

Description of a New Species of Sea Cucumber (Stichopodidae, Holothuroidea, Echinodermata) from the Eastern Indo-Malayan Archipelago: *Thelenota rubralineata* n. sp.

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Abstract—*Thelenota rubralineata* n. sp. is described from specimens off Indonesia and Papua New Guinea. This colorful shallow water species is compared with *T. anax* and *T. ananas*. A short note is given on its behavior.

Introduction

The family Stichopodidae is a group of large aspidochirote sea cucumbers which are particularly common in shallow tropical reefal habitats. Stichopodids have long been recognized as being in need of revision (Cannon & Silver 1986), particularly the genus *Stichopus*. The tropical genus *Thelenota*, however, does not currently present any taxonomic or nomenclatural difficulties, there being just two recorded species: *T. ananas* (Jaeger, 1833) and *T. anax* Clark, 1921. Both are clearly recognizable and are among the largest representatives of the class Holothuroidea, attaining a maximum length of almost 1 m. *T. ananas* is widely distributed on reefs in the Indo-West Pacific and *T. anax*, following its discovery in the Murray Islands, Torres Straits, in 1913 (Clark 1921), has been recorded at a number of other locations amongst the islands of the Pacific region, including Belau (Palau) Islands (Yamanouti 1939), Guam (Rowe & Doty 1977), Enewetok and other atolls in the Marshall Islands (Lamberson 1978), Fiji (Féral & Cherbonnier 1986), Xisha (Paracel) Islands (Liao 1975), Bodgaya Islands (Sabah, Malaysia) (George & George 1987 under the name of *Stichopus* sp.), Pulau Sipadan (Sabah, Malaysia) (Lane, personal observations and photorecord), North coast of Papua New Guinea (Massin, personal observations and photorecords), Motupore, South coast of Papua New Guinea (Brouns & Heijs 1985), John Brewer Reef (central GBR) (Lamberson 1978), Davies Reef (central GBR) (Lane personal observations and photorecords), New Caledonia (Cherbonnier & Féral 1984) and

Moorea, Society Islands (Lamberson 1978). There are also three records for *T. anax* from the Indian Ocean: Iles Glorieuses, Madagascar, (Cherbonnier 1979), Maldives (Levin 1979) and Rowley Shoals, north-western Australia (Marsh 1986).

Recently, in both Pacific and Atlantic Oceans (viz. Cherbonnier 1980, Lambert 1986, Cutress & Miller 1982) large to very large new Stichopodidae have been collected by scuba diving. The present communication reports the discovery, also by scuba diving, of a third species of *Thelenota* from the reefs of the North coast of Papua New Guinea and from the reefs of Flores in the Indonesian Archipelago. The species has been designated *Thelenota rubralineata*. It is surprising that this large and very characteristic shallow water species has not been described earlier, especially as photos have already been published in a book (Halstead 1977).

Methods

Six specimens have been collected by scuba diving in Papua New Guinea, anaesthetized with 7% MgCl₂ or by freezing and fixed in 4% buffered formalin. One specimen has been observed and photographed in Indonesia and a 'V' shaped piece of the dorsal body wall was excised for spicule preparation and preserved in 90% alcohol. The specimen was then released.

Spicules from the bivium, the trivium, the dorsal protuberances, the ventral podia and the tentacles have been prepared for light microscopy and scanning electron microscopy. One specimen from Papua New Guinea has been dissected for observation of the calcareous ring and the internal anatomy.

IRSNB: Royal Belgian Institute of Natural Sciences.

ZRCNUS: Zoological Reference Collection of the National University Singapore.

Thelenota Brandt, 1835

Thelenota rubralineata n. sp.

Material examined: -IRSNB IG n° 27.474/198, 6 specimens (type series).

-ZRCNUS n° ZRC 1989.2233, 1 dorsal piece and photorecords.

-Photorecords from divers.

Type material: the holotype and 4 paratypes are deposited at the IRSNB. One paratype ZRC 1990.21 is deposited at the ZRCNUS.

Type locality: The external slope of the barrier reef in front of Wongat Island, Madang, Papua New Guinea.

Distribution: North coast of Papua New Guinea (Madang, Laing Island, Boisa Island); Pamana Island, North coast of Flores, Indonesia.

Figures 1 to 4. *Thelenota rubralineata* n. sp. 1. General view of the specimen from Flores. 2. Close up of the posterior part of a specimen from Papua New Guinea. 3. Close up of the bivium of the specimen from Flores. 4. Helically coiled position of a specimen from Papua New Guinea.

Description

The body of *Thelenota rubralineata* is roughly square or trapezoid in transverse section and measures 30 to 39 cm long and 8 cm wide in the living, uncontracted state. The posterior part of the body tapers slightly. The ventral surface is flattened and bears numerous podia scattered randomly. The anterior mouth is located ventrally, the anus terminal. The dorsal body wall is characterised by numerous very large conical fleshy protuberances, many of which have subsidiary acutely pointed conical peaks bearing papillae at their extremity (Figs. 1, 2, 4). The dorsal protuberances are arranged in two rows presenting a zigzag pattern, each row being made of 13 to 15 protuberances. The most anterior and posterior of these, when fully extended, are longer and more ramified than the others (Fig. 2). On each side of the body, along the boundary between the bivium and the trivium, there is a continuous row of 14 multipapillate protuberances (Figs. 1, 2). Smaller outgrowths are scattered over the body.

The coloration of the body wall consists of a striking and complex pattern of crimson lines on a white background (Figs. 2, 3). On the bivium, the lines are of variable thickness and form oblique parallel arrays which intersect or anastomose, forming maze-like arrangements (Figs. 1, 2, 3). Patches of dark brown or diffuse yellowish pigment (2 or 3 mm across) mark the base of the papillae and form inconspicuous small spots scattered between the crimson lines. The tips of the protuberances are yellow-brown with white ending papillae. On the specimens from Papua New Guinea, the lateral part of the body wall between the dorsal and the lateral protuberances presents a white longitudinal band because of the lower density of the crimson lines (Fig. 2). Towards the oral end, 3 or more crimson patches may be present or not (in darker individuals) and the yellow spots are larger (3 or 4 mm across) and more numerous. On the ventral sole, the crimson lines are fewer and more irregular. They occur as discontinuous, undulating transverse markings. The podia are pale greenish-yellow or brownish-yellow with white tips. The tentacles, twenty in number, are dull red. The *T. rubralineata* collected have been found during daylight dives at depths ranging from 6 to 40 m, always on the external slope of a barrier reef or on the slope of the fringing reef of an island. The slope is always steep and made of alternating spurs and grooves. The grooves where the *T. rubralineata* are living are characterised by coarse coral sand.

T. rubralineata is never abundant at the collecting places. For example, around Laing Island, the species has been observed and photographed only once on 1,200 dives (M. Claereboudt, personal communication).

When the animal is creeping, the lateral protuberances are resting on the substratum and appear to have an 'ambulatory' role. When disturbed, the animal bends and assumes a helicoidal position, mouth close to the anus (Fig. 4). This position is maintained for up to 10 minutes, or longer, before the animal moves again.

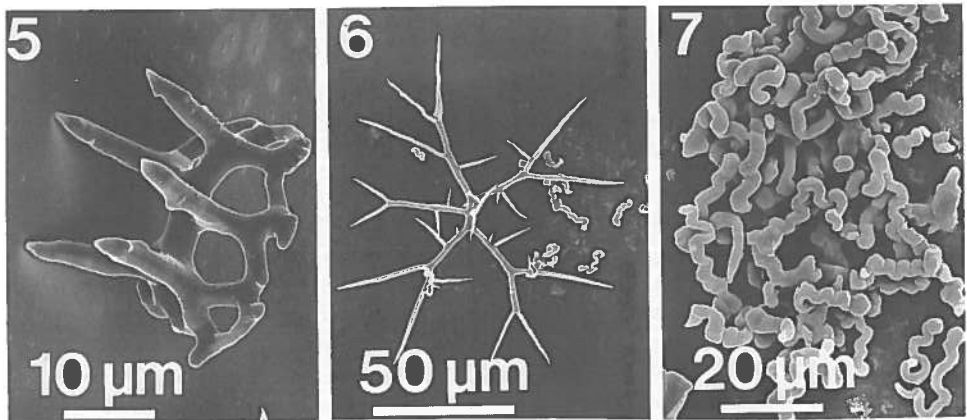
The calcareous ring is made of large radial and small interradial pieces (Fig. 8J). The dorsal pieces of the calcareous ring are larger than the ventral ones. The

tentacular vesicles are thin and short. Two Polian vesicles are present: a long one (3.5 cm) and a very small one. The 5 longitudinal muscles are broad (18 mm), 'V' shaped and attached to the body wall only by their central part. The loop of the digestive tract is short and the empty cloaca long and narrow. The two respiratory trees are narrow; the right one extends to half and the left one to three-quarters of the coelom length respectively. The hemal system (rete mirabile) is reduced to a vessel running parallel to the intestine at the level of the first intestinal loop. The descending and ascending parts of this vessel are connected by a single transverse connection. The specimen dissected (paratype) is 28 cm long and has no gonad (collected 09/88).

The dorsal body wall contains several types of spicules. The most abundant are the numerous granules and the slender dichotomously branched rods. The dichotomous rods (Figs. 6, 8A) are $135 \pm 12.7 \mu\text{m}$ long for the specimen from Indonesia and $94 \pm 4.4 \mu\text{m}$ for the specimens from Papua New Guinea. They are spiny with primary, secondary, tertiary and sometimes quaternary branches (Figs. 6, 8A). The spines are needle like and they arise perpendicularly from the axial rod, the primary and secondary branches or occasionally from nodes. They vary in length, sometimes being as long or longer than the branches from which they originate. They protrude in all directions giving the spicule a three dimensional form. Spines generally arise singly or in pairs, but those located at the center of the axial rod may number three or four and occasionally bear lateral spinelets. One or more of these central spines may be enlarged and dichotomously branched (Figs. 6, 8A).

The very characteristic miliary granules are elongate and serpent-like with a rounded end, about $3 \mu\text{m}$ in diameter, and a slightly narrower cylindrical extension which is sinuous or irregularly contorted (Figs. 7, 8C). The dimension of these granules ranges from about 7 to $20 \mu\text{m}$.

Other spicules are present but far less frequent. These include pseudo-tables and spinose rods. The pseudo-tables are made of a disc bearing 4 to 5 short feet



Figures 5 to 7. Spicules of *Thelenota rubralineata* n. sp. 5. Pseudo-table; 6. Dichotomous rod; 7. Serpent-like miliary granules.

which are prolonged by four to five long spines (Figs. 5, 8B). These spicules measures 20 to 25 μm in diameter and 25 μm in height.

The dorsal protuberances contain almost exclusively, very large numbers of serpent-like granules (5 to 19 μm long) (Fig. 8D). Among these are a few dichotomous rods but no pseudo-tables.

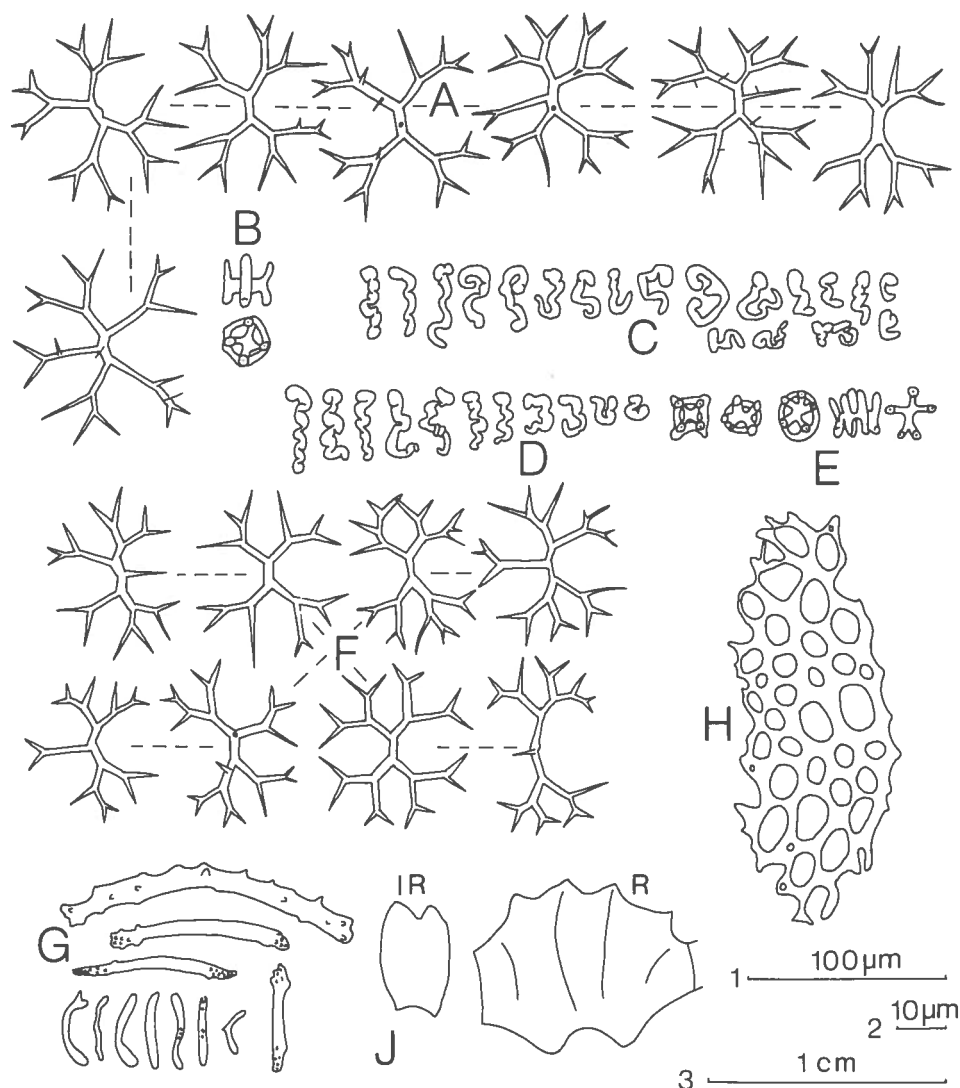


Figure 8. Spicules and calcareous ring of *Thelenota rubralineata* n. sp. A: dorsal dichotomous rods; B: dorsal pseudo-table; C: dorsal serpent-like granules; D: serpent-like granules of the dorsal protuberances; E: ventral pseudo-tables; F: ventral dichotomous rods; G: rods of the tentacles; H: piece of the podia end plate; J: calcareous ring (R: radial piece; IR: interradial piece). A, B, E, F, G, H: scale 1; C, D: scale 2; J: scale 3.

The three types of ventral spicules are dichotomous rods, pseudo-tables and serpent-like granules. The dichotomous rods are smaller ($83 \pm 6.7 \mu\text{m}$) and less spiny than the dorsal ones (Fig. 8F). The pseudo-tables are identical (Fig. 8E) but more numerous than the dorsal ones. The granules are as described above and are very abundant.

The tentacles contain only rods which are spiny or smooth, straight or curved, ranging from 10 to 150 μm long (Fig. 8G).

The podia contain rods, a few pseudo-tables and anastomosing plates forming the end plate (Fig. 8H).

Discussion

Most of the characteristics—viz. the body size, the general appearance, the calcareous ring and the spicules—fit very well with the genus *Thelenot*. The new species *T. rubralineata* is clearly distinct from *T. ananas* and *T.anax* by the dorsal protuberances, the color pattern and the spicules, and cannot be confused with any other holothurian. Regarding the spicules in particular, the serpent-like granules alone are sufficient to distinguish *T. rubralineata* from *T. ananas* and *T.anax*, which have rounded or oval miliary granules. In addition, the pseudo-tables of *T. rubralineata* are smaller (20 to 25 μm diameter) than the ones of *T. ananas* (25 to 47 μm diameter) and *T.anax* (50 μm diameter). Moreover *T. ananas* and *T.anax* have spiny plates in the tentacles whereas *T. rubralineata* does not.

The dichotomous rods (or X bodies) of both *T.anax* and *T. ananas* are quite variable in size and form, according to the origin of the specimens, (see Clark 1921, Liao 1975, Rowe & Doty 1977, Lamberson 1978, Cherbonnier 1980, 1988, Cherbonnier & Féral 1984, Chao & Chang 1989). The form of the dichotomous rods of *T. rubralineata* resembles those of *T. ananas* from Taiwan (Chao & Chang 1989) or those of *T.anax* from Xisha Islands (Liao 1975) or Madagascar (Cherbonnier 1979). According to the literature, the size range of these dichotomous rods is similar for the three species: 75 to 145 μm for *T. ananas*, 40 to 156 μm for *T.anax* and, in this study, 69 to 165 μm for *T. rubralineata*. Therefore, it is difficult to use the size of these spicules to distinguish the three species of *Thelenot*. However, the dorsal dichotomous rods of *T. rubralineata* are more spiny than those of *T.anax* and *T. ananas*.

Diagnosis

Very large holothurian with dorsal acute ramified protuberances. Body wall covered by a complex pattern of crimson lines on a white background. Yellowish spots of pigment appear between the red lines. Three major kinds of spicules present in the body wall: dichotomous spiny rods, pseudo-tables and serpent-like miliary granules.

Etymology: *rubralineata* means 'red lines'. This name is given according to the very characteristic pattern of crimson lines covering the body wall.

Acknowledgments

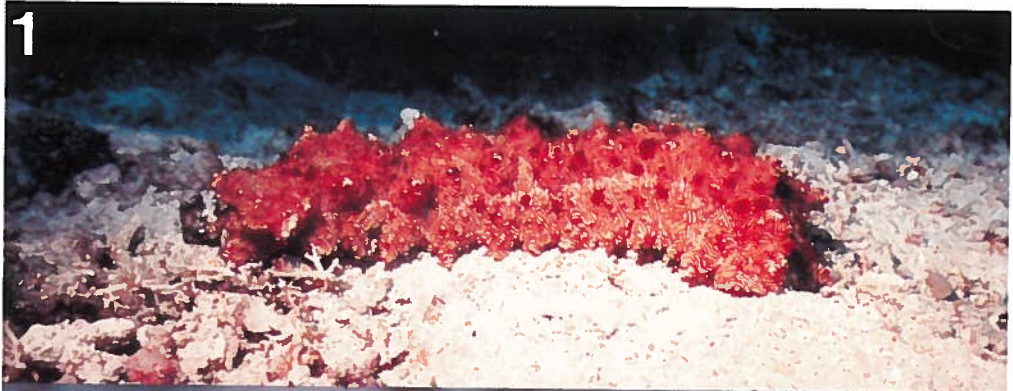
It is a pleasure to thank Dr. M. Jebb who collected most of the specimens and provided much information regarding the biology of *T. rubralineata*. As the Director of the Christensen Research Institute, he provided to one of us (C.M.) all the facilities to collect and study the Papua New Guinea material. The expedition in Papua New Guinea was supported by the Belgian Fund for Basic Research (grant no. 209001.86) and the I.R.Sc.N.B. Contribution no. 207 of the King Léopold III Biological Station, Papua New Guinea.

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Massin & Lane—Plate I.