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Natural Resource Stewardship and Science

Voyageurs National Park Moose Population Survey Report

2017

Natural Resource Report NPS/VOYA/NRR—2017/1455

ON THIS PAGE
Female moose VOYA06, one the few remaining moose wearing functioning GPS collars in VOYA, was found to be partially paralyzed on 1 March 2017. With the assistance of Minnesota Department of Natural Resources Wildlife Health staff, the moose was euthanized in the field for necropsy to determine cause of death. Preliminary findings suggest a liver fluke infection, a parasite carried by white-tailed deer but often fatal for moose.
NPS/BRYCE OLSON

ON THE COVER
A bull moose with "peruke" antlers, a deformity typically caused by a hormone imbalance. This bull was observed several years in a row, easily identified by its very rare antlers.
NPS/BRYCE OLSON

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Abstract

Moose are at the southern edge of their range in Minnesota, where populations have experienced dramatic declines over the last 10 to 20 years. Concern for the status of moose in Voyageurs National Park resulted in the establishment of a monitoring program in 2009 that includes an annual estimate of the moose population in winter. The 2017 survey was conducted 9–18 February on the Kabetogama Peninsula, a 305 km^2 roadless area in the center of the park where >90% of the park's moose reside. We counted 33 moose during the survey (13 bulls, 10 cows, 3 unknown adults, 2 yearlings, and 5 calves). After correcting for sightability, the 2017 population estimate for the Kabetogama Peninsula was 44 moose (90% CI = 39–50), or 0.14 moose/km^2 (0.37 moose/mi^2). The 2017 population estimate is similar to estimates for the period 2009–2016. Indices of calf production in 2017 were relatively low, similar to 2014–2016. No twins were observed in 2017, as has been the case in most survey years. The estimated calf:cow ratio was 0.50, and calves were 16% of the population. The bull:cow ratio observed during the 2017 survey was 1.30, slightly higher than 2014–2015 but much higher than during the 2010–2013 period. Combined with data from GPS collared moose and other sources, our population estimate is indicative of a low density but stable population of moose in the park.

Acknowledgments

Funding for this project was provided by Voyageurs National Park. We also acknowledge support from the University of Minnesota (Duluth and Twin Cities campuses) for GPS collars and data acquisition for collared moose used in the visibility trials. R. Moen, University of Minnesota-Duluth, is a co-investigator for the ongoing moose research in VOYA, including the capture and collaring of moose in the park since 2010. Special thanks to Voyageurs National Park Pilot J. Hummel for assistance with data collection for the 2017 survey. We also appreciate the support of the Minnesota Department of Natural Resources Wildlife Health Program and the University of Minnesota Veterinary Diagnostic Lab for providing pathological examinations of dead moose.

Introduction

Voyageurs National Park (Minnesota) was established in 1975 in part to fulfill the National Park Service's mission to preserve and protect wildlife populations and provide opportunities for the public to enjoy them. Moose (*Alces alces*) are native to Voyageurs National Park (VOYA), but recent declines among other moose populations in the region raised concerns about the long-term viability of moose in the park. Moose populations in northwestern Minnesota declined precipitously during the period 1984–2000 (Murray et al. 2006). Moose populations in northeastern Minnesota have also declined recently. The current estimate for northeastern Minnesota is nearly 50% lower than the 2006 estimate, though it has stabilized over the last five years (DelGiudice 2017).

Voyageurs National Park is not surveyed as part of the state's systematic annual survey because it lies just outside of primary moose range in northeastern Minnesota (Figure 1; DelGiudice 2017). Voyageurs National Park, in collaboration with the University of Minnesota-Duluth, began more intensive monitoring and research of moose in and adjacent to the park in 2009 to better understand local moose population dynamics. The moose population within VOYA has remained stable since 2009, but, due to the small size and isolation of the park's moose herd, annual monitoring is needed to ensure the population remains viable.

Methods

We surveyed the moose population within the boundaries of Voyageurs National Park during 9–18 February 2017. The survey area was limited to the Kabetogama Peninsula, a 305 km^2 roadless area in the center of the park where >90% of the park's moose population occurs (Figure 1). Surveys were conducted using a 2-seat Top Cub aircraft with a pilot and observer searching for moose while the plane flew in overlapping circles at an intensity of at least 3.5 min/km^2. The peninsula was broken down into 23 separate survey units to facilitate the completion of the survey, and all units were surveyed. For each observed moose we recorded location, group size, sex/age class (calf, yearling, adult cow, adult bull, unknown), and whether the animal was standing or bedded. We also recorded all observations of white-tailed deer (*Odocoileus virginianus*) and gray wolves (*Canis lupus*).

We used data collected from four test plots to estimate sightability (detection probability) of moose for our survey method. We searched test plots for moose wearing GPS telemetry collars using the same flight pattern and intensity as the survey plots. Locations of moose not observed in the test plots were confirmed by GPS locations or using VHF telemetry. Test plots were completed during 1–18 February 2017 during conditions similar to those that occurred during the survey.

The number of moose observed during the aerial survey was adjusted with the estimated detection probability, giving a population estimate for the Kabetogama Peninsula (± 90% Confidence Intervals) during the survey period. We also estimated other measures of population status, including calf:cow ratio, twinning rates, and bull:cow ratio. No moose were captured in 2017, therefore we did not estimate pregnancy rates (percent of adult females that were pregnant via blood progesterone levels) as was done from 2010–2013.

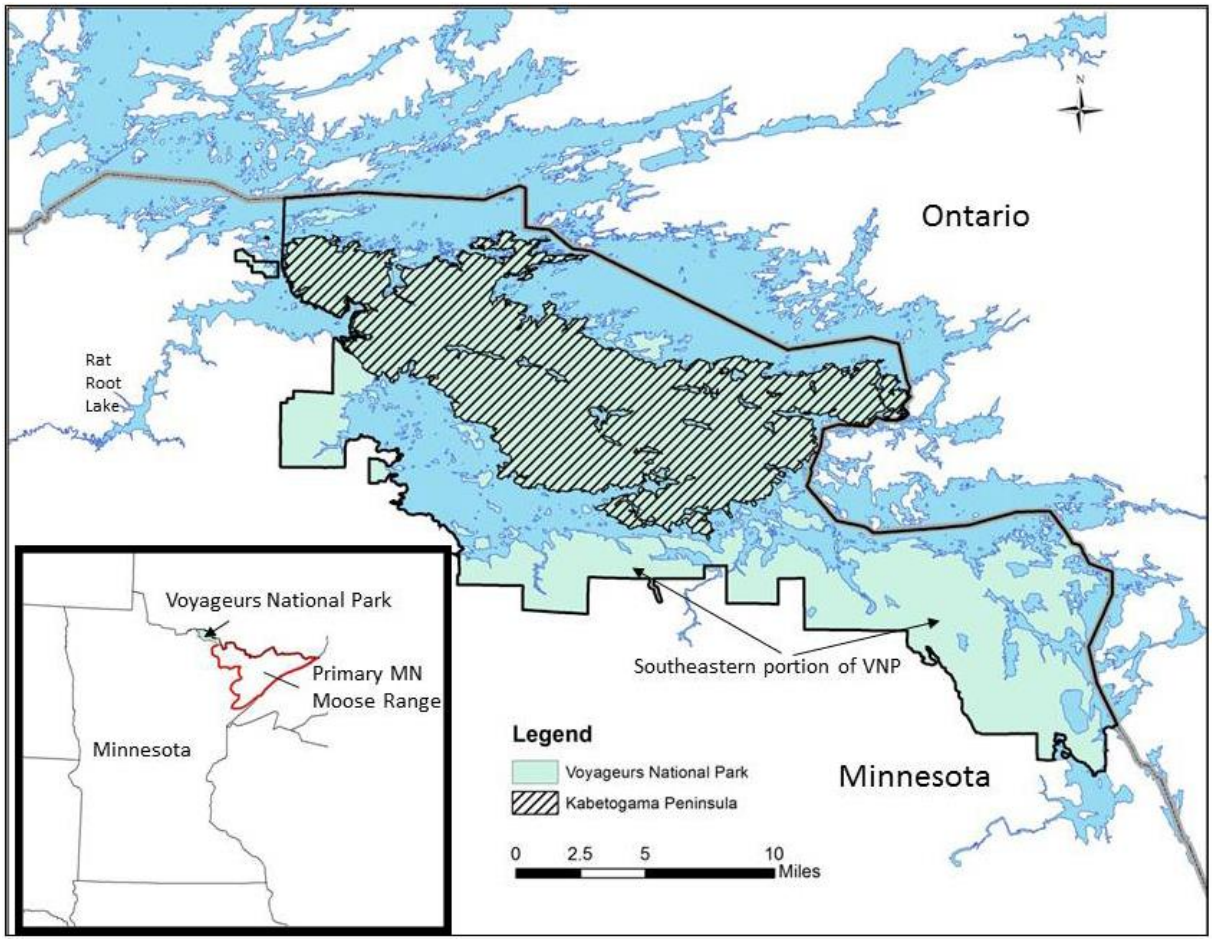

Figure 1. 2017 moose survey area in Voyageurs National Park, Minnesota, USA. The Kabetogama Peninsula (305 km2) contains >90% of the park's moose population. A small pocket of moose (approx. 10–15 individuals) also exists west of the park in the Rat Root Lake area, and evidence from GPS collars suggests that some moose move seasonally between this area and the Kabetogama Peninsula. Some moose also reside in the southeastern portion of the park but we did not survey this part of the park in 2017. Inset shows Minnesota's primary moose range relative to the park's location.

Results

Survey conditions were considered "fair" to "excellent" during the 2017 survey (including sightability trials), with snow depths exceeding 20 cm (8 in) throughout the Kabetogama Peninsula and little snow in the canopies of trees. We only had three functioning GPS/VHF collars at the time of the 2017 survey, and we detected 75% (±36%; 3 out of 4) of collared moose during sightability trials (one moose was used in two sightability trials). Although our point estimate for detection was very similar to those estimated each year from 2013–2016 (mean = 0.75, range = 0.68–0.78), low sample size resulted in large variance around the estimate. In previous years we had 5–11 moose with functioning collars and completed 18–25 independent sightability trials. Survey conditions, survey crew, and aircraft were similar enough between all years sampled using the current methodology (2013–2017) that we used the four-year mean detection probability of 0.75 (mean 90% Confidence Interval [CI] = 0.65–0.84) for the 2013–2016 period to calculate our 2017 population estimate.

We counted 33 moose during the survey (13 bulls, 10 cows, 3 unknown adults, 2 yearlings, and 5 calves). After correcting for sightability (i.e., Sightability Correction Factor = 1/Detection Probability), the 2017 population estimate for the Kabetogama Peninsula was 44 moose (90% CI = 39–50), or 0.14 moose/km^2 (0.37 moose/mi^2). We accounted for one additional moose (a cow) not observed during the formal survey. She was observed during ferry time between plots and confirmed to be a unique individual. The minimum number of moose on the Kabetogama Peninsula during the 2017 survey was 34, based on known individuals. The 2017 population estimate is similar to those from the 2009–2016 period (Table 1). Indices of calf production in 2017 were relatively low, similar to 2014–2016. No twins were observed in 2017, as has been the case in most survey years. The estimated calf:cow ratio was 0.50, and calves were 16% of the population. The bull:cow ratio observed during the 2017 survey was 1.30, slightly higher than 2014–2015 but much higher than during the 2010–2013 period. If we assume that the minimum number of known individuals (i.e., those seen during the survey, plus other observations) is an unbiased representative sample of the population, then calf:cow ratio would be 0.45 and calves would be 15% of the population.

VOYA field staff reported several confirmed sightings of moose or moose sign (droppings or tracks) in the southern part of VOYA during 2016 (i.e., south of Lake Kabetogama and Namakan Lake). Our last formal survey of that area in 2010 confirmed very low densities of moose. Anecdotal evidence confirms that moose continue to be present in that part of the park but at very low densities.

Table 1. Population estimates and demographic characteristics for moose in the Kabetogama Peninsula, Voyageurs National Park, Minnesota, USA, derived from aerial surveys and other sources from 1991–2017. Note that a small error was found in the data for 1997, which has been corrected to exclude five moose observed in two survey units in the southeastern portion of the park. Thus, to be consistent with other years, what is reported here for 1997 is only for the Kabetogama Peninsula.

Year	Population Estimate	90% Confidence Interval for Estimate	Calves: Cow	% Calves	% Twins[a]	Bulls: Cow	% Pregnant[b]
1991	31	23–57	-	9	-	-	-
1992	47	35–72	-	9	-	-	-
1997	45	27–74	-	30	ca. 13[c]	-	-
1998	38	23–63	-	9	0	-	-
2009	51	44–58	-	7	0	-	-
2010	41	36–47	0.54	23	0	0.82	60
2011	45	39–51	0.60	28	8	0.53	69
2012	----------Not Surveyed----------						33
2013	46	43–50	0.61	25	6	0.56	63
2014	40	34–48	0.23	11	0	0.46	-
2015	46	41–52	0.38	14	0	1.00	-
2016	41	40–46[d]	0.46	16	0	1.00	-
2017	44	39–50	0.50	15	0	1.30	-

a Percentage of twins observed among all cows.

b Estimated from serum progesterone levels from blood samples collected during winter capture for GPS collaring during 2010–2013.

c One set of twins recorded; % Twins for 1997 based on assumption of 1:1 adult sex ratio.

d Lower end of 90% CI truncated to minimum number of known individuals.

Discussion

Voyageurs National Park staff have been monitoring the park's moose population since 2009, including conducting aerial surveys to estimate population size and demographics, and monitoring adult moose with GPS collars to understand survival, habitat use, and other behaviors. Aerial survey data continue to suggest that VOYA maintains a stable, low density moose population in the Kabetogama Peninsula. We have monitored adult survival with GPS/VHF telemetry collars since February 2010, with a maximum of 19 live moose collared in 2012. Moose death or collar failure has steadily reduced the numbers of functioning collars in VOYA. Of four adult moose with functioning collars on 1 March 2016, three survived the survey year until 28 February 2017. One cow died of likely health-related causes in early November 2016. Cow VOYA06 survived through the aerial survey period but was found partially paralyzed on 1 March 2017. VOYA staff, with assistance from Minnesota Department of Natural Resources Wildlife Health Program staff, euthanized the moose and conducted a field necropsy to determine cause of death.

Overall, we have confirmed death on 11 of 22 adult moose collared since 2010, resulting in a mean annual mortality rate of approximately 9% during the period 1 February 2010 to 31 January 2016 (range = 0%–20% per year; Voyageurs National Park, unpublished data). Our estimate of annual adult mortality is similar to those reported for non-hunting mortality rates among other moose populations in North America (Van Ballenberghe and Ballard 2007), but noticeably less than the 21% reported for the northwestern Minnesota population in 1995–2000 (Murray et al. 2006) and 19% and 15% for the northeastern Minnesota population in 2002–2008 and 2013–2015, respectively (Lenarz et al. 2009; M. Carstensen, personal communication). Survey data from 2009–2016 suggest that reproduction and recruitment may be enough to offset observed adult mortality and maintain a stable population (Windels 2015).

There is little evidence to support that wolves are having a negative impact on the VOYA moose population at present, despite a relatively high wolf:moose ratio on the Kabetogama Peninsula in 2016–2017 (9–14 wolves : 44 moose; unpublished data). As stated above, adult survival in VOYA is very high and the population has remained stable for the last nine years. Causes of death for the 10 non-capture-related cases of adult collared moose have been health-related (50%), legal hunting [in Ontario] (10%), or unknown (40%). Predation could be responsible for some of the unknown cases where scavengers had consumed too much of the carcass to determine the original cause of death.

Data from studies of wolf diet composition in the VOYA ecosystem confirm that wolves consume primarily deer and beaver and very little moose (Gable et al. 2016; Gable et al., in press). Densities of deer (ca. 10 deer/mi^2; Gable et al. 2017b) and beavers (ca. 13 beavers/mi^2; Johnston and Windels 2015) are relatively high in the VOYA area, and wolves and other potential predators typically prefer to prey on deer and beavers rather than moose. However, if abundance of alternative prey such as deer and beavers drops dramatically, we might expect that predation on adult or calf moose may increase. VOYA staff and university partners are continuing to investigate the dynamic between wolves, beaver, moose, and deer in the park to better understand the relative influence of beavers on wolf predation of other prey species.

In addition to population monitoring, Voyageurs National Park is currently investigating other aspects of moose ecology in collaboration with the University of Minnesota-Duluth, University of Minnesota-Twin Cities, Minnesota Zoo, and other partners. Recently completed projects that include data from VOYA projects include several investigations of moose habitat selection and behavior in response to temperature, landscape features, and predators (Ditmer et al., in press; McCann et al. 2016, Olson et al. 2016, Street et al. 2016); a study to understand factors that affect temperature in different types of moose habitat (Olson et al. 2014); an examination of spatial patterns in deer infected with brainworm, a parasite fatal to moose (VanderWaal et al. 2015); and a study of abundance of terrestrial gastropods, the main vector of brainworm for deer and moose, in different forest habitats (Cyr et al. 2015).

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