

ALL ABOUT ICE: PEARY CARIBOU MOVEMENTS IN THE BATHURST ISLANDS COMPLEX

Report done by the Department of Environment, Government of Nunavut

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Highlights

Take home message: The multi-year-round monitoring of Peary caribou indicates that Cameron Island hosted the majority of wintering animals of the Bathurst Island Complex, while calving areas are much wider than previously thought and cover new areas; inter-island movements between calving and wintering areas follow times when the highest quality and concentration of fast sea ice is present.

Background

Since the last 5 decades, Bathurst Island Complex (BIC; 76°N-99°W) in the High Canadian Arctic is the theater of several surveys and ecological studies focused on Peary caribou (PC). This is a subspecies of *Rangifer tarandus*, classified as *Endangered* under Schedule 1 of the *Species at Risk Act*. While being considered for the establishment of a future national park, BIC is also of interest to the Mining Association of Canada due to high mineral and energy potential. Peary caribou are an important component of the Arctic ecosystem and the BIC a traditional harvesting area for the community of Resolute Bay (Cornwallis Island). Despite past monitoring efforts in this remote environment, how PC use this region year-round is still largely unclear as most information on distribution is confined to summer. Here we analyzed year-round movements of seven satellite tagged female PC from 2003-2006, as indicators of 7 seven different groups. Given the very low density in BIC, this sample is a significant proportion of the total BIC population. Our aim was to understand the seasonal use of the BIC and to track the paths across BIC islands, a small-scale perspective of the archipelago-type range.

Methodology/Principal Findings

Calving areas appeared much extensive than previously thought (up to 2 time larger), even when considering the core of PC home ranges. These new areas covered most of the north-east of the Bathurst Island and also occurred on one island not previously known for calving (Vanier Island); the area amounts to a third of the BIC surface.

Over the years, PC showed high fidelity to both calving and winter home ranges. All but two PC wintered on Cameron Island at the northwest tip of the BIC. These two females are also the only ones using the south portion of Bathurst Island. In terms of island use, Cameron Island hosted the majority of all locations from October to March for all years (Figure 5).

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Overall, the satellite tracks showed evidence that PC used most if not all islands of the BIC. Similar to previous studies located in other parts of PC range, the majority of individuals (5 of the 7 tagged) performed inter-island movements within BIC. The straight –line crossing distances ranged from 1-32 km (95% confidence interval, median=7 km). Such distances are well in the range of the first evidence of inter-island movements between Melville and Prince Patrick Islands (Northwest Territories and Nunavut) (Miller et al. 2005). While PC from BIC could perform the traveling distances needed for connecting to other regions of the High Arctic (e.g. Cornwallis ~10 km - or Melville ~ 37 km), none did such extensive dispersal during the study. Inter-island movements within BIC are shorter than random expectations, suggesting a selection for short between-island paths. Though long water crossings by PC have been recorded, most of the inter-island paths occurred during the period and in the area of the highest quality and concentration of fast ice. Overall, the peaks in movement correspond with travel to winter and spring/summer ranges.

Conclusion/Significance

The present study provides an additional piece in the puzzles of population dynamics and space use of an endangered mammal, relying on sea ice to complete its life cycle. Given warming climate scenarios and declining trends in PC, large and long-term approaches are needed to understand the connectivity between wintering and calving areas.

Key-words

Home range, Peary Caribou, low density, calving areas, sea ice, telemetry, Cameron Island

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- Community consulted: Grise fjord, Resolute, Cambridge Bay

Table 1. Area (in km sq.) occupied by islands of the Bathurst Islands Complex, Nunavut, Canada.

Island name	Area (km sq.)	% of Total
Bathurst	16,030	81.6
Cameron	1,066	5.4
Vanier	1,136	5.8
Alexander	484	2.5
Massey	436	2.2
Helena	328	1.7
Unnamed Bracebridge Inlet	88	0.4
Isle Marc	57	0.3
Loney	19	0.1
Total	19,644	100.0

- All area calculations were completed in North Pole Lambert Azimuthal Equal Area and centered on the specific island group (CM101W; Lo075.833N projection specifics, WGS1984 datum).

Figures

Figure 1. Peary caribou range across the Canadian Arctic with the territorial boundaries, Nunavut, North-West Territories and Yukon in white, shredded, and grey respectively. Grey lines separate Peary Caribou into island groups (Jenkins et al. 2011). Vegetation across the range falls within the High Arctic and Arctic tundra type (Walker et al. 2005). P. 9

Figure 2. Outline of Parks Canada natural regions (1-38), highlighting the established national parks in Nunavut and the land withdrawal *en vue* for a potential new park for Bathurst Island Complex (region 38). The general goal of the plan is to establish a national park in all of the regions. See the full list of natural regions at <http://www.pc.gc.ca/docs/v-g/nation/nation1.aspx> P. 10

Figure 3. The Bathurst Island Complex, Nunavut, Canada and vicinity with 2165 locations of 7 females Peary Caribou throughout 2003-2005. Females were tracked with Argos satellite collars from 29 April 2003 to 18 May 2006. Caribou home ranges are illustrated by their MCP 95% (minimum convex polygon with 95% of their locations) while their core areas were defined by Kernel 50% (area with 50% probability contour from all locations, by individuals). Note that the sampling period for 2003 and 2006 is shorter than 2004 and 2005, explaining the discrepancies. Scale is in meter. P. 11

Figure 4. The calving and deep winter periods of 7 adult females Peary Caribou are contrasted using MCP 95% (minimum convex polygon with 95% of their locations) and kernel 50% estimators (area with 50% probability contour with all positions, by individuals) in Bathurst Island Complex, Nunavut, Canada. Some overlap with previously known calving areas (illustrated in black) (Miller 2002) is evident (see main text for additional information). All but two individuals used Cameron Island, at the northwestern extent of BIC. Females were tracked with Argos satellite collars from 29 April 2003 to 18 May 2006; data are aggregated for all years (2,165 locations). P. 12

Figure 5. Use of Cameron Island in Bathurst Island Complex, Nunavut, Canada by adult females Peary Caribou by months and years; (2003-2006). The range of five caribou overlapped with Cameron Island and this figure shows the percentage of possible caribou locations (for individuals 21384, 21475, 21485, 21502, 21872) by month on

Cameron Island for a total of 1,547 locations. Note that 2003 and 2006 are not complete year of monitoring as females were tracked with Argos satellite collars from 29 April 2003 to 18 May 2006. **P. 13**

Figure 6. Summary maps of Peary Caribou groups (alive and dead) observed during the 2 last systematic aerial surveys of Bathurst Island Complex, Nunavut, Canada (June-July 1997, April-May 2001) and during the 1998 carcasses survey. This figure is to be related to the home range and core areas defined by satellite telemetry throughout the year (Fig. 3-4; 6). The previously known calving areas pictured here are from Gunn and Fournier (2000); note the discrepancies with the calving areas from Miller (2002) used in Fig. 4, though the data are from the very same origin. Note that carcass observations are a cumulative index of presence. **P. 14**

Figure 7. Zoom-in on Peary Caribou range, Canadian Arctic with trans-island movements on the sea ice. For the Bathurst Island Complex, the data are from the present study (see Fig. 6). Movements between Prince of Wales and Somerset Island are from Miller et al. (2005). Paths between Victoria Island and the continent are from M. Dumond (Government of Nunavut) and Poole et al. (Poole et al. 2010), a possible intermediate zone between barren-ground and the Peary Caribou. **P. 15**

Figure 8. Bathurst Island Complex, Nunavut, Canada and vicinity with the various zoning and movement paths for 7 satellite-tagged females Peary Caribou (April 2003-May 2006). The previously known calving areas are from Gunn and Fournier (2000); note the discrepancies with the calving areas from Miller (2002) used in Fig. 4, though the data are from the very same origin. From the movement trajectories, a total of 62 paths were estimated as the minimum number of confirmed path on sea ice. Some shorter movements could have been missed or discarded to take into account the imprecision of animal locations. **P. 16**

Figure 9. Monthly ice concentration charts from the Canadian Ice Service for the western Canadian Arctic Archipelago in 2005. The year 2005 is taken as an average indicator of ice concentration for all years of females Peary Caribou tracking. According to the Canadian Ice Service, the charts combine visual and weather observations from meteorological aircrafts, as well as data obtained from satellites. Ice data are classified

using the international egg code, which defines areas of concentrations (A being the highest quality), stages of development (age), and form (floe size) of ice. are contained in a simple oval form. These data displayed in a simple oval format and charts, show how Bathurst Island Complex (BIC) is interconnected with fast ice for most parts of the year; at a larger spatial scale, this is in contrasts to low ice concentration and losses of fast ice in the Queens Channel, Byam Martin Channels and Barrow Strait attached to the shore. See <http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=D32C361E-1> for further details.

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Figure 10. Ice concentration chart from the Canadian Ice Service contrasted with a TerraMODIS satellite picture (NASA) of the Bathurst Island Complex , Nunavut, Canada for July 2004.

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Figure 11. Density plot and timing of movements between islands within Bathurst Island Complex, Nunavut, Canada. Top: density plot for the straight line distance covered by caribou to cross straits, ranging from less than a km to up to 40 km as the crow flies. A total of 62 paths were estimated as the minimum numbers of confirmed paths between islands for all females Peary Caribou tracked with Argos collars, 2003-2006. Some shorter movements could have been missed or discarded to take into account the imprecision of animal locations. Bottom: timing of the island crossings in a boxplot format (mean: black lines; 50 % of the data: boxes; and 25th and 95th percentiles of the distributions: whiskers). For indication purposes: the minimal distance to cross to other major neighboring islands possible to reach during the periods of good quality sea ice around the Bathurst Island Complex.

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Appendix. Area covered (in sq. km) on Bathurst Island Complex, Nunavut, Canada by 7 females Peary Caribou (2003-2006) for various percentages of home ranges estimated through MCP and Kernel (see above for details).

P.20

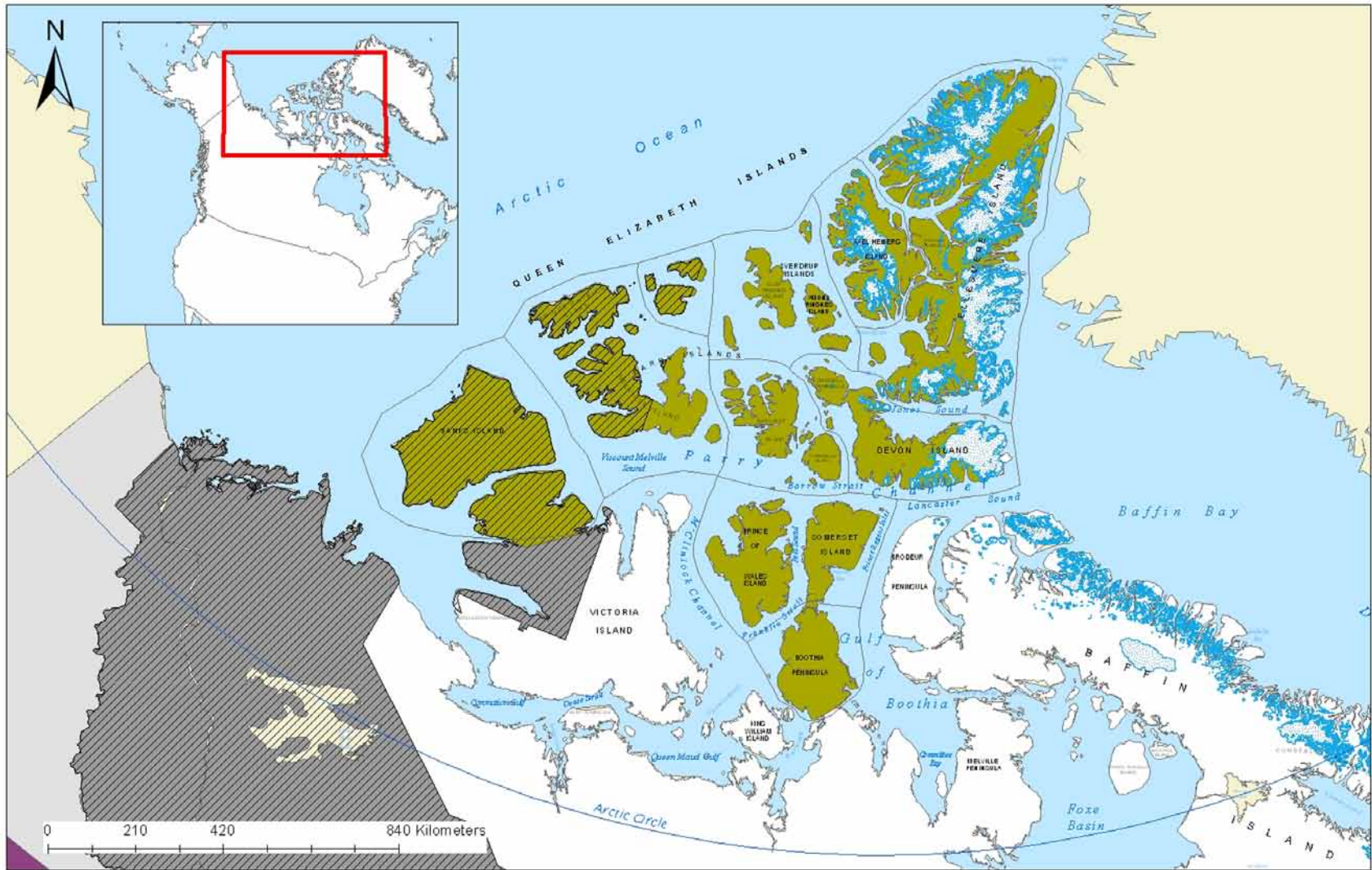


Figure 1.

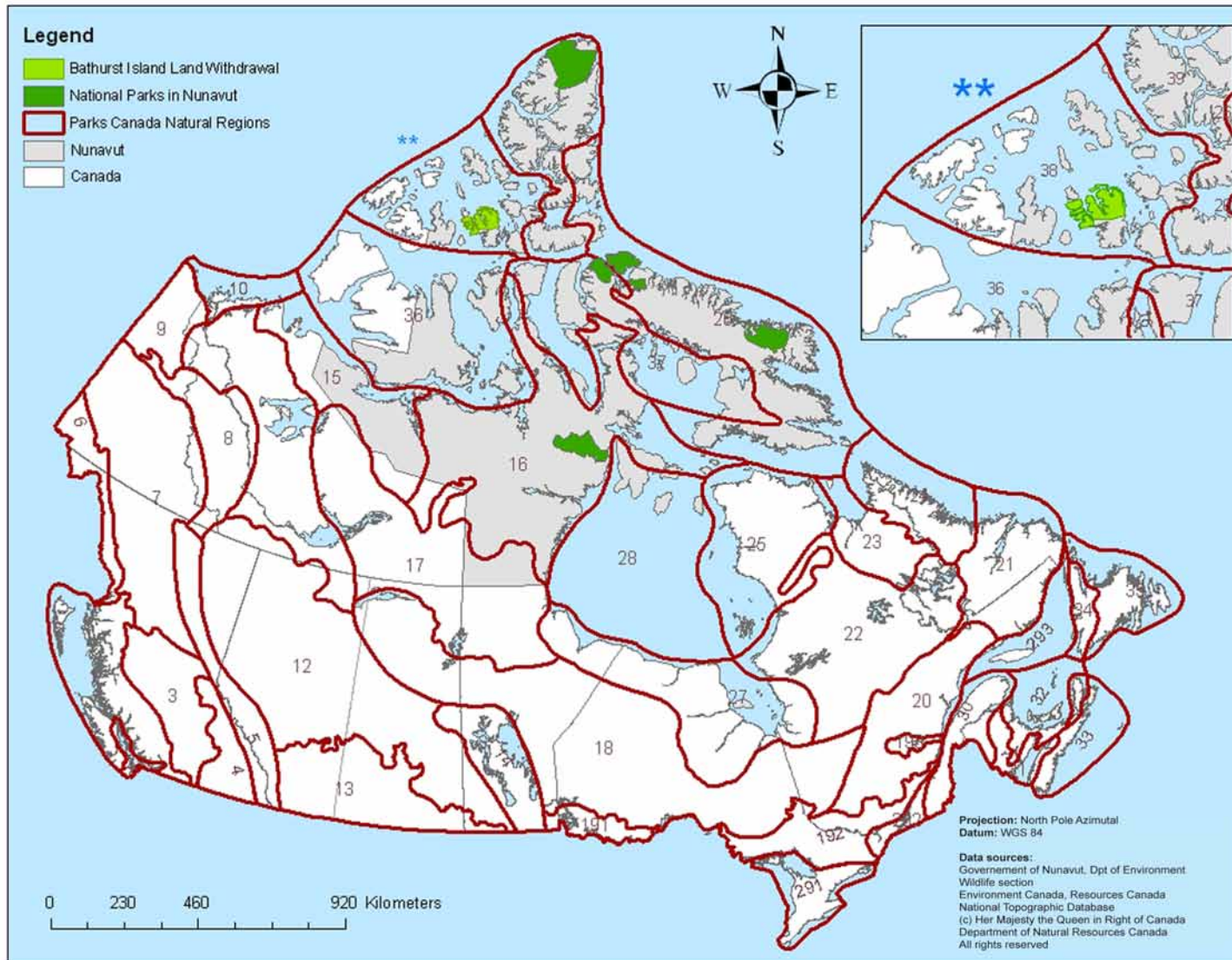


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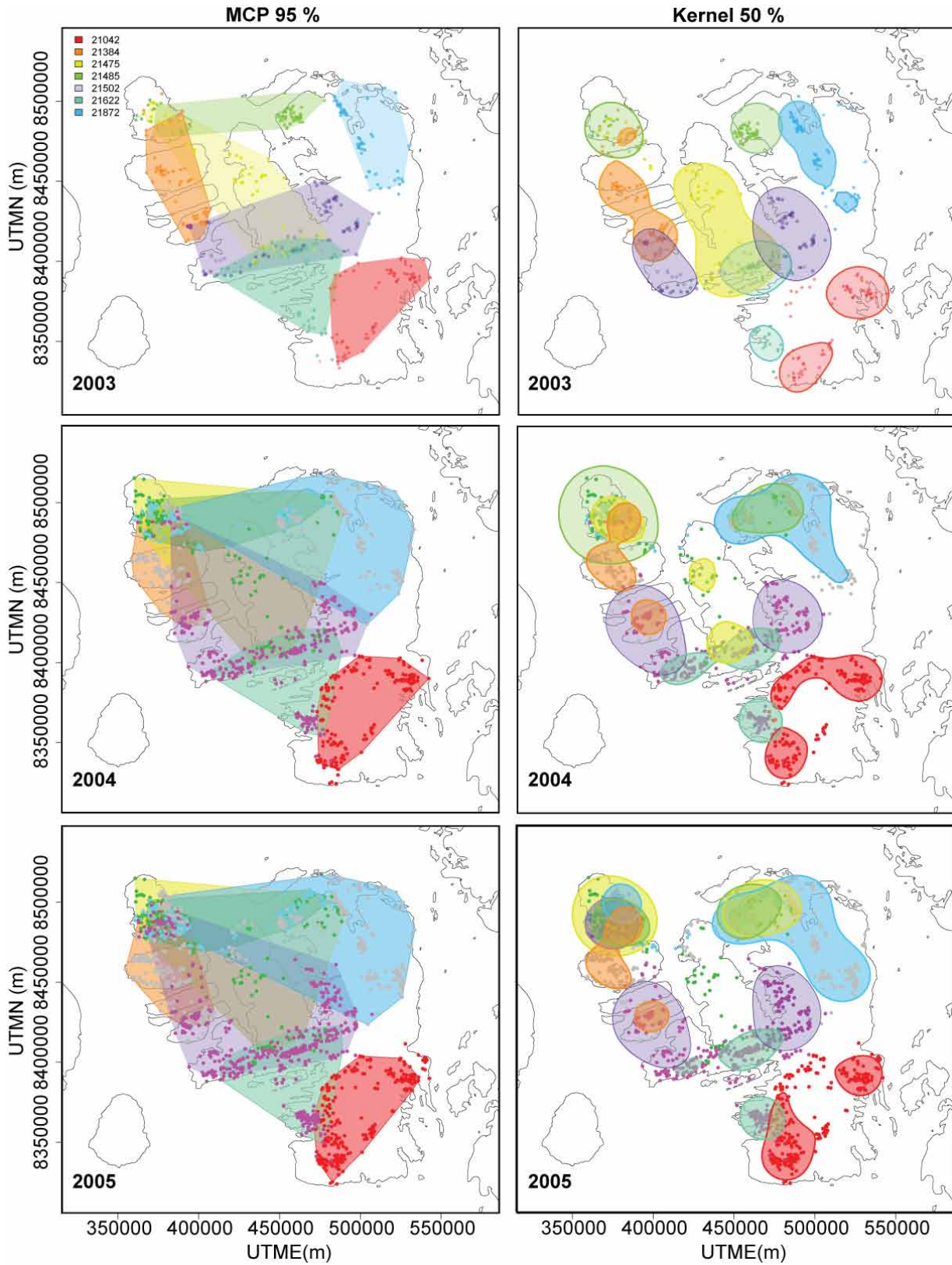


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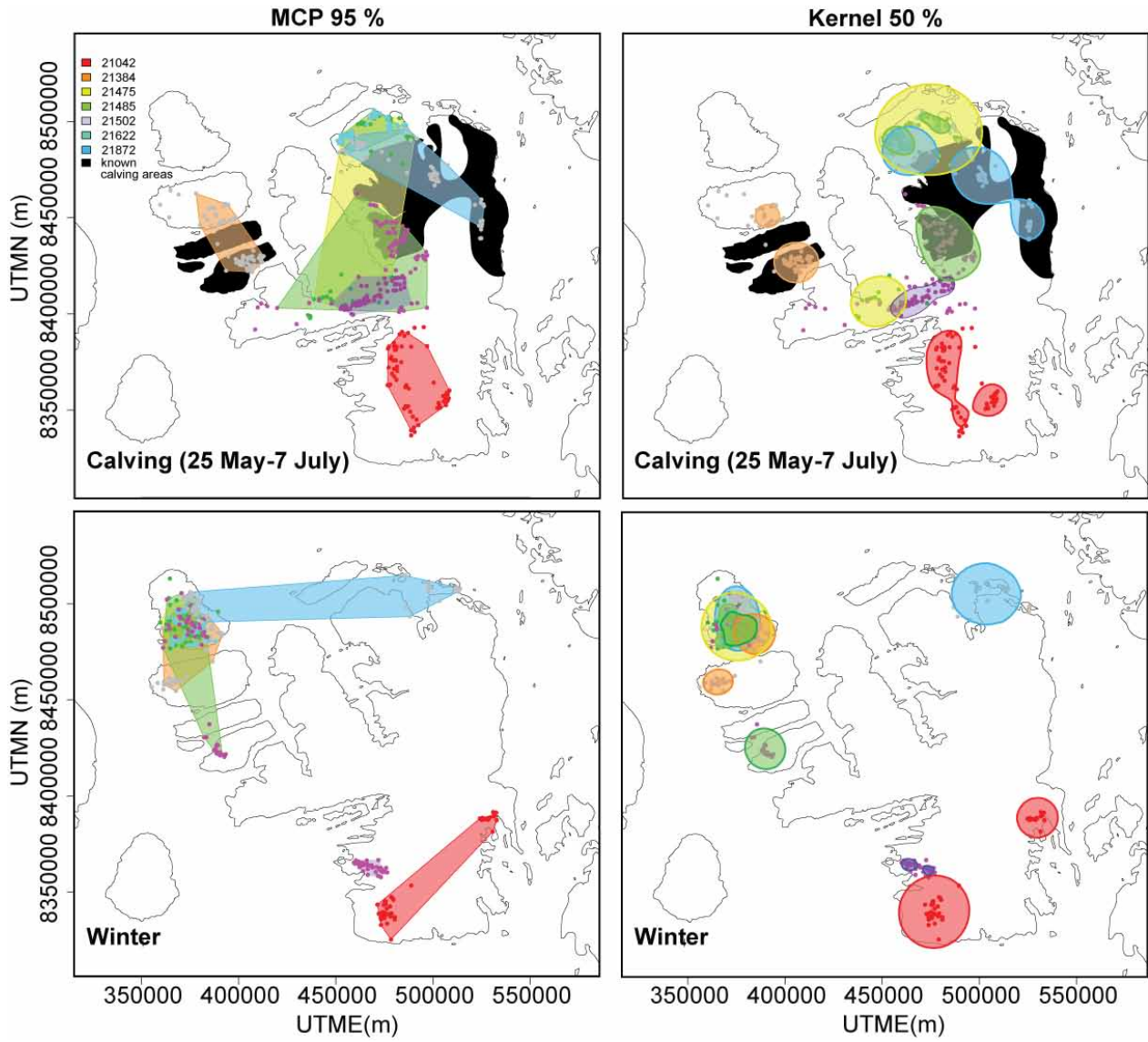


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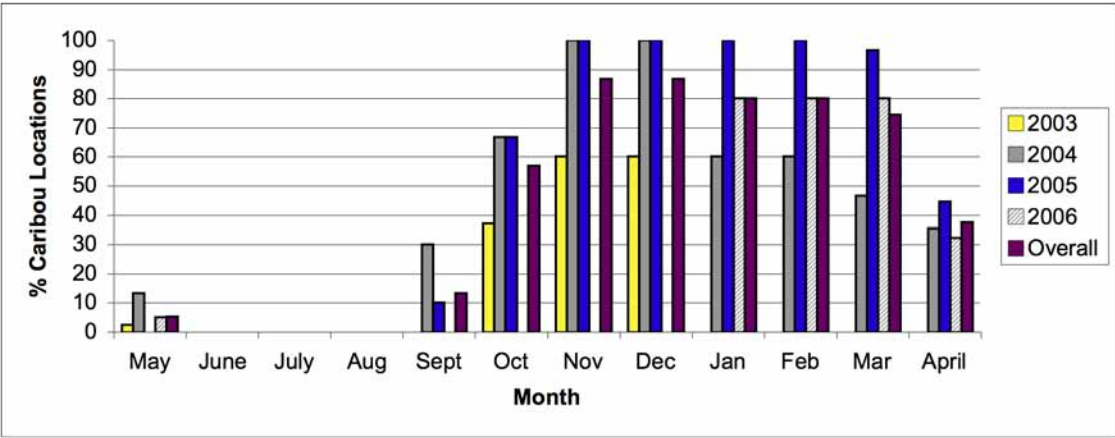


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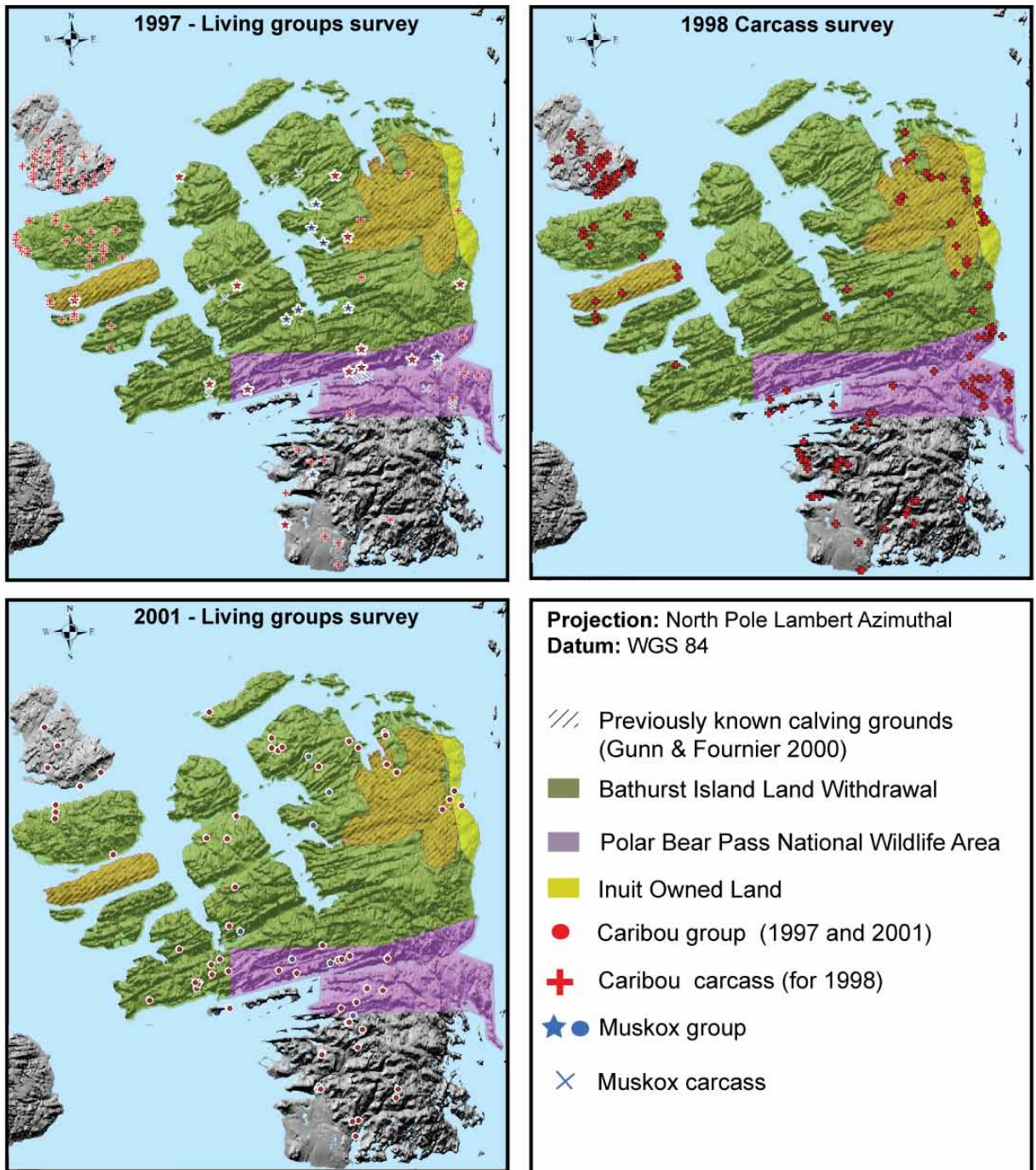


Figure 6.

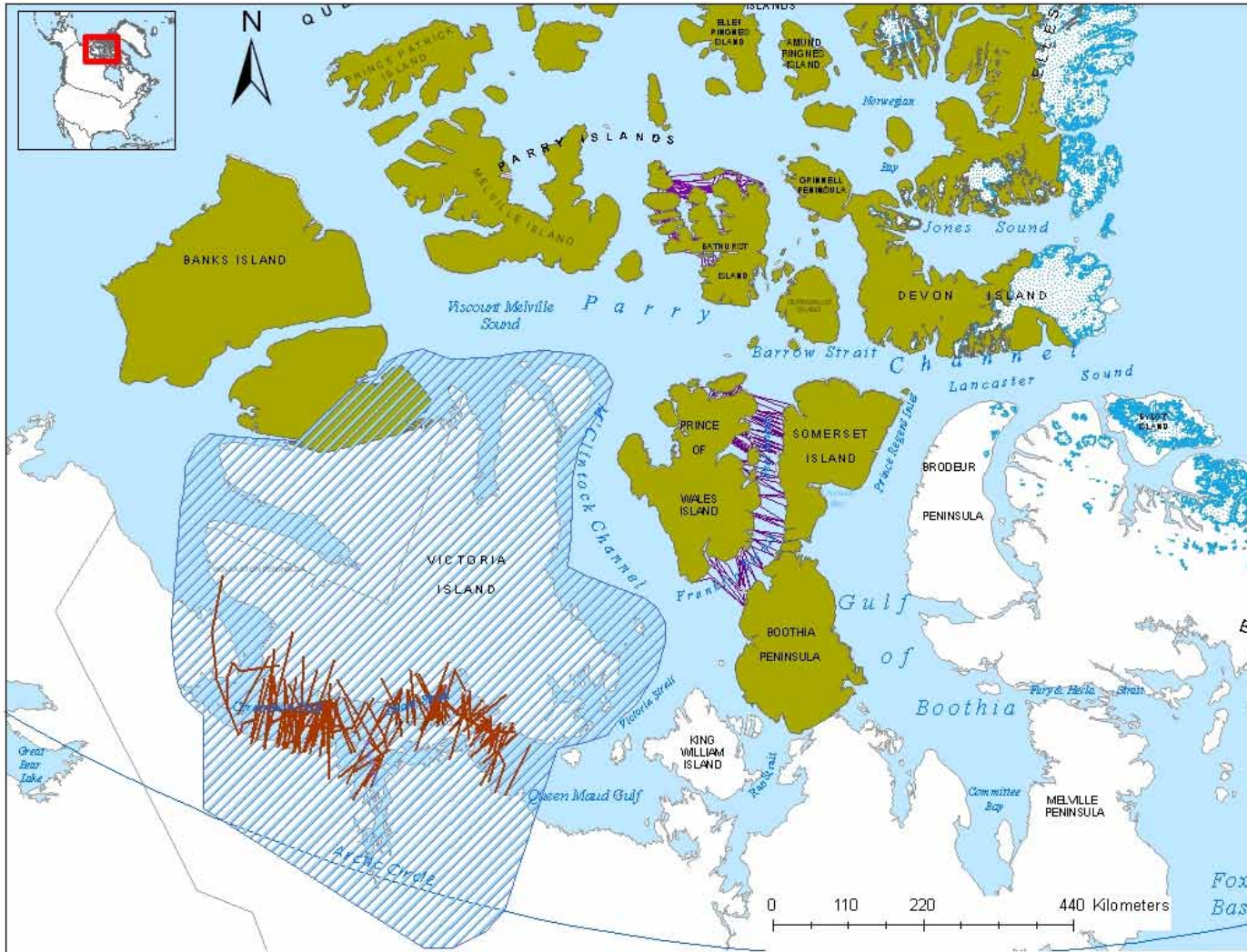


Figure 7.

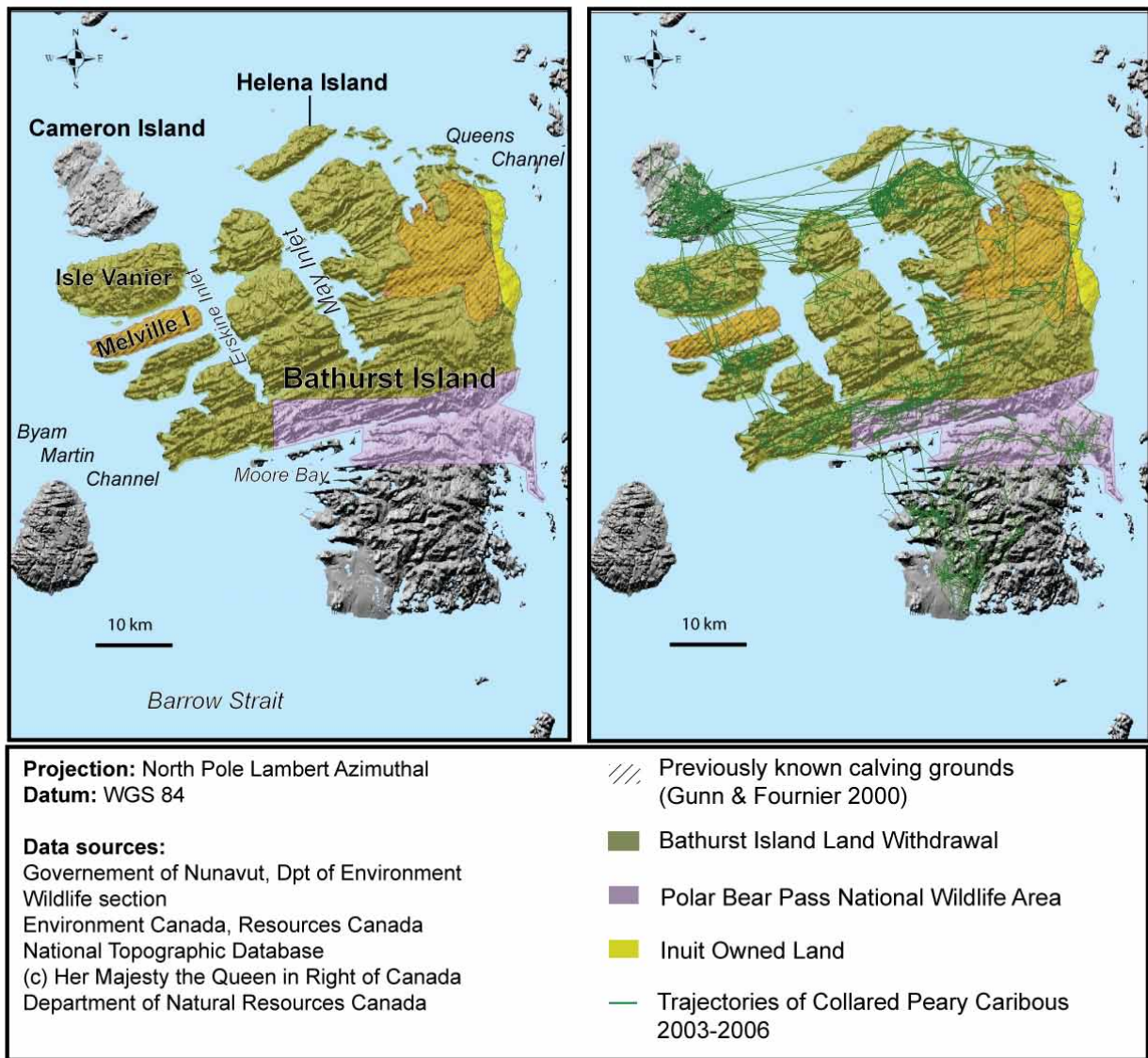


Figure 8.

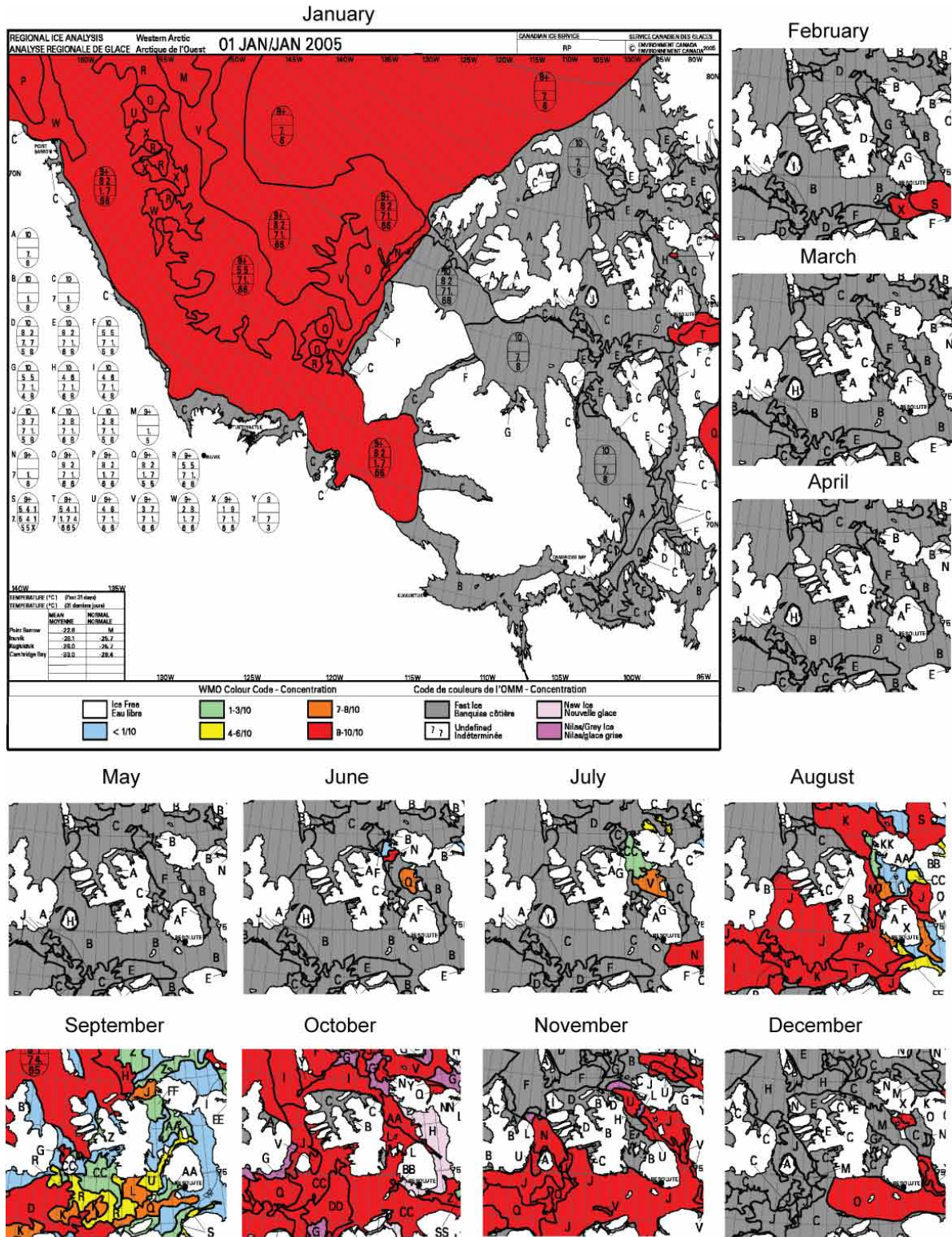


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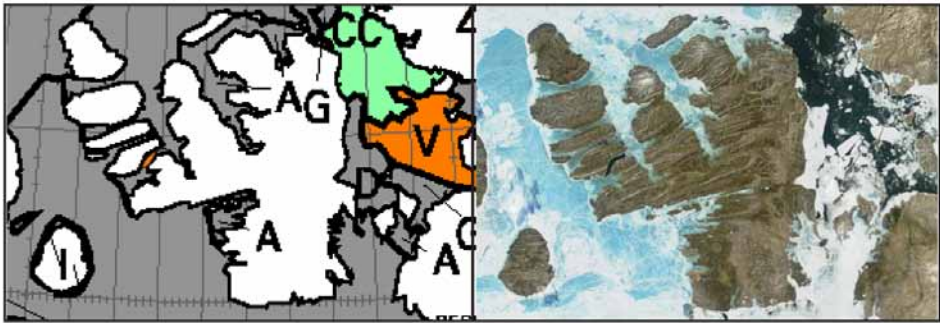


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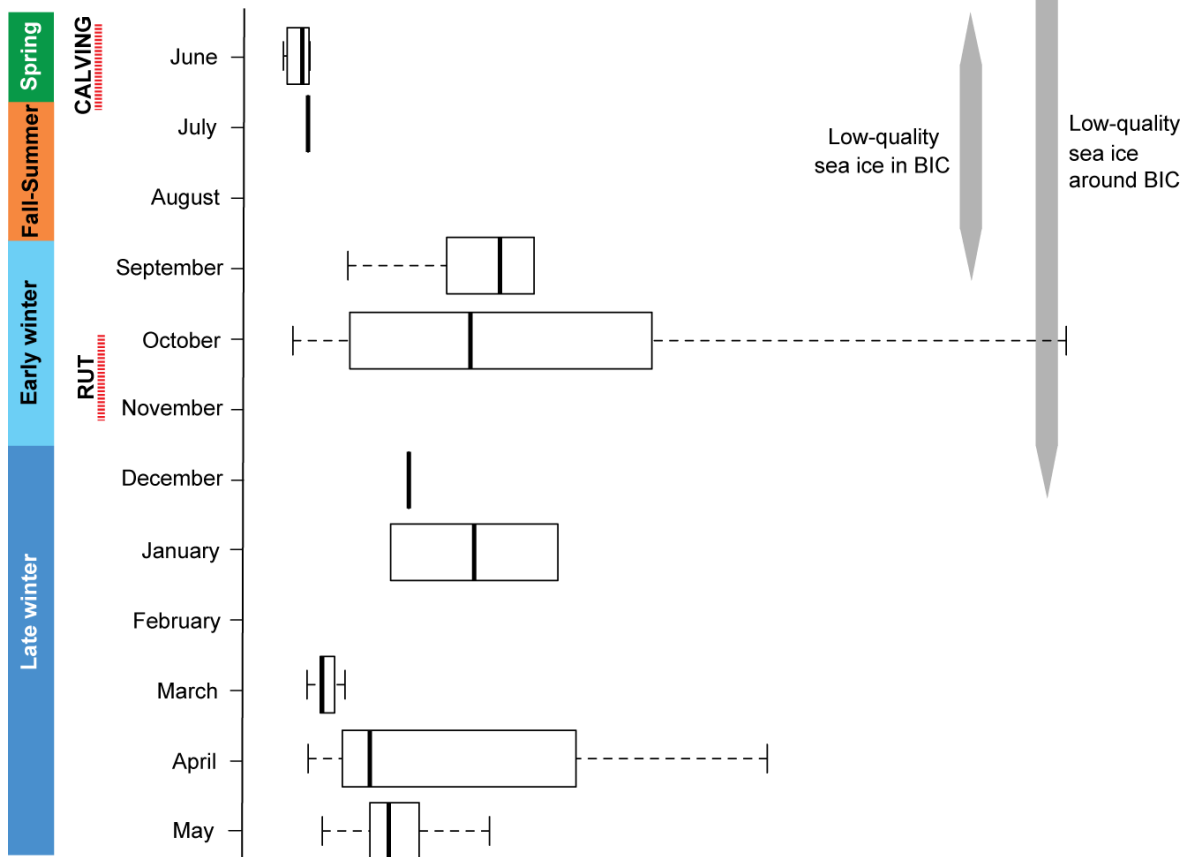
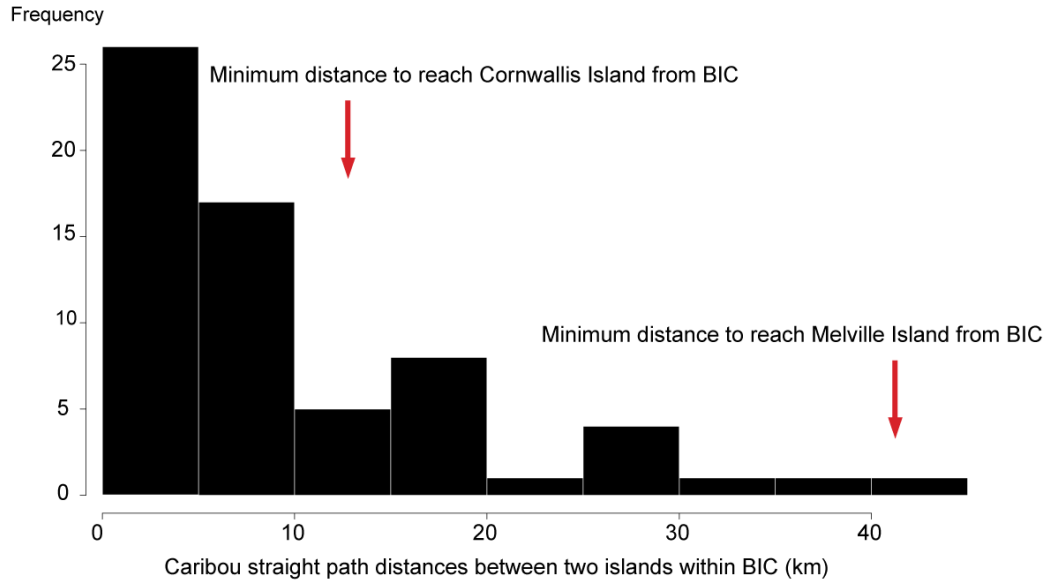
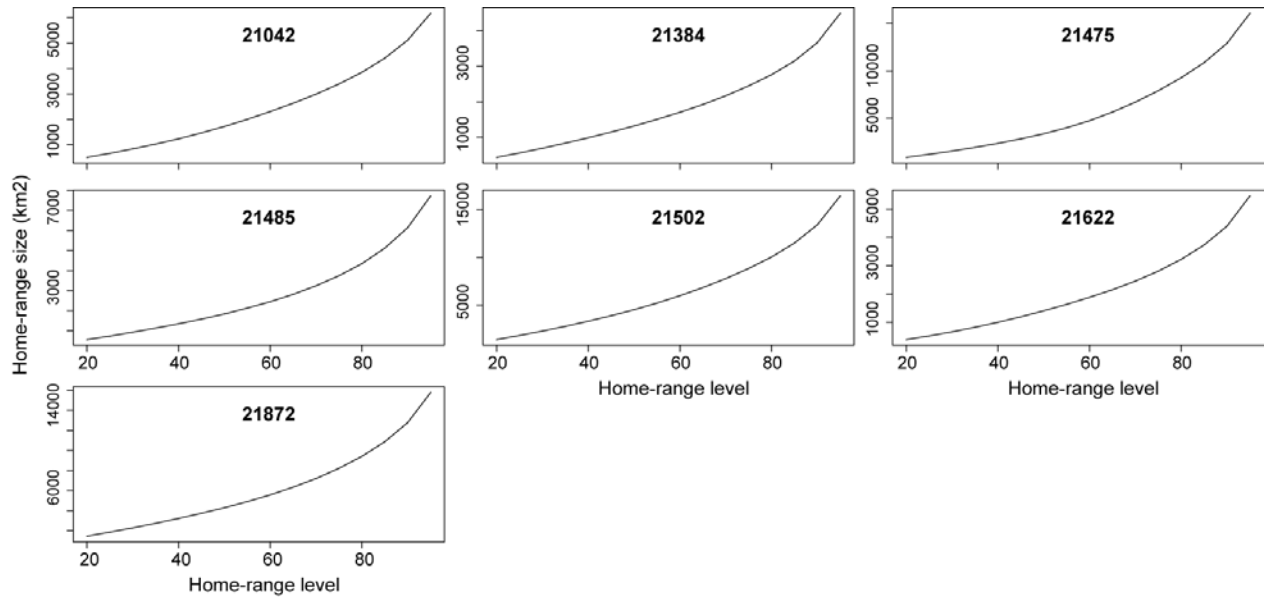


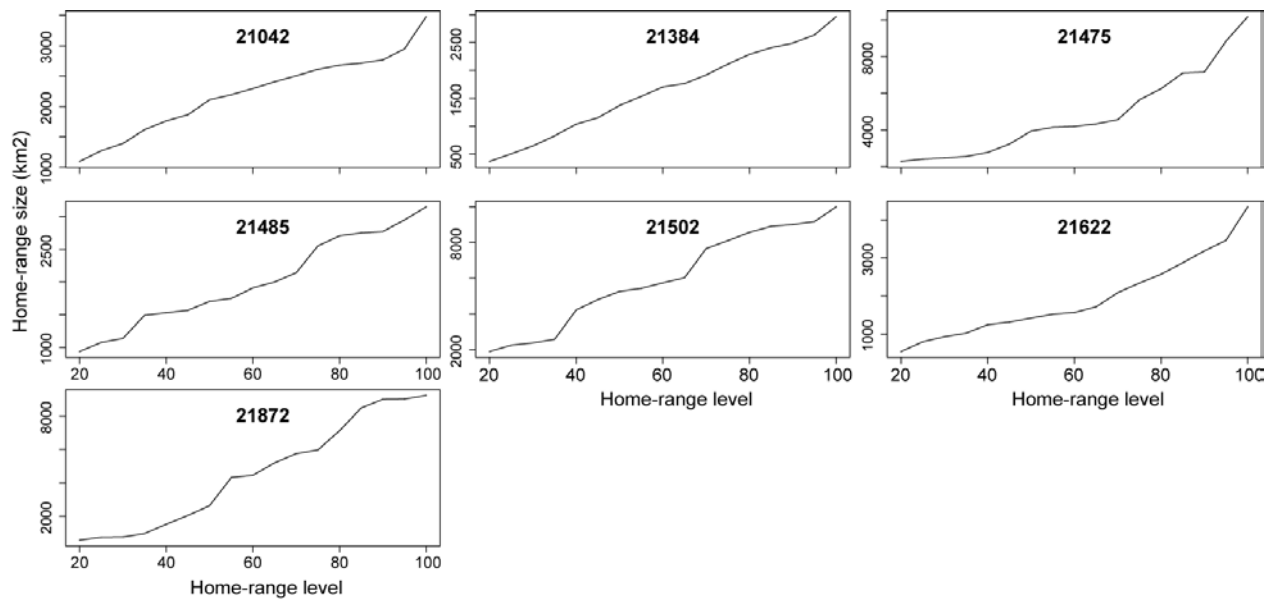
Figure 11.

Appendix

Kernel



MCP



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