Ecography

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Supplementary material

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Appendix 1

Description of the telemetry data of black bears used in the analysis.

Bear ID	Sex	Age	Litter size	Starting date	Duration (days)	Number of GPS locations (DOP < 15)
1	F	3.5	2	30 April 2006	158	612
2	F	7	3	29 April 2006	91	340
3	F	4	0	30 April 2006	124	410
4	F	7.5	0	1 May 2006	178	880
5	M	10	-	8 May 2005	159	670
6	M	6.5	-	24 May 2005	126	424
7	M	9.5	-	21 June 2005	113	515
8	M	6.5	-	20 June 2005	94	466
9	M	5.5	-	31 May 2005	137	650
10	M	5.5	-	30 April 2006	115	462

Appendix 2

Estimation of relative forage abundance index for cover types

The relative forage abundance index for American black bears were estimated based on vegetation survey conducted in June. Survey plots were distributed randomly across the study area, among land cover types, and within 50 to 500 m from paved or derelict roads. Vegetation surveyed included only items generally found in the diet of black bears during spring, which included forbs, graminoids, and tree leaves (Boileau et al. 1994, Samson 1995). At all survey locations, the percent cover of forbs and graminoid plants in four 1-m^2 quadrats located 25 m apart in each cardinal direction were recorded and then converted into biomass using allometric equations developed by Turner et al. (2004). At the same locations, all deciduous trees and shrubs 1 m tall in a 20-m^2 quadrat were also recorded as an index of leaf and bud abundance. A relative index of vegetation abundance for each land cover type was then calculated. The abundance of the different vegetation classes was weighted according to their proportion in the spring diet of black bears in Québec, as described by Boileau et al. (1994) and Samson (1995). Separate indices were estimated based on weighing factors provided by each of the 2 studies and then calculated an average index for each land cover type (see Tables below). A map of relative vegetation abundance (0-1 scale) was then created by considering the average vegetation index associated with each of the 12 land cover types.

Table A1. Vegetation biomass of graminoids and forbs, total biomass, and relative (0–1) biomass in 4 m^2 for each land cover type in the Massif de la Jacques-Cartier during the period of high ungulate neonate vulnerability (20 May–30 June).

Land cover type	Graminoid biomass ($g\ m^{-2}$)	Forb biomass ($g\ m^{-2}$)	Total biomass ($g\ m^{-2}$)	Relative biomass
Roadside	0.612	2.586	3.198	0.695
Bog	3.692	0.908	4.600	1.000
Shrub	0.952	1.453	2.405	0.523
Regenerating	0.431	1.341	1.772	0.385
Young mixed	0.581	0.982	1.563	0.340
Mature mixed	0.000	1.810	1.810	0.394

Young conifer	0.000	1.431	1.431	0.311
Clear-cut	0.000	0.692	0.692	0.150
Mature conifer	0.000	0.843	0.843	0.183

Table A2. Relative abundance of graminoids and forbs, and trees estimated during vegetation surveys conducted in 9 land cover types. An abundance index is also provided for each land cover type based on the availability of items and weighted according to their relative importance in black bear diet (Boileau et al. 1994, Samson 1995). Standardized indices and the final index were scaled between 0 and 1.

Land cover type	Herbs	Trees	Index 1[a]	Index 2[b]	Index 1 standardized	Index 2 standardized	Mean	Final index
Roadside	0.695	1.000	48.194	53.127	0.741	1.000	0.871	1.000
Bog	1.000	0.000	65.000	34.700	1.000	0.653	0.827	0.949
Shrub	0.523	0.633	35.886	36.510	0.552	0.687	0.620	0.712
Regenerating	0.385	0.549	26.681	29.273	0.410	0.551	0.481	0.552
Young mixed	0.340	0.268	22.885	19.567	0.352	0.368	0.360	0.414
Mature mixed	0.394	0.113	25.919	16.939	0.399	0.319	0.359	0.412
Young conifer	0.311	0.210	20.853	16.880	0.321	0.318	0.319	0.367
Clear-cut	0.150	0.238	10.490	12.127	0.161	0.228	0.195	0.224
Mature conifer	0.184	0.000	11.908	6.357	0.184	0.120	0.152	0.174

[a] Index 1 was estimated as 65 × Herbs + 3 × Trees (Boileau et al. 1994).
[b] Index 2 was estimated as 34.7 × Herbs + 29 × Trees (Samson 1995).

Reference

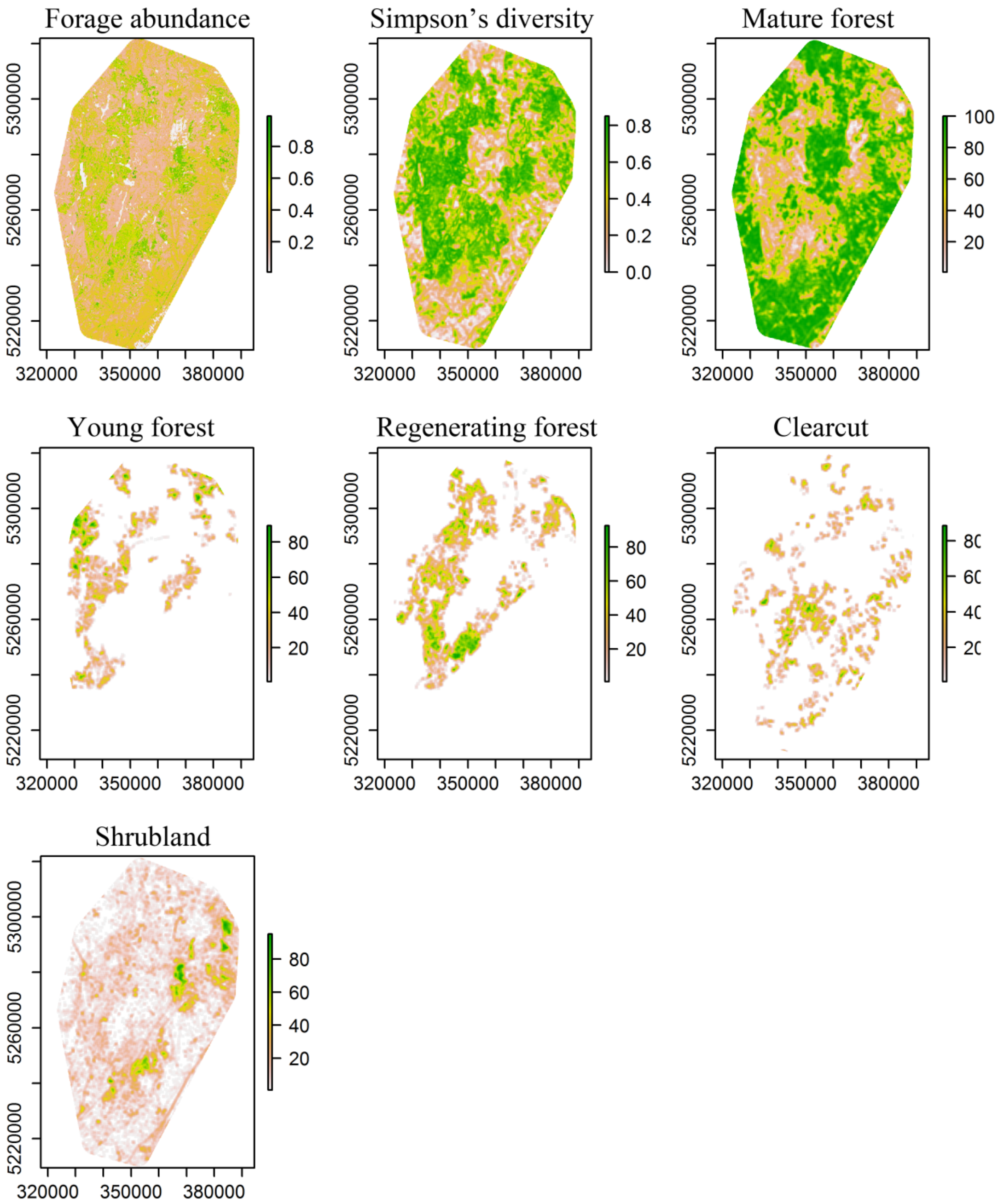
Boileau, F., Crête, M. & Huot, J. (1994) Food habits of the black bear, *Ursus americanus*, and habitat use in Gaspésie Park, eastern Québec. *Canadian Field-Naturalist*, **108**, 162-169.

Samson, C. 1995. Écologie et dynamique de population de l'Ours noir (*Ursus americanus*) dans une forêt mixte protégée du sud du Québec. PhD thesis, Univ. Laval, QC.

Turner, M. G. et al. 2004. Landscape patterns of sapling density, leaf area, and aboveground net primary production in postfire lodgepole pine forests, Yellowstone National Park (USA). Ecosystems 7: 751-775.

Appendix 3

Illustrations of the landscape variables used in the analysis: Simpson's diversity of cover types, forage abundance, and local proportion of mature forest, young forest, regenerating forest, clearcut and shrubland. The variables are mapped at 100 meters resolution.



Appendix 4

Brief description of wavelet-coefficient regression

Wavelet-coefficient regression is, by definition, the multiple regression of wavelet-transformed data. If we consider the case that a wavelet transform is applied to the normal linear model, we can expect that the regression parameters will remain unchanged. This is due to the fact that the wavelet transform is a linear operator. Thus, the standard multiple linear model:

$$y = \beta_0 + \beta_1 x_1 \ldots + \varepsilon$$

can be transformed by a linear operator ψ such that

$$\begin{aligned} \psi(y) &= \beta_0' + \psi(\beta_1 x_1) \ldots + \psi(\varepsilon) \\ &= \beta_0' + \beta_1 \psi(x_1) \ldots + \psi(\varepsilon) \end{aligned}$$

What is different is the intercept term and, in general, the covariance structure of the error terms. By choosing the wavelet transform for our linear operator, we can fit scale-specific models in the sense that the transform is extracting scale-specific components of pattern at each level of the decomposition. For a more detailed description, see Keitt and Urban (2005), and Carl and Kühn (2008).

Reference

Carl, G. and Kühn, I. 2008. Analyzing spatial ecological data using linear regression and wavelet analysis. - Stochastic Environmental Research and Risk Assessment 22: 315-324.

Keitt, T. H. and Urban, D. L. 2005. Scale-specific inference using wavelets. - Ecology 86: 2497-2504.

Appendix 5

Model selection results based on minimization of Akaike's Information Criterion adjusted for small sample sizes (AICc) to identify the best resource utilization function for habitat use of American black bears in the Massif de la Jacques-Cartier, Québec, Canada. Only models having ΔAICc ≤ 2 and weights ≥ 0.01 are presented. (A) structural and functional landscape heterogeneity, and (B) local proportion of different vegetation age-classes.

Level	Model structure	LogLik	AICc	ΔAICc	Weight
(A) Structural and functional landscape heterogeneity					
Level 1	FORAGE + SIDI + FORAGE×SIDI	-154011	308030.1	0	1
Level 2	FORAGE + SIDI + FORAGE×SIDI	-122041	244089.9	0	0.578
	FORAGE	-122043	244090.6	0.633	0.421
Level 3	FORAGE + SIDI + FORAGE×SIDI	-119533	239074.8	0	1
Level 4	FORAGE + SIDI + FORAGE×SIDI	-124167	248341.4	0	1
Level 5	FORAGE + SIDI + FORAGE×SIDI	-115566	231139.5	0	1
(B) Local proportion of vegetation age-class					
Level 1	% Shrub	-154016	308035.5	0	0.115
	% Mature	-154016	308035.6	0.016	0.114
	% Mature + % Young	-154015	308035.6	0.028	0.113
	% Mature + % Shrub	-154015	308035.9	0.326	0.098
	% Mature + % Young + % Regenerating	-154014	308036.2	0.649	0.083
	% Mature + % Young + % Shrub	-154014	308036.4	0.822	0.076
	Intercept only	-154017	308036.4	0.901	0.073

	% Clearcut + % Shrub	-154015	308036.5	0.981	0.070
	% Young + % Shrub	-154015	308036.8	1.258	0.061
	% Mature + % Regenerating	-154015	308036.9	1.344	0.058
	% Young	-154017	308037.4	1.896	0.044
	% Regenerating + % Shrub	-154016	308037.4	1.900	0.044
	% Mature + % Clearcut	-154016	308037.5	1.935	0.043
Level 2	% Young + % Regenerating	-122045	244095.2	0	0.355
	% Young + % Regenerating + % Clearcut	-122044	244096.5	1.342	0.181
	% Regenerating	-122046	244096.6	1.381	0.178
	% Mature + % Young + % Regenerating	-122044	244097	1.796	0.144
	% Young + % Regenerating + % Shrub	-122045	244097	1.850	0.140
Level 3	% Young + % Regenerating + % Shrub	-119537	239081.1	0	0.569
	% Mature + % Young + % Regenerating + % Shrub	-119536	239083	1.917	0.218
	% Young + % Regenerating + % Clearcut + % Shrub	-119537	239083.1	1.976	0.211
Level 4	% Mature + % Young + % Regenerating + % Clearcut + % Shrub	-124152	248315.3	0	1
Level 5	% Mature + % Young + % Regenerating + % Clearcut + % Shrub	-114953	229917.8	0	1