ELECTRONIC APPENDIX

This is the Electronic Appendix to the article

Importance of climatological downscaling and plant phenology for red deer in heterogeneous landscapes

by

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Online supporting information

For: Nathalie Pettorelli, Atle Mysterud, Nigel G. Yoccoz, Rolf Langvatn and Nils Chr. Stenseth: "Importance of climatological downscaling and plant phenology for red deer in heterogeneous landscapes"

Table 1: Parameter estimates for temperature and precipitations in April. 50 stations in Norway (West Coast) were considered over 38 years (1964-2002). For each station, altitude and latitude were known. St is here an abbreviation for Standardized (for each standardized variable, the mean=0 and the standard deviation=1).

Parameters	*Estimates*	*SE*
Model A: Temperature		
Intercept	4.16	0.18
NAO in April	0.30	0.10
St (Latitude)	-0.52	0.02
St (Altitude)	-1.13	0.02
NAO in April*St (Latitude)	0.07	0.01
NAO in April*St (Altitude)	-0.003	0.01
NAO in April*St (Latitude)*St (Altitude)	0.0007	0.01
Model B: Precipitation		
Intercept	77.65	6.54
NAO in April	-1.25	3.67
St (Latitude)	-4.89	1.59
St (Altitude)	-5.08	5.48
NAO in April*St (Latitude)	-4.78	1.59
NAO in April*St (Altitude)	2.26	3.41
NAO in April*St (Latitude)*St (Altitude)	-0.31	2.91

Table 2: Parameter estimates and test statistics for the analysis of snow depth, based on the linear mixed models (with year as random effect). These estimates are the ones used for drawing figure 3 in the main text. The main term of interest related to the mechanisms discussed is bolded. St is here an abbreviation for Standardized (for each standardized variable, the mean=0 and the standard deviation=1).

Parameter	L.S. mean	SE	DF	T	P
Intercept	3.2527	0.1235	2914	26.338	<0.001
st(Latitude)	0.3330	0.0210	2914	15.828	<0.001
st(Altitude)	0.7237	0.0168	2914	43.030	<0.001
NAO-winter	-0.0851	0.0554	25	-1.536	0.137
st(Distance from the coast)	0.0043	0.0232	2914	0.188	0.851
st(Altitude)*st(Distance from the coast)	-0.2496	0.0156	2914	-16.015	<0.001
NAO in Winter*st(Distance from the coast)	-0.0030	0.0067	2914	-0.451	0.652
NAO in Winter*st(Altitude)	**0.0470**	**0.0074**	**2914**	**6.321**	**<0.001**
NAO in Winter*st(Altitude)*st(Distance from the coast)	-0.0061	0.0069	2914	-0.885	0.376

Table 3: Parameter estimates (median and confidence interval limits (CI) at 95%) of (A) NDVI for the 1st of May, body mass of adult (B) female and (C) male red deer, based on the spatial bootstrapping (500 simulations) of the linear mixed models (with year as random effect). These estimates are the ones used for drawing figure 3 in the main text. The main terms of interest related to the mechanisms discussed are bolded. St is here an abbreviation for Standardized (for each standardized variable, the mean=0 and the standard deviation=1).

Parameters	CI low	Mean	CI high
A. NDVI-1st of May			
Intercept	0.15275	0.16497	0.17844
st(Latitude)	-0.01513	-0.00468	0.00414
st(Distance from the coast)	-0.06031	-0.04931	-0.03671
NAO-winter	-0.00411	0.00093	0.00622
NAO-April	0.01334	0.01856	0.02327
st(Altitude)	11.08563	12.51523	13.99098
st(Altitude)^2	1.49808	2.18869	2.78291
st(Diversity of aspects)	0.00182	0.00495	0.00796
st(Prop. of north facing slopes)	0.00408	0.00760	0.01087
NAO-winter*st(Altitude)	**0.00120**	**0.00530**	**0.00926**
NAO-April*st(Latitude)	0.00037	0.00549	0.01104
NAO-April*st(Distance from the coast)	0.00012	0.00578	0.01096
NAO-April*st(Altitude)	0.00150	0.00566	0.00982
st(Latitude)*st(Distance from the coast)	0.01450	0.02221	0.02919
NAO-winter*st(Distance from the coast)	-0.00076	0.00462	0.00996
NAO-winter*st(Distance from the coast)*st(Altitude)	-0.00735	-0.00499	-0.00262
B. Body mass adult female red deer			
Intercept	0.03862	1.77197	2.83186
Age = 2 yrs. old	0.16334	0.17353	0.18599
Age = 3 yrs. old	0.23755	0.24669	0.25634
Age = 4 yrs. old	0.28274	0.29304	0.30419
Age = 5-19 yrs. old	0.32024	0.32945	0.33784
Date of culling	-0.00020	-0.00008	0.00004
Current density	-0.03723	-0.01573	0.00393
NAO-winter	0.00331	0.00570	0.00803
Cohort density	-0.06673	-0.05051	-0.03526
Diversity of altitudes	0.01713	0.04794	0.07755
Diversity of aspects	0.42133	0.93797	1.78428
Prop. of north facing slopes	-0.72811	-0.49306	-0.20226
Prop. of high altitude habitat	-0.09753	-0.03349	0.03112
Latitude	-0.00227	0.00610	0.01688
Distance from the coast	0.04301	0.06103	0.07725
Population P2	-0.04244	0.01354	0.06206
Population P3	-0.01463	0.06774	0.13887
NDVI yearly	**0.06788**	**0.13178**	**0.21402**
NDVI spatial	**0.07972**	**0.14734**	**0.22909**
Population P2*NDVI spatial	-0.13970	-0.06285	0.00997
Population P3*NDVI spatial	-0.22359	-0.14687	-0.05591
Population P2*NDVI yearly	-0.21471	-0.07073	0.03484

Population P3*NDVI yearly	-0.25088	-0.12812	0.00258
C. Body mass adult male red deer			
Intercept	-0.7865	1.6869	3.3700
Age	21.8351	24.4292	26.8717
$(Age)^2$	-14.2211	-12.7262	-10.9379
$(Age)^3$	4.2745	5.3451	6.6754
$(Age)^4$	-1.4900	-1.0302	0.9882
$(Age)^5$	-0.1637	0.2666	1.5010
$(Age)^6$	-0.3673	-0.0038	0.7470
st(Date of culling)	0.0064	0.0118	0.0179
st(Current density)	-0.0272	-0.0084	0.0099
st(Date of culling)*st(Current density)	-0.0070	-0.0024	0.0038
Age*st(Date of culling)*st(Current density)	-0.0015	0.0010	0.0030
Age*st(Date of culling)	-0.0189	-0.0164	-0.0144
Age*st(Current density)	-0.0034	-0.0007	0.0023
NAO-winter	0.0033	0.0067	0.0094
Cohort NAO-winter	-0.0009	0.0005	0.0019
Cohort density	-0.0928	-0.0566	-0.0205
Diversity of altitudes	0.0494	0.0765	0.1074
Diversity of aspects	0.3401	1.1605	2.3759
Prop. of north facing slopes	-0.9424	-0.6686	-0.3577
Prop. of high altitude habitat	-0.2086	-0.1366	-0.0634
Latitude	-0.0049	0.0062	0.0180
Distance from the coast	0.0643	0.0921	0.1112
Population P2	-0.0450	0.0242	0.0915
Population P3	-0.0390	0.0543	0.1511
NDVI yearly	**0.0033**	**0.0802**	**0.1821**
NDVI spatial	**0.0587**	**0.1570**	**0.2382**
Population P2*NDVI spatial	-0.1387	-0.0234	0.1536
Population P3*NDVI spatial	-0.2515	-0.1514	-0.0614
Population P2*NDVI yearly	-0.2775	-0.1116	0.0989
Population P3*NDVI yearly	-0.1367	-0.0105	0.1220

Figure 1A: Example of the spatial blocks considered for the bootstrap analyses. In this particular case, blocks were generated dividing latitude and longitude ranges by 4.

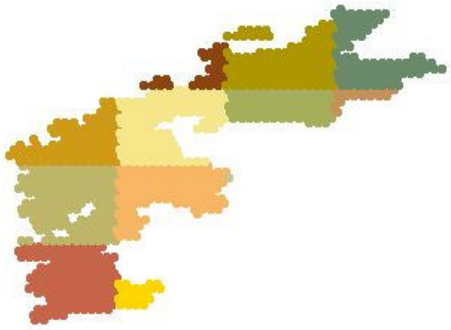

Figure 2A: The relationship between NDVI – 1st of May in the winter range and the starting date of migration for red deer in Norway.

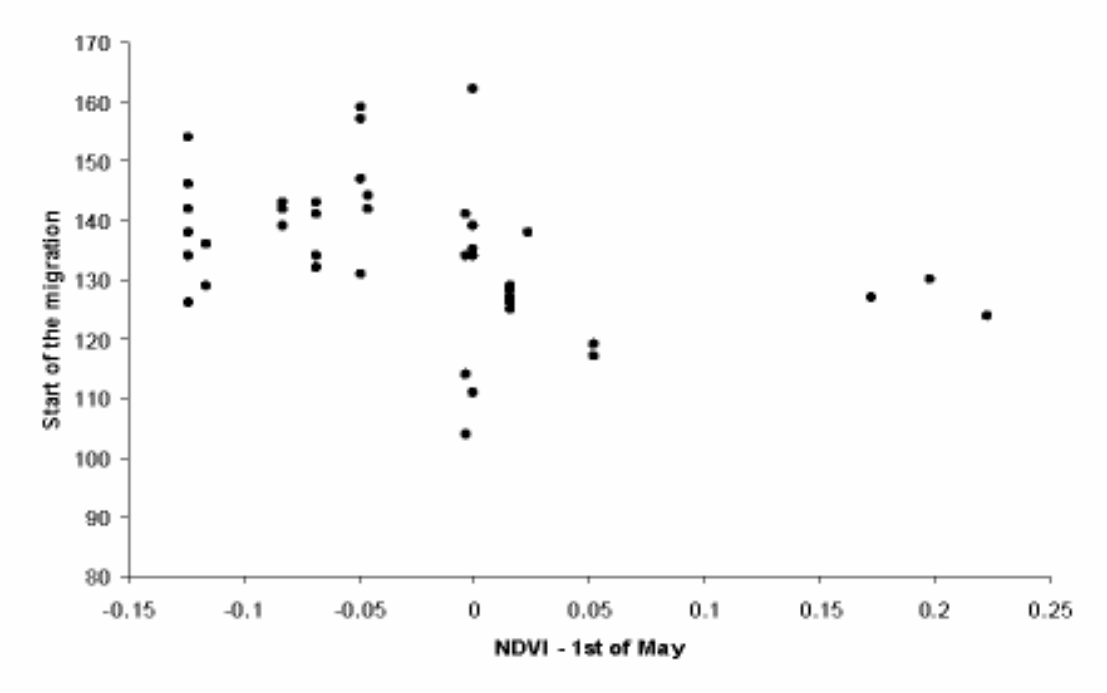

Figure 3A: Partial residual plots (with a smooth term) for the effect of NDVI on body weight of female red deer for population "P1" situated along the west coast of Norway. (a) Annual variation in NDVI on 1st of May. (b) Spatial variation in the NDVI.

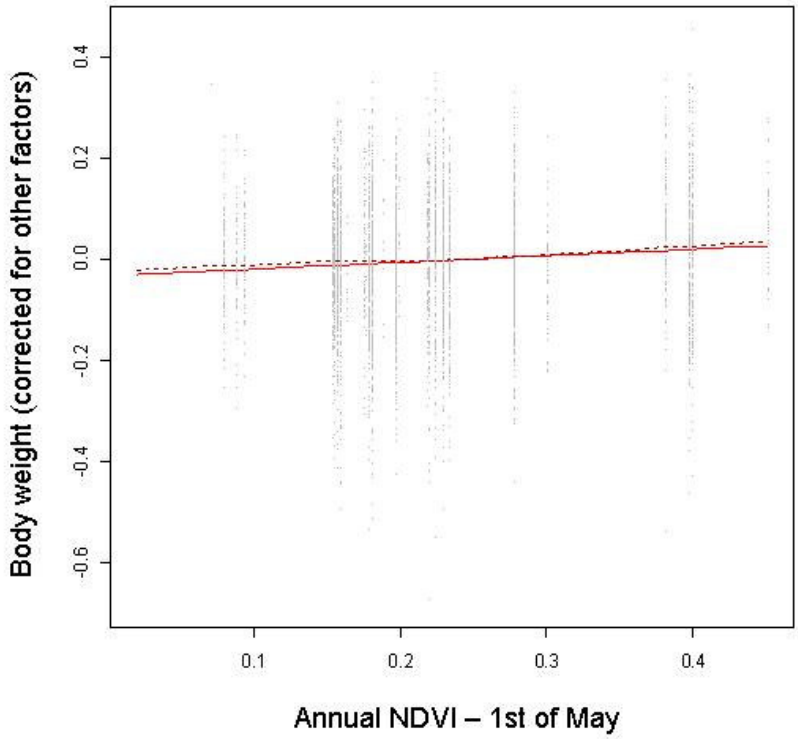

Fig. 3A a

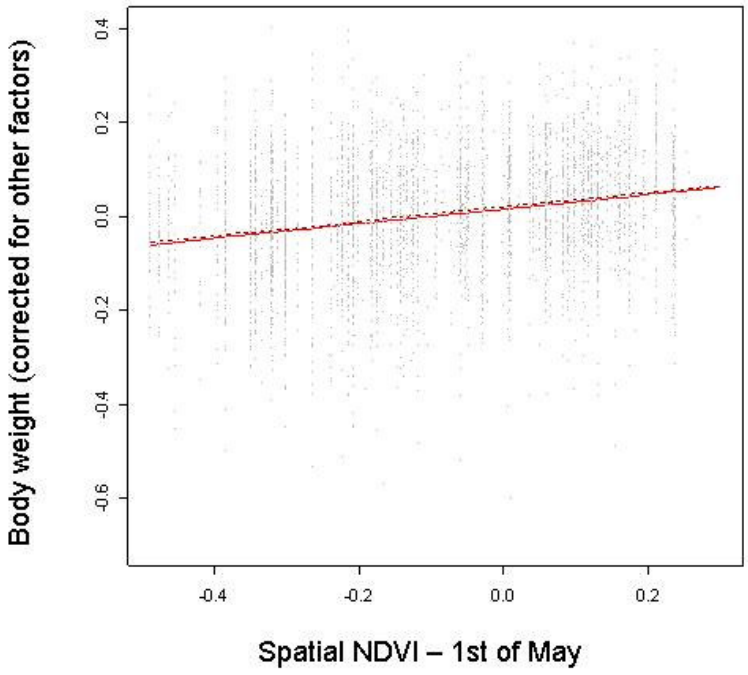
Body weight (corrected for other factors)
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.4
-0.2
0.0
0.2
Spatial NDVI – 1st of May

Fig. 3A b