Molluscan Methuselahs: Extinct Fossil Bivalves that Show Evidence of Extreme Longevity

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Abstract

A previous paper presented strong evidence that fossil *Crassostrea* oysters lived much longer than their modern-day descendants. This paper presents direct and indirect fossil evidence that other (now extinct) bivalves also experienced great longevity. Ontogenetic growth curves constructed for four genera of Cretaceous and Eocene bivalves from Seymour Island, Antarctica, demonstrate that they exhibited longevity described by mainstream paleontologists as "extreme." This longevity is difficult to explain in a uniformitarian framework, but whether it is a strong argument for pre-Flood longevity hinges on whether the pre-Flood Antarctic climate was warm or cold. Likewise, studies of extant animals have revealed a positive correlation between greater longevity and greater adult body size, as well as a positive correlation between greater longevity and greater ages at sexual or skeletal maturity. Some fossil bivalves, such as the genus *Platyceramus*, the rudists (order *Hippuritida*), and Lithiotid bivalves, were large, slow-growing, and apparently long-lived. However, since these particular bivalves are now extinct, it is not possible to know if their lifespans would have been shortened had they survived to the present day. In light of the Bible's claim that humans in the pre-Flood world had centuries-long lifespans, this information should be of great interest to creation researchers, since whatever genetic or environmental factors were enabling extreme human pre-Flood longevity were likely also operating in the animal kingdom. These data may add to a growing body of evidence that at least some fossil creatures experienced great longevity.

Simple Summary

J. Hebert and R. Overman review growth band counts in fossilized bivalve shells, such as Cretaceous and Eocene clams from Antarctica, which indicate that fossil clams and oysters achieved extreme longevity, far exceeding nearly all modern bivalves. Extinct bivalves, including the massive *Platyceramus* and rudists, were characterized by prolonged maturation periods often lasting over a century. Unlike today's long-lived bivalves that typically require cold, deep-water environments, these fossil creatures thrived in shallow, temperate-to-tropical waters. In a creationist framework, these bivalves were killed and buried in the worldwide Noachian Flood (Genesis 6–8). Whatever genetic or environmental factors enabled extreme human pre-Flood longevity (Genesis 5) would likely have also affected the animal kingdom. Thus, the remarkable lifespans seen in these fossil creatures are indirect confirmation of the Bible's testimony regarding extreme human lifespans in the pre-Flood world.

Introduction and Background

Hebert (2023) suggested that fossils could provide evidence of past extreme longevity in animal forms. A follow-up paper (Hebert, Overman, and Sherwin, 2024) presented evidence that fossil *Crassostrea* (and likely *Magallana*) oysters experienced considerably greater longevity than their modern-day descendants. Hebert (2026) also presented evidence that fossil versions of the bivalves *Glycymeris americana*, *Dosinia japonica*, the bivalve genus *Tridacna*, and possibly some *Mercenaria* bivalves also likely experienced greater longevity than their modern-day descendants. Studies of longevity and aging have repeatedly shown positive correlations between (1) greater longevity and larger adult body sizes and between (2) greater longevity and longer maturation intervals (de Magalhães, Costa, and Church, 2007; Ricklefs, 2010a, 2010b; Ridgway, Richardson, and Austad, 2011; and Moss et al., 2016). In short, the larger an organism's adult body size and the longer its time to reach adulthood, the greater the longevity it is expected to have.

Many animals exhibit asymptotic growth; that is, their length L asymptotically approaches a maximum value that we designate as L_∞ (Figure 1). This asymptotic growth can be described mathematically by the von Bertalanffy (1938) growth curve equation:

$$L(t) = L_\infty \left(1 - e^{-k(t-t_0)}\right) \qquad (1)$$

Here t is the time since spawning (measured in years) and k is a parameter (units of years^{-1}) that indicates the relative speed with which an organism becomes mature. Although k is not a growth rate *per se*, it is a proxy for growth rate.

The value t_0 is the (theoretical) time at which the organism's length is zero. If the animal has zero size at birth, t_0 will be zero. If the creature has a positive, non-zero size at birth, t_0 will be a negative number, indicating that the creature had zero size at the beginning of its gestation, $-t_0$ years before birth.

Equation (1) is usually obtained from a population of organisms. L_∞ thus represents the average adult body length for the population, obtained by fitting of a growth curve to the population's size versus age data. Some adult body sizes in the population will be greater than L_∞, and some will be smaller. A growth curve obtained from a single fossil specimen may be somewhat "herky-jerky" in appear-

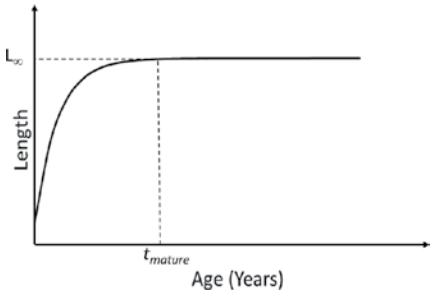

Figure 1. The von Bertalanffy growth curve showing the increase of an organism's length or height as a function of time since birth or hatching. Growth effectively, if not completely, stops when the organism reaches skeletal maturity at time t_{mature}.

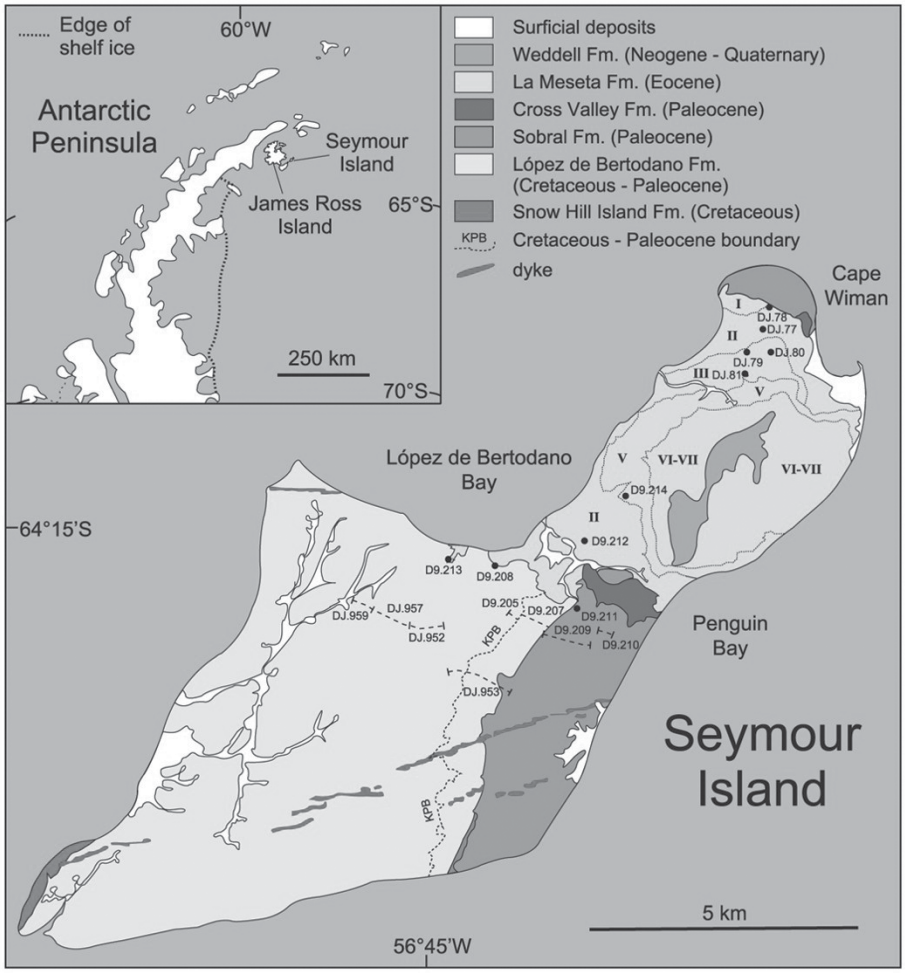

Figure 2. Map of Seymour Island at the tip of the Antarctic Peninsula. The large light-shaded region at the southwestern portion of the island is the López de Bertodano Formation. Image credit: Figure 1 from Crame et al. (2014). CC-BY-SA 4.0 International License. https://creativecommons.org/licenses/by-sa/4.0/.

ance, and not like the smooth function depicted in Figure 2. This is due to uncertainties from the use of allometric equations to estimate body size; see Figure 10 in Hebert (2023) for examples. However, bivalves are somewhat exceptional in that nice, smooth growth curves *can* be obtained from a single fossil or recently-deceased specimen. This is because the growth bands in a bivalve shell give not just body length at time of death, but all the successive cumulative body lengths as a function of age, which enable the construction of a smooth ontogenetic growth curve.

Theoretically, Equation (1) describes indeterminate (never-ceasing) growth, since for any finite time t, the organism's growth never quite stops. As a practical matter, however, Equation (1) is often used to model both indeterminate and determinate growth, since one can treat the age at skeletal maturity t_{mature} as the time at which the slope of the function becomes arbitrarily small. However, Day and Taylor (1997) have criticized this practice, arguing that two separate equations should be used to model growth, one prior to sexual maturity, and one after. Admittedly, von Bertalanffy growth equations sometimes do a poor job of fitting size-versus-age data shortly after birth or spawning. However, in this analysis, we are far more concerned with the behavior of the growth function at ages far after birth or spawning, and so we here ignore this complication, as do many researchers in this field.

Note that t_{mature} is not necessarily the same as the age t_{sex} at sexual maturity, as some animals reach sexual maturity before reaching skeletal maturity. Nevertheless, one might reasonably expect higher ages t_{mature} at skeletal maturity to also imply higher ages of sexual maturity t_{sex}.

Bivalves are excellent choices for longevity comparisons between fossil and modern forms within a taxon. This is because bivalves are extraordinarily numerous in the fossil record, as are other marine invertebrates (Morris and Sherwin, 2011). Also, some extant bivalves are among the longest-lived non-colonial organisms on Earth (Palmer et al., 2021). In Hebert, Overman, and Sherwin (2024), we began a comparison of size and ontogeny data for fossil and modern *Crassostrea* and *Magallana* oysters. The fossil oysters showed evidence of larger adult body sizes, delayed maturation, and greater longevity compared to the extant specimens. Hence, we might expect to see evidence of great longevity in other fossil bivalves. Here, we review fossils of now extinct bivalves showing possible direct and indirect evidence for great longevity. Because these bivalves are extinct, it is not possible to ascertain what their longevities would have been had they survived to the present day.

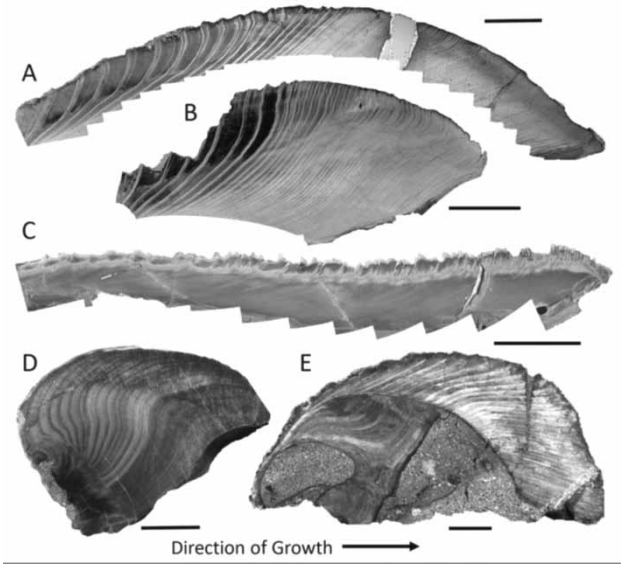

Figure 3. Middle and outer annual growth bands (A-C) in the long-lived Eocene bivalves *Cucullaea raea* and *Retrotapes antarcticus* from Seymour Island, Antarctica. Middle and outer layers of *C. raea* shown in A, with the growth margin shown in B. Middle and outer growth bands of *R. antarcticus* are shown in (C). Also shown (D) are the umbonal (most prominent) region of the *Eurydesma cordatum* valve and the complete shell (E) of *Myonia corrugata*, both from the Permian of South Sydney Basin, Australia. Scale bars: 0.5 cm (A-C) and 1 cm (D-E). Figure 6 from the Open Access Moss, Ivany, and Jones (2021) *Paleobiology* article. CC-BY 4.0 International. (http://creativecommmons.org/licenses/by/4.0/).

Bivalves from Seymour Island, Antarctica

Two studies of fossil marine bivalves from Seymour Island, Antarctica, provide evidence of great fossil bivalve longevity. Seymour Island is a small island located at the tip of the Antarctic Peninsula (Figure 2). It is an especially important high-latitude paleontological site, so much so that it was once dubbed the "'Rosetta Stone' of Southern Hemisphere paleobiology" (Reguero, 2019, p. 328). Buick and Ivany (2004) counted growth rings in twelve *Cucullaea raea* fossils taken from the La Meseta Formation, an Eocene shallow-marine succession of strata located toward the northeast corner of the island (Crame et al., 2014; Moss et al., 2017). *Cucullaea raea* growth bands are shown in Figure 3A-B.

Buick and Ivany estimated that the youngest of these twelve bivalves was 56 years old when it died, and the oldest was 127 years old. Six of the bivalves were more than 90 years old,

and five were more than 100 years old. The average age of the sample was 90 years, with a standard deviation of 26 years. Despite the small sample size, Buick and Ivany (2004, p. 922) concluded, "These are some of the longest-lived clams ever documented from the modern or ancient world." They pointed out (p. 922) that these twelve fossil specimens were *not* exceptional, either in size or number of visible bands. Rather, Buick and Ivany selected those particular twelve specimens because their growth bands were particularly visible and, hence, easy to count.

Moss et al. (2017) studied eleven species of fossil bivalves from the Late Cretaceous López de Bertodano Formation on the southwest part of the island, as well as the Eocene La Meseta Formation mentioned previously (Figure 2). As noted earlier, the La Meseta Formation is thought to represent a shallow-marine environment. The López de Bertodano Formation is thought to represent a shallow-water delta/estuary environment, as well as middle-to-outer-shelf deposits (Moss et al., 2017, p. 366). The four Cretaceous species were *Cucullaea ellioti*, *Cucullaea antarctica*, *Nodenskjoldia nodenskjoldia*, and *Lahillia larseni*. The seven Eocene bivalves were *Cucullaea* sp., *Cucullaea raea*, *Cucullaea donaldi*, *Retrotapes antarcticus*, *Retrotapes newtoni*, *Retrotapes robusta*, and *Lahillia wilckensi*. Moss et al. (2017) chose these particular specimens because their internal growth bands are well-preserved and because they are common in previous studies and archival research collections.

They reported (Moss et al., 2017, p. 365), "Despite significant sampling limitations, we find that all 11 species examined are both slow growing and long-lived, especially when compared with modern bivalves in similar temperature settings." Eight of the eleven species had at least one specimen with a lifespan in excess of 50 years, and the *C. raea*, *C. antarctica*, and *N. nodenskjoldia* species had specimens with maximum lifespans of 121, 101, and 131 years, respectively. Moss et al. (2017, pp. 373–374) elaborated:

> While a number of modern taxa can attain life spans in excess of 50 years, the modal [most common, J.H. and R.O.] value of maximum reported life span for bivalve species today is 3 years (Moss et al., 2016). The shortest-lived species measured from Seymour Island reached life spans of at least 22 years. The longevity of bivalves in this assemblage, even as established from such a restricted sample, is impressive. In addition, modern bivalves have [von Bertalanffy] *k* values that range as high as 3, while the sectioned Seymour specimens all revealed *k* values less than 0.25 (Fig. 5A), on the lowest end of the modern distribution and representing extremely slow growth. Within this sample of slow-growing, long-lived fossil individuals, the relationship between *k* and life span seen in modern populations is also apparent: *those exhibiting slower growth tend to have lived longer lives*…. (emphasis added)

Even so, they stated that these should be considered minimum estimates of maximum possible lifespans (pp. 369–370), given that some collectors were not willing to give permission to the researchers to section the specimens in their collections. Hence, the shells Moss et al. examined typically did not include the largest individuals of a given species: at least one specimen was only a little more than half (53%) the known maximum size of the taxon! Even so, Moss et al. (2017) described these longevities as "extreme." They also noted that even older bivalve specimens of these eleven species are likely to exist (p. 371):

> …the likelihood of finding a longer-lived individual than what is observed (here, 131 years) will increase significantly with more intensive sampling. In each respect, it is highly likely that individuals older than those reported are present in existing collections, and virtually certain that they are present in the field waiting to be discovered.

In summary of these two studies, the fitted von Bertalanffy growth curves for the Eocene bivalves are shown in Figure 4, and their fitted von Bertalanffy curves for the Cretaceous bivalves are shown in Figure 5. Both the Eocene and Cretaceous bivalves show maximum body sizes of ~85 mm and maximum lifespans of ~120 to 130 years.

It is important to note that long-lived, slow-growing bivalves are not necessarily unusual in cold climates. A study (Moss et al., 2016) of 140,000 individual living marine bivalves, consisting of 1,148 local populations, showed that bivalves living in high latitudes grow more slowly and live longer than bivalves living at lower latitudes. The longevity of high-latitude bivalves is generally attributed to a combination of cold temperatures and caloric restriction. Montero-Serra et al. (2018) also demonstrated a positive correlation between greater bivalve longevity and greater habitat depth, although the correlation was stronger for corals, macroalgae, and sponges. Thus, bivalves living in colder and/or deeper waters are expected to exhibit greater longevity than those living in warmer and shallower waters.

The Pre-Flood Antarctic: Warm or Cold?

What is truly remarkable about these reported Seymour Island bivalve longevities is that evolutionists believe these bivalves were living in relatively warm waters, despite their belief that the latitude of Seymour Island (64°

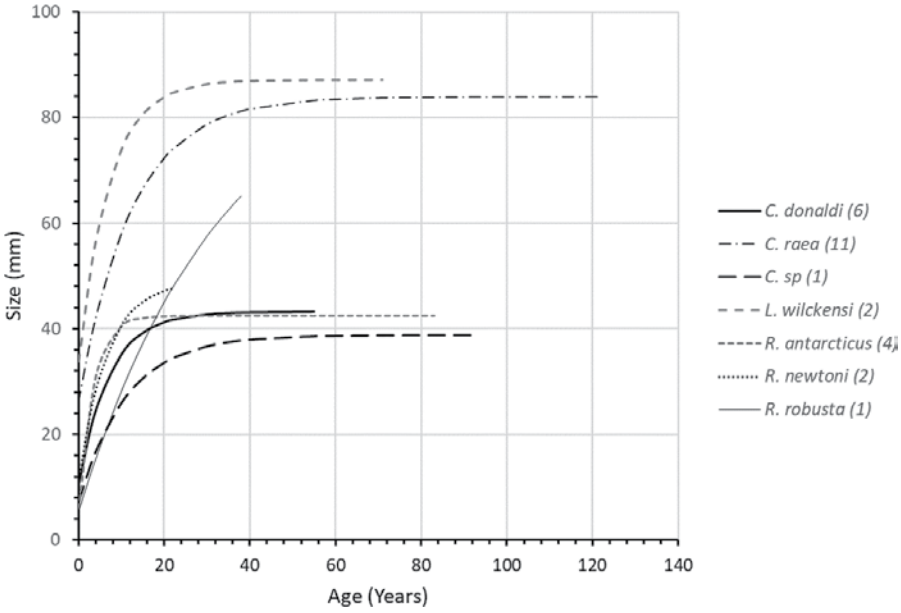

Figure 4. Ontogenetic growth curves for the Eocene *Cucullaea*, *Lahillia*, and *Retrotapes* bivalves from Seymour Island, Antarctica. Numbers in parentheses are the number of specimens in each assemblage. Constructed from data in Table I in Moss et al. (2017). Note that some specimens were living for many decades after achieving skeletal maturity.

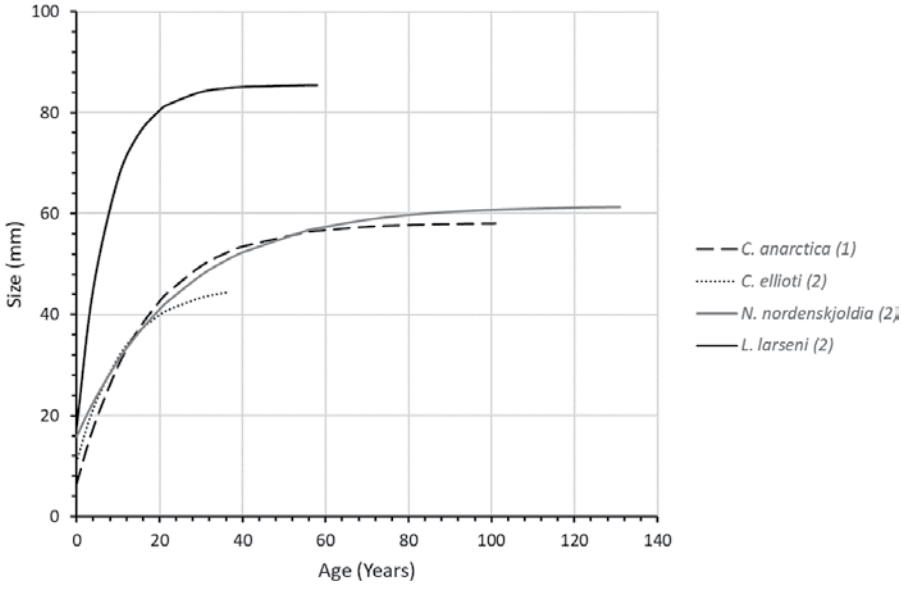

Figure 5. Ontogenetic growth curves for the Cretaceous *Cucullaea*, *Nodenskjoldia*, and *Lahillia* bivalves from Seymour Island, Antarctica. Numbers in parentheses are the number of specimens in each assemblage. Constructed from data in Table I in Moss et al. (2017).

S) has changed very little in the last supposed 100 million years (Moss et al., 2017, p. 374). Based on measured oxygen isotope ($\delta^{18}O$) values within the shells, Buick and Ivany (2004) estimated that their Eocene *C. raea* clams lived in relatively warm shallow seas at a temperature of about 14° C (57° F). Moss et al. (2017) estimated that their Cretaceous and Eocene specimens experienced average annual temperatures between 8 and 17° C (between 46 and 63° F). Moreover, as Moss et al. (2017) point out, uniformitarians think the high latitudes were largely ice-free until about 34 million years ago, at the Eocene-Oligocene transition. Buick and Ivany (2004, p. 922) noted, "Despite living at the Antarctic Circle, these Eocene *Cucullaea* grew in temperate waters, and in a less seasonal regime than might be expected from conditions on modern Earth."

Much fossil material suggestive of warmer past temperatures has been recovered from Antarctica (Oard, 2008, 2014). Within a creationist framework, these could either be fossils buried *in situ*, or material that was rafted in from lower latitudes during the Flood. Oard (2014, p. 17) acknowledges both possibilities but has noted the apparent difficulty in explaining how pre-Flood Antarctica could have been warm:

> It is easier to envision the Arctic being warm but not Antarctica because there is an ocean at the North Pole rather than a high-relief land mass. A warm Arctic Ocean would warm the surrounding high latitudes, but Antarctica should have been relatively cool because of its high latitude. High-latitude continents cool off considerably at night and in winter, especially with four to six months of total darkness. In addition, without the weight of today's ice sheets applying isostatic downward pressure, Antarctica would presumably have been at a higher altitude before glaciation,

> thereby enhancing the effects of cooling.

It is interesting that, despite this apparent difficulty, uniformitarian scientists still think it plausible that Antarctica could have been much warmer in the past, perhaps because of a greater concentration of atmospheric greenhouse gases. Some creationists have long suggested the pre-Flood climate was much warmer (Whitcomb and Morris, 1991), and Humphreys (2009) suggested this could have been due to a greater concentration of atmospheric carbon dioxide in the pre-Flood atmosphere, for which there is some evidence (Yapp and Poths, 1992).

Genesis 1:29 may give us a very important clue regarding the pre-Flood climate. Here, God told Adam and Eve, "Behold, I have given you every herb bearing seed, which is upon the face of *all* the earth, and every tree, in the which is the fruit of a tree yielding seed; to you it shall be for meat" (emphasis added). The word *all* may imply that vegetation was present everywhere on the pre-Flood Earth, which would seem to rule out ice sheets.

Moreover, based on a detailed study of thousands of well logs from around the world, Clarey (2020, p. 178) has suggested that pre-Flood Antarctica was at a lower paleolatitude than assumed by uniformitarian geologists, which would have resulted in a warmer pre-Flood Antarctic climate.

For this reason, Moss et al. (2017, p. 366) recognized that cold temperatures could not be the cause of these bivalves' extreme longevity. They attributed it to the seasonal availability of food resulting from extended seasons of darkness at high latitudes. Obviously, this explanation does not work if pre-Flood Antarctica was at a lower paleolatitude, as suggested by Clarey. Moreover, we have already seen (Hebert, Overman, and Sherwin, 2024) that *Crassostrea* oysters at mid-latitudes (without long periods of winter darkness) also once experienced much greater sizes and longevities, and grew faster, in absolute terms, than their modern-day descendants living in comparable temperatures and/or latitudes (Hebert, Overman, and Sherwin, 2024). In such cases, this longevity does not seem to be the result of caloric restriction, which creationists probably wouldn't expect in the pre-Flood world, anyway. This doesn't necessarily disprove Moss et al.'s (2017) hypothesis, but it does suggest that there could be another cause for this longevity.

Rudist Bivalves: Large Sizes and Delayed Maturation

The now-extinct rudists (order *Hippuritida*) were a group of Upper Jurassic to Upper Cretaceous marine bivalves that lived in warm, shallow, low-latitude seas (Johnson, 2002; Sha, Cestari, and Fabbi, 2020; Gao et al., 2025). Their fossils are often found in limestone rocks. In the Americas, their Cretaceous fossils extend from Mexico to northern South America and are also found throughout Europe (Figure 6), from central to southern Asia, and in northern Africa (Johnson, 2002; Anonymous a., n.d.).

They were characterized by box-like, ringed, and tube-shaped valves, some of which were of "exceptionally large shell size" (Skelton, 2018, p. 18). For instance, *Titanosarcolites giganteus*, whose crescent-shaped shell resembled two rams horns with bases fused together, could be two meters long (Vermeij, 2016, p. 5) As in the case of other large extinct and extant bivalves, some have speculated (Benini, 1985) that the large shell sizes were the result of a symbiotic relationship between the rudists and algae. The algae would recycle the bivalve's wastes, including the waste CO_2, which would improve the bivalve's respiratory function, resulting in an increased rate of calcification that would enable the bivalve shells to grow thicker and longer. However, others disagree with this hypothesis. One problem with the hypothesis is that some extant bivalves, which are known to have a symbiotic relationship with algae, do not grow to large sizes (Benini, 1985, p. 24).

Figure 6. An Upper Cretaceous fossil rudist bivalve from France. Image by Wilson44691 (Wikimedia Commons, public domain).

As described by Skelton (2018, p. 18),

> …while shell size in most bivalves tends to be limited by decelerated adult growth following relatively rapid juvenile size increase, rudists were able to produce elongated tubular valves *simply by maintaining juvenile-like, relatively high rates of incrementation over many years as adults* (Fig. 17.1–17.2), similarly to the large Liassic bivalves of the *Lithiotis* Gümbel, 1871 facies…. (emphasis ours)

Of course, if rudists maintained "juvenile-like" growth rates for many years, this is simply another way of saying they took a long time to attain maturity. Hence, both the large shell sizes of some specimens and these

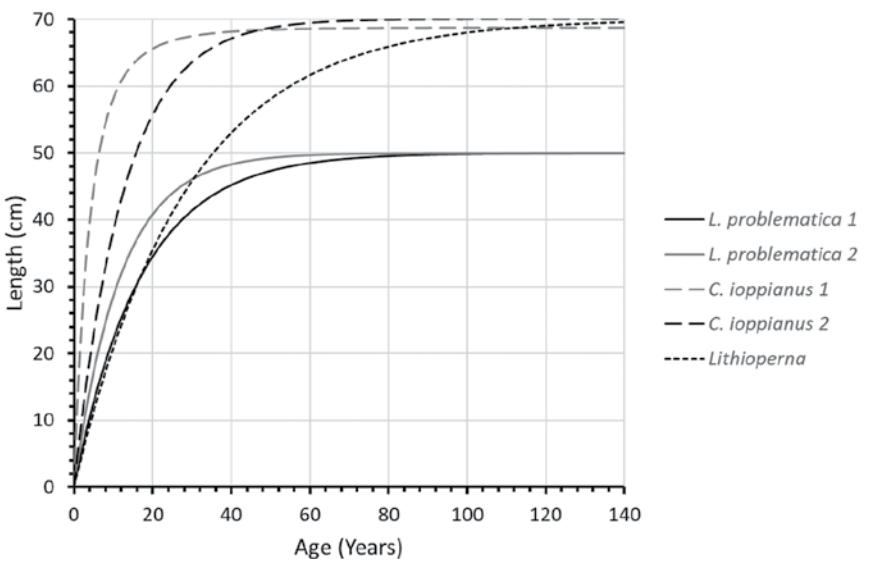

Figure 7. Killam's (2018) implied growth curves for two *L. problematica*, two *C. loppianus*, and one *Lithioperna* lithiotid Jurassic bivalve specimens with postulated values of L_∞ set equal to the known maximum lengths for each taxon. However, these curves are somewhat uncertain, as they were obtained with limited ontological data.

greater ages at maturity are consistent with greater longevity. Because they lived in warm shallow seas, such longevity could not have been the result of cold temperatures or deep water.

Upper Jurassic Lithiotid Bivalves

The above quote by Skelton alluded to large Liassic (Early or Lower Jurassic) *Lithiotis* bivalves. These were large "ubiquitous" bivalves that are thought to have lived in tropical, shallow nearshore tropical marine waters (Fraser, Bottjer, and Fischer, 2004; Posenato et al., 2018, 2022, 2024). As described by Killam (2018, pp. 41, 43), some Early Jurassic lithiotid bivalves reached lengths of 50–70 centimeters (1.6 - 2.3 feet). He noted (p. 43) that these sizes are larger than the largest extant mound-building oyster, *Crassostrea gigas*, which can attain 40 cm (1.3 feet) in length "in exceptional circumstances."

Killam studied three monospecific lithiotid genera from Northern Italy: *Lithiotis problematica*, *Cochlearites loppianus*, and *Lithioperna scutata*. In order to estimate *k* values for these Jurassic bivalves, he inserted into the von Bertalanffy equation a known specimen length $L(t')$ and corresponding ontogenetic age t' for that specimen, obtained either by band counting or from the technical literature. Although he did not say so explicitly, it seems he took the larval size at spawning to be zero, implying $t_0 = 0$. This is a reasonable assumption since even the eggs of the giant clam *Tridacna gigas* are only 100 μm across and are only 160 μm across, even two days after hatching (Ellis, 2003). Killam used known maximum valve sizes for L_∞ in Equation (1) to estimate values of the growth parameter *k*:

$$k = -\frac{1}{t'}\ln\left(1-\frac{L(t')}{L_\infty}\right) \qquad (2)$$

He also obtained an average growth rate (in some cases, the growth rate may have been provided in the literature, in which case the ontogenetic age was inferred). Since the reported lengths for the specimens fell on the linear part of the von Bertalanffy growth equation (see Figure 1), the (juvenile) growth rate could be approximated as

$$\text{Growth Rate} \approx \frac{L(t')}{t'} \qquad (3)$$

Killam obtained *k* values of 0.03 to 0.08 (Killam, 2018, his Table 2, pp. 81–82) for these Jurassic lithiotid bivalves, indicating a prolonged growth interval (by comparison, today's common *Crassostrea virginica* oysters have *k* values of about 0.67 to 0.90). His ontogenetic data for these Jurassic bivalves are summarized in Table I, and the implied growth curves for these species are shown in Figure 7. However, it must be acknowledged that there is some uncertainty in these *k* values, since they were obtained with postulated asymptotic lengths and actual ontogenetic data from only the linear portion of the von Bertalanffy growth curve. Nevertheless, it is generally accepted that these large Jurassic bivalves did take a long time to reach adulthood (Skelton, 2018, p. 18). Again, longer maturation times and larger adult body sizes are generally associated with greater longevity. Killam (2018) rejected the hypothesis that the large sizes of Liassic bivalves were due to accelerated calcification resulting from a photosymbiotic relationship with algae. C. A. Benini (1985, p. 30) also rejected this hypothesis, saying:

> To make a comparison, *Tridacna* [which does have a photosymbiotic relationship with algae]…grows annually 16 times faster than oysters; in just 6 years, *Tridacna* reaches a length of 55 cm. *Lithiotis* and *Cochlearites* grow [sic] to such a length in a time span of more than 20 years.

Benini (1985, p. 30) went on to say:

> Studies based on the growth pattern and periodicity of the Liassic bivalves of the *Lithiotis* facies showed that there is a considerable difference in the growth rate of the intertidal and subtidal taxa (large pelecypods); the large size of the latter is not the result of an accelerated Ca^{2+} mechanism, due to the photosymbiotic action of unicellular algae, *but is just evidence of a long life with constant and "normal" growth under environmental conditions which were apparently very stable.* [emphasis added]

Intertidal organisms are those that live on the part of the seashore that is covered at high tide but uncovered at low tide. Subtidal organisms live below the low-tide mark but still close to shore. So, at least the subtidal *Lithiotis* bivalves seem to have been characterized by relatively long lives.

Figure 8. *Sphenoceramus/Inoceramus steenstrupi* from Greenland on exhibit in the Zoological Museum of Copenhagen, maximum length 1.87 m (6.1 ft); image credit: Mike Beauregard (Wikimedia Commons; Creative Commons Attribution 2.0 Generic license). https://creativecommons.org/licenses/by/2.0/deed.en.

Truly Enormous Bivalves: The Inoceramidae

This section provides additional examples of extremely large bivalves in the fossil record, considering both geographic and geologic location. It is of specific interest that large bivalves have been found far inland from the coast, at high elevations, and throughout the geologic column. This is a testament to the global Flood described in the Bible. Much fossil information may be gleaned from the online Digital Atlas of Ancient Life (digitalatlasofancientlife.org). This, along with the other mentioned references, is the source for the information below.

Here we focus on two genera of the fossil family Inoceramidae, some members of which were truly enormous. Fossil clams in the genus *Inoceramus* are found in Jurassic to Cretaceous rocks, with the Cretaceous specimens being especially widespread (Rodriguez et al., 2017). Cretaceous specimens have an essentially worldwide distribution. Relatively large, 15.5 cm (6.1 inch) *Inoceramus* bivalve shells have been found in the Pierre Shale of South Dakota. Inoceramids from western Kansas are six feet (183 centimeters) in diameter. However, the record holder is a specimen 187 centimeters in diameter (over six feet) in the Geological Museum of Copenhagen (Figure 8).

Giant *Platyceramus* fossil clams strewn throughout the Green River formation in Utah at 4,000 feet (1,219 meters) above sea level were discovered by Kenneth Carpenter, director of Utah State University's Eastern Prehistoric Museum, and one of his university colleagues. Some researchers classify *Platyceramus* as a subgenus of *Inoceramus*, rather than as a separate genus. The press release (Anonymous b., 2013) describing the Utah find stated:

> "Stumbling upon these giant three- and four-foot clams was a real surprise," Carpenter said. "In places, they were so thick we could literally walk from clam to clam…." These giant clams look like large dinner plates, hence the scientific name *Platyceramus* means "flat clam." Today, giant clams are nowhere near the giant four-foot clams in size. The modern pipsqueaks are only two feet or so across and are native to the shallow coral reefs of the South Pacific and Indian Oceans….The giant clam [prepared for exhibition] is 44 by 48 inches, but in life might have weighed 50 pounds. Their

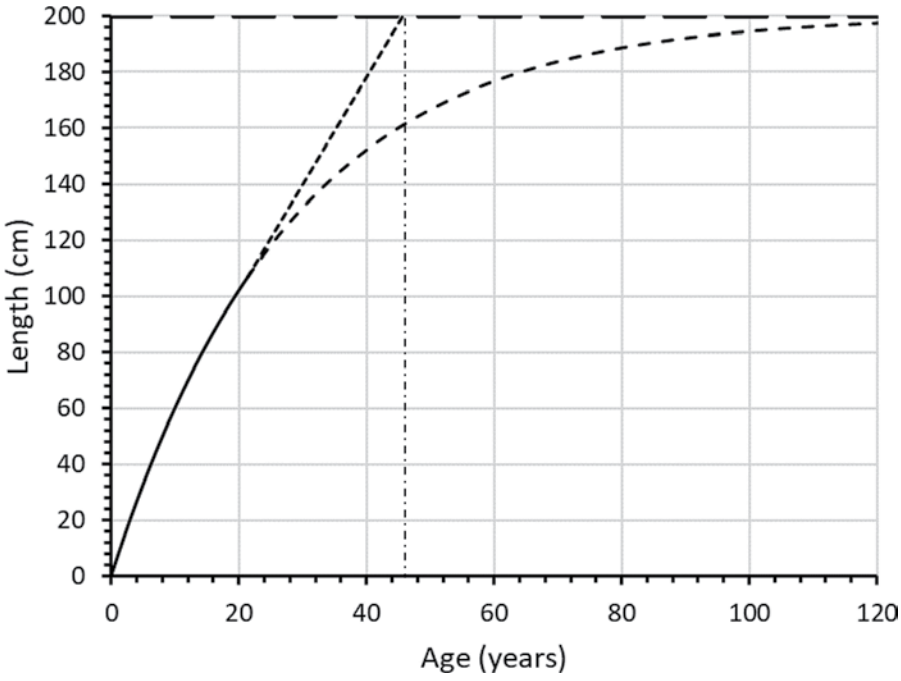

Figure 9. Growth curve (curved dashed line) obtained using Killam's procedure described in the text, for a *P. platinus* bivalve with an assumed (very conservative) asymptotic length of 200 cm. However, this curve is somewhat uncertain, as it was obtained from a limited amount of ontogenetic data, indicated by the solid black curve. Even so, linear extrapolation from the growth trajectory at 21 years implies an age at maturity of nearly 46 years.

average life span might have been 100 years or more.

Platyceramus platinus clams in Late Cretaceous Kansas chalk grew to giant sizes of 4 feet (1.2 meters) or more. Likewise, specimens from the Niobara of Colorado are nearly 9 feet (2.74 meters) in length, with a width of 3–4 feet, or 0.91 to 1.22 meters (Everhart, 2011). Cretaceous *Platyceramus* Seitz shells were often one meter (3.3 feet) long, with some occasionally growing to lengths exceeding 2–3 meters (6.6–9.8 feet) (Kauffman et. al., 2007).

Killam used the same procedure described in the previous section to estimate *k* for *P. platinus*. For a known length of 107 cm at t = 21.4 years, an assumed spawning length of zero, and a (conservative) value of 200 cm for L_∞; the implied value of *k* is 0.035781. Using these data to construct an ontogenetic growth curve for *P. platinus* implies that the bivalve would have taken more than a century to reach maturity (Figure 9). Admittedly, the curve is somewhat uncertain, as it was obtained using only a postulated value of L_∞ and the data indicated by the solid black line in Figure 9. However, even if we extrapolate the known data, this *P. platinus* would have still taken nearly 46 years to reach maturity. Obviously, one would obtain even greater ages at maturity if one took L_∞ = 300 cm.

Conclusion and Discussion

A previous paper (Hebert, Overman, and Sherwin, 2024) presented evidence that fossil *Crassostrea* (and probably *Magallana*) bivalves experienced much greater longevity than their extant counterparts. This paper demonstrated that a number of extinct bivalve species also experienced great longevity, with some having lifespans of a century or more. It is striking that all these fossil bivalves, with the possible exception of some of the Cretaceous Seymour

Table I. Killam's (2018, his Table 2, p. 81) reported lengths, juvenile growth rates, and *k* values for five large lithiotid Jurassic bivalve specimens (representing three species), as well as their postulated asymptotic lengths and implied ontogenetic ages.

Species	Height (cm)	Growth Rate (cm/year)	Approx. Age (yrs)	Postulated L_∞ (cm)	*k* (year^{-1})
Lithiotis problematica	41.3	2.0	21	50	0.084683
	28.0	2.0	14	50	0.058641
Cochlearites loppianus	52.1	3.0	17	70	0.078524
	35.0	4.0	8.8	70	0.079217
Lithioperna scutata	25.0	2.0	13	70	0.035347

Table II. Ages, locations, and depths listed by Moss, Ivany, and Jones (2021) for the ten extant bivalve species with at least one specimen having a reported maximum lifespan of a century or more. Depth and locations were obtained from the listed references. In the case of *Crenomytilus grayanus*, I could not find the original reference cited by Moss (2016), which apparently listed the maximum lifespan as 150 years, rather than 126 years. Also, Moss seems to have mistaken *C. kurriana* for *C. siliqua*. Likewise, the maximum lifespan of *P. generosa* has increased to 179 years since 2016. Also included is the recently discovered deep-sea oyster *Neopycnodonte zibrowii*, which can live for up to 500 years. In some cases, maximum species lengths were obtained from the online *SeaLifeBase* database.

Species	Location	Depth (m)	Age	Max. Species Length (cm)	References
Arctica islandica	N Icelandic Shelf	80	507	13.0	Sample (2007); Butler et al. (2013)
Astarte borealis	Off Ellesmere Island	13.4–14.3	150	3.55	Torres et al. (2011); Moss et al. (2021)
Bathymodiolus childressi	Gulf of Mexico	650	100	12.4	Smith et al. (2000)
Crenomytilus grayanus	Northern Sea of Japan	3–32	126	16.0	Selin and Dulenina (2012); Anisimova et al. (2023)
Cyrtodaria siliqua	Artic & Sub-Arctic	50–500	105	11.0	Símonarson (1974); Kilada et al. (2009)
Glycymeris glycymeris	NW Scotland	25–55	192	6.5	Reynolds et al. (2013)
Hiatella arctica	NE Greenland	10–80	126	5.0	Sejr et al. (2002)
Mercenaria mercenaria	Cape Cod, MA	15	106	13.0	Ridgway et al. (2011)
Neopycnodonte zibrowii	NE Atlantic	420–500+	507	30	Wisshak et al. (2009)
Panopera generosa	British Columbia, CA	10	179	100 (including siphon)	Edge (2021); Wang et al (2023)
Tindaria callistiformis	N Atlantic	3800	100	0.84	Turekian et al. (1975)

Island bivalves, were living in shallow marine environments, and they were all living in temperate to tropical waters. This is a dramatic contrast to long-lived extant bivalves in today's world. Moss, Ivany, and Jones listed 32 bivalve species (their Table I, p. 9) having maximum reported lifespans of fifty years or more. Of these, ten species had maximum reported lifespans of a century or greater. Interestingly, the giant clam *Tridacna gigas* did not make their list. Although some think *T. gigas* can live for more than a century in the wild, this has apparently never been confirmed, as Moss, Ivany, and Jones listed the maximum reported lifespan for *T. gigas* as 60 years. Except for the *M. mercenaria* specimen from Buzzards Bay, Cape Cod (41° N latitude), these extant centenarian specimens were all retrieved from high latitudes (at least 50° N or S latitude) and/or deep (and presumably cold) water (Table II). In the case of the *Bathymodiolus* n. sp., one might wonder if the water temperature at a depth of 650 meters in the Gulf of Mexico would be warm or cold. The *Bathymodiolus* specimens were found at the GC233 brine pool at a depth of 650 meters. Depending upon the precise depth of the mussels in the pool, they could have been living in water as cool as (Joyce et al., 2005) 6° and 8° C (between 43° and 46° F) or as warm as 17° C (63° F).

In contrast, these fossil bivalves were generally exhibiting great longevity in shallow, temperate, or tropical waters, which means that this great longevity had to have a cause other than cold/deep water. And given the lushness of the pre-Flood world, caloric restriction does not seem to be a viable explanation, either.

Bible-believing Christians should be encouraged by this research, as this adds to a growing body of evidence

(Hebert, 2024a, 2024b, 2025a, 2025b, 2026) that animals in the pre-Flood world were experiencing much greater longevity, just as humans were.

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