Ecography

ECOG-01305
Bastille-Rousseau, G., Potts, J. R., Schaefer, J. A., Lewis, M. A., Ellington, E. H., Rayl, N. D., Mahoney, S. P. and Murray, D. L. 2015. Unveiling trade-offs in resource selection of migratory caribou using a mechanistic movement model of availability. – Ecography doi: 10.1111/ecog.01305

Supplementary material

Appendix 1

Table A1. Candidate models of RSFs for black bears and coyotes, Newfoundland, 1 May - 1 August , 2008-2010. Numbers of parameters (K), second-order Akaike information criteria (AICc), delta AICc (ΔAICc), and AIC weight (ωAICc) are presented.

Black bears

Models	K	AICc	ΔAICc	ωAICc
Habitat + Functional response + Elevation + Slope	17	177010.2	0	>0.99
Habitat + Functional response + Elevation	16	177865.4	855.2	0
Habitat + Functional response	15	178748.6	1738.45	0
Habitat	7	179453.3	2443.08	0

Coyotes

Models	K	AICc	ΔAICc	ωAICc
Habitat + Functional response + Elevation + Slope	17	69514.81	0	>0.99
Habitat + Functional response + Elevation	16	69615.21	100.4	0
Habitat + Functional response	15	71850.96	2336.15	0
Habitat	7	72951.27	3436.46	0

Appendix 2

Vegetation model

Our forage model linked two components, a dynamically temporal model of vegetation growth and a spatial model based on habitat categories. The approach presented here is similar to the approach presented in Hebblewhite et al. (2008).

Vegetation growth

Changes in forage biomass over the growing season were documented by repeatedly sampling 100 sites in Newfoundland, between May and August 2010-2012; we visited each permanent plot on a mostly bi-weekly schedule. During each sampling period, we recorded total (green and dead) vegetation abundance (% of cover) in 8, 1-m^2 quadrats. We classified percent cover into the following categories: Lichen, Grass, Forb, Ericaceous shrub, Fern, Tree, Non-Ericaceous shrub, Crawling species, and Other. We averaged values collected in each quadrat at the site level. Although we merged the habitat class Herbs within Other for our movement analysis, we considered it separately within the vegetation model.

Spatial model

We sampled 309 temporary plots during the peak biomass period (mid-July and August, 2012) distributed into 5 habitat categories to capture variation in peak forage biomass. These plots used the same methodology as the permanent plots, but only had 6 quadrats. For 25 of those quadrats, all green vegetation was clipped, dried for 48h at 60^oC and weighed. We used this measure of biomass to develop linear models between observed percent cover and biomass for each vegetation class. Using these equations, we then calculated an average vegetation biomass relative index for each habitat (Table A1).

Table A1. Number of plots in each habitat category with estimates of average biomass for vegetation based on equation between percent cover and dry mass. The relative index was obtained by dividing every biomass by the maximum biomass value (Wetland habitat).

Habitat	N	Biomass	Relative index
Barren	54	42.5742	0.7345
Wetland	101	57.9598	1.0000
Coniferous Open	106	57.4072	0.9904
Coniferous Dense	27	26.5632	0.4583
Herbs	21	53.1574	0.9171

NDVI predictive power

We used the normalized-difference vegetation index (NDVI), a measure of primary productivity frequently used in animal ecology (Pettorelli et al. 2005), from the MODIS Terra satellite (Huete et al. 2002). NDVI predictive power for vegetation growth in the different landcover types was first validated. We extracted values from the NDVI Modis Terra satellite for the pixel corresponding to each permanent plot. We then compared observed patterns in biomass growth to the change in Terra NDVI values to evaluate if the NDVI index represented biomass growth in each landcover type using a linear mixed model without an intercept and with site as a random factor (Hebblewhite et al. 2008).

Coefficients of this model and conditional R^2 (Nagakawa and Schielzeth 2013) are given in Table A2.

Table A2. Slope and conditional R^2 for five linear mixed models of the biomass found at 100 sites based on NDVI values of a given pixel between 2011 and 2012 in Newfoundland.

Habitat	N	Slope	Conditional R^2
Barren	19	0.9076	0.3889
Wetland	29	0.9122	0.4655
Coniferous Open	37	0.9021	0.3800
Coniferous Dense	9	0.8214	0.1512
Herbs	6	0.8118	0.1595

Modelling

Since growth of vegetation in all habitat categories was reasonably well predicted by changes in NDVI, we used the following formula to combine our spatial and temporal model of vegetation and predict Biomass for a specific pixel at a given time (B_{i*T}).

$$B_{i*T} = B_{H_i} * \alpha_{H_i} * \frac{NDVI_{T_i}}{NDVI_{\max_i}}$$

where B_{Hi} is the modeled biomass at peak season in cell i, α_{Hi} is the per habitat slope indicating the rate of change between increase in NDVI and increase in vegetation biomass for a specific habitat, $NDVI_{Ti}$ is the NDVI value for a 250-m^2 MODIS pixel encompassing the site pixel i for the 16-d time period T, and $NDVI_{maxi}$ is the maximum NDVI value observed for the pixel during a season.

References

Hebblewhite, M. et al. 2008. A multi-scale test of the forage maturation hypothesis in a partially migratory ungulate population. - Ecol. Monogr. 78: 141–166.

Huete, A et al. 2002. Overview of the radiometric and biophysical performance of the MODIS vegetation indices. - Remote Sens. Environ. 83: 195–213.

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Pettorelli, N. et al. 2005. Using the satellite-derived NDVI to assess ecological responses to environmental change. - Trends Ecol. Evol. 20: 503–510.