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Supplementary material

Appendix 1. A review of selected studies investigating the influence of nest predator exclosures on hatching success, abandonment, fledging rates, adult mortality, and whether any adult sub-lethal effects were examined. Studies were selected because they involved the use of exclosures on nests with a view of improving breeding success. 'Hatching success' refers to the probability that an egg survives to hatch; 'brood success/survival' refers to the probability of survival of a chick from hatching to the age of first flight (i.e. fledging); and, 'fledging rates' refers to the number of fledged young per unit breeding effort (e.g. per nest, or per pair). Measures of brood success/survival are reported here under 'Fledging rates' for convenience. Increased daily survival rate of eggs and improved hatching success were evident from nests with predator exclosures (Wilcoxon signed rank statistic = 11.000, p = 0.002; n = 17 comparable studies).

			Exclosure					No exclosure				
Study	**Study location and period**	**Study species**	**Hatching success**	**Abandonment rates**	**Fledging rates**	**Adult sub-lethal effects**	**Adult mortality rates**	**Hatching success**	**Abandonment rates**	**Fledging rates**	**Adult sub-lethal effects**	**Adult mortality rates**
Keo et al. (2009)	Preah Vihear province, northern Cambodia (2004-2006)	Giant Ibis (*Thaumatibis gigantea*)	-	-	1.875[a,b], 90% brood survival	-	-	-	-	1.250[a,b], 61.3% brood survival	-	-
Johnson and Oring (2002)	Jay Dow, Sr. Wetlands (1999-2000)	Killdeer (*Charadrius vociferous*)	38%	-	-	-	7.7%	13%	-	-	-	None
Mabee and Estelle (2000)	Southeastern Colorado (1994)	Killdeer	14%	30%[c]	-	-	-	33%	0%[c]	-	-	-
Isaksson et al. (2007)	Swedish west coast (2002, 2004)	Northern Lapwing (*Vanellus vanellus*)	64.5%[d]	8.1%	-	-	None	35.5%[d]	1.3%	-	-	None
Barber et al. (2010)	Prince Edward Island National Park of Canada (1984-2006, except for 1993)	Piping Plover (*Charadrius melodus*)	64.5%	19.7%	2.5 ± 0.14 [e,f,a]	-	8.7%	33.9%	6.3%	2.8 ± 0.13 [e,f,a]	-	0.7%
Larson et	The Great Plains	Piping Plover	-	-	1.15-2.25[e,a]	-	-	-	-	0.89 ±	-	-

			Exclosure					No exclosure				
Study	**Study location and period**	**Study species**	**Hatching success**	**Abandonment rates**	**Fledging rates**	**Adult sub-lethal effects**	**Adult mortality rates**	**Hatching success**	**Abandonment rates**	**Fledging rates**	**Adult sub-lethal effects**	**Adult mortality rates**
al. (2002)[g]	(1986-2000)									0.10[e,a]		
Mabee and Estelle (2000)	Southeastern Colorado (1994)	Piping Plover	60%	0%[c]	-	-	-	75%	0%[c]	-	-	-
Maslo and Lockwood (2009)	New Jersey (1998-2007)	Piping Plover	64%	19%	-	-	-	19%	7%	-	-	-
Murphy et al. (2003a)	Northern Great Plains – Alberta, Saskatchewan, North Dakota, Montana (1993-2002)	Piping Plover	-	-	-	-	>2.7%[i]	-	-	-	-	None[i]
Murphy et al. (2003b)[h]	North Dakota, Montana (1996-1997)	Piping Plover	84%	-	1.73[e,a]	-	-	45%	-	0.72[e,a]	-	-
Rimmer and Deblinger (1990)	Massachusetts (1986-1989)	Piping Plover	92%	-	-	-	-	25%	-	-	-	-
This study (2013)	Cheetham Wetlands, Victoria, Australia (2012-2013)	Red-capped Plover	96.2%	27.8%	8% brood survival [j]	Examined heterophil/ lymphocyte ratio to investigate chronic physiological stress	>0.57%	10.7%	10.5%	0% brood survival [j]	Examined heterophil/ lymphocyte ratio to investigate chronic physiological stress	ND
Isaksson et al. (2007)	Swedish west coast (2002)	Redshank (*Tringa tetanus*)	90.3% [d,k]	-	-	-	21.6%[k]	39%[d]	-	-	-	3.2%
Mabee and Estelle (2000)	Southeastern Colorado (1994)	Snowy Plover (*Charadrius alexandrinus*)	69%	8%[c]	-	-	-	57%	8%[c]	-	-	-
Mabee and Estelle (2000)	Southeastern Colorado (1995)	Snowy Plover	57%	8%[c]	-	-	-	54%	0%[c]	-	-	-

Study	Study location and period	Study species	Exclosure: Hatching success	Exclosure: Abandonment rates	Exclosure: Fledging rates	Exclosure: Adult sub-lethal effects	Exclosure: Adult mortality rates	No exclosure: Hatching success	No exclosure: Abandonment rates	No exclosure: Fledging rates	No exclosure: Adult sub-lethal effects	No exclosure: Adult mortality rates
Neuman et al. (2004)[m,n]	Central Monterey Bay, California (1984-1999)	Snowy Plover	68 ± 12%	25 ± 16%	30 ± 12%	-	18.8 ± 4.6%[l]	43 ± 12%	7 ± 5%	42 ± 6%	-	7.4 ± 1.6%[l]
Pauliny et al. (2008)	Southwest Sweden (1993-2004)	Southern Dunlin (*Calidris alpina schinzii*)	80%	-	15%[c,e,o]	-	7%	56.7%	-	21%[c,e,o]	-	12.5%
Burns et al. (2013)	Prosperous Bay, St Helena (2010)	St Helena Plover (*Charadrius sanctaehelenae*)	23.8%[d]	9.1%	-	-	9.1%	22.7%[d]	18%	-	-	None
Pearson et al. (2012)	Oregon and Washington (2009-2010)	Streaked Horned Lark (*Eremophila alpestris strigata*)	57.5%[c]	27.3%	48.5% brood survival	-	>1.5%	56.1%[c]	0%	51.6% brood survival	-	NR
Niehaus et al. (2004)	Western Alaska (2001)	Western Sandpiper (*Calidris mauri*)	81.7%[d,k]	-	26.6% brood survival [k]	-	Severe threat [k]	44%[d]	-	-	-	NR
Hardy and Colwell (2008)	Coastal northern California (2001-2007)	Western Snowy Plover (*C. a. nivosus*)	47-93%	16.8%	0.430[p,a]	-	0.73%	0-71%	4.5%	0.014[p,a]	-	NR

[a] expected fledglings produced per clutch
[b] average clutch size of two eggs
[c] figure derived from a graph
[d] derived from daily survival estimates
[e] average clutch size of four eggs
[f] excluding failed nests
[g] meta-analysis
[h] exclosures were also tested in conjunction with electric fencing; results not indicated in this table
[i] total adult death occurring across different exclosure designs
[j] calculated from successful clutches only
[k] use of exclosures was discontinued due to severe risks to adults and young
[l] percentages calculated from data presented by the paper for clearer representation in this table
[m] coupled with predator removal
[n] comparing before (1984-1990) and after (1991-1999) predator management
[o] expected fledglings produced per breeding adult
[p] average clutch size of three eggs
ND = none detected
NR = none reported

Appendix 2

Variables used in analyses and references justifying why each variable was included in analysis.

Predictor variables	Response variable	References
Presence (1) or absence (0) of an exclosure	Hatching success, brood survival, abandonment of clutch, parental stress, and adult mortality	Refer to Online Resource 1
Age of eggs at time of discovery (days since laying)	Depredation risk	Dinsmore et al. (2002); Grant et al. (2005); Young (1963)
Time of year the clutch was laid (Julian date)	Depredation risk	Grant et al. (2005); Wilson et al., (2007)
	Parental stress	Biermann and Robertson (1981); Wilson et al. (2007)
Presence (1) or absence (0) of cover	Depredation of eggs	Götmark et al. (1995); Wiebe and Martin (1998)
	Parental stress	Amat and Masero (2004b); Kim and Monaghan (2005)

Predictor variables	Response variable	References
Age of eggs at time of the adult capture (days since laying date)	Parental stress	Andersson et al. (1980); Brunton (1990); Rytkönen et al. (1990); Smith and Wilson (2010)
Interval between discovery of the nest and capture of the adult (days)	Parental stress	Fowler (1999); Knight and Temple (1986); Weston et al. (2011); Zanette et al. (2011)
Female (1) or male (0)	Parental stress	Brunton (1990); Silverin et al. (1997); Wright and Cuthill (1989)
Body condition (Scaled Mass Index [SMI])	Parental Stress	Cardilini et al. 2013; Masello et al. (2009); Peig and Green (2009); Vleck et al. (2000)

Appendix 3. Summary of the 15 General Linear Models explaining the probability of hatching success against four variables: age of clutch at time of discovery from laying date (days), the presence or absence of an exclosure, time of year the clutch was laid (Julian date), and the presence or absence of cover. Asterisks denote which variables were used in each model and the degrees of freedom, AICc, ΔAIC, and Akaike weights are included, ranked by ΔAIC. Data from nests that had been abandoned or flooded were excluded from this analysis.

Age of clutch	Exclosure	Date	Cover	df	AICc	ΔAIC	Akaike Weight
*	*			3	31.52	0.00	0.323
*	*		*	4	32.43	0.91	0.205
*	*	*		4	32.77	1.26	0.172
*	*	*	*	5	33.92	2.40	0.097
	*			2	34.56	3.04	0.071
	*		*	3	35.13	3.61	0.053
	*	*		3	35.35	3.83	0.048
	*	*	*	4	36.20	4.68	0.031
*		*		3	91.80	60.28	0.000
*		*	*	4	92.22	60.70	0.000
		*		2	92.90	61.38	0.000
		*	*	3	92.90	61.38	0.000
*				2	93.95	62.43	0.000
*			*	3	94.32	62.80	0.000
			*	2	96.24	64.73	0.000

Appendix 4. Summary of the 127 Gaussian General Linear Models used to examine the influence of seven variables on the heterophil/lymphocyte [H/L] ratio in blood. The variables were: the presence or absence of an exclosure; sex (male/female); scaled mass index (SMI); age of clutch at capture (days since laying); time of year laid (Julian date); time between first discovery and capture (days); and the presence or absence of cover. Asterisks denote which variables were used in each model and the degrees of freedom, AICc, ΔAIC, and Akaike weights are included, ranked by ΔAIC.

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
						*	3	135.23	0.00	0.12
		*				*	4	136.09	0.86	0.08
					*	*	4	136.88	1.65	0.05
		*			*	*	5	137.14	1.90	0.05
*						*	4	137.34	2.11	0.04
	*					*	4	137.51	2.27	0.04
			*			*	4	137.52	2.29	0.04
				*		*	4	137.53	2.29	0.04
*					*	*	5	138.35	3.11	0.03
		*	*			*	5	138.45	3.21	0.02
	*	*				*	5	138.61	3.37	0.02
*		*				*	5	138.61	3.38	0.02
		*		*		*	5	138.62	3.38	0.02
		*	*		*	*	6	138.73	3.49	0.02
			*		*	*	5	138.84	3.61	0.02
				*	*	*	5	138.98	3.74	0.02

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
	*				*	*	5	139.22	3.98	0.02
*		*			*	*	6	139.47	4.23	0.01
		*		*	*	*	6	139.66	4.42	0.01
*	*					*	5	139.76	4.53	0.01
	*	*			*	*	6	139.77	4.54	0.01
*			*			*	5	139.78	4.55	0.01
*				*		*	5	139.79	4.56	0.01
	*		*			*	5	139.88	4.64	0.01
	*			*		*	5	139.96	4.72	0.01
			*	*		*	5	139.98	4.75	0.01
*			*		*	*	6	140.21	4.97	0.01
*				*	*	*	6	140.53	5.29	0.01
					*		3	140.66	5.42	0.01
*	*				*	*	6	140.83	5.60	0.01
	*	*	*			*	6	141.08	5.85	0.01
		*	*	*		*	6	141.09	5.86	0.01
*		*	*		*	*	7	141.10	5.86	0.01
*		*	*			*	6	141.10	5.87	0.01
	*		*		*	*	6	141.14	5.91	0.01
			*				3	141.18	5.94	0.01
			*	*	*	*	6	141.20	5.96	0.01
*	*	*				*	6	141.26	6.02	0.01
	*	*		*		*	6	141.26	6.03	0.01
*		*		*		*	6	141.27	6.03	0.01
		*					3	141.35	6.12	0.01

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
	*	*	*		*	*	7	141.42	6.19	0.01
*							3	141.44	6.21	0.01
		*	*	*	*	*	7	141.49	6.26	0.01
	*			*	*	*	6	141.52	6.28	0.01
				*			3	141.52	6.29	0.01
	*						3	141.53	6.29	0.01
			*		*		4	141.97	6.73	0.00
*		*		*	*	*	7	142.08	6.84	0.00
*	*	*			*	*	7	142.23	7.00	0.00
*	*		*			*	6	142.29	7.06	0.00
*	*			*		*	6	142.37	7.13	0.00
*			*	*		*	6	142.39	7.16	0.00
	*	*		*	*	*	7	142.44	7.21	0.00
*					*		4	142.45	7.21	0.00
	*		*	*		*	6	142.50	7.27	0.00
		*			*		4	142.62	7.39	0.00
*	*		*		*	*	7	142.65	7.42	0.00
*			*	*	*	*	7	142.69	7.46	0.00
				*	*		4	142.99	7.75	0.00
	*				*		4	143.05	7.82	0.00
*	*			*	*	*	7	143.23	8.00	0.00
		*	*				4	143.36	8.13	0.00
*			*				4	143.52	8.28	0.00
			*	*			4	143.54	8.31	0.00
	*		*				4	143.57	8.34	0.00

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
*			*		*		5	143.61	8.38	0.00
		*	*		*		5	143.70	8.46	0.00
		*		*			4	143.73	8.49	0.00
*		*					4	143.74	8.50	0.00
	*		*	*	*	*	7	143.74	8.51	0.00
	*	*					4	143.75	8.52	0.00
*				*			4	143.84	8.60	0.00
*	*						4	143.84	8.61	0.00
	*	*	*	*		*	7	143.85	8.62	0.00
*	*	*	*			*	7	143.87	8.64	0.00
*		*	*	*		*	7	143.88	8.65	0.00
*	*	*	*		*	*	8	143.92	8.69	0.00
	*			*			4	143.93	8.69	0.00
*		*	*	*	*	*	8	143.99	8.76	0.00
*	*	*		*	*		7	144.05	8.82	0.00
	*	*	*	*	*	*	8	144.36	9.12	0.00
	*		*		*		5	144.38	9.15	0.00
			*	*	*		5	144.47	9.24	0.00
*		*			*		5	144.79	9.56	0.00
*				*	*		5	144.89	9.66	0.00
*	*				*		5	144.97	9.73	0.00
*	*	*		*	*	*	8	145.01	9.78	0.00
*	*		*	*		*	7	145.07	9.84	0.00
		*		*	*		5	145.13	9.90	0.00
	*	*			*		5	145.15	9.91	0.00

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
*	*		*	*	*	*	8	145.39	10.16	0.00
	*			*	*		5	145.51	10.27	0.00
		*	*	*			5	145.75	10.52	0.00
*		*	*		*		6	145.88	10.64	0.00
*		*	*				5	145.88	10.65	0.00
	*	*	*				5	145.89	10.65	0.00
*			*	*			5	145.99	10.75	0.00
*	*		*				5	146.03	10.80	0.00
	*		*	*			5	146.04	10.81	0.00
*	*		*		*		6	146.17	10.93	0.00
*		*		*			5	146.23	11.00	0.00
	*	*		*			5	146.25	11.01	0.00
*			*	*	*		6	146.25	11.02	0.00
*	*	*					5	146.26	11.02	0.00
	*	*	*		*		6	146.32	11.09	0.00
		*	*	*	*		6	146.34	11.10	0.00
*	*			*			5	146.36	11.13	0.00
*	*	*	*	*		*	8	146.80	11.56	0.00
*	*	*	*	*	*	*	9	147.00	11.77	0.00
	*		*	*	*		6	147.03	11.80	0.00
*		*		*	*		6	147.41	12.18	0.00
*	*	*			*		6	147.45	12.21	0.00
*	*			*	*		6	147.54	12.31	0.00
	*	*		*	*		6	147.78	12.55	0.00
	*	*	*	*			6	148.40	13.17	0.00

Exclosure	Sex	Scaled Mass Index	Age of clutch at capture	Date	Days between discovery and capture	Cover	df	AICc	ΔAIC	Akaike Weight
*		*	*	*			6	148.40	13.17	0.00
*	*	*	*				6	148.54	13.30	0.00
*	*		*	*			6	148.62	13.38	0.00
*	*	*	*		*		7	148.63	13.40	0.00
*		*	*	*	*		7	148.67	13.43	0.00
*	*	*		*			6	148.88	13.65	0.00
*	*		*	*	*		7	148.96	13.72	0.00
	*	*	*	*	*		7	149.10	13.87	0.00
*	*	*		*	*		7	150.20	14.97	0.00
*	*	*	*	*			7	151.19	15.96	0.00
*	*	*	*	*	*		8	151.57	16.34	0.00