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A new *Munidopsis* (Crustacea: Decapoda: Galatheidae) associated with gorgonian corals from the deep waters off Taiwan

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Abstract.—*Munidopsis sarissa*, a new galatheid crustacean associated with gorgonian corals, is described from Taiwan at depths of about 1000 m. This new species is unique in the genus by having an extremely spinose carapace with elongated spearhead-like rostrum, fourth thoracic sternite much larger than following sternites, and very long and slender chelipeds possessing broad coxae which are clearly visible from the dorsal view of the animal.

The galatheid genus *Munidopsis* Whiteaves, 1874 is predominantly deep-sea in distribution and has a very high diversity, with 147 species known in the Indo-Pacific and about 70 species in the Atlantic Ocean (Baba 1988, 2005; Macpherson & Segonzac 2005, Macpherson 2007). Species of the genus are often found in the catches of deep-sea benthic trawls from waters deeper than 500 m. The ongoing extensive deep-sea survey off Taiwan down to 4455 m deep has yielded abundant material of *Munidopsis*, including many new locality records and even new species (Wu & Chan 2000, Osawa et al. 2006a, b). Amongst these newly collected *Munidopsis*, a bizarre form associated with gorgonian corals was found. This form is very distinctive in having an extremely spinose carapace with a long spear-head like rostrum, fourth thoracic sternite greatly enlarged, and the chelipeds very long and slender with broad coxae. There is little doubt that the unusual form represents a species new to science and illustrates the morphological diversity exhibited in *Munidopsis*. The type material of the new species is deposited in the National Taiwan Ocean University, Keelung (NTOU). The postorbital carapace length (cl) was measured from the orbital margin to the posterior margin of the carapace along the dorsal midline. The abbreviations "CP" and "PCP" refer to the French beam trawl with the spans of 4.2 and 2.5 m, respectively.

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Systematics

Munidopsis sarissa, new species
Figs. 1–3

Material examined.—"TAIWAN 2005," RV "Fisheries Researcher I," stn CP300, 22°17.16′N, 119°59.91′E, 960–972 m, 11 Aug 2005, 1 male cl 8.8 mm (holotype, NTOU A00820), 1 male cl 5.9 mm, 3 females cl 5.8–8.5 mm, 1 ovig. female cl 7.9 mm (paratypes, NTOU A00821); RV "Ocean Researcher III," stn PCP334, 22°16.71′N, 120°00.11′E, 975–994 m, 5 Oct 2005, 4 males cl 5.6–6.7 mm, 3 ovig. females cl 7.3–8.3 mm (paratypes, NTOU A00822). "TAIWAN 2006," RV "Ocean Researcher III," stn PCP342, 22°16.65′N, 119°59.96′E, 988–1010 m, 8 Mar 2006, 1 male cl 5.3 mm, 1 female cl 5.3 mm (NTOU A00823).

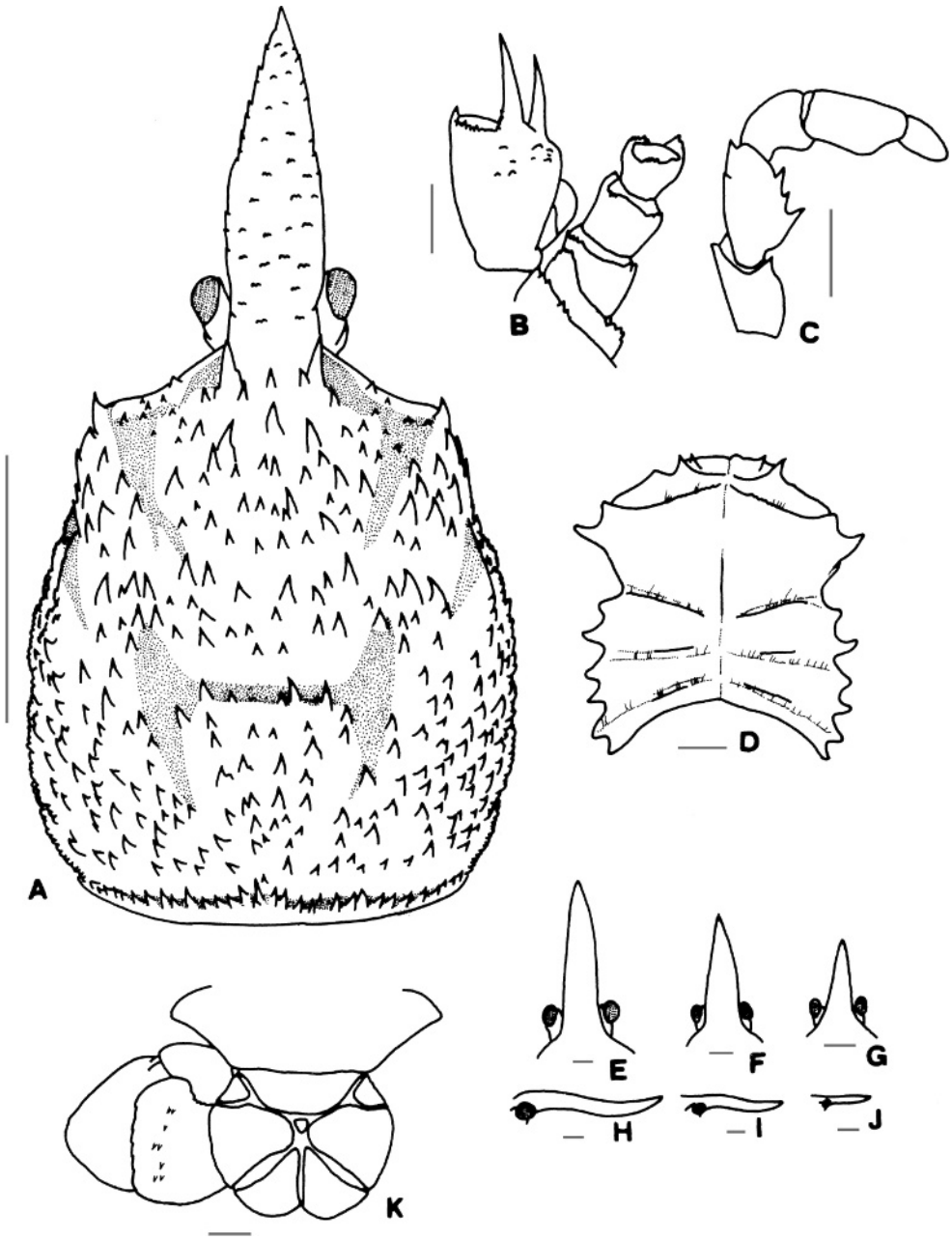

Fig. 1. *Munidopsis sarissa*. A–D, K, holotype male cl 8.8 mm (NTOU A00820); E, H, paratype female cl 8.3 mm (NTOU A00821); F, I, paratype male cl 6.7 mm (NTOU A00821); G, J, paratype male cl 5.6 mm (NTOU A00821). A, carapace, dorsal view; B, ventral view of right cephalic region, showing antennular and antennal peduncles; C, left third maxilliped, lateral view; D, sternal plastron; E–G, rostrum and eyes, dorsal view; H–J, rostrum, lateral view; K, telson and right uropods, dorsal view. Scales = 1.0 mm.

Description.—Carapace (Fig. 1A), excluding rostrum, about 1.2 times longer than broad; dorsal surface with numerous recurved spines, gastric spines prominent; regions well delineated, with strongly excavated cervical grooves; cardiac region with distinct transverse depression. Lateral margins spinose, anteriorly converg-

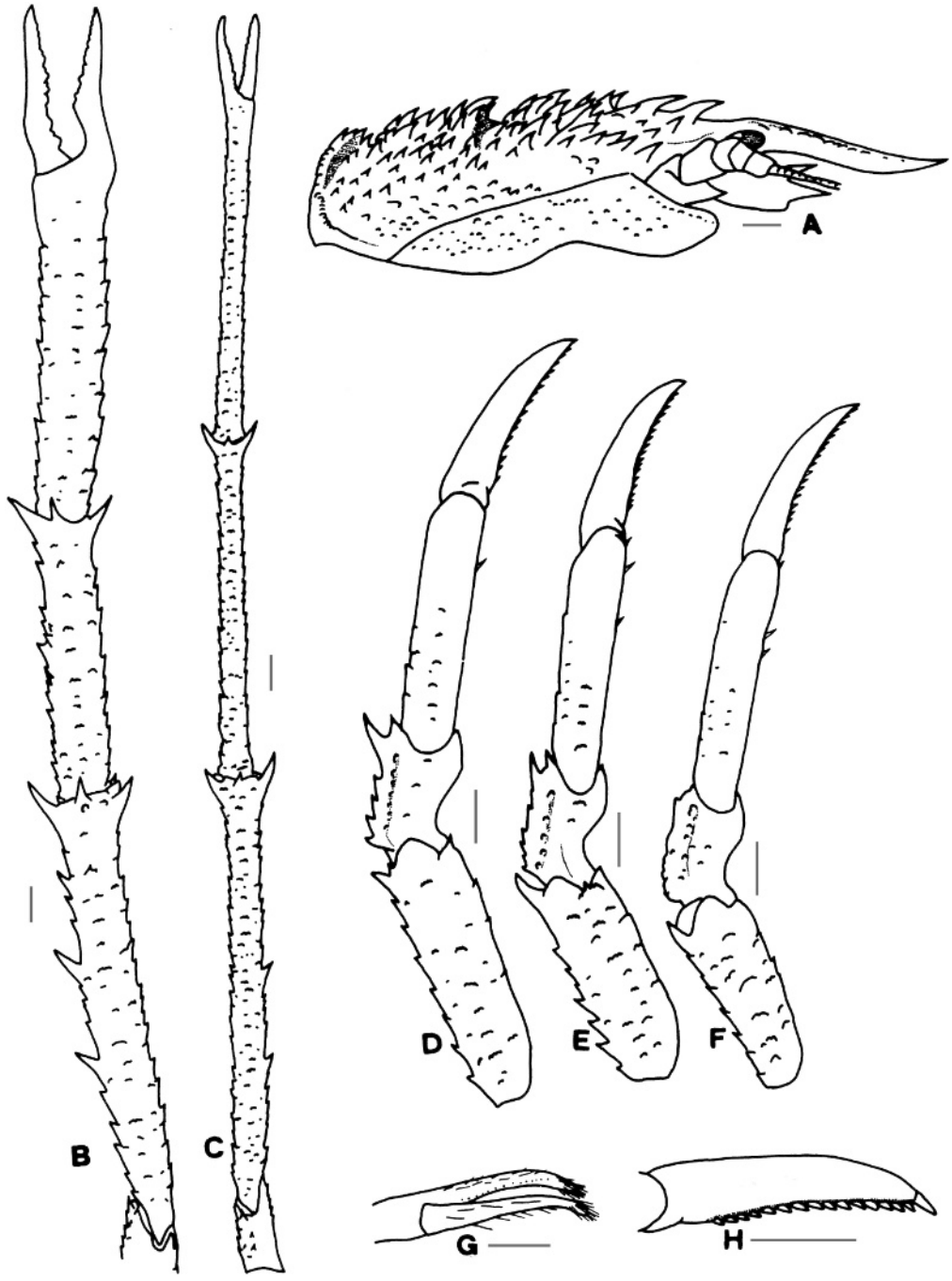

Fig. 2. *Munidopsis sarissa*. A, B, D–F, H, holotype male cl 8.8 mm (NTOU A00820); C, G, paratype ovigerous female cl 7.3 mm (NTOU A00822). A, anterior part of carapace and pterygostomian flap, ocular peduncle, basal article of antennular peduncle and antennal peduncle, right lateral view; B, right cheliped, dorsal view; C, left cheliped, dorsal view; D, right second pereopod, lateral view; E, right third pereopod, lateral view; F, right fourth pereopod, lateral view; G, fingers of cheliped, mesial view; H. dactylus of second pereopod, lateral view. Scales = 1.0 mm.

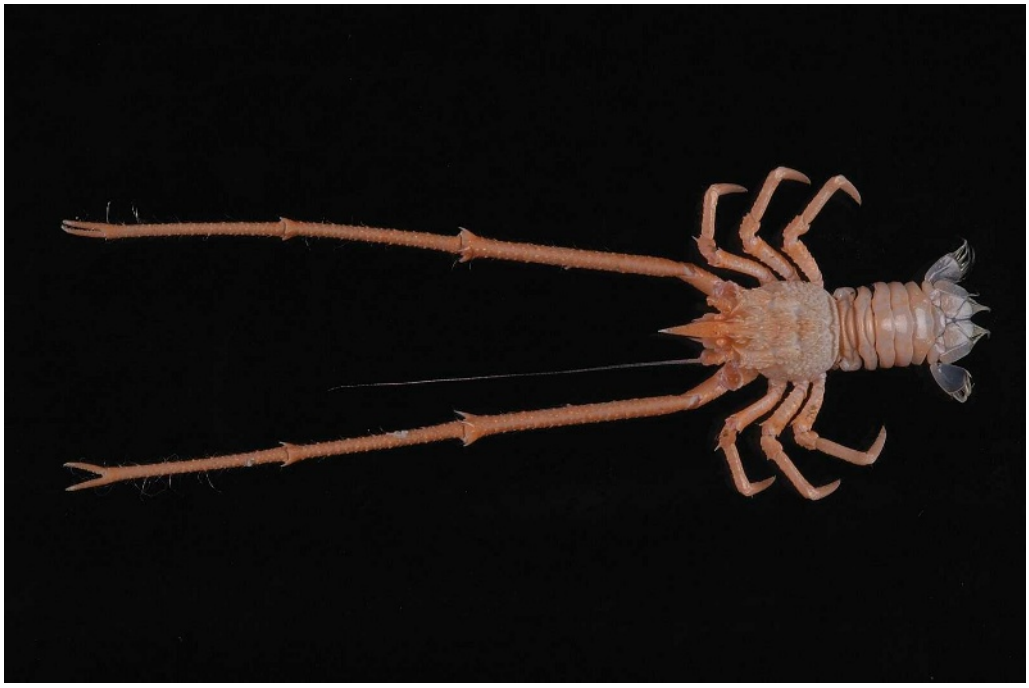

Fig. 3. *Munidopsis sarissa*. paratype ovigerous female cl 7.3 mm (NTOU A00822). Fresh animal dorsal view, with coxae of chelipeds clearly visible.

ing, weakly notched at anterior end of cervical groove, posterior branchial regions inflated. First 2 anterolateral spines larger than other marginal spines. Posterior margin preceded by elevated ridge bearing closely-set small spines and tubercles. Frontal margin strongly oblique, mesial half relatively straight, lateral half slightly concave. Rostrum elongate and lance-like (Figs. 1A,E–J, 2A), terminating acutely, 3.5–4.3 times as long as broad measured at base and 0.4–0.6 length of remaining carapace, longer in large individuals and becoming spearhead-shaped in dorsal view (i.e., with lateral margins gently convex, widest at midlength) and sinuous in lateral view; lateral margins crenulate; dorsal surface flattish or slightly concave in midline, with scattered short, squamiform ridges; ventral surface with rounded carina along midline.

Pterygostomian flap anteriorly rounded (Fig. 2A), surface scattered with small tubercles.

Third sternite short and broad, anterior margin with shallow median notch and pair of sublateral spines (Fig. 1D). Fourth sternite larger than following sternites, 3.5–4.7 times third sternite in greatest breadth, depressed along midline, anterior margins oblique, with row of small flattened tubercles. Remaining sternites essentially smooth.

Abdomen with scattered short and thin setae; second and third somites each with 2 elevated transverse ridges, anterior ridge longer than posterior, pleuron of second somite uneven; fourth somite with indistinct ridge anteriorly; fifth and sixth somites smooth; sixth somite with posterior margin slightly notched sublaterally. Telson divided into 8 calcified plates (Fig. 1K). Endopod of uropod with longitudinal, irregular rows of spinules medially (Fig. 1K).

Ocular peduncle (Fig. 1A) slightly movable, without distinct eye-spine but with very small, subacute projection at ante-

romesial end; cornea globular, cupped in anterolateral part of eyestalk.

Basal segment of antennular peduncle with distodorsal and distolateral spines long and subequal in size (Fig. 1B); ventromesial distal margin minutely tuberculate, unarmed or with 1 terminal spinule; lateral margin anteriorly spinulose.

Antennal peduncle (Fig. 1B) exceeding cornea by half length of third segment. First segment with a serrate distomesial process, distolateral margin minutely tuberculate. Second segment feebly serrate distomesially, sometimes also bearing distolateral spinule. Third and fourth segments unarmed but minutely tuberculate along distal margins.

Third maxilliped (Fig. 1C) with ischium shorter than merus measured at midline; ventral margin ridged, terminating in small spine; dorsal margin with small distal projection; merus with 3 or 4 distinct spines on ventral margin, proximal 1 or 2 spines largest, dorsal margin crenulate and bearing 1 distal spine; carpus, propodus and dactylus unarmed. Epipod reduced, short and slender.

Chelipeds (first pereopods) subcylindrical, very long and slender (Fig. 2B, C); length and slenderness sexually dimorphic, 4.6–4.8 times longer than postorbital carapace in males and 5.4–5.8 times in females; surfaces covered with short, transverse, subacute or squamiform ridges that bear short setae on anterior margins. Coxa large, clearly visible when animal viewed dorsally; dorsodistal margin concave. Ischium 1.5–1.7 times as long as broad, dorsal and ventral margins each with row of small but distinct spinules distally. Merus 8.3–9.3 times as long as broad in males and 12.5–14.3 times in females; with 4 terminal spines (mesial, dorsal, ventrolateral, and lateral); mesial and lateral surfaces serrated with distinct spines, former also bearing 2 prominent spines. Carpus 4.8–6.6 times as long as broad in males and 11.8–14.4 times in females; with 3 terminal spines (mesial, dorsal, and lateral), mesial and lateral spines equal in size and larger than dorsal. Palm elongate, moderately depressed, 1.0–1.3 length of carpus, 5.5–8.0 times as long as broad measured at base of fingers in males and 14.8–19.2 times in females. Fingers 0.4–0.5 length of palm in males and 0.2–0.3 length in females; distally curving ventrally and sharply pointed, obscured by dense short setae (Fig. 2G); surfaces nearly smooth; cutting edges with row of blunt or subacute teeth.

Second to fourth pereopods moderately stout, somewhat compressed laterally (Fig. 2D–F). Second pereopod longest, reaching far behind (in females) to nearly reaching (in males) distal margin of merus of cheliped. Merus with row of small spines on dorsal crest, distal spine prominent; lateral surface covered with short squamiform ridges; ventrolateral margin crenulate or finely serrated, with small distal spine. Carpus with 1 or 2 prominent terminal spines and some smaller spines on dorsal crest; lateral surface with elevated ridge of irregularly arranged small protuberances somewhat dorsally along midline; ventral surface smooth, distal margin unarmed but slightly denticulate. Propodus armed with pair of ventrodistal corneous spines and 1 or 2 spines on distal third of ventral margin, lateral surface feebly rugose on proximal half, dorsal margin with some acute, squamiform ridges. Dactylus 0.7–0.8 length of propodus; terminal claw short, weakly curved; ventral margin slightly curved, crenulated, with row of 13–17 closely set, low subacute spines (Fig. 2H). Third and fourth pereopods similar, except for slightly smaller size and lacking ventrodistal spine, carpus of fourth pereopod also lacking dorsodistal spine (Fig. 2F).

Epipod absent from all pereopods. Eggs large and few, 1–3 eggs remaining

in 4 ovigerous females examined; subspherical and approximately 0.9–1.7 mm in diameter.

Color.—Rostrum and anteromedian part of carapace, sometimes also chelipeds, orange-pink (Fig. 3). Most parts of carapace, abdomen, and pereopods pink to white. Cornea light orange. Eggs orange.

Size.—Largest male 8.8 mm cl and largest females 8.5 mm cl, smallest ovigerous female 7.3 mm cl.

Distribution.—Presently known only off the southwestern coast of Taiwan, at depths of 960–1010 m.

Etymology.—The very long and slender chelipeds, as well as the elongated spearhead-shaped rostrum of this new species, give an impression of the exceptionally long spear, the *Sarissa*, used by the Macedonian *Pezetairoi* in ancient Greece. The name is used as a substantive in apposition.

Remarks.—The present new species is unusual in *Munidopsis* by the coxae of the chelipeds being clearly visible when the animal is viewed dorsally. In no other known species of the genus are the coxae of the chelipeds exposed dorsally. Moreover, *M. sarissa* is very distinctive in having an extremely spinose carapace, with the rostrum elongated and spearhead-like, and the fourth thoracic sternite much larger than the following sternites. The very broad fourth thoracic sternite seems to be a unique character of this new species. *Munidopsis truculenta* Macpherson & Segonzac, 2005 also has a broad thoracic sternite but much less so as compared to that of *M. sarissa* (i.e., with fourth thoracic sternite narrower than following sternites). The spinose carapace and elongated rostrum in *M. sarissa* somewhat resembles those of *M. spinihirsuta* Lloyd, 1907 from the Arabian Sea. Other than the above mentioned unique characters, *M. sarissa* can be readily separated from *M. spinihirsuta* (re-described by Tirmizi 1966) by the carpus of the third maxilliped being smooth on the extensor margin (vs. with a row of small spines) and the abdomen unarmed (vs. armed with spines on the transverse ridges), and by the absence of a distinct eye-spine (vs. with a strong eye-spine). The strong sexual dimorphism in the chelipeds of the present species has not been recorded in the other species of the genus, though some species of *Anoplonida* Baba & de Saint Laurent, 1996 (see Baba & de Saint Laurent 1996) have the chelipeds much longer and more slender in males than in females (vs. chelipeds more slender and longer in females of *Munidopsis sarissa*).

Most specimens of *Munidopsis sarissa* were obtained amongst the branches of gorgonian corals (probably *Chrysogorgia* sp.). This implies that the galatheid has a strong association with these corals. Other galatheid genera such as *Allogalathea* Baba, 1969, *Galathea* Fabricius, 1793, and *Lauriea* Baba, 1971 include species known to associate with sponges, soft corals, or crinoids in shallow waters (see Debelius 1999, Kato & Okuno 2001). In deep waters, such associations seem to be rather common in species of the Chirostylidae (Baba 2005), a close relative of the Galatheidae, but rarely been reported for galatheids. At present, only three species of *Munidopsis* from the western Atlantic have been reported to be associated with echinoderms from depths of 408–741 m (Rice & Miller 1991). The present suspected association, however, is with gorgonian corals. Co-occurrence of other galatheid species with invertebrates has also been observed in the deep-sea catches of the "TAIWAN" cruises (TYC personal observation).

It is interesting to note that *Munidopsis sarissa* has a row of closely set, subacute corneous spines along the ventral margin of the dactyli of the second to fourth pereopods. Similar spination is shown in some species of the chirostylid genus *Uroptychus* Henderson, 1888 (see Baba

1988, 2005). Species of *Uroptychus* are usually found in association with gorgonacean and pennatulacean corals in deep waters (Baba 2005). The similar structure of the ambulatory dactyli in *M. sarissa* may represent a convergence of characters for the association with deep-sea branching corals. In the genus *Munidopsis*, it seems that only *M. levis* Alcock & Anderson, 1894 from the Indo-West Pacific also has such closely set corneous spines on the dactylus of the fourth pereopod (see Baba 2005, Fig. 71C), but no association information is available for this species. Another unusual feature of *M. sarissa* is the ability to raise the chelipeds almost perpendicularly as in many *Uroptychus* species. This is facilitated in *M. sarissa* by the greatly enlarged coxa of the cheliped in which the dorsodistal margin is concave. No other *Munidopsis* can raise the chelipeds to such a degree. This condition in *M. sarissa* may also be an adaptation for living within branching corals. All in all, *M. sarissa* in many ways seems convergent on *Uroptychus*, sharing similar body form, size and habitat.

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