Fossil teeth reveal Methuselah-like longevity and delayed maturation in tiny pre-Flood (Jurassic) mammals

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Paleontologists used synchrotron X-ray microtomography to count growth band pairs in the dental cementum of fossil teeth in small Jurassic mammals (body masses of 18 to 130 grams) from Portugal and the United Kingdom. The seven genera, *Morganucodon, Kuehneotherium, Borealestes, Krusatodon, Haldanodon, Dryolestes,* and an undetermined multituberculate specimen had lifespans of 9 to 14 years, far longer than the typical 2- to 4-year lifespans of comparably sized extant mammals. Another mammal, *Palaeoxonodon*, experienced delayed sexual maturation, as did *Dryolestes*, an undetermined dryolestoid, and the multituberculate. These results are of interest in light of Genesis 5's claim of extreme longevity in pre-Flood humans and its implied suggestion that this greater longevity was accompanied by delayed sexual maturation. Delayed sexual and skeletal maturation have both been positively correlated with greater longevity in living animals. Unless this longevity was supernatural, it seems likely that such longevity and delayed sexual maturation would also have characterized the pre-Flood animal kingdom. These results add to a growing body of evidence for greater animal longevity in the pre-Flood world. X-ray microtomography could be used on other fossil mammal teeth, including those of archaic humans, thus providing still more scientific corroboration of the Bible's testimony in this regard.

The historical record in Genesis 5 states that people in the pre-Flood world were living much, much longer than today's humans. There is no hint in Scripture that the remarkable longevity of the biblical patriarchs was miraculous or supernatural, and it is difficult to envision a 'natural' cause, or causes, for such longevity (fewer genetic mistakes, different atmospheric composition, more abundant food, etc.) that would not also have affected the animal kingdom. If animals in the pre-Flood world did, indeed, experience much greater longevity, counting of periodic growth bands in their fossil remains could potentially provide scientific confirmation for this. Thus, biblical creationists should be very interested in three papers that present fossil evidence for greater longevity in small (estimated body masses of 18 to 130 grams) Jurassic mammals from Portugal and the United Kingdom.[1–3] *Morganucodon*, *Kuehneotherium*, *Borealestes*, *Krusatodon*, *Haldanodon*, *Dryolestes*, and an undetermined genus, had apparent lifespans of 9 to 14 years, far longer than typical lifespans in extant mammals of comparable body size. This evidence has been briefly discussed in a couple of popular-level articles,[4,5] but, to date, it has not been discussed in the technical creation scientific literature. Of the three papers, Newham *et al*. (2024)[3] is arguably the most important, as it is the most comprehensive. The Newham *et al*. (2024) paper is open access and may freely be downloaded and read online, as may Newham *et al*. (2020), their first paper on this subject.[1,3]

Background: description of small Jurassic mammals

In the evolutionary phylogenetic framework, a *clade* is composed of a common ancestor and all its direct descendants. Likewise, a *crown group* consists of living representatives of the clade. Hence, the Mammaliaformes is the clade consisting of the crown group of modern extant mammals plus their closest extinct relatives. The creatures discussed in this paper are all mammaliaforms. Thus, some might quibble that the Jurassic creatures described here are not 'true' mammals. However, in popular science articles, even evolutionary scientists refer to these fossil creatures as 'mammals'.[6,7] The mammaliaform *Morganucodon*, for example, is believed to have produced milk to feed its young,[8] and lactation, of course, is a defining characteristic of virtually all mammals. The seven mammals showing evidence of great longevity include the mammaliaform *Morganucodon watsoni* (figure 1). Moreover, the study includes a 'multituberculate', a rodent-like creature, the cheek teeth of which have multiple rows of cusps, or tubercles. Multituberculates are now all extinct but are considered to have been true mammals, even within an evolutionary framework.

Background: cementochronology

Scientists specializing in the field of sclerochronology and its subfield of skeletochronology count periodic growth bands

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Figure 1. Artistic reconstruction of the small Jurassic mammal *M. watsoni*

or rings in mollusk shells, crocodylian osteoderms, turtle scutes, and shark vertebrae to estimate a creature's age.[9–11] In theory, counting of growth bands/rings in mammalian long bones can also be used to 'age' a specimen, but this method often gives ambiguous or contradictory results.[12] One difficulty is that growth bands in mammal long bones may be remodelled or reabsorbed, forcing scientists attempting to age a specimen to guess how many of the original bone patterns are no longer visible.

A field called *cementochronology* utilizes the counting of periodic growth bands in the dental cementum of the roots of a tooth. Dental cementum is calcified connective tissue that covers the outer root surface and connects to the periodontal ligaments that anchor the tooth's root to the alveolar bone socket. In mammals, one particular kind of dental cementum growth, discussed below, is continuous. Moreover, it is not remodelled and is rarely reabsorbed,[3,13] which means it is a better age proxy than growth bands in mammalian long bones.

There are three kinds of dental cementum. The primary kind is acellular extrinsic fibres cementum (AEFC). AEFC cementum is characterized by slow, steady growth of 2–3 micrometers (µm) per year, even if the tooth is impacted (blocked from erupting, or growing out of the gums). There are also two kinds of secondary cementum. One of these is cellular intrinsic fibres cementum (CIFC), and the other is cellular mixed stratified cementum (CMSC). These two kinds of secondary dental cementum are characterized by fast and irregular growth, often at locations where the mechanical load on a tooth is greatest. Because only AEFC cementum has been shown to be positively correlated with age, only AEFC should be used in cementochronology studies.[14]

In extant mammals, cementum growth is continuous throughout life, with two increments generally deposited per year. A thin opaque layer is deposited at times of slower tissue growth (presumably when food is scarcer; e.g., winter), and a thicker, more translucent layer is deposited at times of faster growth (when food is more abundant; e.g., spring and summer).[13,14]

The correlation between cementum increment counts and age has been well documented. Cementochronology has been used in forensic dentistry, with the first validation study performed on three human cadavers in 1982.[15] In a 1952 study, cementochronology was used to determine the age of elephant seals.[16] A validation study for non-human terrestrial mammals was performed in 1969,[17] with another such validation study performed in 1979.[18] Validation studies show "strong circum-annual periodicity".[3,14] As of 2016, cementochronology had been successfully used to ascertain ages for 72 mammal species across 21 families and 9 orders.[14] It has also been used in zooarchaeology on ancient human fossil teeth.[19]

In a creationist framework, one would expect pre-Flood seasonal variations to be mild, but not necessarily non-existent, as possibly hinted at in Genesis 1:14 and evidenced by tree rings in some fossil trees.[20] A lack of strong yearly seasonality could reduce the strength of this age 'signal'. Likewise, the fossil evidence indicates lush pre-Flood vegetation, so large seasonal 'swings' in food availability seem unlikely, even after the introduction of thorns and thistles (Genesis 3:18) at the Fall.

Newham *et al*. (2024) noted, in their supplementary material, that rainfall patterns in equatorial regions can cause two dark cementum increments per year, rather than just one. Equatorial rainfall in today's world is quite heavy, with annual precipitation of 1.5–10 m (59–394 in).[21] They also noted that the most reliable annual cementum patterns are found in mammals living in temperate (35–50º north or south) latitudes with strong seasonal variation.[22] For these reasons, they used in their analyses only fossil mammals from temperate to subtropical paleolatitudes.

Genesis 2:4–6 may preclude any rainfall at all in the pre-Flood world, although some creationists disagree on this point. But even if one thinks this passage refers only to Creation Week *per se*, so that rain was present in the pre-Flood world,[23] heavy rainfall seems unlikely. It is doubtful that Adam and Eve would have enjoyed an hours-long torrential downpour in the Garden of Eden, even if the rain posed no harm to them! Moreover, even before the Fall, God had commanded Adam and Eve (and by implication, their descendants) to "fill" and "subdue" the Earth (Genesis 1:28). Thus, heavy rainfall in other parts of the world seems unlikely, for the same reason. And there does not seem to be any obvious reason for climatological conditions to change at the Fall, even though thorns and thistles were introduced at that time. Thus, a 'doubling' effect due to heavy pre-Flood rainfall seems unlikely. In the absence of heavy rainfall, weak seasonality would probably cause the number of annual increment pairs to underestimate true age. Thus, creationists can be reasonably, though not absolutely, confident that the longevities of these small Jurassic mammals are *at least* as large as those reported in these three papers.

Background: X-ray microtomography

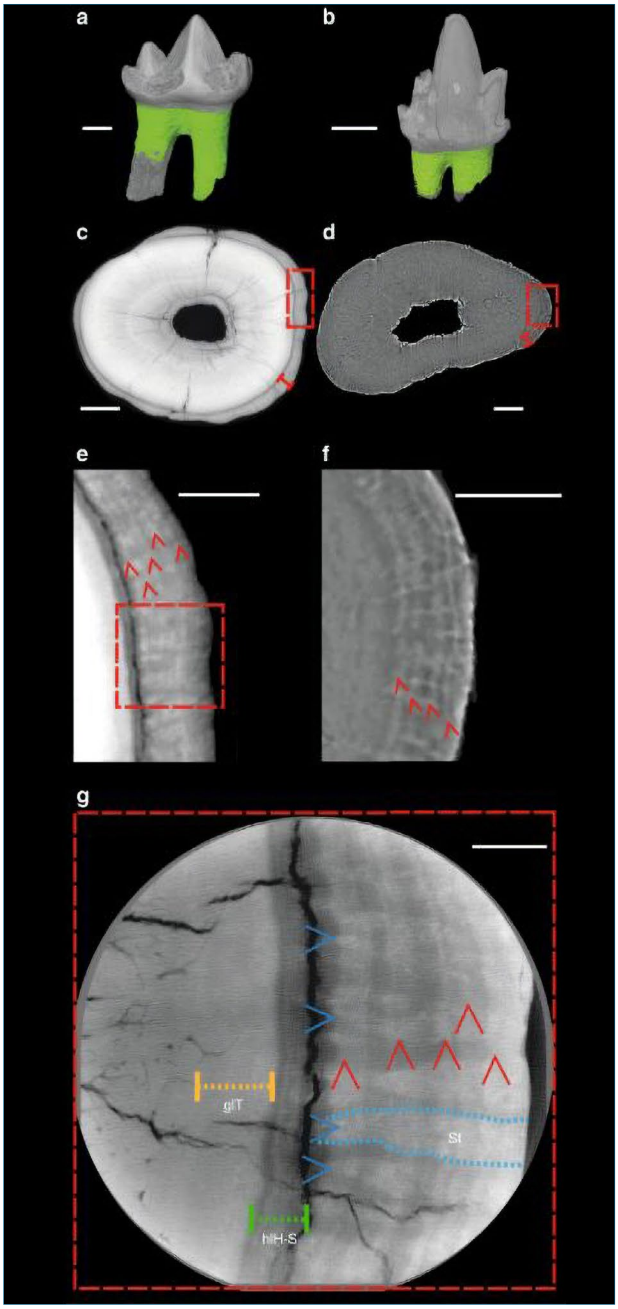
Cementochronology has traditionally required histological thin sections, which require partial destruction of the dental material. That, plus the restricted field of view provided by these thin sections, is why the technique has not often been used for fossils of greater than Pleistocene age.[1] However, in 2020 paleontologists used a non-destructive technology known as ‘propagation phase-contrast X-ray synchrotron radiation microtomography’ (PPC-SRµCT) to count growth patterns in the pinhead-sized teeth of the two small Jurassic mammals *Morganucodon watsoni* (figure 1) and *Kuehneotherium*.[1] These fossil specimens were obtained from Glamorgan, South Wales, in the United Kingdom. This appears to be the first time that this particular X-ray technique was used to ascertain age-at-death of a pre-Pleistocene-age fossil.

Microtomography uses waves to generate multiple two-dimensional image slices of a tiny three-dimensional object. Those images can then be layered to produce a 3D image. As the name implies, X-ray synchrotron microtomography uses X-rays produced by a synchrotron (particle accelerator) for this purpose. Wavelength is a key limiting factor in image resolution, as longer wavelengths diffract more around small objects than do shorter wavelengths. Thus short-wavelength X-rays are ideal for imaging tiny objects. When an X-ray passes through the object being imaged, the wave undergoes a phase shift, which provides much more information about density variations within the object than a standard transmission X-ray (which only uses image brightness as a guide).

Figure 2 illustrates the methodology used. The top row shows the three-dimensional tomographic constructions of a right lower *Morganucodon* molar (at left) and a right lower *Kuehneotherium* molar (at right). The green areas indicate the dental cementum surrounding the molar roots. The horizontal scale bars next to the two molars are both 500 µm long.

The second row shows transverse virtual thin PPC-SRµCT sections of a *Morganucodon* molar (at left) and a *Kuehneotherium* molar (at right). The red boxes and brackets indicate the thickness of the cementum layers that surround the dentin. In these two images the two horizontal scale bars both represent 100 µm.

The third row shows close-ups of the cementum thin sections depicted in the second row. Red carats indicate five light/dark increment pairs in the *Morganucodon* molar (at left) and four light/dark increment pairs in the *Kuehneotherium* molar (at right). The horizontal white lines both represent lengths of 30 µm.



From Newham *et al.* (2020) | CC-BY-SA 4.0

Figure 2. Figure 1 from reference 1, Newham *et al.* (2020). Top row: 3D tomographic constructions of (at left) a right lower *M. watsoni* molar and (at right) a right lower *Kuehneotherium* molar. The green areas indicate the dental cementum surrounding the molar roots. Horizontal scale bar = 500 µm. Second row: transverse virtual thin PPC-SRµCT sections of one of the roots from a *Morganucodon* molar (at left) and a *Kuehneotherium* molar (at right). Red boxes and brackets indicate thickness of the cementum layers surrounding the dentin. Horizontal scale bars = 100 µm. Third row: close-ups of the (left) *Morganucodon* and (right) *Kuehneotherium* thin sections depicted in the second row. Red carats indicate light/dark cementum increments. Horizontal white lines = 30 µm. Bottom row: enlarged image of the *Morganucodon* thin section in the previous row. Horizontal white bar = 10 µm. Red carats indicate five successive light/dark cementum increments.

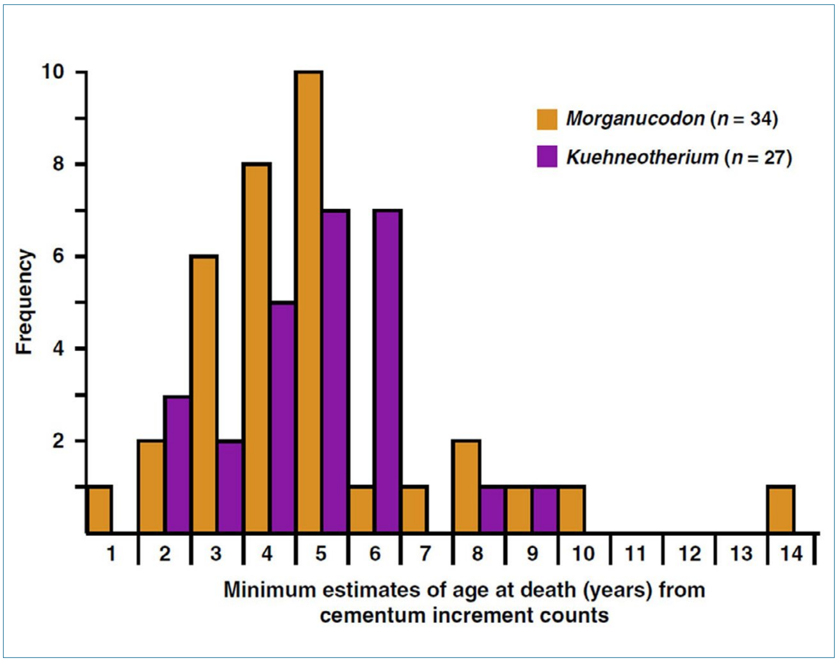


Figure 5a in Newham *et al.* (2020), reference 1 | CC-BY-SA 4.0

Figure 3. Histogram showing estimated ages at death for 34 *M. watsoni* and 27 *Kuehneotherium* fossil specimens. The maximum ages at death were 9 and 14 years for *Kuehneotherium* and *Morganucodon*, respectively. Note that these are ages at death only, and not necessarily true lifespan potentials, since these small mammals were killed during the Genesis Flood.

Finally, the image in the bottom row is an enlarged image of the portion of the *Morganucodon* thin section highlighted at left in the previous row, with the horizontal white bar now representing a length of 10 µm. The dotted yellow bracket indicates a granular layer surrounding the root dentin, called the ‘granular layer of Tomes’ (GlT), and the dotted green bracket indicates the ‘hyaline layer of Hopewell-Smith’ (hlH-S), which helps bind cementum to the tooth’s dentin. The horizontal blue carats indicate ‘Sharpey’s fibres’ that extend radially outward through the dental cementum. Because these are somewhat difficult to see in the image, the authors have highlighted one such fibre with dotted blue lines. Most important for our discussion here, the five vertical red carats indicate, as in the previous row, light/dark cementum increment pairs.

Very long lifespans

Counting of dark/light cementum couplets in 27 *Kuehneotherium* fossil teeth and 34 *Morganucodon* teeth revealed that these two Jurassic mammals attained lifespans as high as 9 and 14 years, respectively (figure 3). Note that the actual lifespans could be even higher than those reported here, for several reasons. First, since these small mammals were killed during the Flood, it is possible that they could have lived even longer had the Flood not occurred. Second, reduced seasonal variations in the pre-Flood world, along with abundant food, might have reduced the number of couplets formed, causing paleontologists to underestimate the true animal ages. Third, Newham *et al*. noted that any damage to the outer cementum would reduce the counted number of increments and thus reduce the mammal’s apparent lifespan.[1]

Newham *et al*. used allometric relationships between total body mass and dentary (lower jaw or mandible) length in living mammals to obtain maximum body mass estimates for *Kuehneotherium* and *Morganucodon.* Likewise, they used a second allometric relationship between body mass and skull length to obtain minimum body mass estimates. However, due to a lack of complete cranial fossil material, a third allometric relationship between jaw length and skull length was used to estimate skull lengths. Their reported average body masses of 17.9 and 23.8 grams for *Morganucodon* and *Kuehneotherium*, respectively, were simple averages of the maximum and minimum body mass estimates for each.

Results for additional mammals

In 2024 Panciroli *et al*. published a paper in *Nature* that used this same methodology to ascertain age at death for both a juvenile and adult Middle Jurassic docodont *Krusatodon kirtlingtonensis* specimen from Scotland’s Isle of Sky.[2] They concluded that the adult *K. kirtlingtonensis* was about 7 years old at death, and the juvenile was 7 to 24 months of age. Moreover, the juvenile was in the process of replacing its ‘baby’ teeth with its final adult teeth. They commented:

> “When analysed against a dataset of life history parameters for extant mammals[5], the relative sequence of adult tooth eruption was already established in *Krusatodon* and in the range observed in extant mammals but this development was prolonged, taking place during a longer period as part of a significantly longer maximum lifespan than extant mammals of comparable adult body size (156 g or less) [footnote in original].”[2]

So, in addition to the original evidence of extreme longevity in Newham *et al*. (2020), Panciroli *et al.* provided evidence that these small mammals were taking a long time to mature. Panciroli stated:

"Recent work has already shown that the first mammals in the Late Triassic and Early Jurassic lived much longer than similar sized mammals today—up to 14 years old. If you compare that with today's shrews of similar body mass, some of which live to just over a year, this is a huge difference in lifespan… . We also know that they continued to grow as adults, because we had information from jaws and teeth that showed this.

"What we didn't know was whether they grew rapidly when young, then slowed down their growth as adults, or whether they grew altogether differently. One way to know this is by finding the fossils of juveniles from this time period—and they are exceptionally rare, especially skeletons. So although this study only includes two specimens, it provides a really precious insight."[24]

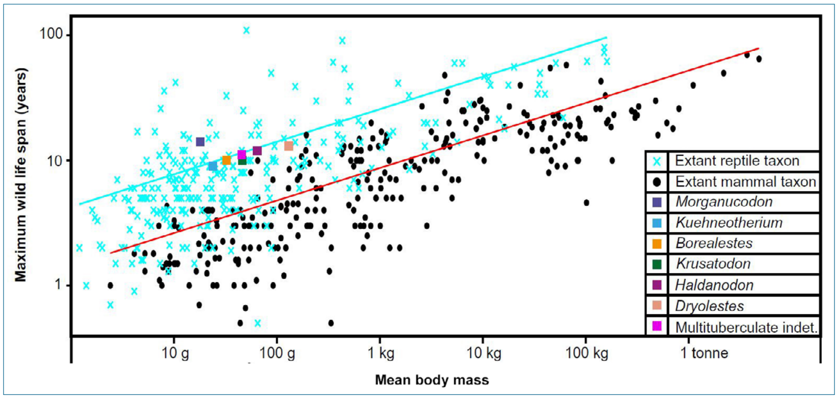


Figure 3A from Newham *et al.* (2024) | CC-BY-SA 4.0

Figure 4. All seven Jurassic mammals experienced maximum lifespans much greater than extant mammals of comparable body mass (black dots and red trend line). The lifespans were so high that they were comparable to the lifespans of living reptiles (blue crosses), which generally live longer than mammals of comparable body size. Hence the authors' description of *Morganucodon* and *Kuehneotherium* physiologies as 'reptile-like' in reference 1.

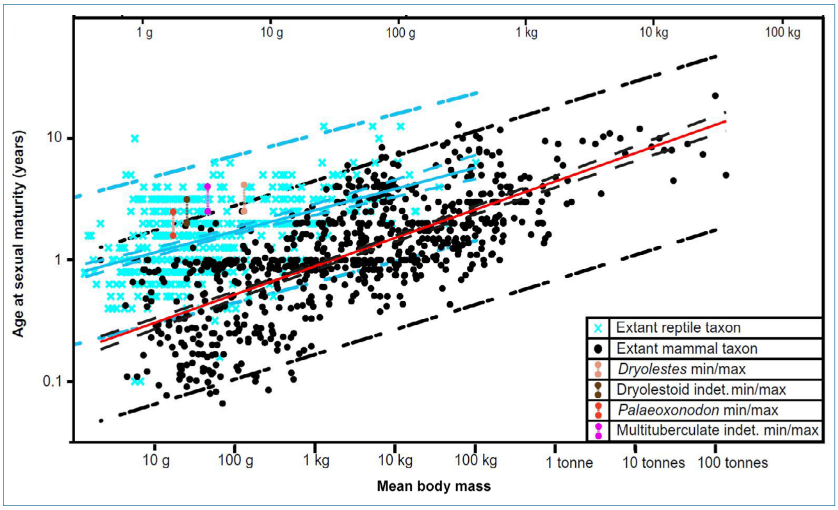


Figure 3C from Newham *et al.* (2024) | CC-BY-SA 4.0

Figure 5. All four Jurassic mammals experienced delayed sexual maturation compared to extant mammals of comparable body mass (black dots and red trend line). Dashed lines are 95% confidence intervals, and dot-dash lines represent 95% predictor intervals.

Soon after, Newham *et al.* published a third paper[3] that attempted to infer life history data from ten different Jurassic mammalian genera from Portugal and the United Kingdom. They included fossil data for the Portuguese genera *Haldanodon*, *Dryolestes*, and an undetermined multituberculate, as well as the genus *Borealestes* from the UK. When combined with *Morganucodon*, *Kuehneotherium*, *and Krusatodon* fossils, the data were sufficient to show that all seven mammals had very long lifespans compared to extant mammals of comparable sizes (figure 4). The data were also sufficient to show that four genera experienced delayed sexual maturation (figure 5). Because sexual maturity was inferred from a decrease in cementum growth rates (thought to correspond to a decrease in overall body growth rates), Newham *et al.* (2024) compared their results only to extant mammals, the lifespans of which in the wild exceed the age at which the maximum reduction in growth rate occurs. They obtained these lifespans for extant mammals from the technical literature.[25] In some cases, they used multiple species from the same genus.

They performed a 'phylogenetically informed' least squares regression (PGLS), which assumes evolution and a common descent, to obtain their trendlines, so the slopes of their trendlines (red and light blue lines in figure 4), may not be completely trustworthy, especially for ages at sexual maturity, discussed below.

Delayed sexual maturation

As noted above, Newham *et al.* (2024) also used their data to infer age at sexual maturity. In some extant mammals, the attainment of sexual maturity is associated with a decrease in the thickness of cementum increments. They had sufficient data to estimate these ages for the genera *Dryolestes* and *Palaeoxonodon*, as well as for an indeterminate dryolestoid, and the indetermined multituberculate. All four creatures

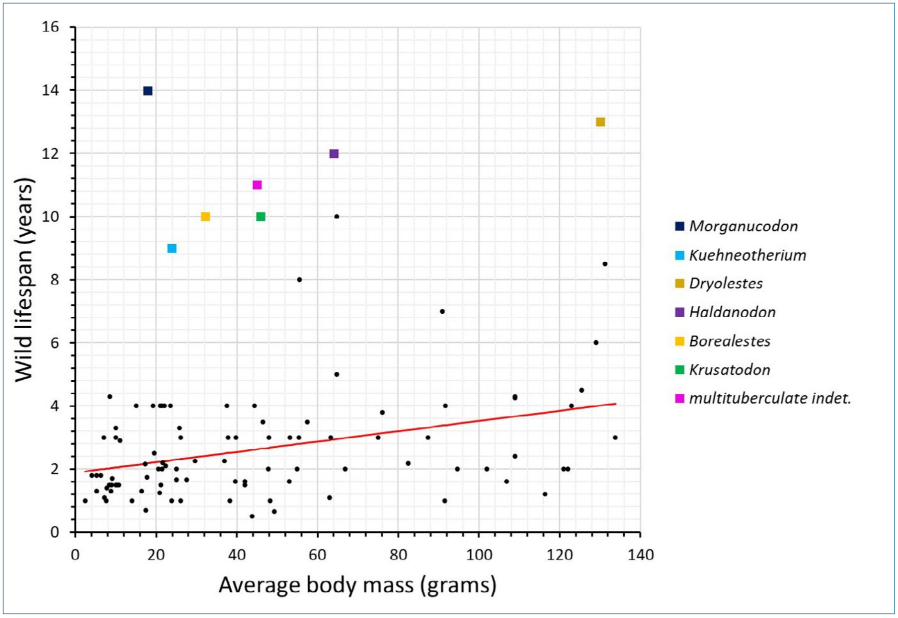


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Figure 6. Extant (black dots) and fossil mammal (coloured squares) wild lifespan data, for body masses less than 140 grams, plotted on a non-logarithmic graph. Informal red trend line obtained from simple least squares regression of the depicted data. Constructed from the supplementary data from Newham *et al.* (2024).

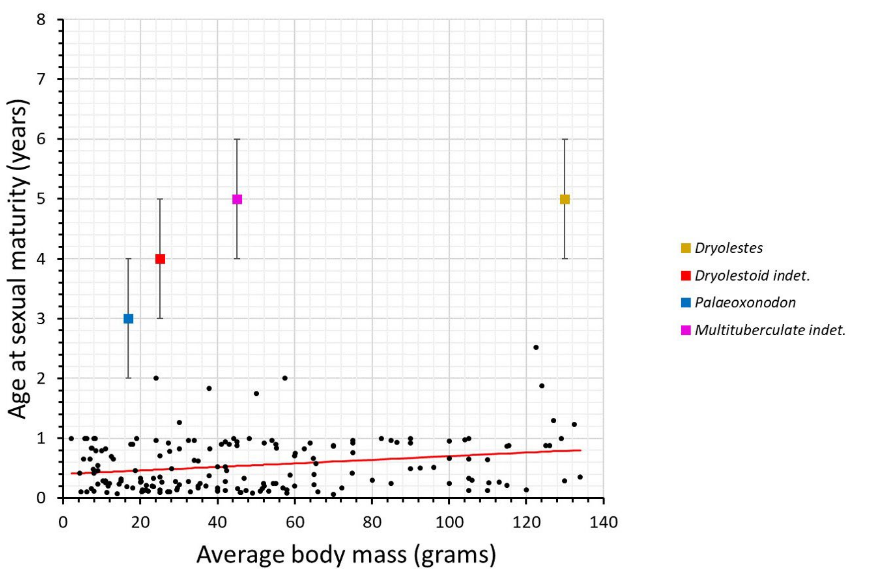

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Figure 7. Extant (black dots) and fossil (coloured squares and whiskers) mammal ages at sexual maturity, for body masses less than 140 grams, plotted on a non-logarithmic graph. Informal red trendline obtained from simple least squares regression of the depicted data. Constructed from the supplementary data for Newham *et al.* (2024).

showed greater estimated ages at sexual maturation than those exhibited by similar-sized extant mammals (figure 5). As before, they obtained their age at sexual maturity data for extant mammals from the technical literature[25] and used a PGLS to obtain their regression lines.

To provide a closer look at the data for body masses less than 140 grams, I replotted the lifespan and age at sexual maturity data on non-logarithmic graphs, along with informal trend lines for the extant mammal data (figures 6 and 7).

Gill, a co-author on Newham *et al.* (2024), was quoted as saying:

> "This data [sic] suggests that while living small-bodied mammals are sexually mature within months from birth, the earliest mammals took several years to reach sexual maturity, corroborating recent findings for one of our studied animals, *Krusatodon* … . We further find here that this long, drawn out life history was common among early mammals all the way through the Jurassic."[6]

This result is extremely interesting because the historical data in Genesis 5 *strongly* suggest that pre-Flood humans also experienced delayed sexual maturation: the earliest age at which a Genesis 5 patriarch is listed as having a son is 65. Although some of the listed sons may not have been firstborn, it seems likely that at least some of them were. Moreover, it seems extremely unlikely that pre-Flood humans were reaching puberty at 13 years or so of age, like humans today, and then were all choosing to wait 50 years to engage in sexual relations!

This evidence of delayed sexual maturation in pre-Flood mammals is consistent with evidence of delayed maturation in pre-Flood fossil sharks,[26–28] pre-Flood fossil *Crassostrea* oysters,[29,30] and preliminary evidence of delayed maturation in pre-Flood fossil crocodylians and some fossil birds.[31]

Evolutionary surprise, creationist confirmation

Popular science articles described these lifespans and maturation rates as “surprisingly long”[7] and “unexpected.”[32] However, Patten (1982) predicted that pre-Flood animals would be characterized by delayed maturation and much greater longevity based on simple logic and the Genesis 5 genealogical data *alone*.[33] Beasley echoed this suggestion in 1990,[34] as did Cuozzo in 1999.[35] Long after they made their predictions, multiple studies showed positive correlations between delayed maturation and greater longevity in extant animals. A partial list of these studies, as well as data contrary to the general trend, are provided in Hebert (2023)[31] and Hebert, Overman, and Sherwin (2024).[29]

Patton and Beasley also suggested that these greater pre-Flood longevities were accompanied by larger adult body sizes. Biologists had published data suggesting a link between body mass and biological timescales, such as lifespan and age at sexual maturity,[36–39]

$$t_{\text{biological}} = kM^{1/4} \qquad (1)$$

in the 1980s and early 1990s. Patton, Beasley, and Cuozzo do not seem to have been aware of these publications, as they did not cite them. Nor could they have been aware that a theoretical justification for a link between delayed sexual maturation and larger adult body sizes would be published later.[40]

When I plotted base-10 log-transformed lifespans against base-10 log-transformed body masses, using the raw data provided by Newham *et al*. (2024), the slope of my straight line was 0.27, very close to the slope of 0.25 expected on the basis of Eqn 1. Likewise, my log-transformed graph of age at sexual maturity versus body mass had a slope of 0.23, also close to this expected value. Newham *et al*. reported slopes of 0.26 and 0.16, respectively, for these same graphs, so it seems their PGLS analysis did not significantly alter the reported slope for lifespan, but it did decrease the slope for age at sexual maturity by 30%.

Body mass: how much of a contributor to longevity?

Given the links between body mass and longevity, one can’t help but wonder how much of pre-Flood longevity may have been due to larger body size, and how much was due to other factors, such as more pristine pre-Flood genomes.[41] I strongly suspect most of the longevity was due to a lack of genetic entropy and a beneficent environment, although larger body size would be a contributing factor. In fact, a more ideal environment was likely a contributing factor to the larger body sizes.

One can deduce this by considering Eqn 1. Many fossil creatures are twice as long or tall as their extant descendants. For instance, giant *Crassostrea* oyster fossils were twice as long as modern *Crassostrea* oysters.[29,30] One Syrian fossil camel has been described as “double the size” of a modern camel.[42]

Suppose, hypothetically, this was also true for pre-Flood humans. If one assumes that the other two linear dimensions, length and width, were also twice as large, this translates into a 2 × 2 × 2 = 8-fold increase in body volume and mass for a pre-Flood human. Taking the fourth root of 8 shows that this would be accompanied by a 1.68-fold increase in lifespan. This is a significant (68%) increase, but nowhere near enough to fully account for the truly extreme 900+ year lifespans of the antediluvian patriarchs, even if we generously assume that pre-Flood humans were on average twice as tall as extant humans. Hence, other factors must have been coming into play.

Taking into account a possible size reduction

As just noted, many fossil creatures are characterized by giantism, with extant forms often significantly larger than the corresponding fossils forms. Of special interest to this study is giantism in fossil mammals. As described in Hebert (2024), fossil mammals, such as camels, bison, bighorn sheep, wild boar, lions, elephants, kangaroos, red deer, foxes, wolves, the European badger, apes, and beavers, were all larger than their living counterparts.[43] Moreover, evolutionary paleontologists concluded more than forty years ago that mammals probably underwent a global reduction in body size at the end of the Pleistocene Epoch:

> “[Finnish paleontologist Björn] Kurtén (1965) discovered that most carnivores in Israel and Lebanon underwent a considerable size reduction at the end of the Pleistocene. The dwarfing of fossil mammal lineages at the end of the late Quaternary was probably world-wide … .”[44]

In this light, it is possible that these small Jurassic mammals, had they not gone extinct, would have *also* undergone a reduction in body size. In fact, an inability to grow smaller or to survive at smaller sizes may have been a contributing factor to their extinction. Thus, in order to do a true apples-to-apples longevity comparison between extant and fossil mammals, one should take this possible morphological shrinkage into account.

Patten claimed that pre-Flood mammals were 30–40% longer or taller than their modern-day counterparts.[33] I have not done an extensive survey, but this seems a reasonable conservative estimate and is consistent with what I have already seen in the technical literature. If we assume that the typical pre-Flood mammals had linear dimensions 35%

longer than their extant descendants, this translates into a 1.35 × 1.35 × 1.35 = 2.46-fold increase in volume and body mass. In that case, the masses of all seven Jurassic mammals should be divided by ~2.46 in order to take into account this possible post-Flood morphological shrinkage, making their masses comparable to those of corresponding extant mammals. In that case, the coloured squares in figures 4–7 should all be shifted to the left.

Note that the informal dotted red trend lines for the extant mammal data (black dots) in figures 6 and 7 slope slightly downward to the left. Thus, dividing the plotted fossil masses (coloured square dots) by 2.46 will enhance slightly the difference between the fossil and extant lifespans and ages at sexual maturity, especially for the more massive fossil mammals like *Dryolestes* and *Haldanodon*.

Future research possibilities

That paleontologists now have a non-destructive way to obtain age-at-death estimates for mammalian fossils should be an exciting development for the creation science community. Evolutionary paleontologists seem to have unwittingly confirmed that small pre-Flood mammals were experiencing much greater lifespans than extant mammals of comparable size. Moreover, four of these small Jurassic mammals were also experiencing delayed sexual maturation compared to comparable extant mammals. Both findings are consistent with suggestions by earlier creation researchers.

Moreover, mainstream paleontologists could conceivably apply this technique to other fossil mammals. Of particular interest to biblical creationists are ancient post-Flood, post-Babel humans like the Neanderthals. Despite a dramatic decrease in longevity after the Flood (Genesis 11), pre-Flood humans were still living for hundreds of years in the centuries after the Flood. Cuozzo argued that classic Neanderthal features such as heavy brow ridges were evidence of extreme longevity and delayed maturation.[35,45] However, Line has questioned this interpretation, arguing that these features, although associated with longevity, were possibly *preparatory* for very long lifespans rather than consequences of such lifespans *per se*.[46] Could PPC-SRμCT help clarify this issue? Could it reveal evidence of greater longevity in the tooth cementum of archaic humans, including Neanderthals?

Encouragement for the church

Although many evangelicals are claiming that the great ages in Genesis 5 and 11 should not be taken literally,[47–49] corroborating evidence for these great ages does exist. Creation researchers have already documented extrabiblical cultural and historical corroboration that men once lived for hundreds of years.[33,50,51] The Jewish historian Josephus cited about a dozen ancient historians who affirmed greater longevity in early humans. Augustine of Hippo also affirmed this longevity,[33] as do some Native American traditions.[52,53] Intriguingly, some of these accounts and histories also affirm that early humans were larger than extant humans.[52,54–56] Moreover, creationists have long pointed out how the decline in longevity recorded in Genesis matches an exponential decay curve, an extremely unlikely coincidence if these ages were fictitious.[33,41,57] And now growth bands in the fossils themselves are providing direct scientific corroboration that at least some fossil creatures experienced much greater longevity than their extant descendants, as well as confirming predictions made by earlier generations of creation researchers. Despite popular misperception, the case for biblical creation isn't getting weaker, it's getting stronger.

References

1. Newham, E., Gill, P.G., Brewer, P. *et al.*, Reptile-like physiology in Early Jurassic stem-mammals, *Nat. Comm.* **11**(1):5121, 2020.
2. Panciroli, E., Benson, R.B.J., Fernandez, V. *et al.*, Jurassic fossil juvenile reveals prolonged life history in early mammals, *Nature* **632**(8026):815–822, 2024.
3. Newham, E., Corfe, I.J., Brewer, P. *et al.*, The origins of mammal growth patterns during the Jurassic mammalian radiation, *Science Advances* **10**(32):eado4555, 2024.
4. Hebert, J., Do tiny mammal fossils corroborate pre-Flood longevity? icr.org, 15 Aug 2024.
5. Hebert, J., Methuselah-like longevity in pre-Flood mammals, icr.org, 7 Oct 2024.
6. Using dental growth rings scientists reveal differences in growth patterns between ancient and modern mammals, phys.org, 7 Aug 2024.
7. Baisas, L., Baby teeth reveal surprisingly long lifespans of small Jurassic mammals, popsci.com, 24 Jul 2024.
8. Goodhue, K., Milk before dinosaurs? The evolution of a household beverage, sercblog.si.edu, accessed 1 Oct 2024.
9. Moss, D.K., Ivany, L.C., and Jones, D.S., Fossil bivalves and the sclerochronological reawakening, *Paleobiology* **47**(4):551–573, 2021.
10. Woodward, H.N., Padian, K., and Lee, A.H., Skeletochronology; in: Padian, K. and Lamm, E.-T. (Eds.), *Bone Histology of Fossil Tetrapods: Advancing methods, analysis, and interpretation*, University of California Press, Berkeley, 2013.
11. Ehret, D.J., Skeletochronology: A method for determing [sic] the individual age and growth of modern and fossil tortoises (Reptilia: Testudines), *Bulletin of the Florida Museum of Natural History* **47**(2):49–72, 2007.
12. Schucht, P.J., Klein, N., and Lambertz, M., What's my age again? On the ambiguity of histology-based skeletochronology, *Proc. Royal Society B: Biological Sciences* **288**, 20211166, 2021.
13. Lieberman, D.E., Life history variables preserved in dental cementum microstructure, *Science* **261**(5125):1162–1164, 1993.
14. Naji, S., Colard, T., Blondiaux, J., Bertrand, B., d'Incau, E., and Boquet-Appel, J.-P., Cementochronology, to cut or not to cut? *Intl. J. Paleopathology* **15**:113–119, 2016.
15. Stott, G.G., Sis, R.F., and Levy, B.M., Cemental annulation as an age criterion in forensic dentistry, *J. Dental Research* **61**(6):814–817, 1982.
16. Laws, R.M., A new method of age determination in mammals, *Nature* **169**(4310):972–973, 1952.
17. Klevezal, G.A. and Kleinenberg, S.E., *Age Determination of Mammals from Annual Layers in Teeth and Bones,* Institute of Animal Morphology, A.N. Severtsova Academy of Sciences, Moscow, U.S.S.R., 1969. Translated from Russian by the Israel Program for Scientific Translations.
18. Grue, H. and Jensen, B., Review of the formation of incremental lines in tooth cementum of terrestrial mammals, *Danish Review of Game Biology* **11**(3):1–48, 1979.

19. Rendu, W., Hunting behavior and Neanderthal adaptability in the Late Pleistocene site of Pech-de-l'Azé I, *J. Archaeological Science* **37**(8):1798–1810, 2010.
20. Wise, K.P., Were there really no seasons? Tree rings and climate, *J. Creation* **6**(2):168–172, 1992.
21. Rafferty, J.P. and Jain, P., Wet equatorial climate, britannica.com, accessed 1 Oct 2024
22. Newham, E. *et al.*, ref. 3, supplementary materials.
23. Snelling, A.A., *Earth's Catastrophic Past*, vol. 2, Institute for Creation Research, Dallas, TX, pp. 669–673, 2009.
24. Schuster, R., Early mammals lived longer. Why can't we? haaretz.com, accessed 1 Oct 2024.
25. Herculano-Houzel, S., Longevity and sexual maturity vary across species with number of cortical neurons, and humans are no exception, *J. Comparative Neurology* **527**(10):1689–1705, 2019.
26. Hebert, J., Giantism and delayed maturation in fossil sharks: evidence for extreme longevity? CRSQ **60**(4):267–283, 2024.
27. Hebert, J., Fossil sharks show signs of greater past longevity, *Acts & Facts* **53**(5):20, 2024.
28. Hebert, J., *Ptychodus* shark fossils—indirect evidence for antediluvian longevity? *J. Creation* **38**(3):7–9, 2024.
29. Hebert, J., Overman, R., and Sherwin, F.J., Crassostrea oyster fossils show evidence of extreme longevity, CRSQ **60**(3):171–190, 2024.
30. Hebert, J., Oysters and pre-Flood longevity, *Acts & Facts* **53**(3):19, 2024.
31. Hebert III, L., Allometric and Metabolic Scaling: arguments for design … and clues to explain pre-Flood longevity? *Proc. 9th ICC*, pp. 206–227, 2023.
32. Tamisiea, J., Fossil hints that Jurassic mammals lived slow and died old, nytimes.com, accessed 1 Oct 2024.
33. Patten, D.W., The longevity accounts in ancient history, CRSQ **19**(1):40–52, 1982.
34. Beasley, G., Pre-Flood giantism: a key to the interpretation of fossil hominids and hominoids, *J. Creation* **4**(1):5–55, 1990.
35. Cuozzo, J., *Buried Alive: The startling truth about Neanderthal man*, Master Books, Green Forest, AR, 1999.
36. McMahon, T.A. and Bonner, J.T., *On Size and Life*, Scientific American Books, New York, 1983.
37. Calder, III, W.A., *Size, Function, and Life History*, Harvard University Press, Cambridge, MA, 1984.
38. Schmidt-Nielsen, K., *Scaling: Why is animal size so important?* Cambridge University Press, Cambridge, 1986.
39. Peters, R.H., *The Ecological Implications of Body Size*, Cambridge University Press, Cambridge, 1993.
40. West, G.B., Brown, J.H., and Enquist, B.J., A general model for ontogenetic growth, *Nature* **413**(6856):628–631, 2001.
41. Sanford, J.C., *Genetic Entropy and the Mystery of the Genome*, FMS Publications, 2014.
42. Anonymous, Giant camel fossil found in Syria, bbc.co.uk, accessed 1 Oct 2024.
43. Hebert, J., Late Pleistocene body size reduction: evidence of a post-Flood decline in longevity? *J. Creation* **38**(1):60–66, 2024.
44. Davis, S.M., The effects of temperature change and domestication on the body size of Late Pleistocene to Holocene mammals of Israel, *Paleobiology* **7**(1):101–114, 1981.
45. Cuozzo, J., What happens to the craniofacial structure of humans who live past 100 years: Neanderthal similarities, *Proc. 4th ICC*, pp. 103–120, 1998.
46. Line, P., Explaining robust humans, *J. Creation* **27**(3):64–71, 2013.
47. Olson, C., How old was Father Abraham? Re-examining the patriarchal lifespans in light of archaeology, academia.edu, accessed 28 Apr 2024.
48. Olson, C., How old was Father Abraham? Part 2: a symbolic interpretation of the patriarchal lifespans, academia.edu, accessed 28 Apr 2024.
49. Excursus on creation of life and biological diversity (part 16): genealogies in Genesis 1–11 (continued), reasonablefaith.org, accessed 02 Oct 2024.
50. López, R.E., The antediluvian patriarchs and the Sumerian king list, *J. Creation* **12**(3):347–357, 1998.
51. Cooper, B.R., *The Authenticity of the Book of Genesis*, Creation Science Movement, Portsmouth, UK, 2011.
52. Kinietz, V. and Voegelin, E.W. (Eds.), *Shawnee Traditions: C.C. Trowbridge's account*, paperback edn, University of Michigan Press, Ann Arbor, p. 59, 1939.
53. Deloria Jr, V., *Red Earth, White Lies: Native Americans and the myth of scientific fact*, Fulcrum Publishing, Golden, CO, p. 153, 1997. Despite Deloria's hostility to Christianity, many of the traditions he reports provide Native American corroboration of details from the early chapters of Genesis.
54. Hebert, J., Rarity of long-lived post-Flood human fossils? *J. Creation* **37**(3):1–2, 2023.
55. Cody, W.F., *Buffalo Bill's Life Story: An autobiography*, paperback edn, Skyhorse Publishing, New York, pp. 266–267, 1998.
56. Deloria Jr, ref. 53, pp. 137–160.
57. Carter, R., The rapid decline in biblical lifespans, creation.com, accessed 02 Oct 2024.

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