

COMPLEMENTARY METHODS FOR IDENTIFYING CALVING GROUNDS OF BARREN-GROUND CARIBOU

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Introduction

Barren-ground caribou (*Rangifer tarandus groenlandicus* and *R.t. grantii*) aggregate births in time and space to^a:

- Increase access to high quality resources
- Decrease predation risk

Conservation measures often focus on protection calving grounds. **Ecological definitions of “calving grounds” are inconsistent, and there is a need for corresponding quantitative methods for identifying calving grounds.**



Female Barren-ground caribou with calves (Credit: A. Gunn)

Objective

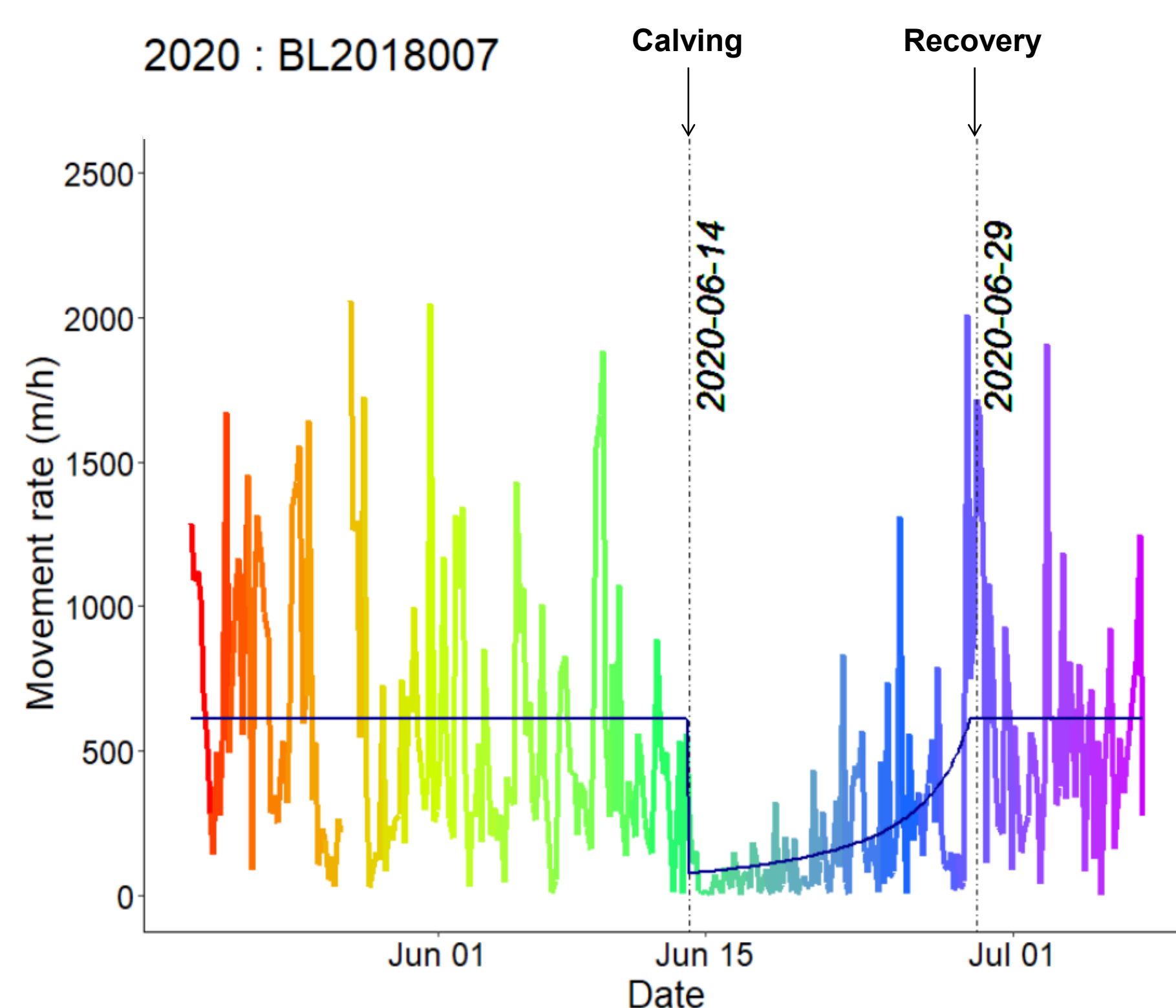
Develop quantitative, reproducible methods for estimating annual calving grounds from telemetry data

Calving ground: the total area used by most mothers of a given herd from calving through early rearing

Methods

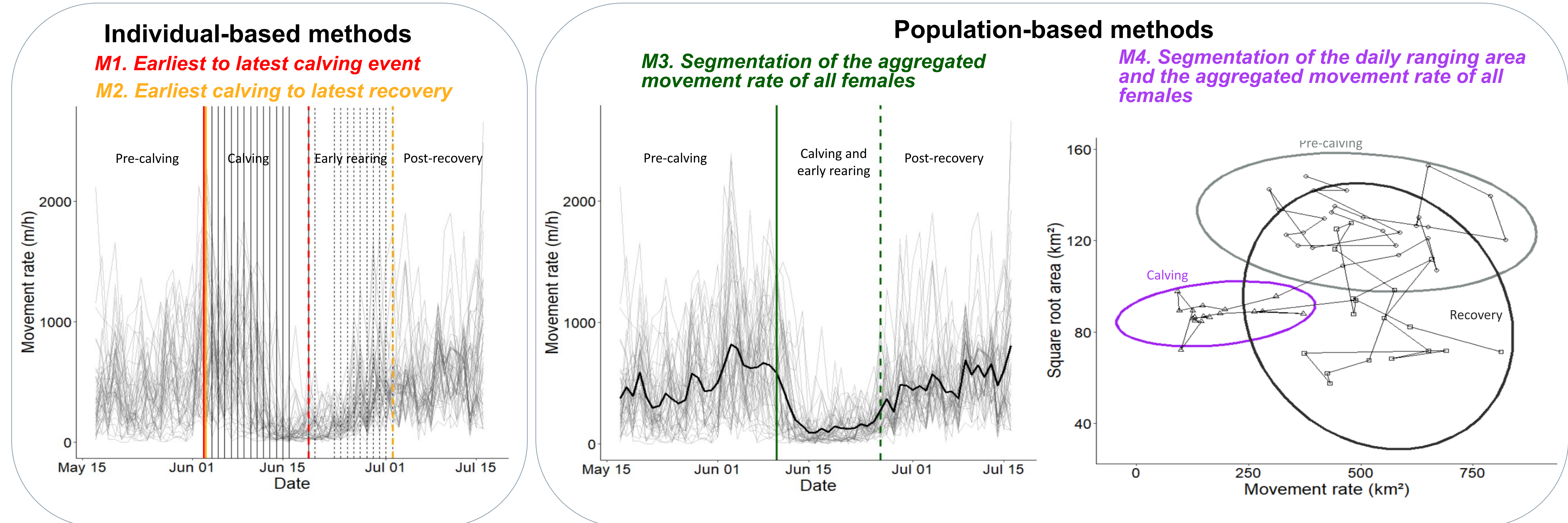
n = 363 female-years

142 female caribou from the Qamanirjuaq Herd
2013 – 2020



Behavioral cues from telemetry can detect calving^{b,c}:

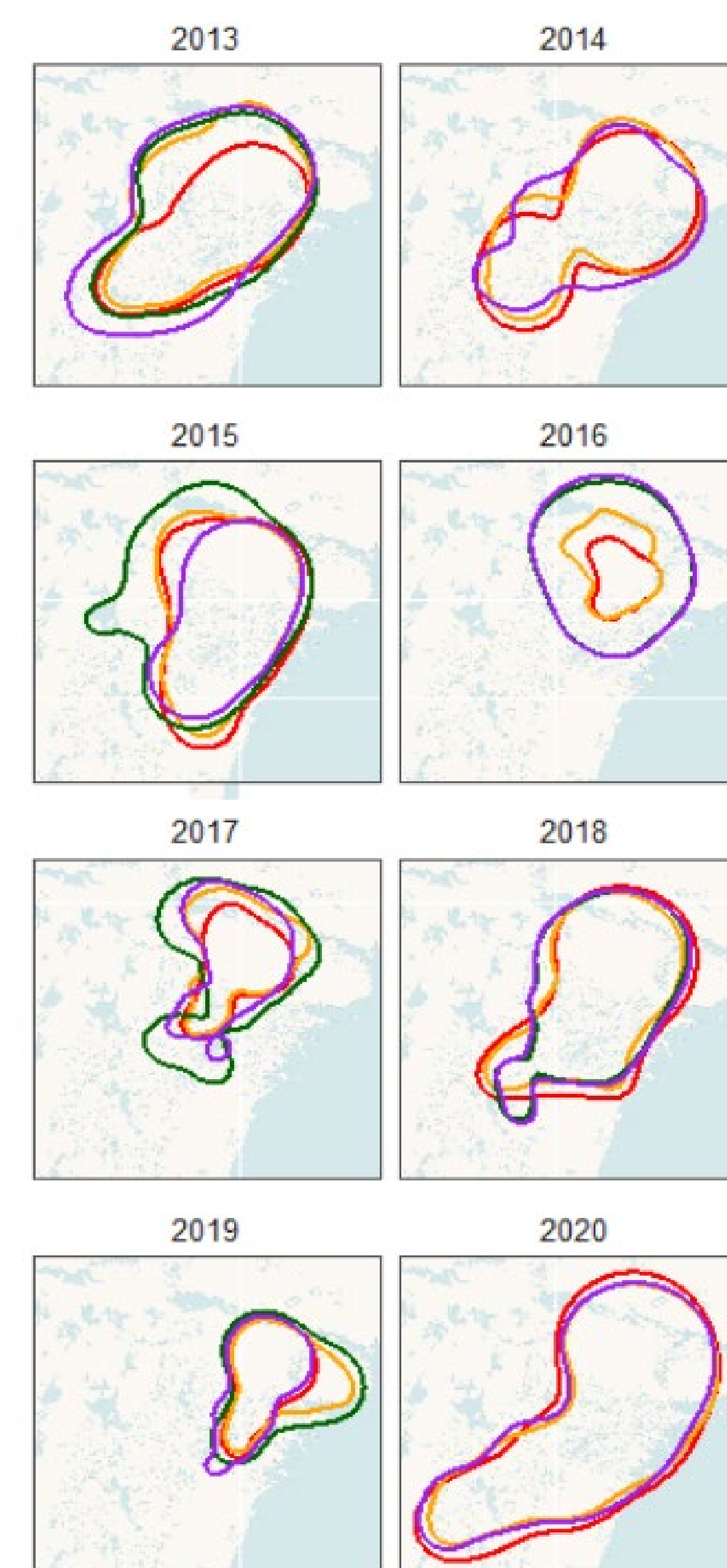
Methods tested for estimating calving grounds



→ **Calving grounds** = 95% kernel density estimator using the first and last GPS locations of all females during the estimated calving period in a given year.

Results

method ■ M1 ■ M2 ■ M3 ■ M4



	Pros	Cons
Individual-based models	<ul style="list-style-type: none"> • Considers individual variation in birth timing and movement pattern • M2 considers early rearing period 	<ul style="list-style-type: none"> • Can produce errors in calving status and in birth and recovery timing^{b,c} • Sensitive to extreme values • M1 did not consider early rearing
Population-based models	<ul style="list-style-type: none"> • Easy and fast to compute • Use the aggregates of all females' movement • Considers sociality of caribou 	<ul style="list-style-type: none"> • Assumes three stationary phases without considering the transition between them, leading to potential timing inaccuracy

Of methods tested, M4 is likely the most reliable method to identify annual calving grounds.

M4 considers both space use and movement rates of all females and accounts for sociality of caribou.

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REFERENCES
^a Rutberg, A. T. (1987). Adaptive hypotheses of birth synchrony in ruminants: An interspecific test. *The American Naturalist*, 130(5), 692–710.
^b Cameron, M. D., et al. (2018). Movement-based methods to infer parturition events in migratory ungulates. *Canadian Journal of Zoology*, 96(11), 1187–1195.
^c Couriot, O., et al. (In review). Continental synchrony and local responses: Climatic effects on spatiotemporal patterns of calving in a social ungulate. *Ecosphere*.



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