

# 1     **Effects of Inter- and Intra-Specific Interactions on** 2     **MooseHabitat Selection Limited by Temperature**

3     **Heng Bao <sup>1,2,†</sup>, Penghui Zhai <sup>1,2,†</sup>, Dusu Wen <sup>1,2</sup>, Weihua Zhang <sup>3</sup>, Ye Li <sup>3</sup>, Feifei Yang <sup>1,2</sup>, Xin Liang**  
4     **<sup>1,2</sup>, Fan Yang <sup>1,2</sup>, Nathan J. Roberts <sup>1,2</sup>, Yanchun Xu <sup>1,2</sup> and Guangshun Jiang <sup>1,2,\*</sup>**

5  
6     <sup>1</sup>     Feline Research Center of National Forestry and Grassland Administration, College of  
7     Wildlife and Protected Area, Northeast Forestry University, Harbin 150040, China;

8     <sup>2</sup>     Research Center for Northeast Asia Biodiversity Conservation, Harbin 150040, China

9     <sup>3</sup>     Inner Mongolia Hanma National Nature Reserve, Genhe 022359, China;

10  
11     \*     Correspondence: [jiangguangshun@nefu.edu.cn](mailto:jiangguangshun@nefu.edu.cn)

12     †     These authors contributed equally to this work.

13 Table S1 | Description of main habitat factors in Hanma National Nature Reserve used in  
14 multi-scale analyses

Habitat factors	Description	Data type	Unit
Elevation	The average of elevation at each scale	Continuous	m
Slope	The average of slope at each scale	Continuous	Degree
Aspect	The average of aspect at each scale	Continuous	Degree
Canopy density	The average value of canopy density at each scale	Continuous	Proportion
Distance to larch ( <i>Larix</i> spp.) forest	Distance to larch forest from camera points at each scale	Continuous	m
Distance to birch ( <i>Betula</i> spp.) forest	Distance to birch forest from camera points at each scale	Continuous	m
Distance to mixed forest	Distance to mixed forest from camera points at each scale	Continuous	m
Distance to shrub swamp	Distance to shrub swamp from camera points at each scale	Continuous	m
Distance to forest swamp	Distance to forest swamp from camera points at each scale	Continuous	m
Distance to river	Distance to river from camera points at each scale	Continuous	m
Distance to road	Distance to road from camera points at each scale	Continuous	m
Amount of fallen logs	Amount of fallen logs at each scale	Continuous	Number
Abundance of <i>Betula exilis</i> shrub	Average height multiplied by average coverage of <i>Betula exilis</i> at each scale	Continuous	-
Abundance of <i>Rhododendron</i> spp. shrub	Average height multiplied by average coverage of <i>Rhododendron</i> at each scale	Continuous	-
Abundance of <i>Chosenia arbutifolia</i> shrub	Average height multiplied by average coverage of <i>Chosenia arbutifolia</i> at each scale	Continuous	-
Herb coverage	Herb coverage at each scale	Continuous	Proportion

15

16 Table S2 | Optimal scale of habitat variables influencing moose occurrence, and respective  
 17 parameter values, determined by generalized linear model (GLM) prediction

Habitat factors	Optimal scale (m)	Coff.	SE	Z value	<i>p</i>	AICc (Min)
Elevation	800	-0.01	0.00	-9.42	< <b>0.01</b>	385.56
Slope	400	-0.27	0.04	-6.46	< <b>0.01</b>	464.56
Aspect	200	0.00	0.00	2.34	< <b>0.05</b>	480.23
Canopy density	3200	-1.73	0.35	-4.90	< <b>0.01</b>	486.76
Distance to road	200	-0.00	0.00	-4.74	< <b>0.01</b>	485.33
Distance to river	800	-0.00	0.00	-6.28	< <b>0.01</b>	456.25
Distance to birch forest	3200	-0.00	0.00	-2.30	< <b>0.05</b>	502.93
Herb coverage	3200	-1.35	0.30	-4.54	< <b>0.01</b>	491.02
Abundance of <i>Betula</i> <i>exilis</i> shrub	3200	0.56	0.12	4.81	< <b>0.01</b>	487.01
Distance to larch forest	800	0.00	0.00	2.20	< <b>0.05</b>	506.99
Amount of fallen log	3200	-0.48	0.13	-3.61	< <b>0.01</b>	477.81
Distance to shrub swamp	3200	0.00	0.00	0.69	> 0.05	508.28
Abundance of <i>Chosenia</i> <i>arbutifolia</i> shrub	400	-0.67	0.12	-5.44	< <b>0.01</b>	476.11
Abundance of <i>Rhododendron</i> shrub	800	0.71	0.19	3.85	< <b>0.01</b>	499.26
Distance to forest swamp	3200	-0.00	0.00	-2.97	< <b>0.01</b>	494.31
Distance to mixed forest	800	-0.00	0.00	-3.52	< <b>0.01</b>	495.12

18

19 Table S3 | Optimal scale of habitat variables influencing roe deer occurrence, and respective  
 20 parameter values, determined by generalized linear model (GLM) prediction

Habitat factors	Optimal scale(m)	Coef.	SE	Z value	<i>p</i>	AICc (Min)
Elevation	3200	-0.00	0.00	-5.82	< <b>0.01</b>	731.77
Slope	200	0.05	0.01	3.98	< <b>0.01</b>	759.92
Aspect	200	0.00	0.00	2.51	< <b>0.01</b>	740.84
Canopy density	3200	-0.33	0.25	-1.32	> 0.05	766.94
Distance to road	3200	-0.00	0.00	-3.60	< <b>0.01</b>	755.15
Distance to river	3200	-0.00	0.00	-2.84	< <b>0.01</b>	760.29
Distance to birch forest	200	-0.00	0.00	-4.15	< <b>0.01</b>	755.29
Herb coverage	3200	-0.01	0.24	-0.06	> <b>0.05</b>	768.65
Abundance of <i>Betula</i> <i>exilis</i> shrub	1600	-0.47	0.12	-3.86	< <b>0.01</b>	758.72
Distance to larch forest	200	0.00	0.00	4.63	< <b>0.01</b>	756.60
Amount of fallen log	800	-0.05	0.02	-2.75	< <b>0.01</b>	766.08
Distance to shrub swamp	3200	0.00	0.00	-0.88	> 0.05	767.88
Abundance of <i>Chosenia</i> <i>arbutifolia</i> shrub	3200	0.08	0.06	1.45	> 0.05	766.59
Abundance of <i>Rhododendron</i> shrub	800	0.52	0.13	4.41	< <b>0.01</b>	761.08
Distance to forest swamp	3200	-0.00	0.00	-2.53	< <b>0.01</b>	760.78
Distance to mixed forest	200	-0.00	0.00	-2.88	< <b>0.01</b>	765.82

21

22 Table S4 | Number of model parameters (K), Akaike's Information Criterion (AIC) scores and R<sup>2</sup>  
 23 of the most supported GLM (family = binomial) by stepwise regression for moose and roe deer  
 24 resource selection

Species	Multivariate optimal habitat selection model	K	AIC	R <sup>2</sup>
Moose	Elevation + Distance to larch forest + Abundance of <i>Betula exilis</i> shrub + Herb coverage	4	357.94	0.77
	Elevation + Slope + Distance to larch forest + Abundance of <i>Betula exilis</i> shrub	4	681.24	0.55
Roe deer				

25

26 Table S5 | Number of model parameters (K), Akaike's Information Criterion (AIC) scores and  $R^2$   
 27 of the most supported GLM (family = binomial) by stepwise regression for female and male  
 28 moose resource selection in the snow-free and snow period.

Model	Multivariate optimal habitat selection model	K	AIC	$R^2$
Female, snow-free period	Elevation + Slope + Distance to larch forest + Herb coverage	4	184.75	0.70
Male, snow-free period	Elevation + Distance to larch forest + Abundance of <i>Betula exilis</i> shrub + Distance to mixed forest + Canopy density	5	183.76	0.53
Female, snow period	Elevation + Aspect + Distance to larch forest + Abundance of <i>Betula exilis</i> shrub + Distance to mixed forest	5	104.03	0.37
Male, snow period	Elevation + Distance to larch forest + Abundance of <i>Betula exilis</i> shrub + Distance to mixed forest	4	114.44	0.42

29

30 Table S6 | Parameter values of the most parsimonious models of general linear models (GLM)  
 31 for female and male moose occurrence frequency in the snow-free and snow periods.

Model	Variable	Coef.	SE	Z value	<i>p</i>	95% CI	
Female ,							
snow-free period	Intercept	19.87	3.13	6.34	< <b>0.01</b>	<b>14.13</b>	<b>26.43</b>
	Elevation (800 m)	-0.02	0.00	-5.92	< <b>0.01</b>	<b>-0.03</b>	<b>-0.02</b>
	Slope (400 m)	-0.12	0.06	-1.91	0.06	<b>-0.24</b>	<b>-0.00</b>
	Distance to larch forest (800 m)	0.00	0.00	3.56	< <b>0.01</b>	<b>0.00</b>	<b>0.00</b>
	Herb coverage (3200 m)	-0.64	0.43	-1.48	> 0.05	-1.47	0.23
Male , snow-free							
period	Intercept	7.79	2.14	3.65	< <b>0.01</b>	<b>3.84</b>	<b>12.27</b>
	Elevation (800 m)	-0.01	0.00	-3.23	< <b>0.01</b>	<b>-0.01</b>	<b>-0.00</b>
	Distance to larch forest (800 m)	-0.00	0.00	-1.46	> 0.05	-0.00	0.00
	Distance to mixed forest (800 m)	-0.00	0.00	-2.42	< <b>0.01</b>	<b>-0.00</b>	<b>-0.00</b>
	Abundance of <i>Betula exilis</i> shrub (3200 m)	0.45	0.21	2.22	< <b>0.05</b>	<b>0.05</b>	<b>0.86</b>
	Canopy density (3200 m)	-1.89	0.62	-3.04	< <b>0.01</b>	<b>-3.11</b>	<b>-0.65</b>
Female, snow							
period	Intercept	10.85	4.41	2.46	< <b>0.01</b>	<b>2.64</b>	<b>20.12</b>
	Elevation (800 m)	-0.02	0.01	-3.20	< <b>0.01</b>	<b>-0.03</b>	<b>-0.01</b>
	Aspect (200 m)	0.00	0.00	1.67	> 0.05	-0.00	0.01
	Distance to larch forest (800 m)	0.00	0.00	2.47	<b>0.01</b>	<b>0.00</b>	<b>0.01</b>
	Distance to mixed forest (800 m)	0.00	0.00	2.91	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
	Abundance of <i>Betula exilis</i> shrub (3200 m)	0.59	0.37	1.57	> 0.05	-0.16	1.32
Male, snow							
period	Intercept	6.18	3.42	1.80	> 0.05	-0.31	13.18
	Elevation (800 m)	-0.01	0.00	-2.71	< <b>0.01</b>	<b>-0.02</b>	<b>-0.00</b>
	Distance to larch forest (800 m)	0.01	0.00	4.06	< <b>0.01</b>	<b>0.00</b>	<b>0.01</b>
	Distance to mixed forest (800 m)	0.00	0.00	2.39	< <b>0.05</b>	<b>0.00</b>	<b>0.00</b>

---

Abundance of <i>Betula exilis</i> shrub (3200 m)	1.19	0.33	3.58	< 0.01	0.55	1.87
--	------	------	------	--------	------	------

---

32