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## Copepoda (Xarifiidae) parasitic in scleractinian corals from the Indo-Pacific

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### Introduction

Since the first description of xarifiid copepods (Humes 1960), many more species belonging to the Xarifiidae Humes, 1960, have been found. At present, representatives of the family are known from many species of Scleractinia in Madagascar (Humes 1960, 1962, Humes and Ho 1967, 1968, Humes and Dojiri 1982), the Red Sea (Humes 1960), south-eastern coast of India (Sebastian, unpublished thesis), the Maldive Islands (Humes 1960), Enewetak Atoll (Humes and Dojiri 1982), Japan (Misaki 1978), and New Caledonia (Humes and Dojiri 1982). In addition to the large genus *Xarifia* Humes, 1960, with more than 60 species either described or in press, the family contains *Orstomella* Humes and Ho, 1968, with two species, *Lipochrus* Humes and Dojiri, 1982 with one species, and *Zazaranus*, described below, also with one species.

The purpose of this paper is to report nine new species of *Xarifia* from the coral genera *Hydnophora*, *Goniopora*, *Euphyllia*, *Physogyra*, *Montipora*, and *Gyrosmlia*, and one new species of the new genus *Zazaranus* from *Fungia*. All copepods came from either north-western Madagascar or the Moluccas (Halmahera, Gomumu, Ceram), in some cases from both areas.

Since xarifiid copepods live inside the coral polyps, they are not usually recovered in rapid washing of the coral. The treatment of the living corals with very weak ethyl alcohol yields good results according to the following method. The freshly collected corals were isolated in plastic bags. Later each colony was placed in a pail of sea water to which sufficient 95% ethyl alcohol was added in order to make a solution of approximately 5%. After several hours the coral was washed vigorously and the wash water passed through a fine net (about 120 holes per 2.5 cm). The copepods were then picked from the sediment retained, and later studied using the wooden slide/lactic acid technique described by Humes and Gooding (1964).

The copepods from Madagascar were collected in 1963-64 during the International Indian Ocean Expedition, and in 1967 with the support of a grant (GB-5838) from the National Science Foundation of the United States. Copepods from the Moluccas were collected during the *Alpha Helix* East Asian Bioluminescence Expedition, which was supported by the National Science Foundation under grants OFS 74 01830 and OFS 74 02888 to the Scripps Institution of Oceanography and grants BMS 74 23242 to the University of California, Santa Barbara. The study of the copepods was aided by NSF grant DEB 80 16421.

We thank Dr. John W. Wells, Department of Geological Sciences, Cornell University, Ithaca, for the identification of the corals from the Moluccas, and Dr. Michel Pichon, James Cook University, Townsville, Australia, for the determination of those from Madagascar.

Measurements were made on specimens cleared in lactic acid. The length of the body includes the caudal rami but not their setae. In the spine and setal formulas for legs 1-4, Roman numerals indicate spines, Arabic numerals represent setae.

All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn. The abbreviations used are:  $a_1$  = first antenna,  $a_2$  = second antenna, md = mandible, p = paragnath,  $mx_1$  = first maxilla, and  $mx_2$  = second maxilla.

### XARIFIIDAE Humes, 1960

#### *Xarifia* Humes, 1960

#### *Xarifia apertipes* sp. nov.

(Figs. 1 *a-i*, 2 *a-k*, 3 *a-c*)

*Type material.* 3 ♀♀, 2 ♂♂ from *Gyrosmlia interrupta* (Ehrenberg), in 10 m, Pte. Loboque, Nosy Bé, north-western Madagascar, 27 December 1963. HOLOTYPE ♀, ALLOTYPE, and one PARATYPIC female deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, D.C.; the remaining paratypes (dissected) in the collection of the first author.

*Other specimens.* 3 ♀♀ from *Montipora verrucosa* (Lamarck), in 10 m, Nosy N'Tangam, near Nosy Bé, north-western Madagascar, 1 January 1964.

*Female.* Body (fig. 1 *a, b*) moderately stout, about 6 times longer than wide. Length 1.48 mm (1.36-1.59 mm) and width 0.20 mm (0.15-0.24 mm) based on 3 specimens. External segmentation not defined except weakly in urosome. Region dorsal to fifth pair of legs bearing 3 long posteriorly directed processes (fig. 1 *c*). Genital and postgenital segments together about 22% of body length. Genital areas situated dorsolaterally. Caudal ramus (fig. 1 *d*) elongate,  $92 \times 27 \mu\text{m}$ , ratio 3.41:1, bearing 5 short terminal setae and 1 lateral seta. Egg sac not seen. Body surface with minute setules.

Rostrum (fig. 1 *e*) slightly pointed but rounded. First antenna (fig. 1 *f*)  $86 \mu\text{m}$  long and 6-segmented. Lengths of segments (measured along anterior side): 24, 18, 15, 5, 12, and  $11 \mu\text{m}$ , respectively. Armature: 3, 11, 7, 3 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae smooth. Second antenna (fig. 1 *g*) slender, 4-segmented,  $180 \mu\text{m}$  long including claw. Armature: 1, 1, 2, and 1, 1. Claw (fig. 1 *h*) on last segment  $24 \mu\text{m}$  and adjacent seta  $11 \mu\text{m}$ ; minute setule near base of claw. All setae smooth.

Labrum (fig. 1 *i*) with truncate, medially incised posteroventral margin. Mandible (fig. 2 *a*) a falcate unarmed blade  $33 \mu\text{m}$  long. Paragnath a small lobe. First maxilla (fig. 2 *b*) with 2 terminal setae and 1 subterminal seta, all smooth. Second maxilla (fig. 2 *c*) 2-segmented, second segment having 2 inner setae and proximal outer knob, with tip of segment lamellate. Maxilliped (fig. 2 *d, e*) 3-segmented, second segment having 2 inner setae and inner and outer lobes; third segment with attenuate tip and adjacent seta.

Legs 1-4 (fig. 2 *f, g*) with 3-segmented exopods and 2-segmented endopods. Spine and setal formula as follows:

$P_1$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 2
$P_{2-4}$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 1

Coxae of all 4 legs showing postero-outer sclerotized area bearing several small

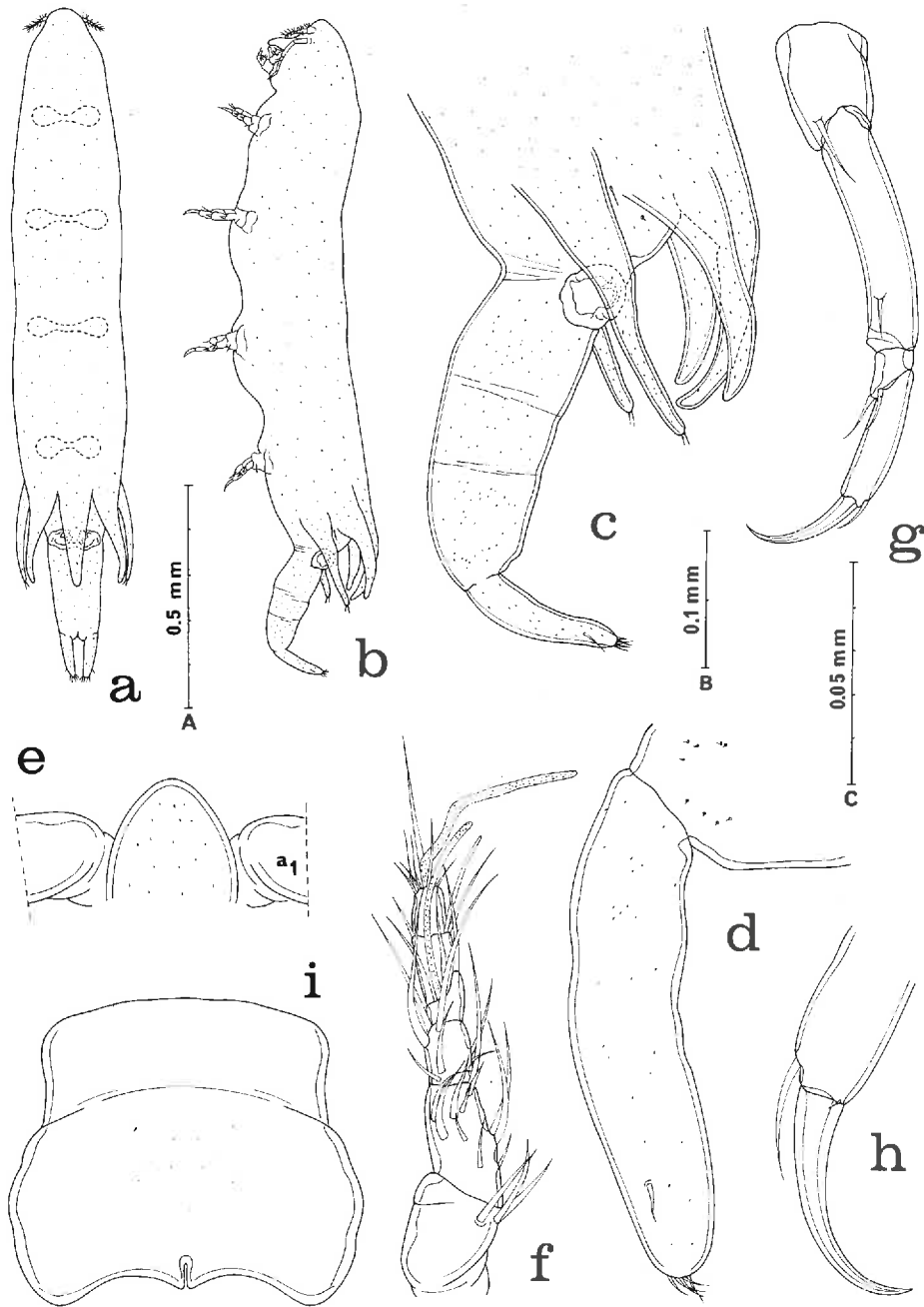


FIG. 1. *Xarisia apertipes* sp. nov., female. *a*, dorsal (A); *b*, lateral (A); *c*, urosome, lateral (B); *d*, caudal ramus, lateral (C); *e*, rostrum, dorsal (C); *f*, first antenna, dorsal (C); *g*, second antenna, ventral (D); *h*, tip of second antenna, dorsal (C); *i*, labrum, ventral (C).

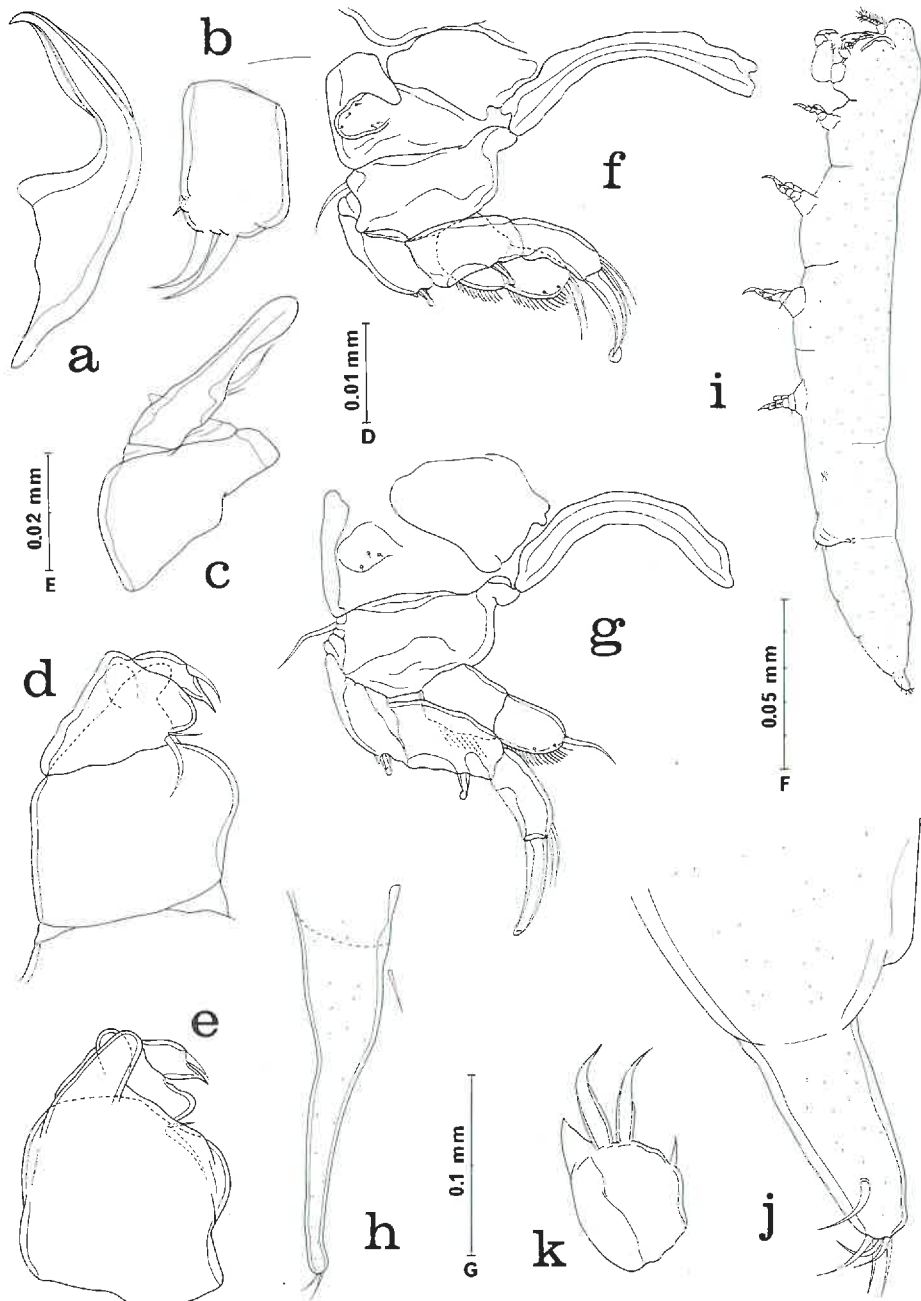


FIG. 2. *Xarificia apertipes* sp. nov., *a-h*, female. *a*, mandible, ventral (D); *b*, first maxilla, dorso-outer (D); *c*, second maxilla, postero-outer (E); *d*, maxilliped, anterior (E); *e*, maxilliped, posterior (E); *f*, leg 1 and intercoxal plate, posterior (F); *g*, leg 2 and intercoxal plate, posterior (F); *h*, leg 5, lateral (G). *i-k*, male. *i*, lateral (A); *j*, caudal ramus, lateral (C); *k*, first maxilla, antero-outer (D).

spinules. Tips of spines on exopods obtuse and hyaline. Outer margin of both segments of endopods with row of hairs.

Leg 5 (fig. 2*h*) elongate, tapered,  $205\ \mu\text{m}$ , with 2 small terminal setae and adjacent seta on body.

Colour in life in transmitted light opaque grey, intestine orange, eye bright red.

*Male*. Body (fig. 2*i*) resembling that of female. Length 1.49 mm and width 0.19 mm (0.17–0.19 mm), based on 2 specimens. External segmentation very weak. Caudal ramus (fig. 2*j*)  $54 \times 22\ \mu\text{m}$ , ratio 2.45:1, with setae as in female.

Rostrum, first antenna, second antenna, labrum, mandible, and paragnath as in female. First maxilla (fig. 2*k*) with dentiform process near 2 terminal setae. Maxilliped (fig. 3*a*) 4-segmented. First segment unarmed. Second segment with 2 inner setae. Small third segment unarmed. Fourth segment forming terminal claw  $57\ \mu\text{m}$  long, bearing 2 setae (1 proximal and other more distal), having serrate process midway on concave margin, and showing trifid tip.

Legs 1–4 as in female.

Leg 5 (fig. 3*b*) consisting of distinct segmentlike lobe  $8 \times 5\ \mu\text{m}$  bearing 2 terminal setae, with adjacent seta on body.

Leg 6 (fig. 3*c*) represented by posteroventral flap on genital segment bearing 2 small setae.

*Etymology*. The specific name *apertipes*, from Latin *apertus*, manifest or evident, and *pes*, foot, alludes to the segmentlike lobe of leg 5 in the male.

*Remarks*. Twelve previously described species of *Xarifia* have, as in the new species, 2-segmented endopods in legs 1–4. *Xarifia apertipes* may be separated from these as follows: in *Xarifia lamellispinosa* Humes and Ho, 1968, and *X. villosa* Humes and Dojiri, 1982, the median process of the three processes above the fifth pair of legs in the female is shorter than the two lateral processes; in *X. dispar* Humes, 1962, *X. comata* Humes, 1962, *X. diminuta* Humes and Ho, 1967, *X. decorata* Humes and Ho, 1968, *X. brevicauda* Humes and Ho, 1968, *X. anomala* Humes and Ho, 1968, *X. hamata* Humes and Ho, 1968, and *X. abtusa* Humes and Dojiri, 1982, leg 5 is less than  $160\ \mu\text{m}$  long; in *X. echinoporae* Humes and Dojiri, 1982, the body exceeds

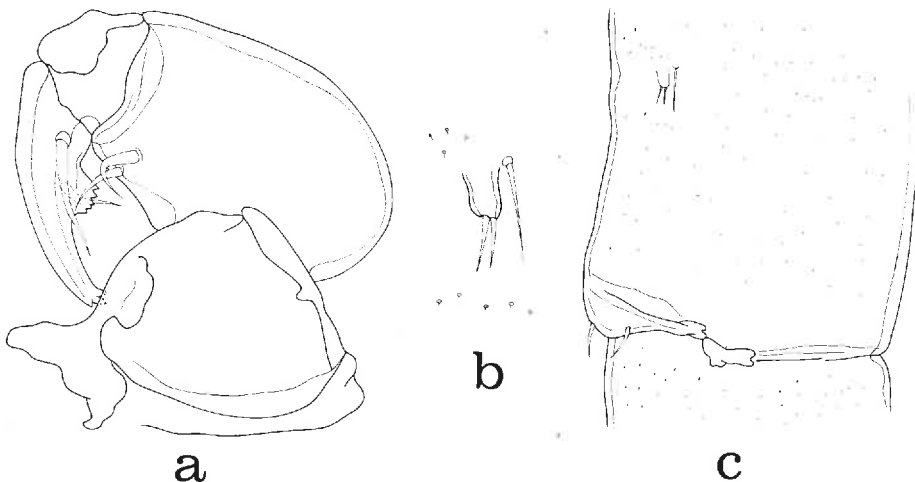


FIG. 3. *Xarifia apertipes* sp. nov., male. a, maxilliped, inner (C); b, leg 5, lateral (C); c, leg 5 and leg 6, lateral (G).

2 mm in average length and the ratio of the caudal ramus of the female is 1.77 : 1; and in *X. fastigiata* Humes and Dojiri, 1982, the caudal ramus of the female has the ratio 2.6 : 1, the second segment of the endopods of legs 1 and 2 has setae, and leg 5 in the male lacks a segment-like lobe.

*Xarifia gradata* sp. nov.

(Figs. 4*a-j*, 5*a-i*, 6*a-d*)

*Type material.* 3 ♀♀, 1 ♂ from *Physogyra* sp., in 2 m, west of Pte. Mahatsinjo, Nosy Be, north-western Madagascar, 27 March 1964. HOLOTYPE ♀, ALLOTYPE (dissected) deposited in the NMNH; the remaining PARATYPES (dissected) in the collection of the first author.

*Female.* Body (fig. 4*a, b*) moderately stout, about 6.7 times longer than wide. Length 1.30 mm (1.26–1.33 mm) and width 0.19 mm (0.17–0.19 mm), based on 3 specimens. External segmentation weak and best seen in urosome. Region dorsal to fifth pair of legs with 3 long processes (fig. 4*c*), median process only slightly shorter than lateral processes. Genital areas located dorsally. Caudal ramus (fig. 4*d*) elongate,  $57 \times 22 \mu\text{m}$ , ratio 2.59 : 1, bearing 4 terminal setae and 1 lateral seta. Egg sac not seen. Body surface with numerous very minute hairs (sensilla).

Rostrum (fig. 4*e*) rounded. First antenna (fig. 4*e*) 50  $\mu\text{m}$  long, 5-segmented (though fifth segment showing evidence of subdivision), with armature: 3, 11, 7, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Lengths of segments (measured along posterior side): 8.4, 13.2 [4.8 + 4.8], 7.2, and 4.8  $\mu\text{m}$ , respectively. All setae smooth. Second antenna (fig. 4*f*) 66  $\mu\text{m}$  long, 4-segmented, with armature: 1, 1, 2, and I + 1 + 3 setules (fig. 4*g*). Terminal claw 12  $\mu\text{m}$  and longest seta 13  $\mu\text{m}$ . All setae smooth.

Labrum (fig. 4*h*) with truncate posteroventral margin indented medially. Mandible (fig. 4*i*) smooth, falcate. Paragnath a small hairy lobe. First maxilla (fig. 4*j*) with 2 setae. Second maxilla (fig. 5*a*) 2-segmented, though distal half of second segment set off from proximal half. First segment unarmed. Second segment with 2 unequal inner setae and small outer spinelike process on proximal part; small seta subterminally on distal part of segment. Maxilliped (fig. 5*b*) 3-segmented. First segment unarmed. Second segment with 2 lobes, 2 minute spinules, and 2 inner setae. Third segment with 2 setae and terminal setiform processes.

Legs 1–4 (figs. 5*c, d, e*) with 3-segmented exopods and 2-segmented endopods, having spine and setal formula as follows:

P <sub>1</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,3
					Enp	0-0; 1
P <sub>2</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,3
					Enp	0-0; 2
P <sub>3+4</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 0

Coxa in all 4 legs with outer seta and inner hairs. Three exopod spines graded in length, shortest on first segment and longest on third segment, in leg 1 lengths of these spines being 8, 13, and 30  $\mu\text{m}$ , respectively. Outer sides of endopodal segments haired.

Leg 5 (fig. 5*f*) elongate, 124  $\mu\text{m}$  long, tapered, with 2 terminal setae 22  $\mu\text{m}$  and 8  $\mu\text{m}$  and adjacent dorsal seta 14  $\mu\text{m}$ .

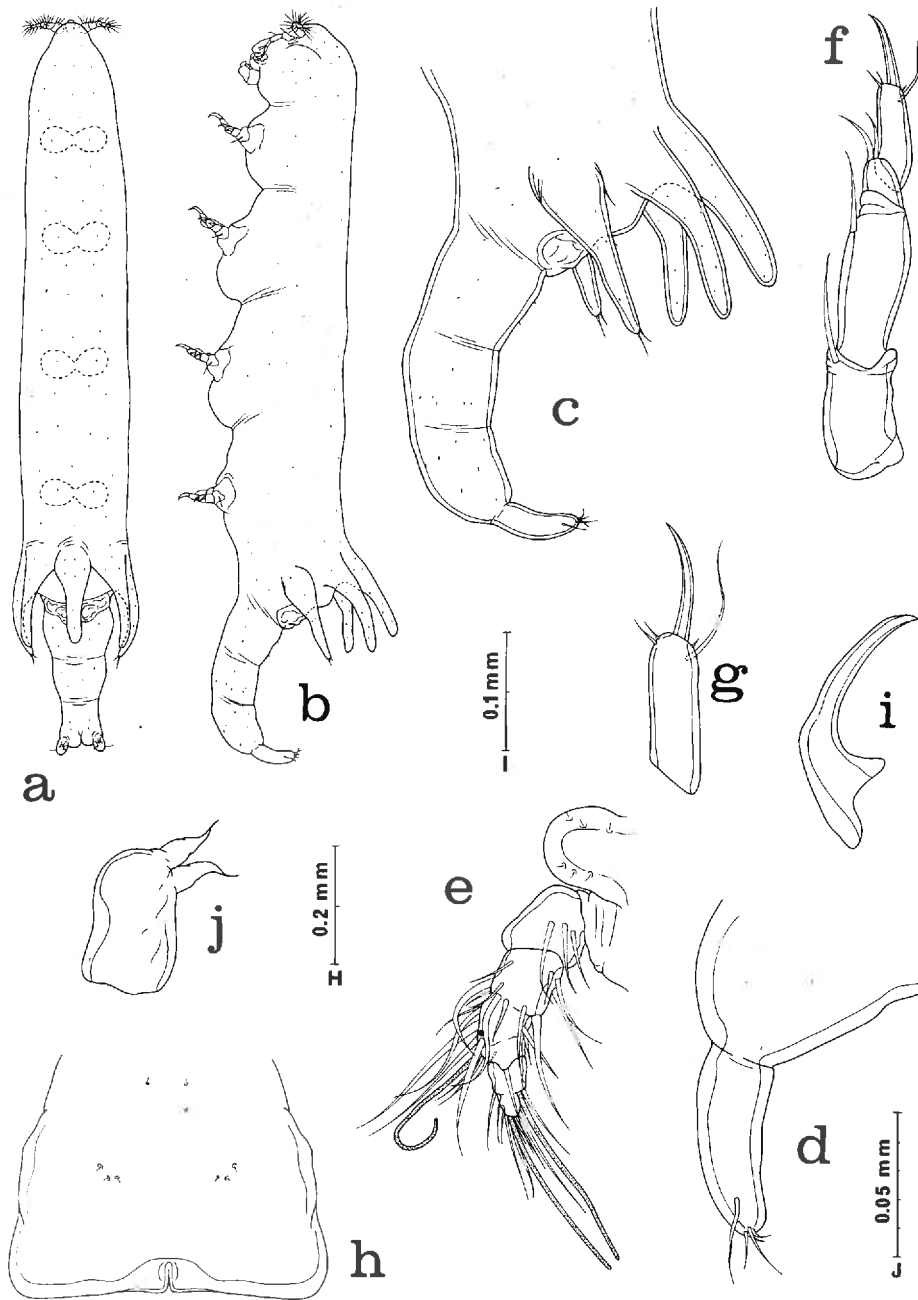


FIG. 4. *Xarisia gradata* sp. nov., female. *a*, dorsal (H); *b*, lateral (H); *c*, urosome, lateral (I); *d*, caudal ramus, lateral (J); *e*, first antenna, anterodorsal (C); *f*, second antenna, dorsal (E); *g*, fourth segment of second antenna, dorsal (D); *h*, labrum, ventral (C); *i*, mandible, ventral (D); *j*, first maxilla, anteroventral (E).



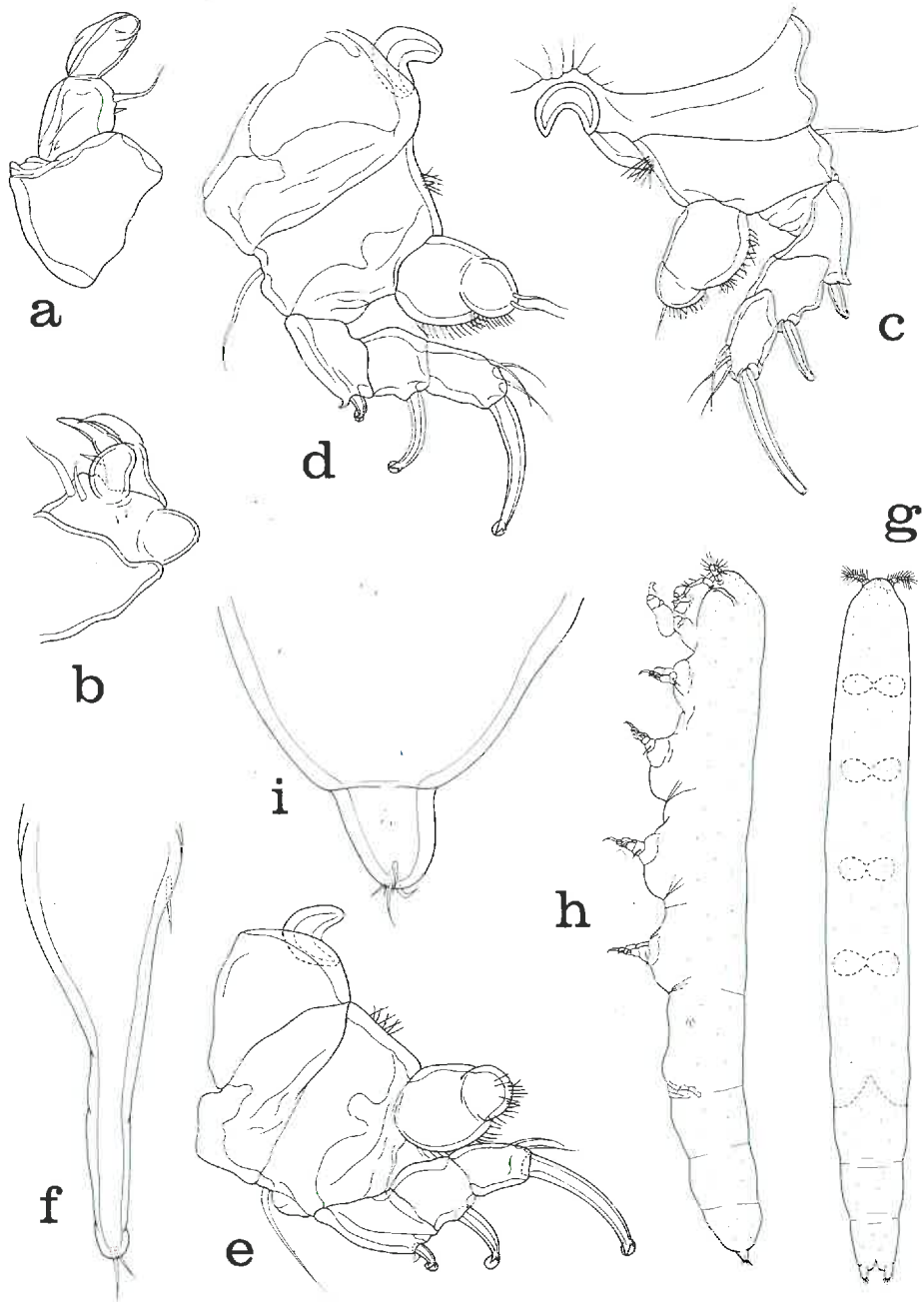


FIG. 5. *Xarijia gradata* sp. nov., a-f, female. a, second maxilla, antero-inner (E); b, maxilliped, inner (E); c, leg 1 and intercoxal plate, anterior (C); d, leg 2 and intercoxal plate, posterior (C); e, leg 3 and intercoxal plate, posterior (C); f, leg 5, lateral (J). g-i, male. g, dorsal (H); h, lateral (H); i, caudal ramus, lateral (C).

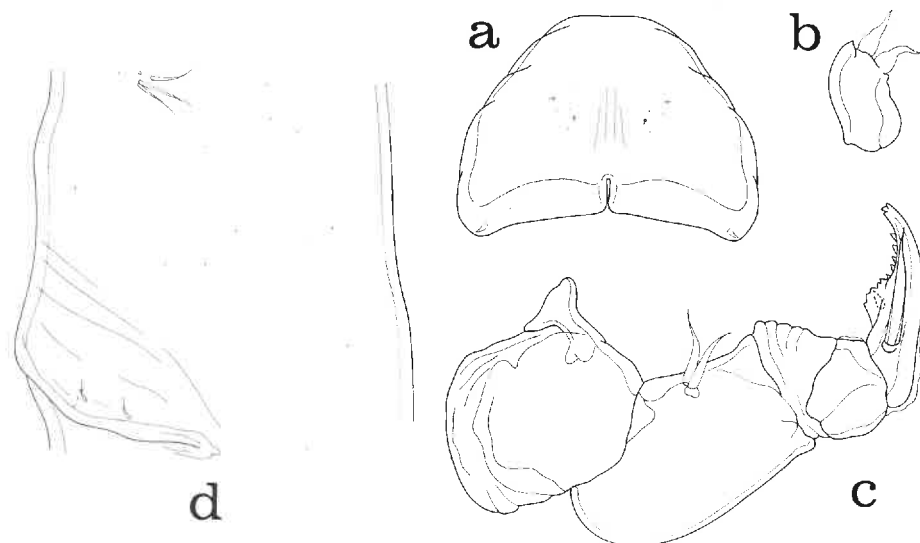


FIG. 6. *Xarifia gradata* sp. nov., male. *a*, labrum, ventral (C); *b*, first maxilla, ventral (C); *c*, maxilliped, inner (C); *d*, leg 5 and leg 6, lateral (J).

*Male*. Body (fig. 5*g, h*) more slender than in female, about 8.4 times longer than wide. Length of allotype 1.20 mm and width 0.14 mm. Caudal ramus (fig. 5*i*)  $23 \times 23 \mu\text{m}$ , shorter than in female.

Rostrum as in female. First antenna like that of female, but 1 aesthete added on third segment (at point indicated by dot in fig. 4*e*). Second antenna similar to that of female.

Labrum (fig. 6*a*) resembling that of female but small outer spinelike process added on both posteroventral corners. Mandible and paragnath like those of female. First maxilla (fig. 6*b*) similar to that of female, but sexually dimorphic in having conical process adjacent to 2 setae. Second maxilla like that of female. Maxilliped (fig. 6*c*) 4-segmented. First segment unarmed. Second segment with 2 inner setae. Third segment unarmed. Claw (fourth segment)  $46 \mu\text{m}$  long, with 2 unequal proximal setae, trifid tip, and concave margin having serrate expansion followed by several denticles.

Legs 1–4 as in female.

Leg 5 (fig. 6*d*) consisting of 3 small setae, without free segment.

Leg 6 (fig. 6*d*) a posteroventral flap on genital segment bearing 2 small setae.

Colour in living specimens in transmitted light opaque grey, intestine slightly reddish, eye red.

*Etymology*. The specific name *gradata*, Latin meaning provided with steps, refers to the graded lengths of the three exopodal spines of legs 1–4.

*Remarks*. The armature of the second segment of the endopod of legs 1–4 in *Xarifia gradata*, namely, 1, 2, 0, 0, sets the new species apart from 14 congeners that like *X. gradata* have a 4-segmented second antenna and 2-segmented endopods in legs 1–4 (*X. dispar* Humes 1962, *X. comata* Humes 1962; *X. diminuta* Humes and Ho, 1967; *X. lamellispinosa*, *X. decorata*, *X. brevicauda*, *X. anomala*, and *X. hamata*, all Humes and Ho, 1968; and the following species described by Humes and Dojiri, 1982: *X. villosa*, *X. echinopora*, *X. abulsa*, *X. fastigiata*, *X. mediolobata*, and *X. radians*).

*Xarifia minax* sp. nov.(Figs. 7*a-j*, 8*a-h*, 9*a-k*)

*Type material.* 3 ♀♀, 3 ♂♂ from *Physogyra* sp., in 2 m, west of Pte. Mahatsinjo, Nosy Bé, north-western Madagascar, 27 March 1964. HOLOTYPE ♀ and ALLOTYPE ♀ deposited in the NMNH; the remaining PARATYPES (dissected) in the collection of the first author.

*Female.* Body (fig. 7*a, b*) elongate, about 7.2 times longer than wide, urosome short. Length 1.43 mm (1.39–1.46 mm) and width 0.20 mm (0.20–0.21 mm), based on 3 specimens. External segmentation not visible except incompletely in urosome. Region dorsal to fifth legs with 3 posteriorly directed processes (fig. 7*e*), middle process nearly twice length of lateral processes. Genital and postgenital segments together about 16% of body length. Genital areas located dorsolaterally. Caudal ramus (fig. 7*d*) elongate,  $67 \times 22 \mu\text{m}$ , ratio 3:1, bearing 4 terminal setae and 1 small lateral seta, and ornamented with minute setules. Body surface with minute setules. Egg sac not seen.

Rostrum (fig. 7*e*) rounded. First antenna (fig. 7*e*)  $45 \mu\text{m}$  long and 5-segmented. Lengths of segments (measured along posterior side): 12, 12, 6, 6, and  $8.4 \mu\text{m}$ , respectively. Armature: 3, 10, 7, 3 + 1 aesthete, and 5 + 2 aesthetes. All setae smooth. Second antenna (fig. 7*f*) 4-segmented,  $54 \mu\text{m}$  long including claw. Armature: I, 1, 2, and I + 1 + 2 setules. Claw (fig. 7*g*) minute, only about  $2 \mu\text{m}$  long, adjacent long seta  $19 \mu\text{m}$ . All setae smooth.

Labrum (fig. 7*h*) with wide nearly straight posteroventral margin indented medially. Mandible (fig. 7*i*) falcate, smooth, with 2 very narrow lamellae distally. Paragnath (fig. 7*h*) a small lobe. First maxilla (fig. 7*j*) with 2 setae between minute process and large fingerlike process. Second maxilla (fig. 8*a*) 2-segmented, with second segment having 2 inner setae and extended in bilamellate distal process. Maxilliped (fig. 8*b, c*) 3-segmented, first segment with large lobe, second segment with 2 unequal inner setae and large lobe, and third segment with 2 terminal obtuse setae.

Legs 1–4 (fig. 8*d, e, f, g*) with 3-segmented exopods and 2-segmented endopods. Spine and setal formula as follows:

P <sub>1</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 2
P <sub>2</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,1
					Enp	0-0; 3
P <sub>3+4</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,1
					Enp	0-0; 0

Exopod spines with narrow flanges and provided with denticle on outer (concave) surface. Leg 3 exopod (fig. 8*g*) with trifid process on anterior surface of first segment near insertion of spine. Endopods largely devoid of hairlike setules.

Leg 5 (fig. 8*h*) elongate,  $116 \mu\text{m}$  long, with 1 terminal seta  $31 \mu\text{m}$  and adjacent seta on body  $5 \mu\text{m}$ .

Colour in life in transmitted light slightly opaque grey, eye red, intestine somewhat reddish.

*Male.* Body (fig. 9*a, b*) elongate, about 8.5 times longer than wide, more slender and longer than in female. Length 1.61 mm (1.56–1.66 mm) and width 0.19 mm

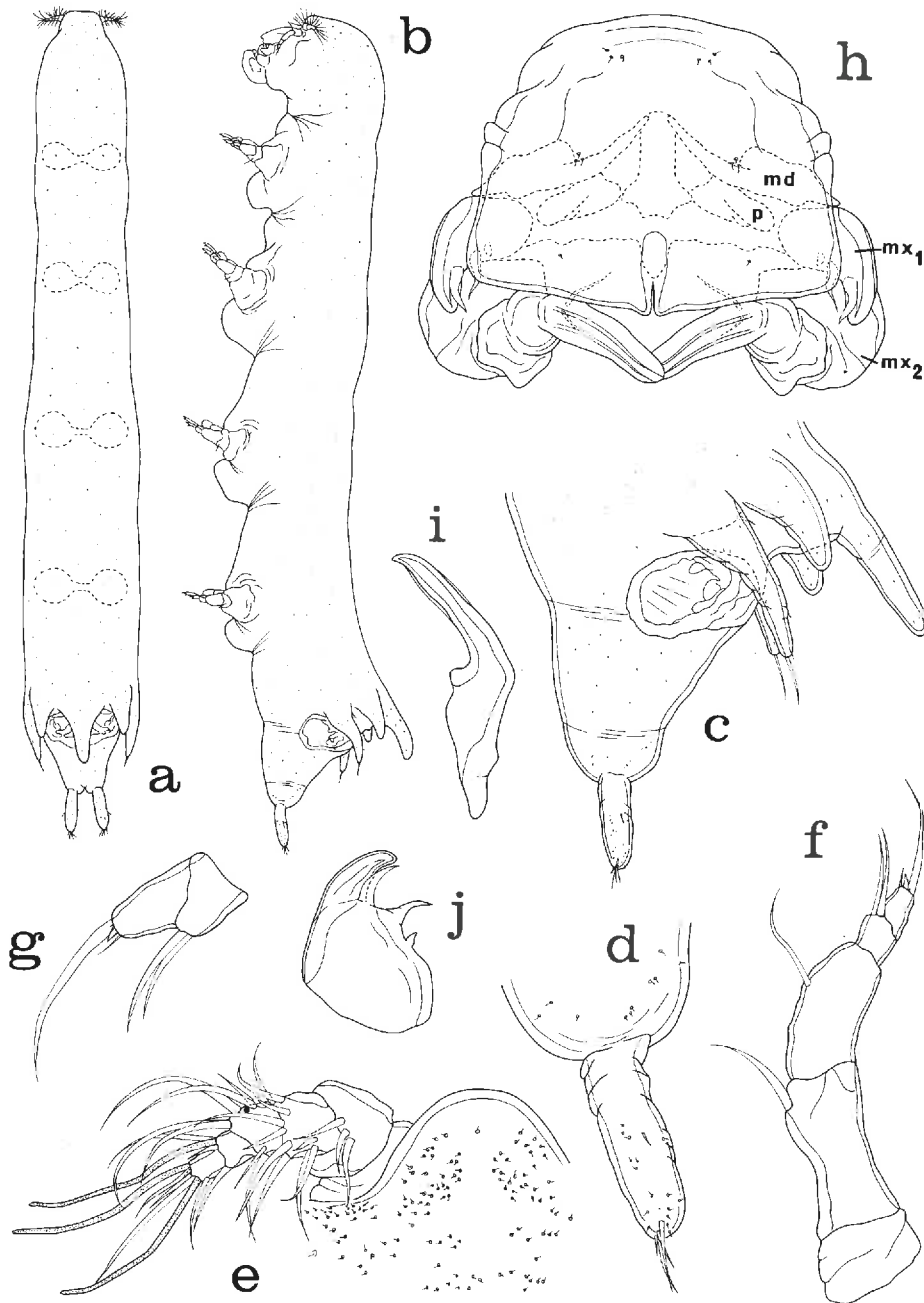


FIG. 7. *Xarifia minax* sp. nov., female. *a*, dorsal (H); *b*, lateral (H); *c*, urosome, lateral (B); *d*, caudal ramus, lateral (J); *e*, rostrum and first antenna, anterodorsal (C); *f*, second antenna, ventro-inner (E); *g*, third and fourth segments of second antenna, ventro-inner (D); *h*, labrum, with mandibles, paragnaths, first maxillae, and second maxillae *in situ*, ventral (C); *i*, mandible, ventral (E); *j*, first maxilla, ventral (E).

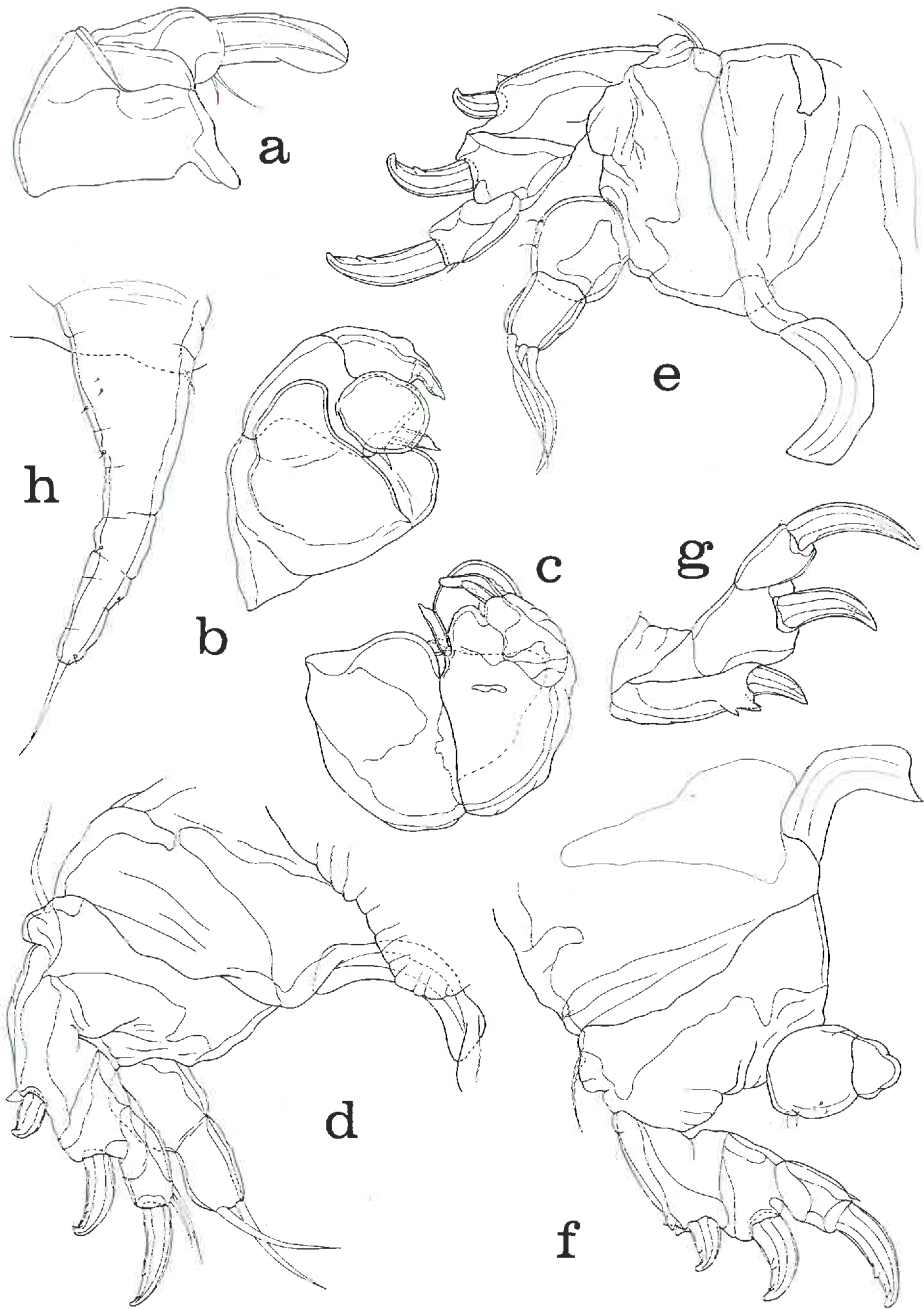


FIG. 8. *Xarifiia minax* sp. nov., female. *a*, second maxilla, postero-outer (E); *b*, maxilliped, posterior (C); *c*, maxilliped, anterior (C); *d*, leg 1 and intercoxal plate, posterior (C); *e*, leg 2 and intercoxal plate, posterior (C); *f*, leg 3 and intercoxal plate, posterior (C); *g*, exopod of leg 3, anterior (C); *h*, leg 5, lateral (J).

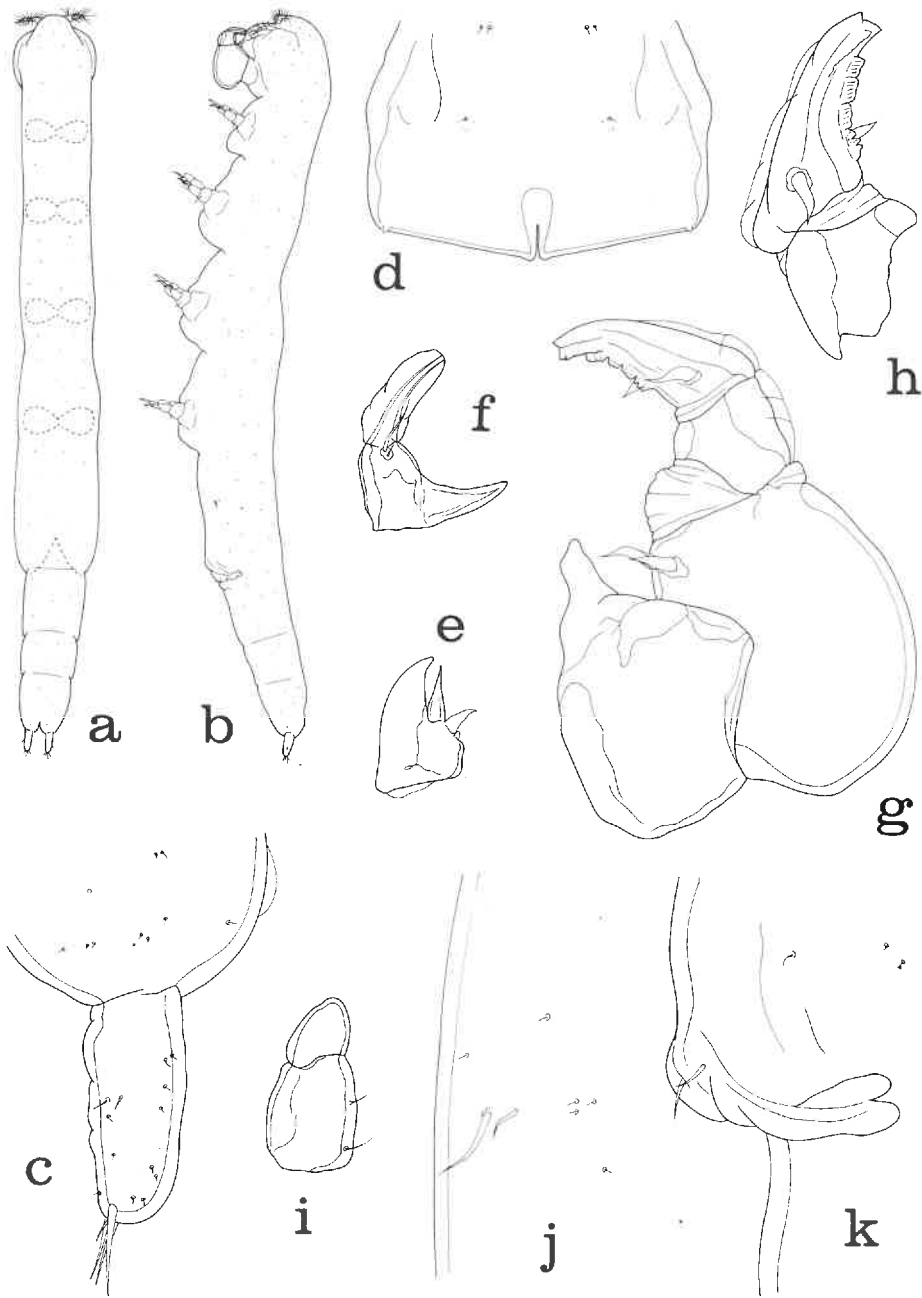


FIG. 9. *Xarifa minax* sp. nov., male. *a*, dorsal (A); *b*, lateral (A); *c*, caudal ramus, lateral (C); *d*, labrum, ventral (C); *e*, first maxilla, anterior (C); *f*, second segment of second maxilla, inner (C); *g*, maxilliped, inner (C); *h*, third segment and claw of maxilliped, inner (C); *i*, endopod of leg 3, posterior (C); *j*, leg 5, lateral (C); *k*, leg 6, lateral (C).

(0.18–0.19 mm), based on 3 specimens. Caudal ramus (fig. 9c)  $54 \times 22 \mu\text{m}$ , ratio 2.5 : 1, shorter than in female.

Rostrum as in female. First antenna similar to that of female, but 1 aesthete added on third segment (at point indicated by dot in fig. 7e). Second antenna as in female.

Labrum (fig. 9d) sexually dimorphic in having small knob at lateral corners of posteroventral margin. Mandible and paragnath as in female. First maxilla (fig. 9e) with large process more pointed than in female. Second maxilla with large inner proximal pointed process (fig. 9f). Maxilliped (fig. 9g) 4-segmented. First segment unarmed. Second segment swollen with 2 inner setae. Third segment unarmed. Claw (fourth segment)  $57 \mu\text{m}$  long, relatively short and stout, with 2 proximal setae, trifid tip, and uneven crenulations along concave edge (fig. 9h).

Legs 1–4 resembling those of female. Endopod of leg 3 (fig. 9i) with second segment a little more elongate than in female.

Leg 5 (fig. 9j) consisting of 2 small setae.

Leg 6 (fig. 9k) a posteroventral flap on genital segment bearing 2 small setae. Colour as in female.

*Etymology.* The specific name *minax*, Latin meaning projecting or overhanging, alludes to the large process adjacent to the two setae on the first maxilla.

*Remarks.* Only four congeners have 2-segmented terminally unarmed endopods in legs 3 and 4 as in *Xarifia minax*. These may be distinguished from the new species as follows: in *Xarifia mediolobata* Humes and Dojiri, 1982, the body is much larger (average length of female 2.64 mm), on the region dorsal to the fifth legs there is only a single large median lobe instead of three long processes, and leg 5 in the female is oval; in *Xarifia gradata*, new species described above, the three long processes above the fifth legs in the female are about equal in length and the first maxilla lacks spiniform processes; in *Xarifia anomala* Humes and Ho, 1968, the second antenna of the female has a long terminal claw ( $10 \mu\text{m}$ ), the 2-segmented endopod of leg 1 lacks terminal armature, and the caudal ramus in the male is fused with the anal segment; and in *Xarifia brevicauda* Humes and Ho, 1968, the second antenna of the female has a long terminal claw ( $28 \mu\text{m}$ ) and leg 5 bears 2 terminal setae.

Only three other species of *Xarifia* have a single seta on the free segment of leg 5 instead of 2 setae, namely, *Xarifia exuta*, *Xarifia guttulifera*, and *Xarifia heteromeles*, all described by Humes and Dojiri, 1982. These species, however, have 1-segmented endopods in legs 1–4 and thus differ significantly from *Xarifia minax*.

### *Xarifia gracilipes* sp. nov.

(Figs. 10a–h, 11a–j, 12a–h, 13a–i)

*Type material.* 20 ♀♀, 1 immature ♀, 48 ♂♂ from *Euphyllia glabrescens* (Chamisso and Eysenhardt), in 10 m, Poelau Gomumu, south of Obi, Moluccas,  $01^{\circ} 50'00''\text{S}$ ,  $127^{\circ} 30'54''\text{E}$ , 30 May 1975. HOLOTYPE ♀, ALLOTYPE ♀, and 59 PARATYPES (15 ♀♀, 44 ♂♂) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Female.* Body (fig. 10a, b) elongate, about 6.3 times longer than wide; urosome unusually slender. Length 2.09 mm (1.86–2.16 mm) and width 0.34 mm (0.31–0.36 mm), based on 10 specimens. External segmentation weak. Region dorsal to fifth legs with 3 posteriorly directed processes (fig. 10c), middle process slightly

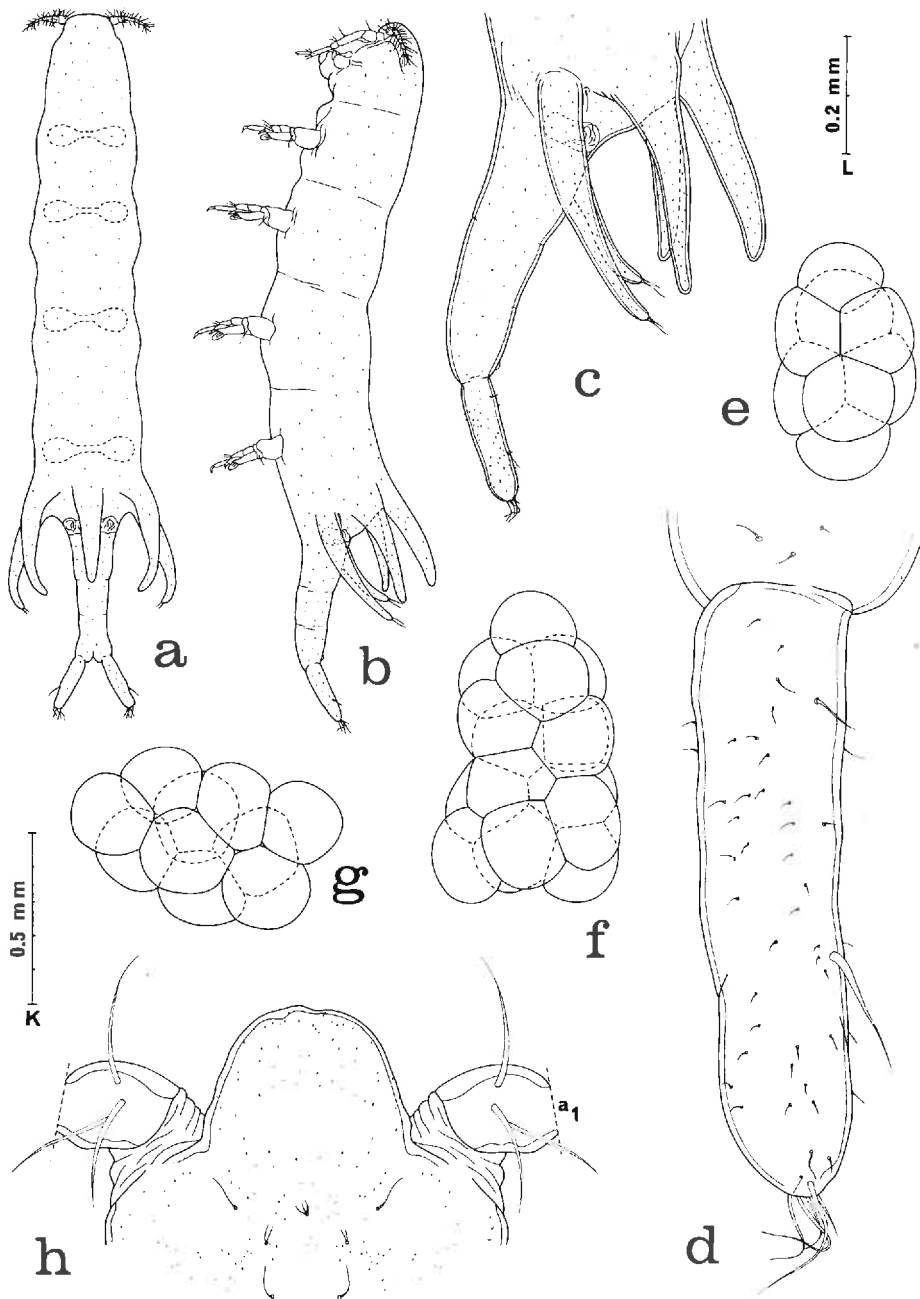


FIG. 10. *Xarifa gracilipes* sp. nov., female. *a*, dorsal (K); *b*, lateral (K); *c*, urosome, lateral (L); *d*, caudal ramus, lateral (F); *e*, egg sac, lateral (L); *f*, egg sac, lateral (L); *g*, egg sac, lateral (L); *h*, rostrum, dorsal (J).



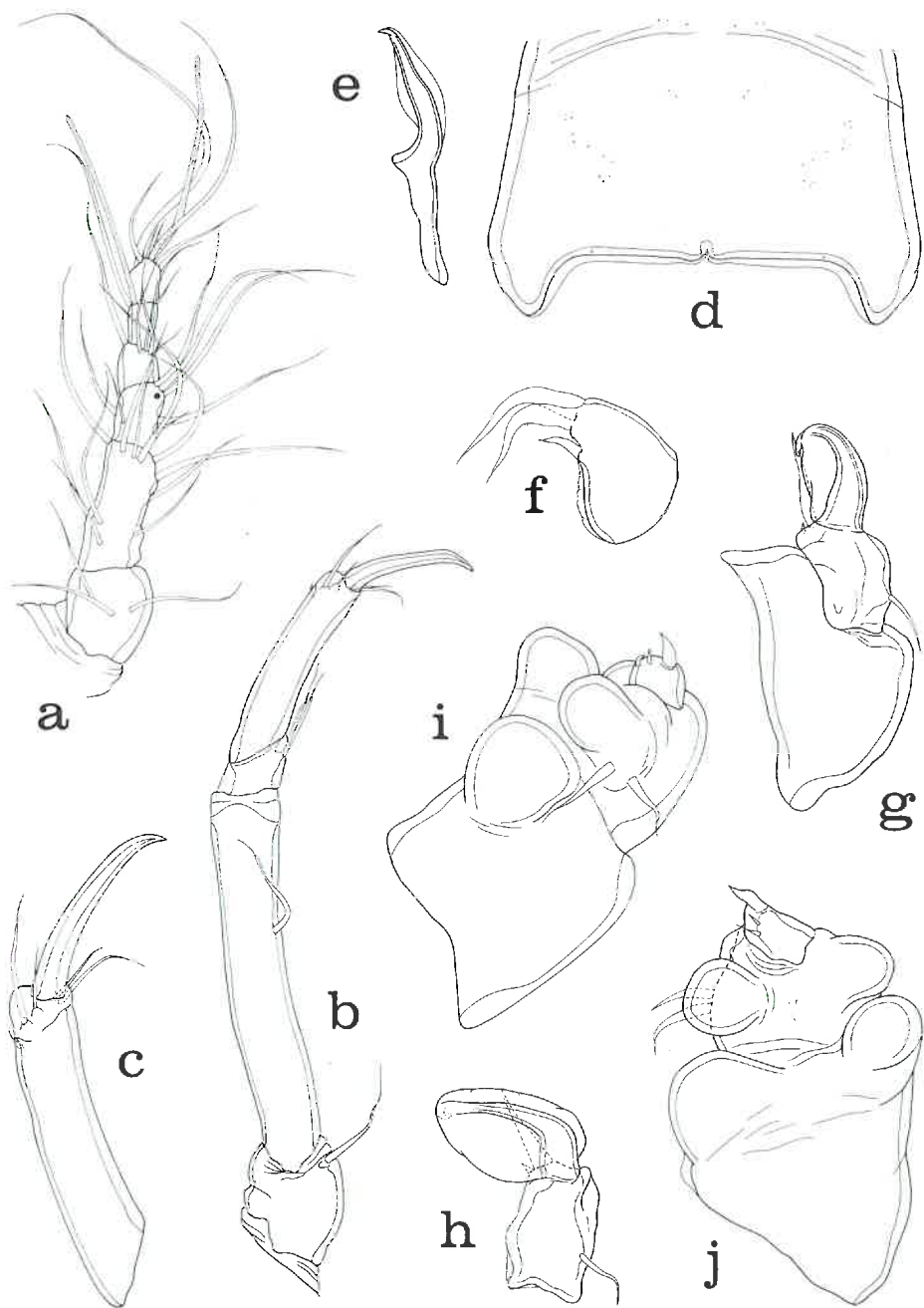


FIG. 11. *Xarifja gravilipes* sp. nov., female. *a*, first antenna, anterodorsal (J); *b*, second antenna, ventral (J); *c*, fourth segment of second antenna, ventral (C); *d*, labrum, ventral (F); *e*, mandible, ventral (C); *f*, first maxilla, ventral (C); *g*, second maxilla, postero-outer (C); *h*, fourth segment of second maxilla, outer (C); *i*, maxilliped, antero-inner (C); *j*, maxilliped, inner (C).

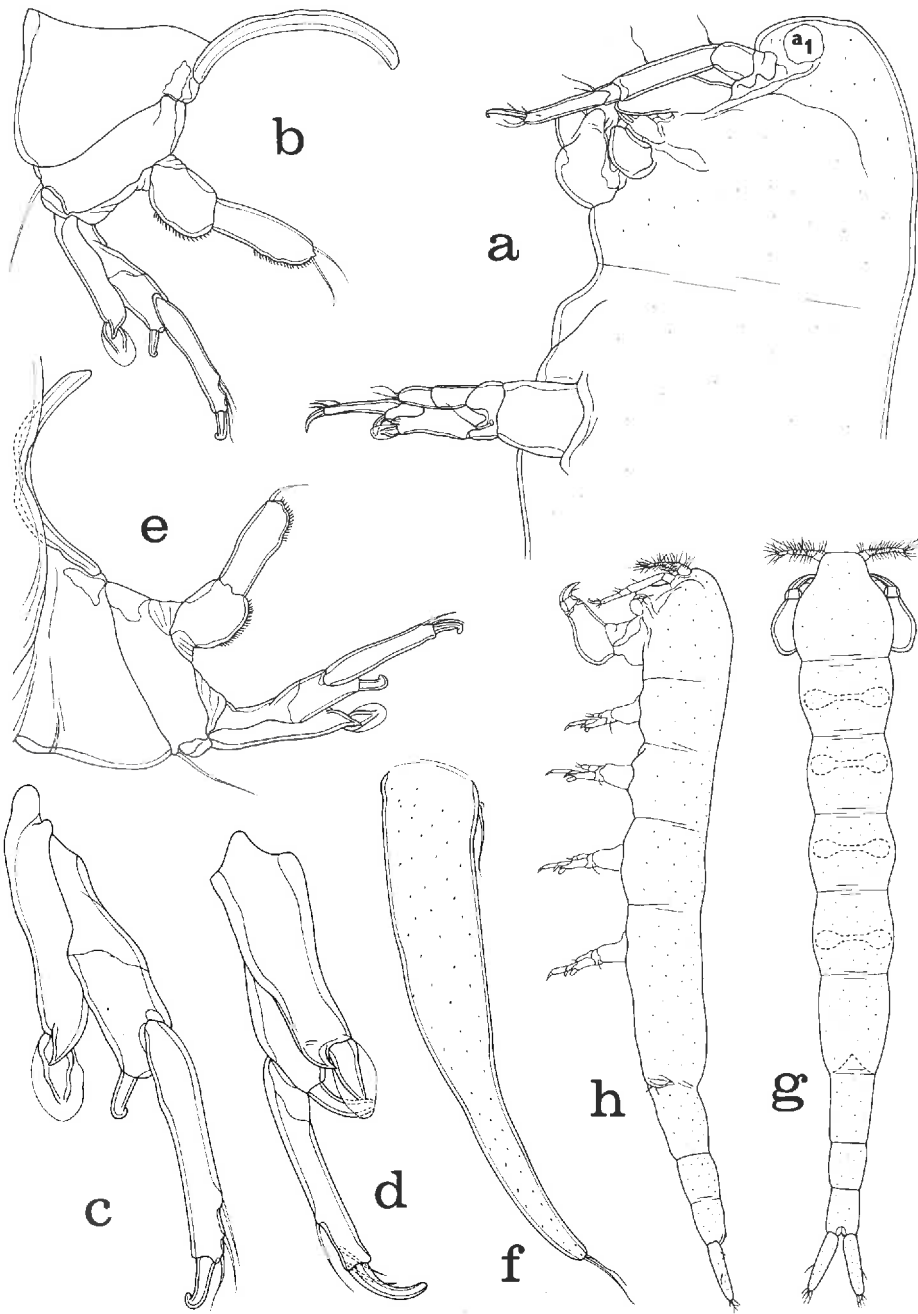


FIG. 12. *Xarifia gracilipes* sp. nov., a-f, female. a, cephalosome and leg 1, lateral (I); b, leg 1 and intercoxal plate, anterior (G); c, exopod of leg 1, anterior (F); d, exopod of leg 1, outer (F); e, leg 3 and intercoxal plate, anterior (G); f, leg 5, lateral (B). g, h, male. g, dorsal (K); h, lateral (K).

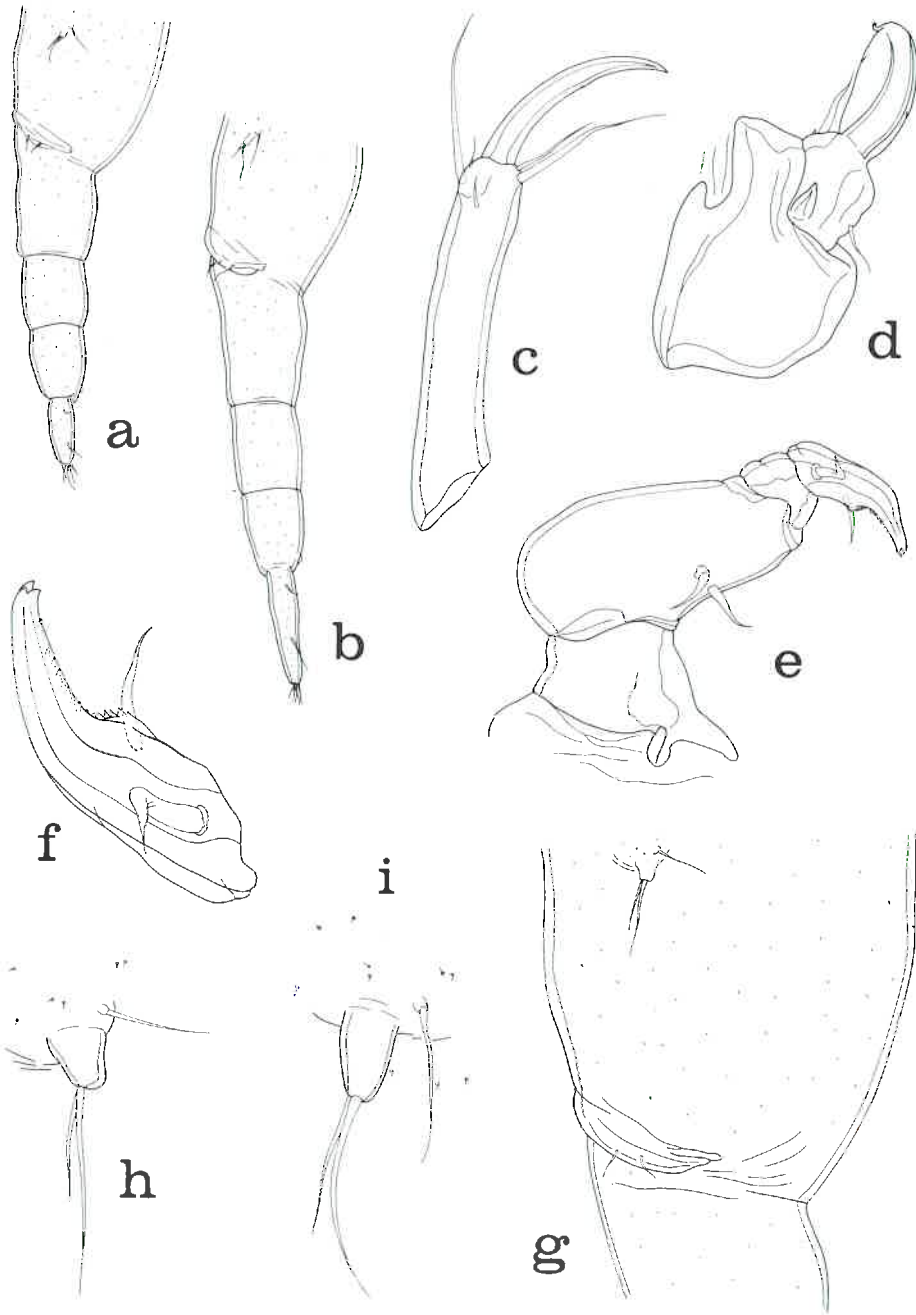


FIG. 13. *Xarifia gracilipes* sp. nov., male. *a*, urosome, lateral (L); *b*, urosome, lateral (L); *c*, fourth segment of second antenna, dorsal (C); *d*, second maxilla, postero-outer (C); *e*, maxilliped, inner (G); *f*, claw of maxilliped, inner (C); *g*, leg 5 and leg 6, lateral (G); *h*, leg 5, lateral (C); *i*, leg 5, lateral (C).

shorter than lateral processes. Genital and postgenital segments together about 28% of body length. Genital areas situated dorsolaterally. Caudal ramus (fig. 10 *d*) elongate,  $167 \times 43 \mu\text{m}$ , ratio 3.88:1, bearing 2 lateral setae, 1 subterminal seta, and 4 terminal setae. Surface of caudal ramus and body surface ornamented with small setules, some of them compound. Egg sac (fig. 10 *e, f, g*) with 8–16 eggs, each egg about  $119 \mu\text{m}$  in diameter.

Rostrum (fig. 10 *h*) bluntly rounded. First antenna (fig. 11 *a*)  $143 \mu\text{m}$  long and 6-segmented. Lengths of segments (measured along posterior side): 22, 44, 14, 17, 16, and  $17 \mu\text{m}$ , respectively. Armature: 3, 11, 7, 5, 2 + 1 aesthete, and 7 + 1 aesthete. All setae smooth. Second antenna (fig. 11 *b*) 4-segmented,  $265 \mu\text{m}$  long including claw. Armature: 1, 1, 2, and I + 1 + 4 setules. Claw (fig. 11 *c*)  $47 \mu\text{m}$  long and long adjacent seta  $26 \mu\text{m}$ . All setae naked.

Labrum (fig. 11 *d*) with medially indented posteroventral margin straight except for relatively small lateral lobes. Mandible (fig. 11 *e*) slender and bilamellate. Paragnath not seen. First maxilla (fig. 11 *f*) with 3 setae. Second maxilla (fig. 11 *g*) 2-segmented. Second segment in 2 parts, proximal part with 2 unequal inner setae, 1 outer seta, and small weak proximal spiniform process; distal part lamellate with 1 small subterminal setiform process (fig. 11 *h*). Maxilliped (fig. 11 *i, j*) 3-segmented, first segment with 2 lobes, second segment with 2 lobes and 2 setae, and small third segment with 1 stout seta and 2 small slender setae. Arrangement of appendages of cephalosome as in fig. 12 *a*.

Legs 1–4 (fig. 12 *b, c, d, e*) with 3-segmented exopods and 2-segmented endopods. Spine and setal formula as follows:

P <sub>1+2</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,3
					Enp	0-0; 2
P <sub>3+4</sub>	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 1

Rami of all 4 legs elongate and slender. Spine on first segment of exopod with large lamella. Outer margin of both segments of endopods with short hairs.

Leg 5 (fig. 12 *f*) elongate, tapered,  $345 \mu\text{m}$  long, with 2 terminal setae 36 and  $43 \mu\text{m}$ . Adjacent seta on body  $43 \mu\text{m}$ .

Colour in life in transmitted light opaque grey, eye red, egg sacs dark grey.

*Male*. Body (fig. 12 *g, h*) slender, about 7.3 times longer than wide, greatest width at cephalosome. Length 1.85 mm (1.59–2.16 mm) and width 0.26 mm (0.23–0.29 mm), based in 10 specimens. Caudal ramus (fig. 13 *a*)  $103 \times 35 \mu\text{m}$  and similar to that of female. (One male with longer caudal ramus  $178 \times 38 \mu\text{m}$  as in fig. 13 *b*.)

Rostrum as in female. First antenna like that of female, but 1 aesthete added on third segment (at point indicated by dot in fig. 11 *a*). Second antenna with 2 long setae on terminal segment (fig. 13 *c*) comparatively longer (31 and  $32 \mu\text{m}$ ) than in female.

Labrum, mandible, and first maxilla as in female. Second maxilla (fig. 13 *d*) resembling that of female, but spiniform process on proximal part of second segment more pronounced. Maxilliped (fig. 13 *e*) 4-segmented. First segment unarmed. Second segment with 2 inner setae. Small third segment unarmed. Claw (fourth segment) (fig. 13 *f*) relatively short,  $81 \mu\text{m}$ , with 2 proximal setae, having trifid tip, and bearing row of denticles along concave margin.

Legs 1-4 as in female.

Leg 5 (fig. 13*g, h, i*) with small free segment weakly set off from body and somewhat variable in dimensions,  $10 \times 9 \mu\text{m}$  or  $12 \times 11 \mu\text{m}$ .

Leg 6 (fig. 13*g*) a posteroventral flap on genital segment bearing 2 small setae. Colour as in female.

*Etymology.* The specific name *gracilipes*. Latin meaning having slender legs, alludes to the unusually elongate slender rami of legs 1-4.

*Remarks.* The slender elongate rami in legs 1-4 are characteristic of the new species. In all other *Xarifia* with 2-segmented endopods in these legs the rami are distinctly stouter. The female of *Xarifia gracilipes* has a longer caudal ramus ( $167 \times 43 \mu\text{m}$ ) than all congeners except *Xarifia radians* Humes and Dojiri, 1982, where it is  $259 \times 70 \mu\text{m}$ . However, the formula for the second segment of the endopod of legs 1-4 in *X. radians* is 3, 3, 1, 1 rather than 2, 2, 1, 1 as in *X. gracilipes*.

### *Xarifia hadra* sp. nov.

(Figs. 14*a-f*, 15*a-m*, 16*a-j*, 17*a-d*)

*Type material.* 23 ♀♀, 12 ♂♂ from *Goniopora tenuidens* (Quelch), in 3 m, Karang Mie, east central Halmahera, Moluccas,  $00^{\circ}20'07''\text{N}$ ,  $128^{\circ}25'00''\text{E}$ , 19 May 1975. HOLOTYPE ♀, ALLOTYPE, and 25 PARATYPES (17 ♀♀, 8 ♂♂) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Other specimens.* 3 ♀♀, 1 ♂ from *Goniopora pedunculata* (Quoy and Gaimard), in 2 m, same locality and date.

*Female.* Body (fig. 14*a, b*) stout, about 4.5 times longer than wide. Urosome short. Length 1.69 mm (1.66-1.79 mm) and width 0.39 mm (0.36-0.41 mm), based on 10 specimens. External segmentation very weak. Region dorsal to fifth legs with 3 posteriorly directed processes (fig. 14*c*) of nearly equal length, though middle process in some specimens slightly shorter than lateral processes. Genital and postgenital segments together about 16% of body length. Genital areas located dorsally. Caudal ramus (fig. 14*d*) moderately elongate,  $54 \times 22 \mu\text{m}$ , ratio 2.45:1, bearing 1 ventro-lateral seta, 1 lateral subterminal seta, and 6 terminal setae, longest about as long as ramus. Surface of body with small setules. Egg sac (fig. 14*e*) oval and flattened, with 12 eggs, each egg about  $140 \mu\text{m}$  in diameter.

Rostrum (fig. 14*f*) with rounded margin bearing long setules. First antenna (fig. 14*f*)  $114 \mu\text{m}$  long and 6-segmented. Lengths of segments (measured along posterior side): 26, 29, 11, 13, 17, and  $13 \mu\text{m}$ , respectively. Armature: 3, 11, 7, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. All setae smooth. Second antenna (fig. 15*a*) slender, 4-segmented,  $198 \mu\text{m}$  long not including terminal claw. Formula: 1, 1, 2, and I, 1 plus 4 small setae (fig. 15*b*). Claw  $41 \mu\text{m}$ , long seta  $78 \mu\text{m}$ .

Labrum (fig. 15*c*) with straight posteroventral margin having small medial indentation and small lateral lobes. Mandible (fig. 15*d*) slender, with bilamellate tip. Paragnath (fig. 15*e*) a small hairy lobe. First maxilla (fig. 15*f*) with 2 stout terminal setae and 1 subterminal setule. Second maxilla (fig. 15*g, h*) 2-segmented, first segment unarmed, second segment bipartite, proximal part with 2 unequal inner setae, 1 proximal outer seta, and small proximal dentiform process. Maxilliped (fig. 15*i, j*) 3-segmented. First segment ornamented with patch of small spinules. Second segment with 2 setae. Third segment with 3 setae, 2 slender and 1 spiniform.

Legs 1-4 (fig. 15*k, l*) with 3-segmented exopods and 1-segmented endopods.

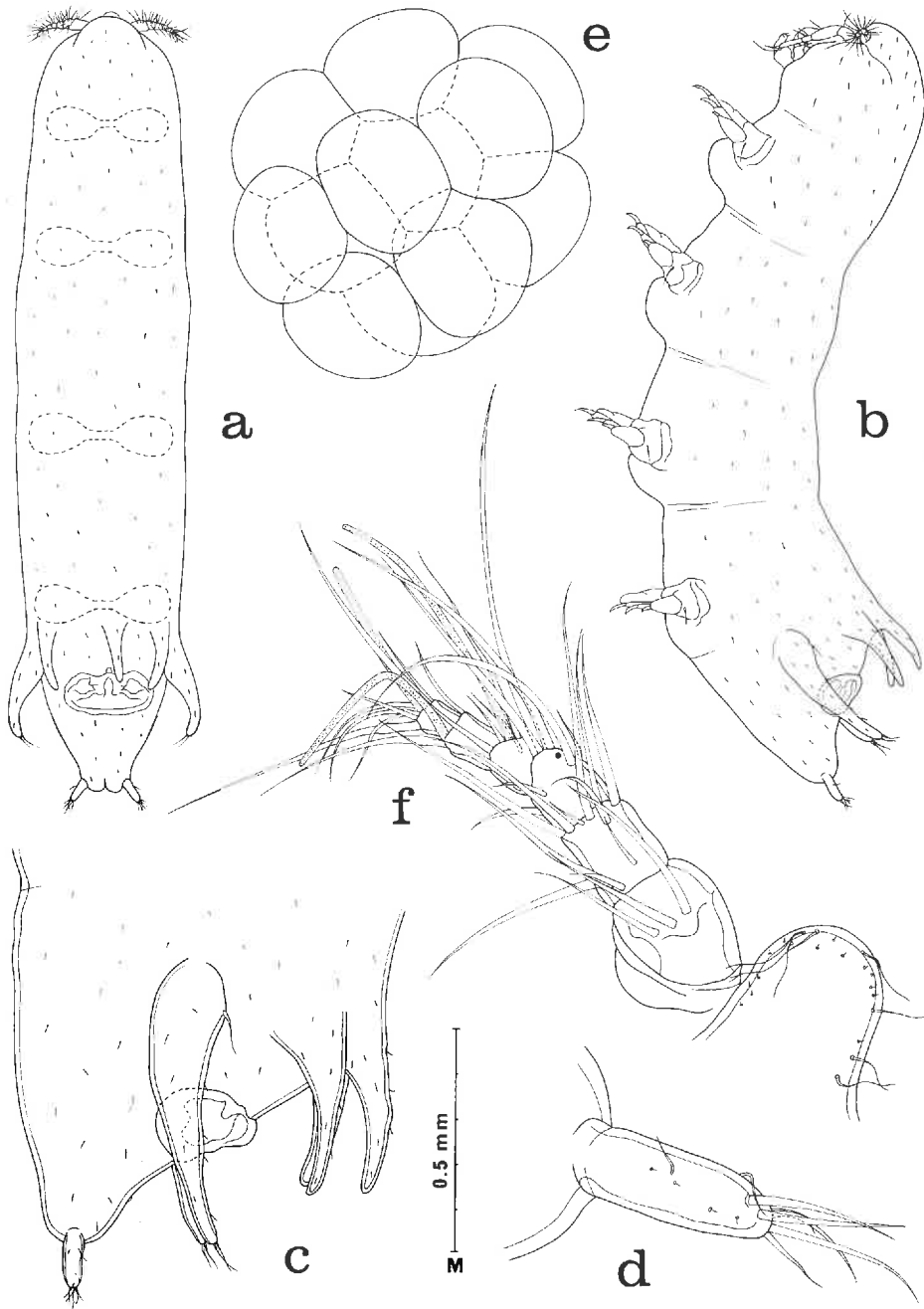


FIG. 14. *Xarifiia hadra* sp. nov., female. *a*, dorsal (A); *b*, lateral (A); *c*, urosome, lateral (M); *d*, caudal ramus, ventrolateral (F); *e*, egg sac, lateral (M); *f*, rostrum and first antenna, anterodorsal (F).

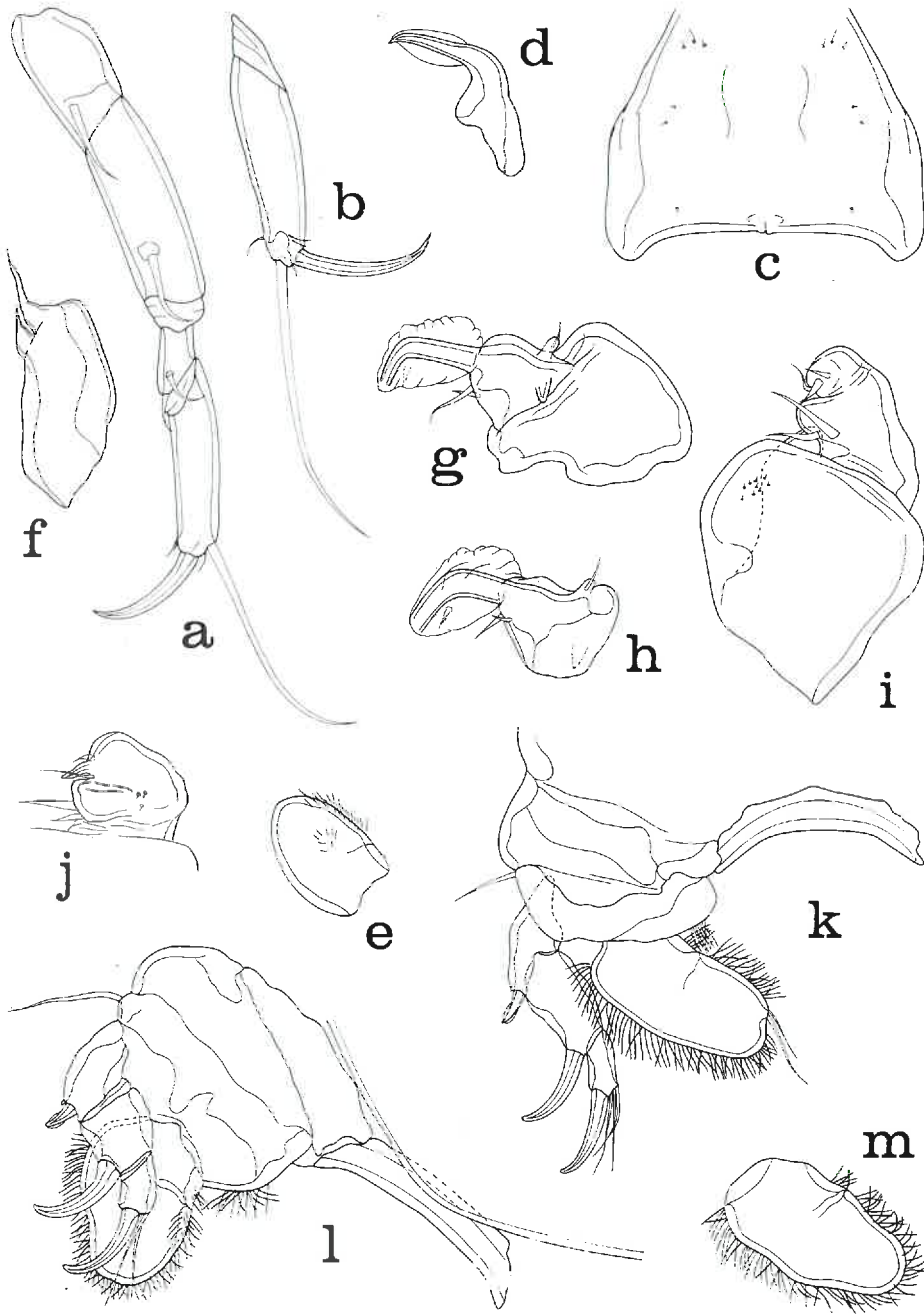


FIG. 15. *Xariffia hadra* sp. nov., female. *a*, second antenna, ventral (J); *b*, fourth segment of second antenna, dorso-inner (F); *c*, labrum, ventral (F); *d*, mandible, ventral (C); *e*, paragnath, ventral (C); *f*, first maxilla, antero-inner (C); *g*, second maxilla, postero-cuter (C); *h*, second segment of second maxilla, antero-inner (C); *i*, maxilliped, antero-inner (C); *j*, distal part of maxilliped, posterior (C); *k*, leg 1 and intercoxal plate, anterior (G); *l*, leg 3 and intercoxal plate, posterior (G); *m*, endopod of leg 3, anterior (G).

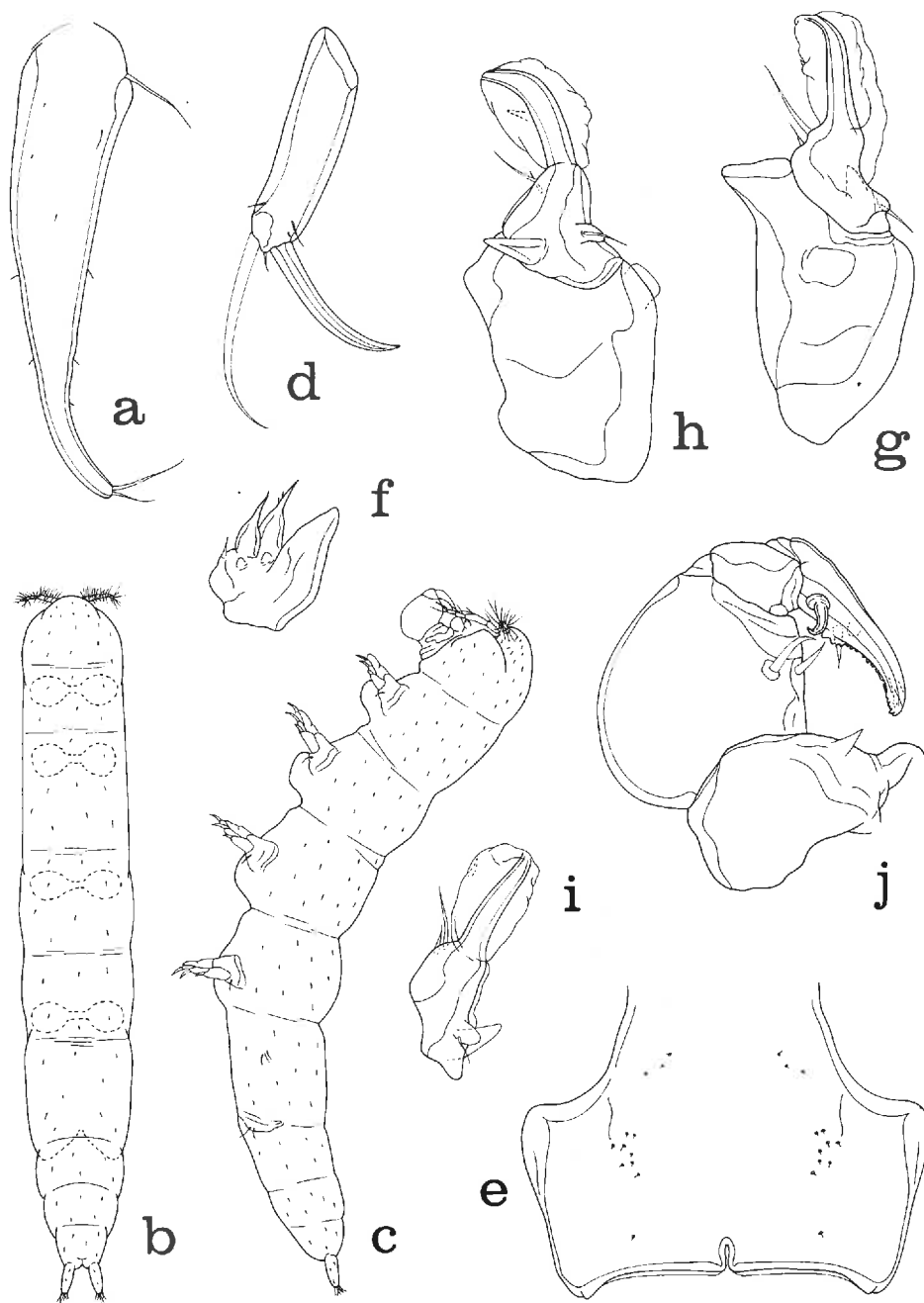


FIG. 16. *Xarifia hadra* sp. nov., female, *a*, leg 5, lateral (G). *b-j*, male. *b*, dorsal (K); *c*, lateral (K); *d*, fourth segment of second-antenna, dorsal (C); *e*, labrum, ventral (C); *f*, first maxilla, antero-outer (C); *g*, second maxilla, antero-inner (C); *h*, second maxilla, postero-outer (C); *i*, second segment of second maxilla, outer (C); *j*, maxilliped, inner (G).



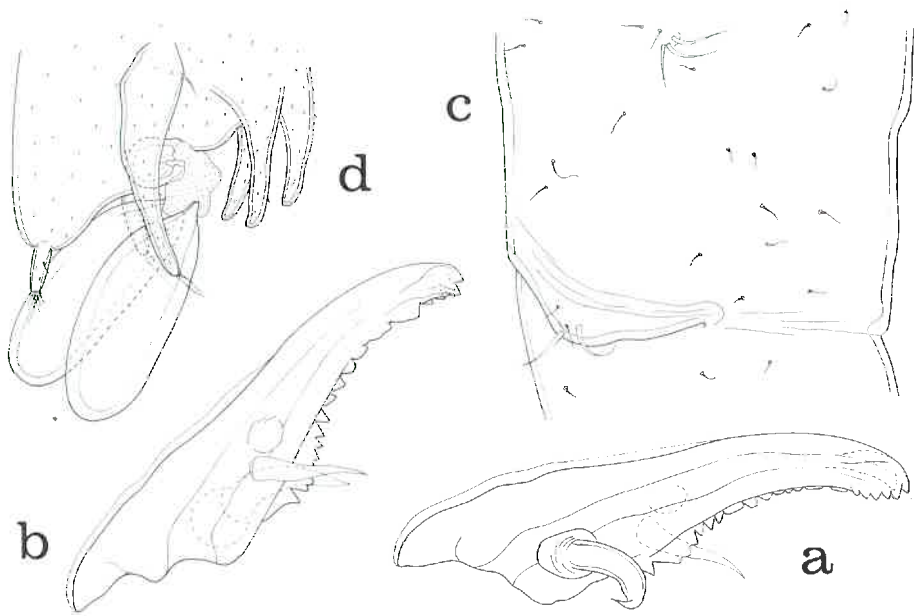


FIG. 17. *Xorifia kadra* sp. nov., male. *a*, claw of maxilliped, inner (C); *b*, claw of maxilliped, outer (C); *c*, leg 5 and leg 6, lateral (B); *d*, spermatophores attached to urosome of female, lateral (L).

Spine and setal formula as follows:

$P_{1+2}$	Coxa	0-0	Basis	1-0	Exp	1-0; 1-0; 1,3
					Enp	2
$P_{3+4}$	Coxa	0-0	Basis	1-0	Exp	1-0; 1-0; 1,2
					Enp	0

Inner margin of basis with row of hairs. Endopods of varying shape (fig. 15 *m*), showing suggestion of subdivision, and bearing dense long hairs on both outer and inner margins.

Leg 5 (fig. 16 *a*) elongate, tapered, 345  $\mu$ m long, its 2 terminal setae 27 and 51  $\mu$ m. Adjacent seta on body 54  $\mu$ m.

Colour in life in transmitted light dense opaque grey, eye red, egg sacs dark grey.

*Male*. Body (fig. 16 *b, c*) more slender than in female, about 6.2 times longer than wide. Length 1.77 mm (1.66–1.86 mm) and width 0.35 mm (0.33–0.36 mm), based on 10 specimens. Caudal ramus similar to that of female but larger, 77  $\times$  33  $\mu$ m.

Rostrum as in female. First antenna like that of female, but 1 aesthete added on third segment (at point indicated by dot in fig. 14 *f*). Second antenna (fig. 16 *d*) resembling that of female but terminal claw (37  $\mu$ m) and long seta (44  $\mu$ m) more nearly equal than in female.

Labrum (fig. 16 *e*) with medial indentation deeper than in female and lateral lobes with small process. Mandible and paragnath as in female. First maxilla (fig. 16 *f*) much more asymmetrical than in female, with stout process about as long as adjacent seta. Second maxilla (fig. 16 *g, h, i*) resembling that of female but proximal dentiform process on second segment larger. Maxilliped (fig. 16 *j*) 4-segmented. First

segment with inner spiniform process. Second segment with 2 inner setae. Small third segment unarmed. Claw (fourth segment)  $113\ \mu\text{m}$ , with 2 proximal setae, small knob on midouter surface, serrate concave margin, and bifid tip (fig. 17*a, b*).

Legs 1–4 as in female.

Leg 5 (fig. 17*c*) lacking free segment and represented only by 3 small setae.

Leg 6 (fig. 17*c*) a posteroventral flap on genital segment bearing 2 setae.

Spermatophore (fig. 17*d*) elongate,  $330 \times 132\ \mu\text{m}$ , not including neck. Colour as female.

*Etymology.* The specific name *hadra*, from Greek *hadros* meaning stout or thick, alludes to the relatively stout body.

*Remarks.* Among those species of *Xarifia* that have 1-segmented endopods in legs 1–4 only one, *Xarifia anopla* Humes and Dojiri, 1982, has, as in the new species, the formula 2, 2, 0, 0 for the terminal armature of these endopods. This congener differs, however, from *Xarifia hadra* in lacking in the female both legs 5 and the 3 processes dorsal to the fifth legs.

### *Xarifia scutipes* sp. nov.

(Figs. 18*a–h*, 19*a–j*, 20*a–h*, 21*a–i*)

*Type material.* 5 ♀♀, 9 ♂♂ from 1 colony of *Goniopora tenuidens* (Quelch), in 3 m, Karang Mie, east central Halmahera, Moluccas,  $00^{\circ}20'07''\text{N}$ ,  $128^{\circ}25'00''\text{E}$ , 19 May 1975. HOLOTYPE ♀, ALLOTYPE, and 6 PARATYPES (1 ♀, 5 ♂♂) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Other specimens.* 2 ♀♀, 5 ♂♂ from 1 colony of *Goniopora pedunculata* (Quoy and Gaimard), in 2 m, same locality and date.

*Female.* Body (fig. 18*a, b*) stout, about 4.5 times longer than wide. Length (measured with tips of caudal rami turned upward) 2.03 mm (1.93–2.09 mm) and width 0.45 mm (0.41–0.46 mm), based on 8 specimens. External segmentation fairly well marked in lateral view. Region dorsal to fifth legs with 3 equal posteriorly directed recurved processes (fig. 18*c*). Genital and postgenital segments together about 15% of body length. Genital areas located dorsolaterally. Caudal ramus (fig. 18*d*)  $97 \times 49\ \mu\text{m}$ , turned upward, ratio approximately 2:1, bearing 1 lateral seta, 1 subterminal seta, and 4 terminal setae. Ornamented with small spinules. Surface of body with numerous spinules. Egg sac (fig. 18*e*) with 10 eggs varying from 115–161  $\mu\text{m}$  in diameter.

Rostrum (fig. 18*f*) subquadrate with posteroventral margin slightly rounded. First antenna (fig. 19*a*) 122  $\mu\text{m}$  long and 6-segmented. Lengths of segments (measured along posterior side): 18, 31, 12, 11, 17, and 13  $\mu\text{m}$ , respectively. Armature: 3, 11, 7, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. All setae naked. Second antenna (fig. 18*g*) 4-segmented, slender, 200  $\mu\text{m}$  long without claw. Formula: 1, 1, 2, and 1,1 plus 3 setules and minute spinule. Terminal claw 36  $\mu\text{m}$  and adjacent long seta 17  $\mu\text{m}$  (fig. 18*h*).

Labrum (fig. 19*b*) with straight posteroventral margin indented medially and having small conical lateral lobes. Mandible (fig. 19*c*) falcate, bilamellate, terminating in minute recurved hook. Paragnath (fig. 19*d*) a small lobe with long hairs. First maxilla (fig. 19*e, f*) with 2 terminal setae and 1 small inner seta. Second maxilla (fig. 19*g, h*) 2-segmented, first segment unarmed, second segment with 2 very unequal inner setae, 1 proximal spinelike process, and lamellate distal part having small proximally directed process. Maxilliped (fig. 19*i, j*) 3-segmented. First

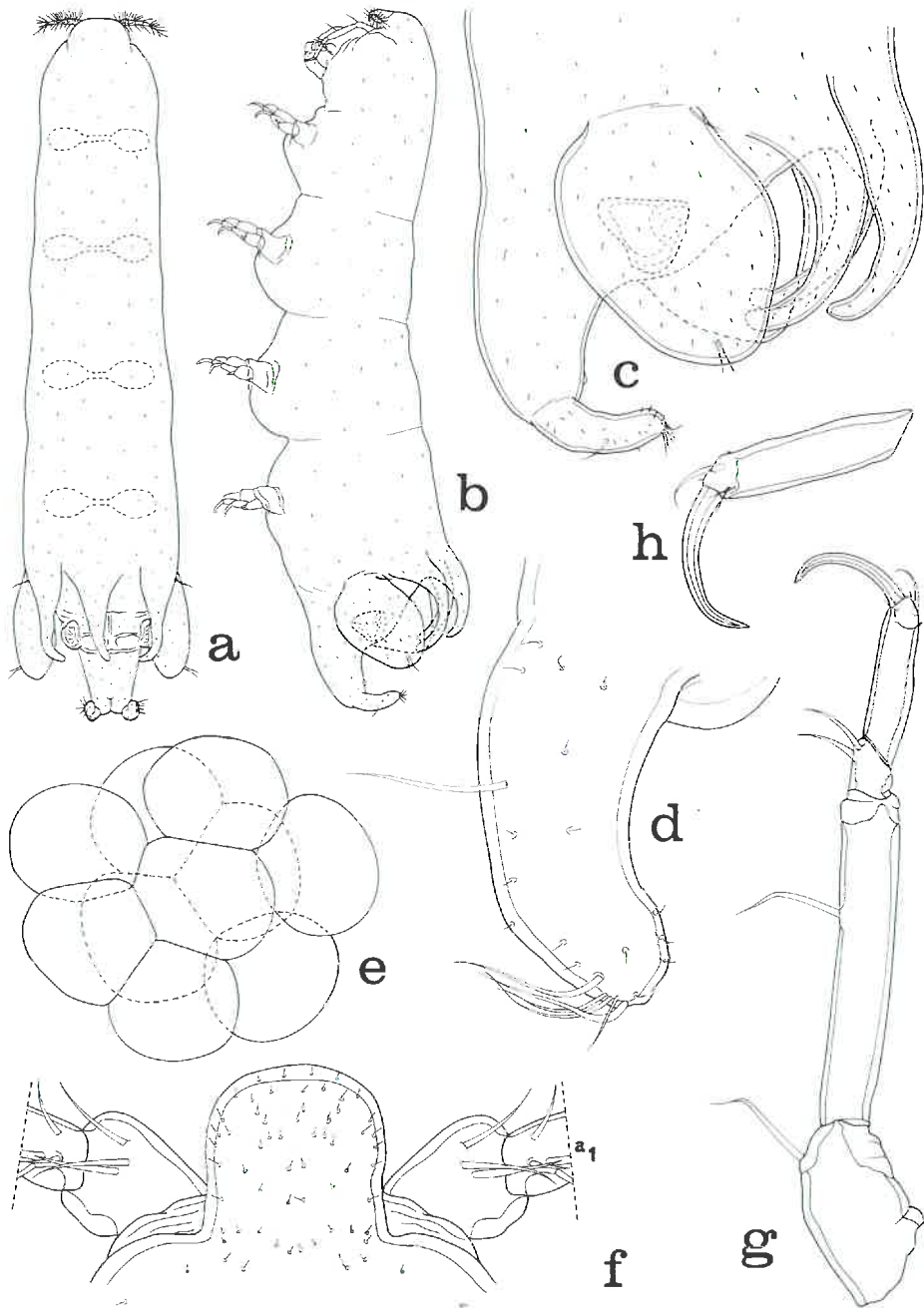


FIG. 18. *Xarifia scutipes* sp. nov., female. *a*, dorsal (K); *b*, lateral (K); *c*, urosome, lateral (M); *d*, caudal ramus, lateral (F); *e*, egg sac, lateral (M); *f*, rostrum, dorsal (F); *g*, second antenna, dorso-inner (F); *h*, fourth segment of second antenna, dorso-inner (C).

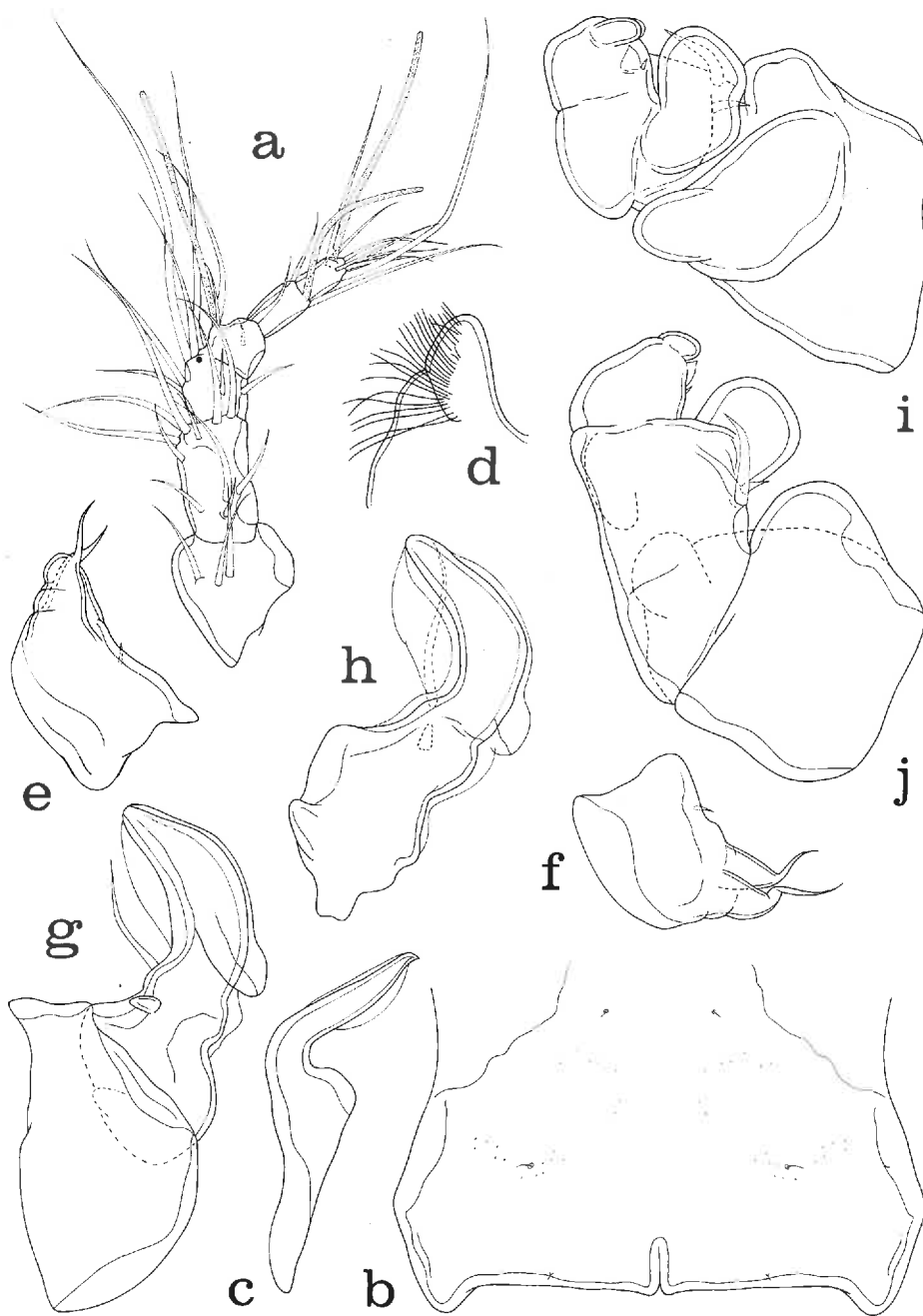


FIG. 19. *Xarifiia scutipes* sp. nov., female. *a*, first antenna, dorsal (F); *b*, labrum, ventral (F); *c*, mandible, ventral (F); *d*, paragnath, ventral (C); *e*, first maxilla, posterior (C); *f*, first maxilla, postero-outer (C); *g*, second maxilla, antero-inner (C); *h*, second segment of second maxilla, postero-outer (C); *i*, maxilliped, antero-outer (C); *j*, maxilliped, antero-inner (C).

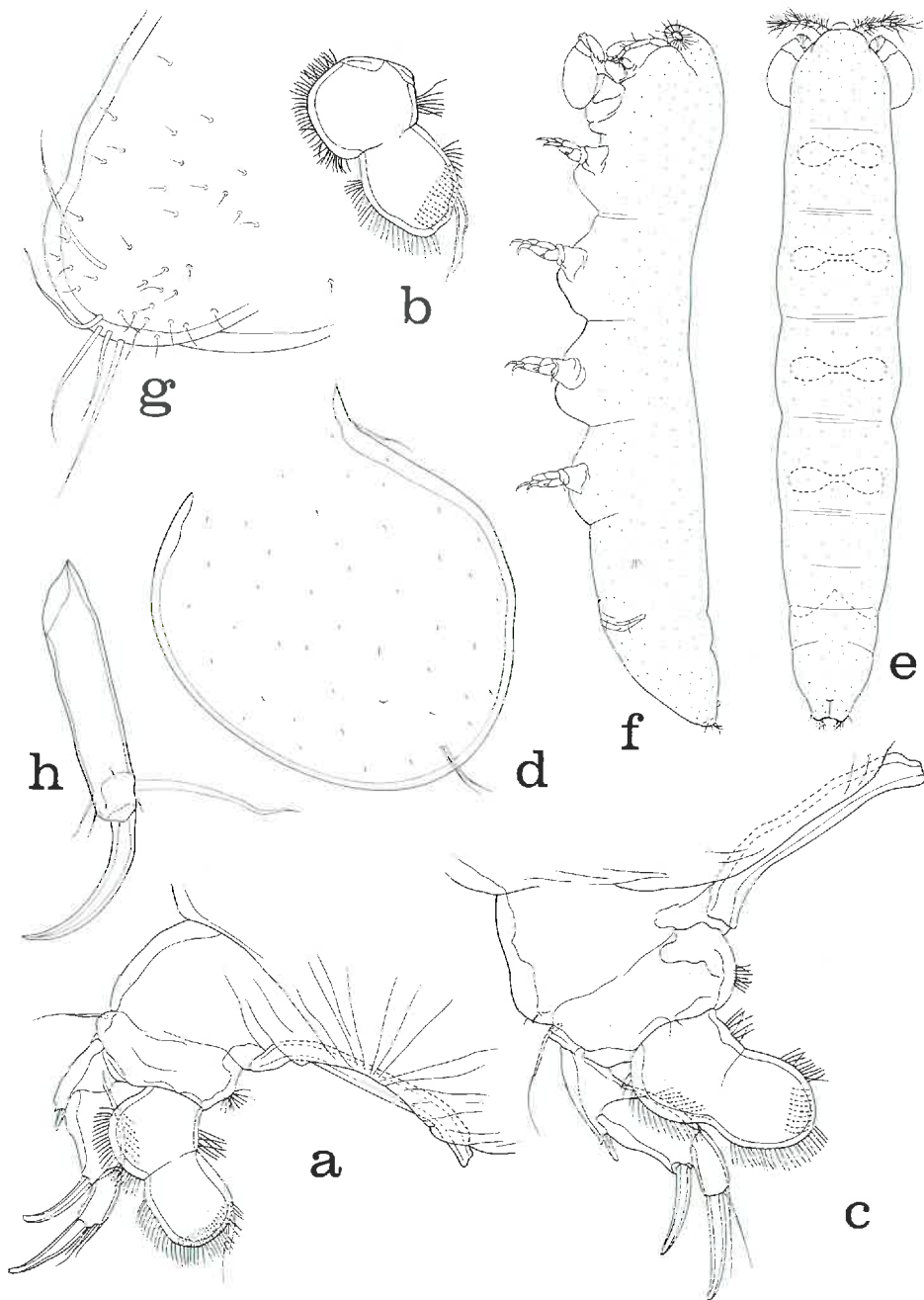


FIG. 20. *Xarífia scutipes* sp. nov., *a-d*, female. *a*, leg 1 and intercoxal plate, anterior (G); *b*, endopod of leg 2, anterior (G); *c*, leg 3 and intercoxal plate, anterior (G); *d*, leg 5, lateral (B). *e-h*, male, *e*, dorsal (K); *f*, lateral (K); *g*, caudal ramus, lateral (F); *h*, fourth segment of second antenna, dorso-outer (C).

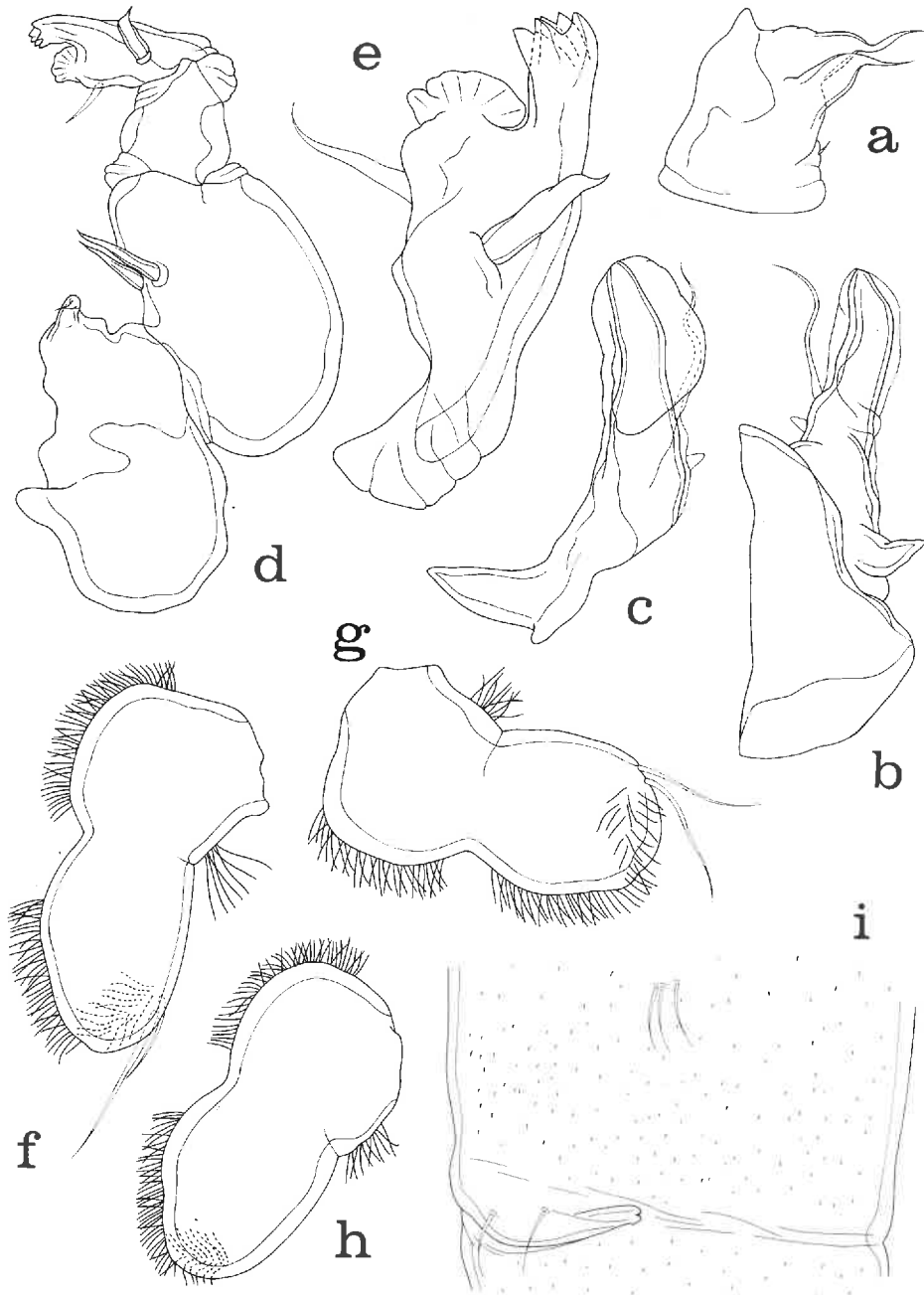


FIG. 21. *Xarifiia scutipes* sp. nov., male. *a*, first maxilla, postero-outer (C); *b*, second maxilla, postero-outer (F); *c*, second segment of second maxilla, posterior (C); *d*, maxilliped, inner (G); *e*, claw of maxilliped, inner (C); *f*, endopod of leg 1, anterior (F); *g*, endopod of leg 2, posterior (F); *h*, endopod of leg 3, anterior (F); *i*, leg 5 and leg 6, lateral (B).

segment unarmed but having outer lobe. Second segment with 2 inner setae and rounded lobe. Third segment with minute spinule, dentiform process, and terminal blunt seta (process?).

Legs 1-4 (fig. 20 *a, b, c*) with 3-segmented exopods and 2-segmented endopods (segments of endopods incompletely separated). Spine and setal formula as follows:

$P_{1+2}$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,3
					Enp	0-0; 2
$P_{3+4}$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 0

Inner margin of basis in all 4 legs with group of hairs. Outer spines on second and third segments of exopods much longer than spine on first segment of exopod. Endopods with outer and inner marginal hairs, extending on posterior surface as shown in figures. Endopod of leg 2 (fig. 20 *b*) with 2 terminal setae almost equal in length.

Leg 5 (fig. 20 *d*) with large, nearly round, flat, shieldlike free segment  $288 \times 259 \mu\text{m}$ , bearing 2 setae  $47 \mu\text{m}$  and  $32 \mu\text{m}$ . Adjacent dorsal seta  $51 \mu\text{m}$ .

Colour in life in transmitted light dense opaque grey, eye red, egg sacs dark grey.

*Male.* Body (fig. 20 *e, f*) fairly stout, about 5.6 times longer than wide. Length 2.02 mm (1.96-2.09 mm) and width 0.37 mm (0.35-0.43 mm), based on 10 specimens. Caudal ramus (fig. 20 *g*) short, fused with anal segment, bearing 5 setae.

Rostrum as in female. First antenna similar to that of female, but 1 aesthete added on third segment (at point indicated by dot in fig. 19 *a*). Second antenna resembling that of female, but fourth segment (fig. 20 *h*) with claw  $36 \mu\text{m}$  and adjacent long seta  $35 \mu\text{m}$ .

Labrum, mandible, and paragnath as in female. First maxilla (fig. 21 *a*) with outer process not present in female. Second maxilla (fig. 21 *b, c*) 2-segmented, first segment unarmed, second segment with 2 inner setae and outer proximal spiniform process. Maxilliped (fig. 21 *d*) 4-segmented. First segment with inner setiform process. Second segment with 2 inner setae. Small third segment unarmed. Claw (fourth segment) short,  $103 \mu\text{m}$ , with 2 unequal proximal setae, having 5 or 6 cusps on tip, and bearing hyaline excrescence on concave margin (fig. 21 *e*).

Legs 1-4 segmented and armed as in female, though endopods less distinctly 2-segmented (fig. 21 *f, g, h*).

Leg 5 (fig. 21 *i*) lacking free segment and represented only by 3 small setae.

Leg 6 (fig. 21 *j*) a posteroventral flap on genital segment bearing 2 setae.

Spermatophore not seen.

Colour as in female.

*Etymology.* The specific name *scutipes*, from Latin *scutum*, a shield, and *pes*, a foot, refers to the shieldlike form of leg 5 in the female.

*Remarks.* *Xarifia scutipes* may be distinguished easily from all congeners by the broad shieldlike leg 5 in the female and by the form of the claw of the maxilliped in the male (with a large hyaline excrescence on the concave margin).

#### *Xarifia resex* sp. nov.

(Figs. 22 *a-i*, 23 *a-h*, 24 *a-i*)

*Type material.* 5 ♀♀, 3 ♂♂ from 1 colony of *Goniopora tenuidens* (Quelch), in 3 m, Karang Nie, east central Halmahera, Moluccas,  $00^{\circ}20'07''\text{N}$ ,  $128^{\circ}25'00''\text{E}$ , 19 May

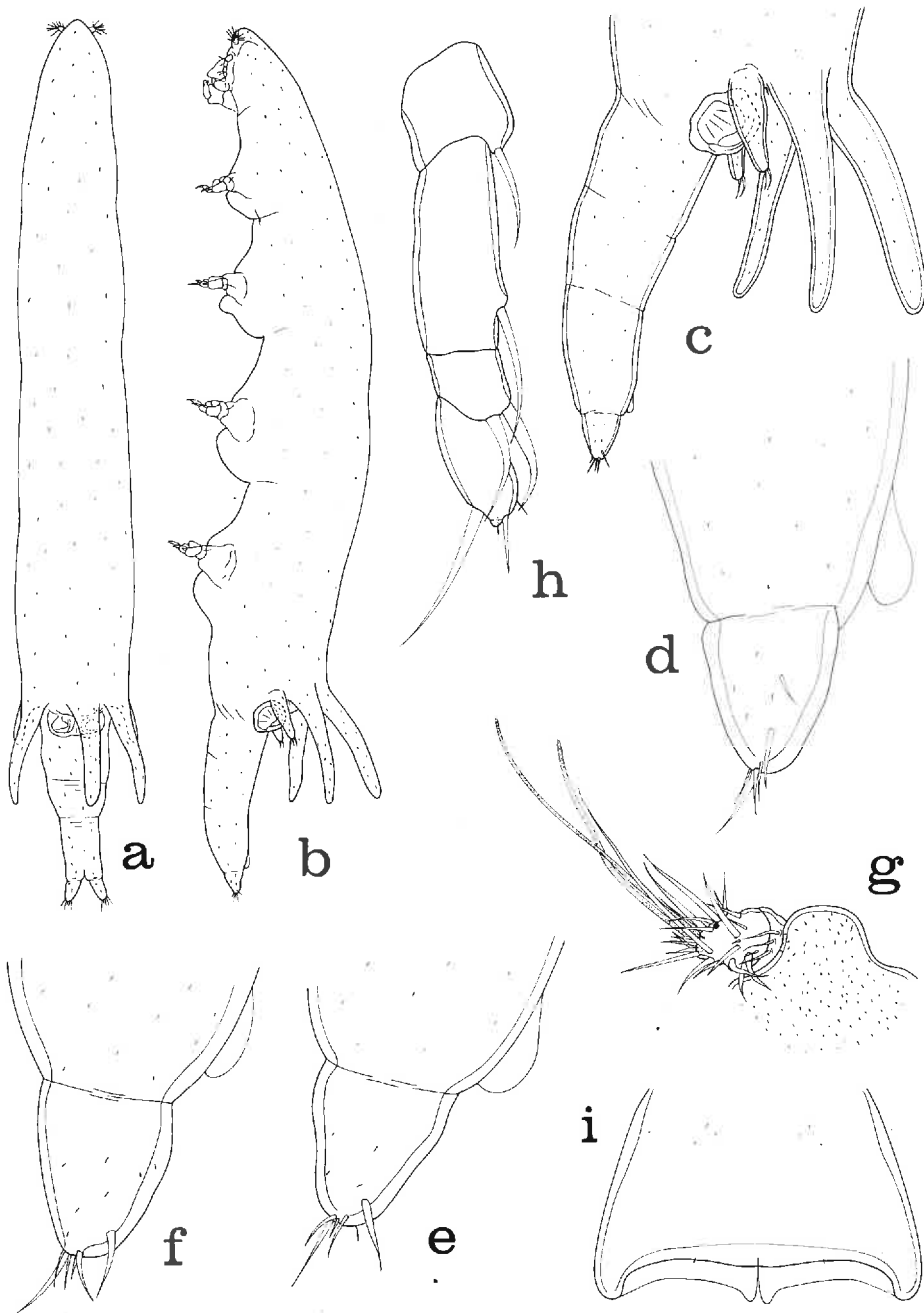


FIG. 22. *Xarifia resex* sp. nov., female. *a*, dorsal (H); *b*, lateral (H); *c*, urosome, lateral (I); *d*, caudal ramus, lateral (C); *e*, caudal ramus, lateral (C); *f*, caudal ramus, lateral (C); *g*, rostrum and first antenna, anterodorsal (C); *h*, second antenna, ventral (D); *i*, labrum, ventral (E).



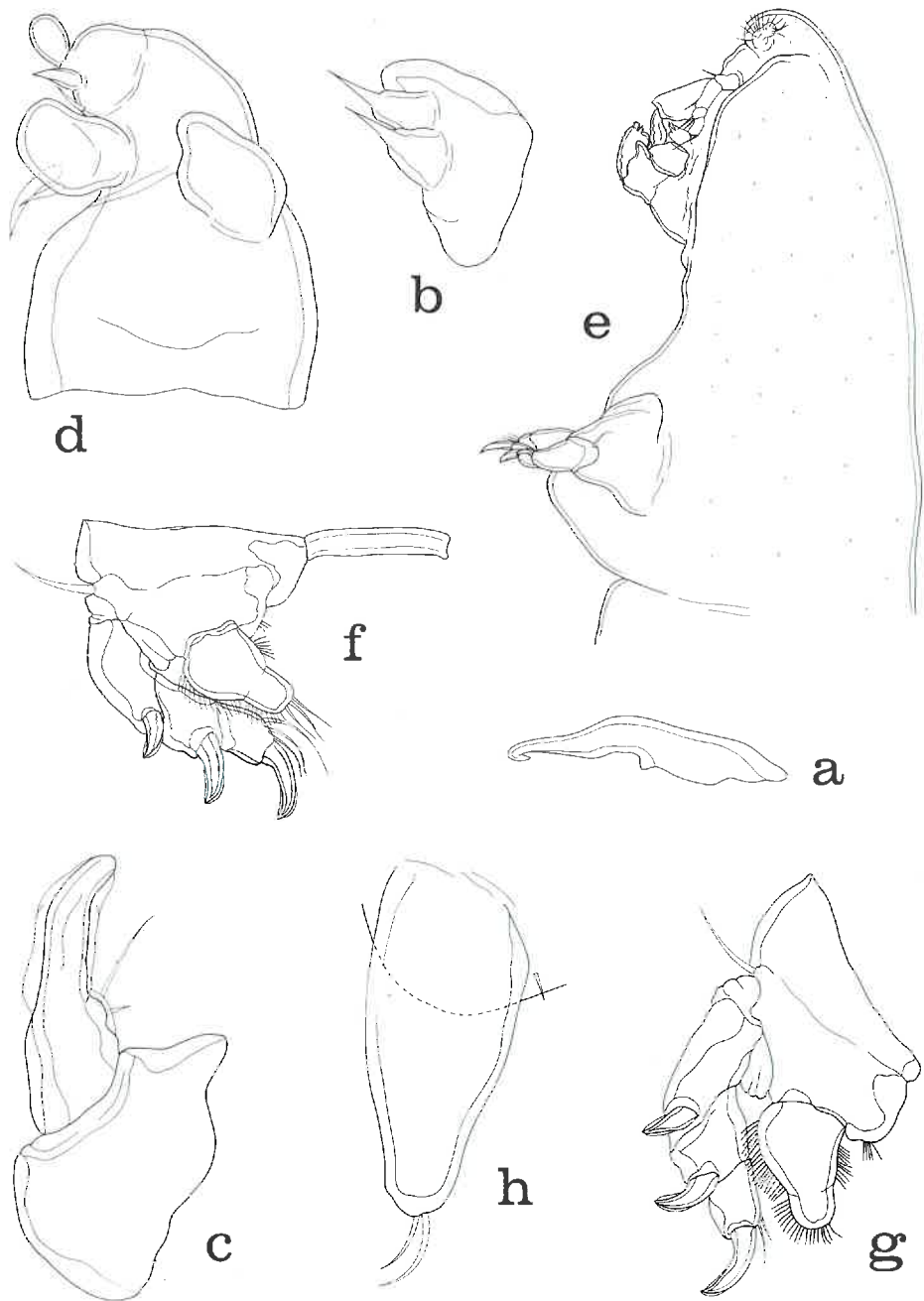


FIG. 23. *Xariffia resex* sp. nov., female. *a*, mandible, outer (D); *b*, first maxilla, antero-inner (D); *c*, second maxilla, postero-outer (D); *d*, maxilliped, posterior (D); *e*, cephalosome and leg 1, lateral (G); *f*, leg 1 and intercoxal plate, anterior (C); *g*, leg 3, anterior (C); *h*, leg 5, lateral (C).

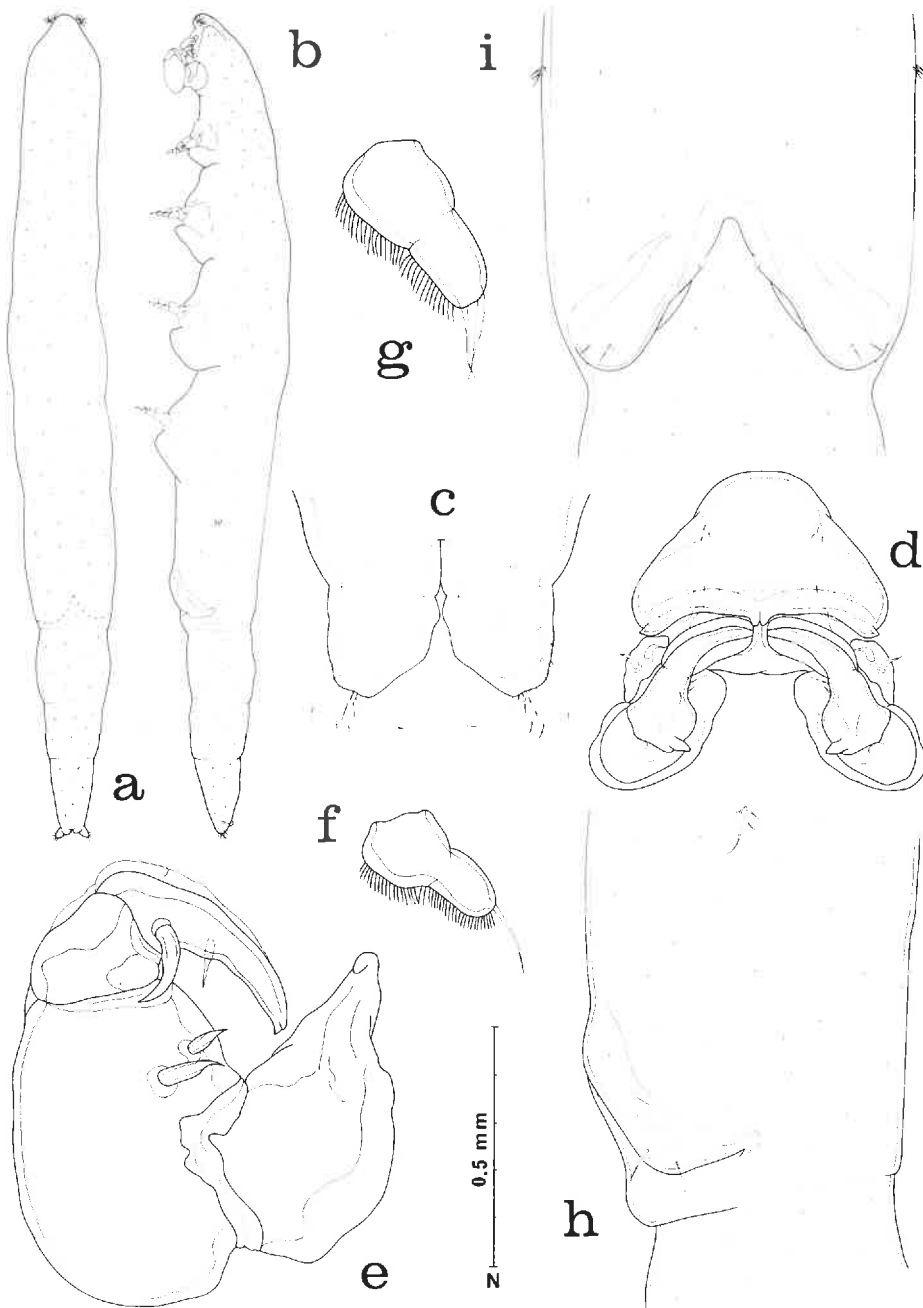


FIG. 24. *Xarifiaresex* sp. nov., male. *a*, dorsal (N); *b*, lateral (N); *c*, caudal rami, ventral (C); *d*, labrum, with mandibles, first maxillae, and second maxillae *in situ*, posteroventral (C); *e*, maxilliped, inner (C); *f*, endopod of leg 1, anterior (C); *g*, endopod of leg 2, anterior (C); *h*, leg 5 and leg 6, lateral (G); *i*, leg 5 and leg 6, ventral (G).

1975. HOLOTYPE ♀, ALLOTYPE, and 3 PARATYPES (2 ♀♀, 1 ♂) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Other specimen.* 1 ♀ from *Goniopora* sp., in 1 m, in crater near Ambatoloaka, Nosy Bé, north-western Madagascar, 11 April 1964.

*Female.* Body (fig. 22 *a, b*) elongate, about 5.8 times longer than wide. Body slightly arched ventrally in lateral view of preserved specimens, cephalosome a little flattened and conical. Length 1.41 mm (1.33–1.49 mm) and width 0.22 mm (0.22–0.23 mm), based on 5 specimens. External segmentation very weak or absent. Region dorsal to fifth legs with 3 nearly equal long posteriorly directed processes (fig. 22 *c*). Genital and postgenital segments together about 28% of body length. Genital areas situated dorsally. Anal operculum prominent. Caudal ramus (fig. 22 *d, e, f*) short,  $35 \times 26 \mu\text{m}$ , ratio 1.35 : 1, bearing 1 lateral seta (not present in some specimens), 1 subterminal seta, and 4 terminal setae, all naked; ornamented with few small spinules. Body surface with many small spinules. Egg sac not seen.

Rostrum (fig. 22 *g*) bluntly rounded. First antenna (fig. 22 *g*) very short, only  $19 \mu\text{m}$  long, and 2-segmented (segmentation difficult to see clearly). Lengths of segments approximately  $5 \mu\text{m}$  and  $14 \mu\text{m}$ , respectively. Armature: 3 and 24 + 2 aesthetes. Setae naked. Second antenna (fig. 22 *h*) 4-segmented, moderately stout,  $46 \mu\text{m}$  long without setae. Formula: 1, 1, 2, and 2 long setae plus 2 small setules (1 arising on small knob). Longer seta  $14 \mu\text{m}$ , shorter seta  $6 \mu\text{m}$ .

Labrum (fig. 22 *i*) insected medially and having slight lateral lobes. Mandible (fig. 23 *a*) slender, smooth, with recurved tip. Paragnath a small lobe. First maxilla (fig. 23 *b*) with 2 broad-based setae. Second maxilla (fig. 23 *c*) 2-segmented, first segment unarmed, second segment with 2 inner unequal setae and having lamellate distal part. Maxilliped (fig. 23 *d*) 3-segmented. First segment with postero-outer lobe. Second segment with inner lobe bearing 2 setae. Small third segment with 2 setae and balloonlike expansion. Slender nature of cephalosome and arrangement of appendages shown in fig. 23 *e*.

Legs 1–4 (fig. 23 *f, g*) with 3-segmented exopods and 2-segmented endopods (segments of endopods not completely separated, however). Spine and setal formula as follows:

P <sub>1+2</sub>	Coxa	0–0	Basis	1–0	Exp	I–0; I–0; I,3
					Enp	0–0; 3
P <sub>3+4</sub>	Coxa	0–0	Basis	1–0	Exp	I–0; I–0; I,2
					Enp	0–0; 0

Inner margin of basis in all 4 legs with few hairs. Endopods with first segment having outer and inner hairs, second segment with outer hairs only.

Leg 5 (fig. 23 *h*)  $70 \mu\text{m}$  long, its terminal setae  $14 \mu\text{m}$  and  $19 \mu\text{m}$ . Adjacent dorsal seta small, approximately  $4 \mu\text{m}$ .

Colour in life in transmitted light opaque grey, eye red.

*Male.* Body (fig. 24 *a, b*) more slender than in female, about 8.4 times longer than wide. Length 1.57 mm (1.49–1.66 mm) and width 0.20 mm (0.20–0.21 mm), based on 3 specimens. Caudal ramus (fig. 24 *c*)  $25 \times 28 \mu\text{m}$ , very slightly wider than long.

Rostrum as in female. First antenna resembling that of female, but 1 aesthete added on second segment (at point indicated by dot in fig. 22 *g*). Second antenna as in female.

Labrum (fig. 24*d*) with small spinelike process on outer corners. Mandible, paragnath, and first maxilla like those of female. Second maxilla with spinelike process on proximal inner part of second segment (fig. 24*d*). Maxilliped (fig. 24*e*) 4-segmented. First segment unarmed. Second segment with 2 inner setae. Third segment unarmed. Claw (fourth segment) 54  $\mu\text{m}$  long, with 2 unequal proximal setae, and having minutely bifid tip.

Legs 1–4 resembling those of female except for armature of endopods of legs 1 and 2. Endopod of leg 1 (fig. 24*f*) with 1 terminal seta and endopod of leg 2 (fig. 24*g*) with terminal 2 setae.

Leg 5 (fig. 24*i*) lacking free segment and represented only by 3 small setae.

Leg 6 (fig. 24*h, i*) a posteroventral flap on genital segment bearing 2 small setae and having minute spiniform process.

Spermatophore not seen.

Colour as in female.

*Etymology.* The specific name *resex*, Latin meaning a stub left after pruning, alludes to the very short first antenna.

*Remarks.* *Xarifia ressex* may be distinguished from other species in the genus by its very short first antennae and by the flattened conical shape of the cephalosome. The endopods of legs 1–4 have the formula 3, 3, 0, 0 in the female, but 1, 2, 0, 0 in the male. No other species of *Xarifia* shows sexual dimorphism in this formula.

#### *Xarifia comptula* sp. nov.

(Figs. 25*a–f*, 26*a–i*, 27*a–h*, 28*a–c*)

*Type material.* 8 ♀♀, 6 ♂♂ from *Hydnophora exesa* (Pallas), in 5 m, Poelau Marsegoe, western Ceram, Moluccas, 02°59'30"S, 128°03'30"E, 15 May 1975 HOLOTYPE ♀, ALLOTYPE, and 5 PARATYPES (4 ♀♀, 1 ♂) deposited in the NMNH; the remaining paratypes in the collection of the first author.

*Other specimens.* 2 ♀♀ from *Hydnophora tenella* Quelch, in 3 m, opposite Ambariotrimaramara, between, Pte. Mahatsinjo and the crater, Nosy Bé, north-western Madagascar, 18 October 1963.

*Female.* Body (fig. 25*a, b*) moderately stout, about 4.6 times longer than wide. Length 2.01 mm (1.86–2.16 mm) and width 0.36 mm (0.32–0.39 mm), based on 10 specimens. External segmentation visible. Region dorsal to area bearing fifth legs with 3 long posteriorly directed processes (fig. 25*c*), lateral processes recurved and slightly longer than median process. Genital and postgenital segments together about 16.5% of body length. Genital areas located dorsolaterally. Caudal ramus (fig. 25*d*) elongate, 130 × 49  $\mu\text{m}$ , ratio 2.7 : 1, bearing 5 terminal setae, 1 outer lateral seta, and numerous long setules. All setae smooth. Surface of body with long slender setules. Entire egg sac not seen, but broken egg sac (fig. 25*c*) containing 10 eggs with diameter of eggs 148  $\mu\text{m}$  (113–173  $\mu\text{m}$ ).

Rostrum (fig. 25*f*) rounded and bearing long setules. First antenna (fig. 26*a*) 140  $\mu\text{m}$  long, 6-segmented. Lengths of segments (measured along posterior side): 20 (44  $\mu\text{m}$  along anterior side), 34, 14, 16, 17, and 18  $\mu\text{m}$ , respectively. Armature: 3, 11, 7, 5, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked. Second antenna (fig. 26*b*) 4-segmented, 168  $\mu\text{m}$  long not including claw. Formula: 1, 1, 2, and I + 1 + 4 setules. Fourth segment (fig. 26*c*) with claw 32  $\mu\text{m}$  and long seta 32  $\mu\text{m}$ .

Labrum (fig. 26*d*) with median sclerotized indentation and small lateral lobes; 2 pairs of setules on anterior surface. Mandible (fig. 26*e*) with slender blade having

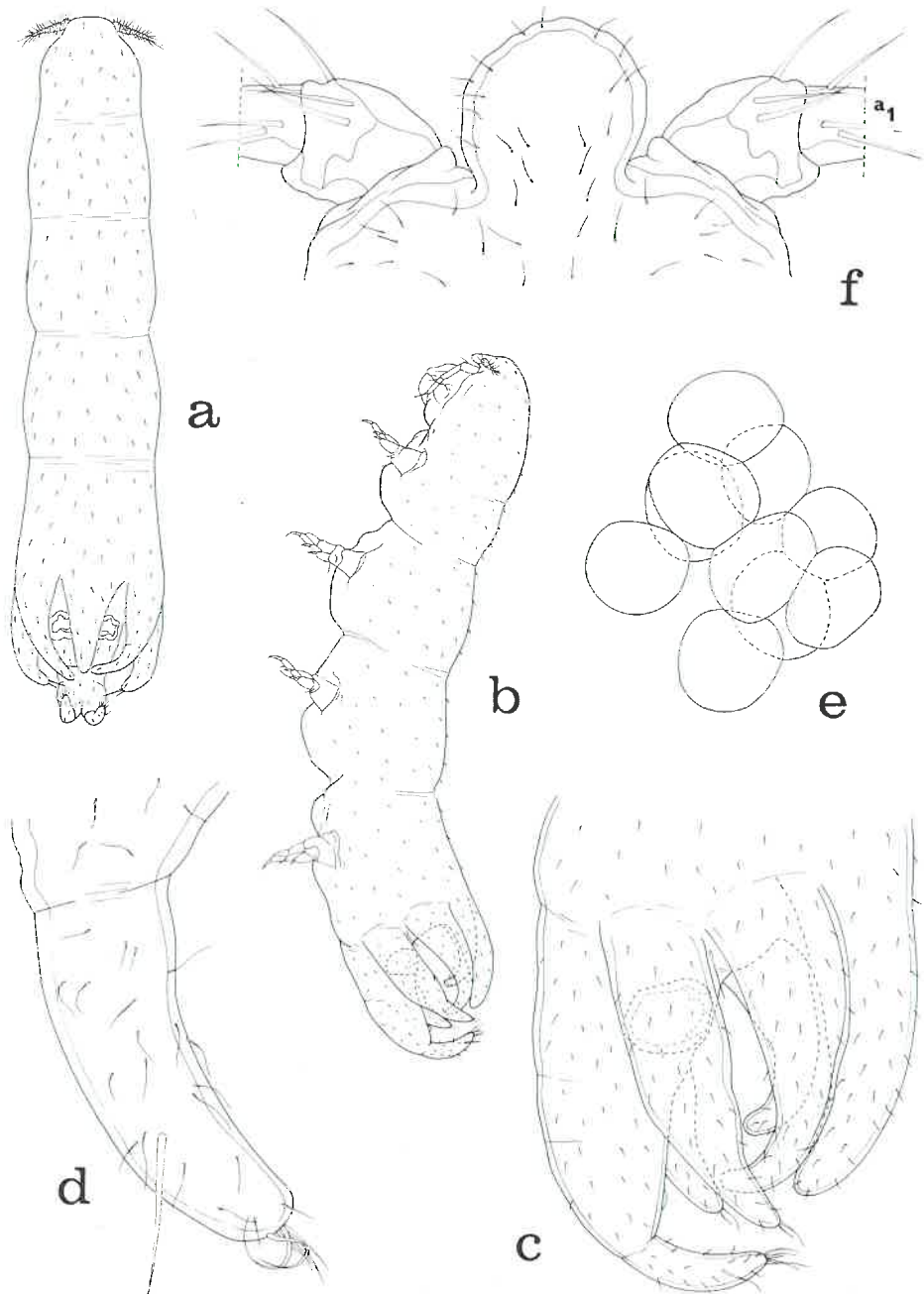


FIG. 25. *Xarifia comptula* sp. nov., female. *a*, dorsal (K); *b*, lateral (K); *c*, urosome, lateral (M); *d*, caudal ramus, lateral (J); *e*, egg sac (broken), lateral (H); *f*, rostrum, dorsal (F).

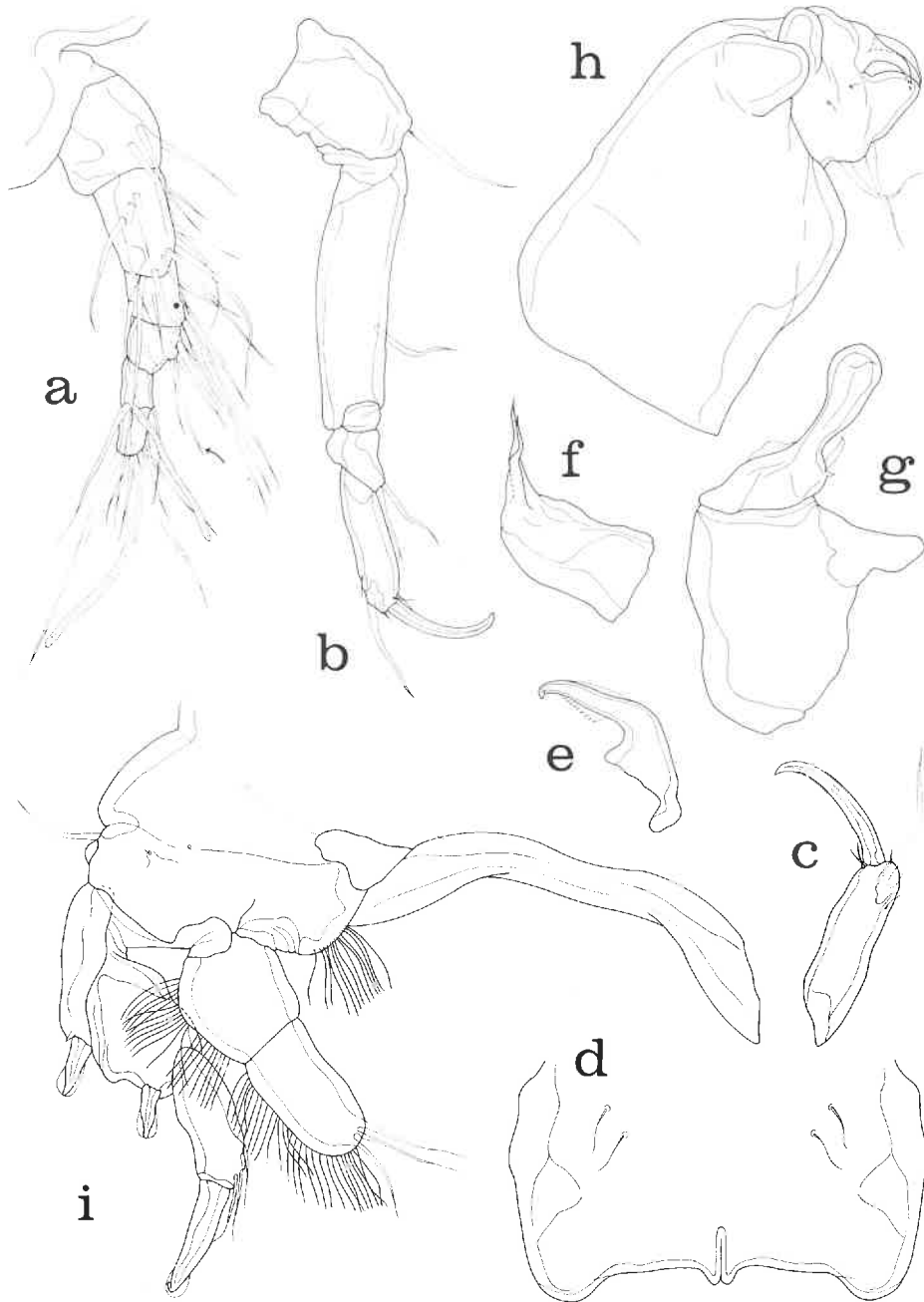


FIG. 26. *Xarifia comptula* sp. nov., female. *a*, first antenna, with dot indicating position of aesthete in male and arrow showing seta that becomes an aesthete in male, anterodorsal (J); *b*, second antenna, dorsal (F); *c*, fourth segment of second antenna, dorsal (C); *d*, labrum, ventral (F); *e*, mandible, ventral (C); *f*, first maxilla, ventro-inner (C); *g*, second maxilla, antero-inner (C); *h*, maxilliped, antero-inner (C); *i*, leg 1 and intercoxal plate, anterior (J).

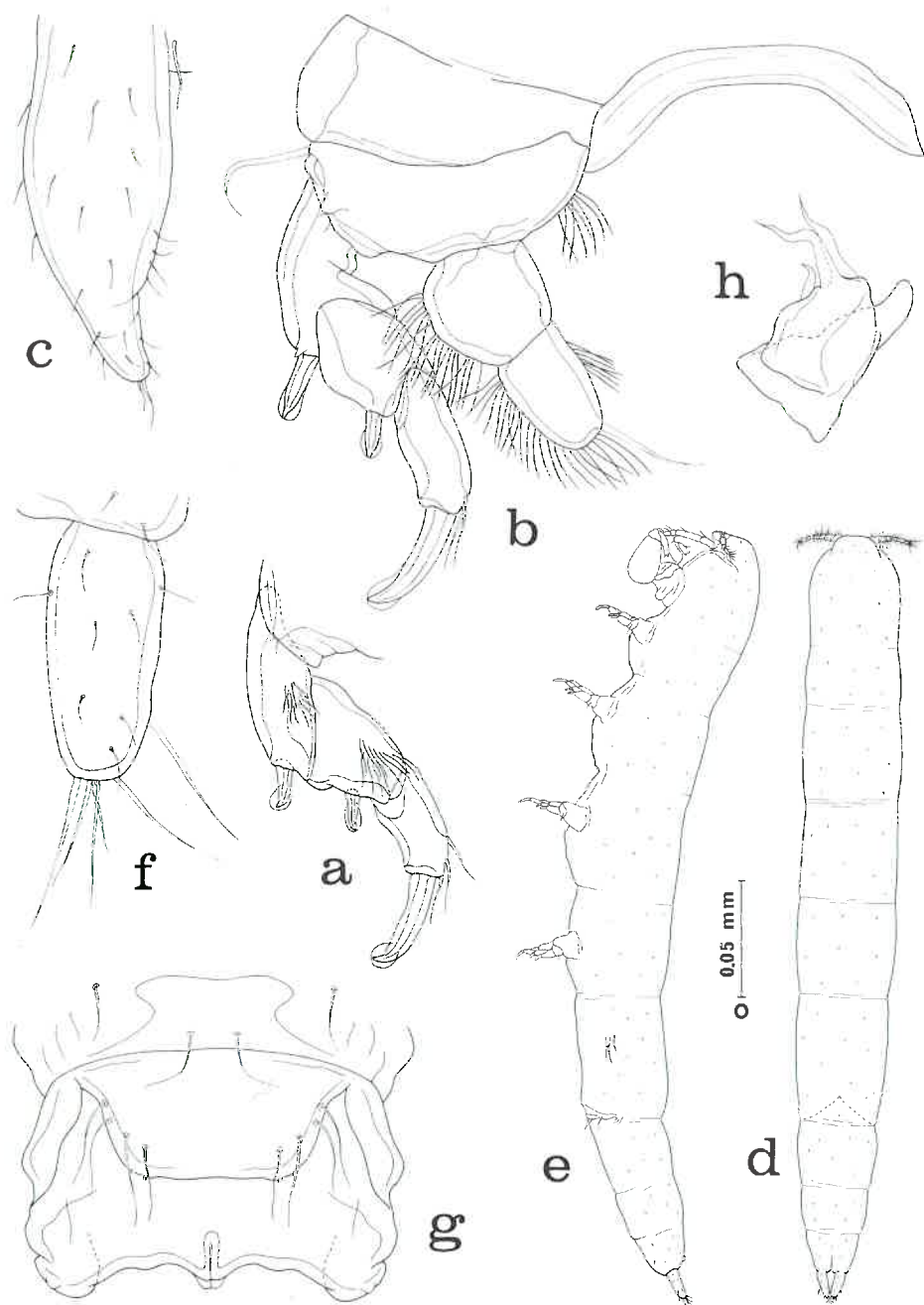


FIG. 27. *Xarifia comptula* sp. nov., *a-c*, female. *a*, exopod of leg 2, posterior (J); *b*, leg 3 and intercoxal plate, anterior (J); *c*, leg 5, lateral (I). *d-h*, male. *d*, dorsal (O); *e*, lateral (O); *f*, caudal ramus, dorsal (J); *g*, labrum, ventral (F); *h*, first maxilla, ventro-inner (F).

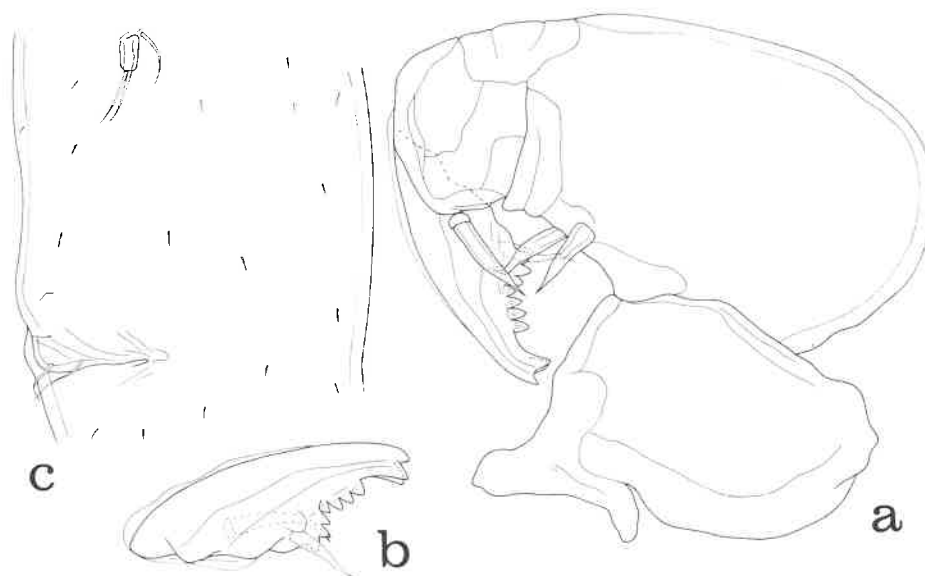


FIG. 28. *Xarifia comptula* sp. nov., male. *a*, maxilliped, inner (J); *b*, claw of maxilliped, outer (J); *c*, leg 5 and leg 6, lateral (I).

recurved tip and bearing serrate lamella on concave side. Paragnath a small lobe. First maxilla (fig. 26*f*) with 2 setae. Second maxilla (fig. 26*g*) 2-segmented, first segment unarmed, second segment elongate digitiform with 2 very unequal small proximal setae. Maxilliped (fig. 26*h*) 3-segmented. First segment with 1 lobe. Second segment with 2 lobes, 2 setules, and 2 long setae. Third segment with 2 setae opposing lobe of second segment.

Legs 1–4 (figs. 26*i*, 27*a, b*) with 3-segmented exopods and 2-segmented endopods. Spine and setal formula as follows:

$P_{1+2}$	Coxa	0–0	Basis	1–0	Exp	I–0; I–0; I,3
					Enp	0–0; 3
$P_{3+4}$	Coxa	0–0	Basis	1–0	Exp	I–0; I–0; I,2
					Enp	0–0; 1

Inner margin of basis, posterior surfaces of first 2 segments of exopods (fig. 27*a*) and outer margin of both segments of endopods with long setules.

Leg 5 (fig. 27*c*) with free segment 322  $\mu$ m long, slightly swollen in midregion and tapered distally, bearing 2 terminal setae 34  $\mu$ m and 20  $\mu$ m. Dorsal seta approximately 30  $\mu$ m. Surface of leg 5 with many long setules.

Colour in life in transmitted light brownish opaque, eye red, intestine red, eggs greenish black.

*Male*. Body (fig. 27*d, e*) more slender than in female, about 7.6 times longer than wide, longer than female. Length 2.41 mm (2.22–2.62 mm) and width 0.31 mm (0.29–0.35 mm), based on 8 specimens. Caudal ramus (fig. 27*f*) 92  $\times$  41  $\mu$ m, ratio 2.27 : 1.

Rostrum as in female. First antenna resembling that of female, but 1 aesthete added on third segment (at location shown by dot in fig. 26*a*) and seta on fourth



segment (indicated by arrow) becoming an aesthete. Formula thus: 3, 11, 7+1 aesthete, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Second antenna as in female.

Labrum (fig. 27*g*) sexually dimorphic in bearing small knob on both lateral lobes and having broad U-shaped laterally sclerotized region bearing 4 long setules and 3 minute spines on both sides. Mandible and paragnath as in female. First maxilla (fig. 27*h*) with 3 setae and prominent digitiform process. Second maxilla like that of female. Maxilliped (fig. 28*a*) 4-segmented. First segment unarmed. Second segment with 2 inner setae. Small third segment unarmed. Claw (fourth segment) short, 97  $\mu\text{m}$  with 2 proximal setae (fig. 28*b*). Concave surface of claw with several teeth and small round protuberance on outer surface. Tip of claw trifold.

Legs 1-4 as in female.

Leg 5 (fig. 28*c*) with small free segment  $23 \times 14 \mu\text{m}$ , having 2 terminal setae and 1 adjacent dorsal seta.

Leg 6 (fig. 28*c*) usual posteroventral flap on genital segment bearing 2 small setae. Colour as in female.

*Etymology.* The specific name *comptula*, a combination of Latin *comptus*, adorned or ornamented, and the diminutive *-ulus*, alludes to the many long setules on the body surface and to the ornamentation of the labrum in the male.

*Remarks.* Five species of *Xarifia* have, as in *Xarifia comptula*, the combination of the following three characters: (1) three long processes dorsal to the region of the fifth legs in the female, (2) 2-segmented endopods in legs 1-4, and (3) armature 3, 3, 1, 1 on the terminal segments of these endopods. Each of these species is distinct from *X. comptula*, however. In *Xarifia decorata* Humes and Ho 1968, the second segment of the exopod in legs 2-4 bears a small outer hyaline seta instead of a spine and leg 5 in the male is reduced to a slight ridge bearing two setae and having an adjacent seta. In *Xarifia villosa* Humes and Dojiri, 1982, the body surface has many tufts of branched setules, the mandible has a smooth blade, and the concave surface of the claw of the maxilliped of the male has a row of obtuse spines rather than teeth. In *Xarifia echinoporae* Humes and Dojiri, 1982, the claw of the maxilliped in the male lacks spines or teeth and leg 5 of the male is represented only by three small setae. In *Xarifia fastigiata* Humes and Dojiri, 1982, the first antenna is 4-segmented, the single seta on the endopod of legs 3 and 4 is unusually stout, and leg 5 in the male is represented only by three small setae. In *Xarifia radians* Humes and Dojiri, 1982, the outer spine on the first segment of the exopod in legs 1-4 is much shorter than the nearly equal spines on the second and third segments of these exopods and leg 5 in the male is represented only by three small setae. The average length of the body of the female in the new species (2.01 mm) is greater than in *X. decorata* (1.49 mm), *X. villosa* (1.09 mm), or *X. fastigiata* (1.49 mm).

#### *Xarifia curtata* sp. nov.

(Figs. 29*a-g*, 30*a-i*, 31*a-g*)

*Type material.* 4 ♀♀, 3 ♂♂ from *Hydnophora exesa* (Pallas), in 5 m, Poelau Marsegoe, western Ceram, Moluccas, 02°59'30"S, 128°03'30"E, 15 May 1975. HOLOTYPE ♀, ALLOTYPE, and 2 PARATYPES (1 ♀, 1 ♂) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Female.* Body (fig. 29*a, b*) stout, about 5.2 times longer than wide. Length 3.12 mm (2.99-3.19 mm) and width 0.58 mm (0.55-0.60 mm), based on 3 specimens.

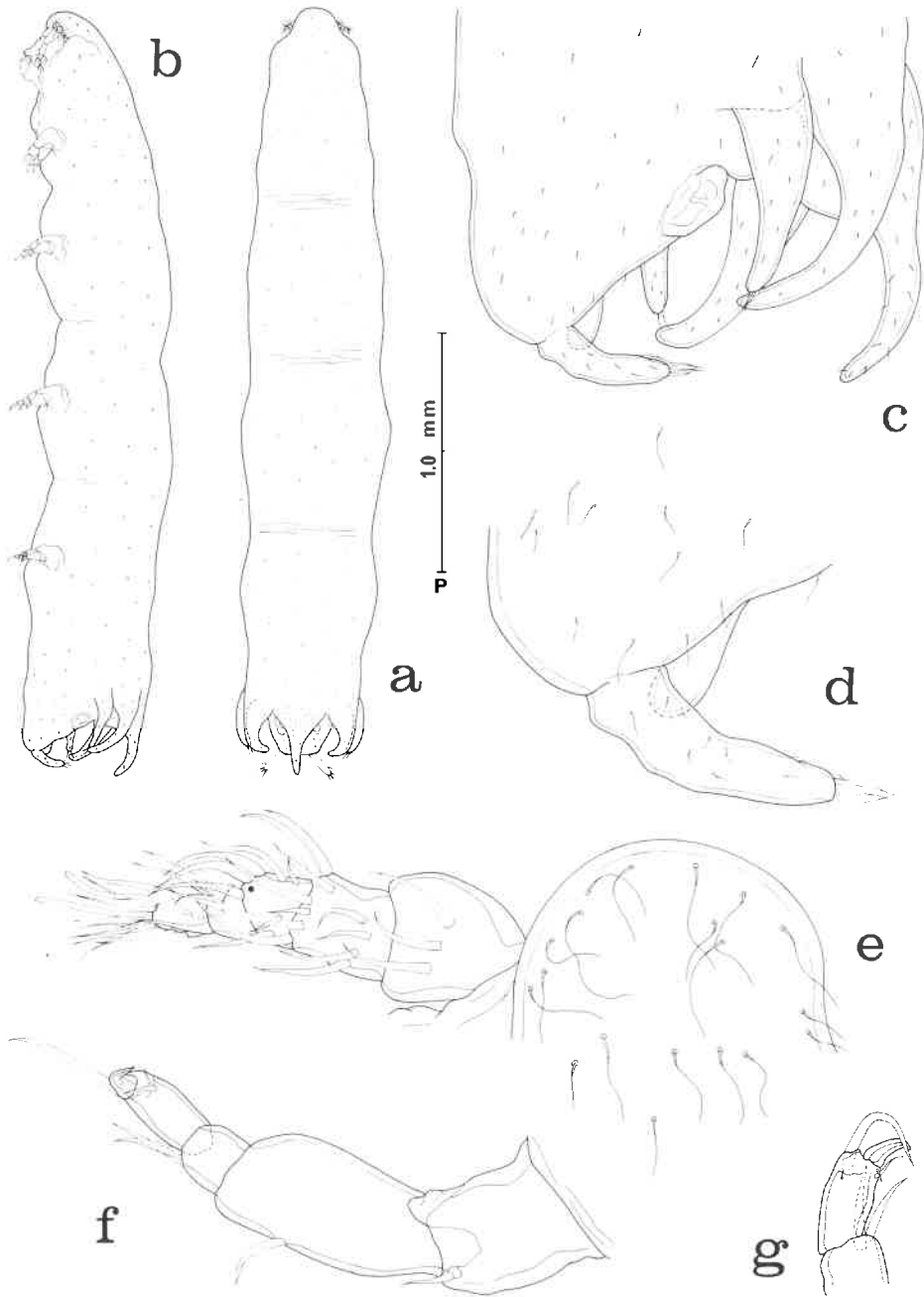


FIG. 29. *Xarifia curtata* sp. nov., female. *a*, dorsal (P); *b*, lateral (P); *c*, urosome, lateral (M); *d*, caudal ramus, lateral (G); *e*, rostrum and first antenna, with dot indicating position of aesthete added in male, anterodorsal (F); *f*, second antenna, dorsal (F); *g*, fourth segment of second antenna, dorsal (F).

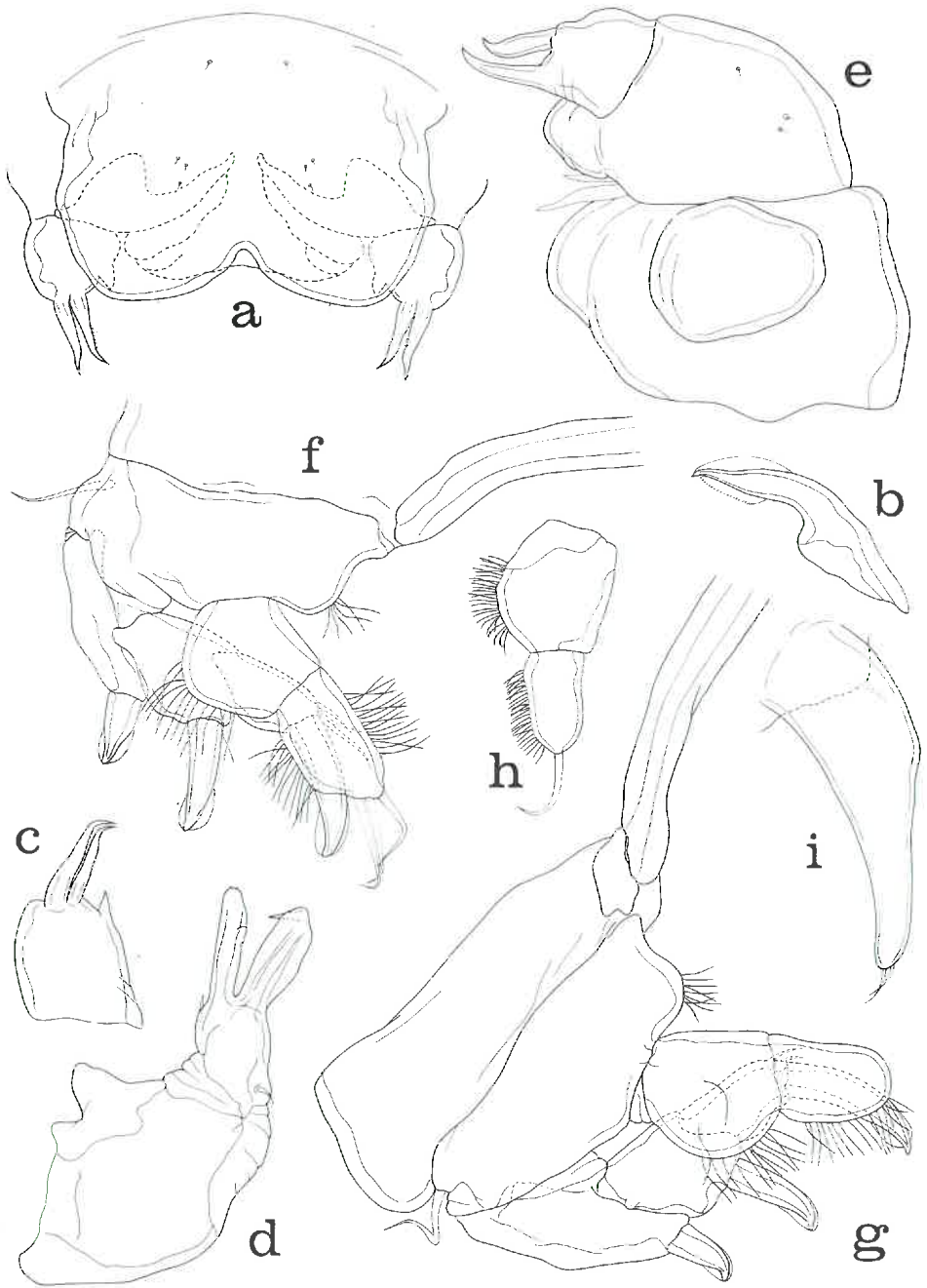


FIG. 30. *Xarifa curtata* sp. nov., female. *a*, labrum, with mandibles, paragnaths, and first maxillae *in situ* (shown partly with broken lines), ventral (F); *b*, mandible, ventral (C); *c*, first maxilla, anteroventral (C); *d*, second maxilla, postero-outer (C); *e*, maxilliped, postero-outer (C); *f*, leg 1 and part of intercoxal plate, anterior (J); *g*, leg 3 and part of intercoxal plate, anterior (J); *h*, endopod of leg 4, anterior (J); *i*, leg 5, lateral (B).

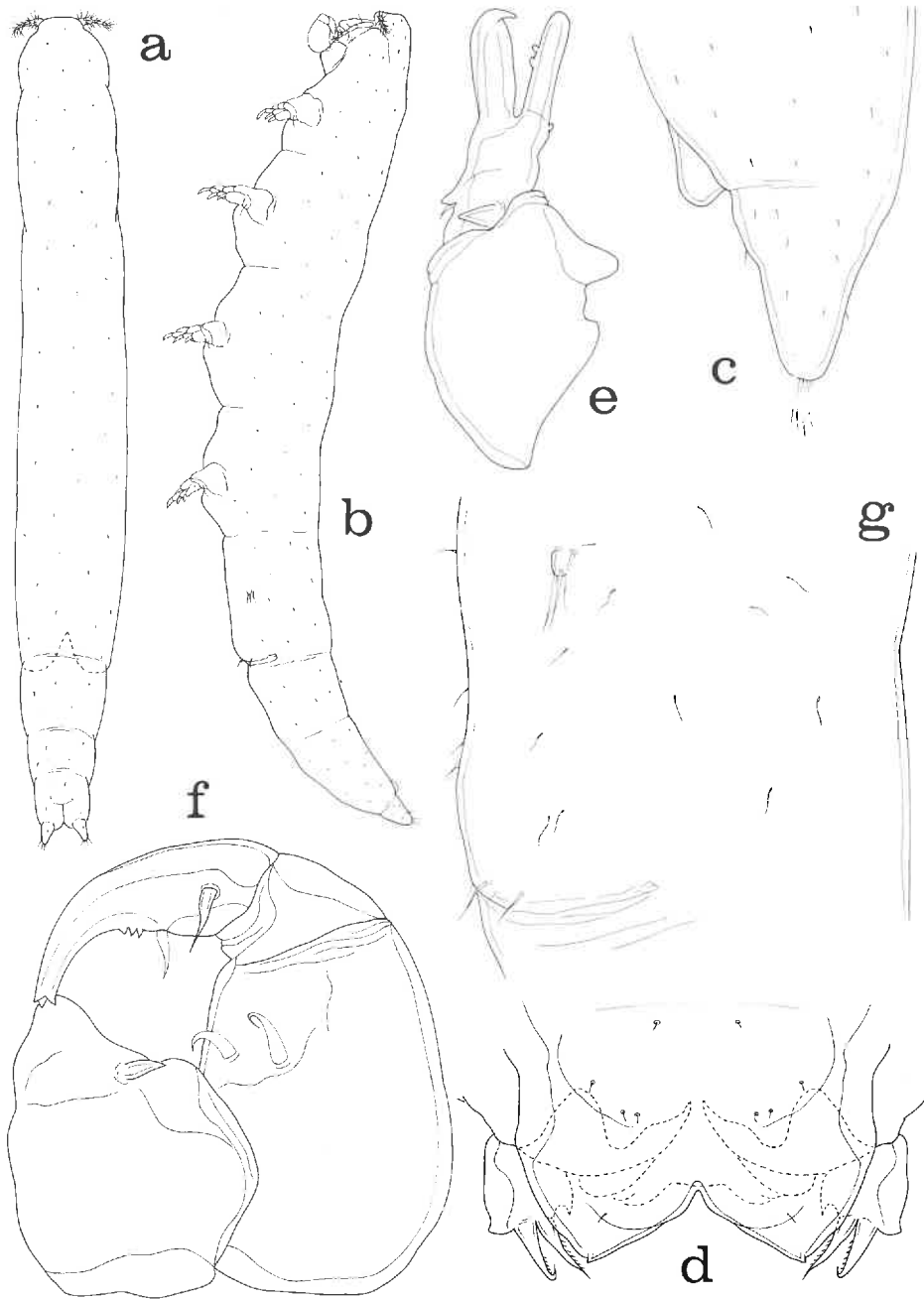


FIG. 31. *Xarifja curtata* sp. nov., male. *a*, dorsal (O); *b*, lateral (O); *c*, caudal ramus and anal operculum, lateral (G); *d*, labrum, with mandibles, paragnaths, and first maxillae *in situ* (shown partly with broken lines), ventral (F); *e*, second maxilla, antero-inner (C); *f*, maxilliped, inner (J); *g*, leg 5 and leg 6, lateral (B).

External segmentation scarcely visible. Region dorsal to area bearing fifth legs with 3 long posteriorly directed processes of nearly equal length (fig. 29 *c*). Genital and postgenital segments together very short, only about 6% of body length. Anal operculum very prominent. Genital areas situated dorsally. Caudal ramus (fig. 29 *d*) elongate,  $119 \times 43 \mu\text{m}$ , ratio 2.77:1, bearing subterminal seta and 3 terminal setae, all smooth; surface of ramus with long setules. Body surface having numerous long slender setules. Egg sac not seen.

Rostrum (fig. 29 *e*) rounded. First antenna (fig. 29 *e*)  $109 \mu\text{m}$  long, 5-segmented. Lengths of segments (measured along posterior side): 26, 30, 11, 13, and  $19 \mu\text{m}$  respectively. Armature: 3, 11, 7, 5, and  $9+2$  aesthetes (probably from fusion of 2 segments having  $2+1$  aesthete and  $7+1$  aesthete). All setae naked. Second antenna (fig. 29 *f*) 4-segmented,  $152 \mu\text{m}$  long including claw. Formula: 1, 1, 2, and  $I+1+3$  setules. Fourth segment (fig. 29 *g*) with short recurved claw  $12 \mu\text{m}$  and adjacent long seta  $41 \mu\text{m}$ .

Labrum (fig. 30 *a*) with 2 broadly rounded posteroventral lobes. Mandible (fig. 30 *b*) with blade having smooth lamella on convex side and finely serrate lamella on concave side. Paragnath (fig. 30 *a*) an elongate lobe. First maxilla (fig. 30 *c*) with 2 setae and acute spiniform process. Second maxilla (fig. 30 *d*) 2-segmented. First segment unarmed. Second segment with outer side having small proximal seta and inner side bearing small seta and long digitiform process (probably derived from seta) with 2 minute terminal spinules and subterminal knob; segment extended as digitiform process with recurved tip. These 2 digitiform processes producing bifurcate aspect. Maxilliped (fig. 30 *e*) 3-segmented. First segment with 2 lobes. Second segment with inner lobe and 2 setae. Third segment bearing 2 terminal setae.

Legs 1-4 (figs. 30 *f, g, h*) with 3-segmented exopods and 2-segmented endopods. Spine and setal formula follows:

$P_{1+2}$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,3
					Enp	0-0; 3
$P_3$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 0
$P_4$	Coxa	0-0	Basis	1-0	Exp	I-0; I-0; I,2
					Enp	0-0; 1

Endopods of legs 1 and 2 with long setules on outer margins of first and second segments and on inner margin of second segment. Endopods of legs 3 and 4 with setules only on outer margins.

Leg 5 (fig. 30 *i*) elongate,  $259 \mu\text{m}$  long, with 2 small terminal setae  $20 \mu\text{m}$  and dorsal seta  $14 \mu\text{m}$ .

Colour in life in transmitted light opaque brown, eye red.

*Male*. Body (fig. 31 *a, b*) more slender than in female, about 7.54 times longer than wide. Length  $3.28 \text{ mm}$  ( $2.86-3.55 \text{ mm}$ ) and width  $0.40 \text{ mm}$  ( $0.39-0.40 \text{ mm}$ ), based on 3 specimens. Caudal ramus (fig. 31 *c*)  $108 \times 92 \mu\text{m}$ , broader than in female, ratio 1.18:1.

Rostrum as in female. First antenna similar to that of female, but aesthete added on third segment (at location indicated by dot in fig. 29 *e*). Second antenna as in female.

Labrum (fig. 31 *d*) with both lobes pointed rather than rounded as in female, terminating in small spinous projection. Mandible, paragnath, and first maxilla like

those of female. Second maxilla (fig. 31*e*) with the second segment having proximal surficial spiniform process, another smaller such process near seta on outer side of segment, seta on inner side apparently reduced to small knob, and adjacent digitiform process (seta) with 2 lateral knobs. Maxilliped (fig. 31*f*) 4-segmented. First segment with inner spiniform process. Second segment with 2 inner setae. Small third segment unarmed. Claw (fourth segment) 97  $\mu\text{m}$  long, with 2 proximal setae, few small teeth on concave margin, and trifid tip.

Legs 1-4 as in female.

Leg 5 (fig. 31*g*) with small free segment about 13  $\mu\text{m}$  long bearing 2 terminal setae, and having adjacent dorsal seta.

Leg 6 (fig. 31*g*) usual posteroventral flap on genital segment bearing 2 setae.

Colour as in female.

*Etymology.* The specific name *curtata*, Latin meaning shortened or abbreviated, refers to the very short urosome in the female.

*Remarks.* By its size alone, *Xarifia curtata* may be separated from all its congeners. *Xarifia mediolobata* Humes and Dojiri, 1982, with the female 2.64 mm (2.49-2.89 mm) in length, approaches most nearly the length of the new species. Features of *X. curtata* by which it may be readily distinguished from other species in the genus include: (1) the very short urosome in the female, (2) the prominent anal operculum, and (3) the bifurcate aspect of the second segment of the second maxilla.

The formula 3, 3, 0, 1 for the terminal armature of the endopods of legs 1-4 is found in only one other species, *Xarifia ablusa* Humes and Dojiri, 1982. This species, however, is much smaller (length of female 1 mm) and the first segment of the exopod in legs 1-4 has a seta rather than a spine as in *X. curtata*.

### *Xarifia* sp.

A single male *Xarifia* was recovered from *Fungia* (*Ctenactis*) *echinata* (Pallas), in 5 m, Poelau Gomumu, south of Obi, Moluccas, 01°50'00"S, 127°30'45"E, 30 May 1975. The specimen is 2.49 mm long and 0.33 mm in greatest width. Both first and second antennae are 4-segmented. Legs 1-4 have distinctly 2-segmented endopods. The exopods of legs 1-4 bear a spine on all three segments, the spine on the second segment being much larger in leg 1 than in legs 2-4. Leg 5 has a small free segment. The caudal ramus is small, conical, and indistinctly set off from the anal segment.

Apparently this male, the first record of *Xarifia* from *Fungia*, represents a new species, but is left undescribed for lack of sufficient material for study.

### ZAZARANUS gen. nov.

*Diagnosis.* Xarifiidae. *Female.* Body with external segmentation strong in urosome, weaker in prosome. Region dorsal to fifth pair of legs without processes. Caudal ramus with 5 setae.

First antenna 7-segmented. Second antenna 4-segmented with 1 terminal claw. Mandible very small, slender. First maxilla with 2 setae. Second maxilla 2-segmented. Maxilliped 3-segmented.

Legs 1 and 2 with 2-segmented exopods and endopods (segments of endopods incompletely separated). Legs 3 and 4 with 2-segmented exopods but endopods lacking. Second segment of endopods of legs 1 and 2 with 1 terminal seta. Exopods in all legs with strong spines. Leg 5 without free segment and represented only by 3 setae.

*Male.* Resembling female with following exceptions. Labrum sexually dimorphic. Maxilliped 4-segmented, with terminal claw. Leg 6 with 1 seta on posteroventral flap.

Living in *Fungia*.

Gender masculine.

*Etymology.* The generic name *Zazaranus* is a Latinized form of the Malgache words 'zaza', child, and 'rano', the sea.

*Remarks.* *Zazaranus* is easily distinguished from *Xarifia* Humes 1960, and *Lipochrus* Humes and Dojiri, 1982, both of which have 3-segmented exopods in legs 1-4. In the third known genus of the Xarifidae, *Orstomella* Humes and Ho 1968, legs 1 and 2 have 2-segmented endopods and legs 3 and 4 lack endopods, as in *Zazaranus*. In spite of these similarities, however, the following characters of *Zazaranus* serve to separate *Zazaranus* from *Orstomella*: (1) first antenna with attenuate setae (not short and blunt) and lacking process on first segment, (2) mandibles present, (3) legs 1-4 with second segment of exopods armed as: IV, 1; III, 1; II; and II, (4) labrum of male laterally with row of spinules (not crenulate depression), and (5) leg 6 in male with 1 seta.

### *Zazaranus fungicolus* sp. nov.

(Figs. 32 *a-g*, 33 *a-i*, 34 *a-i*)

*Type material.* 3 ♀♀, 1 preadult ♀, 15 ♂♂, and 1 immature specimen from 1 *Fungia* sp., in 15 m, Banc du Touareg, south of Nosy Bé and west of Ankify, north-western Madagascar, 1 September 1967. HOLOTYPE ♀, ALLOTYPE and 13 PARATYPES (11 ♂♂, 1 preadult ♀, 1 immature specimen) deposited in the NMNH; the remaining paratypes (dissected) in the collection of the first author.

*Female.* Body (fig. 32 *a, b*) moderately stout, about 4 times longer than wide. Length 1.17 mm (1.12-1.22 mm) and width 0.33 mm (0.32-0.33 mm), based on 3 specimens. External segmentation defined much more strongly in urosome than in prosome. Area dorsal to fifth legs rounded, without processes (fig. 32 *c*). Genital and postgenital segments together about 13.5% of body length. Genital areas situated dorsolaterally. Caudal ramus (fig. 32 *d*) small, 24 × 11 μm, ratio 2.2:1, with 4 terminal setae, 1 outer subterminal seta, and 1 inner setule. Egg sac not seen. Body surface with numerous setules.

Rostrum (fig. 32 *e*) broadly rounded. First antenna (fig. 32 *f*) 156 μm long and 7-segmented. Lengths of segments (measured along anterior side): 36 (18 μm along opposite margin), 20, 17, 25, 28, 20, and 11 μm, respectively. Second and third segments weakly separated. Armature: 3, 3, 3, 5, 4, 2 + 1 aesthete, and 7 + 1 aesthete. All setae smooth. Second antenna (fig. 32 *g*) 4-segmented, 180 μm long without claw. Armature: 1, 1, 2, and I + 3. Terminal claw 30 μm. Adjacent seta largest of three and 7 μm long. Setae naked.

Labrum (fig. 33 *a*) with posteroventral margin having small median lobe and pair of low outer lobes, both with 2 small setae. Mandible (fig. 33 *b*) minute, slender, about 20 μm, and smooth. Paragnath not seen. First maxilla (fig. 33 *c*) with 2 aristate setae. Second maxilla (fig. 33 *d*) 2-segmented. First segment unarmed, second segment with 2 setae and 2 spiniform processes. Maxilliped (fig. 33 *e*) 3-segmented. First segment unarmed, second segment with 1 spiniform process and 1 small knob, third segment bearing 1 seta and terminating in spiniform process.

Legs 1 and 2 (fig. 33 *f, g*) with 2-segmented exopods and indistinctly 2-segmented

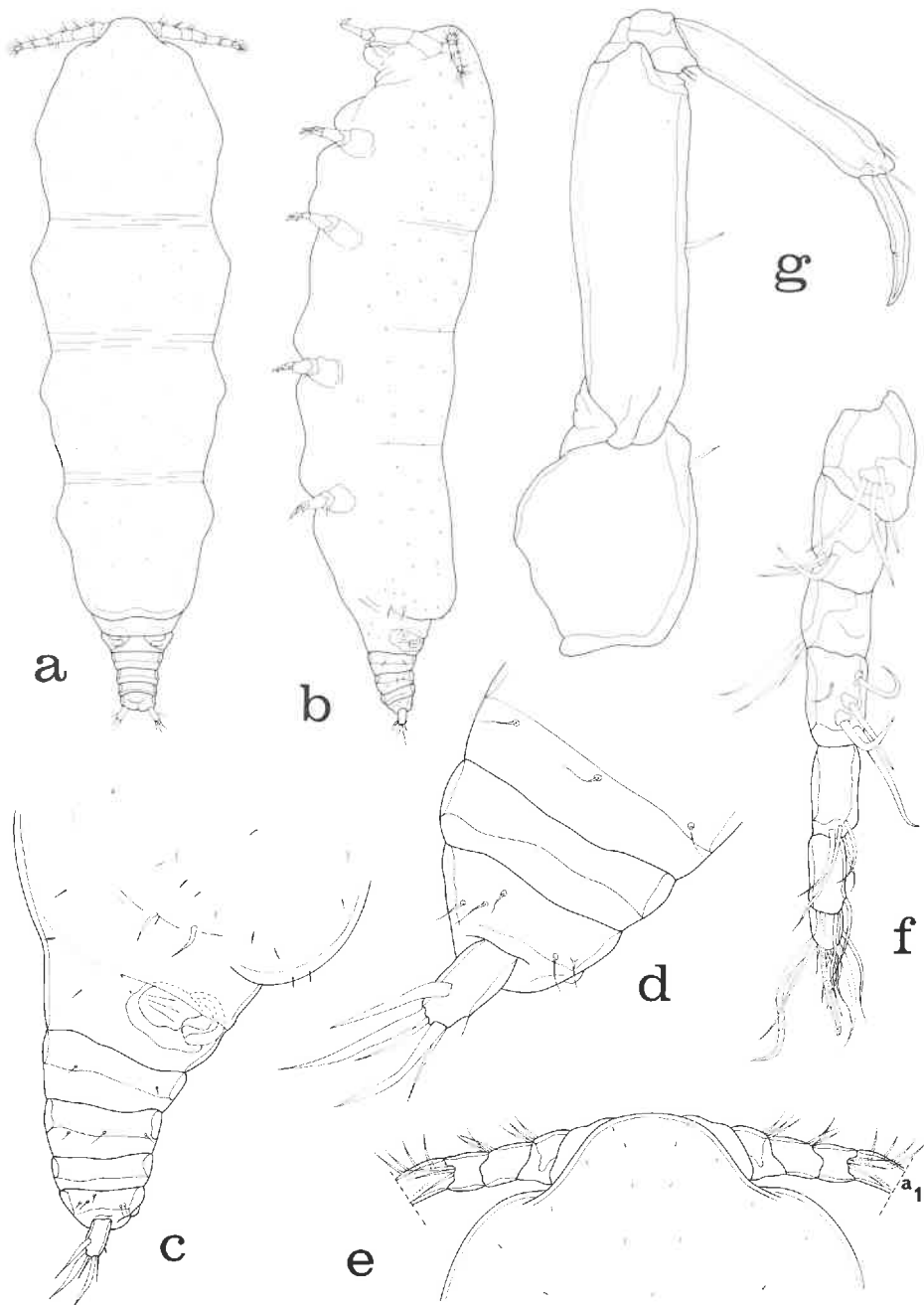


FIG. 32. *Zazaranus fungicolus* gen. nov., sp. nov., female. *a*, female (H); *b*, lateral (H); *c*, urosome, lateral (G); *d*, posterior part of urosome and caudal ramus, lateral (C); *e*, rostrum, dorsal (G); *f*, first antenna, anterodorsal (F); *g*, second antenna, dorsal (C).



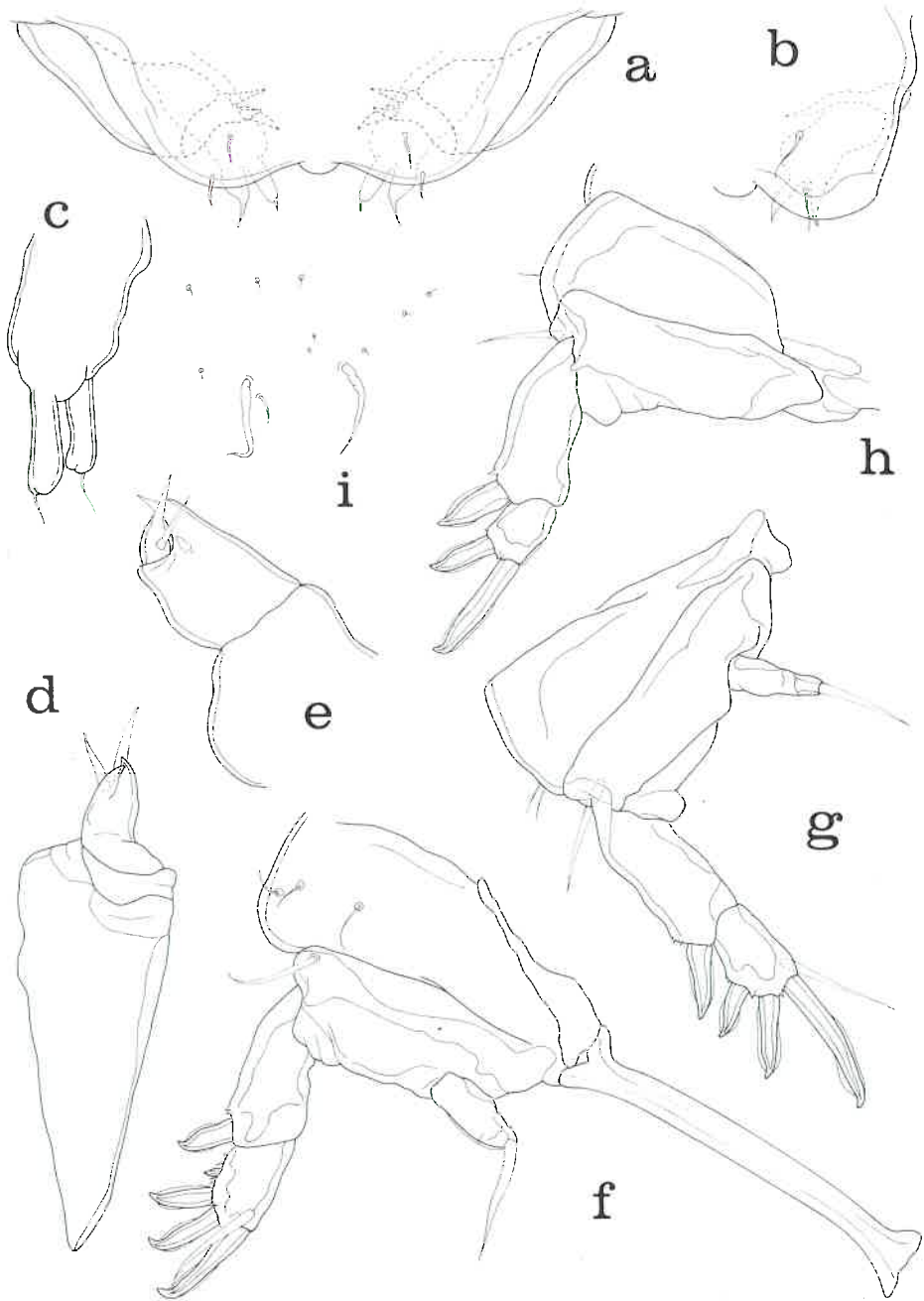


FIG. 33. *Zazaranus fungicolus* gen. nov., sp. nov., female. *a*, labrum, with mandibles and first maxillae *in situ* (shown partly with broken lines), ventral (E); *b*, half of labrum, with mandible and first maxilla indicated by broken lines, ventral (E); *c*, first maxilla, ventral (D); *d*, second maxilla, dorsal (D); *e*, maxilliped, antero-inner (E); *f*, leg 1 and intercoxal plate, posterior (C); *g*, leg 2, anterior (C); *h*, leg 3, anterior (C); *i*, leg 5, lateral (C).

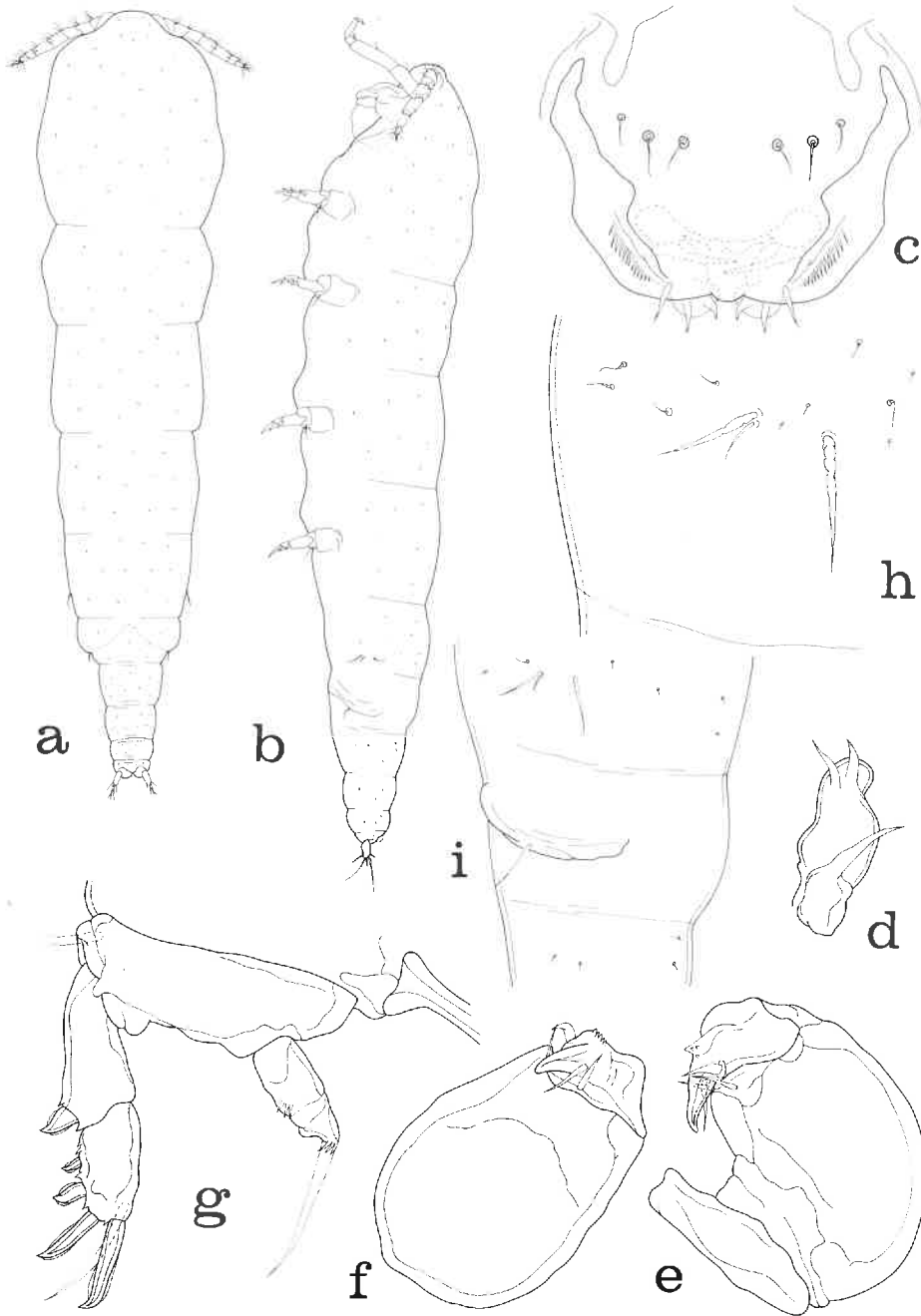


FIG. 34. *Zazaranus fungicolus* gen. nov., sp. nov., male. *a*, dorsal (L); *b*, lateral (L); *c*, labrum, with mandibles and first maxillae *in situ* (shown partly with broken lines), ventral (C); *d*, mandible and first maxilla, ventral (E); *e*, maxilliped, inner (C); *f*, maxilliped, outer (C); *g*, leg 1, anterior (C); *h*, leg 5, lateral (C); *i*, leg 5 and leg 6, lateral (G).

endopods. Legs 3 and 4 (fig. 33 *h*) with 2-segmented exopods but endopods entirely lacking. Spine and setal formula as follows:

$P_1$	Coxa	0-0	Basis	1-0	Exp	1-0;	III,I,1
					Enp	0-0;	1
$P_2$	Coxa	0-0	Basis	1-0	Exp	1-0;	II,I,1
					Enp	0-0;	1
$P_{3+4}$	Coxa	0-0	Basis	1-0	Exp	1-0;	I,I
					Enp	—	

Coxa in all 4 legs with few outer setules. Exopods with few minute spinules near insertions of outer spines. Second segment of endopod of legs 1 and 2 with long smooth terminal seta.

Leg 5 (fig. 33 *i*) lacking free segment and consisting of 2 very unequal setae plus more removed dorsal seta.

Colour in living specimens in transmitted light bright red.

*Male*. Body (fig. 34 *a, b*) a little more slender than in female, about 4.2 times longer than wide. Length 1.13 mm (1.06–1.20 mm) and width 0.26 mm (0.24–0.28 mm), based on 10 specimens. Caudal ramus as in female.

Rostrum, first antenna, and second antenna similar to those of female.

Labrum (fig. 34 *c*) resembling that of female but bearing near posteroventral edge pair of diagonal rows of spines and proximally 2 groups of 3 setules. Mandible (fig. 34 *d*) a slender blade as in female. First maxilla (fig. 34 *d*) with 2 nonaristate setae. Second maxilla as in female. Maxilliped (fig. 34 *e, f*) globular, probably 4-segmented. First segment short and unarmed. Second segment with 2 inner setae. Third segment small and obscure. Claw (fourth segment) short, 32  $\mu$ m long, bearing 2 setae and spinous process.

Legs 1–4 segmented and armed as in female. Endopods of legs 1 (fig. 34 *g*) and 2 with first segment having spines on distal outer corner and second segment with spinules near insertion of seta.

Leg 5 (fig. 34 *h*) similar to that of female.

Leg 6 (fig. 34 *i*) a posteroventral flap on genital segment bearing single seta.

Spermatophore not seen.

Colour as in female.

*Etymology*. The specific name *fungicolus* is a combination of the generic name of the host coral and the Latin *-colus*, meaning living in.

*Remarks*. *Zazaranus fungicolus* apparently lives internally within the host coral. The specimen of *Fungia* from which these copepods were taken was soaked in a solution of approximately 5% ethyl alcohol in sea water for 48 hours. During this time the coral was thoroughly washed 4 times. The first washing yielded 1 *Z. fungicolus*, the second washing 4, the third washing 10, and the fourth washing 8 specimens. The copepods when alive are contractile, show wormlike movements, and are unable to swim.

#### Key to the genera of the *XARIFIIDAE*

- |  |                  |
|--|------------------|
| 1. Leg 1 with 3-segmented exopod . . . . .             | 2                |
| Leg 1 with 2-segmented exopod . . . . .                | 3                |
| 2. Legs 1–4 with endopods 1- or 2-segmented . . . . .  | <i>Xarifia</i>   |
| Legs 1–4 with endopods rudimentary or absent . . . . . | <i>Lipochrus</i> |

3. Mandible absent; first antenna with numerous short obtuse setae and first segment with anterior process; second segment of exopod in legs 1-4 with only 1 spine

*Orstomella*

- Mandible present; first antenna with attenuate setae and first segment lacking process; second segment of exopod in legs 1-4 with 4 spines

*Zazaranus*

### Summary

Nine new species of *Xarifia* are described from various Indo-Pacific corals from Madagascar (*Goniopora*, *Gyrosmlia*, *Hydnophora*, *Montipora*, *Physogyra*) and the Moluccas (*Euphyllia*, *Goniopora*, *Hydnophora*). A single male of an undetermined species of *Xarifia* is reported from *Fungia* in the Moluccas. A new xarifid genus is described from *Fungia* in Madagascar. The family Xarifidae now contains four genera (*Xarifia*, *Orstomella*, *Lipochrus*, and *Zazaranus*) with more than 50 described species. A key to the four genera is provided.

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