

## Short Note



## *Protochelonibia melleni* (Zullo, 1982) comb. nov., an archaic barnacle from the lower Oligocene of Mississippi (USA), and its impact on the stratigraphic and geographic distribution of the early coronuloids of Western Tethys

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The acorn barnacles (Cirripedia: Balanomorpha) assigned to the superfamily Coronuloidea are found most commonly as crown-shaped epibionts of several marine vertebrates (e.g., various species of toothed and baleen whales, sirenians, sea turtles, and sea snakes) and subordinate invertebrates (e.g., gastropods, crabs, and horseshoe crabs) (e.g., Darwin, 1854; Pilsbry, 1916). The coronuloids are presently divided between four families, namely, Coronulidae, Chelonibiidae, Platylepadidae, and the somewhat enigmatic †Emersoniidae (Newman, 1996). Whereas the coronulids are obligate commensals of cetaceans (Monroe, 1981; Bosselaers & Collareta, 2016; Collareta et al., 2017; Buckridge et al., 2018), the chelonibiids and platylepadids exhibit more generalist host habits; however, most species live preferentially or exclusively on the skin, carapace, or plastron of chelonians (e.g., Ross & Newman, 1967; Collareta et al., 2019), hence their vernacular name, “turtle barnacles.” The fossil history of Coronuloidea is still fragmentary and only partly investigated (Collareta et al., 2019); in particular, fossils attributed to the currently monotypic family Chelonibiidae are largely reported as the remains of the extant genus *Chelonibia* Leach, 1817 from various Plio-Pleistocene deposits worldwide (Collareta et al., 2016, and references therein). In deposits older than the late Neogene, fossil chelonibiids are much rarer, the few published records including some specimens of †*Protochelonibia* Harzhauser & Newman in Harzhauser et al. (2011), the only genus assigned to †Protochelonibiinae, an eight-plated form from the Mio-Pliocene of the Paratethyan and Mediterranean basins (Fig. 1b). In particular, †*Protochelonibia* includes the early Miocene (i.e., Aquitanian) Austrian species †*Protochelonibia submersa* Harzhauser & Newman in Harzhauser et al. (2011), known from a cluster of six more or less complete specimens (one of which features a right carinolateral with a curiously straight portion of its basal margin having impressions on it that recall the edge of a carapace scute of a sea turtle, as discussed by Harzhauser et al., 2011), and the late Pliocene (i.e., Piacenzian) Italian species

†*Protochelonibia capellinii* (De Alessandri, 1895), for which there is no hint of what sort of host it might have been on. Both these species display a triangular rostrum not fused with the adjoining rostrolaterals and contributing significantly to the diametric growth of the shell (Fig. 1a-left corner), whereas the rostral complex of *Chelonibia*, as presently known, consists of a narrower rostrum that progressively fuses with the rostrolaterals during growth.

In the light of the study by Harzhauser et al. (2011), a reappraisal of the original description and plates depicting †*Chelonibia melleni* Zullo, 1982 from the lower Oligocene Mint Spring and Byram formations of Mississippi (Gulf Coast of the USA, Mississippian Embayment palaeo-area; Fig. 1c) revealed that this archaic-looking barnacle species displays two characters that, among chelonibiids, are presently regarded as proper of †*Protochelonibia*, namely: 1) all the rostral and rostrolateral plates of †*C. melleni* known to date consist of individual plates having normal sutures, indicating that this species had a rostral complex comprised of obviously unfused compartments, and as such, had an eight-plated wall; and 2) the parietes of both the rostrolaterals and the rostrum of †*C. melleni* exhibit acute triangular outlines (Fig. 1a-right corner). Given these observations, Zullo’s species represents not only the oldest member of Chelonibiidae, but also a bona fide member of †*Protochelonibia*; consequently, the new combination †*Protochelonibia melleni* (Zullo, 1982) is proposed herein. †*Protochelonibia melleni* differs from †*P. capellinii* and †*P. submersa* mainly in having a basal margin of the wall that is locally jagged (e.g., Zullo, 1982, figs 1-3, 10-12). The subpeltate morphology of the shell of †*P. melleni* recalls that of †*P. submersa* rather than the more dome-shaped one of †*P. capellinii*. Like †*P. submersa*, †*P. melleni* also displays: 1) a nearly smooth outer surface of the parietes, ornamented only by fine growth ridges crossed by faint radiating striae; 2) trigonal, rather broad radii, separated from the parietes by sharp angulations; 3) an only slightly dependent sheath that is as long as about one third of the paries; and 4) a dense

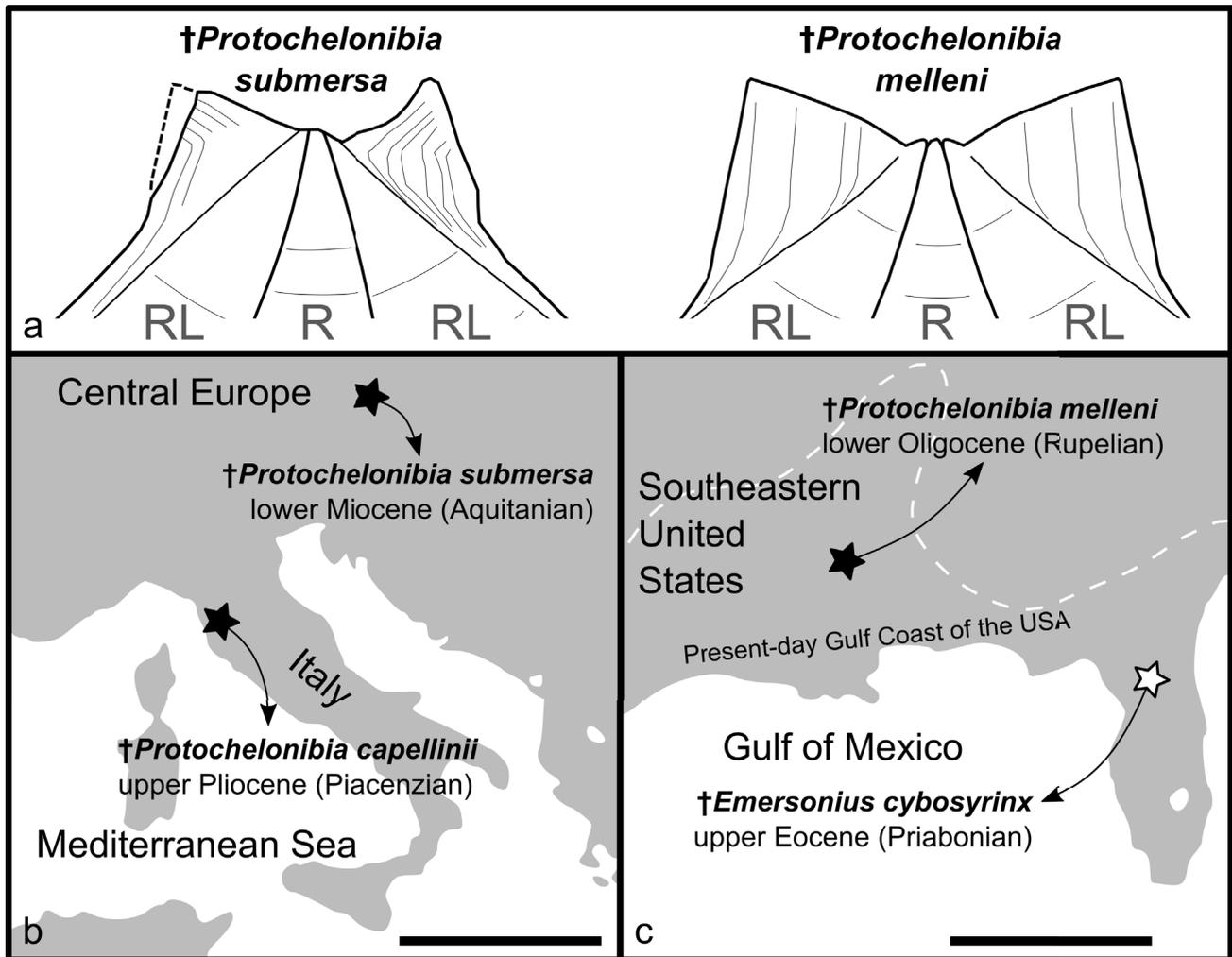


Fig. 1 - a) Schematic comparison, not to scale, between the upper parts of the tripartite rostral complexes (comprised of two rostrilaterals, RL, and one rostrum, R) of †*Protochelonibia submersa* from Austria (left corner, redrawn after Harzhauser et al., 2011, figs 2-3) and †*Protochelonibia melleni* comb. nov. from Mississippi, USA (right corner, reconstructed after Zullo, 1982, figs 8-10, and the author's original description, freely accessible online at the following link: [https://www.mdeq.ms.gov/wp-content/uploads/2013/10/Vol\\_2\\_3.pdf](https://www.mdeq.ms.gov/wp-content/uploads/2013/10/Vol_2_3.pdf)). Note that, in both species, the rostrum exhibits an acutely triangular apex. b) Sketch map of the Central Euro-Mediterranean region (~44°N), showing the indicative location of the finds of †*P. submersa* and †*Protochelonibia capellinii*. Scale bar is equal to 500 km. c) Sketch map of the Southeastern United States (~31°N), showing the indicative location of the finds of †*P. melleni* and †*Emersonius cybosyrinx* (the only pre-Neogene coronuloids known to date) with respect to the approximate outline of the Palaeogene coastline (dashed white line, featuring the pronounced Mississippian Embayment). Scale bars are equal to 500 km. In panels b and c, the black stars indicate the occurrences of the chelonibiid subfamily †Protochelonibiinae, whereas the white star indicates the sole known occurrence of the enigmatic coronuloid family †Emersoniidae.

pattern of fine, continuous, longitudinal septa running centripetally from the inner surface of the wall.

Recognising that †*P. melleni* belongs to †*Protochelonibia* allows us to extend the fossil record of this genus back some 10-12 Ma, to ca. 32-34 Ma (the age of deposition of the Mint Spring and Byram strata according to Pettway & Dunn [1990] and Manning [1997]). Thus, the protochelonibiines would have survived for about 30 million years at least, from the early Oligocene to the late Pliocene. The occurrence of †*P. melleni* in Mississippi represents the first record of †*Protochelonibia* outside the proto-Mediterranean/Paratethyan region, thus indicating that, in late Palaeogene times, the biogeographic range of the protochelonibiines extended over the broad Western Tethyan realm on both sides of the North Atlantic ocean - a distributional pattern revealed also by other groups of

macro-invertebrates such as the tridacnine giant clams (Newman & Gomez, 2003; Harzhauser et al., 2008). Interestingly, the Gulf Coast of the USA that hosts the remains of †*P. melleni* is also home to the holotype and only known specimen of †*Emersonius cybosyrinx* Ross in Ross & Newman (1967), an enigmatic six-plated form from the upper Eocene beds of Florida, which represents the geologically oldest (albeit presumed) coronuloid fossil worldwide (Fig. 1c). Considering also that †*P. melleni* and †*E. cybosyrinx* are the only Palaeogene members of Coronuloidea known to date, it seems reasonable to hypothesise that this superfamily had its centre of distribution somewhere in what is currently considered westernmost Tethys. Until discoveries of more Palaeogene chelonibiid fossils comparable to these materialise in the world, our current understanding of the phylogenetic,

palaeobiogeographical, and ecological aspects of the scarcely known protochelonibiines is again at rest. Hopefully the present work will help in the recognition of these obscure and likely often fragmented forms.

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#### REFERENCES

- Bosselaers M. & Collareta A. (2016). The whale barnacle *Cryptolepas rhachianecti* (Cirripedia: Coronulidae), a phoront of the grey whale *Eschrichtius robustus* (Cetacea: Eschrichtiidae), from a sandy beach in The Netherlands. *Zootaxa*, 4154: 331-338.
- Buckeridge J.S., Chan B.K.K. & Lee S.W. (2018). Accumulations of fossils of the whale barnacle *Coronula bifida* Bronn, 1831 (Thoracica: Coronulidae) provides evidence of a Late Pliocene cetacean migration route through the Straits of Taiwan. *Zoological Studies*, 57: e54.
- Collareta A., Bosselaers M. & Bianucci G. (2016). Jumping from turtles to whales: a Pliocene fossil record depicts an ancient dispersal of *Chelonibia* on mysticetes. *Rivista Italiana di Paleontologia e Stratigrafia*, 122: 35-44.
- Collareta A., Marean C.W., Jerardino A. & Bosselaers M. (2017). *Cetopirus complanatus* (Cirripedia: Coronulidae) from the late Middle Pleistocene human settlement of Pinnacle Point 13B (Mossel Bay, South Africa). *Zootaxa*, 4237: 393-400.
- Collareta A., Reitano A., Rosso A., Sanfilippo R., Bosselaers M., Bianucci G. & Insacco G. (2019). The oldest platylepadid turtle barnacle (Cirripedia, Coronuloidea): a new species of *Platylepas* from the Lower Pleistocene of Italy. *European Journal of Taxonomy*, 516: 1-17.
- Darwin C. (1854). A Monograph on the subclass Cirripedia with figures of all the species. The Balanidae, The Verrucidae, etc. 770 pp. Ray Society, London.
- De Alessandri G. (1895). Contribuzione allo studio dei Cirripedi fossili d'Italia. *Bollettino della Società Geologica Italiana*, 13: 234-314.
- Harzhauser M., Mandic O., Piller W.E., Reuter M. & Kroh A. (2008). Tracing back the origin of the Indo-Pacific mollusc fauna: basal Tridacninae from the Oligocene and Miocene of the sultanate of Oman. *Palaeontology*, 51: 199-213.
- Harzhauser M., Newman W.A. & Grunert P. (2011). A new Early Miocene barnacle lineage and the roots of sea-turtle fouling Chelonibiidae (Cirripedia, Balanomorphia). *Journal of Systematic Palaeontology*, 9: 473-480.
- Leach W.E. (1817). Distribution systématique de la class Cirripèdes. *Journal de Physique de Chimie et d'Histoire Naturelle*, 85: 67-69.
- Manning E.M. (1997). An early Oligocene *Rhinoceros* jaw from the marine Byram Formation of Mississippi. *Mississippi Geology*, 18: 14-31.
- Monroe R. (1981). Studies in the Coronulidae (Cirripedia): shell morphology, growth, and function, and their bearing on subfamily classification. *Memoirs of the Queensland Museum*, 20: 237-251.
- Newman W.A. (1996). Cirripedia; Suborders Thoracica and Acrothoracica. In Forest J. (ed.), *Traité de Zoologie*, Tome VII, Crustacés, Fascicule 2, Masson, Paris: 453-540.
- Newman W.A. & Gomez E.D. (2003). On the status of giant clams, relics of Tethys (Mollusca: Bivalvia: Tridacninae). *Proceedings of the 10<sup>th</sup> International Coral Reef Symposium*, 2: 927-935.
- Pettway W.C. & Dunn D.A. (1990). Paleoenvironmental analysis of the lower Oligocene Mint Spring and Marianna formations across Mississippi and Southwestern Alabama. *Gulf Coast Association of Geological Societies Transactions*, 40: 701-709.
- Pilsbry H.A. (1916). The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a monograph of the American species. *Bulletin of the United States National Museum*, 93: 1-366.
- Ross A. & Newman W.A. (1967). Eocene Balanidae of Florida, including a new genus and species with a unique plan of "turtle-barnacle" organization. *American Museum Novitates*, 2288: 1-21.
- Zullo V.A. (1982). A new species of the turtle barnacle *Chelonibia* Leach, 1817 (Cirripedia, Thoracica) from the Oligocene Mint Spring and Byram Formations of Mississippi. *Mississippi Geology*, 2: 1-6.

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