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Voyageurs National Park Moose Population Survey Report

2015

Natural Resource Data Series NPS/VOYA/NRDS—2015/971

ON THE COVER
Bull moose with deformed antlers observed during the 2015 aerial survey in Voyageurs National Park. The same moose was seen in 2014, based on similar antler development. The cause of the deformity is unknown but similar deformities have been linked to heavy loads of carotid (or arterial) worms in other moose populations.

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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 in 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 been experiencing similar declines in recent years, with recent estimates nearly 50% lower than the 2006 estimate (DelGiudice 2015). 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 2015). 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. Information from these efforts will help NPS managers ensure the survival of moose in VOYA for future generations.

Methods

We surveyed the moose population within the boundaries of Voyageurs National Park during 2–14 February 2015. 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 two-seat Aviat Husky during which the pilot and observer search for moose while the plane flies 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 conducted 18 test plots to estimate visibility (detection probability) of moose for our survey method. We searched test plots, using the same flight pattern and intensity as the survey plots, for moose wearing GPS telemetry collars. Locations of moose not observed during the test plots were confirmed by GPS locations or using VHF telemetry. Test plots were completed during 1 February–11 March 2015 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 2015 and therefore we did not estimate pregnancy rates (percent of adult females that were pregnant via blood progesterone levels) as was done in previous years.

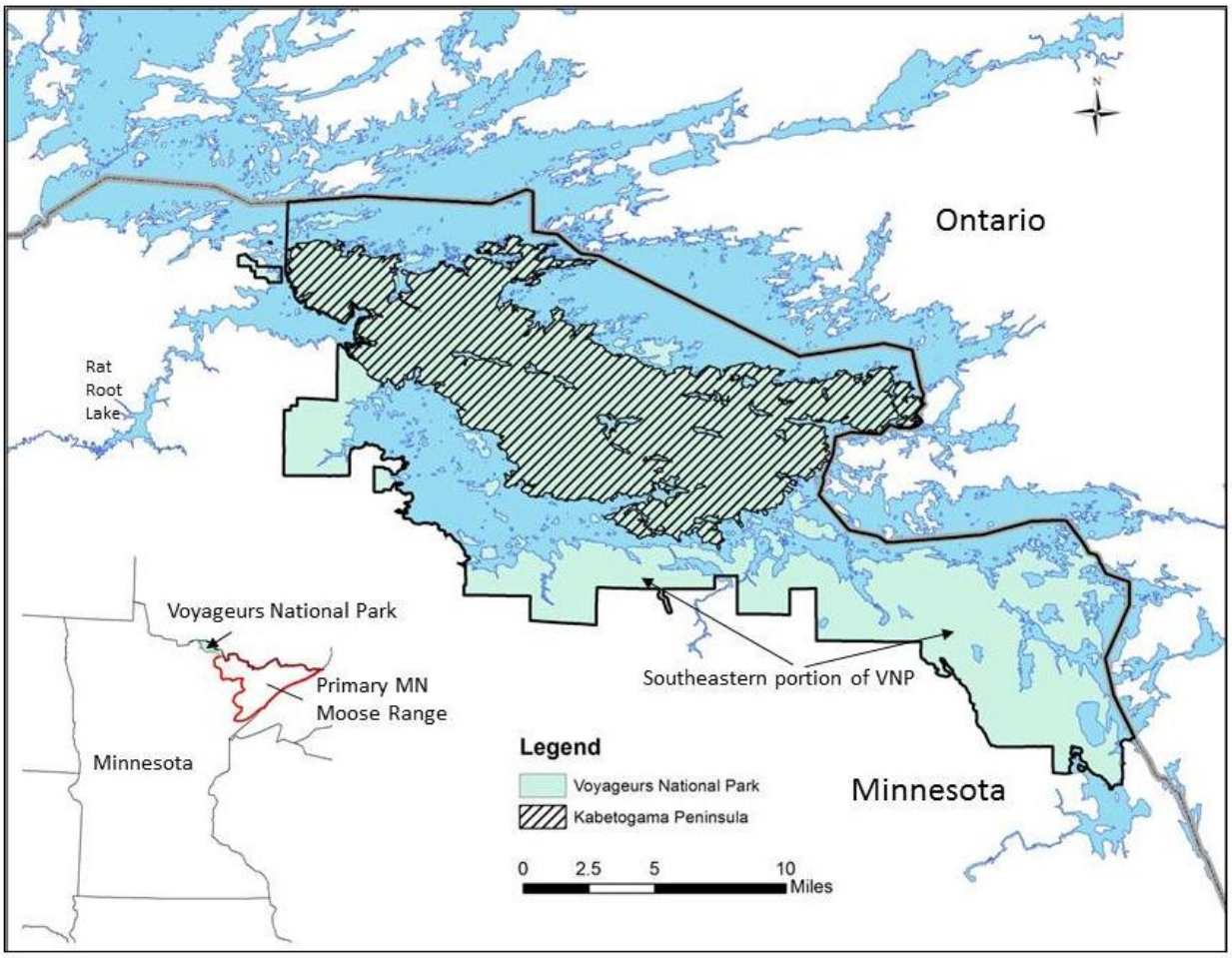

Figure 1. 2015 moose survey area in Voyageurs National Park, Minnesota, USA. The Kabetogama Peninsula (305 km^2) contains >95% of the park's moose population. A small pocket of moose (approx. 10–15 individuals) also exists west of the park in the Rat Root Lake area, and evidence from GPS collars suggests that some moose seasonally move 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 2015.

Results

Survey conditions were considered “good” to “excellent” during the 2015 survey (including visibility trials), with snow depths exceeding 35 cm (14″) throughout the Kabetogama Peninsula and little snow in the canopies of trees. We detected 76% (±9%; 16 out of 21) of collared moose during visibility trials.

We counted 34 moose during the survey (13 bulls, 13 cows, 3 unknown adults, 1 yearling, and 4 calves). After correcting for visibility, the 2015 population estimate for the Kabetogama Peninsula was 46 moose (90% confidence interval = 41–52), or 0.15 moose/km^2 (0.39 moose/mi^2). We accounted for one additional moose (1 calf) not observed during the survey but later observed with its collared mother on the Kabetogama Peninsula. The minimum number of moose on the Kabetogama Peninsula during the 2015 survey based on known individuals was 35, close to the lower end of the 90% confidence interval for the survey estimate. Additionally, one collared bull and one collared cow left the Kabetogama Peninsula for adjacent Ontario in early winter before the survey began. The 2015 population estimate is similar to those from the period 2009–2014 (Table 1). Indices of calf production in 2015 were relatively low, similar to 2014. No twins were observed in 2015, as has been the case in most survey years. The estimated calf:cow ratio was 0.38, and calves were 14% of the population. The bull:cow ratio observed during the 2015 survey (1.0) was higher than in previous years, but is likely a reflection of our sampling protocol rather than an actual change in the adult sex ratio over the last year.

Table 1. Population estimates and demographic characteristics for moose in the Kabetogama Peninsula, Voyageurs National Park, USA, derived from aerial surveys and other sources, 1991–2015.

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	53	32–88	-	25	~10[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	-

[a] Percentage of twins observed among all cows.

[b] Estimated from serum progesterone levels from blood samples collected during winter capture for GPS collaring.

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

Discussion

Voyageurs National Park staff have monitored 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 support that VOYA maintains a stable, low density moose population in the Kabetogama Peninsula. Since February 2010, we have monitored adult survival with GPS/VHF telemetry collars on 25%–50% of the adult population. All 10 collared moose survived the period 1 March 2014 to 28 February 2015. Three additional collared moose survived at least 2–10 months until we lost contact with their collars. Overall, we have confirmed death on 7 of 22 adult moose collared since 2010, resulting in a mean annual mortality rate of approximately 7% during the period 1 February 2010–31 January 2015 (range = 0%–16% per year; Voyageurs National Park, unpublished data). Our estimate of annual adult mortality is similar to those reported for non-hunting mortality rates from other moose populations in North America (Van Ballenberghe and Ballard 2007), but noticeably less than those reported for the northwestern Minnesota population in 1995–2000 (21%) (Murray et al. 2006) and for the northeastern Minnesota population in 2002–2008 (19%) (Lenarz et al. 2009) and 2013–2014 (11%–20%) (M. Carstensen, personal communication). Survey data from 2009–2015 suggest that reproduction and recruitment may be enough to offset observed adult mortality, and therefore maintain a stable population (Windels 2014).

A recent study suggested that increased wolf abundance and hence increased predation may be partially responsible for the dramatic decline in the northeastern moose population since 2006 (Mech and Fieberg 2014). There is little evidence to support that wolves are having a similar negative impact on the moose population in VOYA at present despite a relatively high wolf:moose ratio (16 wolves:46 moose; VOYA, unpublished data) on the Kabetogama Peninsula. As stated above, adult survival in VOYA is very high and the population has remained stable for the last seven years. Causes of death of the six non-capture related cases for adult collared moose have been health-related (50%) or unknown (50%), though predation could be responsible for some of the cases where scavengers had consumed too much of the carcass to determine the original cause of death.

Wolves and black bears, both of which are abundant in Voyageurs, readily prey on young calves and annual survival of calves in most moose populations is low when bears and wolves are present. Productivity data suggest that a relatively low proportion of cow moose have calves in any given year (four-year mean = 62%; Table 1) but those calves that are born have a reasonable chance of survival (four-year mean ca. 40%–45%) to their first birthday (VOYA, unpublished data). Our estimate of one-year survival is similar to that reported for 2002–2008 in northeastern Minnesota (Lenarz et al. 2010) and slightly higher than reported in a current study in the same area (Severud et al. 2014). A recent study of wolf diet in Minnesota based on scat analysis confirms that wolves in VOYA rarely consume moose relative to other areas of northeastern Minnesota; 5%–13% of biomass of VOYA wolf diets in summer and winter were comprised of moose versus 32%–54% in other areas. Wolves in VOYA consume primarily deer (53%–78% of biomass) and beaver (7%–26%) (Ibrahim et al., unpublished data). Densities of deer (ca. 10 deer/mi^2) and beavers (ca. 13 beavers/mi^2) are relatively high in the VOYA area (VOYA, unpublished data), and wolves and other

potential predators typically prefer to prey on deer and beavers rather than moose. If abundance of alternative prey such as deer and beavers dramatically drop, however, we might expect that predation on adult or calf moose may increase.

In addition to population monitoring, Voyageurs National Park is currently investigating other aspects of moose ecology in collaboration with the University of Minnesota-Duluth, Minnesota Zoo, Bemidji State University, Lakehead University, University of Minnesota-Twin Cities, and other partners. Recently completed projects in the park include a study to understand factors that affect temperature in different types of moose habitat (Olson et al. 2014); a study 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. 2014). Ongoing studies include understanding how moose behave in response to high temperatures and other weather events; identifying potential thermal refugia for moose in the face of a changing climate; interactions of moose, deer, beavers, and wolves; and how and why moose use wetlands for foraging and temperature regulation.

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