observable moose ±1,587 (6,922–10,096) at the end of RY10, based on the addition of extrapolated population estimates previously reported (Stout 2010) and estimates reported for each subunit (Table 5). Because the RY13 survey indicated no change in the Kanuti moose population estimate, no change will be made to the Unit 24B estimate. Because no other surveys were conducted, the Unit 24 population estimate of 8,509 observable moose ±1,587 (6,922–10,096) at the end of RY12 was the same as the estimate at the end of RY10.

Population Composition

Population composition from TCA (Tables 2 and 6–8) and GSPE surveys (Tables 1, 3, and 4) conducted during RY11–RY13 throughout Unit 24 were highly variable. Generally, moose density trends in TCAs corroborated GSPE composition data, and indicated the population declined through RY03 in most of Unit 24, but began to stabilize in RY04–RY06.

Bull:Cow Ratios. Bull:cow ratios >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 RY11–RY13 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. GSPE surveys indicated ratios of 38 bulls:100 cows in Unit 24D, but ranged as high as 65–70 bulls:100 cows in Units 24B and 24C. Bull:cow ratios during RY01–RY02, and RY11 in the Middle Fork TCA (in Unit 24A) were questionable due to small sample size but were higher during RY03–RY08 (Table 2). In general, most ratios in TCAs with counts of less than 100 moose tended to have larger annual variation that made interpretation difficult.

Bull:cow ratios were generally high on the Huslia River flats and Kanuti NWR during RY11–RY13. High bull:cow ratios in TCAs were generally consistent with bull:cow ratios in GSPE surveys (Tables 1–8). However, the Dulbi Slough, Treat Island, and Middle Fork TCA (Tables 6, 7, and 8) bull:cow ratios were typically lower than the GSPE composition data (Tables 1 and 3–5). This can likely be explained by the influence of accessibility and higher hunting pressure in higher density moose areas in Unit 24D compared to lower hunting pressure in Units 24A and 24B (Tables 1 and 3–5). The higher density moose areas typically attracted higher levels of hunting pressure and are generally more accessible.

Calf and Yearling Ratios. Ratios of calves and yearlings 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 had dropped in the 4 surveys of RY09–RY13 $\bar{x}$ = 20.5 calves:100 cows; compared to the 4 surveys of RY04–RY07 $\bar{x}$ = 27.8 calves:100 cows. Yearling recruitment in 2011 and 2013 (2-yr $\bar{x}$ = 9 yearling bulls:100 cows) appeared lower compared to 2004–2006 (3-yr $\bar{x}$ = 11 yearling bulls:100 cows). Because yearling bull:cow ratios were low in RY10 and RY13, it indicated that overwinter survival of the remaining calves was poor. High productivity, as evidenced by high twinning rates (Tables 9–12) then low fall calf ratios, suggests high mortality during summer, which is typical of high bear predation. Data available did not explain why high calf:cow ratios in 2004 and 2006 did not result in a stronger

response in the yearling:cow ratios in 2005 and 2007 or a stronger positive response in the total number of moose counted. Results from the GSPE survey on the Kanuti NWR in Unit 24B in RY08, RY10, RY11, and RY13 indicated that recruitment to 5 months of age averaged 41.8 calves:100 cows and recruitment to 17 months of age averaged 10.6 yearling bulls:100 cows.

Twinning Surveys. Radio collars deployed in March 2008 in the upper Koyukuk River drainage in Units 24A and 24B combined, allowed us to obtain adequate sample sizes in 2008–2012. Results indicated high twinning rates (6-yr $\bar{x}$ = 47.5; Table 12). Based on these twinning rates and an anticipated calving rate of 80%, an average of 115 calves:100 cows were likely produced annually during RY08–RY12. Using calf and yearling ratios along with these twinning survey results indicates that approximately 62% of a calf cohort was lost in the first 5 months and approximately 18% of that cohort was lost in the next 12 months (total mortality to 17 months = 80%).

Distribution and Movements

A comprehensive data analysis for moose radiocollared since 2008 in the upper Koyukuk River drainage was not available for this report. Prior information on movements was reviewed by Stout (2010).

MORTALITY

Harvest

Seasons and Bag Limits. Hunting seasons in Unit 24 were diverse during RY11 and RY12 and reflected various moose densities and consumptive use patterns.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24A, that portion in the Dalton Highway corridor management area.		
RESIDENT HUNTERS: 1 bull by drawing permit; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway corridor management area.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway corridor management area.		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24B all drainages of the Koyukuk river upstream from the Henshaw Creek drainage, excluding the North Fork Koyukuk River drainage.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Remainder Unit 24B.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep 15 Dec–15 Apr (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Unit 24C, that portion within the Koyukuk CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	1 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	15 Dec–15 Apr (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk CUA.		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Remainder of Unit 24C.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only) 15 Dec–15 Apr (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk CUA.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk CUA.		5 Sep–25 Sep
Unit 24D, that portion within the Koyukuk CUA.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	1 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk CUA.		5 Sep–25 Sep
Remainder of Unit 24D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24C outside the Koyukuk CUA.	5 Sep–25 Sep	

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: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 board during RY02–RY08 were reported in Stout (2010).

At the 2010 spring meeting, the Board of Game adopted a 15 December–15 April season in portions of Unit 24B and 24C, eliminated the 1–10 December season in those areas, and reduced the size of the Kanuti controlled use area by 298 mi^2. At the 2012 spring meeting, the board adopted a wolf predation control plan for Unit 24B to improve moose survival.

Intensive Management — All of Unit 24 has a positive finding for intensive management (IM) and the objectives in regulation [5AAC 92.108] for RY11–RY12 were as follows:

Unit	Population Objective	Harvest Objective
24A	1,200–1,500 moose	75–125
24B	4,000–4,500 moose	150–250
24C	1,000–1,500 moose	50–125
24D	5,000–6,000 moose	225–425

An IM plan [5AAC 92.124(c)] was adopted by the Alaska Board of Game 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. The IM plan for moose in Unit 24B was developed based on the recommendation of Koyukuk River Fish and Game Advisory Committee and at the request of the board. The IM plan and the operational plan (ADF&G 2012) included information and recommendations from a feasibility assessment prepared by the Alaska Department of Fish and Game (Alaska Department of Fish and Game 2011) and recommendations by the board following public comment at the March 2011 board meeting. The Unit 24B wolf predation control activities are an experimental treatment to evaluate whether 1) wolf control in a focused area can allow reallocation of moose mortality from predators to humans and 2) whether moose harvest per unit effort is a feasible response metric at low moose density. Under the IM plan, wolf predation control to improve moose survival was initiated in spring 2013. Implementation of the IM plan [5AAC 92.124(c)] is directed by the IM operational plan (ADF&G 2012). An annual report was submitted to the board at the spring 2014 meeting (ADF&G 2014).

Harvest by Hunters. Annual reported harvest during RY03–RY12 averaged 168 moose (128–202, Table 13). Harvest reported under potlatch, ceremonial, and cultural and education permits averaged 5.3 moose/year during RY03–RY12. Unreported harvest and was estimated from Subsistence Division reports (Brown et al. 2004), historical information, and public interviews (Table 13). Typically, 60–70% of ceremonial and unreported harvest was cows.

Illegal and unreported harvests by local residents continued to hamper our efforts to manage moose. During some years, I estimated unreported harvest was nearly equal to the harvest reported on harvest ticket and permit hunt reports (Table 13). 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. Checkstation results, including the meat evaluation survey and the hunter viewing survey, are found in the RY11–RY12 Unit 21D moose management report (Stout 2014).

Federal harvest during RY00–RY03 averaged 4.8 moose/year, increased to 13.6 moose/year during RY04–RY08, 11 moose in RY09, and 0 moose in RY10. At the time of this report no federal harvest data from Unit 24 were available for RY11–RY13. There were 4 federal moose hunts in Unit 24 (FM2402, FM2403, FM2405, and FM2406). Federal harvest data we received were incomplete and reporting requirements and data entry protocols were not comparable to our methodology. As the sustainable harvest of moose in Unit 24 is reallocated to federal hunts, the number of moose available to state permitted hunts will have to be reduced. Additionally, some federal hunts in Unit 24 allowed the harvest of cows, contradicting the current management strategy for growth of the moose population.

Permit Hunts — There were 6 drawing hunts in the Koyukuk CUA (DM823, DM825, DM827, DM828, DM829 and DM830), 2 outside the Koyukuk CUA in Unit 24D (DM892 and DM896), and 2 registration permits (RM832 and RM834) (Tables 14–16). Results of the RM834 permit are reported in the Unit 21D report (Stout 2014). There were 2 drawing hunts in Unit 24A (DM920 and DM922). Average rates for successfully drawing a Dalton Highway corridor management area permit were relatively high during RY11–RY13, at 11% for DM920 and 31% for DM922. However, hunting success rates were low at 9% north of Slate Creek (DM920) and 13% south of Slate Creek (DM922; Table 16).

Harvest Chronology. Over 95% of reported harvest occurred in the September hunting seasons (Table 17). However, much of the unreported harvest probably occurred during October–March (Brown et al. 2004). During RY03–RY12 $\bar{x}$ = 44% of harvest was in the first half of September and $\bar{x}$ = 55% was in the second half of September.

Hunter Residency and Success. Assessing harvest success rate trends has become increasingly problematic in Unit 24 since RY04. Based on harvest reports, the average annual number of moose hunters was 415 during RY03–RY12; most were Alaska residents (Table 18). The number of hunters was probably underreported because Unit 24 residents often did not report unsuccessful hunt information. This became especially apparent beginning in RY04, when failure to report reporting requirements were initiated that fined hunters who failed to report and barred them from obtaining any drawing or registration permits during the following year. Reporting rates increased but apparent success rates declined (Fig. 2) despite an increase in total harvest (Fig. 3). Increased reporting by unsuccessful hunters and subsequent declining success

rates, can be explained by 2 changes in Unit 24 hunt administration. First, reporting rates by unsuccessful hunters increased with the higher level of reporting accountability associated with registration and drawing permit systems. Second, an individual hunter could possess more than one reporting mechanism (harvest ticket, registration permits, and/or federal permits), which increased the total number of permits reported but did not increase the number of individual hunters. The first outcome was implemented by design, and improved our ability to manage moose in Unit 24, while the second by-product was not anticipated.

Transportation Methods. During RY11–RY12, boats continued to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 19). 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.

Other Mortality

A minimum of 374–540 wolves in 57–68 packs (Stout 2009) and a large population of black bears inhabit the middle and southern portions of Unit 24. Grizzly bears 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).

HABITAT

Browse removal rates were low in Units 24B and 24C (Stout 2010). No monitoring activity occurred during RY11–RY12.

CONCLUSIONS AND RECOMMENDATIONS

The development and initiation of the IM program in Unit 24B was the focus of management activities in Unit 24 during RY11–RY13. The response of the Unit 24B moose population to wolf removal will be monitored by calf and yearling survival of radiocollared moose and GSPE moose surveys. Moose were radiocollared in spring 2012, fall 2012, and fall 2013. Harvest and hunter effort in the communities of Alatna and Allakaket will be monitored through household surveys conducted by ADF&G-Division of Subsistence, and general harvest will continue to be monitored through the statewide harvest monitoring program. Household surveys were conducted after the September moose seasons in fall RY11, RY12, and RY13. The wolf predation control program will continue through RY17.

Without current ADF&G-Division of Subsistence survey data in the remainder of Unit 24, it was not certain if Unit 24 residents met their wild food requirements, but local public comments suggest those needs were not being met. Predation on moose by wolves and bears was likely the primary factor limiting Unit 24 moose populations. Where predators were lightly harvested 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).

Completion of the moose telemetry study in Units 24A and 24B was an important accomplishment in RY12 and data from that study has improved our understanding of population dynamics and distribution in this low-density portion of Unit 24. Analysis and reporting of that telemetry data will continue in RY13 and RY14.

During RY11–RY13 we completed population estimates for the Koyukuk NWR in central Unit 24D, the upper Koyukuk management area, and Kanuti NWR in Unit 24B. We recommend annual or biennial GSPE moose surveys in the high density portions of Unit 24D to develop a reliable population trend analysis, even if those surveys are conducted at a low sampling intensity (Kellie and DeLong 2006, Ver Hoef 2008). Analysis of GSPE data collected in Unit 24B between 1999 and 2011 showed that low intensity surveys conducted in the intervening years of 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.

A baseline population estimate for all of Unit 24A should be conducted in cooperation with Bureau of Land Management, and low intensity (100 SUs) population estimates of the Kanuti NWR in Unit 24B should be conducted annually in lieu of trend count surveys. High intensity estimation surveys (150–200 SUs) should continue to be conducted once every 5 years on the Kanuti NWR.

My estimate of 8,509 moose ±1,587 (6,922–10,096), not including an SCF, probably did not achieve the objective to maintain a population of 10,000–12,000 moose for the seventh consecutive reporting period. We achieved the objective to provide for an adequate moose harvest without exceeding 360 moose or a 5% harvest rate (RY12 estimated harvest rate = 4.0%). We also achieved the objective to provide for hunting opportunity that did not exceed 500 hunters.

The long-term objective to implement at least 2 habitat enhancement activities was not achieved during RY06–RY12. We will continue to encourage land managers to liberalize fire management options and implement habitat enhancement activities, but habitat manipulation will be removed from our objectives because it is unlikely to be accomplished.

In RY11 and RY12 we continued to monitor the objective to maintain an overall meat assessment score of less than "3" for ≤5% of the hunters each regulatory year at the Koyukuk River checkstation. Fewer than 5% of the hunters scored less than 3 on the overall meat care (0.0% in RY11, 0.0% in RY12), and the average number of days hunters stayed in the field with their meat was less than 2.9 days. Therefore, the meat care objective was met.

Finally, we discontinued our program to monitor and evaluate the number of people engaged in nonconsumptive activities due to poor public participation and interest.

In RY11 and RY12, we did not meet IM population objectives for any of the subunits in Unit 24 (Table 5). In RY11–RY12, our total harvest including estimated unreported harvest for Unit 24 also failed to meet the combined Unit 24 IM harvest objective of 500 moose (RY11 = 304 moose, RY12 = 339 moose).

MANAGEMENT OBJECTIVES

Activity 2 of Goal 1, Objective 2 will be removed in the next reporting period. Funding and methods to accomplish monitoring social and environmental impacts on private lands are unlikely to be available in the foreseeable future.

Goal 2 will be removed in the next reporting period. There have been no habitat enhancement projects in Units 21D or 24 and it is unlikely that resources will be available to do so in the foreseeable future.

Goal 4 will be removed in the next reporting period, due to poor public participation and interest.

Therefore, management goals, objectives, and activities for the next reporting period are as follows:

GOAL 1: Manage Koyukuk River drainage moose 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.

OBJECTIVE 1: Maintain a moose population of 10,000–12,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

OBJECTIVE 2: Provide for a harvest of moose not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Develop programs to improve population and harvest data for moose in Unit 24.

OBJECTIVE 3: Provide for moose hunting opportunity not to exceed 500 hunters per regulatory year.

GOAL 2: Reduce meat spoilage by hunters.

OBJECTIVE 1: Maintain an overall meat assessment score of less than "3" for ≤5% of the hunters each regulatory year.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 2011. Feasibility assessment for maintaining or increasing sustainable harvest of moose in GMU 24B. Version 1, effective date 25 February 2011. Division of Wildlife Conservation, Fairbanks. http://www.adfg.alaska.gov/static/regulations/regprocess/gameboard/pdfs/2010-2011/3-4-central-sw/rcs/RC91.pdf (Accessed 22 July 2014).

ADF&G (Alaska Department of Fish and Game). 2012. Operational plan for intensive management of moose in Game Management Unit 24(B) during regulatory years 2012–2017. Division of Wildlife Conservation, Fairbanks. http://www.adfg.alaska.gov/static-f/regulations/regprocess/gameboard/pdfs/2011-2012/interior-3-2-12/24b-imopsplan.pdf (Accessed 14 July 2014).

ADF&G (Alaska Department of Fish and Game). 2014. Annual report to the Alaska Board of Game on intensive management for moose with wolf predation control in GMU 24B. Division of Wildlife Conservation, Fairbanks. http://www.adfg.alaska.gov/static-f/regulations/regprocess/gameboard/pdfs/2013-2014/Interior_02-14-14/24b_pred_control_report_2014.pdf (Accessed 14 July 2014).

Boertje, R. D., M. A. Keech, D. D. Young, K. A. Kellie, and C. T. Seaton. 2009. Managing for elevated yield of moose in Interior Alaska. Journal of Wildlife Management 73:314–327.

Boertje, R. D., K. A. Kellie, C. T. Seaton, M. A. Keech, D. D. Young, B. W. Dale, L. G. Adams, and A. R. Aderman. 2007. Ranking Alaska moose nutrition: Signals to begin liberal antlerless harvests. Journal of Wildlife Management 71:1494–1506.

Brown, C. L., R. Walker, and S. B. Vanek. 2004. The 2002–2003 harvest of moose, caribou, and bear in middle Yukon and Koyukuk River communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 280, Juneau.

Gasaway, W. C., R. D. Boertje, D. V. Grangaard, D. G. Kelleyhouse, R. O. Stephenson, and D. G. Larsen. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.

Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Institute of Arctic Biology, Biological Papers of the University of Alaska, No. 22, Fairbanks.

Huntington, S. 1993. Shadows on the Koyukuk: An Alaskan Native's life along the river. Alaska Northwest Books, Portland, Oregon.

Kellie, K. A., and R. A. DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks. http://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/propubs/GSPEOperationsManual.pdf (Accessed 14 July 2014).

Lawler, J., L. Saperstein, T. Craig, and G. Stout. 2006. Aerial moose survey in the upper Game Management Unit 24, Alaska, fall 2004, including state land and lands administered by the Bureau of Land Management, Gates of the Arctic National Park and Preserve, and Kanuti National Wildlife Refuge. National Park Service, Project Report NPS/AR/NR/TR-2006-55, Fairbanks, Alaska.

Martin, P. A., and A. H. Zirkle. 1996. Moose population estimate, Kanuti National Wildlife Refuge, November 1993. U.S. Fish and Wildlife Service, Unpublished Final Report, Fairbanks, Alaska.

Paragi, T. F., C. T. Seaton, and K. A. Kellie. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: Moose range assessment. Alaska Department of Fish and Game, Division of Wildlife Conservation, Final Research Technical Report, Federal Aid in Wildlife Restoration Project 5.10, Juneau.

Schwartz, C. C. 1998. Reproduction, natality, and growth. Pages 141–171 [*In*] A. W. Franzmann and C. C. Schwartz, editors. Ecology and management of the North American moose. Wildlife Management Institute, Smithsonian Institution Press, Washington, D.C.

Stout, G. W. 2006. Unit 24 moose. Pages 566–597 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Stout, G. W. 2009. Unit 24 wolf. Pages 237–247 [*In*] P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2005–30 June 2008. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 14.0, Juneau.

Stout, G. W. 2010. Unit 24 moose. Pages 572–610 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.

Stout, G. W. 2012a (*In prep*). Unit 21D moose. [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2012, Juneau.

Stout, G. W. 2012b. Unit 24 wolf. Pages 240–250 [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2008–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2012-4, Juneau.

Stout, G. W. 2014 (*In prep*). Unit 21D moose. [*In*] P. Harper, editor. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014, Juneau.

Ver Hoef, J. M. 2001. Predicting finite populations from spatially correlated data. Pages 93–98 [*In*] Proceedings of the section on statistics and the environment of the American Statistical Association, 13–17 August 2000, Indianapolis, Indiana.

Ver Hoef, J. M. 2008. Spatial methods for plot-based sampling of wildlife populations. Environmental and Ecological Statistics 15(1):3–13. doi:10.1007/s10651-007-0035-y

Woolington, J. D. 1998. Unit 24 moose. Pages 421–433 [*In*] M. V. Hicks, editor. Moose management report of survey and inventory activities 1 July 1995–30 June 1997. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

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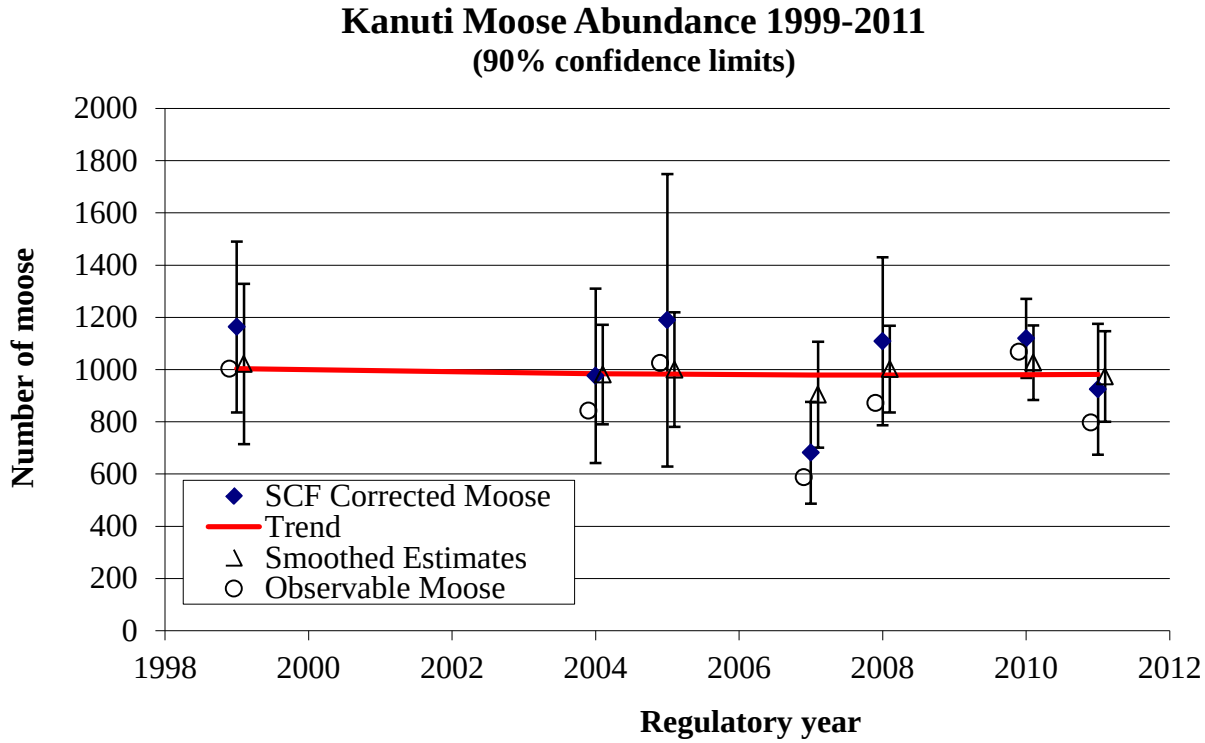

Figure 1. Unit 24 Kanuti National Wildlife Refuge moose density estimates from GSPE surveys and smoothed estimates fitted to the modeled regression line, indicating a stable population for regulatory years[a] 1999–2011. The 2008 (1.272) and 2010 (1.048) sightability correction factors (SCF) were based on the estimate derived from radiocollared moose. The average SCF of those years (1.160) was applied as a correction factor constant for all remaining years. Lambda = 0.9996 (SE = 0.024) rounded to 1.00 (SE = 0.024). Lambda is not significantly different than 1.0 at the 90% confidence level.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1999 = 1 July 1999–30 June 2000).

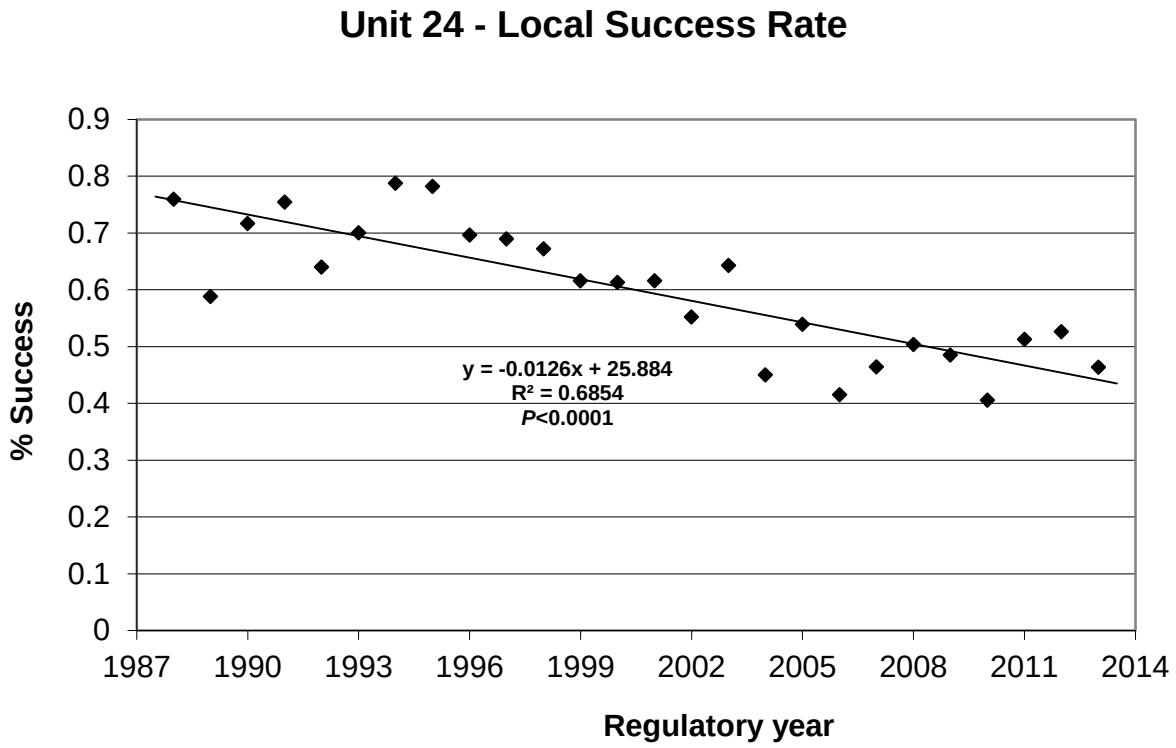

Figure 2. Unit 24 moose harvest success rate by Unit 24 local resident hunters, regulatory years[a] 1988–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1988 = 1 July 1988–30 June 1989).

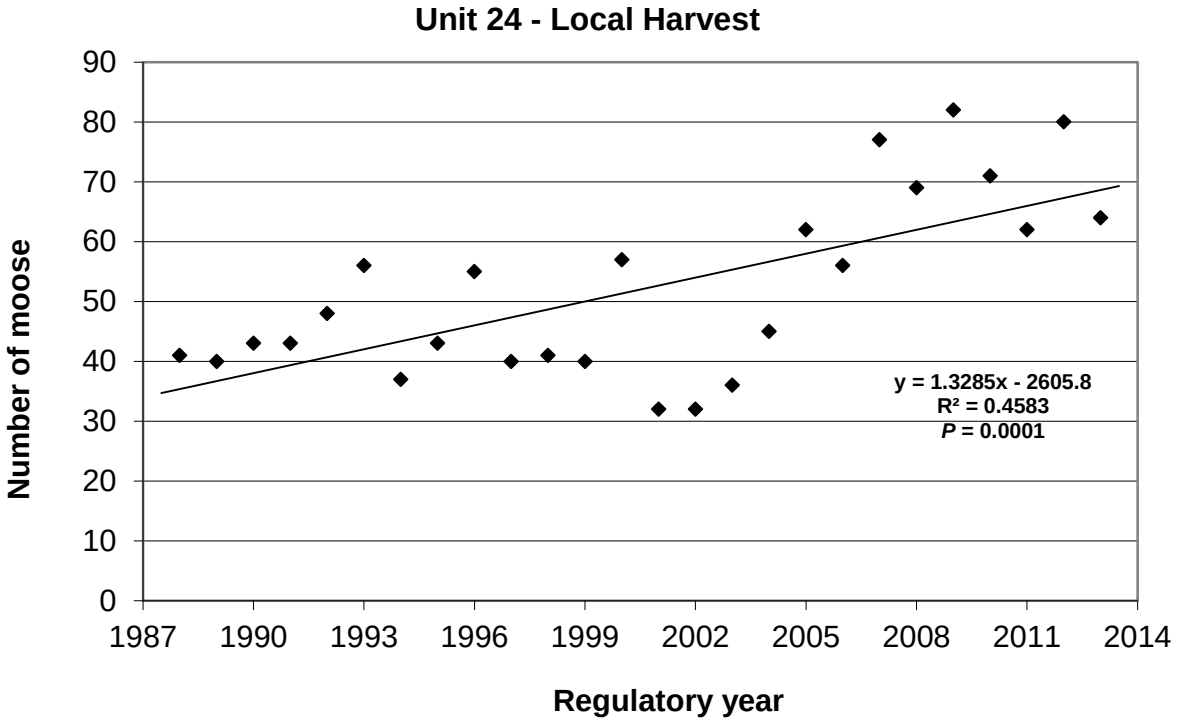

Figure 3. Unit 24 moose harvest reported by Unit 24 local residents, regulatory years[a] 1988–2013.

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1988 = 1 July 1988–30 June 1989).

Table 1. Unit 24B Kanuti National Wildlife Refuge population estimation surveys, regulatory years[a] 1989–2013.

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[b])	$Moose/mi^2$
1989[c]	2,615	64	17	4	9.2		1,172 (±25.1%)	0.45
1993[c]	2,644	61	33	8	17.0		2,010 (±22.0%)	0.76
1999[c]	2,714	61	28	4	14.7	858	1,003 (±20.8%)	0.37
2004[c]	2,710	62	46	9	20.7	650	842 (±28.6%)	0.31
2005[d,e]	2,710	70	43	20	19.7	810	1026 (±43.3%)	0.38
2007[d]	2,715	60	53	13	24.7	451	588 (±21.4%)	0.22
2008[d]	2,715	46	58	14	28.5	624	872 (±23.3%)	0.32
2010[d]	2,715	51	33	8	17.5	861	1,068 (±11.5%)	0.39
2011[d]	2,715	69	41	10	19.9	656	797 (±19.3%)	0.29
2013	2,715	65	36	11	19.6	466	551 (±25.7%)	0.20

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1989 = 1 July 1989–30 June 1990).
[b] Confidence interval (% ±).
[c] Martin and Zirkle (1996), Gasaway (1986) survey estimate with sightability correction factor (1.00 in 1989; 1.17 in 1993).
[d] GSPE survey estimate, without sightability correction factor.
[e] Lawler et al. (2006).

Table 2. Unit 24A Middle Fork trend count area aerial moose composition counts, regulatory years[a] 1987–2011.

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
1987	78	49	5	21	0	13	104	1.33
2000	77	13	0	43	10	27	62	0.81
2001	77	36	9	18	0	12	34	0.44
2002	77	0	0	33	0	25	24	0.31
2003	113	23	9	24	0	16	104	0.92
2004	113	38	6	22	0	14	110	0.97
2005	113	33	5	14	0	11	86	0.76
2007	113	41	5	25	15	15	101	0.89
2008	113	40	13	18	0	11	99	0.87
2011	113	21	5	30	6	20	92	0.81

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1987 = 1 July 1987–30 June 1988).

Table 3. Unit 24B upper Koyukuk management area[a] geospatial population estimation surveys, regulatory years[b] 2010–2013.

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[c])	Moose/mi^2
2010[d]	1,340	52	34	8	18.3	328	405 (±23.9%)	0.30
2011[d]	1,340	103	49	8	18.8	250	324 (±29.0%)	0.24
2013	1,340	67	37	11	17.4	243	300 (±31.4%)	0.22

[a] Area partially overlaps Kanuti National Wildlife Refuge survey area.
[b] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).
[c] Confidence interval (% ±).
[d] Without sightability correction factor.

Table 4. Units 24C and 24D geospatial population estimation (GSPE) survey, regulatory year 2007[a].

Area	Survey area (mi^2)	Bulls:100 cows	Calves:100 cows	Yearling bulls:100 cows	Percent calves	Adults	Population estimate (90% CI[b])	$Moose/mi^2$
Eastern Koyukuk NWR	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] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2007 = 1 July 2007–30 June 2008).
[b] Confidence interval (% ±).

Table 5. Unit 24 total population estimation summary, regulatory years[a] 2004–2011.

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate without sightability correction factor[b]
Units 24A and 24B[c]					
2008 Estimated	8,779				1,929±550
2004–2011 Survey block avg, (Kanuti NWR)[d]	2,715	508	60:100	46:100	885±130
Moose habitat Unit 24, North[e]	3,402				595±200
Remainder Unit 24, North[f]	3,150				158±100
Subtotal (2004–2011)	18,046				3,567±980
Unit 24C[c]					
2007 Survey block (Hogatza River)	2,672	498	70:100	45:100	562±129 (90% CI)
Subtotal (2007)[d]	2,672				562±130
Unit 24D[g]					
2011 Survey block (lower Koyukuk)[d]	1,843	336	38:100	23:100	2,627±210 (90% CI)
2007 Survey block (eastern Koyukuk refuge)[d]	1,623	296	78:100	42:100	983±93 (90% CI)
2010 Survey block (western Koyukuk refuge)[d,h]	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				8,509±1,587

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).
[b] Values following (±) symbol without a 90% CI designation are range approximations and are not statistically derived confidence intervals.
[c] Cumulatively, Units 24A (4,146 mi^2), 24B (13,52 mi^2), and 24C (3,049 mi^2) were formerly defined as Management Zone 2 (Stout 2006).
[d] GSPE survey.
[e] 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.
[f] 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.
[g] Unit 24D (5,350 mi^2) was formerly defined as Management Zone 1 (Stout 2006).
[h] Survey results provided by Koyukuk National Wildlife Refuge.

Table 6. Unit 24D Dulbi Slough trend count area aerial moose composition counts, regulatory years[a] 1982–2011[b].

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
1982	35.0	45	5	7	0	4.5	111	3.2
1983	39.0	17	8	33	14	22.5	113	2.9
1984	48.1	19	8	20	6	14.6	130	2.7
1985	54.2	19	9	10	0	7.7	170	3.1
1989	48.7	53	7	23	18	13.1	298	6.1
1996	86.4	24	8	37	1	23.0	443	5.1
1999	89.0	11	3	22	5	16.1	411	4.6
2001	132.8	24	8	28	0	18.2	280	2.1
2004	132.8	28	16	40	11	23.7	389	2.9
2006[c]	149.4	23	7	53	15	30.1	436	2.9
2011	132.8	47	10	32	9	17.6	204	1.5

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1982 = 1 July 1982–30 June 1983).
[b] Data reported prior to 2001 used Gasaway et al. (1986) sample units. Beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).
[c] Low snow year.

Table 7. Unit 24D Huslia River flats trend count area aerial moose composition counts, regulatory years[a] 1983–2013[b].

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
1983	80.0	36	7	23	3	14.6	212	2.7
1985	64.5	45	17	10	25	6.7	254	3.9
1989	38.2	50	2	30	7	16.7	90	2.4
1993	80.2	81	15	24	8	11.8	483	6.0
1997	80.2	58	15	24	9	13.2	438	5.5
2000	80.2	35	3	17	4	11.2	259	3.2
2001	125.9	38	9	16	0	10.0	603	4.8
2003	136.8	36	10	29	4	17.7	623	4.6
2004	142.3	38	16	33	7	19.1	768	5.4
2005	142.3	31	14	23	4	15.0	752	5.3
2006[c]	142.3	40	12	37	11	20.8	811	5.7
2007	142.3	38	13	33	5	19.4	684	4.8
2008	142.3	35	11	29	7	14.5	509	3.6
2009	142.3	34	13	19	6	12.4	693	4.9
2010	142.3	33	8	30	4	18.2	632	4.4
2011	125.9	42	15	24	3	14.6	541	4.3
2013	125.9	31	6	21	2	13.6	433	3.4

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1983 = 1 July 1983–30 June 1984).
[b] Data reported prior to 2001 used Gasaway et al. (1986) sample units. Beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).
[c] Low snow year.

Table 8. Unit 24D Treat Island trend count area aerial moose composition counts, regulatory years[a] 1985–2013[b].

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
1985	41.0	35	13	17	5	10.9	192	4.7
1993	40.3	39	11	25	7	15.1	317	7.9
1998	67.1	25	6	19	2	13.5	379	5.7
1999	67.1	21	5	15	11	10.8	279	4.2
2000	67.1	16	4	13	5	10.0	430	6.4
2001	163.3	23	4	9	2	7.1	604	3.7
2003	174.1	27	9	21	4	14.3	762	4.4
2004	168.7	29	7	30	9	18.9	800	4.7
2005	168.7	25	9	14	9	10.2	566	3.4
2006[c]	168.7	35	8	30	5	18.2	740	4.4
2007	163.3	29	11	22	10	14.4	711	4.4
2008	163.3	29	13	20	4	13.1	724	4.4
2009	163.3	34	11	11	11	7.7	689	4.2
2010	163.3	39	7	21	5	12.7	688	4.2
2011	163.3	36	7	18	3	11.8	601	3.7
2013	163.3	29	5	20	3	13.5	496	3.0

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1985 = 1 July 1985–30 June 1986).

[b] Data reported prior to 2001 used Gasaway et al. (1986) sample units. Beginning in 2001 surveys used geospatial population estimator sample units (Kellie and DeLong 2006).

[c] Low snow year.

Table 9. Unit 24D moose aerial twinning surveys in the combined areas of Huslia Flats and Treat Island areas, regulatory years[a] 2001–2011.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date(s)
2001		17	2	11	3	29 May–1 Jun
2002	144	53	22	29	41	28–30 May
2003	58	55	23	29	34	29 and 30 May
2004[c]	30	21	12	36	13	27 May
2005	36	40	27	40	32	28 and 29 May
2006	31	40	8	17	21	28 and 29 May
2007	47	38	18	32	22	28 and 29 May
2008	97	37	13	26	29	28–30 May
2009[d]	51	41	10	20	12	29 and 30 May
2010	34	38	15	28	24	28 and 29 May
2011	74	47	13	22	14	29 and 30 May

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2001 = 1 July 2001–30 June 2002).
[b] Percent of cows with calves that had twins.
[c] Extensive flooding and early leaf-out, so survey flight path was "high-graded" to maximize observations.
[d] Early leaf-out.

Table 10. Unit 24D moose aerial twinning surveys in the Dulbi Slough area, regulatory year[a] 2005.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date
2005	16	18	16	47	10	29 May

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2005 = 1 July 2005–30 June 2006).
[b] Percent of cows with calves that had twins.

Table 11. Unit 24C moose aerial twinning surveys in the Hogatza River, regulatory year[a] 2006.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date
2006	7	1	2	n/a	1	30 May–1 Jun

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).
[b] Percent of cows with calves that had twins.

Table 12. Units 24A and 24B combined moose aerial twinning surveys in the Kanuti–Alatna–Middle Fork Koyukuk rivers, regulatory years[a] 2006–2012.

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Date(s)
2006	4	3	1	n/a	0	30–31 May
2007[c]	n/a	32	17	35	n/a	27–31 May
2008[c]	n/a	19	28	60	n/a	29–31 May
2009[c,d]	n/a	15	21	58	n/a	28–30 May
2010[c,e]	n/a	34	20	37	n/a	31 May–2 Jun
2011[c]	n/a	25	27	52	n/a	31 May–2 Jun
2012[c]	27	28	21	43	n/a	30 May–1 Jun

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2006 = 1 July 2006–30 June 2007).
[b] Percent of cows with calves that had twins.
[c] Sample from radiocollared cows.
[d] Early leaf-out.
[e] Including 1 cow with 3 calves.

Table 13. Unit 24 moose hunter harvest, regulatory years[a] 1997–2013.

Regulatory	Harvest by hunters				Unreported	Potlatch/	
year	Bull	Cow	Unk	Total	harvest[b]	Stickdance[c]	Total
1997	168	10	2	180	100	n/a	280
1998	213	17	0	230	100	n/a	330
1999	228	10	2	240	100	n/a	340
2000	211	7	1	219	100	n/a	319
2001	183	5	1	189	96	4	289
2002	186	4	0	190	99	1	290
2003	149	5	1	155	90	10	255
2004	127	1	0	128	99	1	228
2005	162	0	0	162	95	5	262
2006	141	0	0	141	140	5	286
2007	199	3	0	202	135	10	347
2008	168	1	0	169	136	9	314
2009	183	3	3	189	144	1	334
2010	179	0	2	181	143	2	326
2011	158	0	1	159	141	4	304
2012	190	0	4	194	139	6	339
2013[d]	154	0	0	154	141	4	299

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Unreported harvest based on ADF&G-Subsistence Division's door-to-door survey and other sources.
[c] Includes reported potlatch, stickdance, ceremonial, and cultural permit harvest.
[d] Preliminary data.

Table 14. Units 21D and 24 Koyukuk controlled use area moose harvest by permit hunt, regulatory years[a] 2002–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	2002	359	49	51	17	145 (100)	0 (0)	0	145
	2003	401	45	55	12	155 (99)	0 (0)	2	157
	2004	399	38	62	8	141 (100)	0 (0)	0	141
	2005	411	37	63	9	132 (100)	0 (0)	0	132
	2006	382	42	58	7	142 (99)	0 (0)	1	143
	2007	349	41	59	8	131 (100)	0 (0)	0	131
	2008	341	53	47	6	168 (99)	1 (1)	0	169
	2009	429	48	52	9	187 (100)	0 (0)	0	187
	2010	418	47	53	7	181 (100)	0 (0)	1	182
	2011	405	47	53	9	174 (100)	0 (0)	0	174
	2012	394	48	52	7	174 (100)	0 (0)	1	175
	2013[c]	469	46	54	6	204 (100)	0 (0)	0	204
DM823	2005	2	100	0	0	2 (100)	0 (0)	0	2
	2006	2	50	50	0	1 (100)	0 (0)	0	1
	2007	2	100	0	0	2 (100)	0 (0)	0	2
	2008	4	75	25	0	3 (100)	0 (0)	0	3
	2009	4	100	0	0	4 (100)	0 (0)	0	4
	2010	7	29	71	0	2 (100)	0 (0)	0	2
	2011	7	43	57	0	3 (100)	0 (0)	0	3
	2012	6	100	0	17	5 (100)	0 (0)	0	5
	2013[c]	6	83	17	0	5 (100)	0 (0)	0	5
DM825	2005	3	100	0	33	2 (100)	0 (0)	0	2
	2006	4	100	0	0	4 (100)	0 (0)	0	4
	2007	4	100	0	0	4 (100)	0 (0)	0	4
	2008	6	100	0	33	4 (100)	0 (0)	0	4
	2009	4	50	50	0	2 (100)	0 (0)	0	2
	2010	7	86	14	0	6 (100)	0 (0)	0	6
	2011	7	83	17	0	5 (100)	0 (0)	0	5

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2012	6	100	0	0	6 (100)	0 (0)	0	6
	2013[c]	6	100	0	17	5 (100)	0 (0)	0	5
DM827	2002	20	69	31	35	9 (100)	0 (0)	0	9
	2003	26	37	63	19	7 (100)	0 (0)	0	7
	2004	5	75	25	20	3 (100)	0 (0)	0	3
	2005	3	100	0	33	2 (100)	0 (0)	0	2
	2006	3	100	0	66	1 (100)	0 (0)	0	1
	2007	3	100	0	66	1 (100)	0 (0)	0	1
	2008	4	50	50	50	1 (100)	0 (0)	0	1
	2009	4	50	50	50	1 (100)	0 (0)	0	1
	2010	7	17	83	14	1 (100)	0 (0)	0	1
	2011	7	75	25	43	3 (100)	0 (0)	0	3
	2012	6	17	83	0	1 (100)	0 (0)	0	1
	2013[c]	6	75	25	33	3 (100)	0 (0)	0	3
DM828	2002	79	55	45	56	17 (100)	0 (0)	0	17
	2003	103	60	40	48	27 (100)	0 (0)	0	27
	2004	20	57	43	55	4 (100)	0 (0)	0	4
	2005	20	44	56	55	4 (100)	0 (0)	0	4
	2006	20	60	40	50	6 (100)	0 (0)	0	6
	2007	20	80	20	75	3 (75)	1 (25)	0	4
	2008	32	56	44	50	9 (100)	0 (0)	0	9
	2009	32	69	31	50	11 (100)	0 (0)	0	11
	2010	54	65	35	43	20 (100)	0 (0)	0	20
	2011	54	75	25	48	21 (100)	0 (0)	0	21
	2012	47	60	40	36	18 (100)	0 (0)	0	18
	2013[c]	48	52	48	52	12 (100)	0 (0)	0	12
DM829	2002	20	100	0	45	11 (100)	0 (0)	0	11
	2003	26	62	38	12	13 (100)	0 (0)	0	13
	2004	5	33	67	40	1 (100)	0 (0)	0	1

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2005	2	0	100	50	0 (0)	0 (0)	0	0
	2006	2	100	0	0	2 (100)	0 (0)	0	2
	2007	2	100	0	0	2 (100)	0 (0)	0	2
	2008	4	75	25	0	3 (100)	0 (0)	0	3
	2009	4	50	50	0	2 (100)	0 (0)	0	2
	2010	7	67	33	14	4 (100)	0 (0)	0	4
	2011	7	50	50	43	2 (100)	0 (0)	0	2
	2012	6	75	25	33	3 (100)	0 (0)	0	3
	2013[c]	6	100	0	50	3 (100)	0 (0)	0	3
DM830	2002	79	84	16	38	41 (100)	0 (0)	0	41
	2003	103	76	24	36	44 (100)	0 (0)	0	44
	2004	20	57	43	60	4 (100)	0 (0)	0	4
	2005	20	73	27	45	8 (100)	0 (0)	0	8
	2006	20	47	53	32	9 (100)	0 (0)	0	9
	2007	20	100	0	30	14 (100)	0 (0)	0	14
	2008	32	86	14	56	12 (100)	0 (0)	0	12
	2009	32	70	30	25	16 (100)	0 (0)	0	16
	2010	54	73	27	39	24 (100)	0 (0)	0	24
	2011	54	89	11	31	33 (100)	0 (0)	0	33
	2012	47	78	22	43	21 (100)	0 (0)	0	21
	2013[c]	47	88	12	32	28 (100)	0 (0)	0	28
Total	2002	557	54	46	27	223 (100)	0 (0)	0	223
	2003	659	50	50	22	246 (100)	0 (0)	2	248
	2004	449	38	62	13	153 (100)	0 (0)	0	153
	2005	461	40	60	15	150 (100)	0 (0)	0	150
	2006	433	44	56	12	165 (100)	0 (0)	1	166
	2007	400	46	54	13	157 (99)	1 (1)	0	158
	2008	423	56	44	14	200 (99)	1 (1)	0	201
	2009	509	51	49	13	223 (100)	0 (0)	0	223

Hunt	Regulatory year	Permits issued	Percent successful hunters[b]	Percent unsuccessful hunters[b]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2010	554	50	50	14	238 (100)	0 (0)	1	239
	2011	541	53	47	16	241 (100)	0 (0)	0	241
	2012	512	51	49	13	228 (100)	0 (0)	1	229
	2013[c]	588	51	49	13	260 (100)	0 (0)	0	260

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] 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.
[c] Preliminary data.

Table 15. Units 24C and 24D Huslia River and Hogatza River drainages moose harvest by permit hunt, regulatory years[a] 2004–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM892	2004	32	89	11	72	8 (100)	0 (0)	0	8
	2005	32	64	36	31	14 (100)	0 (0)	0	14
	2006	32	60	40	53	9 (100)	0 (0)	0	9
	2007	35	73	27	26	19 (100)	0 (0)	0	19
	2008	35	39	61	34	9 (100)	0 (0)	0	9
	2009	35	62	38	40	13 (100)	0 (0)	0	13
	2010	35	29	71	20	8 (100)	0 (0)	0	8
	2011	28	56	44	43	9 (100)	0 (0)	0	9
	2012	22	38	62	41	5 (100)	0 (0)	0	5
	2013[b]	35	38	62	63	5 (100)	0 (0)	0	5
DM896	2004	54	35	65	31	13 (100)	0 (0)	0	13
	2005	54	48	52	57	11 (100)	0 (0)	0	11
	2006	54	18	82	80	2 (100)	0 (0)	0	2
	2007	60	43	57	63	9 (100)	0 (0)	0	9
	2008	31	44	56	39	8 (100)	0 (0)	0	8
	2009	48	43	57	48	10 (100)	0 (0)	0	10
	2010	47	56	44	47	14 (100)	0 (0)	0	14
	2011	60	52	48	58	12 (100)	0 (0)	0	12
	2012	60	45	55	33	18 (100)	0 (0)	0	18
	2013[b]	39	50	50	49	10 (100)	0 (0)	0	10

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2004 = 1 July 2004–30 June 2005).

[b] Preliminary data.

Table 16. Unit 24A Dalton Highway corridor management area moose harvest by permit hunt, regulatory years[a] 2002–2013.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM920	2002	20	0	100	30	0 (0)	0 (0)	0	0
	2003	20	0	100	40	0 (0)	0 (0)	0	0
	2004	20	9	91	45	1 (100)	0 (0)	0	1
	2005	20	6	94	20	1 (100)	0 (0)	0	1
	2006	20	33	67	55	3 (100)	0 (0)	0	3
	2007	20	15	85	35	2 (100)	0 (0)	0	2
	2008	20	0	100	20	0 (100)	0 (0)	0	0
	2009	20	13	87	25	2 (100)	0 (0)	0	2
	2010	20	36	64	45	4 (100)	0 (0)	0	4
	2011	20	19	81	20	3 (100)	0 (0)	0	3
	2012	20	8	92	35	1 (100)	0 (0)	0	1
	2013[b]	20	0	100	20	0 (100)	0 (0)	0	0
DM922	2002	50	12	88	29	4 (100)	0 (0)	0	4
	2003	50	14	86	54	3 (100)	0 (0)	0	3
	2004	50	8	92	46	2 (100)	0 (0)	0	2
	2005	50	21	79	42	6 (100)	0 (0)	0	6
	2006	50	12	88	32	4 (100)	0 (0)	0	4
	2007	50	3	97	24	1 (100)	0 (0)	0	1
	2008	50	6	94	30	2 (100)	0 (0)	0	2
	2009	50	9	91	30	3 (100)	0 (0)	0	3
	2010	51	8	92	49	2 (100)	0 (0)	0	2
	2011	50	3	97	30	1 (100)	0 (0)	0	1
	2012	50	33	67	46	9 (100)	0 (0)	0	9
	2013[b]	50	3	97	38	1 (100)	0 (0)	0	1

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2002 = 1 July 2002–30 June 2003).
[b] Preliminary data.

Table 17. Unit 24 moose harvest chronology percent by month/day, regulatory years[a] 1997–2013.

Regulatory year	Harvest chronology percent by month/day				
	9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	*n*
1997	49	46	1	4	170
1998	49	47	0	5	219
1999	43	52	0	4	231
2000	46	49	0	4	205
2001	37	60	2	2	179
2002	43	55	0	2	174
2003	48	48	0	5	145
2004	46	54	0	1	123
2005	34	66	0	0	152
2006	44	56	0	1	128
2007	36	60	0	4	191
2008	44	56	0	0	159
2009	44	53	0	3	184
2010	42	58	0	0	178
2011	46	54	0	0	158
2012	51	49	0	0	192
2013[b]	41	59	0	0	150

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Preliminary data.

Table 18. Unit 24 moose hunter residency and success, regulatory years[a] 1997–2013[b].

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	Local[c] resident	Nonlocal resident	Nonresident	Unk	Total	
1997	40	97	41	2	180	18	81	20	0	119	299
1998	41	125	59	5	230	20	120	25	2	167	397
1999	40	119	77	4	240	25	143	39	3	210	450
2000	57	124	38	1	220	36	141	55	0	232	452
2001	32	101	48	1	182	20	181	57	0	258	440
2002	32	90	68	0	190	26	130	56	2	214	404
2003	36	76	35	8	155	20	104	50	10	184	339
2004	45	51	29	2	127	55	139	35	1	230	357
2005	62	73	24	2	161	53	145	38	1	237	398
2006	56	66	20	0	142	79	152	32	1	264	406
2007	77	89	36	0	202	89	170	30	0	289	491
2008	69	69	30	1	169	68	151	40	0	259	428
2009	82	82	24	0	188	87	142	41	5	275	463
2010	71	84	26	0	181	104	118	50	1	273	454
2011	62	68	27	2	159	59	109	29	0	197	356
2012	80	76	35	3	194	72	143	43	1	259	453
2013[d]	64	60	30	0	154	74	106	30	5	215	369

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).
[b] Some hunters have up to 3 reporting mechanisms (1 harvest permit and 2 harvest permits). Data presented here count each reporting mechanism as one "hunter," in terms of effort.
[c] Unit resident only.
[d] Preliminary data.

Table 19. Unit 24 moose harvest percent by transport method, regulatory years[a] 1997–2013.

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1997	19	1	51	7	6	1	11	6	178
1998	17	0	62	2	4	0	10	5	230
1999	17	1	56	3	4	0	18	1	240
2000	16	0	61	3	4	1	14	2	220
2001	19	1	62	2	3	0	14	0	182
2002	18	1	69	1	2	0	7	2	190
2003	19	1	69	1	5	0	5	1	155
2004	19	0	59	2	1	0	17	2	127
2005	7	1	75	1	0	0	13	4	161
2006	9	3	69	1	1	2	11	4	142
2007	15	1	70	2	4	2	7	0	201
2008	16	1	70	2	1	1	8	1	167
2009	12	0	72	5	0	0	4	7	185
2010	14	1	74	4	0	0	6	1	180
2011	16	1	69	5	0	1	5	3	159
2012	16	1	72	3	0	1	7	1	191
2013[b]	12	1	82	3	0	1	1	0	153

[a] Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1997 = 1 July 1997–30 June 1998).

[b] Preliminary data.