APPENDIX A – Model and data assumptions for the candidate set of multinomial logit models.

For a large population, let π_0, π_1, and π_2 correspond to the proportion of population units that have responses of 0, 1, and 2, respectively. If a sample of size n is obtained by independently sampling units from this large population, then the sampled frequencies f_0, f_1, and f_2 of response categories 0, 1, and 2, respectively, follow a multinomial distribution with expected frequencies $F_0 = n\pi_0$, $F_1 = n\pi_1$, and $F_2 = n\pi_2$.

For each species monitored during our study, the population consisted of all winter OSV human/wildlife encounters with that species along established roads used by snowmobiles and coaches. The sampling unit was an encounter with a wildlife group, not an encounter with individual animals. Across the four winter seasons (2003-2006), the size of these encounter populations were large for bison, elk, and trumpeter swans. Though the number of bald eagle and coyote observations did not appear large, it was the number of actual encounters that formed the populations (both observed and unobserved). Thus, we can reasonably assume the populations for these species are also large.

Ideally, the collected sample should be random, but this was not the case during our study for two reasons. First, we did not know when or where human/wildlife encounters would occur. Hence, we had no control to randomly select which encounters would be observed. Second, the established roads used by snowmobiles and coaches were stratified into road segments that were repeatedly sampled across the winter. The effects of this deviation from strict random sampling (which often is infeasible in wildlife studies) should be negligible given similar effort in sampling each road segment within a winter season. That is, given equal sampling effort in each road segment across time, we expect the observed numbers and types of human/wildlife encounters in each segment to be close to the numbers and types of encounters that would be expected under with true random sampling during the winter.

Hypothetically, a predetermined sample of size n should be collected. However, our sample sizes were random rather than predetermined. Like other statistical procedures where a fixed sample size is assumed but not obtained, the fact that it is random should not seriously affect our conclusions.

APPENDIX B – The *a priori* candidate set of multinomial logit models. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *sppnum* (group size); *onroad* (on or off road); *hact* (human activity); *intxn* (interaction time); *sb* (number of snowmobiles); *coach* (number of coaches); *hab* (habitat), and *cumvis* (cumulative daily number of over-snow vehicles).

Bison and Elk (86 models): Each *a priori* model contains the base model, *year* + *sppnum* + *dist* + *hact* + *intxn* + *onroad* + *sb* + *coach* + *sppnum*dist*, plus the effects indicated by X in the table.

ID	*hab*	*cumvis*	*dist*hact*	*sppnum*hact*	*intxn*dist*	*intxn*sppnum*	*sppnum*hab*	*year*cumvis*
A	X	X	X	X	X	X	X	X
B	X	X	X	X	X	X		X
C	X	X	X	X	X	X	X	
D	X	X	X	X	X	X		
E		X	X	X	X	X		X
F		X	X	X	X	X		
G	X		X	X	X	X	X	
H	X		X	X	X	X		
I			X	X	X	X		
1A1	X	X		X	X	X	X	X
1A2	X	X	X		X	X	X	X
1A3	X	X	X	X		X	X	X
1A4	X	X	X	X	X		X	X
1B1	X	X		X	X	X		X
1B2	X	X	X		X	X		X
1B3	X	X	X	X		X		X
1B4	X	X	X	X	X			X
1C1	X	X		X	X	X	X	
1C2	X	X	X		X	X	X	
1C3	X	X	X	X		X	X	
1C4	X	X	X	X	X		X	
1D1	X	X		X	X	X		
1D2	X	X	X		X	X		
1D3	X	X	X	X		X		
1D4	X	X	X	X	X			
1E1		X		X	X	X		X
1E2		X	X		X	X		X
1E3		X	X	X		X		X

ID	***hab***	***cumvis***	***dist*hact***	***sppnum*hact***	***intxn*dist***	***intxn*sppnum***	***sppnum*hab***	***year*cumvis***
1E4		X	X	X	X			X
1F1		X		X	X	X		
1F2		X	X		X	X		
1F3		X	X	X		X		
1F4		X	X	X	X			
1G1	X			X	X	X	X	
1G2	X		X		X	X	X	
1G3	X		X	X		X	X	
1G4	X		X	X	X		X	
2A1	X	X			X	X	X	X
2A2	X	X		X		X	X	X
2A3	X	X		X	X		X	X
2A4	X	X	X			X	X	X
2A5	X	X	X		X		X	X
2B1	X	X			X	X		X
2B2	X	X		X		X		X
2B3	X	X		X	X			X
2B4	X	X	X			X		X
2B5	X	X	X		X			X
2C1	X	X			X	X	X	
2C2	X	X		X		X	X	
2C3	X	X		X	X		X	
2C4	X	X	X			X	X	
2C5	X	X	X		X		X	
2D1	X	X			X	X		
2D2	X	X		X		X		
2D3	X	X		X	X			
2D4	X	X	X			X		
2D5	X	X	X		X			
2E1		X			X	X		X
2E2		X		X		X		X
2E3		X		X	X			X
2E4		X	X			X		X
2E5		X	X		X			X
2F1		X			X	X		

ID	*hab*	*cumvis*	*dist*hact*	*sppnum*hact*	*intxn*dist*	*intxn*sppnum*	*sppnum*hab*	*year*cumvis*
2F2		X		X		X		
2F3		X		X	X			
2F4		X	X			X		
2F5		X	X		X			
2G1	X	X			X	X	X	
2G2	X	X		X		X	X	
2G3	X	X		X	X		X	
2G4	X	X	X			X	X	
2G5	X	X	X		X		X	
3A1	X	X				X	X	X
3A2	X	X			X		X	X
3B1	X	X				X		X
3B2	X	X			X			X
3C1	X	X				X	X	
3C2	X	X			X		X	
3D1	X	X				X		
3D2	X	X			X			
3E1		X				X		X
3E2		X			X			X
3F1		X				X		
3F2		X			X			
3G1	X					X	X	
3G2	X				X		X	

Trumpeter Swans (36 models): Each *a priori* model contains the base model, *year* + *sppnum* + *dist* + *hact* + *intxn* + *sb* + *coach* + *sppnum*dist*, plus the effects indicated by X in the table.

ID	*cumvis*	*dist*hact*	*sppnum*hact*	*intxn*dist*	*intxn*sppnum*	*year*cumvis*
A	X	X	X	X	X	X
B	X	X	X	X	X	
C		X	X	X	X	
1A1	X		X	X	X	X
1A2	X	X		X	X	X
1A3	X	X	X		X	X
1A4	X	X	X	X		X

ID	***cumvis***	***dist*hact***	***sppnum*hact***	***intxn*dist***	***intxn*sppnum***	***year*cumvis***
1B1	X		X	X	X	
1B2	X	X		X	X	
1B3	X	X	X		X	
1B4	X	X	X	X		
1C1			X	X	X	
1C2		X		X	X	
1C3		X	X		X	
1C4		X	X	X		
2A1	X			X	X	X
2A2	X		X		X	X
2A3	X		X	X		X
2A4	X	X			X	X
2A5	X	X		X		X
2B1	X			X	X	
2B2	X		X		X	
2B3	X		X	X		
2B4	X	X			X	
2B5	X	X		X		
2C1				X	X	
2C2			X		X	
2C3			X	X		
2C4		X			X	
2C5		X		X		
3A1	X				X	X
3A2	X			X		X
3B1	X				X	
3B2	X			X		
3C1					X	
3C2				X		

Bald Eagles (12 models): Each *a priori* model contains the base model, *year* + *sppnum* + *dist* + *hact* + *intxn* + *sb* + *coach*, plus the effects indicated by X in the table.

ID	***cumvis***	***intxn*dist***	***year*cumvis***	***hab***
A	X	X	X	X
B	X	X	X	
C	X	X		X
D	X	X		
E		X		X
F		X		
1A	X		X	X
1B	X		X	
1C	X			X
1D	X			
1E				X
1F				

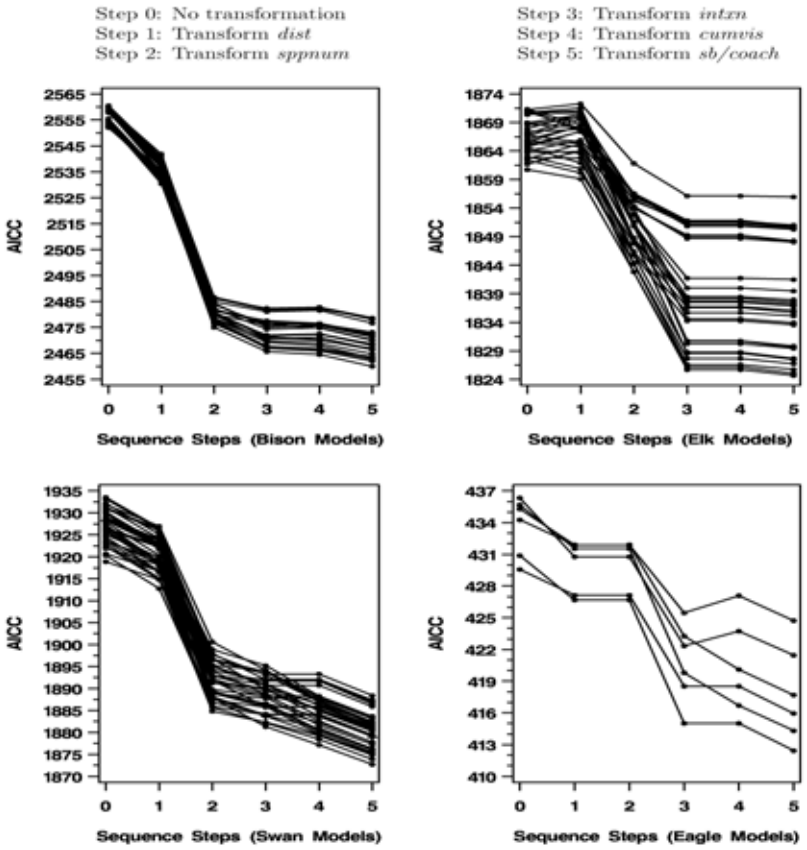
Coyotes (6 models): Each *a priori* model contains the base model, *year* + *sppnum* + *dist* + *hact* + *intxn* + *sb* + *coach*, plus the effects indicated by X in the table.

ID	***cumvis***	***intxn*dist***	***year*cumvis***
A	X	X	X
B	X	X	
C		X	
1A	X		X
1B			X
1C			

APPENDIX C – Results of the sequential approach for evaluating various forms of the quantitative covariates.

We graphically summarized the AIC_C values for the best models at each step in the sequential process determining the best covariate forms for bison, elk, swans, and eagles (Figure 1). A change in covariate form can cause dramatic changes in AIC_C. For bison, elk, and swans, the greatest improvements in AIC_C occurred with setting a threshold for group size (*sppnum*), while for bald eagles and coyote the greatest improvements occurred with setting a threshold for interaction time (*intxn*). There were also large improvements in AIC_C by using either a distance (*dist*) threshold form for bison, bald eagles, and coyotes, or a moderated form for swans. A large improvement in elk model AIC_C values also occurred with an interaction time (*intxn*) threshold. Limiting the number of best models prior to examining alternative covariate forms can seriously affect the final results. For example, the initial elk models at Step 0 had the 31st and 32nd smallest AIC_C values, but had the 7th and 2nd smallest AIC_C values after Step 5 in the sequential process.

Figure 1: AICC Values from Sequential Modeling Process



APPENDIX D – Estimates, standard errors, and *P*-values for the movement (M) logit and vigilance (V) logit from exploratory analyses of the bison model best supported by the data. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *sppnum* (group size); *onroad* (on or off road); *hact* (human activity); *intxn* (interaction time); *sb* (number of snowmobiles); *coach* (number of coaches); *hab* (habitat); *cumvis* (cumulative daily number of over-snow vehicles); IH (impeded/hastened animal movement); AP (approached animals on foot); D (dismounted or exited OSVs); S (stopped to observe animals); N (no visible reaction); ON (animals on the road); OFF (animals off the road); A (aquatic); BF (burned forest); F (unburned forest); TH (thermal); and M (meadow). For each categorical variable, results are presented relative to the baseline level (i.e., 2006 for *year*, N for *hact*, ON for *onroad*, and M for *hab*) and each estimate represents a departure from zero (i.e., no effect).

	Movement logit			**Vigilance logit**		
Effect	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
intercept	-0.23	0.63	0.776	0.82	0.42	0.055
year = 2003	2.20	0.42	<0.0001	0.74	0.25	0.003
= 2004	-0.08	0.40	0.839	-0.03	0.27	0.912
= 2005	-0.08	0.48	0.545	0.21	0.30	0.478
= 2006	-1.83	0.63	0.004	-0.92	0.31	0.003
sppnum	-2.9	0.72	<0.0001	1.53	0.54	0.004
dist	-6.82	2.61	0.009	-2.32	0.81	0.004
hact = IH	1.41	0.33	<0.0001	1.12	0.31	<0.001
= AP	0.33	0.65	0.608	-0.53	0.49	0.282
= D	-1.47	0.50	0.003	0.08	0.30	0.782
= S	0.20	0.27	0.456	-0.07	0.22	0.738
= N	-0.47	0.30	0.112	-0.60	0.23	0.009
intxn	0.27	0.21	0.206	0.49	0.14	<0.001
onroad = OFF	-1.43	0.20	<0.0001	-0.50	0.12	<0.0001
= ON	1.43	0.20	<0.0001	0.50	0.12	<0.0001
sb	0.11	0.04	0.002	0.08	0.03	0.002
coach	0.41	0.15	0.009	0.32	0.12	0.009
hab = A	1.90	0.53	<0.001	1.28	0.34	<0.001
= BF	-0.37	0.27	0.161	-0.27	0.19	0.156
= F	-0.11	0.21	0.588	0.08	0.14	0.581
= TH	-0.47	0.24	0.047	-0.66	0.17	<0.0001
= M	-0.95	0.22	<0.0001	-0.43	0.14	0.002
cumvis	0.00	0.02	0.825	-0.04	0.01	0.001
*sppnum*dist*	4.85	1.25	<0.001	-0.74	0.72	0.305
*dist*hact* = IH	1.06	3.77	0.779	-2.10	2.47	0.395
= AP	-11.62	8.87	0.190	-0.11	1.29	0.935
= D	5.38	2.47	0.029	0.70	0.84	0.406
= S	2.59	2.39	0.279	0.85	0.75	0.256
= N	2.59	2.38	0.277	0.66	0.72	0.364
intxn sppnum*	0.01	0.32	0.966	-0.66	0.22	0.003
*cumvis*year* = 2003	-0.07	0.02	0.005	0.03	0.02	0.095
= 2004	0.07	0.03	0.786	-0.03	0.02	0.110
= 2005	0.03	0.04	0.496	-0.01	0.03	0.656
= 2006	0.03	0.04	0.399	0.02	0.02	0.392

APPENDIX E – Estimates, standard errors, and *P*-values for the movement logit and vigilance logit from exploratory analyses of the elk model best supported by the data. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *sppnum* (group size); *onroad* (on or off road); *hact* (human activity); *intxn* (interaction time); *coach* (number of coaches); *hab* (habitat); *cumvis* (cumulative daily number of over-snow vehicles); AP (approached animals on foot); D (dismounted or exited OSVs); S (stopped to observe animals); N (no visible reaction); ON (animals on the road); OFF (animals off the road); A (aquatic); BF (burned forest); F (unburned forest); TH (thermal); and M (meadow). For each categorical variable, results are presented relative to the baseline level (i.e., 2006 for *year*, ON for *onroad*, N for *hact*, and M for *hab*) and each estimate represents a departure from zero (i.e., no effect).

	Movement logit			**Vigilance logit**		
Effect	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
intercept	-1.87	0.50	<0.001	-0.50	0.35	0.151
year = 2003	0.40	0.30	0.182	0.40	0.15	0.008
= 2004	0.24	0.22	0.203	-0.02	0.10	0.841
= 2005	1.17	0.29	<0.0001	0.61	0.15	<0.0001
= 2006	-1.81	0.35	<0.0001	-0.99	0.14	<0.0001
intxn	1.34	0.17	<0.0001	0.98	0.13	<0.0001
onroad = OFF	-1.71	0.32	<0.0001	-0.18	0.30	0.536
= ON	1.71	0.32	<0.0001	0.18	0.30	0.536
coach	0.58	0.29	0.045	-0.04	0.15	0.786
cumvis	0.02	0.02	0.332	0.03	0.01	0.007
*sppnum*hact* = AP	1.69	0.57	0.003	0.19	0.40	0.635
= D	0.31	0.71	0.666	-0.14	0.41	0.729
= S	0.46	0.56	0.414	0.60	0.30	0.043
= N	-2.45	0.62	<0.0001	-0.65	0.26	0.011
*intxn*dist*	-0.42	0.13	0.001	-0.43	0.09	<0.0001
intxn sppnum*	-1.13	0.18	<0.0001	-0.69	0.13	<0.0001
*sppnum*hab* = A	3.18	0.70	<0.0001	1.37	0.39	<0.001
= BF	-0.66	0.60	0.275	-0.33	0.24	0.173
= F	1.30	0.63	0.039	0.57	0.34	0.089
= TH	-3.67	1.07	<0.001	-0.98	0.38	0.010
= M	-0.15	0.64	0.809	-0.62	0.27	0.020

APPENDIX F – Estimates, standard errors, and *P*-values for the movement logit and vigilance logit from exploratory analyses of the trumpeter swan model best supported by the data. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *sppnum* (group size); *hact* (human activity); *intxn* (interaction time); *sb* (number of snowmobiles); *coach* (number of coaches); and *cumvis* (cumulative daily number of over-snow vehicles); AP (approached animals on foot); D (dismounted or exited OSVs); S (stopped to observe animals); and N (no visible reaction). For each categorical variable, results are presented relative to the baseline level (i.e., 2006 for *year* and N for *hact*) and each estimate represents a departure from zero (i.e., no effect).

	Movement logit			**Vigilance logit**		
Effect	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
intercept	0.56	0.68	0.409	2.07	0.45	<0.0001
year = 2003	1.40	0.56	0.013	0.32	0.39	0.414
= 2004	0.75	0.77	0.331	1.44	0.48	0.003
= 2005	-1.99	0.97	0.041	0.04	0.45	0.932
= 2006	-0.15	0.64	0.811	-1.80	0.50	<0.001
sppnum	-1.83	0.55	<0.001	-2.16	0.34	<0.0001
dist	-2.12	0.48	<0.0001	-2.07	0.30	<0.0001
hact = AP	0.33	0.34	0.340	0.30	0.31	0.334
= D	0.34	0.28	0.228	-0.30	0.27	0.266
= S	0.11	0.22	0.616	0.23	0.18	0.208
= N	-0.77	0.23	<0.001	-0.23	0.18	0.215
intxn	0.21	0.05	<0.0001	0.03	0.04	0.569
sb	0.09	0.03	0.009	0.06	0.02	0.004
coach	0.55	0.18	0.002	0.45	0.14	0.001
cumvis	-0.10	0.07	0.156	-0.08	0.04	0.060
*cumvis*year* = 2003	-0.10	0.09	0.272	0.00	0.06	0.981
= 2004	-0.09	0.12	0.473	-0.18	0.07	0.018
= 2005	0.38	0.15	0.011	0.08	0.07	0.263
= 2006	-0.20	0.11	0.070	0.09	0.08	0.232

APPENDIX G – Estimates, standard errors, and *P*-values for the movement logit and vigilance logit from exploratory analyses of the bald eagle model best supported by the data. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *hact* (human activity); *intxn* (interaction time); *sb* (number of snowmobiles); *coach* (number of coaches); *hab* (habitat); AP (approached animals on foot); S (stopped to observe animals); N (no visible reaction); BF (burned forest); F (unburned forest); and M (meadow). For each categorical variable, results are presented relative to the baseline level (i.e., 2006 for *year*, N for *hact*, and M for *hab*) and each estimate represents a departure from zero (i.e., no effect).

	Movement logit			**Vigilance logit**		
Effect	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
intercept	0.13	1.36	0.925	-3.38	1.23	0.006
year = 2003	1.13	0.45	0.011	0.09	0.37	0.814
= 2004	-0.23	0.50	0.648	0.78	0.34	0.020
= 2005	0.53	0.43	0.220	0.35	0.36	0.334
= 2006	-1.43	0.55	0.010	-1.21	0.35	<0.001
dist	-1.25	0.71	0.080	0.59	0.55	0.284
hact = AP	0.83	0.77	0.280	-0.43	0.67	0.518
= S	-0.08	0.48	0.860	-0.70	0.42	0.093
= N	-0.75	0.64	0.239	1.14	0.52	0.028
intxn	-0.06	1.25	0.960	4.09	1.14	<0.001
sb	0.24	0.08	0.002	0.19	0.07	0.004
coach	1.44	0.65	0.027	0.66	0.50	0.185
hab = BF	.45	0.36	0.211	2.14	0.33	<0.0001
= F	-0.72	0.39	0.066	-0.29	0.32	0.365
= M	0.26	0.45	0.556	-1.85	0.48	<0.0001
*intxn*dist*	0.28	0.65	0.667	-1.21	0.57	0.032

APPENDIX H – Estimates, standard errors, and *P*-values for the movement logit and vigilance logit from exploratory analyses of the coyote model best supported by the data. Abbreviations are: *year* (year of study); *dist* (distance of group from road); *hact* (human activity); *intxn* (interaction time); AP (approached animals on foot); N (no visible reaction). For each categorical variable, results are presented relative to the baseline level (i.e., 2006 for *year* and N for *hact*) and each estimate represents a departure from zero (i.e., no effect).

	Movement logit			**Vigilance logit**		
Effect	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
intercept	-0.50	1.33	0.706	-1.54	1.05	0.141
year = 2003	0.79	0.56	0.157	1.06	0.40	0.008
= 2004	-0.44	0.58	0.449	-0.32	0.40	0.428
= 2005	0.49	0.53	0.356	0.73	0.37	0.048
= 2006	-0.84	0.54	0.120	-1.47	0.43	<0.001
dist	-5.10	1.21	<0.0001	-1.49	1.06	0.160
hact = AP	1.13	0.58	0.053	-0.42	0.74	0.571
= N	-1.13	0.58	0.053	0.42	0.74	0.571
intxn	3.21	1.22	0.008	2.18	0.68	0.001

APPENDIX I – Output from a maximum likelihood analysis of variance for *a priori* and post hoc exploratory bison model main effects and interactions. Degrees of freedom (*df*) and *P*-values indicate if a variable's effect was statistically significant.

	a priori model		exploratory model	
Model Effect	*df*	*P*-value	*df*	*P*-value
year	6	<.0001	6	<.0001
sppnum	2	.0001	2	.0001
dist	2	.0009	2	.0009
hact	8	<.0001	8	<.0001
intxn	2	.0027	2	.0027
oroad	2	<.0001	2	<.0001
sb	2	.0009	2	.0009
coach	2	.0083	2	.0083
hab	8	<.0001	8	<.0001
cumvis	2	.0020	2	.0020
*sppnum*dist*	2	<.0001	2	<.0001
*dist*hact*	6	.1490	6	.1490
*sppnum*intxnt*	2	.0055	2	.0055
*cumvis*year*	8	.0048	8	.0048

APPENDIX J – Output from a maximum likelihood analysis of variance for *a priori* and post hoc exploratory elk model main effects and interactions. Degrees of freedom (*df*) and *P*-values indicate if a variable's effect was statistically significant.

	a priori model		exploratory model	
Model Effect	*df*	*P*-value	*df*	*P*-value
year	6	<.0001	6	<.0001
sppnum	2	.3628		
dist	2	.1443		
hact	6	.1512		
intxn	2	<.0001	2	<.0001
oroad	2	<.0001	2	<.0001
sb	2	.7010		
coach	2	.0843	2	.0758
hab	8	.0004		
cumvis	2	.0258	2	.0272
*sppnum*dist*	2	.0556		
*sppnum*hact*	6	.0023	6	.0002
*dist*intxn*	2	.0325	2	<.0001
*sppnum*intxn*	2	<.0001	2	<.0001
*sppnum*hab*			8	<.0001

APPENDIX K – Output from a maximum likelihood analysis of variance for *a priori* and post hoc exploratory trumpeter swan model main effects and interactions. Degrees of freedom (*df*) and *P*-values indicate if a variable's effect was statistically significant.

	a priori model		exploratory model	
Model Effect	*df*	*P*-value	*df*	*P*-value
year	6	.0005	6	.0006
spnum	2	.0275	2	<.0001
dist	2	.0004	2	<.0001
hact	6	.0073	6	.0094
intxn	2	.0163	2	.0003
sb	2	.0037	2	.0035
coach	2	.0017	2	.0014
cumvis	2	.1045	2	.1072
*sppnum*dist*	2	.7007		
*dist*intxn*	2	.2631		
*cumvis*year*	6	.0349	6	.0420

APPENDIX L – Output from a maximum likelihood analysis of variance for *a priori* and post hoc exploratory bald eagle model main effects and interactions. Degrees of freedom (*df*) and *P*-values indicate if a variable's effect was statistically significant.

	a priori model		exploratory model	
Model Effect	*df*	*P*-value	*df*	*P*-value
year	6	.0004	6	.0003
sppnum	2	.3114		
dist	2	.0356	2	.0363
hact	6	.0230	4	.0056
intxn	2	<.0001	2	.0001
Sb	2	.0094	2	.0064
coach	2	.1098	2	.0855
hab	4	<.0001	4	<.0001
*dist*intxn*	2	.0195	2	.0254

APPENDIX M – Output from a maximum likelihood analysis of variance for *a priori* and post hoc exploratory coyote model main effects and interactions. Degrees of freedom (*df*) and *P*-values indicate if a variable's effect was statistically significant.

	a priori model		exploratory model	
Model Effect	*df*	*P*-value	*df*	*P*-value
year	6	.0160	6	.0111
sppnum	2	.1999		
dist	2	.0061	2	<.0001
hact	6	.1407	2	.0087
intxn	2	.0230	2	.0015
oroad	2	.9078		
sb	2	.2457		
coach	2	.9410		