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Moose twinning rate estimates for portions of Alaska GMU 12 including Tetlin National Wildlife Refuge and adjacent lands, 2021-2026.

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Photo: USFWS

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Summary

We conducted surveys from fixed-wing aircraft between May 26 and June 3 each year. The observed twinning rate for the overall study area in 2026 was 0.32 (*n* =31), notably higher than the preceding five-year average of 0.16 (*n* =164).

Twinning rates for the portion of the survey area west of the Nabesna River were consistently lower than that east of the river, and we found that the difference between these rates was significantly different after accounting for year-to-year variation in search effort (CMH $\chi^2_1 = 5.39$, $P = 0.020$). The multi-year estimate for the western portion was 0.14 (*n*=134), while that in the eastern portion was 0.30 (*n*=60).

Continued monitoring of twinning rates in the western portion of the survey area is recommended to evaluate long-term trends. Documenting habitat use by cows that calve west of the Nabesna River and gathering habitat data (e.g., overall forage availability and conducting browse surveys) in these areas may improve understanding of this population.

Suggested reference:

Terasa, C.R. and B.E. Jamison. 2026. Moose twinning rate estimates for portions of Alaska GMU 12 including Tetlin National Wildlife Refuge and adjacent lands, 2021-2026. Unpublished report. U.S. Fish and Wildlife Service, Tok, Alaska.

Introduction

Moose (*Alces alces gigas*) are among the most highly valued subsistence resources on Tetlin National Wildlife Refuge (NWR) and are subsequently a focal species identified in the Inventory and Monitoring Plan for Tetlin NWR (USFWS 2022). Twinning rates are the most useful single index of the nutritional status of cow moose and are closely tied to habitat quality (Franzmann and Schwartz 1985, Keech et al. 2000, Boertje et al. 2007). We began annual surveys in 2021 to estimate moose twinning rates for the Tetlin NWR and adjacent lands to complement population surveys that are conducted in cooperation with the Alaska Department of Fish and Game (ADF&G).

Methods

The survey area was within Alaska Game Management Unit (GMU) 12 and encompassed 3,065 mi^2. The area was bounded by the Tok Cutoff (AK Hwy 1) on the west, Nutzotin and Mentasta Mountain ranges on the south and southwest, the Alaska Highway to the north, and the Canadian border to the east (Figure 1). Land ownership includes Alaska state lands, Wrangell-St. Elias National Preserve, Tetlin National Wildlife Refuge, Native village of Tetlin, Tetlin Native Corporation lands, Native Village of Northway, Northway Native Association, and Doyon Limited Regional Corporation.

We conducted surveys in accordance with approved protocols described by Jamison and Cobb (2025). No telemetry studies of moose were ongoing and no radio-collared cows were present within the survey area from 2021-2026. Therefore, we conducted survey flights to search suitable habitat for uncollared cows with calves. We performed surveys from fixed-wing aircraft (Piper PA-18 Super Cub) annually between May 26 and June 3. We operated aircraft at ≤500 ft above ground level and at 65-85 mph ground speed, and continued survey flights until we encountered ≥30 cows with one or more calves.

The pilot and observer both searched for moose. We categorized moose as bull, yearling cow, cow with no calf, cow with one calf, or cow with two calves. We recorded the location of each moose observation with a handheld GPS unit to avoid double counting moose during flights on subsequent days.

We calculated the twinning rate (*T*) as,

$$T = \frac{M_t}{M_c + M_t}$$

where M_c was the number of cows observed with one calf and M_t was the number of cows observed with twins. We calculated the Standard Error (SE) of the estimate and binomial 90% confidence intervals following Cochran (1977) and Boertje et al. (2007). The multiyear twinning rate was calculated by pooling observations across years. We calculated twinning rates separately for the eastern and western portions of the survey area (east and west of the Nabesna River) after examining preliminary results of the first three years of surveys. To statistically compare twinning rates east and west of the Nabesna River while accounting for unequal sampling effort among years, we used a Cochran-Mantel-Haenszel (CMH) test stratified by survey year (Agresti 2013). We assessed homogeneity of the odds ratio across years with a Breslow-Day test.

Results

We conducted 22 survey flights with two individual pilots and six unique observers over six years. Over the entire survey area, we observed 1,078 adult and yearling moose (Table 1). Of these, 158 were cows with one calf and 37 were cows with twins. The estimated twinning rate ranged from 0.03 (SE = 0.03) to 0.32 (SE = 0.08) across years (Figure 2). The multiyear twinning rate was 0.19 (SE = 0.03; Table 2).

Based on our field observations in earlier survey years, we suspected that the twinning rate may differ between habitats in the eastern versus western portions of the survey area. Subsequently, we compared data for moose observed east versus west of the Nabesna River.

We observed 619 adult and yearling moose east of the Nabesna River and 617 west of the river over the 6 survey years. Of those in the eastern portion, 60 were cows with calves whereas we observed 135 cows with calves west of the river. The multiyear twinning rate estimates for the eastern and western portions were 0.30 (SE = 0.06) and 0.14 (SE = 0.03), respectively (Table 2, Figure 3).

By running the Cochran-Mantel-Haenszel (CMH) test, we found that twinning rates were significantly higher east of the Nabesna River than west after accounting for year-to-year variation in effort (CMH $\chi^2_1 = 5.39$, $P = 0.020$). The common odds of twinning were roughly 2.5 times higher in the eastern portion than the west (Mantel-Haenszel OR = 2.48, 95% CI = 1.14–5.37). This difference was consistent across all six survey years (Breslow-Day $\chi^2_5 = 2.12$, $P = 0.83$), indicating the pattern is not driven by any single year.

Table 1. Moose observations during spring twinning surveys for a portion of Alaska GMU 12 including the Tetlin National Wildlife Refuge, 2021-2026.

		Cow moose					
Year	Bulls	Yearling	no calf	one calf	twins	triplets	Total[a]
2021	58	18	66	25	6	0	173
2022	109	18	86	29	7	0	249
2023	46	5	40	31	1	0	123
2024	58	2	35	24	7	0	126
2025	109	15	45	28	6	0	201
2026	100	9	66	21	10	0	206
Totals	480	67	338	158	37	0	1078

[a] Total adults and yearlings; does not include calves.

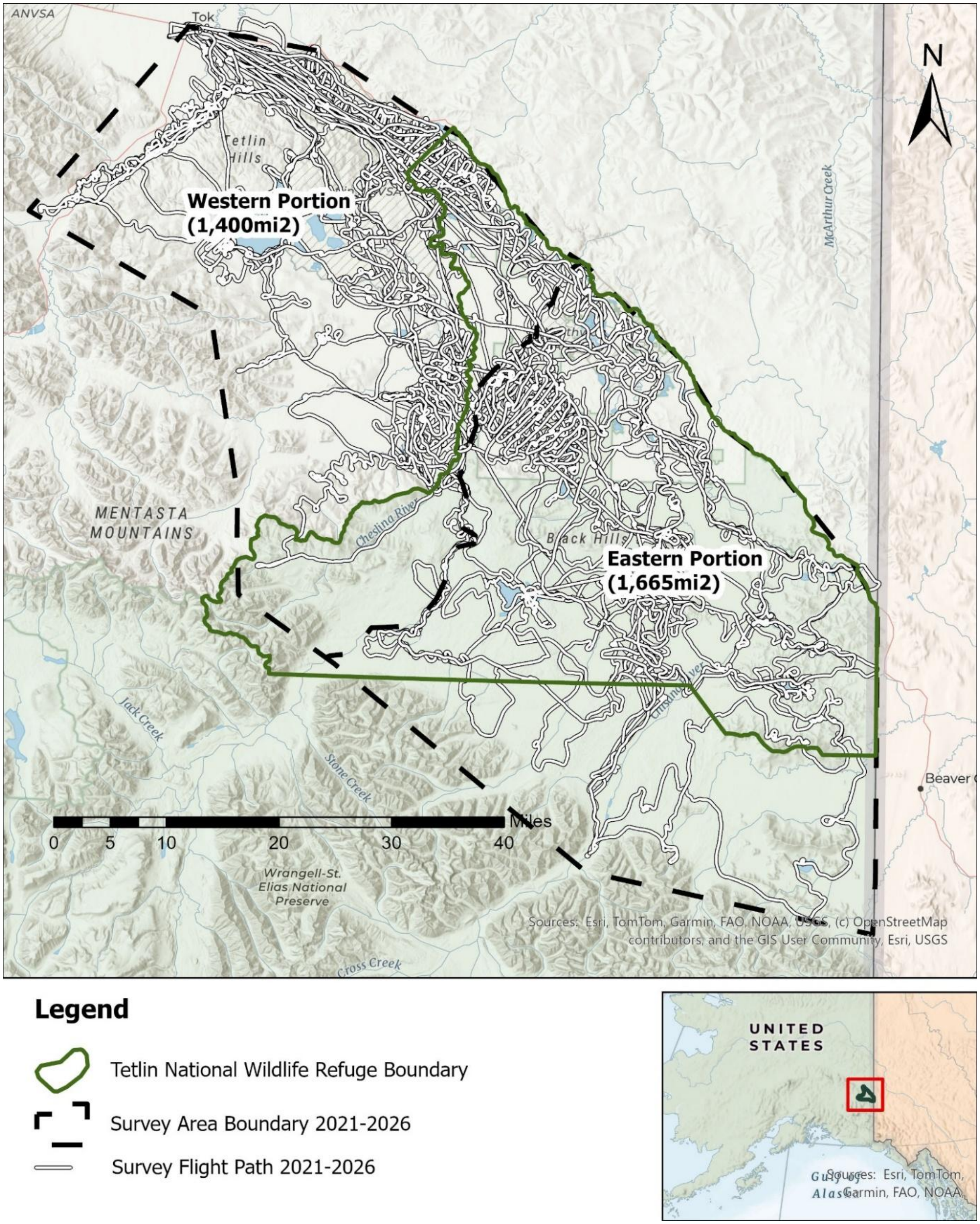

Figure 1. Survey area for moose twinning rate surveys conducted by Tetlin NWR, 2021-2026.

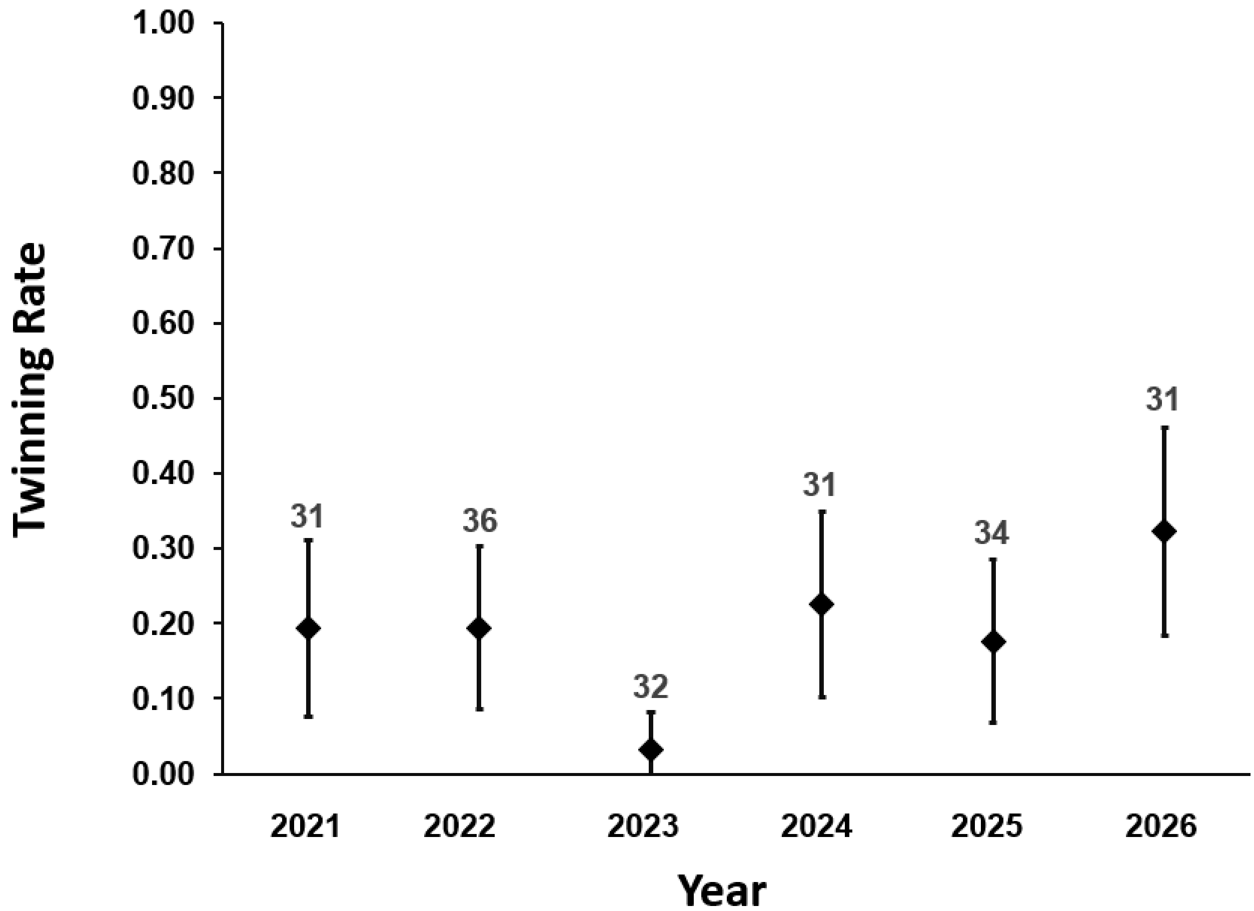

Figure 2. Twinning rates and 90% CI for a portion of GMU 12 including the Tetlin National Wildlife Refuge 2021-2026 estimated from observations of uncollared cows with calves. Data labels are the number of cows with calves observed during surveys.

Table 2. Moose twinning rates (T) for a portion of Alaska GMU 12 including the Tetlin National Wildlife Refuge, 2021-2026. Estimates for the eastern and western portion of the survey area are for those areas east and west of the Nabesna River, respectively.

Year	n	T	SE	90% CI
Overall 2021	31	0.19	0.071	0.076 – 0.311
Overall 2022	36	0.19	0.066	0.086 – 0.303
Overall 2023	32	0.03	0.031	0.000 – 0.082
Overall 2024	31	0.23	0.075	0.102 – 0.350
Overall 2025	34	0.18	0.065	0.070 – 0.290
Overall 2026	31	0.32	0.084	0.184 – 0.461
Overall multiyear	194	0.19	0.028	0.143 – 0.236
Eastern multiyear	60	0.30	0.059	0.202 – 0.398
Western multiyear	134	0.14	0.030	0.092 – 0.192

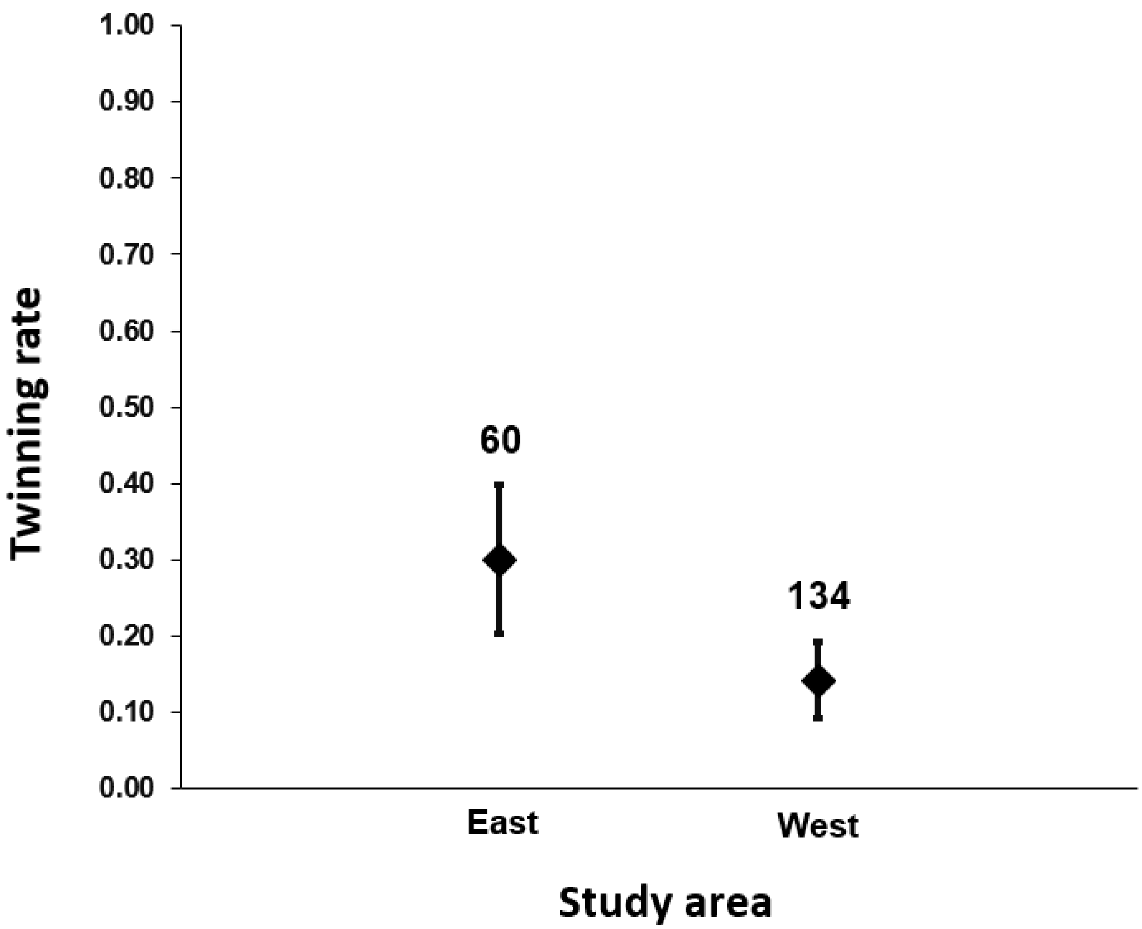

Figure 3. Multi-year twinning rates and 90% CI for areas east and west of the Nabesna River within a portion of GMU 12 including the Tetlin National Wildlife Refuge, 2021-2026.

Discussion

The multiyear twinning rate estimate for our survey area (0.19) remains lower than that reported for many moose populations across Alaska. Boertje et al. (2007) summarized twinning rate data for 15 populations in the state and documented a broad range of 0.07 to 0.67. The most recent comparable estimate from the southern portion of GMU 20E—the nearest population with recent twinning data—was approximately 0.54 (Aidan Hunter, personal communication, June 2, 2026). In contrast to the low multiyear average, the 2026 twinning rate observed in our study area was 0.32.

The eastern and western portions of the twinning survey area correspond to known differences in moose density in the two population survey areas (Northwestern Unit 12 Survey Area vs. Southeastern Unit 12 Survey Area) that overlap our twinning survey area. Moose in the eastern portion, which includes Tetlin National Wildlife Refuge, characterize a low-density population ranging between 0.28 and 0.62 moose/mi² from 2000 to 2025 (Gasaway et al. 1992, Wells 2022, Jamison 2026). In contrast, densities in the western portion are generally higher, averaging just over 1.0 moose/mi² over the same period (Jamison 2026). Statistical comparisons revealed that twinning rates in the western portion are significantly lower than those in the eastern portion after accounting for year-to-year variation in survey effort (Cochran-Mantel-Haenszel test, χ^2_1= 5.39, P = 0.020; common OR = 2.48, 95% CI = 1.14–5.37), and this difference was consistent across all six survey years (Breslow-Day test, χ^2_5= 2.12, P = 0.83). Additionally, because 69% of cow-calf observations over the study period occurred in the western portion, this lower-twinning area is largely driving the multiyear twinning rate for the survey area as a whole.

Twinning rates below 0.10 are strong indicators of nutritional stress and may suggest that a population has reached or exceeded carrying capacity (Boertje et al. 2007). Although the multiyear estimate for the western portion has not declined to this threshold, it is close and warrants continued monitoring to evaluate long-term trends. Collection of additional habitat and diet data—such as browse utilization and pellet analysis—could provide insight into the nutritional status of our population (Breithaupt et al. 2024). Preliminary browse surveys initiated during spring 2026 may soon provide information on habitat use and conditions across the survey area.

Interannual variability in twinning rates has been documented in both our survey area and GMU 20E. Estimates for 2023, for example, were lower than those recorded in the two preceding years (Wells 2023). This pattern may reflect the influence of above-average snowfall during the winters of 2021–2022 and 2022–2023, which may have reduced individual fitness in these populations (Coady 1974). Despite the apparent increase in twinning rate observed in 2026 (0.32), a Chi-Square Test of among-year variation in the pooled twinning rate was not statistically significant (χ^2_5 = 9.10, P = 0.105), and the 2026 estimate fell within the 90% confidence interval for most years of the study. We therefore interpret 2026 as falling within the range of normal interannual variation rather than representing a distinct shift. Even if there were a true change in twinning rate, we lack sufficient environmental or other data to evaluate what might drive such a change.

Several survey limitations inherent to the study design limit our ability to fully interpret both temporal and spatial patterns in twinning rate. First, annual sample sizes were small, resulting in relatively wide confidence intervals around annual estimates. Consequently, caution is warranted when interpreting year-to-year fluctuations.

Sightability bias represents another source of uncertainty. Though newly born twins were often located close to one another and the cow, we occasionally observed twins far apart from one another and/or the cow, creating potential for some twins to be incorrectly classified as single calves. This issue is compounded by the tendency of cows to select densely vegetated habitats during and immediately following parturition, where calves are more concealed from aerial view (Melin et al. 2016, McLaren and Benson 2017).

Interpretation of interannual variability is further complicated by the fact that surveys were conducted during a fixed annual window rather than timed to peak parturition dates, which in other twinning studies have been estimated through long-term radio or GPS-collar monitoring (Hunter 2025, Bowyer et al. 1998, McLaren et al. 2017). Without radio-marked cows, we cannot determine whether surveys are conducted during true peak parturition, assess individual fidelity to areas east or west of the Nabesna River between years, or determine whether the same cows were sampled repeatedly or whether movements between units influenced year-to-year estimates.

Limited information on predator abundance and activity—particularly bears—in the eastern interior also restricts our understanding of how predation may influence moose population density, and in turn twinning rate, in the study area. Evidence suggests moose populations in parts of Alaska may experience a "low density dynamic equilibrium," in which predators remove enough calves each year that moose remain at low density despite abundant forage and even high fecundity (Ballard and Ballenberghe 1998, Gasaway et al. 1992, Messier 1994). To determine whether predator-driven calf mortality contributes to the trends we observe in moose density and calving patterns, direct estimates of calf predation rates and, ideally, bear density are needed. Although no studies have examined whether predation pressure directly affects twinning rates, some evidence indicates that high predation pressure can select for earlier calving dates over time (Testa et al. 2000, Patterson, et al. 2016). Quantifying calf predation by bears and wolves in our study area would substantially improve our ability to interpret moose population trends and evaluate potential drivers of low twinning rates.

Continued monitoring will be important for evaluating long-term trends in twinning rates and assessing whether year-to-year changes in estimates represent temporary fluctuations, sustained changes in moose reproduction, or are simply consequences of inadequate sample size and limitations in determining statistical significance. Incorporating radio-marked cows into future survey designs would reduce sightability-related biases and allow surveys to be timed more precisely relative to parturition. Radio-marked individuals would also improve interpretation of annual variation, movement patterns, and spatial differences in twinning rates.

Increasing the minimum sample size of cows with calves to 40 across the study area would also narrow confidence intervals and align our protocols with those used by the ADF&G. Increasing sample size further to 40 cows with calves east and 40 cows with calves west of the Nabesna River may also permit further statistical comparison between the two survey area portions. Collectively, these improvements would enhance our ability to monitor the Tetlin NWR moose population and detect meaningful changes over time.

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