Paper:
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Supplementary Material

Measuring post-reproductive lifespan

An extensive literature search was conducted to identify all wild mammalian species for which reliable PRLS data is available using the following search term in Google Scholar (where … is substituted for each mammalian taxonomic order): "Post reproductive lifespan" OR PRLS OR Menopause OR "Reproductive cessation" AND "…" . When a hit was found for a given order, the search term was repeated for each genus within that order, and resulting hits were examined individually to assess the information contained in each.

We made an effort to standardise definitions of PRLS since most of our source publications used different methods and criteria. PRLS was quantified in two ways: 1. The average interval between last birth and death (only for females whose span between last live birth and death exceeded that of their own average inter-birth interval, plus two standard deviations). 2. The maximum lifespan minus the average age at reproductive cessation (where reproductive cessation was confirmed through the cessation of menstrual cycle, changes in ovarian anatomy, low/erratic progesterone levels or the absence of pregnancies in a population). Table S1 details the ways in which PRLS was determined for each study population. We note that definition 2, which considers the maximum lifespan and average age at reproductive cessation, could feasibly lead to a bias in which better sampled populations are more likely to find a particularly long-lived individual which leads to inference of PRLS being present. However, our data suggest that this is not a problem here as the median sample size for species found to have PRLS was actually slightly lower than that for species lacking PRLS (medians of 184 and 257 respectively). Also, the overall distributions of sample size in these two groups were greatly overlapping, again suggesting that we are not seeing such a bias. Nevertheless we stress that this measure more accurately reflects the presence of PRLS in some individuals within the population, rather than implying that it is commonly experienced by individuals (the prevalence within the population was also recorded – see below).

In order to measure the duration of PRLS, we calculated the proportion of maximum lifespan spent post-reproductive. This allowed us to include all species that show PRLS. In contrast, using the mean period post-reproductive would under-estimate the occurrence of PRLS in species with high early-life mortality, even when a substantial number of females showed PRLS (Cohen 2004). We therefore chose to measure intrinsic PRLS, even if it is realised in a relatively small (but non-zero) proportion of individuals. Data were also collected from the literature on the proportion of females experiencing PRLS.

While we considered using a combined index for PRLS, such as Levitis and Lackey's (2011) measure: PrR, this measure was not used for two reasons. First, the calculation of PrR requires life-history tables, which are not available for the vast majority of wild species. Second, by independently analysing three separate aspects of PRLS (presence, relative duration, and frequency) we are able to reveal factors that influence these components separately. In contrast, combining these different (and independent) aspects into one index, such as PrR, could easily obscure variation in one element of PRLS and also fails to acknowledge that different reasons could be behind these different aspects of the trait.

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Table S1. Life-history data obtained from the literature. Numbers after values indicate the literature source of the data. M
abbreviated to pg: polygynous, pga: polygynandrous, mg: monogamous. PRLS definitions are coded as follows: (1) averag
birth and death, only for females whose span between last live birth and death exceeded that of their own average inter
(2) maximum lifespan minus age at reproductive cessation. For definition 2, reproductive cessation was defined through
menstrual/oestrous cycle (b) changes in ovarian/uterine anatomy (c) last birth/ no more pregnant females / no more fem
recorded (d) low/erratic progesterone levels (e) no decrease in pregnancy rate with age (f) no changes in ovarian anatom
recorded (g) substantial decrease in pregnancy rate with age (but no data available on individual females - there may be
just reduced success shortly before death)

Species	PRLS present	Relative duration PRLS (% max. lifespan)	Maximum lifespan	Mean group size	Frequency of PRLS (%)	Philopatry	Type of study population	Sample size	Definition of PRLS
Primates									
Common marmoset *Callithrix jacchus*	yes[1]	21.15[1]	10[1]	9[2]	36.4% (of females reaching middle age)[1]	none[3, 4]	captive	14[1]	1
Vervet monkey *Chlorocebus*	no[1]	NA	17[1]	40.5[2]	NA[1]	female[2]	captive	12[1]	1

aethiops									
Western lowland gorilla *Gorilla gorilla*	yes[5]	20[5]	50[5]	12[2]	NA	none[2]	captive	NA	2d
	yes[1]	15.11[1]	30[1]	12[2]	40% (of females reaching middle age)[1]	none[2]	captive	12[1]	1
	yes[63]	16.15[63]	52[63]	12[2]	23% (of geriatric females)[63]	none[2]	captive	22[63]	2a
Golden lion tamarin *Leontopithecus rosalia*	yes[1]	32.22[1]	12[1]	9[2]	47.4% (of females reaching middle age)[1]	none[2]	captive	21[1]	1

Japanese macaque *Macaca fuscata*	yes[6]	13.64 (mean PRLS 4.5 years)[6]	33[6]	47.25[66]	50% (of old females)[6]	female[2]	wild (provisioned)	33 (total females), 14 old aged females (20+ years)	1*
	yes[6]	18 (mean PRLS 3.6 years)[6]	20[6]	47.25[66]	28.6% (20 of 70 females experienced post reproductive lifespan)[6]	female[2]	wild (non-provisioned)	9 old aged females (15+ years)	1*
Rhesus macaque *Macaca mulatta*	yes[1]	12.90[1]	20[1]	30[2]	13.2% (of females that reached middle age)[1]	female[2]	captive	38[1]	1

Pigtail macaque *Macaca nemestrina*	yes[1]	20.11[1]	20[1]	27.5[2]	25.6% (of females that reached middle age)[1]	female[2]	captive	209[1]	1
Bonnet macaque *Macaca radiata*	yes[1]	35.28[1]	19[1]	27.5[2]	3.8% (of females that reached middle age)[1]	none[2]	captive	26[1]	1
Barbary macaque *Macaca sylvanus*	yes[7]	21.43[7]	28[7]	35.5[2]	NA	female[2]	captive	NA	2a
Ring-tailed lemur *Lemur catta*	no[67]	NA	17[65]	11.5[64]	NA	female[70]	wild	77[65]	2e
Mouse lemur *Microcebus*	no[8]	NA	14[8]	1[2]	NA	none[10]	captive	NA	NA

murinus									
Chimpanzee *Pan troglodytes*	yes[11]	16.75 (based on average PRLS of 8.38)[11]	50[11]	74[11]	23.5% (of old females)[11]	male[2]	wild	34 old females[11]	1*
	yes[1]	19.28[1]	48[1]	74[11]	60% (of females that reached middle age)[1]	male[2]	captive	15[1]	1
	no[62]	NA	NA (last birth with 55)[62]	74[11]	NA	male[2]	wild	165[62]	NA

Olive baboon *Papio anubis*	yes[12]	11.11 (fertility ceases at 24 years)[12]	27[12]	50[2]	NA	female[2]	wild	NA	2a
Orangutan *Pongo*	yes[1]	18.64[1]	38[1]	2[2]	31.9% (of females that reached	none[2]	captive	53[1]	1

pygmaeus					middle age)[1]				
Milne-Edward's sifaka *Propithecus diadema edwardsi*	no[13]	NA	32[13]	6[2]	NA	female[2]	wild	NA	2f
Saddleback tamarin *Saguinus fuscicollis*	yes[1]	33.54[1]	12[1]	6.5[2]	47.4% (of females that reached middle age)[1]	none[14]	captive	6[1]	1
	yes[15]	16.67[15]	20.4[15]	6.5[2]	100% (of old females *)	none[14]	captive	6[15]	2a,2b,2d
Cotton-top tamarin *Saguinus oedipus*	yes[15]	6.59[15]	18.2[15]	8[2]	100% (of old females *)	none[16]	captive	6[15]	2a,2b,2d

Hanuman Langur *Semnopithecus entellus*	Yes[17]	14.57 (5.1 average PRLS)[17]	35[17]	38.5[17]	16.13 % (includes all observed females, not only aged females)	female[17]	Wild (1/3 of foraged food provisioned)	31	1
Squirrel monkey *Saimiri sciureus*	yes[1]	17.29[1]	19[1]	32[2]	32.1% (of females that reached middle age)	female[2]	captive	28[1]	1
Humans *Homo sapiens* Ache people, Paraguay	yes[58]	45.45[58]	77[58]	168[58]	-	male[102]	wild	292[58]	2a
!Kung Bushmen, Botswana	yes[59]	60.23[59]	88[59]	35[61]	80%[59]	male[102]	wild	500[59]	2a

(Krummhorn, Germany, 18th & 19th Century)	yes[1]	30.18[1]	97[1]	NA	97% (of females that reached middle age)[1]	male[102]	wild	106[1]	1
Cetaceans									
Antarctic minke whale *Balaenoptera acutorostrata*	no[18]	NA	50[20]	2[19]	NA	none[19]	wild	>12000[18]	2e
Antarctic fin whale *Balaenoptera physalus*	no[96]	NA	85[96]	1.56[97]	NA	NA	wild	1422[96]	2e
Sei whale *Balaenoptera borealis*	no[18]	NA	60[21]	3[19]	NA	NA	wild	1521[18]	2e

Short-finned pilot whale *Globicephala macrorhynchus*	yes[22]	45.24[22]	63[22]	27.5[19]	25%[24]	both[23]	wild	245[22]	2b, 2c
Long-finned pilot whale *Globicephala melas*	yes[24]	0.32[24]	59[24]	30[19]	4.4% (of mature females)[24]	both[25, 26]	wild	1070[24]	2a, 2b
Killer whale *Orcinus orca Northern*	yes[28]	54.44 (50% post reproductive at 41 years)[28]	90[28]	9.7[28]/ 26[8]*	10% of population[28]	both[23]	Wild	63[28]/ 41[28]*	2c
Franciscana *Pontoporia blainvillei*	no[30]	NA	19[30]	NA	NA	female[32]	Wild	97[30]	2f
False killer whale	yes[18]	NA	NA	30[19]	17.91% (of all mature	female[68]	wild	67 (mature females)[1]	2c

Pseudorca crassidens					females)[18]			[8]	
Estuarine dolphin *Sotalia guianensis*	yes[33]	16.67[33]	30[34]	12.4[35]	NA	NA	wild	23[33]	2b
Spinner dolphin *Stenella longirostris*	yes[98]	NA	536[98]	211[69]	0.74% (of adult females)[101]	Variable[70]	wild	536[98]	2b
Spotted dolphin *Stenella attenuata*	yes[36]	55.43[36]	46 (mean LS)[37]	252.5[19]	NA	Uncertain[71]	wild	257[36]	2c

Bottlenose dolphin *Tursiops truncatus*	no[18]	NA	40[18]	13[19]	NA	female[38]	wild	151[18]	2e
Perissodactyla									
Domestic horse *Equus caballus*	Yes[73]	6.67[73]	45[73]	4.52[72]	NA	none[74]	captive (domestic)	NA	2c
Artiodactyla									
Domestic cattle *Bos primigenius Taurus*	yes[40]	25	20[40]	10.5[41]	>50% (infertile at 15 years)	female[42]	captive	152[40]	2c
White-tailed deer	no[44]	NA	17.50[44]	3[47]	NA	female[45]	wild	284[44]	2e

Odocoileus virginianus									
Bighorn sheep *Ovis canadensis*	Yes[75]	5.26[75]	19[75]	10[75]	0.75%[75]	female[78]	wild	265[75]	2c
Soay sheep *Ovis aries*	Maybe[91]	NA	12[91]	NA	NA	NA	wild	894[91]	2f

Red deer *Cervus elaphus*	yes[92, 93]	> 9.52[93]	> 21 (females were culled at 21 years)[93]	30[95]	47.5% (of population)[93]	female[98]	captive	40[93]	2c
	maybe[94]	NA	18 (very few females live beyond this age)	30[95]	NA	female[98]	wild	551[95]	2f

Carnivora									
Cat *Felis catus*	Yes[82]	30[82]	20[85]	Variable [83] (solitary and group-living)	NA	none[83]	captive (domestic)	NA	NA
Polar bear *Ursus maritimus*	yes[48]	33.33[48]	30[48]	1[49]	2.2%*	none[49]	wild	402[48]	2c
African lion *Panthera*	yes[12]	14.27[12]	19.83[12]	4.64[77]	1.7% (pers. com. Prof C Packer)	female/none[76]	wild	123[12]	2c

leo									
Banded Mongoose *Mungos mungo*	no[61]	NA	10.50[61]	14[61]	NA	none[61]	wild	NA	1
Meerkat *Suricata suricatta*	maybe[80]	NA	12[80]	16.7[81]	NA	none[81]	Wild	42 (dominant females)[80]	2f

Dog *Canis familiaris*	yes[73]	43.75[73]	16	4[78]	<50%[79]	none[78]	captive (domestic)[73]	NA	2c
Proboscidae									
African elephant *Loxodonta africana*	no[50]	NA	65[50]	9[51]	NA	female[52]	wild	546 (38 survived reached >50)[50]	2e
Asian elephant Elephas maximus	Yes[85]	12.5[85]	79.64[85]	8[84]	32.95% (457/1040) live past 40 years: age when 75% of females ceased to reproduce)[85]	female[84]	Mixed[84]	1040[85]	Mean lifespan – mean age at last reproduction

	No/maybe[85]	17.01(54 oldest reproducing female) 54.11 (Mean age at last reproduction 29.88) [85]	65.11[85]	8[84]	NA	female[84]	captive	471[85]	1*
	Yes [85]	56.49 (mean age at last reproduction 34.65)[85]	79.64[85]	8[84]	32.95% [85]	female[84]	wild	569[85]	1*
Lagomorpha									
Domestic rabbit *Oryctolagus*	yes[86]	66.67[86]	15[86]	7[90]	NA	female[87]	captive (domestic)	NA	2 (method NR)

cuniculus									
Rodontidae									
Lab mouse *Mus musculus*	yes[73]	60.00[73]	4.17[73]	1[88]	NA	none[88]	captive (domestic)	NA	2c
Lab rat *Rattus norvegicus*	yes[76]	52.00[73]	4.17[73]	Variable (solitary when food dispersed, in urban environments mean groups of 22.5) [89]	NA	none[90]	captive (domestic)	NA	2c
Chinese hamster *Cricetulus*	no[53]	NA	1.75[53]	NA	NA	NA	captive	25 (aged females) [53]	2c, g

griseus									
Columbian ground squirrel *Spermophilus columbianus*	no[54]	NA	9[54]	29[57]	NA	female[55]	wild	229[54]	2g

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PRLS. We coded the absence or presence of PRLS as having states 0 and 1 respectively and used this as our response variable. Estimated coefficients and 95% confidence intervals are given, and significant predictors are highlighted in bold. N is the number of species included in the model. Species that had missing data for a particular variable were excluded from the relevant models (i.e. those models that included that variable). We considered a variable to be a significant predictor of the presence of PRLS when P≤0.05.

natural history variable	β	lower 95% CI	upper 95% CI	P	N
Maximum lifespan	3.186	-1.872	9.211	0.190	27
Group size	1.740	-0.062	3.504	0.073	26
Male philopatry	**340.523**	**39.603**	**632.792**	**0.018**	**25**
Female philopatry	-59.950	-375.380	292.930	0.692	25

Table S3. Results from GEEs testing for effects of four natural history variables on the relative duration of PRLS and on the frequency with which PRLS is experience in the population. Estimated coefficients (± SE) are given, and significant predictors are highlighted in bold. Species that had missing data for a particular variable were excluded from the relevant models (i.e. those models that included that variable). N is the number of species included in the model.

Response term	Natural history variable	β±SE	t	P	N
Relative duration of PRLS	**Maximum lifespan**	**0.038±0.011**	**3.482**	**0.007**	**25**
	Group size	0.009±0.005	1.841	0.100	24
	Male philopatry	1.394±0.676	2.063	0.071	22
	Female philopatry	**-1.573±0.681**	**-2.308**	**0.048**	**22**
Frequency with which PRLS is experienced in population (proportion of females that experience PRLS)	Maximum lifespan	0.0376±0.0159	2.364	0.052	16
	Group size	**0.0515±0.0137**	**3.762**	**0.007**	**17**
	Male philopatry	**1.900±0.786**	**2.418**	**0.047**	**17**
	Female philopatry	-0.914±0.828	-1.104	0.307	17