

New species and new records of *Ergasilus* Nordmann (Copepoda: Ergasilidae) from the gills of grey mullet (Mugilidae)

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Abstract

Four new *Ergasilus* species are described from five host species of grey mullet, family Mugilidae, held in the fish collections of The Natural History Museum, London. *Ergasilus extensus* n. sp. was found on *Myxus petardi* (Castelnau) from Australia, *E. sittangensis* n. sp. on *Sicamugil hamiltoni* (Day) from Burma, *E. piriformis* n. sp. on *Sicamugil cascasia* (Hamilton Buchanan) from India, and *E. ecuadorensis* n. sp. on *Mugil curema* Valenciennes and *M. hospes* Jordan & Culver from Ecuador. New records of *E. cyanopictus* Carvalho, *E. magnicornis* Yin, *E. orientalis* Yamaguti and *E. rostralis* Ho, Jayarajan & Radhakrishnan on grey mullet are also given.

Introduction

Ergasilus Nordmann, 1832 is the largest genus of the family Ergasilidae, comprising nearly two thirds of the species currently included in the family. All the new species described below and most of the material examined were obtained from grey mullet (family Mugilidae) stored in the fish collections of The Natural History Museum in London. The work forms part of a larger study aimed at unravelling the complex history of co-evolution and repeated colonisation of mugilid fishes and their ergasilid parasites (El-Rashidy, 1999). The large volume of descriptive taxonomy generated by this study (El-Rashidy & Boxshall, 1999, 2000, 2001a,b,c) demonstrates how poorly these parasites are known.

Preliminary analysis of the family at the species level (El-Rashidy, 1999) leads us to infer that the genus *Ergasilus*, as currently constituted, is polyphyletic. Resolving this major taxonomic problem is beyond the scope of the present paper, but we are here providing part of the essential knowledge base that is required before any comprehensive revision of the genus can be undertaken.

Materials and methods

The material was removed from the gills of preserved grey mullet deposited in the fish collections of The Natural History Museum in London. The copepods were removed from the gill-filaments, dissected and mounted as temporary preparations in lactophenol. Measurements were made with an ocular micrometer and drawings were made with the aid of camera lucida on an Olympus BH2 microscope equipped with differential interference contrast.

Ergasilus extensus n. sp.

Type-material: Female holotype (BMNH Reg. No. 1999. 1422); three female paratypes (BMNH Reg. Nos 1999. 1423-1425).

Type-host and locality: *Myxus petardi* (Castelnau), Hawkesbury River, New South Wales, Australia.

Other records: Numerous females on *Myxus petardi* from Presby Great Reef, Australia.

Etymology: The specific name refers to the posterior extension of the urosomites.

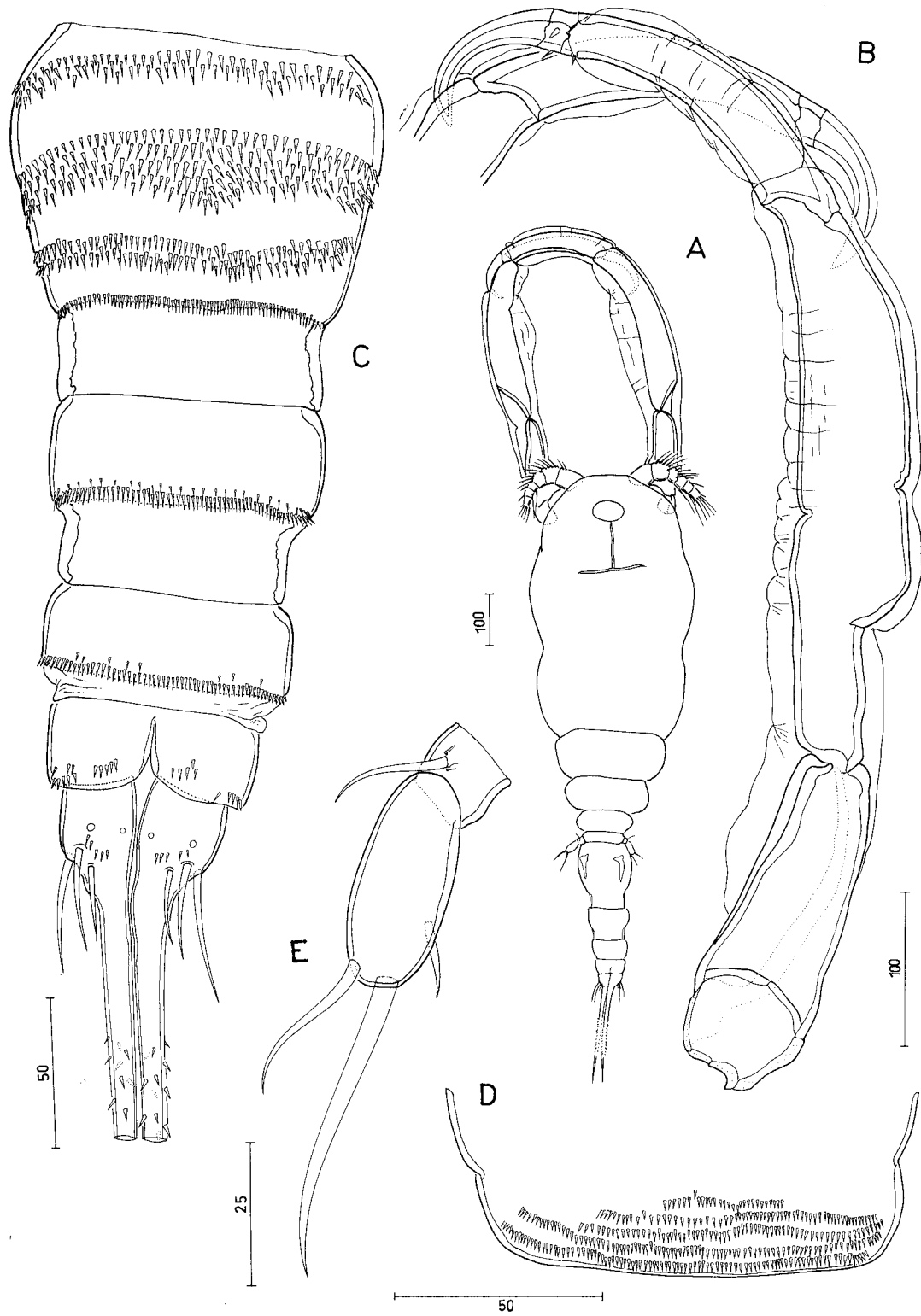


Figure 1. *Ergasilus extensus* n. sp. Adult female. A, dorsal view; B, antenna, showing interlocking with tip of opposing antenna; C, posterior part of urosome, ventral view showing ornamentation; D, interpodal sternite of first swimming leg; E, fifth swimming leg. Scale-bars in μm .

Description of adult female (Figures 1A-E, 2A-D, 3A)

Cephalothorax oblong, slightly constricted at posterior third, constituting about half body length (excluding caudal setae). Dorsal surface of cephalic shield ornamented with circular and inverted T-shaped markings (Figure 1A). Free second to fourth pedigerous somites narrowing posteriorly. Genital double-somite slightly elongate posteriorly, comprising wider anterior part with more highly sclerotised cuticle than posterior part, nearly twice as long as first free abdominal somite; spinules arranged in 4 transverse bands on ventral surface of anterior part only (Figure 1C). First free abdominal somite similarly bipartite, as long as second and third abdominal somites combined, with row of spinules on ventral surface marking level of division of somite into wide anterior part and narrow posterior extension. Second free abdominal somite longer than anal somite, ornamented with row of spinules along posterior margin, separated from anal somite by zone of folded integument. Anal somite incised medially, with spinules ventrally and laterally on posterior margin. Caudal rami nearly as long as anal somite, ornamented with spinules and pores ventrally; longest caudal seta ornamented with spinules; 2 small ventral setae and longer dorsal seta, all naked. Mean body length 1.19 ± 0.08 mm, range 1.00-1.30 mm ($n = 10$), mean body width 0.39 ± 0.03 mm, range 0.35-0.43 mm ($n = 10$).

Antennule 6-segmented (Figure 2A), tapering distally; first antennular segment bearing 2 setae only; setal formula: 2, 10, 5, 4, 2, 6 + aesthetasc. Aesthetascs not apparent on fourth and fifth segments.

Antenna 4-segmented (Figure 1B), comprising relatively long coxobasis and 3-segmented endopod bearing curved claw. Antennal segments enclosed by loose, cuticular membrane except for distal endopodal segment and claw. Second segment (= first endopodal segment) nearly twice as long as coxobasis; proximal quarter of segment narrower than distal part. Third (= second endopodal) segment curved, with minute seta distally on concave margin; third endopodal segment very small, with 2 minute setae. Second plus third endopodal segments together, comprising just over half length of first. Curved claw fitting into distal socket located in expanded cuticular membrane of first endopodal segment of opposing antenna.

Mandible bearing anterior, middle and posterior blades; anterior blade small with teeth on anterior margin; middle blade with teeth anteriorly and pos-

teriorly; posterior blade with teeth on posterior margin only. Maxillule lobate, bearing 2 long distal setae, minute inner seta and small medial process. Maxilla consisting of large syncoxa tapering distally and small spatula-shaped basis, armed anteriorly with rows of sharp teeth (Figure 2B).

Legs 1-3 (Figures 2C, D; 3A) with rami 3-segmented; leg 4 with both rami 2-segmented. Coxa of leg 1 with outer patch of spinules. Basis of legs 2 and 3 with rows of spinules along inner margin, leg 4 with single row. Outer seta located on posterior surface of basis of all legs. Interpodal sternites spinulate (Figure 1D). Spine and seta formula of legs as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; II,5	0-1; 0-1; II,4
Leg 2	0-0	1-0	I-0; 0-1; 6	0-1; 0-1; I,4
Leg 3	0-0	1-0	I-0; 0-1; 6	0-1; 0-1; I,4
Leg 4	0-0	1-0	0-0; 4	0-1; I,4

All ramal segments except third exopodal segment with 2 rows of spinules on posterior surface, one marginal, one submarginal. Legs 2 and 3 with 2 similar rows on exopodal segments; single row on endopod; both rami of leg 4 with row of coarse spinules along outer margin; setules present on inner margin of first exopodal segment of all legs. Terminal segments of both rami of leg 1 with 2 curved outer spines (Figure 2C). One inner seta only present on second endopodal segment of legs 1 to 3.

Fifth leg 2-segmented, protopodal segment short with outer seta; free exopodal segment with one short lateral seta and 2 terminal naked setae of unequal length (Figure 1E).

Remarks

The new species exhibits an interesting mix of features, some shared with species of *Dermoergasilus*, and others, such as the possession of 2-segmented endopod on leg 4, characteristic of a group of Brazilian species currently placed in *Ergasilus* and of the two known species of *Nipergasilus* Yamaguti, 1939 (see El-Rashidy & Boxshall, 2000). The new species shares with most species of *Dermoergasilus* (see El-Rashidy & Boxshall, 2001b), the presence of interlocking antennae ensheathed with inflated cuticular membrane and, with all *Dermoergasilus*, the presence of only a single inner seta on the second endopodal segment of legs 2 and 3. The relatively elongate genital double-somite and first free abdominal somite also resemble most species of *Dermoergasilus*, although in two members of that genus these somites are unmodified. The new species can be differentiated from

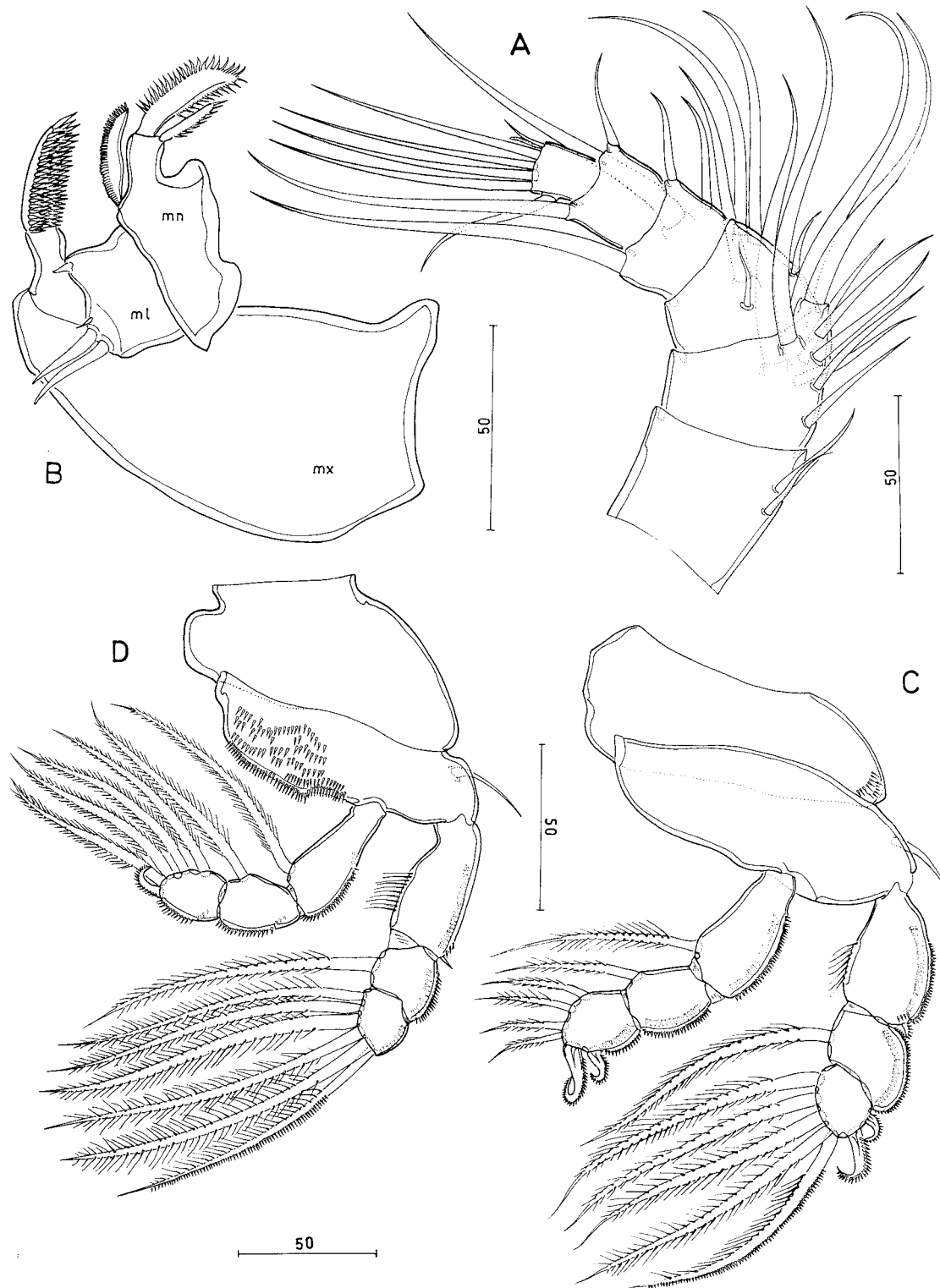


Figure 2. *Ergasilus extensus* n. sp. Adult female. A, antennule; B, mandible (mn), maxillule (ml) and maxilla (mx), ventral; C, first swimming leg, anterior; D, second swimming leg, anterior. Scale-bars in μm .

true *Dermoergasilus* species by the absence of the diagnostic digitiform process on the caudal ramus. In addition the 2-segmented endopod of leg 4 is not found in any *Dermoergasilus* species, all of which retain a 3-segmented ramus.

The new species shares a 2-segmented endopod of leg 4 with the following 11 *Ergasilus* species from Brazil: *E. bryconis* Thatcher, 1981, *E. holobryconis* Malta & Varella, 1986, *E. hypophthalmi* Boeger, Matins & Thatcher, 1993, *E. hydrolochus* Thatcher, Boeger & Robertson, 1984, *E. jaraquensis* Thatcher & Boeger, 1982, *E. iheringi* Tidd, 1942, *E. leporinidis* Thatcher, 1981, *E. triangularis* Malta, 1994, *E. urupaensis* Malta, 1993, *E. yumaricus* Malta & Varella, 1995 and *E. turucuyus* Malta & Varella, 1996. However, the setation of the 2-segmented endopod of leg 4 in the new species is different, comprising an outer spine and four inner setae on the terminal segment, whereas in the Brazilian species group there are five inner setae plus the outer spine. The I,5 setal formula of the Brazilian species is undoubtedly derived from the fusion of the original second (bearing two inner setae) and third endopodal segments (bearing one spine and three setae). The setal formula I,4 of the 2-segmented endopod in the new species probably results from the loss of the proximal seta on the second endopodal segment of leg 4. The loss of this seta is also a synapomorphy of all *Dermoergasilus* species. In addition, the antennae of the new species are interlocking and ensheathed with a cuticular membrane, whereas the Brazilian species have an unmodified antenna. Finally, the endopod of leg 1 of the new species is 3-segmented, whereas in the Brazilian species it is 2-segmented.

The new species shares the 2-segmented rami of leg 4 with *Nipergasilus* species, but differs from them in the form of the endopod of leg 1, which is modified by the elongation of the middle segment in *Nipergasilus* but normal in *E. extensus* n. sp. The unusual bipartite form of the genital double and first free abdominal somites is shared by *E. extensus* n. sp. and *Nipergasilus parabora* El-Rashidy & Boxshall, 2000. Preliminary phylogenetic analysis (El-Rashidy, 1999) suggests that *Dermoergasilus*, *Nipergasilus*, *Ergasilus mosulensis* Rahimo, 1982 and *E. extensus* n. sp. form a monophyletic group defined, in part, by the loss of the proximal inner seta originating on the second endopodal segment of legs 2 to 4.

The new species shares with *E. acusicestraeus* El-Rashidy & Boxshall, 1999 from Papua New Guinea, the interlocking ensheathed antenna, the relatively

elongate urosome and the plesiomorphic leg 5 bearing three setae on a well-developed exopodal segment. However, it differs from *E. acusicestraeus* in the presence of only a single inner seta on the second endopodal segment of legs 2 and 3 rather than two, and in having a 2-segmented rather than 3-segmented endopod on leg 4.

Ergasilus sittangensis n. sp.

Type-material: Female holotype (BMNH Reg. No. 1999. 1426); three female paratypes (BMNH Reg. Nos 1999. 1427-1429).

Type-host and locality: *Sicamugil hamiltoni* (Day), Sittang River, Burma.

Etymology: The specific name refers to the type locality.

Description of adult female (Figures 3B-E, 4A-D, 5A-E)

Cephalothorax oblong (Figure 3B); first pedigerous somite not incorporated into cephalothorax. Mean body length 0.78 ± 0.05 mm; mean body width 0.24 ± 0.04 mm ($n = 4$). Dorsal surface of cephalic shield ornamented with inverted T-shaped marking. Free second to fourth pedigerous somites narrowing posteriorly. Genital double-somite (Figure 3C) wider than long, ornamented with 5 rows of spinules ventrally. First free abdominal somite slightly longer than second. Urosomites separated by zone of folded cuticle. Anal somite smaller than second somite, deeply incised. Posterior margin of each abdominal somite ornamented with spinule row(s). Caudal rami 1.7 times longer than anal somite, irregular rows of spinules present ventrally: medial caudal seta longest, armed with spinules, longer of lateral setae sparsely plumose.

Antennule (Figure 4A) 6-segmented; setal formula 3, 13, 5 + aesthetasc, 4 + aesthetasc, 2 + aesthetasc, 7 + aesthetasc.

Antenna 4-segmented (Figure 5B), with short coxobasis armed with inner seta; second segment (= first endopodal segment) nearly twice as long as coxobasis, armed with peg seta near mid-point of inner margin. Third (= second endopodal) segment curved, with minute spines proximally and distally on concave margin; third endopodal segment very small, bearing minute seta anteriorly (Figure 5C). Second plus third endopodal segments together, comprising

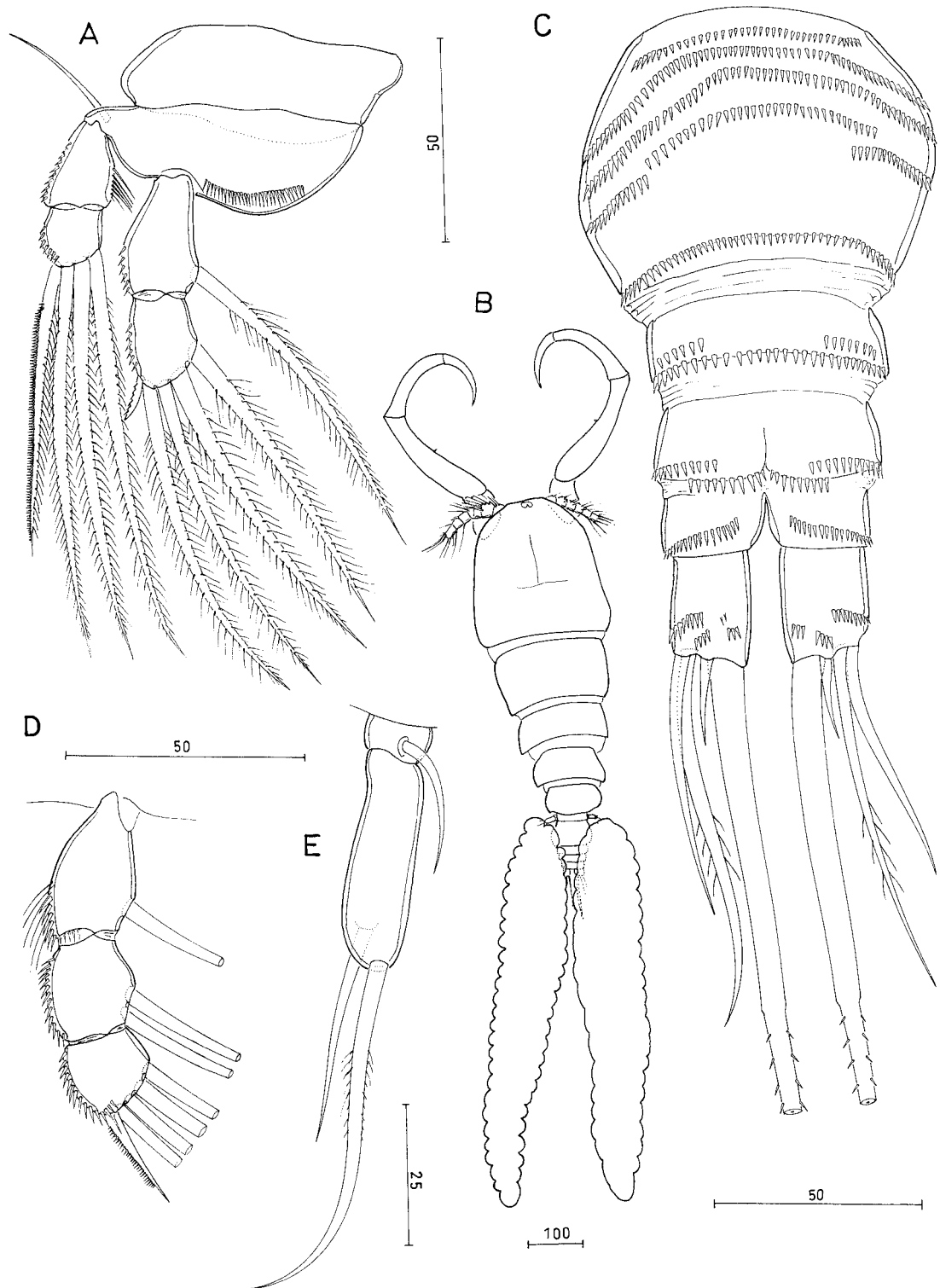


Figure 3. *Ergasilus extensus* n. sp. Adult female. A, fourth swimming leg, anterior. *E. sittangensis* n. sp. Adult female. B, dorsal view; C, posterior part of urosome, ventral view showing ornamentation; D, endopod of third swimming leg, anterior; E, fifth swimming leg. Scale-bars in μm .

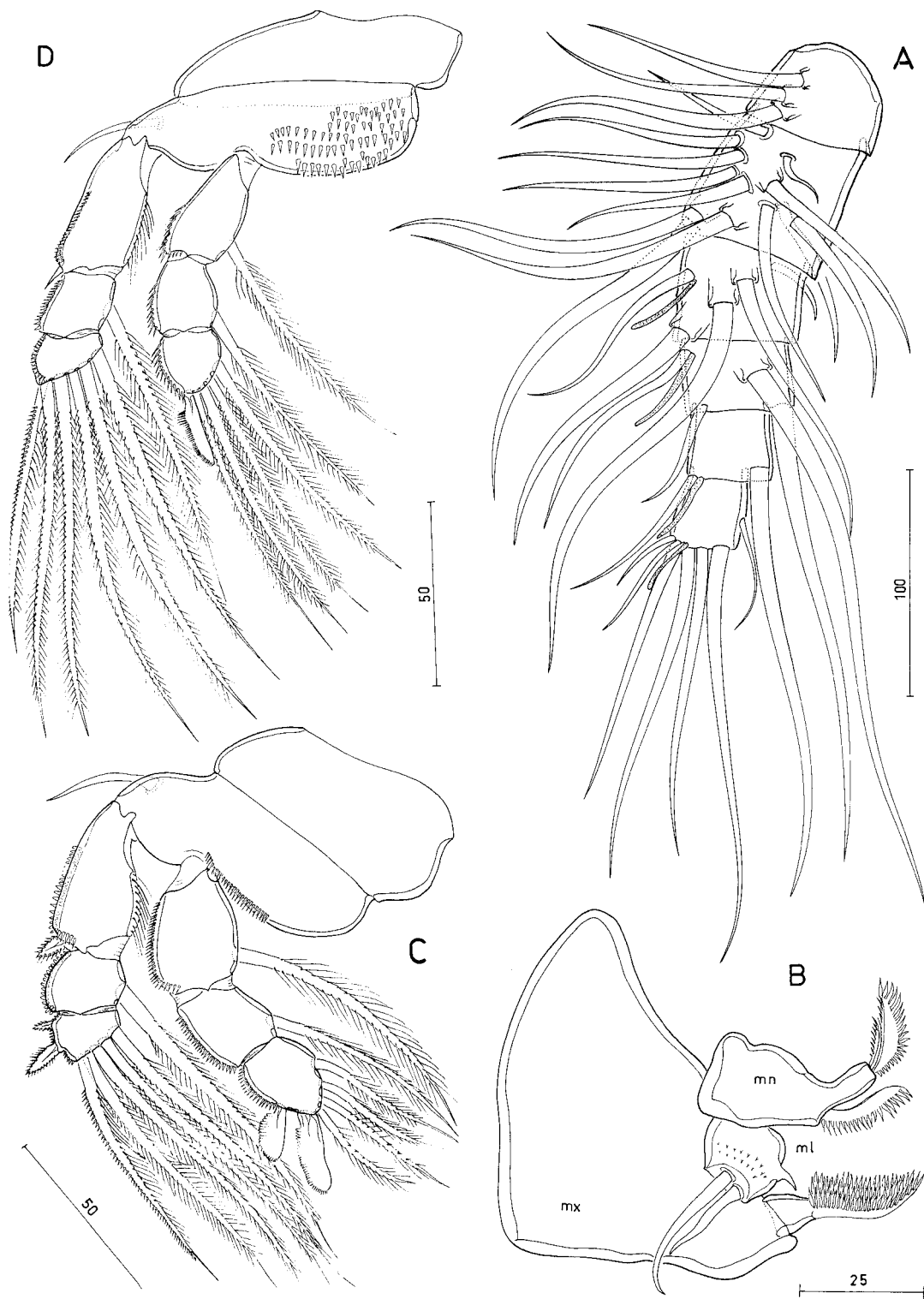


Figure 4. *Ergasilus sittangensis* n. sp. Adult female. A, antennule, B, mandible (mn), maxillule (ml) and maxilla (mx), ventral; C, first swimming leg, anterior; D, second swimming leg, anterior. Scale-bars in μm .

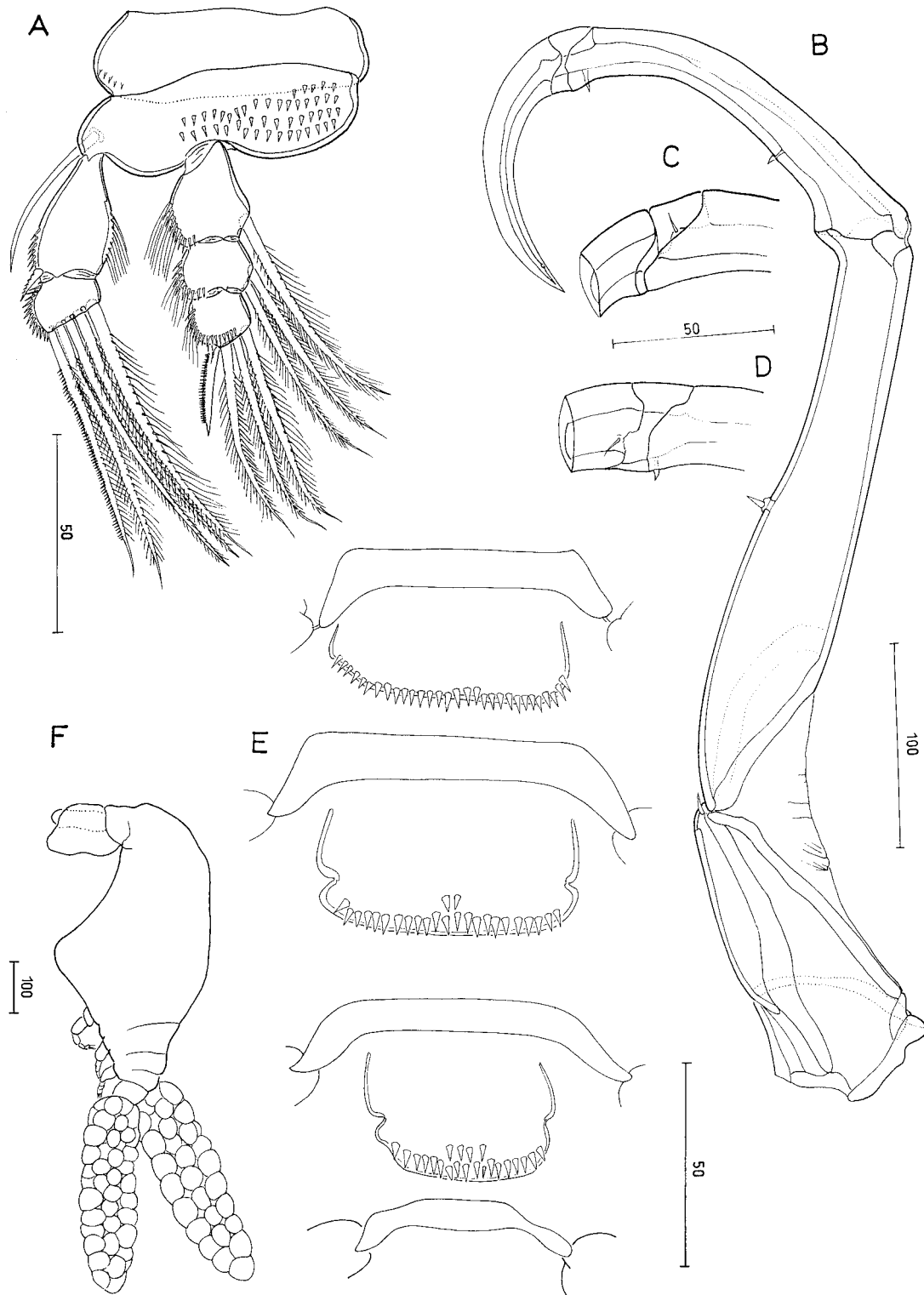


Figure 5. *Ergasilus sittangensis* n. sp. Adult female. A, fourth swimming leg, anterior; B, antenna; C, third endopodal segment of antenna, anterior; D, third endopodal segment of antenna, posterior; E, interpodal sternites of swimming legs. *E. piriformis* n. sp. Adult female, F, lateral view. Scale-bars in μm .

nearly 75% of first endopodal segment length. Terminal claw strongly recurved, nearly 3/4 length of second plus third endopodal segments, minute seta present posteriorly at base of claw (Figure 5D).

Mouthparts as in Figure 4B. Mandible bearing anterior, middle and posterior blades: anterior blade small with teeth on anterior margin; middle blade with teeth anteriorly and posteriorly; posterior blade with teeth on posterior margin. Maxillule lobate, bearing 2 outer setae and small medial process; surface ornamented with minute spinules. Maxilla consisting of large syncoxa, tapering distally, and small spatula-shaped basis ornamented anteriorly with rows of sharp teeth.

Swimming legs 1-4 (Figures 3A; 4C, D; 5A) with all rami 3-segmented, except 2-segmented exopod of leg 4. Basis with row(s) of spinules along inner margin of leg 1 and over inner anterior surface of legs 2 to 4, with outer seta on posterior surface of all legs. Lateral margins of both rami spinulate and setules present on inner margin of first exopodal segment of all legs. Setules present on outer margin of first endopodal segments of legs 2 and 3, and on all endopodal segments of leg 4. Distal and outer spines on endopod of leg 1 spatulate (Figure 4C). Posterior margins of interpodal sternites ornamented with large conical spinules (Figure 5E). Armature formula as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; II,5	0-1; 0-1; II,4
Leg 2	0-0	1-0	I-0; 0-1; 6	0-1; 0-1; I,4
Leg 3	0-0	1-0	I-0; 0-1; 6	0-1; 0-2; I,4
Leg 4	0-0	1-0	I-0; 5	0-1; 0-2; I,3

Fifth leg 2-segmented; protopodal segment short, with outer seta; free exopodal segment with 2 terminal setae of unequal length (Figure 3E).

Remarks

The new species is characterised by the loss of one (the proximal) seta from the second endopodal segment of leg 2 in combination with the retention of two setae on the same segment of both legs 3 and 4. On the basis of published descriptions, this character is shared with only five other species in the genus: *E. polynemi* Redkar, Rangnekar & Murti, 1952 from India, *E. mirabilis* Oldewage & van As, 1986 from South Africa, *E. monodi* Brian, 1927 from Africa, and *E. bagarii* Kuang, 1983 and *E. leiocassi* Xu, 1987 from China. The new species differs from *E. polynemi* in the shape of the cephalothorax and in the setation of the terminal segments of both rami of all legs. It differs from *E. mirabilis* in the setation of the swimming legs

and the modification of the proximal part of the second endopodal segment of the antenna. The new species shares with *E. monodi* an oblong cephalothorax and has the same setation of legs 2-4, but they differ in antennular setation, in the absence of an outer spine from the second exopodal segment of leg 1 (present in *E. monodi*) and in the presence of only two terminal setae on the free exopodal segment of leg 5 compared to three setae in *E. monodi*.

The reduced leg 5 of *E. bagarii* is represented by a basal seta and an apical (probably exopodal) seta on a large papilla and serves to distinguish it from the new species in which it is 2-segmented with a basal seta and two terminal setae. *E. leiocassi* is similar to the new species in possessing a distinct first pedigerous somite and in retaining two terminal setae on leg 5. However, *E. leiocassi* has an outer spine on the terminal exopodal segments of legs 2, 3 and 4, which is lacking in the new species. In addition, the second endopodal segment of the antenna is only two-thirds the length of the first in *E. leiocassi*, compared to three-quarters in the new species.

Ergasilus piriformis n. sp.

Type-material: Female holotype (BMNH Reg. No. 1999. 1430); 10 female paratypes (BMNH Reg. Nos 1999. 1431-1440).

Type-host and locality: *Sicamugil cascasia* (Hamilton Buchanan), Calcutta

Other records: *S. cascasia* from Delhi.

Etymology: The specific name refers to the pear-shaped cephalothorax.

Description of adult female (Figures 5F, 6A-F, 7A-D, 8A,B)

Cephalothorax inflated, pear-shaped (Figures 5F, 6A); tergite of first pedigerous somite conspicuous dorsally on posterior part of cephalothorax. Mean body length 0.68 ± 0.02 mm, mean body width 0.33 ± 0.02 mm ($n = 5$). Dorsal cephalic shield ornamented with circular and inverted T-shaped markings. Rostrum ornamented ventrally with 4 sensilla and 3 integumental pores (Figure 6C). Second to fourth pedigerous somites narrowing posteriorly. Genital double-somite (Figure 7A) subspherical, wider than long; just longer than free abdominal somites and caudal rami combined; ornamented ventrally with 2 curved rows of spinules near posterior margin. Second and third abdominal somites

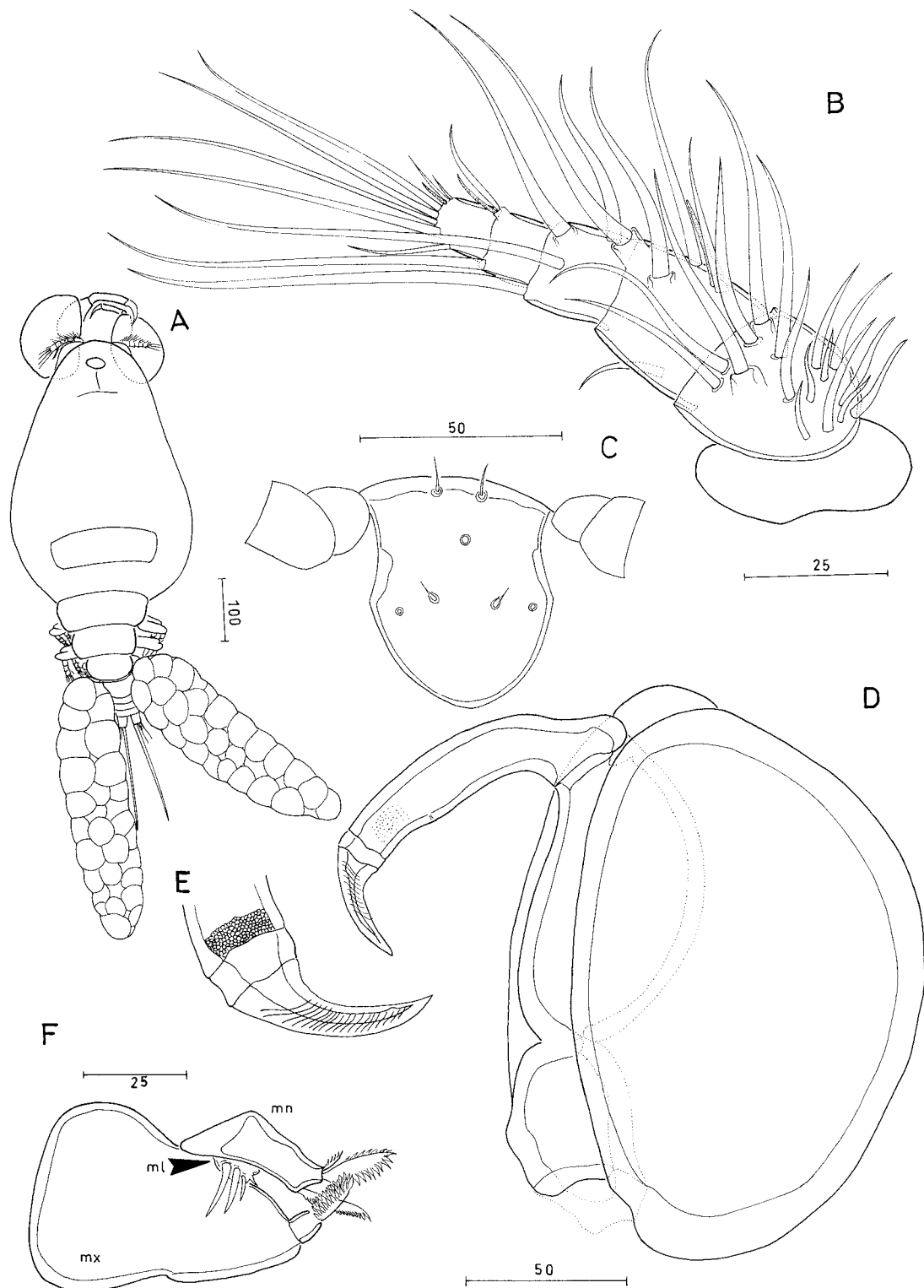


Figure 6. *Ergasilus piriformis* n. sp. Adult female. A, dorsal view of ovigerous female; B, antennule; C, rostrum, ventral; D, antenna, posterior view; E, detail of striations on claw; F, mandible (mn), maxillule (ml) and maxilla (mx), ventral. Scale-bars in μm .

similar in length; second with posterior row of widely-spaced, with minute spinules. Anal somite deeply incised, ornamented with paired rows of spinules ventrally. Caudal rami 1.3 times longer than anal somite, ornamented with 2 oblique rows of spinules, caudal setae apparently naked.

Antennule (Figure 6B) 5-segmented, located on small pedestal; setal formula 16, 5 + aesthetasc, 4, 2 + aesthetasc, 7 + aesthetasc.

Antenna (Figure 6D) 4-segmented, with short coxobasis bearing large, inflated, subspherical process extending laterally around entire coxobasis and first endopodal segment. First endopodal segment nearly twice as long as coxobasis. Second endopodal segment with pitted cuticle distally. Third endopodal segment very short, unarmed. Second and third endopodal segments together constituting 92% of first endopodal segment length. Claw small, surface ornamented with diagonal striations (Figure 6E).

Mouthparts (Figure 6F): mandible bearing anterior, middle and posterior blades; anterior blade small, with teeth on anterior margin; middle blade with teeth anteriorly and posteriorly; posterior blade with teeth on posterior margin only. Maxillule lobate, bearing 3 outer setae and small process medially. Maxilla consisting of large syncoxa tapering distally and small spatulate basis, armed anteriorly with rows of sharp teeth.

Swimming legs 1-4 (Figures 7B, 8A, B) with all rami 3-segmented, except 2-segmented exopod of leg 4. Coxa with outer row of spinules in leg 1 and outer patch of spinules in legs 2 and 3. Basis of each leg ornamented with row of spinules along inner margin and bearing outer seta on posterior surface. Lateral margins of both rami spinulate. Setules present on inner margin of first exopodal segment of all legs and on outer margin of endopodal segments 1 and 2 of all legs. Posterior margin of interpodal sternites ornamented with 3 or 2 rows of conical spinules (Figure 7C). Spine and seta formula as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; I,5	0-1; 0-1; II,4
Leg 2	0-0	1-0	I-0; 0-1; 6	0-1; 0-1; I,4
Leg 3	0-0	1-0	I-0; 0-1; 6	0-1; 0-1; I,4
Leg 4	0-0	1-0	0-0; 5	0-1; 0-2; I,3

Leg 5 represented by papilla bearing single seta (Figure 7D).

Remarks

This species is characterised by the following combination of characters: 5-segmented antennule carried on

a pedestal, the massive lateral process on the antenna extending to the distal end of the first endopodal segment, and a single inner seta on the second endopodal segment of legs 2 and 3. In addition, leg 5 is represented by a single seta borne on a papilla. The derived form of the antenna, with an inflated lateral process on the coxobasis, is shared with the following 12 species from North America: *E. auritus* Markevich, 1940, *E. cotti* & Kellikott, 1892, *E. cyprinaceus* Rogers, 1969, *E. luciopercarum* Henderson, 1926, *E. wareaglei* Johnson, 1971, *E. lanceolatus* Wilson, 1914, *E. centrarchidarum* Wright, 1882, *E. nerkae* Roberts, 1963, *E. caeruleus* Wilson, 1911, *E. labracis* Krøyer, 1863, *E. manicatus* Wilson, 1911 and *E. turgidus* Frazer, 1920. Among these only *E. cyprinaceus* and *E. manicatus* possess such an enormous process; in all others it is much smaller. All 12 of these species differ from the new species in possessing a 6-segmented antennule and in retaining two inner setae on the second endopodal segment of legs 2 and 3.

An inflated coxobasis on the antenna is also found in the following Eurasian species: *E. plecoglossi* Yamaguti, 1939, *E. gibbus* Nordmann, 1832, *E. tumidus* Markevich, 1940, *E. gobiolum* Markevich, 1967, *E. orientalis* Yamaguti, 1939, *E. rotundicarpus* Jones & Hine, 1983 and *E. wilsoni* Markevich, 1933. The first four of these species have only one seta on the second endopodal segment of legs 2 and 3; but they differ from the new species in retaining a 6-segmented antennule. *E. orientalis* from Japan and Australia and *E. rotundicarpus* from the Philippines resemble the new species in the inflated cephalothorax, the small urosome and the diagonal striations on the antennary claw. However, the antennule is 6-segmented and the lateral process on the antenna extends only midway along the second segment. *E. wilsoni* is the only species that shares a 5-segmented antennule with the new species, but the posterior process on the antennary coxobasis is very small and the second endopodal segment of leg 2 retains two inner setae.

Ergasilus ecuadorensis n. sp.

Type-material: Female holotype (BMNH Reg. No. 1999.1452); 7 female paratypes (BMNH Reg. Nos 1999.1453-1459).

Type-host and locality: *Mugil curema* Valenciennes, Ecuador.

Other records: *Mugil hospes* Jordan & Culver, Ecuador

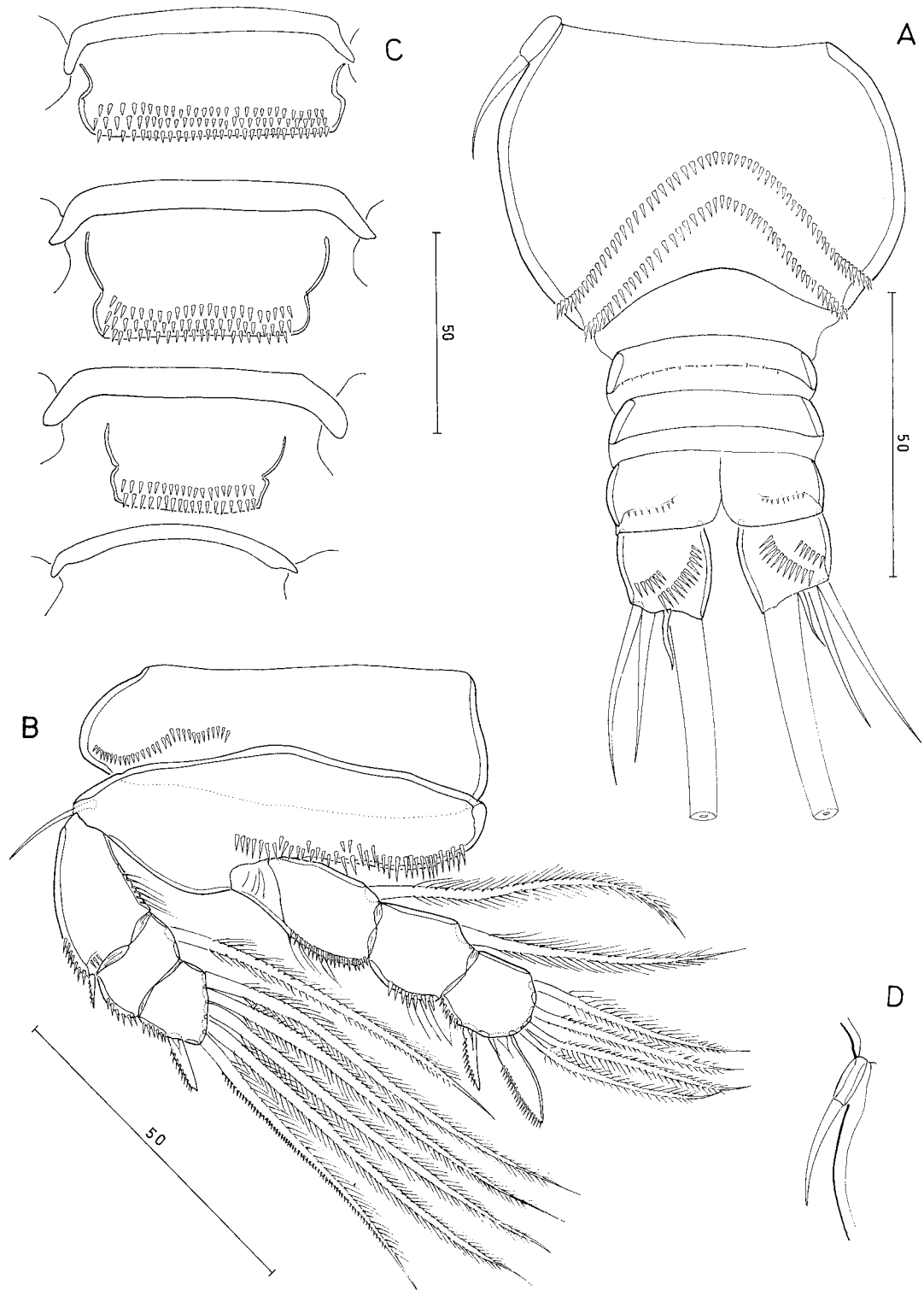


Figure 7. *Ergasilus piriformis* n. sp. Adult female. A, urosome, ventral view showing ornamentation; B, first swimming leg, anterior; C, interpodal sternites of swimming legs; D, fifth leg. Scale-bars in μm .

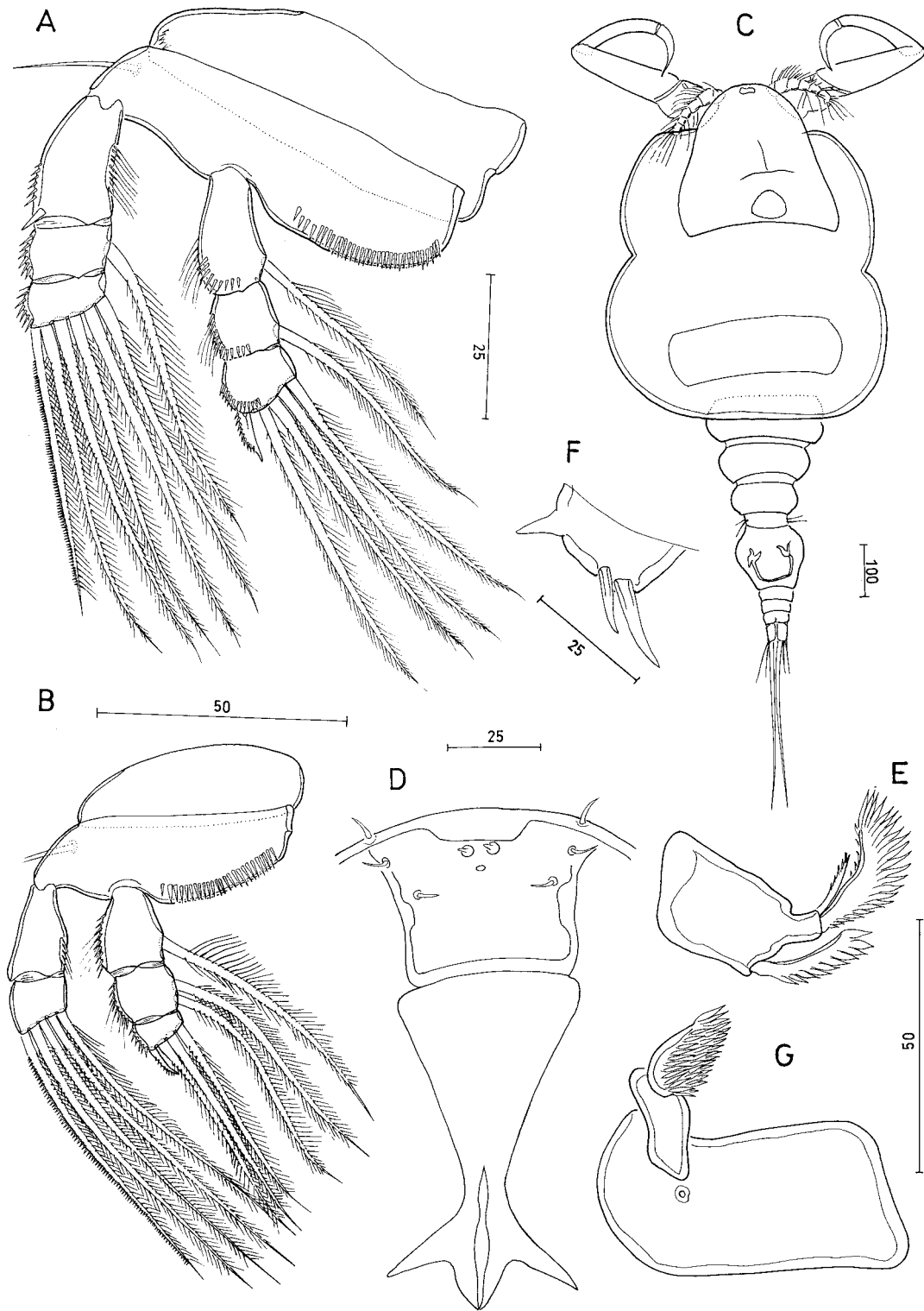


Figure 8. *Ergasilus piriformis* n. sp. Adult female. A, second swimming leg, anterior; B, fourth swimming leg, anterior. *E. ecuadorensis* n. sp. Adult female. C, dorsal view; D, rostrum, ventral; E, mandible, ventral; F, maxillule, ventral; G, maxilla, ventral. Scale-bars in μm .

Description of adult female (Figures 8C-G, 9A-E, 10A-C, 11A)

Cephalothorax inflated, violin-shaped (Figure 8C); first pedigerous somite delimited only by constriction but dorsal tergite retained. Mean body length 1.06 ± 0.06 mm; mean body width 0.47 ± 0.04 mm ($n = 8$). Dorsal surface of cephalic shield ornamented with circular and inverted T-shaped markings. Free second to fourth pedigerous somites narrowing posteriorly. Rostrum subquadrate anteriorly, with 8 sensilla; posterior part wedge-shaped (Figure 8D). Patches of blue and violet pigment scattered on cephalothorax, legs and urosome. Genital double-somite (Figure 9A) barrel-shaped, longer than wide; 9 rows of spinules present ventrally. First free abdominal somite slightly longer than second. Anal somite smaller than second somite, deeply incised. Posterior margin of each abdominal somite ornamented with spinule row. Caudal rami 1.5 times longer than anal somite; all caudal setae apparently unarmed.

Antennule (Figure 9B) 6-segmented; first and second antennular segments partially fused anteriorly but distinct posteriorly (see inset Figure 9C); setal formula 1, 11, 5, 4, 2 + aesthetasc, 6 + aesthetasc.

Antenna 4-segmented (Figure 9D), with short coxobasis; second segment (= first endopodal segment) nearly twice as long as coxobasis, armed with curved peg seta near mid-point of inner margin. Third (= second endopodal) segment curved, with minute setae proximally (see inset Figure 14B) and distally on concave margin; third endopodal segment very small, bearing minute seta anteriorly. Second plus third endopodal segments together, about 80% as long as first segment. Terminal claw strongly recurved, nearly 3/4 length of third segment; fossa located near tip (arrowed in Figure 9D).

Mandible (Figure 8E) bearing anterior, middle and posterior blades: anterior blade small with slender teeth on anterior margin; middle blade with teeth anteriorly and posteriorly; posterior blade with large teeth on posterior margin. Maxillule lobate bearing 2 long distal setae and small process medially (Figure 8F). Maxilla consisting of large syncoxa, tapering distally, and small spatulate basis, armed anteriorly with rows of sharp teeth (Figure 8G).

Swimming legs 1-4 (Figures 10A,B; 11A) with all rami 3-segmented, except endopod of leg 1 and exopod of leg 4 which are 2-segmented. Outer seta present on posterior surface of basis of all legs. Lateral margins of both rami spinulate. Setules present on inner

margin of first exopodal segment of all legs and on outer margin of endopodal segments of legs 2-4. First endopodal segment of leg 1 with modified outer margin produced into obtuse process, ornamented with spinules distal to process. Distal spines on terminal endopodal segment of leg 1 curved; inner setae reduced. Setae on swimming legs armed with pinnules and setules. Posterior margins of interpodal sternites ornamented with large conical spinules (Figure 10C). Spine and seta formula as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	1-0; 0-1; II,5	0-1; II,5
Leg 2	0-0	1-0	1-0; 0-1; I-6	0-1; 0-2; I,4
Leg 3	0-0	1-0	1-0; 0-1; I-6	0-1; 0-2; I,4
Leg 4	0-0	1-0	0-0; I,5	0-1; 0-2; I,3

Fifth leg represented by 2 papillate setae (Figure 9E).

Remarks

The new species is characterised by the presence of a 2-segmented endopod of leg 1, only a single seta on the first antennular segment and the possession of an inflated, violin-shaped cephalothorax. It shares the presence of a single seta on the first antennular segment with 17 *Ergasilus* species from South America and four *Ergasilus* species from North America. The new species is particularly close to *E. cerastes* Roberts, 1969 from Florida, *E. versicolor* Wilson, 1911 from Indiana, *E. pitalicus* Thatcher, 1984 from Colombia and *E. cyanopictus* Carvalho, 1962 from Sao Paulo, Brazil, since they all share most of these features and, in addition, have the same segmentation and setation formula of the swimming legs.

The new species differs from *E. cerastes* in the shape of the cephalothorax, which is more inflated than in *E. cerastes*, and in the presence of three setae, rather than one, on the first antennular segment in *E. cerastes* (cf. Roberts, 1969). This latter character should be verified in *E. cerastes*. The new species differs from *E. versicolor* mainly in the shape of the antenna and the cephalothorax.

The new species differs from *E. pitalicus* in the antenna, the second endopodal segment being relatively longer in *E. pitalicus*, with the claw about half as long as the second endopodal segment.

E. cyanopictus is the most closely related to the present species, since they share the following characters: inflated cephalothorax, elongate rostrum and the armature of the swimming legs. *E. cyanopictus*, as re-described below, differs from the new species in the following antennal characters: the membrane between coxobasis and first endopodal segment of the antenna

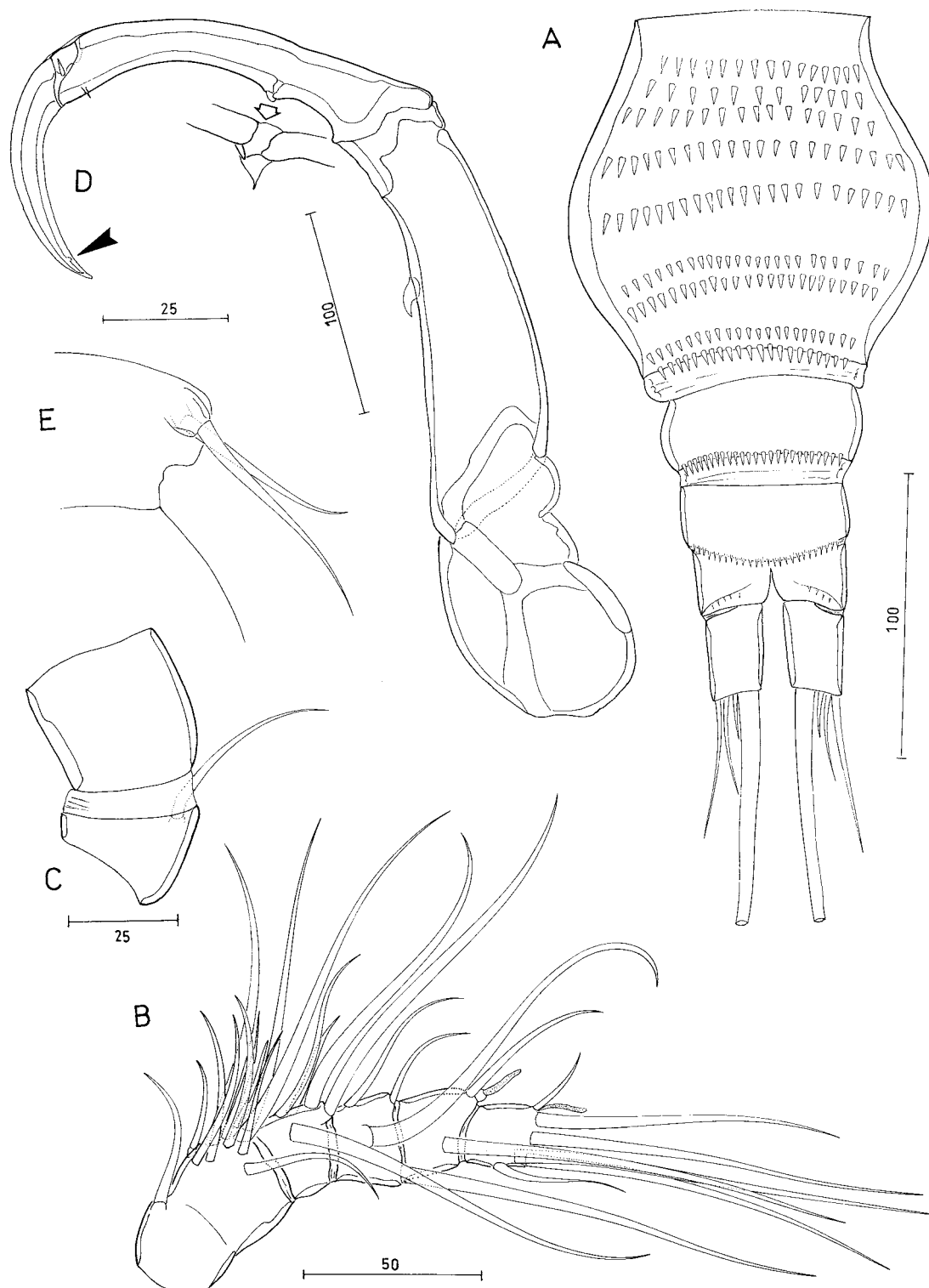


Figure 9. *Ergasilus ecuadorensis* n. sp. Adult female. A, posterior part of urosome, ventral view showing ornamentation; B, antennule, anteroventral view; C, detail of antennule showing partial expression of segmental articulation on posterior surface; D, antenna, with inset showing detail of proximal sensory element on second endopodal segment, fossa in claw arrowed; E, fifth leg. Scale-bars in μm .

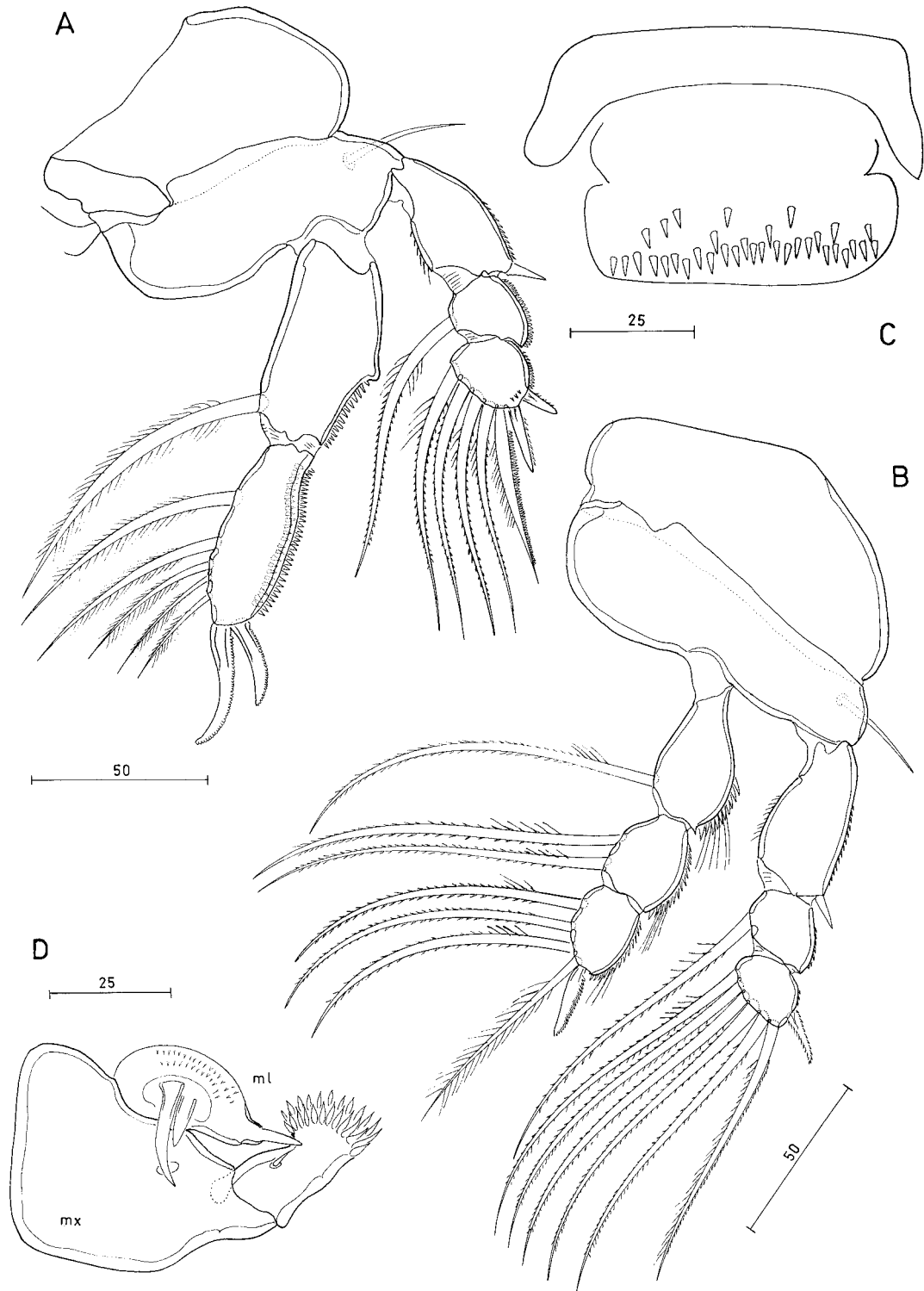


Figure 10. *Ergasilus ecuadorensis* n. sp. Adult female. A, first swimming leg, anterior; B, second swimming leg, anterior; C, interpodal sternite of second leg. *E. cyanopictus*. Adult female. D, maxillule (ml) and maxilla (mx), ventral. Scale-bars in μm .

is inflated; the first endopodal segment is relatively wider than that of the new species; the proximal spinule on the concave margin of the second endopodal segment is simple and located closer to the proximal end of the segment; and the claw is longer, attaining more than 85% of the length of second endopodal segment.

Ergasilus cyanopictus Carvalho, 1962

Material

Numerous females were collected from *Mugil cephalus* at Rio Grande do Sul, Brazil. The original description was incomplete and lacking many details, which are given below.

Supplementary description of adult female (Figures 10D, 11A-E, 12A-D)

Cephalothorax violin-shaped; cephalic shield produced anteriorly into frontal region, carrying antennules and antennae (Figure 11B). Rostrum long; anterior part subquadrate, with 2 long and 2 small sensilla; posterior part wedge-shaped (Figure 11C).

Antennule 6-segmented; setal formula 1, 11, 5, 4, 2 + aesthetasc, 7 + aesthetasc (Figure 12B).

Antenna 4-segmented (Figure 12C), with membrane between coxobasis and first endopodal segment, slightly inflated. Peg seta located about 2/3 of distance along inner margin of first endopodal segment; minute seta present proximally and another distally on concave margin of second endopodal segment. Third endopodal segment very small with minute seta anteriorly. Claw long, attaining about 85–90% of length of second plus third endopodal segments combined. Maxillule and maxilla as in Figure 10D.

Swimming legs with all rami 3-segmented, except 2-segmented endopod of leg 1 (Figure 11D) and exopod of leg 4. Outer seta present on posterior surface of basis of all legs. Setules present on inner margins of first exopodal segment of all legs and on outer margins of endopodal segments of legs 2–4. Interpodal sternites 2 and 3 ornamented with conical spinules along posterior margins (Figure 12D). Spine and seta formula as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; II,5	0-1; II,5
Leg 2	0-0	1-0	I-0; 0-1; I,6	0-1; 0-2; I,4
Leg 3	0-0	1-0	I-0; 0-1; I,6	0-1; 0-2; I,4
Leg 4	0-0	1-0	0-0; I,5	0-1; 0-2; I,3

Leg 5 represented by 2 setae, one carried on papilla (Figure 11E).

Remarks

This species was originally described from *Mugil cephalus* (as *M. platanus*) collected in the Rio Nóbrega, in the south of Sao Paulo State, Brazil, near the coast (Carvalho, 1962). This species is quite common in southern Brazil. It was treated as a synonym of *E. versicolor* by Boxshall & Montù (1997), following the proposals of Roberts (1969) and Kabata (1988). However, the discovery of new material indicates that *E. cyanopictus* is a valid species, distinguished from *E. versicolor* by the following characters: the inflated cephalothorax; the membrane between coxobasis and first endopodal segment of the antenna is slightly inflated; and the claw of the antenna is relatively longer, attaining more than 85% of the length of the second endopodal segment.

Ergasilus magnicornis Yin, 1949

Material

Two specimens were found on *Liza subviridis* from Madras.

Supplementary description of adult female (Figure 13A-F)

Mean body length 0.69 mm; mean body width 0.31 mm. Cephalothorax oval; dorsal cephalic shield ornamented anteriorly with circular and inverted T-shaped markings (Figure 13A). Rostrum with 4 integumental pores and 9 sensilla (Figure 13B). Urosomites ornamented with spinules ventrally (Figure 13C). Antennule 6-segmented; setal formula 3, 13, 5 + aesthetasc, 4 + aesthetasc, 2 + aesthetasc, 7 + aesthetasc. Antenna 4-segmented, with membrane between coxobasis and first endopodal segment slightly inflated and claw ornamented with diagonal surface striations (Figure 13D). Labrum with small teeth (Figure 13E). Basis of maxilla armed with spinulate seta (arrowed in Figure 13F). Spine and seta formula of swimming legs as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; II,5	0-1; 0-1; II,4
Leg 2	0-0	1-0	I-0; 0-1; I,6	0-1; 0-2; I,4
Leg 3	0-0	1-0	I-0; 0-1; I,6	0-1; 0-2; I,4
Leg 4	0-0	1-0	I-0; I,5	0-1; 0-2; I,3

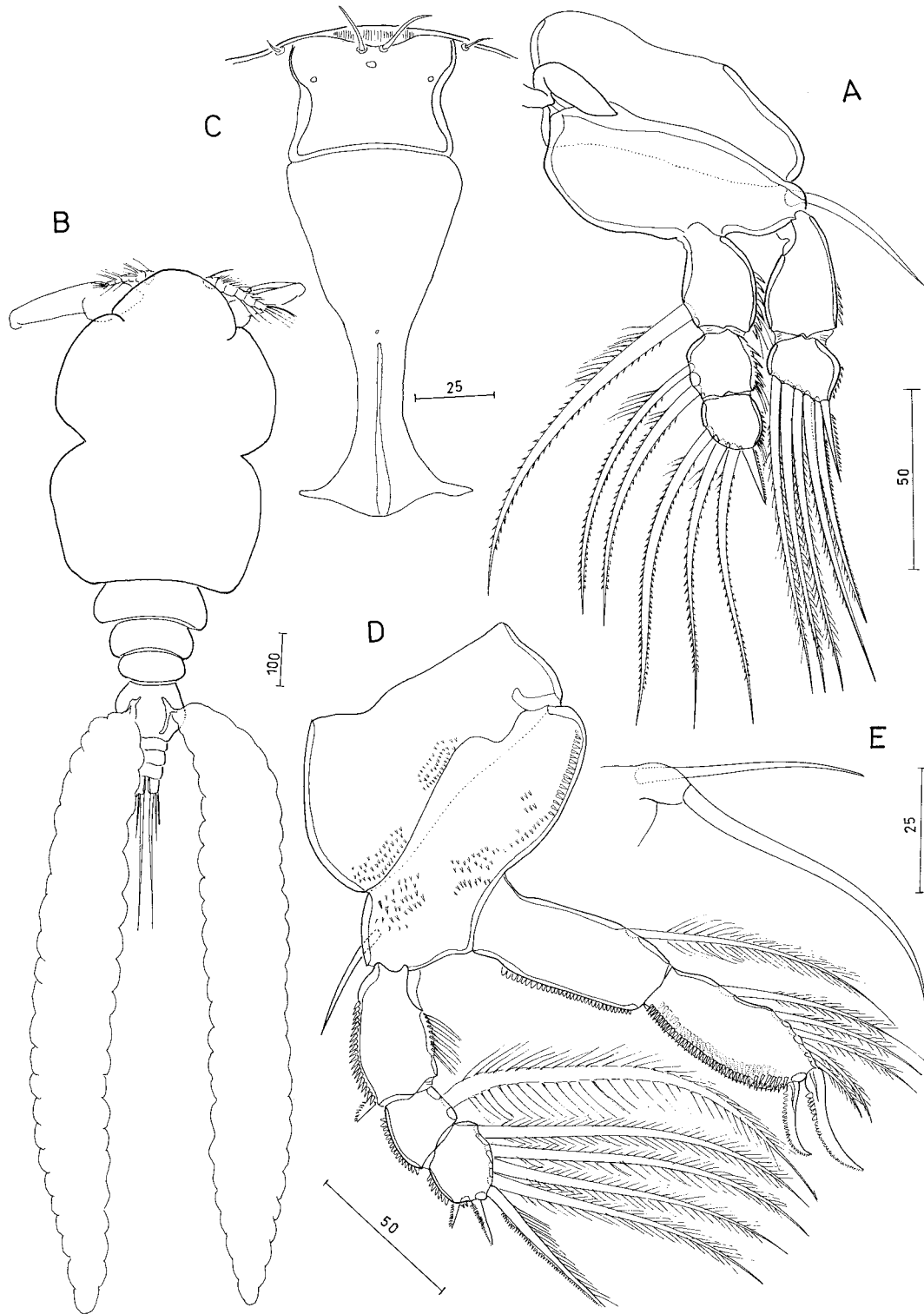


Figure 11. *Ergasilus ecuadorensis* n. sp. Adult female. A, fourth swimming leg, anterior. *E. cyanopictus*. Adult female. B, dorsal view; C, rostrum, ventral; D, first swimming leg, anterior; E, fifth leg. Scale-bars in μm .

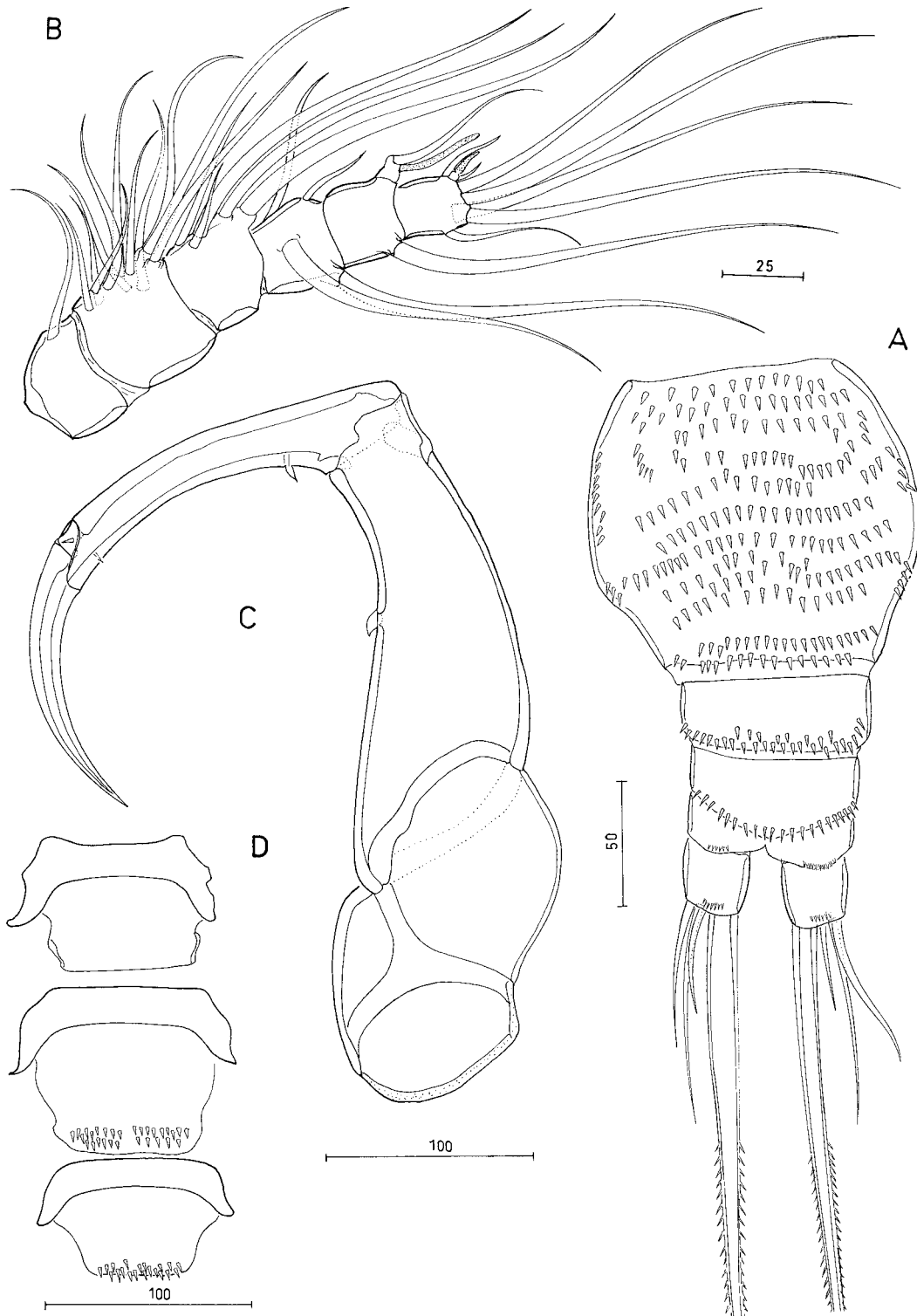


Figure 12. *Ergasilus cyanopictus*. Adult female. A, posterior part of urosome, ventral view showing ornamentation; B, antennule; C, antenna; D, interpodal sternites, ventral. Scale-bars in μm .

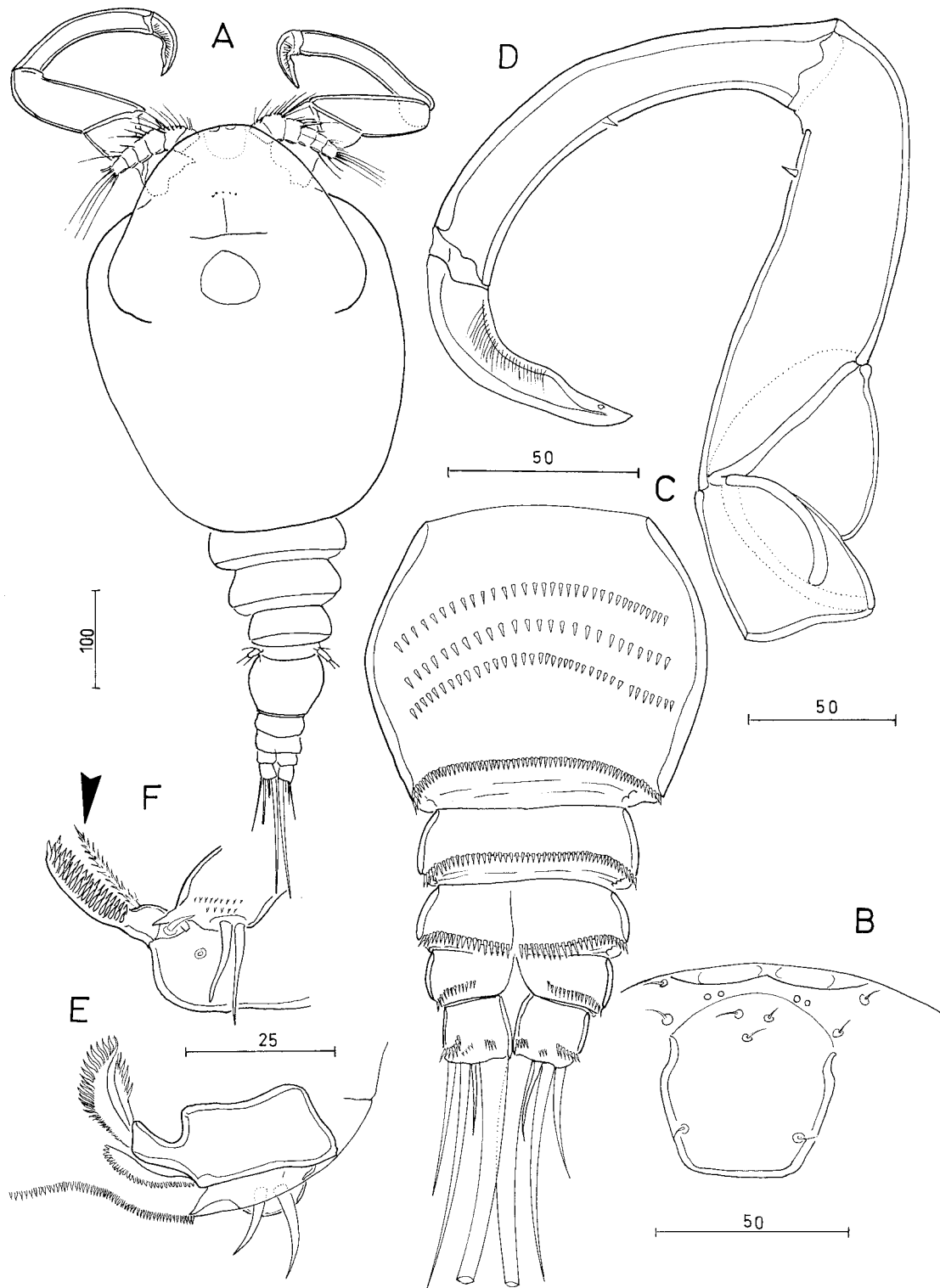


Figure 13. *Ergasilus magnicornis*. Adult female. A, dorsal view, anterior; B, rostrum, ventral; C, urosome; D, antenna; E, labrum, mandible and maxillule; F, maxillule and maxilla (with spinulate seta on basis of maxilla arrowed). Scale-bars in μm .

Leg 5 comprising incorporated protopod bearing outer seta and free exopodal segment bearing small lateral seta and 2 longer setae.

Remarks

This species was first described from the gills of *Carassius carassius* (Linn.) collected from Chinese fishponds (Yin, 1949). It was recorded again in China by Yin (1956) and Kuang & Qian (1991) and from Russia by Gusev (1987). The new record is the first from a mugilid host. The distinctive striated surface of the antennal claw is a useful diagnostic character for this species.

Ergasilus orientalis Yamaguti, 1939

Material: Twenty females of *E. orientalis* were found on *Liza vaigiensis* (Quoy & Gaimard) (as *Liza vaigiensis* Seale) from Tahiti and twelve females on *Valamugil engeli* (as *L. engeli*) from Sydney, Australia. The range of body lengths is 0.60 to 0.72 mm, and the range of body widths is 0.22 to 0.30 mm. The setal formula of the terminal endopodal segment of leg I is II,4, whereas the previous records showed II,3.

Remarks

This species was first described by Yamaguti (1939) from fishes belonging to the families Gobiidae and Atherinidae collected in Japanese waters. Cressey & Collette (1970) subsequently recorded *E. orientalis* from needle fishes (Belonidae) from Australia and Brazil (near the mouth of the Amazon River).

Ergasilus rostralis Ho, Jayarajan & Radhakrishnan, 1992

Material:

E. rostralis was recorded here on three species of grey mullet: *Liza parsia*, *L. subviridis*, *V. cunnesius*. The present material has a mean body length of 0.66 (range 0.61-0.69) mm and mean body width of 0.28 (range 0.24-0.30) mm. These measurements are slightly smaller than those reported by Ho et al. (1992). The localities for the new records are: Madras and Calcutta (on *Liza parsia*), Madras and Calcutta (on *L. subviridis*) and Mangalore, Orissa and Sind (on *V. cunnesius*).

Remarks

This species was discovered by Ho et al. (1992) on coastal water fishes from Kerala, India. They recorded it on three species of grey mullet: *Liza tade* from Veli Lake (estuarine), Trivandrum; *L. macrolepis* (Smith) from Neendakara (estuarine), Quilon; and *Valamugil seheli* from Veli Lake, Trivandrum, India.

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