Oikos

OIK-06166

Nouailhetas Simon, R., Cherry, S. G. and Fortin, D. 2019. Complex tactics in a dynamic large herbivore–carnivore spatiotemporal game. – Oikos doi: 10.1111/oik.06166

Appendix 1

Distribution of bison and wolf GPS collar data across years and seasons

Table A1. Number of individuals and number of GPS locations (range, i.e. minimum and maximum) across seasons and years for bison and wolves in Prince Albert national park, Canada, used to assess their predator–prey spatiotemporal game from 2007 to 2016.

Year	Spring–autumn		Summer–autumn		Winter	
	Bison	Wolf	Bison	Wolf	Bison	Wolf
2007	9 (957-1958)	3 (440-2750)	8 (132-1122)	4 (22-2673)	7 (187-396)	3 (22-1441)
2008	7 (583-3938)	1 (1012)	5 (88-2442)	1 (3003)	6 (44-2959)	3 (308-1287)
2009	5 (231-814)	1 (605)	----	----	4 (319-2783)	1 (2299)
2010	----	----	5 (1078-2497)	1 (3179)	3 (1078-1782)	1 (2222)
2011	14 (726-3487)	5 (187-4323)	14 (88-3069)	5 (2101-7293)	12 (33-4224)	5 (2002-5126)
2012	15 (2244-5544)	2 (3201-4884)	14 (330-6479)	2 (7777-8294)	15 (638-7579)	5 (132-7678)
2013	14 (5071-6039)	2 (4257-5049)	14 (198-7370)	2 (8459-8932)	15 (2211-9119)	3 (1826-8613)
2014	----	-----	12 (726-3091)	4 (11-5280)	15 (506-14333)	7 (121-17402)
2015	11 (6721-10758)	1 (6171)	11 (1815-11550)	3 (11-17512)	15 (55-10505)	5 (165-24365)
2016	----	----	----	----	3 (44-429)	2 (33-1100)

Appendix 2

Variance inflation factors

Table A2. Variance inflation factors for covariables used in step selection function models investigating habitat selection and responses of female bison to wolf distribution in Prince Albert national park, Canada, from 2007 to 2016.

Covariable	Spring–summer	Summer–fall	Winter
step length	16,634.28	15,961.91	14,657.52
s2	22,844.27	21,943.62	20,223.61
s3	1,514.14	1,463.84	1,395.23
s4	52.66	51.06	50.76
meadow	3.60	3.36	3.51
water	1.03	1.02	1.03
river	1.00	1.00	1.01
road	1.00	1.01	1.00
remain	3.99	3.67	3.87
wolf UD	2.88	2.29	2.88
dir.wolf	1.19	1.14	1.29
remain × *wolf UD*	2.13	5.39	2.68
meadow × *wolf UD*	4.02	6.68	4.57
remain × *pred*	1.14	1.08	1.16
dir.wolf × *pred*	1.23	1.14	1.30

Table A3. Variance inflation factors for covariables used in step selection function models investigating habitat selection and responses of wolves to bison distribution in Prince Albert national park, Canada, from 2007 to 2016.

Covariable	Spring–summer	Summer–fall	Winter
step length	80,456.58	83,086.59	77,806.44
s2	98,204.83	101,405.68	94,857.92
s3	3,084.11	3,216.21	2,988.54
s4	9.60	9.64	9.24
meadow	7.46	5.16	6.34
water	1.02	1.03	1.02
river	1.01	1.00	1.00
road	1.00	1.01	1.00
remain	5.28	5.17	4.88
log (bison UD)	1.54	1.54	1.53
dir.bison	4.38	1.72	1.11
remain × bison UD	2.66	-----	-----
remain × log (bison UD)	-----	3.47	4.23
meadow × log (bison UD)	6.49	4.48	5.89
remain × prey	4.49	1.57	1.13
dir.bison × prey	4.37	1.72	1.11

Appendix 3

Direction of bison movement with respect to wolf position in spring–summer

Female bison in spring–summer appeared to move towards wolves irrespective of the distance between them. We argued that this pattern resulted from bison inadvertently moving towards wolves when moving back to the centre of their range. To investigate this hypothesis, we partitioned the spring-summer location data into two subsets: one including only real steps occurring within a 4-km radius from the centre of the bison range (and their corresponding random steps), and the other including the remaining real steps located outside the radius (along with their corresponding random steps). Bison range in spring-summer was represented by the 95% minimum convex polygon. The 4-km radius was determined visually as the best value splitting the number of real steps roughly equally between inside and outside the radius. Finally, we built SSFs using only *dir.wolf* as the covariable of interest: if our hypothesis is correct, female bison should not move towards wolves when inside the radius, but generally do so when moving outside of the radius. Supporting Table 3 below shows this is actually the case.

Table A4. Parameter estimates for bison movement with respect to wolf position in Prince Albert National Park, Canada, for locations inside and outside a 4-km radius around the centre of the bison range in spring-summer.

	Inside 4-km radius (close to range center) n = 15,267 events			Outside 4 km-radius (away from range center) n = 14,436 events		
Variable	β	robust *se*	p	β	robust *se*	p
step length	0.021	0.0083	< 0.05	0.038	0.0091	< 0.001
s2	–0.021	0.0089	< 0.05	–0.034	0.0094	0.616
s3	0.003	0.0018	0.07	–0.001	0.0017	< 0.001
s4	–0.004	0.0004	< 0.001	–0.003	0.0007	< 0.001
dir.wolf	0.020	0.0127	0.115	0.035	0.0123	< 0.001

Appendix 4

Direction of bison movement with respect to wolf position in winter in Prince Albert national park, Canada, from 2007 to 2016

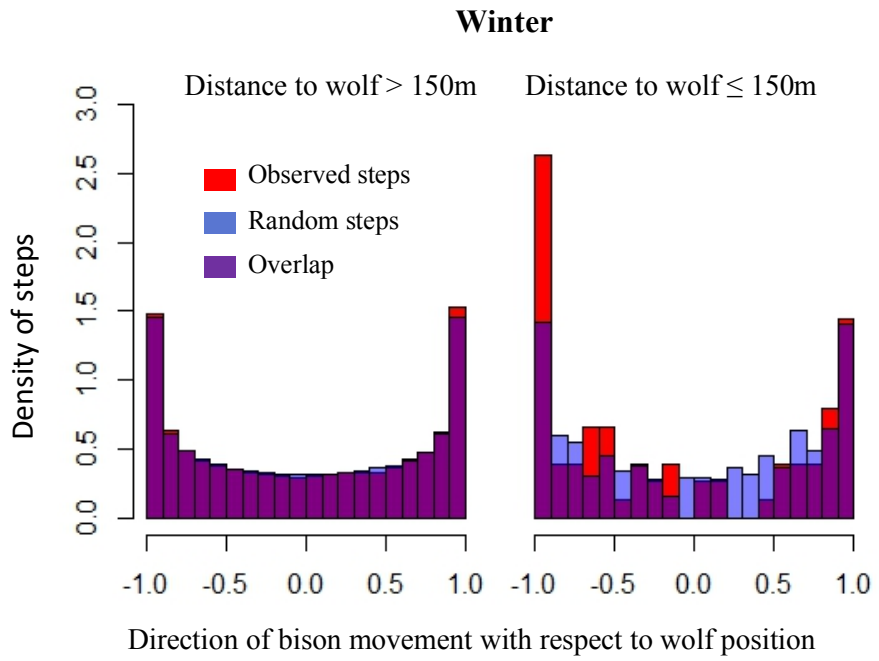

Figure A1. Direction of movement with respect to the location of the nearest collared wolf for GPS-collared female bison in Prince Albert National Park, Canada, from 2007 to 2016, when the predator was either far (> 150 m) or close (≤ 150 m) in winter. The value of 150 m was chosen to illustrate model effects, but the analysis was conducted on a continuous scale. A value of –1 indicates bison movement in the opposite direction of wolf position, whereas a value of +1 indicates the opposite. Observed steps: n = 34 742 and n= 76 for left and right panels above respectively. Random steps: n = 347 420 and n = 760 for left and right panels respectively.