

THE GENUS *PARAXIOPSIS* DE MAN, WITH
DESCRIPTIONS OF NEW SPECIES FROM THE WESTERN
ATLANTIC (CRUSTACEA: DECAPODA: AXIIDAE)

Brian Kensley

ABSTRACT

The axiid shrimp genus *Paraxiopsis* De Man is reinstated, and separated from *Eutrichocheles* Wood Mason on the basis of five characters. Nine species are assigned to *Paraxiopsis*, two from the Pacific and seven from the western Atlantic. Five of the latter are previously undescribed: *P. foveolata* from the eastern Gulf of Mexico; *P. gracilimana* from South Carolina to Tobago, Belize, and the Gulf of Mexico; *P. granulimana* from Trinidad and the Florida Shelf; *P. hispida* from the Yucatan; and *P. spinipleura* from Belize and the Florida Keys. The type species, *P. brocki* De Man from the Indo-Pacific is redescribed, as is *P. defensus* Rathbun from the Caribbean. The species range from the intertidal to 95 m, in a variety of habitats including coral buttresses, coarse rubble, sand and mud.

Axiid shrimps are, almost without exception, cryptic in habit. Consequently, little is known of their biology, while the taxa are often poorly represented in museum collections. Excluding the five new species described here, 14 species of axiids have been recorded in the tropical western Atlantic, of which the four species of *Eiconaxius* Bate, 1888, are all deepwater sponge commensals. Only *Coralaxius nodulosus* (Meinert, 1877) and *Axiopsis serratifrons* (A. Milne Edwards, 1873) have been observed alive, and even for these species there is only scant biological information. The material described here has been accumulated over the course of several years, often incidental to collecting efforts for fishes and other crustacean groups, or as part of surveys of the shallow continental shelf. The apparent radiation of the genus *Paraxiopsis* in the Western Atlantic reported here is thus probably more an artefact of collecting than a genuine phenomenon, and is the result of numerous collections made especially on and around coral reefs and other shallow-water habitats in the Caribbean Sea, the Florida Keys, and the Gulf of Mexico.

ABBREVIATIONS. AM—Australian Museum; AMNH—American Museum of Natural History; cl—carapace length; MAFLA—Bureau of Land Management's Mississippi-Alabama-Florida Outer Continental Shelf Study; ovig.—ovigerous; SOFLA—Bureau of Land Management's Southwest Florida Shelf Ecosystems Study; USNM—National Museum of Natural History, Smithsonian Institution.

Genus *Paraxiopsis* De Man, 1905

Axiopsis (*Paraxiopsis*) De Man, 1905: 597; 1925: 6, 71.—Balss, 1957: 1579.—Poore and Griffin, 1979: 221.

Paraxiopsis.—Sakai and de Saint Laurent, 1989: 3, 51.

Type Species.—By original designation, *Axius Brocki* De Man, 1887. Type locality: Amboina and Edam, Indonesia. Gender: Masculine.

Diagnosis.—Gonochoristic (some species possibly hermaphroditic). Carapace with distinct rostrum set at lower level to anterior carapace; linea thalassinica absent. Postcervical carina and spines absent. Rostral margins dentate. Median carina entire; submedian carina usually dentate; lateral carina dentate. Abdominal pleura broadly rounded or triangular, lacking dense setation.

Table 1. Gill and exopod formula for *Paraxiopsis brocki*. r = reduced

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—	—	—
Epipod	1	1	1	1	1	1	1	—
Podobranch	—	—	r	r	r	r	—	—
Arthrobranch	—	—	2	2	2	2	2	—
Pleurobranch	—	—	—	—	—	—	—	—
Setobranch	—	—	1	1	1	1	1	—

Eye with normal pigmentation, ommatidial facets square, eyestalk rounded. Antennular peduncle with basal article slightly inflated, with small stylocerite tooth; articles 2 and 3 short. Antennal peduncle article 3 set obliquely on article 2, with 3 or 4 teeth on mesial margin, article 5 usually shorter than 4; antennal acicle reduced to bifid scale. Mandibular palp with 3 articles; mandibular body with strong transverse ridge on inner surface. Maxillule with exopod of 2 slender articles, basal endite bearing numerous setae. Maxilla with basial and coxal endites bilobed, heavily setose on mesial margins; exopod slender; scaphognathite bearing single posterior whip. Maxilliped 1 having short digitiform endopod, more elongate setose curved exopod bearing small distal process; epipod large, bilobed. Maxilliped 2 exopod elongate, slender, not geniculate; endopod pediform, with short rounded dactylus bearing several stout fringed setae; epipod accompanied by short podobranch. Maxilliped 3 pediform; epipod present, margins entire; exopod elongate, slender, not geniculate; strong dentate ischial crest present on inner surface of ischium; merus dentate on mesial margin. Pereopod 1, chelae asymmetrical. Pereopod 2 chelate. Pereopods 3–5, ischium and merus free, ischium and basis fused; pereopods 2–4, propodi cylindrical; epipods present on pereopods; pleurobranchs absent. Pereopod 5 simple. Pleopod rami narrow. Pleopod 1 in male absent; pleopod 2 in male present, endopod of single article, lacking stiff distal setae or spines, appendix interna absent, appendix masculina present. Pleopods 3–5 lacking appendix interna. Uropodal rami broad, flexible; lateral uropodal ramus with transverse suture. Telson with dorsal non-articulating spines, with single mobile posterolateral spine, single median spine on posterior margin.

Remarks.—*Paraxiopsis* De Man, 1905, was created as a subgenus for those species of *Axiopsis* characterized by having the anterior carapace sloping anteroventrally to the rostrum, and in which the antennal stylocerite and scaphocerite were very small (De Man 1925: 101). De Man designated *Axiopsis (Paraxiopsis) brocki* as the type species of his new subgenus. Poore and Griffin (1979: 221) extended the subgeneric diagnosis by adding the character of a distolateral (i.e., posterolateral) mobile spine on the telson. A further difference lies in the absence of an appendix interna on the pleopods in *Paraxiopsis*. *Axiopsis* (s.s.) possesses an appendix interna on pleopods 2–5, and an elongate antennal acicle.

Wood Mason (1875) placed *Cancer modestus* Herbst, 1794, into his new genus *Eutrichocheles*, in the family Astacidae (=Nephropsidae), based on a single specimen from off the coast of Burma. Chopra (1933: Text-fig. 1, pl. 6) reexamined Wood Mason's specimen, and concurred with Balss (1933) that *Cancer modesta* was in fact an axiid, probably a species of *Axiopsis*. From Chopra's figures and description, and those of Balasubrahmanyam and Jacob (1961), there seemed little doubt that this was a species of *Paraxiopsis*, in which case *Paraxiopsis* De Man

had to be regarded as a junior synonym of *Eutrichocheles* Wood Mason (see Sakai and de Saint Laurent, 1989: 51).

Several differences between *E. modestus* and *P. brocki* (along with the several species of *Paraxiopsis* described here), however, suggest that two separate genera are involved, even while sharing a number of features. The carapace in *P. brocki* lacks a postcervical median carina as is seen in *E. modestus*; the chelae of pereopod 1 have neither the exaggerated gape nor the strong digitiform tubercle on the propodal cutting edge as seen in *E. modestus*; the telson of the latter is shown to have a distinct median notch in the posterior margin (see Chopra, 1933: text fig. 1c), whereas *P. brocki* and the western Atlantic species all possess a short median spine and no median notch in the telson. There is also a marked difference in size between the two genera; all the species of *Paraxiopsis* are small, with a carapace length between 5 and 12 mm, whereas the three most recently collected specimens of *E. modestus* have a total length of 73 mm, 75.2 mm, and 80 mm, implying a carapace length of around 20–30 mm. Nothing is known of the presence or absence of an appendix interna on the pleopods of *E. modestus*.

For these reasons, and although not recognized by Poore (1994) in his revision of the thalassinidean families and genera, De Man's *Paraxiopsis* is reinstated as a full genus to contain two Pacific species, *P. brocki* De Man, 1905, and *P. johnstoni* (Edmondson, 1925), and seven western Atlantic species. The type species, *P. brocki* is redescribed and illustrated, along with the five new western Atlantic species. The recently described *P. pindatyba* (Rodrigues and Kensley, 1991), is not redescribed.

The only species of *Paraxiopsis* previously known from the Western Atlantic-Caribbean area is *P. defensus* (Rathbun, 1901). The five new species described here, all from the same broad area, are each so distinctive as to preclude any confusion, either amongst each other or with the earlier Rathbun species. Their separation may be easily accomplished by means of the key below.

Paraxiopsis bisquamosa De Man, 1905, from the tropical Indo-Pacific differs in five features from all other species of the genus: the antennal acicle bears a single point, the submedian carina is absent, the lateral carinae are entire, the anterior carapace bears a submedian pair of strong rounded tubercles, and the first pereopod chelae are subsimilar. Perhaps the strongest character linking this species to *Paraxiopsis* is the absence of an appendix interna on the pleopods. For these reasons, *Axiopsis bisquamosa* is excluded from *Paraxiopsis*.

Very little is known about the biology or ecological requirements for the species of *Paraxiopsis*. The species with the greatest depth range, *P. granulimana*, has been found from the intertidal to 95 m. Western Atlantic species are to be found in the vicinity of coral reefs, perhaps more associated with the rubble and interstices found around reefs, although two of the deeper-occurring species, *P. granulimana* and *P. foveolata*, were both taken from soft sand and mud bottoms. *P. gracilimana*, known from 13 separate samples, is best represented in the collections, and occurs in depths of 1–40 m, in a range of habitats from coarse sand, through coral rubble and rock, to spur-and-groove coral buttresses.

Species.—*Paraxiopsis brocki* (De Man, 1887). Indonesia; Bikini Atoll; western to northern Australia, intertidal to shallow infratidal.

Paraxiopsis defensus (Rathbun, 1901). Dominican Republic; Puerto Rico, 15.5 m.

Paraxiopsis foveolata, new species. Florida Shelf, Gulf of Mexico, 53.7 m.

Paraxiopsis gracilimana, new species. South Carolina to Tobago, 1–2 m; Gulf of Mexico; Belize; 1–33 m.

Paraxiopsis granulimana, new species. Trinidad; Florida Shelf, 95 m.

Paraxiopsis hispida, new species. Yucatan, 37 m.

Paraxiopsis johnstoni (Edmondson, 1925). Johnston Atoll, Pacific Ocean.

Paraxiopsis pindatyba Rodrigues and Kensley, 1991. South-central Brazil, intertidal.

Paraxiopsis spinipleura, new species. Belize; Florida Keys, 1.5–6 m.

KEY TO THE SPECIES OF *PARAXIOPSIS* OF THE WESTERN ATLANTIC

- | | |
|---|--------------------|
| 1a. Abdominal pleura 2–5 triangular | 2 |
| 1b. Abdominal pleura 2–5 rounded-truncate | 3 |
| 2a. Pereopod 1 chela densely setose and tuberculate; Abdominal pleura lacking strong spine on anterior margin | <i>granulimana</i> |
| 2b. Pereopod 1 chela smooth, not setose; Abdominal pleura 2–5 each with strong spine on anterior margin | <i>spinipleura</i> |
| 3a. Submedian carina of carapace multidentate | 4 |
| 3b. Submedian carina of carapace anteriorly with single tooth or blunt tubercle | 5 |
| 4a. Carapace smooth; Pereopod 1, dorsal margin of merus with single spine | <i>defensus</i> |
| 4b. Carapace obviously pitted; Pereopod 1, dorsal margin of merus with 4 spines | <i>foveolata</i> |
| 5a. Submedian carina with anterior acute tooth; Uropodal lateral ramus lacking dorsal spines (other than those of suture spine row) | <i>gracilimana</i> |
| 5b. Submedian carina anteriorly blunt; Uropodal lateral ramus with several small dorsal spines near lateral margin | 6 |
| 6a. Carapace and abdomen bearing numerous moderately dense short bristles | <i>hispida</i> |
| 6b. Carapace and abdomen lacking dense short bristles | <i>pindatyba</i> |

Paraxiopsis brocki (De Man, 1887)

Figures 1, 2

Axiops Brocki De Man, 1887: 475, pl. 20, fig. 3.

?*Axiopsis Brocki*.—Borradaile, 1903: 539.

Axiopsis (Paraxiopsis) Brockii De Man, 1905: 597; 1925: 7, 71, 101–109, pl. 8, fig. 19.

Axiopsis (Paraxiopsis) brocki.—Poore and Griffin, 1979: 228, fig. 3.—Tirmizi, 1983: 88, fig. 3.—Sakai, 1987: 304.—Morgan, 1990: 6, 63.

Eutrichocheles brocki.—Sakai and de Saint Laurent, 1989: 3, 8, 52, 101, fig. 4B.

Material Examined.—USNM 95562, 2 ovig. ♀ cl 6.0 mm, 6.2 mm, ♀ cl 5.7 mm, Bikini Atoll lagoon, 3 Apr 1946.—AM-P20357, ♀, Waigait Reef, Darwin, Northern Territory, Australia, coll. O. J. Cameron, 17 Oct 1970.—AM-P6824, immature ♀, Rail Pier, Darwin, Northern Territory, Australia.

Description.—Carapace surface smooth; rostrum with 3–4 pairs teeth, posterior pair strongest, supraocular in position; median carina lacking teeth; submedian carina with single anterior spine or with second small spine more posteriorly; lateral carina with single anterior spine; small antennal tooth present on anterior margin (Fig. 1A, B). Abdominal pleura ventrally rounded, small spine sometimes present on anterior margin of pleura 3–5 (Fig. 1A). Telson having 4 pairs fixed marginal spines, 1 pair submarginal mobile spines, 3 or 4 pairs spines on dorsal surface, shallow middorsal sulcus running from anteriormost pair of submedian spines to posterior margin (Fig. 1C).

Antennular peduncle (Fig. 1D) with basal article slightly inflated, with small stylocerite tooth; articles 2 and 3 short. Antennal article 3 set obliquely on article 2 (Fig. 1E), with 3 or 4 teeth on mesial margin; article 5 shorter than 4. Mandibular palp article 3 subequal in length to articles 1 and 2, with lateral margin curved, bearing numerous short setae (Fig. 1F). Maxillule (Fig. 1H) having exopod of 2 slender articles, basal endite bearing numerous setae. Maxilla (Fig. 1G) with basal and coxal endites bilobed, most proximal endite largest, all with heavily setose mesial margins; exopod slender, reaching beyond anterior apex of scaphognathite; latter posteriorly triangular, bearing single spinulose whip.

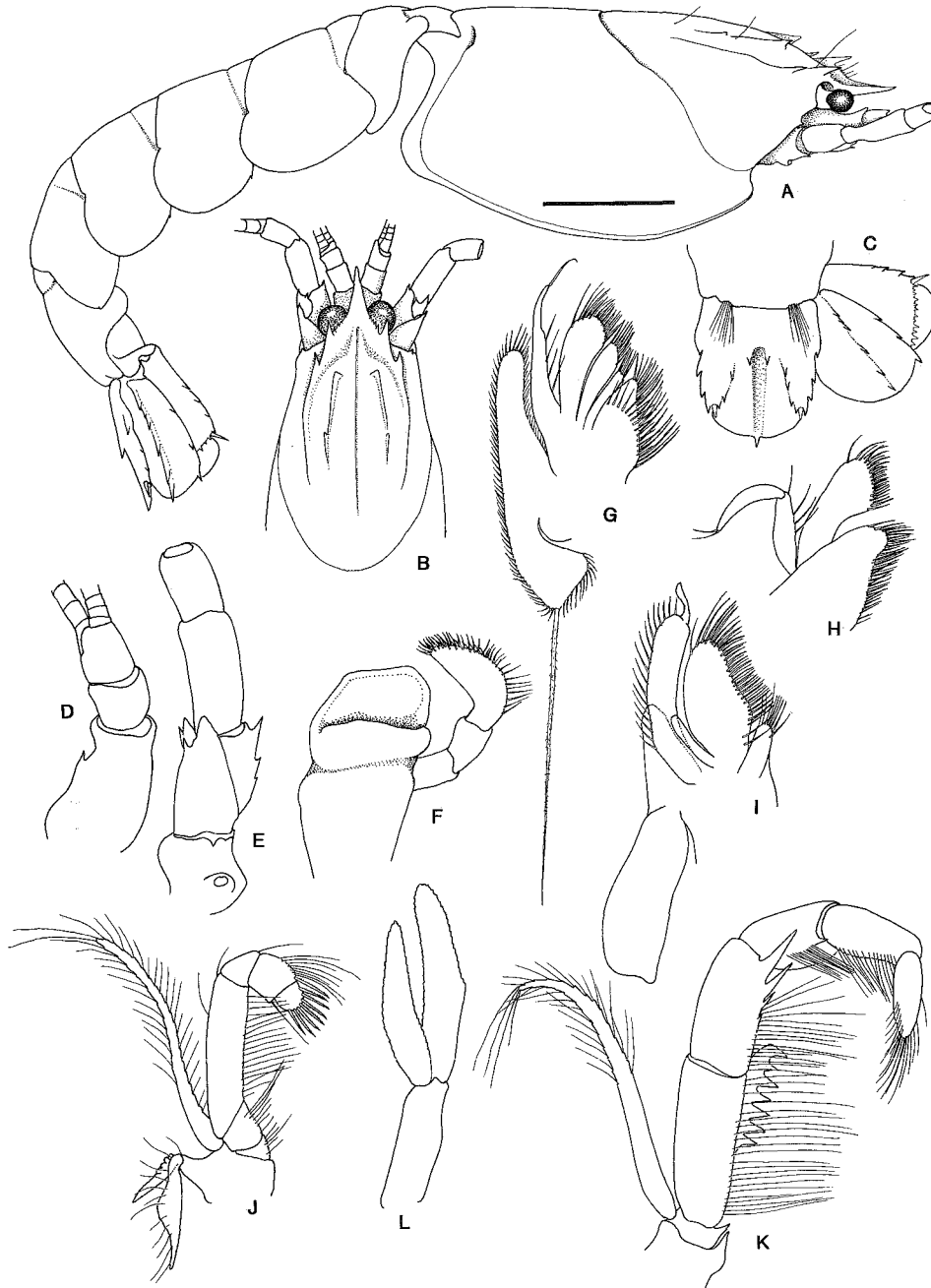


Figure 1. *Paraxiopsis brocki*, USNM 95562: A, carapace and abdomen in lateral view, scale = 2 mm; B, anterior carapace in dorsal view; C, telson and right uropod; D, antennular peduncle; E, antennal peduncle; F, mandible; G, maxilla; H, maxillule; I, maxilliped 1; J, maxilliped 2; K, maxilliped 3; L, pleopod 2.

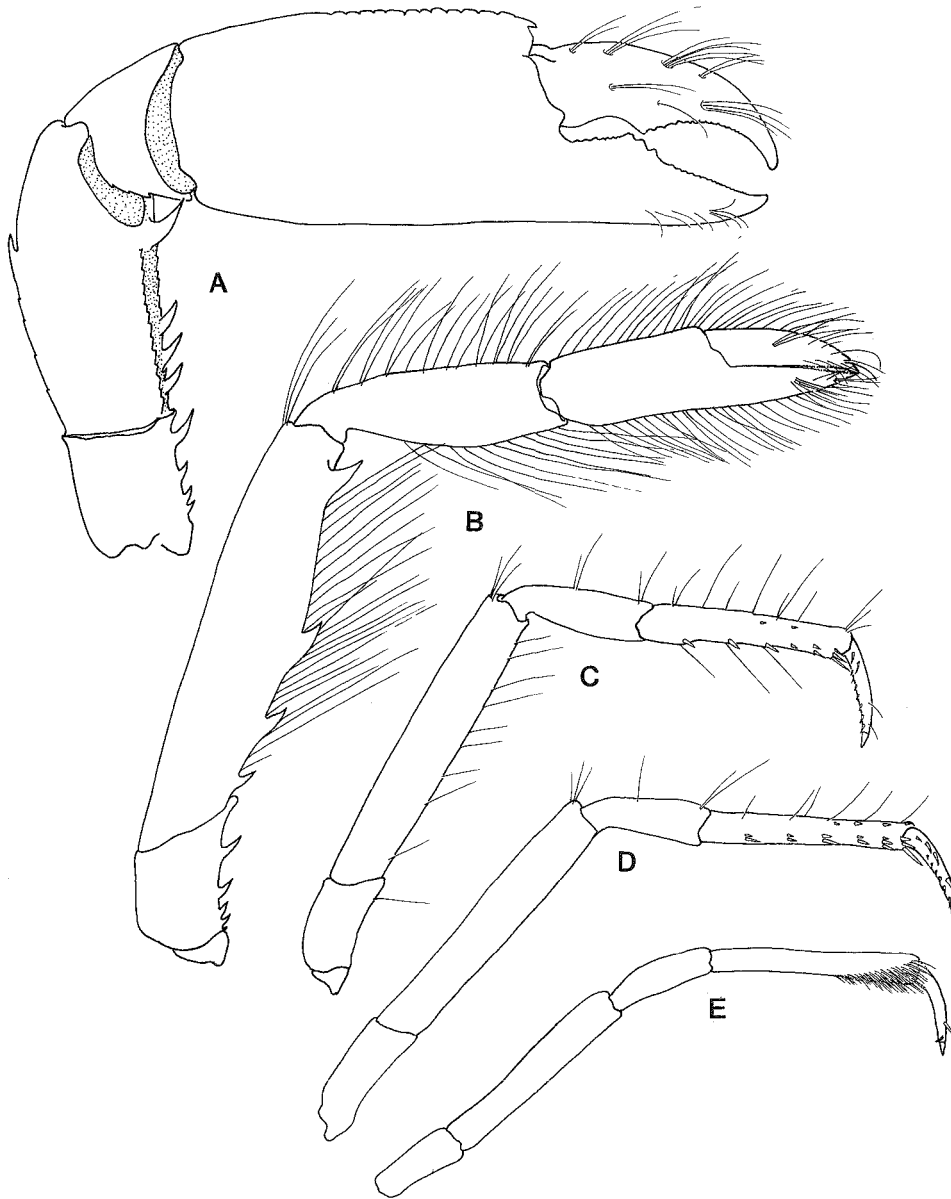


Figure 2. *Paraxiopsis brocki*, USNM 95562: A, pereopod 1; B, pereopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5.

Maxilliped 1 (Fig. 1I) having short digitiform endopod, more elongate setose curved exopod bearing small digitiform distal process; epipod large, bilobed. Maxilliped 2 (Fig. 1J), exopod elongate, slender, not geniculate; endopod pediform, with short rounded dactylus bearing several stout fringed setae; epipod accompanied by short podobranch. Maxilliped 3 (Fig. 1K) pediform; exopod elongate, slender, non-geniculate; strong dentate crest on inner surface of ischium, latter with mesial margin unarmed; merus with 2 strong distal and 5-7 small

proximal spines on posterior margin. Pereopod 1, larger cheliped (Fig. 2A), ischium with 3–4 small spines on posterior margin; merus with 1 spine on upper margin, 4 spines on posterior margin; carpus with 2 or 3 small tubercles on posterior margin; propodal palm about 1.5 times finger length, upper margin carinate, distally becoming crenulate, ending in small distal spine, cutting edge of fixed finger with 3 somewhat stronger teeth on triangular cusp; dactylus with 1 or 2 larger rounded teeth proximally, rest of edge finely denticulate. Pereopod 1, smaller cheliped, ischium with 1 large and 2 small teeth on posterior margin; merus with 1 spine on upper margin, 3 spines on posterior margin; carpus with 2 small tubercles on posterior margin; propodal palm about 1.3 times finger length, upper margin carinate, entire, ending distally in small spine; cutting edges of propodus and dactylus as in larger chela. Pereopod 2 (Fig. 2B), ischium with 4 or 5 spines on posterior margin; merus with 3 strong spines and 1 smaller proximal spine on posterior margin; carpus unarmed; fingers of chela slightly shorter than propodal palm, margins setose. Pereopods 3 and 4 (Fig. 2C, D), propodus with 6 rows of 2 or 3 short spines on posterior margin; dactyli slender, with row of short spines on posterior margin, and 2 or 3 spines on lateral surface. Pereopod 5 (Fig. 2E) shorter than preceding leg, propodus with dense posterodistal clump of setae; dactylus lacking spines on posterior margin. Uropod (Fig. 1C) with lateral ramus having 3–5 lateral spines, 1 submarginal mobile spine, 12–13 spines along transverse suture; mesial ramus with 3 lateral spines, 5 or 6 spines on middorsal ridge.

Paraxiopsis defensus (Rathbun, 1901)

Figures 3, 4

Axius defensus Rathbun, 1901: 95, fig. 17.

?*Axiopsis defensus*.—Borradaile, 1903: 539.

Axiopsis (Paraxiopsis) defensa.—De Man, 1925: 7, 67, 68, 71.—Schmitt, 1935: 191, fig. 51.

Eutrichocheles defensus.—Sakai and de Saint Laurent, 1989: 3, 52, 101.

Material Examined.—*Holotype*, USNM 23780, ovig. ♀ cl. 9.1 mm, off Boca Prieta, Puerto Rico, 15.5 m, coral and sand.

ADDITIONAL MATERIAL AMNH A6963, ♀ cl 4.0 mm, Piedra Prieta Reef, Barahona Harbour, Dominican Republic, coll. J. C. Armstrong, 8 Dec 1933.

Diagnosis.—Carapace surface smooth; rostrum reaching well beyond eyes, with 1 pair spines in supraocular position; median carina lacking spines; submedian carina with up to 8 spines decreasing in size posteriorly; lateral carina with single anterior spine; small antennal tooth present on anterior carapace margin (Fig. 3A, B). Abdominal pleura 2–5 ventrally rounded (Fig. 3A). Telson (Fig. 3C) having 4 pairs of lateral spines, 1 submarginal posterolateral mobile spine, 4 pairs of spines on dorsal surface; well marked shallow median groove running from anteriormost dorsal spines to posterior margin; latter bearing small median spine.

Antennular peduncle, basal article slightly inflated, bearing small stylocerite tooth; articles 2 and 3 together shorter than basal article. Antennal peduncle with basal article bearing 2 distomesial teeth; article 3 set obliquely on article 2, with 2 spines on mesial margin. Mandible (Fig. 3E, F) with broad molar ridge on inner surface; palp with article 3 subequal in length to articles 1 and 2 together, with lateral margin curved, bearing numerous short setae. Maxillule (Fig. 3D) having exopod of 2 slender articles, basal endite bearing numerous setae. Maxilla (Fig. 3I) with basial and coxal endites bilobed, most proximal endite largest, all with heavily setose mesial margins; exopod slender; scaphognathite subequal in length to spinulose whip.

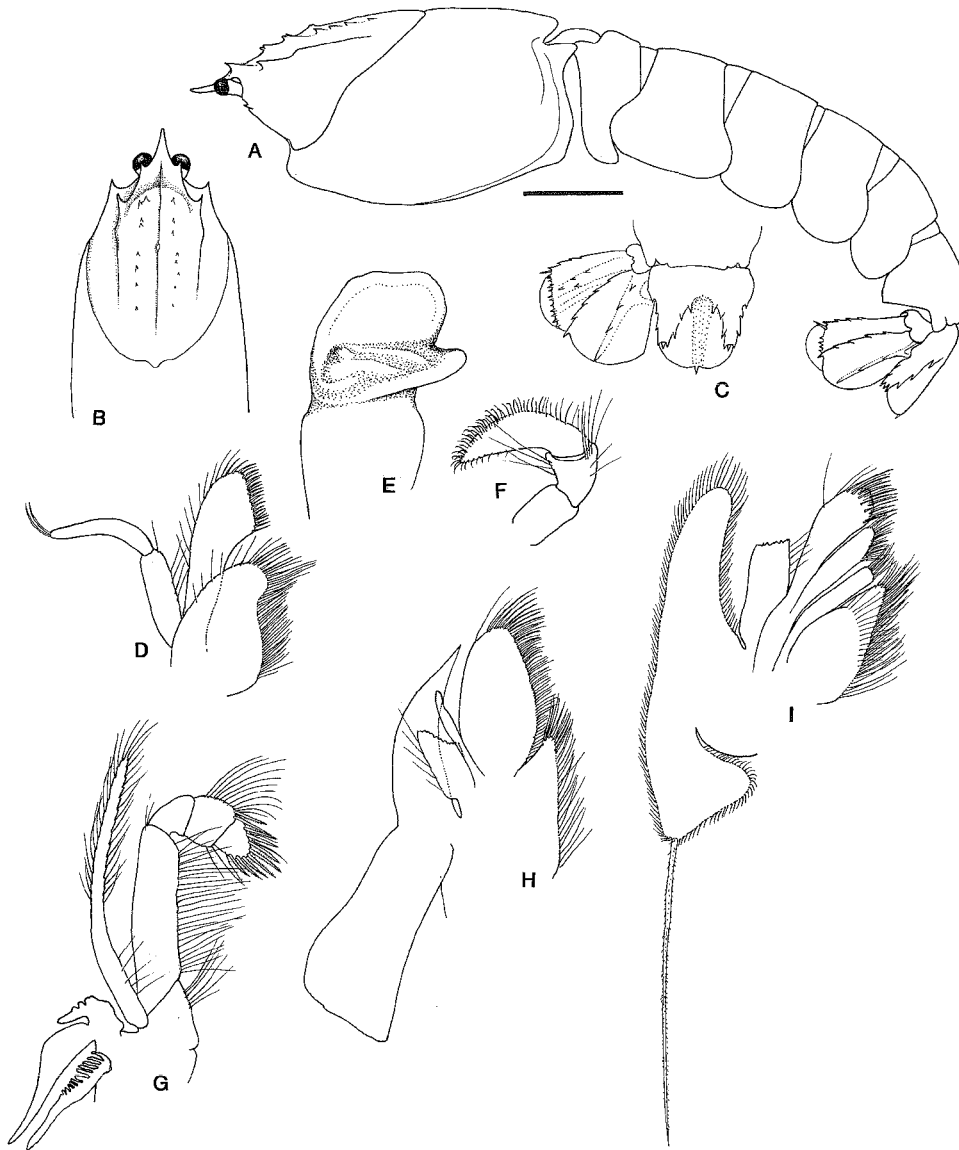


Figure 3. *Paraxiopsis defensus*, holotype, USNM 23780: A, carapace and abdomen in lateral view, scale = 3 mm; B, anterior carapace in dorsal view; C, telson and left uropod; D, maxillule; E, mandible; F, mandibular palp; G, maxilliped 2; H, maxilliped 1; I, maxilla.

Maxilliped 1 (Fig. 3H) having 2 broad setose endites, endopod slender, digitiform; epipod large, bilobed, anterior lobe triangular, posterior lobe distally truncate. Maxilliped 2 (Fig. 3G), exopod elongate, slender, non-geniculate; endopod pediform, with short rounded dactylus bearing several stout fringed setae; epipod accompanied by rudimentary podobranch. Maxilliped 3 (Fig. 4D) pediform, exopod elongate, slender, non-geniculate; endopodal coxa and basis each bearing strong mesiodistal tooth; ischium with 4 small spines on posterior margin, strong dentate

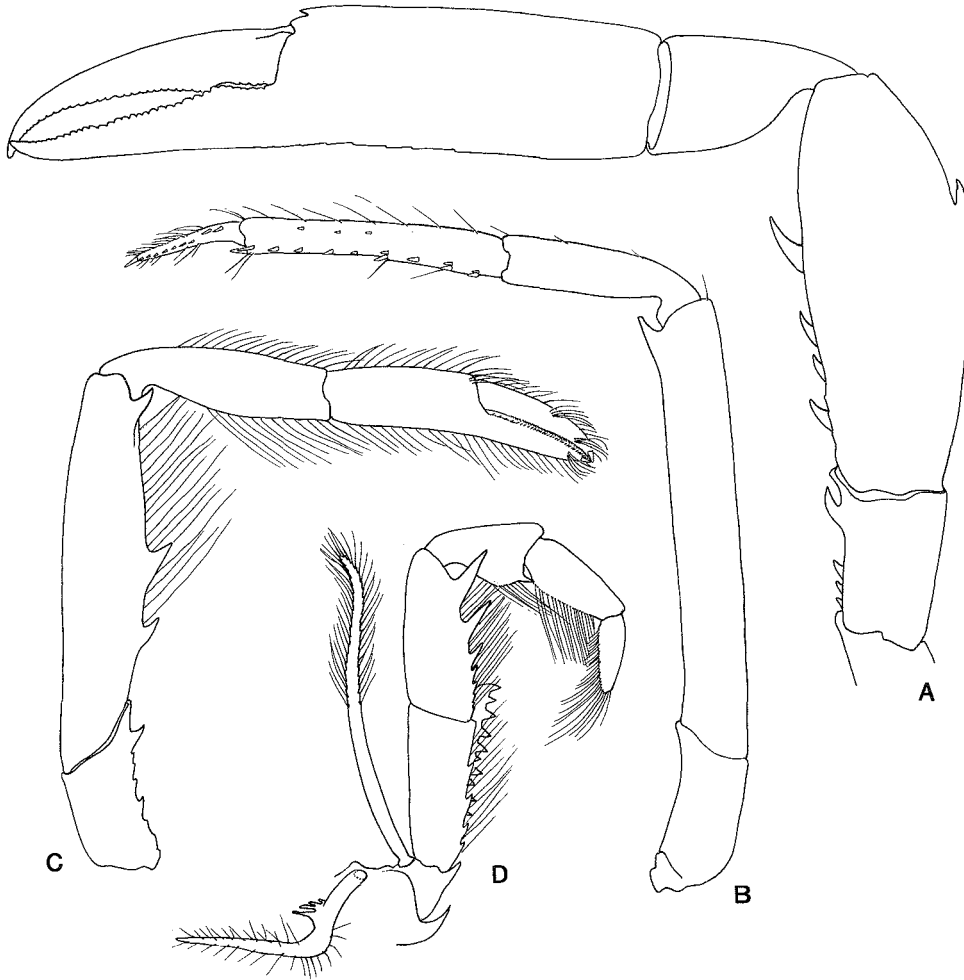


Figure 4. *Paraxiopsis defensus*, holotype, USNM 23780: A, pereopod 1; B, pereopod 3; C, pereopod 2; D, maxilliped 3.

crest on inner surface; merus with 2 strong distal and 4–5 small proximal spines on posterior margin; carpus with short posterodistal spine. Pereopod 1 (Fig. 4A), chelipeds subsimilar, subequal; ischium with one strong and 3 or 4 smaller spines on posterior margin; merus with 1 strong spine on upper margin, 1 strong distal and 3 smaller proximal spines on posterior margin; propodal palm dorsally carinate, ending in distal tooth, 1.4 times finger length; cutting edge of fixed finger and dactylus finely denticulate, with low triangular basal cusp. Pereopod 2 (Fig. 4C) ischium with several small teeth on posterior margin; merus with 1 strong distal tooth and 2 strong teeth in proximal half of posterior margin. Pereopod 4, merus with strong posterodistal tooth; propodus with row of about 9 single or double series of short spines; dactylus with 7 small spines on posterior margin, 2 spines on lateral surface. Lateral ramus of uropod (Fig. 3C) with 4 lateral spines, slender mobile distolateral spine, 11–12 spines along suture, 4 spines along dorsal ridge; mesial ramus with 5 lateral spines including distal spine, 4 spines on dorsal ridge.

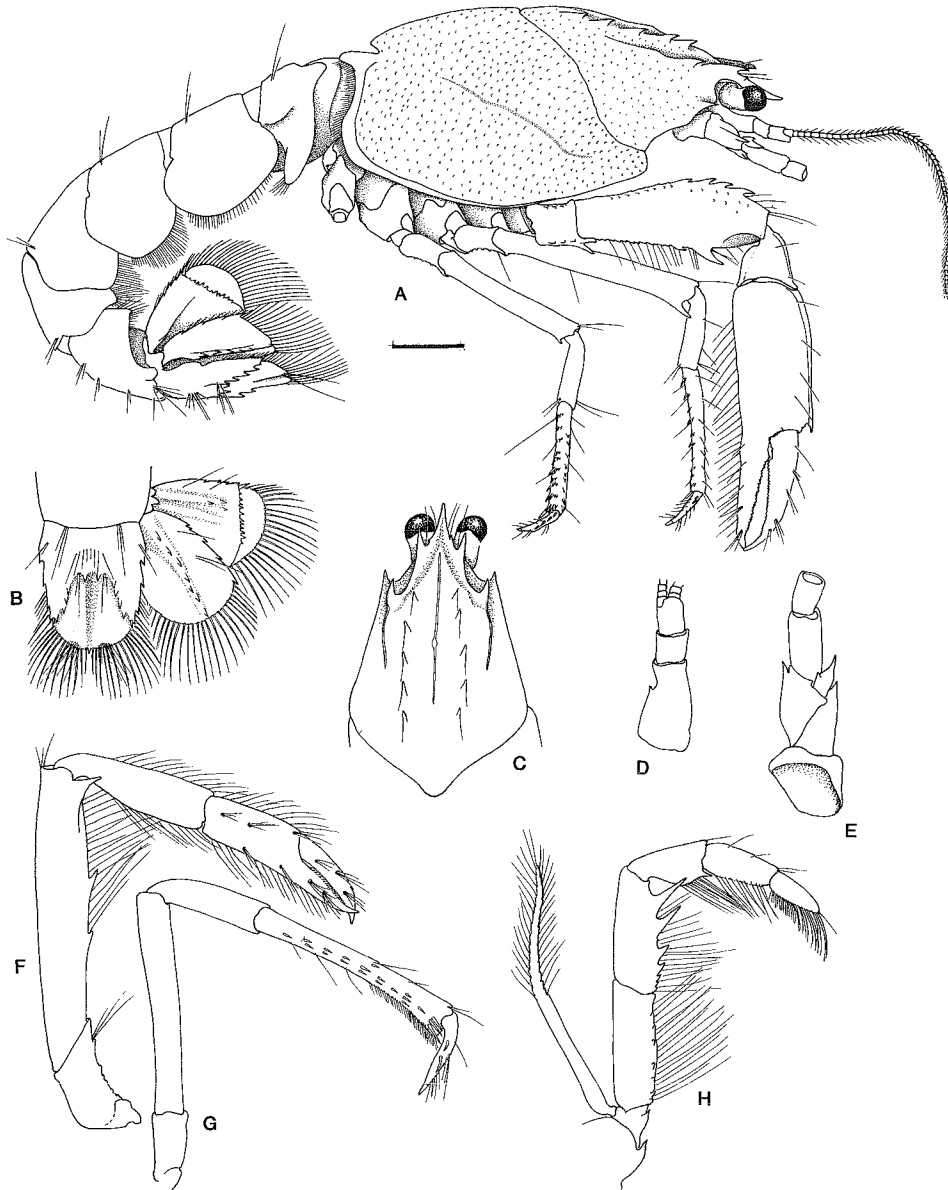


Figure 5. *Paraxiopsis foveolata*, holotype, USNM 243390: A, lateral view, scale = 2 mm; B, telson and right uropod; C, anterior carapace in dorsal view; D, antennular peduncle; E, antennal peduncle; F, pereopod 2; G, pereopod 4; H, maxilliped 3.

Paraxiopsis foveolata new species

Figure 5

Material Examined.—*Holotype*, USNM 243390, ♀ cl 10.0 mm, Mote Marine Lab. sta 16B, Florida Shelf, Gulf of Mexico, 25°45'42"N, 83°11'04"W, 53.7 m, soft sand and mud bottom, 27 Jul 1981.

Diagnosis.—Carapace surface finely pitted; rostrum with 2 pairs of teeth, anterior pair tiny, posterior large, supraocular; median carina lacking teeth; submedian

carina with 5 strong spines; lateral carina with single strong anterior tooth; strong antennal spine on anterior carapace margin (Fig. 5A, C). Abdominal pleura 2–4 ventrally rounded, 5–6 posteriorly angular, lacking spines (Fig. 5A). Telson (Fig. 5B) having 4 pairs lateral marginal spines, 1 mobile submarginal spine, 5 pairs of spines on dorsal surface.

Antennular peduncle (Fig. 5D) basal article with small stylocerite tooth, slightly longer than articles 2 and 3 together; flagella subequal to carapace length. Antennal peduncle (Fig. 5E) with articles 2 and 3 each with strong distal tooth; acicle bifid, distal tooth much stronger than proximal. Mouthparts typical of genus.

Maxilliped 3 (Fig. 5H), coxa and basis each with strong distomesial tooth; ischium with 7 small denticles on posterior margin; merus with 2 strong distal and 5 small proximal spines on posterior margin; carpus with posterodistal tooth. Pereopod 1 (Fig. 5A), chelipeds subsimilar, subequal; ischium with 1 strong posterodistal spine and 3–4 denticulations; merus with 4 strong spines on upper margin, 1 strong, 1 weak, and several denticulations on posterior margin; upper margin of carpus carinate; propodal palm 1.15 times finger length, upper margin carinate, ending in distal spine, fixed finger with low basal triangular cusp; dactylus with low triangular basal cusp on cutting edge, rest of edge denticulate. Pereopod 2 (Fig. 5F), ischium with few low tubercles on posterior margin; merus with 1 strong distal, and 2 smaller spines at about midlength of posterior margin; fingers of chela slightly shorter than propodal palm, cutting edges bearing series of small spines. Pereopod 3, merus having strong posterodistal tooth; propodus with series of short spines on posterior margin; dactylus with 2 spines on lateral surface. Pereopod 4 (Fig. 5G), merus with small posterodistal tooth; propodus with series of short spines on posterolateral surface; dactylus with 4 spines on lateral surface. Pereopod 5, propodus with series of short spines on posterolateral surface, widening distally and bearing dense setal brush; dactylus twisted, with 2 spines on lateral margin. Lateral ramus of uropod (Fig. 5B) with 4 lateral spines and slender mobile spine, 10–11 spines along suture, 3 small dorsal spines on ridge; mesial ramus with 5 lateral spines, 6 or 7 dorsal spines on median ridge.

Etymology.—The specific epithet is from the Latin ‘foveola,’ meaning small pit, and refers to the finely pitted condition of the carapace.

Paraxiopsis gracilimana new species

Figures 6, 7

Material Examined.—*Holotype*, USNM 169669, ♀ cl 9.9 mm, Bonaire Harbor, Netherlands Antilles, sandy bottom near coral-encrusted iron machinery, 2 m, coll. R. V. HARRISON, 25 Aug 1976. *Paratypes*. USNM 211453, 2 ♀ cl 4.8 mm, 6.5 mm, juv. cl 3.8 mm, Looe Key reef, Florida, sta FLK-12, buttress wall in spur and groove area, 6 m, coll. B. Kensley and M. Schotte, 28 Sep 1982.—USNM 211454, ♀ cl 7.9 mm, juv., cl 3.0 mm, Looe Key reef, Florida, sta FLK-21, buttress wall in spur and groove area, 6 m, coll. B. Kensley and M. Schotte, 29 Sep 1982.—USNM 211455, 2 juvs., cl 3.3, 3.0 mm, Looe Key reef, Florida, sta FLK-24, buttress wall in upper spur and groove area, 5–6 m, coll. B. Kensley and M. Schotte, 27 Jan 1983.—USNM 211457, ♂ cl 7.9 mm (specimen badly damaged), Carrie Bow Cay, Belize, large rubble slabs from back reef-flat, 1 m, coll. B. Kensley, 30 Nov 1985.—USNM 174452, ♀ cl 4.2 mm, off South Carolina, 27 m, coll. Bureau of Land Management, 25 Aug 1977.—USNM 211464, ♂ cl 8.4 mm, Gulf of Mexico, off Florida, 28°34'N, 84°17'W, BELLOWS sta 21; host of holotype of bopyrid isopod *Gigantione uebelackerae*.

ADDITIONAL MATERIAL USNM 243385, ♀ cl 4.8 mm, MAFLA sta 2103-01, Gulf of Mexico, 26°25'00"N, 82°57'59.7"W, fine sand, 33 m.—USNM 243386, ♂ cl 6.1 mm, MAFLA sta 2852, Gulf of Mexico, 28°30'00.4"N, 83°29'58.4"W, medium sand, 22 m.—USNM 243570, ♀ cl 4.9 mm, Charlottesvile, Tobago, coarse sand and rock around patch reefs, 1.5–3 m, coll. M. Schotte, 5 Sep 1990.—USNM 243583, ♂ cl 8.2 mm, MAFLA sta 34, off Panama City, Florida, 29°56'N, 86°06.4'W, 40–32 m.

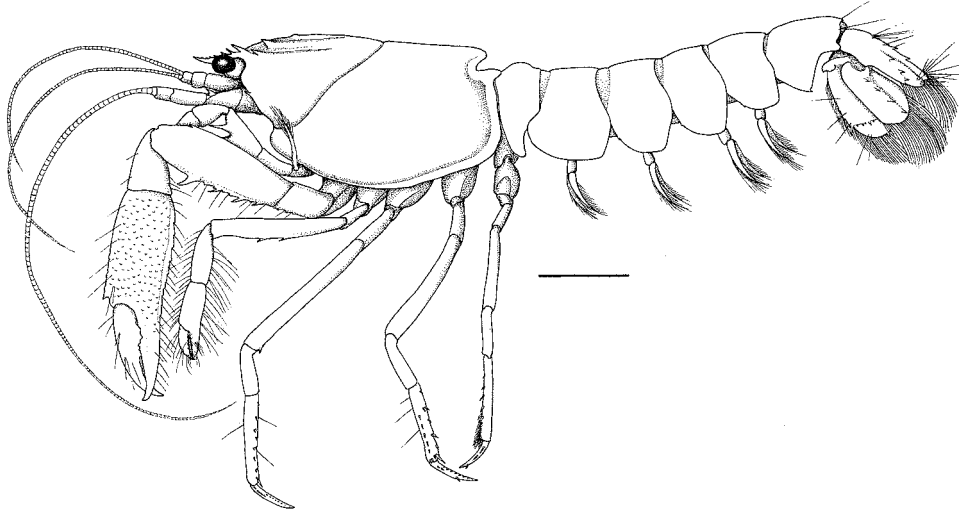


Figure 6. *Paraxiopsis gracilimana*, holotype, USNM 169669: lateral view, scale = 4 mm.

Diagnosis.—Carapace surface smooth; rostrum reaching well beyond eyes, with 4 pairs lateral spines, basal pair strongest, supraocular in position; median carina lacking spines; submedian carina with single anterior spine; lateral carina continuous with lateral rostral margin, with single anterior spine (Fig. 6, Fig. 7A). Abdominal pleura ventrally rounded, with small spine on anterior margin of pleura 3–5 (Fig. 6). Telson (Fig. 7B) with 4 pairs of fixed marginal spines, one pair of mobile spines, 3 pairs of spines on dorsal surface; posterior margin with small median spine.

Antennular basal article with small stylocerite tooth (Fig. 7E); flagella about $1.5\times$ carapace length. Antennal peduncle (Fig. 7F) article 3 with 2 small spines on mesial margin; acicle with distal tooth stronger than proximal; flagellum about $3\times$ carapace length. Maxilliped 3 (Fig. 7D), coxa and basis each with single strong mesiodistal tooth; ischium with 4–5 low serrations on posterior margin; merus with 2 strong distal and 4–5 small proximal spines on posterior margin; carpus with single posterodistal spine. Pereopod 1 (Fig. 6), chelipeds subequal, similar; ischium with 3 small spines on posterior margin; merus with 2 spines on upper margin, 4–5 spines on posterior margin; carpus with 3 denticulations on posterior surface; propodal palm 1.3 times finger length, upper margin crenulate and with distal spine, lower margin finely serrulate, lateral surface with numerous low rounded tubercles, cutting edge of fixed finger with proximal triangular cusp; cutting edge of dactylus with triangular cusp, remainder of edge denticulate. Pereopod 2 (Fig. 6) with row of about 8 small tubercles on posterior margin of ischium; merus with 2 spines at about midlength of posterior margin plus single strong posterodistal spine. Pereopod 3 (Fig. 6), merus with single strong posterodistal tooth; propodus with row of about 8 single or double short spines on posterior margin; dactylus with about 8 small slender spines on posterior margin, 4 stouter spines on lateral surface. Pereopod 4 (Fig. 6) similar to pereopod 3 but lacking tooth on merus. Pereopod 5 (Fig. 6), propodus with row of about 8 single or double spines on posterior margin plus dense posterodistal band of short setae; dactylus with 2 spines on lateral surface. Lateral ramus of uropod (Fig. 7B) with

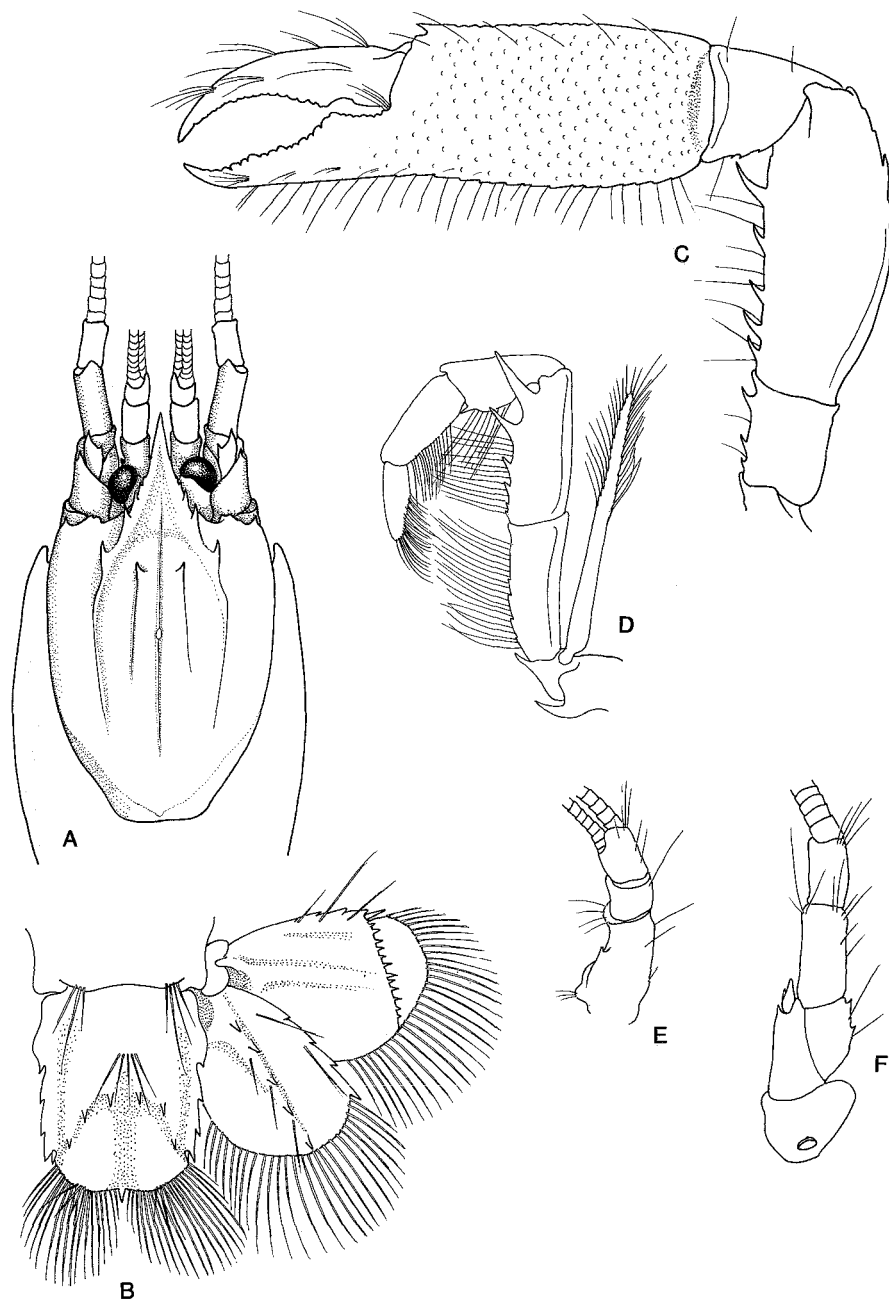


Figure 7. *Paraxiopsis gracilimana*, holotype, USNM 169669: A, anterior carapace in dorsal view. B, telson and right uropod; C, pereopod 1; D, maxilliped 3; E, antennular peduncle; F, antennal peduncle.

4 spines on lateral margin, 12 spines along suture; mesial ramus with 4 lateral marginal spines including distal spine.

Etymology.—The specific epithet refers to the slender form of the first pair of chelipeds.

Paraxiopsis granulimana new species

Figure 8

Material Examined.—*Holotype*, USNM 243387, ♂ cl 11.0 mm, SOFLA sta 16B, S. W. Florida Shelf, Gulf of Mexico, soft bottom, 53.7 m, 27 Jul 1981. *Paratype*, USNM 243388, ♂ cl 8.4 mm, PILLSBURY sta P-838, off Trinidad, 10°32'N, 60°23'W, 93–95 m, 30 Jun 1969.

Diagnosis.—Carapace surface pitted, especially posteroventrally; strong antennal spine on anterior margin; rostrum with 1 or 2 pairs of teeth, posterior pair largest, supraocular; median carina unarmed; submedian carina with 4 or 5 low spines; lateral carina with single anterior spine (Fig. 8A, B). Abdominal pleura 2–5 triangular, with tiny tooth on anterior margin of pleura 3–5 (Fig. 8A). Telson (Fig. 8C) bearing 4 pairs of lateral marginal teeth, 1 pair mobile submarginal spines, 3 pairs of teeth on dorsal surface; shallow posteromedian furrow flanked by 4–5 spinules.

Antennular peduncle basal article with small stylocerite tooth; flagella about 1.3 times carapace length. Antennal peduncle article 2 with strong distolateral tooth; article 3 with small mesiodistal tooth; acicle with distal tooth stronger than proximal. Mouthparts typical of genus. Maxilliped 3 (Fig. 8F), ischium with about 5 low serrations on posterior margin; merus with 2 strong distal and 5 tiny spines on posterior margin. Pereopod 1 (Fig. 8E), larger cheliped; ischium with strong posterodistal spine; merus with 1 or 2 strong and 1 weak spine on upper (anterior) margin, 1 spine on posterior margin; carpus with 1 or 2 blunt tubercles on posterior margin, outer surface tuberculate and densely setose; propodal palm 1.3 times finger length, densely setose, bearing numerous small rounded to subacute tubercles on outer surface, cutting edge of fixed finger with large rounded cusps proximally, becoming smaller rounded teeth distally; dactylus with 2 strong rounded cusps proximally. Pereopod 1, smaller cheliped, ischium with 1 strong posterodistal spine; merus with 1 spine on posterior margin, 1 strong and 1 weak spine on upper margin; propodal palm subequal in length to fingers, outer surface densely setose and granulate as in larger cheliped, cutting edge as in larger cheliped; dactylus with cutting edge proximally entire, distally denticulate. Pereopod 2 (Fig. 8G), merus bearing 2 proximal, and one strong posterodistal tooth on posterior margin. Pereopod 3 (Fig. 8H), merus with strong posterodistal tooth; propodus with row of about 10 single or double spines on posterior margin, about 7 small spines on lateral surface; dactylus with about 7 small spines on posterior margin, 5 small spines on lateral surface. Pereopod 4 lacking in both specimens. Pereopod 5 (Fig. 8I), propodus with row of about 9 single or double spines on posterior margin; dactylus twisted, with 2 strong spines on lateral surface. Lateral ramus of uropod (Fig. 8C) with 4 teeth on lateral margin, bearing 10–15 teeth along suture; mesial ramus with 4 teeth on lateral margin, including distalmost tooth, 5 teeth on dorsal ridge.

Etymology.—The specific epithet refers to the granulate condition of the first chela.

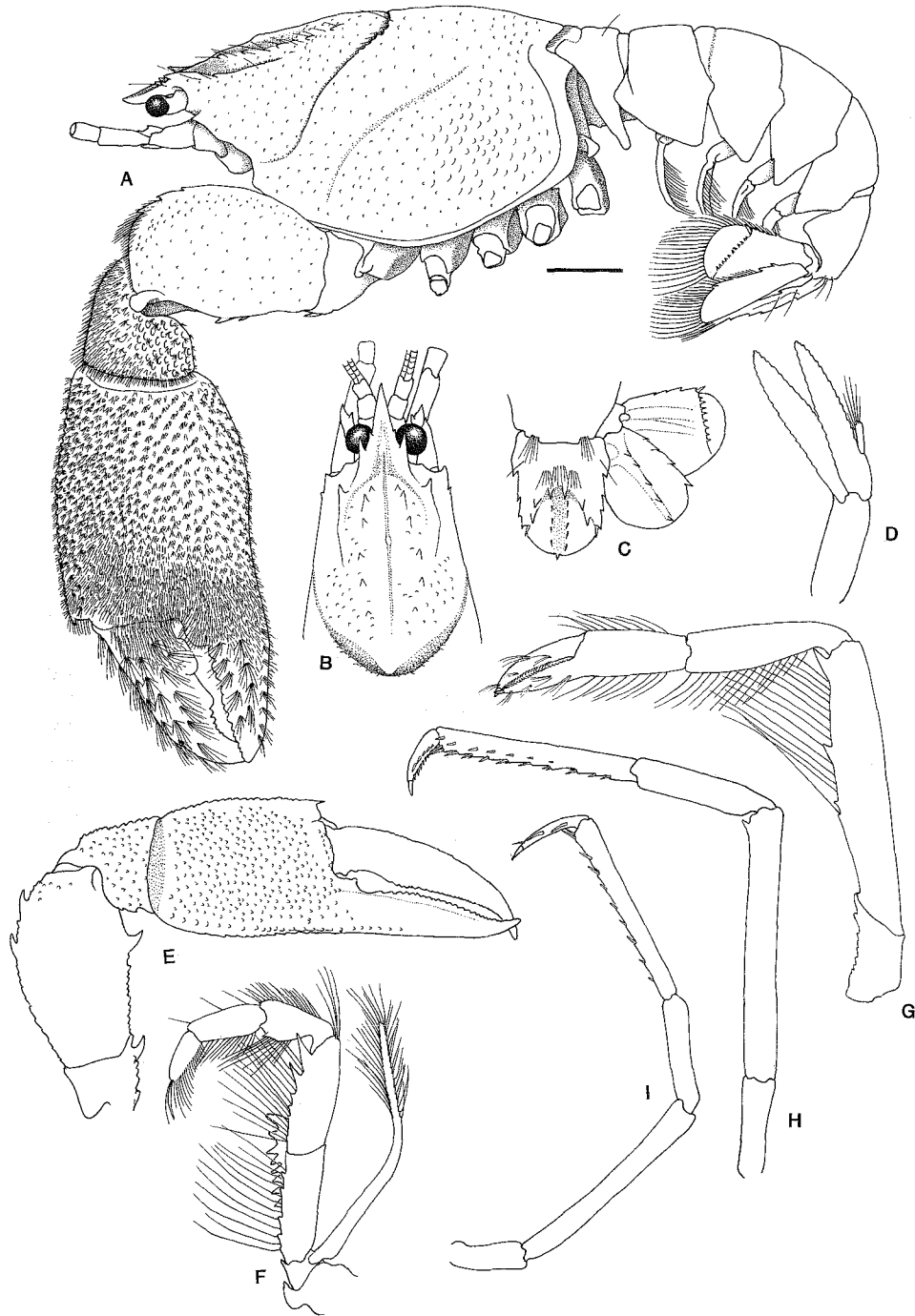


Figure 8. *Paraxiopsis granulimana*, holotype, USNM 243387: A, lateral view, scale = 2 mm; B, anterior carapace in dorsal view; C, telson and right uropod; D, pleopod 2; E, pereopod 1, smaller cheliped; F, maxilliped 3; G, pereopod 2; H, pereopod 3; I, pereopod 5.

Paraxiopsis hispida new species

Figure 9

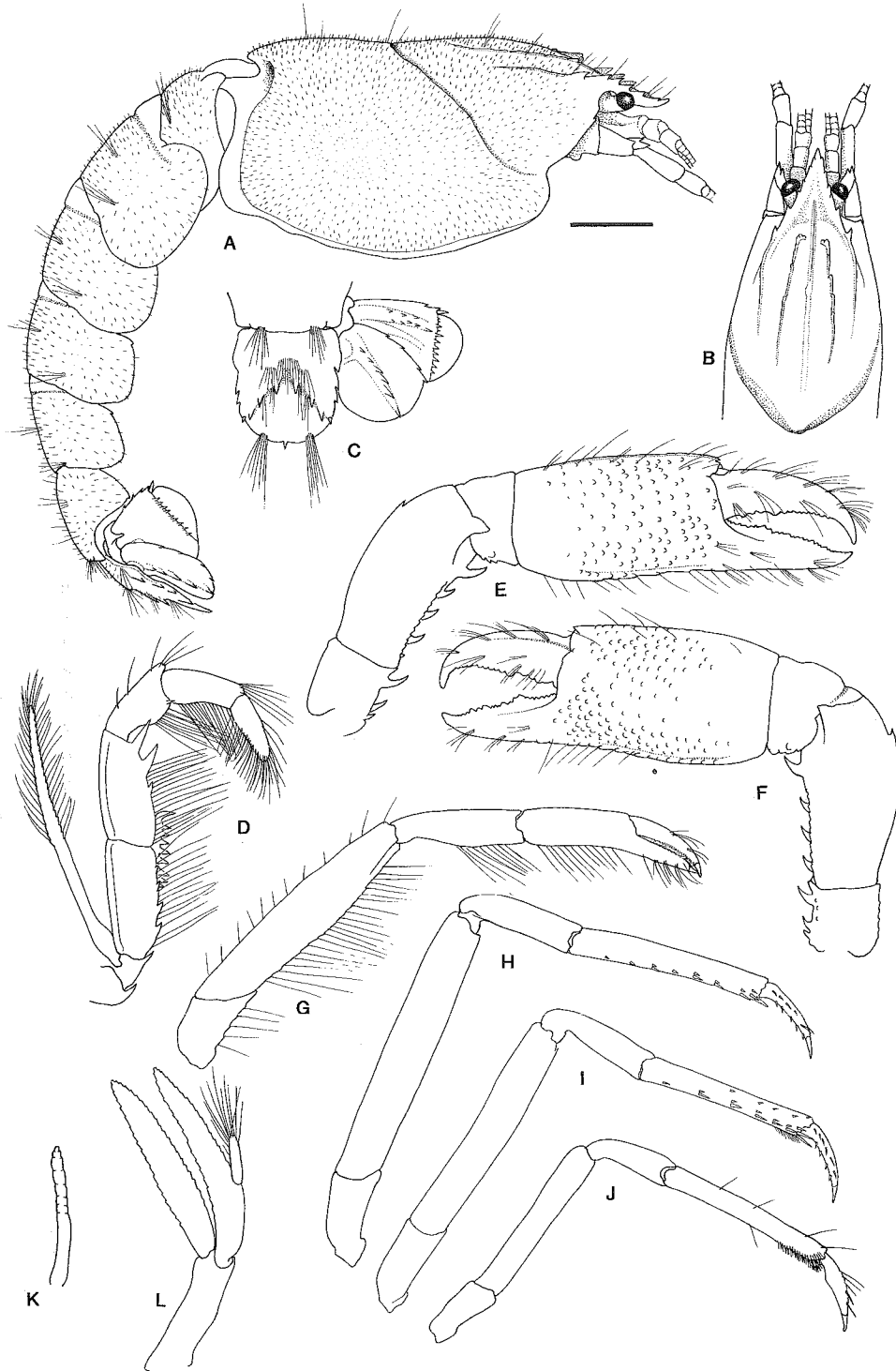
Material Examined.—*Holotype.* USNM 243389, hermaphrodite (?) cl 8.6 mm, PILLSBURY sta P-630, off Yucatan Peninsula, 15°59.2'N, 86°02'W, rocks, corals, and sponges, 35–37 m, 21 Mar 1968. *Paratypes.* USNM 211462, ovig. ♀, cl 7.5 mm, ♀ cl 7.5 mm, Carrie Bow Cay, Belize, reef drop-off, 24.4 m, coll. G. Hendler, 6 Apr 1986.

Diagnosis.—Carapace with integument having pile of short bristles. Small marginal antennal tooth present. Rostrum with 5 pairs of teeth on lateral margins. Median carina unarmed, sharply keeled from anterior of tubercle to just anterior of rostral base, rounded posterior to tubercle. Submedian carina anteriorly with 2 or 3 rounded small tubercles, or with single rounded tubercle, with few poorly defined blunt teeth. Lateral carina continuing posteriorly from rostral margin, unarmed except for single strong anterior tooth (Fig. 9A, B). Abdominal pleura with integument bearing scattered short bristles; pleuron 1 ventrally narrowed; pleuron 2 broadly rounded; pleura 3–5 ventrally rounded, with small denticle on anteroventral margin; pleuron 6 with small posteroventral denticle (Fig. 9A). Telson (Fig. 9C) with lateral margin with 3 or 4 teeth anterior to small mobile spine, posterior margin convex, with median point, 3 pairs strong teeth on dorsal surface.

Antennular peduncle basal article with small stylocerite tooth; flagella 1.25 times carapace length. Antennal peduncle article 3 with 3 or 4 small teeth on mesial margin; acicle bifid, with distal tooth longer than proximal. Mouthparts typical of genus. Maxilliped 3 (Fig. 9D), coxa with very strong mesiodistal tooth; basis with smaller mesiodistal tooth; ischium with 2 low proximal teeth and few low serrations on posterior margin; merus with 3 distal teeth on posterior margin; carpus with single small posterodistal tooth. Pereopod 1 (Fig. 9F), chelae slightly unequal, larger chela, ischium with 3 teeth on posterior margin; merus with single tooth on anterior margin distal to midlength, 4 strong teeth on posterior margin; carpus with few low serrations on posterior margin; fingers slightly more than half length of propodal palm, latter with anterior (upper) margin having rounded carina, ending distally in short tooth, outer surface granulate especially anterodistally and posterodistally, fixed finger with several low teeth on cutting edge, posterior margin with rounded ridge running onto fixed finger; dactyl having several low teeth on cutting edge. Smaller chela ischium, merus, and carpus as in larger chela, fingers about $\frac{3}{5}$ length of propodal palm, latter with anterior margin carinate, ending distally in low tooth, outer surface granulate, cutting edges of fingers bearing several low teeth or serrations. Pereopod 2 (Fig. 9G), posterior margin of merus, carpus, and propodal palm setose; fingers about two-thirds length of propodal palm. Pereopods 3 and 4 (Fig. 9H, I), propodus with series of 7 or 8 short rows of spines on posterior margin; dactylus with row of 4 or 5 small spines on posterior margin, series of small spines on lateral surface. Pereopod 5 (Fig. 9J), propodus with cluster of posterodistal setae; dactylus twisted, with few spines on lateral surface. Pleopod 1 ♀ (Fig. 9K) uniramous, bearing marginal setae in distal half. Pleopod 2 (Fig. 9L) in non-ovigerous ♀ (or hermaphrodite?) with short distally setose appendix masculina on mesial margin of endopod. Lateral ramus of uropod (Fig. 9C) with 2 or 3 distal teeth on lateral margin, mobile spine at articulation of suture, 11 teeth along suture, about 8 small dorsal teeth on lateral ridge; mesial ramus with 4 teeth on lateral margin, 6 teeth along dorsal ridge.

→

Figure 9. *Paraxiopsis hispida*, holotype: A, lateral view of carapace and abdomen, scale = 2 mm; B, anterior carapace in dorsal view; C, telson and right uropod; D, maxilliped 3; E, pereopod 1, left



cheliped; F, pereopod 1, right pereopod; G, pereopod 2; H, pereopod 3; I, pereopod 4; J, pereopod 5; K, pleopod 1; L, pleopod 2.

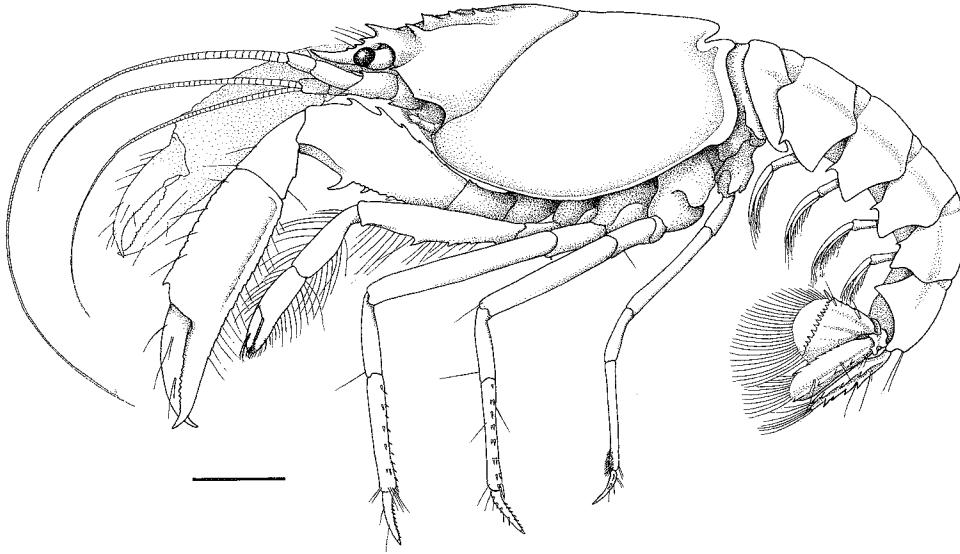


Figure 10. *Paraxiopsis spinipleura*, paratype, USNM 211451: lateral view, scale = 2 mm.

Etymology.—The specific epithet, from the Latin for hairy or bristly, refers to the character of the carapace.

Remarks.—All three specimens of this species are remarkable for having both male and female genital apertures, and pleopod 1 as in female *Paraxiopsis* species (pleopod 1 in males is lacking in *Paraxiopsis*). While the ovigerous specimen lacks an appendix masculina on pleopod 2, this structure is present in the two other specimens. This suggests that protandrous hermaphroditism (which has not before been recorded in *Paraxiopsis*) might occur in this species.

***Paraxiopsis spinipleura* new species**
 Figures 10–12

Material Examined.—*Holotype*. USNM 243581, ovig. ♀ cl 11.3 mm, St. Thomas, U.S. Virgin Islands, submarine dock, coll. H. R. Bullis, 2 Oct 1959. *Paratypes*. USNM 211449, ♀ cl 5.5 mm, sta FLK-21, Looe Key reef, Florida, buttress wall in spur and groove area, 6 m, coll. B. Kensley and M. Schotte, 29 Sep 1982.—USNM 211450, ♀ cl 4.0 mm, sta FLK-21, Looe Key reef, Florida, buttress wall in spur and groove area, 6 m, coll. B. Kensley and M. Schotte, 29 Sep 1982.—USNM 211451, ♀ cl 7.5 mm, Carrie Bow Cay, Belize, back reef coral rubble, 1.5 m, coll. D. and W. Greenfield, 13 May 1977.

Diagnosis.—Carapace surface smooth; 4 pairs lateral rostral teeth; median carina lacking teeth; submedian carina with 5 teeth; lateral carina with single anterior tooth; strong antennal spine on anterior margin, small marginal denticle on anterior margin of branchiostegite (Figs. 10, 11A). Abdominal pleura 2–6 triangular, 2–5 with strong tooth on anterior margin (Fig. 10). Telson (Fig. 11I) with 4 pairs of lateral marginal spines, 1 pair mobile spines, 3 pairs of spines on dorsal surface.

Antennular peduncle (Fig. 11B), basal article with small stylocerite tooth. Antennal peduncle (Fig. 11C) article 2 with strong distolateral tooth; article 3 with strong mesiodistal tooth and 2 small proximal denticles; acicle broad, with 2 teeth well separated. Mouthparts typical of genus. Maxilliped 3 (Fig. 12B), coxa and basis each with strong mesiodistal tooth; ischium with 7–8 small teeth on posterior margin; merus with 2 strong distal and 5 small proximal teeth on posterior margin;

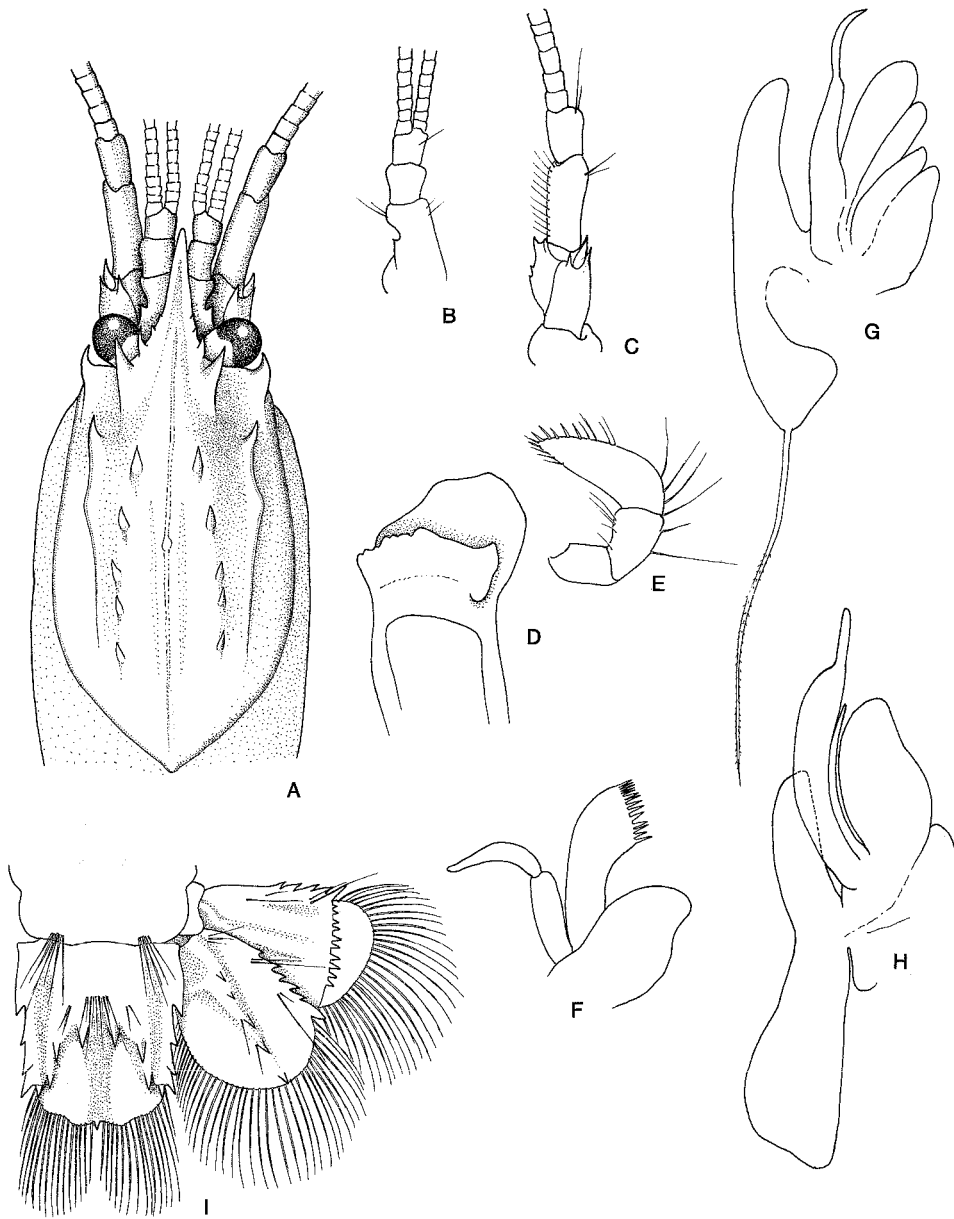


Figure 11. *Paraxiopsis spinipleura*, paratype, USNM 211451: A, anterior carapace in dorsal view; B, antennular peduncle; C, antennal peduncle; D, mandible; E, mandibular palp; F, maxillule; G, maxilla; H, maxilliped 1; I, telson and right uropod.

carpus with single posterodistal tooth. Pereopod 1 (Fig. 10), chelipeds subequal, similar; ischium with 2 teeth on posterior margin; merus with 6 teeth on upper margin, increasing in size distally, 4 teeth on posterior margin; carpus with blunt tubercle on ventral margin; propodal palm 1.5 times length of fingers, upper margin crenulate with distal tooth, lower margin serrate, fixed finger cutting edge with

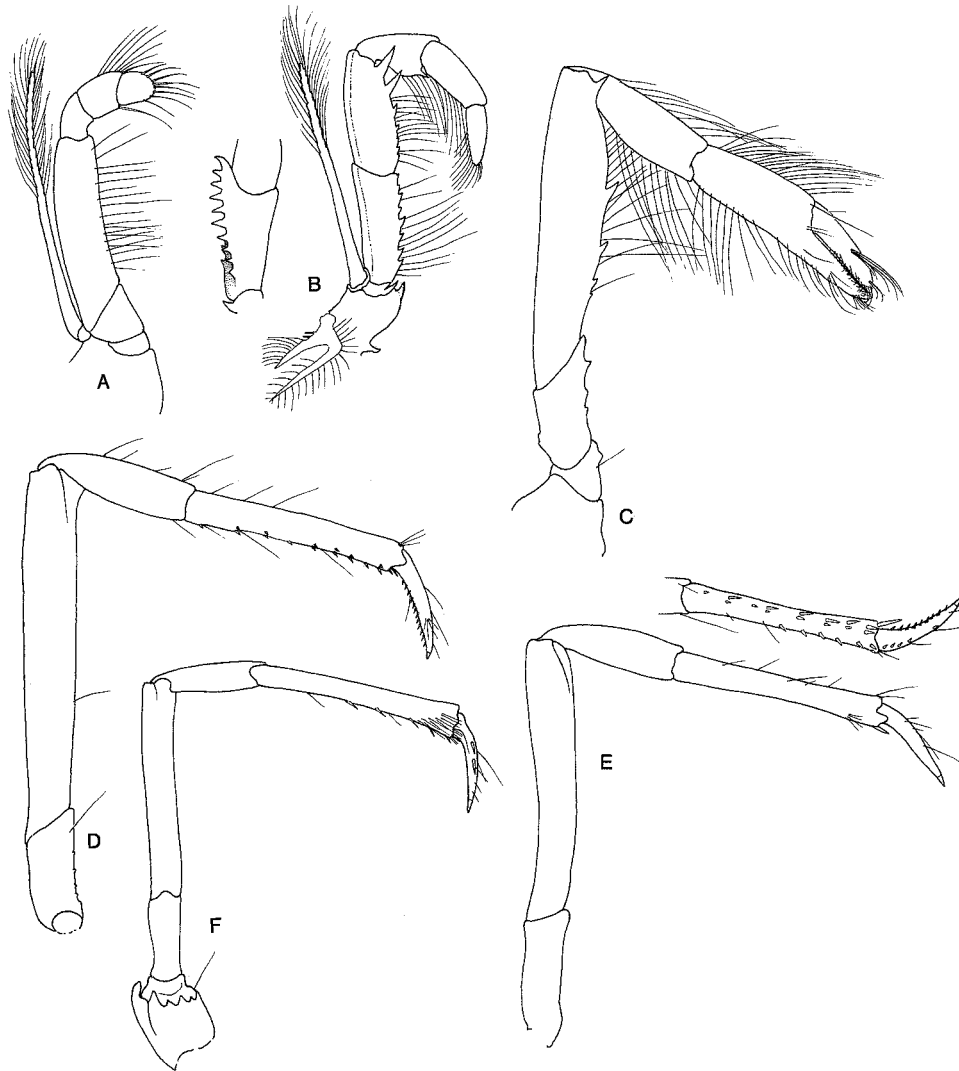


Figure 12. *Paraxiopsis spinipleura*, paratype, USNM 211451: A, maxilliped 2; B, maxilliped 3, with mesial view of ischium; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5.

basal triangular tooth, remainder of cutting edge finely denticulate; cutting edge of dactylus evenly denticulate. Pereopod 2 (Fig. 12C), ischium with 3 low tubercles on posterior margin; merus with 1 strong distal and 3 smaller proximal teeth on posterior margin. Pereopod 3 (Fig. 12D), propodus with about 10 short single or double spines on posterior margin; dactylus with about 12 small spines on posterior margin. Pereopod 4 (Fig. 12E), propodus with row of about 8 single or double spines on posterior margin, 5 spines on lateral surface; dactylus with about 8 spines on posterior margin. Pereopod 5 (Fig. 12F), propodus with dense posterodistal band of short setae; dactylus with 2 spines on lateral margin. Lateral ramus of uropod (Fig. 11I) with 4 spines on lateral margin, 10 spines along suture; mesial ramus with 6 spines on lateral margin including distal spine.

Etymology.—The specific epithet refers to the strong triangular tooth on the anterior margin of abdominal pleura 2–5.

ACKNOWLEDGMENTS

I thank all those collectors whose efforts and conscientiousness resulted in this accumulation of material in the Smithsonian collections. I am grateful to R. Lemaitre (National Museum of Natural History, Smithsonian Institution), and A. Williams (National Marine Fisheries Service, Systematics Laboratory), who read a draft of this paper and made many useful suggestions and comments.

This paper is Contribution Number 425 of the Caribbean Coral Reef Ecosystems program of the National Museum of Natural History, Dr. K. Ruetzler, Principal Investigator.

LITERATURE CITED

- Balasubrahmanyam, K. and J. Jacob. 1961. Occurrence of *Eutrichocheles modestus* (Herbst) in the near-shore waters of Porto Novo, south India. *Nature*, Lond. 191: 830.
- Balss, H. 1933. Ueber einige systematisch interessante indopacifische Dekapoden. *Mitt. Zool. Mus. Berl.* 19: 84–98.
- . 1957. Decapoda. Bronn's Kl. Ordn. Tierreichs 5(1)7(12): 1505–1672.
- Bate, C. S. 1888. Report on the Crustacea Macrura collected by H. M. S. Challenger during the years 1873–76. *Rep. Voy. Challenger, Zoology* 24: i–xc, 1–942.
- Borradaile, L. A. 1903. On the classification of the Thalassinidea. *Ann. Mag. Nat. Hist.* (7)12: 534–551.
- Chopra, B. 1933. Further notes on Crustacea Decapoda in the Indian Museum. V. On *Eutrichocheles modestus* (Herbst): Family Axiidae. *Rec. Indian Mus.* 35: 277–281.
- Edmondson, C. H. 1925. Marine zoology of tropical central Pacific Crustacea. *Bull. Bernice P. Bishop Mus.* 27: 3–62.
- Herbst, J. F. W. 1794. Versuch einer Naturgeschichte der Krabben und Krebse nebst einer systematischen Beschreibung ihrer verschiedenen Arten. Vol. 2 (1791–1796), p. 1–226, pls. 22–46.
- Man, J. G. de. 1887. Bericht über die von Herrn Dr. J. Brock im indischen Archipel gesammelten Decapoden und Stomatopoden. *Arch. Naturgesch.* 53: 215–600.
- . 1905. Diagnoses of new species of macrurous decapod Crustacea from the "Siboga Expedition". *Tijdschr. ned. dierk. Vereen.* (2)9(3/4): 587–614.
- . 1925. The Decapoda of the Siboga-Expedition. Part VI. The Axiidae collected by the Siboga-Expedition. *Siboga Exped.* 39a5: 1–127.
- Meinert, F. W. A. 1877. Crustacea Isopoda, Amphipoda et Decapoda Daniae: Fortegnelse over Danmarks isopode, amphipode og decapode krebsdyr. *Natur. Tidsskr.* 11: 57–248.
- Milne Edwards, A. 1873. Description de quelques Crustacés nouveaux ou peu connus provenant du Musée de M. C. Godeffroy. *J. Mus. Godeffroy* 4: 77–88.
- Morgan, G. J. 1990. A collection of Thalassinidea, Anomura and Brachyura (Crustacea: Decapoda) from the Kimberley Region of northwestern Australia. *Zool. Verh. Leiden.* 265: 1–90.
- Poore, G. C. B. 1994. A phylogeny of the families of Thalassinidea (Crustacea: Decapoda) with keys to families and genera. *Mem. Mus. Victoria* 54: 79–120.
- and D. J. G. Griffin. 1979. The Thalassinidea (Crustacea: Decapoda) of Australia. *Rec. Aust. Mus.* 32(6): 217–321.
- Rathbun, M. J. 1901. The Brachyura and Macrura of Porto Rico. *U.S. Fish. Comm. Bull.* 1900. 2: 1–137.
- Rodrigues, S. and B. Kensley. 1991. *Eutrichocheles pindatyba*, a new axiid shrimp (Crustacea: Decapoda: Thalassinidea) from Brazil. *Proc. Biol. Soc. Wash.* 104: 556–560.
- Sakai, K. 1987. Two new Thalassinidea (Crustacea: Decapoda) from Japan, with the biogeographical distribution of the Japanese Thalassinidea. *Bull. Mar. Sci.* 41: 296–308.
- and M. de Saint Laurent. 1989. A check list of Axiidae (Decapoda, Crustacea, Thalassinidea, Anomura), with remarks and in addition descriptions of one new subfamily, eleven new genera and two new species. *Naturalists* 3: 1–104.
- Schmitt, W. L. 1935. Crustacea Macrura and Anomura of Porto Rico. Pages 125–227 in *Scientific survey of Porto Rico and the Virgin Islands*. New York Academy of Sciences, New York.
- Tirmizi, N. M. 1983. Four axiids (Decapoda, Thalassinidea) from Indonesia. *Research. Crust.* 12: 85–95.
- Wood Mason, J. 1875. On new or little-known crustaceans. *Proc. Asiat. Soc. Beng.* 1875: 230–232.

DATE ACCEPTED: December 8, 1994.

ADDRESS: Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C., 20560.