

**DESCRIPTION OF SOME ECTOPARASITIC COPEPODS (CRUSTACEA)
ON RED SEA FISHES**

BY

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ABSTRACT

Samples of seven species of marine fish from the gulf of Suez area that adjoining the Red sea were examined for copepod ectoparasites over a period of 30 months from 1997 to 1999 belong to the fish families [Scaridae, Plectorhynchidae, Nemipteridae, Lutjanidae, Lethrinidae, Hemirhamphidae and Serranidae]. The copepods including Hatschekia plectropomi [family:Hatschekidae], Anuretes plectorhynchi & Anuretes heckelli [family:Caligidae], and Ergasilus lizae [family Ergasilidae], were comprehensively described for the first time with light and scanning electron microscopy.

INTRODUCTION

The copepods constitute one of the largest classes of subphylum crustacea. They exhibit an extremely wide diversity in form and mode of life. Copepods may be marine or fresh water, and are found in wide range of habitats, plankton, sediments, cryptic habitats such as forest, litter and water tanks, subterranean habitats, deep-sea vents and anchialine caves as well as associated with plant or animal hosts as commensal or parasite forms (Lamb, 1998). The first review about the family Caliginae in North America was presented by Wilson (1905, 1907a & b and 1932).

A significant contribution to our understanding of the Lernaeids and descriptions of new species of the genera *Ergasilus* and genus *Chonopeltis* was made by Fryer (1956, 1959, 1961a&b, 1964, 1965a,b&c) who studied the fresh water parasitic crustaceans on African

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fishes. He analysed the phylogeny and adaptations of the lernaeids.. Fourteen species of the genus *Ergasilus* von Nordmann were recorded from the African continent mostly from the great lakes of Central Africa (Fryer, 1956; Fryer, 1961), the Congo (Capart, 1944; Fryer, 1964), the Volta River system (Paperna, 1996). Avenant-Oldewage (1991) recorded a new species of *Chonopeltis* (*Branchiura*) from the Kruger National Park. In 1994 Douëllou & Erlwanger recorded two crustaceans from Lake Kariba (Zimbabwe), 46 species of copepods and 29 species of branchiurans recorded from Africa. More recently Paperna (1996) published an update book on the parasitic crustaceans in Africa including species diversity, geographical range, taxonomy, diagnosis, life cycle and biology, epizootology, pathology and control. Yamaguti & Yamasu (1959) described 26 new species of parasitic copepods, three of which represented new genera, from fish on the Japanese Islands. . In the middle east reigion, Kabata & Tareen (1987) described a new species *Caligus kuwaitensis* from Kuwait. Jones (1985) reviewed the genus *Hatscheki* (*Siphonostomatoida*), and recorded 68 *Hatschekia* sp.

The review supported with key for clear identification accompanied with an illustration for each species as well as the interspecies variation. A most recent comprehensive classification of the copepods by Huys & Boxshall (1991) recognized a total of ten orders and introduced a high classification system for the group as a whole. Kabata (1992) doubled the number of *Ergasilus* species (*Copepoda*) known to parasitize Australian fishes by adding five new species. In 1997 Boxshall & Montú, published a handbook about copepods parasitic on Brazilian Coastal Fishes including classification and key to the families.

Ergasilus lizae was collected from Egypt by Wilson (1923a) from *Mugil cephalus*, in France by Delamare Deboutteville & Nunes (1952) and Raibaut & Ben Hassine (1980) and from Israel, by Paperna (1964b).

Finally, in 1999, El Rashidy re-described the *E lizae* (*Poecilostomatoida*) and stated an *E lizae* complex which is composed of four new species in addition to the already existed five species, to make a group of nine species.

In the Red Sea, studies on the parasitic copepods are rarely and poor. Badawy,(1994), recorded *Caligus carangis* on the gills of *Caranx sem* and *Lepeophtheirus lethrini* infesting the gills and skin of *Lethrinus nebulosu* This paper aimed to describe comprehensively parasitic copepods on the Red Sea fish.

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MATERIALS AND METHODS

Collection of fish and parasites

About 1500 fresh fish were collected and kept on ice in an insulated containers before being transferred to the laboratory where examination and isolation of the parasitic crustaceans were carried out immediately.

The body weight, the total length and the sex of each fish were recorded. Gills, skin, fins, anus, eye and nose carefully examined for evidence of external crustacean parasites. The operculum was removed to expose the gill cavity, the arches were transferred to a petri-dish, containing tap water and examined under a dissecting microscope. The location and the number of parasites found on each individual gill were recorded.

The copepod specimens, removed from the infected gills, were identified under light microscopy. They were fixed in neutral buffered formaldehyde at room temperature, and then cleared and dissected in lactophenol. Drawings were made with the aid of a camera Lucida using a differential interference contrast Leitz Wetzlar microscope. Relevant measurements were recorded through a calibrated eyepiece graticule.

Measurements and morphological characters of the copepods were compared with published description and type species in the Natural History Museum in London (UK). Some parasites, including those attached to the gill were prepared for scanning electron microscopy (SEM) by fixation in 3% glutaraldehyde for 2 hours and transferred to 0.1M phosphate buffer (pH 7.2). Specimens were then rinsed in fresh buffer, followed by distilled water (3x5 min changes) and transferred to an ultrasonic cell disrupter to sonicate. Samples were dehydrated through ascending series of ethanol, transferred to acetone; critical pointed dried and mounted on aluminium stubs. Specimens were finally coated with gold and viewed under a Hitachi S-1300 scanning electron microscope.

RESULTS AND DISCUSSION

Parasite list:

Class: Copepoda Milne Edward, 1840

Infraclass: Neocopepoda Huys & Boxshall, 1991

Superorder: Podoplea Giesbrecht, 1882

1- Order: Siphonostomatida Thorell, 1859

A- Family Hatschekiidae Kabata, 1979 Recent

Genus *Hatschekia* Poche, 1902

- *Hatschekia suezi* sp. n.
- *Hatschekia plectropomi* Ho & Dojiri, 1978

B- Family: Caligidae Burmeister, 1835

Genus: *Anuretes* Heller, 1865

- *Anuretes plectorhynchi* Yamaguti, 1936
- *Anuretes heckelii* (Krøyer, 1863)

2- Order: Poecilostomatidae Thorell, 1859

Family: Ergasilidae Burmeister, 1835

Genus: *Ergasilus* von Nordmann, 1832

Ergasilus lizae Krøyer, 1863

Description of the crustacean parasites

***Hatschekia plectropomi* Ho & Dojire 1978**

Hatschekia plectropomi, named and described by Ju-Shey Ho and Masahiro Dojire in 1978. More than hundred individual parasite were investigated in this study *Hatschekia plectropomi* was collected from the gills of the Red Sea fish *Cephalophalis miniata* for the first time, while Badawy (1994) recorded *Hatschekia sigani* from the gills of *Siganus Canaliculatus* from the Mediterranean Sea Egypt coast.

Female body long with flattened ventral surface; head more wide than long, with rounded margin extending posteriorly into trunk, distinct cuticular ribs on dorsal surface.

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(Plate 1a&b; Fig. 1a). First and second pedigerous somites short and completely fused. Third and fourth pedigerous segments completely fused to form a long trunk bearing a prominent lateral swelling on either right or left side (Fig. 1a).

First antenna three-segmented with stout basal portion covered by a semi-transparent membrane. Armature of these segments is 9, 10 and 12+1 (Plate 1c; Fig. 1b; Plate 2a). Second antenna, a strong prehensile apparatus bearing numerous microtubercles on its huge second segment. These tubules appear as minute scales on the surface of cuticle. Terminal segment a simple re-curved hook. Base of second antenna lacking papilla (Plate 1c; Fig. 1c).

Mandible stubby, bearing three stout teeth. Maxilla small consisting of two lobes, each bears two processes (Plate 1d; Fig. 1d). Second maxilla, long, slender, and four-segmented; second and third segments each bear a seta; terminal segment bears a break on its cuticle and a forked tip (Plate 1c; Fig. 1e). Both leg 1 and leg 2 biramous, with two-segmented ramie bearing spinules only on their anterior surface (Plate 1e; Fig. 4a&b; Plate 2b&c).

Armature on these legs as follows:

	propodite	exopodite	endopodite
Leg 1	1-1	1-0,6	0-0,5
Leg 2	1-0	1-0,5	0-1,5

Third leg represented by a small lobe tipped with two plumose setae, and fourth leg with one plumose seta. Genital segment small, attached to ventral surface of trunk. Egg sacs attached to posterodorsal surface of genital segment (Fig. 1a)

Abdomen distinctly more wide than long, bearing a pair of small setules on postero-dorsal surface. Caudal ramus about 3 times bigger in length than in width, armed with 6 unequal setae (3 plumose, 3 naked) (Plate 1f; Fig. 2e; Plate 2d)

The body dimensions measured in μm :

	largest	smallest
Trunk length	1162	928
Trunk width with swelling	415	341
Trunk width without swelling	342	323

Remarks; The most prominent and distinctive characteristic of this specimen is the curious swelling on the body of all the specimens and the fact that the body is curved towards the side where the lateral swelling is formed.

***Anuretes plectorhynchi* Yamaguti, 1936**

Anuretes spp. (*Anuretes plectorhynchi* and *A heckelii*) collected and identified in the present study have not been recorded before in Egypt Meanwhile *Caligus carangis* and *Lepeophtheirus lethrini* were collected From the Red Sea fish by Badawy (1994).

Ten female specimens with broken egg sacs were found on the gills of fish *Plectorhynchus gatinus*. Body 1.5-1.74 mm. long, greyish. Carapace orbicular, 1.15-1.18 mm. long in the median line, 1.18 mm maximum breath behind middle; thoracic area nearly quadrangular; median lobe a little less than half the breadth of carapace, with its straight posterior margin level with blunt tips of lateral lobes or slightly further behind and sometimes overlapping genital segment; posterior sinuses shallow; lateral area narrow, with simple ventral rib; frontal plates well defined, with median incision on anterior margin (Plate 3a&b; Fig. 3a).

Free thoracic segment about 0.23mm broad, sometimes not clearly visible in dorsal view, but in the whole mount picture it is quiet visible.

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Genital segment rounded, 32-0.63x 0.48-0.96 mm. Abdomen reduced, fused with genital segment, caudal ramie short, on ventral side of abdomen, each tipped with six plumose setae, of which the three ventral are larger than the dorsal (Plate 3a; Fig. 3a).

Proximal segment of first antenna nearly triangular, about twice as long as distal, with numerous short plumose setae; distal segment rod-shaped, 60 μ m long with about a dozen terminal and one subterminal setae (Plate 3c; Fig. 3b).

Second antenna with a strong backward spine on basal segment; terminal claw slender, curved at right angles, maxillary hook falcate Maxilla spiniform, palp with three setae (Plate 5d; Fig. 5c). Mandible with 12 very small sharp teeth. Distal segment of first maxilliped slender, slightly longer than proximal, with a laminate fold near its middle terminal claw of second maxilliped which is strongly curved; basal segment folded on the margin opposite the tip of the claw (Plate 3c&d; Fig. 3 d,e&f).

Furca with base projecting strongly outward; branches nearly parallel, blunt-pointed, with narrow flanges (Fig. 3g). Terminal segment of first leg with three plumose setae on posterior margin, and one simple setae and three claws at tip, two inner claws with bifid tips. A pair of spiniform processes lie on the ventral with the branches of the furca (Plate 3e; Fig. 4a).

Middle segment of second leg endopod with very short hairs along outer margin; basal and terminal segment of second exopod with six setae and two spines. (Plate 3f; Fig. 4b). Terminal segment of third leg exopod with five setae, indistinctly segmented from basal segment, which has one plumose and two simple setae; basal spine sharply pointed 57 μ long, fourth leg slender, 3 -segmented; basal segment slightly shorter than the other two segments combined; middle with one terminal with three finely pectinate spines. Fifth leg setiform, antero-lateral to six leg (Plate 4; Fig. 4 c&d).

On ventral side of genital segment near its posterior end is a nodular base and three plumose setae and a rudimentary spine (Fig. 4e).

Remarks; Genital segment rounded and the abdomen reduced, fused with genital segment.

Anuretes heckelii (Krøyer, 1863)

In the present study it has been collected from *Plectorhyncus gatrinus*. The body length of female about 2.8 mm., cephalothorax typical of family, lacking lunules on frontal plates. Frontal plates distinct, but narrow and only slightly emarginate at the centre. Posterior sinuses broad and shallow; median lobe about half the entire width, projecting scarcely at all beyond the lateral lobes (Plate 5; Fig. 5a&b).

First antennae small and plump, the joints about even and armed as in other genera; second pair with a large terminal claw bent at a sharper angle than usual. First maxilla rather large and plump, not much swollen at base; second pair little more than half as long as mouth cone, separated from it quite a distance on either side, simple and pointed, with a greatly enlarged base (Plate 5; Fig. 5b&c).

First maxillipeds with a blunt lobe on the middle of inner margin of the terminal joint. Second pair very large and strong, the basal segment much swollen but without knobs or spines, the terminal claw stout, bent abruptly, and without any accessory spine on the inner border (Plate 5e&f; Plate 6a; Fig. 5d&e).

Furca small, plump, the basal part slightly longer than the branches, with a membranous frame and larger oval foramen (Fig. 5f). The branches simple, parallel and club-shaped, with obtuse ends; the sinus between them long and very narrow.

There is no spine at the distal corner of the terminal joint of the first thoracic legs, but only the three terminal claws, the longest of which about the length of the joint (Plate 6b&c; Fig. 6a).

Second swimming legs as in caligus. Third pair, the basal laminae are larger and the ramie not attached to their posterior border or at the posterior corners, but high up on the lateral border and close together so that they partially overlap.

Furthermore, the endopod consists of a single segment, armed with three strongly curved bristles, which hardly deserve the name of plumose setae. The exopod two-jointed and scantily armed (Plate 6d; Fig. 6b). Third leg with five setae on the terminal segment of exopod, indistinctly segmented from basal segment, has one plumose and two simple setae;

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basal spine sharply pointed (Plate 6e; Fig. 6c). The fourth legs small but comparatively strong, three-jointed, the basal joint as long as the other two. There is a spine at the end of the second joint and three on the terminal joint, all so close together as to form a single bunch or cluster (Plate 6f; Fig. 6d).

The fifth legs appear as a pair of very stout and long papillae projecting from the posterior corners of the genital segment, each ending in a single stout spine. Free segment narrow and proportionally long with almost parallel sides (Plate 7a). Genital segment two-thirds as long as the carapace and three-fourths as wide, its sides strongly curved and projecting backward at the corners as a pair of stout papillae, representing the fifth legs. Between these papillae the posterior border of the genital segment slightly convex, but the projecting papillae give this border a deeply emarginate appearance. Abdomen entirely lacking, or only appearing in the finest traces on the ventral surface of the genital segment. Anal laminae as in other genera, not at all degenerate, but attached to the ventral surface of the genital segment owing to the absence of the abdomen. Their exact position varies considerably in different specimens, but they are usually attached some little distance in front of the posterior border. For this reason they are wholly, or almost wholly, concealed in dorsal view, only their tips or the setae attached to them appearing beyond the edge of the genital segment. Genital complex with slightly concave posterior margin and rounded postero-lateral lobes bearing the fifth legs. Abdomen absent (Plate 5a).

Remarks: Genital segment semilunar, deeply cut posteriorly; fourth legs small, three-jointed, four spines close together at tip.

Ergasilus lizae Krøyer 1963

Syn; *Ergasilus nanus* van Beneden, 1870

Ergasilus lizae of Byrnes (1986)

The copepod: *Ergasilus lizae* recorded in this study on the gills of *Lethrinus nobulosus*, while it has not been recorded before on Red Sea fish, but in the mean time it was collected in Egypt from the gills of the *Mugil cephalus* of the Mediterranean Sea (Wilson 1923a).

The body length 1.0 mm, cephalothorax oblong, slightly narrow posteriorly, violin-shaped with shallow notches just anterior to midlength on lateral margins, slightly

protruding antennary region and rounded posterior margins; dorsal surface with low transverse welt in anterior half look like inverted T shape, ventral with somewhat protruding oral region.

Second to fourth pedigerous segments gradually diminishing in width, fifth very short and narrow (Plate 8; Fig. 7a).

Genital segment sub-spherical, abdomen three-segmented, segments of sub-equal sizes, terminal segment with deep posterior notch, first and second nearly equal in length and ornamented with rows of spinules ventrally. Anal somite about two-thirds of preceding somite length, with a notch in the middle. Posterior margin of abdominal somites ornamented with rows of spinules.

First antenna six-segmented, armature formula 3-13-5+ae-4+ae-2+ae-7+ae; apical armature of four long and three short setae (ae= Aesthetasc) (Plate 8; Fig. 7b). Second antenna slender, lacking any inflation between coxobasis and first endopodal segment, subchelal shaft of subchela gently curving with a single short setule at two-third length of concave margin and one similar setule on convex margin at base of claw; latter 4 halves as long as shaft, curving, tapering with smooth and fossa distally on concave margins (Plate 8; Fig. 7c).

Mouth parts as in interpodal-bar extended posteriorly at both ends (Plate 8) associated plate with indistinct posterior margin, without ornamentation. The mandible un-segmented bearing anterior, mid and posterior blades; anterior blade small with teeth on anterior margin; posterior blade with teeth on posterior margin. The distal and posterior blades assist the maxilla in rasping away the epithelial tissues of the host and in passing dislodged tissue into the mouth (Fig. 7d). The first maxilla lobate bearing three unequal outer setae and a medially minute one (Fig. 7e). The second maxilla falcate bearing long spinulate seta on basis, armed with a dense array of sharp, distally-directed teeth that used to rasp the surface of the host's gill epithelium (Fig. 7f).

First four pairs of legs biramous with all ramie 3- segmented, only leg four with segmented exopod. Basis with two rows of spinules along the inner margins except leg one. There is an outer setae on the posterior surface of all the basis of the legs. Outer margins of both ramie spinulate, setules present on inner margin of first exopodal segment of the four

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legs; and on outer margin of their endopodal segments. Curved row of spinules present on posterior surface of exopodal segments of leg one; inner setae on endopodal segments of leg 1 armed with setules proximally followed by spinules. Leg two with small conical process located anteriorly between ramie, armature of the 4 legs are as follow: (Plate 8&9, Fig. 8),

	Exopod			Endopod		
	1	2	3	1	2	3
1 st leg	1.0	1.1	11.5	0.1	0.1	11.4
2 nd leg	1.0	0.1	6	0.1	0.2	1.4
3 rd leg	1.0	0.1	6	0.1	0.2	1.4
4 th leg	1.0	5	-	0.1	0.2	1.3

All coxae with coarsely spinulated posterolateral area, all basses with similarly spinulated postero-medial area, spines at tip of first endopod, with serrated lateral margins.

Urosome consists of a small fifth pedigerous somite bearing the fifth leg, the genital double-somite and three free abdominal somites. Caudal ramie unsegmented, each one bearing four setae; large medial inner, outer and posterolateral seta. (Plate 9, Fig. (7)g).

Remarks; The conical process on the basis between the ramie of leg two, the outer spine on the second exopodal segment of leg one, characteristic to *Ergasilus lizae* and the fifth leg carries two terminal setae and one lateral on its second segment.

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ACKNOWLEDGEMENTS

I am most grateful to Dr. G. A. Boxshall (BM, Natural History Museum, London) for confirming the identification of the parasitic copepods and helping me to comment on their descriptive morphology.

The willing help and unlimited attention of the technical staff of the Electron Microscope Unit (Royal Holloway, University of London) were a great advantage to this work.

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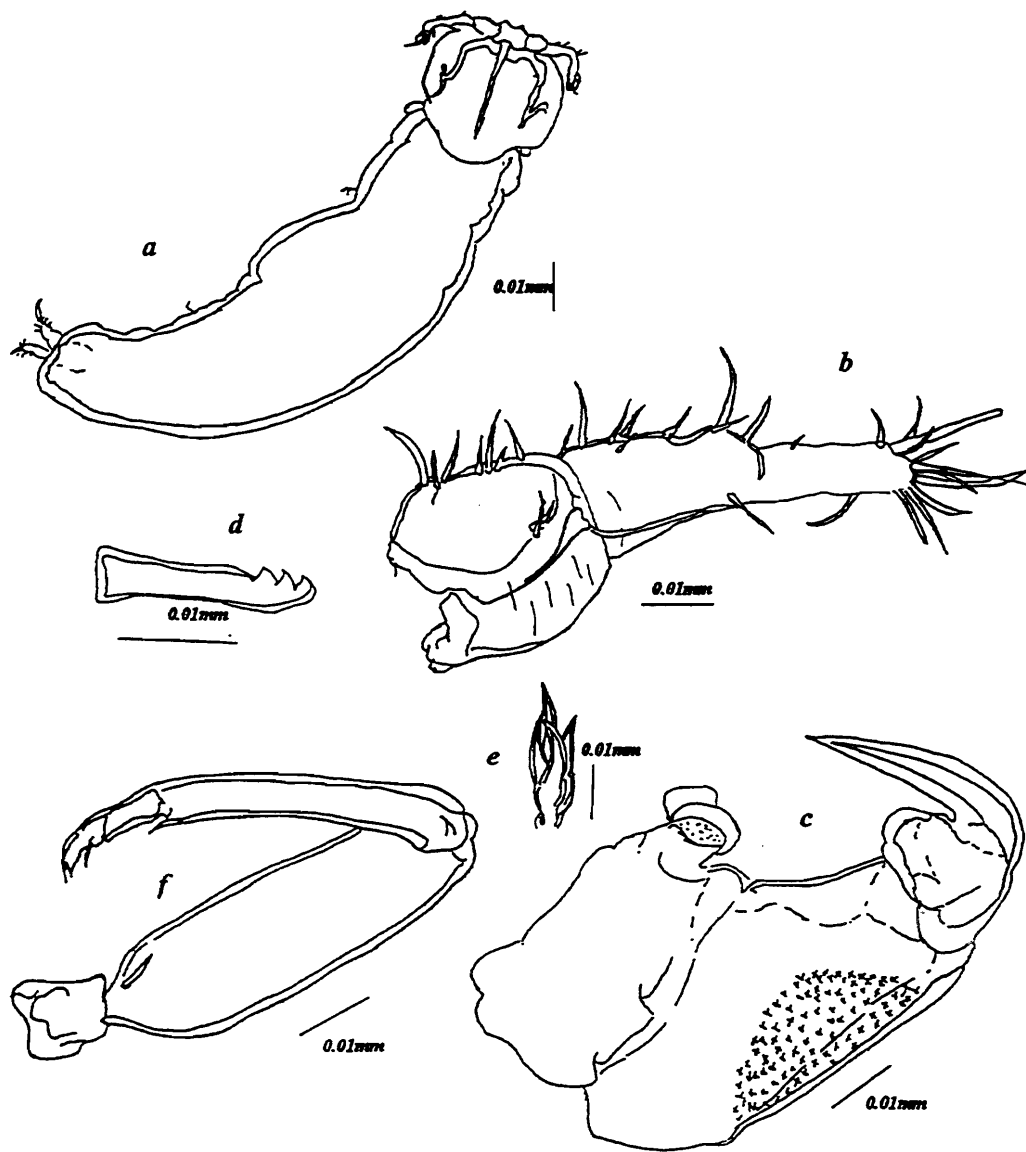


Fig (1) *Hatschekia plectropomi*. Camera lucida drawings. a) *Hatschekia plectropomi* dorsal b) First antenna. c) Second antenna. d) Toothed mandible. e) First maxilla. f) Second maxilla.

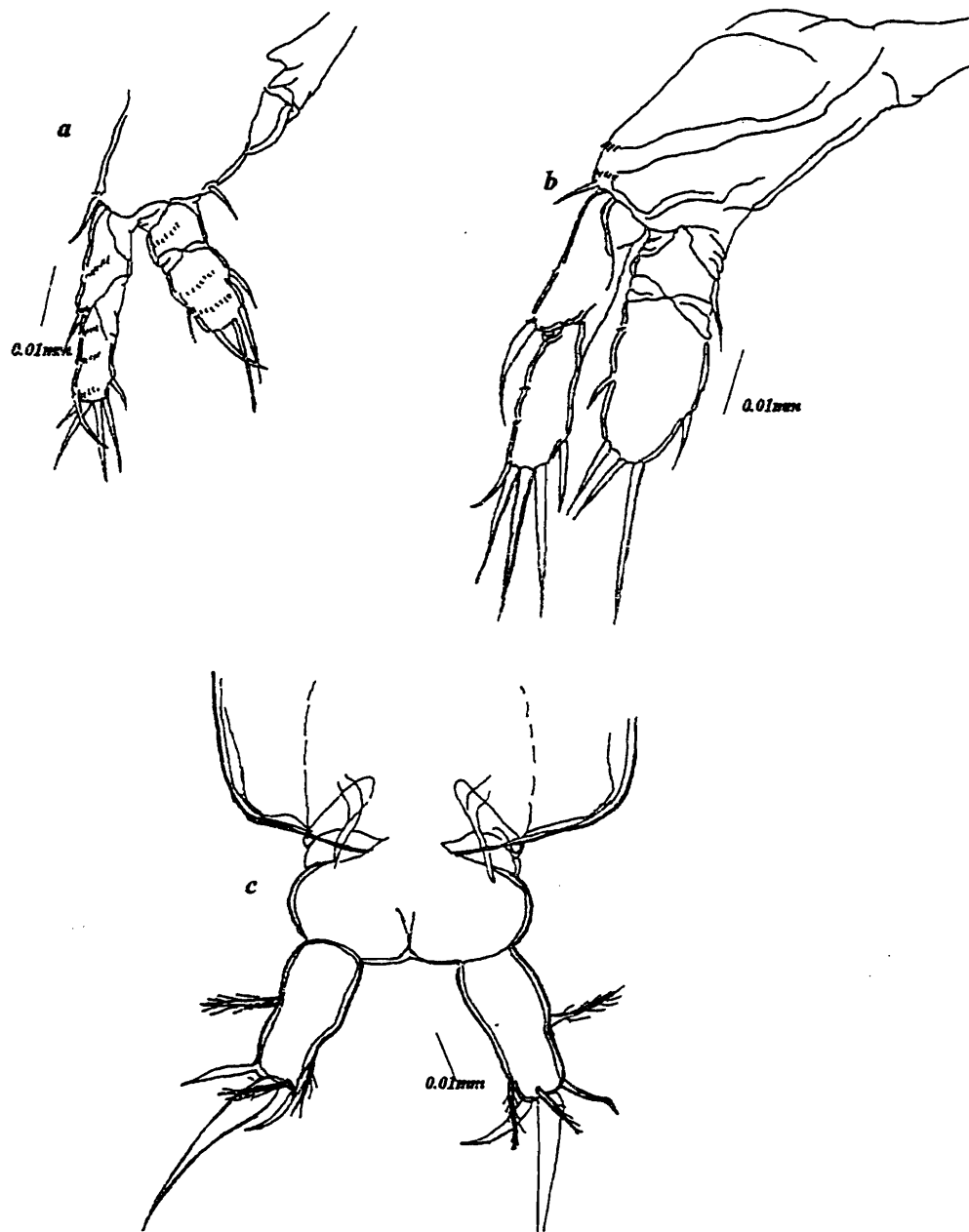


Fig (2) *Hatschekia plectropomi* Camera lucida drawings. a) First leg (ventral). b) Second leg (ventral). c) Abdominal segment ,with egg sac attachment area and caudal ramie

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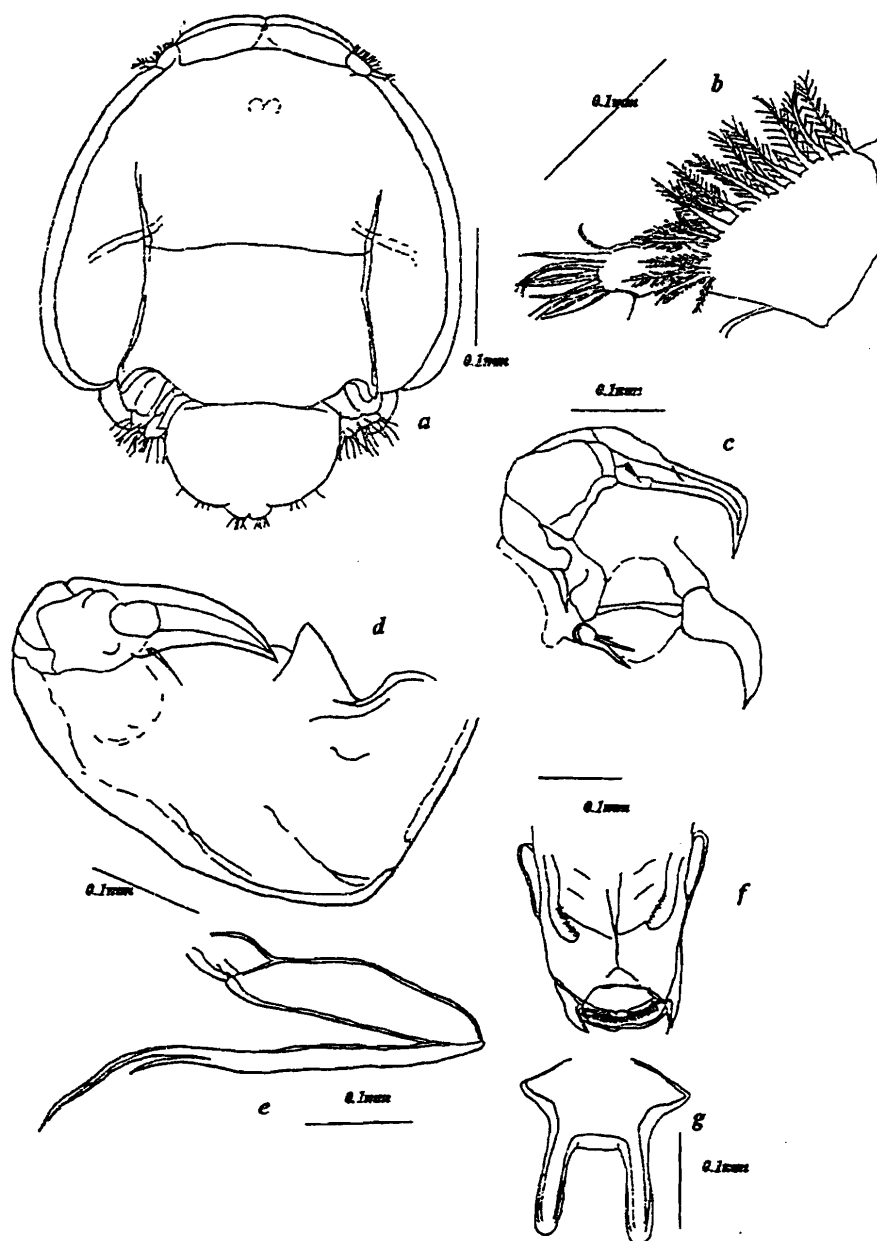


Fig (3) *Anuretes plectorhynchi* Camera lucida drawings
a) *Anuretes plectorhynchi* female, dorsal. b) First antenna. c) Second
antenna and first maxilla (maxillary hook). d) Maxilliped.. e) Second
maxilla. f) Mouth-cone and mandible. g) Sternal furca.

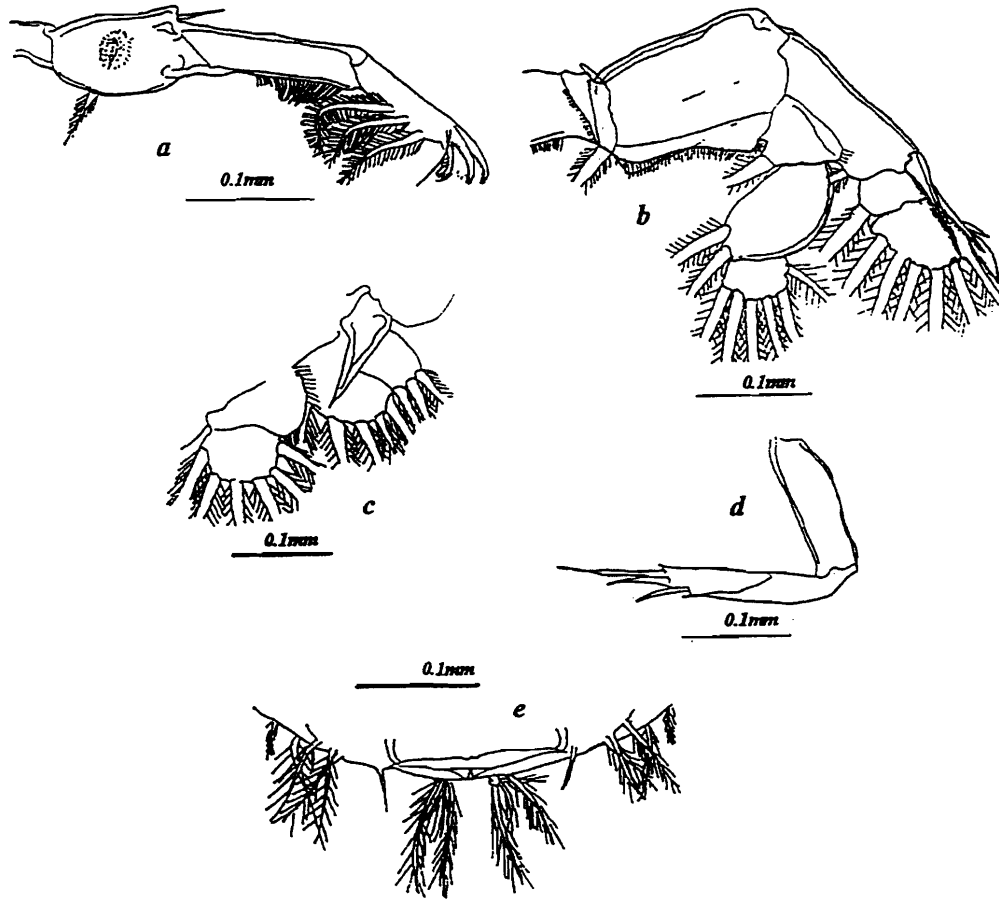


Fig (4) *Anuretes plectorhynchi*. Camera lucida drawings. a) First leg
b) Second leg. c) Third leg. d) Fourth leg.. e) Ventral side of the genital
segment with plumos setae.

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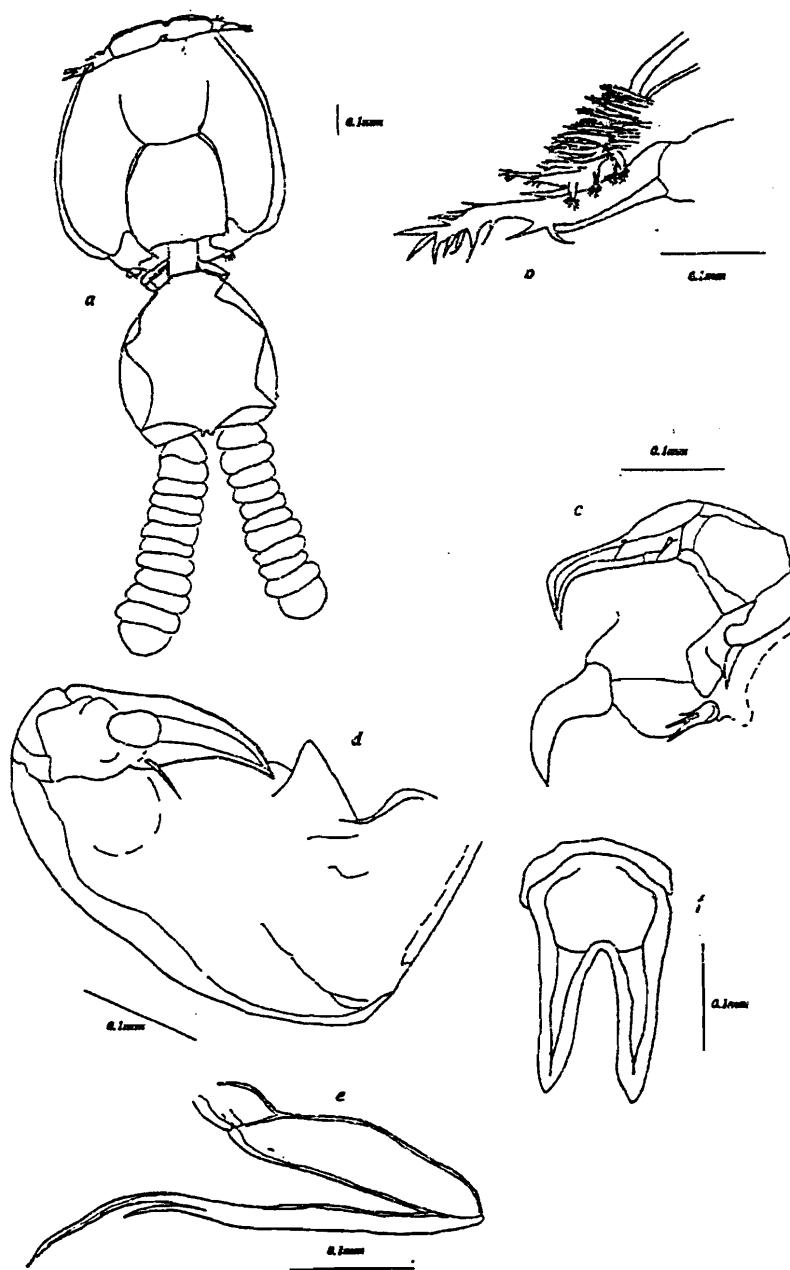


Fig (5) *Amuretus heckellii*. Camera lucida drawings. a) *Amuretus heckellii* female, dorsal. b) First antenna. c) Second antenna and first maxilla (maxillary hook). d) Maxilliped. e) Second maxilla. f) Sternal furca.

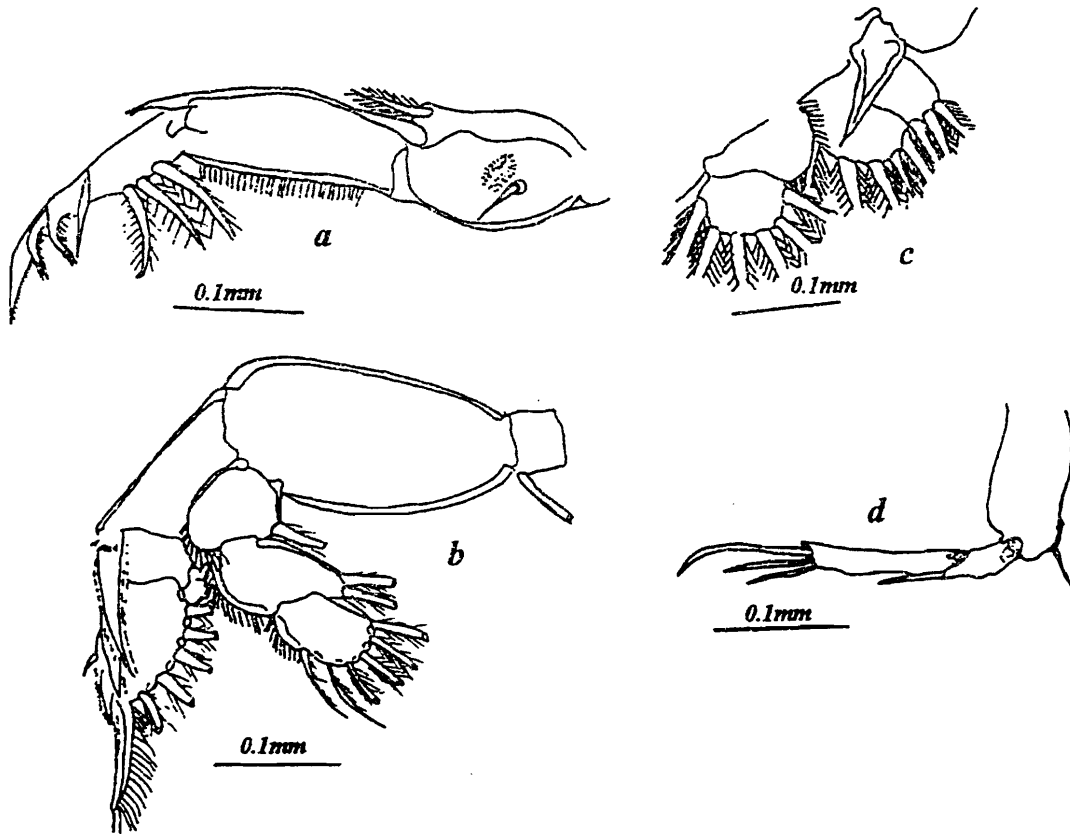


Fig (6) *Anuretus heckellii*. Camera lucida drawings. a)First leg. b)Second leg. c) Third leg. d)Fourth leg.

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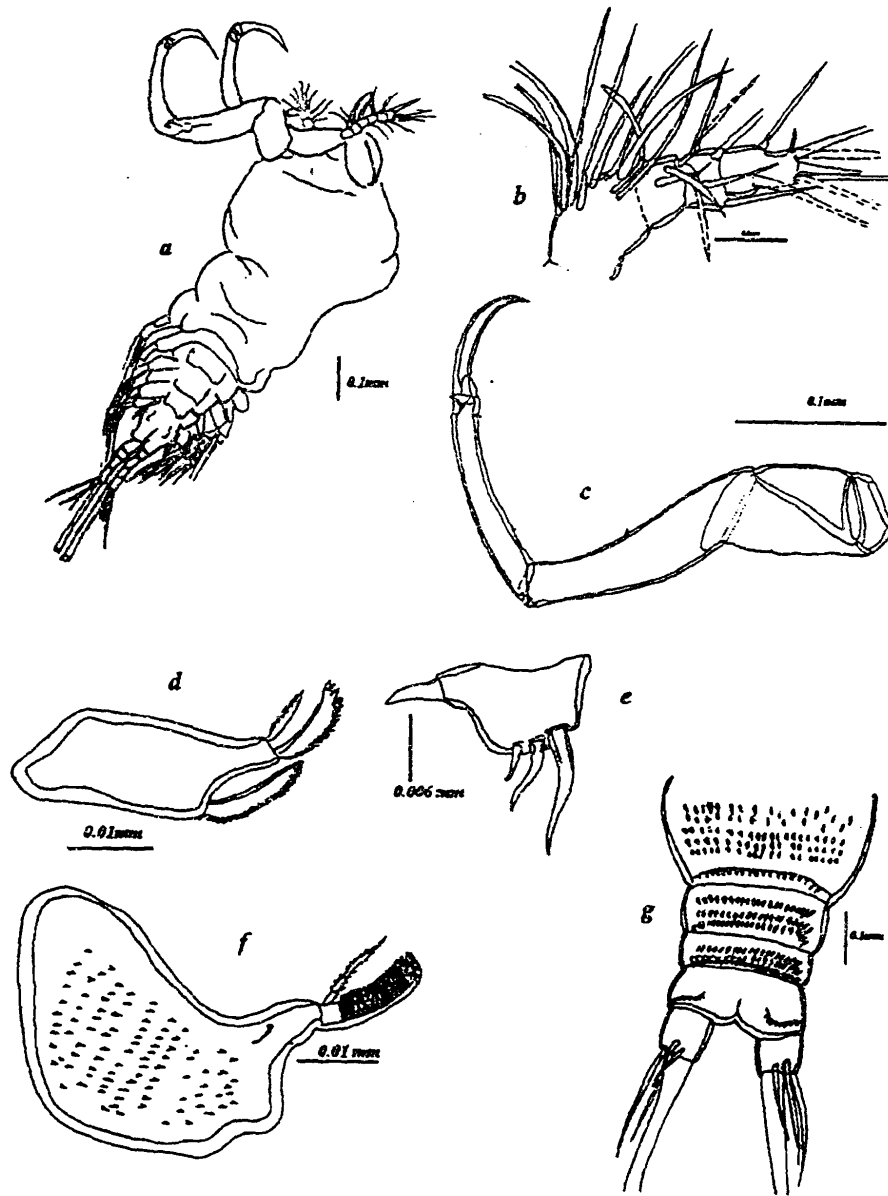


Fig (7) *Ergasilus lizae*. Camera lucida drawings. a) *Ergasilus lizae* lateral view. b) First antenna. c) Second antenna. d) Mandible. e) Maxilla. f) Maxilla. g) Uropod and caudal rami

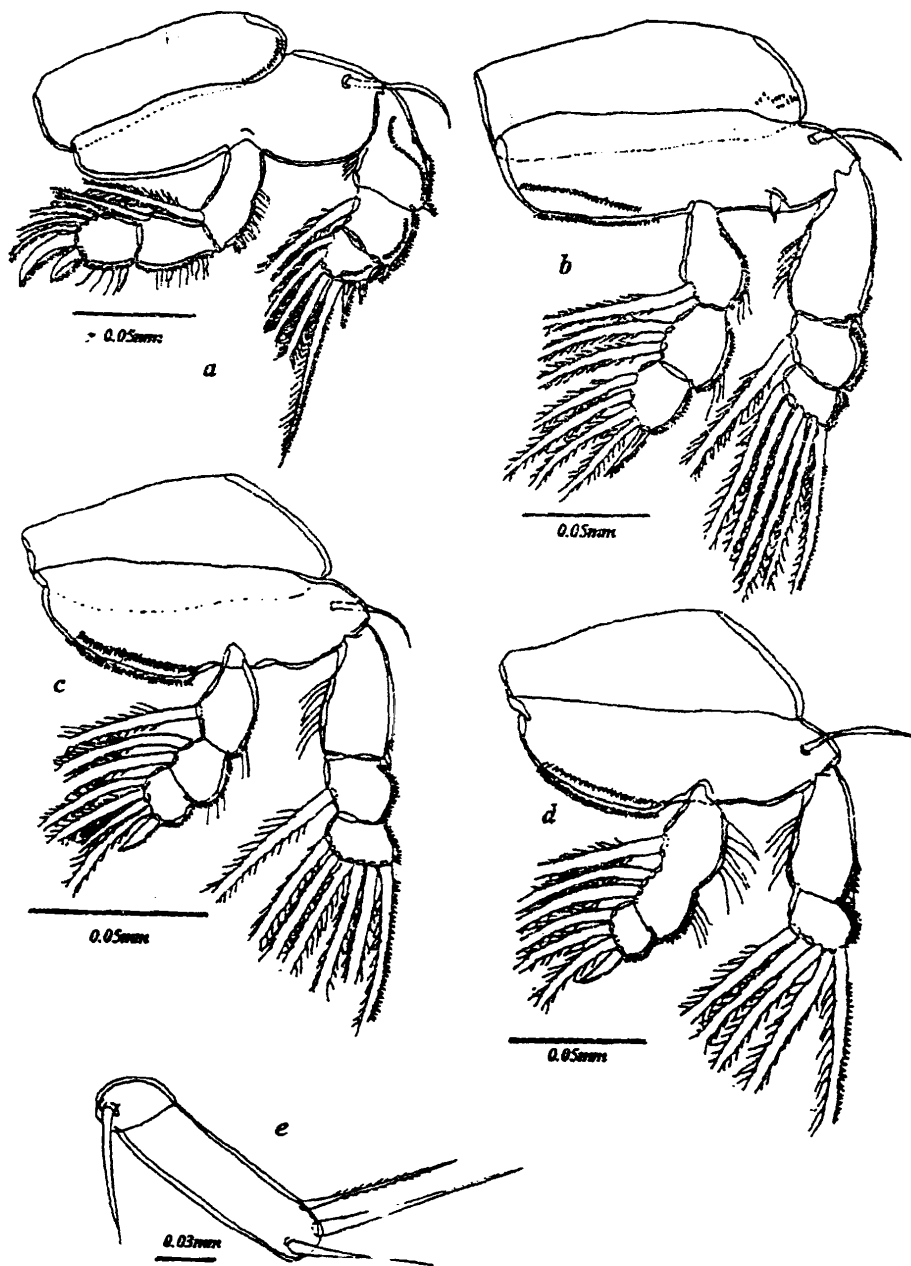


Fig (8) *Ergasilus lizae*. Camera lucida drawings. a) First leg ventral. b) Second leg ventral. c) Third leg ventral d) Fourth leg ventral e) Fifth leg

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Plate (1)

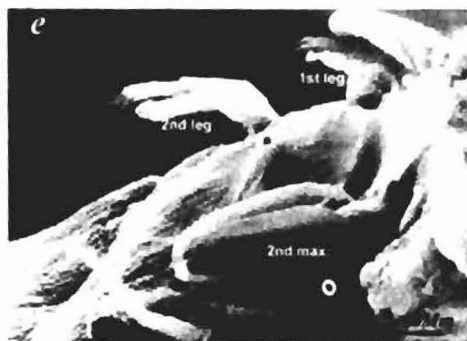
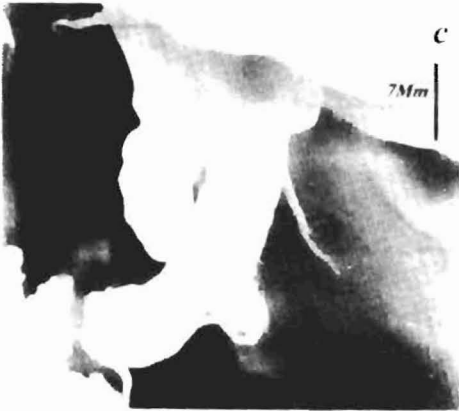
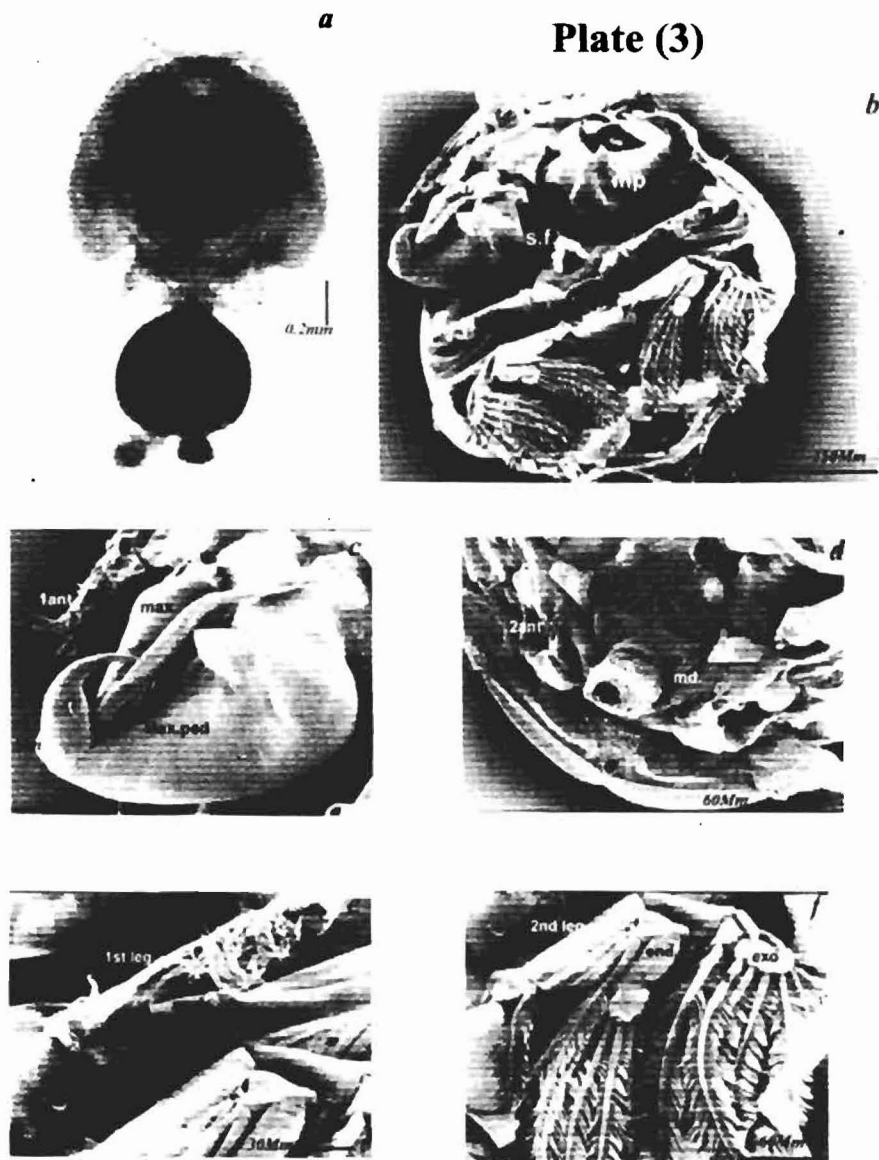


Plate (2)



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Plate (3)



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Plate (4)



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Plate (5)

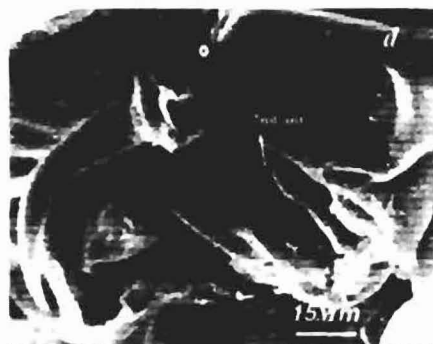
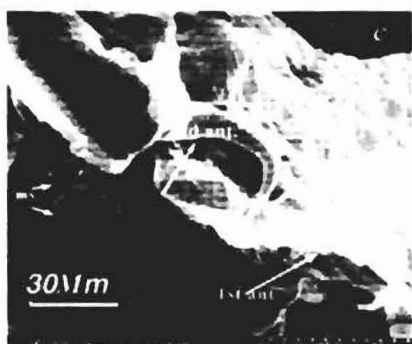


Plate (6)

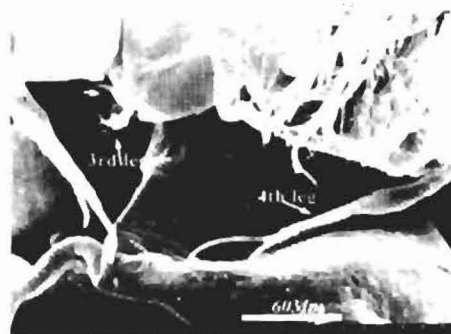
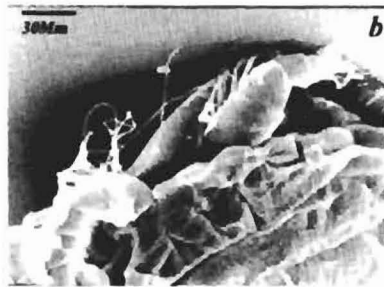
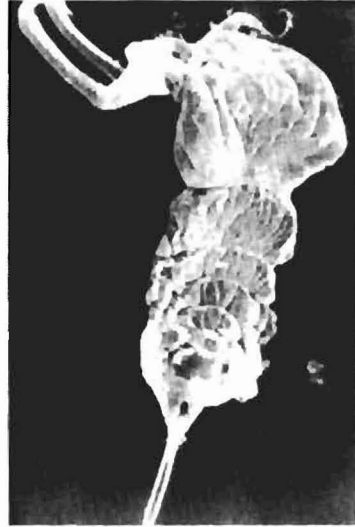


Plate (7)



Plate (8)



1st antenna



2nd antenna



1st leg



1st leg exopod

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Plate (9)



2nd leg



5th leg



Uropod & Caudal ramus

Plate

PLATE (1) SEM of *Hatschekia plectropomi*. a) *Hatschekia plectropomi* on the gill lamellae of *Cephalophalis miniata*. b) *Hatschekia plectropomi* dorsal view, c) Cephalothorax ventral, showing first antenna (1st ant.), second antenna (2nd ant.) and second maxilla (2nd max.) and, mouth (m). d) Toothed mandibles (md.) surrounded with the labium., e) First pedigerous somite (ventral) carrying first leg, and second pedigerous somite carrying second leg. f) Abdomen, with egg sac attachment area and caudal rami.

PLATE (2) SEM of *Hatschekia plectropomi*. a) First antenna, b) First maxilla. c) First leg. d) Second leg.

PLATE (3) SEM of *Anuretes plectorhynchi*. a) Photomicrograph of *Anuretes plectorhynchi*, female, dorsal. b) SEM of *Anuretes plectorhynchi* cephalothorax (ventral) sf, sternal furca; mp, maxilliped; 2nd max, second maxilla. c) First antenna (1st ant.), second maxilla and maxilliped (Max.ped) d) Second antenna (2nd ant), mouth-cone (m.con) and first maxillae. e) First leg (1st leg). f) Second leg (2nd leg).

PLATE (4) SEM of *Anuretes plectorhynchi*.
Ventral, Second leg, third leg (3rd leg) and fourth leg (4th leg).

PLATE (5) SEM of *Anuretes heckellii*. a) *Anuretes heckellii* female, (ventral). b) Ventral view of the anterior part of cephalothorax showing the mouth-cone. c) First antenna (1st ant.) and second antenna (2nd ant. d) Second antenna and First maxilla (maxillary hook, mx.). e) Maxilliped (mxp), second maxilla. f) Second maxilla and sternal furca (s.f.).

PLATE (6) SEM of *Anuretes heckellii*. a) Second maxilla and maxilliped b) First leg. c) Terminal segment of first leg (arrow). d) Second leg. e) Third leg. f) Third (3rd leg) and fourth leg (4th leg).

PLATE (7) SEM of *Anuretes heckellii*. a) Plumose setae on the posterior end of the cephalothorax. b) Plumose setae on the ventral side of the genital segment.

PLATE (8) SEM of *Ergasilus lizae*. a) First antenna. b) Second antenna. c) First leg. d) First leg exopod.

PLATE (9) SEM of *Ergasilus lizae*. a) Second leg with processes (arrow). b) Two segmented-Fifth leg. c) Uropod and Caudal rami. d) Rows of spines on the uropod.

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