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## ***Asterocheres reginae*, a new species of parasitic copepod (Siphonostomatoida: Asterocheridae) from a sponge in Belize**

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### **Abstract**

*Asterocheres reginae* n. sp., of the family Asterocheridae, is described from the sponge *Agelas clathrodes* (Schmidt) collected at Carrie Bow Cay, Belize. It inhabits the internal canal system of its sponge host. A detailed description of both sexes is presented, and emphasis has been placed on the recognition of homologies between the limb segments and armature elements in accordance with the new evolutionary scheme established by Huys & Boxshall (1991).

### **Introduction**

Coral reef communities are rich in sponges and sponges act as hosts to a varied assemblage of associated organisms dominated by copepods, amphipods and polychaetes. Siphonostomatoid copepods are frequently associated with sponges and several families, such as the Spongiocnizontidae and Sponginticolidae, are known only from sponge hosts (Stock, 1967; Stock & Kleeton, 1964). Although copepods can be extracted from sponges with relative ease, there have been few faunal surveys of the sponge-inhabiting copepods from particular areas. The usefulness of the study by Boxshall (1990) of copepods from sponges in Hong Kong was limited by lack of information on the identity of the sponge hosts. The sponge fauna of Carrie Bow Cay, Belize is better known, and Ruetzler (pers. comm.) provided identifications of over 30 sponge species from on and around Carrie Bow Cay that were examined in 1987 for associated copepods. These were found to harbour over 45 different species of siphonostomatoid copepods belonging to the families Asterocheridae and Dinopontiidae. Virtually all of these

copepods are new species and full descriptions will not be completed for some time, but one species from these Belizean samples was selected as representing a typical siphonostomatoid by Huys & Boxshall (1991). This species is described in detail below.

### **Materials and methods**

*Material examined.* Holotype female plus 3 female and 13 male paratypes; extracted from sponge, *Agelas clathrodes* (Schmidt), collected by hand at about 1.5 m depth off Carrie Bow Cay, Belize: stored in collections of The Natural History Museum, London, BM(NH) Reg. Nos 1991.88 (holotype female), 1991.89–101 (paratypes). Dissected female and male paratypes, mounted on 12 and 7 slides respectively, Reg. Nos 1992.1078 (female) and 1992.1079 (male).

Specimens were dissected in lactic acid and examined as temporary mounts in lactophenol. All drawings were prepared using a camera lucida on a Leitz Dialux 20 interference microscope. All

appendage segments and setation elements are named and numbered using the system established by Huys & Boxshall (1991).

***Asterocheres reginae* n. sp.**

*Description* (Figs 1–10)

*Adult female* (Figs 1A, 2A). Body cyclopiform, with dorso-ventrally flattened prosome and cylindrical urosome. Mean body length 0.97 mm, with range of 0.93–1.00 mm (based on 3 specimens); length of prosome of figured specimen c. 0.65 mm; length of urosome 0.35 mm. Prosome very broad, about 1.16 times wider than long; comprising cephalothorax fully incorporating first pedigerous somite and 3 free pedigerous somites, all with well-developed epimeral margins. Dorsal cephalothoracic shield and tergites of free pedigerous somites ornamented with dense array of integumental pores and sensilla (Fig. 1A). Urosome 4-segmented, comprising 5th pedigerous somite, genital double somite representing fused genital and first abdominal somites, and 2 free abdominal somites. Dorsal surface of free abdominal somites and posterior (abdominal) part of genital double somite ornamented with large, flattened epicuticular scales, arranged in irregular, overlapping rows. Some scales also present anteriorly on genital double and 5th pedigerous somites. Posterior margins of all somites ornamented with hyaline frills with more or less serrated free margins. Genital double somite about 1.28 times wider than long, bearing bipartite genital apertures, paired gonopores (oviduct openings) located laterally about midway along double somite (Fig. 5A) and paired copulatory pores (arrowed in Fig. 2B,C) located laterally on ventral surface of double somite. Copulatory pore connected to genital antrum beneath gonopore by subsurface copulatory duct (Fig. 2B). Lateral margin of double somite ornamented with fringe of long spinules just posterior to gonopores. Integumental pores and sensilla present on urosomal somites as indicated by Figs 1A, 2A,C.

Caudal rami (Fig. 1B–D) slightly longer than

wide, ornamented dorsally with epicuticular scales and spinous marginal processes that obscure precise margins; armed with 7 setae; seta I located laterally near proximal margin (Fig. 1D), setae III, IV, V and VI arranged in horizontal row across distal margin of ramus, seta II offset onto dorsal surface near distal margin, adjacent to dorsal seta (VII).

Antennule (Fig. 3A–E) 21-segmented; segmental fusion pattern as follow: 1(I), 2(II), 3(III), 4(IV), 5(V), 6(VI), 7(VII), 8(VIII), 9(IX–XII), 10(XIII), 11(XIV), 12(XV), 13(XVI), 14(XVII), 15(XVIII), 16(XIX), 17(XX), 18(XXI), 19(XXII–XXIII), 20(XXIV–XXV), 21(XXVI–XXVIII). Segments 1–8 each with 2 setae; segment 9 with 8 setae; segments 10–17 each with 2 setae; segment 18 with 2 setae plus an aesthetasc; segment 19 with 2 setae; segment 20 with 3 setae; segment 21 with 7 setae. Segment 10(XIII) reduced, partly overlapped by distal expansion of compound segment 9(IX–XII).

Antenna (Fig. 4A,B) biramous; protopodal part comprising small unarmed coxa and large unarmed basis; coxa with fine spinule row; basis with row of stout spinules. Exopod small, one-segmented, bearing one subapical and 2 unequal, apical setae. Endopod 3-segmented; first segment elongate, unarmed but ornamented with lateral row of fine spinules; 2nd segment produced distally on medial side but articulating with 3rd segment proximally on lateral side. Second segment armed with single seta; 3rd with large distal claw, one well-developed spiniform seta and 2 short, naked setae lacking basal articulation with segment. Third segment also ornamented with patch of fine spinules on lateral margin.

Mandible (Fig. 5C) comprising stylet-like gnathobase and slender 2-segmented palp. Stylet with denticulate margin subapically. First segment of palp (basis) unarmed, ornamented with spinules laterally; 2nd segment with 2 long, unequal apical setae and scattered spinules. Stylet located in oral cone, formed by labrum and labium (Fig. 5B).

Maxillule (Fig. 3F) bilobed; praecoxal endite (inner lobe) considerably larger than palp (outer lobe). Praecoxal endite armed with 4 distal setae,

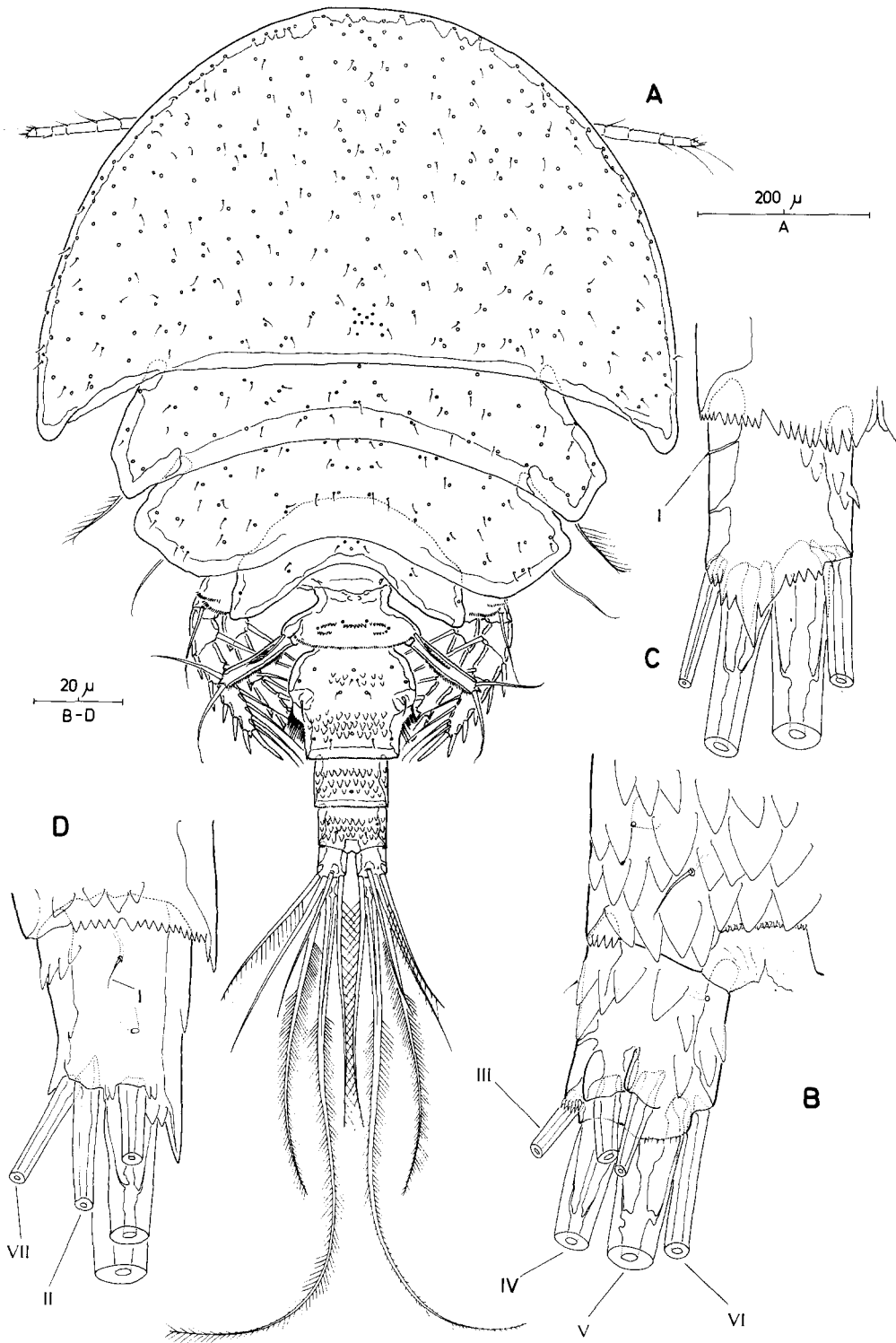


Fig. 1. *Asterocheres reginae* n. sp. A, Female, dorsal; B, Caudal ramus and part of anal somite, dorsal; C, Idem, ventral; D, Idem, lateral.

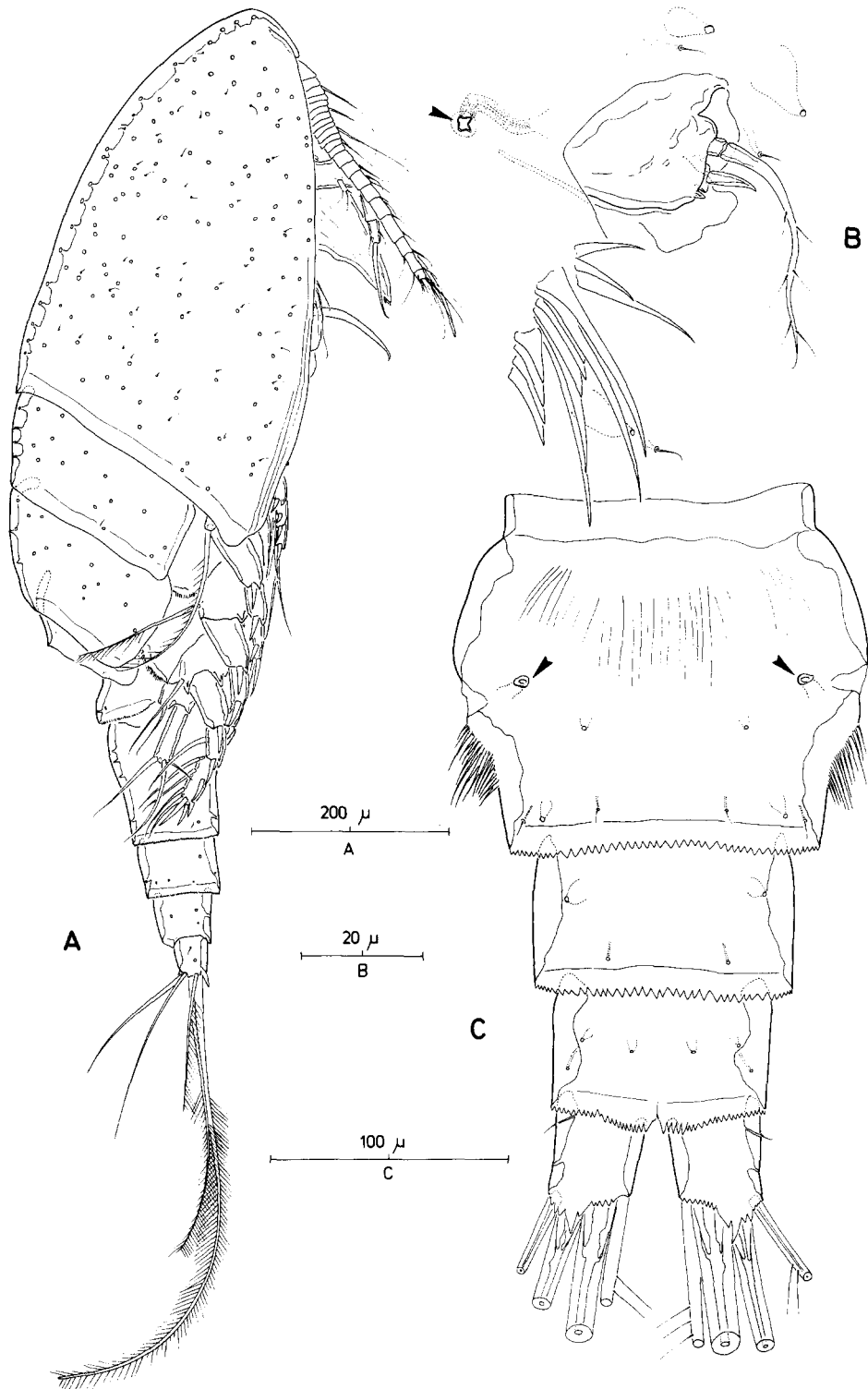


Fig. 2. *Asterocheres reginae* n. sp. A, Female, lateral; B, Genital aperture, with copulatory pore arrowed, lateral; C, Genital double somite and free abdomen, ventral, with copulatory pores arrowed.

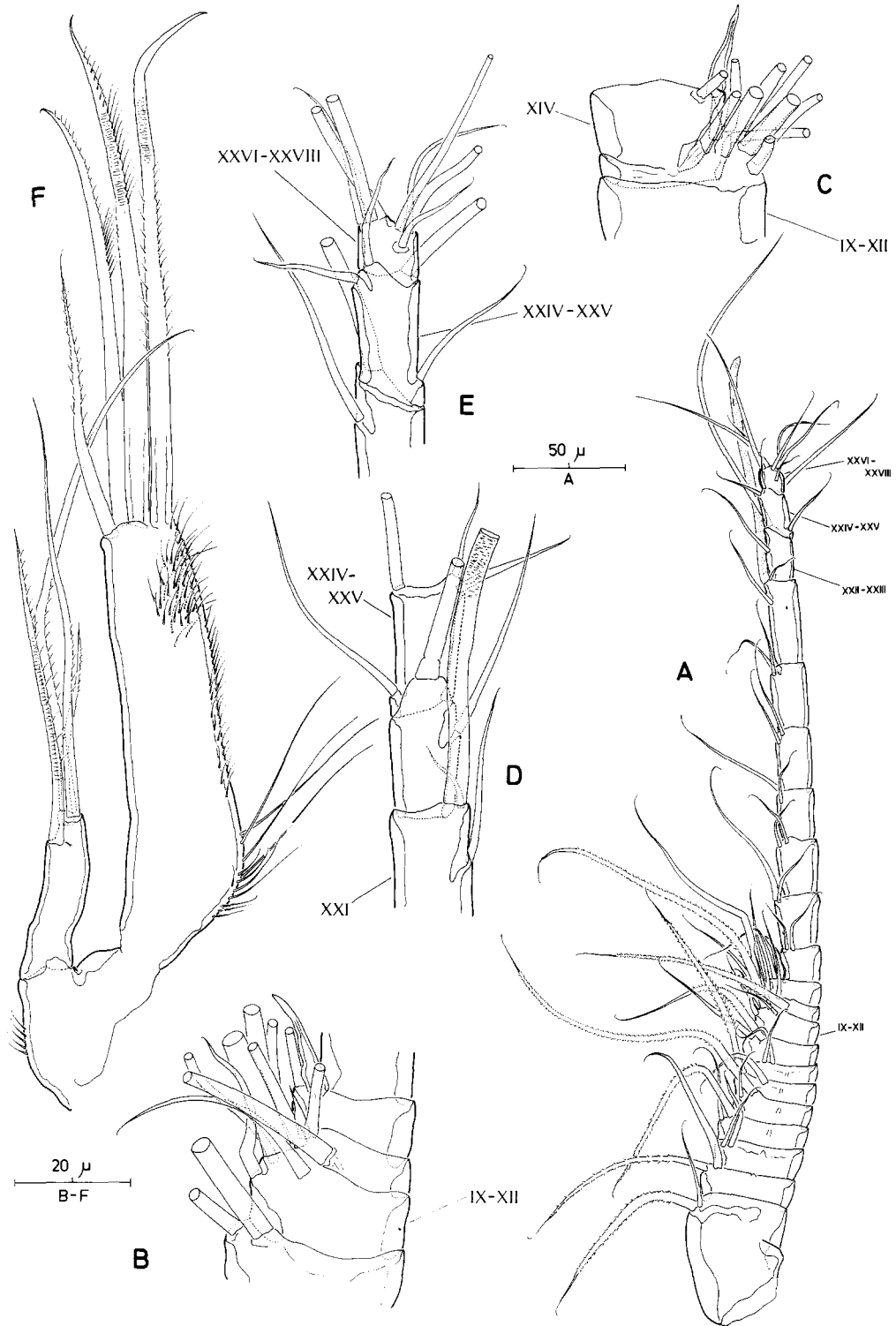


Fig. 3. *Asterocheres reginae* n. sp. A, Female antennule, ventral; B, Detail of segments IX–XII, XIII and XIV, ventral; C, Idem, dorsal; D, Detail of segments XXI to XXIV–XXV, dorsal; E, Detail of segments XXIV–XXV to XXVI–XXVIII, ventral; F, Maxillule, ventral. [Roman numerals indicate ancestral segment numbers, see Huys & Boxshall, 1991].

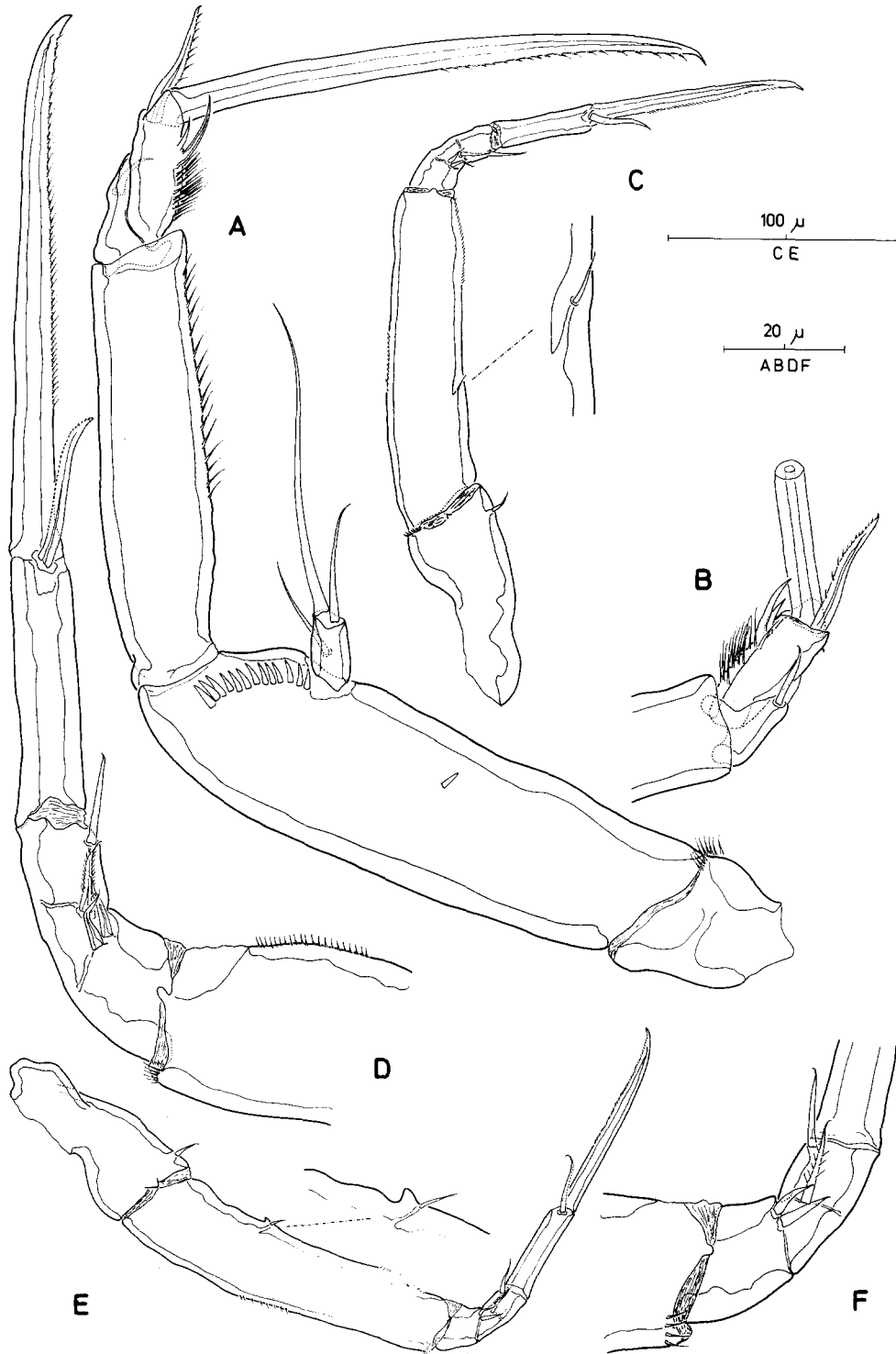


Fig. 4. *Asterocheres reginae* n. sp. A, Antenna, posterior; B, Detail of second and third endopodal segments, anterior; C, Female maxilliped, posterior view with inset showing minute basal seta; D, Idem, showing detail of endopod; E, Male maxilliped, posterior view with inset showing minute basal seta; F, Idem, showing detail of segmentation in proximal part of endopod.

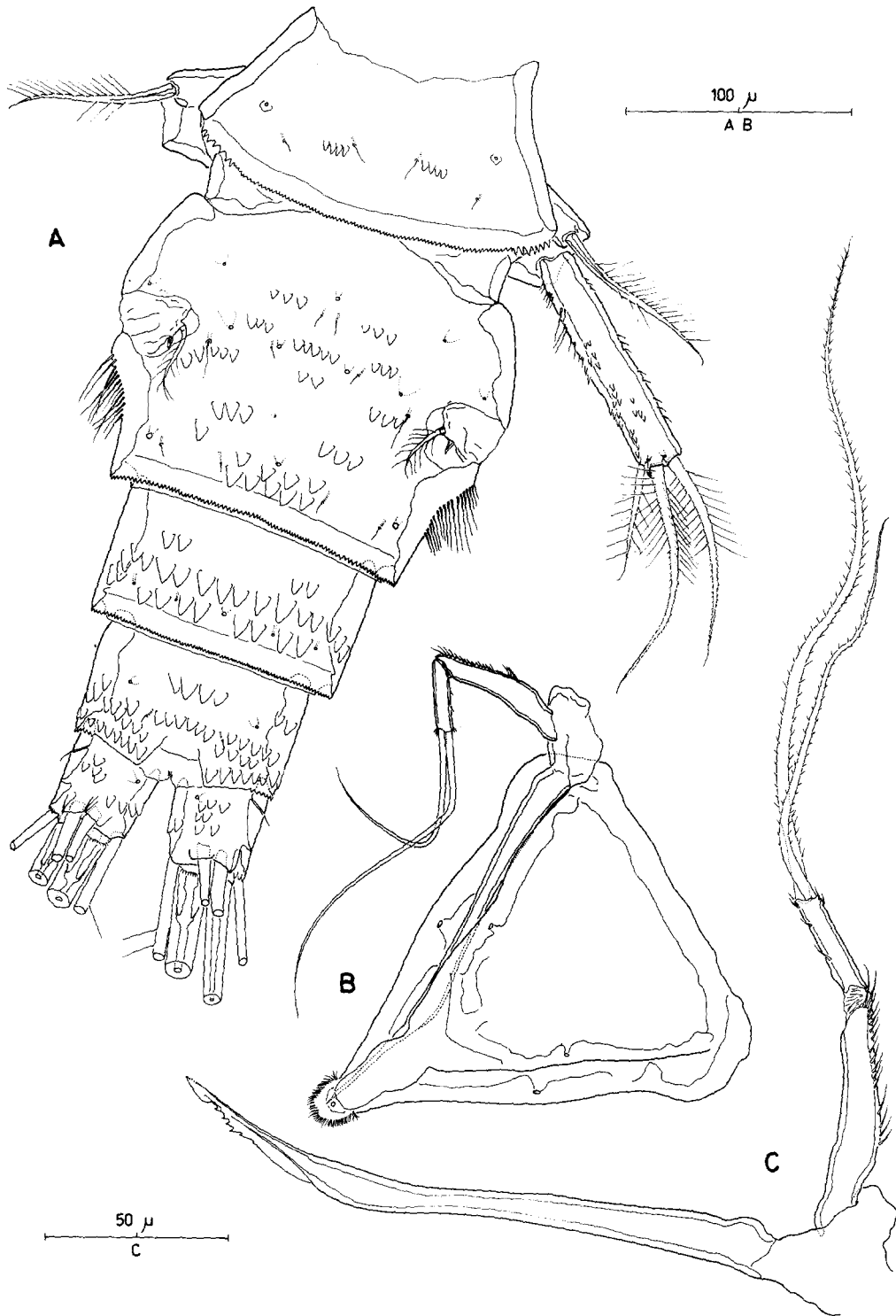


Fig. 5. *Asterocheres reginae* n. sp. A, Female urosome, dorsal; B, Oral cone and mandible, antero-ventral; C, Mandible, ventral.



ornamented with patches of long spinules proximally and shorter spinules distally, connected by marginal row of spinules. Palp separated by proximal suture; armed with 4 unequal setae distally.

Maxilla 2-segmented but with partial transverse suture on syncoxa (proximal segment) possibly marking plane of praecoxa-coxa fusion; praecoxal part bearing long flaccid element medially, possibly an aesthetasc; coxal part unarmed but ornamented with lateral row of spinules. Claw-like basis more or less straight, bearing small hyaline process proximally in axil; armed with 2 very small setae at about one quarter and one half its length; distal margins of claw provided with rows of minute spinules. Female maxilla similar to that of male (cf. Fig. 8C).

Maxilliped (Fig. 4C,D) 4-segmented, comprising short syncoxa, long basis and distal subchela consisting of 2 free endopodal segments armed with distal claw-like element. Syncoxa with one medial seta; basis with one minute seta in proximal half of medial margin and row of minute spinules in distal half. First endopodal segment compound, bearing 2 partial sutures marking planes of fusion between 3 original segments with (2,1,1) armature formula; 2nd endopodal segment bearing long terminal claw plus additional apical seta.

Swimming legs 1–4 (Figs 6A,B 7A,B) biramous, with 3-segmented protopods and 3-segmented rami. Intercoxal sclerite present in legs 1–4, ornamented with pair of processes and patches of spinules in legs 1 and 2. Praecoxa represented by incomplete hoop-like sclerite located laterally at basal articulation of legs. Spine and seta formula:

	coxa	basis	exopod segments	endopod segments
Leg 1	0-1	1-I	I-1;I-1;III,1,3	0-1;0-2;1,2,3
Leg 2	0-1	1-0	I-1;I-1;III,I,4	0-1;0-2;1,2,3,
Leg 3	0-1	1-0	I-1;I-1;III,I,4	0-1;0-2;1,1+I,3
Leg 4	0-1	1-0	I-1;I-1;III,I,4	0-1;0-2;1,1+I,2

Coxae ornamented with spinule rows laterally, as figured; coxal seta very small in leg 4 (arrowed in Fig. 7B). Outer spines of all exopodal segments

bilaterally serrate; terminal exopodal element setiform in leg 1, spiniform in legs 2–4 serrate laterally and with setules medially. Inner apical element on endopod of legs 3 and 4 modified as serrate spine. Lateral margins of exopodal segments with minute serrations; lateral margins of endopodal segment with rows of setules.

Fifth leg (Fig. 5A) 2-segmented; protopodal segment with outer seta located dorsally; exopod slender, armed with 3 distal setae; ornamented with spinules and fine setules.

Sixth leg (Fig. 5A) represented by paired opercular plates closing off gonopores on genital double somite; armed with 1 plumose seta and one spiniform element.

*Adult male* (Fig. 8A). Body cycloform, with dorso-ventrally flattened prosome and cylindrical urosome. Mean body length 0.87 mm, with range of 0.84–0.91 mm (based on 12 specimens); length of prosome of figured specimen about 0.61 mm; length of urosome 0.31 mm. Prosome very broad, about 1.05 times wider than long; comprising cephalothorax fully incorporating first pedigerous somite and 3 free pedigerous somites all with well-developed epimeral margins. Dorsal cephalothoracic shield and tergites of free pedigerous somites ornamented with dense array of integumental pores and sensilla (Fig. 8A). Urosome 5-segmented, comprising 5th pedigerous somite, genital somite and 3 free abdominal somites. Dorsal surface of genital somite and dorsal and ventral surfaces of free abdominal somites ornamented with large flattened, epicuticular scales, arranged in irregular, overlapping rows. Some spinules present on dorsal surface of 5th pedigerous somite. Posterior margins of all somites ornamented with hyaline frills with more or less serrated free margins. Genital somite about 1.5 times wider than long; bearing genital apertures postero-laterally on ventral surface (Fig. 10A). Integumental pores and sensilla present on urosomal somites as indicated by Fig 8A, 10A.

Appendages as for female except antennules, maxillipeds and 5th and 6th legs.

Antennule (Fig. 9A–E) 18-segmented, geniculate; segmental fusion pattern as follow: 1(I), 2(II),

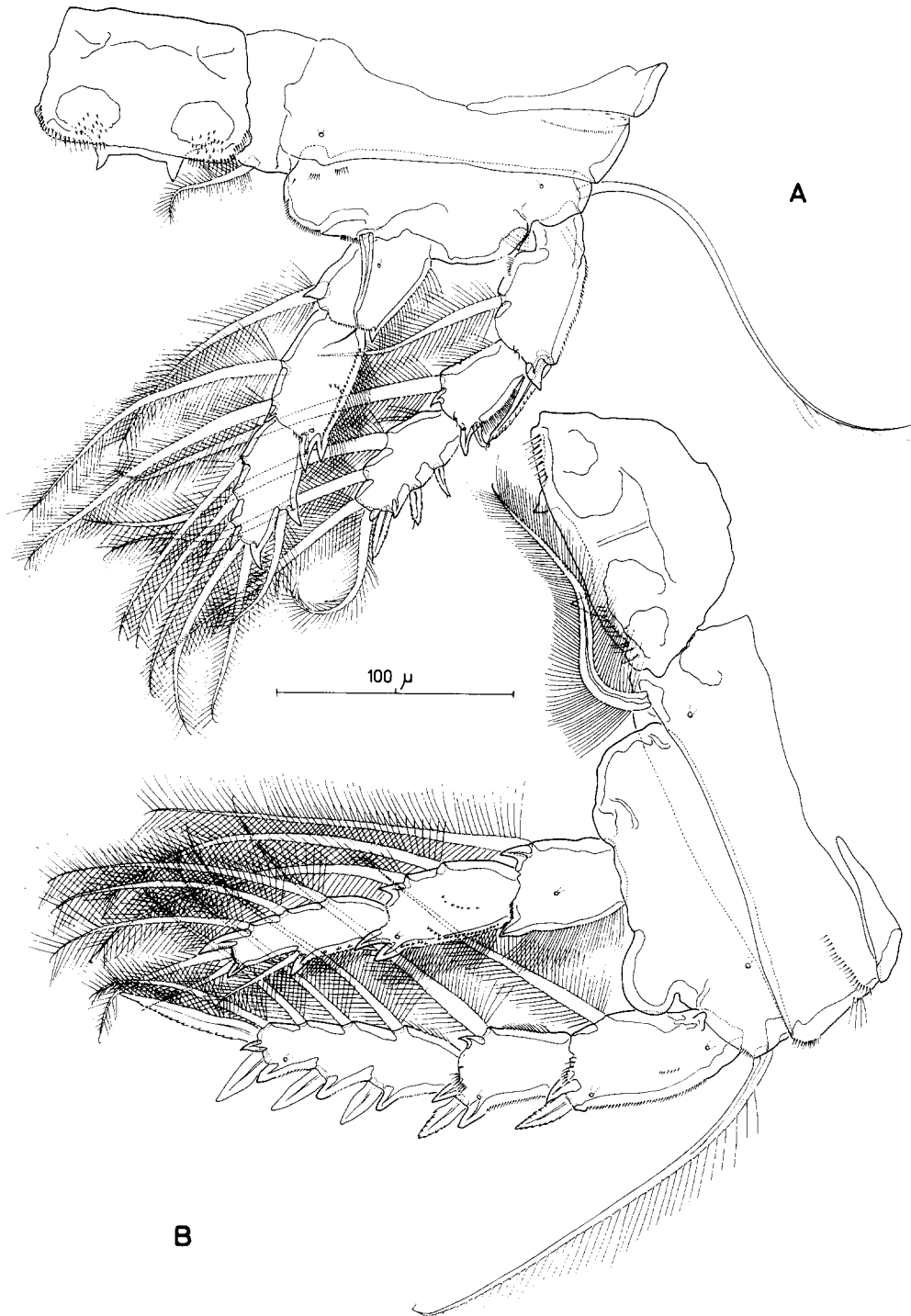


Fig. 6. *Asterocheres reginae* n. sp. A, First leg, anterior; B, Second leg, anterior.

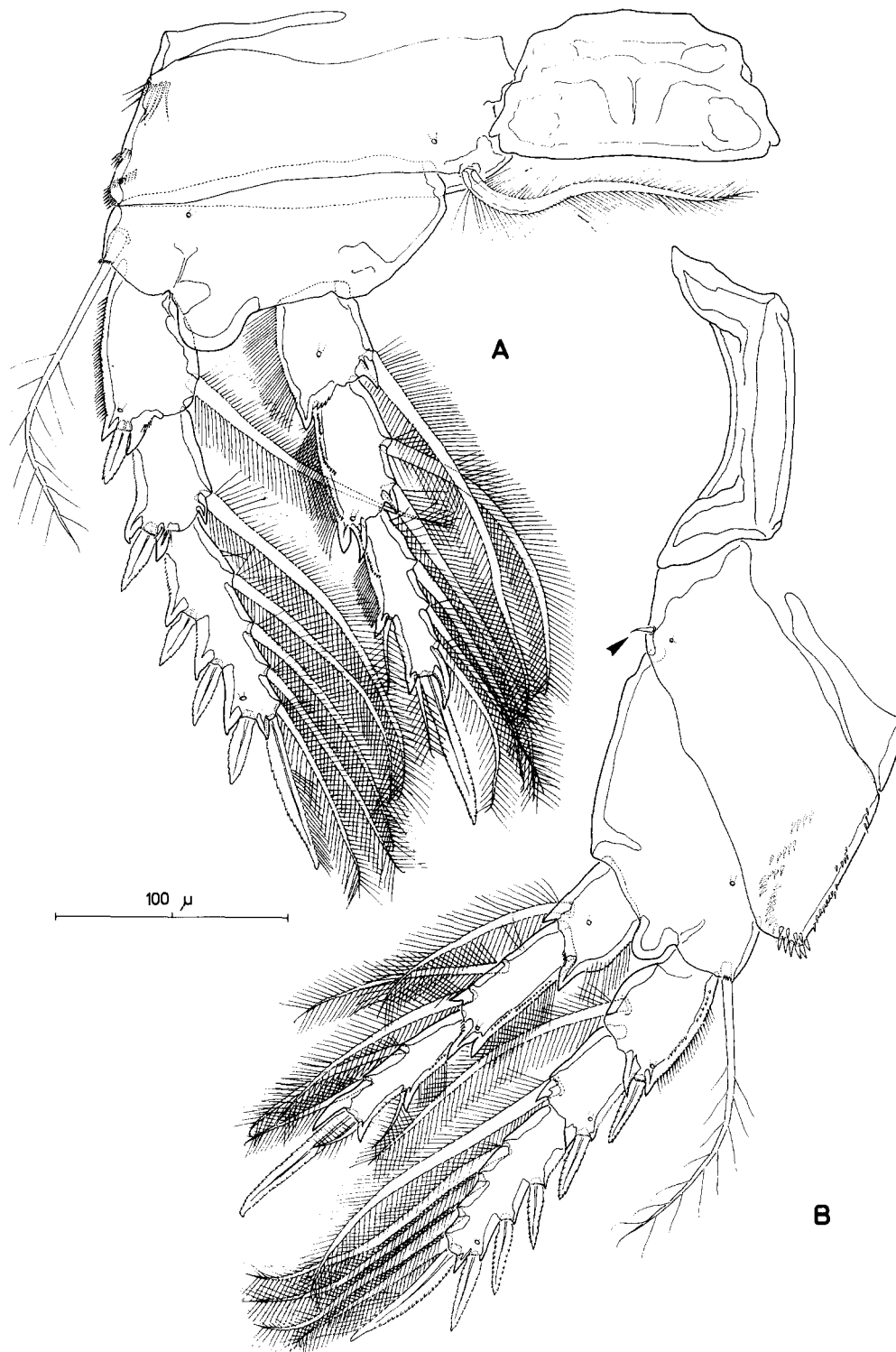


Fig. 7. *Asterocheres reginae* n. sp. A, Third leg, anterior; B, Fourth leg, anterior view with small coxal seta arrowed.

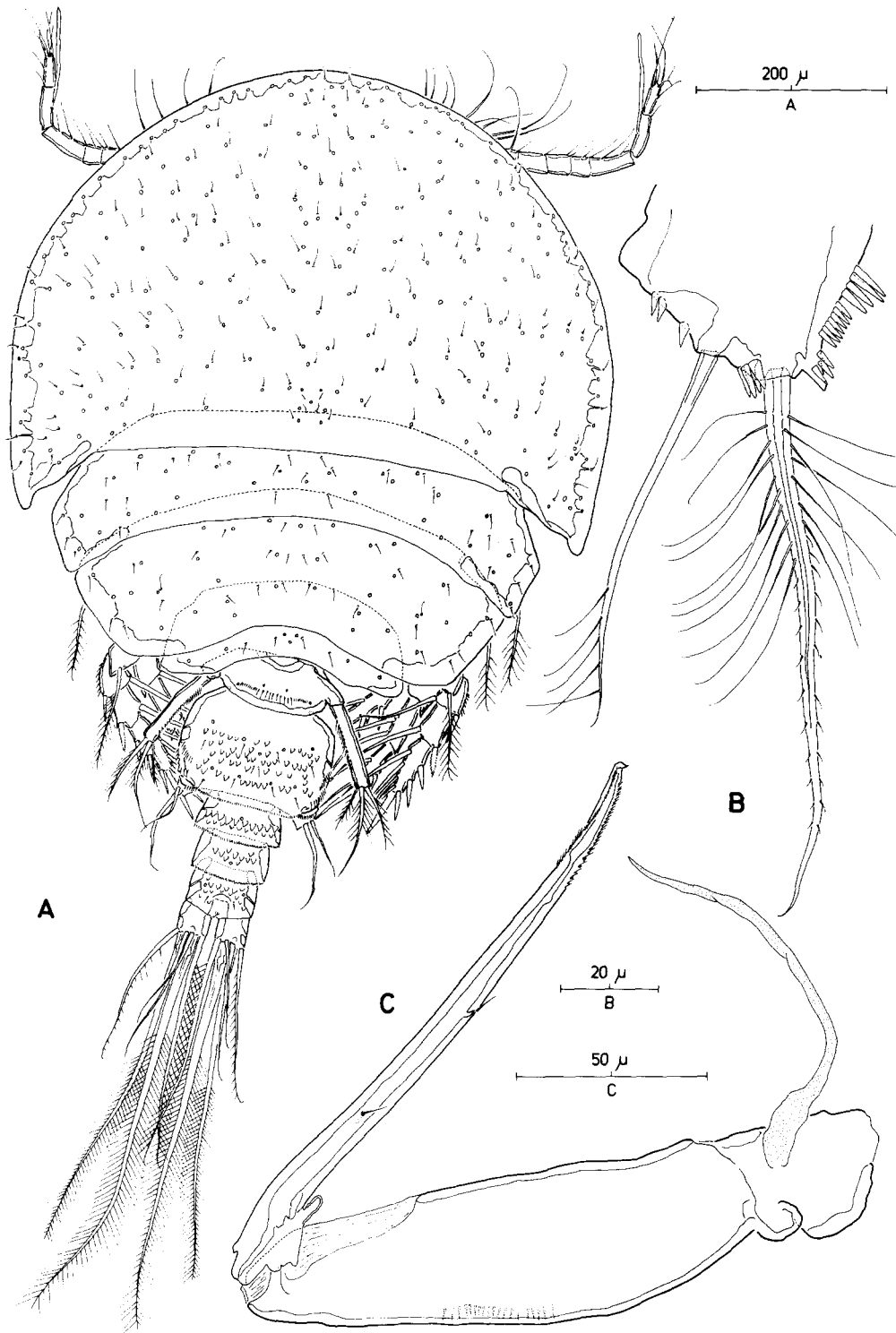


Fig. 8. *Asterocheres reginae* n. sp. A, Male, dorsal; B, Sixth leg, lateral; C, Maxilla, posterior.

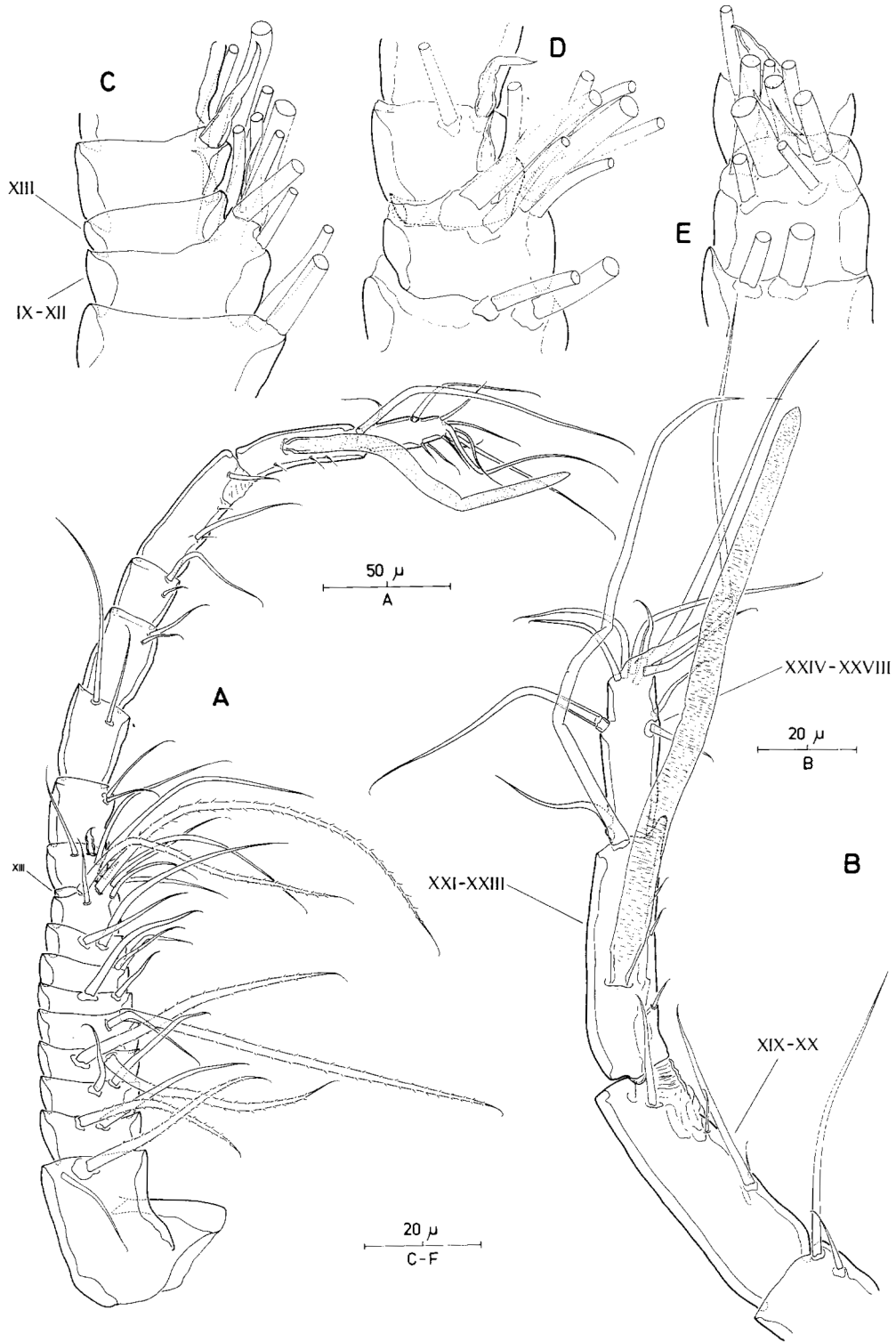


Fig. 9. *Asterocheres reginae* n. sp. A, Male antennule, ventral; B, Idem, showing detail of segmental fusions around geniculation; C, Idem, showing detail of segments IX–XII to XIV, dorsal; D, Idem, ventral; E, Idem, anterior. [Roman numerals indicate ancestral segment numbers, see Huys & Boxshall, 1991].

3(III), 4(IV), 5(V), 6(VI), 7(VII), 8(VIII), 9(IX–XII), 10(XIII), 11(XIV), 12(XV), 13(XVI), 14(XVII), 15(XVIII), 16(XIX–XX), 17(XXI–XXIII), 18(XXIV–XXVIII). Geniculation located between segments 16 (XIX–XX) and 17 (XXI–XXIII). Segments 1–8 each with 2 setae; segment 9 with 8 setae; segments 10–15 each with 2 setae; segment 16 with 4 setae, segment 17 with 4 setae plus one aesthetasc; segment 18 with 11 setae. Segment 10(XIII) reduced, partly overlapped by distal expansion of compound segment 9(IX–XII).

Maxilliped (Fig. 4E,F) 5-segmented; comprising short syncoxa, long basis and distal subchela consisting of 3 free endopodal segments armed with distal claw-like element. Syncoxa with one medial seta; basis with one minute seta, one small tooth-like process in proximal half of medial margin and row of minute spinules in distal half. First endopodal segment simple, armed with 2 setae; 2nd endopodal segment compound, bearing partial suture marking plane of fusion between original segments with (1,1) armature formula; 3rd endopodal segment bearing long terminal claw plus additional apical seta.

Fifth leg (Fig. 10B) 2-segmented, comprising protopodal segment armed with outer basal seta and exopod bearing 3 setae distally. Exopodal segment ornamented with patches and rows of fine spinules.

Sixth legs (Figs 8B, 10A) forming large opercular plates closing off genital apertures, armed with 2 setae, ornamented with rows of stout spinules and scattered epicuticular scales.

*Etymology*: The species is named in honour of Regina, “Queen” of Carrie Bow Cay.

## Discussion

This species was selected by Huys & Boxshall (1991) as a typical siphonostomatoid because it retains many of the plesiomorphic character states of the order, including 21-segmented female antennules, antenna with 3-segmented endopod and one-segmented exopod, 2-segmented mandibular

palp and a 3-segmented maxillipedal endopod, at least in the male. Several of its appendages were figured by Huys & Boxshall (1991) and the name *Asterocheres reginae* Boxshall & Huys was used by them as an intentional *nomen nudum*. The full description of both sexes and the designation of types are presented here, together with a statement of the characters that differentiate the taxon which is lacking in Huys & Boxshall (1991), in order to correctly establish the name.

*Asterocheres* Boeck is the largest genus in the Asterocheridae, containing at least 42 species, many of which occur on sponge hosts. The possession of an aesthetasc on the proximal part of the syncoxa of the maxilla, as found in *A. reginae*, is an unusual character in *Asterocheres*. *A. aesthetes* Ho was the first species, and currently, only species described as showing this character state (Ho, 1984) and its presence was used as the basis for the specific name. Boxshall (1990) reported an aesthetasc in a similar position on the maxilla in two other asterocherid genera, *Sinopontius* Boxshall and *Inermocheres* Boxshall, and it is possible that it is more widely distributed within the Asterocheridae but has been overlooked. Huys & Boxshall (1991) suggested a possible alternative interpretation of this aesthetasc-like structure. They considered that it might represent a tubular extension around the external opening of the maxillary gland, since a short tube pore is present in such a position in some other siphonostomatoids.

Detailed comparison between *A. aesthetes* and *A. reginae* reveals a number of significant differences, including the segmentation of the antennule in the female (19 segments in *A. aesthetes* compared to 21 in *A. reginae*), the more dorsoventrally flattened and highly ornamented body in *A. reginae*, and the more elongate shape of the caudal rami in *A. reginae*. The inner basal spine on leg 1 is present in *A. reginae* but was not found by Ho (1984) in *A. aesthetes*. However, Boxshall (1990) reported that this spine is present in material of *A. aesthetes* from Hong Kong.

Only six species of *Asterocheres* have been reported as possessing a 21-segmented antennule in the female; most have either 19 or 20 segments,

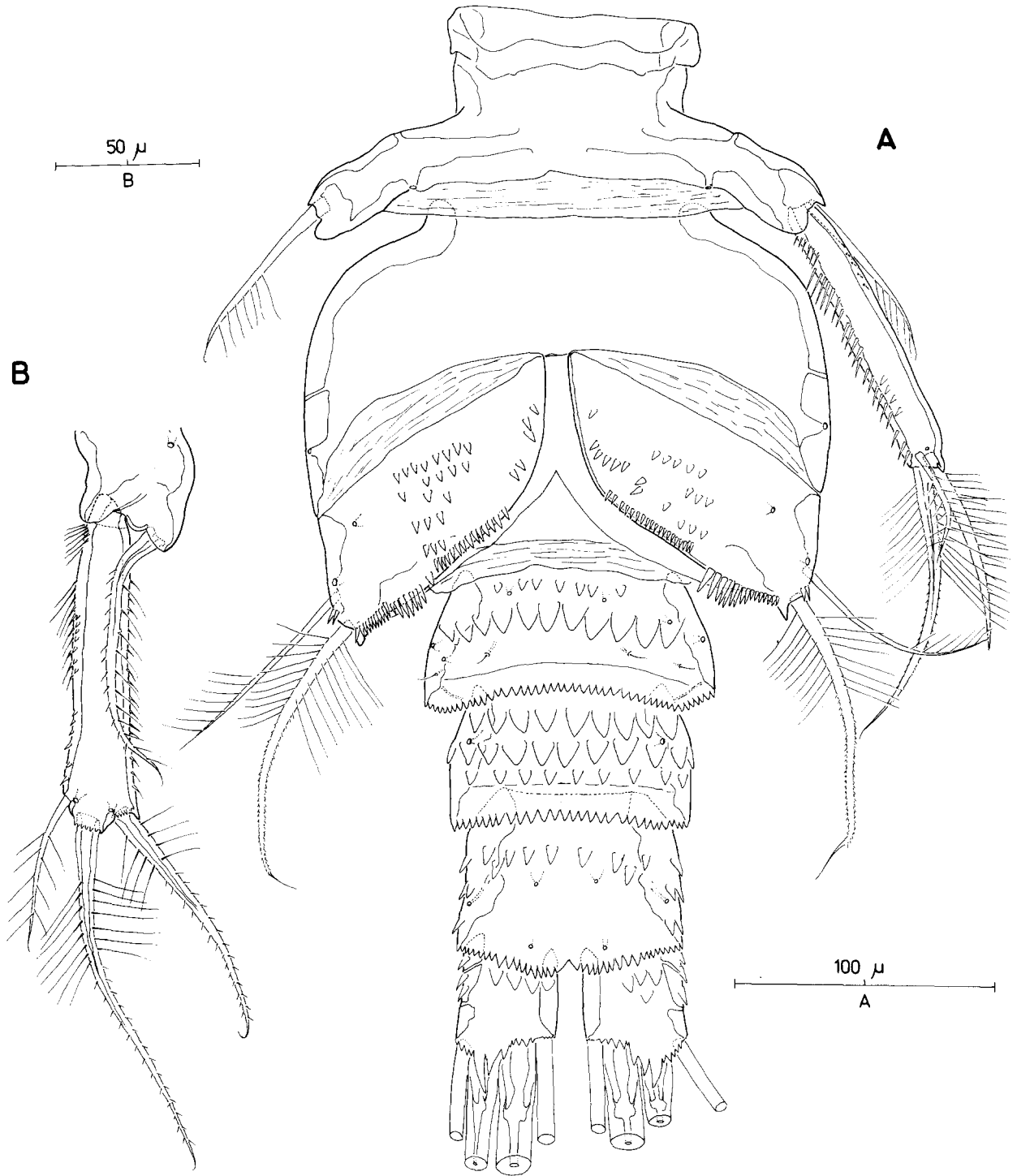


Fig. 10. *Asterocheres reginae* n. sp. A, Male urosome, ventral; B, Male fifth legs, dorsal.

although a few species are too poorly described to allow a precise segment count, or are known only from males. Giesbrecht (1899) described 21-segmented antennules in the females of *A. suberitidis* Giesbrecht, *A. violaceus* (Claus) and *A. minutus* (Claus). This number also occurs in *A. bulbosus* Malt (Malt, 1991), *A. jeanyeatmanae* Yeatman (Yeatman, 1970) and *A. tenuicornis* Brady (Eiselt, 1965). All of these species also resemble *A. reginae* in having a relatively short oral cone which does not extend markedly beyond the bases of the maxillipeds. However, *A. bulbosus* and *A. violaceus* both differ from *A. reginae* in their possession of one-segmented mandibular palps. *A. tenuicornis* is readily distinguished from *A. reginae*, and all of its congeners, by its very elongate caudal rami. The extremely flattened shape of the prosome of *A. reginae* serves to separate it from the remaining three species, *A. jeanyeatmanae*, *A. suberitidis* and *A. minutus*, which have a much more slender prosome.

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