

Supporting Information. Wilson, E.C., B. Zuckerberg, M.Z. Peery and J.N. Pauli.

Experimental repatriation of snowshoe hares along a southern range boundary reveals historical community interactions. Ecological Monographs

Appendix S1

Table S1: Full model selection results for survival of porcupines (*Erethizon dorsatum*) at Sandhill Wildlife Area from 1997-2018 using Cormack-Jolly-Seber mark-recapture analysis. We tested for the effects of snow duration (Snow), mean minimum temperature between 1 December and 31 March (Temp), presence of snowshoe hares (*Lepus americanus*; Hares), fully-time varying models (time) and sex. k =number of parameters, AICc=Akaike's Information Criterion corrected for small sample size, Δ AICc=difference in AICc from top model, w_i =AICc model weight.

	Model	k	AICc	Δ AICc	weight
p	Phi(.)p(Sex + Snow)	4	1593.25	0.00	0.35
	Phi(.)p(Sex + Temp + Snow)	5	1593.51	0.27	0.31
	Phi(.)p(Sex + Temp)	4	1594.01	0.78	0.24
	Phi(.)p(Sex * Temp)	5	1595.96	2.71	0.09
	Phi(.)p(Sex)	3	1600.23	6.99	0.01
	Phi(.)p(time)	20	1608.68	15.43	0.00
	Phi(.)p(Temp + Snow)	4	1618.81	23.61	0.00
	Phi(.)p(Snow)	3	1616.91	23.66	0.00
	Phi(.)p(Temp)	3	1617.29	24.04	0.00
	Phi(.)p(.)	2	1624.31	31.06	0.00
Φ	Phi(Age + Sex)p(.)	5	1520.58	0.00	0.40
	Phi(Age + Sex + Snow)p(.)	6	1521.76	1.18	0.22
	Phi(Age + Sex + Temp)p(.)	6	1522.55	1.97	0.15
	Phi(Age + Sex + Hares)p(.)	6	1522.61	2.03	0.15
	Phi(Age + Sex + Snow + Hares)p(.)	7	1523.81	3.23	0.08
	Phi(Age + Sex + time)p(.)	23	1534.02	13.44	0.00
	Phi(Age)p(.)	4	1542.95	22.37	0.00
	Phi(Age + Snow)p(.)	5	1543.26	22.68	0.00
	Phi(Hares + Age)p(.)	5	1544.48	23.90	0.00
	Phi(Age + Temp)p(.)	5	1544.80	24.22	0.00
	Phi(Age + Snow + Temp)p(.)	6	1545.25	24.67	0.00
	Phi(Age + Snow + Temp)p(.)	6	1545.25	24.67	0.00

Phi(Age * Snow)p(.)	7	1545.80	25.22	0.00
Phi(Age + Snow * Temp)p(.)	7	1547.06	26.48	0.00
Phi(Age + time)p(.)	22	1557.12	36.54	0.00
Phi(Sex)p(.)	3	1585.75	65.17	0.00
Phi(.)p(.)	2	1624.31	103.73	0.00
Phi(Temp)p(.)	3	1626.25	105.67	0.00
Phi(Hares)p(.)	3	1626.30	105.72	0.00
Phi(Snow)p(.)	3	1626.33	105.75	0.00
Phi(Snow + Temp)p(.)	4	1628.26	107.68	0.00
Phi(time)p(.)	20	1638.88	118.30	0.00

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Candidate	Phi(~age + Sex + Snow)p(~Sex + Snow)	8	1510.44	0.00	0.19
	Phi(~age + Sex + Snow)p(~Sex + Snow + Temp)	9	1510.95	0.51	0.15
	Phi(~age + Sex)p(~Sex + Snow)	7	1511.97	1.54	0.09
	Phi(~age + Sex + Snow)p(~Sex + Temp)	8	1512.27	1.84	0.08
	Phi(~age + Sex + Snow + Hares)p(~Sex + Snow)	9	1512.46	2.03	0.07
	Phi(~age + Sex)p(~Sex + Snow + Temp)	8	1512.73	2.29	0.06
	Phi(~age + Sex + Snow + Hares)p(~Sex + Snow + Temp)	10	1512.85	2.41	0.06
	Phi(~age + Sex)p(~Sex + Temp)	7	1513.10	2.66	0.05
	Phi(~age + Sex + Temp)p(~Sex + Snow + Temp)	9	1513.33	2.90	0.05
	Phi(~age + Sex + Temp)p(~Sex + Temp)	8	1513.34	2.91	0.05
	Phi(~age + Sex + Temp)p(~Sex + Snow)	8	1513.35	2.91	0.05
	Phi(~age + Sex + Hares)p(~Sex + Snow)	8	1513.89	3.45	0.03
	Phi(~age + Sex + Snow + Hares)p(~Sex + Temp)	9	1514.03	3.59	0.03
	Phi(~age + Sex + Hares)p(~Sex + Snow + Temp)	9	1514.44	4.01	0.03
	Phi(~age + Sex + Hares)p(~Sex + Temp)	8	1514.70	4.26	0.02
	Phi(~age + Sex + Snow)p(~Sex + Snow)	8	1510.44	0.00	0.19
	Phi(~age + Sex + Snow)p(~Sex + Snow + Temp)	9	1510.95	0.51	0.15
	Phi(~age + Sex)p(~Sex + Snow)	7	1511.97	1.54	0.09
	Phi(~age + Sex + Snow)p(~Sex + Temp)	8	1512.27	1.84	0.08
	Phi(~age + Sex + Snow + Hares)p(~Sex + Snow)	9	1512.46	2.03	0.07
	Phi(~age + Sex)p(~Sex + Snow + Temp)	8	1512.73	2.29	0.06

Phi(~age + Sex + Snow + Hares)p(~Sex + Snow + Temp)	10	1512.85	2.41	0.06
Phi(~age + Sex)p(~Sex + Temp)	7	1513.10	2.66	0.05
Phi(~age + Sex + Temp)p(~Sex + Snow + Temp)	9	1513.33	2.90	0.05

Table S2: Full model output from risk factor analysis of cox proportional survival models of neonate porcupines (*Erethizon dorsatum*) at Sandhill Wildlife Area in 2012, 2015-2018. We tested for the effects of maternal condition, mean minimum temperature (Temp), winter North Atlantic Oscillation Index (wNAO), growing-degree days (GDD), amount of non-snow precipitation (Precip), days between estimated birth date and previous years end of growing season (EOST), days between estimated birthdate and start of growing season of current year (SOST), juvenile mass at discovery, days between estimated birth and most recent day snow was >1cm (Snow) and habitat the neonate was discovered in (Habitat; 0=open,1=forest). k =number of parameters, AICc=Akaike's Information Criterion corrected for small sample size, Δ AICc=difference in AICc from top model, w_i =AICc model weight.

Model	k	AICc	Δ AICc	w
Maternal Condition + Temp	4	233.32	0.00	0.29
Maternal Condition	2	234.92	1.60	0.13
Maternal Condition*Temp	6	235.35	2.03	0.11
Temp	2	235.85	2.54	0.08
wNAO	2	236.63	3.32	0.06
Maternal Condition +wNAO	4	236.69	3.37	0.05
GDD	2	236.87	3.55	0.05
Temp+Precip	4	237.47	4.15	0.04
Maternal Condition+Precip	4	237.50	4.18	0.04
Precip	2	237.72	4.40	0.03
EOST	2	237.76	4.45	0.03
Maternal Condition+SOST	4	238.51	5.19	0.02
Juvenile Mass	2	239.21	5.89	0.02
Snow	2	239.52	6.21	0.01
Maternal Condition*wNAO	6	239.53	6.21	0.01
SOST	2	239.69	6.37	0.01
Habitat	2	240.46	7.14	0.01
Maternal Condition*Precip	6	241.59	8.28	0.00
SOST+Precip	4	242.00	8.68	0.00
Temp*Precip	6	242.23	8.91	0.00
Maternal Condition*Juvenile Mass	6	242.91	9.60	0.00
Global Model	18	262.78	29.46	0.00
.	1	287.81	54.49	0.00

Table S3: Full model selection of general linear models testing the effects of variables on maternal condition of female porcupines (*Erethizon dorsatum*) at Sandhill Wildlife Area from 2011-2018. We tested the effects of timing of appearance of initial snow cover (Snow Initiation), duration of previous winter's snow cover (Previous Winter Duration), difference between start and end of previous year's growing season (Grow Seas Duration) and minimum known age (Age). k =number of parameters, AICc=Akaike's Information Criterion corrected for small sample size, Δ AICc=difference in AICc from top model, w_i =AICc model weight.

Model	k	AICc	Δ AICc	weight
Snow Initiation+Previous Winter Duration	4	121.40	0.00	0.43
Snow Intitiation	3	122.10	0.78	0.29
Snow Initiation+Age+Previous Winter Duration	5	123.20	1.85	0.17
Snow Initiation+Age	4	124.20	2.88	0.10
Age+Previous Winter Duration+Grow Seas Duration	5	131.20	9.82	0.00

Table S4: Full candidate model set of known-fate models for survival of ruffed grouse (*Bonasa umbellus*) in Sandhill Wildlife Area from 2016-2018. We tested the effects of sex, age (0=juvenile, 1=adult, mean minimum temperature (Temp), whether snow was present (Snow), and presence of snowshoe hares (*Lepus americanus*, Hare). k =number of parameters, AICc=Akaike's Information Criterion corrected for small sample size, Δ AICc=difference in AICc from top model, w_i =AICc model weight.

Model	k	AICc	DeltaAICc	weight	Deviance
Sex	2	396.63	0.00	0.19	207.91
Sex + Age	3	397.15	0.52	0.15	206.42
Temp	2	397.24	0.61	0.14	393.23
.	1	397.71	1.08	0.11	211.00
Sex * Hare	4	398.50	1.87	0.08	390.48
Snow + Temp	3	398.64	2.01	0.07	392.63
Age	2	399.07	2.44	0.06	210.35
Hare + Temp	3	399.24	2.60	0.05	393.22
Snow	2	399.42	2.79	0.05	395.42
Time	2	399.54	2.91	0.04	210.82
Hare	2	399.71	3.08	0.04	395.71
Age * Hare	4	402.79	6.15	0.01	394.76
Snow * Hare	4	403.01	6.38	0.01	394.99
Time	156	623.63	227.00	0.00	98.84
Sex + Age + Time	158	625.07	228.44	0.00	95.52
Sex * Time	312	983.33	586.70	0.00	51.63

Table S5: Identities of predators from translocated snowshoe hare (*Lepus americanus*) mortalities (n=64) in Sandhill Wildlife Area from 11 January 2017 through 31 May 2018.

Predator	Confirmed Hare Predations
Bobcat (<i>Lynx rufus</i>)	15
Coyote (<i>Canis latrans</i>)	18
Fisher (<i>Pekania pennanti</i>)	0
Grey Wolf (<i>Canis lupus</i>)	1
Avian spp.	4
Unidentified	26