SUPPLEMENTARY INFORMATION

DATA SOURCES

	Developmental mode	Male mating system	Female mating system	Male care	Female care	Male display agility	Male mass	Female mass	Male wing length	Female wing length
Actophilornis africanus	1	5	5	14	14	5	5	5	5	5
Aethia cristatella	1	2	2	15	15	2	15	15	15	15
Aethia pusilla	1	2	2	15	15	15			15	15
Aethia pygmaea	2								44	44
Alca torda	1	10	10	10	10		10	10	10	10
Alle alle	1	10	10	10	10	10	10	10	10	10
Anarhynchus frontalis	1	12	12	16	16	8	10	10	12	12
Anous minutus	1	12	12	3	3		3	3	3	3
Anous stolidus	1	5	5	3	3	3	3	3	3	3
Anous tenuirostris	3			3	3		3	3	3	3
Arenaria interpres	1	4	4	17	17	90	4	4	4	4
Arenaria melanocephala	1	2	2	18	18	2	95	95	2	2
Bartramia longicauda	2			2	2	2			2	2
Brachyramphus brevirostris	2									
Brachyramphus marmoratus	1			15	15	2	15	15	15	15
Burhinus capensis	1	5	5	5	5			5	5	5
Burhinus grallarius	1	12	12	19	19	12	94	94	94	94
Burhinus oedicnemus	1	4	4	20	20	4	4	4	4	4
Calidris alba	1	4	4	21	21	4	4	4	4	4
Calidris alpina	1	4	4	22	22	4	4	4	4	4
Calidris bairdii	1	2	2	23	23	90	4	4	4	4
Calidris canutus	4	4	4	24	24	4	4	4	4	4
Calidris fuscicollis	1	2	2	25	25	2	4	4	4	4
Calidris maritima	1	4	4	4	4	90, 99	4	4	4	4
Calidris mauri	1	2	2	26, 27	26, 27	90, 99	3	3	4	4
Calidris melanotos	1	2	2	28	28	90	4	4	4	4
Calidris minutilla	1	2	2	29	29	2	4	4	4	4
Calidris ptilocnemis	1	2	2	23	23	91	95	95	98	98
Calidris pusilla	1	2	2	30	30	91	4	4	4	4
Calidris temminckii	1	4	4	4, 31	4, 31	4	4	4	4	4
Catharacta lonnbergi	4									
Catharacta maccormickii	1	12	12	3	3	3, 90	94	94	94	94
Catharacta skua	1	4	4	3	3	32	3	3	3	3
Catoptrophorus semipalmatus	1	2	2	32	32	32	9	9	9	9
Cepphus columba	1	2	2	8	8		2	2	2	2
Cepphus grylle	1	2, 10	2, 10	15	15	10	15	15	15	15
Cerorhinca monocerata	1			2	2	2	2	2	2	2
Charadrius alexandrinus	4	2, 4	2, 4	33	33	4	4	4	4	4
Charadrius asiaticus	1			4	4	4	4	4	4	4
Charadrius bicinctus	1	12	12	12	12	12	12	12	12	12
Charadrius dubius	1	4	4	34	34	4	4	4	4	4
Charadrius hiaticula	1	4	4	4	4	4	4	4	4	4
Charadrius marginatus	5	5	5				5	5	5	5
Charadrius melodus	1	2	2	2	2	2	2	2	2	2
Charadrius montanus	6	2	2	35	35	2	9	9	9	9

Charadrius sanctaehelenae	7			36	36					
Charadrius semipalmatus	1	2	2	2	2		2	2		
Charadrius tricollaris	1	5	5	5	5	5				
Charadrius vociferus	1	2	2	37	37		4	4	4	4
Charadrius wilsonia	1			38	38		9	9	9	9
Chionis alba	1	12	12	39	39	12	12	12	12	12
Chionis minor	1	12	12	40	40	12	83	83	90	90
Chlidonias albostriatus	3									
Chlidonias hybridus	1	5	5	10	10	10	10	10	10	10
Chlidonias leucopterus	1	10	10	10	10				10	10
Chlidonias niger	1	10	10	4	4	4	4	4	4	4
Cladorhynchus leucocephalus	1			12	12	8	12	12	12	12
Coenocorypha aucklandica	1	3	3	41	41	3	3	3	3	3
Coenocorypha pusilla	1	3	3	41	41	3	3	3	3	3
Cursorius coromandelicus	1			42	42				42	42
Cursorius cursor	1			4	4	5	4	4	4	4
Cyclorhynchus psittacula	1	2	2	15	15	2	15	15	15	15
Dromas ardeola	8					90			4	4
Eudromias morinellus	1	4	4	43	43	4	4	4	4	4
Fratercula arctica	1	10	10	10	10	10	15	15	15	15
Fratercula cirrhata	1			44	44		2	2	2	2
Fratercula corniculata	2	2	2				2	2	2	2
Gallinago gallinago	1	4	4	45	45	4	4	4	4	4
Gallinago media	1	4	4	4	4	90	96	96	4	4
Glareola cinerea	1								5	5
Glareola pratincola	1	4	4	4	4	4	4	4	4	4
Gygis alba	1	3	3	3	3	2	3	3	3	3
Haematopus bachmani	1	2	2	46	46				90	90
Haematopus finschi	1	12	12	12	12	8	12	12	12	12
Haematopus fuliginosus	1	12	12	47	47	8	90	90	90	90
Haematopus longirostris	1	12	12	47	47	8	12	12	12	12
Haematopus moquini	1	5	5	48	48	5	5	5	5	5
Haematopus ostralegus	1	4	4	49	49	90	44	44	4	4
Haematopus palliatus	1	2	2	50	50				90	90
Haematopus unicolor	1	12	12	9	9		12	12	12	12
Himantopus himantopus	1	4	4	4	4	4	12	12	4	4
Himantopus mexicanus	1	2	2	51	51	2	2	2	2	2
Himantopus novaezelandiae	1	12	12	52	52		12	12		
Hydrophasianus chirurgus	1	13	13	53	53		97	97		
Ibidorhyncha struthersii	1			54	54				9	9
Irediparra gallinacea	1	12	12	8	8	8	12	12	12	12
Jacana jacana	1			55	55	92	9	9	9	9
Jacana spinosa	1	2	2	56	56	4	90	90	90	90
Larus argentatus	1	4	4	4	4	4	94	94	94	94
Larus atricilla	1	2	2	2	2	2	4	4	5	5
Larus audoinii	4	4	4	4	4	4			4	4
Larus californicus	1			2	2	2	2	2	2	2
Larus canus	1	4	4	4	4	4	4	4	4	4
Larus cirrocephalus	1			4	4	4	5	5	4	4
Larus delawarensis	1	2	2	2	2	2	2	2	5	5
Larus dominicanus	1	3	3	3	3	5	5	5	5	5

Larus fuscus	1	4	4	4	4	4	4	4	4	4
Larus genei	1	4	4	4	4	4	4	4	4	4
Larus glaucescens	1	2	2	2	2	2	2	2	2	2
Larus heermanni	2								2	2
Larus hemprichii	1			5	5	5	5	5	5	5
Larus hyperboreus	1	4	4	4	4	2	4	4	4	4
Larus ichthyaetus	1			4	4	4	4	4	4	4
Larus livens	1	2	2	2	2				2	2
Larus marinus	1	4	4	4	4	4	4	4	4	4
Larus melanocephalus	1	4	4	4	4	4			4	4
Larus minutus	1	2	2	4	4	4	4	4	4	4
Larus novaehollandiae	1	3	3	3	3	3	3	3	3	3
Larus occidentalis	1	2	2	2	2	2	2	2	2	2
Larus philadelphia	1			2	2		4	4	4	4
Larus pipixcan	1	2	2	2	2	2	3	3	3	3
Larus ridibundus	1	4	4	4	4	4	4	4	4	4
Limicola falcinellus	1	4	4	4	4	4			4	4
Limnodromus griseus	1	2	2	57	57	2	4	4	4	4
Limnodromus scolopaceus	1			8	8		4	4	4	4
Limosa fedoa	1	2	2	58, 100	58, 100		9	9	9	9
Limosa haemastica	1			59	59	93	9	9	9	9
Limosa lapponica	1	4	4	4	4	4	4	4	4	4
Limosa limosa	1	4	4	60	60	4	4	4	4	4
Micropalama himantopus	10	2	2	61	61	61	4	4	4	4
Microparra capensis	1			62	62	62			5	5
Numenius americanus	1	2	2	63	63	2	9	9	9	9
Numenius arquata	1	4	4	64	64	4	4	4	4	4
Numenius phaeopus	1	4	4	64	64	90	4	4	4	4
Numenius tahitiensis	1	2	2	65	65	2	9	9	9	9
Pagophila eburnea	1	4	4	4	4	4	4	4	4	4
Pedionomus torquatus	1	12	12	66	66	12	95	95	12	12
Phalaropus fulicaria	1	2	2	67	67	4	4	4	4	4
Phalaropus lobatus	1	2	2	68	68	4	4	4	4	4
Philomachus pugnax	1	4	4	4	4	4	4	4	4	4
Pluvialis apricaria	1	4	4	69	69	4	4	4	4	4
Pluvialis dominica	1	2	2	70	70		9	9	9	9
Pluvialis fulva	1	2	2	2	2		2	2	12	12
Pluvialis squatarola	1	4	4	4	4	4	90		90	90
Pluvianellus socialis	1			71	71		71	71	71	71
Recurvirostra americana	1	2	2	72	72		9	9	9	9
Recurvirostra avosetta	1	4	4	51	51	4	4	4	4	4
Rhinoptilus africanus	1	5	5	73	73	5	5	5		
Rissa brevirostris	1	2	2	2	2	2	95	95		
Rissa tridactyla	1	2	2	4	4	4	4	4	4	4
Rostratula benghalensis	1	4	4	74	74	12	4	4	4	4
Rynchops flavirostris	1	5	5	5	5		5	5	5	5
Rynchops niger	1	2	2	75	75	75	95	95	93	93
Scolopax minor	1	2	2	76	76	90	76	76	9	9
Scolopax rusticola	1	4	4	77	77	4	4	4	4	4
Steganopus tricolor	1	2	2	78	78	2	4	4	4	4
Stercorarius longicaudus	4	4	4				2	2	2	2

Stercorarius parasiticus	1	4	4	4	4	4	4	4	4	4
Stercorarius pomarinus	1	4	4	4	4	90	4	4	4	4
Sterna acuticauda	8									
Sterna albifrons	4	10	10	4	4		10	10	10	10
Sterna aleutica	2								2	2
Sterna anaethetus	3	10	10	3	3				3	3
Sterna antillarum	184	2	2	2	2	2	2	2	2	2
Sterna balaenarum	5	5	5	5	5				5	5
Sterna bengalensis	3			5	5					
Sterna bergii	1	10	10	10	10	3			3	3
Sterna caspia	4	10	10	4	4	4	4	4	4	4
Sterna dougallii	1	3	3	10	10	3			10	10
Sterna elegans	2								93	93
Sterna fuscata	2	3	3	2	2				10	10
Sterna hirundo	1	10	10	10	10	10	4	4	4	4
Sterna lunata	2									
Sterna nereis	3			3	3		3	3	3	3
Sterna paradisea	1	10	10	10	10	10	10	10	10	10
Sterna repressa	5	5	5						10	10
Sterna sandvicensis	10	10	10	10	10				10	10
Sterna striata	1	3	3	3	3	3	3	3	3	3
Sterna sumatrana	3	3	3	3	3	3	3	3	3	3
Sterna vittata	1			3	3					
Stiltia isabella	1			3	3	3, 90	3	3	3	3
Synthliboramphus antiquus	1			2	2		2	2	2	2
Synthliboramphus hypoleucos	1			15	15		2	2	15	15
Thinocorus orbignyianus	1			79	79	79	79	79	79	79
Thinocorus rumicivorus	1			79	79	79	79	79	79	79
Tringa erythropus	1	4	4	80	80	4	4	4	4	4
Tringa flavipes	2	2	2	2	2	91	4	4	4	4
Tringa glareola	1	4	4	4	4	4	4	4	4	4
Tringa hypoleucos	4	4	4	81	81	4	4	4	4	4
Tringa incana	1			2	2		3	3	3	3
Tringa macularia	4	2, 4	2, 4	82	82	90	4	4	4	4
Tringa melanoleuca	1			2	2	91	2	2	4	4
Tringa nebularia	1	4	4	69	69	4	4	4	4	4
Tringa ochropus	1	4	4	83	83	4	9	9	4	4
Tringa stagnatilis	1	4	4	4	4	4	4	4	4	4
Tringa totanus	1	4	4	4	4	4	4	4	4	4
Tryngites subruficollis	1	2	2	84	84	90	4	4	4	4
Uria aalge	1	10	10	10	10	94	15	15	15	15
Uria lomvia	1	10	10	10	10		15	15	15	15
Vanellus albiceps	5	5	5	5	5				5	5
Vanellus armatus	1	5	5	85	85	5	5	5	5	5
Vanellus chilensis	1			86	86				9	9
Vanellus coronatus	5	5	5	87	87		5	5	5	5
Vanellus crassirostris	1	5	5	86	86		5	5	5	5
Vanellus gregarius	1	4	4	4	4		4	4	4	4
Vanellus lugubris	1	5	5	87	87				5	5
Vanellus malabaricus	11			11	11				9	9
Vanellus miles	1	12	12	88	88	8	12	12	12	12

Vanellus senegallus	5	5	5	89	89				5	5
Vanellus spinosus	1	4	4	4	4	4	94	94	4	4
Vanellus tricolor	12	12	12	12	12	8			12	12
Vanellus vanellus	4	4	4	69	69	4	4	4	4	4
Xema sabini	1	4	4	4	4	4	4	4	4	4

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Simulations

We tested the adequacy of the maximum likelihood estimation of θ by randomisation under a Brownian motion model where θ = 1. If the method performs adequately, the maximum likelihood estimate of θ should not differ significantly from 1. We tested ordinal dummy data with three, five, and eight states (to match the range of ordinal data in our dataset) in addition to continuous dummy data. We generated a distribution of 1000 maximum likelihood estimates of θ to estimate the sampling interval and significance values. The results of the simulations are summarised below (Table 1). We found that for continuous data the Type I error rates (i.e. rejecting the null hypothesis of θ = 1) were very close to the 5% level. However, for ordinal data Type 1 errors increased as the number of trait states decreased. Consequently, the maximum likelihood estimates of θ for ordinal traits must be interpreted cautiously and we recommend carrying out simulations for all analyses of ordinal data. The ordinal traits in our analyses were male and female social mating system (five states), male and female parental care (eight states), and male display type and breeding habitat productivity (three states). If the maximum likelihood value of θ falls within the confidence limits of the simulated sampling interval then the null hypothesis of no difference in the Brownian variance of the two groups cannot be safely rejected, even if the likelihood ratio test suggests otherwise. For our data and phylogenies, the likelihood ratio tests and simulations were fully consistent.

Table 1. Simulated sampling intervals, mean and Type I error rate of θ for three, five, and eight state ordinal, and continuous traits estimated from dummy data for θ = 1 (1000 replicates).

Trait type	Lower confidence interval	Upper confidence interval	Mean	Type I error rate
Ordinal, 3 states	0.803	2.644	1.540	0.50
Ordinal, 5 states	0.846	2.077	1.380	0.38
Ordinal, 8 states	0.784	1.793	1.206	0.14
Continuous	0.683	1.498	1.029	0.05

Results for precocial coding

Table 2. Maximum likelihood estimates of θ and comparison of mean trait values. Eight species with uncertain developmental mode were classified as precocial.

	θ	χ^2	*P*	Semiprecocial taxa mean ± 95% confidence intervals	Precocial taxa mean ± 95% confidence intervals
Male mating system	0.303	26.446	<0.001	0.042 ± 0.036	0.274 ± 0.063
Female mating system	0.010	346.668	<0.001	0.562 ± 0.004	1.001 ± 0.037
Male care	0.010	407.179	<0.001	6.816 ± 0.007	6.309 ± 0.068
Female care	0.010	411.552	<0.001	5.933 ± 0.008	5.279 ± 0.072
Display agility	0.681	2.282	0.131	0.770 ± 0.035	0.609 ± 0.038
SSD body mass	0.489	9.911	0.002	-0.025 ± 0.002	-0.024 ± 0.003
SSD wing length	0.451	14.340	<0.001	-0.008 ± 0.001	-0.002 ± 0.001
Body mass	2.035	9.827	0.002	2.403 ± 0.015	2.210 ± 0.010
Wing length	6.069	67.675	<0.001	2.277 ± 0.009	2.229 ± 0.004

Results with reduced data set

Table 3. Maximum likelihood estimates of θ and comparison of mean trait values. Eight species with uncertain developmental mode were excluded.

	θ	χ^2	*P*	Semiprecocial taxa mean ± 95% confidence intervals	Precocial taxa mean ± 95% confidence intervals
Male mating system	0.369	18.503	<0.001	0.112 ± 0.037	0.154 ± 0.060
Female mating system	0.010	346.703	<0.001	0.510 ± 0.004	0.927 ± 0.037
Male care	0.010	408.509	<0.001	6.878 ± 0.006	6.203 ± 0.061
Female care	0.010	410.555	<0.001	6.271 ± 0.007	5.072 ± 0.075
Display agility	0.835	0.532	0.466	1.178 ± 0.034	0.120 ± 0.036
SSD body mass	0.579	5.568	0.018	-0.026 ± 0.002	-0.031 ± 0.003
SSD wing length	0.944	0.070	0.791	-0.012 ± 0.001	0.001 ± 0.001
Body mass	2.010	9.142	0.002	2.459 ± 0.015	2.214 ± 0.010
Wing length	6.696	69.265	<0.001	2.278 ± 0.009	2.226 ± 0.004