Supplementary Materials for

Reptile-like physiology in Early Jurassic stem-mammals

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Materials and Methods

Choice of fossil specimens. All *Morganucodon* and *Kuehneotherium* specimens are from the Early Jurassic St Brides Island fissure suite, from Glamorgan, South Wales, UK *(1, 44)*. The two genera co-existed on a small landmass during the Early Jurassic marine transgression (Hettangian-early Sinemurian, ~200 Ma) *(45)*. Thousands of their bones and teeth were washed into karst fissures that have subsequently been revealed by quarrying. The *Morganucodon* and *Kuehneotherium* specimens used for cementum analysis are from the Natural History Museum, London, UK (NHMUK) and *Morganucodon* femora specimens from the University Museum of Zoology, Cambridge, UK (UMZC). *Morganucodon* specimens are *Morganucodon watsoni* from Pontalun 3 fissure in Pontalun quarry (now Lithalun), excavated in 1962-1963 *(44, 45)*. *Kuehneotherium* specimens are from three Glamorgan fissures in Pontalun and Pant quarries; Pontalun 3, Pant 2 and Pant 4. Although the Pant 2 *Kuehneotherium* collection is more extensive, teeth are poorly mineralized and so produced relatively fewer usable increment counts. Pontalun 3 and Pant 2 fissures have a relatively impoverished fauna, and Pant 4 has a more diverse biota *(45)*. *Kuehneotherium* from Pontalun 3 fissure is *Kuehneotherium praecursoris (46),* but those from Pant fissures are considered different species *(47)*. Pontalun 3 fissure specimens in NHMUK were prepared by immersing dried blocks of clay matrix in hot water, adding dilute hydrogen peroxide or sodium hexametaphosphate (Calgon) if required, but those in UMZC were prepared with 10% acetic acid. *Kuehneotherium* specimens from Pant quarry (Pant 2 and Pant 4) were collected by the University College London Kermack team, from 1955-1978, and are from harder matrix, prepared with 15% acetic acid *(47)*.

Morganucodon and *Kuehneotherium* specimens used for cementum analysis are either isolated teeth, or dentary specimens with a range of teeth *in-situ.* The lower dental formula of

Morganucodon is i4: c1: p4; m4-5 and for *Kuehneotherium* i?: c1: p6: m6 *(1)*. In *Morganucodon,* most isolated teeth measured were lower second molars (m2) since they are easily identified, relatively large, have robust separated roots, and, as anterior diphyodont molars, should erupt relatively early and are not replaced, therefore offering a near-complete record of life history. However, i4, c, p3, p4, m1, m3, and m4 teeth were also studied in dentulous *Morganucodon* specimens. *Kuehneotherium* is not abundant from Pontalun 3 fissure, and so specimens were also selected from two Pant quarry fissures. Dentulous *Kuehneotherium* specimens are extremely rare, so mainly isolated teeth were used. There are relatively fewer *Kuehneotherium* mid row lower molars with well-preserved cementum than for *Morganucodon*, so all appropriate teeth were chosen; p5, p6, and a range of lower and upper molars *(47)*.

Tomographic imaging of cementum. Pilot scans of two *Morganucodon* lower second molars (NHMUK PV M 104131 and NHMUK PV M 104132) were carried out on the nanotomography imaging beamline ID22 at the European Synchrotron Radiation Facility (ESRF), Grenoble, France (project EC 1064). For ID22 we used these experimental settings for computed tomographic (CT) imaging: X-ray energy of 29.6 keV, 1999 projections over 180° rotation, 0.5 ms exposure time, 321 nm voxel size, 405 mm sample-to-detector distance, diamond window, a 20 µm thick LSO scintillator doped with Tb, and 1.5 mm Al filter, single propagation distance tomography.

71 additional *Morganucodon* specimens (52 isolated teeth and 19 dentaries) and two pilot *Kuehneotherium* specimens were scanned at the ID19 beamline of ESRF (project ES 152). A single harmonic U13 undulator X-ray source was used, delivering a pink X-ray beam with peak energy at 26.5 keV, with 1.4 mm Al filter used to cut background lower energies. The detector was a microscope optic system coupled to a sCMOS sensor (PCO edge 5.5), mounted with a 10

μm thick $GGG:_{Eu}$ scintillator. Scans were performed using single propagation distance tomography (15 mm sample-to-detector propagation distance), exposure time of 250-300 ms, 2499 angular projections over 360°, and at voxel sizes of 280, 347 and 700 nm.

117 additional *Kuehneotherium* specimens (116 isolated teeth and one dentary) and 12 additional *Morganucodon* dentary specimens were scanned at the TOMCAT tomographic beamline of the Swiss Light Source (SLS), Villigen, Switzerland. The beam was set at 20 keV using a double multilayer monochromator, a LSO:Tb scintillator and a pco.EDGE 5.5 detector. Samples were scanned using single propagation distance tomography (14 mm sample-to-detector propagation distance), exposure time 150 ms, and 1500 angular projections over 180^0 at voxel size 330 nm. A *Kuehneotherium* lower molar (UMZC Sy 141) was imaged at 1.2 μm voxel size (with exposure time 150 ms and 1500 angular projections over 180°) to provide the 3D volume in Fig 1B.

Three juvenile *Morganucodon* dentary specimens with roots from final deciduous premolars (NHMUK PV M 27312, NHMUK PV M 27474 and NHMUK PV M 27475), and an older individual with extensive molar wear (NHMUK PV M 27465), were scanned during a separate experiment at TOMCAT beamline, SLS. Energy was 21 keV using a double multi-layer monochromator. Samples were scanned using single propagation distance tomography (14 mm sample-to-detector propagation distance), exposure time 200 ms and 1601 angular projections over 180° at voxel size 330 nm.

CT reconstructions of resulting tomographic data were generated using a filtered back-projection algorithm coupled with 'Paganin-style' single distance phase retrieval *(48)* algorithms developed in-house at the respective beamlines *(49)*. For data from ID19, $\beta = 8.1\ 10^{-8}$, $\delta = 9.8\ ^{10-9}$. For data from TOMCAT, $\beta = 3.7\ 10^{-8}$, $\delta = 1.7\ 10^{-10}$.

Of 71 *Morganucodon* specimens imaged at beamline ID19, four were additionally imaged at the ESRF nano-imaging beamline ID16A (project ES 152). These were imaged using holotomography *(50)* from four propagation distances. Holograms were recorded using a CCD detector with a physical pixel size of 1.5 µm and a 23 µm thick GGG:Eu scintillator at both 15 keV and 33.6 keV. Voxel sizes were 10 nm, 25 nm, 30 nm and 130 nm. Angular projections recorded over 180^0 varied between 1200 and 2000, exposure times were 250 to 800 ms. To generate the image containing the virtual section in Fig 1G, with 30 nm voxel size, the four focus-to-sample distances were 2.65 mm, 13.19 mm, 15.36 mm and 19.87 mm and sample-to-detector distance was 1.2648 m.

For the 3D model in Fig 1A, a *Morganucodon* lower molar (NHMUK PV M 104134) was imaged using micro CT (µCT) at the University of Helsinki using a Nanotom 180 NF (phoenix|X-ray Systems & Services GmbH) with a CMOS detector (Hamamatsu Photonics) and a high-power transmission-type X-ray nanofocus source with tungsten anode. 900 angular projections were collected over 180°, with exposure time of 1840 ms and voxel size 2 µm. Raw projection data were reconstructed using filtered back-projection by datos|x rec reconstruction software, supplied by the system manufacturer.

Increment counting and the creation of virtual thin sections. Cementum increments were counted in CT data using modifications to techniques suggested by the Cementochronology Research Program[32] to account for the 3D nature of the PPC-SRµCT cementum data. First, cementum was visually inspected throughout the volume of each scan, in transverse PPC-SRµCT slices using ImageJ/Fiji *(51)* to distinguish between specimens that were confidently interpreted as preserving cementum increments, and those too badly affected by diagenesis for increment counting. Phase contrast imaging of incremental features is understood to be prone to recurrent destructive interference patterns from Fresnel diffraction that create periodic blurring at differing frequencies when they are scanned using inappropriate experimental parameters (principally X-ray energy, sample-to-detector propagation distance and voxel size). However, our parameters produce blurring frequencies that are too narrow (approx. 500-900 nm) to significantly affect contrast between cementum increments (1-3 μm radial thickness). Therefore, no significant masking of increments from Fresnel diffraction blurring should be expected in our data. In specimens that preserved increments, volumes were inspected by eye to identify regions of highest increment contrast with no lensing and/or coalescence between increments. Increments identified in these regions were followed by eye throughout the entire cementum tissue surrounding these regions, both longitudinally and transversely through the root, to distinguish between principal increments and accessory increments formed by lensing and coalescence (Fig S1). Principal increments were distinguished as those that persisted vertically through the entire scanned region of cementum, whereas accessory increments lasted only for short periods before coalescing into neighbouring increments (Fig S1).

Once regions of highly contrasting primary cementum increments were identified, virtual thin sections of these were created by isolating 10 transverse PPC-SRμCT slices through each region and summing their greyscale values using the "Sum slices" option of the "Z projection" tool in ImageJ/Fiji. This created a new image of increased contrast between dark and light cementum increments, and reduced image noise. Three-to-five virtual thin sections were created for all specimens with readable cementum increments. For each virtual thin section, increments were counted manually by three observers: Observer One (EN) had considerable experience in counting cementum increments (>100 specimens studied); Observer Two (KW) had training in counting cementum increments (30 specimens studied under guidance from Observer One) and experience in studying growth patterns in PPC-SRµCT data of long-bones; Observer Three (CN) had no prior experience in counting increments or studying growth patterns. Each observer studied virtual thin sections blind, following numbering and randomization between specimens using the RAND function in Microsoft Excel. For each observer, final specimen increment counts were determined as the maximum number counted in all their virtual thin sections.

Precision between observers increment counts (Fig S5, Table S1) was compared by calculating the coefficient of variation (*CV*; formula 1) (Table S3):

1. $$CV = \left[\frac{standard\ deviation}{mean}\right] * 100$$

3D modelling of cementum increments. 3D modelling was performed, using Avizo image analysis software (Avizo 8.0; Thermo Fisher Scientific), on a subsample of teeth: the first tooth imaged using PPC-SRµCT (NHMUK PV M 104131), specimens with the highest cementum increment count for each fossil taxon (NHMUK M 104127 for *Morganucodon* and UMCZ Sy 141 for *Kuehneotherium*), and a *Morganucodon* specimen with both dentary lags and cementum increments (NHMUK PV M 96413). Original tomographic data was downsampled in each axis by a factor of two to decrease manual processing time while retaining sufficient spatial resolution to preserve cementum increments. Principal increments originally identified by eye were manually traced in each PPC-SRµCT slice and assigned to different materials in the 'label field' tool-kit. Models were created and analysed using the 'surface view' feature of Avizo. This allowed the pattern of incrementation to be viewed in 3D, to test whether increments defined in 2D slices were true principal increments or diffuse accessory increments (Fig S1).

Body mass estimation for *Morganucodon* and *Kuehneotherium* and choice of extant taxa for physiological comparison. Body mass of our fossil taxa were estimated using two techniques, based on scaling between single cranial dimensions and measured body mass in extant mammals. Maximum body mass estimates were made using the scaling relationship between dentary length (mm) and body mass (g) published for extant marsupial mammals of small body mass, and subsequently used to estimate body mass in several Mesozoic fossil taxa from the Late Jurassic Morrison Formation and elsewhere *(52)*:

$$\textbf{2.} \qquad \ln \text{ body mass(g)} = 2.9677*(\ln \text{ dentary length(mm)}) - 5.6712$$

Dentary lengths are from published CT reconstructions *(1)* (20 mm for *Morganucodon* and 21.9 mm for *Kuehneotherium*), resulting in body mass estimates of 25.0 g and 32.7 g respectively. However, this estimate may be an overestimate for *Kuehneotherium* as it has a longer, more gracile dentary relative to *Morganucodon*, due to their differing feeding ecologies *(1)*.

Secondly, minimum body mass estimates were calculated using the scaling relationship between skull length (mm) and body mass (g) found for 64 extant species of small 'lipotyphlan' insectivores *(53)* and used to estimate the body masses of several Mesozoic mammaliaforms *(20, 53, 54)*.

$$\textbf{3.} \qquad \text{Ln(body mass(g))} = 3.68*(\ln(\text{skull length(mm)}) - 3.83$$

Due to a lack of complete, diagnostic cranial material for UK samples of *Morganucodon* and *Kuehneotherium*, skull lengths were estimated using a scaling relationship between dentary length and skull length calculated for *Morganucodon oehleri* from Fig S1 *(19)* (skull length(mm) = 1.0458*jaw length(mm)). Following this relationship, we used dentary length to estimate a skull length of 21.0 mm for *Morganucodon watsoni* and 22.9 mm for *Kuehneotherium*, resulting in body mass estimates of 10.7 g and 14.9 g respectively (as above this may be an overestimate for *Kuehneotherium*). Body masses presented in Fig S3 and S4 are mean values of the two estimates (17.9 g for *Morganucodon*, 23.8 g for *Kuehneotherium*).

Information on maximum wild lifespan and mean body mass was obtained for 278 extant terrestrial mammal species (body mass: mean = 70.2 kg, S.D. = 395 kg; wild lifespan: mean = 10.8 years, S.D. = 11.2 years) and 256 extant terrestrial non-avian reptile species (body mass: mean = 3.6 kg, S.D. = 20 kg; wild lifespan: mean = 12 years, S.D. = 14 years) (SI Table 1). Information for flying or gliding taxa (including birds) was not included as their body masses are known to be secondarily reduced to aid their lifestyle and so may distort observed overall relationships between lifespan and body mass *(55-57)*; birds and bats live on average three-to-four times as long as terrestrial mammals of similar mass *(58)*. Marine mammals were not included as their environment positively affects available body mass, allowing significantly higher body masses than terrestrial taxa *(59-61)*. Mammal wild lifespan data is from primary literature; the majority from a download from (https://www.demogr.mpg.de/longevityrecords/0203.htm) on 10/03/2019. Most reptile lifespans come from the supplementary information of *(62)*. Body mass estimates were from an online *Ecological Archives* database *(63)*. (http://www.esapubs.org/archive/ecol/E084/094/metadata.htm), the Anage database (https://genomics.senescence.info/species/), and published data *(38, 62)*.

Data on standard metabolic rate (SMR) for extant mammals (n=117; mean = 915; S.D. = 3018) and reptiles (n=55; mean = 62.3; S.D. = 159) was obtained from a published electronic appendix *(38)*. SMRs for mammals were included only if measured under basal metabolic conditions *(38)* and so are synonymous with basal metabolic rates.

Data on the post-natal growth rate constant *K* was obtained upon request for extant mammals *(64)* (n = 115, mean = 0.03, S.D. = 0.03), and reptiles (n=33, mean = 0.002, S.D. = 0.003) from previous publications *(65, 66)*. Growth rate is measured in $days^{-1}$, and the dimensionless constant *K* is considered the best measure for comparing growth rates between multiple species *(67)*.

µCT study of femoral nutrient foramina. Femoral nutrient foramina in *Morganucodon* and 11 extant mammal taxa of comparable size were µCT imaged in the X-Ray Micro-Imaging Laboratory, University of Helsinki (Table S4). We used µCT data of femoral foramina rather than photographic images of foramina *(39)* because many of the *Morganucodon* foramina were sediment-filled, making photographic measurement difficult/impossible, whereas the differential density of sediment and fossilized bone in µCT data allowed visualization and analysis. All femora (fossil and extant) were scanned using a Bruker Skyscan 1272 µCT scanner at 70 kVp source tension and with 0.5mm Al filter. 1125-1800 angular projections were collected over 180° with exposure time 1344 ms. One fossil specimen was scanned at isotropic voxel size 4 µm (Fig 4A), and five specimens at 5 µm. All femora from extant taxa were scanned at 4µm voxel sizes. Raw projection data were reconstructed using filtered back-projection with the Feldkamp algorithm by the Bruker reconstruction software "NRecon" (Version 1.7.1.0).

Analysis of µCT femora data was conducted using Avizo image analysis software (Version 9.3.0; Thermo Fisher Scientific). Foramina were located using the "Orthoslice" tool to scroll through transverse CT slices. Once located, foramina were imaged in 3D using the "Volume rendering" tool, allowing the minimum diameter, and so minimum radius (in cm), of the foramen aperture to be measured using the "3D line measurement" tool. Minimum diameter was used *(39)*, in the study of foramina in small mammals, as it is not always possible to see the direction of nutrient vessel penetration. Resulting foramina radii were used to generate estimates of blood flow index (Q_i) following the method outlined in *(39)*. If multiple foramina were found in a single specimen, their radii were summed following the assumption that this represents the total entry/exit potential of nutrient circulation through the femur *(39)*. Single or summed radii (abbreviated as r; measured in cm), were used with femur length (L; measured in cm) to estimate Q_i:

4. $$Q_i = r^4/L$$

Although *Morganucodon* femoral elements are relatively common in the *Hirmeriella* fissure suite, almost all are incomplete *(68)*. We used the six most complete femoral specimens (UMZC EoPC 19_1 to EoPC 19_6) from the Pontalun 3 fissure where *Morganucodon* teeth imaged using PPC-SRµCT originated, which preserve at least two thirds of the femoral shaft. Length was estimated from the minimum mid-shaft diaphysial width using the scaling relationship between these established for a reconstructed *Morganucodon* femur created by concatenating three incomplete femora:

5. **Femur length = 10.3 * maximum mid-diaphysial diameter**

Statistics. One-way ANOVA comparison of intra-observer CV between cementochronological studies; Shapiro-Wilks normality test: PPC-SRμCT data $W = 1$, $p = 1$, histological data $W = 0.93$, $p = 0.41$; test statistics F = 11.12, degrees of freedom(df) = 10, Cohen's effect size $d = 3.13$, $p = 0.00728$. One-way ANCOVA comparison of OLS regression slopes for lifespan against body mass in mammals ($\log_{10}$ lifespan = 0.274($\log_{10}$ body mass) - 0.05; 95% CI = 0.255, 0.292; $r^2 = 0.69$) and reptiles ($\log_{10}$ lifespan = 0.253($\log_{10}$ body mass) + 0.465; 95% CI = 0.225, 0.281; $r^2 = 0.46$); slopes are statistically similar ($F = 1.09$, $p = 0.3$) while means are significantly separated ($F = 243$, df = 529, partial eta squared effect size = 0.32, $p = 2.3E^{-45}$). OLS regression of mammalian lifespan against msSMR: $\log_{10}$ msSMR = -0.623($\log_{10}$ lifespan) + 0.298; 95% CI = -0.71, -0.526; $r^2 = 0.59$, $p = 0.0001$). OLS regression of reptilian lifespan against msSMR: $\log_{10}$ msSMR = -0.494($\log_{10}$ lifespan) – 0.067; 95% CI = -1.328, -0.479; $r^2 = 0.43$, $p = 0.0001$). OLS regression of mammalian lifespan against growth constant K; $\log_{10} K$ = -0.99($\log_{10}$ lifespan) – 0.972; 95% CI = -1.138, -0.853; $r^2 = 0.66$, $p < 0.0001$). OLS regression of reptilian lifespan against growth constant K; $\log_{10} K$ = -0.948($\log_{10}$ lifespan) – 1.937; 95% CI = -1.4, -0.415; $r^2 = 0.43$, $p = 0.0002$). One-way ANCOVA comparison of OLS regression slopes for Q_i against body mass in extant mammals ($\log_{10}(Qi) = 0.513*\log_{10}$(body mass) - 6.104) and non-varanid reptiles ($\log_{10}(Qi) = 0.685*\log_{10}$(body mass) - 8.139); slopes are statistically similar ($F = 2$, $p = 0.16$) while means are significantly different ($F = 87.6$, df = 89, partial eta squared effect size = 0.50, $p = 7.4E^{-15}$).

Supplementary Text

Taxonomic description of *Morganucodon* and *Kuehneotherium*

Order MORGANUCODONTA Kermack, Mussett and Rigney, 1973

Family MORGANUCODONTIDAE Kühne 1958

Genus and species MORGANUCODON WATSONI Kühne, 1949

Family KUEHNEOTHERIIDAE Kermack, Kermack and Mussett, 1968

Genus and species KUEHNEOTHERIUM PRAECURSORIS Kermack, Kermack and Mussett, 1968

The phylogenetic relationship of *Morganucodon* and *Kuehneotherium* is shown in Fig S2. The position of *Morganucodon* at the base of Mammaliaformes (Node 4) has remained stable between multiple studies *(1, 19, 28, 69)*. We have also chosen to position *Kuehneotherium* at the Mammaliaformes node in Fig S2, as its lack of diagnostic post-cranial material makes its phylogenetic placement uncertain and poorly supported amongst studies *(28, 47, 69)*. However, it is generally placed either within a clade including *Morganucodon (47. 69)*, or further crownward than *Morganucodon* based mainly based on the triangulation of its molars *(28, 47, 69)*.

Eruption sequence and timing

As noted in the main text, establishing individual ages from several teeth along *Morganucodon* lower jaws provides information on the tooth eruption sequence and timing. Eight scanned dentaries provided information (Table S2). There are several specimens with tooth row increment counts covering p1 to m2: For example, NHMUK PV M 95790 for p1 to p3; NHMUK PV M96413 for p3 to m1; NHMUK PV M 96396 for p4 to m2 (Table S2). NHMUK PV M 96413 and NHMUK PV M 96396 also show readable lines of arrested growth (LAGs) in the dentary bone, which provide the same count as their p3 to m1 and p4-m2 teeth respectively. This indicates that p1 to m2 erupted within one year of each other in *Morganucodon*.

There is also a specimen (NHMUK PV M 27312) with an increment count of one (Table S1). This specimen has the deciduous fourth premolar in situ, with signs of the developing permanent third and fourth premolars forming, but also the first molar *in situ* and m2 in the process of erupting. This shows that m1 erupted before p3 and 4, and all within one year of life. In the mammaliaform *Docodon victor* the third premolar p3 is the earliest tooth position for premolar replacement *(70)*, but that level of differentiation cannot yet be determined in *Morganucodon*.

Three specimens (NHMUK PV M 96396; NHMUK PV M 104129; NHMUK PV M 104130) show that the third molar erupted during the year after the permanent p1-m2 erupted. One specimen (NHMUK PV M 95790) has cementum increment counts indicating that the permanent final incisor i4, and the canine, erupted during the year after the eruption of the first three permanent premolars. We therefore conclude that the ultimate incisor, canine and the third molar erupted during the year following the eruption of p1 to m2 in *Morganucodon*. We do not have information on eruption timing of more anterior incisors, or the fourth molar. The fifth molar is only very occasionally present.

The eruption of the final incisor and canine after the premolars may be a plesiomorphic feature in *Morganucodon* and does not follow the general antero - posterior pattern seen in later therians. In the Late Jurassic dryolestids *(71)*, tooth replacement takes place in two waves; with i2, i4, p1, and p3 in the first series and i1, i3, c, p2, and p4 in the second. However, this is also different from the pattern seen here in *Morganucodon*, where the ultimate incisor and canine come in after the permanent premolars.

Morganucodon could live to at least 14 years, commonly to six and not unusually to nine years, so this pattern of most of the adult tooth row being in place during the first two years of life is also supportive of a relatively short (compared with its total lifespan) juvenile stage *(69)* and determinate growth as established by O'Meara and Asher *(40)*. The absolute length of these stages in *Morganucodon* is however considerably longer than extant mammals of comparable body size *(31)*.

Unfortunately, there are no available tooth rows of *Kuehneotherium* with cementum increment counts. Dentulous specimens are rare and the three specimens in the UMZC collection are not suitable for scanning for cementum annuli as they were previously mounted in plaster and dissected to reveal the tooth roots. *Kuehneotherium* has a longer tooth row than *Morganucodon* with six premolars and six molars *(47).* A difference from *Morganucodon* is that there is evidence from specimens of juvenile *Kuehneotherium* dentaries *(47),* that the canine, ultimate premolar, p6, and third molar all erupted at about the same time, which suggests that the canine erupted relatively earlier in *Kuehneotherium* than in *Morganucodon*.

The loss of the anterior permanent postcanines has been noted in *Morganucodon* jaws *(72)*, and is assumed to proceed along the tooth row with age. In some dentaries, the first premolar appears to be lost relatively early and is only represented by a small, indistinct, resorbed root just posterior to the canine. Accordingly, it is not certain if the timing, and degree, of loss of the anterior premolars is variable in individuals, but this question is part of a current study. Specifically, the specimen NHMUK PV M 95790 with cementum annuli counts for i4 to p3, obviously has not shed the anterior premolars, in spite of a minimum age of eight years.

Using lifespan to estimate growth rates in stem mammals

We investigated a final third proxy for metabolic potential in fossil mammaliforms; their post-natal growth rate. Growth rates have been shown to correlate strongly with metabolic power in extant vertebrates, with endotherms growing an order of magnitude faster than ectotherms *(30, 65)*, and show significant correlation with lifespan in terrestrial vertebrates *(64-67).* We estimated growth rates using Ordinary Least Squares correlations between wild lifespan and growth rate from published data from 115 extant mammals *(64)* and 31 extant reptiles *(65, 66)* (Fig. S4B). From mammal data we estimate growth rate constants *K* ($days^{-1}$ - Methods) of $7.68e^{-3}$ $days^{-1}$ (*Morganucodon*) and $1.19e^{-2}$ $days^{-1}$ (*Kuehneotherium*). From reptile data we estimated $K = 9.53e^{-4}$ $days^{-1}$ (*Morganucodon*) and $K = 1.44e^{-3}$ $days^{-1}$ (*Kuehneotherium*). Log_{10} OLS regression against body mass again places both mammaliaforms outside the mammalian 95% PI and within the reptile growth rate range, whether estimated from mammalian or reptilian data (Fig. S4C). The lowest growth rate of any <100g extant mammal is $K = 3.24e^{-2}$ $days^{-1}$ for the Mongolian gerbil *Meriones unguiculatus* (Fig. S4C).

Fig. S1.

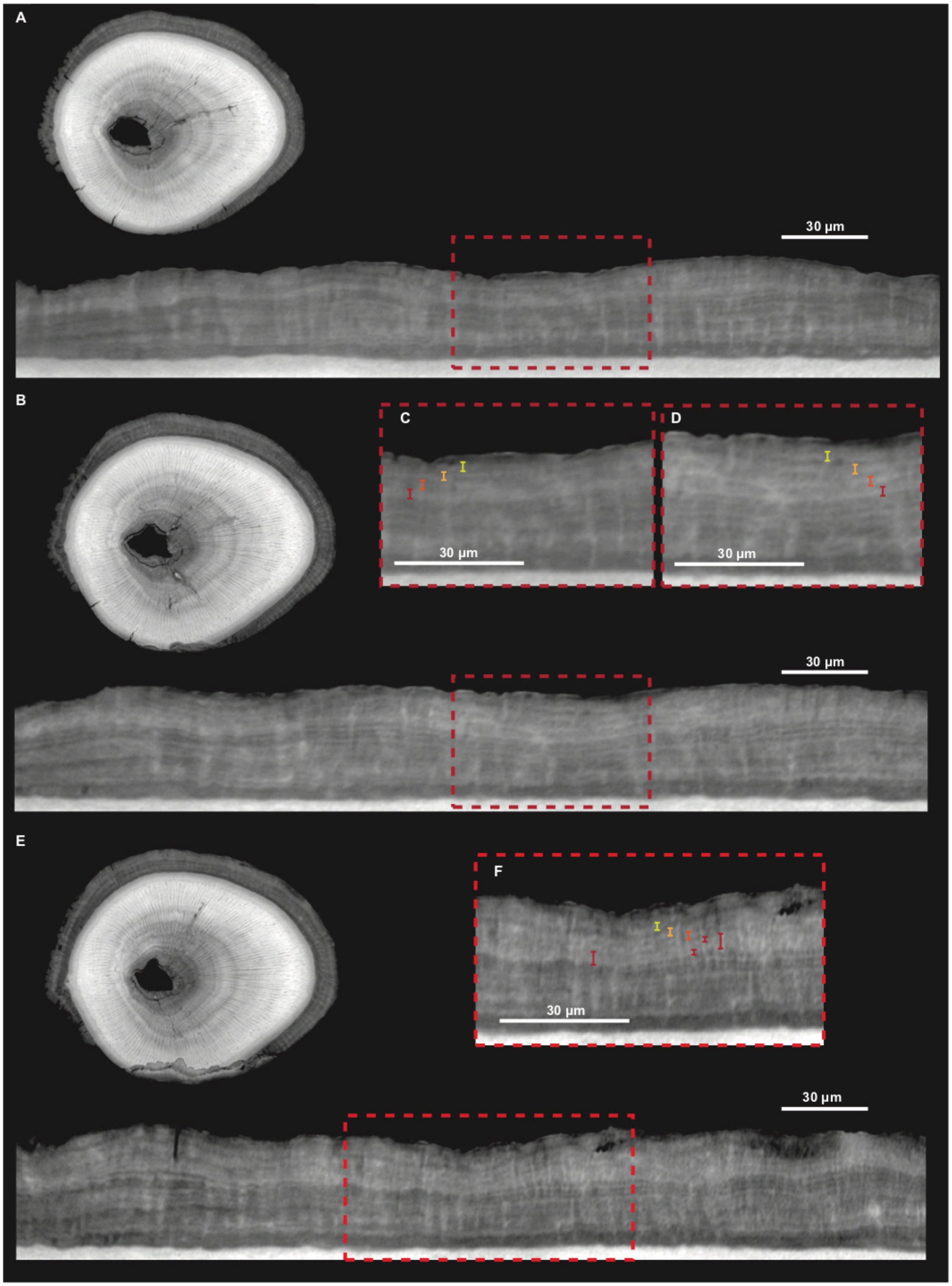

Fig. S1. Example of lensing and coalescence of cementum increments in specimen NHMUK PV M 104138. A. Transverse PPC-SRμCT slice selected from region of the cementum closest to the crown. Inset to the left is the entire slice, and the straightened portion represents the region of highest increment contrast from this slice. **B.** Transverse PPC-SRμCT slice 100 μm towards the root apex relative to **A**. **C.** Detail from **A** highlighted by dashed red box, with four outermost higher density (lighter coloured) cementum increments annotated with coloured bracketed lines. **D**. Detail from **B** highlighted by dashed red box. The same increments imaged in **A** and **C** are annotated with the same coloured bracketed lines. However, they are more clearly defined in **B** and **D**, with the innermost two annotated increments **(**dark red and orange bracketed lines) coalescing in **A** and **C**. **E.** Transverse PPC-SRμCT slice 100 μm towards the root apex relative to **B. F**. Detail from **E** highlighted by dashed red box. While the four outermost increments imaged in the other PPC-SRμCT slices are also imaged here, the innermost increment (dark red bracketed lines) has lensed, creating two accessory increments. All straightening performed using the "straighten" tool in ImageJ/Fiji *(51)*.

Fig. S2.

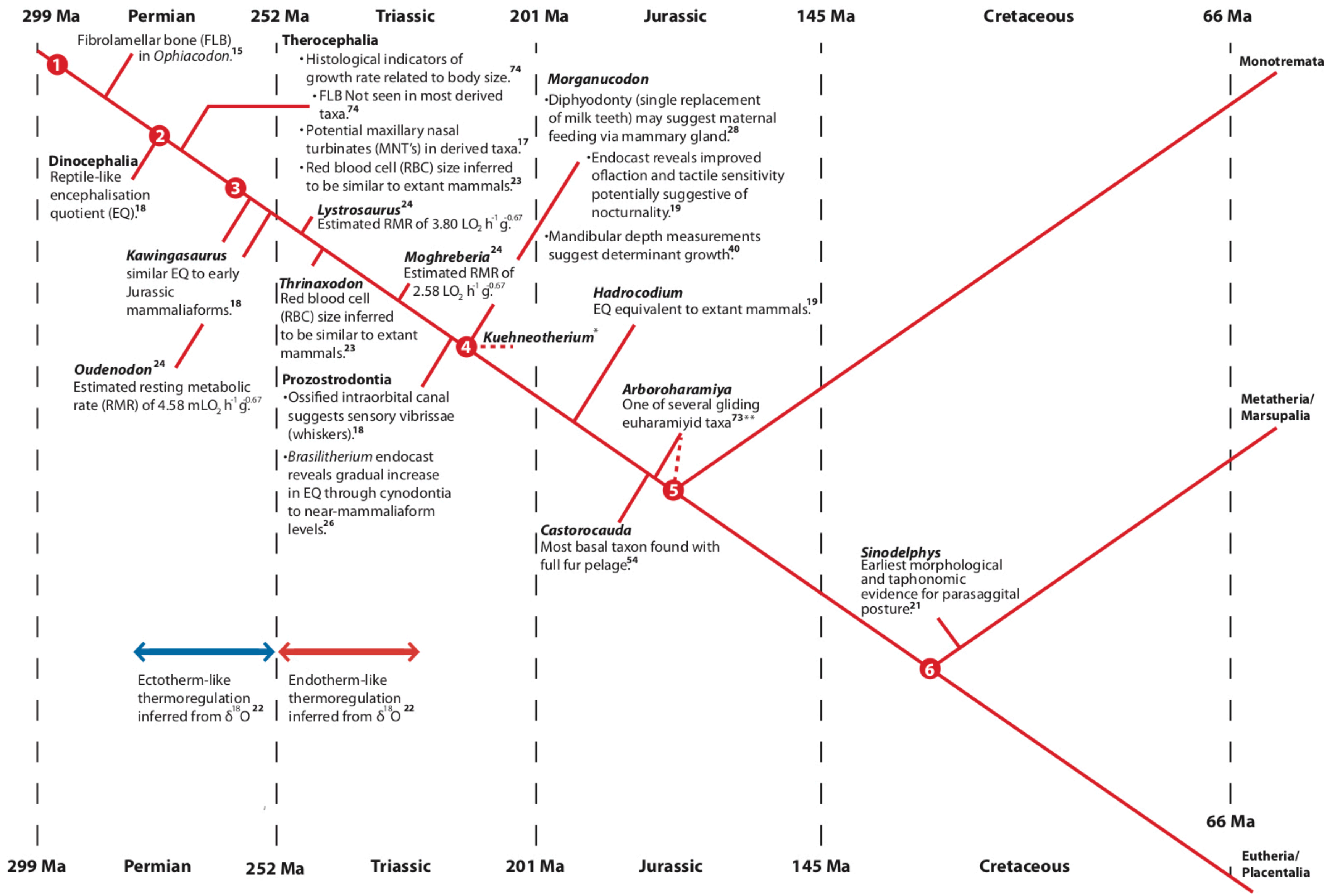
299 Ma
Permian
252 Ma
Triassic
201 Ma
Jurassic
145 Ma
Cretaceous
66 Ma
Fibrolamellar bone (FLB) in Ophiacodon.15
Therocephalia
•Histological indicators of growth rate related to body size.74
•FLB Not seen in most derived taxa.74
•Potential maxillary nasal turbinates (MNT's) in derived taxa.17
•Red blood cell (RBC) size inferred to be similar to extant mammals.23
Morganucodon
•Diphyodonty (single replacement of milk teeth) may suggest maternal feeding via mammary gland.28
•Endocast reveals improved oflaction and tactile sensitivity potentially suggestive of nocturnality.19
•Mandibular depth measurements suggest determinant growth.40
Monotremata
Dinocephalia
Reptile-like encephalisation quotient (EQ).18
Lystrosaurus24
Estimated RMR of 3.80 LO2 h-1 g-0.67
Kawingasaurus
similar EQ to early Jurassic mammaliaforms.18
Moghreberia24
Estimated RMR of 2.58 LO2 h-1 g-0.67
Thrinaxodon
Red blood cell (RBC) size inferred to be similar to extant mammals.23
Hadrocodium
EQ equivalent to extant mammals.19
Kuehneotherium*
Oudenodon24
Estimated resting metabolic rate (RMR) of 4.58 mLO2 h-1 g-0.67
Prozostrodontia
•Ossified intraorbital canal suggests sensory vibrissae (whiskers).18
•Brasilitherium endocast reveals gradual increase in EQ through cynodontia to near-mammaliaform levels.26
Arboroharamiya
One of several gliding euharamiyid taxa73**
Metatheria/ Marsupalia
Castorocauda
Most basal taxon found with full fur pelage.54
Sinodelphys
Earliest morphological and taphonomic evidence for parasaggital posture.21
Ectotherm-like thermoregulation inferred from δ18O22
Endotherm-like thermoregulation inferred from δ18O22
66 Ma
299 Ma
Permian
252 Ma
Triassic
201 Ma
Jurassic
145 Ma
Cretaceous
Eutheria/ Placentalia

Fig. S2. Timescaled phylogeny summarising evidence for physiological evolution along the synapsid lineage towards mammals. Red nodes highlight the divergence of major lineages; Node 1 = divergence of the Pelycosaur lineage; Node 2 = the Therapsida clade; Node 3 = the Cynodontia clade; Node 4 = the Mammaliaformes clade; Node 5 = the Mammalia clade; Node 6 = the Theria clade. Superscript numbers denote references in the main text. * Denotes the uncertain phylogenetic affinities of *Kuehneotherium* within the Mammaliaformes clade *(28).* ** Denotes the uncertain phylogenetic affinities of *Arboroharamiya (73).*

Fig. S3.

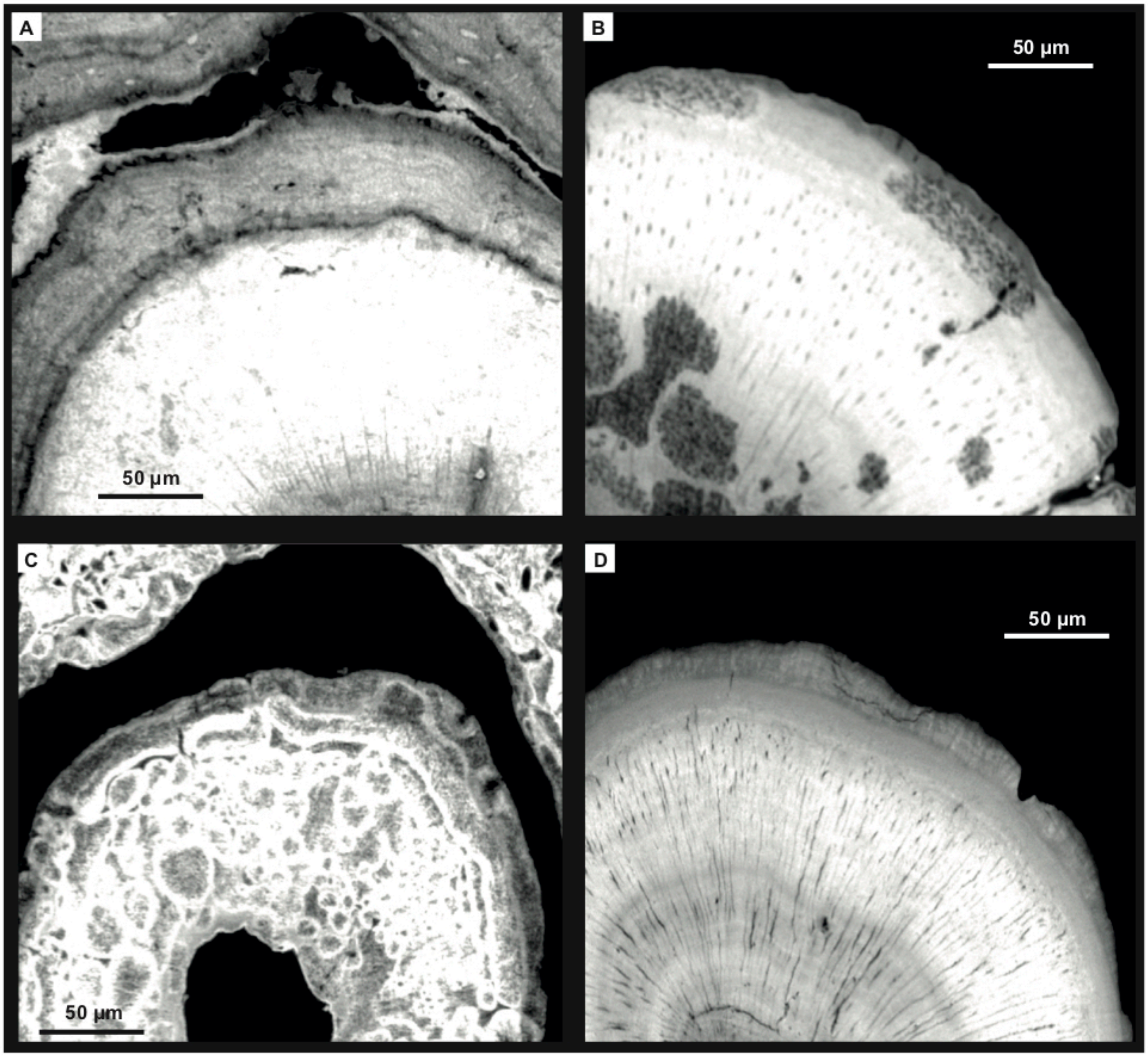

Fig. S3. Common biological and physical features, and diagenetic fabrics, encountered in tomographic data of fossil cementum. A. Substantial variation in the thickness of individual cementum increments in the anterior root of the m2 specimen NHMUK PV M 104129. **B.** Discrete dark, less dense regions of diagenetic alteration within the root of NHMUK PV M 96086, a specimen of otherwise excellent dentine and cementum preservation. **C.** Globular diagenetic fabrics have adulterated virtually all microstructure in the anterior root of the m1 specimen NHMUK PV M 95809, though it may still be possible to separate dentine and cementum. **D**. Physical damage to the cementum tissue has removed outer increments in discrete regions of the cementum of the anterior root of NHMUK PV M 96273. The dentine has been over-saturated (white) by decreasing the dynamic range in imageJ/Fiji *(51)*, to improve the visibility of the cementum.

Fig. S4.

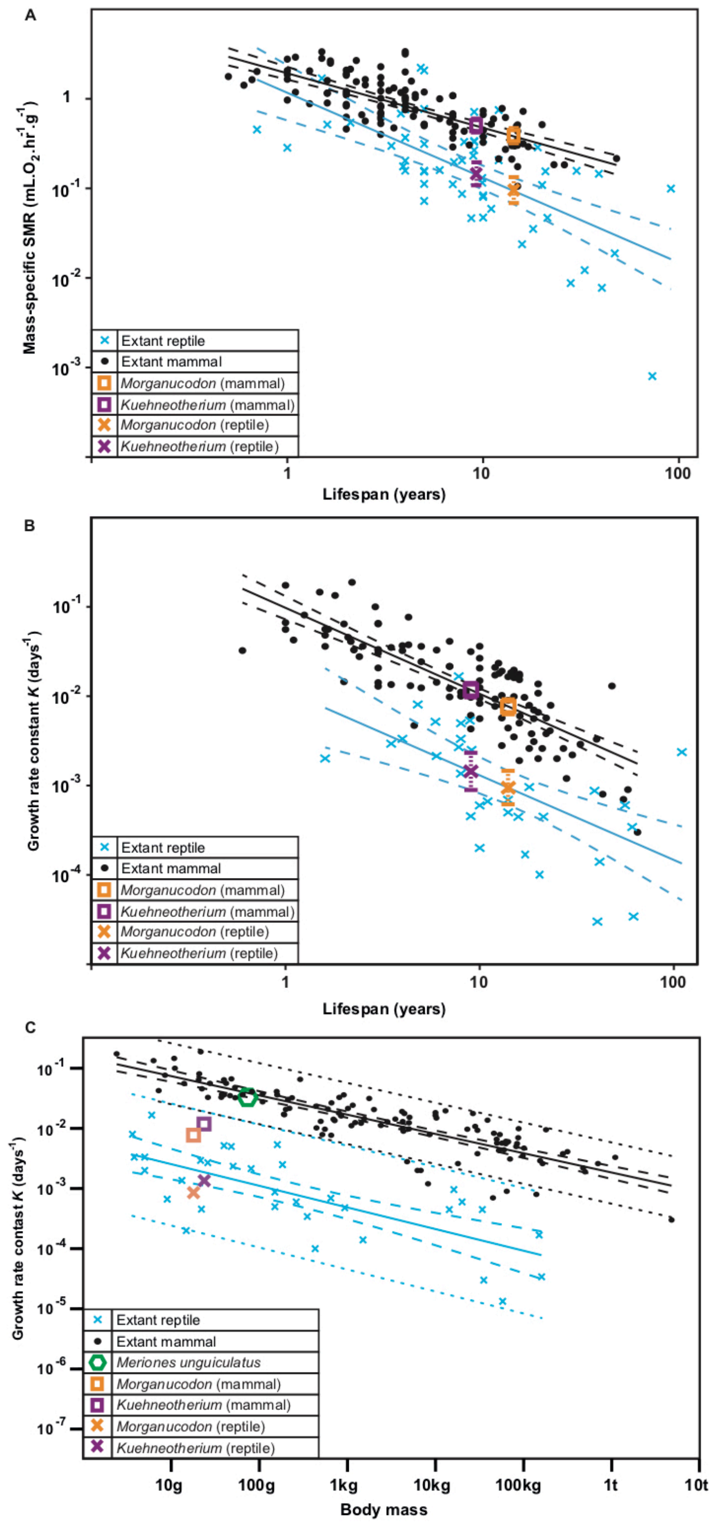
A
Mass-specific SMR (mL.O$_2$.hr^{-1}.g^{-1})
Lifespan (years)
Extant reptile
Extant mammal
Morganucodon (mammal)
Kuehneotherium (mammal)
Morganucodon (reptile)
Kuehneotherium (reptile)
B
Growth rate constant *K* (days^{-1})
Lifespan (years)
Extant reptile
Extant mammal
Morganucodon (mammal)
Kuehneotherium (mammal)
Morganucodon (reptile)
Kuehneotherium (reptile)
C
Growth rate contast *K* (days^{-1})
Body mass
10g
100g
1kg
10kg
100kg
1t
10t
Extant reptile
Extant mammal
Meriones unguiculatus
Morganucodon (mammal)
Kuehneotherium (mammal)
Morganucodon (reptile)
Kuehneotherium (reptile)

Fig. S4. The relationship between lifespan and msSMR, and lifespan and growth rate constant *K*, in mammals and reptiles. A. Log_{10} biplot between maximum wild lifespan (years) and mass-specific standard metabolic rate (msSMR; $mL.O_2.hr^{-1}.kg^{1}$) for extant mammals (n=117) and reptiles (n=55). **B.** Log_{10} biplot between maximum wild lifespan (years) and post-natal growth rate constant *K* ($days^{-1}$) for extant mammals (n=115) and reptiles (n=31). **C.** Log_{10} biplot of mean body mass (g) against post-natal growth rate constant *K* ($days^{-1}$) for extant mammals (n = 115) and extant reptiles (n = 33) and estimates for fossil mammaliaforms. OLS regression means for each clade (black lines for mammals, blue lines for reptiles) are used to estimate msSMR (**A**), and *K* (**B**) for mammaliaforms *Morganucodon* and *Kuehneotherium*. 95% confidence intervals are represented by dashed lines, 95% predictor intervals by dotted lines in **C**.

Fig. S5.

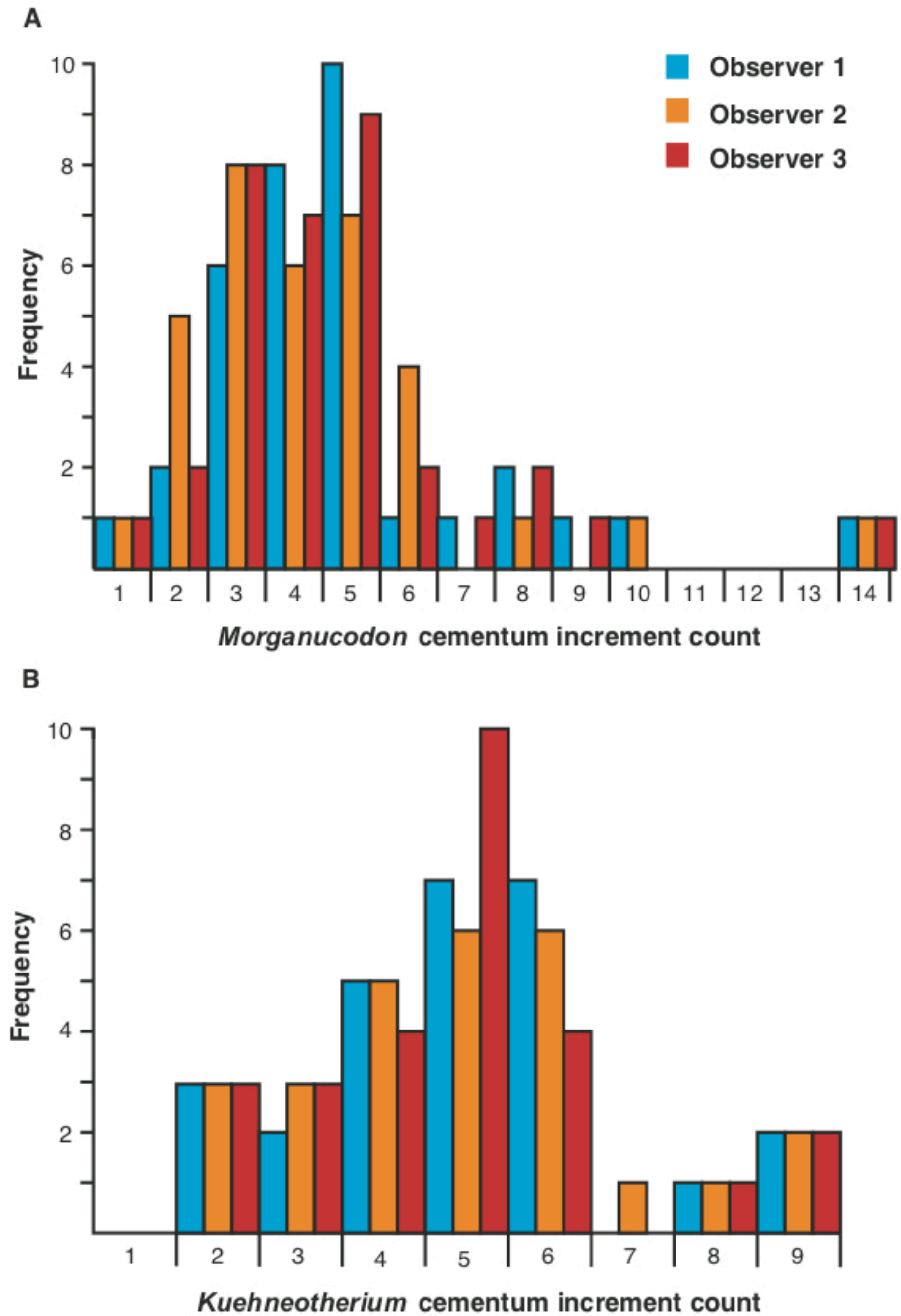

Fig. S5. Comparison between distributions of cementum increment counts estimated by three independent observers. A. Distributions of increment counts estimated for *Morganucodon.* **B.** Distributions of increment counts estimated for *Kuehneotherium.*

Table S1

Taxon	Specimen	Observer 1 increment count	Observer 2 increment count	Observer 3 increment count
Morganucodon	NHMUK PV M 104126	5	6	5
Morganucodon	NHMUK PV M 104127	14	14	14
Morganucodon	NHMUK PV M 104128	5	5	5
Morganucodon	NHMUK PV M 104129	9	5	6
Morganucodon	NHMUK PV M 104130	5	5	5
Morganucodon	NHMUK PV M 104131	4	3	3
Morganucodon	NHMUK PV M 104132	4	3	4
Morganucodon	NHMUK PV M 104133	3	3	3
Morganucodon	NHMUK PV M 104134	4	4	4
Morganucodon	NHMUK PV M 104135	5	5	5
Morganucodon	NHMUK PV M 104136	2	2	2
Morganucodon	NHMUK PV M 104137	5	3	4
Morganucodon	NHMUK PV M 104138	10	10	9
Morganucodon	NHMUK PV M 27312	1	1	1
Morganucodon	NHMUK PV M 92528	3	2	3
Morganucodon	NHMUK PV M 95790	8	8	8
Morganucodon	NHMUK PV M 95805	8	4	8
Morganucodon	NHMUK PV M 95809	3	2	3
Morganucodon	NHMUK PV M 95810	5	6	5
Morganucodon	NHMUK PV M 96075	8	8	8
Morganucodon	NHMUK PV M 96085	3	2	3
Morganucodon	NHMUK PV M 96086	4	3	4
Morganucodon	NHMUK PV M 96141	5	5	3
Morganucodon	NHMUK PV M 96380	4	4	4
Morganucodon	NHMUK PV M 96396	4	4	4
Morganucodon	NHMUK PV M 96406	2	2	2
Morganucodon	NHMUK PV M 96413	5	5	5
Morganucodon	NHMUK PV M 96418	7	6	7
Morganucodon	NHMUK PV M 96441	5	3	5
Morganucodon	NHMUK PV M 96444	3	3	3
Morganucodon	NHMUK PV M 96463	6	6	6
Morganucodon	NHMUK PV M 96464	4	4	4
Morganucodon	NHMUK PV M 96474	4	4	5
Morganucodon	NHMUK PV M 96476	5	5	5
Morganucodon	NHMUK PV M 96490	3	3	3
Kuehneotherium	NHMUK PV M 20982	5	6	5
Kuehneotherium	NHMUK PV M 20990	3	3	3
Kuehneotherium	NHMUK PV M 21069	6	6	6
Kuehneotherium	NHMUK PV M 21080	5	5	4
Kuehneotherium	NHMUK PV M 21081	2	2	2
Kuehneotherium	NHMUK PV M 27257	4	3	4
Kuehneotherium	NHMUK PV M 27273	5	4	5
Kuehneotherium	NHMUK PV M 27301	2	2	2
Kuehneotherium	NHMUK PV M 27305	2	2	2
Kuehneotherium	NHMUK PV M 27308	6	6	5
Kuehneotherium	NHMUK PV M 27344	6	5	5
Kuehneotherium	NHMUK PV M 27436	4	4	4
Kuehneotherium	NHMUK PV M 27443	4	4	4
Kuehneotherium	NHMUK PV M 27505	6	6	5
Kuehneotherium	NHMUK PV M 27520	5	5	5
Kuehneotherium	NHMUK PV M 27529	5	5	5
Kuehneotherium	NHMUK PV M 27537	5	5	5
Kuehneotherium	NHMUK PV M 27538	6	6	6
Kuehneotherium	NHMUK PV M 27545	6	6	6
Kuehneotherium	NHMUK PV M 27550	4	5	5
Kuehneotherium	NHMUK PV M 27628	5	4	5
Kuehneotherium	NHMUK PV M 27653	9	9	9
Kuehneotherium	NHMUK PV M 27745	6	7	6
Kuehneotherium	NHMUK PV M 27816	3	3	3
Kuehneotherium	UCMZ Sy 106	8	8	8
Kuehneotherium	UCMZ Sy 121	4	4	3
Kuehneotherium	UCMZ Sy 141	9	9	9

Table S1. Independent estimates of cementum increment counts estimated by three observers.

Observer 1 = EN; observer 2 = CN; observer 3 = KW.

Table S2

Specimen	Element	Observer 1 count
NHMUK PV M 95790	i4	7
NHMUK PV M 95790	c	7
NHMUK PV M 95790	p1	8
NHMUK PV M 95790	p2	8
NHMUK PV M 95790	p3	8
NHMUK PV M 96413	p3	5
NHMUK PV M 96413	p4	5
NHMUK PV M 96413	m1	5
NHMUK PV M 96413	dentary	5
NHMUK PV M 96396	p4	4
NHMUK PV M 96396	m1	4
NHMUK PV M 96396	m2	4
NHMUK PV M 96396	m3	3
NHMUK PV M 96396	dentary	4
NHMUK PV M 95809	m1	3
NHMUK PV M 95809	m2	3
NHMUK PV M 104128	m1	5
NHMUK PV M 104128	m2	5
NHMUK PV M 96441	m1	5
NHMUK PV M 96441	m2	5
NHMUK PV M 104130	m1	5
NHMUK PV M 104130	m2	5
NHMUK PV M 104130	m3	4
NHMUK PV M 104129	m1	9
NHMUK PV M 104129	m2	9
NHMUK PV M 104129	m3	8

Table S2. Cementum and dentary increment counts for each element of dentulous *Morganucodon* specimens. The lower dental formula of *Morganucodon* is i4: c: p4: m4-5.

Table S3

Study	Taxon	*n*	Maximum age (years)	mean *CV*
Newham et al. (presented here)	*Morganucodon*	34	14	9.32
Newham et al. (presented here)	*Kuehneotherium*	27	9	4.89
Grau et al.[75]	*Procyon lotor*	54	9	20.6
Gasawey et al.[76]	*Alces alces*	72	9	14.2
Klevezal and Pucek[77]	*Bison bonasus*	45	21	20.57
Kay and Cant[78]	*Macaca mulatta*	65	24	29.34
Cederlund et al.[79]	*Capreolus capreolus*	74	9	30.5
Bodkin et al.[80]	*Enhydra lutris*	14	14	26.24
Landon et al.[81]	*Canis lupus*	12	6.8	25.92
Christensen-Dalsgaard et al.[82]	*Ursus maritimus*	32	15	15.2
Pasda[83]	*Rangifer tarandus*	63	16	19.4
Perez-Barberia et al.[84]	*Cervus elaphus*	164	17	16.22

Table S3. Results of quantitative analyses of precision between three independent observers for the cementum increment counts of fossil mammals studied here, *Morganucodon* and *Kuehneotherium*, and those of ten previous studies of extant mammals with comparable age ranges. *CV* – coefficient of variation. Superscript numbers denote references in the main text.

Table S4

Taxon	Average femur length (cm)	Average foramen radius (cm)	Average Q_i (mm^3)
Apodemus flavicolis	2.15	0.082	3.15E-05
Micromys minutus	1.1	0.062	1.47E-05
Microtus levis	1.43	0.071	2.26E-05
Mus musculatus	1.32	0.073	2.38E-05
Peromyscus truei	1.75	0.063	1.10E-05
Sorex minutissimus	0.48	0.045	1.00E-05
Sicista betulina	1.04	0.071	2.59E-05
Sorex araneus	0.82	0.044	4.89E-06
Myodes rutilus	1.17	0.066	1.61E-05
Neomys fodiens	1.04	0.068	2.28E-05
Sorex minutus	0.56	0.042	6.37E-06
Morganucodon	1.25	0.026	3.83E-07

Table S4. Results of measuring femur length and nutrient foramen radius in μCT data for 11 extant mammal taxa and *Morganucodon*, with resulting estimates of blood flow index Q_i.

Table S5

Order	Taxon	Aka	Body mass (g)	Body mass ref.	Alt. body mass (g)	Alt. body mass ref.	Alt. body mass (g)	Alt. body mass ref.	Wild lifespan (years)	SMR ($mL.O_2.hr^{-1}$)	Growth rate constant (day^{-1})	Wild lifespan ref.
Mammalia	*Acinonyx jubatus*	Cheetah	37900	38					12	8099.751		219
Mammalia	*Acomys cahirinus*	Spiny mouse	42	38	45.2	64			1.6	48.6511	0.05623	273
Mammalia	*Acomys russatus*	Golden spiny mouse	55.4	86			55.55	38	3	46.35892		273
Mammalia	*Aepyceros melampus*	Impala	52500	64					9		0.0043	296
Mammalia	*Ailuropoda melanoleceuca*	Giant panda	125000	86					26			115
Mammalia	*Ailurus fulgens*	Red panda	4325	64	5740	85			14	915.3	0.009	168
Mammalia	*Alcelaphus buselaphus*	Hartebeest	159000	86					20			211
Mammalia	*Alces alces*	Moose	325000	86					27			259
Mammalia	*Alouatta palliata*	Mantled howler	4670	86					20			163
Mammalia	*Alouatta seniculus*	Red howler	6543	86					25			271
Mammalia	*Antechinomys laniger*	Kultarr	25.8	38					3.3	31.90611		316
Mammalia	*Antechinus flavipes*	Yellow-footed antechinus	46.5	38					3.5	61.50761	0.0351	291
Mammalia	*Antechinus stuartii*	Brown antechinus	25	86			28.2	38	2	45.75579		118

Mammalia	*Antechinus swainsoni*	Dusky antechinus	66.9	38					2	77.27176		147
Mammalia	*Antidorcas marsupialis*	Springbok	39000	64					20		0.0137	85
Mammalia	*Antilocapra americana*	Pronghorn	46100	64			34779	85	10		0.0083	219
Mammalia	*Antilope cervicapra*	Blackbuck	37500	86					18			267
Mammalia	*Aotus trivirgatus*	Night/owl monkey	820	38					20	422		271
Mammalia	*Aplodontia rufa*	Mountain beaver	630	38					10	277.2		219
Mammalia	*Apodemus agrarius*	Striped field mouse	21.2	86					1.5			188
Mammalia	*Apodemus sylvaticus*	Old World wood and field mouse	23.9	38					1	49.48212		196
Mammalia	*Arctocebus calabarensis*	Golden potto	206	86					9.5			183
Mammalia	*Arvicola amphibius*	European water vole	94.7	86					2			274
Mammalia	*Atelerix frontalis*	African hedgehog	555	86					4			185
Mammalia	*Baiomys taylori*	Northern pygmy mouse	7.2	86	8	64	7.15	38	1.1	21.01403	0.0425	155
Mammalia	*Bassariscus astutus*	Ringtail	1015	64					7		0.0215	85
Mammalia	*Bettongia penicillata*	Woylie	1018	38					6	609.8379		129

Mammalia	*Bison bonasus*	European bison	610000	86					20			204
Mammalia	*Blarina brevicauda*	Northern short-tailed shrew	21.6	64	20.9	85			2.2		0.188	85
Mammalia	*Burramys parvus*	Mountain pygmy possum	44.3	38					4	44.75014		245
Mammalia	*Callimico goeldii*	Goeldi's monkey	555	64					9		0.0097	182
Mammalia	*Callithrix jacchus*	Common marmoset	190	85	255.2	64			12		0.0172	182
Mammalia	*Canis latrans*	Coyote	10000	38	13250	64			14.5	2979.196	0.0183	107
Mammalia	*Canis lupus*	Wolf	26625	64					16		0.0177	201
Mammalia	*Canis mesomelas*	Black-backed jackal	10250	64					10	3860	0.0149	216
Mammalia	*Capra ibex*	ibex	82500	64					16		0.005	108
Mammalia	*Castor fiber*	Eurasian beaver	25,000	85					24			164
Mammalia	*Cavia porcellus*	Guinea pig	629	38					14.8	312.1045		117
Mammalia	*Ceratotherium simum*	White rhinoceros	2E+06	85					50			175
Mammalia	*Cercartetus nanus*	Eastern pygmy possum	64.8	85			70	38	5	77.154		312
Mammalia	*Cercocebus albigena*	Gray-cheeked mangabey	9318	85					21			184

Mammalia	*Cercocebus atys*	Sooty mangabey	8600	86					18			184
Mammalia	*Cercocebus torquatus*	Collared mangabey	9493	85					20.5			184
Mammalia	*Cercopithecus diana*	Diana monkey	4550	85					34.8			184
Mammalia	*Cervus elaphus*	Red deer	67000	85	200000	64			16.1		0.006	240
Mammalia	*Chaetodipus formosus*	Long-tailed pocket mouse	15.1	85					4			207
Mammalia	*Chaetodipus penicillatus*	Desert pocket mouse	17.35	85					2.16			234
Mammalia	*Chinchilla lanigera*	Chinchilla	426	38			436.7	85	11.3	253.9436		117
Mammalia	*Choloepus didactylus*	Southern two-toed sloth	6250	64					25		0.002	302
Mammalia	*Clethrionomys glareolus*	Bank vole	20.8	64	21.5	85			1.25		0.0809	307
Mammalia	*Colobus polykomos*	Western black and white colobus	9525	85					30.5			271
Mammalia	*Connochaetes taurinus*	Blue wildebeest	164500	64	196500	85			21		0.0026	109
Mammalia	*Cratogeomys castanops*	Mexican pocket gopher	270	85					2.6			295
Mammalia	*Crocidura leucodon*	Bicolored shrew	11	64					2.9		0.1	85

Mammalia	*Crocidura russula*	Greater white-toothed shrew	10.8	85	11.6	64			1.5		0.146	222
Mammalia	*Crocuta crocuta*	Spotted hyena	63000	64					19		0.0056	149
Mammalia	*Cryptotis parva*	Least shrew	6.3	85	5.5	64			1.8		0.134	264
Mammalia	*Ctenomys talarum*	Tuco-tuco	121	38					2	133.4216		124
Mammalia	*Cynomys ludovicianus*	Black-tailed prairie dog	1112	38	1125	64			8	483.4789	0.0111	189
Mammalia	*Damaliscus dorcas*	Sassaby	84500	85					21.4			196
Mammalia	*Damaliscus pygargus*	Blesbok	84500	64					10		0.0056	164
Mammalia	*Dasycercus cristicauda*	Mulgara	91	85			101	38	7	57.44462		317
Mammalia	*Dasypus novemcinctus*	Common long-nosed armadillo	3510	38					15	1242.45		318
Mammalia	*Dasyuroides byrnei*	Kowari	91.7	38					4	95.984815		135
Mammalia	*Dasyurus geoffroii*	Western quoll	1327	85					5	684.9998		282
Mammalia	*Dasyurus hallucatus*	Northern quoll	571	85			558	38	3	301.9363		250
Mammalia	*Diceros bicornis*	Black rhinoceros	1100000	64					40		0.0033	253
Mammalia	*Didelphis marsupialis*	Southern opossum	1244	85			1165	38	2	778.1077		300

Mammalia	*Didelphis virginiana*	Large American opossum	2847	85	3000	64	2488	38	3	1138.385	0.0129	192
Mammalia	*Dipodomys heermani*	Heermann's kangaroo rat	63.3	85					3			166
Mammalia	*Dipodomys merriami*	Merriam's kangaroo rat	37.6	85	42	64	36.5	38	4	47.08432	0.0368	207
Mammalia	*Dipodomys nitratoides*	Fresno kangaroo rat	37.8	85					3			166
Mammalia	*Dipodomys ordii*	Ord's kangaroo rat	47.8	85			46.8	38	2	91.25668		178
Mammalia	*Echinops telfairi*	Lesser Madagascar “hedgehog”	116.4	85					1.2			196
Mammalia	*Elaphurus davidianus*	Pere David's deer	186500	85					23.3			195
Mammalia	*Elephantulus myurus*	Long-eared elephant shrew	62.97	38					1.1	74.60186		292
Mammalia	*Elephantulus rufescens*	Rufous elephant shrew	53	38	58	64			1.6	61.13734	0.0481	292
Mammalia	*Elephas maximus*	Asiatic elephant	4E+06	85					70			208
Mammalia	*Eligmodontia typus*	Highland gerbil mouse	17.5	38					0.7	35.30826		170

Mammalia	*Eliomys quercinus*	Garden dormouse	82.5	64					2.17		0.0409	99
Mammalia	*Enhydra lutris*	Sea otter	26833	85					23			272
Mammalia	*Equus burchellii*	Burchell's zebra	######	64					22		0.0038	293
Mammalia	*Equus zebra*	Mountain zebra	######	85					24			174
Mammalia	*Erethizon dorsatum*	North American porcupine	8600	64			6871	85	18		0.0079	150
Mammalia	*Erinaceus europaeus*	Eurasian hedgehog	750	38					7	510.3632		237
Mammalia	*Erinaceus europaeus*	Western European hedgehog	1214	85					7	510.3632		237
Mammalia	*Felis chaus*	Jungle cat	10000	64					14		0.0165	251
Mammalia	*Fukomys damarensis*	Damaraland mole-rat	131.3	85			138	38	8.5			278
Mammalia	*Galago senegalensis*	Senegal bushbaby	192.2	64	171.7	85			16	139.35	0.0169	182
Mammalia	*Galea musteloides*	Yellow-toothed cavy	322	38					1.3	283.8147		271
Mammalia	*Galemys pyrenaicus*	Pyrenean desman	57.5	85					3.5			269
Mammalia	*Galerella sanguinea*	Slender mongoose	519.6	85			540	38	10	381.7477		172
Mammalia	*Geocapromys ingrahami*	Bahamian hutia	775	85					8			228

Mammalia	*Geomys bursaris*	Plains pocket gopher	197	38					4	188.0479		137
Mammalia	*Georychus capensis*	Cape mole-rat	195	38					3	136.4734		304
Mammalia	*Gerbillus gerbillus*	Lesser gerbil	29.7	38					2.25	46.1332		288
Mammalia	*Gerbillus pyramidum*	Greater Egyptian gerbil	37	64	108.5	85			2.25	99.04	0.0329	288
Mammalia	*Giraffa camelopardalis*	Giraffe	800000	85					26			141
Mammalia	*Glis glis*	Fat dormouse	174.4	85					9			260
Mammalia	*Gorilla gorilla*	Gorilla	139842	64					43		0.0008	120
Mammalia	*Gymnobelideus leadbeateri*	Leadbeater's possum	166	85					7.5			212
Mammalia	*Herpestes auropunctatus*	Javanese mongoose	611	85					6.75	336.1698		97
Mammalia	*Hyaena brunnea*	Brown hyena	42250	85					12			235
Mammalia	*Hylobates lar*	White-handed gibbon	6810	64					20		0.002	254
Mammalia	*Hylobates syndactylus*	Siamang	10900	85					25			129
Mammalia	*Ictonyx striatus*	Striped polecat	910	64					5		0.0361	206
Mammalia	*Isoodon macrourus*	Northern brown bandicoot	1551	64					2	713.03	0.0145	310

Mammalia	*Isoodon obesulus*	Southern brown bandicoot	717	38	700	64			3.5	339.6069	0.0135	215
Mammalia	*Kobus ellipsiprymnus*	Waterbuck	175333	85					18.5			297
Mammalia	*Lagorchestes conspicillatus*	Spectacled hare-wallaby	2660	85					6			227
Mammalia	*Lemur catta*	Ring-tailed lemur	2555	85					27.1			184
Mammalia	*Leontopithecus rosalia*	Golden lion tamarin	654.5	64					12		0.0077	200
Mammalia	*Lepus americanus*	Snowshoe hare	1603	85					5			289
Mammalia	*Lepus europaeus*	European hare	4175	64					13		0.0191	119
Mammalia	*Liomys adspersus*	Spiny pocket mouse	42	85					1.5			159
Mammalia	*Litocranius walleri*	Gerenuk	43500	85					8			210
Mammalia	*Loxodonta africana*	African bush elephant	5E+06	64					65		0.0003	238
Mammalia	*Lutreolina crassicaudata*	Lutrine opossum	812	38					3	509.6935		152
Mammalia	*Lycaon pictus*	African hunting dog	8750	85					11			161
Mammalia	*Lynx lynx*	Eurasian lynx	23000	64					17		0.0097	148

Mammalia	*Macaca arctoides*	Stump-tailed macaque	9275	85					30			184
Mammalia	*Macaca mulatta*	Rhesus macaque	8235	64					28		0.0012	242
Mammalia	*Macaca sinica*	Toque macaque	4370	85					30			271
Mammalia	*Macaca sylvanus*	Barbary ape	10875	85					22			271
Mammalia	*Macropus fuliginosus*	Western gray kangaroo	28250	64					20		0.0108	85
Mammalia	*Macropus giganteus*	Eastern gray kangaroo	49500	64					20		0.0066	85
Mammalia	*Macropus parma*	Parma wallaby	4250	64					8		0.01	85
Mammalia	*Macropus robustus*	Wallaroo	30000	64	29648	85			18.5		0.0038	188
Mammalia	*Macropus rufogriseus*	Red-necked wallaby	16200	85					18.5			223
Mammalia	*Macropus rufus*	Red kangaroo	55000	85			28500	38	22			188
Mammalia	*Macrotis lagotis*	Rabbit-bandicoot	1246	85					7.2	613.19		135
Mammalia	*Madoqua kirkii*	Kirk's dik-dik	5000	64					5		0.0124	164
Mammalia	*Marmosa murina*	Murine opossum	26	85					1			192

Mammalia	*Marmosa robinsoni*	Robinson's mouse opossum	122	38					2	147.5895		135
Mammalia	*Marmota marmota*	Apline marmot	3500	85					15			245
Mammalia	*Martes americana*	American marten	966.5	85			900	38	13	597.9833		255
Mammalia	*Martes pennanti*	Fisher	3175	85					10			261
Mammalia	*Meles meles*	Old world badger	13000	64					15		0.0196	220
Mammalia	*Mellivora capensis*	Honey badger	10000	85					26.4			196
Mammalia	*Mephitis mephitis*	Striped skunk	3500	64					6		0.0143	126
Mammalia	*Meriones unguiculatus*	Mongolian jird	53.2	64					3	75.47	0.0324	305
Mammalia	*Metachirus nudicaudatus*	Brown four-eyed opossum	336	38					2	279.4945		135
Mammalia	*Microcebus murinus*	Gray mouse lemur	64.8	64					10		0.0362	181
Mammalia	*Microcebus rufus*	Brown mouse lemur	55.5	85					8			321
Mammalia	*Micromys minutus*	Harvest mouse	7.6	85			7.37	38	1	21.078		306
Mammalia	*Microtus agrestis*	Field vole	25	85			28	38	1.66	66.28537		241
Mammalia	*Microtus arvalis*	Common vole	27.5	64	21.9	85			1.66	68.75	0.0561	241

Mammalia	*Microtus guentheri*	Vole	43.8	38					0.5	77.70604		134
Mammalia	*Microtus ochrogaster*	Prairie vole	48.2	85	40	64	46.7	38	1	79.62561	0.0666	176
Mammalia	*Microtus pennsylvanicus*	Meadow vole	38.2	85			38.9	38	1	71.29453		284
Mammalia	*Microtus subterraneus*	European pine vole	17.8	85					1.75			144
Mammalia	*Monodelphis brevicaudata*	Short bare-tailed opossum	91.5	85			75.5	38	1	88.60531		247
Mammalia	*Muscardinus avellanarius*	Hazel dormouse	23.5	85					4	79.065		197
Mammalia	*Mustela erminea*	Ermine	125.5	85			75	38	4.5	139.8433		153
Mammalia	*Mustela lutreola*	European mink	590	85					10			244
Mammalia	*Mustela putorius*	European polecat	809	64					6		0.0328	85
Mammalia	*Mustela vison*	American mink	660	38	925	64			10	440.4273	0.0266	176
Mammalia	*Myodes glareolus*	Bank vole	21.5	85					2			176
Mammalia	*Nannospalax spp.*	Mediterranean blind mole rat	160	85					4.5	134.94		275
Mammalia	*Napaeozapus insignis*	Woodland jumping mouse	22	38					4	43.91335		245
Mammalia	*Neotoma floridana*	Eastern woodrat	291	64					3		0.0654	100

Mammalia	*Nycticebus coucang*	Slow loris	1129	85			1160	38	14	358.5209		245
Mammalia	*Ochotona collaris*	Collared pika	129	85					6			176
Mammalia	*Ochotona curzoniae*	Plateau pika	109	85					4.25			265
Mammalia	*Ochotona princeps*	North American pika	109	85	100	64			4.3		0.0376	266
Mammalia	*Ochrotomys nuttalli*	Golden mouse	19.5	38					2.5	32.04717		258
Mammalia	*Octodon degus*	Degu	235	64	199.6	85			4	177.43	0.0323	298
Mammalia	*Odocoileus hemionus*	Mule deer	57000	64					22		0.0057	85
Mammalia	*Odocoileus virginianus*	White-tailed deer	87000	64					19		0.007	217
Mammalia	*Ondatra zibethicus*	Muskrat	1005	38					3	684.0912		245
Mammalia	*Ornithorhynchus anatinus*	Duck-billed platypus	1030	85	1030	85	693	38	17	293.4248		112
Mammalia	*Orycteropus afer*	Aardvark	48000	38					23	8822.792		115
Mammalia	*Oryctolagus cuniculus*	Old World rabbit	2168	85					9			176
Mammalia	*Otomys irroratus*	Southern African vlei rat	102	38					2	88.44719		102
Mammalia	*Ovibos moschatus*	Muskox	315000	64					23		0.0041	122
Mammalia	*Ovis canadensis*	Bighorn sheep	70275	64	67031	85			19		0.0031	110

Mammalia	*Pan troglodytes*	Chimpanzee	44984	64					55		0.0007	186
Mammalia	*Panthera leo*	Lion	98000	38	175000	64			15	17130.2	0.0035	219
Mammalia	*Panthera pardus*	Leopard	53750	64					23.2		0.0079	104
Mammalia	*Panthera tigris*	Tiger	137900	38					26	25267.61		224
Mammalia	*Papio cynocephalus*	Yellow baboon	23000	85					40			271
Mammalia	*Papio hamadryas*	Hamadryas baboon	18000	64					27		0.0026	85
Mammalia	*Perameles gunni*	Eastern barred bandicoot	695	85	766	64	837	38	3	561.2457	0.0142	281
Mammalia	*Perameles nasuta*	Long-nosed bandicoot	645	38					3	384.6524		135
Mammalia	*Perodicticus potto*	Potto	1225	64	968.6	85			10	399.55	0.0125	182
Mammalia	*Perognathus longimembris*	Little pocket mouse	8.5	85	8	64	8.9	38	4.3	13.39517	0.0766	162
Mammalia	*Perognathus parvus*	Great basin pocket mouse	19.2	85					4			248
Mammalia	*Peromyscus leucopus*	White-footed mouse	22.3	85	23	64	26	38	2.1	47.82757	0.0456	133
Mammalia	*Peromyscus maniculatus*	Deer mouse	20.5	64					2	42.85	0.0643	85
Mammalia	*Peromyscus polionotus*	Oldfield mouse	14	64	12	85			1		0.0558	143

Mammalia	*Phascogale tapoatafa*	Brush-tailed phascogale	153.7	85			157	38	3.5	135.3086		277
Mammalia	*Phascolarctos cinereus*	Koala	4765	38	9300	64			13	1298.093	0.0028	219
Mammalia	*Phenacomys intermedius*	Western heather vole	21.5	38					4	67.99437		226
Mammalia	*Philander opossum*	Gray four-eyed opossum	751	38					2.5	424.2633		128
Mammalia	*Planigale ingrami*	Long-tailed planigale	8.8	85					1.3			135
Mammalia	*Planigale tenuirostris*	Narrow-nosed planigale	7.1	38					3	16.21102		268
Mammalia	*Poliocitellus franklini*	Franklin's ground squirrel	607	85					5			252
Mammalia	*Pongo pygmaeus*	Orangutan	64475	64					58		0.0009	313
Mammalia	*Potamochoerus porcus*	Red river hog	88000	64					15		0.0099	209
Mammalia	*Potorous tridactylus*	Long-nosed potoroo	1430	64	1045.5	85	976	38	7	520.0876	0.0122	177
Mammalia	*Priodontes maximus*	Giant armadillo	45190	38					15	4771.811		232
Mammalia	*Procavia capensis*	Rock hyrax	2400	38	3600	64			8.5	731.8892	0.0112	188
Mammalia	*Procyon cancivorus*	Crab-eating raccoon	1160	85					16			218

Mammalia	*Procyon lotor*	Common raccoon	5075	38	6000	64			16	1598.625	0.0153	196
Mammalia	*Proechimys semispinosus*	Spiny rat	498	38	500	64			4.4	316.9601	0.0131	249
Mammalia	*Psammomys obesus*	Fat sand rat	212	64					3		0.0304	116
Mammalia	*Pseudocheirus peregrinus*	Ring-tailed possum	916	38					5	458.0722		190
Mammalia	*Puma concolor*	Cougar	63000	64	37200	85			9		0.0061	165
Mammalia	*Rangifer tarandus*	Caribou	101250	64	85000	85			4.6		0.0047	240
Mammalia	*Rattus fuscipes*	Bush rat	76	38					3.8	89.29607		303
Mammalia	*Rattus lutreolus*	Australian swamp rat	109	38	115	64			2.4	72.31488	0.0277	303
Mammalia	*Rattus norvegicus*	Norway rat	206.9	85					3			132
Mammalia	*Rattus rattus*	Rat	200	64	117	85			3		0.0207	132
Mammalia	*Redunca fulvorufula*	Mountain reedbuck	30000	64					12		0.0093	164
Mammalia	*Reithrodontomys megalotis*	Western harvest mouse	9	38					1.5	25.47207		158
Mammalia	*Reithrodontomys spp.*	American harvest mouse	10.3	85					1.5			158
Mammalia	*Rhabdomys pumilio*	Four-striped grass mouse	39.6	38	51	64			1.6	35.56981	0.0361	145
Mammalia	*Rhombomys opimus*	Great gerbil	285	85					4			242

Mammalia	*Saguinus nigricollis*	Black-mantled tamarin	519.2	64					13		0.0079	182
Mammalia	*Saguinus oedipus*	Cotton-top tamarin	445.5	64					13		0.0102	182
Mammalia	*Sarcophilus harrisii*	Tasmanian devil	5775	38					7	1672.487		219
Mammalia	*Scalopus aquaticus*	Eastern aquatic mole	48	38					3	83.22678		183
Mammalia	*Sciurus carolinensis*	Eastern gray squirrel	440	38	533	64			12.5	343.7961	0.0234	196
Mammalia	*Sciurus niger*	Eastern fox squirrel	800	64					12.6		0.018	203
Mammalia	*Sciurus vulgaris*	Eurasian red squirrel	600	64					12		0.021	85
Mammalia	*Setonix brachyurus*	Quokka	2702	85					10			287
Mammalia	*Sicista betulina*	Northern birch mouse	10	85					3			263
Mammalia	*Sicista sp.*	Birch mouse	10	85					3.3			193
Mammalia	*Sigmodon hispidus*	Hispid cotton mouse	159.6	85	185	64	139.3	38	2.5	228.0326	0.0362	111
Mammalia	*Sminthopsis crassicaudata*	Fat-tailed dunnart	16.4	38					1.3	33.6602		135
Mammalia	*Sminthopsis psammophila*	Sandhill dunnart	55	85					2			221
Mammalia	*Sorex alpinus*	Alpine shrew	7.8	85					1.4			176

Mammalia	*Sorex araneus*	Common shrew	8.4	85					1.5			131
Mammalia	*Sorex cinereus*	Cinereus shrew	5.2	85					1.8			154
Mammalia	*Sorex coronatus*	Crowned shrew	9.1	85					1.7			301
Mammalia	*Sorex minutus*	Eurasian pygmy shrew	4.1	85					1.8			257
Mammalia	*Sorex vagrans*	Vagrant shrew	5.2	85					1.3			154
Mammalia	*Spalax ehrenbergi*	Palestine mole rat	133.8	85			135.3	38	3	163.5204		156
Mammalia	*Spermophilus citellus*	European ground squirrel	240	38					6	240.0963		187
Mammalia	*Spermophilus lateralis*	Ground squirrel	240	38					11	125.0856		285
Mammalia	*Spermophilus sp.*	Golden-mantled ground squirrel	157.6	64	249.6	85			7	170.96	0.0411	106
Mammalia	*Suncus etruscus*	Etruscan shrew	2.4	85	2.1	64			1		0.174	279
Mammalia	*Suncus murinus*	Asian house shrew	39.7	85	45.9	64			3		0.0643	286
Mammalia	*Sundamys muelleri*	Giant sunda rat	334	85					0.5			231
Mammalia	*Suricata suricata*	Meerkat	850	38	776	64			15	369.8655	0.0161	309

Mammalia	*Sus scrofa*	Wild boar	180000	64	135000	85			10		0.0095	194
Mammalia	*Sylvilagus audubonii*	Audubon's cottontail rabbit	686.9	85					2			213
Mammalia	*Sylvilagus floridanus*	Eastern cottontail	1150	85	1530	64			5		0.0243	280
Mammalia	*Syncerus caffer*	African buffalo	700000	64					18		0.0026	85
Mammalia	*Tachyglossus aculeatus*	Short-beaked echidna	4250	64	2909	85			48	915.81	0.013	101
Mammalia	*Tamias minimus*	Least chipmunk	49.3	85			45.8	38	0.66	80.65219		311
Mammalia	*Tamias striatus*	Eastern American chipmunk	87.4	38					3	88.63667		236
Mammalia	*Tamias townsendii*	Townsend's chipmunk	75	64					3		0.0333	236
Mammalia	*Tamiasciurus hudsonicus*	Red squirrel	219.6	85	200	64	228.3	38	7	238.0098	0.0216	225
Mammalia	*Tarsipes rostratus*	Honey possum	10	38					1.5	33.5166		315
Mammalia	*Tarsius tarsier*	Spectral tarsier	173	85					10.75			283
Mammalia	*Taurotragus oryx*	Eland	500000	64	141404	85			16		0.0019	125
Mammalia	*Taxidea taxus*	American badger	9000	38					14	2700		196
Mammalia	*Thomomys bottae*	Botta's pocket gopher	143	38					4.5	147.7128		142

Mammalia	*Thomomys talpoides*	Pocket gopher	106.8	38					1.6	171.0982		115
Mammalia	*Thylogale billardierii*	Tasmanian pademelon	5000	64					7		0.0098	229
Mammalia	*Tolypeutes matacus*	Three-banded armadillo	1160	38					15	352.0817		232
Mammalia	*Tragelaphus imberbis*	Lesser kudu	82500	85					10			210
Mammalia	*Tragelaphus scriptus*	Bushbuck	60000	64					14		0.0044	164
Mammalia	*Tragelaphus spekei*	Sitatunga	87500	85					20			198
Mammalia	*Trichosurus caninus*	Mountain brush-tailed possum	3150	85					17			299
Mammalia	*Trichosurus vulpecula*	Brush-tailed possum	2005	38	2395	64			10	899.7082	0.0206	133
Mammalia	*Tupaia glis*	Common tree shrew	123	38					4	103.6621		205
Mammalia	*Urocitellus richardsonii*	Richardson's ground squirrel	266.3	85					6			233
Mammalia	*Ursus americanus*	American black bear	154250	64					33		0.0029	85
Mammalia	*Ursus arctos*	Grizzly bear	277500	85					25			139
Mammalia	*Ursus maritimus*	Polar bear	475000	64					30		0.0022	146
Mammalia	*Vicugna vicugna*	Vicugna	50000	64					13		0.0057	136
Mammalia	*Vulpes lagopus*	Arctic fox	3600	85					10			96
Mammalia	*Vulpes velox*	Swift fox	1769	85	2400	64			9		0.0315	270

Mammalia	*Vulpes vulpes*	Red fox	4440	38	8500	64			15	2271.51	0.0177	239
Mammalia	*Xerospermophilus mohavensis*	Mohave ground squirrel	240	85					5	125.0865		178
Mammalia	*Zapus hudsonicus*	Meadow jumping mouse	26.1	85	18	64	23.8	38	3	38.37949	0.0328	191
Mammalia	*Zapus princeps*	Western jumping mouse	21	85					4			121
Reptilia	*Acanthodactylus boskianus*		7.8	38	19.6	62			9	5.572925		62
Reptilia	*Acanthodactylus dumerilii*		7.3	62					1.5			62
Reptilia	*Acanthodactylus erythrurus*		9	38	13.7	62			2.1	4.881291		62
Reptilia	*Acanthodactylus pardalis*		9.7	38	10.6	62			4	7.383813		62
Reptilia	*Acontias meleagris*		7.3	38					3.9	1.28466		160
Reptilia	*Alligator mississippiensis*		150000	85	1287	38			73.1	120.01	0.00017	314
Reptilia	*Alligator sinensis*	Chinese alligator	35800	93					50			93
Reptilia	*Alsophylax pipiens*		1.7	62					3.5			62
Reptilia	*Amalosia lesueurii*		10.3	62					9.5			62
Reptilia	*Amblyrhynchus cristatus*		7406.5	62					28	64.81586		62

Reptilia	*Amphibolurus muricatus*		46.8	62					9.9	6.105519		117
Reptilia	*Amphibolurus norrisi*		38.2	62					7			62
Reptilia	*Anatololacerta anatolica*		9.8	62					10			62
Reptilia	*Anolis acutus*		5	62	1.481	65			1.6	2.58	0.002	62
Reptilia	*Anolis carolinensis*		10.5	62					7.1	2.061847		117
Reptilia	*Anolis cristatellus*		9.8	62					6.9			62
Reptilia	*Anolis cupreus*		3.9	62					1.5			62
Reptilia	*Anolis garmani*		52.6	62					10			62
Reptilia	*Anolis gemmosus*		6	62					3			62
Reptilia	*Anolis gundlachi*		9.1	62					3			62
Reptilia	*Anolis humilis*		2.7	62					1.5			62
Reptilia	*Anolis intermedius*		3.3	62					2			62
Reptilia	*Anolis limifrons*		1.4	38					1	0.3981		62
Reptilia	*Anolis stratulus*		4.8	62					1.6			62
Reptilia	*Anolis tropidolepis*		4.3	62					2			62
Reptilia	*Aspidoscelis deppei*		23.7	62					2			62
Reptilia	*Aspidoscelis dixoni*		40	62					4			62
Reptilia	*Aspidoscelis exsanguis*		30.7	62					4			62

Reptilia	*Aspidoscelis laredoensis*		21.4	62					3			62
Reptilia	*Aspidoscelis neomexicana*		18.6	62					4			62
Reptilia	*Aspidoscelis rodecki*		12.1	62					2			62
Reptilia	*Aspidoscelis scalaris*		59.5	62					3			62
Reptilia	*Aspidoscelis tesselata*		36.7	62					5			62
Reptilia	*Aspidoscelis tigris*		79.1	62					8			62
Reptilia	*Aspidoscelis uniparens*		18.6	62					4			62
Reptilia	*Basiliscus basiliscus*		554	62					7			62
Reptilia	*Bassiana duperreyi*		10.5	62					7			62
Reptilia	*Blanus cinereus*		2.4	38	16	62			0.7	1.09		160
Reptilia	*Boa constrictor*	Common boa constrictor	35283	62	7815.5	38			40.4	273.6353	0.00003	62
Reptilia	*Boaedon fuliginosus*		315.1	62					9			62
Reptilia	*Caimen latirostris*	Broad-nosed caiman	60000	62					22			294
Reptilia	*Callisaurus draconoides*		39.7	62					5.9		0.00518	62
Reptilia	*Caretta caretta*		57778	85							1.33E-05	

Reptilia	*Carlia bicarinata*		2	62					2			62
Reptilia	*Carlia rostralis*		6.8	62					3.8			62
Reptilia	*Carlia rubrigularis*		4.4	62					3.6			62
Reptilia	*Carlia storri*		1.8	62					3.3			62
Reptilia	*Chalcides chalcides*		34.2	62					4			62
Reptilia	*Chalcides ocellatus*		22.06	38	218.6	62			8.9	5.11		160
Reptilia	*Chelonia mydas*	Green sea turtle	160000	85	50889	65			62		3.41E-05	171
Reptilia	*Chelydra serpentina*	Common snapping turtle	10250	85	3473	38			47	192.7		62
Reptilia	*Chioninia coctei*		1229.7	62					16			62
Reptilia	*Chlamydosarus kingi*	Filled dragon	620.8	62					6			173
Reptilia	*Chrysemys picta*	Painted turtle	350	85					61		0.00034	136
Reptilia	*Clemmys guttata*	Spotted turtle	50.37	85					110		0.00235	214
Reptilia	*Cnemidophorus murinus*		85	38	125.7	62			5	13.07877		62
Reptilia	*Cnemidophorus sexlineatus*	Six-lined racerunner	6	86					7.8		0.01667	85
Reptilia	*Cnemidophorus tigris*		26	86					7.8	5.34	0.00269	319
Reptilia	*Coelognathus helena*		437.6	62					15			62
Reptilia	*Coleonyx brevis*		5.4	62					5			62

Reptilia	*Coluber constrictor*		262	38	606.9	62			10	21.91	0.0006	62
Reptilia	*Conolophus pallidus*		5288.6	62					60			62
Reptilia	*Conolophus subcristatus*		6288.5	62					60			62
Reptilia	*Cophosaurus texanus*		23.1	62					6			62
Reptilia	*Coronella girondica*		66.5	62					16			62
Reptilia	*Crocodylus moreletii*	Morelet's crocodiles	51000	95					60			95
Reptilia	*Crocodylus siamensis*	Siamese crocodile	151000	86					80			89
Reptilia	*Crotalus durissus*	Neotropical rattlesnake	2883	62					19.8			62
Reptilia	*Crotaphytus collaris*		30	38	68.1	62			10	10.6507		62
Reptilia	*Ctenophorus fordi*		4.4	62					2			62
Reptilia	*Ctenophorus isolepis*		13.3	62					2			62
Reptilia	*Ctenophorus maculosus*		7.9	62					3.5			62
Reptilia	*Ctenophorus ornatus*		20.1	62					11			62
Reptilia	*Ctenosaura hemilopha*		2724.7	62					13			62
Reptilia	*Ctenotus atlas*		8.5	62					4			62
Reptilia	*Ctenotus labillarderi*	Lancelin Island skink	8.9	62					7	0.99		294

Reptilia	*Ctenotus lancelini*		13.7	62					6			62
Reptilia	*Ctenotus leonhardii*		2.8	38	10.1	62			7			62
Reptilia	*Ctenotus regius*		11.8	62					4			62
Reptilia	*Ctenotus schomburgkii*		11.8	62					5			62
Reptilia	*Ctenotus strauchii*		4.8	62					2.5			62
Reptilia	*Ctenotus taeniolatus*		14.8	62					5			62
Reptilia	*Cyclura carinata*		5609.2	62					14			62
Reptilia	*Cyclura cychlura*		11800	62					40			62
Reptilia	*Cyclura nubila*	Cuban rock iguana	17648	62					40			113
Reptilia	*Darevskia armeniaca*		9	62					8			62
Reptilia	*Darevskia brauneri*		8.3	62					13			62
Reptilia	*Darevskia dahli*		6.1	62					6			62
Reptilia	*Darevskia portschinskii*		7	62					6			62
Reptilia	*Darevskia raddei*		10.2	62					6			62
Reptilia	*Darevskia rostombekovi*		5.1	62					6			62
Reptilia	*Darevskia rudis*		15.9	62					8			62
Reptilia	*Darevskia unisexualis*		9	62					7			62
Reptilia	*Darevskia valentini*		11.8	62					7			62

Reptilia	*Diadophis punctatus*		14.8	85					10	1.19	0.0002	114
Reptilia	*Dinarolacerta mosorensis*		11.8	62					9			62
Reptilia	*Diplodactylus conspicillatus*		5.5	62					3.2			62
Reptilia	*Draco volans*		20.8	62					3			62
Reptilia	*Egernia cunninghami*		414.9	62					20	45.22809		169
Reptilia	*Egernia kingii*		414.9	62					13			62
Reptilia	*Elgaria coerulea*		45.7	62					8			62
Reptilia	*Elgaria multicarinata*		116.5	62					15			62
Reptilia	*Emoia atrocostata*		21.5	62					3.5		0.00294	62
Reptilia	*Eremias argus*		7.2	62					11			62
Reptilia	*Eremias strauchi*		11.8	62					7			62
Reptilia	*Ergenia whitii*	White's skink	25	91					8.5			89
Reptilia	*Eulamprus leuraensis*		12.7	62					6			62
Reptilia	*Eulamprus tympanum*		21.6	62					15			62
Reptilia	*Eumeces fasciatus*		13.2	62	22	66			8		0.00136	138
Reptilia	*Eutropis multifasciata*		63.8	62					5			62
Reptilia	*Farancia abacura*		689.9	62					19			62
Reptilia	*Furcifer labordi*		64.8	62					0.5			62

Reptilia	*Gallotia bravoana*		164	62					6			62
Reptilia	*Gallotia intermedia*		91.5	62					10.4			62
Reptilia	*Gallotia simonyi*		2671.6	62					20			62
Reptilia	*Gambelia sila*		58.5	62					4.8			62
Reptilia	*Gambelia wislizenii*		96.8	62					9.8			62
Reptilia	*Gehyra variegata*		7.4	62					26			62
Reptilia	*Gerrhonotus multicarinatus*		29	91					5	9.07957		92
Reptilia	*Gopherus agassizi*		20000	87	829.63	65			56		0.0006	140
Reptilia	*Heloderma suspectum*	Gila monster	958.5	62								62
Reptilia	*Hemidactylus brookii*		12.2	62					4			62
Reptilia	*Hemidactylus frenatus*		6.3	62					4	1.283539		62
Reptilia	*Hesperoedura reticulata*		7.2	62					11			62
Reptilia	*Heterodon platirhinos*		183	62					9.1		0.0025	62
Reptilia	*Holbrookia maculata*		14.6	62					5			62
Reptilia	*Holcosus quadrilineatus*		20	62					2			62
Reptilia	*Homonota darwinii*		4.4	62					17			62

Reptilia	*Hoplodactylus duvaucelii*		87.6	62					50			62
Reptilia	*Hoplodactylus maculatus*	Common gecko	8	87					36			87
Reptilia	*Iberolacerta aurelioi*		6.5	62					17			62
Reptilia	*Iberolacerta monticola*		14	62					15			62
Reptilia	*Iguana delicatissima*		3472.3	62					20			62
Reptilia	*Iguana iguana*		1500	38	8220.7	62			41.5		0.00014	98
Reptilia	*Klauberina riversiana*		19	38					9.9	2.2		157
Reptilia	*Lacerta agilis*		8.4	38	33.6	62			12	6.295178		62
Reptilia	*Lacerta schreiberi*		55.4	62					10			62
Reptilia	*Lacerta strigata*		91.5	62					4			62
Reptilia	*Lacerta viridis*	European green lizard	91.5	62					10	4.323572		62
Reptilia	*Lacerta vivipara*	vVviparous lizard	12	86					12	2.472949		103
Reptilia	*Lamprolepis smaragdina*		34.8	62					5			62
Reptilia	*Lampropholis delicata*		3.1	62					2			62
Reptilia	*Lampropholis guichenoti*		2.6	62					5			62
Reptilia	*Leposoma guianense*		1.2	62					2			62

Reptilia	*Liolaemus multiformis*		22	62					9		0.00045	246
Reptilia	*Liolaemus pictus*		37	62					9			62
Reptilia	*Liolaemus quilmes*		22.9	62					7			62
Reptilia	*Liopholis inornata*		12.7	62					10			62
Reptilia	*Liopholis modesta*		31	62					5			62
Reptilia	*Liopholis multiscutata*		18.9	62					10			62
Reptilia	*Lissolepis coventryi*		79.7	62					9			62
Reptilia	*Lucasium stenodactylum*		4.9	62					5			62
Reptilia	*Lygodactylus capensis*		1.9	62					2.1			62
Reptilia	*Macrochelys temminckii*	Alligator snapping turtle	11300	85					45			94
Reptilia	*Macroprotodon cucullatus*		25.7	62					16			62
Reptilia	*Malpolon monspessulanus*		388.4	62					20			62
Reptilia	*Mesalina olivieri*		3.3	62					5			62
Reptilia	*Natrix erythrogaster*	Plain-bellied snake	160	86					8.9		0.00538	262
Reptilia	*Natrix natrix*		37.5	38	2800.9	62			9	10.01764		127

Reptilia	*Natrix tessellata*		283.8	62					14			62
Reptilia	*Nephrurus stellatus*		16.6	62					8			62
Reptilia	*Niveoscincus ocellatus*		12.7	62					12			62
Reptilia	*Notechis scutatus*		1338.4	62					17			62
Reptilia	*Oligosoma alani*		66.8	62					20			62
Reptilia	*Oligosoma chloronoton*		44.3	62					8			62
Reptilia	*Oligosoma lineoocellatum*		30.2	62					8			62
Reptilia	*Oligosoma suteri*		45.4	62					12			62
Reptilia	*Oligosoma whitakeri*		22.2	62					20			62
Reptilia	*Ophisaurus apodus*	Armored glass lizard	450	62					54			62
Reptilia	*Ophisops elegans*		8	62					5			62
Reptilia	*Osteolaemus tetraspis*	West African dwarf crocodile	40000	62					34			151
Reptilia	*Papuascincus stanleyanus*		4.1	62					6			62
Reptilia	*Paralaudakia caucasia*		94.2	62					13			62
Reptilia	*Paralaudakia stoliczkana*		143.4	62					10			62

Reptilia	*Parvilacerta parva*		5.6	62					8			62
Reptilia	*Petrosaurus thalassinus*		141.1	62					20			62
Reptilia	*Phrynocephalus guttatus*		6.3	62					5			62
Reptilia	*Phrynocephalus mystaceus*		44.2	62					3.8			62
Reptilia	*Phrynocephalus persicus*		4.7	62					5			62
Reptilia	*Phrynoscma solace*	Regal horned lizard	48	62					8		0.005	230
Reptilia	*Phrynosoma m'calli*		16	38	40	62			9	5.298626		62
Reptilia	*Phrynosoma platyrhinos*		27.5	62					8			62
Reptilia	*Phymaturus tenebrosus*		55.9	62					16			62
Reptilia	*Physignathus lesuerii*		504	38					6	80.6		169
Reptilia	*Plestiodon obsoletus*	Great Plains skink	30	38	68.3	62			7.3			180
Reptilia	*Plestiodon reynoldsi*		5.4	62					10			62
Reptilia	*Plestiodon septentrionalis*		15.3	62					7			62
Reptilia	*Plestiodon skiltonianus*		13.2	62					8			62
Reptilia	*Podarcis bocagei*		8	62					4			62

Reptilia	*Podarcis erhardii*		13.7	62					5	1.533823		62
Reptilia	*Podarcis gaigeae*		22.9	62					5	3.600951		62
Reptilia	*Podarcis muralis*		5.5	38	11	62			5	4.236083		105
Reptilia	*Pogona vitticeps*		393.4	62					12			62
Reptilia	*Pristidactylus achalensis*		33.9	62					11			62
Reptilia	*Psammodromus hispanicus*		4.1	62					0.9			62
Reptilia	*Psammophilus dorsalis*		66.2	62					4			62
Reptilia	*Pseudemoia entrecasteauxii*		5.4	62					5			62
Reptilia	*Ptyas mucosa*		3248.4	62					11.3			62
Reptilia	*Ptyodactylus hasselquistii*		8.5	38	29.5	62			3.4	2.534776		160
Reptilia	*Python molurus*		33955	38	119935	62			34.2	807.38	0.0004475	62
Reptilia	*Python regius*		830.5	38	1610	62			8.7	38.58		160
Reptilia	*Python reticulus*		14326	38					21.3	672.56	0.00045	160
Reptilia	*Python sebae*		16140	38	50518	62			18	569.014	0.00096	160
Reptilia	*Rhinechis scalaris*		386.6	62					16			62
Reptilia	*Rhynchoedura ornata*		3.7	62					2.8			62
Reptilia	*Sauromalus ater*		512.6	62					39			62
Reptilia	*Sauromalus obesus*		150	62					39	21.83	0.000875	62
Reptilia	*Scelarcis perspicillata*		5.1	62					5			62

Reptilia	*Sceloporus arenicolus*		12.1	62					2			62
Reptilia	*Sceloporus bicanthalis*		8.8	62					1.3			62
Reptilia	*Sceloporus cowlesi*		17.4	62					5			62
Reptilia	*Sceloporus graciosus*		5	38	23.1	62			8	1.649415	0.00333	62
Reptilia	*Sceloporus grammicus*		17.9	62					3			62
Reptilia	*Sceloporus jarrovii*		36.9	62					2.8			62
Reptilia	*Sceloporus magister*		80.7	62					6		0.0021429	62
Reptilia	*Sceloporus merriami*		10.4	62					6			62
Reptilia	*Sceloporus occidentalis*		29.1	62					5	2.104958		62
Reptilia	*Sceloporus olivaceus*		13	38	56.1	62			3.8	8.902697		62
Reptilia	*Sceloporus scalaris*		16.2	62					5			62
Reptilia	*Sceloporus tristichus*		23.8	62					5			62
Reptilia	*Sceloporus undulatus*		3.8	38	24.5	62			4	1.4	0.003333	62
Reptilia	*Sceloporus variabilis*		15.7	62					1.5	26.56		62
Reptilia	*Scincella lateralis*		3.9	62					4	0.6145		62

Reptilia	*Sitana ponticeriana*		12.3	62					6			62
Reptilia	*Sphaerodactylus vincenti*		1.6	62					4			62
Reptilia	*Sphenodon punctatus*		430	38	1300	62			91	42.76	0.0001	62
Reptilia	*Teira dugesii*		12.3	62					16			62
Reptilia	*Telescopus fallax*		186.2	62					10			62
Reptilia	*Teratoscincus roborowskii*		20.4	62					6			62
Reptilia	*Thamnophis marcianus*		365.9	62					7			62
Reptilia	*Thamnophis proximus*		31	38	562.3	62			9	10.48		128
Reptilia	*Thamnophis sirtalis*	Common garter snake	150	38	862.3	62			14		0.0005	308
Reptilia	*Tiliqua rugosa*	Blue-tongued lizard	617	38	1229.7	62			20.8	95.69247		62
Reptilia	*Tiliqua scincoides*	Australian blue-tongued lizard	493	62					30	77.43		202
Reptilia	*Toropuku stephensi*		12.4	62					16			62
Reptilia	*Trachemys scripta*	Common slider	240	38					30			167
Reptilia	*Trachylepis varia*		35.7	62					1.9			62
Reptilia	*Trioceros hoehnelii*		29.8	62					4.5			62

Reptilia	*Tropidophis caymanensis*		46.9	62					25.1			62
Reptilia	*Tropidurus hispidus*		87.7	62					2			62
Reptilia	*Tropidurus torquatus*		79.2	62					3			62
Reptilia	*Tupinambis nigropunctatus*		836	90								90
Reptilia	*Tympanocryptis centralis*		3.8	62					6			62
Reptilia	*Uma inornata*		56.1	62					5			62
Reptilia	*Uromastyx aegyptia*		1909.3	62	291.55	38			33	23.305		62
Reptilia	*Urosaurus graciosus*		11.2	62					5	23.305		62
Reptilia	*Urosaurus ornatus*		11.7	62					3			62
Reptilia	*Uta stansburiana*		3.625	38	15.7	62			4.8	8.06	0.008	62
Reptilia	*Varanus acanthurus*		73.61	86								
Reptilia	*Varanus exanthematicus*		1040	62					12.7			62
Reptilia	*Varanus gouldi*		674	38					7.8	58.447		160
Reptilia	*Varanus griseus*	Desert monitor	647	86	5542	62			14		0.00069	290
Reptilia	*Varanus komodoensis*		102478	62					62			62
Reptilia	*Varanus niloticus*	Nile monitor	1926	85					8.5		0.0004798	121

Reptilia	*Varanus panoptes*		931	86								277
Reptilia	*Vipera berus*		63	62					19	18.06557		62
Reptilia	*Vipera latastei*		200.4	62					14			62
Reptilia	*Woodworthia brunneus*		10.3	62					42			62
Reptilia	*Xantusia riversiana*		32.2	62					32.9			62
Reptilia	*Xantusia vigilis*	Desert night lizard	9	38	6.7	62			11	0.531749	0.000666	320
Reptilia	*Zootoca vivipara*		10.6	62					5			62

Table S5. Physiological data for extant mammals and reptiles.