Gastropod evidence against the Early Triassic Lilliput effect: COMMENT

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Brayard et al. (2010) assert that their study of late Early Triassic gastropods provides evidence against the post-extinction Lilliput effect. Regrettably, their data provide no such evidence.

The Lilliput effect as defined by Urbanek (1993) is a quantifiable, temporary decrease in the size of surviving taxa in the immediate aftermath of an extinction event. Demonstrating that the Lilliput effect is or is not present in the aftermath of an extinction event requires the collection and analysis of quantitative pre- and post-extinction body-size data for those taxa that range through the crisis interval. A fundamental flaw of the Brayard et al. study is the lack of any quantitative size data from the pre-extinction Late Permian and the immediate post-extinction Early Triassic. Their data comprise only Olenekian (late Early Triassic) samples that significantly post-date the extinction event (by at least 2 m.y.), and are inadequate for any discussion of the Lilliput effect. Furthermore, two of the five genera in the study first appear in the Early Triassic, and therefore cannot have experienced Urbanek’s (1993) Lilliput effect.

Other studies questioning the Lilliput effect also omit the first 2 m.y. of the Triassic (e.g., Nützel, 2005), while those working at high resolution all report small body size in the earliest Early Triassic (e.g., Posenato, 2009). Quantitative pre- and post-extinction size data have demonstrated that the Lilliput effect (sensu Urbanek, 1993) is confined to the first 1–2 conodont zones of the Early Triassic (Twitchett, 2007). Brayard et al. (2005) proposed that small body size among gastropods was less pronounced by the Spathian, and was a primarily low-latitude phenomenon, perhaps related to pulses of deleterious environmental conditions that differed from ocean to ocean through the Early Triassic. That the largest early Induan Omphalophtya are recorded in East Greenland supports this hypothesis (Twitchett, 2007).

Empirical data also demonstrate that body size in many marine groups remained relatively low for much of the Early Triassic, beyond the earliest zones of the Induan (e.g., Fraiser et al., 2005; Twitchett, 2007); the Lilliput effect sensu lato. Even using this broader definition of the Lilliput effect, the Brayard et al. study still fails to provide the evidence needed to refute it.

(1) Brayard et al. erroneously use a uniformitarian approach to argue that the Lilliput effect did not affect Early Triassic gastropods by citing a study in which 60% of modern mollusk species are smaller than 10 mm (Bouchet et al., 2002). Small (<10 mm) gastropods are indeed found in all modern marine environments, but a key difference between modern and many Early Triassic ecosystems is that large gastropods are commonly found and may be the dominant group. For example, the modern Turritella and Nucella, which are abundant in many modern marine environments, are represented by a few species that are less than 10 mm in height (Taylor and Glover, 2003).

(2) Despite these new specimens, gastropods are still much larger before and after the Early Triassic. The largest Permian and Middle Triassic gastropods reported are 12–15 cm and 20 cm in height, respectively (Fraiser and Bottjer, 2004). The authors are to be congratulated on discovering some of the largest Early Triassic gastropods, but a handful of specimens larger than 1 cm from among thousands of Early Triassic fossils does not refute the hypothesis that Early Triassic gastropods exhibited the Lilliput effect.

(3) Brayard et al.’s data set is deficient. A meager data set of only three collections was presented, with no details of sampling strategy. Fraiser and Bottjer’s (2004) finding that 99% of the Sinbad Limestone Member fauna (incorrectly stated as the “Sinbad Formation” in Brayard et al. [2010]) were less than 1 cm in height was based on mechanical disaggregation of 27,200 cm³ of material from 120 m of strata exposed over a 3,750 km² area, and its examination under a dissecting microscope. Brayard et al. did not report any gastropods smaller than 4 mm, in contrast to Fraiser and Bottjer (2004) and Bouchet et al. (2002) in which 66% of gastropods were <2 mm and 34% of mollusks were <4.1 mm in height, respectively. New data from the Griesbachian Dinwoody Formation reveal that 100% of examined gastropods are <1.60 mm in height. At least some of the measured gastropods reported by Brayard et al. should have been under 4 mm in height (e.g., juveniles). The absence of very small (<4 mm) gastropods recorded by Brayard et al. suggests a sampling bias in their analysis. Crucially, too, they neglected statistical testing to determine the significance of perceived differences between their new data and previously published data.

Brayard et al. have not reported evidence to refute the Lilliput effect among Early Triassic gastropods, or demonstrated that recovery occurred significantly earlier than previously proposed. If the authors can demonstrate, with quantitative data, no significant difference in gastropod body sizes from the pre-extinction Late Permian through to the post-recovery Middle Triassic, then they will have refuted the Lilliput effect in one region.

REFERENCES CITED


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