

The genus *Labidodemas* (Holothuroidea: Aspidochirotida) revisited, with description of three new species and with re-positioning of *Holothuria* (*Irenothuria*) *maccullochi* Deichmann, 1958

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Prior to the present revision the taxon *Labidodemas* comprised *Labidodemas americanum*, *L. pertinax*, *L. rugosum* and *L. semperianum*. An up-to-date re-evaluation of the group proved that at least four additional species need to be assigned to it. Three of these are new to science: one has recently been discovered in the shallow waters of KwaZulu-Natal, Republic of South Africa; one originates from Low Island, Australia, and was erroneously identified as *L. semperianum*, and one stems from South-West Sulawesi, again erroneously identified as *L. semperianum*. In addition, *Holothuria maccullochi*, classified in the monotypic subgenus *Irenothuria*, and *Holothuria proceraspina* are assigned to *Labidodemas*; the former as a valid species and the latter as a synonym of *L. semperianum*. Annotated taxonomic descriptions, distribution maps and an identification key are given. The new observation that *L. americanum* possesses Cuvierian tubules suggests that its rank remains at generic level rather than at family level as was recently proposed.

KEYWORDS: Holothuroidea, Holothuriidae, Labidodematidae, Labidodemas, *Holothuria* (*Irenothuria*) *maccullochi*, new species, new combination, systematics.

Introduction

Currently, five nominal genera are commonly recognized in the family Holothuriidae: *Actinopyga* Bronn, 1860, *Bohadschia* Jaeger, 1833, *Holothuria* Linnaeus, 1767, *Labidodemas* Selenka, 1867 and *Pearsonothuria* Levin, 1984. Although the monophyletic origin of these genera has never been fully tested, no author has, since Rowe's revision of the Holothuriidae (1969), doubted their validity. In fact, the rank that is accorded to these genera is accepted by all but one

subsequent author. Indeed, James (1981) took Rowe's (1969: 126) phrase 'In truth I think *Labidodemas* may even prove to warrant separation at family level' quite literally and erected the family Labidodematidae. However, the diagnostic characters that James (1981) attributes to the Labidodematidae are not only not synapomorphic, but can also not be used to distinguish and separate the Labidodematidae from the Holothuriidae. We think it is imprudent, and at this stage even problematic, to treat *Labidodemas* as anything other than a valid genus in the Holothuriidae, until a phylogenetic analysis (be it a cladistic or an evolutionary one) indicates that the rank needs up- or downgrading.

The present paper re-describes the four species currently classified under *Labidodemas*, adds three species new to science, assigns *Holothuria (Ireothuria) maccullochi* Deichmann, 1958 to it and recognizes *H. proceraspina* (Cherbonnier, 1967) as a synonym of *L. semperianum* (Selenka, 1867). All eight species are keyed and distribution maps are given.

Museum acronyms

The following acronyms are used: ICML-UNAM, Institute of Marine Sciences and Limnology, National University of Mexico, Mexico; IRSNB, Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA; NHM, Natural History Museum, London, UK; NHM LAC, Natural History Museum Los Angeles County, Los Angeles, USA; RMCA, Royal Museum for Central Africa, Tervuren, Belgium; RMNH, Nationaal Natuurhistorisch Museum (Naturalis), Leiden, Netherlands; USNM, National Museum of Natural History, Washington, DC, USA; ZMG, Zoologisches Museum Göttingen, Göttingen, Germany; ZMH, Zoologisches Institut und Zoologisches Museum der Universität Hamburg, Hamburg, Germany.

Taxonomy

Family HOLOTHURIIDAE Ludwig, 1894

Genus *Labidodemas* Selenka, 1867

Emended diagnosis (after Deichmann, 1938: 363 and Rowe, 1969: 132).

[Type species: *Labidodemas semperianum* Selenka, 1867; by monotypy].

Size medium to moderate (100–200 mm long); body has two distinct morphotypes: vermiform or more cylindrical; ventral tube feet mainly in ambulacral areas, in one to four rows (sometimes also spread into the interambulacral areas); dorsal papillae and tube feet in ambulacral and often also in interambulacral areas, or absent altogether; anal papillae present or absent. Species fugitive to fossorial, with thin body wall and 20 tentacles. Tentacle ampullae short (1/12 to 1/100 of body length). Calcareous ring with massive radial pieces and narrow ribbon-like interradiial pieces. Body wall ossicles consist of variously developed tables, either with disc reduced and spire low, ending in a cluster of firm, often clavate, spines frequently longer than radius of table disc, or with disc well developed and with low to moderate spire ending in a cluster of firm spines or a wide, centrally perforated crown; buttons (when present), usually with rim smooth to slightly knobbed, some buttons spiny, often irregular and incompletely formed; in most cases minute, occasionally perforate, branching or

curved rods also present. Tube feet ossicles similar to those of body wall, with in addition rounded perforated plates. Tentacles always with smooth to slightly spiny rods. Longitudinal, transversal and cloacal retractor muscles devoid of ossicles. Cuvierian tubules present or absent.

Key to the genus *Labidodemas*

- 1 Tables with large disc perforated by at least two circles of peripheral holes 2
 – Tables with small disc without peripheral holes or with one circle of peripheral holes 3
- 2 Cuvierian tubules absent, tables with high spire. *L. maccullochi*
 – Cuvierian tubules present, tables with low spire or no spire *L. americanum*
- 3 Tables with low spire; table crown > table disc 4
 – Tables with low or high spire; table crown < table disc 5
- 4 Table disc spiny, with very few or without peripheral holes, four central holes; table crown with four long acute spines, occasionally bifurcated distally; table crown > table disc; buttons absent in body wall *L. quadripartitum* sp. nov.
 – Table disc spiny, with one circle of peripheral holes, four to six central holes; table crown with four to five long spines most of them bifurcated distally; table crown > table disc; buttons present in dorsal body wall *L. semperianum*
 – Table disc smooth, with one circle of peripheral holes, five to eight central holes; table crown with five to eight huge spines deeply bifurcated distally; table crown >> table disc (up to twice the diameter); buttons present in dorsal and ventral body wall. *L. pseudosemperianum* sp. nov.
- 5 Table spire high, buttons present and smooth *L. rugosum*
 – Table spire low, buttons present or absent; if present, spiny 6
- 6 Table disc with peripheral holes, buttons present; table crown very irregular
 *L. spineum* sp. nov.
 – Table disc nearly always without peripheral holes, buttons absent; table crown regular *L. pertinax*

Systematic account

Labidodemas americanum Deichmann, 1938

(figure 1A–F; map 1)

Labidodemas americanum Deichmann, 1938: 363, text-figures 1–5; H. L. Clark, 1946: 421; Domantay, 1953: 136; Deichmann, 1958: 286, pl. 1, figure 5; Caso, 1961: 373; Rowe, 1969: 133; James, 1981: 2; Maluf, 1988: 159; Maluf, 1991: 360; Nepote, 1998: 25.
Labidodemas americanum?; Brusca and Thomson, 1975: 46.

Original name. *Labidodemas americanum* Deichmann, 1938.

Name-bearing type. MCZ number not given.

Type locality. Jasper Island (Costa Rica).

Material examined. Mexico (Colima, La Peruena, Morro Pulpito), 10 January 1995, coll. F. Solis-Marin, USNM E51623 (one specimen); Mexico (Nayarit, Punta de Mita, Corral del Mangle), May 1995, 3 m depth, coll. C. Vizcarra, USNM E51619 (one specimen); Galapagos Islands (South Seymour Island), 19 January 1938, shore, NHMLAC 452-1 (two specimens); Costa Rica (Coco Islands, Chatham Bay), 14 January 1938, shore, NHMLAC 452-2 (two specimens); Galapagos Islands (Tower Island, Darwin Bay), 16 January 1938, shore, NHMLAC 452-3 (one specimen); Galapagos Islands (Osborn Island), 9 December 1934, intertidal, NHMLAC 452-5 (two specimens); Mexico (Gulf of California, Espiritu Santo Island), 23 February 1936, shore, NHMLAC 452-6 (three specimens); Mexico (Gulf of California, Calerita), 5 February 1997, coll. C. Sanchez

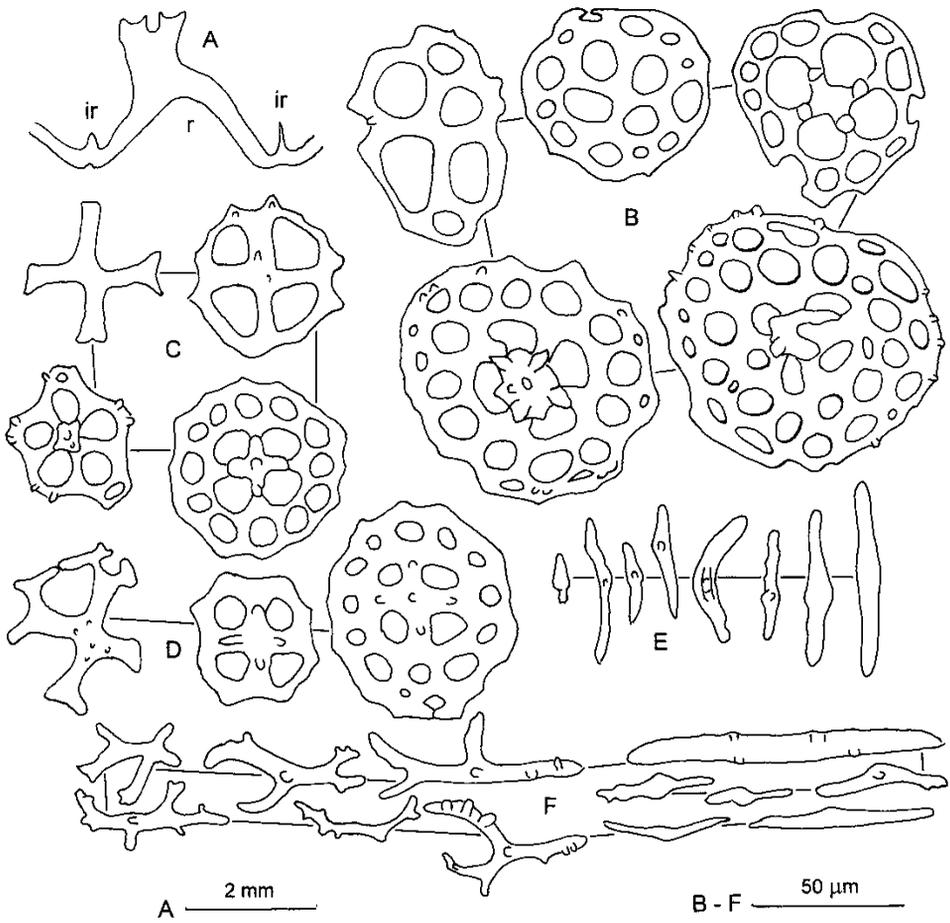
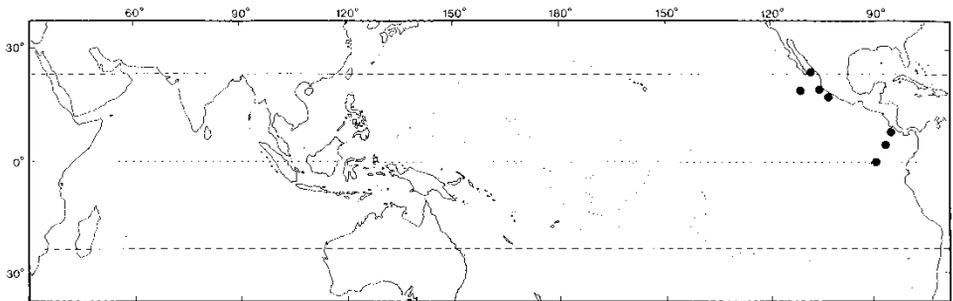


FIG. 1. *Labidodemas americanum* Deichmann, 1938. (A) Calcareous ring (r, radial plate; ir, interradial plate) (L=40 mm); (B) tables of body wall (L=85 mm); (C) tables of dorsal tube feet (L=85 mm); (D) tables of ventral tube feet (L=85 mm); (E) rods of tentacles (L=85 mm); (F) rods of tentacles (L=70 mm). Scale bars: 2 mm (A); 50 μ m (B-F).



MAP 1. Distribution of *Labidodemas americanum* Deichmann, 1938.

Ortiz and F. Solis-Marin, intertidal pool, ICML-UNAM 5.42.7 (three specimens); Mexico (Bahia de Banderas, Marieta Islands, Redonda Island), 22 March 1996, coll. F. Solis-Marin and C. Nepote, 15 m, ICML-UNAM 5.42.1 (one specimen); Mexico (Revillagigedo's Archipelago, Isla Socorro, Colima), 16 February 1992, ICML-UNAM 5.42.5 (two specimens); Galapagos Islands (Osborn Island, Hood Island), 19 December 1934, coll. F. C. Ziesenhenné, intertidal pool, ICML-UNAM 5.42.0 (one specimen); Mexico (Nayarit, Punta de Mita), 20 May 1995, unknown depth, coll. Y. Rodriguez, ICML-UNAM 5.42.3 (one specimen).

Diagnosis. See Deichmann, 1938: 363, text-figures 1–5; present revision.

Description. Colour of living specimens varies from green and almost transparent to yellowish. Colour in alcohol white to beige with yellow-brown tube feet to brown with brown-black tube feet. Specimens small (from 21×10 to 80×14 – 19 mm). Body cylindrical, slightly tapering anteriorly. Mouth and anus terminal, with large opening (nearly as wide as body). Mouth generally surrounded by 20 short tentacles. Ventrally, tube feet restricted to ambulacral areas; a zigzag pattern in lateral ambulacra, in double row mid-ventrally. Dorsally, tube feet few, scattered over the whole dorsal side, more or less aligned in four to five rows. Anal papillae absent. Calcareous ring (figure 1A) ribbon-like with large quadrangular radial plates and small, narrow, triangular, interradianal ones, anteriorly pointed. Radial plates with a small central anterior notch (attachment of the longitudinal muscle) surrounded by two small concavities (figure 1A) and a large posterior concavity. Polian vesicle single, one-tenth of body length; stone canal single, almost straight, anteriorly directed, ending in an ovoid madreporic plate close to calcareous ring. Tentacle ampullae very short ($\pm 3\%$ of body length). Tube feet ampullae visible on inner side of body wall. Gonad not observed. Cuvierian tubules brown to greenish, numerous, short and thick. Intestine contains coarse coral pieces up to $4.9 \times 4.6 \times 2$ mm.

Ossicles. Body wall and tube feet with tables only. Tables often reduced to disc (figure 1B), perforated by four large central holes and one (rarely two) circle(s) of smaller peripheral holes. Tables of body wall 50 – 75 μm across; rim of disc slightly knobbed or spiny (figure 1B), diameter of crown of spines 20 – 25% of disc diameter. Tables of tube feet derived from primary crosses (figure 1C, D), smaller (40 – 65 μm across) than those of body wall; disc often without peripheral holes. End plate of tube feet smaller dorsally (300 – 375 μm across) than ventrally (400 – 450 μm across). Tentacles hold short rods, 20 – 100 μm long, with central node (figure 1E); longer, branched and/or spiny rods in smaller specimens (figure 1F).

Ecology. Observation of *Labidodemas americanum* in their natural habitat in Bahia de La Paz (Gulf of California) and in Jalisco (Mexico) (F. Solis Marin, personal communication) shows that the species lives amongst pebbles and small rocks in shallow tidal pools or in waters up to 17 m depth. In the tidal pools of Bahia de La Paz, fissiparous behaviour was observed in one relatively long individual (Solis-Marin, personal communication). Such behaviour has been reported for other members of the Holothuriidae (Emson and Wilkie, 1980; Jaquemé et al., 1999), but hitherto not in *Labidodemas*. It is interesting to note that we, as Deichmann (1938: 364), failed to locate the gonad in all the specimens studied.

Geographical distribution (see map 1). Costa Rica (Jasper Island, Cocos Islands), Galapagos Islands (Osborn Island, Tower Island, South Seymour Island).

New geographical records made in present work: Mexico (Calerita, Bahia de Banderas, Marieta Islands, Redonda Island, Revillagigedo's Archipelago, Isla Socorro, Colima, Jalisco, La Peruena, Punta Mita, Pulmo Reef, Espiritu Santo Island, Bahia de La Paz).

Comments. Deichmann (1938) described two contracted specimens from Jasper Island (Costa Rica) as *L. americanum*. By doing so, she was the first to break the monotypy of the genus, as previous new species in *Labidodemas* all proved to be junior synonyms of *L. semperianum* or some *Holothuria* species (Sluiter, 1901; H. L. Clark, 1921; Panning, 1935a, b). H. L. Clark (1946) expressed some doubt about the generic status of Deichmann's species, but refrained from assigning it to another genus: 'Deichmann's *Labidodemas americanum* (1938) from the west coast of Costa Rica lacks the very characteristic tables of *semperianum*, and I am sceptical as to the two being congeneric' (H. L. Clark, 1946: footnote on p. 421). Later, in 1958, Deichmann had the opportunity to examine 13 additional specimens that were collected in the Galapagos Islands, Cocos Island and Espiritu Santo Island by the Hancock expeditions. She identified these specimens again as *L. americanum*, but unfortunately illustrated only a single ossicle and also did not address H. L. Clark's (1946) reservations.

Examination of several specimens from the NHMLAC (Hancock material) and the USNM leaves no doubt that *L. americanum* is a valid species. It can easily be distinguished from the other *Labidodemas* spp. by the presence of Cuvierian tubules, by the absence of rods and buttons in the body wall and by the reduced table spire. The number of ossicles present in the body wall is highly variable from one specimen to another.

The small size of the tentacles and the ampullae, and the very coarse intestinal content, show that *L. americanum* is clearly a non-selective feeder, only able to push very rough material into the mouth. Ingestion and ejection of such rough material is facilitated respectively by the wide opening of mouth and anus.

Labidodemas maccullochi (Deichmann, 1958)

(figures 2A–L, 3A–V; map 2)

Irenothuria maccullochi Deichmann, 1958: 306, pl. 4 figures 1–4; Caso, 1965:268, text-figure 16, pls IV (1–4), V (1–2).

Holothuria (Irenothuria) maccullochi: Rowe, 1969: 142, figure 11a, b; Maluf, 1988: 157.

Holothuria maccullochi: Hickman, 1998: 55 (colour picture), 65.

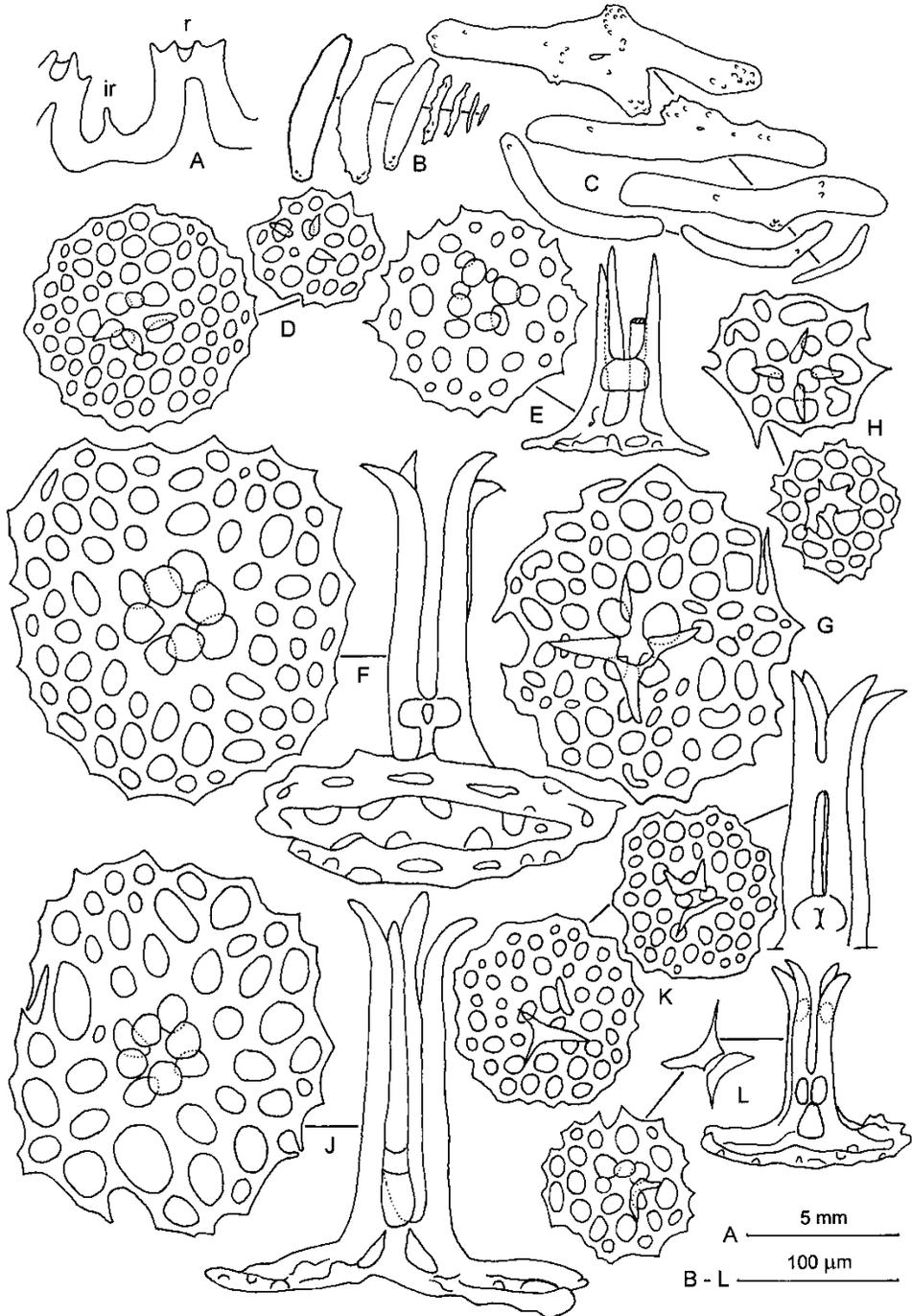
Original name. *Irenothuria maccullochi* Deichmann, 1958.

FIG. 2. *Labidodemas maccullochi* (Deichmann, 1958). (A) Calcareous ring (r, radial plate; ir, interradial plate) (L=98 mm, holotype); (B) rods of tentacles (L=98 mm, holotype); (C) rods of tentacles (L=220 mm); (D) tables of dorsal body wall (L=41 mm, paratype); (E) tables of dorsal body wall (L=51 mm); (F) tables of dorsal body wall (L=98 mm, holotype); (G) tables of dorsal body wall (L=100 mm); (H) tables of dorsal body wall (L=140 mm); (J) tables of dorsal body wall (L=220 mm); (K) tables of ventral body wall (L=41 mm, paratype); (L) tables of ventral body wall (L=51 mm). Scale bars: 5 mm (A); 100 μ m (B–L).

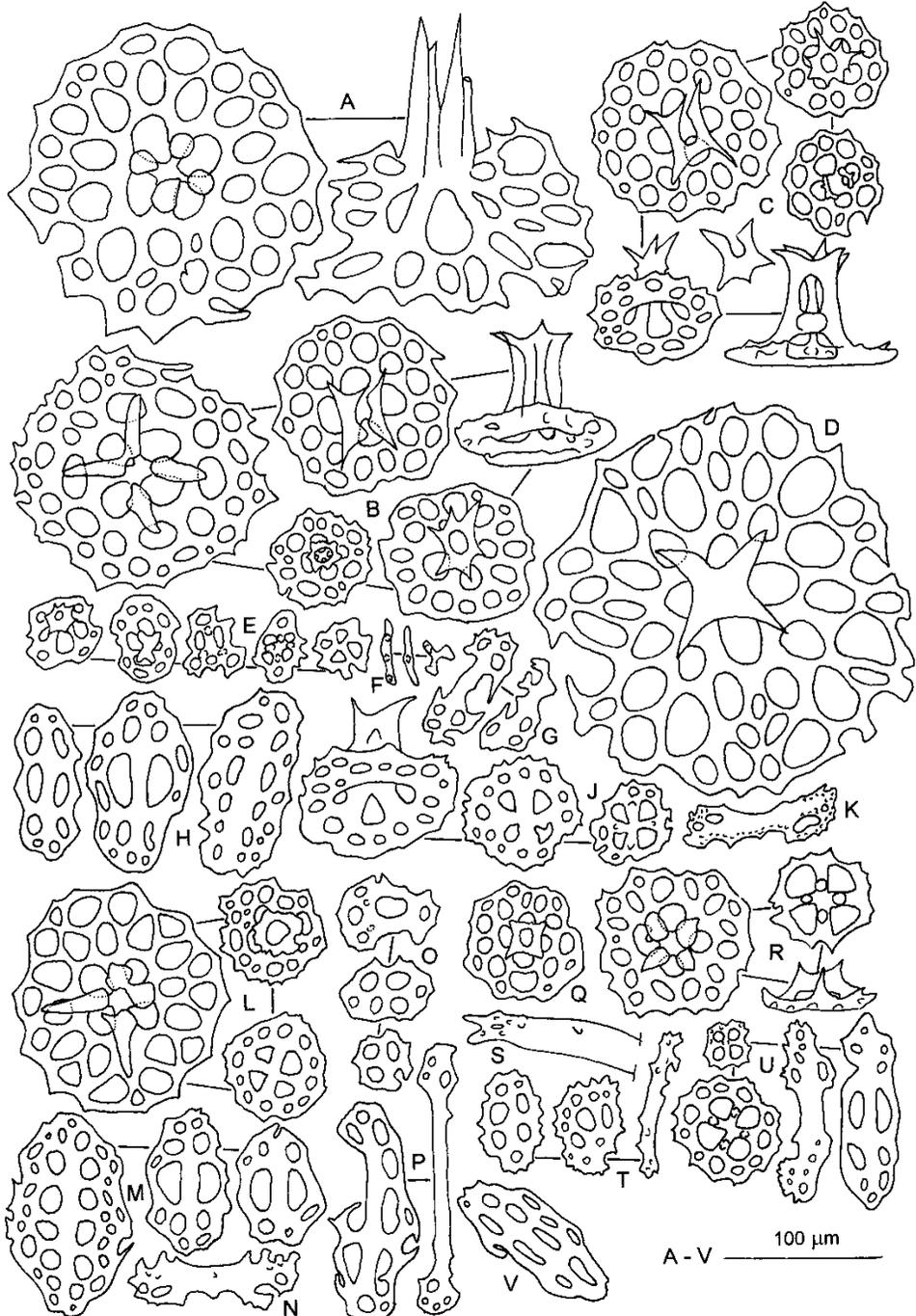
Name-bearing type. Holotype NHMLAC 232-34; paratype NHMLAC 256-34b.

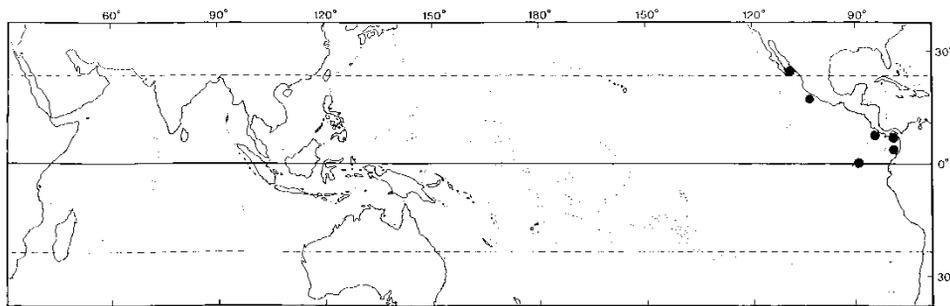
Type locality. Puerto Utria (Columbia).

Current status. *Labidodemas maccullochi* (Deichmann, 1958).



Material examined. Columbia (Puerto Utria, Velero III station 232-34: 5°59'10"N, 77°20'20"W), 14 February 1934, shore, rock, coll. Hancock expedition, NHMLAC 232-34 (holotype); Costa Rica (South of Mala pt., Port Culebra, Velero III station 256.34, 10°36'30"N, 85°42'15"W), 24 February 1934, coll.





MAP 2. Distribution of *Labidodemas maccullochi* (Deichmann, 1958).

Hancock expedition, NHMLAC 256–34b (paratype); Columbia (Octavia Bay, Velero III station 433.35: 6°49'50"N, 77°41'35"W), 27 January 1935, shore, coll. Hancock expedition, NHMLAC 433–35; Panama (Bahia Honda, Velero III station 861.38, 7°44'25"N, 81°32'45"W), 1 March 1938, shore, rock, coll. Hancock expedition, NHMLAC 861–38; Mexico (Bahia California, 7°44'25"N, 81°32'45"W), 16 August 1996, rock, sand, 15.9 m depth, coll. Ramirez-Murillo, ICML-UNAM 5.42.8 (two specimens identified as *Labidodemas americanum*).

Diagnosis. See Deichmann, 1958: 306; present revision.

Description. Medium to large species, live specimens up to 260 mm long (Hickman, 1998); preserved specimens from 41 to 220 mm long. Body cylindrical, but ventral side somewhat flattened. Body colour in life 'deep, brick red' (Hickman, 1998: 55), or as 'an unusually dark coloured *Brandtothuria impatiens*' (Deichmann, 1958: 307). Live specimens characterized by ventral tube feet that are 'yellow and arranged in irregular double rows', and dorsal papillae that are 'scattered, small and papilliform' (Hickman, 1998: 55). Preserved specimens with ventral tube feet arranged in somewhat irregular double rows in each ambulacrum and with dorsal papillae fewer in number and scattered over the bivium. Skin thin (1–3 mm thick), gritty to the touch. Mouth terminal surrounded by 20 tentacles; occasionally two of these positioned closer to the mouth than the rest. Anus terminal, very large, unguarded by anal papillae. Inner body wall with distinct dark brown spots. Cuvierian tubules absent. Tentacle ampullae

FIG. 3. *Labidodemas maccullochi* (Deichmann, 1958). (A) Tables of ventral body wall (L=98 mm, holotype); (B) tables of ventral body wall (L=100 mm); (C) tables of ventral body wall (L=140 mm); (D) table of ventral body wall (L=220 mm); (E) reduced tables of dorsal papillae (L=41 mm, paratype); (F) rods of dorsal papillae (L=41 mm, paratype); (G) pseudo-buttons of dorsal papillae (L=41 mm, paratype); (H) buttons to perforated plates of dorsal papillae (L=100 mm); (J) table and tables reduced to the disc of dorsal papillae (L=100 mm); (K) rugose, perforated rod of dorsal papillae (L=100 mm); (L) tables and table reduced to disc of dorsal papillae (L=140 mm); (M) buttons and perforated plate of dorsal papillae (L=140 mm); (N) rugose, perforated rod of dorsal papillae (L=140 mm); (O) tables reduced to the disc of dorsal papillae (L=220 mm); (P) pseudo-plate and perforated rod of dorsal papillae (L=220 mm); (Q) table of ventral tube feet (L=41 mm, paratype); (R) tables of ventral tube feet (L=98 mm, holotype); (S) fragment of perforated rod of ventral tube feet (L=98 mm, holotype); (T) pseudo-buttons and rod of ventral tube feet (L=100 mm); (U) reduced tables and pseudo-plates of ventral tube feet (L=140 mm); (V) irregular button of ventral tube feet (L=220 mm). Scale bar: 100 μ m (A–V).

short (1/20 of body length in the 220 mm specimen). Two well-developed Polian vesicles (one-tenth of body length in the 220 mm specimen). Single, heavily twisted stone canal, short (4.5 mm long in the 220 mm specimen) ending in an ovoid madreporic plate. Calcareous ring ribbon-like, composed of large radial pieces and low interradial ones; radial pieces with deep posterior concavity; anteriorly a central notch (attachment for the longitudinal muscle) surrounded by two small concavities (figure 2A); interradial pieces very slender with a well-developed anterior tooth (figure 2A). Digestive tract filled with very coarse debris, ranging from sand and coral pieces to shell fragments and spine fragments of cidarid sea urchins.

Ossicles. Tentacles with variously developed rods, generally smooth but some minute knobs can be found (figure 2B, C). Ventral and dorsal body wall with numerous tables only (figures 2D–L, 3A–D). Diameter of tables of dorsal body wall varies from one specimen to another but without clear relationships with body length (see table 1).

Disc perforated by numerous holes sometimes arranged in two to three circles around the four central holes which are slightly wider than the rest (figures 2D–L, 3A–D), rim of disc spiny; spire moderately high to high; generally one cross beam although the pillars can be connected two by two near the apex giving the impression of a crown; pillars diverge near the tip, tapering to a point. Tables of ventral body wall similar to those of dorsal body wall, but generally somewhat smaller and with the pillars more often connected to each other (figures 2K, L, 3A–D). Dorsal papillae with tables, rods, pseudo-buttons and wide plates (figure 3E–P). Tables similar to those of body wall but of the reduced type (disc only); type specimen has numerous tables with a low spire; smallest specimen (41 mm) only with reduced tables (figure 3E), slightly knobbed rods (figure 3F) and pseudo-buttons (figure 3G). Specimens from Bahia California (L = 100 and 140 mm) with reduced as well as well-developed tables (always smaller than those from the body wall) (figure 3J, L), variously perforated rods (figure 3K, N), buttons to wide plates (figure 3H, M); the longest specimen (L = 220 mm) with variously developed tables, rods and pseudo-buttons, never with wide plates (figure 3O, P). Ventral tube feet with an ossicle assemblage similar to that of dorsal papillae, however, without wide plates (figure 3Q–V).

Ecology (after Deichmann, 1958 and Hickman, 1998). Rare species, intertidal and shallow water, covered with sand while foraging. The specimens from Bahia California were found subtidally, at depths of ± 16 m.

Table 1. Length of specimens table versus sizes and localities for *Labidodemas maccullochi* (Deichmann, 1958).

Length of specimens (mm)	Diameter of tables from dorsal body wall (μm)	Locality	Figures
41	85–150	Costa Rica	2D
51	110–175	Columbia	2E
98	110–235	Columbia	2F
100	100–185	Mexico, Bahia California	2G
140	80–125	Mexico, Bahia California	2H
220	215–235	Panama	2L

Geographic distribution (see map 2). From the Gulf of California to Columbia and the Galápagos Islands

Comments. As can be seen on the original labels, Domantay, in 1949 and 1950, seems to be the first who attempted to identify the NHMLAC specimens. He put the name *Holothuria mortenseni* sp. nov. to them, after the first collector, T. Mortensen, who, in 1916, had found the species in Panama. Domantay (1953: 135) published the name *Holothuria mortenseni* sp. nov. in a list, without any description or illustration. Under the rules of the International Code of Zoological Nomenclature, Domantay's name *mortenseni* is not valid (article 9.6: labels of specimens do not constitute published work; article 13.1.1: to be available a new name published after 1931 must be accompanied by a description or a definition that states in word characters that are purported to differentiate the taxon) and Deichmann's (1958) name *maccullochi* must be retained. The specimens here examined are to a large extent the same as those Deichmann (1958) studied (Hancock material). Deichmann (1958: 307) noted that 'The Hancock material ranges in length from 4 to 20 cm. No striking differences were found between the spicules in these different age groups except that they become slightly larger with advancing age [*sic.*]'. The present observations substantiate Deichmann's (1958) observations. However, we are at present not able to construct unambiguous growth series as not enough material is available to us.

Deichmann's (1958) statement that Cuvierian tubules are present in some individuals could not be substantiated, hence we believe that Deichmann's (1958) specimen series holds an additional species. *Labidodemas americanum* is a likely candidate as it thrives in the same region and has a comparable habit, but it is strange that Deichmann failed to recognize it as such for, she had erected *L. americanum* 20 years earlier.

It is interesting to note that the calcareous ring of *L. maccullochi* is very similar to that of *L. americanum*. Both species share also two circles of peripheral holes in the table discs, a character which is not present in the other species belonging to the genus *Labidodemas*.

It is tempting to create a new species for the two specimens from Bahia California, as these differ from the other material in possessing wide plates in the dorsal papillae (figure 3H, M). It could be coincidental, but they were also found subtidally rather than intertidally as has always been reported for *L. maccullochi*. However, we refrain from doing so because the ossicle assemblage from the dorsal papillae of the type could not be examined since these could not be located on the poorly preserved specimen. For now, we keep a conservative attitude and attribute the observed differences to geographic variation. As such, two discrete populations are discernible: one in Bahia California and one on the west coast of northern South America. The specimens from the Galápagos Islands most probably belong to the southern population as Hickman (1998: 65) reports that the 'dorsal papillae contain a few supporting rods with perforated ends, and small perforated discs of various shapes' [*sic.*], exactly as Deichmann (1958) put in the diagnosis of *Ireothuria*.

***Labidodemas pertinax* (Ludwig, 1875)**

(figure 4A–K; map 3)

Holothuria pertinax Ludwig, 1875: 100, pl. 7 figure 50; Théel, 1886: 208; Cherbonnier, 1955: 139, figure 3a–j; Cherbonnier, 1967: 63.

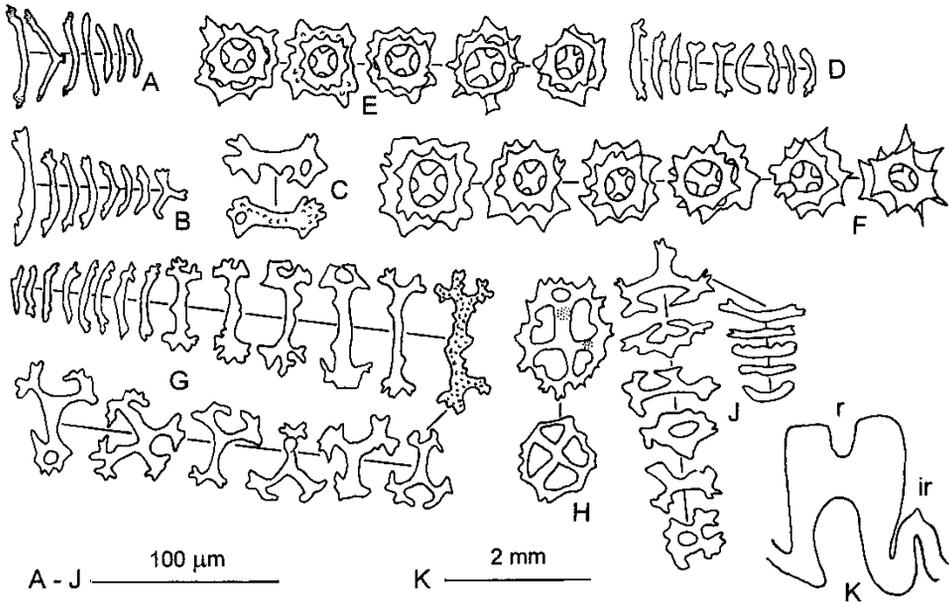


FIG. 4. *Labidodemas pertinax* (Ludwig, 1875) (L=140 mm). (A) Rods of tentacles; (B, C) rods of ventral body wall; (D) rods of dorsal body wall; (E) tables of ventral body wall; (F) tables of dorsal body wall; (G) rods of ventral tube feet; (H) tables of ventral tube feet; (J) rods of dorsal papillae; (K) calcareous ring (r, radial plate; ir, interradial plate). Scale bars: 100 μ m (A–J); 2 mm (K).

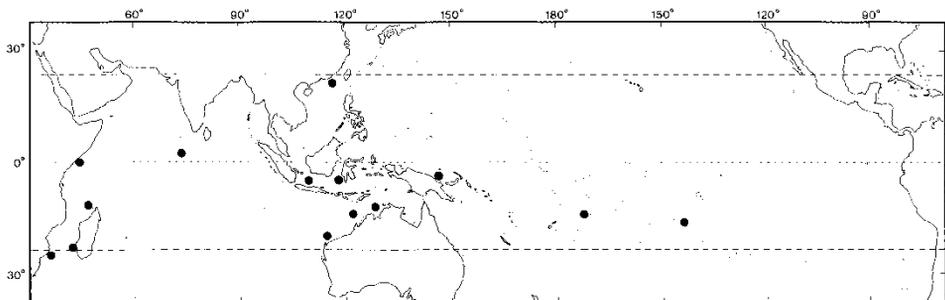
Holothuria (Holothuria) pertinax: Panning, 1935a: 75, figure 57.

Labidodemas pertinax: Cherbonnier, 1988: 52, pl. 18A–L; Marsh *et al.*, 1993: 57; Rowe and Gates, 1995: 304; Liao, 1997: 92, figure 52a–d; Samyn and Vanden Berghe, 2000: 25, pl. 2D; Samyn, 2000: 15; Lane *et al.*, 2000: 489.

Labidodemas semperianum: Rowe, 1969: 132, figure 4 only (not text); Clark and Rowe, 1971: 176 (part); Liao, 1975: 209, figure 9 (1–7) (non *L. semperianum* Selenka, 1867); Humphreys, 1981: 33 (non *L. semperianum* Selenka, 1867); Massin, 1999: 61, figure 49 (specimen IRSNB IG.28251/197: non *L. semperianum* Selenka, 1867).

Labidodemas semperiana: Clark and Rowe, 1971: pl. 28 figure 12 (*lapsus calami* for *Labidodemas semperianum*; non *L. semperianum* Selenka, 1867).

Labidodemas petinax: Rowe and Richmond, 1997: 302 (*lapsus calami* for *Labidodemas pertinax*).



MAP 3. Distribution of *Labidodemas pertinax* (Ludwig, 1875).

Original name. *Holothuria pertinax* Ludwig, 1875.

Name-bearing type. Holotype ZMH E. 2608.

Type locality. Samoa (as Navigator Islands).

Current status. *Labidodemas pertinax* (Ludwig, 1875).

Material examined. Samoa, collecting date and depth unknown, coll. Kubary, ZMH. E.2608 (Mus. Godeffroyi 9946, holotype); Republic of South Africa (KwaZulu-Natal, Sodwana Bay, 7 Mile Reef), February 2000, 23 m depth, coll. Y. Samyn, RMcA1692/RSAKZN/0064 (one specimen); Republic of South Africa (KwaZulu-Natal, Sodwana Bay, 2 Mile Reef), February 2001, 12 m depth, coll. Y. Samyn, RMcA1693/RSAKZN/0156 (one specimen); Kenya (Kiunga Marine Reserve, Mkomani), April 1999, 1 m depth, coll. Y. Samyn, IRSNB IG 28 268/KKiun/9919 (one specimen); Kenya (Kiunga Marine Reserve, Mlango wa Bomani), April 1999, 1–4 m depth, coll. Y. Samyn, IRSNB IG 28 268/KKiun/9920 (two specimens); Indonesia (Java Sea), NHM 89.6.15.34 (one specimen); Maldives, NHM 1955.10.14.48 (one specimen); Indonesia (Celebes Islands, Kapoposang), 28 September 1994, 5 m depth, under a coral slab, coll. C. Massin, IRSNB IG.28251/197 (one specimen identified as *L. semperianum*); Kenya (Watamu), 20 August 1969, beneath rock, coll. W. Humphreys, NHM 1979.2.5.229 (one specimen identified as *L. semperianum*); Maldives (Male Atoll, Dunidu Island), 18 March 1964, 4 m depth, coll. F. Ziesenhenné, USNM E11583 (one specimen); Papua New Guinea (Hansa Bay, Laing Island, K3), 12 October 1996, 1 m depth under rocks, coll. J.-M. Ouin, IRSNB IG 28455/36 (one specimen).

Diagnosis. See Cherbonnier, 1988: 51, figure 18.

Description. Small to medium-sized species, preserved specimens 84–152 mm long and 10–19 mm wide. Body cylindrical, tapering anteriorly, mouth and anus terminal. Colour in life and alcohol identical: uniform white dorsally with a very faint yellow to pinkish shine ventrally; mouth surrounded by a 5 mm wide dark purple to brown ring in largest specimen and 1 mm wide in smallest specimens. Skin thin, gritty to the touch. Mouth surrounded by 20 (occasionally fewer), small, dirty white, tentacles. Tentacle ampullae very short: 1.5–4 mm long for specimens 88–100 mm long. Ventral side with long, cylindrical, yellow to brownish tube feet in ambulacral areas (in two rows in median ambulacrum); dorsal side with fewer, short, whitish tube feet and papillae somewhat scattered in ambulacra and interambulacra. Cuvierian tubules absent. Calcareous ring slender with massive radial pieces, each with anterior notch, and interradial pieces minute, ribbon-like, each with one anterior tooth-like projection (figure 4K).

Ossicles. Tentacles with smooth rods, 25–50 μm long, slightly rugose at extremities (figure 4A). Ventral and dorsal body wall with small, 25–65 μm long, rods similar to those of tentacles (figure 4B, D), some more stout rods (figure 4C) and tables (figure 4E, F). Rods more abundant in ventral than in dorsal body wall; the reverse for the tables. Tables with disc 40–60 μm across, perforated by four central holes and occasionally some small peripheral holes (see Cherbonnier, 1988: 52, figure 18A, B, D, H); rim of disc regularly spiny; height of spire lower than width of disc; spire with single cross beam or none, ending in a crown with a wide central opening; diameter of crown 60–90% of disc diameter (figure 4E, F). Ventral tube feet with rods similar to those of body wall in addition to more stout rods, 45–75 μm long, occasionally branched and/or perforated

(figure 4G); some ill-formed tables (disc and occasionally one or two pillars) present (figure 4H). Dorsal papillae with rods similar to those of ventral tube feet (figure 4J).

Ecology. Shallow-water species reported from tidal pools to depths of 23 m; deposit/detritus feeder; hides under coral slabs, in and on coarse coral debris and small rocks.

Geographical distribution (see map 3). Madagascar (Glorious Islands), Kenya, Maldives, Java Sea, Australia (NW Coast, Western Australia, Scott Reef), Samoa.

New geographical records made in present work: South Africa (KwaZulu-Natal), Madagascar (Tuléar), China, Tahiti.

Comments. Rowe (1969) did not distinguish between *L. semperianum* and *L. pertinax*, and used the latter species (specimen NHM 1955.10.14.48 from the Maldives) to illustrate the ossicles of *L. semperianum* in his revision of the Holothuriidae. Cherbonnier (1970) correctly noted that the ossicles illustrated by Rowe (1969) are different from those typical of *L. semperianum*. Regrettably, he explained this anomaly by stating that Rowe (1969) perhaps illustrated ossicles from tube feet or corroded ossicles. In 1971, Rowe (*in* Clark and Rowe) illustrated specimen NHM 89.6.15.34 as *L. semperiana*. An examination of his illustration clearly shows that it is *L. pertinax*. It was only in 1988, on the basis of two specimens from Glorious Islands and one from the NHM collections, that Cherbonnier (1988) realized that *H. pertinax* is a valid species in *Labidodemas*. It has been treated as such since then (Marsh *et al.*, 1993; Rowe and Gates, 1995; Liao, 1997; Rowe and Richmond, 1997; Lane *et al.*, 2000; Samyn, 2000; Samyn and Vanden Berghe, 2000). The present revision corroborates this finding.

***Labidodemas pseudosemperianum* sp. nov.**

(figures 5A–K, 6A–G; map 4)

Labidodemas semperianum: Massin, 1999: 61, figures 49, 111f (non *L. semperianum* Selenka, 1867).

Name-bearing type. Holotype RMNH Ech 6087.

Material examined. Indonesia (Celebes, Kapoposang), 30 September 1994, 5 m depth under a coral slab, coll. C. Massin, RMNH Ech 6087 (holotype); Mariana Islands (Guam, Tumon Bay), 14 August 1992, 1 m depth under rocks, outer reef flat at south part of bay, coll. A. Kerr, USNM E 53083 (one specimen).

Diagnosis. Medium-sized species, body cylindrical, white-pink with yellow tube feet; around the mouth colour deep pink to brown. Calcareous ring ribbon-like; ventral body wall with tables and buttons; dorsal body wall with tables, buttons, pseudo-buttons and rods; disc of tables smooth; spire of tables low, single cross beam; crown of spines with 2–10 central holes and five to eight huge, often deeply bifurcated spines; crown of spines up to twice the diameter of the table disc.

Description. Holotype 120 × 10 mm; specimen from Guam 48 × 11 mm. Living holotype white pink with pink-brown around the mouth; in alcohol uniformly white. Body cylindrical with mouth and anus terminal; mouth surrounded by 20 tentacles; few long, slender, slightly conical papillae scattered over the whole bivium, presenting a vague alignment in three double rows close to the mouth

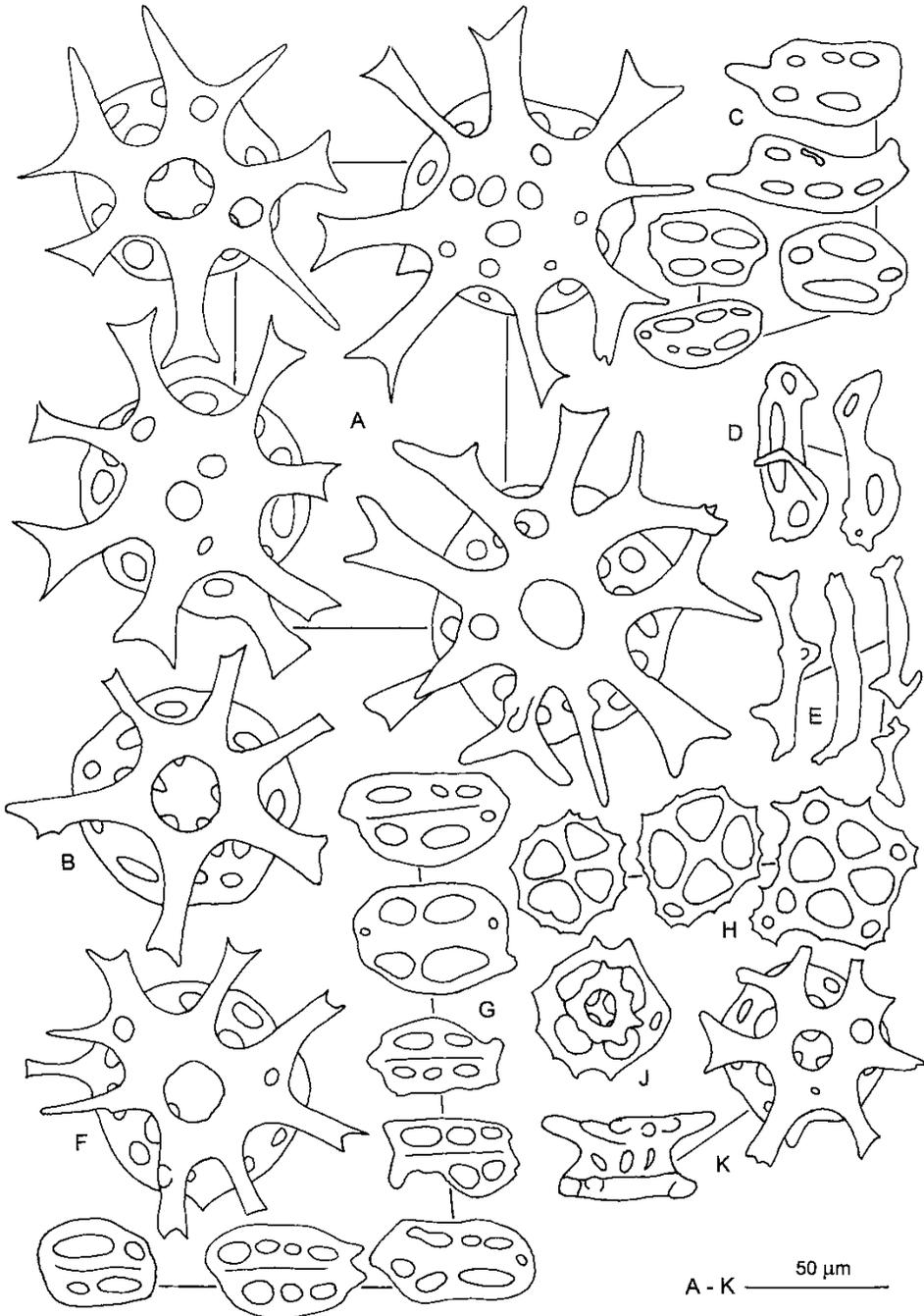


FIG. 5. *Labidodemas pseudosemperianum* sp. nov. (A) Tables of dorsal body wall (holotype); (B) table of dorsal body wall (USNM E53083); (C) buttons of dorsal body wall (holotype); (D) pseudo-buttons of dorsal body wall (USNM E53083); (E) rods of dorsal body wall (USNM E53083); (F) table of ventral body wall (holotype); (G) buttons of ventral body wall (holotype); (H) tables reduced to disc of dorsal tube feet (holotype); (J) reduced table of dorsal tube feet (holotype); (K) tables of dorsal tube feet. Scale bar: 50 μ m (A-K).

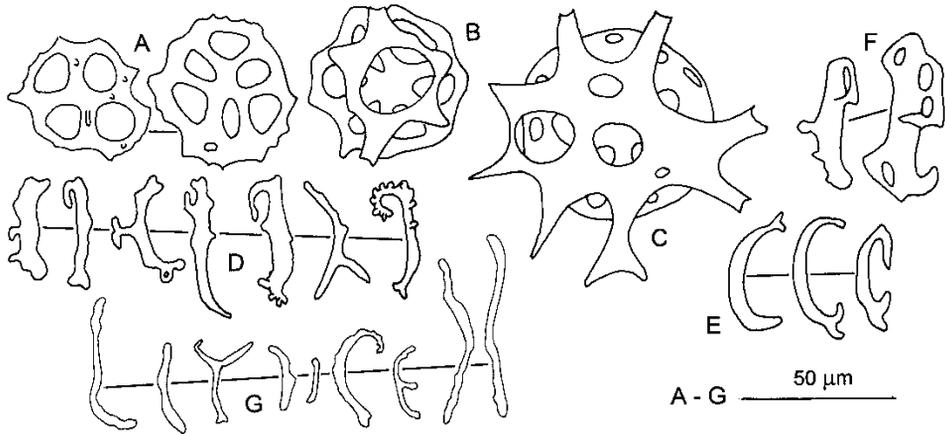
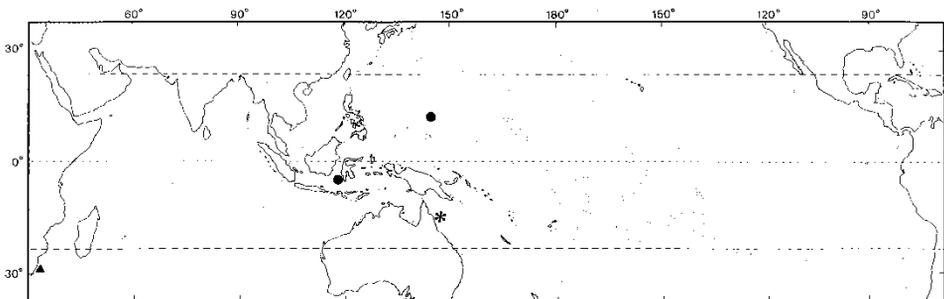


FIG. 6. *Labidodemas pseudosemperianum* sp. nov. Holotype. (A) Tables reduced to disc of ventral tube feet; (B) reduced table of ventral tube feet; (C) table of ventral tube feet; (D) rods of ventral tube feet; (E) C-shaped rods of ventral tube feet; (F) pseudo-buttons of ventral tube feet; (G) rods of tentacles. Scale bar: 50 μm (A–G).

and the anus. Tube feet very long, restricted to the ambulacra; in each ambulacrum two rows of tube feet in a zigzag pattern. Calcareous ring ribbon-like, composed of massive radial pieces and narrow interradiar pieces (cf. figure 49 in Massin, 1999). One Polian vesicle and one stone canal going upwards and ending in a muriform madreporic plate. Digestive tract filled with very rough calcareous sand. Cuvierian tubules not observed; tentacle ampullae short (1/12 to 1/20 of body length).

Ossicles. Dorsal body wall with tables (figure 5A, B), buttons (figure 5C), pseudo-buttons (figure 5D) and rods (figure 5E). Table disc 70–95 μm across with five to eight central holes and 5–15 peripheral holes; rim of disc smooth, sometimes with single long spine (figure 5A). Table spire low with one cross beam and ending in a crown of spines with 2–10 central holes and five to eight huge spines, most of these deeply bifurcated distally; table crown always larger than table disc (up to twice the table disc; figure 5A). Buttons very irregular, 40–70 μm long, with two to four pairs of holes (figure 5C); numerous in the holotype, rare in the specimen from Guam. Rods and pseudo-buttons present



MAP 4. Distribution of *L. pseudosemperianum* sp. nov. (dots); *L. quadripartitum* sp. nov. (triangle) and *L. spineum* sp. nov. (asterisk).

Table 2. Differences in body wall ossicles of *Labidodemas semperianum* Selenka, 1867, *L. pseudosemperianum* sp. nov. and *L. quadripartitum* sp. nov.

Character	<i>L. quadripartitum</i> sp. nov.	<i>L. semperianum</i> Selenka, 1867	<i>L. pseudosemperianum</i> sp. nov.
Tables	Disc with four central holes Disc with zero to two (occasionally six) peripheral holes Disc 30–60 μm across Rim of disc spiny Crown with four huge spines that occasionally bifurcate distally Table disc < table crown Crown of spines with one central hole	Disc with four to six central holes Disc with 5–10 peripheral holes Disc 55–90 μm across Rim of disc spiny Crown with four to five huge spines that bifurcate slightly distally Table disc \leq table crown Crown of spines with one (occasionally two) central hole	Disc with five to eight central holes Disc with 5–15 peripheral holes Disc 70–95 μm across Rim of the disc smooth Crown with five to eight huge spines that bifurcate deeply distally Table disc << table crown (crown up to twice the disc) Crown of spines with 2–10 central holes
Ventral buttons	Dorsal tables few Absent	Dorsal tables numerous Absent	Dorsal tables numerous Present
Dorsal buttons	Absent	Present	Present

only in the specimen from Guam (figure 5D, E). Ventral body wall with tables (figure 5F) and buttons (figure 5G) similar to those of dorsal body wall; a few irregular rods in the specimen from Guam. Dorsal tube feet with plates and tables; close to the end plate, perforated plates with spiny edge (figure 5H); middle of tube feet has tables with reduced crown of spines (figure 5J); base of tube feet with tables, 40–60 μm across, similar to those of body wall (figure 5K). Ventral tube feet with numerous rods (figure 6D), some of them C-shaped (figure 6E), and a few pseudo-buttons (figure 6F); base of tube feet with few tables similar to those of body wall (figure 6C) in addition to many reduced tables (figure 6B); close to end-plate spiny perforated plates (tables reduced to disc) also present (figure 6A). Tentacles with small rods, 15–60 μm long, straight, curved and Y-shaped (figure 6G).

Etymology. The name *pseudosemperianum* refers to the close similarity between the new species and *Labidodemas semperianum*.

Geographical distribution (see map 4). Indonesia (Celebes, Kapoposang); Mariana Islands (Guam).

Ecology. Shallow waters (1–5 m depth) under coral rocks; digestive tract filled with rough sand.

Comments. At first glance (general morphological and anatomical aspects), *Labidodemas pseudosemperianum* is hard to distinguish from *L. semperianum* or *L. pertinax*. However, close examination of the ossicles (mainly the tables) reveals clear differences (see table 2) which cannot be linked to the size of the specimens. The two examined specimens of *L. pseudosemperianum* are 120 and 48 mm long and both have smooth table discs whereas all the examined specimens of *L. semperianum* (from 64 to 125 mm long) have spiny table discs. If the observed ossicle variation should be dependent on the body length, one would expect to find more spiny or knobbed ossicles with increasing body size (Massin, 1994; Massin *et al.*, 2000); the reverse is true in the present situation.

The three main characters specific to *L. pseudosemperianum* are: (1) the smooth edge of the table disc, (2) the numerous holes of the crown of spines and (3) the presence of buttons in the dorsal and ventral body wall. As the other characters (see table 2) show a progressive change from *L. quadripartitum* sp. nov. (see below) over *L. semperianum* to *L. pseudosemperianum*, one could suspect a highly variable species. However, as these variations could not be linked to zoogeography, ecology or to the size of the specimens, such cannot be the case. Moreover, a highly variable species would be exceptional within the genus *Labidodemas*, as all the other species show little, if any, variation through their distribution area and their size.

Up to now, *L. pseudosemperianum* is restricted to the West Pacific shallow waters.

***Labidodemas quadripartitum* sp. nov.**
(figure 7A–G; map 4)

Name-bearing type. Holotype RMcA1694/RSAKZN/0196.

Type locality. Sodwana Bay, 1/4 Mile Reef (Republic of South Africa).

Material examined. Republic of South Africa (KwaZulu-Natal, Sodwana Bay, 1/4 Mile Reef), February 2001, 12 m depth, coll. Y. Samyn, RMcA1694/RSAKZN/0196 (holotype).

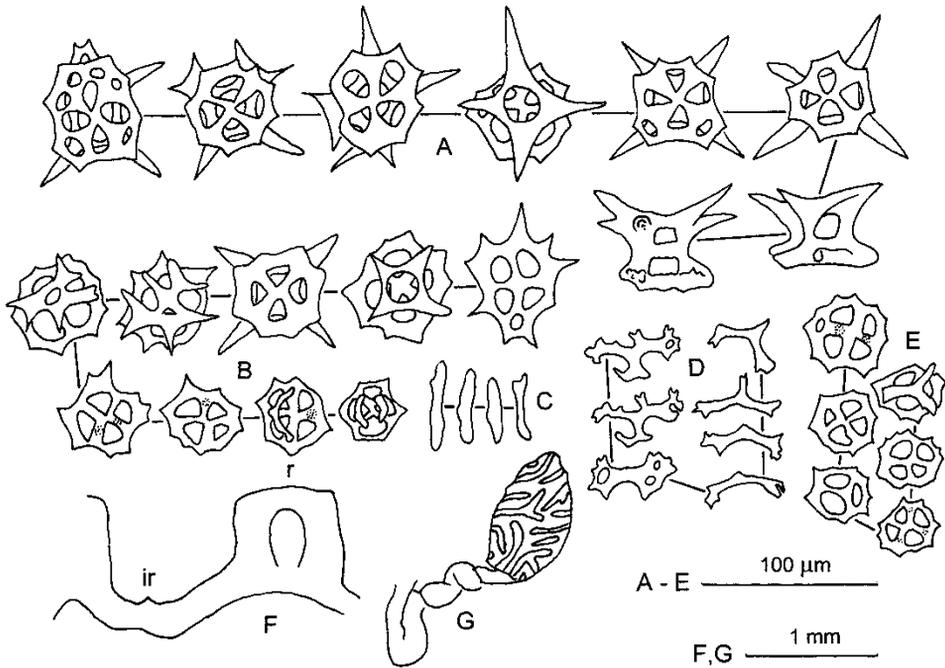


FIG. 7. *Labidodemas quadripartitum* sp. nov. (L=110 mm). (A) Tables of ventral body wall; (B) tables of dorsal body wall; (C) rods of dorsal body wall; (D) rods of ventral tube feet; (E) tables of ventral tube feet; (F) calcareous ring (r, radial plate; ir, interradial plate); (G) stone canal and madreporic plate. Scale bars: 100 μ m (A-E); 1 mm (F, G).

Diagnosis. Medium-sized species; body vermiform; dorsal body wall whitish, ventral body wall reddish; calcareous ring ribbon-like; ventral body wall with tables only; dorsal body wall with tables and rods; tables with rim of disc spinose; spire of table low, single cross beam; crown of tables with four huge (occasionally slightly bifurcated) spines, wider than disc diameter.

Description. Specimen 110 mm long and 8 mm wide at its widest point. Body vermiform, tapering anteriorly with mouth and anus terminal. Colour in life similar to colour in alcohol: dorsally whitish yellow, ventrally claret-red. Skin thin (1–2 mm), rather smooth to the touch. Mouth terminal, tentacles retracted; number could not be determined. Anus small, terminal. Anal papillae absent. Ventral side with short but wide brownish tube feet distributed in three rows in ambulacral areas; dorsal side at first sight apparently without tube feet or papillae, but examination of inner body wall reveals large tube feet ampullae in ambulacral areas. Cuvierian tubules absent. Calcareous ring ribbon-like, with radial pieces 2.5 times height of interradials; radial pieces massive, with medial depression for longitudinal muscle, posterior margin slightly concave; interradial pieces brittle, anteriorly with tooth-like projection (figure 7F). Stone canal contorted, ending in large madreporic plate (figure 7G). Gonad not observed.

Ossicles. Dorsal and ventral body wall devoid of buttons. Ventral body wall (figure 7A) with tables only; table disc 45–60 μ m across, perforated by four large central holes and zero to occasionally six peripheral holes; rim of disc spinose, height of spire equal to width of disc, spire with single cross beam and ending in a crown with four huge spines that occasionally bifurcate distally, crown

of spines considerably wider than disc. Dorsal body wall with tables and rods (figure 7B, C); tables (figure 7B) with disc 30–60 μm across, perforated by four large central holes and zero to one peripheral hole, rim of disc moderately to very spinose, spire often reduced to knobs on disc, but occasionally persists as high as width of disc but then with a single cross beam that ends in a four-spined crown, usually not wider than disc; rods, 35–50 μm long, straight or with slightly undulating margins (figure 7C). Ventral tube feet with tables and rods (figure 7D, E); tables mostly reduced to disc, 33–42 μm across, perforated by three to four central holes and occasionally a single peripheral one, rim of disc slightly spinose, spire reduced to two or four knobs on surface of disc; rods 33–55 μm long, branched medially or distally, often perforated by one to several holes.

Etymology. The name *quadripartitum* refers to the crown of the tables that ends in four huge spines; *quadripartitum* (Latin) meaning split into four.

Ecology. The single specimen was collected at 12 m depth; over coarse sand under and between several large slabs of dead coral and rock.

Geographical distribution (see map 4). At present only known from the type locality.

Comments. The new species, with its ribbon-like calcareous ring, its ventral side with three rows of tube feet and dorsal side with two rows of tube feet, and its ossicle assemblage, undoubtedly belongs to *Labidodemas*. Nevertheless, the general body morphology of *L. quadripartitum* is unique to the genus. The dorsal body wall is yellowish to light brown and at first sight seems devoid of tube feet or papillae; however, inspection of the inner surface of the body wall reveals large tube feet ampullae in all five ambulacra. The ventral body wall is claret-red and has three rows of wide brownish tube feet. Although we have currently only one specimen at our disposal it is unlikely that this species will ever present a body wall that is translucent. The ossicle assemblage reveals that *L. quadripartitum* is very close to *L. semperianum* and *L. pseudosemperianum*, but several differences warrant it new species status. Table 2 lists the differences in the body wall ossicles of the three species.

***Labidodemas rugosum* (Ludwig, 1875)**

(figure 8A–L; map 5)

Holothuria rugosa Ludwig, 1875: 110, pl. 7, figure 33d–e; Pearson, 1913: 82 (synonymy and records before 1908).

Holothuria (Holothuria) rugosa; Panning, 1935a: 75.

Labidodemas rugosum: Rowe, 1969: 133; Levin, 1979: 20; James, 1981: 83; Mukhopadhyay, 1991: 408; Rowe and Gates, 1995: 304; Rowe and Richmond, 1997: 302; Massin, 1999: 58, figures 46a–j, 47a–c, 48 (records before 1998); Lane *et al.*, 2000: 489.

Holothuria triremis Sluiter, 1901: 19, pl. 6, figure 3a–c.

? *Holothuria triremis*: Pearson, 1913: 82.

Holothuria (Halodeima) trimensis: Panning, 1931: 119 (*lapsus calami* for *Holothuria triremis* Sluiter, 1901).

Original name. *Holothuria rugosa* Ludwig, 1875.

Name-bearing type. Holotype ZMH E.2625.

Type locality. Samoa (as Navigator Islands).

Current status. *Labidodemas rugosum* (Ludwig, 1875).

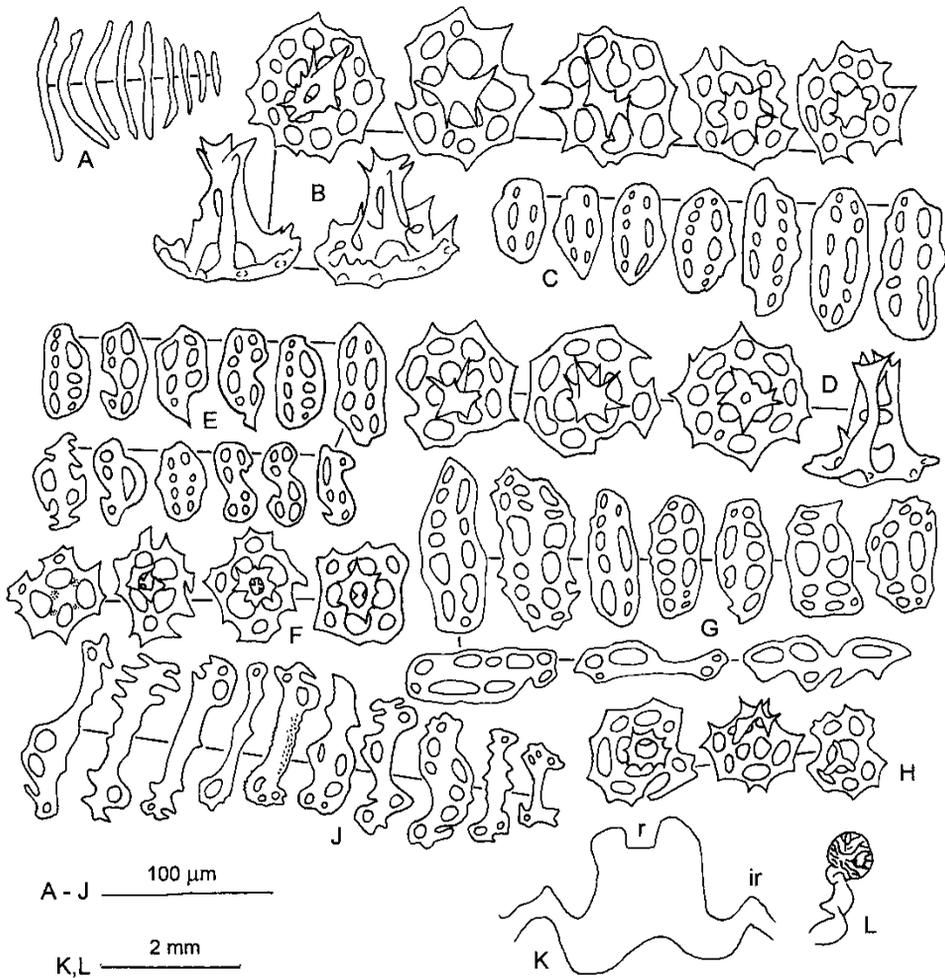
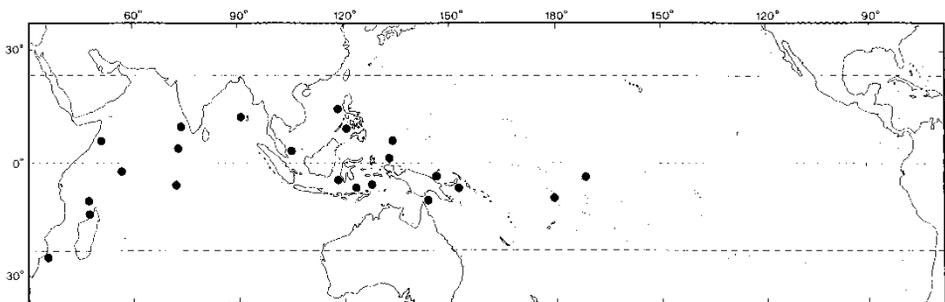


FIG. 8. *Labidodemas rugosum* (Ludwig, 1875) (L=130 mm). (A) Rods of tentacles; (B) tables of dorsal body wall; (C) buttons of dorsal body wall; (D) tables of ventral body wall; (E) buttons of ventral body wall; (F) tables of ventral tube feet; (G) buttons of ventral tube feet; (H) tables of dorsal papillae; (J) buttons to rods of dorsal papillae; (K) calcareous ring (r, radial plate; ir, interradial plate); (L) stone canal and madreporic plate. Scale bars: 100 μ m (A-J); 2 mm (K, L).



MAP 5. Distribution of *Labidodemas rugosum* (Ludwig, 1875).

Material examined. Samoa, collecting date and depth unknown, coll. Dr Graeffe, ZMH E.2625 (Mus. Godeffroyi 9937, holotype); Republic of South Africa (KwaZulu-Natal, Sodwana Bay, 2 Mile Reef), July 2001, 15 m depth, coll. Y. Samyn, RMcA1695/RSaKZN/0099 (one specimen); Indonesia (Celebes Islands, Kudingareng Keke), 5 October 1994, 2 m depth, coll. C. Massin, IRSNB IG.28251/256 (one specimen); Papua New Guinea (Hansa Bay, Laing Island, L4), 18 October 1996, reef flat at low tide, under rock, coll. C. Massin, IRSNB IG28455/55 (one specimen); Papua New Guinea (Hansa Bay, Laing Island, K3), 20 October 1996, reef flat at low tide, coll. J. M. Ouin, IRSNB IG28455/62 (two specimens); British Indian Ocean Territory (Chagos Archipelago, Diego Garcia), 7 August 1967, coll. J. D. Taylor, NHM 1969.5.27.22 (two specimens); British Indian Ocean Territory (Chagos Archipelago, Diego Garcia), 8 August 1967, sublittoral fringe, coll. J. D. Taylor, NHM 1969.5.27.23.26 (five specimens).

Diagnosis. See Cherbonnier, 1988: 53–55, figure 19.

Description. Small to medium-sized species; preserved specimens 67–133 mm long and 4–20 mm wide. Body cylindrical, mouth and anus terminal. Colour in life uniform whitish with yellowish tube feet; fading slightly after preservation. Skin thin (1–2 mm thick), but rather gritty to the touch. Mouth terminal surrounded by 20 small, yellowish tentacles. Ventral side with tube feet in three to four rows in median ambulacrum and in two rows in each lateral ambulacrum; some tube feet in interambulacral areas. Dorsal side with whitish papillae and short yellowish tube feet more or less confined to ambulacra, but also scattered in interambulacra. Ampullae of tube feet conspicuous on inner side of body wall. Cuvierian tubules absent. Tentacle ampullae short (1/12 body length). Single, well-developed Polian vesicle (one-sixth of body length). Single, small (4 mm), straight stone canal ending in minute madreporic plate (figure 8L). Calcareous ring composed of huge radial pieces and slender interradials; posterior margin of ring undulating; radial pieces with anterior notch, and central depression for longitudinal muscle; interradial pieces ribbon-like with minute anterior tooth-like projection (figure 8K). Digestive tract filled with rough coral sand and pieces of coral smaller than in *L. americanum*.

Ossicles. Tentacles with simple, straight or curved, smooth rods, 25–85 μm long (figure 8A). Ventral and dorsal body wall with similar tables and buttons (figure 8B–E). Table discs 65–90 μm across, perforated by four large central holes and 6–11 peripheral holes; rim of disc very spinose; margin of disc slightly turned upward; height of spire equal to diameter of disc; spire with four undulating pillars, united by one or two cross beams and terminating in crown consisting of cluster of stout spines; crown occasionally with small central perforation (figure 8B, D). Buttons, 45–85 μm long, with two to six pairs of irregular holes, margins smooth, but undulating (figure 8C, E). Ventral tube feet with tables and buttons (figure 8F, G): tables similar in shape to those of body wall, but disc only 45–65 μm across; crown of spines less developed but often perforated by central hole; spire occasionally reduced to knobs on surface of disc (figure 8F); buttons plate-like, surrounding end plate, 70–100 μm long, generally rim more irregular than that of body wall buttons (figure 8G). Dorsal papillae with tables and buttons: tables similar in shape to those of body wall, but generally smaller (figure 8H); buttons very irregular, often rod-like, generally larger than those of body wall (figure 8J).

Ecology. Found in shallow waters, always less than 20 m deep (Lane *et al.*, 2000); deposit/detritus feeder; under coral slabs and in and on coarse coral debris. Gut of the South African and Chagos specimens filled with coarse sand.

Geographical distribution (see map 5). If compared with figure 48 in Massin (1999: 61), the following new localities are here added: Republic of South Africa (KwaZulu-Natal), Malaysia, northern part of the Philippines.

Comments. In his revision of the Holothuriidae, Rowe (1969) realized that *H. rugosa* Ludwig, 1875, because of its body form and ribbon-like calcareous ring, belongs in *Labidodemas*. It has been treated as such since then and the present revision corroborates this.

***Labidodemas semperianum* Selenka, 1867**

(figures 9A–J, 10A–H; map 6; figure 11A–L for *L. selenkianum*)

Labidodemas Semperianum Selenka, 1867: 309, pl. 17, figures 1–3.

Labidodemas semperianum Selenka, 1867; Rowe and Richmond, 1997: 302; Massin, 1999: 61 (records before 1998, *partim*); Lane *et al.*, 2000: 489; Samyn, 2000: 15; Marsh, 2000a: 26; Marsh, 2000b: 101.

Labidodemas dubiosum Ludwig, 1875: 98, pl. 7, figure 25; Lampert, 1885: 110; Théel, 1886: 189.

Labidodemas egestosum Sluiter, 1901: 22.

? *Labidodemas Selenkianum* Semper, 1868: 77; Lampert, 1885: 110.

? *Labidodemas selenkianum*; Théel, 1886: 188.

Labidodemas semperlanum: Allen and Steene, 1994: 245 (*lapsus calami* for *L. semperianum*).

Labidodemas semprianum: Arakaki and Fagoonee, 1996: 122 (*lapsus calami* for *L. semperianum*).

? *Holothuria pertinax*: Sluiter 1887: 186, pl. 1, figures 1, 2.

Labidodemas pertinax: Rowe and Doty, 1977: figures 3b, 5g [non *L. pertinax* (Ludwig, 1875)].

Labidodemas sp.: Price and Reid, 1985: 3 (here identified as *L. semperianum*).

Holothuria proceraspina Cherbonnier, 1967: 62, figure 3a–o (syn. nov.); Price, 1982: 11; Tortonese, 1977: 275.

Original name. *Labidodemas semperianum* Selenka, 1867.

Name-bearing type. Syntypes ZMG (no number given by Selenka, 1867), MCZ 736 (two specimens). As the syntypes of the ZMG are untraceable (Troester, personal communication), a lectotype and a paralectotype are here designated in the MCZ 736 material: as lectotype the dissected specimen (75 mm long) and as paralectotype the non-dissected specimen (90 mm long) are chosen.

Type locality. Formerly Hawaiian Islands (as Sandwich-Inseln) but now Society Islands according to the designation of lectotype.

Current status. *Labidodemas semperianum* Selenka, 1867.

Material examined. Society Islands, collecting date, depth and collector unknown, MCZ 736 (two specimens); Maldives (Male Atoll, Dunidu Island), 18 March 1964, 4 m depth, coll. F. Ziesenhenné, USNM E11583 (one specimen identified as *L. pertinax*); Philippine Islands, 26 May 1978, 6–7 m depth, USNM E24458 (one specimen); Indonesia (Sumatra, Pula Wé), 1980–1981, 2 m depth, sublittoral rock, coll. A. Price, NHM 1999.2148 (one specimen); Philippine Islands (La Onoy Gulf, Luzon Island), 5 April 1989, intertidal, USNM E40771 (one specimen identified as *L. rugosum*); China, collecting date and depth unknown, coll. Kpt. Schnehagen, ZMH. E. 2933 (one specimen identified as *L. pertinax*); Fidji, collecting date and depth unknown, coll. Dr Graeffe, ZMH E.2674 (Mus. Godeffroy 1170, holotype of *L. selenkianum* Semper, 1868).

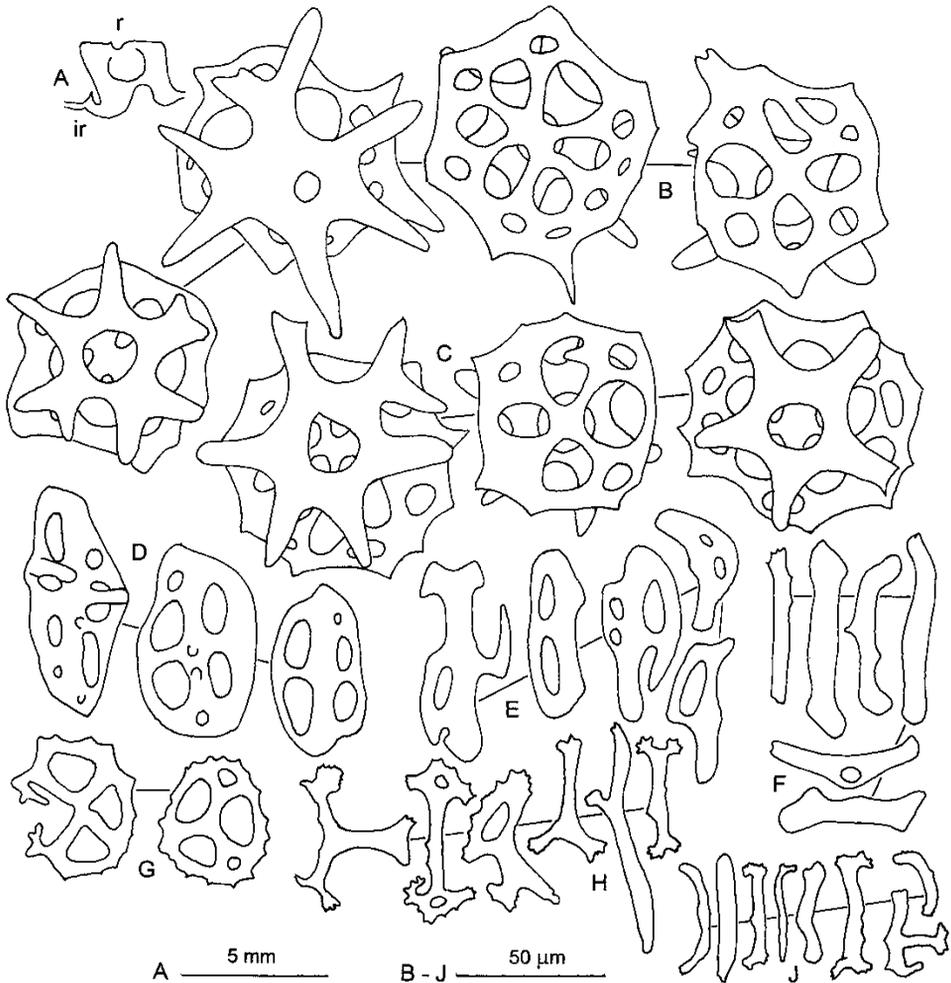


FIG. 9. *Labidodemas semperianum* Selenka, 1867. Lectotype. (A) Calcareous ring (r, radial plate; ir, interradial plate); (B) tables of ventral body wall; (C) tables of dorsal body wall; (D) buttons of dorsal body wall; (E) pseudo-buttons of dorsal body wall; (F) rods of dorsal body wall; (G) spiny perforated plates of ventral tube feet; (H) rods of ventral tube feet; (J) rods of dorsal papillae. Scale bars: 5 mm (A); 50 μ m (B–J).

Diagnosis. Cherbonnier, 1970: 566, figure A–P; present revision.

Description. The lectotype and paralectotype are cylindrical, 70 \times 20 and 90 \times 15 mm, respectively. Both type specimens are grey-white in alcohol; mouth and anus terminal; lectotype with 12 tentacles visible but, most probably the number is 20 as in all the other species belonging to the genus *Labidodemas*. Ventral tube feet very long, cylindrical and only present in the ambulacral areas; each ambulacrum with two rows of tube feet in a zigzag pattern, more densely crowded at mid-body and fewer close to mouth and anus. Dorsally tube feet few, dispersed in ambulacral and interambulacral areas; no clear alignment visible. Body wall gritty to the touch. Calcareous ring of the lectotype ribbon-like with large quadrangular radial plates and very thin interradial plates (figure 9A). One

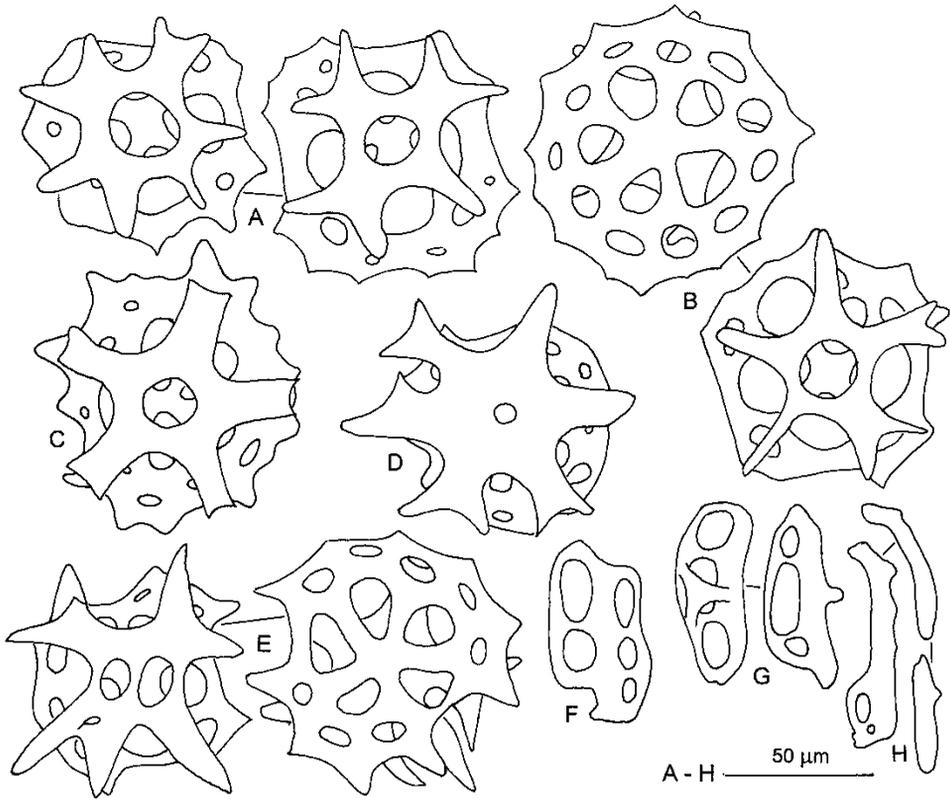
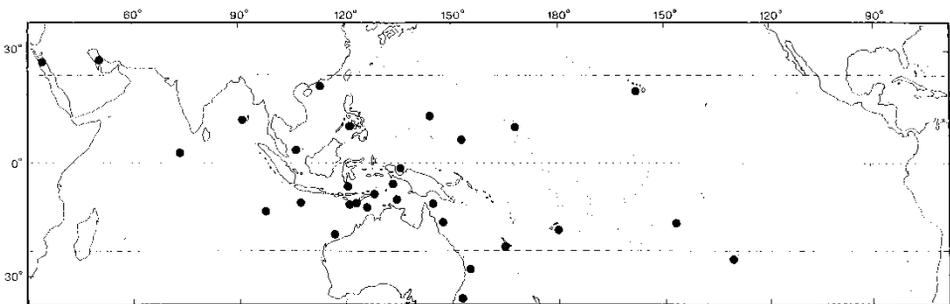


FIG. 10. *Labidodemas semperianum* Selenka, 1867. (A) Tables of dorsal body wall (paralectotype); (B) tables of ventral body wall (paralectotype); (C) table of dorsal body wall (USNM E11853); (D) table of dorsal body wall (USNM E40771); (E) tables of ventral body wall (USNM E40771); (F) buttons of dorsal body wall (USNM E40771); (G) pseudo-buttons of dorsal body wall (USNM E40771); (H) rods of the dorsal body wall (USNM E40771). Scale bar: 50 μm (A–H).

huge Polian vesicle (one-third of body length); tentacle ampullae very short (1–2 mm long); stone canal not observed. Vesicles of ventral tube feet prominent. Gonad well developed, made of several very large tubules. Cuvierian tubules absent.



MAP 6. Distribution of *Labidodemas semperianum* Selenka, 1867.

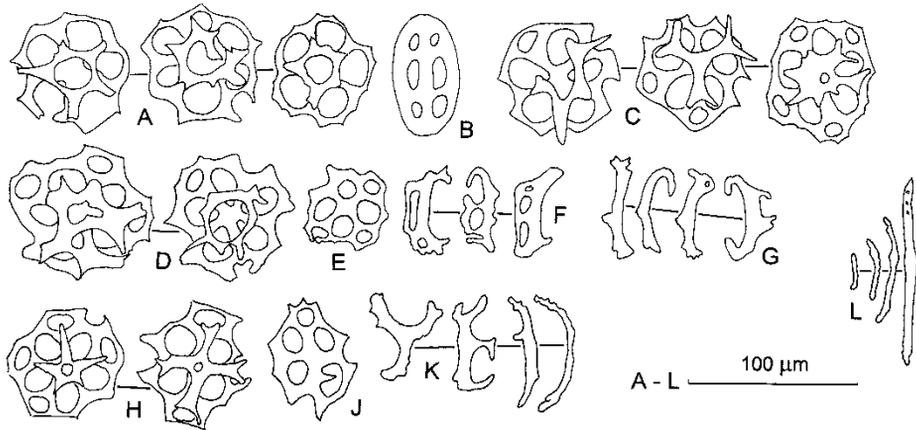


FIG. 11. *Labidodemas selenkianum* Semper, 1868. Holotype. (A) Tables of dorsal body wall; (B) button of dorsal body wall; (C) tables of ventral body wall; (D) tables of dorsal tube feet; (E) spiny perforated plate of dorsal tube feet; (F) pseudo-buttons of dorsal tube feet; (G) rods of dorsal tube feet; (H) tables of ventral tube feet; (J) perforated plate of ventral tube feet; (K) rods of ventral tube feet; (L) rods of tentacles. Scale bar: 100 μm (A–H).

Ossicles. In the ventral body wall of the lectotype tables only (figure 9B), 55–80 μm across; rim of the table disc spiny with sometimes one very long spine; table disc perforated by four to six central holes and 5–10 peripheral holes; spire low, ending in four to six long spines, most of them bifurcated distally; table crown generally larger than table disc. In the dorsal body wall tables (figure 9C) similar to the ones of the ventral body wall, buttons (figure 9D) 60–75 μm long, sometimes knobbed, pseudo-buttons (figure 9E) 55–65 μm long and rods 50–70 μm long (figure 9F). Number of buttons, pseudo-buttons and rods highly variable from one specimen to the other. In some specimens they seem to be gathered in heaps. Ventral tube feet have tables that are reduced to the spiny-edged disc (figure 9G) and rods (figure 9H). End plates more or less 500 μm across. Dorsal papillae with small rods (figure 9J) and no end plate. Tentacles with rods 20–60 μm long, very similar to the ones of *Labidodemas pseudosemperianum* (cf. figure 6G).

The paralectotype (figure 10A, B), the specimens from Maldives (figure 10C) and the Philippines (figure 10D–H) show very few variations from the lectotype. Re-examination of the holotype of *Labidodemas selenkianum* Semper, 1868 (figure 11A–L) shows somewhat corroded ossicles; the tables have a reduced crown but the general aspect is very similar to that of *L. semperianum*.

Ecology. Lives under coral slabs and coral rocks in shallow water (0–10 m depth).

Geographical distribution (see map 6). The following new localities are added since Massin's (1999: 62, figure 50) publication: China, South China Sea, Montebello Islands, Christmas Island; Pitcairn Islands. Moreover, Kenya has to be removed from Massin's (1999) map, since Humphreys' (1981) record of *L. semperianum* (NHM 1979.2.5.229, identified by A. M. Clark) proved to be *L. pertinax* after examination. Celebes (Indonesia) also needs to be omitted since

Massin's records (1999) of *L. semperianum* (RMNH Ech 6087 and IRSNB IG 28251/197) proved to be *L. pseudosemperianum* and *L. pertinax*, respectively.

Comments. *Labidodemas semperianum*, with its wide Indo-Pacific distribution, is one of those species which seems easy to identify due to its very characteristic ossicle assemblage (especially the tables). However, re-examination of material from IRSNB, MCZ, NHM, RMNH and ZMH revealed many misidentifications with, very often, a confusion between *L. semperianum* and *L. pertinax*. This confusion undoubtedly results from the similar external aspects of both species. As such, when one sample includes several specimens they are often designated under a single species name whereas careful examination of the ossicles of all the specimens in the sample reveals several species.

Cherbonnier (1970) gave a very good description of *L. semperianum* but, unfortunately, it was based on non-type material from Marshall Islands (Guam). According to Rowe and Gates (1995), syntypes are housed in the ZMG and the MCZ. The ZMG type series is currently untraceable in the ZMG (Troester, personal communication) whereas MCZ syntypes are available. To stabilize the taxonomy of *L. semperianum*, we here designate a lectotype and a paralectotype (see name-bearing type). Selenka (1867) examined material from ZMG and MCZ and indicated that all the material was coming from Hawaiian Islands (as Sandwich Inseln). However, on the original label of the two syntypes from MCZ, the locality mentioned is 'Society Islands'. With the designation of a lectotype among the syntypes from MCZ, the type locality thus can no longer be the Hawaiian Islands but becomes the Society Islands.

Material from Maldives (figure 10C) and the Philippines (figure 10D–H) shows few variations from the type material. A specimen from China (ZMH E 2933) has some tables of the ventral body wall with table crown much larger than table disc. However, unlike *L. pseudosemperianum*, the spines of the crown are only occasionally divided distally. Moreover, tables reduced to the disc (with spiny edge), coming from the apex of ventral tube feet, have fewer but larger spines than those from ventral tube feet of the holotype of *L. spineum*.

In terms of ossicle assemblage, the most constant features are: (1) presence of buttons and rods dorsally but not ventrally, (2) rim of table disc spiny and (3) diameter of table crown equal to or slightly larger than diameter of table disc. These characters allow separation of *L. semperianum* from the two closely allied new species that are here described: *L. quadripartitum* and *L. pseudosemperianum*.

After re-evaluation of the original description, *Holothuria proceraspina* Cherbonnier, 1967 is here recognized as a junior synonym of *Labidodemas semperianum*. Indeed, the body morphology of *H. proceraspina* as described by Cherbonnier (1967)—'Il est entièrement blanc jaunâtre, sauf la partie orale qui est brune tout autour de la bouche. Le tégument est peu épais, lisse, plissé. Les pieds ventraux sont peu nombreux et dispersés sur les radius et les interradius, à l'exception de la région anale où ils s'alignent sur deux rangs sur le radius médian et sur un rang sur les radius latéraux' [*sic*—the structure of the calcareous ring (Cherbonnier, 1967: 62, figure 3m) and the ossicle assemblage (Cherbonnier, 1967: 62, figure 3a–l, o) are typical of *Labidodemas*. Cherbonnier (1967) implicitly came to the same conclusion as in his remarks he states that the form of the tables are reminiscent of the majority of species under *Halodeima* and of *Holothuria pertinax* Ludwig, 1875 (now *L. pertinax*). It should, however, be noted that the structure of the calcareous ring of *H. proceraspina*—'Couronne calcaire petite mais bien

calcifiée, à larges et hautes radiales, à courtes interradianales triangulaires' [*sic.*]—conflicts with that of *Halodeima* (now a subgenus of *Holothuria*) (see Rowe, 1969: 137, figure 7a), but Cherbonnier (1967) was correct to recognize that *L. pertinax* is very close to *H. proceraspina*. However, *L. pertinax* differs from *H. proceraspina* in lacking buttons in the body wall. In fact, four species currently recognized in *Labidodemas* possess buttons in the body wall: *L. semperianum*, *L. pseudosemperianum*, *L. spineum* sp. nov. (for description see below) and *L. rugosum*; the ossicle assemblage of the first of these is identical to that of *H. proceraspina*, hence the decision for synonymy. Re-examination of *Labidodemas* sp. collected by Price (Price and Reid, 1985) in Indonesia reveals that this specimen almost certainly is also *L. semperianum*.

Re-examination of the type material of *L. selenkianum* Semper, 1868 shows that the ossicles are partly eroded by the preserving fluid. This could explain the reduced table crown and the eroded rim of the table discs. As the general morphological aspect and the ossicle assemblage of the holotype are very close to *L. semperianum* as the species is here defined, it is tempting to accept the decision of Sluiter (1901) and many authors after him (a.o. Cherbonnier, 1970; Rowe and Gates, 1995), to regard *L. selenkianum* as a mere synonym of *L. semperianum*. However, we feel reluctant to base the final judgement on *L. selenkianum* with only a single specimen (with eroded ossicles) at hand. As such, our list of synonyms of *L. semperianum* marks *L. selenkianum* with a question mark. The here, for the very first time, depicted (figure 11) ossicle assemblage of the holotype will, once more material is available, allow definite rejection or acceptance of this species.

***Labidodemas spineum* sp. nov.**
(figures 12A–N, 13A–G; map 4)

Name-bearing type. Holotype NHM 1974.12.3.42.43 (L = 125 mm); paratype NHM 1974.12.3.42.43 (L = 112 mm).

Type locality. Low Island, Great Barrier Reef, Australia.

Material examined. Australia (Low Island, Great Barrier Reef), 1973, sand flat (LWM), coll. P. Gibbs, NHM 1974.12.3.42.43 under the name *L. semperianum* (holotype and paratype).

Diagnosis. Medium-sized species; 20 short tentacles. Ribbon-like calcareous ring. Tables, buttons and rods present in body wall and tube feet. Buttons and rods spiny. Tables with quadrangular or triangular disc, with low spire without cross beam, crown irregular.

Description. The holotype is 125 × 11–14 mm and the paratype 112 × 8–11 mm. Body cylindrical, worm-like, tapering anteriorly. Colour in alcohol white-beige with both extremities brown; tube feet same colour as body wall. Mouth and anus terminal. Mouth surrounded by 20 short tentacles; anus wide, surrounded by five groups of paired papillae. Ventrally, tube feet restricted to ambulacra; lateral ambulacra with one row of tube feet in a zigzag pattern, median ambulacrum with two rows of tube feet. Dorsally, tube feet present in ambulacral and interambulacral areas, small, arranged in about five to six rows.

Calcareous ring ribbon-like (figure 12A) with large quadrangular radial plates and narrow interradianal plates with short anterior projection. Radial plate with small anterior notch and indentation for insertion of longitudinal muscle. Two Polian vesicles, the larger one-seventh of body length. Single stone canal. Tentacle

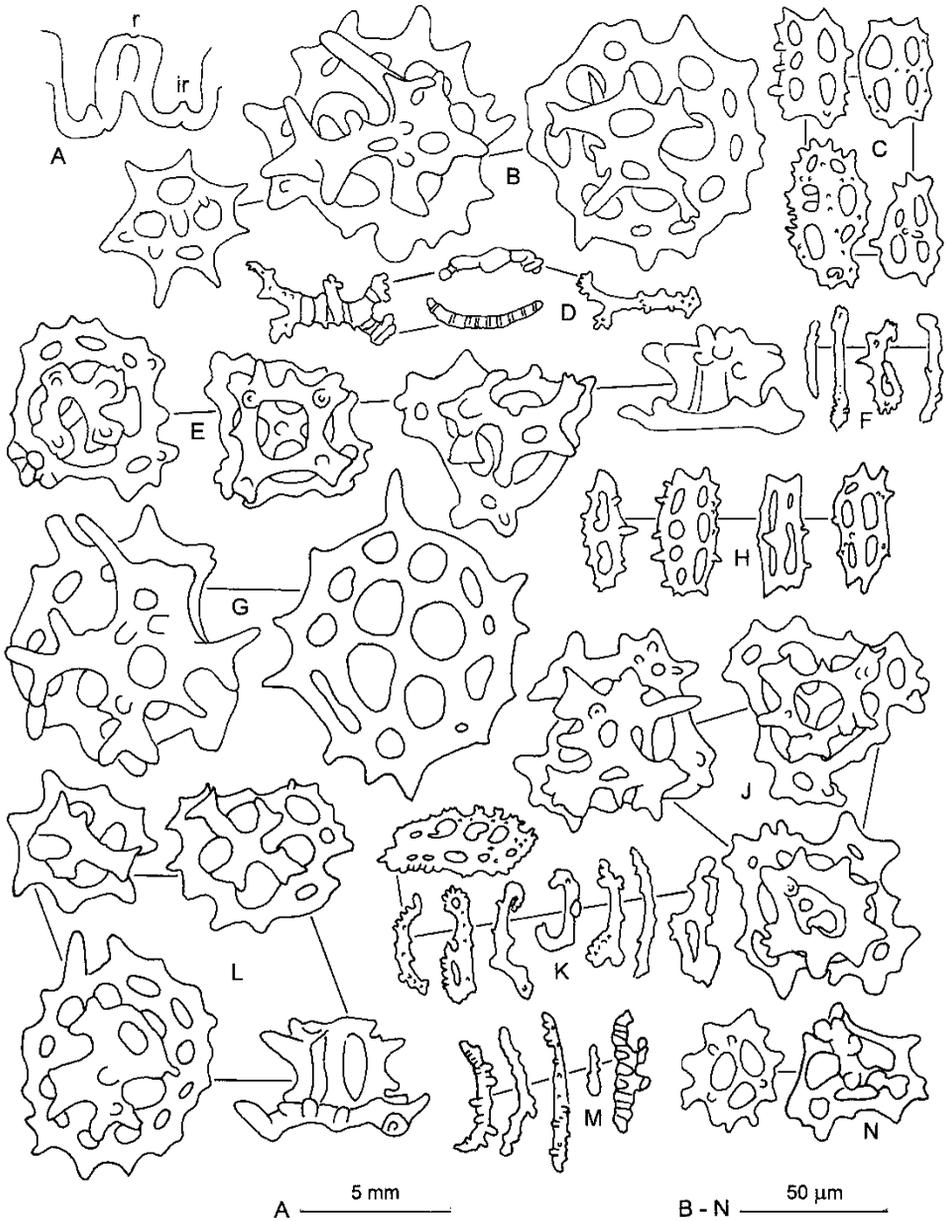


FIG. 12. *Labidodemas spineum* sp. nov. (A) Calcareous ring (r, radial plate; ir, interradial plate) (holotype); (B) tables of dorsal body wall (holotype); (C) buttons of dorsal body wall (holotype); (D) rods of dorsal body wall (holotype); (E) tables of dorsal body wall (paratype); (F) rods of dorsal body wall (paratype); (G) tables of ventral body wall (holotype); (H) buttons of ventral body wall (holotype); (J) tables of ventral body wall (paratype); (K) rods and buttons of ventral body wall (paratype); (L) tables of dorsal tube feet (holotype); (M) rods of dorsal tube feet (holotype); (N) tables of dorsal tube feet (paratype). Scale bar: 5 mm (A); 50 μ m (B-M).

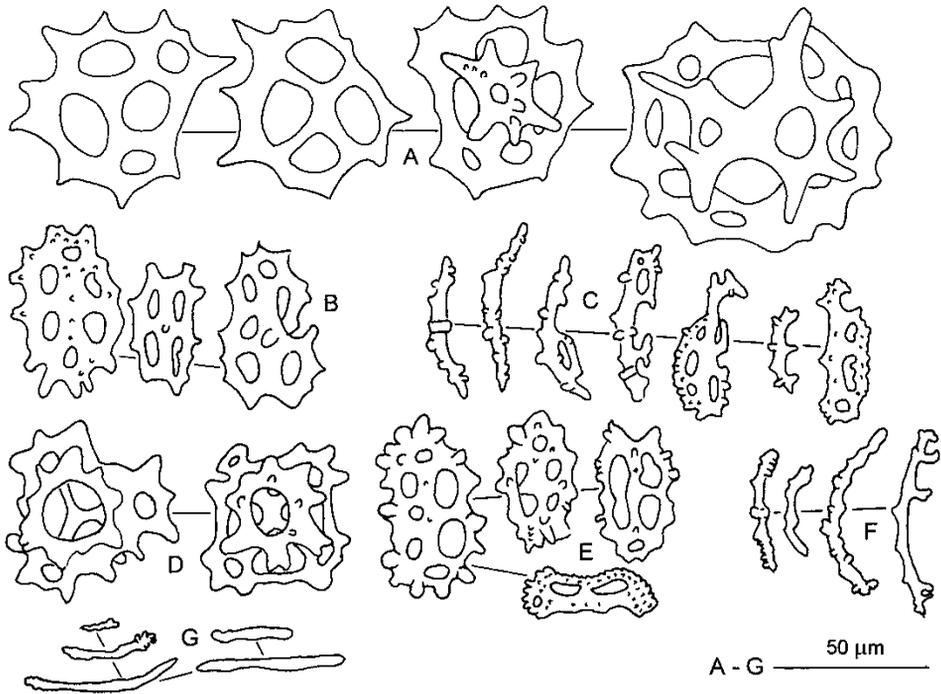


FIG. 13. *Labidodemas spineum* sp. nov. (A) Tables of ventral tube feet (holotype); (B) buttons of ventral tube feet (holotype); (C) rods and pseudo-buttons of ventral tube feet (holotype); (D) tables of ventral tube feet (paratype); (E) buttons of ventral tube feet (paratype); (F) rods of ventral tube feet (paratype); (G) rods of the tentacles (holotype). Scale bar: 50 μm (A–G).

ampullae very short (1 mm long); tube feet ampullae visible on inner side of body wall. Specimens partly eviscerated (gonad, part of intestine and left respiratory tree missing). Presence/absence of Cuvierian tubules could not be ascertained because specimens are partly eviscerated. Segment of digestive tract still present, filled with rough coral sand.

Ossicles. Both dorsal and ventral body wall with tables, rods and buttons. Dorsally, tables irregular with a spiny quadrangular disc (figure 12B) (very often triangular in the paratype; figure 12E), 50–80 μm across, perforated by four large central holes and 4–10 peripheral ones; four short pillars without cross beam, ending in a crown of spines (figure 12B, E), often irregular (figure 12B). Spire low (figure 12E). Tables of ventral body wall similar to dorsal tables (figure 12G, J) in size and shape, but sometimes reduced to disc only (figure 12G). Buttons spiny (figure 12C, H, K), 35–50 μm long, with two to four pairs of holes; rods short, 30–35 μm long, often spiny (figure 12D, F, K), either straight or C-shaped. Some ossicles intermediate between rods and buttons (figure 12H, K). Tube feet with ossicles similar to those of body wall. Tables 45–85 μm across (figures 12L, N, 13A, D), often reduced to disc only (figure 13A). Buttons 45–55 μm long (figure 13B, E), rare or absent in dorsal tube feet. Rods spiny, 30–60 μm long (figures 12M, 13C, F), sometimes branching at extremities (figure 13F). Some ossicles (pseudo-buttons) with intermediate stages between buttons and rods

(figure 13C). End plate of dorsal tube feet 125 μm across. In tentacles small rods, 10–50 μm long (figure 13G).

Etymology. The name *spineum*, Latin, means spiny and refers to the numerous spines covering the buttons and the rods from the body wall and the tube feet.

Ecology. No data currently available.

Geographical distribution (see map 4). Only known from the type locality.

Comments. Rods and buttons are similar in holotype and paratype but the tables are quite different. In the holotype, seen from above, they are *rugosum*-like whereas in the paratype they are *pertinax*-like. The tables of *L. spineum* differ from those of *L. rugosum* by the very low spire without cross beam and from those of *L. pertinax* by a more irregular crown of spines and the triangular shape of some discs. *Labidodemas spineum* is very easy to separate from all the other *Labidodemas* spp. because it is the only species with spiny buttons and rods in the body wall.

Discussion

Historical overview

Since Selenka (1867), several authors have described other, not well-defined (H. L. Clark, 1946) species in *Labidodemas*: *L. dubiosum* Ludwig, 1875 from Tahiti and *L. selenkianum* Semper, 1868 from Viti Levu Islands (Fiji). Both these species were referred to the synonymy of *L. semperianum* by Sluiter (1901; subsequently followed by H. L. Clark, 1921). The 18 mm long *Labidodemas egestosum* Sluiter, 1901 from Saleyer (Indonesia), marked by the total absence of ossicles and calcareous ring, is a dubious species. Even Sluiter (1901) considered this form as being abnormal. It was also referred to the synonymy of *L. semperianum* by H. L. Clark (1921). Ludwig (1883) referred *L. leucopus* Haacke, 1880 and *L. neglectum* Haacke, 1880 from Mauritius to the synonymy of *Holothuria monacaria* Lesson, 1830 and *Holothuria decorata* Marenzeller, 1881, respectively. He also referred *L. punctulatum* Haacke, 1880 from Mauritius to the synonymy of *Holothuria lineata* Ludwig, 1874 (see also Pearson, 1910). Mitsukuri (1912) referred *L. leucopus*, *L. neglectum* and *H. decorata* to the synonymy of *H. monacaria* [= *H. (Merteniothuria) hilla* Lesson, 1830]. Panning (1935a) and Rowe (1969), on the other hand, referred both *L. leucopus* and *L. neglectum* to the synonymy of *Holothuria monacaria* and *L. punctulatum* to the synonymy of *H. (Lessonothuria) pardalis* Selenka, 1867 (Panning, 1935b; see also Rowe, 1969). Table 3 summarizes the history of the taxonomy of *Labidodemas*.

The large number of synonyms recorded in table 3 is symptomatic of the turbulent, and at times even chaotic, classification history of the Holothuriidae. Whereas Selenka's (1867) taxon *Labidodemas* was accepted by most subsequent workers (a.o. Semper, 1868; Ludwig, 1875, 1883; Haacke, 1880; Lampert, 1885; Sluiter, 1901; Fisher, 1907; H. L. Clark, 1921; Deichmann, 1938, 1958; Rowe, 1969), it remained in the background until in 1969, Rowe created some controversies in regard to the taxonomic rank that should be attributed to it. This led to a re-description of *L. semperianum* (Cherbonnier, 1970), the creation of the Labidodematidae (James, 1981) and to the re-positioning of *H. pertinax* (Cherbonnier, 1988). Despite these bold decisions, many inconsistencies still pertained in literature. *Labidodemas semperianum*, for example, has numerous

Table 3. Nominal species versus the present disposition and authority.

Nominal species as they have appeared in literature	Present disposition and authority
<i>Labidodemas americanum</i> Deichmann, 1938	No change
<i>Irenothuria maccullochi</i> Deichmann, 1958	<i>Labidodemas maccullochi</i> (Deichmann, 1958): present work
<i>Holothuria pertinax</i> Ludwig, 1875	<i>Labidodemas pertinax</i> (Ludwig, 1875): Cherbonnier, 1988
<i>Holothuria rugosa</i> Ludwig, 1875	<i>Labidodemas rugosum</i> (Ludwig, 1875): Rowe, 1969
<i>Holothuria triremis</i> Sluiter, 1901	<i>Labidodemas rugosum</i> (Ludwig, 1875): Panning, 1935a
<i>Labidodemas semperianum</i> Selenka, 1867	No change
<i>Labidodemas dubiosum</i> Ludwig, 1875	<i>Labidodemas semperianum</i> Selenka, 1867: Sluiter, 1901, here confirmed
<i>Labidodemas selenkianum</i> Semper, 1868	<i>Labidodemas semperianum</i> Selenka, 1867: Sluiter, 1901, here confirmed
<i>Labidodemas egestosum</i> Sluiter, 1901	<i>Labidodemas semperianum</i> Selenka, 1867: H. L. Clark, 1921
<i>Holothuria proceraspina</i> Cherbonnier, 1967	<i>Labidodemas semperianum</i> Selenka, 1867: present work
<i>Labidodemas leucopus</i> Haacke, 1880	<i>Holothuria (Mertensiothuria) hilla</i> Lesson, 1830: Ludwig, 1883 (as <i>H. (Holothuria) monacaria</i> Lesson, 1830)
<i>Labidodemas neglectum</i> Haacke, 1880	<i>Holothuria (Mertensiothuria) hilla</i> Lesson, 1830: Ludwig, 1883 (as <i>Holothuria decorata</i> Marenzeller, 1881)
<i>Labidodemas punctulatum</i> Haacke, 1880	<i>Holothuria (Lessonothuria) pardalis</i> Selenka, 1867: Panning, 1935b (as <i>H. (Holothuria) pardalis</i> Selenka, 1867)

buttons according to Selenka (1867), Fisher (1907), Cherbonnier (1970), Cannon and Silver (1986) and the present revision, few buttons according to Semper (1868) and present work (specimen from Guam), or no buttons according to Domantay (1934).

The present work, based on available type material and numerous voucher specimens from different, representative, localities, thus not only exposed a large number of misidentifications, revealed an erroneous classification (*Holothuria (Irenothuria) maccullochi*) and a synonym (*H. proceraspina*), but also uncovered the presence of Cuvierian tubules in one species (*L. americanum*).

Systematic implications

In 1981, James erected the Labidodematidae in order to give a higher rank to the aberrant (but not unique!) characters of *Labidodemas vis-à-vis* the other genera in the family Holothuriidae. In his distinct and not too accurate diagnosis of the new family, James (1981) stressed that the tube feet and papillae of *Labidodemas* spp. are confined to the ambulacra, that the ambulacral and interambulacral areas are disproportional in size, and that the body wall is translucent. With our current knowledge of the Holothuriidae, it is problematic to accept this diagnosis at family level. Indeed, the characters given by James (1981) are not only plesiomorphic, as evidenced by the fact that some species (or at least the juveniles) belonging to *Actinopyga*, *Bohadschia*, *Holothuria* and *Pearsonothuria*

also have their tube feet restricted to the ambulacral areas, but, they also do not apply to all the species currently classified in *Labidodemas* (e.g. the tube feet in *L. quadripartitum* do spread into the interambulacral areas). Moreover, a character of higher taxonomic value (unique to *Labidodemas*) was ignored by James (1981): the ribbon-like structure of the calcareous ring. Despite this, the ossicle assemblage characterizing the different species of *Labidodemas* is typical of the family Holothuriidae since variously developed tables in combination with rods and/or buttons are also found in *Holothuria* and *Pearsonothuria*. The fact that *L. americanum* possesses Cuvierian tubules, a feature common to several species within the Holothuriidae, not only in *Holothuria* but also in *Actinopyga*, *Bohadschia* and *Pearsonothuria*, convincingly justifies the retention of *Labidodemas* within the family Holothuriidae. In regard to the taxonomic rank that should be attributed to it, we believe it is best to maintain a conservative attitude and keep *Labidodemas* on generic level within the Holothuriidae.

Nevertheless, we urge for a phylogenetic analysis to determine if *Labidodemas*'s fossorial life style, its reduced peltate tentacles, its tube feet and papillae mostly restricted to the ambulacral areas, its ribbon-like calcareous ring, its (presumably) non-functional Cuvierian tubules (only present in *L. americanum*), its extremely variable ossicle assemblage, its non-selective feeding strategy and its wide Indo-Pacific distribution represents the primitive condition, as Levin (1999) convincingly argues, or if it represents the derived form. If the latter will turn out to be the case, *Labidodemas* has closest affinity with *Holothuria* and may ultimately even prove to be part of it.

Geographical distribution

Labidodemas is restricted to the Indo-Pacific. *L. pertinax* (map 3) and *L. rugosum* (map 5) have a wide Indo-Pacific distribution. *Labidodemas pseudo-semperianum* (map 4) is up to now restricted to the West Pacific. *Labidodemas americanum* and *L. maccullochi*, on the other hand, are restricted to the tropical eastern Pacific region (maps 1, 2). *Labidodemas quadripartitum* and *L. spineum* are to date only known from the type locality: Sodwana Bay (Republic of South Africa) and Low Island (Australia), respectively (map 4). From a biogeographical point of view, it is interesting to note that Humphreys' (1981) record from Kenya (NHM 1979.2.5.229) of *L. semperianum* should be *L. pertinax*. This implies that *L. semperianum* is not present along the coastline of eastern Africa; the records of Cherbonnier (1967) of *Holothuria proceraspina* and those of Tortonese (1977) of *H. proceraspina* and *L. semperianum* from the Gulf of Aqaba appear to be valid. On the other hand, Price's (1981) determination of *L. semperianum* from the Persian Gulf was based on the key of Clark and Rowe (1971), hence it is not impossible that this record may also prove to be *L. pertinax* (see also comments under *L. pertinax*); similarly Price's (1983) record from the Arabian Gulf coast of Saudi Arabia, identified as *L. semperianum* most possibly is *L. pertinax* rather than *L. semperianum* for the ossicle assemblage described (tables with short spire ending in a cross with up to five forked branches and minute rods) contradicts Selenka's (1867), Cherbonnier's (1970) and the present description where buttons have been described. Hence the distribution of *L. semperianum* most possibly is narrower than is generally assumed (map 6).

However, given the many misidentifications and erroneous classifications

uncovered in the present revision, it is not improbable that careful re-examination of all the *Labidodemas* specimens deposited in museums world wide, will still alter the distribution maps as they are here provided.

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