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Parks as Proving Grounds: Research Tools and Techniques





New Insights from an Enduring Tool: Using GPS Data to Detect Calving Events in Alaskan Caribou Herds

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Since movement is the norm for caribou, it is noticeable when an animal changes its movement pattern—especially when it slows down or stops. By using GPS collar data, biologists have been able to detect when female caribou slow down long enough to give birth to a calf.

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The life of a caribou is defined by movement and Arctic, barren-ground caribou (*Rangifer tarandus granti*) exemplify this lifestyle at a staggering scale. Caribou of the Western Arctic Herd, living in northwest Alaska, travel an average of ~1,900 miles (3,000 km) in a year and some individuals cover an astounding ~2,500 miles in a single year (4,000 km; Joly and Cameron 2019). This places caribou among the farthest walking mammals on the planet (Joly et al. 2019). Since movement is the norm for caribou, it is noticeable when an individual changes its movement pattern—especially when it slows down. This observation was the basis for recent developments using GPS collar data to detect when a female caribou delivers a calf (referred to as *calving*), which is a fundamental component of caribou monitoring and management.

In the early days of caribou management, knowledge of where caribou were located was obtained by biologists flying in small aircraft and tracking animals outfitted with VHF (radio) collars. This limited tracking to daylight hours with good flying weather. The use of GPS collars began replacing older VHF technology in Alaska in the 1990s and is now the standard for wildlife monitoring. They allow for tracking of animals 24 hours a day, 7 days a week, and 365 days a year. Even with the increased use of GPS collars, biologists still rely on aerial VHF tracking to monitor reproduction during the calving season, typically following protocols similar to Whitten and others (1992). Biologists locate

collared females via airplane and count the number of females with calves; these collared females act as a representative sample of the population that are used to estimate calving success for the herd. Monitoring calving provides insight into the condition of individuals, since caribou have a higher probability of getting pregnant if they have larger body mass the previous fall (Cameron et al. 1993, Cameron and Ver Hoef 1994). When considered at the herd level, low reproductive rates could signify poor range conditions and potential future herd decline. While these surveys are straightforward, they still rely on extensive periods of good flying weather, which can be unpredictable and are costly for very remote herds such as the Western Arctic Herd and the Porcupine Herd in northeast Alaska.

Recent analytical methods developed in Canada offered a potential solution to this problem. The idea was that during calving, the movement of a female caribou that delivers a calf slows down more than a female that does not deliver a calf, owing to the fact that newborn caribou calves are initially limited in their mobility. To analyze this potential difference, two approaches were developed using GPS collar data (DeMars et al. 2013). One approach, the Individual Method, fits two movement models to the GPS data using the distance covered by an individual between locations. The first movement model represents a female that did not have a calf, therefore the model is expressed as a constant rate of movement across the time span analyzed. The

second model represents a female that delivered a calf and the model is expressed as a sudden decrease in movement followed by a steady increase (as the calf develops) until movement reaches the pre-calving rate. Both models are fit to an individual caribou's observed movements (tracked by GPS) and compared to each other to see which best represents what was observed. If identified as having a calf, the model returns an estimate (date) for when the calf was delivered (Figure 1), based on the date of the sudden decrease and slowest movement.

The second approach is called the Population Method. This approach still analyzes the movement of an individual caribou, but in a different way: a moving average is applied to the speed of each individual, which results in a smoothed rate of travel. The first step in applying this approach is to obtain a group of individual females with a verified calving date. With the assumption that females slow down after calving, the smoothed movement rate of these known females directly after calving is used to generate a threshold for the herd being analyzed (the threshold indicating a calving event). Next, the movement data for the rest of the females without a verified calving date is analyzed by the model and if any of their smoothed movement rates slow down below this threshold, then the female is labeled as calving on that date (Figure 1).

These methods were developed for woodland caribou subspecies (*Rangifer tarandus caribou*) that seek isolation in the boreal forest to have their calves and were not expected to work for gregarious migratory barren-ground caribou (the subspecies native to Alaska) that deliver their calves on the open tundra. Researchers from the National Park Service, University of Alaska Fairbanks, and Alaska Department of Fish and Game set out to test this assumption for Alaskan herds and found that the Individual and Population methods correctly

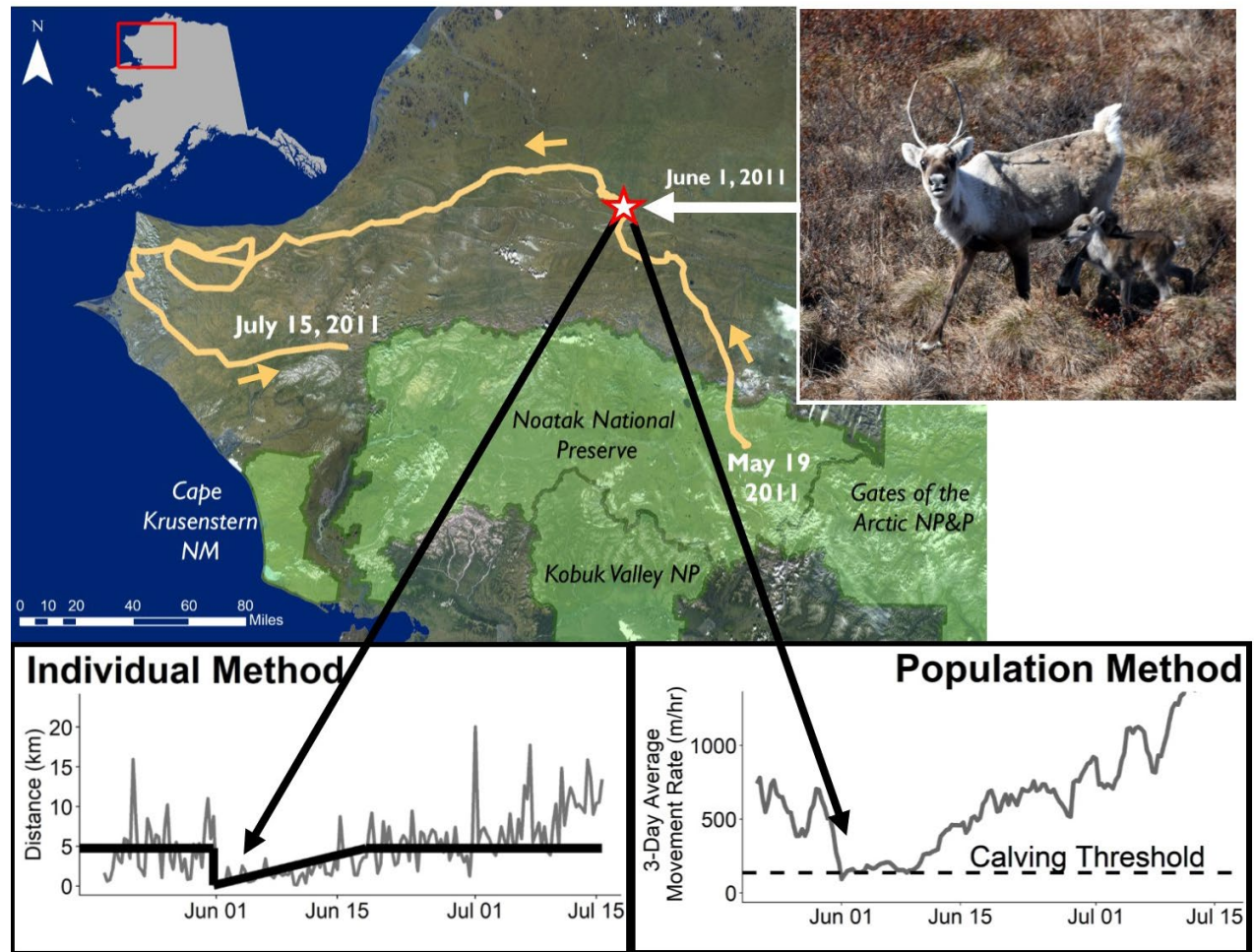


Figure 1. A collared female caribou's path (map) and movement rate (two lower plots) analyzed for calving in 2011. The Individual Method is depicted in the lower left and the Population Method the lower right. Both methods identified the female as having a calf near June 1, in the heart of the calving ground for the herd.
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identified whether calves were born with nearly 90% accuracy across six years of data for the Western Arctic Herd (Cameron et al. 2018) and across two years of data for the Porcupine Herd (Hepler 2019). These results are striking because they indicate that despite

congregating on the calving ground, individuals are moving independently at the time when they deliver a calf. This is supported by observations on the calving ground—pregnant females are often left behind the group when they deliver their calf (Lent 1966).

These two recent studies highlight the utility of GPS collars to analyze animal behaviors beyond simply tracking animal locations and movement. Recent work with moose (*Alces alces*) has found similar success in detecting calving events from GPS movement data (Nicholson et al. 2019), suggesting that identifying reproductive events from movement data is applicable beyond just caribou. While we do not expect these methods to completely replace aerial surveys for calving caribou, they do provide an additional option to managers in the event that weather conditions or logistics do not permit an aerial survey in a given year. These methods were employed in follow-up research that investigated the spatial trends of the calving ground for the Western Arctic Herd and found that caribou rely on memory to guide them back to the general area each year (Cameron et al. 2020). Additional research is being conducted to more broadly apply these methods to herds across the Canadian Arctic and Alaska.

These results also highlight the truly incredible rate at which calf mobility develops. Considering the calving threshold (the smoothed speed indicating a female had a calf) of the Porcupine Herd, calves could conceivably cover over 1.2 miles (2 km) in their first day of life. Lent (1966) observed that by the second day after birth, calves were able to maintain their mother's running pace for an extended distance and swim across streams. Caribou are remarkably well adapted, even in their first days, to a life constantly on the move.

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For further reading, see:

[Movement of caribou and their calves](#)

[Why do caribou calve where they do?](#)

[Monitoring caribou in the Arctic Network](#)

[About the Porcupine Caribou Herd](#)

REFERENCES

Cameron, M. D., K. Joly, G. A. Breed, C. P. H. Mulder, and K. Kielland. 2020.

Pronounced fidelity and selection for average conditions of calving area suggestive of spatial memory in a highly migratory ungulate. *Frontiers in Ecology and Evolution* 8:564567.

Cameron, M. D., K. Joly, G. A. Breed, L. S. Parrett, and K. Kielland. 2018.

Movement-based methods to infer parturition events in migratory ungulates. *Canadian Journal of Zoology* 96: 1187–1195.

Cameron, R. D., W. T. Smith, S. G. Fancy, K. L. Gerhart, and R. G. White. 1993.

Calving success of female caribou in relation to body weight. *Canadian Journal of Zoology* 71: 480–486.

Cameron, R. D. and J. M. Ver Hoef. 1994.

Predicting parturition rate of caribou from autumn body mass. *The Journal of Wildlife Management* 58: 674–679.

DeMars, C. A., M. Auger-Méthé, U. E. Schlägel, and S. Boutin. 2013.

Inferring parturition and neonate survival from movement patterns of female ungulates: A case study using woodland caribou. *Ecology and Evolution* 3: 4149–4160.

Hepler, J. D. 2019.

Validating a GPS collar-based method to estimate parturition

events and calving locations for two barren-ground caribou herds. Master's Thesis. University of Alaska Fairbanks.

Joly, K. and M. D. Cameron. 2019.

Caribou vital sign annual report for the Arctic Network Inventory and Monitoring Program: September 2018–August 2019. Natural Resource Report NPS/ARC/NRR—2019/2041. National Park Service, Fort Collins, Colorado.

Joly, K., E. Gurarie, M. S. Sorum, P. Kaczensky, M. D. Cameron, A. F. Jakes, B. L. Borg, D. Nandintsetseg, J. G. C. Hopcraft, B. Buuveibaatar, P. F. Jones, T. Mueller, C. Walzer, K. Olson, J. C. Payne, A. Yadamsuren, and M. Hebblewhite. 2019.

Longest terrestrial migrations and movements around the world. *Scientific Reports* 9: 15333.

Lent, P. C. 1966.

Calving and related social behavior in the barren-ground caribou. *Zeitschrift für Tierpsychologie* 23: 701–756.

Nicholson, K. L., M. J. Warren, C. Rostan, J. Månsson, T. F. Paragi, and H. Sand. 2019.

Using fine-scale movement patterns to infer ungulate parturition. *Ecological Indicators* 101: 22–30.

Whitten, K. R., G. W. Garner, F. J. Mauer, and R. B. Harris. 1992.

Productivity and early calf survival in the Porcupine caribou herd. *The Journal of Wildlife Management* 56: 201–212.