Supplement 1: Extended first-passage time methods

The ecology of individual differences empirically applied to space-use and movement tactics

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We define area-restricted search as an individual's tendency to focus search efforts in areas where forage has been found in the past, or upon encountering forage (Fauchald and Tveraa 2003; Hills 2006). We used first-passage time (FPT) as an individually-based empirical proxy for area-restricted search (e.g., Fauchald and Tveraa (2003)) with first-passage time values assigned to each individual in each 10-day time-window. First-passage time was calculated by determining the amount of time, measured in hours, required for an individual to cross a circle of a given radius during each 10-day time-window (Fauchald and Tveraa 2003). Higher first-passage time values, and thus area-restricted search, reflect slower linear movement, and presumably more intensive local foraging, while lower first-passage time values, and thus area-restricted search, reflect faster linear movement, and presumably less intensive local foraging (e.g., Barraquand and Benhamaou (2008)). To estimate biologically relevant radii for first-passage time, we followed the method outlined by Fauchald and Tveraa (2003) where the radius of an FPT zone is selected based on the relationship between radius size and maximum variance in log-transformed mean first-passage time (Figure S1.1). Specifically, we used each individual's trajectory in each 10-day time-window (see above) and calculated variance in log-transformed mean first-passage time for a range of radius values (from 0 to 10,000 m at 50 m intervals) to determine the radius where variance in log-transformed mean first-passage time was greatest (Fauchald and Tveraa 2003; Barraquand and Benhamaou 2008).

The radius with the maximum variance was 5714 m, however, visual inspection of our analysis suggested that variance plateaued, so we used a broken-stick regression to identify the point at which the relationship between var(FPT) and radius values transitioned (Figure S1.1 A). To define first-passage time, and thus area-restricted search, we selected the transition radius of 1958 m, as opposed to 5714 m because 1958 m was the approxi-

mate transition between increasing variance in log(FPT) and radius size (Figure S1.1 B). A small subset of individuals (8% of all individual by time-window by year combinations: 158/1879) did not move from within their initial radius during the 10-day window, so we assigned these individuals a first-passage time value 240 hours, i.e., the number of hours in each 10-day time-window. Our transition radius of 1958 m is also biologically relevant in the context of foraging behavior and resource selection for Newfoundland caribou. Specifically, caribou in Newfoundland make foraging and resource selection decisions at a scale of approximately 2 km, suggesting that coarse grain, or long-distance, selection is important for selecting and avoiding certain habitats (Bastille-Rousseau et al. 2017).

To ensure that FPT values were not influenced by the fix-interval, i.e., duration of time between successive GPS fixes, we repeated the same procedure described above based on data that was filtered to only include fixes every four, eight, and twelve hours. We filtered data at the population level (i.e., all herds combined) and re-generated FPT values for all individuals in each 10-day time-window (Figure S1.1). We also conducted the same sensitivity analyses as described above for FPT values generated at each fix-interval (figure S1.2).

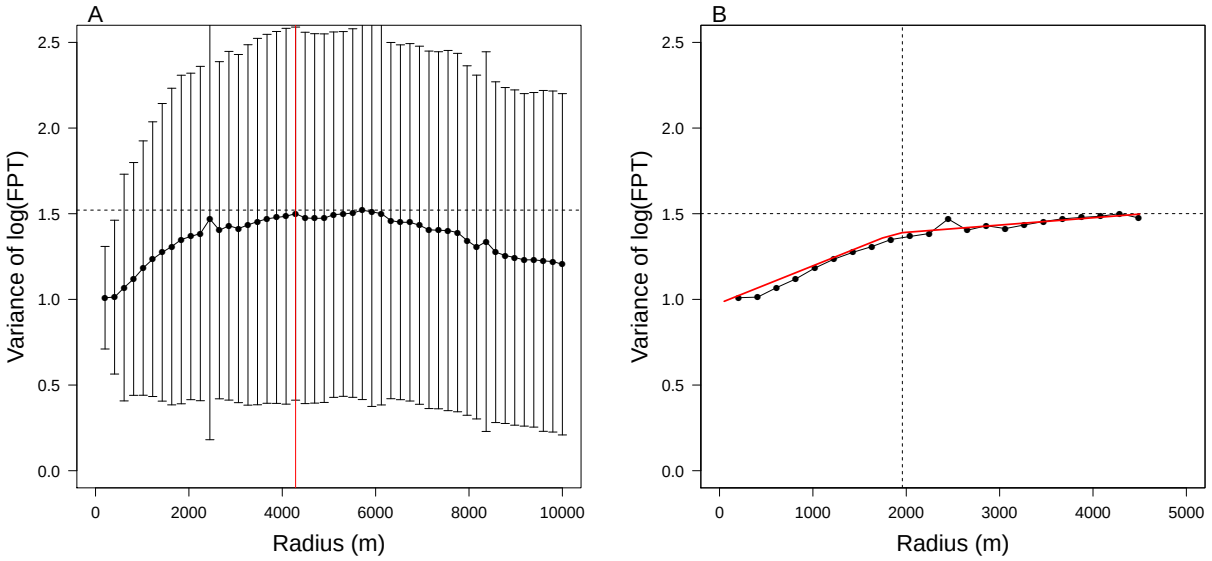

Figure S1.1: **A)** Variance in log first-passage time (FPT) as a function of radius (r) of a given circle for 129 individual caribou (*Rangifer tarandus*). Dashed horizontal line represents the maximum variance of log(FPT), while the solid vertical red line represents the radius (r = 1958 m) at which the maximum variance of log(FPT) occurred. **B)** Truncated relationship between variance of log(FPT) and radius overlaid by the output of a broken stick regression model, i.e. red best fit line (β = 0.00023 ± 0.00001, t = 17.4, p < 0.001). The breakpoint of our broken stick was 5714 m (standard error, ± 99 m).

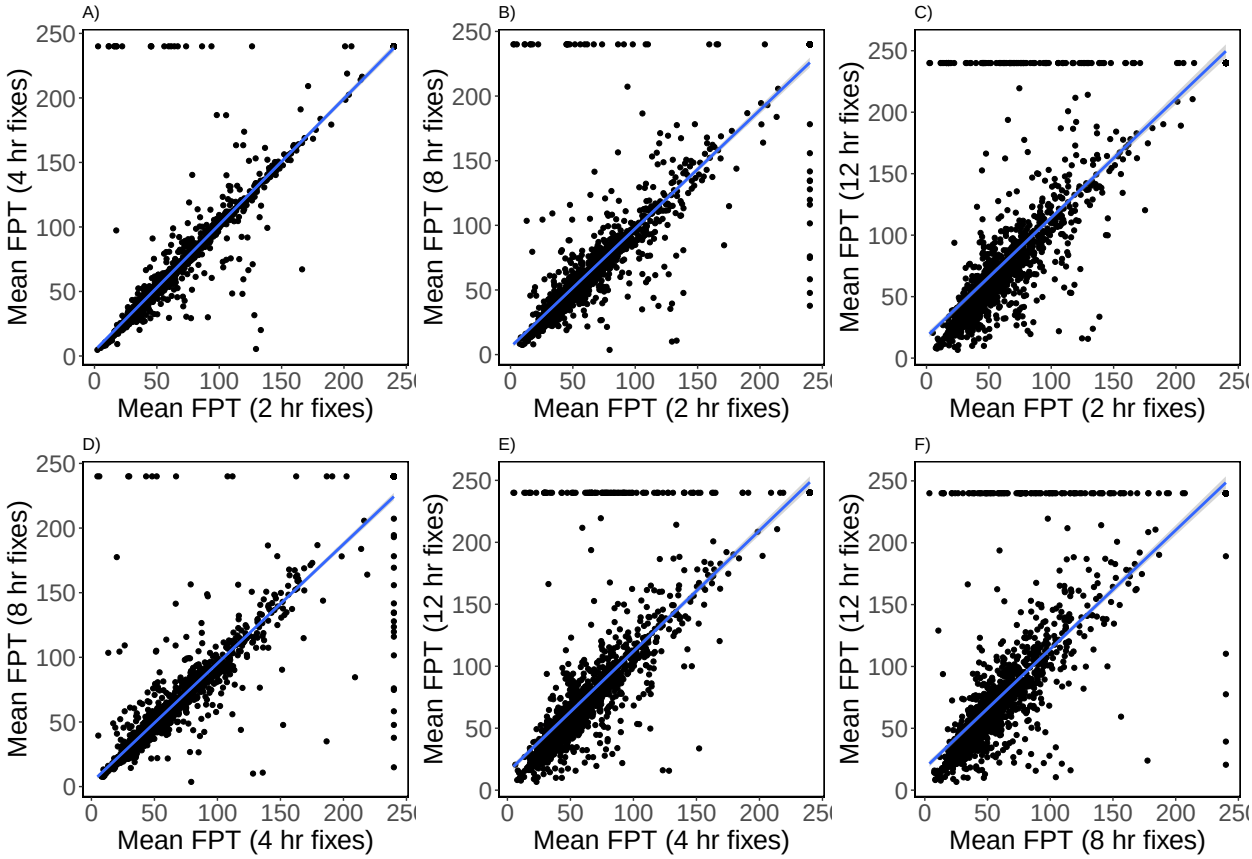

Figure S1.2: Comparison between mean first-passage time (FPT, in hours) for caribou (*Rangifer tarandus*) in Newfoundland (n = 129) generated based on fix-intervals of two (used in the main analysis of this study), four, eight, and twelve hours. **A)** comparison between FPT generated using two and four hour fixes ($F_{1,1980}$ = 13813, $p < 0.001$, r^2 = 0.87); **B)** comparison between FPT generated using two and eight hour fixes ($F_{1,1980}$ = 7198, $p < 0.001$, $r^2 = 0.78$); **C)** comparison between FPT generated using two and twelve fixes ($F_{1,1980}$ = 3744, $p < 0.001$, $r^2 = 0.65$); **D)** comparison between FPT generated using four and eight hour fixes ($F_{1,1980}$ = 12580, $p < 0.001$, $r^2 = 0.86$); **E)** comparison between FPT generated using four and twelve hour fixes ($F_{1,1980}$ = 5237, $p < 0.001$, $r^2 = 0.73$); **F)** comparison between FPT generated using eight and twelve hour fixes ($F_{1,1980}$ = 4459, $p < 0.001$, $r^2 = 0.69$). Note, blue lines represent the predicted best-fit line estimated based linear regression comparing FPT values generated using different fix-intervals.

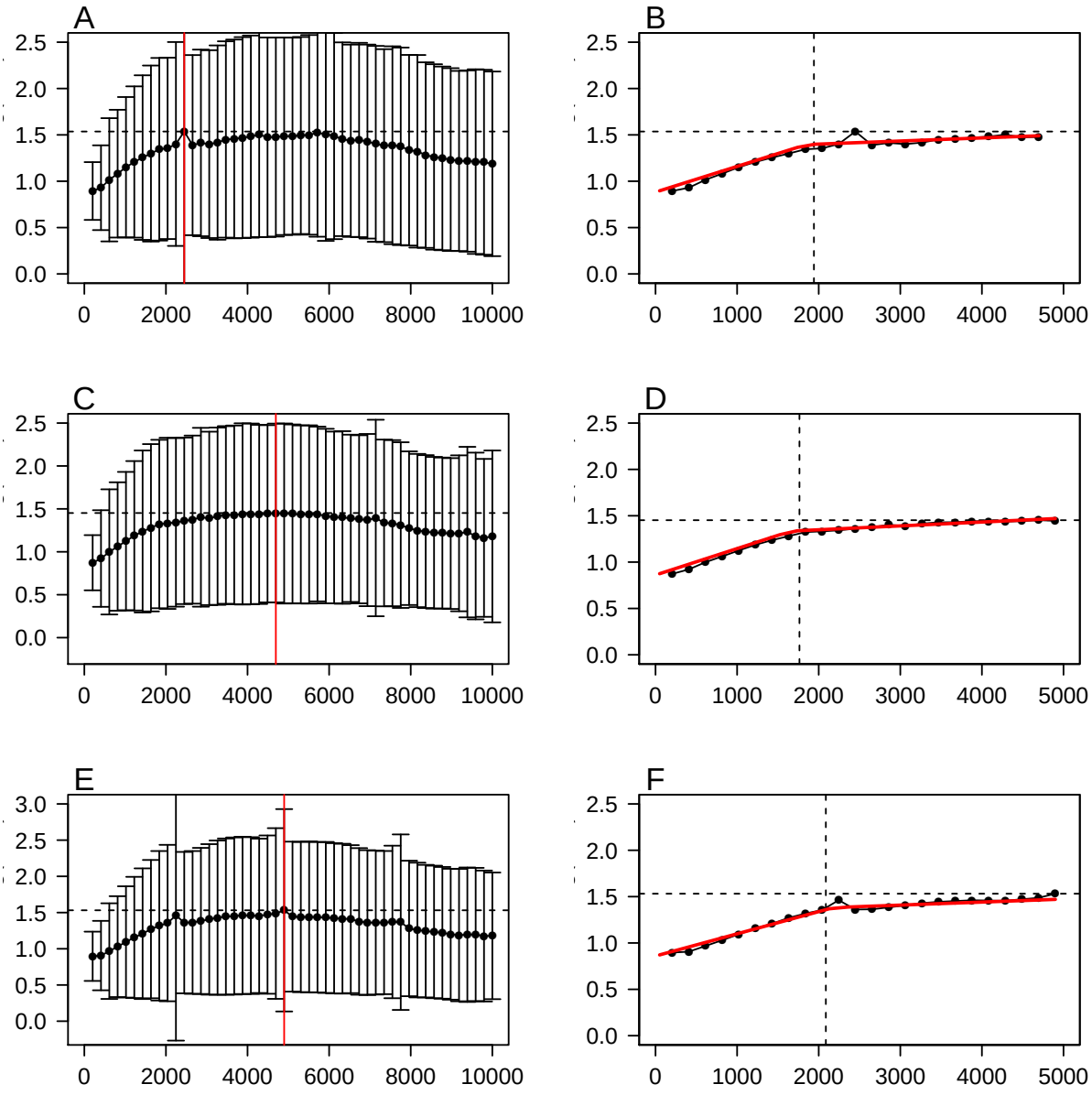

Figure S1.3: **A, C, E)** Variance in log first-passage time (FPT) as a function of radius (r) of a given circle for 129 individual caribou (*Rangifer tarandus*) filtered for four (**A**), eight (**C**), and twelve (**E**) hour fix-intervals. Dashed horizontal lines represents the maximum variance of $log(FPT)$, while the sold vertical red lines represents the radius (**A**: r = 2449 m; **C**: r = 4694 m; **E**: r = 4898 m) at which the maximum variance of $log(FPT)$ occurred. **B, D, F)** Truncated relationship between variance of $log(FPT)$ and radius overlaid by the output of a broken stick regression model, i.e. red best fit line. Four hour intervals (**B**): β = 0.00029 ± 0.00002, t = 12.99, p < 0.001; the breakpoint of our broken stick was 1941 m (standard error, ± 119 m). Eight hour intervals (**D**): β = 0.00029 ± 0.0003, t = 28.83, p < 0.001; the breakpoint of our broken stick was 1764 m (standard error, ± 47 m). Twelve hour intervals (**F**): β = 0.00027 ± 0.00001, t = 20.01, p < 0.001; the breakpoint of our broken stick was 2088 m (standard error, ± 91 m).

References

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