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2014 Voyageurs National Park Moose Population Survey Report

Natural Resource Data Series NPS/VOYA/NRDS—2014/645

ON THE COVER
A cow moose with GPS collar observed during the 2014 aerial survey in Voyageurs National Park, Minnesota.
Photograph by: Bryce Olson, Voyageurs National Park.

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Introduction

Voyageurs National Park (Minnesota) was established in 1975 in part to fulfill the National Park Service's (NPS) mission to preserve and protect wildlife populations and provide opportunities for the public to enjoy them. Moose are native to Voyageurs National Park (VOYA), but recent declines in other moose populations in the region have 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 the 2014 estimate more than 49% lower than the 2006 estimate (DelGuidice 2014). 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; DelGuidice 2014). Voyageurs National Park, in collaboration with the University of Minnesota–Duluth and the U.S. Geological Survey, 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

The moose population was surveyed within the boundaries of Voyageurs National Park during 7–19 February 2014. 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 searched for moose while flying 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 data recorded were location, group size, sex/age class (calf, yearling, adult cow, adult bull, unknown), and whether the animal was standing or bedded. All observations of white-tailed deer and gray wolves were also recorded.

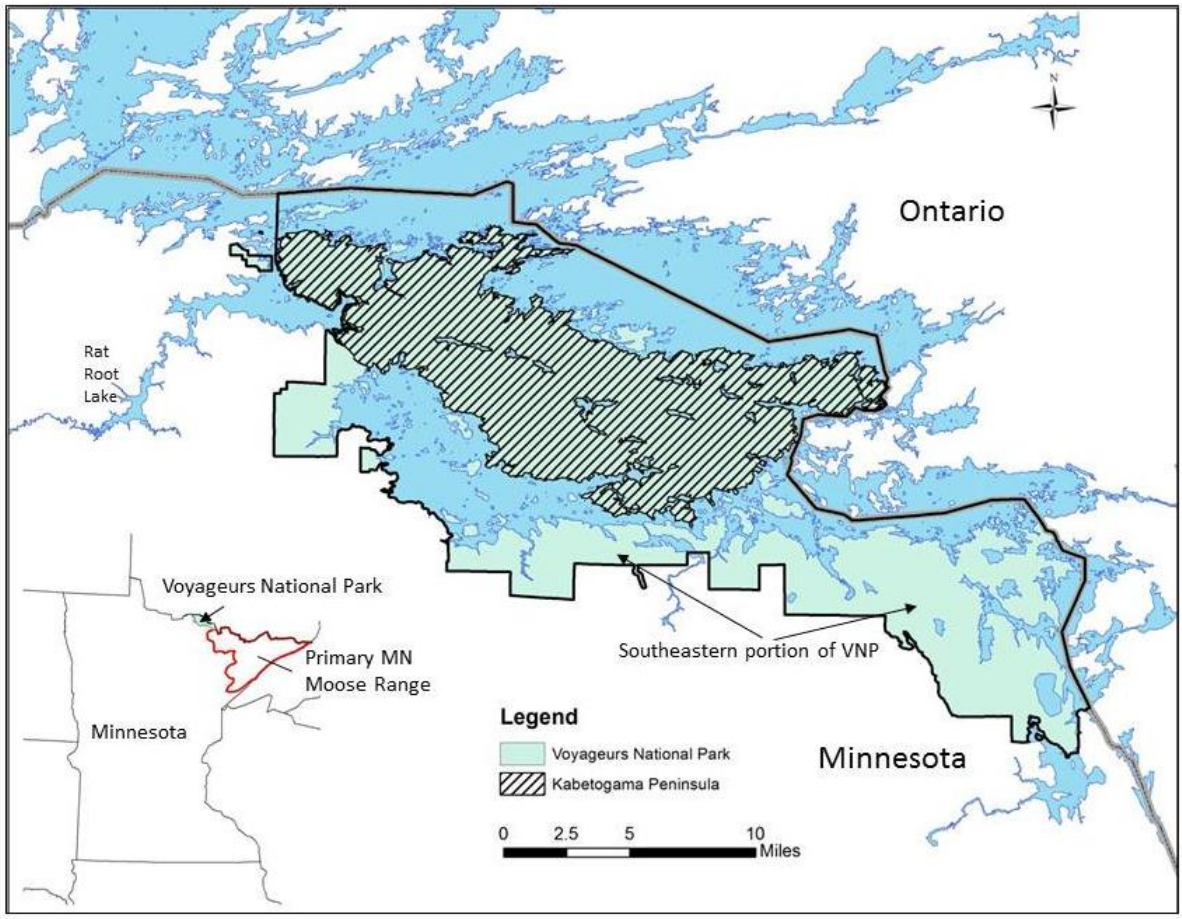

Figure 1. Moose survey area in Voyageurs National Park, Minnesota, USA, 2014. The Kabetogama Peninsula (305 km^2) contains >95% of the park's moose population. A small pocket of moose (approx. 10–15 individuals) also exists west of the park in the Rat Root Lake area, and evidence from GPS collars suggests that some moose seasonally move between this area and the Kabetogama Peninsula. Some moose also reside in the southeastern portion of the park, confirmed by observation of a few sets of fresh moose tracks during overflights on 31 January/1 February 2014.

Twenty-five test plots were conducted to estimate visibility (detection probability) of moose using this survey method. Test plots were searched for moose wearing GPS telemetry collars, using the same flight pattern and intensity as the survey plots. Locations of moose not observed during the test plots were confirmed by GPS locations or using VHF telemetry. Test plots were completed between 30 January and 13 March 2014 under conditions similar to those that occurred during the survey.

The number of moose observed during the aerial survey was adjusted using the estimated detection probability, giving a population estimate for the Kabetogama Peninsula (± 90% Confidence Intervals) during the survey period. Other measures of population status were also estimated, including calf:cow ratio, twinning rates, and bull:cow ratio. No moose were captured in 2014, therefore pregnancy rates (percent of adult females that were pregnant) were not estimated as in previous years.

Moose reside in the southeastern portion of the park, but at a much lower density than in the Kabetogama Peninsula area. This section of the park was last surveyed in 2010. A cursory survey of this area was conducted from 30 January to 1 February 2014 by flying east-west transects separated by 1 km at an airspeed of 75 knots, which equates to a survey intensity of about 0.35 min/km^2.

Results

Survey conditions were considered “good” to “excellent” during the 2014 survey (including visibility trials), with snow depths exceeding 60–90 cm (24–36 in) throughout the Kabetogama Peninsula and little snow in the canopies of trees. Most collared moose (68% ±12%; 19 out of 28) were detected during visibility trials.

Twenty-seven moose were counted during the survey (6 bulls, 13 cows, 2 unknown adults, 3 yearlings, and 3 calves). After correcting for visibility, the 2014 population estimate for the Kabetogama Peninsula was 40 moose (90% Confidence Interval = 34–48), or 0.13 moose/km^2. Two moose (1 bull and 1 cow) not observed during the survey but known to occur on the Kabetogama Peninsula during the survey period were accounted for from GPS collar data and incidental observations. In addition, one collared bull is known to have died around 13 February before the survey was flown. Preliminary pathology results identified the cause of death as related to a brainworm (*Parelaphastrongylus tenuis*) infection. The minimum number of moose on the Kabetogama Peninsula during the 2014 survey, based on observed and known individuals, was 30 which is slightly less than the lower end of the 90% Confidence Interval for the survey estimate. Additionally, one collared bull and one collared cow with a yearling left the Kabetogama Peninsula for adjacent Ontario in January before the survey began. The 2014 population estimate is similar to those during the period 2009–2013 (Table 1). Indices of calf production in 2014 were low. The estimated calf:cow ratio was 0.23, and calves were 11% of the population. The bull:cow ratio was relatively low (0.46), similar to estimates from 2010–2013.

No moose were observed during the survey of the southeastern portion of the park. However, survey conditions were only considered “fair,” and given the low search intensity and very low density of moose in the area, this was not an unexpected result. Several sets of fresh moose tracks were observed, and at least three moose are estimated to be in this area.

Table 1. Population estimates and demographic characteristics for moose in the Kabetogama Peninsula, Voyageurs National Park, USA, derived from aerial surveys and other sources, 1991–2014. Note the gap in years between 1992 and 1997 and between 1998 and 2009.

Year	Population Estimate	90% Confidence Interval for Estimate	Calf: Cow	% Calves	% Twins[a]	Bull: Cow	% Pregnant[b]
1991	31	23-57	-	9	-	-	-
1992	47	35-72	-	9	-	-	-
1997	53	32-88	-	25	ca. 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	-

[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

Survey results from 2014, when combined with earlier survey results from 2009–2013 and other available data, suggest Voyageurs National Park currently maintains a stable, low density moose population. The observed stability in the VOYA population during the present study, which is in contrast to the declining pattern observed in the core portion of Minnesota's moose range, may be further corroborated by estimates of adult survival obtained from telemetry/GPS collars and estimates of calf recruitment obtained from aerial surveys. Since February 2010, adult survival has been monitored with GPS telemetry collars. Seven of 22 adult moose collared since 2010 have died, resulting in a mean annual mortality rate of approximately 10% (Voyageurs National Park, unpubl. data). Though the sample size for estimating survival is small in a statistical sense, it does represent a sizeable fraction of the estimated adult population (25–50%) in the park area, and it is believed to be a biologically representative of the population. The 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 it is noticeably less than those reported for the northwestern Minnesota population in 1995–2000 (21%; Murray et al. 2006), the northeastern Minnesota population in 2002–2008 (19%; Lenarz et al. 2009), and for 2013 (21%; Carstensen et al., unpublished data, as cited in DelGuidice 2014).

Indices of productivity (i.e., calf:cow ratio and percent calves) estimated from 2010–2013 surveys were relatively high for moose in the region. When considered in relation to the low pregnancy rates observed from 2010-2013 (Table 1), recent calf:cow ratios suggest that calves produced by those cows that do give birth have a relatively high chance of surviving to mid-winter. However, results from the 2014 survey were noticeably lower than the previous four years (unpublished data), including only 20% of cows pregnant in winter 2013 still had a calf with them during Jan.-Mar. 2014, suggesting low calf recruitment this year. Though data are lacking about actual recruitment of calves into the adult population at VOYA, the recent survey data suggest that recruitment may be enough to offset the observed adult mortality, and therefore maintain a stable population. However, gray 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 (Ballard and Van Ballenberghe 2007). Densities of white-tailed deer (ca 4 deer/km^2) and beavers (ca. 5 beavers/km^2) are relatively high in the VOYA area (unpublished data), and wolves and other potential predators typically prefer to prey on deer and beavers rather than moose. More study is needed to better understand calf survival and recruitment in the VOYA area in relation to other populations in the region.

Pregnancy rates in most North American moose populations typically exceed 80–90% (Van Ballenberghe and Ballard 2007). The low pregnancy rates observed in VOYA since 2010 could be indicative of poor condition or health-related issues in the population. They also may reflect the low bull:cow ratio (i.e., there may not be enough bulls available to breed all cows in the population). A cow moose was observed making large movements (from GPS collar data) during the October rutting period, which is typical for low density populations where females must also actively seek out males

for breeding opportunities (Van Ballenberghe and Ballard 2007). There is certainly an incomplete understanding of what factors may be contributing to the low bull:cow ratios observed, since this result runs counter to expectations for an unhunted population. (Moose hunting is not allowed in VOYA, and the area west of the park has also been closed to hunting since 1923.)

It is not clear why the moose population in VOYA appears relatively stable when nearby populations are declining. Spatial variability in population trends and demographic patterns likely exist in most populations if examined at a fine enough scale. In other words, the apparent stability of the moose population in VOYA may not be unique in the region. Moose density in VOYA is considered low at present, and this has likely been relatively consistent since at least the early 1990s (Gogan et al. 1997; Voyageurs National Park, unpublished data). Although apparently stable at present, the long-term persistence of the small, isolated moose population in VOYA is at risk from large-scale impacts such as climate change or regional disease outbreaks.

The method employed in 2013–2014—flying overlapping circles in fixed-wing aircraft at a high search intensity—appears to be effective for surveying moose at the low density that occurs in VOYA. The method will continue to be refined for future surveys, particularly in estimating visibility in different years under variable conditions. In addition to population monitoring, Voyageurs National Park is currently investigating other aspects of moose ecology in collaboration with the University of Minnesota–Duluth, Lakehead University, and the U.S. Geological Survey. Other studies include understanding how moose behave in response to high temperatures and other weather events, how and why moose use wetlands for foraging and temperature regulation, and the interactions of moose, deer, beavers, and wolves.

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