

R. E. RICKLEFS, LIFE HISTORY CONNECTIONS TO RATES OF AGING IN TERRESTRIAL VERTEBRATES

SUPPLEMENTARY INFORMATION

APPENDIX 1. Regression of log-transformed rate of aging as a function of body mass, incubation period, age at maturity, and presence or absence of flight across 124 families of vertebrates.

Table 1. The means of the log₁₀-transformed variables across 124 families.

Variable	N	Mean	Standard deviation	Minimum	Maximum
Adult mass	118	3.184	1.290	0.600	6.592
Omega	124	-0.989	0.237	-1.519	-0.247
m ₀	124	-1.190	0.354	-2.199	-0.400
Egg mass	89	1.834	1.301	-1.750	5.025
Incubation period	104	1.779	0.472	0.300	2.817
Postnatal growth rate	65	-1.682	0.703	-3.523	-0.451
Age at maturity	90	2.795	0.387	1.781	3.675

Regression results using log₁₀-transformed data for all four vertebrate classes with omega as a function of body mass, length of the gestation/incubation period, age at female sexual maturity, presence or absence of flight.

Overall model: $F_{4,82} = 34.9$, $P < 0.0001$, $R^2 = 0.630$; equation: $\log_{10}\omega =$

$-0.0365 \log_{10}\text{body mass} (\pm 0.0174 \text{ SE})$, $F_{1,82} = 4.41$, $P = 0.039$ (stand. coeff. = -0.208)

$-0.1416 \log_{10}\text{incubation period} (\pm 0.0487 \text{ SE})$, $F_{1,82} = 8.47$, $P = 0.0047$ (stand. coeff. = -0.289)

$-0.3141 \log_{10}\text{age at maturity} (\pm 0.0455 \text{ SE})$, $F_{1,82} = 47.6$, $P < 0.0001$ (stand. coeff. = -0.524)

$-0.1951 \log_{10}\text{flight} (0 \text{ or } 1) (\pm 0.0392 \text{ SE})$, $F_{1,82} = 24.8$, $P < 0.0001$ (stand. coeff. = -0.388)

Note: the standardized regression coefficients (stand. coeff.) are normalized by the standard deviations of the dependent and independent variables.

After eliminating egg mass and postnatal growth rate (K) as non-significant independent variables, the lowest AICc value was for a model including adult mass, m_0 , incubation/gestation period, age at maturity, and presence/absence of flight. The weight (w_i) for this model was 0.455; variable weights were adult mass = 0.681 (weighted regression coefficient = -0.036), $m_0 = 0.373$ (0.063), incubation/gestation period = 0.972 (-0.159), age a maturity = 1.00 (-0.315), and presence/absence of flight = 1.00 (-0.188).

APPENDIX 2. Regression of log-transformed rate of aging as a function of body mass, incubation period, age at maturity, and presence or absence of flight across 51 families of mammals.

Table 1. The means of the log₁₀-transformed variables across 51 families.

Variable	N	Mean	Standard		
			deviation	Minimum	Maximum
Omega	51	-0.973	0.253	-1.519	-0.247
m ₀	51	-1.156	0.379	-2.199	-0.544
Incubation period	51	2.056	0.364	1.079	2.817
Age at maturity	51	2.738	0.389	1.781	3.560

Regression results using log₁₀-transformed data for mammals only with omega as a function of body mass, length of the gestation/incubation period, age at female sexual maturity, presence or absence of flight.

Overall model: $F_{3,47} = 47.8$, $P < 0.0001$, $R^2 = 0.753$; equation: $\log_{10}\omega = 0.490 (\pm 0.135 \text{ SE})$

+0.1437 $\log_{10}m_0$ ($\pm 0.0604 \text{ SE}$), $F_{1,47} = 5.66$, $P = 0.022$ (stand. coeff. = 0.215)

-0.1509 \log_{10} gestation period ($\pm 0.0713 \text{ SE}$), $F_{1,47} = 4.48$, $P < 0.040$ (stand. coeff. = -0.217)

-0.3604 \log_{10} age at maturity ($\pm 0.0729 \text{ SE}$), $F_{1,47} = 24.4$, $P < 0.0001$ (stand. coeff. = -0.553)

Note: the standardized regression coefficients (stand. coeff.) are normalized by the standard deviations of the dependent and independent variables.

After eliminating egg mass, postnatal growth rate (K), and presence/absence of flight as non-significant independent variables, the lowest AICc value was for a model including adult mass, m_0 , incubation/gestation period, weaning period, and age at maturity. The weight (w_i) for this model was 0.227; variable weights were adult mass = 0.235 (weighted regression coefficient = 0.0083), $m_0 = 0.793$ (0.124), incubation/gestation period = 0.791 (-0.160), age at weaning = 0.521 (-0.120), and age a maturity = 0.995 (-0.353).

APPENDIX 3. Estimation of B/M for birds and mammals.

When more independent offspring are produced in a population than the number of adults that die each year, then the age at maturity must be delayed until the survival of adult recruits equals the annual adult mortality. Equation (3) derived for such a balanced population is $a = -\log(B/M)/\log(S)$, where a is the age at maturity, B is the annual fecundity, M is the annual adult mortality ($1 - S$), and S is the annual adult survival.

For the data provided by Saether and Bakke (1) for a sample of 49 species of birds, annual fecundity (number of female offspring produced to fledging [not independence] per female) is related to annual mortality by regression (SAS GLM procedure) through the origin by $B = 3.34 (\pm 0.25 \text{ SE}) M$. The ratio logarithm of the ratio B/M can be estimated from the slope of the regression through the origin of age at maturity (a) as a function of $-1/\log(S)$. In this case, the slope is $0.519 (\pm 0.028 \text{ SE})$, which corresponds to $B/M = 1.68$. The ratio B/M also can be estimated by nonlinear regression (SAS NLIN procedure) from the relationship between a and the logarithm of S , giving $B/M = 1.68 (\pm 0.05 \text{ SE}, 95\% \text{ CI} = 1.59-1.78)$ ($F_{1,48} = 341, P < 0.0001$). The estimate of B/M from the age at first reproduction and S is about half the estimate from the regression of B (fledged offspring) on M , which implies that first-year survival of fledged young averages about one-half the annual adult survival.

For the data provided by Ricklefs (2) for a sample of 34 species of birds (only 14 of which were common to the data of Saether and Bakke), annual fecundity (total number of offspring produced to fledging [not independence] per breeding pair) is related to annual mortality by $B = 5.68 (\pm 0.37 \text{ SE})$, or 2.84 female offspring per female. The slope of a versus $-1/\log(S)$ is $0.477 (\pm 0.024 \text{ SE})$, implying $B/M = 1.61$. The ratio B/M estimated by nonlinear regression was $B/M = 1.61 (\pm 0.04 \text{ SE}, 95\% \text{ CI} = 1.53-1.69)$ ($F_{1,33} = 385, P < 0.0001$). Because the estimate of B/M from the age at first reproduction and S (1.61) is 57% of the estimate from the regression of B on M (2.84), first-year survival of fledged young averages about 57% of the annual adult survival.

For the data summarized by Millar and Zammuto (3) for 26 species of mammals with $M < 0.80$, annual fecundity (litter size) is related to annual mortality by $B = 11.34 (\pm 0.80 \text{ SE})$, or 5.67 female offspring per female. The slope of a versus $-1/\log(S)$ was $0.674 (\pm 0.028 \text{ SE})$, implying $B/M = 1.96$. The ratio B/M estimated by nonlinear regression was $1.96 (\pm 0.05 \text{ SE}, 95\% \text{ CI} = 1.86-2.07)$ ($F_{1,28} = 650, P < 0.0001$). Because the estimate of B/M from the age at first reproduction and S (1.96) was 35% of the estimate from the regression of B on M , first-year survival of newborn young averages 35% of the annual adult survival.

APPENDIX 4. Parameters of Weibull functions ($m_x = m_0 + ax^b$, where $\omega = a^{1/(b+1)}$) fitted to the proportion of individuals surviving as a function of age. Status refers to data from zoo or wild populations. All the zoo data were provided by the International Species Information System (ISIS; www.isis.org/). Weibull parameters for wild populations were obtained from Ricklefs (4) or from Weibull functions fitted to data in Lunch and Fagan (5, Note a) or Loison et al. (6, Note b). References are at the end of the Supplemental Information. n is the number of reported ages at death; oldest is the age (years) of the maximum reported age at death in the sample.

Mammals

Order	Family	Genus	Species	Status	b	a	m_0	ω	n	oldest	Notes
Artiodactyla	Antilocapridae	<i>Antilocapra</i>	<i>americana</i>	zoo	2.02	3.19E-03	0.234	0.149	364	15.15	
Artiodactyla	Bovidae	<i>Addax</i>	<i>nasomaculatus</i>	zoo	3.27	1.90E-05	0.038	0.078	142	27.68	
Artiodactyla	Bovidae	<i>Aepyceros</i>	<i>melampus</i>	wild	1.10	4.84E-02	0.007	0.237	.	.	a
Artiodactyla	Bovidae	<i>Aepyceros</i>	<i>melampus</i>	zoo	4.28	2.54E-06	0.111	0.087	208	20.33	
Artiodactyla	Bovidae	<i>Ammotragus</i>	<i>lervia</i>	zoo	2.13	7.01E-04	0.085	0.098	182	27.95	
Artiodactyla	Bovidae	<i>Antilope</i>	<i>cervicapra</i>	zoo	3.09	1.28E-04	0.129	0.112	567	22.97	
Artiodactyla	Bovidae	<i>Bison</i>	<i>bison</i>	zoo	3.00	1.84E-05	0.028	0.065	166	33.29	
Artiodactyla	Bovidae	<i>Bos</i>	<i>frontalis</i>	zoo	2.01	5.68E-04	0.141	0.083	32	24.76	
Artiodactyla	Bovidae	<i>Bos</i>	<i>grunniens</i>	zoo	2.92	4.04E-05	0.061	0.076	103	26.26	
Artiodactyla	Bovidae	<i>Bos</i>	<i>javanicus</i>	zoo	3.94	2.07E-06	0.064	0.071	92	23.83	
Artiodactyla	Bovidae	<i>Bos</i>	<i>taurus</i>	zoo	3.88	4.71E-06	0.061	0.081	48	21.91	
Artiodactyla	Bovidae	<i>Bubalus</i>	<i>bubalis</i>	zoo	4.49	4.34E-07	0.042	0.069	42	42.58	
Artiodactyla	Bovidae	<i>Capra</i>	<i>falconeri</i>	zoo	2.77	1.00E-04	0.105	0.087	79	24.56	
Artiodactyla	Bovidae	<i>Capra</i>	<i>hircus</i>	zoo	1.90	1.12E-03	0.146	0.096	109	20.16	
Artiodactyla	Bovidae	<i>Capra</i>	<i>ibex ibex</i>	zoo	3.03	6.42E-05	0.103	0.091	113	21.56	
Artiodactyla	Bovidae	<i>Connochaetes</i>	<i>taurinus</i>	zoo	3.55	1.78E-05	0.058	0.091	37	23.80	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>lunata</i>	wild	.	.	0.166	0.311	.	.	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>lunata</i>	wild	.	.	0.182	0.326	.	.	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>lunata</i>	wild	2.54	1.88E-02	0.094	0.325	.	.	a
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>pygargus</i>	zoo	3.95	1.33E-05	0.063	0.104	71	17.12	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>pygargus</i>	zoo	2.57	4.65E-04	0.086	0.116	205	18.64	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>gazella</i>	zoo	3.03	2.77E-04	0.095	0.131	69	14.57	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>granti</i>	zoo	3.16	5.00E-05	0.155	0.092	169	19.75	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>subgutturosa</i>	zoo	1.05	9.36E-02	0.057	0.315	206	14.57	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>thomsonii</i>	zoo	2.93	8.30E-05	0.132	0.092	278	21.45	
Artiodactyla	Bovidae	<i>Hemitragus</i>	<i>jemlahicus</i>	zoo	2.29	3.83E-04	0.116	0.092	397	27.30	
Artiodactyla	Bovidae	<i>Hemitragus</i>	<i>jemlahicus</i>	wild	1.60	9.19E-03	0.058	0.165	.	.	a

Artiodactyla	Bovidae	<i>Hippotragus</i>	<i>equinus</i>	zoo	3.71	1.69E-05	0.097	0.097	139	17.95	
Artiodactyla	Bovidae	<i>Hippotragus</i>	<i>niger</i>	zoo	2.80	8.13E-05	0.070	0.084	200	23.66	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>ellipsiprymnus</i>	zoo	4.59	1.05E-06	0.049	0.085	25	23.33	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>kob</i>	wild	.	.	0.206	0.242	.	.	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>leche</i>	zoo	3.25	4.05E-05	0.053	0.093	38	23.72	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>megaceros</i>	zoo	3.12	9.07E-05	0.056	0.104	80	18.88	
Artiodactyla	Bovidae	<i>Oreamnos</i>	<i>americanus</i>	zoo	2.23	9.95E-04	0.071	0.118	104	15.98	
Artiodactyla	Bovidae	<i>Oryx</i>	<i>dammah</i>	zoo	2.29	1.60E-03	0.124	0.141	58	19.2548	
Artiodactyla	Bovidae	<i>Oryx</i>	<i>leucoryx</i>	zoo	3.84	6.04E-06	0.047	0.084	57	20.6274	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>aries</i>	zoo	3.71	1.02E-05	0.099	0.087	54	18.06	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>canadensis</i>	wild	3.16	9.60E-05	0.0527	0.108	.	.	b
Artiodactyla	Bovidae	<i>Ovis</i>	<i>canadensis</i>	wild	6.35	1.00E-08	0.0827	0.0815	.	.	b
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	wild	.	.	0.107	0.118	.	.	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	wild	.	.	0.049	0.170	.	.	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	wild	4.39	3.20E-05	0.000	0.147	.	.	a
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	wild	5.71	1.02E-06	0.046	0.128	.	.	a
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	wild	1.56	7.14E-03	0.038	0.145	.	.	a
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>rupicapra</i>	zoo	0.62	2.39E-02	0.109	0.100	26	15.75	
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>rupicapra</i>	wild	.	.	0.219	0.211	.	.	
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>pyrenaica</i>	wild	2.39	3.50E-04	0.0574	0.0957	.	.	b
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>pyrenaica</i>	wild	6.22	1.00E-08	0.0787	0.0779	.	.	b
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>rupicapra</i>	wild	1.87	2.37E-02	0.000	0.271	.	.	a
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	wild	1.14	2.26E-02	0.000	0.170	.	.	a
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	zoo	4.26	4.72E-07	0.020	0.063	39	27.30	
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	wild	.	.	0.092	0.084	.	.	
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	wild	.	.	0.026	0.096	.	.	
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	wild	.	.	0.026	0.119	.	.	
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	wild	.	.	0.030	0.143	.	.	
Artiodactyla	Camelidae	<i>Camelus</i>	<i>bactrianus</i>	zoo	2.03	2.77E-04	0.012	0.067	71	35.99	
Artiodactyla	Camelidae	<i>Camelus</i>	<i>dromedarius</i>	zoo	3.36	7.11E-06	0.036	0.066	149	33.59	
Artiodactyla	Camelidae	<i>Lama</i>	<i>glama</i>	zoo	2.32	1.90E-04	0.041	0.076	54	28.04	
Artiodactyla	Camelidae	<i>Lama</i>	<i>guanicoe</i>	zoo	2.15	3.54E-04	0.021	0.081	37	32.58	
Artiodactyla	Cervidae	<i>Alces</i>	<i>alces</i>	zoo	1.45	5.70E-03	0.091	0.121	125	15.77	
Artiodactyla	Cervidae	<i>Axis</i>	<i>axis</i>	zoo	3.13	3.75E-05	0.125	0.085	224	73.90	
Artiodactyla	Cervidae	<i>Capreolus</i>	<i>capreolus</i>	zoo	2.92	9.05E-04	0.044	0.167	25	12.23	
Artiodactyla	Cervidae	<i>Capreolus</i>	<i>capreolus</i>	wild	6.98	1.00E-08	0.1656	0.0994	.	.	b
Artiodactyla	Cervidae	<i>Capreolus</i>	<i>capreolus</i>	wild	1.96	7.50E-04	0.0408	0.088	.	.	b
Artiodactyla	Cervidae	<i>Cervus</i>	<i>elaphus</i>	wild	.	.	0.050	0.112	.	.	
Artiodactyla	Cervidae	<i>Cervus</i>	<i>elaphus</i>	wild	.	.	0.025	0.115	.	.	
Artiodactyla	Cervidae	<i>Cervus</i>	<i>elaphus</i>	zoo	3.92	3.28E-06	0.054	0.077	144	22.55	

Artiodactyla	Cervidae	<i>Damaliscus</i>	<i>dama</i>	zoo	1.11	1.36E-02	0.028	0.131	157	32.29	
Artiodactyla	Cervidae	<i>Odocoileus</i>	<i>virginianus</i>	zoo	4.38	4.74E-06	0.116	0.103	34	20.07	
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandrus</i>	wild	1.60	7.31E-03	0.051	0.151	.	.	a
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandus</i>	wild	.	.	0.076	0.111	.	.	
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandus</i>	wild	.	.	0.076	0.212	.	.	
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandus</i>	zoo	3.44	2.69E-04	0.131	0.157	87	18.48	
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandus</i>	zoo	3.17	6.35E-05	0.095	0.099	313	22.70	
Artiodactyla	Giraffidae	<i>Giraffa</i>	<i>camelopardalis</i>	zoo	2.64	3.59E-05	0.027	0.060	93	39.93	
Artiodactyla	Giraffidae	<i>Giraffa</i>	<i>camelopardalis</i>	zoo	1.88	4.19E-04	0.022	0.067	51	31.82	
Artiodactyla	Giraffidae	<i>Giraffa</i>	<i>camelopardalis</i>	zoo	3.85	9.39E-07	0.053	0.057	59	29.90	
Artiodactyla	Hippopotamidae	<i>Hippopotamus</i>	<i>amphibius</i>	zoo	3.30	3.41E-07	0.002	0.031	27	61.21	
Artiodactyla	Hippopotamidae	<i>Hippopotamus</i>	<i>amphibius</i>	wild	.	.	0.030	0.048	.	.	
Artiodactyla	Hippopotamidae	<i>Hippopotamus</i>	<i>amphibius</i>	wild	4.70	1.00E-08	0.005	0.040	.	.	a
Artiodactyla	Suidae	<i>Sus</i>	<i>scrofa</i>	zoo	2.49	4.81E-04	0.044	0.112	35	19.46	
Carnivora	Ailuropodidae	<i>Ailurus</i>	<i>fulgens</i>	zoo	3.11	5.35E-05	0.096	0.091	209	17.35	
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	zoo	2.67	1.34E-04	0.025	0.088	91	16.00	
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	zoo	4.82	1.58E-06	0.008	0.101	38	11.00	
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	zoo	4.93	1.41E-05	0.042	0.152	23	10.00	
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	zoo	1.98	5.08E-03	0.000	0.170	89	14.00	
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	zoo	3.01	1.03E-04	0.052	0.101	414	27.81	
Carnivora	Canidae	<i>Chrysocyon</i>	<i>brachyurus</i>	zoo	5.42	2.96E-07	0.049	0.096	146	20.00	
Carnivora	Canidae	<i>Lycaon</i>	<i>pictus</i>	zoo	5.91	4.24E-07	0.070	0.119	210	13.65	
Carnivora	Canidae	<i>Vulpes</i>	<i>vulpes</i>	zoo	3.18	7.22E-05	0.089	0.102	50	16.47	
Carnivora	Felidae	<i>Acinonyx</i>	<i>jubatus</i>	zoo	3.42	3.82E-05	0.046	0.100	575	27.32	
Carnivora	Felidae	<i>Felis</i>	<i>silvestris</i>	zoo	2.74	2.53E-04	0.062	0.109	83	.	
Carnivora	Felidae	<i>Lynx</i>	<i>lynx</i>	zoo	5.32	4.47E-07	0.086	0.099	24	21.51	
Carnivora	Felidae	<i>Panthera</i>	<i>leo</i>	zoo	2.49	1.69E-04	0.010	0.083	350	51.52	
Carnivora	Felidae	<i>Panthera</i>	<i>leo</i>	wild	.	.	0.032	0.126	.	.	
Carnivora	Felidae	<i>Panthera</i>	<i>onca</i>	zoo	3.21	1.22E-05	0.018	0.068	225	35.09	
Carnivora	Felidae	<i>Panthera</i>	<i>pardus</i>	zoo	2.32	2.06E-04	0.012	0.078	486	36.72	
Carnivora	Felidae	<i>Panthera</i>	<i>tigris</i>	zoo	2.95	3.70E-05	0.019	0.076	199	46.83	
Carnivora	Felidae	<i>Panthera</i>	<i>tigris altaica</i>	zoo	6.18	9.04E-09	0.053	0.076	501	22.19	
Carnivora	Felidae	<i>Uncia</i>	<i>uncia</i>	zoo	3.78	7.52E-06	0.042	0.085	157	35.96	
Carnivora	Herpestidae	<i>Suricata</i>	<i>suricatta</i>	zoo	2.81	3.72E-04	0.104	0.126	137	20.63	
Carnivora	Hyaenidae	<i>Crocuta</i>	<i>crocuta</i>	zoo	2.94	8.60E-06	0.039	0.052	52	42.16	
Carnivora	Mustelidae	<i>Lutra</i>	<i>lutra</i>	zoo	5.91	5.13E-07	0.172	0.123	47	11.40	
Carnivora	Mustelidae	<i>Martes</i>	<i>zibellina</i>	wild	.	.	0.280	0.153	.	.	
Carnivora	Mustelidae	<i>Mephitis</i>	<i>mephitis</i>	zoo	3.15	8.89E-04	0.114	0.184	188	36.27	
Carnivora	Mustelidae	<i>Mustela</i>	<i>putorius</i>	zoo	2.84	2.03E-03	0.117	0.199	158	17.96	
Carnivora	Mustelidae	<i>Mustela</i>	<i>putorius</i>	zoo	2.57	3.24E-03	0.100	0.201	83	17.96	

Carnivora	Mustelidae	<i>Myodes</i>	<i>glareolus</i>	wild	5.40	1.07E-07	*.2827	0.979	.	.	a
Carnivora	Otaridae	<i>Callorhinus</i>	<i>ursinus</i>	wild	.	.	0.051	0.096	.	.	
Carnivora	Otaridae	<i>Callorhinus</i>	<i>ursinus</i>	wild	4.55	7.52E-07	0.037	0.079	.	.	a
Carnivora	Phocidae	<i>Phoca</i>	<i>hispidia</i>	wild	.	.	0.032	0.056	.	.	
Carnivora	Phocidae	<i>Phoca</i>	<i>hispidia</i>	wild	.	.	0.063	0.057	.	.	
Carnivora	Phocidae	<i>Phoca</i>	<i>vitulina</i>	zoo	3.84	6.39E-06	0.033	0.084	15	47.62	
Carnivora	Phocidae	<i>Phoca</i>	<i>vitulina</i>	zoo	2.43	1.12E-04	0.018	0.070	59	47.62	
Carnivora	Procyonidae	<i>Nasua</i>	<i>nasua</i>	zoo	1.95	1.39E-03	0.035	0.107	79	20.67	
Carnivora	Procyonidae	<i>Potos</i>	<i>flavus</i>	zoo	1.07	9.17E-03	0.029	0.103	66	35.29	
Carnivora	Procyonidae	<i>Procyon</i>	<i>lotor</i>	zoo	1.90	1.33E-03	0.066	0.102	87	36.34	
Carnivora	Ursidae	<i>Ursus</i>	<i>americanus</i>	zoo	3.61	2.10E-06	0.010	0.059	63	38.87	
Carnivora	Ursidae	<i>Ursus</i>	<i>americanus</i>	wild	5.68	2.06E-08	0.171	0.071	.	.	a
Carnivora	Ursidae	<i>Ursus</i>	<i>arctos</i>	zoo	3.27	2.67E-06	0.026	0.050	39	35.38	
Carnivora	Ursidae	<i>Ursus</i>	<i>arctos</i>	zoo	3.60	4.56E-07	0.006	0.042	38	50.73	
Carnivora	Ursidae	<i>Ursus</i>	<i>horribilis</i>	wild	3.25	1.20E-05	0.060	0.069	.	.	a
Cetacea	Delphinidae	<i>Tursiops</i>	<i>truncatus</i>	wild	2.52	4.80E-05	0.013	0.059	.	.	a
Chiroptera	Desmodontidae	<i>Desmodus</i>	<i>rotundus</i>	zoo	3.34	9.82E-06	0.057	0.070	28	30.25	
Chiroptera	Desmodontidae	<i>Desmodus</i>	<i>rotundus</i>	wild	5.98	3.35E-08	0.207	0.085	.	.	a
Chiroptera	Phyllostomatidae	<i>Carollia</i>	<i>perspicillata</i>	zoo	3.54	7.11E-04	0.173	0.202	58	16.12	
Chiroptera	Pteropodidae	<i>Pteropus</i>	<i>rodricensis</i>	zoo	3.86	8.36E-05	0.100	0.145	36	24.07	
Chiroptera	Pteropodidae	<i>Rousettus</i>	<i>egyptiacus</i>	zoo	3.70	2.39E-05	0.149	0.104	91	16.30	
Chiroptera	Vespertilionidae	<i>Pipistrellus</i>	<i>pipistrellus</i>	wild	5.49	2.30E-05	0.274	0.193	.	.	a
Didelphimorphia	Didelphis	<i>Didelphis</i>	<i>vrginiana</i>	zoo	3.56	6.15E-03	0.333	0.327	113	8.33	
Diprodonta	Acrobatidae	<i>Acrobatas</i>	<i>pygmaeus</i>	zoo	2.36	1.42E-02	0.107	0.282	19	8.76	
Diprodonta	Macropodidae	<i>Macropus</i>	<i>rufus</i>	zoo	2.45	3.62E-04	0.115	0.101	361	34.53	
Diprodonta	Phascolarctidae	<i>Phascolarctos</i>	<i>cinereus</i>	zoo	1.40	7.74E-03	0.030	0.132	30	17.00	
Insectivora	Erinaceidae	<i>Atelerix</i>	<i>albiventris</i>	zoo	2.36	2.05E-02	0.056	0.314	196	9.68	
Lagomorpha	Leporidae	<i>Oryctolagus</i>	<i>cuniculus</i>	zoo	3.43	3.95E-04	0.218	0.171	145	13.57	
Lagomorpha	Leporidae	<i>Sylvilagus</i>	<i>floridanus</i>	wild	4.80	9.93E-09	0.137	0.499	.	.	a
Perrisodactyla	Equidae	<i>Equus</i>	<i>burchelli</i>	wild	.	.	0.057	0.094	.	.	
Perrisodactyla	Equidae	<i>Equus</i>	<i>burchelli</i>	wild	.	.	0.064	0.106	.	.	
Perrisodactyla	Equidae	<i>Equus</i>	<i>burchelli</i>	zoo	3.65	1.97E-06	0.034	0.059	119	29.84	
Perrisodactyla	Equidae	<i>Equus</i>	<i>burchelli</i>	zoo	3.49	2.27E-06	0.066	0.056	158	31.46	
Perrisodactyla	Equidae	<i>Equus</i>	<i>burchelli</i>	wild	3.46	2.40E-05	0.042	0.092	.	.	a
Perrisodactyla	Equidae	<i>Equus</i>	<i>caballus</i>	zoo	2.39	2.17E-04	0.011	0.083	3322	31.00	
Perrisodactyla	Equidae	<i>Equus</i>	<i>caballus</i>	zoo	2.27	3.21E-04	0.002	0.086	1535	30.00	
Perrisodactyla	Equidae	<i>Equus</i>	<i>caballus</i>	zoo	3.30	1.64E-06	0.034	0.045	135	33.05	
Perrisodactyla	Equidae	<i>Equus</i>	<i>caballus</i>	wild	4.78	1.41E-07	0.000	0.065	.	.	a
Perrisodactyla	Equidae	<i>Equus</i>	<i>asinus</i>	zoo	2.40	1.93E-04	0.054	0.081	44	39.0548	
Primates	Callitrichidae	<i>Callimico</i>	<i>goeldii</i>	zoo	1.81	2.02E-03	0.062	0.110	103	21.08	

Primates	Callitrichidae	<i>Callithrix</i>	<i>geoffroyi</i>	zoo	4.42	7.23E-06	0.161	0.113	94	13.09
Primates	Callitrichidae	<i>Callithrix</i>	<i>jacchus</i>	zoo	2.63	1.08E-04	0.247	0.081	133	18.48
Primates	Callitrichidae	<i>Callithrix</i>	<i>penicillata</i>	zoo	2.27	1.47E-03	0.193	0.136	25	12.42
Primates	Callitrichidae	<i>Callithrix</i>	<i>pygmaea</i>	zoo	2.89	1.29E-04	0.186	0.100	121	17.02
Primates	Callitrichidae	<i>Leontopithecus</i>	<i>rosalia</i>	zoo	5.03	2.76E-07	0.115	0.082	316	24.78
Primates	Callitrichidae	<i>Saguinus</i>	<i>imperator</i>	zoo	4.36	3.94E-06	0.096	0.098	88	19.23
Primates	Callitrichidae	<i>Saguinus</i>	<i>midas</i>	zoo	1.59	6.13E-03	0.098	0.140	30	15.50
Primates	Callitrichidae	<i>Saguinus</i>	<i>oedipus</i>	zoo	3.32	1.18E-05	0.143	0.072	346	24.94
Primates	Cebidae	<i>Alouatta</i>	<i>caraya</i>	zoo	0.96	7.61E-03	0.051	0.083	36	26.05
Primates	Cebidae	<i>Ateles</i>	<i>fusciceps</i>	zoo	1.58	1.05E-03	0.058	0.070	32	31.31
Primates	Cebidae	<i>Ateles</i>	<i>geoffroyi</i>	zoo	3.65	1.85E-07	0.049	0.036	55	41.99
Primates	Cebidae	<i>Cebus</i>	<i>apella</i>	zoo	5.20	1.00E-10	0.091	0.024	62	46.18
Primates	Cebidae	<i>Cebus</i>	<i>capucinus</i>	zoo	4.52	5.66E-08	0.092	0.049	24	47.95
Primates	Cebidae	<i>Pithecia</i>	<i>pithecia</i>	zoo	5.37	4.44E-09	0.163	0.049	89	36.18
Primates	Cebidae	<i>Saimiri</i>	<i>boliviensis</i>	zoo	3.72	1.06E-05	0.028	0.088	48	23.01
Primates	Cebidae	<i>Saimiri</i>	<i>sciureus</i>	zoo	1.52	2.18E-03	0.051	0.088	233	37.75
Primates	Cebidae	<i>Saimiri</i>	<i>sciureus</i>	zoo	3.56	1.73E-05	0.076	0.090	29	18.71
Primates	Cercopithecidae	<i>Cercocebus</i>	<i>torquatus</i>	zoo	4.09	8.68E-07	0.064	0.064	34	25.96
Primates	Cercopithecidae	<i>Cercopithecus</i>	<i>diana</i>	zoo	2.71	2.87E-05	0.053	0.060	60	32.78
Primates	Cercopithecidae	<i>Cercopithecus</i>	<i>neglectus</i>	zoo	0.74	1.78E-02	0.016	0.099	128	30.76
Primates	Cercopithecidae	<i>Erythrocebus</i>	<i>patas</i>	zoo	3.29	1.37E-05	0.053	0.073	115	27.91
Primates	Cercopithecidae	<i>Macaca</i>	<i>fascicularis</i>	zoo	2.97	9.96E-06	0.075	0.055	48	29.85
Primates	Cercopithecidae	<i>Macaca</i>	<i>fuscata</i>	zoo	4.95	2.59E-09	0.051	0.036	26	39.66
Primates	Cercopithecidae	<i>Macaca</i>	<i>mulatta</i>	zoo	4.02	7.13E-07	0.014	0.060	16	28.70
Primates	Cercopithecidae	<i>Macaca</i>	<i>nemestrina</i>	zoo	4.25	5.24E-08	0.066	0.041	44	32.06
Primates	Cercopithecidae	<i>Macaca</i>	<i>nigra</i>	zoo	2.36	1.25E-04	0.057	0.069	97	45.13
Primates	Cercopithecidae	<i>Macaca</i>	<i>silenus</i>	zoo	3.60	5.41E-07	0.042	0.043	88	38.4192
Primates	Cercopithecidae	<i>Macaca</i>	<i>sylvanus</i>	zoo	3.25	1.22E-05	0.057	0.070	48	25.7781
Primates	Cercopithecidae	<i>Mandrillus</i>	<i>sphinx</i>	zoo	3.02	1.20E-05	0.043	0.060	204	39.58
Primates	Cercopithecidae	<i>Papio</i>	<i>hyamadryas</i>	zoo	2.12	1.80E-04	0.065	0.063	37	29.99
Primates	Cercopithecidae	<i>Theropithecus</i>	<i>gelada</i>	zoo	2.72	4.43E-05	0.040	0.068	102	32.78
Primates	Cercopithecidae	<i>Macaca</i>	<i>mulata</i>	wild	.	.	0.087	0.059	.	.
Primates	Hominidae	<i>Gorilla</i>	<i>gorilla</i>	zoo	2.95	1.90E-06	0.026	0.036	35	54.01
Primates	Hominidae	<i>Pan</i>	<i>trogodytes</i>	zoo	3.45	2.07E-07	0.042	0.032	68	55.22
Primates	Hominidae	<i>Pan</i>	<i>trogodytes</i>	wild	.	.	0.055	0.045	.	.
Primates	Hominidae	<i>Pan</i>	<i>trogodytes</i>	wild	1.85	1.15E-04	0.018	0.042	.	.
Primates	Hominidae	<i>Pongo</i>	<i>pygmaeus</i>	zoo	3.65	1.78E-07	0.029	0.035	35	44.48
Primates	Hylobatidae	<i>Hylobates</i>	<i>lar</i>	zoo	3.92	3.26E-07	0.052	0.048	99	40.26
Primates	Hylobatidae	<i>Hylobates</i>	<i>syndactylus</i>	zoo	4.65	7.16E-09	0.069	0.036	47	40.03
Primates	Lemuridae	<i>Eulemur</i>	<i>fulvus</i>	zoo	2.58	3.53E-05	0.053	0.057	17	34.0877

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Primates	Lemuridae	<i>Eulemur</i>	<i>macaco</i>	zoo	4.28	1.75E-06	0.044	0.081	29	26.063	
Primates	Lemuridae	<i>Eulemur</i>	<i>mongoz</i>	zoo	4.00	3.08E-07	0.040	0.050	49	80.337	
Primates	Lemuridae	<i>Galago</i>	<i>senegalensis</i>	zoo	1.22	1.63E-02	0.095	0.156	228	21.38	
Primates	Lemuridae	<i>Lemur</i>	<i>catta</i>	zoo	3.70	1.42E-06	0.051	0.057	239	35.6658	
Primates	Lemuridae	<i>Microcebus</i>	<i>murinus</i>	zoo	1.72	4.94E-03	0.026	0.142	162	17.95	
Primates	Lemuridae	<i>Mirouga</i>	<i>leonina</i>	wild	4.45	1.44E-06	0.205	0.085	.	.	a
Primates	Lemuridae	<i>Nycticebus</i>	<i>coucang</i>	zoo	2.04	5.92E-04	0.072	0.087	151	25.54	
Primates	Lemuridae	<i>Varecia</i>	<i>variegata</i>	zoo	2.03	7.66E-04	0.031	0.093	60	30.44	
Proboscidea	Elephantidae	<i>Elephas</i>	<i>maximus</i>	zoo	3.76	1.42E-07	0.002	0.036	13	74.3534	
Proboscidea	Elephantidae	<i>Loxodonta</i>	<i>africana</i>	wild	.	.	0.040	0.036	.	.	
Proboscidea	Elephantidae	<i>Loxodonta</i>	<i>africana</i>	zoo	2.29	1.08E-04	0.007	0.062	66	42.14	
Rodentia	Bathyergidae	<i>Heterocephalus</i>	<i>glaber</i>	zoo	2.68	4.95E-04	0.162	0.127	62	11.41	
Rodentia	Castoridae	<i>Castor</i>	<i>canadensis</i>	zoo	2.63	4.04E-04	0.087	0.116	67	18.31	
Rodentia	Caviidae	<i>Cavia</i>	<i>porcellus</i>	zoo	3.14	3.02E-03	0.246	0.246	138	7.46	
Rodentia	Caviidae	<i>Dolichotis</i>	<i>patagonum</i>	zoo	1.64	5.14E-03	0.203	0.135	448	20.937	
Rodentia	Chinchillidae	<i>Chinchilla</i>	<i>lanigera</i>	zoo	1.71	4.52E-03	0.176	0.137	195	25.79	
Rodentia	Dasyproctidae	<i>Dasyprocta</i>	<i>leporina</i>	zoo	4.32	2.11E-04	0.241	0.203	22	17.38	
Rodentia	Dasyproctidae	<i>Dasyprocta</i>	<i>punctata</i>	zoo	2.32	3.22E-03	0.090	0.178	54	12.03	
Rodentia	Erethizontidae	<i>Erethizon</i>	<i>dorsatum</i>	zoo	1.02	6.34E-03	0.117	0.082	75	21.02	
Rodentia	Hydrochaeridae	<i>Hydrochaeris</i>	<i>hydrochaeris</i>	zoo	3.87	1.80E-05	0.212	0.106	326	16.75	
Rodentia	Hystricidae	<i>Hystrix</i>	<i>cristata</i>	zoo	3.67	3.42E-06	0.059	0.068	61	27.76	
Rodentia	Hystricidae	<i>Hystrix</i>	<i>indica</i>	zoo	4.00	2.66E-06	0.069	0.077	29	23.56	
Rodentia	Muridae	<i>Acomys</i>	<i>cahirinus</i>	zoo	2.12	1.59E-02	0.232	0.265	77	7.92	
Rodentia	Muridae	<i>Apodemus</i>	<i>flaveolus</i>	wild	5.48	9.32E-08	0.224	0.987	.	.	a
Rodentia	Muridae	<i>Mus</i>	<i>musculus</i>	zoo	7.62	1.50E-04	0.022	0.360	35	3.84	
Rodentia	Muridae	<i>Mus</i>	<i>musculus</i>	zoo	14.68	1.25E-06	0.026	0.420	54	3.02	
Rodentia	Muridae	<i>Mus</i>	<i>musculus</i>	zoo	6.81	2.76E-03	0.005	0.470	691	3.16	
Rodentia	Muridae	<i>Mus</i>	<i>musculus</i>	zoo	7.29	2.25E-03	0.085	0.479	60	3.08	
Rodentia	Muridae	<i>Mustela</i>	<i>ermina</i>	wild	1.81	3.58E-03	0.017	0.135	.	.	a
Rodentia	Muridae	<i>Rattus</i>	<i>norvegicus</i>	zoo	3.47	9.43E-02	0.263	0.590	109	4.10	
Rodentia	Muridae	<i>Rattus</i>	<i>rattus</i>	zoo	5.06	5.85E-03	0.031	0.428	123	3.85	
Rodentia	Muridae	<i>Rattus</i>	<i>rattus</i>	zoo	3.51	3.10E-02	0.004	0.463	210	3.22	
Rodentia	Muridae	<i>Rattus</i>	<i>rattus</i>	zoo	4.00	5.88E-02	0.422	0.567	23	5.99	
Rodentia	Muridae	<i>Rattus</i>	<i>rattus</i>	zoo	9.98	4.22E-03	0.000	0.608	115	2.47	
Rodentia	Sciuridae	<i>Callosciurus</i>	<i>prevostii</i>	zoo	3.12	2.11E-04	0.184	0.128	92	14.47	
Rodentia	Sciuridae	<i>Cynomys</i>	<i>ludovicianus</i>	zoo	2.43	3.62E-03	0.099	0.194	205	17.73	
Rodentia	Sciuridae	<i>Tamiasciurus</i>	<i>hudsonicus</i>	wild	.	.	0.437	0.213	.	.	
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>glis</i>	zoo	2.15	2.18E-03	0.214	0.143	190	14.48	
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>glis</i>	zoo	2.97	1.80E-05	0.056	0.064	.	.	a
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>minor</i>	zoo	4.28	4.49E-05	0.274	0.150	104	9.32	

Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>tana</i>	zoo	3.49	1.86E-04	0.184	0.148	26	9.68
Xenarthra	Bradypodidae	<i>Choloepus</i>	<i>didactylus</i>	zoo	1.77	8.57E-03	0.197	0.179	21	23.46
Xenarthra	Dasypodidae	<i>Dasypus</i>	<i>novemcinctus</i>	zoo	8.68	3.99E-09	0.240	0.136	51	18.47

Birds

All data are from captive populations. Additional values for a small number of wild populations (4) were excluded to ensure uniformity of the data.

Order	Family	Genus	Species	<i>b</i>	<i>a</i>	<i>m</i> ₀	ω	<i>n</i>	oldest
Anseriformes	Anatidae	<i>Aix</i>	<i>galericulata</i>	4.67	3.77E-06	0.146	0.111	304	18.8
Anseriformes	Anatidae	<i>Aix</i>	<i>sponsa</i>	2.79	1.40E-04	0.138	0.096	210	26.6
Anseriformes	Anatidae	<i>Alopochen</i>	<i>aegyptiacus</i>	3.32	2.26E-05	0.099	0.084	113	25.1
Anseriformes	Anatidae	<i>Anas</i>	<i>acuta</i>	2.46	3.64E-04	0.108	0.101	218	20.3
Anseriformes	Anatidae	<i>Anas</i>	<i>capensis</i>	2.16	1.95E-03	0.110	0.139	101	27.5
Anseriformes	Anatidae	<i>Anas</i>	<i>castanea</i>	1.29	6.85E-03	0.039	0.113	46	41.2
Anseriformes	Anatidae	<i>Anas</i>	<i>clypeata</i>	2.93	1.64E-04	0.139	0.109	108	17.5
Anseriformes	Anatidae	<i>Anas</i>	<i>penelope</i>	7.26	6.46E-09	0.129	0.102	85	25.2
Anseriformes	Anatidae	<i>Anas</i>	<i>platyrhynchos</i>	1.33	4.50E-03	0.096	0.098	210	30.9
Anseriformes	Anatidae	<i>Anas</i>	<i>rubripes</i>	1.91	5.68E-03	0.024	0.170	29	18.3
Anseriformes	Anatidae	<i>Anas</i>	<i>strepera</i>	4.17	1.43E-05	0.064	0.115	66	17.4
Anseriformes	Anatidae	<i>Anas</i>	<i>sibilatrix</i>	2.04	1.12E-03	0.063	0.107	71	22.5
Anseriformes	Anatidae	<i>Anser</i>	<i>albifrons</i>	3.64	1.93E-06	0.041	0.059	29	28.3
Anseriformes	Anatidae	<i>Anser</i>	<i>anser</i>	4.69	5.29E-07	0.061	0.079	22	31.9
Anseriformes	Anatidae	<i>Anser</i>	<i>cygnoides</i>	1.11	9.43E-03	0.031	0.109	38	24.8
Anseriformes	Anatidae	<i>Anser</i>	<i>indicus</i>	2.43	9.85E-05	0.029	0.068	45	36.4
Anseriformes	Anatidae	<i>Anser</i>	<i>rossi</i>	2.75	5.97E-04	0.057	0.138	46	22.9
Anseriformes	Anatidae	<i>Aythya</i>	<i>americana</i>	1.29	5.56E-03	0.048	0.103	137	30.1
Anseriformes	Anatidae	<i>Aythya</i>	<i>ferina</i>	2.91	1.27E-04	0.027	0.101	36	26.6
Anseriformes	Anatidae	<i>Aythya</i>	<i>fuligula</i>	2.37	5.03E-04	0.050	0.105	76	29.2
Anseriformes	Anatidae	<i>Aythya</i>	<i>nyroca</i>	2.16	7.05E-04	0.068	0.101	50	18.8
Anseriformes	Anatidae	<i>Branta</i>	<i>bernicla</i>	3.32	1.61E-05	0.042	0.078	21	35.7
Anseriformes	Anatidae	<i>Branta</i>	<i>canadensis</i>	2.74	5.94E-05	0.042	0.074	115	31.4
Anseriformes	Anatidae	<i>Branta</i>	<i>leucopsis</i>	2.06	4.82E-04	0.042	0.083	41	38.3
Anseriformes	Anatidae	<i>Branta</i>	<i>ruficollis</i>	1.49	3.48E-03	0.019	0.103	94	36.2
Anseriformes	Anatidae	<i>Branta</i>	<i>sandvicensis</i>	2.89	3.53E-05	0.055	0.072	46	27.1
Anseriformes	Anatidae	<i>Bucephala</i>	<i>clangula</i>	2.99	4.37E-05	0.105	0.081	65	19.9
Anseriformes	Anatidae	<i>Cairinia</i>	<i>moschata</i>	2.21	9.72E-04	0.148	0.115	51	37.8

Anseriformes	Anatidae	<i>Callonetta</i>	<i>leucophrys</i>	2.02	1.05E-03	0.070	0.103	139	25.4
Anseriformes	Anatidae	<i>Cereopsis</i>	<i>novaehollandiae</i>	2.20	2.15E-04	0.055	0.072	41	31.6
Anseriformes	Anatidae	<i>Cygnus</i>	<i>atratus</i>	3.39	5.91E-06	0.063	0.065	72	31.0
Anseriformes	Anatidae	<i>Cygnus</i>	<i>cygnus_buccinator</i>	2.90	1.76E-05	0.046	0.061	40	40.5
Anseriformes	Anatidae	<i>Cygnus</i>	<i>melanocoryphus</i>	4.30	1.89E-08	0.086	0.035	58	26.7
Anseriformes	Anatidae	<i>Cygnus</i>	<i>olor</i>	3.26	6.56E-06	0.056	0.061	61	27.3
Anseriformes	Anatidae	<i>Marmaronetta</i>	<i>anguirostris</i>	7.90	2.15E-10	0.165	0.082	73	13.9
Anseriformes	Anatidae	<i>Mergus</i>	<i>cucullatus</i>	2.96	1.62E-04	0.082	0.110	148	23.2
Anseriformes	Anatidae	<i>Mergus</i>	<i>merganser</i>	3.28	6.51E-05	0.119	0.105	55	16.0
Anseriformes	Anatidae	<i>Netta</i>	<i>peposaca</i>	4.49	2.31E-07	0.089	0.062	92	26.4
Anseriformes	Anatidae	<i>Netta</i>	<i>rufina</i>	2.26	4.64E-04	0.123	0.095	119	30.0
Anseriformes	Anatidae	<i>Oxyura</i>	<i>jamaicensis</i>	2.72	1.99E-04	0.109	0.101	106	24.0
Anseriformes	Anatidae	<i>Somateria</i>	<i>mollissima</i>	0.64	1.49E-02	0.144	0.077	106	20.8
Anseriformes	Anatidae	<i>Tadorna</i>	<i>ferruginea</i>	1.22	3.00E-03	0.084	0.073	87	26.9
Anseriformes	Anatidae	<i>Tadorna</i>	<i>tadorna</i>	2.33	6.33E-04	0.044	0.110	109	29.8
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>bicolor</i>	3.73	1.55E-06	0.163	0.059	110	28.3
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>autumnalis</i>	1.38	7.09E-03	0.021	0.125	70	29.6
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>viduata</i>	3.27	3.93E-05	0.107	0.093	153	24.0
Ciconiiformes	Accipitridae	<i>Aquila</i>	<i>chrysaetos</i>	3.83	2.75E-07	0.042	0.044	34	41.1
Ciconiiformes	Accipitridae	<i>Aquila</i>	<i>rapax</i>	2.74	2.38E-05	0.025	0.058	12	29.8
Ciconiiformes	Accipitridae	<i>Buteo</i>	<i>jamaicensis</i>	2.41	8.90E-05	0.060	0.065	37	36.6
Ciconiiformes	Accipitridae	<i>Falco</i>	<i>sparverius</i>	2.56	4.56E-03	0.160	0.220	20	9.6
Ciconiiformes	Accipitridae	<i>Falco</i>	<i>tinnunculus</i>	0.66	7.69E-02	0.026	0.213	25	16.2
Ciconiiformes	Accipitridae	<i>Gyps</i>	<i>fulvus</i>	3.52	4.38E-08	0.023	0.024	9	40.7
Ciconiiformes	Accipitridae	<i>Haliaeetus</i>	<i>leucocephalus</i>	3.76	6.12E-07	0.026	0.050	31	43.5
Ciconiiformes	Accipitridae	<i>Milvus</i>	<i>migrans</i>	3.74	2.11E-05	0.114	0.103	14	27.9
Ciconiiformes	Ardeidae	<i>Ardea</i>	<i>cinerea</i>	2.70	4.13E-05	0.066	0.065	17	25.8
Ciconiiformes	Ardeidae	<i>Ardeola</i>	<i>ibis</i>	4.65	9.76E-08	0.082	0.058	34	29.0
Ciconiiformes	Ardeidae	<i>Egretta</i>	<i>thula</i>	4.07	7.21E-07	0.023	0.061	10	29.5
Ciconiiformes	Ardeidae	<i>Nycticorax</i>	<i>nycticorax</i>	2.44	2.95E-05	0.086	0.048	56	30.0
Ciconiiformes	Charadriidae	<i>Himantopus</i>	<i>himantopus_mexicanus</i>	2.65	4.76E-05	0.028	0.065	33	28.4
Ciconiiformes	Charadriidae	<i>Recurvirostra</i>	<i>avosetta</i>	3.96	5.29E-06	0.081	0.087	18	20.4
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>armatus</i>	2.28	4.14E-04	0.074	0.093	29	18.6
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>miles</i>	6.85	2.37E-06	0.212	0.192	15	16.8
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>spinus</i>	2.55	4.80E-04	0.124	0.116	92	22.7
Ciconiiformes	Ciconiidae	<i>Ciconia</i>	<i>ciconia</i>	3.99	3.10E-07	0.052	0.050	48	41.9
Ciconiiformes	Ciconiidae	<i>Ciconia</i>	<i>nigra</i>	4.97	4.97E-07	0.098	0.088	19	44.7
Ciconiiformes	Ciconiidae	<i>Leptoptilos</i>	<i>crumeniferus</i>	3.88	7.24E-07	0.081	0.055	46	29.9
Ciconiiformes	Ciconiidae	<i>Sarcorhamphus</i>	<i>papa</i>	4.03	1.48E-07	0.049	0.044	48	34.0
Ciconiiformes	Ciconiidae	<i>Vultur</i>	<i>gryphus</i>	2.97	1.53E-06	0.034	0.034	11	70.5

Ciconiiformes	Laridae	<i>Fratercula</i>	<i>arctica</i>	2.23	1.55E-03	0.092	0.135	50	14.3
Ciconiiformes	Laridae	<i>Larosterna</i>	<i>inca</i>	3.11	5.68E-05	0.065	0.093	73	28.7
Ciconiiformes	Laridae	<i>Lunda</i>	<i>cirrhatta</i>	2.97	3.31E-05	0.004	0.074	20	28.5
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>crispus</i>	1.28	1.23E-03	0.037	0.053	17	34.1
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>erythrorhynchus</i>	3.67	1.15E-06	0.085	0.053	42	28.9
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>occidentalis</i>	4.48	6.11E-07	0.136	0.073	169	20.3
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>onocrotalus</i>	2.17	2.26E-04	0.032	0.071	27	45.9
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>rufescens</i>	5.24	9.89E-07	0.145	0.109	32	15.4
Ciconiiformes	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>carbo</i>	4.15	8.49E-07	0.024	0.066	14	21.3
Ciconiiformes	Phoenicopteridae	<i>Phoeniconaias</i>	<i>minor</i>	2.97	3.33E-05	0.043	0.075	28	34.9
Ciconiiformes	Phoenicopteridae	<i>Phoenicopterus</i>	<i>chilensis</i>	3.28	2.15E-06	0.014	0.047	46	39.7
Ciconiiformes	Phoenicopteridae	<i>Phoenicopterus</i>	<i>ruber</i>	2.95	6.29E-06	0.011	0.048	97	42.1
Ciconiiformes	Scopidae	<i>Scopus</i>	<i>umbretta</i>	4.72	5.42E-07	0.221	0.080	46	24.5
Ciconiiformes	Spheniscidae	<i>Aptenodytes</i>	<i>patagonica</i>	4.19	1.24E-07	0.027	0.047	15	47.4
Ciconiiformes	Spheniscidae	<i>Eudyptes</i>	<i>crestatus</i>	4.14	1.49E-07	0.041	0.047	10	48.2
Ciconiiformes	Spheniscidae	<i>Eudyptula</i>	<i>minor</i>	3.26	1.19E-04	0.059	0.120	26	22.4
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>demersus</i>	3.60	1.82E-06	0.048	0.057	62	31.2
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>humboldti</i>	3.14	6.90E-06	0.054	0.057	62	32.3
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>magellanicus</i>	2.31	1.85E-03	0.033	0.149	33	23.5
Ciconiiformes	Threskiornithidae	<i>Ajaja</i>	<i>ajaja</i>	2.74	7.51E-05	0.044	0.079	85	26.0
Ciconiiformes	Threskiornithidae	<i>Eudocimus</i>	<i>albus</i>	3.97	2.09E-06	0.077	0.072	54	33.9
Ciconiiformes	Threskiornithidae	<i>Eudocimus</i>	<i>ruber</i>	2.67	7.92E-05	0.031	0.076	142	31.0
Ciconiiformes	Threskiornithidae	<i>Geronticus</i>	<i>eremita</i>	5.02	1.90E-09	0.067	0.036	21	33.6
Ciconiiformes	Threskiornithidae	<i>Platalea</i>	<i>alba</i>	0.91	6.45E-03	0.094	0.071	18	20.9
Ciconiiformes	Threskiornithidae	<i>Platalea</i>	<i>leucorodia</i>	3.27	4.76E-05	0.079	0.097	19	25.0
Ciconiiformes	Threskiornithidae	<i>Plegadis</i>	<i>falcinellus</i>	3.75	1.08E-06	0.046	0.056	24	35.5
Ciconiiformes	Threskiornithidae	<i>Threskiornis</i>	<i>aethiopicus</i>	3.67	6.03E-06	0.040	0.076	56	29.5
Coliiformes	Coliidae	<i>Colius</i>	<i>striatus</i>	3.32	1.31E-04	0.140	0.126	92	15.3
Columbiformes	Columbidae	<i>Caloenas</i>	<i>nicobarica</i>	3.12	1.30E-05	0.050	0.065	64	29.4
Columbiformes	Columbidae	<i>Columba</i>	<i>guinea</i>	2.17	3.93E-04	0.008	0.084	12	33.5
Columbiformes	Columbidae	<i>Columba</i>	<i>livia</i>	4.87	7.29E-07	0.204	0.090	12	15.4
Columbiformes	Columbidae	<i>Ducula</i>	<i>bicolor</i>	2.91	5.68E-05	0.053	0.082	22	24.1
Columbiformes	Columbidae	<i>Gallucolumba</i>	<i>luzonica</i>	4.63	1.55E-07	0.107	0.062	47	21.2
Columbiformes	Columbidae	<i>Geopelia</i>	<i>cuneata</i>	2.19	3.43E-03	0.157	0.168	146	16.7
Columbiformes	Columbidae	<i>Geopelia</i>	<i>striata</i>	2.00	1.46E-03	0.013	0.114	24	23.3
Columbiformes	Columbidae	<i>Goura</i>	<i>victoria</i>	2.56	8.98E-05	0.079	0.073	59	33.0
Columbiformes	Columbidae	<i>Ocyphaps</i>	<i>lophotes</i>	0.87	2.59E-02	0.007	0.142	38	20.5
Columbiformes	Columbidae	<i>Ptilinopus</i>	<i>jambu</i>	2.19	1.89E-03	0.227	0.140	53	11.6
Columbiformes	Columbidae	<i>Streptopelia</i>	<i>risoria</i>	4.90	2.49E-06	0.182	0.112	38	17.5
Coraciiformes	Bucerotidae	<i>Aceros</i>	<i>undulatus</i>	2.89	4.98E-05	0.025	0.078	17	26.4

Coraciiformes	Bucerotidae	<i>Bucorvus</i>	<i>abyssinicus</i>	1.02	1.63E-03	0.047	0.042	8	48.6
Coraciiformes	Bucerotidae	<i>Tookus</i>	<i>erythrorhynchus</i>	4.86	7.97E-08	0.120	0.062	18	23.6
Coraciiformes	Coraciidae	<i>Coracias</i>	<i>caudata</i>	3.41	5.08E-05	0.131	0.106	68	16.5
Coraciiformes	Dacelonidae	<i>Dacelo</i>	<i>novaeguineae</i>	2.60	7.52E-05	0.061	0.071	85	28.9
Coraciiformes	Momotidae	<i>Momotus</i>	<i>momota</i>	3.71	8.90E-06	0.046	0.085	34	30.3
Craciformes	Megapodiidae	<i>Alectura</i>	<i>lathamii</i>	3.12	8.54E-05	0.065	0.103	36	21.0
Galliformes	Numididae	<i>Acryllium</i>	<i>vulturinum</i>	1.12	1.44E-02	0.071	0.135	141	21.2
Galliformes	Numididae	<i>Numida</i>	<i>meleagris</i>	2.58	1.04E-03	0.168	0.147	145	20.0
Galliformes	Phasianidae	<i>Alectoris</i>	<i>chukar</i>	2.11	2.33E-02	0.062	0.299	55	12.4
Galliformes	Phasianidae	<i>Chrysolophus</i>	<i>amherstiae</i>	3.23	4.75E-05	0.119	0.095	69	23.5
Galliformes	Phasianidae	<i>Chrysolophus</i>	<i>pictus</i>	3.09	0.00	0.14	0.13	109.00	20.05
Galliformes	Phasianidae	<i>Gallus</i>	<i>gallus</i>	3.63	1.12E-04	0.173	0.140	59	12.4
Galliformes	Phasianidae	<i>Lophophorus</i>	<i>impeyanus</i>	4.19	3.17E-06	0.090	0.087	82	18.4
Galliformes	Phasianidae	<i>Lophura</i>	<i>edwardsi</i>	4.50	2.52E-07	0.103	0.063	37	19.6
Galliformes	Phasianidae	<i>Lophura</i>	<i>nycthemera</i>	0.68	8.45E-02	0.006	0.229	93	21.6
Galliformes	Phasianidae	<i>Meleagris</i>	<i>gallopavo</i>	2.46	1.07E-03	0.106	0.138	147	20.5
Galliformes	Phasianidae	<i>Pavo</i>	<i>cristatus</i>	3.28	7.29E-05	0.109	0.108	187	20.3
Galliformes	Phasianidae	<i>Phasianus</i>	<i>colchicus</i>	2.01	1.90E-03	0.162	0.124	66	17.3
Galliformes	Phasianidae	<i>Rollulus</i>	<i>roulroul</i>	1.10	2.27E-02	0.104	0.165	159	40.8
Galliformes	Phasianidae	<i>Syrnaticus</i>	<i>reevesi</i>	2.87	6.90E-04	0.148	0.152	75	13.7
Galliformes	Phasianidae	<i>Tympanuchus</i>	<i>cupido_attwateri</i>	2.94	8.85E-03	0.425	0.301	69	8.9
Gruiformes	Eurypygidae	<i>Eurypyga</i>	<i>helias</i>	3.98	3.04E-08	0.062	0.031	21	56.7
Gruiformes	Gruidae	<i>Anthropoides</i>	<i>virgo</i>	2.89	1.04E-05	0.039	0.053	83	40.7
Gruiformes	Gruidae	<i>Balearica</i>	<i>pavonina</i>	2.44	2.10E-05	0.034	0.044	46	39.9
Gruiformes	Gruidae	<i>Balearica</i>	<i>regulorum</i>	3.24	2.91E-06	0.038	0.050	82	48.9
Gruiformes	Gruidae	<i>Grus</i>	<i>antigone</i>	2.06	1.52E-04	0.031	0.056	51	41.8
Gruiformes	Gruidae	<i>Grus</i>	<i>canadensis</i>	2.30	1.21E-04	0.059	0.065	60	31.5
Gruiformes	Gruidae	<i>Grus</i>	<i>grus</i>	2.29	2.85E-05	0.049	0.041	50	43.2
Gruiformes	Gruidae	<i>Grus</i>	<i>vipio</i>	4.06	1.78E-06	0.059	0.073	12	56.3
Gruiformes	Rallidae	<i>Fulica</i>	<i>atra</i>	5.02	6.50E-06	0.116	0.137	22	14.7
Musophagiformes	Musophaginae	<i>Musophaga</i>	<i>violacea</i>	1.78	4.57E-03	0.019	0.144	31	17.9
Musophagiformes	Musophaginae	<i>Tauraco</i>	<i>corythaix</i>	2.26	1.98E-04	0.094	0.073	50	23.6
Passeriformes	Bombycillidae	<i>Bombycilla</i>	<i>cedrorum</i>	2.27	7.62E-03	0.030	0.225	60	12.6
Passeriformes	Corvidae	<i>Corvus</i>	<i>brachyrhynchos</i>	3.10	1.73E-04	0.062	0.121	26	40.6
Passeriformes	Corvidae	<i>Corvus</i>	<i>corax</i>	2.72	2.60E-05	0.022	0.059	12	30.2
Passeriformes	Fringillidae	<i>Cyanerpes</i>	<i>cyaneus</i>	2.50	3.24E-04	0.226	0.101	130	18.2
Passeriformes	Fringillidae	<i>Ramphocelus</i>	<i>carbo</i>	3.15	1.48E-04	0.126	0.119	24	16.6
Passeriformes	Fringillidae	<i>Thraupis</i>	<i>episcopus</i>	0.01	1.89E-01	0.001	0.192	57	19.1
Passeriformes	Irenidae	<i>Irena</i>	<i>puella</i>	2.86	1.34E-04	0.194	0.099	178	17.4
Passeriformes	Muscicapidae	<i>Leiothrix</i>	<i>argenteauris</i>	5.74	6.98E-07	0.231	0.122	75	12.2

Passeriformes	Muscicapidae	<i>Leiothrix</i>	<i>lutea</i>	3.21	3.75E-04	0.142	0.154	153	18.9
Passeriformes	Passeridae	<i>Amadina</i>	<i>fasciata</i>	3.20	2.10E-04	0.298	0.133	77	10.8
Passeriformes	Passeridae	<i>Amandava</i>	<i>amandava</i>	1.43	2.60E-02	0.094	0.223	81	12.4
Passeriformes	Passeridae	<i>Carduelis</i>	<i>carduelis</i>	2.14	1.77E-02	0.351	0.277	63	6.3
Passeriformes	Passeridae	<i>Chloebia</i>	<i>gouldiae</i>	2.87	9.51E-04	0.212	0.166	64	13.6
Passeriformes	Passeridae	<i>Emblema</i>	<i>guttata</i>	4.75	3.10E-01	0.310	0.816	65	8.4
Passeriformes	Passeridae	<i>Euplectes</i>	<i>orix</i>	3.01	2.72E-05	0.102	0.073	49	25.9
Passeriformes	Passeridae	<i>Neochmia</i>	<i>ruficauda</i>	6.25	2.61E-07	0.240	0.123	74	14.3
Passeriformes	Passeridae	<i>Padda</i>	<i>oryzivora</i>	1.57	1.28E-02	0.206	0.183	84	11.9
Passeriformes	Passeridae	<i>Ploceus</i>	<i>cucullatus</i>	2.66	1.45E-04	0.061	0.089	20	25.4
Passeriformes	Passeridae	<i>Poephila</i>	<i>acuticauda</i>	2.91	1.23E-03	0.331	0.180	124	11.1
Passeriformes	Passeridae	<i>Poephila</i>	<i>guttata</i>	1.17	3.91E-02	0.292	0.224	203	12.4
Passeriformes	Passeridae	<i>Serinus</i>	<i>canaria</i>	0.86	2.86E-01	0.081	0.511	6	7.2
Passeriformes	Passeridae	<i>Uraeginthus</i>	<i>cyanocephala</i>	6.51	6.26E-06	0.203	0.203	24	13.4
Passeriformes	Pycnonotidae	<i>Pycnonotus</i>	<i>jocosus</i>	0.16	2.96E-02	0.100	0.049	54	25.7
Passeriformes	Sturnidae	<i>Cosmopsarus</i>	<i>regius</i>	1.74	2.42E-03	0.032	0.111	42	19.9
Passeriformes	Sturnidae	<i>Gracula</i>	<i>religiosa</i>	2.72	1.05E-04	0.163	0.085	167	23.6
Passeriformes	Sturnidae	<i>Lamprotornis</i>	<i>iris</i>	2.52	3.19E-04	0.078	0.102	31	19.0
Passeriformes	Sturnidae	<i>Leucopsar</i>	<i>rothschildi</i>	2.57	1.60E-04	0.045	0.087	100	28.3
Passeriformes	Sturnidae	<i>Spreo</i>	<i>superbus</i>	2.52	1.89E-04	0.099	0.087	65	26.3
Passeriformes	Turdidae	<i>Copsychus</i>	<i>malabaricus</i>	5.51	1.17E-07	0.246	0.086	87	14.1
Passeriformes	Zosteropidae	<i>Zosterops</i>	<i>palpebrosa</i>	2.75	3.19E-04	0.196	0.117	42	12.7
Piciformes	Ramphastidae	<i>Ramphastos</i>	<i>toco</i>	3.70	1.95E-05	0.109	0.100	148	20.8
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>fischeri</i>	1.43	4.97E-02	0.067	0.291	20	7.7
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>personata</i>	2.46	3.85E-03	0.097	0.200	28	14.0
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>roseicollis</i>	2.32	4.67E-03	0.124	0.199	102	27.0
Psittaciformes	Psittacidae	<i>Amazona</i>	<i>aestiva</i>	2.71	2.75E-05	0.008	0.059	11	38.1
Psittaciformes	Psittacidae	<i>Amazona</i>	<i>ochrocephala</i>	1.37	1.15E-03	0.055	0.058	27	39.0
Psittaciformes	Psittacidae	<i>Anodorhynchus</i>	<i>hyacinthinus</i>	3.92	3.39E-07	0.024	0.048	34	35.9
Psittaciformes	Psittacidae	<i>Ara</i>	<i>ararauna</i>	3.28	3.96E-06	0.025	0.055	41	43.6
Psittaciformes	Psittacidae	<i>Ara</i>	<i>chloroptera</i>	3.32	9.17E-06	0.015	0.068	45	36.5
Psittaciformes	Psittacidae	<i>Ara</i>	<i>macao</i>	2.88	9.89E-06	0.012	0.051	35	58.7
Psittaciformes	Psittacidae	<i>Ara</i>	<i>militaris</i>	2.86	1.82E-05	0.020	0.059	19	58.2
Psittaciformes	Psittacidae	<i>Aratinga</i>	<i>solstitialis</i>	2.08	8.46E-04	0.042	0.100	28	20.0
Psittaciformes	Psittacidae	<i>Cacatua</i>	<i>galerita</i>	3.21	2.44E-06	0.025	0.047	31	49.7
Psittaciformes	Psittacidae	<i>Cacatua</i>	<i>moluccensis</i>	1.34	1.52E-03	0.035	0.063	62	68.0
Psittaciformes	Psittacidae	<i>Cyanoliseus</i>	<i>patagonus</i>	4.67	2.13E-07	0.094	0.067	36	23.4
Psittaciformes	Psittacidae	<i>Eclectus</i>	<i>roratus</i>	1.19	2.65E-03	0.036	0.067	58	38.1
Psittaciformes	Psittacidae	<i>Eolophus</i>	<i>roseicapillus</i>	4.07	2.59E-07	0.065	0.050	41	56.3
Psittaciformes	Psittacidae	<i>Melopsittacus</i>	<i>undulatus</i>	1.32	9.70E-03	0.214	0.135	58	11.0

Psittaciformes	Psittacidae	<i>Myiopsitta</i>	<i>monachus</i>	1.21	8.33E-03	0.060	0.115	31	21.6
Psittaciformes	Psittacidae	<i>Nymphicus</i>	<i>hollandicus</i>	3.02	1.03E-04	0.126	0.102	96	16.2
Psittaciformes	Psittacidae	<i>Psittacula</i>	<i>krameri</i>	3.81	4.69E-06	0.048	0.078	31	36.6
Psittaciformes	Psittacidae	<i>Psittacus</i>	<i>erithacus</i>	2.98	5.89E-06	0.034	0.048	37	41.9
Psittaciformes	Psittacidae	<i>Trichoglossus</i>	<i>haematodus</i>	4.43	6.03E-07	0.084	0.071	79	18.4
Strigiformes	Podargidae	<i>Podargus</i>	<i>strigoides</i>	5.00	2.71E-08	0.093	0.055	37	27.3
Strigiformes	Strigidae	<i>Athene</i>	<i>cunicularia</i>	1.55	7.35E-03	0.016	0.145	84	20.9
Strigiformes	Strigidae	<i>Bubo</i>	<i>bubo</i>	2.22	1.58E-04	0.001	0.066	26	42.8
Strigiformes	Strigidae	<i>Bubo</i>	<i>virginianus</i>	3.98	3.89E-07	0.010	0.052	17	38.2
Strigiformes	Strigidae	<i>Nyctea</i>	<i>scandiaca</i>	3.20	9.69E-06	0.041	0.064	61	43.7
Strigiformes	Strigidae	<i>Otus</i>	<i>asio</i>	2.74	2.97E-04	0.087	0.114	66	21.6
Strigiformes	Strigidae	<i>Pulsatrix</i>	<i>perspicillata</i>	1.24	3.54E-03	0.022	0.081	19	23.7
Strigiformes	Strigidae	<i>Strix</i>	<i>varia</i>	4.89	6.53E-07	0.065	0.089	13	28.4
Strigiformes	Tytonidae	<i>Tyto</i>	<i>alba</i>	3.29	3.13E-05	0.083	0.089	46	22.8
Struthioniformes	Apterygidae	<i>Apteryx</i>	<i>australis</i>	4.17	2.65E-06	0.054	0.083	25	20.3
Struthioniformes	Casuaridae	<i>Dromaius</i>	<i>novaeollandiae</i>	2.10	6.29E-05	0.042	0.044	37	37.3
Struthioniformes	Rheidae	<i>Rhea</i>	<i>americana</i>	1.93	5.93E-04	0.070	0.079	87	37.4
Struthioniformes	Struthionidae	<i>Struthio</i>	<i>camelus</i>	2.67	6.56E-05	0.063	0.072	99	29.6

Reptiles and amphibians

The orders Caudata and Anura are amphibians. All data are from captive populations.

Order	Family	Genus	Species	<i>b</i>	<i>a</i>	<i>m</i> ₀	ω	<i>n</i>	oldest
Squamata	Agamidae	<i>Pogona</i>	<i>vitticeps</i>	1.14	5.35E-02	0.027	0.254	97	11.11
Squamata	Anguillidae	<i>Ophisaurus</i>	<i>apodus</i>	3.24	4.20E-05	0.019	0.093	18	25.52
Squamata	Boidae	<i>Boa</i>	<i>constrictor</i>	4.06	1.14E-06	0.020	0.067	66	25.68
Squamata	Boidae	<i>Chondropython</i>	<i>viridis</i>	4.04	4.24E-06	0.089	0.086	92	21.09
Squamata	Boidae	<i>Eunectes</i>	<i>murinus</i>	3.37	1.67E-05	0.020	0.081	22	26.77
Squamata	Boidae	<i>Python</i>	<i>reticulatus</i>	2.32	2.87E-04	0.020	0.086	45	35.90
Squamata	Boidae	<i>Python</i>	<i>regius</i>	3.64	8.27E-06	0.000	0.080	19	50.02
Squamata	Boidae	<i>Python</i>	<i>molurus bivittatus</i>	2.10	2.00E-04	0.003	0.064	14	32.03
Squamata	Boidae	<i>Sanzinia</i>	<i>madagascariensis</i>	4.76	4.92E-07	0.083	0.080	33	24.58
Squamata	Chamaeleonidae	<i>Chamaeleo</i>	<i>calyptratus</i>	6.84	3.63E-05	0.435	0.272	49	5.19
Squamata	Colubridae	<i>Elaphe</i>	<i>guttata</i>	3.67	2.73E-06	0.065	0.065	25	26.04
Squamata	Colubridae	<i>Lampropeltis</i>	<i>getulus californiae</i>	6.38	8.92E-09	0.069	0.081	31	23.48
Squamata	Gekkonidae	<i>Eublepharis</i>	<i>macularius</i>	2.99	6.30E-05	0.024	0.089	36	25.33
Squamata	Gekkonidae	<i>Phelsuma</i>	<i>standingi</i>	3.44	7.40E-04	0.259	0.197	30	12.48
Squamata	Helodermatidae	<i>Heloderma</i>	<i>suspectum suspectum</i>	3.56	9.61E-06	0.012	0.079	21	24.18

Squamata	Helodermatidae	<i>Heloderma</i>	<i>suspectum</i>	2.39	1.11E-04	0.013	0.068	28	29.61
Squamata	Iguanidae	<i>Iguana</i>	<i>iguana</i>	1.29	8.06E-04	0.156	0.044		57.83
Squamata	Scincidae	<i>Corucia</i>	<i>zebrata</i>	4.50	2.51E-06	0.101	0.096	43	16.47
Squamata	Viperidae	<i>Bitis</i>	<i>gabonica rhinoceros</i>	2.01	1.99E-03	0.005	0.126	65	18.32
Squamata	Viperidae	<i>Crotalus</i>	<i>atrox</i>	3.50	1.16E-05	0.014	0.080	25	26.87
Squamata	Xenosauridae	<i>Shinisaurus</i>	<i>crocodilurus</i>	1.92	6.60E-03	0.041	0.180	55	16.14
Crocodylia	Crocodylidae	<i>Alligator</i>	<i>sinensis</i>	3.48	1.43E-04	0.025	0.139	15	46.81
Crocodylia	Crocodylidae	<i>Alligator</i>	<i>mississippiensis</i>	3.74	4.93E-07	0.019	0.047	30	77.84
Crocodylia	Crocodylidae	<i>Crocodylus</i>	<i>niloticus</i>	3.95	8.67E-07	0.012	0.060	15	39.12
Crocodylia	Crocodylidae	<i>Paleosuchus</i>	<i>palpebrosus</i>	2.06	2.71E-03	0.017	0.145	16	21.58
Chelonia	Chelidae	<i>Chelus</i>	<i>fimbriatus</i>	2.55	1.70E-04	0.128	0.086	45	35.60
Chelonia	Chelydridae	<i>Chelydra</i>	<i>serpentina</i>	3.57	1.83E-05	0.047	0.092	18	14.79
Chelonia	Emydidae	<i>Terrapene</i>	<i>carolina triunguis</i>	4.04	6.54E-06	0.026	0.094	11	23.53
Chelonia	Emydidae	<i>Trachemys</i>	<i>scripta elegans</i>	3.64	1.13E-05	0.062	0.086	37	47.42
Chelonia	Pelomedusidae	<i>Podocnemis</i>	<i>unifilis</i>	4.37	2.58E-07	0.032	0.059	25	32.91
Chelonia	Testudinidae	<i>Geochelone</i>	<i>elephantopus</i>	1.30	5.90E-03	0.000	0.107	24	81.52
Chelonia	Testudinidae	<i>Geochelone</i>	<i>carbonaria</i>	4.15	5.49E-06	0.048	0.095	36	30.21
Chelonia	Testudinidae	<i>Geochelone</i>	<i>elegans</i>	4.41	1.73E-06	0.036	0.086	21	24.34
Chelonia	Testudinidae	<i>Geochelone</i>	<i>pardalis</i>	1.16	2.55E-03	0.031	0.063	35	28.52
Chelonia	Testudinidae	<i>Geochelone</i>	<i>gigantea</i>	0.97	1.40E-03	0.000	0.036	12	96.53
Chelonia	Testudinidae	<i>Gopherus</i>	<i>agassizii</i>	2.02	3.72E-04	0.017	0.073	21	50.97
Chelonia	Testudinidae	<i>Malacochersus</i>	<i>tornieri</i>	1.74	1.51E-02	0.051	0.216	63	25.90
Chelonia	Testudinidae	<i>Testudo</i>	<i>graeca</i>	4.39	1.28E-06	0.000	0.081	9	45.63
Chelonia	Testudinidae	<i>Testudo</i>	<i>hermanni</i>	2.90	4.03E-05	0.023	0.074	11	84.73
Caudata	Ambystomatidae	<i>Ambystoma</i>	<i>tigrinum</i>	3.12	1.77E-04	0.105	0.123	73	20.06
Caudata	Salamandridae	<i>Salamandra</i>	<i>Salamandra</i>	3.68	3.75E-05	0.079	0.113	9	13.91
Anura	Bufo	<i>Bufo</i>	<i>baxteri</i>	3.12	3.51E-02	0.103	0.443	23	4.25
Anura	Dendrobatidae	<i>Dendrobates</i>	<i>azureus</i>	4.27	4.53E-05	0.339	0.150	43	11.65
Anura	Dendrobatidae	<i>Dendrobates</i>	<i>tinctorius</i>	4.71	1.09E-05	0.182	0.135	52	10.75
Anura	Dendrobatidae	<i>Dendrobates</i>	<i>auratus</i>	3.48	2.76E-05	0.175	0.096	56	16.84
Anura	Hylidae	<i>Agalychnis</i>	<i>callidryas</i>	1.05	1.07E-01	0.325	0.337	132	7.95
Anura	Hylidae	<i>Litoria</i>	<i>caerulea</i>	1.59	9.55E-03	0.011	0.166	107	18.22
Anura	Leptodactylidae	<i>Leptodactylus</i>	<i>pentadactylus</i>	2.95	1.12E-03	0.018	0.179	19	18.6438
Anura	Microhylidae	<i>Dyscophus</i>	<i>antongilii</i>	0.37	2.67E-01	0.014	0.383	146	9.68493
Anura	Pipidae	<i>Pipa</i>	<i>pipa</i>	1.03	8.77E-02	0.093	0.301	85	15.76
Anura	Ranidae	<i>Rana</i>	<i>catesbeiana</i>	3.91	3.74E-04	0.138	0.200	41	8.75

APPENDIX 5. The rate of aging (ω) is strongly correlated with maximum recorded life span.

The data for animals in captive populations analyzed in this study included the age of the oldest individual recorded, which was highly correlated with the estimated rate of actuarial aging ($r = -0.831$, $n = 150$, $P < 0.0001$). This was marginally dependent ($P = 0.025$) on the number of individuals used in the analysis of omega, which varied from 13 to 1664. The regression relating the log-transformed oldest recorded age to the rate of aging was $\log_{10}(\text{oldest}) = 0.522 (\pm 0.048 \text{ SE}) - 0.831 (\pm 0.046 \text{ SE}, t = -23.4, P < 0.0001) \log_{10}(\omega) + 0.057 (\pm 0.025 \text{ SE}, t = 2.3, P = 0.025) \log_{10}(n)$ ($F_{2,169} = 274$, $P < 0.0001$, $R^2 = 0.764$) (some species were represented by more than 1 value).

A similar regression of the maximum recorded longevity in the AnAge database (7) on the species average for omega estimated in this study was: $\log_{10}(\text{oldest}) = 0.602 (\pm 0.035 \text{ SE}) - 0.779 (\pm 0.033 \text{ SE}) \log_{10}(\omega)$ ($F_{1,160} = 542$, $P < 0.0001$, $R^2 = 0.772$). Thus, ω and maximum recorded life span can be used interchangeably in analyses of the rate of aging and potential longevity.

APPENDIX 6. Life history variables for the species used in this analysis. Data are from the AnAge database and references therein.

Mammals

Order	Family	Genus	Species	Age at maturity (d)		Mass (g)			Period (d)		Growth rate	Oldest (y)
				Females	Adult	Neonate	Weaning	Gestation	Weaning	k (1/d)		
Artiodactyla	Antilocapridae	<i>Antilocapra</i>	<i>americana</i>	547	46100	3000	8900	235	91	0.0083	15.5	
Artiodactyla	Bovidae	<i>Addax</i>	<i>nasomaculatus</i>	1065	92500	5600	.	282	198	.	28	
Artiodactyla	Bovidae	<i>Aepyceros</i>	<i>melampus</i>	456	52500	5550	15900	198	167	0.0043	25.6	
Artiodactyla	Bovidae	<i>Ammotragus</i>	<i>lervia</i>	335	92500	4500	.	149	122	0.0053	21.7	
Artiodactyla	Bovidae	<i>Antelope</i>	<i>cervicapra</i>	466	37500	3850	.	168	60	.	23.9	
Artiodactyla	Bovidae	<i>Bison</i>	<i>bison</i>	912	630000	20000	158000	274	259	.	33.5	
Artiodactyla	Bovidae	<i>Bos</i>	<i>frontalis</i>	590	825000	23000	.	275	137	.	26.2	
Artiodactyla	Bovidae	<i>Bos</i>	<i>grunniens</i>	738	667000	18000	.	274	228	.	26.3	
Artiodactyla	Bovidae	<i>Bos</i>	<i>javanicus</i>	730	700000	.	.	295	304	.	27.1	
Artiodactyla	Bovidae	<i>Bos</i>	<i>taurus</i>	548	750000	.	.	277	.	0.0031	.	
Artiodactyla	Bovidae	<i>Bubalus</i>	<i>bubalis</i>	502	725000	37500	.	311	228	.	34.9	
Artiodactyla	Bovidae	<i>Capra</i>	<i>falconeri</i>	745	41000	.	.	163	167	.	19.1	
Artiodactyla	Bovidae	<i>Capra</i>	<i>hircus</i>	406	61000	2250	.	155	160	0.0041	20.8	
Artiodactyla	Bovidae	<i>Capra</i>	<i>ibex</i>	797	82500	2850	.	169	274	0.005	20.9	
Artiodactyla	Bovidae	<i>Connochaetes</i>	<i>taurinus</i>	411	164500	18125	.	253	278	0.0026	24.3	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>lunatus</i>	639	110000	11100	.	238	.	.	23.6	
Artiodactyla	Bovidae	<i>Damaliscus</i>	<i>pygargus</i>	707	84500	6792	.	243	152	0.0056	23	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>gazella</i>	476	23250	2360	.	180	88	.	18.3	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>granti</i>	251	67000	5602.5	.	196	.	.	19.7	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>subgutturosa</i>	646	48500	2625	13500	175	106	.	16.3	
Artiodactyla	Bovidae	<i>Gazella</i>	<i>thomsonii</i>	365	25000	2600	.	170	102	.	20	
Artiodactyla	Bovidae	<i>Hemitragus</i>	<i>jemlahicus</i>	547	35200	2000	.	183	151	.	21.8	
Artiodactyla	Bovidae	<i>Hippotragus</i>	<i>equinus</i>	730	225000	15167	.	284	183	.	25.9	
Artiodactyla	Bovidae	<i>Hippotragus</i>	<i>niger</i>	768	225000	16375	.	271	213	.	22.2	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>ellipsiprymnus</i>	771	175333	9000	.	264	213	.	30	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>kob</i>	403	105000	5405	31600	251	189	.	21.9	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>leche</i>	898	94800	5100	.	229	137	.	25.4	
Artiodactyla	Bovidae	<i>Kobus</i>	<i>megaceros</i>	730	90000	5100	.	235	.	.	21.1	
Artiodactyla	Bovidae	<i>Oreamnos</i>	<i>americanus</i>	912	90000	3200	.	184	122	.	20.8	
Artiodactyla	Bovidae	<i>Oryx</i>	<i>dammah</i>	639	177500	10317	.	247	.	.	27.5	
Artiodactyla	Bovidae	<i>Oryx</i>	<i>leucoryx</i>	794	121350	.	.	243	137	.	20.8	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>aries</i>	548	110000	2370	17500	146	182	.	22.8	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>canadensis</i>	707	70275	4400	28000	180	152	0.0031	20.6	
Artiodactyla	Bovidae	<i>Ovis</i>	<i>dalli</i>	684	73100	2819	.	173	129	.	19.6	
Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>pyrenaica</i>	.	30000	.	.	.	.	.	.

Artiodactyla	Bovidae	<i>Rupicapra</i>	<i>rupicapra</i>	674	37500	2400	.	122	76	.	17.6
Artiodactyla	Bovidae	<i>Syncerus</i>	<i>caffer</i>	1475	700000	44000	166000	331	289	0.0026	29.8
Artiodactyla	Camelidae	<i>Camelus</i>	<i>bactrianus</i>	1278	475000	36000	.	395	319	.	35.4
Artiodactyla	Camelidae	<i>Camelus</i>	<i>dromedarius</i>	1095	434000	37000	253484	405	500	.	28.4
Artiodactyla	Camelidae	<i>Lama</i>	<i>glama</i>	800	140000	11000	.	330	152	.	28.9
Artiodactyla	Camelidae	<i>Lama</i>	<i>guanicoe</i>	365	127500	11500	.	335	345	.	33.7
Artiodactyla	Cervidae	<i>Alces</i>	<i>alces</i>	751	386000	12844	94000	243	100	0.0039	.
Artiodactyla	Cervidae	<i>Axis</i>	<i>axis</i>	766	36000	3144	.	226	122	.	20.8
Artiodactyla	Cervidae	<i>Capreolus</i>	<i>capreolus</i>	413	21666.7	1010	8692.5	153	89	.	17.5
Artiodactyla	Cervidae	<i>Cervus</i>	<i>elaphus</i>	852	200000	10100	56500	245	156	0.006	31.5
Artiodactyla	Cervidae	<i>Dama</i>	<i>dama</i>	487	70000	4500	22570	233	183	.	21.1
Artiodactyla	Cervidae	<i>Odocoileus</i>	<i>virginianus</i>	309	87000	3000	36000	198	129	0.007	21.6
Artiodactyla	Cervidae	<i>Rangifer</i>	<i>tarandus</i>	662	101250	6500	20000	228	120	0.0047	21.7
Artiodactyla	Giraffidae	<i>Giraffa</i>	<i>camelopardalis</i>	1278	800000	58500	.	457	152	.	39.5
Artiodactyla	Hippopotamidae	<i>Hippopotamus</i>	<i>amphibius</i>	1279	3.75E+06	40000	237500	234	341	.	61.2
Artiodactyla	Suidae	<i>Sus</i>	<i>scrofa</i>	334	180000	960	5700	115	56	0.0095	27
Carnivora	Ailuridae	<i>Ailurus</i>	<i>fulgens</i>	550	4325	100	1140	116	137	0.009	19
Carnivora	Canidae	<i>Canis</i>	<i>lupus</i>	669	26625	450	5250	62	47	0.0177	20.6
Carnivora	Canidae	<i>Chrysocyon</i>	<i>brachyurus</i>	730	21500	368	.	64	227	0.0116	16.8
Carnivora	Canidae	<i>Lycaon</i>	<i>pictus</i>	639	26500	318	.	72	91	.	17
Carnivora	Canidae	<i>Vulpes</i>	<i>vulpes</i>	304	4131.7	100	1397	52	48	0.0177	21.3
Carnivora	Felidae	<i>Acinonyx</i>	<i>jubatus</i>	456	53500	489	1940	88	107	.	20.5
Carnivora	Felidae	<i>Felis</i>	<i>silvestris</i>	304	5500	100	643	64	87	0.0113	19
Carnivora	Felidae	<i>Lynx</i>	<i>lynx</i>	639	23000	246.5	1860	66	87	0.0097	23.7
Carnivora	Felidae	<i>Panthera</i>	<i>onca</i>	730	81150	820	5033.5	99	126	0.0072	28
Carnivora	Felidae	<i>Panthera</i>	<i>pardus</i>	937	53750	550	1940	97	110	0.0079	27.3
Carnivora	Felidae	<i>Panthera</i>	<i>tigris</i>	1268	119700	1190	11003	105	121	.	26.3
Carnivora	Felidae	<i>Panthera</i>	<i>leo</i>	1095	175000	1300	8480	109	216	0.0035	27
Carnivora	Felidae	<i>Uncia</i>	<i>uncia</i>	730	50000	475	7500	96	77	.	21.2
Carnivora	Herpestidae	<i>Suricata</i>	<i>suricatta</i>	365	776	29	225.5	77	44	0.0161	20.6
Carnivora	Hyaenidae	<i>Crocuta</i>	<i>crocuta</i>	1095	63000	1390	14500	110	265	0.0056	41.1
Carnivora	Mephitidae	<i>Mephitis</i>	<i>mephitis</i>	335	3500	33.5	493.5	63	60	0.0143	13.9
Carnivora	Mustelidae	<i>Lutra</i>	<i>lutra</i>	548	6750	110.5	.	61	55	.	18.2
Carnivora	Mustelidae	<i>Martes</i>	<i>zibellina</i>	456	1066.7	30	600	30	56	.	18.4
Carnivora	Mustelidae	<i>Mustela</i>	<i>erminea</i>	95	110.3	2.3	26.6	43	45	.	12.5
Carnivora	Mustelidae	<i>Mustela</i>	<i>putorius</i>	312	809	9.5	.	42	63	0.0328	11.1
Carnivora	Otariidae	<i>Callorhinus</i>	<i>ursinus</i>	1095	165500	5281	12925	240	107	0.0007	.
Carnivora	Phocidae	<i>Mirounga</i>	<i>leonina</i>	1059	1.40E+06	42500	124500	220	21	0.0008	.
Carnivora	Phocidae	<i>Pusa</i>	<i>hispida</i>	1826	90000	6000	14000	251	53	.	46
Carnivora	Phocidae	<i>Phoca</i>	<i>vitulina</i>	1095	115000	11000	23945	253	30	0.0013	47.6
Carnivora	Procyonidae	<i>Nasua</i>	<i>nasua</i>	730	4750	140	730	73	86	.	23.7
Carnivora	Procyonidae	<i>Potos</i>	<i>flavus</i>	820	3000	175	.	115	119	0.0102	38.4
Carnivora	Procyonidae	<i>Procyon</i>	<i>lotor</i>	365	6000	80	1175	63	91	0.0153	21

Carnivora	Ursidae	<i>Ursus</i>	<i>americanus</i>	1278	154250	277.5	14050	70	198	0.0029	34
Carnivora	Ursidae	<i>Ursus</i>	<i>arctos</i>	1313	277500	510	26000	103	213	.	40
Cetacea	Delphinidae	<i>Tursiops</i>	<i>truncatus</i>	2831	200000	19350	.	365	548	.	51.6
Chiroptera	Phyllostomidae	<i>Carollia</i>	<i>perspicillata</i>	258	17.8	5	12.5	95	.	0.0347	17
Chiroptera	Phyllostomidae	<i>Desmodus</i>	<i>rotundus</i>	285	33.2	8	.	189	274	0.0294	29.2
Chiroptera	Pteropodidae	<i>Pteropus</i>	<i>rodricensis</i>	.	350	45	.	198	.	.	28
Chiroptera	Pteropodidae	<i>Rousettus</i>	<i>egyptiacus</i>	365	125	21.06	73.8	116	122	0.0149	22.9
Chiroptera	Vespertilionidae	<i>Pipistrellus</i>	<i>pipistrellus</i>	456	5	1.125	.	42	42	0.0668	16
Cingulata	Dasyopodidae	<i>Dasypus</i>	<i>novemcinctus</i>	365	5500	66	.	133	137	.	22.3
Didelphimorphia	Didelphidae	<i>Didelphis</i>	<i>virginiana</i>	184	3000	0.147	142.5	12	102	0.0129	6.6
Diprotodontia	Acrobatidae	<i>Acrobates</i>	<i>pygmaeus</i>	240	13	0.0178	5.65	.	99	0.0254	8.8
Diprotodontia	Macropodidae	<i>Macropus</i>	<i>rufus</i>	517	55000	0.784	5000	33	360	0.0075	25
Diprotodontia	Phascolarctidae	<i>Phascolarctos</i>	<i>cinereus</i>	646	9300	0.36	1155	31	342	0.0028	22.1
Erinaceomorpha	Erinaceidae	<i>Atelerix</i>	<i>albiventris</i>	84	600	10	.	35	44	0.039	11.4
Lagomorpha	Leporidae	<i>Oryctolagus</i>	<i>cuniculus</i>	730	1800	45	214	30	26	0.0228	.
Lagomorpha	Leporidae	<i>Sylvilagus</i>	<i>floridanus</i>	123	1150	40	118.5	30	24	0.0243	9.8
Perissodactyla	Equidae	<i>Equus</i>	<i>burchellii</i>	900	280000	32000	205000	365	395	0.0038	38
Perissodactyla	Equidae	<i>Equus</i>	<i>caballus</i>	914	250000	79200	.	337	274	.	57
Perissodactyla	Equidae	<i>Equus</i>	<i>asinus</i>	708	164998	30000	.	359	.	.	47
Pilosa	Megalonychidae	<i>Choloepus</i>	<i>didactylus</i>	1279	6250	356	.	279	152	0.002	36.8
Primates	Callitrichidae	<i>Callimico</i>	<i>goeldii</i>	365	555	48.15	215	153	77	0.0097	22.2
Primates	Callitrichidae	<i>Callithrix</i>	<i>geoffroyi</i>	.	342	.	.	.	.	.	17.6
Primates	Callitrichidae	<i>Callithrix</i>	<i>jacchus</i>	477	255.2	26.5	86.67	144	62	0.0172	16.5
Primates	Callitrichidae	<i>Callithrix</i>	<i>penicillata</i>	.	307	.	.	.	.	.	15.4
Primates	Callitrichidae	<i>Callithrix</i>	<i>pygmaea</i>	684	124	16	70	125	91	.	18.6
Primates	Callitrichidae	<i>Leontopithecus</i>	<i>rosalia</i>	547	654.5	55.3	165	128	131	0.0077	31.6
Primates	Callitrichidae	<i>Saguinus</i>	<i>imperator</i>	546	518.5	47	.	145	.	.	23.7
Primates	Callitrichidae	<i>Saguinus</i>	<i>midas</i>	608	553.8	40	.	127	71	.	21
Primates	Callitrichidae	<i>Saguinus</i>	<i>oedipus</i>	548	445.5	39.36	105	178	52	0.0102	26.2
Primates	Cebidae	<i>Alouatta</i>	<i>caraya</i>	1167	5462.5	187.5	.	187	195	.	32.4
Primates	Cebidae	<i>Ateles</i>	<i>fusciceps</i>	1515	7000	400	.	227	410	.	46
Primates	Cebidae	<i>Ateles</i>	<i>geoffroyi</i>	1825	7267.5	426	2000	232	821	.	47.1
Primates	Cebidae	<i>Cebus</i>	<i>apella</i>	1703	2642.5	239.7	1000	158	307	.	46
Primates	Cebidae	<i>Cebus</i>	<i>capucinus</i>	1505	2655	230	1350	162	521	.	54
Primates	Cebidae	<i>Saimiri</i>	<i>boliviensis</i>	.	615	.	.	.	.	.	30.3
Primates	Cebidae	<i>Saimiri</i>	<i>sciureus</i>	1003	925	107	403	161	177	0.0125	30.2
Primates	Cercopithecidae	<i>Cercocebus</i>	<i>torquatus</i>	973	9492.5	.	.	167	.	.	46
Primates	Cercopithecidae	<i>Cercopithecus</i>	<i>diana</i>	1962	4550	475	.	.	365	.	35.1
Primates	Cercopithecidae	<i>Cercopithecus</i>	<i>neglectus</i>	1611	5945	260	1640	177	395	.	30.8
Primates	Cercopithecidae	<i>Erythrocebus</i>	<i>patas</i>	956	7750	504.5	1950	167	162	.	28.3
Primates	Cercopithecidae	<i>Macaca</i>	<i>fascicularis</i>	1238	6362.5	320	848.4	165	242	.	39
Primates	Cercopithecidae	<i>Macaca</i>	<i>fuscata</i>	1483	8882.5	496	1767	174	366	.	38.5
Primates	Cercopithecidae	<i>Macaca</i>	<i>mulatta</i>	1231	8235	464	1454	165	292	0.0012	40

Primates	Cercopithecidae	<i>Macaca</i>	<i>nemestrina</i>	1125	7912.5	462.5	1416.5	172	324	0.0015	37.6
Primates	Cercopithecidae	<i>Macaca</i>	<i>nigra</i>	1490	7965	461	.	176	365	.	34
Primates	Cercopithecidae	<i>Macaca</i>	<i>silenus</i>	1429	7875	407	.	176	365	.	40
Primates	Cercopithecidae	<i>Macaca</i>	<i>sylvanus</i>	1399	10875	450	2420	164	213	.	29.1
Primates	Cercopithecidae	<i>Mandrillus</i>	<i>sphinx</i>	1186	23000	613	3000	173	354	.	40
Primates	Cercopithecidae	<i>Papio</i>	<i>hamadryas</i>	1514	18000	814	3950	171	300	0.0026	37.5
Primates	Cercopithecidae	<i>Theropithecus</i>	<i>gelada</i>	1391	16200	464	3900	168	433	.	36
Primates	Cheirogaleidae	<i>Microcebus</i>	<i>murinus</i>	243	64.8	6	.	61	37	0.0362	18.2
Primates	Galagonidae	<i>Galago</i>	<i>senegalensis</i>	240	192.2	12.2	100	126	89	0.0169	17.1
Primates	Hominidae	<i>Gorilla</i>	<i>gorilla</i>	2829	139842	2061.4	12595	256	834	0.0008	53.5
Primates	Hominidae	<i>Homo</i>	<i>sapiens</i>	4745	62035	3312.5	11750	280	639	0.0005	122.5
Primates	Hominidae	<i>Pan</i>	<i>troglodytes</i>	3376	44983.5	1821	8500	229	1111	0.0007	74
Primates	Hominidae	<i>Pongo</i>	<i>pygmaeus</i>	2555	64475	1736.5	11000	249	1003	0.0009	59
Primates	Hylobatidae	<i>Hylobates</i>	<i>lar</i>	2555	6810	307.2	1070	217	600	0.002	57
Primates	Hylobatidae	<i>Hylobates</i>	<i>syndactylus</i>	2190	10900	517	.	231	642	.	43
Primates	Lemuridae	<i>Eulemur</i>	<i>fulvus</i>	608	3150	83.3	.	118	153	.	35.5
Primates	Lemuridae	<i>Eulemur</i>	<i>macaco</i>	548	2500	74.67	.	127	152	.	36.2
Primates	Lemuridae	<i>Eulemur</i>	<i>mongoz</i>	796	2060	53	.	128	154	.	36.2
Primates	Lemuridae	<i>Lemur</i>	<i>catta</i>	595	2555	70.6	.	135	152	.	37.3
Primates	Lemuridae	<i>Varecia</i>	<i>variegata</i>	604	3670	87.2	2893	99	112	.	36
Primates	Loridae	<i>Nycticebus</i>	<i>coucang</i>	578	890.5	48.2	520	188	177	.	25.8
Primates	Pitheciidae	<i>Pithecia</i>	<i>pithecia</i>	775	1480	.	.	158	122	.	36
Proboscidea	Elephantidae	<i>Elephas</i>	<i>maximus</i>	3287	3.18E+06	107000	.	644	548	.	65.5
Proboscidea	Elephantidae	<i>Loxodonta</i>	<i>africana</i>	4018	4.80E+06	105000	600000	670	1071	0.0003	65
Rodentia	Agoutidae	<i>Dasyprocta</i>	<i>leporina</i>	193	3265	.	.	112	.	.	17.8
Rodentia	Agoutidae	<i>Dasyprocta</i>	<i>punctata</i>	487	2150	227	.	112	.	.	13.8
Rodentia	Bathyergidae	<i>Heterocephalus</i>	<i>glaber</i>	228	35	2	11	70	36	0.0046	28.3
Rodentia	Castoridae	<i>Castor</i>	<i>canadensis</i>	639	20250	430	.	128	60	.	23.4
Rodentia	Caviidae	<i>Cavia</i>	<i>porcellus</i>	66	728	85	228	68	18	0.0106	12
Rodentia	Caviidae	<i>Dolichotis</i>	<i>patagonum</i>	158	12500	561.94	.	85	65	.	14.4
Rodentia	Chinchillidae	<i>Chinchilla</i>	<i>lanigera</i>	240	642.5	35	.	111	54	.	17.2
Rodentia	Erethizontidae	<i>Erethizon</i>	<i>dorsatum</i>	1095	8600	500	1000	210	60	0.0079	23.4
Rodentia	Hydrochaeridae	<i>Hydrochaeris</i>	<i>hydrochaeris</i>	456	55000	1500	8299	150	103	.	15.1
Rodentia	Hystricidae	<i>Hystrix</i>	<i>cristata</i>	.	20000	1000	.	66	.	.	28
Rodentia	Hystricidae	<i>Hystrix</i>	<i>indica</i>	.	20000	.	.	113	.	.	27.1
Rodentia	Muridae	<i>Acomys</i>	<i>cahirinus</i>	58	45.2	5.27	15.16	38	14	0.0147	5.9
Rodentia	Muridae	<i>Apodemus</i>	<i>flavicollis</i>	52	29.4	2.4	8.7	26	22	.	4.5
Rodentia	Muridae	<i>Clethrionomys</i>	<i>glareolus</i>	47	20.8	1.82	9.8	20	20	0.0809	4.9
Rodentia	Muridae	<i>Mus</i>	<i>musculus</i>	42	20.5	1.25	8.9	19	22	0.0298	4
Rodentia	Muridae	<i>Rattus</i>	<i>norvegicus</i>	90	300	5.81	63.8	21	25	.	5
Rodentia	Muridae	<i>Rattus</i>	<i>rattus</i>	90	200	4.55	39.7	22	26	0.0207	4.2
Rodentia	Sciuridae	<i>Callosciurus</i>	<i>prevostii</i>	.	400	16.35	.	48	.	.	21.1
Rodentia	Sciuridae	<i>Cynomys</i>	<i>ludovicianus</i>	730	1125	15.75	148.35	30	63	0.0111	11

Rodentia	Sciuridae	<i>Tamiasciurus</i>	<i>hudsonicus</i>	342	200	7	83.8	37	63	0.0216	9.8
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>glis</i>	90	200	12.94	100	46	36	.	12.4
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>minor</i>	.	58.6	.	.	.	.	.	12.2
Scandentia	Tupaiaidae	<i>Tupaia</i>	<i>tana</i>	.	197.8	.	.	.	31	.	11.6

Birds

Order	Family	Genus	Species	Female age at maturity (d)	Adult mass (g)	Egg mass (g)	Incubation period (d)	Growth rate <i>k</i> (d)	Oldest (y)
Anseriformes	Anatidae	<i>Aix</i>	<i>galericulata</i>	.	299	41	29	0.069	.
Anseriformes	Anatidae	<i>Aix</i>	<i>sponsa</i>	365	630	43.3	29	.	22.5
Anseriformes	Anatidae	<i>Alopochen</i>	<i>aegyptiacus</i>	730	1935	97	29	.	25.5
Anseriformes	Anatidae	<i>Anas</i>	<i>acuta</i>	240	700	45	23	.	27.4
Anseriformes	Anatidae	<i>Anas</i>	<i>capensis</i>	.	410	30	25	.	.
Anseriformes	Anatidae	<i>Anas</i>	<i>castanea</i>	.	500	40	26	.	.
Anseriformes	Anatidae	<i>Anas</i>	<i>clypeata</i>	240	550	40	22	.	20.4
Anseriformes	Anatidae	<i>Anas</i>	<i>penelope</i>	365	800	44	24.5	.	34.7
Anseriformes	Anatidae	<i>Anas</i>	<i>platyrhynchos</i>	365	1200	60	26.5	0.12	29.1
Anseriformes	Anatidae	<i>Anas</i>	<i>rubripes</i>	365	1160	63	27	0.084	26.4
Anseriformes	Anatidae	<i>Anas</i>	<i>strepera</i>	240	650	44	26	0.115	22.3
Anseriformes	Anatidae	<i>Anas</i>	<i>sibilatrix</i>	.	828	.	.	.	.
Anseriformes	Anatidae	<i>Anser</i>	<i>albifrons</i>	1095	2180	125	27	.	47
Anseriformes	Anatidae	<i>Anser</i>	<i>anser</i>	1095	3250	173	27.5	0.104	31
Anseriformes	Anatidae	<i>Anser</i>	<i>cygnoides</i>	.	3500	145	29	.	.
Anseriformes	Anatidae	<i>Anser</i>	<i>indicus</i>	.	2000	141	29	.	.
Anseriformes	Anatidae	<i>Anser</i>	<i>rossi</i>	.	1500	94	23.5	.	.
Anseriformes	Anatidae	<i>Aythya</i>	<i>americana</i>	365	1020	65	25	0.089	22.6
Anseriformes	Anatidae	<i>Aythya</i>	<i>ferina</i>	365	850	66	25	.	23.2
Anseriformes	Anatidae	<i>Aythya</i>	<i>fuligula</i>	365	660	56	24	0.144	22
Anseriformes	Anatidae	<i>Aythya</i>	<i>nyroca</i>	.	600	43	26	.	.
Anseriformes	Anatidae	<i>Branta</i>	<i>bernicla</i>	730	1400	85	25.5	0.08	28.7
Anseriformes	Anatidae	<i>Branta</i>	<i>canadensis</i>	730	5000	163	28	0.113	42
Anseriformes	Anatidae	<i>Branta</i>	<i>leucopsis</i>	730	1600	107	24.5	.	26.9
Anseriformes	Anatidae	<i>Branta</i>	<i>ruficollis</i>	.	1400	90	25	.	.
Anseriformes	Anatidae	<i>Branta</i>	<i>sandvicensis</i>	912	2090	144	30	.	42
Anseriformes	Anatidae	<i>Bucephala</i>	<i>clangula</i>	730	650	57	28	.	18.4
Anseriformes	Anatidae	<i>Cairinia</i>	<i>moschata</i>	.	1750	70	35	.	.
Anseriformes	Anatidae	<i>Callonetta</i>	<i>leucophrys</i>	.	310	32	29	.	.
Anseriformes	Anatidae	<i>Cereopsis</i>	<i>novaeollandiae</i>	.	3500	137	35	.	28.1
Anseriformes	Anatidae	<i>Cygnus</i>	<i>atratus</i>	.	5000	300	39	.	.

Anseriformes	Anatidae	<i>Cygnus</i>	<i>cygnus_buccinator</i>	730	10200	324	32.5	.	32.5
Anseriformes	Anatidae	<i>Cygnus</i>	<i>melanocoryphus</i>	.	4000	247	35	.	.
Anseriformes	Anatidae	<i>Cygnus</i>	<i>olor</i>	1095	11000	340	35	0.08	70
Anseriformes	Anatidae	<i>Marmaronetta</i>	<i>anguirostris</i>	.	470	31	25	.	.
Anseriformes	Anatidae	<i>Mergus</i>	<i>cucullatus</i>	.	610	.	.	.	.
Anseriformes	Anatidae	<i>Mergus</i>	<i>merganser</i>	730	1300	85.2	28	.	14.8
Anseriformes	Anatidae	<i>Netta</i>	<i>peposaca</i>	.	1005	60	28	.	.
Anseriformes	Anatidae	<i>Netta</i>	<i>rufina</i>	365	1070	56	27	.	7.2
Anseriformes	Anatidae	<i>Oxyura</i>	<i>jamaicensis</i>	365	510	73	23.5	.	13.6
Anseriformes	Anatidae	<i>Somateria</i>	<i>mollissima</i>	730	2050	100	25.5	0.061	37.8
Anseriformes	Anatidae	<i>Tadorna</i>	<i>ferruginea</i>	.	1250	83	29	0.151	.
Anseriformes	Anatidae	<i>Tadorna</i>	<i>tadorna</i>	730	1000	78	30	0.074	24.8
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>bicolor</i>	365	735	50	26	.	6.5
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>autumnalis</i>	365	830	44	26	0.17	8.2
Anseriformes	Dendrocygnidae	<i>Dendrocygna</i>	<i>viduata</i>	.	700	36	26	.	12
Ciconiiformes	Accipitridae	<i>Aquila</i>	<i>chrysaetos</i>	1460	5273	142	44	0.126	48
Ciconiiformes	Accipitridae	<i>Aquila</i>	<i>rapax</i>	.	2625	92.8	45	0.093	40.3
Ciconiiformes	Accipitridae	<i>Buteo</i>	<i>jamaicensis</i>	730	1126	.	31	0.188	29.5
Ciconiiformes	Accipitridae	<i>Falco</i>	<i>sparverius</i>	365	75	16	29	0.285	17
Ciconiiformes	Accipitridae	<i>Falco</i>	<i>tinnunculus</i>	365	230	21	28	0.294	23.8
Ciconiiformes	Accipitridae	<i>Gyps</i>	<i>fulvus</i>	1460	7500	252	55.5	0.059	41.4
Ciconiiformes	Accipitridae	<i>Haliaeetus</i>	<i>leucocephalus</i>	1460	5000	117	35	0.098	48
Ciconiiformes	Accipitridae	<i>Milvus</i>	<i>migrans</i>	1095	625	56	34	0.179	24
Ciconiiformes	Ardeidae	<i>Ardea</i>	<i>cinerea</i>	730	1500	49.6	25.5	0.149	35.1
Ciconiiformes	Ardeidae	<i>Ardeola</i>	<i>ibis</i>	.	338	.	.	.	.
Ciconiiformes	Ardeidae	<i>Egretta</i>	<i>thula</i>	365	371	.	18	0.253	22.8
Ciconiiformes	Ardeidae	<i>Nycticorax</i>	<i>nycticorax</i>	365	650	20.8	25	.	21.1
Ciconiiformes	Charadriidae	<i>Himantopus</i>	<i>himantopus</i>	.	161	22.8	24	0.175	10.2
Ciconiiformes	Charadriidae	<i>Recurvirostra</i>	<i>avosetta</i>	730	340	31.7	23.4	0.192	27.8
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>armatus</i>	.	156	.	.	.	.
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>miles</i>	.	379	.	.	.	.
Ciconiiformes	Charadriidae	<i>Vanellus</i>	<i>spinosus</i>	.	152	.	.	.	17
Ciconiiformes	Ciconiidae	<i>Ciconia</i>	<i>ciconia</i>	1460	3350	75.1	33.5	0.17	39
Ciconiiformes	Ciconiidae	<i>Ciconia</i>	<i>nigra</i>	.	3000	.	.	.	31.3
Ciconiiformes	Ciconiidae	<i>Leptoptilos</i>	<i>crumeniferus</i>	1460	6325	.	30	0.073	44.7
Ciconiiformes	Ciconiidae	<i>Sarcorhamphus</i>	<i>papa</i>	.	3400	.	57	0.078	40
Ciconiiformes	Ciconiidae	<i>Vultur</i>	<i>gryphus</i>	2555	11300	.	56	0.078	75
Ciconiiformes	Laridae	<i>Fratercula</i>	<i>arctica</i>	1460	500	65	38	0.145	33.8
Ciconiiformes	Laridae	<i>Larosterna</i>	<i>inca</i>	.	180	.	.	.	.
Ciconiiformes	Laridae	<i>Lunda</i>	<i>cirrhata</i>	.	779	.	.	.	.
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>crispus</i>	.	9000	.	.	.	35.3
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>erythrorhynchos</i>	1095	7000	.	36	0.113	54
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>occidentalis</i>	365	3500	92.1	28	0.112	43

Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>onocrotalus</i>	.	9520	.	.	.	51
Ciconiiformes	Pelecanidae	<i>Pelecanus</i>	<i>rufescens</i>	.	5200	.	.	.	.
Ciconiiformes	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>carbo</i>	1460	2200	58	28.5	0.115	23.5
Ciconiiformes	Phoenicopteridae	<i>Phoeniconaias</i>	<i>minor</i>	.	1900	.	.	.	.
Ciconiiformes	Phoenicopteridae	<i>Phoenicopterus</i>	<i>chilensis</i>	.	2277	.	.	.	36.7
Ciconiiformes	Phoenicopteridae	<i>Phoenicopterus</i>	<i>ruber</i>	1825	3035	.	30	.	44
Ciconiiformes	Scopidae	<i>Scopus</i>	<i>umbretta</i>	.	422.5	.	.	.	.
Ciconiiformes	Spheniscidae	<i>Aptenodytes</i>	<i>patagonica</i>	.	16000	300	53	0.124	26
Ciconiiformes	Spheniscidae	<i>Eudyptes</i>	<i>crestatus</i>	.	2500	110	34	0.068	.
Ciconiiformes	Spheniscidae	<i>Eudyptula</i>	<i>minor</i>	.	1100	52	39	0.13625	.
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>demersus</i>	.	2900	103	40	0.06625	.
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>humboldti</i>	.	5000	.	.	.	.
Ciconiiformes	Spheniscidae	<i>Spheniscus</i>	<i>magellanicus</i>	1040	4500	.	40	0.069	30
Ciconiiformes	Threskiornithidae	<i>Ajaja</i>	<i>ajaja</i>	.	1522.5	.	.	.	.
Ciconiiformes	Threskiornithidae	<i>Eudocimus</i>	<i>albus</i>	730	900	.	22	0.13	27.6
Ciconiiformes	Threskiornithidae	<i>Eudocimus</i>	<i>ruber</i>	.	664.5	.	23	.	33.2
Ciconiiformes	Threskiornithidae	<i>Geronticus</i>	<i>eremita</i>	.	1200	.	.	0.237	32.9
Ciconiiformes	Threskiornithidae	<i>Platalea</i>	<i>alba</i>	.	1521	.	.	.	17.9
Ciconiiformes	Threskiornithidae	<i>Platalea</i>	<i>leucorodia</i>	1095	1892	.	.	0.174	30.1
Ciconiiformes	Threskiornithidae	<i>Plegadis</i>	<i>falcinellus</i>	1095	633.75	.	21	.	26.8
Ciconiiformes	Threskiornithidae	<i>Threskiornis</i>	<i>aethiopicus</i>	.	1497	.	.	.	37
Coliiformes	Coliidae	<i>Colius</i>	<i>striatus</i>	.	55	2.7	12	.	.
Columbiformes	Columbidae	<i>Caloenas</i>	<i>nicobarica</i>	.	492	.	.	.	.
Columbiformes	Columbidae	<i>Columba</i>	<i>guinea</i>	.	352	14.6	16	0.254	.
Columbiformes	Columbidae	<i>Columba</i>	<i>livia</i>	140	282	17	17.5	0.28	35
Columbiformes	Columbidae	<i>Ducula</i>	<i>bicolor</i>	.	483	.	.	.	.
Columbiformes	Columbidae	<i>Galliolumba</i>	<i>luzonica</i>	.	196	.	.	.	.
Columbiformes	Columbidae	<i>Geopelia</i>	<i>cuneata</i>	.	30	2.4	13	0.129	.
Columbiformes	Columbidae	<i>Geopelia</i>	<i>striata</i>	.	36.5	3.2	13.5	.	.
Columbiformes	Columbidae	<i>Goura</i>	<i>victoria</i>	.	2000	.	.	.	.
Columbiformes	Columbidae	<i>Ocyphaps</i>	<i>lophotes</i>	.	205	.	.	.	.
Columbiformes	Columbidae	<i>Ptilinopus</i>	<i>jambu</i>	.	135	.	.	.	.
Columbiformes	Columbidae	<i>Streptopelia</i>	<i>risoria</i>	.	134.2	8.1	13.5	0.333	12
Coraciiformes	Bucerotidae	<i>Aceros</i>	<i>undulatus</i>	.	.	.	.	.	.
Coraciiformes	Bucerotidae	<i>Bucorvus</i>	<i>abyssinicus</i>	.	4000	.	.	.	70
Coraciiformes	Bucerotidae	<i>Tockus</i>	<i>erythrorhynchus</i>	.	139	.	.	.	.
Coraciiformes	Coraciidae	<i>Coracias</i>	<i>caudata</i>	.	160	14.3	17.5	0.249	9.2
Coraciiformes	Dacelonidae	<i>Dacelo</i>	<i>novaeguineae</i>	.	305	.	.	.	.
Coraciiformes	Momotidae	<i>Momotus</i>	<i>momota</i>	.	120	13.1	21	.	10.4
Craciformes	Megapodiidae	<i>Alectura</i>	<i>lathami</i>	.	2330	.	.	0.03	12.5
Galliformes	Numididae	<i>Acryllium</i>	<i>vulturinum</i>	.	1390	.	.	.	.
Galliformes	Numididae	<i>Numida</i>	<i>meleagris</i>	.	1299	.	.	.	.
Galliformes	Phasianidae	<i>Alectoris</i>	<i>chukar</i>	.	578	22.6	23	0.051	6.2

Galliformes	Phasianidae	<i>Chrysolophus</i>	<i>amherstiae</i>	.	700	29.7	24	.	.
Galliformes	Phasianidae	<i>Chrysolophus</i>	<i>pictus</i>	.	550.00	32.10	24.00	.	.
Galliformes	Phasianidae	<i>Gallus</i>	<i>gallus</i>	.	2050	36	21	0.037	30
Galliformes	Phasianidae	<i>Lophophorus</i>	<i>impeyanus</i>	.	2078	63.7	28	.	.
Galliformes	Phasianidae	<i>Lophura</i>	<i>edwardsi</i>	.	1082	.	.	.	.
Galliformes	Phasianidae	<i>Lophura</i>	<i>nycthemera</i>	.	1250	39.9	26	.	.
Galliformes	Phasianidae	<i>Meleagris</i>	<i>gallopavo</i>	304	5811	.	28	0.023	13
Galliformes	Phasianidae	<i>Pavo</i>	<i>cristatus</i>	730	3500	90	28	0.03	23.2
Galliformes	Phasianidae	<i>Phasianus</i>	<i>colchicus</i>	240	1132.8	29.2	24	0.043	27
Galliformes	Phasianidae	<i>Rollulus</i>	<i>roulroul</i>	.	217	.	.	.	.
Galliformes	Phasianidae	<i>Syrmaticus</i>	<i>reevesi</i>	.	1239	.	.	.	9.2
Galliformes	Phasianidae	<i>Tympanuchus</i>	<i>cupido_attwateri</i>	365	885	23.8	24.5	0.064	5
Gruiformes	Eurypygidae	<i>Eurypyga</i>	<i>helias</i>	.	222	.	27	.	15
Gruiformes	Gruidae	<i>Anthropoides</i>	<i>virgo</i>	730	2308	.	28	0.084	27
Gruiformes	Gruidae	<i>Balearica</i>	<i>pavonina</i>	.	3590	.	.	0.065	.
Gruiformes	Gruidae	<i>Balearica</i>	<i>regulorum</i>	.	3772	.	.	.	.
Gruiformes	Gruidae	<i>Grus</i>	<i>antigone</i>	.	8863	214.3	31.8	0.052	.
Gruiformes	Gruidae	<i>Grus</i>	<i>canadensis</i>	1095	4368.5	196.4	26.7	0.047	31.2
Gruiformes	Gruidae	<i>Grus</i>	<i>grus</i>	1825	5500	200	30	0.054	43
Gruiformes	Gruidae	<i>Grus</i>	<i>vipio</i>	1095	4663	188.2	30.6	0.057	45
Gruiformes	Rallidae	<i>Fulica</i>	<i>atra</i>	365	102	.	.	0.174	20.6
Musophagiformes	Musophaginae	<i>Musophaga</i>	<i>violacea</i>	.	360	.	.	.	.
Musophagiformes	Musophaginae	<i>Tauraco</i>	<i>corythaix</i>	.	297	26.3	25	.	12.4
Passeriformes	Bombycillidae	<i>Bombycilla</i>	<i>cedrorum</i>	365	31.8	.	14	0.52	8.2
Passeriformes	Corvidae	<i>Corvus</i>	<i>brachyrhynchos</i>	730	440	38	16.5	0.172	20
Passeriformes	Corvidae	<i>Corvus</i>	<i>corax</i>	1095	1199	.	19	.	69
Passeriformes	Fringillidae	<i>Cyanerpes</i>	<i>cyaneus</i>	.	14	1.8	12.2	0.28	17
Passeriformes	Fringillidae	<i>Ramphocelus</i>	<i>carbo</i>	.	28	3.4	12	0.504	.
Passeriformes	Fringillidae	<i>Thraupis</i>	<i>episcopus</i>	.	35	3.1	13.7	0.37	9.5
Passeriformes	Irenidae	<i>Irena</i>	<i>puella</i>	.	62.5	.	.	.	.
Passeriformes	Muscicapidae	<i>Leiothrix</i>	<i>argentaureis</i>	.	28.4	.	.	.	.
Passeriformes	Muscicapidae	<i>Leiothrix</i>	<i>lutea</i>	.	21.8	.	.	.	.
Passeriformes	Passeridae	<i>Amadina</i>	<i>fasciata</i>	.	15.5	1.5	12.5	.	.
Passeriformes	Passeridae	<i>Amandava</i>	<i>amandava</i>	.	9.6	.	.	0.382	.
Passeriformes	Passeridae	<i>Carduelis</i>	<i>carduelis</i>	365	15.6	.	.	.	27
Passeriformes	Passeridae	<i>Chloebia</i>	<i>gouldiae</i>	.	14.5	.	.	.	.
Passeriformes	Passeridae	<i>Emblema</i>	<i>guttata</i>	.	19	.	.	.	.
Passeriformes	Passeridae	<i>Euplectes</i>	<i>orix</i>	.	16.2	1.7	12.5	.	.
Passeriformes	Passeridae	<i>Neochmia</i>	<i>ruficauda</i>	.	10.5	.	.	.	.
Passeriformes	Passeridae	<i>Padda</i>	<i>oryzivora</i>	.	24.8	.	14	.	.
Passeriformes	Passeridae	<i>Ploceus</i>	<i>cucullatus</i>	.	41	2.8	12	.	.
Passeriformes	Passeridae	<i>Poephila</i>	<i>acuticauda</i>	.	.	.	.	.	.
Passeriformes	Passeridae	<i>Poephila</i>	<i>guttata</i>	60	11	0.9	14	0.255	12

Passeriformes	Passeridae	<i>Serinus</i>	<i>canaria</i>	.	8.4	.	.	0.315	24
Passeriformes	Passeridae	<i>Uraeginthus</i>	<i>cynocephala</i>	.	10.1	.	.	.	.
Passeriformes	Pycnonotidae	<i>Pycnonotus</i>	<i>jocosus</i>	.	27.4	.	12	.	11.1
Passeriformes	Sturnidae	<i>Cosmopsarus</i>	<i>regius</i>	.	.	.	.	.	.
Passeriformes	Sturnidae	<i>Gracula</i>	<i>religiosa</i>	.	192	.	.	.	.
Passeriformes	Sturnidae	<i>Lamprotornis</i>	<i>iris</i>	.	100	5.6	14	.	.
Passeriformes	Sturnidae	<i>Leucopsar</i>	<i>rothschildi</i>	.	.	.	13	.	24
Passeriformes	Sturnidae	<i>Spreo</i>	<i>superbus</i>	.	.	.	.	.	.
Passeriformes	Turdidae	<i>Copsychus</i>	<i>malabaricus</i>	.	30	.	.	.	.
Passeriformes	Zosteropidae	<i>Zosterops</i>	<i>palpebrosa</i>	365	8.6	.	11	.	5.1
Piciformes	Ramphastidae	<i>Ramphastos</i>	<i>toco</i>	.	339	17.3	15.3	0.199	.
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>fisheri</i>	.	42	3.5	23	.	12.6
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>personata</i>	.	40	3.6	23	0.235	.
Psittaciformes	Psittacidae	<i>Agapornis</i>	<i>roseicollis</i>	.	45	3.7	23.3	0.231	.
Psittaciformes	Psittacidae	<i>Amazona</i>	<i>aestiva</i>	.	300	17.5	29	0.181	49
Psittaciformes	Psittacidae	<i>Amazona</i>	<i>ochrocephala</i>	.	302.5	20.9	29	0.158	56
Psittaciformes	Psittacidae	<i>Anodorhynchus</i>	<i>hyacinthinus</i>	.	1500	.	.	.	38.8
Psittaciformes	Psittacidae	<i>Ara</i>	<i>ararauna</i>	.	1125	.	.	0.126	43
Psittaciformes	Psittacidae	<i>Ara</i>	<i>chloroptera</i>	.	1250	.	.	0.112	50.1
Psittaciformes	Psittacidae	<i>Ara</i>	<i>macao</i>	.	1015	.	.	0.12	33
Psittaciformes	Psittacidae	<i>Ara</i>	<i>militaris</i>	.	1134	.	.	0.12	46
Psittaciformes	Psittacidae	<i>Aratinga</i>	<i>solstitialis</i>	.	.	.	.	.	.
Psittaciformes	Psittacidae	<i>Cacatua</i>	<i>galerita</i>	.	450	27.3	30	0.126	57
Psittaciformes	Psittacidae	<i>Cacatua</i>	<i>moluccensis</i>	.	335	29.2	30	.	65.8
Psittaciformes	Psittacidae	<i>Cyanoliseus</i>	<i>patagonus</i>	.	273	.	.	.	19.5
Psittaciformes	Psittacidae	<i>Eclectus</i>	<i>roratus</i>	.	428	20.2	26	0.128	28.5
Psittaciformes	Psittacidae	<i>Eolophus</i>	<i>roseicapillus</i>	.	320	13	28	0.173	40
Psittaciformes	Psittacidae	<i>Melopsittacus</i>	<i>undulatus</i>	180	28	2.2	18	0.231	21
Psittaciformes	Psittacidae	<i>Myiopsitta</i>	<i>monachus</i>	730	101	.	31	0.244	22.1
Psittaciformes	Psittacidae	<i>Nymphicus</i>	<i>hollandicus</i>	.	85	4.6	22	.	35
Psittaciformes	Psittacidae	<i>Psittacula</i>	<i>krameri</i>	.	110	8.7	23	.	.
Psittaciformes	Psittacidae	<i>Psittacus</i>	<i>erithacus</i>	.	250	.	.	0.128	49.7
Psittaciformes	Psittacidae	<i>Trichoglossus</i>	<i>haematodus</i>	.	136	7.1	25	.	16.1
Strigiformes	Podargidae	<i>Podargus</i>	<i>strigoides</i>	.	350	.	.	.	.
Strigiformes	Strigidae	<i>Athene</i>	<i>cunicularia</i>	365	155	.	28	.	11
Strigiformes	Strigidae	<i>Bubo</i>	<i>bubo</i>	730	2000	69.3	35	0.12	68
Strigiformes	Strigidae	<i>Bubo</i>	<i>virginianus</i>	730	1543	.	27	0.138	29
Strigiformes	Strigidae	<i>Nyctea</i>	<i>scandiaca</i>	.	1049	60.3	32	0.148	.
Strigiformes	Strigidae	<i>Otus</i>	<i>asio</i>	365	129.8	16.5	23	0.264	8.1
Strigiformes	Strigidae	<i>Pulsatrix</i>	<i>perspicillata</i>	.	873	.	36	.	25
Strigiformes	Strigidae	<i>Strix</i>	<i>varia</i>	730	716.5	.	28	0.101	23
Strigiformes	Tytonidae	<i>Tyto</i>	<i>alba</i>	365	381.6	18.7	30.5	0.17	34
Struthioniformes	Apterygidae	<i>Apteryx</i>	<i>australis</i>	.	2250	402.6	79	0.0312	35

Struthioniformes	Casuaridae	<i>Dromaius</i>	<i>novaehollandiae</i>	.	40500	578	59	.	16.6
Struthioniformes	Rheidae	<i>Rhea</i>	<i>americana</i>	.	20000	609	40	.	.
Struthioniformes	Struthionidae	<i>Struthio</i>	<i>camelus</i>	.	90000	1517	42	.	50

Reptiles and amphibians

Class	Order	Family	Genus	Species	Female age at maturity (d)	Adult body mass (g)	Adult length (m)	Incubation period (d)	Longevity (y)
Reptilia	Squamata	Agamidae	<i>Pogona</i>	<i>vitticeps</i>	547.5	3970	0.470	65	.
Reptilia	Squamata	Anguidae	<i>Ophisaurus</i>	<i>apodus</i>	.	.	.	.	.
Reptilia	Squamata	Boidae	<i>Boa</i>	<i>constrictor</i>	1095	3532	2.500	125	40.4
Reptilia	Squamata	Boidae	<i>Chondropython</i>	<i>viridis</i>	.	.	.	.	.
Reptilia	Squamata	Boidae	<i>Eunectes</i>	<i>murinus</i>	912.5	97500	5.200	180	31.8
Reptilia	Squamata	Boidae	<i>Python</i>	<i>reticulatus</i>	1095	32000	6.248	85	29.4
Reptilia	Squamata	Boidae	<i>Python</i>	<i>regius</i>	1825	11609	1.500	77	47.5
Reptilia	Squamata	Boidae	<i>Python</i>	<i>molurus bivittatus</i>	1095	.	.	100	34.2
Reptilia	Squamata	Boidae	<i>Sanzinia</i>	<i>madagascariensis</i>	.	.	.	.	.
Reptilia	Squamata	Chamaeleonidae	<i>Chamaeleo</i>	<i>calypttratus</i>	135	4365	0.521	.	.
Reptilia	Squamata	Colubridae	<i>Elaphe</i>	<i>guttata</i>	600	900	0.165	60	32.3
Reptilia	Squamata	Colubridae	<i>Lampropeltis</i>	<i>getulus californiae</i>	1095	.	.	64	33.3
Reptilia	Squamata	Gekkonidae	<i>Eublepharis</i>	<i>macularius</i>	400	.	.	55	28.5
Reptilia	Squamata	Gekkonidae	<i>Phelsuma</i>	<i>standingi</i>	.	214.5	0.020	.	9.6
Reptilia	Squamata	Helodermatidae	<i>Heloderma</i>	<i>suspectum suspectum</i>	.	555.7	0.056	300	28.9
Reptilia	Squamata	Helodermatidae	<i>Heloderma</i>	<i>suspectum</i>	.	.	.	.	28.9
Reptilia	Squamata	Iguanidae	<i>Iguana</i>	<i>iguana</i>	1640	5000	1.750	105	19.8
Reptilia	Squamata	Scincidae	<i>Corucia</i>	<i>zebrata</i>	.	.	.	.	24.3
Reptilia	Squamata	Viperidae	<i>Bitis</i>	<i>gabonica rhinoceros</i>	.	8500	1.200	210	18.0
Reptilia	Squamata	Viperidae	<i>Crotalus</i>	<i>atrox</i>	1095	6700	1.500	167	27.0
Reptilia	Squamata	Xenosauridae	<i>Shinisaurus</i>	<i>crocodilurus</i>	.	.	.	.	.
Reptilia	Crocodylia	Crocodylidae	<i>Alligator</i>	<i>sinensis</i>	2190	11250	1.450	.	60.7
Reptilia	Crocodylia	Crocodylidae	<i>Alligator</i>	<i>mississippiensis</i>	4830	170000	3.000	65	73.1
Reptilia	Crocodylia	Crocodylidae	<i>Crocodylus</i>	<i>niloticus</i>	.	.	.	.	43.8
Reptilia	Crocodylia	Crocodylidae	<i>Paleosuchus</i>	<i>palpebrosus</i>	3650	6500	1.500	90	24.1
Reptilia	Chelonia	Chelidae	<i>Chelus</i>	<i>fimbriatus</i>	.	3814	0.450	200	35.8
Reptilia	Chelonia	Chelydridae	<i>Chelydra</i>	<i>serpentina</i>	3285	10250	0.325	126	47.0
Reptilia	Chelonia	Emydidae	<i>Terrapene</i>	<i>carolina triunguis</i>	2190	1339	0.145	.	138.0
Reptilia	Chelonia	Emydidae	<i>Trachemys</i>	<i>scripta elegans</i>	2920	240	0.207	75	41.3

Reptilia	Chelonia	Pelomedusidae	<i>Podocnemis</i>	<i>unifilis</i>	.	4500	.	60	70.0
Reptilia	Chelonia	Testudinidae	<i>Geochelone</i>	<i>elephantopus</i>	.	.	.	.	.
Reptilia	Chelonia	Testudinidae	<i>Geochelone</i>	<i>carbonaria</i>	.	.	.	.	49.0
Reptilia	Chelonia	Testudinidae	<i>Geochelone</i>	<i>elegans</i>	3650	3600	0.265	130	24.3
Reptilia	Chelonia	Testudinidae	<i>Geochelone</i>	<i>pardalis</i>	.	.	.	.	30.0
Reptilia	Chelonia	Testudinidae	<i>Geochelone</i>	<i>gigantea</i>	.	.	.	.	152.0
Reptilia	Chelonia	Testudinidae	<i>Gopherus</i>	<i>agassizii</i>	5500	17000	0.255	118	62.8
Reptilia	Chelonia	Testudinidae	<i>Malacochersus</i>	<i>tornieri</i>	.	.	.	.	25.9
Reptilia	Chelonia	Testudinidae	<i>Testudo</i>	<i>graeca</i>	4650	320	.	.	127.0
Reptilia	Chelonia	Testudinidae	<i>Testudo</i>	<i>hermanni</i>	4650	.	.	.	.
Amphibia	Caudata	Ambystomatidae	<i>Ambystoma</i>	<i>tigrinum</i>	1460	9.4	0.250	28	25.0
Amphibia	Caudata	Salamandridae	<i>Salamandra</i>	<i>Salamandra</i>	.	19.1	0.200	.	24.0
Amphibia	Anura	Bufo	<i>Bufo</i>	<i>baxteri</i>	.	.	.	.	.
Amphibia	Anura	Dendrobatidae	<i>Dendrobates</i>	<i>azureus</i>	730	3	0.038	16	7.6
Amphibia	Anura	Dendrobatidae	<i>Dendrobates</i>	<i>tinctorius</i>	.	5.00	0.045	.	.
Amphibia	Anura	Dendrobatidae	<i>Dendrobates</i>	<i>auratus</i>	365	.	0.040	12	20.5
Amphibia	Anura	Hylidae	<i>Agalychnis</i>	<i>callidryas</i>	.	.	.	.	4.1
Amphibia	Anura	Hylidae	<i>Litoria</i>	<i>caerulea</i>	730	9.73	0.093	2	20.0
Amphibia	Anura	Leptodactylidae	<i>Leptodactylus</i>	<i>pentadactylus</i>	.	.	.	.	18.8
Amphibia	Anura	Microhylidae	<i>Dyscophus</i>	<i>antongilii</i>	.	.	.	.	.
Amphibia	Anura	Pipidae	<i>Pipa</i>	<i>pipa</i>	.	14.09	0.138	.	7.7
Amphibia	Anura	Ranidae	<i>Rana</i>	<i>catesbeiana</i>	1460	54.4	0.138	4	16.0

APPENDIX 7. Body mass in reptiles and amphibians estimated from the mass-length relationship.

In many species of reptiles and amphibians, body mass values are not available. It is, however, possible to use body length to predict body mass, as shown in an analysis of covariance of body mass (effect = class, covariate = length) of the data compiled for this analysis. Body lengths (m) and masses (g) were recorded as the means or middle values for adult individuals. All values are log-10 transformed. Interactions between taxon and length were not significant ($P > 0.05$). The following relationship was used to calculate body mass from length for several species of reptiles and amphibians: $\log_{10}(\text{mass}) = 3.90 (\pm 0.15 \text{ SE}) + 0.924 (\pm 0.275 \text{ SE}) \log_{10}(\text{length}) - 1.96 (\pm 0.40 \text{ SE})$ for Amphibia ($F_{2,14} = 44$, $P < 0.0001$, $R^2 = 0.863$).

APPENDIX 8. The relationship between the initial, or extrinsic, mortality rate (m_0) in wild and captive populations of mammals.

The actuarial rate of aging (ω) has been shown to be positively related to the extrinsic mortality rate independent of body mass in birds, mammals, and reptiles (4, 8). However, these relationships were based on a relatively small sample of wild populations. It would be useful for comparative analyses if extrinsic mortality in the wild could be estimated from m_0 in captivity, for which many values are available.

Ricklefs (9) reported on a data set consisting of matched species or close relatives in captivity (zoo) and in natural environments. The 57 observations (33 wild, 24 zoo) represented 18 sets of paired taxa. Multiple observations for each comparison were averaged, providing 36 observations for 18 pairs. m_0 was log-transformed for analysis with comparison ($n = 18$) and wild vs. captive as effects.

For $\log m_0$, wild vs. zoo was not significant ($F_{1,17} = 2.63$, $P = 0.12$), although captive populations had somewhat lower $\log m_0$ (-1.03 ± 0.33 SD) than the wild populations (-0.88 ± 0.51 SD); differences between comparisons were significant ($F_{17,17} = 3.50$, $P = 0.0068$) (overall $F_{18,17} = 3.45$, $P = 0.0065$, $R^2 = 0.785$).

With respect to the rate of aging ($\log \omega$), both wild (-0.75 ± 0.34 SD) vs. zoo (-0.95 ± 0.24 SD) ($F_{1,17} = 14.30$, $P = 0.0015$) and comparison ($F_{17,17} = 6.0$, $P = 0.0003$) were significant effects (overall model $F_{18,17} = 6.5$, $P = 0.0002$, $R^2 = 0.87$); animals appear to age less rapidly in the zoo setting in this comparison. As found in previous analyses, the rate of aging is positively related to the initial mortality rate in both settings: wild, $F_{1,16} = 7.14$, $P = 0.017$, $R^2 = 0.31$, intercept -0.43 (± 0.14 SE), slope 0.38 (0.14); zoo, $F_{1,16} = 30.8$, $P < 0.0001$, $R^2 = 0.66$, intercept -0.35 (0.12), slope 0.59 (0.11).

Among the 18 paired comparisons, m_0 in the wild can be predicted by m_0 in the zoo by an essentially linear relationship: $F_{1,16} = 9.4$, $P = 0.0073$, $R^2 = 0.37$, intercept $= -0.094$ (0.33 SE, ns), slope 0.94 (0.31 SE). In addition, $\log \omega$ in the wild can be predicted by m_0 in the zoo: $F_{1,16} = 22.3$, $P = 0.0002$, $R^2 = 0.58$, intercept $= 0.29$ (0.23 , ns), slope $= 1.095$ (0.232). Accordingly, I estimated values by $\log m_0(\text{wild}) = -0.094 + 0.94 \log m_0(\text{zoo})$.

APPENDIX 9. Results of nested analyses of variance and covariance

Each of the \log_{10} -transformed traits related to the rate of aging in mammals was analyzed in a nested analysis of variance, with levels Orders within class, Families within order, Genera with families, and Species within genus. Proportions of the variance at each of the levels are shown in the following table.

Table 1. Nested analysis of variance for aging and life history parameters of mammals.

Level	Adult mass		m_0		ω		Gestation period		Age at maturity		Weaning period		Neonate mass		Brain mass		Postnatal growth rate	
	df	%	df	%	df	%	df	%	df	%	df	%	df	%	df	%	df	%
Order	14	0.547	14	0.279	14	0.339	14	0.623	14	0.398	14	0.439	14	0.676	11	0.613	11	0.204
Family	38	0.350	38	0.218	38	0.396	37	0.303	37	0.420	36	0.402	37	0.266	30	0.318	27	0.699
Genus	66	0.089	66	0.145	66	0.030	66	0.061	64	0.092	62	0.089	65	0.048	41	0.043	29	0.024
Error	49	0.015	49	0.358	49	0.235	42	0.013	42	0.091	35	0.070	37	0.010	7	0.030	4	0.072
Mean		4.045		-1.189		-0.999		2.130		2.791		2.124		2.634		1.681		-2.170
sd		1.248		0.102		0.266		0.327		0.375		0.398		1.308		0.900		0.521
n	168		168		168		160		158		148		154		90		72	

Note that most of the variance in the life history attributes is distributed at the levels of orders within the class Mammalia, and families within orders. The variables fitted by Weibull functions to the actuarial data are notable exceptions, with 50% of the variance in m_0 and 27% of the variance in ω distributed at the levels of species and genera. Most of this variation is measurement error associated with small sample size. This is emphasized by the lack of significant relationships between the rate of aging and either adult body mass or the initial mortality rate, particularly at the species level. The following table is adopted from Ricklefs (9), but updated with additional data to total 168 species, and with the variable m_0 added.

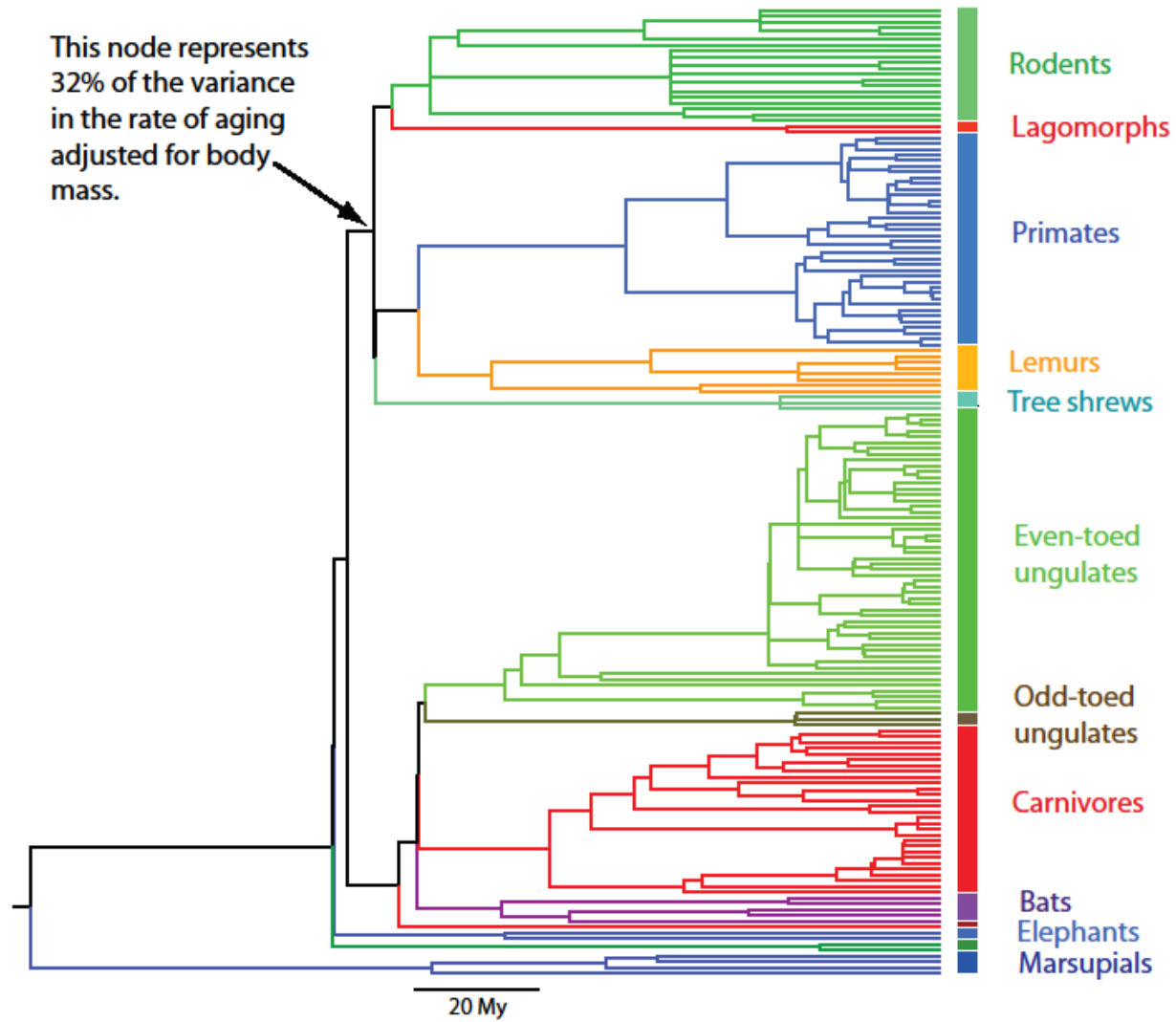
Table 2. Nested analysis of covariance in \log_{10} -transformed adult body mass (M), estimated initial mortality rate (m_0), and rate of actuarial senescence (ω) in 168 species of mammal based on analysis of primarily captive populations. As in Table 1, the analysis partitions variance (proportion of the total) into components representing species within genera, genera within families, families within orders, and orders within mammals. Correlation coefficients (r) and regression slopes (b) are calculated from partitioned covariance components. Bolded values for correlations and regression slopes were significant at $P < 0.0001$.

Level	df	Variance components			Correlation	Regression	Correlation	Regression
		M	ω	m_0	(r) ω vs. M	slope (b) ω vs. M	(r) ω vs. m_0	slope (b) ω vs. m_0
Total	167	1.000	1.000	1.000	-0.450	-0.094	0.540	0.411
Order	14	0.547	0.339	0.279	-0.123	-0.021	0.859	0.722
Family	35	0.350	0.396	0.218	-0.993	-0.206	0.721	0.740
Genus	66	0.088	0.030	0.145	-1.118	-0.136	-0.017	-0.006
Species	42	0.015	0.235	0.358	0.158	0.130	0.224	0.138

Note: df = degrees of freedom.

The lack of a significant ordinal-level correlation between $\log\omega$ and $\log M$ might have been caused by the anomalous genus level correlation (< -1.00). The correlation between ordinal mean values of $\log\omega$ and $\log M$ is significant ($F_{1,13} = 10.3$, $P = 0.007$, $R^2 = 0.44$), $\log\omega = -0.365 (\pm 0.172 \text{ SE}) - 0.137 (\pm 0.043 \text{ SE}) \log M$.

APPENDIX 10. Phylogenetic independent contrasts.



Because species share much of their phylogenetic histories, data values for individual species are not fully independent. Several methods have been developed to circumvent this problem (Paradis), the most widely used being the method of independent contrasts (Felsenstein, Harvey, Garland). Other indices have been developed to quantify the degree of phylogenetic (evolutionary) conservatism in a particular parameter, which reflects the shared evolutionary histories of species and also appears as the distribution of a large proportion of the variance in the parameter among higher level taxa (see Appendix 6).

Here, I present phylogenetically informed analyses on aging and life-history data for mammals based on the phylogeny constructed as a supertree by Bininda-Emonds et al. (10). Olaf Bininda-Emonds kindly provided a Newick file solely of the species in this analysis subsampled from the complete tree. Independent contrasts and further analyses of contrasts were calculated using the program PHYLOCOM (11).

In the program PHYLOCOM, the significance of the influence of phylogeny (evolutionary history) on variance in trait parameters is estimated by the variance in contrasts relative to the distribution of variances for many randomizations of the values on the tree. For \log_{10} -transformed values of body mass (M), initial mortality (m_0), and rate of aging (ω), as well as the residuals of m_0 and ω on M , the observed variance was less than 999 of 1000 randomized values, showing highly significant phylogenetic conservatism.

Residuals about the regression of $\log(\omega)$ on $\log(M)$ were calculated from the linear regression $\log(\omega) = -0.593 (\pm 0.062 \text{ SE}) - 0.100 (\pm 0.015 \text{ SE}) \log(M)$ ($F_{1,166} = 47.3$, $P < 0.0001$, $R^2 = 0.222$). Residuals about the regression of $\log(m_0)$ on $\log(M)$ were calculated from $\log(m_0) = -0.645 (\pm 0.082 \text{ SE}) - 0.135 (\pm 0.019 \text{ SE}) \log(M)$ ($F_{1,166} = 48.4$, $P < 0.0001$, $R^2 = 0.226$).

Points of rapid transition in life-history parameters in the mammal phylogenetic tree

PHYLOCOM calculates the proportional contribution of changes occurring at particular nodes to the total phenotypic variance, using an approach described by Moles et al. (12).

For the logarithm of adult mass, important nodes (out of a total of 167, with their percentage contribution to the total variance) are:

Bats (-) versus (ungulates, carnivore) (+) (28.6 %)

(Tree shrews, primates, lagomorphs, rodents)(-) versus (Bats, carnivores, ungulates)(+) (17.1%)

Elephants (+) versus other placentals (-) (8.5%)

Carnivores (-) versus ungulates (+) (6.6%)

For logarithm of the rate of aging (ω), the important nodes are:

(Primates, tree shrews) (+) versus (Rodents, lagomorphs)(-) (22.8%)

Marsupials (-) versus placentals (+) (9.8%)

(Hippopotamus, dolphin) (+) versus (rest of artiodactyls except pigs and camels)(-) (9.4%)

Muridae (-) versus (remainder of rodents, excl. Sciuridae)(+) (6.0%)

For the logarithm of the initial mortality rate (m_0) adjusted to the wild (see APPENDIX 5) the important nodes were:

(Hippopotamus, dolphin) (-) versus (rest of artiodactyls except pigs and camels)(+) (43.8%)

Elephants (-) versus other placentals (+) (14.5%)

(Tree shrews, primates, lagomorphs, rodents)(-) versus (bats, carnivores, ungulates)(+) (12.4%)

Bats (-) versus carnivores and ungulates (+) (9.4%)

(Primates, tree shrews) (-) versus (rodents, lagomorphs)(+) (8.4%)

For the residuals from the $\log(\omega)$ vs. $\log(M)$ regression, the important nodes were:

(Primates, tree shrews) (-) versus (rodents, lagomorphs)(+) (31.7%)

Marsupials (+) versus placentals (-) (9.7%)

(Hippopotamus, dolphin) (-) versus (rest of artiodactyls except pigs and camels)(+) (7.4%)

Muridae (+) versus (remainder of rodents, excl. Sciuridae)(-) (5.1%)

Note: The residuals for *Rattus rattus* (-0.484) and *Mus musculus* (-0.830) were much too low and thus were adjusted to the mean of the remainder of the rodents (0.248).

For the residuals of $\log(m_0)$ versus $\log(M)$ regression, the important nodes were:

(Hippopotamus, dolphin) (-) versus (rest of artiodactyls except pigs and camels)(+) (47.1%)

(Primates, tree shrews) (-) versus (rodents, lagomorphs)(+) (15.9%)

Elephants (-) versus other placentals (+) (9.6%)

These transitions in the mammal phylogeny emphasize the striking reduction in both initial (extrinsic) mortality (m_0) and rate of aging (ω) in the few semi-aquatic and aquatic species (hippopotamus and dolphin) and in the primates and tree shrews.

The relationships between $\log(\omega)$, $\log(m_0)$, and $\log(M)$ in a phylogenetic context

The simple correlation between $\log(\omega)$ and $\log(M)$ is $r = -0.450$ and the slope of the regression is -0.094 (Table 2, above). In a phylogenetic context, using generalized estimating equations (Paradis, page 147) with link: identity, and a Gaussian variance to mean relation, the slope of the relationship becomes $-0.136 (\pm 0.006 \text{ SE})$, $t = -23.8$, $P < 0.0001$, phylogenetic $df = 32.7$ (168 observations).

The relationship based on independent contrasts in PHYLOCOM (A-values, calculated on the basis of node trait estimates and not tip values, number of contrasts = 149 rather than 167 because there are several polytomies in the tree) gives a correlation (r) of -0.245, which is less than the correlation among the tip values, as is usually the case (13). The regression of the rectified contrasts for $\log(\omega)$ as a function of the positivized contrasts for $\log(M)$ was $\log(\omega) = 0.0053 (\pm 0.0043 \text{ SE}) - 0.123 (\pm 0.040 \text{ SE}) \log(M)$ ($F_{1,147} = 9.3$, $P = 0.0027$, $R^2_{\text{adj}} = 0.053$), which is similar to the generalized estimating equation and not very different from the regression based on tip (species) values.

When this regression is based on contrasts for nodes that are >40 Mya, the results are much cleaner, suggesting that there is a lot of noise in the tips of the phylogeny. The regression for this relationship is $\log(\omega) = 0.0016 (\pm 0.0052 \text{ SE}) - 0.1142 (\pm 0.032 \text{ SE}) \log(M)$ ($F_{1,34} = 20.0$, $P < 0.0001$, $R^2_{\text{adj}} = 0.352$)

The evolutionary change in rate of aging relative to initial mortality, using contrasts for the residuals of $\log(\omega)$ and $\log(m_0)$ relative to $\log(M)$, was not significant ($n = 149$, $P = 0.17$).

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