Plastic response of fearful prey to the spatio-temporal dynamics of predator distribution

—Appendix A: Choice of the temporal window—

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Abstract

In this document, we compare of four temporal windows for the evaluation of anti-predator responses: 1) 15 days prior to each caribou location, as presented in the main text; 2) 15 days a month after each caribou location; 3) every wolf locations from the beginning of winter; 4) every wolf locations regardless of time. We show that only the selected 15-day temporal window provided anti-predator responses.

The definition of the temporal window to investigate anti-predator responses of caribou to the proximity of wolves was based on the best of our knowledge of the data on hand and previous studies addressing the issue in this study system. However, a lack of a strong biological framework for this decision calls for a better justification to decide the temporal window.

In order to better understand the impact of the temporal window, we thus implemented the approach detailed in the manuscript using four different temporal windows to select wolf locations:

1. The preceding 15 days, which is the approach selected in the manuscript [W_{15}];
2. A 15-day period in the future, a month after each caribou location (this is to prevent the 15 days immediately after each caribou location to be too similar to the 15 days immediately before) [W_{future}];
3. All wolf locations from the beginning of winter, which was defined as November 28 for wolves (see Basille et al., 2013, for more details on the delineation of seasons) [W_{season}];
4. All wolf locations, regardless of time [W_{total}].

For all four temporal windows, we use the same analytic protocol as detailed in the manuscript:

- Extracting only caribou steps with wolves closer than 5 km within the temporal window;
- Drawing 10 random steps for each observed step, using the complete data set of caribou locations;
- Fitting a conditional logistic regression for case-control data (i.e. Step Selection Functions, Fortin et al., 2005) to contrast observed and random steps: only the full model (corresponding to H_{multi}) was fit, to allow comparison of effects for each temporal window. The full model included the land cover type at the end of the step, the average slope along the step, speed and directional persistence, as well as the spatial proximity to wolves in interaction with the 4 risky land cover types, with speed, with directional persistence, and with the direction to the closest wolf. Every model took into account the stratified structure of the data (observed vs. random), and estimated robust variances using clusters of independent steps (see *Material and Methods* for more details).

The results of the full model for the four different temporal windows are shown in Table A1 of this document. Since we were primarily interested in the effect of predation risk, as given by the proximity to wolves, we focused on the significance of the interaction of this variable with other variables of interest. While the results are qualitatively consistent between all four models regarding main effects, we can see that none of the interactions with wolf proximity (indicated by "*var* × Wprox" in Table 1) are significant for other temporal windows than the original 15-day: 95 % confidence intervals for all interaction terms overlap with 0. The only exception is the effect of wolf proximity on speed using all wolf locations regardless of the time. In other words, none of the alternative temporal windows provided results that highlighted an effect of wolf spatial proximity on caribou movement, which clearly supports the relevance of the original 15-day window.

References

Basille, M., Fortin, D., Dussault, C., Ouellet, J.-P., Courtois, R., 2013. Ecologically based definition of seasons clarifies predator-prey interactions. Ecography 36, 220–229.

Fortin, D., Beyer, H., Boyce, M., Smith, D., Duchesne, T., Mao, J., 2005. Wolves influence elk movements: Behavior shapes a trophic cascade in Yellowstone National Park. Ecology 86, 1320–1330.

Table A1: Coefficient and 95 % confidence intervals for the full Step Selection Function (SSF) model, using four different temporal windows.

	W_{15}			W_{future}		
Variable	β	CI 2.5	CI 97.5	β	CI 2.5	CI 97.5
Open	0.51	0.12	0.89	-4.92	-12.98	3.15
Conifer w. lichen	0.51	0.35	0.66	0.28	0.04	0.53
Shrub	0.28	-0.01	0.58	0.35	-0.25	0.94
Deciduous	-0.13	-0.35	0.10	0.33	0.00	0.67
Cuts	-0.14	-0.48	0.19	0.01	-0.42	0.44
Conifer	-0.23	-0.46	-0.01	-0.16	-0.52	0.20
Water	-0.83	-1.32	-0.34	-1.16	-2.01	-0.31
Slope	-0.02	-0.04	0.00	-0.04	-0.08	0.00
Speed	0.49	0.31	0.67	0.64	0.40	0.88
DirP	0.10	0.02	0.14	0.14	0.02	0.26
Conifer × Wprox	0.30	-0.24	0.84	-0.06	-0.25	0.13
C.Lichen × Wprox	-0.22	-0.39	-0.05	0.04	-0.26	0.33
Deciduous × Wprox	-1.98	-3.55	-0.42	0.14	-0.05	0.34
Open × Wprox	-2.66	-4.87	-0.45	-10.72	-26.82	5.39
DiffProx	0.01	-0.17	0.20	0.74	0.41	1.07
Speed × Wprox	0.11	-0.24	0.46	0.11	-0.09	0.30
DirP × Wprox	0.08	0.00	0.15	-0.03	-0.15	0.09
Wangle	0.00	-0.07	0.06	-0.10	-0.23	0.03
Wangle × Wprox	0.08	-0.04	0.20	0.03	-0.13	0.19

	W_{season}			W_{total}		
Variable	β	CI 2.5	CI 97.5	β	CI 2.5	CI 97.5
Open	0.09	-0.28	0.46	0.36	0.16	0.57
Conifer w. lichen	0.24	0.14	0.34	0.32	0.25	0.40
Shrub	0.20	0.05	0.36	0.13	0.02	0.25
Deciduous	-0.06	-0.18	0.06	-0.15	-0.23	-0.06
Cuts	-0.10	-0.38	0.19	0.16	-0.11	0.43
Conifer	-0.45	-0.55	-0.34	-0.34	-0.42	-0.26
Water	-0.79	-1.26	-0.32	-0.84	-1.21	-0.46
Slope	-0.02	-0.03	0.00	-0.02	-0.03	-0.01
Speed	0.43	0.30	0.56	0.42	0.28	0.56
DirP	0.07	0.03	0.12	0.09	0.06	0.13
Conifer × Wprox	0.01	-0.05	0.07	0.00	-0.01	0.01
C.Lichen × Wprox	-0.04	-0.12	0.03	-0.02	-0.04	0.00
Deciduous × Wprox	0.02	-0.07	0.11	0.00	-0.04	0.05
Open × Wprox	-0.08	-0.18	0.01	-0.06	-0.13	0.00
DiffProx	0.86	0.72	1.00	2.02	1.82	2.22
Speed × Wprox	0.04	-0.05	0.14	0.07	0.04	0.11
DirP × Wprox	-0.01	-0.04	0.01	0.00	0.00	0.01
Wangle	-0.16	-0.20	-0.11	-0.19	-0.22	-0.16
Wangle × Wprox	-0.01	-0.03	0.01	0.00	0.00	0.01