Supplementary material - File S1

Detailed method descriptions

1. Simulation of moose density per 1000 ha land area

The program Helge is available for download at https://simthinc.com/ladda-ner.html (accessed: 2021-05-10) and was scientifically evaluated by Kalén (2018) and Kalén et al. (2022). It is a modern computer model developed for Swedish moose management. Via advanced simulations, the program assesses the complex dynamics of a moose population that is managed via hunting. Population size and development of moose populations as well as reproduction and the proportion of bulls in a population can be simulated.

Kalén, C., 2018. Simulating selective harvest and impact on age structure and harvest efficiency of moose in Sweden. Alces 54, 15–26.

Kalén, C., Andrén, H., Månsson, J., & Sand, H. (2022). Using citizen data in a population model to estimate population size of moose (Alces alces). Ecological Modelling, 471, 110066. https://doi.org/https://doi.org/10.1016/j.ecolmodel.2022.110066

2. Extrapolation of deer density per 1000 ha land area

To establish harvest data of roe deer, fallow deer, and red deer for each moose management area (MMA, in Swedish *Älgförvaltningsområde*), we used the proportional overlap of MMAs and hunting districts (in Swedish *Jaktvårdskrets*). We approximated that the harvest in each hunting district was proportional to its area represented within the MMA. In this way, data was aggregated to the common scale of MMAs using ArcMap (version 10.7.1).

Supplementary material - File S2

Underlying correlation matrices and additional results of path analysis

Table S1. Pearson's product moment correlations among used variables in the national model (144 MMAs).

		V1	V2	V3	V4	V5	V6	V7	V8	V9
V1	Damaged pine	1								
V2	Pine availability	-0.41 ***	1							
V3	Pine forest	-0.22 **	0.67 ***	1						
V4	Agricultural land	0.13	-0.50 ***	-0.59 ***	1					
V5	Preferred deciduous	0.17 *	-0.43 ***	-0.34 ***	0.36 ***	1				
V6	Young forest	0.06	0.40 ***	0.38 ***	-0.47 ***	0.01	1			
V7	Snow days	-0.30 ***	0.63 ***	0.36 ***	-0.61 ***	-0.46 ***	0.12	1		
V8	Moose density	0.11	0.26 **	0.41 ***	-0.45 ***	0.10	0.56 ***	0.15	1	
V9	Deer index	0.24 **	-0.49 ***	-0.31 ***	0.49 ***	0.18 *	-0.25 **	-0.64 ***	-0.29 ***	1

**p<0.05; **p<0.01; ***p<0.001*

Table S2. Pearson's product moment correlations among used variables in the model for northern Sweden (*n*=68).

		V1	V2	V3	V4	V5	V6	V7	V8	V9
V1	Damaged pine	1								
V2	Pine availability	-0.39 **	1							
V3	Pine forest	-0.21	0.60 ***	1						

V4	Agricultural land	0.23	-0.37 **	-0.30 *	1				
V5	Preferred deciduous	0.19	-0.32 **	-0.30 *	0.32 **	1			
V6	Young forest	-0.04	0.46 ***	0.54 ***	-0.05	0.34 **	1		
V7	Snow days	-0.18	0.24	-0.14	-0.71 ***	-0.41 ***	-0.36 **	1	
V8	Moose density	0.21	0.05	0.17	-0.01	0.49 ***	0.50 ***	-0.28 *	1
V9	Deer index	0.26 *	-0.39 **	-0.09	0.84 ***	0.31 *	0.09	-0.81 ***	0.04

**p<0.05; **p<0.01; ***p<0.001*

Table S3. Pearson's product moment correlations among used variables in the model for southern Sweden (*n*=76).

		V1	V2	V3	V4	V5	V6	V7	V8	V9
V1	Damaged pine	1								
V2	Pine availability	-0.26 *	1							
V3	Pine forest	-0.04	0.64 ***	1						
V4	Agricultural land	-0.11	-0.36 **	-0.61 ***	1					
V5	Preferred deciduous	-0.09	-0.04	-0.06	0.16	1				
V6	Young forest	0.25 *	0.29 *	0.17	-0.59 ***	-0.10	1			
V7	Snow days	-0.08	0.37 ***	0.30 **	-0.29 *	0.18	0.28 *	1		
V8	Moose density	0.18	0.39 ***	0.52 ***	-0.62 ***	-0.10	0.58 ***	0.31 **	1	
V9	Deer index	0.03	-0.05	-0.02	0.18	-0.35 **	-0.19	-0.09	-0.27 *	1

**p<0.05; **p<0.01; ***p<0.001*

Table S4. Unstandardized parameter estimates (est), corresponding standard errors (SE), outcomes of significance testing (*Z*- and *p* value), and standardized estimates (std. est) of the northern model. The table contains first estimates for the path coefficients, followed by covariance estimates between collaboration variables, and variance estimates for all endogenous variables. Estimates of indirect and total effects have been calculated, standard errors for these have been computed using the delta method.

Variable		est	SE	Z-value	p value	std. Est
Moose density						
	Pine forest	5.000	4.586	1.090	0.276	0.166
	Agricultural land	-3.826	3.084	-1.241	0.215	-0.100
	Preferred deciduous	7.383	1.910	3.865	0.000	0.485
	Young forest	30.641	18.168	1.687	0.092	0.244
Deer index						
	Agricultural land	14.011	3.451	4.059	0.000	0.484
	Young forest	-6.776	5.860	-1.156	0.248	-0.072
	Snow days	-0.030	0.007	-4.079	0.000	-0.492
Damaged pine						
	Pine availability	-0.001	0.000	-2.490	0.013	-0.348
	Pine forest	0.002	0.122	0.017	0.987	0.003
	Moose density	0.007	0.003	2.782	0.005	0.271
	Deer index	0.009	0.007	1.330	0.183	0.275
	Snow days	0.000	0.000	0.950	0.342	0.198
Covariance						
	Moose density ~~ Deer index	-0.301	0.193	-1.559	0.119	-0.166

Variance						
	Moose density ~~ Moose density	4.189	1.198	3.496	0.000	0.612
	Deer index ~~ Deer index	0.786	0.171	4.603	0.000	0.202
	Damaged pine ~~ Damaged pine	0.004	0.001	3.907	0.000	0.791
I**ndirect effects on damaged pine**						
	Pine forest via Moose density	0.035	0.032	1.080	0.280	0.045
	Agricultural land via Moose density	-0.027	0.023	-1.145	0.252	-0.027
	Preferred deciduous via Moose density	0.052	0.020	2.621	0.009	0.131
	Young forest via Moose density	0.214	0.160	1.337	0.181	0.066
	Agricultural land via Deer index	0.132	0.117	1.130	0.259	0.133
	Young forest via Deer index	-0.064	0.068	-0.935	0.350	-0.020
	Snow days via Deer index	0.000	0.000	-1.335	0.182	-0.135
Total effects						
	Pine forest	0.037	0.128	0.290	0.772	0.047
	Snow days	0.000	0.000	0.451	0.652	0.063

Note: Parameter estimates for the southern model are not presented, as fit indices showed that our hypothesized model does not fit well to the southern dataset.