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**EIGHT NEW SPECIES OF *XARIFIA* (COPEPODA,  
CYCLOPOIDA), PARASITES OF CORALS  
IN MADAGASCAR.**

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No. 2—*Eight new species of Xarifia (Copepoda, Cyclopoida), parasites of corals in Madagascar.*

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### INTRODUCTION

The copepods to be described here were collected in the vicinity of the island of Nossi Bé, Madagascar (Malagasy Republic), during August through mid-November, 1960, while the author was the leader of a collecting expedition to Madagascar sponsored by the Academy of Natural Sciences of Philadelphia. I wish to thank Dr. R. Tucker Abbott for arranging my return to Madagascar and to acknowledge with appreciation the financial help received from the Academy. I wish also to express my thanks to Dr. Renaud Paulian, then Directeur-adjoint of the Institut de Recherche Scientifique de Madagascar, for placing at my disposal certain facilities of the Station Océanographique at Nossi Bé.

I am indebted to Dr. Donald F. Squires of the American Museum of Natural History for the identification of the coral hosts.

The laboratory study of the copepods has been supported by a grant from the National Science Foundation of the United States.

### SYSTEMATIC DESCRIPTION

The genus *Xarifia* (family Xarifiidae) was described by Humes (1960) on the basis of two new species from the Maldivian Islands, *X. maldivensis* and *X. fimbriata*, both from madreporarian corals, *Pocillopora* sp. Eight new species of this genus are now described from Madagascar. All specimens are from the shores of Nossi Bé or nearby islands. The collecting localities are indicated on the accompanying map.

## XARIFIA GERLACHI, n. sp.

Pls. I; II; III, figs. 26-33

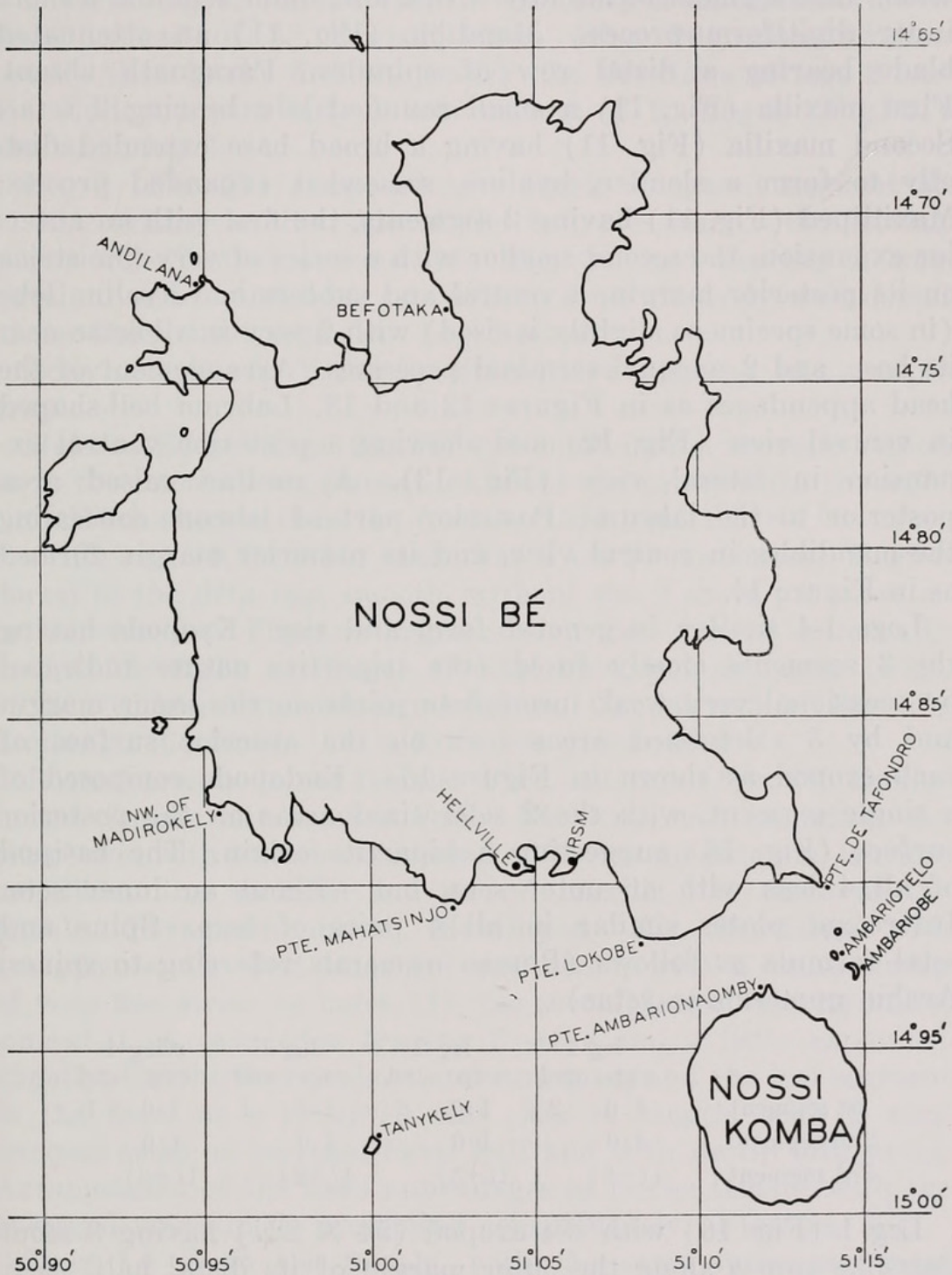
*Type material.* — 619 specimens (427 females and 192 males) from washings of a single colony of *Acropora corymbosa* (Lamarck) about 45 cm in diameter, at a depth of 1 meter at low tide at Pointe Lokobe, Nossi Bé, Madagascar, November 1, 1960. Holotype, allotype, and 119 paratypes (83 females and 36 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the Institut de Recherche Scientifique de Madagascar at Tananarive, the Academy of Natural Sciences at Philadelphia, the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Other specimens.* — 5 males from *Acropora* cf. *A. teres* (Verrill) in 0.5 meter at Ambariotelo, NE of Nossi Komba, September 23, 1960. One female and 2 males from *Acropora cytherea* Dana in 3 meters at Pointe Lokobe, Nossi Bé, October 16, 1960. 21 females, 1 male, and 3 immature specimens from *Acropora cytherea* Dana in 1 meter at Andilana, Nossi Bé, September 4, 1960. 7 females from *Acropora cytherea* Dana in 2 meters at Pointe Lokobe, Nossi Bé, September 2, 1960.

*Female.* — Body moderately stout (Figs. 1, 2), about 5 times longer than wide, 2.044 mm (1.856-2.400 mm)  $\times$  0.407 mm (0.384-0.445 mm), based on 10 individuals. Body of living specimens flexible and contractile, especially so in the abdominal region. Alcoholic specimens in various states of flexure and contraction and therefore measurements approximate. Ventral body wall tumid behind each of legs 1-4. Segmentation obscure and indicated externally only by slight swellings of the body. (In contracted specimens segmentation more evident.) Region dorsal to the fifth legs bearing 3 short, posteriorly-directed processes (Fig. 1), the median one shorter than the two lateral ones which are about 145 $\mu$  in length. A broad protuberance (Fig. 3) below the median process. The two oviducal openings dorsal in position. Genital segment and abdomen (Fig. 1) slenderer than the thorax, with a short transverse flap over the anal region. Rows of minute setules on the anal area as indicated in Figure 4. Caudal ramus (Figs. 4, 5) consisting of a rounded lobe not sharply delimited from the abdomen and bearing a terminal row of 4 (sometimes 3) setules and a subterminal outer setule. A few minute hairs on the dorsal surface of the ramus. Egg

sacs (Figs. 6, 7) flattened and held dorsolaterally to the abdomen. Each egg sac usually containing from 8-13 eggs (one female had sacs with only 2 eggs), arranged in one or (in the central region of the sac) 2 layers. Each egg about  $105\mu$  in diameter.

Rostral area broadly rounded (Fig. 8). First antenna (Fig. 9) short ( $35\mu$  in length without the setae), probably with 5



COLLECTING LOCALITIES IN THE NOSSI BÉ REGION, MADAGASCAR

segments, but the last 4 incompletely separated from each other. With 3 long aesthetes and naked hyaline setae as indicated in the figure. Second antenna (Fig. 10) having 4 segments (the last 2 rather indistinctly separated, the basal one showing an incomplete transverse line). First and second segments with an inner marginal seta. Third segment with 2 inner marginal setae. Last segment terminally with a long outer seta and a short inner digitiform process. Mandible (Fig. 11) an attenuated blade bearing a distal row of spinules. Paragnath absent. First maxilla (Fig. 11) a small rounded lobe bearing 2 setae. Second maxilla (Fig. 11) having a broad base extended distally to form a slender, hyaline, somewhat expanded process. Maxilliped (Fig. 11) having 2 segments, the first with an anterior expansion, the second smaller with a series of very fine striae on its posterior margin, a ventral and subterminal hyaline lobe (in some specimens slightly incised) with 2 very small setae near its base, and 2 unequal terminal processes. Arrangement of the head appendages as in Figures 12 and 13. Labrum bell-shaped in ventral view (Fig. 12) and showing a posterior ventral expansion in lateral view (Fig. 13). A median raised area posterior to the labrum. Posterior part of labrum concealing the mandibles in ventral view, and its posterior margin formed as in Figure 14.

Legs 1-4 similar in general form and size. Exopods having the 3 segments mostly fused (the tripartite nature indicated by occasional very weak incomplete joints on the inner margin and by 3 sclerotized areas seen on the anterior surface of each exopod as shown in Figure 15). Endopods composed of a single segment, with the 2 sclerotized areas on the posterior surface (Fig. 16) suggesting a bipartite origin. The basipod of all 4 legs with an outer seta, but without an inner seta. Intercoxal plates similar in all 4 pairs of legs. Spine and setal formula as follows (Roman numerals referring to spines, Arabic numerals to setae):

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	2	I:0	2	I:0	1	I:0	1
2nd segment	I:0		I:0		I:0		I:0	
3rd segment	I(+3)		I(+3)		I(+2)		I(+2)	

Leg 1 (Fig. 16) with the exopod ( $54 \times 22\mu$ ) having 3 stout claw-like spines along the outer margin of its distal half, each claw being swollen basally and attenuated distally to form a

recurved hook directed posteriorly (Fig. 17); 3 small subterminal inner setae near the distalmost claw. Inner margin of the exopod with an angular indentation near its base. Endopod ( $40 \times 27\mu$ ) broadened basally and rounded distally, with 2 inner subterminal setae and a band of hairs along the outer edge of the ramus. Leg 2 (Fig. 18) similar to leg 1. Leg 3 (Fig. 19) similar to leg 1, but the exopod with only 2 inner subterminal setae instead of 3. Exopod claws (Fig. 20) more swollen basally than in the first leg (much like the claws of legs 2 and 4). Endopod with only 1 seta instead of 2. Leg 4 (Fig. 21) similar to leg 3.

Leg 5 (Fig. 22) composed of a single elongated segment  $55 \times 30\mu$ , arising on the side of the body ventral to the lateral, posteriorly-directed process (see Fig. 3), and bearing 2 long terminal setae. A slender seta arising from the body wall dorsal to the base of the segment. Leg 6 absent.

Body colorless in living specimens, eye red, egg sacs opaque gray.

*Male*.— Body (Figs. 23, 24) not stout in the thoracic region as in the female, but, instead, of about the same width throughout. Much shorter than the female, 0.894 mm (0.818-0.963 mm)  $\times$  0.129 mm (0.112-0.140 mm), based on 10 specimens. Region dorsal to the fifth legs smooth, without the 3 short processes as in the female. Thoracic segmentation not evident externally except for slight swellings. Genital area and abdomen (Figs. 25, 26) without external segmentation. Caudal ramus (Fig. 27) similar to the female, but a little less pronounced.

Rostral area as in the female. First antenna (Fig. 28) similar to the female but smaller (only  $23\mu$  long, not including the setae) and with 4 aesthetes instead of 3. Second antenna, labrum, mandible, first maxilla, and second maxilla like those of the female. Paragnath absent. Maxilliped (Fig. 29) large, with 4 segments, the first unarmed and short, with a small group of very fine striae or hairs (?), the second large with its inner, somewhat concave edge bearing 2 setae and a little expanded distally, the third very short and unarmed, and the last segment in the form of a recurved claw  $33\mu$  in length, with 2 very unequal setae on its basal inner half and with its tip bifurcated. Arrangement of the head appendages as in the female, with the enlarged maxillipeds projecting conspicuously (Figs. 24, 30).

Legs 1-4 as in the female, with the same spine and setal formula, but with the rami smaller (exopod of leg 1,  $31 \times 13\mu$ , endopod  $20 \times 17\mu$ ) and with the claw-like spines on the exopods

not conspicuously swollen basally and more elongate (Fig. 31). Leg 5 (Fig. 32) located on the side of the body, without a distinct segment, composed of 2 setae measuring 6 and 9 $\mu$ , respectively, arising from a small protuberance, and an adjacent more dorsal seta. Leg 6 (Figs. 24, 26, 33) apparently represented by a slightly crescentic, well-sclerotized ridge with 2 small setae.

Color as in the female.

(The species is named in recognition of Dr. Sebastian A. Gerlach who first discovered the existence in madreporarian corals of copepods belonging to the genus *Xarifia*.)

*Remarks.*—The female of *X. gerlachi* may be readily distinguished from the two previously described species, *X. maldivensis* Humes and *X. fimbriata* Humes, by its larger size, by the nature of the processes on the posterior part of the thorax, by the structure of the caudal ramus, and by many details of the armature of the appendages. The male of *X. gerlachi* may be recognized by the structure of the caudal ramus, by the nature of the maxilliped, and by the armature of legs 1-4.

#### XARIFIA LONGIPES, n. sp.

Pls. III, figs. 34-39; IV;V, figs. 55-57.

*Type material.*—141 specimens (72 females and 69 males) from *Pavona angulata* Klunzinger at a depth of 0.5 meter at low tide at Befotaka, on the northern shore of Nossi Bé, September 24, 1960. Holotype, allotype, and 31 paratypes (16 females and 15 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the Institut de Recherche Scientifique de Madagascar at Tananarive, the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Female.*—Body (Figs. 34, 35) about 7 times longer than wide, 1.483 mm (1.434-1.557 mm)  $\times$  0.213 mm (0.202-0.220 mm), based on 10 individuals. Abdominal region contractile. Segmentation obscure and indicated externally only by slight swellings. Region dorsal to the fifth legs bearing 3 very long, slender, posteriorly directed processes (Figs. 36, 37), the middle one only slightly shorter than the other two. Openings of the oviducts dorsal. Abdomen (Fig. 36) slenderer than the thorax. Caudal ramus (Fig. 38) elongated and slender, 110  $\times$  30 $\mu$ , bearing 3 terminal setae and one subterminal outer seta. A few minute hairs on the surface of the ramus. Egg sac unknown.



Rostral area broadly rounded (Figs. 34, 39). First antenna (Fig. 40) about  $66\mu$  in length (not including the setae), the segmentation obscure but apparently only 3-segmented. With 3 broad aesthetes and numerous naked setae as shown in the figures. Second antenna (Fig. 41) with 4 segments. First and second segments with an inner marginal seta, the third with 2 such setae, and the last with a subterminal outer seta and a falciform terminal claw. Mandible (Fig. 42) a slender blade with a slightly recurved tip and apparently not having minute spinules as in the previous species. First and second maxillae similar to those of *X. gerlachi*. Maxilliped (Fig. 43) with 2 segments, the first with an inner anterior expansion, the second with a large inner lobe with 2 small setae near its base, a small round subventral lobe, and 2 digitiform terminal processes. Labrum and the arrangement of the head appendages as in the previous species.

Legs 1-4 similar, with the exopods 3-segmented and the endopods composed of a single segment (though a bipartite origin is suggested by an inner marginal notch). All 4 legs with an outer basipod seta and with a tuft of long hairs on the inner basipod area. Intercoxal plates similar in all 4 pairs of legs. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	2	I:0	1	I:0	1	I:0	1
2nd segment	I:0		I:0		I:0		I:0	
3rd segment	I(+3)		I(+3)		I(+3)		I(+3)	

Leg 1 (Fig. 44) with the first segment of the exopod subtriangular and bearing a short broad spine on its outer distal corner; the second segment subrectangular with a similar outer distal spine, a rounded expansion of the outer margin below the spine, and a few long hairs on the inner margin; the third segment slender with a crescent-shaped ridge on the posterior surface of its basal half, a large terminal spine, and 3 subterminal spinules. The 3 outer spines slightly recurved posteriorly, their tips surrounded by hyaline expansions (Fig. 45). Endopod elongated, with a row of long hairs along its outer margin, a small notch in the middle of its inner margin, and 2 slender terminal setae. Leg 2 (Fig. 46) similar to leg 1, but with only one terminal seta on the endopod. Leg 3 (Fig. 47) and leg 4 (Fig. 48) very similar to leg 2.

Leg 5 (Fig. 49) a single, greatly elongated, slender segment 170 $\mu$  long, arising on the side of the body ventral to the lateral, posteriorly-directed process (see Fig. 37) and bearing 2 unequal terminal setae, 36 and 16 $\mu$ , respectively. A slender seta arising from the body wall dorsal to the base of the leg. Leg 6 absent.

Body colorless in living specimens, eye red.

*Male.* — Body (Figs. 50, 51) with the thoracic and abdominal regions not conspicuously different in width. Only slightly shorter than the female, 1.426 mm (1.344-1.504 mm)  $\times$  0.163 mm (0.157-0.175 mm), based on 10 specimens. Segmentation indicated only by slight swellings. Genital segment (Fig. 52) with 2 ventrolateral ridges (bearing the sixth legs). Caudal ramus (Fig. 53) short, 39  $\times$  21 $\mu$ , somewhat tapered posteriorly, and bearing setae as in the female, though relatively longer.

Rostral area as in the female. First antenna (Fig. 54) similar to that of the female, but apparently with only 3 aesthetes which are relatively longer than in the female. Second antenna, labrum, mandible, first maxilla, and second maxilla like those of the female. Paragnath absent. Maxilliped (Fig. 55) composed of 4 segments, the first broad, unarmed, and rather poorly defined, the second large with 2 inner setae, the third short and unarmed, and the fourth in the form of a recurved claw 50 $\mu$  long, with 2 very unequal setae and an inner projection near its base, and with 3 terminal teeth (in one specimen only 2). Arrangement of the head appendages as in the female, but the enlarged maxillipeds projecting conspicuously (Fig. 51).

Legs 1-4 as in the female, with the same spine and setal formula. Leg 5 (Fig. 56), arising on the side of the body, consisting of a small protuberance bearing 2 setae and an adjacent dorsal seta. Leg 6 (Fig. 57) represented by 2 setae arising from a ventrolateral ridge.

Color as in the female.

(The specific name *longipes*, long-footed, alludes to the very elongated fifth legs.)

*Remarks.* — The female of *X. longipes* may be readily separated from *X. maldivenesis*, *X. fimbriata*, and *X. gerlachi* by the 3 very long, posteriorly-directed processes above the fifth legs and by the elongated fifth legs themselves, by the structure of the caudal ramus, and by the nature of the claws on the exopods of legs 1-4. The male of *X. longipes* may be distinguished by the structure of the caudal ramus, the form of the maxilliped, and the armature of legs 1-4.

## XARIFIA DISPAR, n. sp.

Pls. V, figs. 58-69; VI, figs. 70-80

*Type material.* — 255 specimens (111 females and 144 males) from *Echinopora carduus* Klunzinger at a depth of 2 meters at low tide at Pointe Ambarionaomby, Nossi Komba, near Nossi Bé, August 27, 1960. Holotype, allotype, and 60 paratypes (26 females and 34 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the Institut de Recherche Scientifique de Madagascar at Tananarive, the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Female.* — Body (Figs. 58, 59) about 6 times longer than wide, in alcoholic specimens arched ventrally in the thoracic region and again in the abdominal area, with the caudal rami directed dorsally and somewhat anteriorly. Length (from tip of rostral area to posterior edge of curved abdomen, plus estimated correction of  $50\mu$  for curvature) 1.407 mm (1.266-1.456 mm), width 0.234 mm (0.224-0.246 mm), based on 10 specimens. Segmentation indicated only faintly. Region dorsal to the fifth legs bearing 3 moderately long, slender, posteriorly-directed processes (Figs. 60, 61), the middle one slightly shorter than the other two. Oviducal openings dorsal. Genital segment and abdomen (Fig. 60) slenderer than the thorax. Abdomen probably 3-segmented (though the joint between the genital segment and the first abdominal segment is obscure). Caudal ramus (Fig. 62) about twice as long as wide,  $51 \times 25\mu$ , bearing 3 terminal setae and one seta on the outer margin. With the arching of the abdomen the rami come to be directed dorsally, as in Figure 61.

Egg sac (Fig. 63) with 2 eggs (in each of 6 ovigerous females), each egg about  $100\mu$  in diameter.

Rostral area broadly rounded (Fig. 59). First antenna (Fig. 64) about  $73\mu$  long (not including the setae), and 5-segmented, with a suggestion of a sixth terminal segment. With an aesthete on the penultimate segment and 2 aesthetes on the terminal segment. Second antenna (Fig. 65) 4-segmented, the second segment long and slender, the terminal claw distinctly falciform and the adjacent seta short. Mandible (Fig. 66) a slender unarmed blade with a recurved tip. Paragnath absent. First maxilla (Fig. 67) with the 2 setae unequal in size. Second maxilla (Fig. 68) with a broad terminal lamelliform process with hyaline edges (possibly representing a modified seta). Maxilliped

(Fig. 69) with 2 segments, the first with a small rounded distal lobe, the second with a large inner lobe having 2 hyaline setae near its base, a smaller outer lobe, and 2 slender digitiform processes. Labrum with its contour in lateral view (Fig. 70) slightly different from that of *X. gerlachi*, but otherwise generally similar.

Legs 1-4 similar, with the exopods 3-segmented and the endopods 2-segmented. All 4 legs with a slender outer basipod seta and with a group of short hairs on the inner basipod area. Intercoxal plates similar in all 4 pairs of legs. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	0:0	I:0	0:0	I:0	0:0	I:0	0:0
2nd segment	I:0	2	I:0	2	I:0	1	I:0	1
3rd segment	I(+3)		I(+3)		I(+2)		I(+2)	

Leg 1 (Fig. 71) with first and second exopod segments bearing a short slender spine very slightly hooked at its tip; the last segment bearing terminally a large, nearly straight claw and 3 slender, inner subterminal setae. Endopod with the first segment with its outer margin expanded and bearing a few hairs distally; second segment slenderer with 2 delicate terminal setae and a row of hairs along its outer margin. Leg 2 (Fig. 72) similar to leg 1 in general form and armature. Legs 3 and 4 similar to leg 2, but with only one terminal seta on the endopod and only 2 subterminal, inner, small setae on the exopod.

Leg 5 (Fig. 73) elongated and slender, 156 $\mu$  long, arising laterally ventral to the lateral, posteriorly-directed process (see Fig. 61) and bearing 2 small terminal setae unequal in length. A slender seta arising from the body wall dorsal to the base of the leg. Leg 6 absent.

Body colorless in living specimens, intestine red, eye bright red.

*Male*. — Body (Figs. 74, 75) with the segmentation weakly indicated. Of about the same length as the female but slenderer, 1.423 mm (1.355-1.456 mm)  $\times$  0.205 mm (0.196-0.213 mm), based on 10 specimens. Abdomen (Fig. 76) weakly segmented. Genital segment bearing the two ventrolateral ridges of the sixth legs. Caudal ramus (Fig. 77) very small, 20  $\times$  15 $\mu$ , and directed inwardly, bearing setae as in the female, though relatively longer.

Rostral area as in the female. Antennae, mouth parts (except maxilliped) and labrum similar to those in the female. Paragnath absent. Maxilliped (Fig. 78) generally like that of *X. longipes*,

but with the claw about  $58\mu$  long and having a bifurcated tip.

Legs 1-4 as in the female, with the same spine and setal formula. Leg 5 (Fig. 79) consisting of a minute process  $9 \times 8\mu$  bearing 2 setae and an adjacent dorsal seta. Leg 6 (Fig. 80) represented by 2 small setae arising from a ventrolateral ridge.

Color as in the female.

(The specific name *dispar*, dissimilar, is given in reference to the difference in size of the exopod claws on legs 1-4.)

*Remarks.*—Both sexes may be distinguished from known species by the nature of the three claws on the exopods of legs 1-4 and by the elongated, clearly 2-segmented endopods of these legs.

#### XARIFIA REDUCTA, n. sp.

Pls. VI, figs. 81-84; VII; VIII, figs. 102-104

*Type material.*—654 specimens (370 females and 284 males) from *Seriatopora octoptera* Ehrenberg at a depth of 2 meters at low tide at Pointe Ambarionaomby, Nossi Komba, near Nossi Bé, August 18, 1960. Holotype, allotype, and 136 paratypes (78 females and 58 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the Institut de Recherche Scientifique de Madagascar at Tananarive, the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Other specimens.*—47 specimens (35 females and 12 males) from *Seriatopora caliendrum* Ehrenberg in 1 meter at Ambarioto, NE of Nossi Komba, September 9, 1960.

*Female.*—Body (Figs. 81, 82) about 7 times longer than wide. Length (including the caudal rami) 1.056 mm (0.997-1.120 mm), width 0.147 mm (0.134-0.159 mm), based on 10 specimens. External segmentation scarcely discernible. Region dorsal to the fifth legs lacking processes, but with 2 minute internal sclerotized bars (Fig. 83). Oviducal openings dorsolateral, more widely separated than in the previous species. Abdomen showing very slight evidence of segmentation. Caudal ramus (Fig. 84) about twice as long as wide,  $23 \times 11\mu$ , bearing 3 terminal setae (the innermost shorter than the other two) and an outer marginal seta.

Egg sac (Figs. 83, 85) with 1, 2 or 3 eggs, each egg about  $127 \times 81\mu$ . Most commonly with 1 egg in each sac, but 3 females seen with 2 eggs in each sac, and 2 females with 3.

Rostral area (Fig. 86) broad, with 3 lobes ventrally. First antenna (Fig. 87) about  $44\mu$  long (not including the setae) and apparently 4-segmented (though the second segment may actually represent 2 segments). Two long aesthetes on the terminal segment and one on the penultimate. Second antenna (Fig. 88) 4-segmented, the terminal claw rather weak, and the seta adjacent to the claw greatly elongated. Mandible (Fig. 89) a slender blade. Paragnath absent. First maxilla (Fig. 90) with the 2 setae very unequal in size. Second maxilla (Fig. 91) with the terminal hyaline process rather attenuated. Maxilliped (Fig. 92) with 2 segments, the first unarmed, the second with an inner lobe with 2 setae near its base and with a distal lobe bearing 2 rather hyaline setae. Labrum in lateral view with its contour indented (Fig. 93).

Legs 1-4 similar, with the exopods 3-segmented and the endopods of a single segment. All 4 legs with a slender outer basipod seta and without ornamentation on the inner basipod area. Intercoxal plates V-shaped and similar in all 4 pairs of legs. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	2	I:0	2	I:0	1	I:0	1
2nd segment	0:0		0:0		0:0		0:0	
3rd segment	I(+3)		I(+2)		I(+1)		I(+1)	

Leg 1 (Fig. 94) with the first exopod segment bearing a short claw-like spine, the second bearing only a small knob, and the third bearing a large terminal claw and 3 small subterminal inner setae. Tips of the claws with a hyaline fringe. Endopod composed of a single segment somewhat tapered distally, bearing 2 long terminal setae, a minute hair on its outer middle area, and a few hairs along the outer margin. Leg 2 like leg 1, but usually with only 2 small subterminal inner setae on the last exopod segment. Leg 3 (Fig. 95) similar to the preceding legs but with only one small subterminal inner seta on the last exopod segment and with only one long terminal seta on the endopod. Leg 4 like leg 3.

Leg 5 (Fig. 96) about  $34\mu$  long, tapering toward the tip, bearing 2 unequal terminal setae. A slender seta arising dorsal to the base of the leg. Leg 6 absent.

Body colorless in living specimens, intestine yellow-red, eye red, egg sacs brown to gray.

*Male*. — Body (Figs. 97, 98) with the external segmentation

very obscure. Length of body 0.914 mm (0.843-0.974 mm), width 0.101 mm (0.090-0.112 mm), based on 10 specimens. Genital segment and abdomen (Fig. 99) with very slight swellings probably indicating segmentation. Caudal ramus (Fig. 100) minute,  $12 \times 7.5\mu$ , bearing setae as in the female.

Rostral area as in the female. First antenna similar to that of the female but with 4 long aesthetes, the longest seta on the antepenultimate segment in the female here forming an aesthete. Second antenna, mandible, first maxilla, second maxilla, and labrum as in the female. Paragnath absent. Maxilliped (Fig. 101) elongated and slender, the claw  $39\mu$  long and in addition to the usual 2 setae bearing a row of slender dentiform spinules along its concave surface.

Legs 1-4 as in the female, with the same spine and setal formula. Leg 5 (Fig. 102) consisting of 2 unequal setae arising from a slight ridge and an adjacent dorsal seta. Leg 6 (Fig. 103) composed of 2 setae.

Spermatophore (Fig. 104)  $224 \times 45\mu$ , not including the neck. Color as in the female.

(The specific name *reducta*, reduced, refers to the rudimentary condition of the middle exopod claw on legs 1-4.)

*Remarks.* — The 2-clawed condition of the exopods of legs 1-4, with only a remnant of the middle claw, serves to separate both sexes of this species from other known species. The male may further be distinguished by the slender, elongated maxilliped.

#### XARIFIA SERRATA, n. sp.

Pls. VIII, figs. 105-119; IX; X, figs. 134-136

*Type material.* — 45 specimens (22 females and 23 males) from *Pocillopora damicornis* Dana in 15 cm of water at low tide on sand flat with *Cymodocea ciliata* west of Pointe Mahatsinjo, Nossi Bé, September 22, 1960. Holotype, allotype, and 11 paratypes (5 females and 6 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number in the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Other specimens.* — 9 specimens (7 females and 2 males) from *Seriatopora subseriata* Ehrenberg in 1 meter on sand flat with *Cymodocea ciliata* at Pointe Mahatsinjo, Nossi Bé, September 5, 1960. 5 specimens (3 females and 2 males) from the same mass of *Pocillopora verrucosa* (Ellis and Solander) from which the

type specimens of *X. comata* (to be described below) were obtained, in 2 meters, west of Pointe Mahatsinjo, Nossi Bé, November 2, 1960. 1 male from *Pocillopora* cf. *P. verrucosa* (Ellis and Solander) (along with *X. comata*) in 2 meters, west of Pointe Mahatsinjo, Nossi Bé, October 18, 1960. 32 specimens (16 females and 16 males) from *Pocillopora damicornis* Dana in 30 cm on sand at Ambariobe, NE of Nossi Komba, September 23, 1960.

*Female*. — Body (Figs. 105, 106) about 6 times longer than wide. Length (including the caudal rami) 1.302 mm (1.176-1.400 mm), width 0.205 mm (0.190-0.220 mm), based on 10 specimens. External segmentation not visible except in abdomen. Region dorsal to the fifth legs lacking separate processes (Fig. 107), but may be produced as a transverse ridge (Fig. 110). Oviducal openings dorsolateral and rather widely separated (Fig. 108). Abdomen sometimes showing slight evidence of segmentation (Fig. 109) and much slenderer than the thoracic region. Caudal ramus (Fig. 111) 55 $\mu$  long and somewhat tapered distally, with the usual outer marginal seta, 3 terminal setae (the innermost of these shorter than the other two), and a very small seta at the bases of the terminal setae.

Egg sac (Fig. 112) with as many as 7 eggs, each 117 $\mu$  in diameter, arranged in an arcuate row.

Rostral area broad and rounded. First antenna (Fig. 113) about 50 $\mu$  long (not including the setae) and 3-segmented, though the middle segment shows evidence of a subdivision into 3 segments. Three long aesthetes as in *X. reducta*. Second antenna (Fig. 114) 4-segmented, the terminal claw recurved and the seta adjacent to the claw greatly elongated. Mandible (Fig. 115) with the slender blade bearing minute lateral spinules. Paragnath absent. First maxilla (Fig. 116) with 2 unequal setae. Second maxilla (Fig. 117) bearing a rather hyaline slender setiform process; near the base of this process a minute, pointed projection and a very small knob. Maxilliped (Fig. 118) 2-segmented, the first segment unarmed, the second bearing an inner lobe with 2 small hyaline setae near its base and a distal lobe with terminally a seta and an elongated blunt process and with subterminally a minute, inner, digitiform process. Labrum with its contour in lateral view (Fig. 119) not deeply indented and with its posterolateral angles bearing a small spiniform projection (Fig. 120).

Legs 1-4 similar, with the exopods 3-segmented and the endopods of a single segment. All 4 pairs of legs with an



outer basipod seta and with a tuft of long hairs on the inner basipod area. Intercoxal plates broadly U-shaped and alike in all 4 pairs of legs. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	3	I:0	2	I:0	1	I:0	1
2nd segment	0:0		0:0		0:0		0:0	
3rd segment	I(+3)		I(+2)		I(+2)		I(+2)	

Leg 1 (Fig. 121) with the first exopod segment bearing a small outer claw-like spine, the second without a spine, and the third with a large claw-like spine (Fig. 122) and 3 small inner subterminal setae. Endopod composed of a single segment constricted so as to suggest subdivision into 2 segments. In addition to the hairs on the outer and inner margins, a single hair on the posterior surface of the segment and 3 long setae on the distal end. Leg 2 (Fig. 123) similar to leg 1, but with only 2 small subterminal inner setae on the last exopod segment and with only 2 long terminal setae on the endopod. Leg 3 (Fig. 124) like leg 2 but with only one long terminal seta on the endopod. Leg 4 like leg 3.

Leg 5 (Fig. 125) elongated and slender,  $122\mu$  in length (measured along the shorter edge), tapered distally, and bearing 2 small unequal terminal setae. Seta arising dorsal to the base of the leg very small. Leg 6 absent.

Body colorless in living specimens, intestine often greenish, eye red, egg sacs green.

*Male*. — Body (Figs. 126, 127) about 8 times longer than wide, with external segmentation suggested only in the abdominal region. Length 1.345 mm (1.243-1.546 mm), width 0.169 mm (0.157-0.210 mm), based on 10 specimens. Genital segment and abdomen as in Figure 128. Caudal ramus (Fig. 129) much shorter than in the female, about  $39\mu$  in length, and with the 3 terminal setae nearly equal.

Rostral area as in the female. First antenna similar to that of the female, but with 4 long aesthetes as in *X. reducta*. Second antenna, mandible, first maxilla, and second maxilla as in the female. Paragnath absent. Labrum as in the female but with 6 minute setules on its posterior border (Fig. 130). Maxilliped (Fig. 131) rather robust, the claw moderately short, about  $60\mu$  in length, and bearing in addition to the usual 2 setae a row of irregular blunt serrations along its concave margin (Figs. 132, 133).

Legs 1-4 as in the female, with the same spine and setal formula. Leg 5 (Fig. 134) composed of 2 unequal setae arising from a small ridge and an adjacent slender dorsal seta. Leg 6 (Fig. 135) consisting of 2 subequal setae.

Spermatophore (Fig. 136)  $314 \times 101\mu$ , not including the neck. Body colorless in living specimens, eye red.

(The specific name *serrata*, toothed like a saw, alludes to the serrations on the claw of the male maxilliped.)

*Remarks.* — The absence of the middle exopod claw of legs 1-4 in both sexes distinguishes this species from other described species. The serrations on the claw of the male maxilliped serve to distinguish this from other known males. In several ways (terminal claw and seta of the second antenna, armature of legs 1-4, absence of processes dorsal to the fifth legs, armature of the claw of the male maxilliped) this species seems to be closely related to *X. reducta*.

The five specimens from *Pocillopora verrucosa* (Ellis and Solander), collected November 2, 1960, differ slightly from those in the type material. The body is slightly larger, the length of the female being 1.471 mm, width 0.221 mm; the male, 1.557 mm and 0.185 mm. The row of hairs on the inner edge of the second exopod segment of legs 1 and 2 appears to be absent. Otherwise the specimens are clearly referable to *X. serrata*.

#### XARIFIA TENUIS, n. sp.

Pls. X, figs. 137-151; XI, figs. 152-158

*Type material.* — 15 specimens (10 females and 5 males) from *Acropora cytherea* Dana in 1 meter at low tide west of Pointe de Tafondro, Nossi Bé, October 19, 1960. Holotype, allotype, and 5 paratypes (4 females and 1 male) deposited in the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Female.* — Body (Figs. 137, 138) slender, about 11 times longer than wide. Length (including the caudal rami) 1.382 mm (1.288-1.478 mm), width 0.126 mm (0.123-0.134 mm), based on 5 specimens. External segmentation not apparent. Region dorsal to the fifth legs with 3 slender processes (Fig. 139), the median one about twice as long ( $130\mu$ ) as the other two ( $60\mu$ ). Abdomen (Figs. 139, 140) only slightly narrower than the thorax and with only slight traces of segmentation. Caudal ramus (Fig. 141) greatly elongated and slender,  $115 \times 13\mu$ ,

with 4 short terminal setae, the outermost corresponding to the outer marginal seta in other species. With surficial hairs as in the figure.

Egg sac (Fig. 142), observed in 2 females, with 2 elongated eggs, each  $160 \times 78\mu$ .

Rostral area rounded. First antenna (Fig. 143) about  $42\mu$  in length (not including the setae) and probably 3-segmented, although the joints are difficult to observe. Apparently only 2 long aesthetes instead of 3 as in other species. Second antenna (Fig. 144) with probably 4 segments, though the last two are incompletely separated; the terminal claw weak and the adjacent seta elongated. Mandible, first maxilla, and second maxilla as in Figure 145. Paragnath absent. Maxilliped (Fig. 146) 2-segmented, the first segment with a pronounced inner distal lobe, the second with 2 setiform processes terminally and 2 small setae near its base. Labrum with its contour in lateral view as in Figure 147.

Legs 1-4 similar, with the exopods 3-segmented and the endopods of a single segment. All 4 pairs of legs with an outer basipod seta and lacking ornamentation on the inner basipod area. Intercoxal plates V-shaped. Behind each pair of legs a median rounded projection (Figs. 148, 149), about  $22\mu$  high. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	0:0	0	0:0	0	0:0	0	0:0	0
2nd segment	0:0		0:0		0:0		0:0	
3rd segment		1		1		1		1

Leg 1 (Fig. 150) with the exopod segments unarmed except for a very minute process on the distal outer angle of the first segment and a large terminal claw on the last segment. Endopod oval,  $16 \times 12\mu$ , with only a slight suggestion of subdivision along the inner edge. A row of hairs along the outer margin. Four of these hairs slightly stronger than the others. Legs 2, 3, and 4 similar to leg 1.

Leg 5 (Fig. 151)  $33\mu$  long, tapering distally, with 2 unequal terminal setae. Small seta arising dorsal to the base of the leg. Leg 6 absent.

Body colorless in living specimens, eye red.

*Male*. — Body (Figs. 152, 153) very slender, about 12 times longer than wide, with segmentation not visible except for traces in the abdominal region. Length 1.271 mm (1.220-1.299 mm),

width 0.104 mm (0.100-0.112 mm), based on 4 specimens. Genital segment and abdomen as in Figure 154. Caudal ramus (Fig. 155)  $28 \times 11\mu$ , much shorter than in the female, and with 4 terminal setae.

Rostral area as in the female. First antenna like that of the female, but with 3 long aesthetes, the large seta arising in the female near the middle of the antenna here transformed to an aesthete. Second antenna, mandible, first maxilla, and second maxilla as in the female. Paragnath absent. Maxilliped (Fig. 156) 4-segmented, the claw short,  $22\mu$  long, and bearing in addition to the usual 2 setae a prominent bidentate process near the middle of its concave edge. Tip of the claw tridentate and having a short row of minute subterminal spinules.

Legs 1-4 as in the female, with the same spine and setal formula. Leg 5 (Fig. 157) composed apparently of 2 setae about  $13\mu$  long. Leg 6 (Fig. 158) also consisting of 2 minute setae.

Body colorless in living specimens, eye red.

(The specific name *tenuis*, slender, refers to the very slender body in this species.)

*Remarks.* — The extremely minute spiniform process on the first exopod segment and the absence of armature on the second exopod segment of legs 1-4 in both sexes separate this species from other known forms. The nature of the processes on the region dorsal to the fifth legs in the female and the conformation of the claw of the maxilliped in the male also serve as useful distinguishing features.

#### XARIFIA INFREQUENS, n. sp.

Pls. XI, figs. 159-167; XII, figs. 168-171

*Type material.* — 8 specimens (5 females and 3 males) from *Acropora corymbosa* (Lamarck) in 1 meter at low tide at Pointe Lokobe, Nossi Bé, November 1, 1960 (type specimens of *X. gerlachi* collected from this coral also). Holotype, allotype, and 2 paratype females deposited in the United States National Museum at Washington, and the remaining paratypes in the author's collection.

*Other specimens.* — One female and 1 male from *Acropora cytherea* Dana in 3 meters at Pointe Lokobe, Nossi Bé, October 16, 1960 (3 specimens of *X. gerlachi* also in this coral).

*Female.* — Body (Figs. 159, 160) slender, about 10 times longer than wide. Length (including caudal rami) 1.540 mm,

width 0.140 mm, based on 2 specimens. External segmentation not apparent. Region dorsal to the fifth legs with 3 slender processes (Fig. 161), the median one about twice as long ( $109\mu$ ) as the other two ( $49\mu$ ), but all shorter than in *X. tenuis*. Abdomen (Figs. 161, 162) with almost no evidence of segmentation. Caudal ramus (Fig. 163) elongated and moderately slender,  $88 \times 21\mu$ , with the usual 3 terminal setae and the outer marginal seta inserted at some distance from the tip of the ramus. Small hairs scattered over the surface of the ramus.

Egg sac unknown.

Rostral area rounded. First antenna resembling that of *X. tenuis*, but with 3 aesthetes, one terminal, one subterminal, and the third still more proximal. Second antenna (Fig. 164) with probably 4 segments, but the last 2 indistinctly separated; the terminal claw a little stronger than in *X. tenuis*, the seta adjacent to the claw elongated. Mouthparts resembling those of *X. tenuis*. Paragnath absent. Labrum with its contour in lateral view as in Figure 165.

Legs 1-4 similar, with the exopods 3-segmented (the joint between the 3rd segment and the claw being obscure on the anterior surface of the leg). Endopods of a single segment. All 4 pairs of legs with an outer basipod seta and a small group of minute hairs on the inner basipod area. Intercoxal plates broadly U-shaped. Behind each pair of legs a median rounded projection (Fig. 166) as in *X. tenuis*. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	0	I:0	0	I:0	0	I:0	0
2nd segment	0:0		0:0		0:0		0:0	
3rd segment	I		I		I		I	

Leg 1 (Fig. 166) with a small spine on the first exopod segment, a minute projection on the outer distal angle of the second, and with a stout terminal claw on the third segment. Endopod oval with a very slight suggestion of subdivision on the inner margin. A row of hairs on the outer margin and 4 pairs of hairs on the surface of the ramus as indicated in the figure. Legs 2, 3, and 4 like the first leg, but lacking the minute outer projection on the second exopod segments.

Leg 5 (Fig. 167)  $47\mu$  long, tapering distally, with 2 very unequal distal setae. Small seta arising dorsal to the base of the leg. Leg 6 absent.

Body colorless in living specimens, eye red.

*Male*. — Body (Figs. 168, 169) very slender, about 11 times longer than wide, with external segmentation not visible. Length 1.266 mm, width 0.117 mm, based on 2 specimens. Abdomen similar to that of *X. tenuis*. Caudal ramus (Fig. 170)  $48 \times 19\mu$  with the setae as in the female.

Rostral area as in the female. First antenna like that of *X. tenuis*, but with 4 long aesthetes, the longest seta in the middle region of the female antenna here forming an aesthete. Second antenna, mandible, first maxilla, and second maxilla as in the female. Paragnath absent. Maxilliped (Fig. 171) 4-segmented, the claw  $33\mu$  long and somewhat angular, bearing the usual 2 setae and a row of 4 or 5 minute teeth near the distal end of the concave surface. Tip of claw trifid.

Legs 1-4 as in the female, with the same spine and setal formula. Legs 5 and 6 as in *X. tenuis*.

Color as in the female.

(The specific name *infrequens*, infrequent, rare, alludes to the small numbers of specimens found in the type collection, even though over 600 *X. gerlachi* were found in the same mass of coral.)

*Remarks*. — This species seems to be close to *X. tenuis*, but clearly differs from it in several significant details, among which in the female are the armature of legs 1-4, the relative length of the processes dorsal to the fifth legs, and the size and shape of the caudal rami and the arrangement of their setae, and in the male the armature of legs 1-4, the caudal ramus, and even more significantly the nature of the claw on the maxilliped.

#### XARIFIA COMATA, n. sp.

Pls. XII, figs. 172-179; XIII

*Type material*. — 43 specimens (14 females and 29 males) from *Pocillopora verrucosa* (Ellis and Solander) in 2 meters at low tide west of Pointe Mahatsinjo, Nossi Bé, November 2, 1960. Holotype, allotype, and 13 paratypes (4 females and 9 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the United States National Museum at Washington, and the remaining paratypes in the author's collection. (A few specimens of *X. serrata* occurred in this collection also.)

*Other specimens*. — One female and 1 male from *Pocillopora verrucosa* (Ellis and Solander) in 2 meters at Pointe Mahatsinjo,

Nossi Bé, October 26, 1960. 3 females and 3 males from *Pocillopora* cf. *P. verrucosa* (Ellis and Solander) in 2 meters west of Pointe Mahatsinjo, October 18, 1960 (1 specimen of *X. serrata* occurred in this collection also).

*Female*. — Body (Figs. 172, 173) about 6 times longer than wide. Length (including the caudal rami) 1.158 mm (1.086-1.221 mm), width 0.195 mm (0.190-0.220 mm), based on 10 specimens. External segmentation not visible. Region dorsal to the fifth legs with 3 long, slender, nearly equal processes (Fig. 174) each about 180 $\mu$  in length. Oviducal openings dorsal and closely approximated. Abdomen without external segmentation and much slenderer than the thoracic region (Fig. 175). Caudal ramus (Fig. 176) 53  $\times$  16 $\mu$ , with the marginal seta rather far from the tip and about 30 $\mu$  in length. Distal end of the ramus with the usual 3 setae elongated and with 2 additional short slender setae. A few long hairs on the surface of the ramus.

Egg sac (Fig. 177) with usually 2 eggs, each about 104 $\mu$  in diameter. Two females with only one egg on one side but 2 eggs on the other, one female with 3 eggs on both sides, and one female (not a type specimen) with 4 eggs on both sides (Fig. 178).

Rostral area rounded. First antenna about 45 $\mu$  long, similar to that of *X. serrata*, with 3 similarly placed aesthetes, but with the setae rather long. Second antenna (Fig. 179) 4-segmented, slender, the terminal claw about 13 $\mu$  long and the adjacent seta of about the same length. Mandible and first maxilla similar to those of *X. longipes*. Paragnath absent. Second maxilla (Fig. 180) with the setiform process terminating in a conspicuous hyaline expansion bearing distally a minute spiniform scale. Maxilliped (Fig. 181) 2-segmented, with the usual lobes and 2 pairs of setae, one pair terminal, the other near the inner base of the second segment. Labrum with its contour in lateral view as in Figure 182.

Legs 1-4 similar, with the exopods 3-segmented and the endopods probably 2-segmented, though the separation is not clear. All legs with an outer basipod seta and a row of long hairs on the inner basipod area. Intercoxal plates V-shaped. Region immediately posterior to each pair of legs covered with long hairs. Spine and setal formula as follows:

	leg 1		leg 2		leg 3		leg 4	
	exp	end	exp	end	exp	end	exp	end
1st segment	I:0	0	I:0	0	I:0	0	I:0	0
2nd segment	0:0	2	0:0	2	0:0	2	0:0	1
3rd segment	I(+1)		I(+1)		I(+1)		I(+1)	

Leg 1 (Fig. 183) with the first exopod segment bearing a minute outer spine and an inner row of long hairs, the second unarmed, the third with a large terminal spine and a minute subapical inner spinule. Endopod distinctly constricted into 2 regions, probably representing 2 segments. Outer margin with a row of long hairs. Two long terminal hyaline setae, difficult to distinguish from the adjacent hairs. Inner margin of the basal half of the endopod with a row of long hairs. Legs 2 and 3 similar to leg 1. Leg 4 also like leg 1, but with only one terminal seta on the endopod.

Leg 5 (Fig. 184) elongated and slender,  $135\mu$  in length, bearing 2 terminal nearly equal setae from  $35\text{-}40\mu$  in length. Seta adjacent to the base of the leg about  $40\mu$  long. Leg 6 absent.

Body colorless in living specimens, sometimes with a dark brown intestine, eye red.

*Male*. — Body (Figs. 185, 186) about 8 times longer than wide, without external segmentation. Length 1.128 mm (1.086-1.176 mm), width 0.159 mm (0.146-0.168 mm), based on 10 specimens. Genital segment and abdomen as in Figure 187. Caudal ramus (Fig. 188) much shorter and relatively stouter than in the female, about  $31\mu$  in length, the setae relatively much longer. Rostral area as in the female. First antenna as in the female but with 4 aesthetes, the long seta on the distal part of the middle segment (possibly to be interpreted as the 3rd segment) of the female antenna here forming an aesthete. Second antenna, mandible, first maxilla, second maxilla, and labrum as in the female. Paragnath absent. Maxilliped (Fig. 189) with the second segment outwardly expanded. Claw short, about  $33\mu$  in length, with a small process on the concave edge near the base of the inner seta, and terminating in 2 unequal teeth.

Legs 1-4 as in the female, with the same spine and setal formula, and with similar long hairs behind each pair of legs. Leg 5 (Fig. 190) composed of 2 long setae arising from a common base and an adjacent dorsal seta. Leg 6 (Fig. 191) consisting of 2 subequal setae; with 2 long hairs nearby.

Color as in the female.

(The specific name *comata*, long-haired, refers to the long hairs seen on legs 1-4.)

*Remarks*. — This species may be distinguished from the 3 other species which have 3 long, nearly equal processes on the region above the fifth legs (*X. maldivensis*, *X. dispar*, and *X. longipes*) by the absence here of a spine or seta on the distal outer region



of the second exopod segment of legs 1-4. The arrangement of the long hairs on these legs is also distinctive. The male may be further separated from other known species by the nature of the claw of the maxilliped.

#### Revised Diagnosis of the Genus *Xarifia*

The discovery of the eight new species of *Xarifia* has so broadened our understanding of the limits of specific variation in this genus that a revision of the original generic diagnosis seems desirable.

*Female*. — Body elongated, rather slender, the thorax a little broader than the abdomen. Segmentation rather weakly defined. Region dorsal to the fifth legs usually bearing posteriorly-directed processes. Rostral area broadly rounded. Caudal ramus usually with 3 terminal setae and 1 lateral seta.

First antenna with several segments (3-5, but often difficult to determine) bearing numerous naked setae and a few long aesthetes. Second antenna consisting of 4 segments (the last 2 sometimes incompletely separated) and a terminal claw or process. Labrum bell-shaped in ventral view. Mandible a small lobe bearing a slender blade. Paragnath absent. First maxilla a small lobe bearing 2 setae. Second maxilla somewhat variable, usually a basal lobe bearing a hyaline distal process. Maxilliped 2-segmented, the second segment lying parallel to the long axis of the body and bearing 2 inner basal setae and 2 distal processes.

Legs 1-4 similar in segmentation, the exopod with 3 usually clearly defined segments, the last always with a terminal spine. Endopod either 2-segmented or consisting of a single segment showing evidence of a bipartite origin. Leg 5 with 2 setae arising from a separate segment or from the body directly, and an adjacent dorsal seta. Leg 6 absent.

Two egg sacs attached dorsally, with the small number of eggs either in a cluster or in a row.

*Male*. — Body more slender than in the female and of nearly the same width throughout, lacking the processes on the region dorsal to the fifth legs. Maxilliped large, 4-segmented, terminating in a prominent claw. Head appendages, legs 1-4, rostral area, and the caudal ramus generally as in the female. Leg 5 with usually 3 setae as in the female, but without a distinct segment. Leg 6 consisting of 2 small setae.

Living on or in various madreporarian corals.

*Type species*. — *Xarifia maldivensis* Humes, 1960.

Keys to the described species of the genus *Xarifia*

## Females

1. With 2 or 3 posteriorly-directed processes on the region dorsal to the fifth legs ..... 2  
Without such processes ..... 9
2. With 2 processes, the median one being absent ..... *fimbriata*  
With 3 processes ..... 3
3. Median process a rounded knob, shorter than the 2 lateral processes; caudal ramus a small rounded lobe not clearly delimited from the abdomen ..... *gerlachi*  
Median process elongate; caudal ramus of more usual form ..... 4
4. Median process approximately as long as the 2 lateral processes ..... 5  
Median process distinctly longer than the 2 lateral processes ..... 8
5. Leg 5 very small, only about  $\frac{1}{10}$  the length of the processes ..... *maldivensis*  
Leg 5 at least  $\frac{1}{2}$  as long as the processes ..... 6
6. Second exopod segment of legs 1-4 unarmed ..... *comata*  
Second exopod segment of legs 1-4 with a distal outer spine ..... 7
7. Caudal ramus about  $2\times$  longer than wide; second exopod segment of legs 1-4 with a slender spine ..... *dispar*  
Caudal ramus about  $3\frac{1}{2}\times$  longer than wide; second exopod segment of legs 1-4 with a stout spine ..... *longipes*
8. Caudal ramus about  $9\times$  longer than wide; first exopod segment of legs 1-4 without a distal outer spine but only a minute spiniform projection at that point ..... *tenuis*  
Caudal ramus about  $4\times$  longer than wide; first exopod segment of legs 1-4 with a distinct outer spine ..... *infrequens*
9. Second exopod segment of legs 1-4 with a small distal outer knob but no spine; caudal ramus about  $23\mu$  long ..... *reducta*  
Second exopod segment of legs unarmed; caudal ramus  $55\mu$  long *serrata*

## Males

1. Caudal ramus a small rounded lobe not clearly delimited from the abdomen ..... *gerlachi*  
Caudal ramus of more usual form and more or less delimited from the abdomen ..... 2
2. A distinct spine or seta on both first and second exopod segments of legs 1-4 ..... 3  
Second exopod segment of legs 1-4 without a distinct spine or seta (although a minute knob may be present, as in *reducta*), or both first and second segments lacking a spine or seta ..... 5
3. The two spines or setae on the first and second exopod segments of legs 1-4 subequal; inner margin of claw of maxilliped smooth ..... 4  
A stout spine on the first exopod segment, a slender seta on the second exopod segment of legs 1-4; inner margin of the claw of maxilliped with a row of spinules ..... *maldivensis*

4. Spines on first and second exopod segments of legs 1-4 stout; caudal ramus  $3\frac{1}{2}\times$  longer than wide..... *longipes*  
 Spines on first and second exopod segments of legs 1-4 slender; caudal ramus  $2\times$  longer than wide..... *dispar*
5. A spine on first exopod segments only of legs 1-4, second segment at most with only a knob or minute spiniform protuberance; caudal ramus not more than  $5\times$  longer than wide..... 6  
 A distinct spine lacking on both first and second exopod segments of legs 1-4; caudal ramus  $11\times$  longer than wide..... *tenuis*
6. Second exopod segment of legs 1-4 with a small digitiform knob; inner margin of claw of maxilliped with a row of about 12 long spinules..... *reducta*  
 Second exopod segment of legs 1-4 without a digitiform knob; inner margin of claw of maxilliped with at most only a few minute spinules near the tip, smooth, or serrated..... 7
7. Inner margin of claw of maxilliped with irregular rounded serrations..... *serrata*  
 Inner margin of claw of maxilliped not with such serrations..... 8
8. Claw of maxilliped about  $51\mu$  long..... *fimbriata*  
 Claw of maxilliped about  $33\mu$  long..... 9
9. Claw of maxilliped slender, slightly angular; a few minute teeth on the inner margin near the tip..... *infrequens*  
 Claw of maxilliped fairly stout, its outer margin with a slight concavity; inner margin without teeth but with a small protuberance near the base of the seta..... *comata*

#### INCIDENCE AND HOSTS OF XARIFIA

The number of *Xarifia* recovered from a coral mass appears to vary with the method used. When a fresh coral is rinsed gently in alcoholized sea water (about 5% alcohol), a few *Xarifia* may be washed out, but more of these copepods will be recovered from the sediment obtained after crushing the coral with a hammer under the water. For example, a mass of *Echinopora carduus* yielded 7 *Xarifia dispar* after being rinsed whole, but 35 of these copepods after the coral had been crushed. In several cases, however, large numbers of *Xarifia* were found in the sediment after leaving the uncrushed coral in a pail of alcoholized sea water for 7-10 hours. Using this method 624 *X. gerlachi* and 8 *X. infrequens* were recovered from a mass of *Acropora corymbosa*. The copepods apparently are stimulated by the dilute alcohol to leave the polyps, when they fall to the bottom of the container. Since they are incapable of swimming, they are unable to regain their positions in the polyps even though the effect of the alcohol gradually diminishes over the hours. This last method is

very useful, since the very small amount of debris and mucus in the sediment greatly facilitates collection of the copepods.

No specimens of *Xarifia* were found in the following species of corals from the region of Nossi Bé:

*Acropora hemprichi* (Ehrenberg) from Pointe Lokobe, Nossi Bé

*Acropora scherzeriana* Brueggemann from Pointe Lokobe, Nossi Bé

*Pavona cactus* (Forskål) from Pointe de Tafondro, Nossi Bé

*Porites* cf. *P. andrewsi* Vaughan from Pointe Lokobe, Pointe de Tafondro, and NW of Madirokely, Nossi Bé; Ambariotelo; Tany Kely.

*Psammocora* sp. from Pointe de Tafondro, Nossi Bé, and Pointe Ambarionaomby, Nossi Komba.

The following list gives the known hosts and distribution of the ten species of the genus *Xarifia*:

<i>species</i>	<i>coral host</i>	<i>locality</i>
<i>X. maldivensis</i> Humes	<i>Pocillopora</i> sp.	Maldive Islands
<i>X. fimbriata</i> Humes	<i>Pocillopora</i> sp.	Maldive Islands
<i>X. gerlachi</i> , n. sp.	<i>Acropora corymbosa</i>	All from the Nossi Bé region in northwestern Madagascar (see preceding text for precise localities)
	<i>Acropora</i> cf. <i>A. teres</i>	
	<i>Acropora cytherea</i>	
<i>X. longipes</i> , n. sp.	<i>Pavona angulata</i>	
<i>X. dispar</i> , n. sp.	<i>Echinopora carduus</i>	
<i>X. reducta</i> , n. sp.	<i>Seriatopora octoptera</i>	
	<i>Seriatopora caliendrum</i>	
<i>X. serrata</i> , n. sp.	<i>Pocillopora damicornis</i>	
	<i>Pocillopora verrucosa</i>	
	<i>Pocillopora</i> cf. <i>P. verrucosa</i>	
	<i>Seriatopora subseriata</i>	
<i>X. tenuis</i> , n. sp.	<i>Acropora cytherea</i>	
<i>X. infrequens</i> , n. sp.	<i>Acropora corymbosa</i>	
	<i>Acropora cytherea</i>	
<i>X. comata</i> , n. sp.	<i>Pocillopora verrucosa</i>	
	<i>Pocillopora</i> cf. <i>P. verrucosa</i>	

In addition to these described species, Humes (1960) has listed an undescribed *Xarifia* from *Stylophora* sp. in the Red Sea. Re-examination of this single female shows that it possesses three very long slender processes above the equally long fifth legs (not four processes as previously mentioned). It seems impossible to assign it to any of the species already described. The fragment of the second undetermined species listed by Humes remains also unassignable at the present.

## REFERENCE CITED

HUMES, ARTHUR G.

1960. New copepods from madreporarian corals. *Kieler Meeresforschungen* **16**: 229-235.

## EXPLANATION OF FIGURES

All figures were drawn with the aid of a camera lucida. The letter after each figure refers to the scale at which it was drawn.



Humes, A G. 1962. "Eight new species of Xarifia (Copepoda, Cyclopoida), parasites of corals in Madagascar." *Bulletin of the Museum of Comparative Zoology at Harvard College* 128, 35–63.

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