Supplementary material

Appendix 1.

Senescence in the city: exploring ageing patterns of a long-lived raptor across an urban gradient

Figure A1. Juveniles and 1st year adults can be identified by plumage, since they will still show brown juvenile feathers during the breeding season in their first calendar year. Age estimation of adult Black Sparrowhawk was based on the colour of their eye. In a juvenile the eyes are yellow (top left). By the end of the first calendar year the eyes darken into orange brown (top right) which then progresses into a dark red colour (bottom left to right). Photos: author B.

Table A1. Generalized linear mixed model (negative binomial) for productivity in relation to the age since the first breeding attempt (to represent the relative contribution of within-individual variation) and the age at the first breeding attempt (to represent the relative contribution of between-individual variation) to account for selective appearance in **(a)** females (n=226) and **(b)** males (n=218). Note that territory ID and year were used as random terms.

(a) Productivity females	estimate	SE	z-value	χ^2	df	P-value	Sign.
Intercept	0.22	0.29	0.75	0.56	1	0.455	ns
Age since first breeding attempt	0.00	0.08	-0.06	0.00	1	0.952	ns
Age at first breeding	0.04	0.07	0.56	0.32	1	0.574	ns
binary 'first breeding attempt'	0.00	0.19	-0.01	0.00	1	0.990	ns
(b) Productivity males	estimate	SE	z-value	χ^2	df	P-value	Sign.
Intercept	0.08	0.31	0.25	0.06	1	0.805	ns
Age since first breeding attempt	0.05	0.10	0.51	0.26	1	0.612	ns
Age at first breeding	0.00	0.07	-0.03	0.00	1	0.977	ns
binary 'first breeding attempt'	0.17	0.21	0.83	0.69	1	0.406	ns

Table A2. GLM to test for selective disappearance in Black Sparrowhawks *Accipiter melanoleucus* in Cape Town, South Africa. Comparison on a year by year basis whether those individuals that disappear at a given age (fate: 'last breeding attempt') have higher productivity than those individuals that do not disappear (fate: 'continued breeding'). Models were fitted with 'fate' and 'sex' as predictor variables against the response variable productivity that followed a 'Poisson' distribution. No random terms were considered due to single fit errors, but we controlled for 'sex' throughout (i.e., repeated sample of male and female at the same nest and in the same breeding season). No statistically significant estimates were found.

age subset	model predictors	estimate	SE	z-value	p-value	continued breeding					last breeding attempt				
						lsmeans	SE	LCI	UCI	n	lsmeans	SE	LCI	UCI	n
6	fate	-0.09	0.20	-0.46	0.647	1.39	0.15	1.13	1.72	64	1.27	0.22	0.91	1.78	27
	sex	-0.09	0.18	-0.50	0.620										
	intercept	0.38	0.13	2.97	0.003										
7	fate	-0.10	0.22	-0.44	0.659	1.56	0.19	1.24	1.97	41	1.42	0.26	0.99	2.04	21
	sex	-0.07	0.20	-0.35	0.724										
	intercept	0.48	0.14	3.45	0.001										
8	fate	-0.42	0.38	-1.12	0.264	1.24	0.20	0.91	1.69	38	0.81	0.27	0.42	1.56	11
	sex	0.08	0.29	0.26	0.792										
	intercept	0.17	0.17	0.98	0.325										
9	fate	0.49	0.27	1.77	0.076	1.16	0.18	0.86	1.58	36	1.89	0.45	1.19	3.01	12
	sex	-0.02	0.27	-0.09	0.931										
	intercept	0.16	0.19	0.86	0.391										
10	fate	0.05	0.31	0.16	0.875	1.29	0.29	0.83	2.02	16	1.35	0.28	0.90	2.04	17
	sex	0.19	0.31	0.61	0.543										
	intercept	0.16	0.25	0.64	0.521										
11	fate	-0.16	0.40	-0.40	0.692	1.56	0.35	1.01	2.43	13	1.33	0.46	0.68	2.63	8
	sex	0.18	0.40	0.44	0.662										
	intercept	0.36	0.28	1.27	0.203										
12	fate	<0.001	0.58	<0.001	1.000	1.06	0.38	0.53	2.12	8	1.06	0.57	0.37	3.06	4
	sex	-0.69	0.71	-0.98	0.327										
	intercept	0.41	0.41	0.99	0.321										
13	fate	-0.33	1.19	-0.28	0.782	0.48	0.33	0.13	1.84	5	0.35	0.35	0.05	2.50	4
	sex	-1.02	1.19	-0.86	0.389										
	intercept	-0.22	0.62	-0.35	0.729										

Table A3. Linear mixed model for the timing of breeding (lay month) in relation to the age of the breeding adult in interaction with **(a)** sex (n=338) and **(b)** the urban gradient (n=338). Note that territory ID and year were used as random terms.

(a) Productivity decline × sex	estimate	SE	z-value	χ^2	df	P-value	Sign.
Intercept	0.36	0.11	3.16				
Sex (male)[‡]	-0.02	0.14	-0.14	0.39	1	0.5340	ns
Age	-0.17	0.09	-1.83	6.64	1	0.0100	**
Sex × age	-0.07	0.14	-0.47	0.22	1	0.6353	ns
(b) Productivity decline × urban gradient	estimate	SE	z-value	χ^2	df	P-value	Sign.
Intercept	0.36	0.10	3.71				
Urban gradient	-0.02	0.10	-0.16	0.29	1	0.5879	ns
Age	-0.20	0.08	-2.64	6.42	1	0.0113	**
Urban gradient × age	0.08	0.08	0.98	0.95	1	0.3286	ns

[‡] Females were used as a reference category.