Oikos

OIK-00938

Lone, K., Loe, L. E., Gobakken, T., Linnell, J. D. C., Odden, J., Remmen, J. and Mysterud, A. 2013. Living and dying in a multi-predator landscape of fear: roe deer are squeezed by contrasting pattern of predation risk imposed by lynx and humans. – Oikos doi: 10.1111/j.1600-0706.2013.00938.x

Appendix 1

Table A1. Detailed sample sizes for individuals by season for individual GPS marked roe deer, lynx providing kill-sites and hunters providing kill-sites. Sex of roe deer and lynx, and GPS collar fix success rate for roe deer.

individual	hunt	summer	winter	total	sex	fix rate (%)
Roe deer	*47*	*40*	*45*	*132*		
6212	3	0	0	3	female	99.8
6214	3	2	4	9	female	99.1
6216	0	0	5	5	male	99.5
6219	4	2	4	10	male	99.2
6221	6	2	2	10	male	99.0
62242	2	3	4	9	male	99.5
6480	4	4	2	10	male	98.8
6484	3	5	2	10	male	99.2
6485	3	4	2	9	female	98.6
8001	4	3	3	10	male	99.1
8003	1	4	4	9	female	95.0
8004	3	3	4	10	female	77.2
8005	3	3	3	9	female	86.8
8006	5	3	2	10	female	91.8
8007	3	2	4	9	female	89.7
Lynx	*20*	*11*	*40*	*71*		
F189	8	5	4	17	female	
F218	5	1	14	20	female	
F228	1	0	5	6	female	
F237	1	1	7	9	female	
M187	0	1	0	1	male	
M209	3	1	2	6	male	
M263	2	1	6	9	male	
M273	0	0	2	2	male	
M275	0	1	0	1	male	
Hunters	*53*			*53*		
EK	3			3		
GRAN	2			9		
HT	9			4		
JA	7			3		
JN	4			2		
KHJ	3			7		
KPR	16			16		
ODE	9			9		

Table A2. Results of the univariate modeling for variable selection (included variables for lynx models and hunting models are in bold). Variables denoted with the same letter (a–g) were correlated ρ > 0.5. In some of the groups it was possible to include several variables because only some of the variables were correlated ρ > 0.5, within these groups, the lowest AIC variable was chosen first, highly correlated variables were excluded, and again the lowest AIC variable was chosen. From groups denoted with a * (a, f) one variable measuring cover was chosen by minimizing overall AIC in both analyses. Variables AICs marked with ** were chosen out of their groups prioritizing ease of interpretation, as there was only very minor differences in AIC. ΔAIC values are relative to the constant model.

Variable	Comparison	AIC_{lynx}	ΔAIC_{lynx}	AIC_{hunt}	ΔAIC_{hunt}
constant	0	292.8	0.0	245.5	0.0
cov10	a*	294.6	1.8	240.9	-4.6
cov20	**a***	**294.2**	**1.4**	**229.3**	**-16.2**
cov30	a*	292.8	0.0	237.7	-7.8
covgone	a*	294.8	2.0	237.3	-8.1
canopy	b	289.1	-3.7	**244.8**	**-0.7**
total.ba	b	**288.8**	**-4.0**	247.2	1.7
habitat	**c**	**277.4**	**-15.4**	**234.2**	**-11.3**
SP.prop	c	279.1	-13.7	246.2	0.7
spruce.prop	**c**	**272.1**	**-20.7**	**245.1**	**-0.4**
devclass	c	-	-	240.3	-5.2
pine.prop	c	-	-	**240.9**	**-4.6**
total.ba	c	-	-	247.2	1.7
slope	d	294.5	1.7	242.2	-3.2
slope10	**d****	**293.4**	**0.6**	**242.4**	**-3.1**
elev	e	288.4	-4.4	246.7	1.2
dist_road	**e**	**286.0**	**-6.8**	**245.1**	**-0.4**
ulcd	**f***	**284.1**	**-8.7**	**242.9**	**-2.6**
dground	f*	288.5	-4.3	241.4	-4.1
d0.5	f*	282.6	-10.2	245.6	0.1
h20	g	294.2	1.4	247.2	1.7
h40	g	294.6	1.8	247.1	1.6
h60	g	294.8	2.0	247.1	1.6
h80	g	294.5	1.7	247.1	1.6
h90	**g****	**293.5**	**0.7**	**247.1**	**1.6**
hmean	g	294.8	2.0	247.1	1.6
hqmean	g	294.6	1.8	247.1	1.6

Table A3. Model estimates for the LiDAR data model of lynx predation risk applied to subsets of the data: hunting season only and geographical subset excluding the southernmost points (south of UTMN 32V N6708000, south of the cluster of points close to Nesbyen). The model estimates from the full dataset are the same as presented in Results and are included here for ease of comparison. Sample sizes differ between the three: The full dataset compares 71 lynx kill sites to year round used sites (132 GPS + 36 feces), hunting season dataset compares 20 lynx kill sites to 47 used sites (all GPS). In Nesbyen and north dataset, 56 lynx kill sites are compared to year round used sites (131 GPS + 25 feces).

	full dataset			Hunting season dataset			Nesbyen and north dataset		
	β	SE	p	β	SE	p	β	SE	p
(intercept)	**-2.16**	0.39	<0.001	**-2.03**	0.78	0.009	**-2.66**	0.46	<0.001
ALS data									
ulcd	**12.6**	3.6	<0.001	**20.6**	7.5	0.006	**11.5**	4.0	0.004
hcv	-	-	-	-	-	-	-	-	-
Terrain									
dist.road	**0.000604**	0.00022	0.005	-0.0000792	0.00040	0.84	**0.000757**	0.00025	0.002
slope10	-0.0394	0.025	0.11	-0.0221	0.048	0.64	-0.0179	0.028	0.53
vrm	**93.0**	35	0.008	153	81	0.060	**156**	52	0.002
vrm10	**112**	43	0.009	-236	188	0.21	93.4	49	0.057
AUC	0.756			0.784			0.802		

Table A4. Model estimates for the LiDAR data model of hunter risk, using only subsets of the data to test its robustness: hunting season only and geographical subset excluding the southernmost points (south of UTMN 32V N6708000, south of the cluster of points close to Nesbyen). The model estimates from the full dataset are the same as presented in Results and are included here for ease of comparison. Sample sizes differ between the three: The full dataset compares 53 hunter kill sites to year round used sites (132 GPS + 36 feces), hunting season dataset compares 53 hunter kill sites to 47 used sites (all GPS). In Nesbyen and north dataset, 46 hunter kill sites are compared to year round used sites (131 GPS + 25 feces).

	full dataset			Hunting season dataset			Nesbyen and north dataset		
	β	SE	p	β	SE	p	β	SE	p
(intercept)	**-1.82**	0.57	0.001	**-1.73**	0.85	0.040	-2.62	0.64	<0.001
<u>ALS data</u>									
ulcd	**-17.6**	5.3	<0.001	**-23.7**	7.7	0.002	**-17.7**	5.8	0.002
hcv	0.0158	0.0090	0.080	0.0409	0.016	0.012	0.0151	0.0095	0.11
<u>Terrain</u>									
dist.road	**-0.00113**	0.00049	0.020	**-0.00156**	0.00063	0.012	-0.000757	0.00047	0.11
slope10	0.0441	0.029	0.12	0.0540	0.039	0.17	**0.0797**	0.031	0.011
vrm	**80.0**	44	0.026	**234**	87	0.022	**138**	64	0.030
vrm10	**131**	59	0.026	149	87	0.087	**155**	64	0.015
AUC	0.714			0.775			0.769		

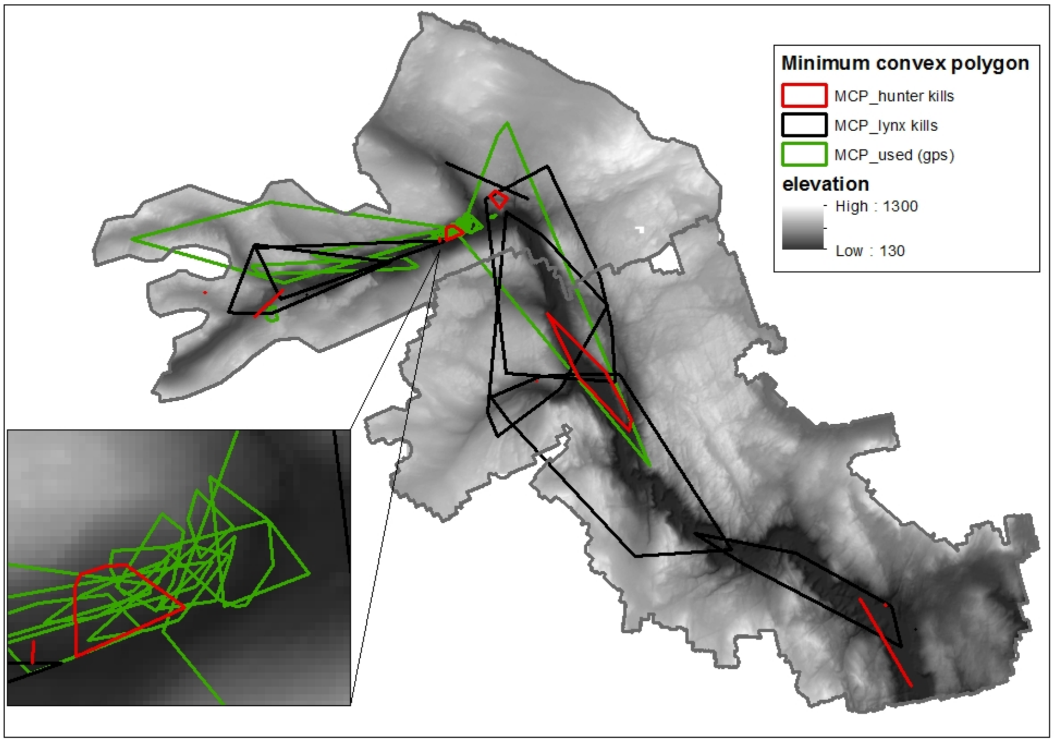

Figure A1. Distribution of individuals across the landscape shown by minimum convex polygons (MCPs) of the plots associated with unique individuals: hunters contributing kill sites, marked lynx contributing kill sites and marked roe deer contributing used sites.

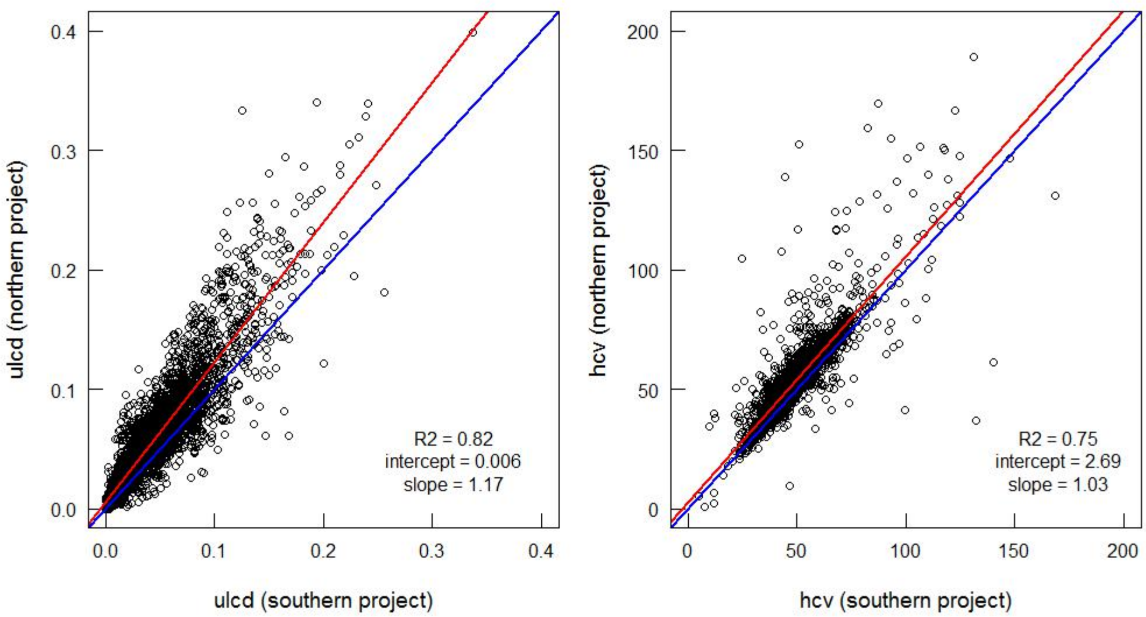

Figure A2. Correlation between LiDAR variables understory LiDAR cover density (ulcd) and coefficient of variation of non-ground echoes (hcv) calculated for the same cells in an area of overlap of the two LiDAR scanning projects. All ulcd values are shown (n = 3906), while only hcv values < 200 are used in the comparison (n = 3839). The blue line shows the ideal 1:1 relationship between the two variables, the red line is the estimated slope; coefficients are given in the plot panels.

Appendix 2

Explorative multivariate analysis

To identify differences between the groups of plots belonging to used sites, lynx kill sites and hunter kill sites, we performed a between-class principal component analysis. The three groups can be separated in multivariate space, but not fully, as the region of overlap is substantial (Fig. A3). We can assess which variables capture differences between the groups by looking at their contribution to the principal components (PC) in the loading plot (Fig. A4). PC1 (x-axis) is an axis representing a gradient from more open to more closed, left to right, and separates lynx kills from hunter kills with used sites in the middle. PC2 (y-axis) separates both types of kill sites from used sites, and aligns with the contrast between deciduous and coniferous habitat, ruggedness measures, laser height measurements, and slope. How different individuals are placed in the multivariate space is shown in Fig. S5. Here, we see that there is some inter-individual variation, and it is the greatest in hunters where some individuals (HPR and GRAN) lean into the region typical of lynx kill sites, while other individuals (e.g. JN, KHJ) are farther to the right on PC1, and hunt in terrain characterized by openness. This is as expected, and shows that the data spans a range of methods known to be used in hunting. Differences between seasons are also present in lynx kill sites (Fig. A6), but the kill sites from the hunting season represent the centre of mass of year-round lynx-kill sites.

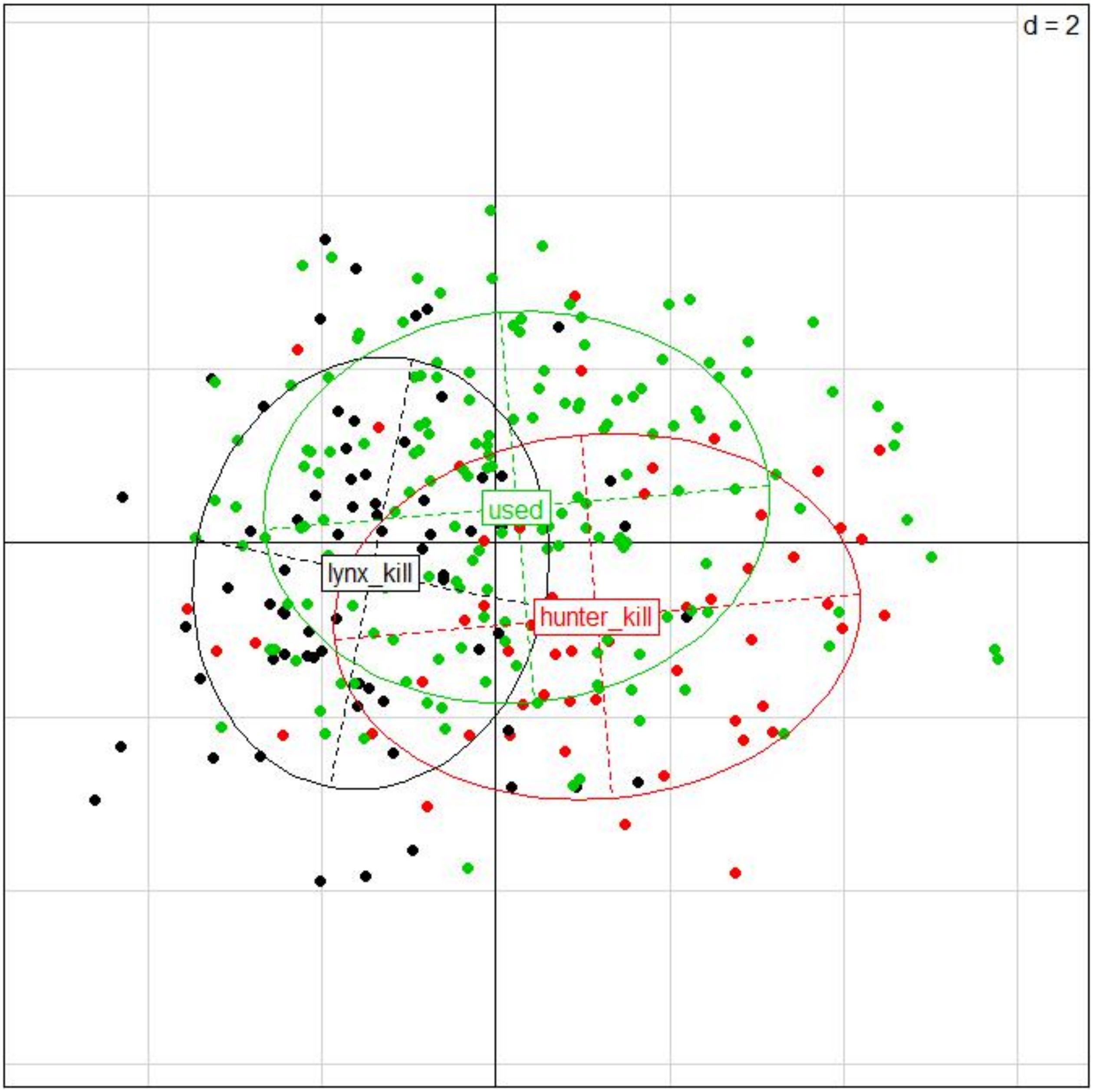

Figure A3. Observations and their group membership (used, lynx kill or hunter kill) shown on the principal component axis 1 (x) and 2 (y).

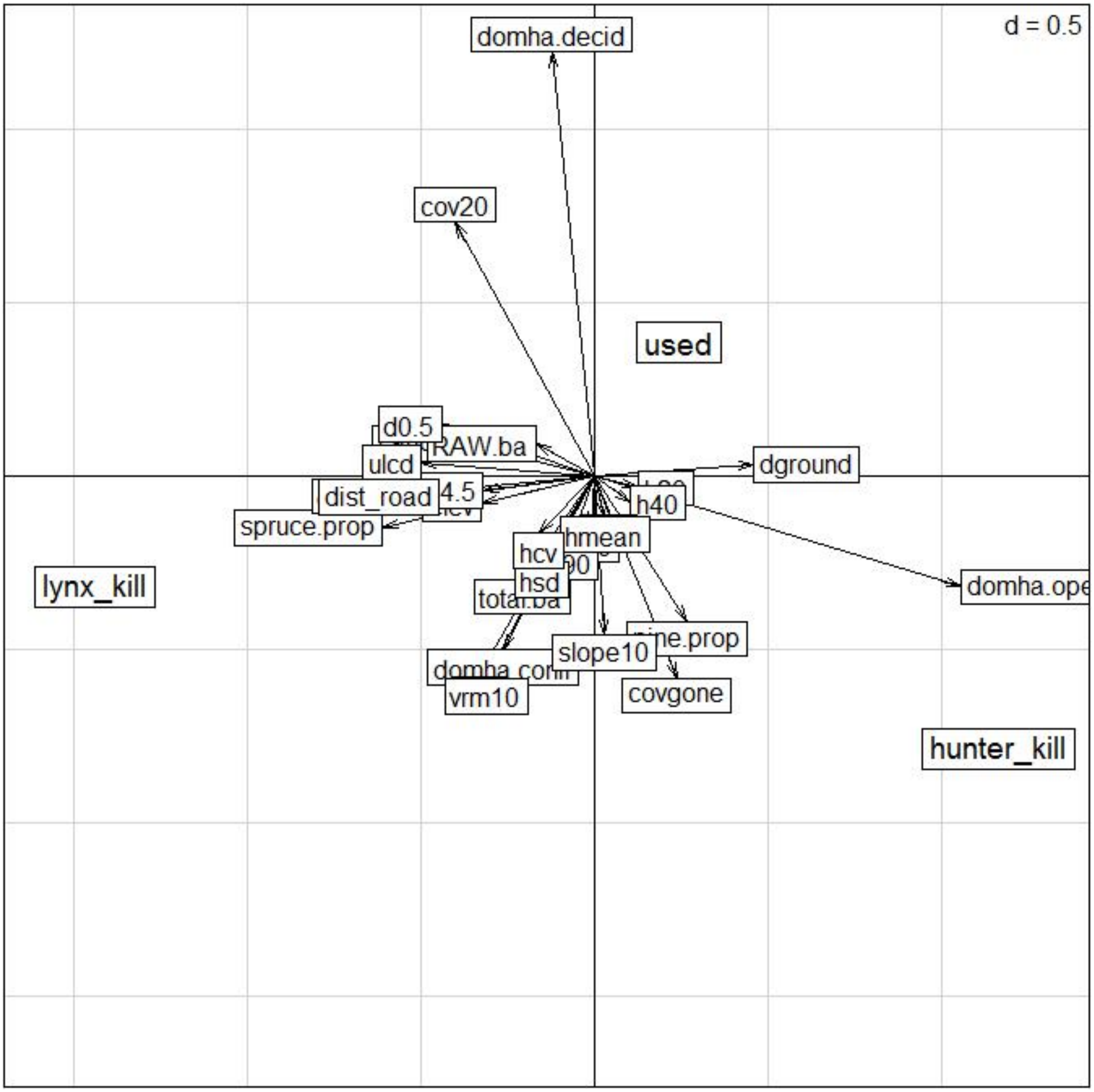

Figure A4. Loadingplot of the contribution of the variables to the principal components axis 1 (x) and 2 (y). The centers of the three groups of observations (used, lynx kill and hunter kill) are shown.

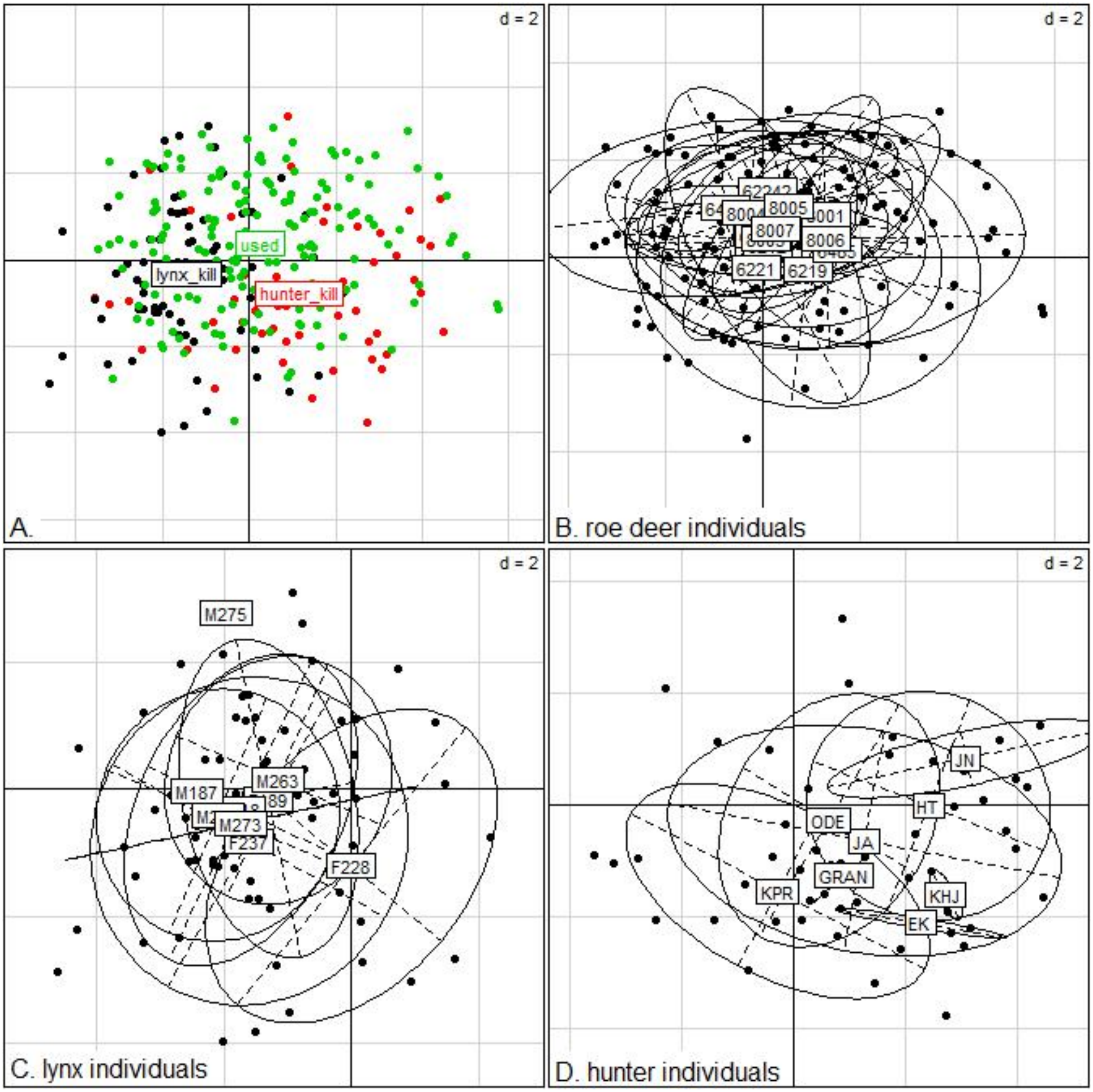

Figure A5. Panel A: Observations and their group membership (used, lynx kill or hunter kill) shown on the principal component axis 1 (x) and 2 (y). Panels B, C, D: Observations are grouped by individuals on the same scales (PC1 and PC2). Lynx M275 contributed only a single point, and has no associated ellipse.

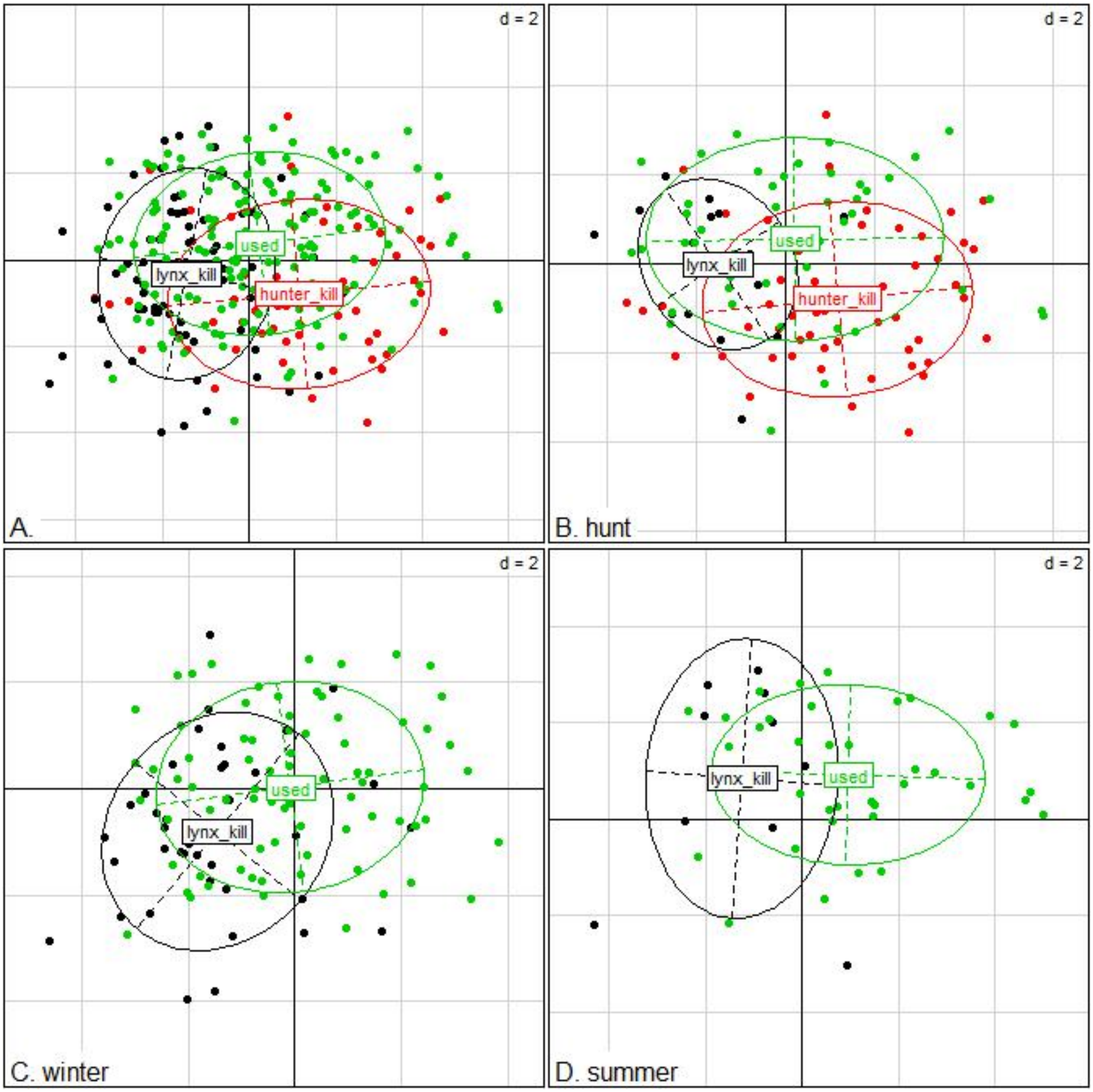

Figure A6. Observations and their group membership (used, lynx kill or hunter kill) shown on the principal component axis 1 (x) and 2 (y). Panel A shows all data together, while it is split by season in panels B through D.