

A new turtle barnacle (Thoracica, Coronuloidea, Platylepadidae) from the Pliocene (Piacenzian) of Fountain Quarry, Pitt County, North Carolina, USA

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ABSTRACT:

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We identify a small turtle barnacle rostral plate from the Piacenzian (Pliocene) of North Carolina, USA as belonging to the family Platylepadidae Newman and Ross, 1976. It is named *Fountainlepas hayashii* gen. et sp. nov. and shows some similarities to the living *Cylindrolepas sinica* Ren, 1980, but differs significantly in the imbricate structure of the parietes and the presence of basally directed sharp flanges on the external surface.

Key words: Turtle barnacle; Platylepadidae; Piacenzian, North Carolina.

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INTRODUCTION

Turtle barnacles are mostly obligate commensals on marine turtles, although a few forms also attach to crustaceans, marine mammals (sirenians), sea snakes and a variety of marine-dwelling invertebrates (Darwin 1854; Newman and Ross 1976; Hayashi 2012, 2013a, 2025). They are closely related to whale barnacles (Coronulidae Leach, 1817) with which they form a monophyletic clade called the Coronuloidea (Hayashi *et al.* 2013; Pérez-Losada *et al.* 2014; Chan *et al.* 2021). Turtle barnacles are placed in two families, the Chelonibiidae Pilsbry, 1916 and the Platylepadidae Newman and Ross, 1976. The chelonibiids tend to be larger, of conical shape, and embed within the keratinised epidermis forming the scutes of sea turtles, although they are capable of moving about on the surface of the host (Chan

et al. 2021). Many of the platylepadids are smaller, cylindrical and embed deeply within the epidermis (Hayashi 2012).

Turtle barnacles have a very limited fossil record, although the more robust chelonibiids are quite well represented from the Oligocene to the present day by species of *Protochelonibia* Harzhauer and Newman in Harzhauer *et al.*, 2011 (lower Oligocene to Lower Pleistocene; see Collareta *et al.* 2022a–c; Perreault *et al.* 2022; Gale in De Schutter *et al.* 2023) and *Chelonibia* Leach, 1817 (Lower Pleistocene to present). In contrast, the platylepadids are extremely rare as fossils, being sparsely known from approximately 12 isolated parietal plates, ranging in age from Oligocene to Pleistocene (Karasawa and Kobayashi 2022; Perreault *et al.* 2025). It was therefore remarkable that one of us (ES) found a small, but very well preserved plate of a platylepa-



did in a sample from the Morgarts Beach Member at Fountain Quarry North Carolina. We describe this as a new genus and species and discuss how this might fit within the phylogenetic framework for turtle barnacles.

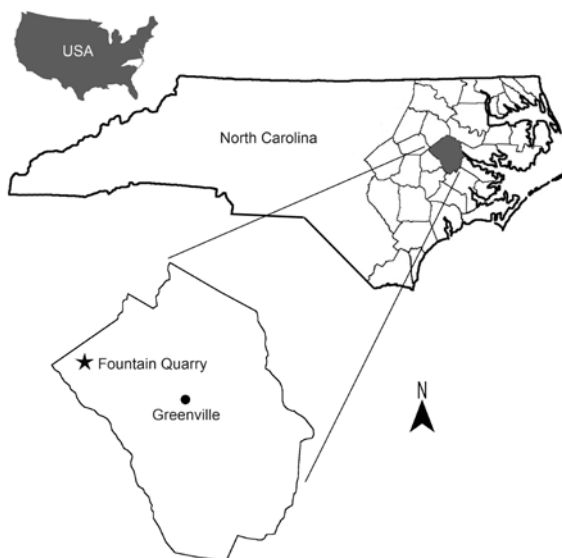
MATERIAL AND METHODS

A bulk sample of approximately 5 kg was collected from a spoil pile that contained silty clay with abundant small bivalves including *Mulinia congesta* (Conrad, 1833). The lithology and fauna match the description of the Morgarts Beach Member of the Yorktown Formation. This sample was dried and then wet sieved using 0.6 mm mesh screen, and the residue was searched using magnification.

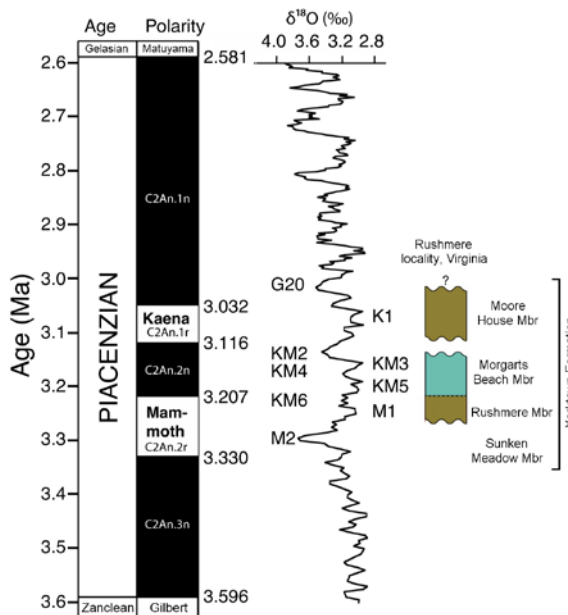
LOCALITY AND GEOLOGY

The bulk sample was collected from a spoil pile at the Martin-Marietta Fountain Quarry near the town of Fountain, North Carolina, USA (Text-fig. 1). The quarry produces aggregate excavated from an exposed granite monadnock, the only exposed igneous rock in the area (Brown 1959). Cretaceous and younger strata were deposited around the monadnock. The quarry scrapes this sediment and dumps it to the side to access the granite beneath. Snyder and Katrosh (1979) determined that a shell bed on top of the weathered granite surface was early Pleistocene in age, based on the shape of the bivalve *Noetia variabilis* (MacNeil, 1938). Farrell and Keyworth (2003) mentioned thin slivers of Cretaceous deposits (Cape Fear Formation and Black Creek Group), Pliocene Yorktown Formation equivalents (Text-fig. 2), upper Pliocene Bacons Castle Formation, and the upper Pliocene or lower Pleistocene Moorings Unit exposed above the granite at Fountain Quarry.

The spoil heaps consist of silty sand and clay with abundant molluscs, including the age-indicative gastropod *Ecphora quadricostata* (Say, 1824) that occurs in the Pliocene Yorktown Formation and its equivalents (Wilson 1987; Campbell and Campbell 1995) as well as the enigmatic cashew-shaped fish bone that Emmons (1858) considered to be a fish tooth. These later became known as “Emmons’ Fish Tooth” and are found in the Rushmere Member of the Yorktown Formation (Ray and Bohaska 2001; Ward 2007). Dowsett *et al.* (2019, 2021) equated the Rushmere Member with the mid-Piacenzian Warm Period (mPWP), dated to 3.3–3.2 Ma.

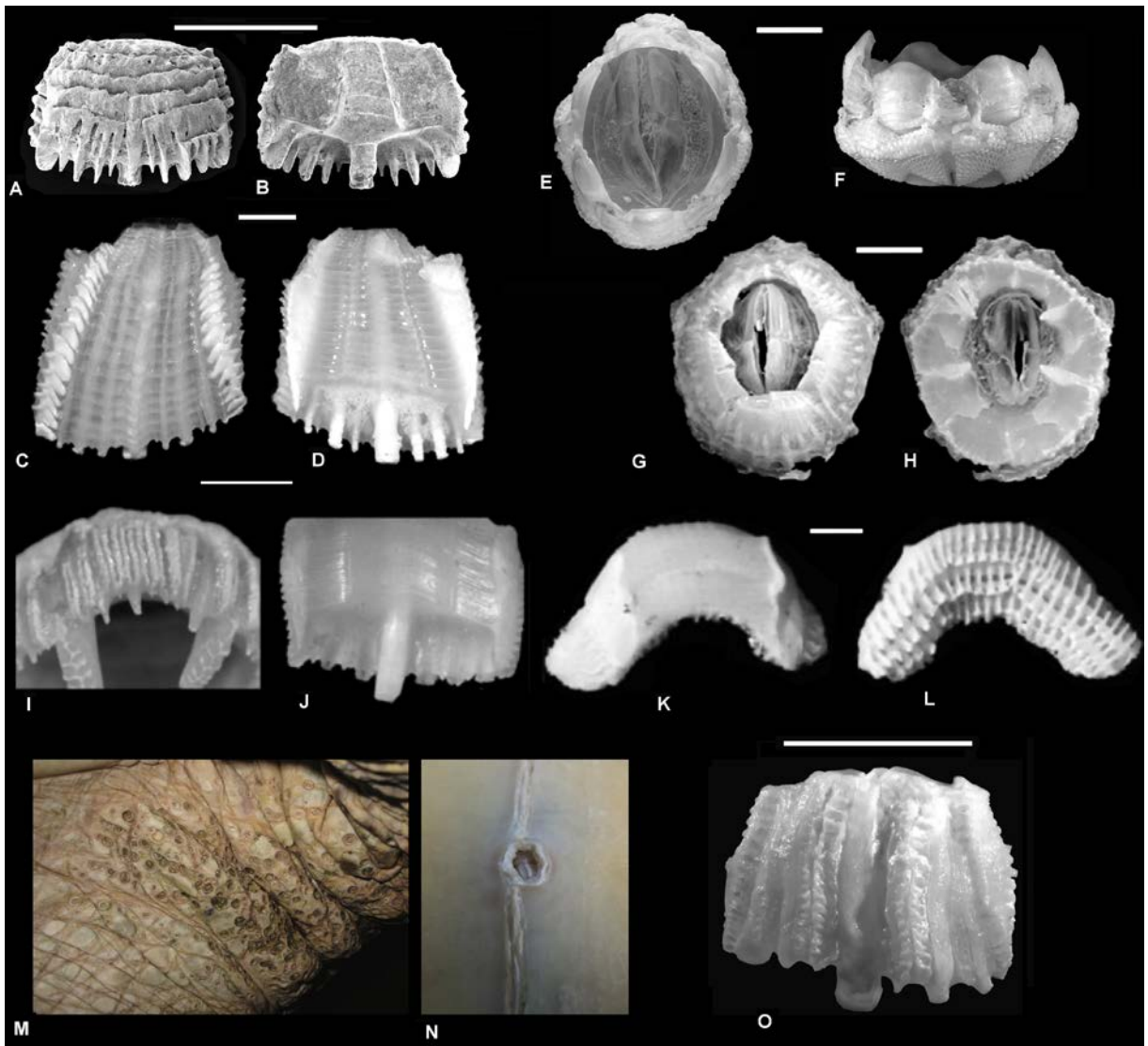


Text-fig. 1. Map to show the position of North Carolina in the USA (top left map), the position of Pitt County (shaded grey) and Fountain Quarry (marked with a star).



Text-fig. 2. Stratigraphy and age of the Yorktown Formation, based on data obtained from the James River composite section, Virginia (Dowsett *et al.* 2021, modified after their fig. 6). The oxygen isotope curve is taken from the LR04 oxygen isotope stack of Lisiecki and Raymo (2005) with Marine Isotope Stages M2–G60 labelled.

The Rushmere Member grades upward into the very fine silty sand, sandy silt, or silty clay of the Morgarts Beach Member (Ward and Blackelder 1980; Dowsett *et al.* 2021). This represents the highstand or stillstand of the Rushmere/Morgarts Beach transgres-



Text-fig. 3. Extinct and extant turtle barnacles. A, B – *Fountainlepas hayashii* gen. et sp. nov. Holotype rostral plate in external (A) and internal (B) views (NHMUK PI In 66796), Morgarts Beach Member, Yorktown Formation, Piacenzian, Pliocene, Fountain Quarry, Pitt County, North Carolina, USA. C, D, M, N – *Cylindrolepas sinica* Ren, 1980, present-day, Japan. C, D – rostral plate in external (C) and internal (D) views, figured after Hayashi (2013b, fig. 1D); M, N – individuals in skin of tail (M) and between plastron plates (N) of green sea turtle, figured after Hayashi (2013b, fig. 2A, B). E, F – *Stomatolepas praegustator* (Pilsbry, 1910), in apical (E) and lateral (F) views, figured after Frick *et al.* (2010, figs 1, 2), present-day, Georgia. G–J – *Platylepas decorata*, Darwin, 1854, present-day Mexico. G, H – individual in apical (G) and basal (H) views, figured after Lazo-Wasem *et al.* (2011, fig. 4C); I, J – parietal plate in external (I) and internal (J) views, figured after Hayashi (2012, fig. 8F, G). K, L – rostral plate of *Xenobalanus globiticeps* Steenstrup, 1852, in internal (K) and external (L) views, figured after Hayashi (2012, fig. 6F), present-day, Japan. Scale bars equal 1 mm (A–J, O); 0.5 mm (K, L).

sion (Ward *et al.* 1991). Ward *et al.* (1991) described the laminated silty clay of the Morgarts Beach Member as containing a low diversity molluscan assemblage dominated by the small bivalve *Mulinia congesta*. The new platylepadid *Fountainlepas hayashii* gen. et sp. nov. specimen found at Fountain Quarry was in a silty clay containing abundant bivalves including *Mulinia congesta*. Dowsett *et al.* (2021) estimated the

age range of the Morgarts Beach Member to be approximately 3.2–3.15 Ma.

Gale and Sadorf (2025a) recorded the verrucid *Verruca stroemia* (O.F. Müller, 1776) from Fountain Quarry, and samples have also yielded abundant balanomorphs, including *Arossia glyptopoma* (Pilsbry, 1916), *Chesaconcaus proteus* (Conrad, 1834) and *Membranobalanus distortus* Gale and Sadorf, 2025b.

Institutional abbreviation

NHMUK – The Natural History Museum, London, UK.

SYSTEMATIC PALAEOLOGY

Superfamily Coronuloidea Leach, 1817

Family Platylepadidae Newman and Ross, 1976

Fountainlepas gen. nov.

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DIAGNOSIS: Rostral plate rectangular, slightly concavo-convex, composed of six transverse, basally imbricating layers, the lower margins of which have basally directed processes symmetrically arranged about a central structure; these form rounded flanges on the basal margin of the plate. The central axis of the plate bears a robust midrib which extends basally from the centre of the tall sheath.

TYPE SPECIES: *Fountainlepas hayashii* sp. nov.

DERIVATION OF NAME: After Fountain Quarry, Pitt County, North Carolina, where the specimen was collected.

DISCUSSION: The rostral plate bears resemblance to that of *Cylindrolepas sinica* Ren, 1980 (Text-fig. 3C, D; see also Hayashi 2013b, fig. 1) in the presence of a tall sheath from which processes project basally; the central is the most robust in both taxa and was called the mid-tooth or rib by Ross and Frick (2011). However, the external structure of the plate is very different; in *C. sinica* this comprises a central reticulate region with a sculpture of seven vertical ribs conjoined horizontally by narrow septa. In *Fountainlepas* gen. nov. the external surface is made up of six basally imbricating transverse sheets, reflecting successive growth increments of the basal margin which carries bladed processes. In *C. sinica*, two columns of reflexed, apically imbricating flanges are present towards the external margins of the rostral plate. The columns of noded processes on the lateral margins of the plate in *Fountainlepas* gen. nov. are possibly homologous with structures are present on the lateral margins of the parietes of *Cylindrolepas sinica*.

The shapes of the basal internal processes are also different in the two taxa. In *Fountainlepas* gen. nov. (Text-fig. 3A, B) these form exterior rounded

flanges but have straight margins internally. In *C. sinica* (Text-fig. 3C, D) the basal processes appear as short knobs on the basal margin but are rounded and elongated on the interior surface beneath the sheath. The robust central process is also found on other platylepadids such as *Platylepas decorata* Darwin, 1854 (Text-fig. 3G–J, O). In *Stomatolepas praegustator* (Pilsbry, 1910) (Text-fig. 3E, F) the lower parts of the parietes comprise imbricated rows of scale-like plates, but these are smaller and more regularly arranged than those in *Fountainlepas* gen. nov. Additionally, the parietes and radii are not differentiated in both *Fountainlepas* gen. nov. and *Cylindrolepas sinica*.

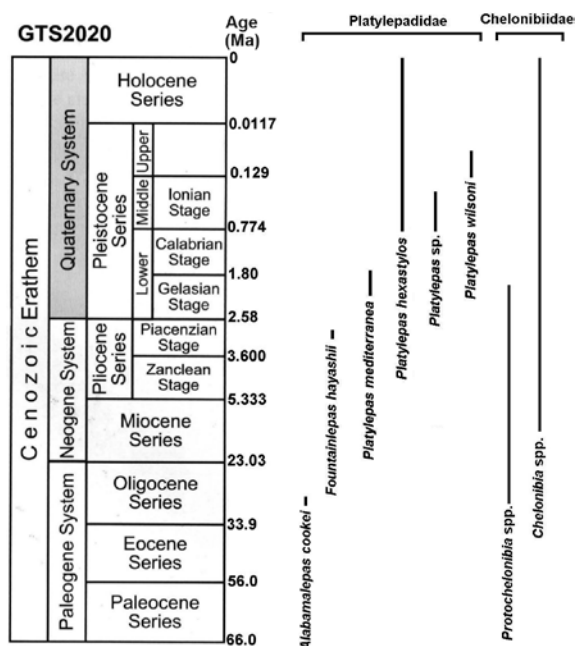
Fountainlepas hayashii sp. nov.

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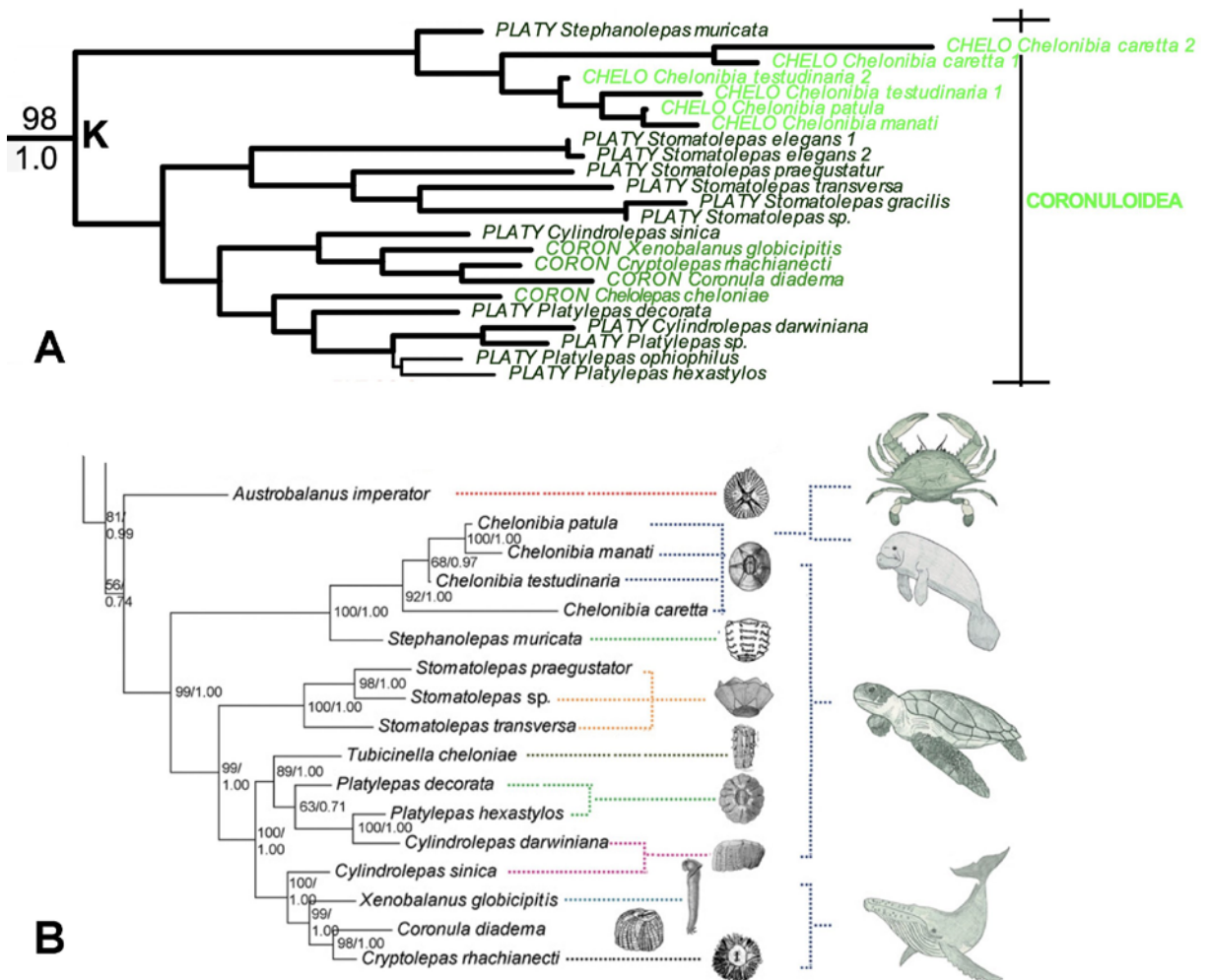
DIAGNOSIS: As for genus.

HOLOTYPE: The unique rostral plate from the Yorktown Formation (Pliocene, Piacenzian) of Fountain Quarry, Pitt County, North Carolina, USA is holotype (NHMUK PI In 66796).

DERIVATION OF NAME: The species is named for Ryota Hayashi, in honour of his extensive studies on whale and turtle barnacles.



Text-fig. 4. Stratigraphical distribution of fossil platylepadids and chelonibiids.



Text-fig. 5. Molecular phylogenies of Coronuloidea (A) after Pérez-Losada *et al.* (2014, fig. 1) and (B) after Hayashi *et al.* (2013, fig. 1A). Both trees are similar in topology, and both imply polyphyly of the Platylepadidae, with *Cylindrolepas sinica* placed at the base of the coronulid clade and *C. darwiniana* nested within *Platylepas* spp. *Fountainlepas hayashii* gen. et sp. nov. is probably closely related to *Cylindrolepas sinica*. *Tubicinella cheloniae* should correctly be placed in *Chelolepas* Ross and Frick, 2007.

DESCRIPTION: The rostral plate (Text-fig. 3A, B) is trapezoidal in outline and measures 1.5 mm in breadth, 1 mm in height and is gently concavo-convex. The external surface (Text-fig. 3A) comprises a central zone of six basally imbricating, transverse sections representing discrete growth increments and narrow, symmetrically placed marginal columns of laterally projecting short nodes. The basal margin bears a centrally placed basal projection, which is triangular in cross-section and flat based. This is symmetrically flanked on each side by five flanged, laterally flattened projections that terminate as rounded blades. The projections adjacent to the central process are shorter than the others. On the interior of the valve (Text-fig. 3B) the centrally placed, trapezoidal sheath occupies two thirds of the height of the plate

and bears six transverse ridges representing successive positions of attachment of the arthrodiol membrane. The regions lateral to the sheath are smooth and weakly concave. A transverse ridge extends laterally from the base of the sheath and separates the inset lower portion of the valve from the upper part. The central process extends basally from the centre of the sheath and its inner margin is flush with the sheath's surface. The five paired, bladed lateral processes are inset on the interior of the plate.

DISCUSSION

Platylepadids are very rare fossils, probably because the small size and fragility of many taxa

does not suit preservation or discovery (Hayashi *et al.* 2013; Perreault *et al.* 2025). The oldest known taxon is *Alabamalepas cooki* Perreault, Collareta and Buckeridge, 2025 from the lower Oligocene of Alabama, USA, based on three parietal plates, interpreted as a platylepadid on account of the robust midrib and presence of four basal prongs (Text-fig. 4). There is then a gap up to the Lower Pleistocene of Sicily, Italy, which has yielded a single plate of *Platylepas mediterranea* Collareta, Reitano, Rosso, Sanfilippo, Bosselaers, Bianucci and Insacco, 2019. A single plate of *Platylepas wilsoni* Ross, 1963, is from the Upper Pleistocene of Florida. The extant *Platylepas hexastylus* (Fabricius, 1798) was recorded from the Middle Pleistocene of Japan (6 plates; Karasawa and Kobayashi 2022) and an indeterminate *Platylepas* plate of the same age is also from Japan (Mimoto 1991). Thus, the total fossil record of the family comprises approximately 12 parietal plates.

Molecular phylogenies of whale and turtle barnacles support the monophyly of the Coronuloidea (Hayashi *et al.* 2013; Pérez Losada *et al.* 2014; Text-fig. 5 herein) and both show very similar branching patterns. Both show *Cylindrolepas sinica* as associated with the the coronulid, rather than the core platylepadids, as sister taxon to *Coronula* Lamarck, 1802, *Xenobalanus* Steenstrup, 1852 and *Cryptolepas* Dall, 1872. The time-calibrated phylogeny of Hayashi *et al.* (2013, fig. 1) infers that other coronulids diverged from *C. sinica* in the late Oligocene. As *Fountainlepas hayashii* gen. et sp. nov. is morphologically fairly similar to *Cylindrolepas sinica* (see above) it probably also falls within or close to the base of the coronulid clade. The imbricate constructional structure differs from that of other platylepadids but displays some similarities with *Xenobalanus globicipitis* Steenstrup, 1852 (Text-fig. 3K, L) which also comprises imbricate transverse strips that bear short basal projections. However, in *Xenobalanus* the individual compartments are strongly reflexed, with the exterior surface concave and the interior convex (see Hayashi 2012, fig. 6).

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