Supporting Online Information

Materials and Methods

Databases

Our measure of extinction risk was derived from the 2003 IUCN Red List (*S1*) converted to a numerical index from 0-5, following previous studies (*S2-4*). We excluded from our dataset those threatened species not listed under criterion A (recent or ongoing decline in distribution or population size), to avoid any circularity inherent in predicting extinction risk from geographic range size or population density. Our extinction risk index therefore corresponds to a quantitative measure of a species' rate of decline. We did not include extinct species in our analysis due to lack of information on biology and geographic range sizes.

All analyses used phylogenetically independent contrasts to control for confounding effects of shared ancestry among species. To calculate independent contrasts we constructed a composite phylogeny of 4497 mammal species by combining previously published mammal supertrees with new interordinal and intraordinal supertrees (*S5*). These were constructed by Matrix Representation with Parsimony using procedures to minimize non-independence among source phylogenies (*S6*). We estimated divergence times for 784 of the 1994 supertree nodes by mapping sequence data for *cytochrome b* and RBP3 genes on to the supertree topology, and calibrating divergence times against an assumed basal split of 150 million years; divergence times for undated nodes were interpolated from these dates (*S7*). The resulting branch lengths are approximate and are only intended for use in scaling phylogenetically independent contrasts.

Mammal biological trait values were obtained from a compilation of data on 25 ecological and life-history traits (Table S1) for 4030 mammal species, from over 3300 published literature sources (*S8*). Mammal geographic range maps (*S9*) were used to calculate geographic range sizes and derive variables summarizing human impact and environmental conditions within each species' distribution. In the absence of adequate global-scale data on direct measures of human impact, we used three indirect measures: the mean and 5th percentile of human population density (*S10*) within the geographic range of each species, and the External Threat Index (ETI). ETI is calculated for a given species *i* as

$$\mathrm{ETI}_i = \frac{\sum_{j \neq i} r_j . w_{ij}}{\sum_{j \neq i} w_{ij}}$$

where *r* is the extinction risk index value, *j* is a species that shares part of its geographic distribution with species *i*, and *w* is the size of the geographic distribution shared by two species. ETI is thus a proxy measure of the level of threat within a species' distribution, as reflected in the mean extinction risk of other species found within that distribution. For each species we also recorded the climatic variables mean actual evapotranspiration, temperature and precipitation within its geographic distribution, and whether or not the species is island-endemic. All geographic calculations were corrected for latitudinal area distortion.

Key predictors were chosen *a priori* to represent each of three major predictor types (environmental, ecological and life history), ensuring each was recorded for a reasonably large number of species, measurable on a continuous scale, and not collinear with adult body mass (r^2 values for regressions of each predictor against body mass and with eachother, using independent contrasts, were all <0.14). Preliminary analyses suggest that mammal life-history traits combine into two orthogonal axes (investment in reproductive speed and investment in offspring biomass per litter); weaning age and gestation length correlate strongly with the reproductive speed and offspring biomass axes, respectively (*S11*), and were chosen to represent these two aspects of life history.

Statistical Models

Independent contrasts were calculated after optimizing branch-length power transformations to minimize the correlation between absolute scaled contrasts and their standard deviations (*S12*). Soft polytomies were resolved arbitrarily and contrasts computed at each resulting bifurcation; these contrasts were given reduced weight to ensure a single degree of freedom for each polytomy. Models were then fitted as linear regressions through the origin (*S12*). Separate models for each key predictor all included as a covariate geographic range size, which usually accounts for by far the largest proportion of variance in extinction risk. Models for weaning age, gestation length and population density also included adult body mass as a covariate, if significant. Other key predictors do not covary with body mass and its inclusion made little difference to model parameters. Omitting nonlinear terms from the models with interactions made no qualitative difference to interaction coefficients. Because weaning age and gestation length may not be equivalent between marsupials and placental mammals, we re-tested models that include these variables with the marsupial-placental contrast omitted from the analysis; in all cases, this made no qualitative difference to the models.

To find minimum adequate models (MAMs) from the full set of potential predictors, we followed a heuristic search procedure used in previous studies (*S2, S4*), avoiding the inclusion of collinear terms in the same model. We tested the robustness of all models to the removal of outliers, removing contrasts with studentized residual values >±3; all models were qualitatively robust. For the sliding-window analyses presented in Figure 1, phylogenetic branch lengths were set to equal before calculating independent contrasts, to allow comparability of slopes between different data subsets.

Table S1. Full list of predictor variables from which minimum adequate models were constructed.

Predictor type	Predictor	Units	Species
body size	adult mass	grams	3402
life history: speed	age at eye opening	days	440
	age at first breeding	days	416
	interbirth interval	days	633
	weaning age	days	1075
	sexual maturity age	days	977
life history: output	litter size	individuals	2279
	litters per year	litters	1197
	neonatal mass	grams	1041
	gestation length	days	1246
ecology	home range size	hectares	651
	population group size	individuals	337
	social group size	individuals	622
	trophic level	1 = purely herbivorous, 2 = omnivorous, 3 = purely carnivorous	1925
	population density	individuals/km^2	865
	diurnality	1 = nocturnal, 2= nocturnal / crepuscular, cathemeral, crepuscular or diurnal / crepuscular, 3 = diurnal	1455

	diet breadth	dietary types	1925
	habitat breadth	habitat types	2056
	terrestriality	1 = fossorial and/or ground dwelling, 2 = aerial or arboreal	2370
geographic	geographic range size	km^2	3671
	median absolute latitude	degrees north or south of equator	3671
	island endemic status	0 = not island endemic, 1 = island endemic	3671
	mean annual precipitation	mm	3633
	actual evapotranspiration	mm	3633
	mean annual temperature	degrees C	3633
anthropogenic	human population density 5th percentile	individuals/km^2, 5^{th} percentile of values across species' geographic range	3671
	human population density mean	individuals/km^2, mean of values across species' geographic range	3671
	human population density rate of increase	percent change between 1990-1995	3671
	external threat index	see Materials & Methods for definition	3653

Table S2. Full model results for separate regressions of key predictors against extinction risk. Results shown are for a separate test for each key predictor, with geographic range size as a covariate in each model and adult body mass as a covariate (where significant) in models for weaning age, gestation length and population density. HPD = mean human population density, ETI = External Threat Index. †$p \leq 0.1$; * $p \leq 0.05$; ** $p \leq 0.01$; ***$p \leq 0.001$.

	Predictors tested without body-mass interaction		Predictors tested with body mass interaction	
Predictors	slope	t	slope	t
(a) weaning age				
weaning age	0.034	0.5	-0.344	-2.87**
geographic range size	-0.223	-13.19***	-0.22	-15.38***
body mass	0.187	3.13**	-0.223	-1.88†
weaning age : body mass			0.074	3.8***
(b) gestation length				
gestation length	-5.754	-3.34***	-1.447	-2.96**
gestation length^2	0.666	3.5***		
geographic range size	-0.451	-4.21***	-0.53	-4.86***
geographic range size^2	0.009	0.037*	0.012	2.67**
body mass	0.161	0.006*	-0.638	-3.07**
gestation length : body mass			0.183	4.19***
(c) population density				

population density	-0.058	-3.35***	0.064	1.73†
geographic range size	-0.88	-7.4***	-0.91	-7.68***
geographic range size^2	0.026	5.8***	0.027	6.08***
body mass	0.215	3.97***	0.288	5.04***
population density : body mass			-0.015	-3.73***
(d) geographic range size				
geographic range size	0.311	1.61	0.305	1.52
geographic range size^2	-0.043	-2.47*	-0.042	-2.36*
geographic range size^3	0.001	2.37*	0.001	2.26*
body mass			0.127	1.84†
geographic range size : body mass			0.0004	0.12
(e) HPD				
HPD	-0.154	-2.95**	-0.075	-0.63
HPD^2	0.024	3.14**	-0.053	-1.34
HPD^3			0.008	2.06*
geographic range size	-0.169	-19.5***	0.301	1.53
geographic range size^2			-0.042	-2.38*
geographic range size^3			0.001	2.32*
body mass			0.04	0.36
HPD : body mass			0.018	3.51***
(f) ETI				
ETI	-0.562	-1.32	-5.783	-4.45***

ETI^2	1.02	3.6***	6.256	3.48***
ETI^3			-1.941	-2.71**
geographic range size	-0.163	-19.09***	0.433	2.19*
geographic range size^2			-0.053	-2.99**
geographic range size^3			0.001	2.88**
body mass			-0.114	-2.01*
ETI : body mass			0.366	5.73***

Table S3. Minimum adequate regression models of extinction risk for small and large species, using bracketed body-size cutoff values of one logarithmic body-mass unit below and above 3kg (1.1kg and 8.1kg, respectively).

†p≤0.1; * p≤0.05; ** p≤0.01; ***p≤0.001.

	Body-mass cutoff 1.1kg				Body-mass cutoff 8.1kg			
	Small species		Large species		Small species		Large species	
	(d.f = 1063)		(d.f. =190)		(d.f. = 1329)		(d.f. = 90)	
Predictors	slope	t	slope	t	slope	t	slope	t
geographic range size	-0.143	-13.09***	-0.199	-6.77***	-0.153	-14.786***	-0.168	-0.308**
latitude	0.012	5.597***			0.009	5.307***		
HPD	-0.044	-1.022			-0.085	-2.031*		
HPD^2	0.02	2.163*			0.033	3.808***		
ETI	0.591	3.329***	1.459	3.109**	0.596	3.444***	1.758	2.136*
neonatal mass			0.322	2.323*				
litters per year							-1.184	-2.278**
population density			-0.131	-4.027***			-0.17	-3.177**

References

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Supporting Online Material

Materials and Methods

Tables S1, S2, S3