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A New *Stomatolepas* Barnacle Species (Cirripedia: Balanomorpha: Coronuloidea) from Leatherback Sea Turtles

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ABSTRACT

A new species of the commensal barnacle genus *Stomatolepas* has been collected from leatherback turtles in the southern Atlantic Ocean. It is described here as *S. pilsbryi* n. sp. and compared to its congeners *S. elegans* (Costa, 1838) and *S. praegustator* Pilsbry, 1910. A neotype is also designated for *S. elegans*.

KEYWORDS

Dermochelys coriacea, epibionts, leatherback sea turtle, new species.

Introduction

Barnacles of the genus *Stomatolepas* Pilsbry, 1910 (Platylepadidae: Stomatolepadinae) are common commensals of sea turtles. These small, bowl-shaped (ca. 5 mm average maximum diameter) cirripeds often attach to the soft skin areas of their hosts and form rows or rings of small, scale-like and upwardly projecting emanations along the basal margin of the shell. During a study of epibionts of leatherback sea turtles (*Dermochelys coriacea* (Vandelli)) from Georgia, USA, the Republic of Gabon in Africa and Nova Scotia, Canada, three specimens of an unidentified *Stomatolepas* were collected. The external ornamentation of these specimens differed from that of previously recognized *Stomatolepas*, therefore we describe the material here as a new species and present comparisons with *S. elegans* (Costa) and *S. praegustator* Pilsbry. All specimens are deposited in the Division of Invertebrate Zoology collections at the Peabody Museum of Natural History, Yale University (YPM).

Systematics

GENUS *Stomatolepas* Pilsbry, 1910

Type species. *Stomatolepas praegustator* Pilsbry, 1910:304; by original designation. Tortugas, Florida, USA; recent, in the gullet of a loggerhead turtle (*Caretta caretta* (L.)).

Description. Six-plated (R-CL2-CL1-C) (R, rostrum; CL, carinolateral; C, carina). Wall bowl-shaped, the orifice larger than the basis; compartments with the outer layer composed of rows of imbricating calcareous scales; inner layer projecting above, fingernail-like, beyond the outer layer (apical inner-laminar projection). The shell's basal edge is thin and simple; sheath very long, transversely grooved, without a distinct lower edge. Opercular valves long, narrow and thin; outer layer is deciduous. The radii are well developed and saw-like. The base is membranous. Sutural elaborations or fimbriations are reflected medially from the sutures and over the external surfaces of the parietes. Fimbriations over most of the plate can be as follows: *simple* (scale-like rows that are clearly separated by a groove in the center of the plate, or the scale-like rows emanating from the sutural region are not perfectly continuous across the breadth of the plate; they occur as two distinct sections; and scant, platyspherulic projections line the apices of the plates below the apical inner-laminar projection, usually in a single row); *intermediate* (a combination of scale-like rows and platyspherulic rows where the scale-like rows are perfectly continuous, or nearly so, across the breadth



FIGURE 1. Apical view of *Stomatolepas praegustator* Pilsbry (YPM 47956). Diameter 7.36 mm.



FIGURE 2. Lateral view of *Stomatolepas praegustator* Pilsbry (YPM 47956). Diameter 7.36 mm.



FIGURE 3. Basal view of *Stomatolepas praegustator* Pilsbry (YPM 47956). Diameter 7.36 mm.

of the plate and where platyspherulic projections are aggregated near the apex of each plate, creating a distinct ridge that often protrudes half way down the plate); or *complex* (very long or bifurcated, antler-like emanations that interdigitate or nearly interdigitate with those from an adjacent plate [at the radii], or they interdigitate with those from the opposite side of the same plate at the center of the compartment, or both). The fimbriations closest to the basis form undulating plates rather than scale-like projections. The fimbriations include extensions of mantle tissue along their lower surfaces and host connective tissue entwines them from all sides. The sheath is visible externally as an unadorned triangle running across the basal margin of each plate and projecting upwards from one-third to half the height of the plate. The scuta and terga touch but do not articulate. These opercular plates extend from one end of the orifice to the other. The opercular membrane can be extended and expand well above the orifice in some preserved specimens, separating the scuta and tergal connection.

Remarks. Although originally described from the gullet of the loggerhead turtle, this genus is also known to occur externally in the skin of a variety of sea turtles. *Stomatolepas* is similar to

the genus *Stephanolepas muricata* Fischer, but differs in being not as deep and in having more elaborate ornamentation emanating from the borders of the sutures. *Stomatolepas* occur along the margins of turtle shells and successive rows of growth-rings imbricate as the barnacle grows, enabling it to grasp the turtle's skin (often, much of the apex will protrude from the host turtle, notably in *Stomatolepas praegustator* Pilsbry). The orifice of *Stomatolepas* is open to the external environment to facilitate filter feeding.

Stomatolepas praegustator Pilsbry, 1910 Figures 1, 2 and 3

Stomatolepas praegustator Pilsbry, 1910:304, 1916:289;
Monroe and Limpus 1979:203.

Material examined. Wassaw Island, Georgia, USA: M.G. Frick personal collection, May 2005, 16 specimens from *Dermochelys coriacea*, coll. M. G. Frick; YPM 47956, July 2003, 1 specimen from *Caretta caretta*, coll. M. G. Frick.

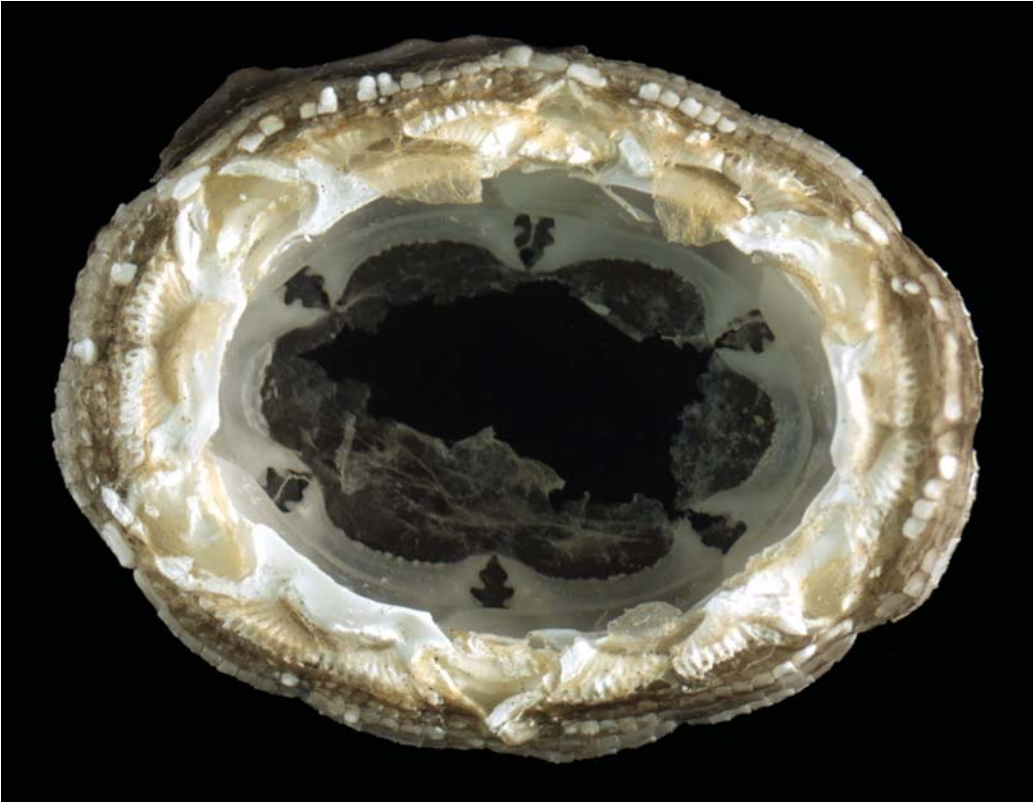


FIGURE 4. Apical view of neotype of *Stomatolepas elegans* (Costa) (YPM 42775). Diameter 6.64 mm.



FIGURE 5. Lateral view of neotype of *Stomatolepas elegans* (Costa) (YPM 42775). Diameter 6.64 mm.

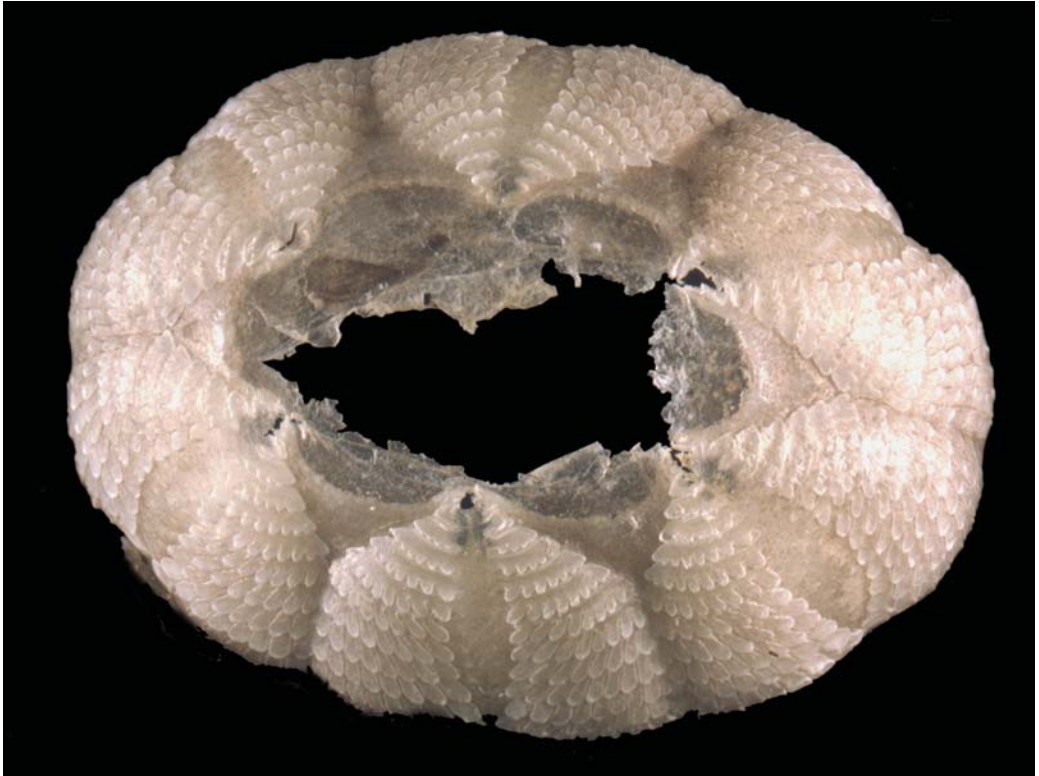


FIGURE 6. Basal view of neotype of *Stomatolepas elegans* (Costa) (YPM 42775). Diameter 6.64 mm.

Description. The profile of the shell is generally apicobasally depressed. When viewed from above the shell is oval to round in outline (Figure 1). Fimbriations moderate with platyspherulic projections surrounding where the inner-lamina extends above the orifice to one-third the length of the compartment (Figure 2). Platyspherulic projections can occur in a single row surrounding the inner-laminar projection or occur in several rows extending halfway down the length of the compartment. Occasionally the tips of the platyspherulic projections break off, leaving only small, scale-like projections. The area encompassed by the platyspherulic projections often forms a ridge, marking the limit of the portion of the barnacle that is embedded in host tissue. The portion of the compartment below the platyspherulic projections is embedded into the host and is composed of distinctly separated rows of scale-like projections followed by rows of undulating projections. The latter two series of rows are arranged in two conspicuous and abutting chevrons (a series of nearly perfectly continuous rows forming the shape of a “W”). The inner-lamina is visible as a smooth triangle with its base extending along the entire base of the compartment (Figure 3). The scuta and terga are oblong, with the terga only three-quarters the size of the scuta.

Geographic distribution. Mediterranean, Atlantic Ocean, Pacific Ocean and Indian Ocean. Temperate to tropical waters.

Habitat. Chelonophilic, encapsulated in the lining of the mouth and the tongue of loggerhead sea turtles or attached to the

marginal edges (supermarginal and submarginal) of the carapace. The species attaches to all external dermal surfaces, including softer areas of the plastron. It is often found in sympatry with *S. elegans* and *S. pilsbryi* sp. n. when occurring on external regions of host turtles, particularly loggerheads. On nesting leatherbacks in Georgia, USA, it attaches to the skin on the sides of the neck and is situated in the wrinkle-borne crevices created when the host turtle moves its head.

Remarks. Pilsbry (1916) noted that *S. praegustator* bears a median groove (sulcus) running down the middle of each compartment, terminating at the tip of the triangle along the basal margin where the outer layer is wanting. Monroe and Limpus (1979) noted variability in this structure, with a conspicuous median groove generally more apparent and pronounced in *S. elegans*. The specimens collected from a single nesting leatherback turtle in Georgia, USA (n=16) were 7.0 to 4.5 mm in rostrocarinal diameter (RCD) and averaged 5.2 mm. *S. elegans* was also collected from the same leatherback turtle but occurred only on the skin of the shoulder region.

Stomatolepas elegans (Costa, 1838)
Figures 4, 5 and 6

Coronula elegans Costa: Costa 1838:117.

Chelonibia elegans (Costa): Costa 1839:14.

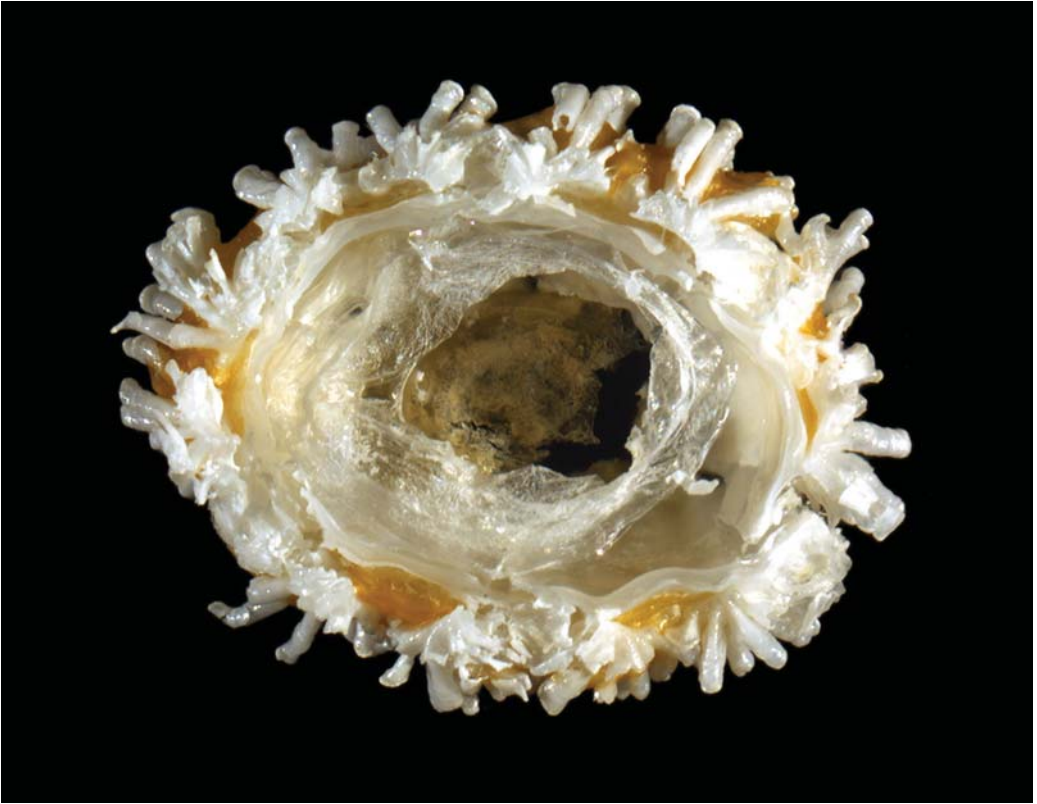


FIGURE 7. Apical view of paratype of *Stomatolepas pilsbryi* sp. n. (YPM 47954). Diameter 5.2 mm.



FIGURE 8. Lateral view of paratype of *Stomatolepas pilsbryi* sp. n. (YPM 47954). Diameter 5.2 mm.

Stomatolepas elegans (Costa): Pilsbry 1916;
Zullo and Bleakney 1966:162; McCann 1969:152;
Holthuis 1969:44; Smaldon and Lyster 1976:317; Carriol
and Vade, 2002:1033; Zardus and Balazs 2007:1307.
Stomatolepas dermochelys Monroe and Limpus, 1979:203;
Eckert and Eckert 1987:684, 1988:401; Haelters and
Kerckhoff 1999:30; Haelters et al. 2001:14.

Material examined. Nova Scotia, Canada: YPM 42743, 42746–42748, 42750, 42752–42753, 42755–42756, 42760, 42764, 42767, 42775–42778, 42788, 42794, 42796, 42798, coll. M. James, 18 Jul 2007 to 19 Sep 2007; Republic of Gabon, Africa: several specimens, coll. S. Deem; Wassaw Island, Georgia, USA: several specimens, coll. M. Frick.

Description. The shell profile is deeply bowl-shaped to conical and elliptical when viewed from above (Figures 4 and 5). Fimbriations simple, external surfaces of the plates elaborately ornamented with a closely situated series of rows of scale-like projections and a single, smooth triangular area, corresponding to the inner lamina, at the base of each plate. Platyspherulic projections are occasionally present, only surrounding the apical inner-laminar projections, but these never form aggregations creating a wide ridge as seen in *S. praegustator*. There is often a groove down the middle of each plate, separating the fimbriations or rows into two distinct sections. The lateral fimbriations are often slightly outwardly projected. The scales of the top third of each plate, including those surrounding the inner-laminar projection, are strongly projected out and upward, long and occasionally imbricate with those of neighboring plates. The inner-laminar apical projection is short and rarely exceeds a quarter of the length of the compartment. The basis is membranous (see Figure 5). The opercular valves are long, narrow, thin and deciduous. The scuta and terga are not similar. The terga are subrectangular. The scuta are sinusoidal with the tergal end wider than the rostral end, which is one-half to one-third as wide as the tergal end.

Geographic distribution. Cosmopolitan; tropical, subtropical and temperate waters (Carriol and Vader 2002) and likely sub-polar waters.

Habitat. Chelonophilic; attached to carapace, flippers and skin of sea turtles: *Caretta caretta*, *Chelonia mydas* (L.), *Dermochelys coriacea* and *Lepidochelys olivacea* (Eschscholtz).

Remarks. Specimens of *S. elegans* from Nova Scotia ranged in size from less than 1 mm to 7 mm RCD and were fully embedded in host tissue. Both male and female leatherbacks hosted *S. elegans* (n=10 and n=8, respectively) and two turtles of undetermined gender also hosted this species. Zullo and Bleakney (1966) also report *S. elegans* from this population of *D. coriacea*. Specimens from nesting and stranded leatherback turtles in Gabon, Africa (all adult females) ranged in size from less than 1 mm to 10.4 mm RCD and occurred in sympatry with *Stomatolepas pilsbryi* sp. n. in the shoulder region of host turtles. A single leatherback from Georgia, USA, hosted three *S. elegans* on the shoulder region. These specimens each measured 5 mm in RCD. The same turtle hosted *S. praegustator* on the neck region.

There has been confusion regarding the name *S. elegans*. The genus *Stomatolepas* was erected by Pilsbry (1910) to include the new taxon *Stomatolepas praegustator* Pilsbry from Florida, USA. Unbeknownst to Pilsbry, Costa (1838) had described a similar taxon from the Mediterranean as *Coronula elegans* Costa. Pilsbry (1916) later transferred *C. elegans* to the genus *Stomatolepas* and the combination *S. elegans* has been used subsequently in the literature. Monroe and Limpus (1979) discussed the occurrence of three distinct *Stomatolepas* (*S. transversa* Nilsson-Cantell, *S. praegustator* and *S. elegans*) on Australian sea turtles and declared *S. elegans* to be a *nomen dubium* because of the apparent loss of Costa's types, scant original description, and lack of host data. They then renamed *S. elegans* as *Stomatolepas dermochelys* Monroe and Limpus, and *S. dermochelys* has been used in tandem with *S. elegans* in several studies to refer to the same barnacle species (e.g., Haelters et al. 2001). In our opinion, the name *S. dermochelys* is unnecessary and we treat it here as a junior synonym of *S. elegans*. Because of the prior confusion in the *Stomatolepas* literature, and the scant original description of *S. elegans*, in order to stabilize nomenclatural usage we hereby designate specimen YPM 42775 (see Figures 4, 5 and 6) as **neotype** for *S. elegans* Pilsbry.

Stomatolepas pilsbryi Frick and Zardus n. sp. Figures 7 to 19

Material examined. *Holotype*: YPM 47953, Republic of Gabon, Africa, 19 Jan 2007, 1 specimen, coll. S. Deem. *Paratypes*: YPM 47954, no locality data, coll. S. Deem; YPM 47955, Gabon, 22 Jan 2007, 2 specimens, coll. S. Deem.

Description. Oval to round, apicobasally depressed shell that appears urchin-like when cleaned of host tissue (Figures 7, 8 and 9). Fimbriations are complex, bearing long multidirectional projections across the lateral surface of each plate. The projections are long, dorsoventrally flattened, thin, with their edges curling downward. Some of these projections are bifurcated and antler-like. They emanate from the edges of the radii and eventually interlock at the center of each plate in older, larger specimens, visually covering the entire exterior surfaces of all six plates. The branching emanations, up to 11 rows from apex to basis, form relatively, evenly spaced, concentric rings around the shell, where "rings" closest to the basis bear smaller, folded or ribbon-like emanations. The apical inner-laminar projection is very thin, almost transparent, and curves slightly inward to partially cover the orifice. The basal margin of each plate is curved upward and lacks the opaque triangular exposed inner-lamina seen in *S. elegans* and *S. praegustator*. The small portion of the inner lamina that is exposed along the basal margin of each plate is extremely thin and transparent, and can be altogether wanting on some specimens. The membranous basis is markedly smaller than the orifice (Figure 9). The sheath is long, regularly and delicately striated transversely, and has no distinct basal edge (Figures 10 and 11). The opercular plates are dissimilar. The terga are subrectangular. The scuta are sinusoidal with the tergal end wider than the other, which is one-half to one-third as wide as the tergal end. The labrum is notched, fringed with hairs and has three teeth on one side of the notch

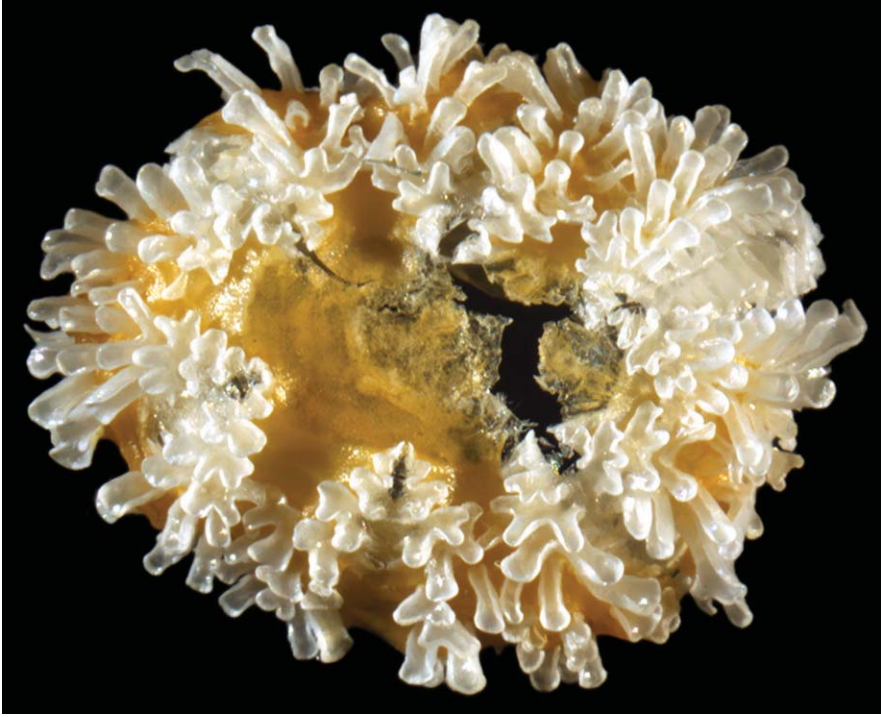


FIGURE 9. Basal view of paratype of *Stomatolepas pilsbryi* n. sp. (YPM 47954). Diameter 5.2 mm.



FIGURE 10. Carinolateral plate of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).



FIGURE 11. Carina of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

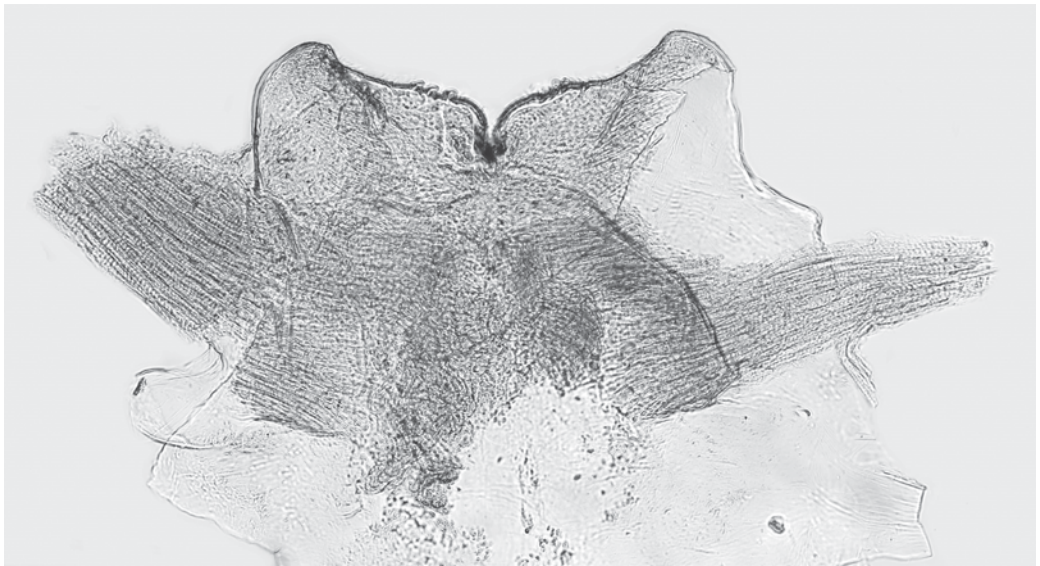


FIGURE 12. Labrum of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

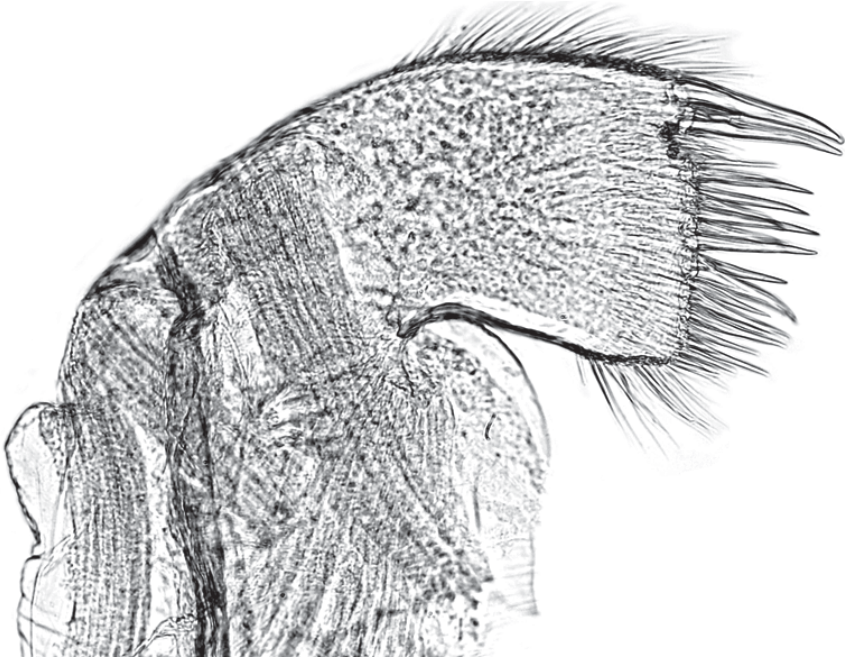


FIGURE 13. Palpus of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).



FIGURE 14. Mandible of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

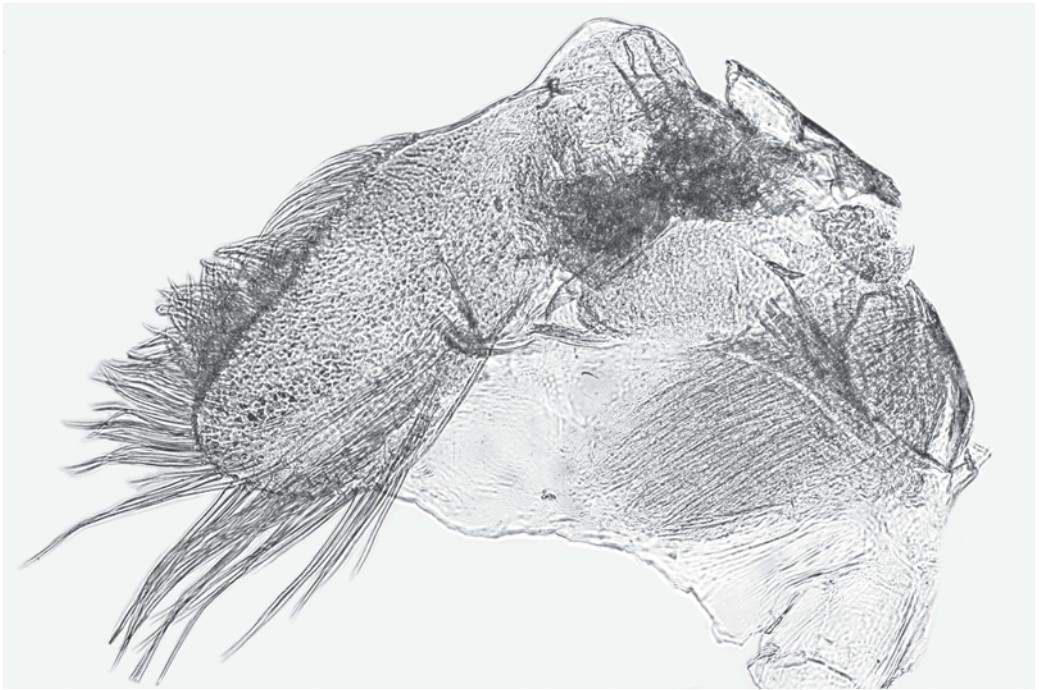


FIGURE 15. Maxilla of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).



FIGURE 16. Cirri 1 of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).



FIGURE 17. Cirri 2 of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

and one to two on the other (Figure 12). The palp is club-shaped, fringed medially, apically and disterolaterally with long setose setae (Figure 13). The mandible bears four to five main teeth. Occasionally there is one intertooth between the third and fourth main teeth and one between the fourth and fifth main teeth. The first main tooth is single, the second is double, the third and fourth are triple and the fifth, when present, is single (Figure 14). The inferior angle is moderately pectinate. Maxilla I is notched, with two large spines above the notch and 13 below; maxilla II bears a rounded outer lobe fringed with setae and a sparsely setose, small inner lobe (Figure 15). The cirri all bear a dense covering of long fine hairs (Figures 16 to 19). The penis is twice the length of the sixth cirrus, annulated and with an apical setal fringe.

Habitat. Chelonophilic; encapsulated in the soft skin of leatherback turtles.

Geographic distribution. Currently eastern South Atlantic distribution only (Gabon, Africa).

Etymology. Named for Henry August Pilsbry, late taxonomist and invertebrate zoologist who erected the genus *Stomatolepas* and described *S. praegustator*, among hundreds of other species of invertebrates.

Remarks. The rostracarinal diameters of the three *S. pilsbryi* specimens described here measure 6.5, 5.5 and 5.2 mm. Features of both *S. praegustator* and *S. elegans* are represented in the characters associated with *S. pilsbryi*. Both *S. praegustator* and *S. pilsbryi* are markedly depressed in profile when compared to the deeply bowl-shaped *S. elegans*. Like *S. praegustator*, a median groove where the ornamentation from each suture meets at the center of the plate is often obscure or absent altogether. Like *S. elegans*, *S. pilsbryi* is fully embedded within the host tissue in the shoulder region, although *S. elegans* will also colonize most other areas of the host turtle excepting the gullet. Both *S. elegans* and *S. pilsbryi* bear dissimilar opercular plates that are similarly shaped between the two species. *S. pilsbryi*, unlike *S. elegans* and *S. praegustator*, has an extremely thin transparent inner-lamina. The basal margin of each plate either lacks an exposed inner-laminar area along the basal edge of each compartment or the exposed inner-lamina is very short and curved, not opaque and triangular as in *S. elegans* and *S. praegustator*. The external ornamentation displayed by *S. pilsbryi* is very complex, more so than any other *Stomatolepas*, and only the basal fimbriations bear any similarity to either *S. praegustator* or *S. elegans*. Finally, the fimbriations of *S. pilsbryi* often bifurcate and interdigitate over the center of the radii, a characteristic not yet noted for either *S. elegans* or *S. praegustator*.

Acknowledgments

We thank Sharon Deem and Michael James for providing samples from leatherback turtles, and Kristina Williams for her support. Bill Newman of the Scripps Institution of Oceanography provided fruitful discussions on the new species and



FIGURE 18. Cirri 4 of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

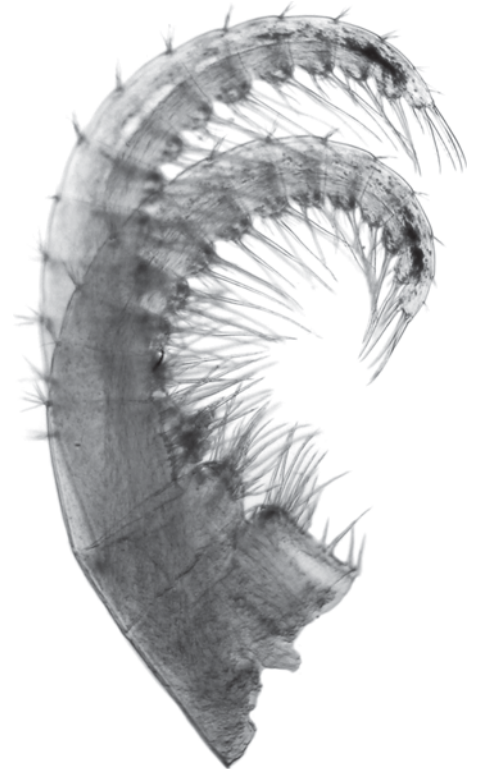


FIGURE 19. Cirri 6 of holotype of *Stomatolepas pilsbryi* n. sp. (YPM 47953).

comments from four reviewers greatly improved the initial manuscript.

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