



A re-evaluation of the *Macrothrix rosea-triserialis* group, with the description of two new species (Crustacea Anomopoda: Macrothricidae)

Henri J. Dumont¹, Marcelo Silva Briano² & K. K. Subhash Babu³

¹Institute of Animal Ecology, Ghent University, K. L. Ledeganckstraat 35, B-9000 Gent, Belgium

E-mail: henri.dumont@rug.ac.be

²Universidad Autónoma de Aguascalientes, Centro de Ciencias Básicas, Depto. de Biología, Av. Universidad 940, Fracc. Primo Verdad, C. P. 20100, Aguascalientes, Mexico

E-mail: msilva@cbasico.basico.uaa.mx

³Christian College, Dept. of Zoology, Irinjalakuda 680 125, Kerala, India

Key words: Cladocera, Macrothricidae, taxonomy, males, trunk limbs, species groups and subgroups, world distribution

Abstract

We redescribe *Macrothrix rosea* (females and males) based on material collected in Belgium. We also compare seven populations of *Macrothrix triserialis* from different parts of the world, including a topotypical population of *M. triserialis* s. str. from Sri Lanka, and males from South India (here first described), relying heavily on the structure of the trunk limbs, beside classical features of morphology. *M. rosea* and *M. triserialis* are extremely closely related: males are easily separated, but the identification of females requires micro-characters such as the relative length of the apical segment of the setae natatoriae and the adornment of the first antenna and of the longest swimming seta of the antenna. *M. rosea* and *triserialis* together constitute a sub-group of the *rosea*-group.

Macrothrix triserialis-like animals occur in the tropical–subtropical belts of four continents. We compare populations from Asia, South America and Africa, and find differences in microcharacters of the trunk limbs, but cannot decide whether these represent random variation or sound taxonomical differences.

One of the basic characters of the *Macrothrix rosea-triserialis* subgroup is that the setae natatoriae of the postabdomen are implanted on a prominence, the ‘heel’. Other characters include the fact that the Fryer’ forks are adorned with one or two big teeth only, and that the scrapers of trunk limb two form a row of eight without any doublings. Possibly, scraper five, and scraper four to a lesser degree has an enlarged subapical tooth. The exopodite of trunk limb three has four plumose setae, the back and front row of the endopodite six setae and/or receptors, the exopodite of trunk limb four has two setae, and the back row of the endopodite six setae, plus one on the gnathobase. The pre-epipodite of trunk limb five consists of three lobes, the ‘endopodite’ is small, and the ‘exopodite’ is reduced to a single seta. The male postabdomen has a tubular ending, without true end-claws, although a rudiment of an end-claw is seen in *M. triserialis*.

Two new species are described: *M. tabrizensis* and *M. agsensis*. A comparison, including the males of *Macrothrix triserialis*, *M. rosea*, *M. smirnovi* and *M. tabrizensis* confirms the relationship of all these taxa, but also reveals a morphological series in the shape of the postabdomen, from a complete absence of end-claws, over rudiments of a pair of end-claws, to complete endclaws. Absence of end-claws is here considered to represent an evolved character state. *Macrothrix smirnovi* Ciro & Elías (1987) is less closely related to the *rosea-triserialis* group, and is considered to form a sub-group in its own right. It shows a short ‘heel’ on the postabdomen, but carries a supplementary seta behind scraper 4 of the endopodite of trunk limb two, and has a male with a postabdomen that closely resembles that of the female. These are primitive characters, which are also found in *Wlassicsia*, *Bunops* and *Onchobunops* and provide a possible phylogenetic link between *Macrothrix* and these three genera, although the genetic distance between them is considered to be quite large.

Introduction

During the past few years, taxonomic studies on macrothricid anomopods have revealed the existence of complexes of species. One example was suggested by Frey (1988). He noticed that *Guernella raphaelis* from different parts of the world (Africa: Congo River, Asia: Sri Lanka) and *Macrothrix paulensis* (South America: Brazil, and South of North America: Florida, U.S.A.), showed differences in several micro-characters which had not been given previous consideration. Although he did not arrive at a clear conclusion, he proposed the existence of related taxa, different at the species level. As in many other anomopods, incomplete and superficial morphological descriptions lie at the heart of much taxonomic confusion. Yet, the morphology of the Macrothricidae had been studied in detail. Fryer (1974) made an important contribution to the functional morphology of the trunk limbs in this group. Smirnov (1976) attempted the first world fauna of Macrothricidae. A recent identification guide for that family (Smirnov, 1992) provided more progress, but a coherent and standard recipe for describing a *Macrothrix* was still lacking. Recent descriptions and redescriptions (Ciros-Pérez & Elías-Gutiérrez, 1997; Silva-Briano et al., 1999; Kotov, 1999) have begun to pave the way for a better understanding of the nature of a number of species and species-groups.

In the present investigation, we attempt to shed new light on a group of *Macrothrix* species that occurs almost worldwide, and that, for priority reasons, should be called the *rosea*-group, although the tropical-subtropical *M. triserialis* is potentially more widespread and, therefore, more often cited. Eight populations of *Macrothrix triserialis* from different parts of the world, including *M. triserialis* s. s. are studied here, with an aim at clarifying their taxonomic status. It turns out that this group is especially speciose, and the taxa described hereinafter are possibly only a sample of the true diversity that is extant.

The gross taxonomic characters of this group, according to Smirnov (1992), are: female with dorso-posterior corner of caparace pointed, its dorsal margin with fine serration. Antennule with small indentations. Antennal setae 0-0-1-3/1-1-3, spines 0-1-0-1/0-1-1. Largest seta with two largest spines in the area of the joint between its proximal and distal segments, distally followed by many small spines. Labrum with few serrations. Thoracic limb one with three setae of different size on the Inner Distal Lobe (IDL). Inner spines

(Fryer's forks) on endites 1 and 2 present. Seta natatoria with a short distal segment. Postabdomen with teeth which shorten distally on the preanal margin, and groups of spines along the anal margin. Ocellus small and situated closer to base of antennule than to eye. Length c. 0.5 mm. Descriptions and figures of the male of *rosea* can be found in Flössner (1972) of '*triserialis*' in Sars (1901) (from South America) (!), and in Korinek (1984) (from Africa) and summarise to: antennule bent, postabdomen with a narrowed distal part and **no** endclaws. Thoracic limb one with a hook.

Clearly, this diagnosis is excessively vague and partly irrelevant, and needs extensive emendation.

Materials and methods

Samples, preserved in the plankton collection of the University of Ghent (see the individual species descriptions for data on their origin) were obtained from different parts of the world. All are fixed in formalin 5%. Permanent glass slides of isolated specimens were produced after transfer of specimens to glycerin and mounting with DePex Gurr mounting medium. SEM photographs were made after critical-point drying and gold-coating of other specimens, using a JEOL JSM 840 Scanning Electron Microscope.

Specimens were hand-dissected, and drawing made using a Leitz microscope equipped with a camera lucida. All drawings were made under oil immersion, occasionally using phase contrast. For the identification of parts of the trunk limb, and the numbering system of setae, spines, and other elements of the trunk limb, we used the system of Dumont & Silva-Briano (1997), in which such appendages are invariably numbered from outside to inside. An exception is trunk limb one, in which we numbered the nine setae from endite 1 towards endite 3 (i.e. from the inside to the outside). A list of abbreviations used is given hereunder:

Cl – clasper on first trunk limb of male; E1–E3 – endites 1–3 of trunk limb one; EE – external endite of trunk limb three; Ej. H. – ejector hooks at base of trunk limb one; Ep – epipodite; Ex – exopodite; FC – filtratory comb of plumose setae; GT – gnathobase; IDL – inner distal lobe, or endite four of trunk limb one; IE – internal endite of trunk limb three; Lab. – labrum; ODL – outer distal lobe or exopodite of trunk limb one; PEP – pre-epipodite of trunk limb five; Ro. – rostrum; R – receptor; Sc – scrapers of endopodite

Table 1. Overview of diagnostic characters used in the *Macrorhix rosea*-group

	<i>rosea</i>	<i>triserioides</i> Sri-Lanka	<i>triserioides</i> Kerala	<i>cf. triserioides</i> Kenya	<i>elegans</i> Brazil	<i>cf. triserioides</i> Mexico	<i>tubrizensis</i>	<i>egsensis</i>	<i>smitzovi</i>
First antenna, female	1 With spines not distinctly grouped	With spines not distinctly grouped	With spines not distinctly grouped	With spines not distinctly grouped	With spines not distinctly grouped	With spines not distinctly grouped	About nine rows of spines	About four rows of long, thin spines	About eight rows of rather long spines
	2 No bigger spines near apex	Few bigger spines near apex	Few bigger spines near apex	Few bigger spines near apex	Few bigger spines near apex	Few bigger spines near apex	Apical crown of small spines	?	With half-way seta, and complex field of spinules
First antenna, male	3 With one (two?) basal setae and rows of lateral spinules	?	With one (two?) basal setae and rows of lateral spinules	?	?	?	With strong additional seta on papilla about halfway the antenna and rows of spinules	?	With five strong spines decreasing in size apical, in middle section
Second antenna, longest seta	4 With out 20 medium-sized spines along apical two-thirds	With three strong spines in middle section	–	With sparse medium-sized spines along apical two-thirds	With two strong spines in middle section	With 2–4 strong spines in middle section	With numerous spines, medium-sized all along	With numerous small species all along	With five strong spines decreasing in size apical, in middle section
Trunk limb 1									
Seta 8	5 With very long and fine setules	With normal setules	With normal setules	With short setules	With normal setules	With normal setules	With short setules	With apical tuft of setules	With short setules
Setae 3–4	6 Setulated	Setulated	Setulated	Setulated	Setulated	Setulated	Setulated	With five thick spines	Setulated
Seta 5	7 As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4	As long as seta 4
epipodite	8 Simuous, elongated	Simuous, elongated	Simuous, elongated	Simuous, elongated	Simuous, elongated	Simuous, elongated	Simuous, elongated	Elongated	Elongated
Trunk limb 2									
Seta of exopodite	9 Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2	Curved over scrapers 1–2
Scraper 5	10 Normal	With enlarged subapical tooth	With enlarged subapical tooth	With normal subapical tooth	With enlarged subapical tooth	With normal subapical tooth	With strong but not enlarged subapical tooth	With normal subapical tooth	With strong but not enlarged teeth
Scraper doublings?	11 No	Enlarged	Normal	Enlarged	Enlarged	Enlarged	Enlarged	Enlarged	Enlarged
Trunk limb 3									
Seta 3 of exopodite	12 Longer than seta 2	Much longer than seta 2 (which is glabrous)	Longer than seta 2	Twice as long as seta 2	Longer than seta 2	Twice as long as seta 2 (which is plumose)	Longer than seta 2	Shorter than seta 2	Shorter than seta 2
Back row of setae on endopodite	3 Two long, four short	Two long, four short	Two long, four short	Two long, four short	Two long, four short	Two long, four short	All six long	All six long	All six long
Trunk limb 4									
Setae of exopodite	14 Of equal length	Of equal length	Of equal length	One long, one short	One long, one short	Of equal length	Both short	Of subequal length	Of subequal length
External scraper of endopodite	15 Spinulated	Spinulated	Spinulated	Spinulated	Spinulated	Spinulated	Spinulated	Glabrous	Glabrous
Posterior row of plumose setae on endopodite	16 Composed of 5+1 setae	5+1 setae	5+1 setae	5+1 setae	5+1 setae	5+1 setae	3 setae	5 setae	5 setae

Continued on p. 4

Table 1. Continued

	<i>rosea</i>	<i>triseriatis</i> Sri-Lanka	<i>triseriatis</i> Kerala	cf <i>triseriatis</i> Kenya	<i>elegans</i> Brazil	cf <i>triseriatis</i> Mexico	<i>tabrizensis</i>	<i>agensis</i>	<i>smitnovi</i>
Trunk limb 5									
Pre-epipodite	17 Triple	Triple	Triple	Triple	Triple	Triple	Double Globular	Triple	Double Elongate
epipodite	18 Elongate	Elongate	Elongate	Elongate	Very elongate	Globular	Elongate	Elongate	
Exopodite seta	19 Plumose, pointed	Glabrous	?	Plumose, rounded	Plumose, short	Short	Two lobes	Plumose	Rounded
long gnathobasic	20 Normal	Normal	Normal	Normal	Normal	Normal	Widened (bulging) at base	Normal	Normal
seta									
Postabdomen									
female									
Seta natatoria	21 Well developed	Vestigial	Vestigial	Vestigial	Vestigial	Vestigial	Well developed	Well developed	Well developed
apical segment									
Rows of marginal	22 Spines increase	Spines increase	Spines increase	Spines increase	Spines increase	Spines increase	Spines only	Spines of same size	Spines of same size
spines between anus	in size towards	in size towards	in size towards	in size towards	in size towards	in size towards	slightly	throughout	throughout
and seta natatoria	seta	seta	seta	seta	seta	seta	increasing in	throughout	throughout
							size towards seta		
Postabdomen	23 No endclaw, apically ?	No endclaw but	Korinek (1984)	Sars (1901)	?	?	End-claws well	?	Postabdomen shaped as
male	tapering	small dorsal	gives a figure	gives a figure			developed, but		in female
		'leaflets'	which suggests	which is similar			postabdomen		
		present; apically	the same shape	to that of true			hook-shaped,		
		rounded	as in true	<i>triseriatis</i>			different from		
			<i>triseriatis</i>				that of female		

of trunk limb two; Sca – ‘scales’, pointed or rounded hillocks behind scrapers 2–4 of trunk limb two.

We provide descriptions of all taxa, and discuss their degree of relatedness, partly in tabular form. Ample illustration, both as line drawings and as SEM micrographs are provided in the form of an atlas at the end of the paper. Diagnostic characters are highlighted in two different ways: by arrows pointing at them, by rendering them in a gray-tone, or by a combination of both.

Results

1. Macrothrix rosea (Jurine, 1820)

Material examined: Achel, Molenvijver, Belgium, 9 Sep 1933, leg. W. Luyten (see Luyten, 1934, for details). Number of specimens analyzed: three females, two males.

Smirnov (1992) lists Liévin (1848) as the first describer, because Jurine’s description is not usable beyond the genus level. However, this applies to a great number of pioneer descriptions, and cannot be accepted. Liévin (1848) is to be considered the first revisor, but the oldest name available is clearly *Monoculus roseus* Jurine, 1820. *M. rosea* has a holarctic range, but is generally rare.

Description of the parthenogenetic female

Shape: (Fig. 1) oval, length 0.63 mm, height 0.38 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner; the latter produced into a spine (arrow on figure), with fine serration along the valve. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 1) rostral region with lateral depression, arched in lateral view, head-shield not reticulate, dorsal margin not serrated. Head-pore window-like, rounded. Ventral margin of head smooth. Compound eye located close to margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented, with transversal lines along the edge, distal part a lobe with some hair-setae. This structure was found to apply to all species studied, and will not be repeated further on.

First antenna: (Figs 1 and 4) rod-like. Ventro-dorsal margin with short spines. One sensory seta located ventro-laterally of proximal end of antennular length. Nine terminal aesthetascs in two groups (two and seven) of different length. A distal external row of spines.

Second antenna: (Fig. 2). Basipod with an inner ap-

ical seta and a stout apical spine on outer surface. Swimming setae 0-0-1-3/1-1-3; spines 0-1-0-1/0-0-1. Largest seta bi-segmented, unilaterally setulated, with fine spines at its basis and about 20 stronger spines yet shorter than the diameter of the seta, from median region to apex (Fig. 11).

Trunk limb 1: (Figs 12 and 13) epipodite (EP) long and elongated, sinuous. ODL with long apical, bi-segmented seta, its distal segment unilaterally setulated, and with short lateral seta. IDL with three curved spine-setae of different length; the longest bi-segmented, with serrated distal segment. The middle one bi-segmented, serrated distally. The smallest bi-segmented, serrated distally. Endite 3 with four setae. Seta 9 long, curved back towards setae 6–8. Seta 8 short and thin 1, with long and fine setules all along (arrow). Setae 6–7 strong bi-segmented spines, with a transverse row of spinules. Seta 7 shorter than seta 6. Endite 2 with three setae. Setae 3–5 similar in length, bi-segmented, with dense setulation at their tip. Endite 1 with two setae. Setae 8–9 long of similar length, bi-segmented, serrate distally. Fryer’s forks on endites 1 and 2 with one and two large teeth, respectively. Ejector hooks are present but only shown in Figure 34. The basic structure of limb one is similar in all species dealt with here, and therefore, only deviations from this basic pattern will be recorded in subsequent descriptions.

Trunk limb 2: (Fig. 14) Exopod oval, bearing a plumose apical seta. This seta sharply curves back over the scrapers, reaching scraper 3. Endopod with eight scrapers. Scrapers 1–2 long and seta-like, serrate. Scraper 1 implanted on a segment. Scraper 3, long, bi-segmented, with a comb of teeth of similar size along its distal segment. Scrapers 4–5 similar in length, bi-segmented, with a comb of strong tooth, of which the subapical one is larger than the others. Scrapers 6 and 8 short, denticulated. Scraper 7 longer than 6 and 8, bi-segmented, with fine teeth. No sensillum or hairy seta behind scraper 8 or scraper 4. Rounded hillocks behind scrapers 2–4. Gnathobase conical, with three apical and one short internal seta. Gnathobasic seta 1 naked. Brushing seta 2 crooked, its apical half bent outwardly and adorned with long setules. Seta 3 apically hooked. A filter comb of four long unsegmented, plumose setae. The innermost seta not conspicuously thicker than the other three.

Trunk limb 3: (Fig. 15) exopod with **four** hyaline setae, of which 1–3 plumose and 4 serrate. Seta 1 shorter than Seta 2. Seta 3 longest, about 1/3 longer than seta 2. Seta IV slightly shorter than seta 2. En-

dopod differentiated into an external (EE) and internal endite (IE). Endopodite with two rows of appendages. Anterior row composed of two strong scrapers (1–2), an inwardly curved plumose seta (3) on the EE, and two bottle-shaped receptors and three plumose setae on the IE, i.e. six setal elements and two scrapers in all. The posterior row begins with a fat, spinulated seta 1'; seta 2' longer than 1', with very long internal setules. Setae 3'–6' short and plumose, forming one line, although there is a small gap between 3' and the three internal setae. Gnathobase blunt, with rows of thick setules, and outwardly pointing, bottle-shaped receptor. Two papillae at its posterior end. This basic structure is repeated in most species, and only deviations from it will be discussed.

Trunk limb 4: (Fig. 16) exopod small, with two plumose setae (I–II) of similar length. Endopod a single bloc, with two rows of appendages. Anterior row with an external scraper and three flaming-torch setae (broad-based setae with complex, contorted setules) and a small, conical receptor. A posterior row of five similarly shaped filter-setae. Gnathobase with a large, outwardly turned setose seta (the 'horsetail' seta). Horsetail seta reinforced by a distal, naked support seta. This overall structure too is generalised.

Trunk limb 5: (Fig. 17) pre-epipodite composed of three apically rounded, hyaline lobes with long setules at their tip. Epipodite large, elongate, tapering at its apex. 'Exopod' reduced to a single plumose seta. 'Endopod' a small, rounded, setulated hillock. Gnathobase with three plumose setae of which Seta 1 the longest, and Seta 3 (more like a short rounded lobe than a true seta) the smallest.

Postabdomen: (Fig. 3) elongated in lateral view. Ventral margin smooth. Dorsal margin not clearly bilobed, without flange. Preanal zone with numerous rows of spines, increasing in size towards the seta natatoria. The latter implanted onto a distinctive prominence, the 'heel'. Terminal claws small, evenly curved, with lateral teeth. Setae natatoria with long proximal segment and a distal segment which amounts to about 1/5–1/6 of the total length of the seta, and carries few setules.

Description of the male

Shape: (Fig. 6) oval-acute, length 0.22 mm, height 0.37 mm, dorsal margin curved from tip of rostrum, and straight in posterior dorsal corner, not produced into a spine. Fine serration on posterior dorsal part of valve. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 6) with eye bulging, head-shield not reticulate, dorsal margin not serrated. Head-pore oval, small. Ventral margin of head smooth. Compound eye located close to margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented, serrated, distal segment round.

First antenna: (Figs 6 and 7) long, with two sensory setae, located ventro-laterally, near each other. Some groups of strong setules border the ventral angulation, and several rows in lateral orientation. Nine terminal aesthetascs, in two groups of different length. Distally, neither setules nor spines.

Second antenna: as in female.

Trunk limb 1: (Figs 9 and 10) as in female, except for the presence of a copulatory clasper on the ODL, plus a long, curved acute seta (Fig. 9). The clasper is characteristic: it widens at its apex, and is provided with an apical cleft, somewhat reminiscent of a pair of castanets.

Trunk limbs 2–5: as in female.

Postabdomen: (Fig. 8) the part between the setae natatoria and the anus is as in the female, but the post-anal part is tubular, and tapering at its apex. No trace of end-claws present. Ventral margin slightly convex.

2. *Macrothrix triserialis* Brady, 1886

Macrothrix triserialis was originally described from the Island of Sri Lanka (Brady, 1886), but subsequently cited from most of the tropics, although there is doubt whether all records refer to the same species. Most descriptions and illustrations are indeed incomplete, unclear and fragmentary.

2.1. Redescription of the parthenogenetic female from the terra typica

Material examined: sample 7.730, Ratrapura, Sri Lanka, 18 Aug 1972, leg. C. H. Fernando. Number of specimens analyzed: 4.

Shape: (Fig. 18) ovoid, length 0.451 mm, height 0.302 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner, the latter produced into a spine (arrow). A slight but clear serration with fine latero-vertical lines. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 18) laterally depressed in rostral region, arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Head-pore small, round. Ventral margin of head smooth, slightly concave. Compound eye located close the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bilobed, with light serration along

the edge; distal part a lobe with short hair-setae (Fig. 20).

First antenna: (Fig. 19) rod-like. Dorsal and ventral margin with rows of spines. Two aesthetascs long and standing in a V *vis-à-vis* each other. Seven other terminal aesthetascs of only slightly different length.

Second antenna: (Fig. 21); Basipod with inner apical seta and stout apical spine on outer surface. Swimming setae 0-0-1-3/1-1-3; spines 1-2-1-1/0-0-1. Largest seta bi-segmented, unilaterally setulated, with three big spines (longer than diameter of seta) at mid-length (Fig. 25).

Trunk limb 1: (Figs 22–24) epipodite long and sinuous. ODL and endite lobes indistinguishable from those of *M. rosea*, except perhaps that the setulation of seta 8 is shorter and less abundant.

Trunk limb 2: (Fig. 26) as that of *M. rosea* in all details of structure. Perhaps fourth seta of the gnathobasic filter comb more robust than the other three.

Trunk limb 3: (Fig. 27) exopod as in *M. rosea*, but seta 2 almost twice as long as seta 2. Endopodite identical to that of *M. rosea*.

Trunk limb 4: (Fig. 28) exactly as in *M. rosea*.

Trunk limb 5: (Fig. 29) as in *M. rosea*.

Postabdomen: (Fig. 30) general shape and adornment as in *M. rosea*, but postanal spines longer from the anus onwards. Seta natatoria with long proximal segment, its distal segment **almost completely reduced**.

Male: no males from Sri Lanka were seen, but males were obtained from a sample collected in adjacent continental South India (Kerala State).

2.2. *Macrothrix triserialis* from South India

Monastery pond, Kerala state, India, 14 Feb 1992, leg. K. K. Subbhash Babu.

Parthenogenetic female

Only differences with Sri Lankan specimens are indicated here.

Shape: (Fig. 31) length female 0.787 ± 0.0004 mm (SD for $n=8$); male 0.45 ± 0.0005 mm ($n=3$), shape as in Sri Lankan specimens.

Head: (Fig. 31) as in Sri Lankan material.

First antenna: (Fig. 32) as in Sri Lankan material.

Second antenna: (Fig. 33) Largest seta bi-segmented, unilaterally setulated, with numerous small spines throughout, and two long spines at mid-length.

Trunk limb 1: (Fig. 34) indistinguishable from that of *M. rosea* and *M. triserialis* from Sri Lanka.

Trunk limb 2: (Fig. 35) indistinguishable from that of *M. rosea* and *M. triserialis* from Sri Lanka, but fourth

filter seta of gnathobasic comb not thicker than the other three.

Trunk limb 3: (Fig. 36) two apically ciliated hillocks between setae 1 and 2. Seta 3 only slightly longer than seta 2.

Trunk limb 4: (Fig. 37) as in *M. rosea* and *M. triserialis* from Sri Lanka.

Trunk limb 5: (Fig. 38) pre-epipodite with two hyaline setae (third one broken off?), setulated at their tip. Epipodite massive. Exopod not seen. Endopod reduced to a rounded lobe with short setules at tip. Gnathobase: third seta not seen.

Postabdomen: (Fig. 39) not different from that of *M. rosea* and specimens from Sri Lanka.

Description of the male

Shape: (Fig. 40) oval acute in lateral view. Dorsal margin curved from tip of rostrum to posterior dorsal corner, into a small spine. Slight serration in dorsal margin. Ventral margin serrated with spines of two different lengths. Intestine without convolutions.

Head: (Fig. 40) as in female.

First antenna: (Figs 40, 41, 45 and 46) long, nearly halfway to valve, with two sensory setae, located ventro-laterally and dorsally. Groups of spinules near ventral angulation.

Second antenna: (Fig. 42) as in female.

Trunk limb 1: (Fig. 43) as in female, but with clasper at the ODL, shaped exactly as in *M. rosea* (Figs 43, 47 and 51).

Trunk limbs 2–5: as in female.

Postabdomen: (Figs 40, 44, 48–50) as in *M. rosea*, but the apical tubular part rounded, not pointed. True end-claws absent, but **a pair of soft, triangular leaflet-like appendages** in subdistal position on the dorsal side. Two large sperm ducts open at the ventral tip (Figs 49 and 50). Seta natatoria with long proximal segment, its distal segment reduced.

3. *Macrothrix cf triserialis* from Kenya

Material examined: Mirim Ahero Dam, Kisumu, Kenya, 30 Aug 1995, Leg. Mutune David Masai. Number of animals examined: 5.

Description of the parthenogenetic female

Shape: (Fig. 52) oval, length 0.619 mm, height 0.321 mm.

Head: (Fig. 52) laterally depressed in rostral region, evenly arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Head-pore small, round. Ventral margin of head smooth. Labrum bi-

segmented, with fine serration along the edge, and distal end with a lobe with few short hair-setae (Fig. 54).

First antenna: (Fig. 55) rod-like. Dorsal and ventral margins with strong spines. One sensory seta located ventro-laterally at proximal end. Seven terminal aesthetascs of different length. Distally an external row of spines.

Second antenna: (Fig. 57) Basipod with inner apical seta (arrow), and a stout apical spine on outer surface. Swimming setae 0-0-1-3/1-1-3; spines 1-1-0-1/0-0-1. Largest seta with a mix of *rosea*- and *triserialis*-like characters: one long spine and a rather large number of short spines (beside numerous spinules) (Fig. 56).

Trunk limb 1: (Figs 58–60) as in *triserialis*, but seta 8 provided with rather short setules.

Trunk limb 2: (Fig. 61) as in *triserialis*, but scraper 5 without enlarged subapical spine.

Trunk limb 3: (Fig. 62) as in *triserialis*, but seta 3 of exopodite twice as long as seta 2, and two hillocks between setae 1 and 2.

Trunk limb 4: (Fig. 63) as in *triserialis*, but both setae of exopodite unequal in length and external scraper seta of endopodite provided with conspicuously long setules along most of its length.

Trunk limb 5: (Fig. 64) as in *triserialis*, but ‘exopodite’ apically rounded, not seta-like.

Postabdomen: (Fig. 53) as in *M. triserialis*.

Male: not seen.

4. *Macrothrix elegans* Sars, 1901

New synonym: *Macrothrix superaculeata* Smirnov, 1992.

Material: numerous parthenogenetic females from Broa (Lobo) Reservoir, SP, Brazil, 1994, leg H. J. Dumont.

Description of the parthenogenetic female

Shape: (Fig. 65) oval, length 0.538 mm, height 0.317 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner. The latter produced into a spine (arrow), with fine serration along the valve. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 65) laterally depressed in rostral region, arched in lateral view. Head-shield not reticulated, dorsal margin slightly serrated. Head-pore medium sized, oval. Ventral margin of head smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented with transversal lines along the edge, distal part a lobe with short hair-setae (Fig. 67).

First antenna: (Fig. 68) rod-like, with subapical group of robust spines. Rows of spinules all over body. Terminal aesthetascs of different length: two long, V-shaped, and seven short ones.

Second antenna: (Fig. 66) Swimming setae 0-0-1-3/1-1-3; spines 2-2-1-1/2-2-1. Largest seta, with fine spines from basis to tip (Fig. 70), and two strong spines at mid-length.

Trunk limb 1: (Figs 71 and 72) as in typical *triserialis* or *rosea*.

Trunk limb 2: (Fig. 73) as in *triserialis*, but subapical spines of scrapers 4 and, especially, 5 enlarged and fourth filter seta of gnathobasic comb thickened.

Trunk limb 3: (Fig. 74) similar to that of *triserialis* and *rosea*, but seta 3 of the exopodite relatively short, and on the endopodite seta 2' relatively much longer than seta 1', and no gap between the seta row on the internal and external endites.

Trunk limb 4: (Fig. 75) exopod with the two hyaline (I–II) setae subequal in length. All other characters as in *triserialis* and *rosea*.

Trunk limb 5: (Fig. 76). Epipodite gigantic. Other characters as in *triserialis* and *rosea*.

Postabdomen: (Fig. 69) with postanal rows of dorsal marginal spines very robust.

Male: not seen, but described by Sars (1901) and very similar to that of *M. triserialis* (see discussion).

5. *Macrothrix* cf. *triserialis* from Mexico

Material examined: Cenote Azul y Cenote Zacate. Quintana Roo, México. 29 jun 1995 and 18 Aug 1987, leg. Eduardo Suárez Morales & Rebeca Gasca Serrano. Four specimens were analyzed.

Description of the parthenogenetic female

Shape: (Fig. 77) oval, length 0.608 mm, height 0.402 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner, the latter produced in a small spine (arrow), with serrations along the valve. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 77) laterally with a depression in rostral region. Arched in lateral view, head-shield not reticulated. Dorsal margin serrated. Head-pore small and round. Ventral margin of head smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bilobed, bi-segmented, serrated, with transversal lines along the edge (Fig. 79).

First antenna: (Fig. 78) rod like. Ventral and dorsal margins with rows of spines, more robust near tip. One sensory seta located ventro-laterally near base of

antennula. Seven short, two long aesthetascs.

Second antenna: (Fig. 80) basipod with inner apical seta (arrow), and a stout apical spine on outer surface (arrow). All segments spinulose. Swimming setae 0-0-1-3/1-1-3; spines 2-2-2-1/0-0-1. Apex of segments two and three of exopodite widened. Largest seta with numerous short pines and about four stronger spines around mid-length.

Trunk limb 1: (Figs 83 and 84) as in *triserialis* and *rosea*, but epipodite small and rounded.

Trunk limb 2: (Fig. 85) scrapers 4–5 without enlarged subapical teeth. Seta 4 of gnathobasic filter-comb moderately larger than three other setae.

Trunk limb 3: (Fig. 86) exopodite with seta 3 at least twice as long as seta 2. Hillocks between setae 1 and 2 weakly indicated. Other characters as in *triserialis* and *rosea*.

Trunk limb 4: (Fig. 87) exopod with two hyaline setae of similar size. Endopod as in *triserialis* and *rosea*.

Trunk limb 5: (Fig. 88) pre-epipodite composed of three hyaline hillocks, with setules at their apex. Epipodite round. Exopod of one seta. Endopod with a rounded setulated lobe. Gnathobase with the three usual setae.

Postabdomen: (Fig. 82) as in *M. triserialis*, with robust postanal spines.

Male: not seen.

6. *Macrothrix tabrizensis* n. sp.

Holotype: an adult parthenogenetic female on a permanent glycerin glass slide sealed with Glyceel mounting medium, accession number 2000.274, deposited at the British Museum (Natural History) London.

Paratypes: two adults parthenogenetic females, accession number 2000.275, 2000.276; one adult ephippial female, accession number: 2000.277 and one male, accession number 2000.278; all on permanent slides, deposited in the British Museum. Two adult parthenogenetic females, one ephippial female and one male on permanent slides, access number respectively: I.G.28.882c, I.G.28.882d, I.G.28.882a, I.G.28.882b, deposited at Royal Belgian Institute of Natural Sciences, Brussels. One adult parthenogenetic female on permanent slide, accession number ECO CHZ 778. One adult ephippial female on permanent slide, access number: ECO CHZ 777; and one male on permanent slide, accession number ECO CHZ 776, deposited at ECOSUR. Carr. Chetumal-Bacalar, Quintana Roo. C. P. 77000. MEXICO. All material (Holotype and Para-

types) obtained from cultures by G. Murugan and H. J. Dumont from dry mud collected at Tabriz, Iran, 18 Nov 1995.

Diagnosis of the female

Dorsal margin of finely serrated valves curved, with dorsal spine, intestine not convoluted. Head laterally depressed, head-shield not reticulated, head-pore oval and small. Labrum bi-segmented, with setose apex. First antenna rod-like, with rows of spines of similar size all along. Nine aesthetascs in two groups (2 and 7) of different length. Second antenna: swimming setae 0-0-1-3/1-1-3; spines 0-1-0-1/0-0-1. Largest seta with fine spines from its basis to tip, and some slightly stronger spines along the body. Exopod of trunk limb one with long apical seta and very short lateral seta. Epipodite small. Seta 5 shortened. Exopodite of trunk limb two with plumose seta not curved inwardly, endopod with scraper 5 strongly developed but subapical spine not enlarged and middle seta of gnathobase erect, not curved outwardly. Third limb: all setae of the back row of the endite approximately of the same size. Exopod of trunk limb four very small. Endopod: posterior row with only three filter setae. Pre-epipodite of trunk limb five composed of three fused hyaline setae. Epipodite big and round. Exopod of two small mushroom-shaped setae. Biggest gnathobasic seta inserted on a hillock. Second biggest with a bulge. Postabdomen: preanal zone with small heel, postanal rim with groups of relatively small spines. Setae natatoria with well individualised distal segment.

Description of the parthenogenetic female

Shape: (Fig. 89) length 0.759 mm, height 0.504 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner, produced into a spine (arrow), with fine serration along the valve. Ventral margin serrated. Intestine without convolutions.

Head: (Figs 98, 109 and 110) with depression in rostral region, arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Head-pore small, round. Ventral margin smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented with transversal lines along the edge, distal end with a setose lobe (Fig. 91).

First antenna: (Figs 90, 112–114) rod-like, with rows of short spines over most of its length. These spines not increasing in size distally. One sensory seta ventrolaterally on proximal end of antennular length. Nine terminal aesthetascs in two groups of different length.

A distal external row of crown spines.

Second antenna: (Fig. 92) Basipod with inner apical seta and outer apical spine. Swimming setae- 1-3/1-1-3; spines 0-1-0-1/0-0-1. Largest seta bi-segmented, with row of fine spines from basis to tip (Fig. 93), and few slightly stronger spines dispersed over the seta.

Trunk limb 1: (Figs 94–96, 119, 121–124) epipodite small and rounded. Exopod with long apical and very short lateral seta. Endite 4 with three setae of decreasing length. Endite 3 with four setae, as in *rosea* and *triserialis*. Endite 2 with three setae, of which setae 3–4 of normal appearance, but seta 5 shortened. Endite 1 with two setae. Fork on endite 1 with one big tooth. Fork on endite 2, with two small teeth (Figs 96 and 125).

Trunk limb 2: (Figs 96, 127–131) exopod digitiform with heavy, not curved inwardly plumose apical seta. Endopod with eight scrapers. Scrapers 1–2 long and setiform. Scraper 3–8 of various length, their apical segment comb-shaped. Scraper 5 the most robust of all, its subapical spines not enlarged. Sensillum behind scrapers 8 and 4 absent. Between scrapers 3 and 4 a very small receptor (Figs 126 and 128). Gnathobase with brushing seta erect, setulose. Filter comb composed of the four usual plumose setae. A pore on the surface of the gnathobase (Figs 127–129).

Trunk limb 3: (Figs 97, 132 and 133) exopod with four plumose setae of subequal length. Seta 3 the longest, seta 4 unilaterally setulated. Endopodite with two external scrapers and two rows of setae. Anterior row apparently of five setae only. Posterior row of six setae, all of which about equal in length. Gnathobase with rows of thick setules. A bottle-shaped receptor near its base. Two setose hyaline papillae on its posterior end.

Trunk limb 4: (Fig. 98) exopod reduced in size, with two small plumose setae, similar in length. Endopod with two rows of appendages. Anterior row with five elements and a gnathobasic horsetail-seta, as in *triserialis*. Posterior row with **three** filter setae (1'–3').

Trunk limb 5: (Fig. 99) pre-epipodite composed of three fused hyaline setose setae. Epipodite big and round. Exopod composed of two coalesced lobes (I–II), with setules around their tip. Endopod a lobe, round and broad. Gnathobase with three setae. Seta 1' long, swollen at its broad basis, constricted and pointed apically. Distal segment with long setules at its basis and short apical setules. Seta 2 with basal swelling. Seta 3 very short, setulated.

Postabdomen: (Figs 100, 116–118) with heel (arrow).

Dorsal margin bilobed. Basal portion with numerous rows of small spines. Anus with groups of larger spines. Terminal claw small, evenly curved, with lateral small teeth. Seta natatoria with distal segment relatively long, about 1/5 of the whole, carrying few setae.

Diagnosis of the male

Shape oval-acute, dorsal margin curved from tip of rostrum to straight in posterior dorsal corner. No serration along the valves. Intestine without convolutions. Head with a depression in rostral region, arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Labrum bi-segmented, without ornamentation. First antenna long, nearly halfway to body, with two sensory setae. Distally neither setules nor spines. Second antenna as in female. Trunk limb 1 as in female, but a clasper plus a strong curved seta present. Clasper not widened apically. Trunk limb 2–5 as in female. Postabdomen hook-shaped in lateral view. Pre-anal zone with small heel. Dorsal margin not bilobed. Anus bordered with groups of spines. Terminal claw big, slightly curved, without lateral teeth. Seta natatoria with long proximal segment, distal segment shorter (about 1/4 of the total length of the seta).

Description of the male

Shape: (Figs 101 and 134) oval-acute, length 0.384 mm, height 0.250 mm, dorsal margin curved from tip of rostrum to straight in posterior dorsal corner. No serration along the valve. Intestine without convolutions.

Head: (Figs 101 and 134) with a depression in rostral region, arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Head pore small, oval. Ventral margin of head smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented, without ornamentation, distal segment round.

First antenna: (Figs 102, 134, 135 and 137) long, nearly halfway to valves, with two sensory setae, located ventro-laterally and dorsally. Some groups of strong spinules border the ventral angulation, and several rows occur in lateral orientation. Seven terminal aesthetascs, of which one much longer than the others. Distally, neither setules nor spines.

Second antenna: (Figs 103, 104 and 134) as in female. Distal segment of largest seta, with numerous strong spines (Fig. 104).

Trunk limb 1: (Figs 105 and 106) as in female, but

a clasper and curved acute seta attached to the exopod (Fig. 105). Clasper not widened apically.

Trunk limbs 2–5: as in female.

Postabdomen: (Figs 108, 138 and 139) hook-shaped in lateral view. Ventral margin convex. Preanal zone with small heel. Dorsal margin not bilobed. Pre-anal zone with numerous rows of spines similar in length, stronger than in the female. Anus bordered with groups of spines. Terminal claw big, slightly curved, smooth, without lateral teeth. Seta natatoria with long proximal segment, distal segment short (c. 1/4) in comparison with proximal. Distal segment carrying some long setae at its tip.

7. *Macrothrix agsensis* n. sp.

Holotype: an adult parthenogenetic female on a permanent glycerine glass slide sealed with Glyceel mounting medium, accession number 2000.279, deposited in the British Museum (Natural History), London.

Paratypes: three adult parthenogenetic females on permanent slides, accession number: 2000.280, 2000.281, 2000.279, deposited in the British Museum. Three adult parthenogenetic females on permanent slides, accession number I.G.28.881a, I.G.28.881b, I.G.28.881c, deposited at the Belgian Institute of Natural Sciences, Brussels, Belgium. Three adult parthenogenetic females on permanent slides, deposited at ECOSUR, Carr. Chetumal Bacalar, Chetumal Quintana Roo, C.P. 77000, Mexico, accession number ECO CHZ 771, 772, 773. All the material (Holotype and Paratypes) was collected by M. Silva-Briano, Araceli Adabache-Ortiz, Gustavo Quintero Díaz & Joel Vázquez Díaz. EL salto del burro (El Jagüey), Aguascalientes, México, 31 July 1993.

Diagnosis

Shape: oval in lateral view, dorsal margin curved from tip of rostrum to posterior dorsal corner. No dorsal serration. Intestine without convolutions. **Head** laterally depressed, head-shield not reticulated, head-pore big and oval. Labrum bi-segmented with transversal lines along the edge. First antenna rod-like. Dorsal margin with four rows of long spines, sensory seta located ventro-laterally. Nine terminal aesthetascs in two groups of somewhat different length. **Second antenna:** coxal region with unusually long apical spine on outer surface. Swimming setae 0-0-1-3/1-1-3; spines 0-1(1)-1-1/0-0-1. Largest seta with fine spines from basis to tip. Exopod of trunk limb one with long apical seta and very short lateral seta. Setae

4–5 of endite 2 with five spines along their inner apical rim. Epipodite elongated. Trunk limb two: exopod oval with plumose apical seta, turned inwardly. Endopod with eight scrapers, none of which have enlarged subapical teeth. Filter comb composed of four long setae; seta four much thicker than the others. Trunk limb three: exopod with four plumose setae, and seta 2 slightly longer than seta 3. Endopod with back row of six setae, all of the same length. Anterior row with five setae. Exopod of trunk limb four with two short setae. Endopod with naked external scraper. Trunk limb five: exopod composed of one seta, endopod a rounded lobe, epipodite big, elongated, gnathobase composed of three setae of different length. Postabdomen: ovoid in lateral view, pre-anal zone with small heel, dorsal margin not bilobed. Anus bordered with several groups of spines. Terminal claw small, with lateral teeth. Seta natatoria with long proximal segment, distal segment shorter but not reduced, carrying some setae at its tip.

Description of the parthenogenetic female

Shape: (Figs 140 and 153) oval, length 0.807 mm, height 0.515 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner, without dorsal serration, but with slight reticulation (Fig. 154). Intestine without convolutions.

Head: (Figs 140 and 153) laterally depressed in rostral region, arched in lateral view, head-shield not reticulated, dorsal margin not serrated. Head-pore big, oval. Ventral margin of head smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented with transversal lines along the edge, and apex a lobe with few short hairs (Fig. 142).

First antenna: (Figs 141 and 156) rod-like. Dorsal margin with four rows of long, strong spines. One sensory seta ventro-laterally near proximal end. Nine terminal aesthetascs of different length. Two longer ones inserted in a V-shape. Distally, an external row of small spines.

Second antenna: (Fig. 143) coxal region with two inner basal sensory setae. Basipod with inner apical seta (arrow), and a stout apical spine in outer surface (arrow). Swimming setae 0-0-1-3/1-1-3; spines 0-1-(1)-1-1/0-0-1. Largest seta bi-segmented, unilaterally setulated, with fine spines from basis to tip (Fig. 144).

Trunk limb 1: (Figs 146–148, 158–162) epipodite elongated. Exopod with long apical seta, and a very short lateral seta. Endite 4 with three setae of decreasing length. Endite 3 with four setae. Seta 1 long with

short unilateral setules. Seta 2 smaller and finer than 1, with long setules at its tip. Seta 8 with apical tuft of setules. Endite 1 as is *triserialis* and *rosea*. Endite 2 with setae 4–5 modified: their inner apical half lined with about five thick, short setae. Fork on endite 1 with two teeth, on endite 2 with one tooth (Fig. 148).

Trunk limb 2: (Figs 149, 163, 164 and 166) exopod oval with a plumose seta, inserted apically and curved inwardly over scrapers 1–2. Endopod with eight scrapers. Scrapers 1–2 setiform. Scrapers 3–5 robust, their subapical teeth not enlarged. Scrapers 6–8 with fine teeth. No sensillum behind scrapers 8 or 4. Gnathobase with filter comb composed of four plumose setae, of which seta 4 the more robust one.

Trunk limb 3: (Figs 150, 165, 167–169) exopod with four plumose setae. Setae 1–2 similar in length, seta 3 slightly shorter. Seta 4 short and serrate. Endopod: two external scapers and two rows of appendages. Anterior row with five setae. Posterior row with six setae, all of similar length. Gnathobase blunt, with rows of long and thick setules, a receptor and two setose hyaline papillae. A pore at the base of the gnathobase (Figs 125–127).

Trunk limb 4: (Fig. 151) exopod with two plumose setae of similar length. Endopod with two row of setules. Anterior row with the usual five elements. Posterior row with **five** setae (1'–5'). Gnathobase with horsetail seta (6). **Trunk limb 5:** (Figs 152 and 171) pre-epipodite composed of three lobes, setulated at their tip. Epipodite big. Exopod one seta (1), with short setules at its terminal part. Endopod rounded, setulated at its apex. Gnathobase with three setae. Seta 1 very long, bi-segmented, unilaterally setulated. Seta 2 long, fully setulated. Seta 3 small, fully setulated. A probable pore on the gnathobase.

Postabdomen: (Figs 145, 155 and 157) Ventral margin slightly convex with two rows of small spines. Preanal zone with small heel. Dorsal margin not bilobed. Pre-anal portion with numerous rows of small spines, all similar in length. Anus too bordered with several groups of spines. Terminal claw, small, evenly curved, with lateral teeth. Seta natatoria with long proximal segment, distal segment shorter than proximal, carrying long setae at its tip.

Male unknown.

8. *Macrothrix smirnovi* Ciro-Pérez & Elías-Gutiérrez, 1997

Material examined: Presa La Araña, Sierra Fría, Ags. 25 Sep 1995. Charco en carr. Tanque Los Jimenez, Ags. 17 Aug 1991, México; 20 specimens analysed,

leg. M. Silva-Briano.

Description of the parthenogenetic female

Shape: (Fig. 172) oval, length 0.901 mm, height 0.624 mm, dorsal margin curved from tip of rostrum to posterior dorsal corner. No serration along the valve. Intestine without convolutions.

Head: (Fig. 172) with depression in rostral region, arched in lateral view. Head-shield not reticulate, dorsal margin slightly serrated. Head-pore big, round. Ventral margin of head smooth. Compound eye located close to margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented; distal part a lobe bearing short hair-setae (Fig. 174).

First antenna: (Fig. 173) rod-like. Dorsal margin with up to eight rows of long spines. One sensory seta on proximal end of antennular length. Seven terminal aesthetascs in two groups of different length. Distally, an external crown of spines.

Second antenna: (Fig. 175) Basipod with inner apical seta and stout apical spine. Swimming setae 0-0-1-3/1-1-3; spines 0-2-1-1/0-0-1. Largest seta, with fine spines at its basis, about five strong spines, decreasing in size, at its median part, and fine spines at its distal tip (Fig. 176).

Trunk limb 1: (Figs 178–180) epipodite big, elongated. Exopod with long, serrated apical seta, and short lateral seta. Near its basis, a small plumose seta, and an oblique row of setules between both. Endite 4 with three serrate setae of decreasing length. Endite 3 with four setae. Setae 8 and 7 similar in size, and slightly smaller and less robust than seta 6. Endite 2 with three, endite 1 with two feathered setae 8–9. Forks on endites 1–2 with one big tooth each (Fig. 180).

Trunk limb 2: (Fig. 181) exopod with inwardly curved apical seta. Endopod with eight scrapers. Scrapers 1–2 long and setiform. Scraper 3 the longest of the 'true' scrapers, but scraper five has the most robust teeth. Scrapers 6–8 smaller and similar in length, with fine teeth along their distal segment. No sensillum behind scraper 8, but **a hairy seta behind scraper 4**. Gnathobase with conical posteriormost gnathobasic seta 1. Brushing seta 2 not curved inwardly. Seta 3 hooked. Small seta between gnathobase and filter comb, with fine setules at its tip. Filter comb composed of four plumose setae. Seta four the strongest.

Trunk limb 3: (Fig. 182) exopod with four plumose setae. Setae 1–2 about equally long,. Setae 3–4 also similar in length, and shorter than 1–2. Seta 3 plumose, but seta 4 serrate. Endopod with two external

scrapers, and two rows of appendages. Anterior row with **five** appendages, including at least one receptor seta. Posterior row with six setae, all of similar length. Gnathobase with rows of thick setules, an elongated receptor, and two setose papillae.

Trunk limb 4: (Fig. 183) exopod with two plumose setae, similar in length. Endopod with two rows of setae. Anterior part with a scraper, three flaming-torch setae, and a receptor. Posterior row of five plumose setae long. Gnathobase with horsetail seta and support seta. Gnathobasic filter seta absent.

Trunk limb 5: (Fig. 184) pre-epipodite composed of **two** hyaline lobes of different shape, with long setules at their tip. Epipodite big, curved, apically tapering and pointed. Exopod a hyaline lobe with fine setules at its tip. Endopod a rounded lobe. Gnathobase with three setae.

Postabdomen: (Fig. 177) Ventral margin slightly convex. Pre-anal zone with small heel. Dorsal margin bilobed. Pre-anal portion with numerous rows of spines, all similar in length. Anus bordered with groups of spines. Terminal claw small, evenly curved, with lateral teeth. Seta natatoria with long proximal segment, distal segment much shorter than proximal but not rudimentary, carrying some setae.

Description of the male

Shape: (Fig. 185) oval-acute, length 0.346 mm; dorsal margin curved from tip of rostrum to posterior dorsal corner. No serration along the valve. Ventral margin serrated. Intestine without convolutions.

Head: (Fig. 185) laterally without depression in rostral region. Arched in lateral view, head-shield not reticulate, dorsal margin not serrated. Head-pore not seen. Ventral margin of head smooth. Compound eye located close to the margin. Ocellus smaller than compound eye, located near tip of rostrum. Labrum bi-segmented, with small distal segment rounded.

First antenna: (Fig. 186) long, extending nearly halfway of valve, with two sensory setae located ventro-laterally, close each other. Groups of strong spines border the ventral angulation. Nine terminal aesthetascs in two groups of different length. Distally neither setules nor spines.

Second antenna: (Fig. 185) as in female.

Trunk limb 1: as in female, but exopod with clasper and long curved seta (Fig. 187).

Trunk limbs 2–5: as in female.

Postabdomen: (Fig. 188) similar to that of the female.

Discussion

It is convenient to begin by an attempt to determine a set of characters common to all the animals described above that provide a contrast with other groups within the genus. Unfortunately, only the *laticornis*-group and *M. tripectinata* have been described in sufficient detail to be usable. *M. tripectinata* is a mesasiatic representative of the *M. hirsuticornis*-group as re-defined by Silva-Briano (1998). In spite of this limited information, trunk limbs 2–5 turn out to be richly endowed with diagnostic characters: the endopodite of limb two has eight scrapers and no receptor or ciliated seta behind scraper 8 in the *rosea*-group, while it has a receptor in the *laticornis*-group, and a seta in *M. tripectinata* (as in other representatives of the *M. hirsuticornis*-group). The exopodite of limb three has four plumose setae in the *rosea*-group and in the *laticornis*-group, against five in *M. tripectinata-hirsuticornis*. The anterior row of setae of the endopodite is composed of five or six setae in *rosea*-group, but of seven setae, of which the three externalmost are modified into aesthetascs and the remaining four are mushroom-shaped in *laticornis* and *tripectinata*. The exopodite of limb four has two plumose setae in the *rosea*-group, three in *laticornis* and *tripectinata*. Limb five has a complex pre-epipodite and a single exopodital seta in the *rosea*-group, a simple pre-epipodite and two exopodital setae in the *laticornis*-group, and one exopodital seta in *M. tripectinata*. In addition, as Kotov (1999) advocated, the first antenna also permits to separate lineages: a first antenna with nine equally long aesthetascs is primitive (*M. tripectinata*), one in which the aesthetascs form two groups is evolved (*rosea* and *laticornis*). It is, therefore, possible to unequivocally create a *rosea*-group, in which *smirnovi* stands out as the only species that has a setose seta behind scraper 4 of limb two, a character which was suggested to provide a transition between *Macrothrix* on the one hand and *Wlassicsia* and *Bunops* on the other hand (Silva-Briano & Dumont, 2001). However, there are many important differences between *Macrothrix* and the latter genera, suggesting that *M. smirnovi* had better continued to be considered a member of the *rosea*-group sl. Examples include the total absence of gnathobasic filter-combs on limbs three and four. Such combs are present and well developed in *Wlassicsia* and *Bunops*, the endite of trunk limb two has three doublings, and pointed, scale-like hillocks behind scrapers 2–4, the exopodite of their limb three has five setae and limb four is with three setae, additional

setae occur on the endite 1 of limb one, the Fryer's forks are incompletely modified, etc.

Having thus defined the *rosea*-group s.l. (see Conclusion for a full statement of diagnostic characters), we will now attempt to bring order to the *rosea-triserialis* species complex, sorting out which characters may be useful to delimit species here. Clearly, *rosea* and *triserialis* are nearly related, and in the absence of males, attempts to separate them may fail. In this respect, we note that Korinek misidentified some Czech material as *rosea*, having in hand a species with a 'normal' (i.e. female-like) male postabdomen. Yet, good figures of the blunt-ending postabdomen without end-claws of true *rosea* are available in identification manuals, e.g. Flössner (1972). What Korinek, who kindly allowed us to re-examine his material, had in front of him turned out to be a mixture of three species, including *Wlassicsia pannonica*.

Table 1 provides an overview of 23 diagnostic characters used in the present paper, of which 20 apply to females only. Taking *M. triserialis* from its *terra typica* in Sri Lanka as the species of reference, a systematic comparison of all characters listed shows that three differences exist with the population from Kerala, against seven with *M. rosea*. Of these, female characters 2, 4 and 21 appear taxonomically usable. Even so, there might have been reason for doubting the specific identity of *M. rosea* (as done, e.g. by Dumont & Van de Velde, 1977), had males not been available for comparison. Females of *rosea* can now safely be separated from females of *triserialis* by the fact that their first antenna has no apical enlarged spines, the largest seta of the second antenna has a large number of medium-sized spines throughout, and the terminal segment of the seta natatoria is short but not reduced to just the very apex of the seta (a character first identified by Smirnov, 1992). Here, we also accept that the differences between the *triserialis* population from Sri Lanka and from Kerala (only few hundreds of kilometers apart) are interpopulation variation. It follows that at least the following three characters are suspect as taxonomic tools: the size of the fourth gnathobasic seta of trunk limb two, the size of seta 3 of exopodite 3 relative to that of seta 2, and the lack of plumosity on seta 2 (as seen in the topotypical population).

Comparing new type-*triserialis* with the three African and American populations analysed, it appears that the Kenyan sample shows variation in the same characters as the two populations from India, in addition to the fact that scraper 5 of trunk limb 2 is without enlarged subapical teeth. We find it difficult,

at this point in time, to weigh this difference, since the population from Mexico shows it too. In addition, the Mexican population has globular epipodites on trunk limbs 1 and 5, and thus stands a little further away from true *triserialis* than the African population. *Macrothrix elegans* from Sao Paulo state is again closer to typical *triserialis*, except that it has an enormous epipodite on trunk limb 5. If we maintain *elegans* as a good species (which is here done mainly for convenience), the population from Mexico may deserve the same status. Because of the absence of males (males of *triserialis* s.l. have now become available from three sources: Sao Paulo, Central Africa and Kerala State in India, but all look similar), such a decision is not taken here. We suggest to first resample both populations, to test for the stability of the differentiating characters, and to apply Sars' technique of culturing animals in the laboratory (as done here with *M. tabrizensis*). Large numbers of individuals, as well as males can be obtained by this technique. Our proposal to synonymise *M. superaculeata* with *M. elegans* is motivated by the fact that both occur in the same general area, and by the variability of the spine formula of antenna 2 (*superaculeata*-like spines occur as well in the Lobo sample as in the sample from Mexico), leaving no 'solid' characters to separate the two.

M. tabrizensis has 18 differences (out of 23 possible, including male characters) in diagnostic traits with topotypical *M. triserialis*, and is therefore accorded full specific status without hesitation. In *M. agsensis*, of which unfortunately no males were available, 11 differences (out of 20 traits) were recorded, and it is consequently also considered to be of full specific rank. For comparison, it may be stated that *M. smirnovi* differs only by 15 characters out of 23 (14 in males). Its status, of a species and even a subgroup is not questioned here, but the comparison shows that it is almost of the same rank as *agsensis* and *tabrizensis*.

Conclusion

We conclude by summing up all characters that currently allow us to characterise a *M. rosea* s.l. group, a *M. rosea-triserialis* subgroup, and a *M. smirnovi* subgroup.

M. rosea-group s.l.: first trunk limb with nine setae on endites 1–3, three on endite 4, and two (one very short, one long) on the exopodite. Fryer's forks with one or two big teeth. Limb two with eight scrapers in a row, without any doublings (ex-

cept in *smirnovi*-subgroup). Hillocks behind scrapers 2–4 rounded. Exopodite with apical seta curved inwardly over scrapers 1–2 (except in *M. tabrizensis*). Gnathobase with three apical appendages, of which the middle one the largest, usually curved outwardly and plumose, and a fourth, internal seta between the apex and the four gnathobasic setae. Exopodite of limb three with four setae; endopodite with two marginal scrapers, six appendages in the front row, and six appendages in the back row. Some of the frontal appendages modified to tubular receptors, but none mushroom- or aesthetasc-shaped. Exopodite of limb four with two setae; endopodite with a frontal marginal scraper, three flaming torch setae, a receptor, a horsetail seta, and a support seta. A posterior row of plumose setae composed of 3–6 setae. No gnathobasic filter setae on trunk limbs three and four. Limb five with a complex pre-epipodite, a strongly developed epipodite, reduced ecto- and endopodites, and three gnathobasic setae. Female postabdomen at least with a rudiment of a heel. Male postabdomen showing a morphological series from end-claws totally reduced to postabdomen fully female-like.

M. rosea-triserialis subgroup: showing the characters of the group, with the following restrictions: postabdominal heel always well developed; rows of strong spines between the rim of the anus and the base of the seta natatoria; fifth (to a lesser degree fourth) scraper of limb two with enlarged subapical teeth (except in populations of Mexico and Kenya, and trait therefore open to further evaluation); hind row of setae on endopodite of limb three composed of two long and four short setae; hind row of setae on endopodite of limb four composed of 5+1 setae (five on the endopodite, one on the gnathobase); epipodite of limb five elongated (exception: population from Mexico); pre-epipodite trilobed.

M. smirnovi-subgroup: showing the characters of the group, with the following restrictions: limb two with a setulated seta behind scraper 4; scraper 5 by far the most robust of the eight, but none of its teeth conspicuously longer than the others; middle appendix of gnathobase not plumose; pre-epipodite of limb five bilobed.

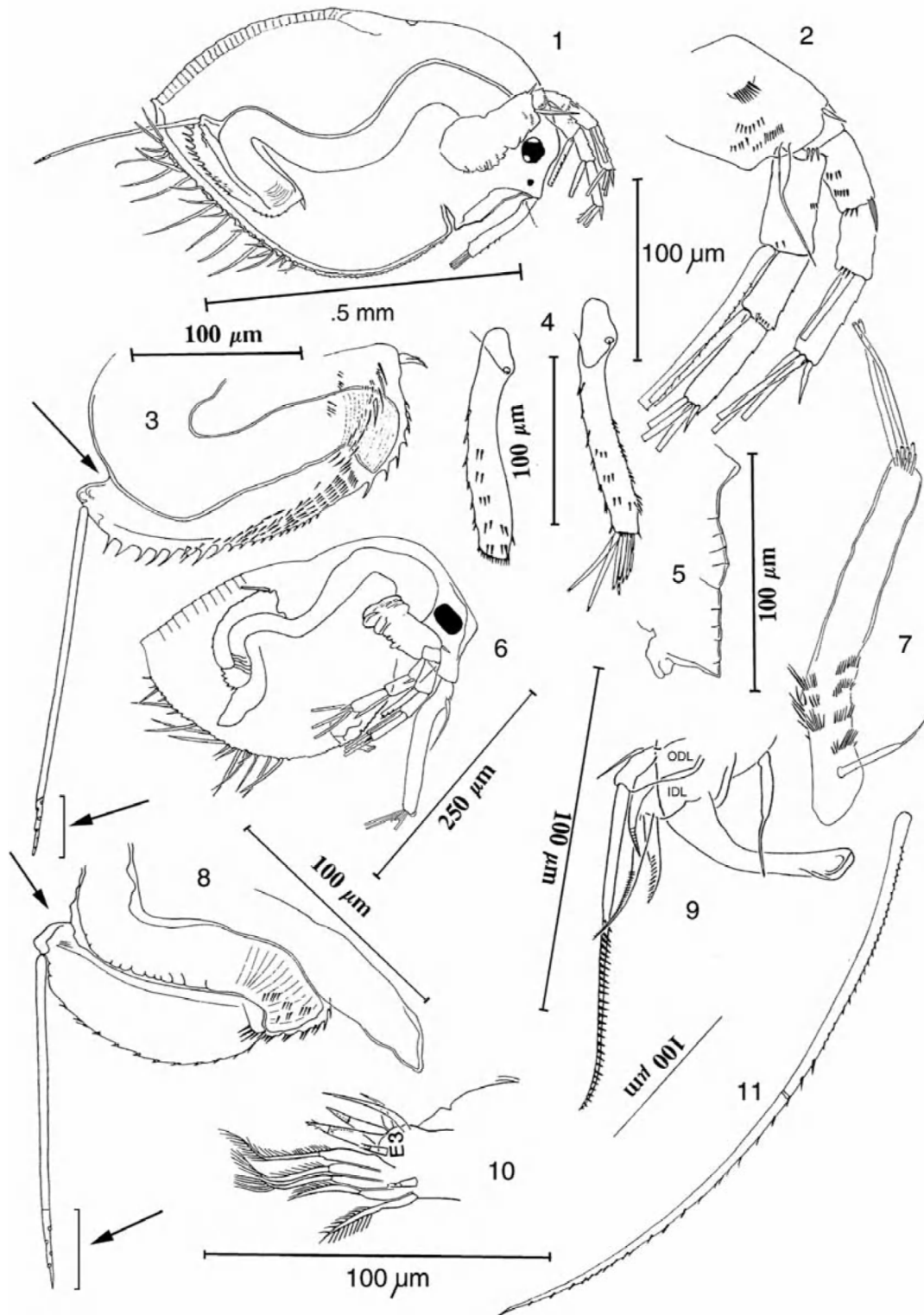
Acknowledgements

We are grateful to Dr V. Korinek, Dr C. F. Fernando, and Dr M. David Masai for presenting us with specimens of various *Macrothrix*. M. Silva-Briano par-

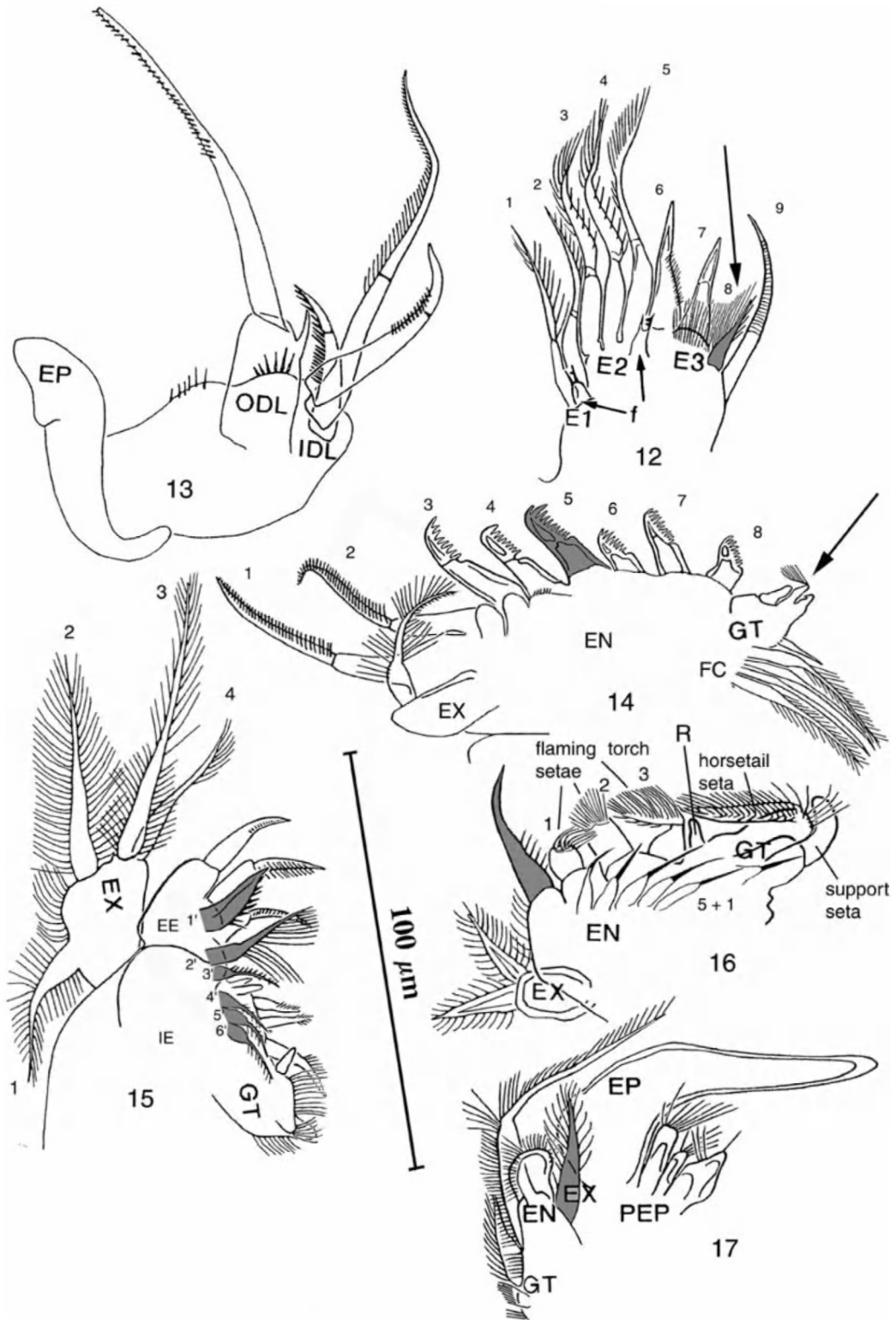
ticularly thanks Prof. Enrique Olivares Santana, and the members of the Centro de Ciencias basicas de la Universidad Autonoma de Aguascalientes for their support.

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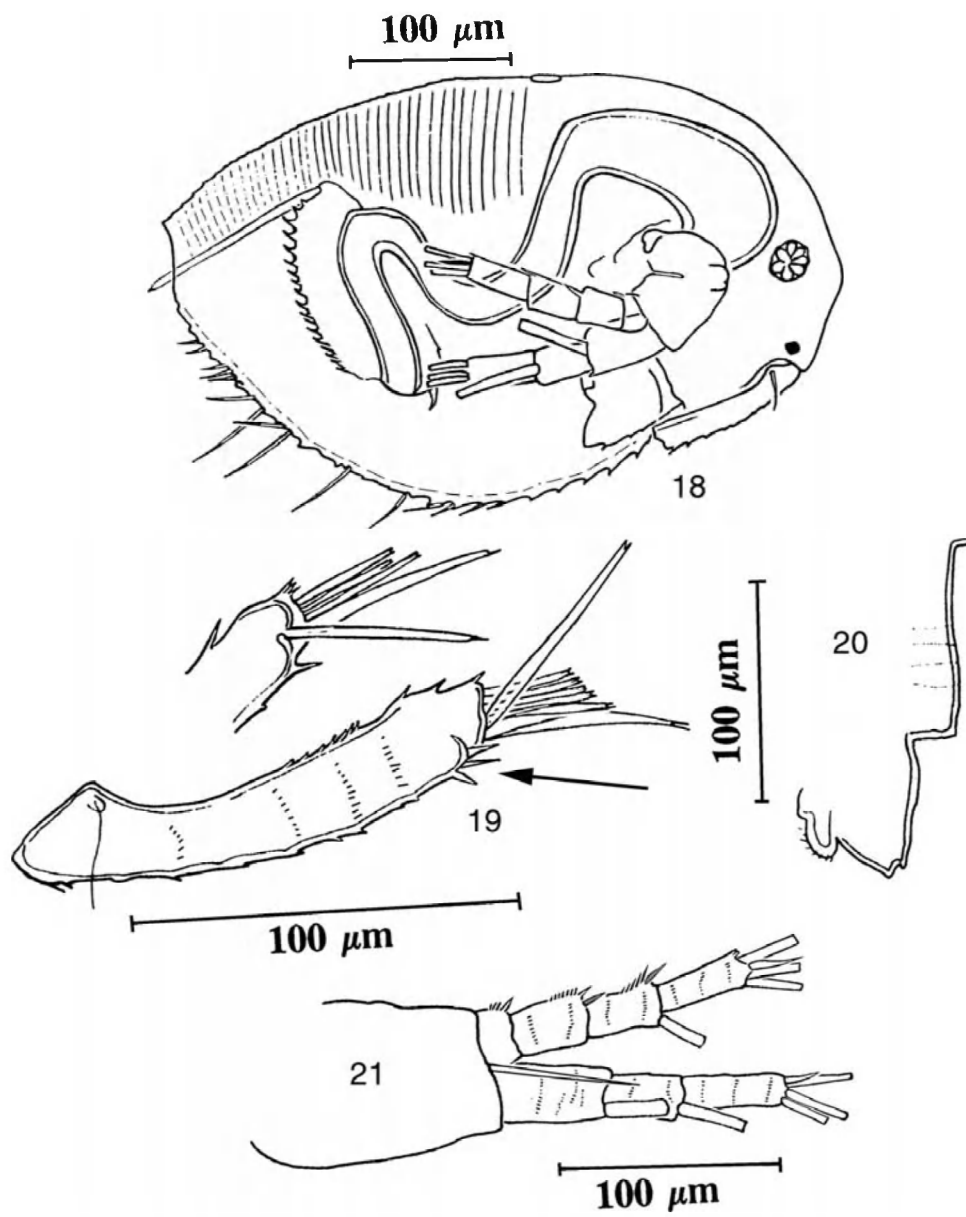
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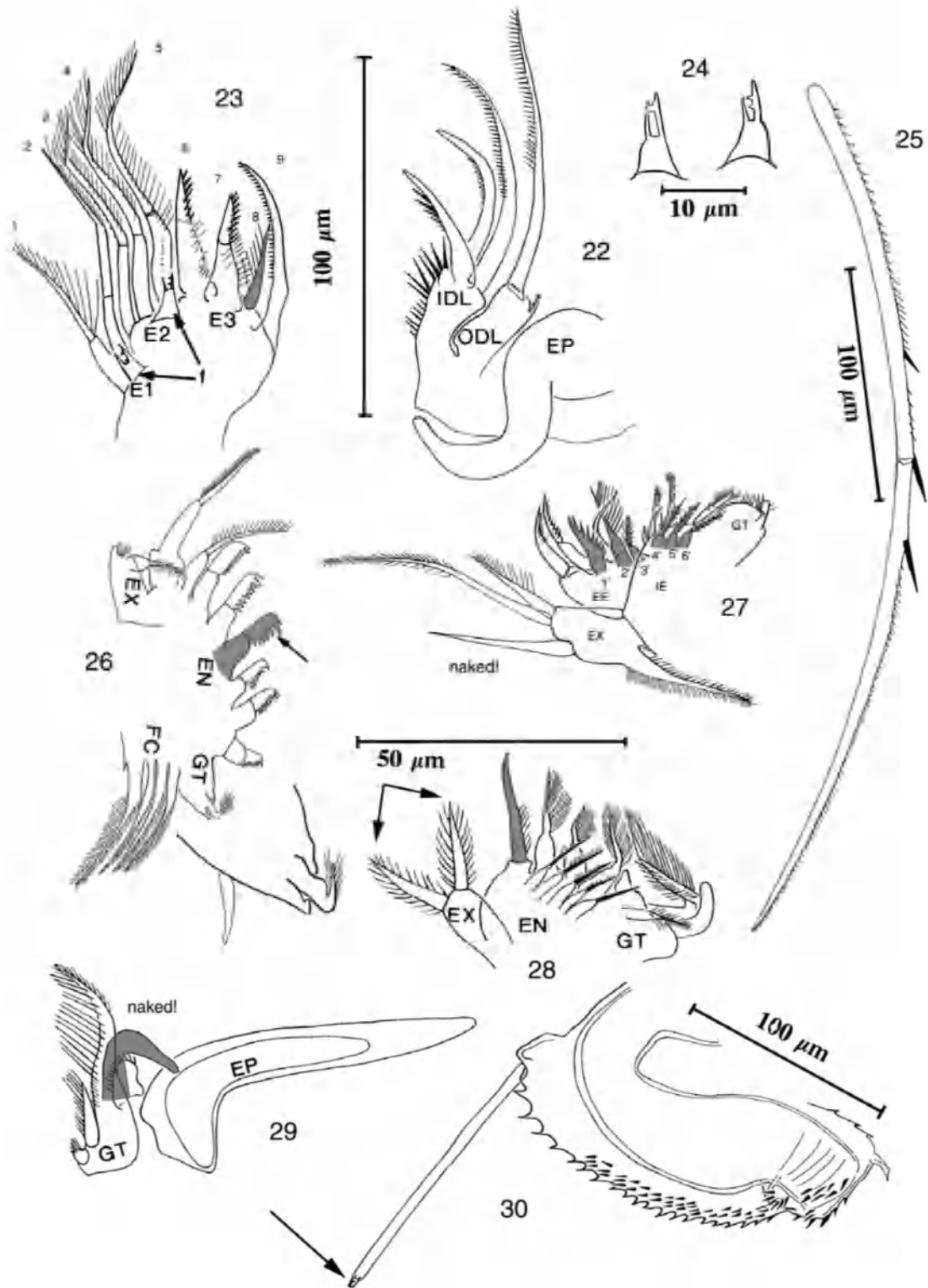
Figures 1–11. *Macrothrix rosea*, Belgium. Figure 1. Habitus of a parthenogenetic female. Figure 2. Second antenna of female. Figure 3. Postabdomen of female. Figure 4. First antenna of female. Figure 5. Labrum of female. Figure 6. Habitus of a male. Figure 7. First antenna of male. Figure 8. Postabdomen of male. Figure 9. IDL, ODL and copulatory clasper of male. Figure 10. Limb one (endites 1–3) of male. Figure 11. Longest seta on second antenna in female.



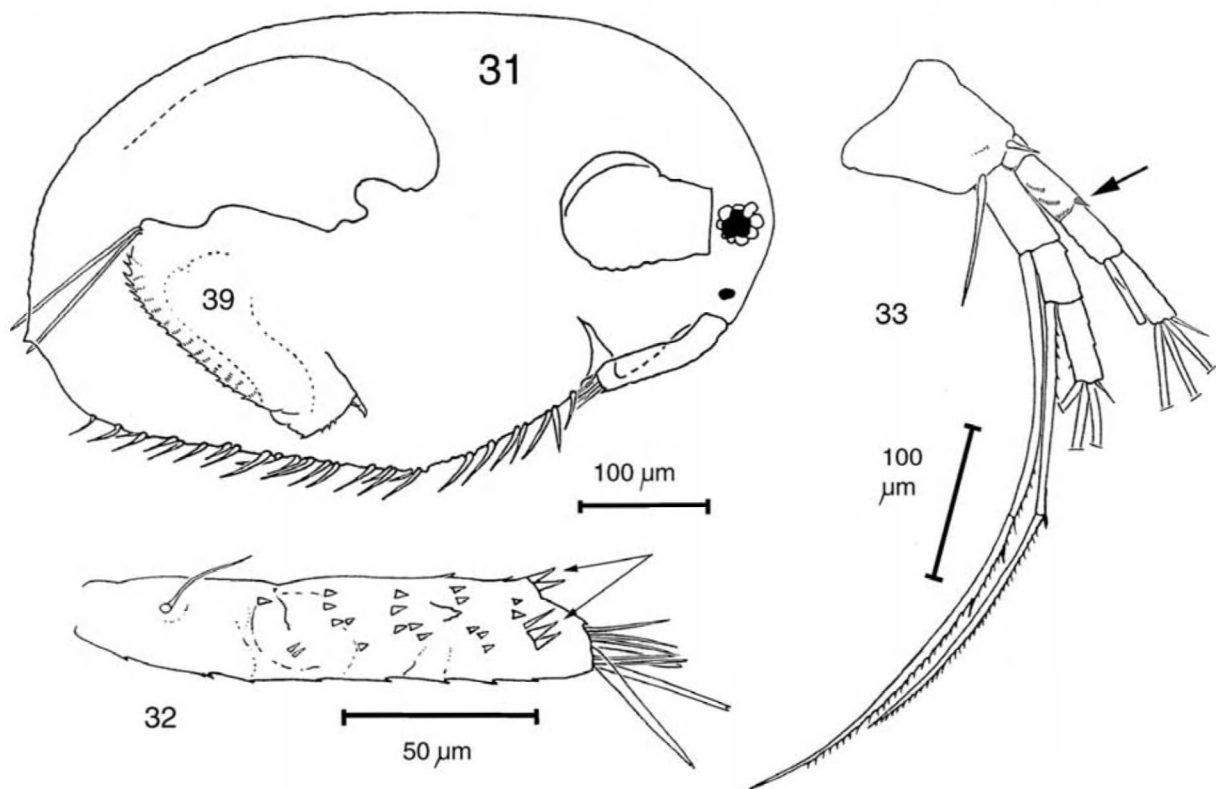
Figures 12–17. Trunk limbs of a female of *Macrothrix rosea*, Belgium. Figure 12. Trunk limb one with setae on endites numbered consecutively. Figure 13. IDL, ODL and epipodite of limb one. Figure 14. Limb two. Figure 15. Limb three with rows of setae on exo- and endopodites, provided with a standard numbering. Figure 16. Limb four. Figure 17. Limb five.



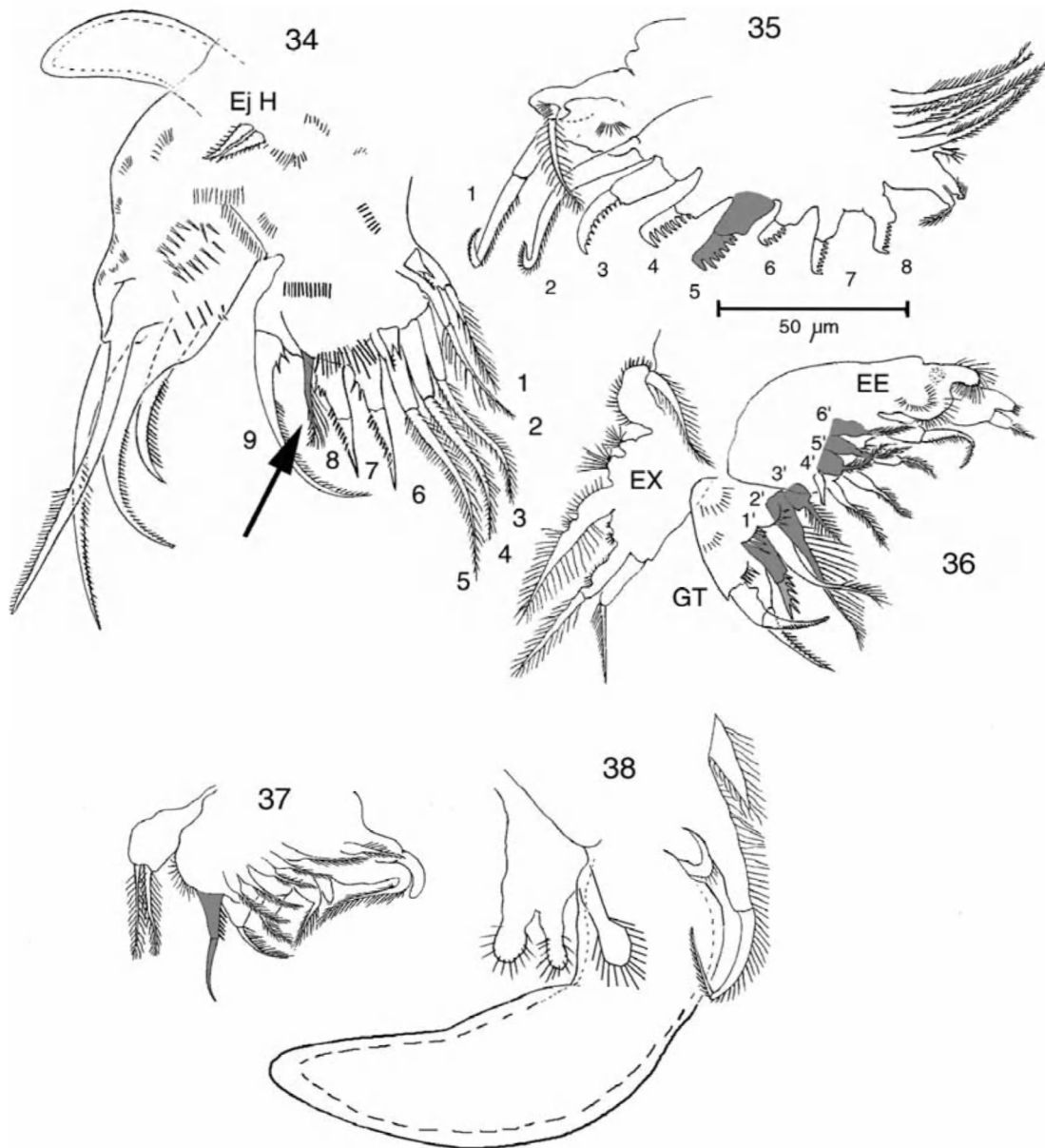
Figures 18–21. Topotypical *Macrothrix triserialis* from Sri Lanka. Figure 18. female habitus. Figure 19. First antenna. Figure 20. Labrum. Figure 21. Second antenna.



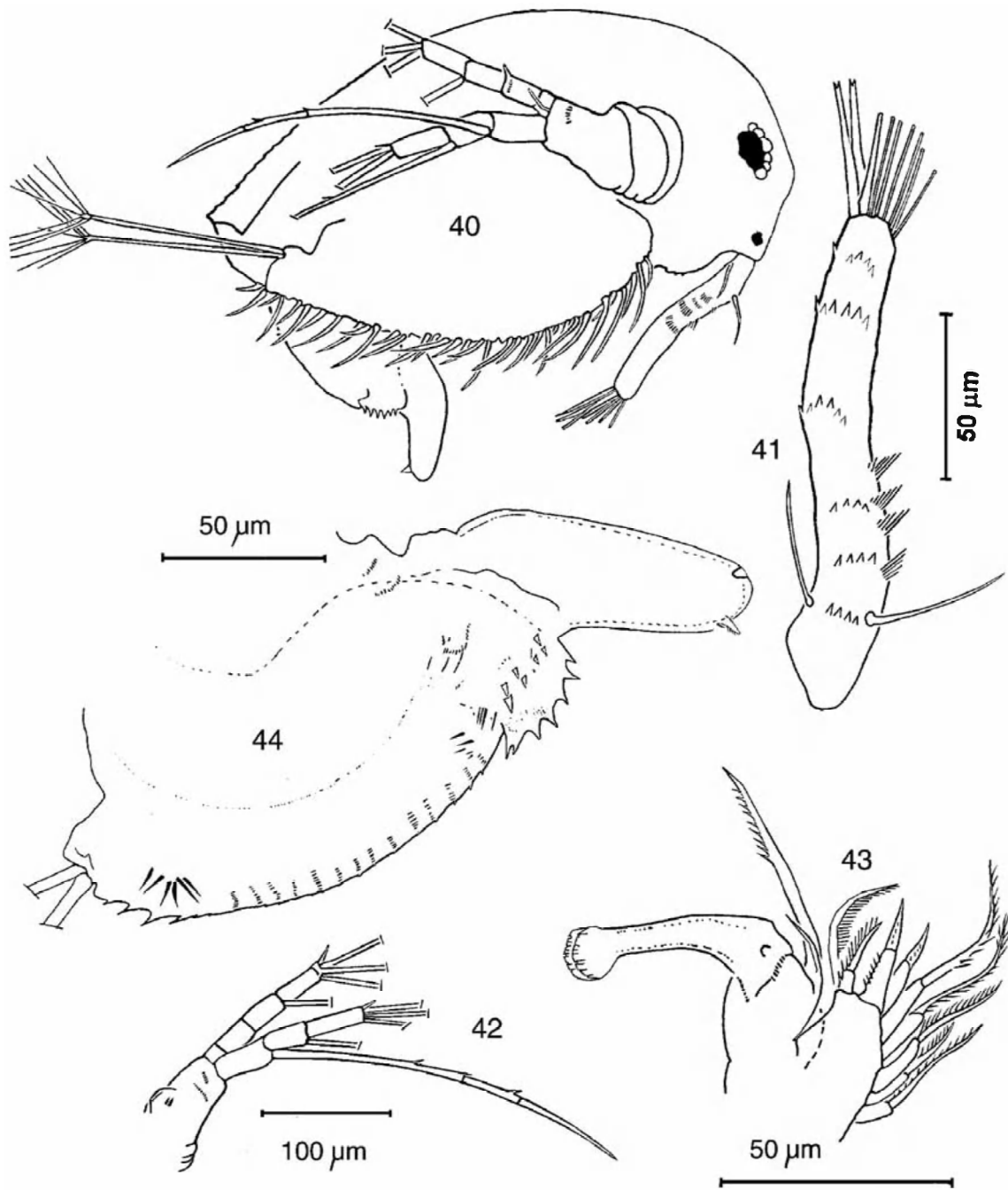
Figures 22–30. *Macrothrix triserialis* female, Sri Lanka. Figure 22. IDL, ODL and epipodite of limb one. Figure 23. Endites 1–3 of limb one. Figure 24. Fryer's forks. Figure 25. Long seta of second antenna. Figure 26. Limb two. Figure 27. Limb three. Figure 28. Limb four. Figure 29. Limb five. Figure 30. Postabdomen.



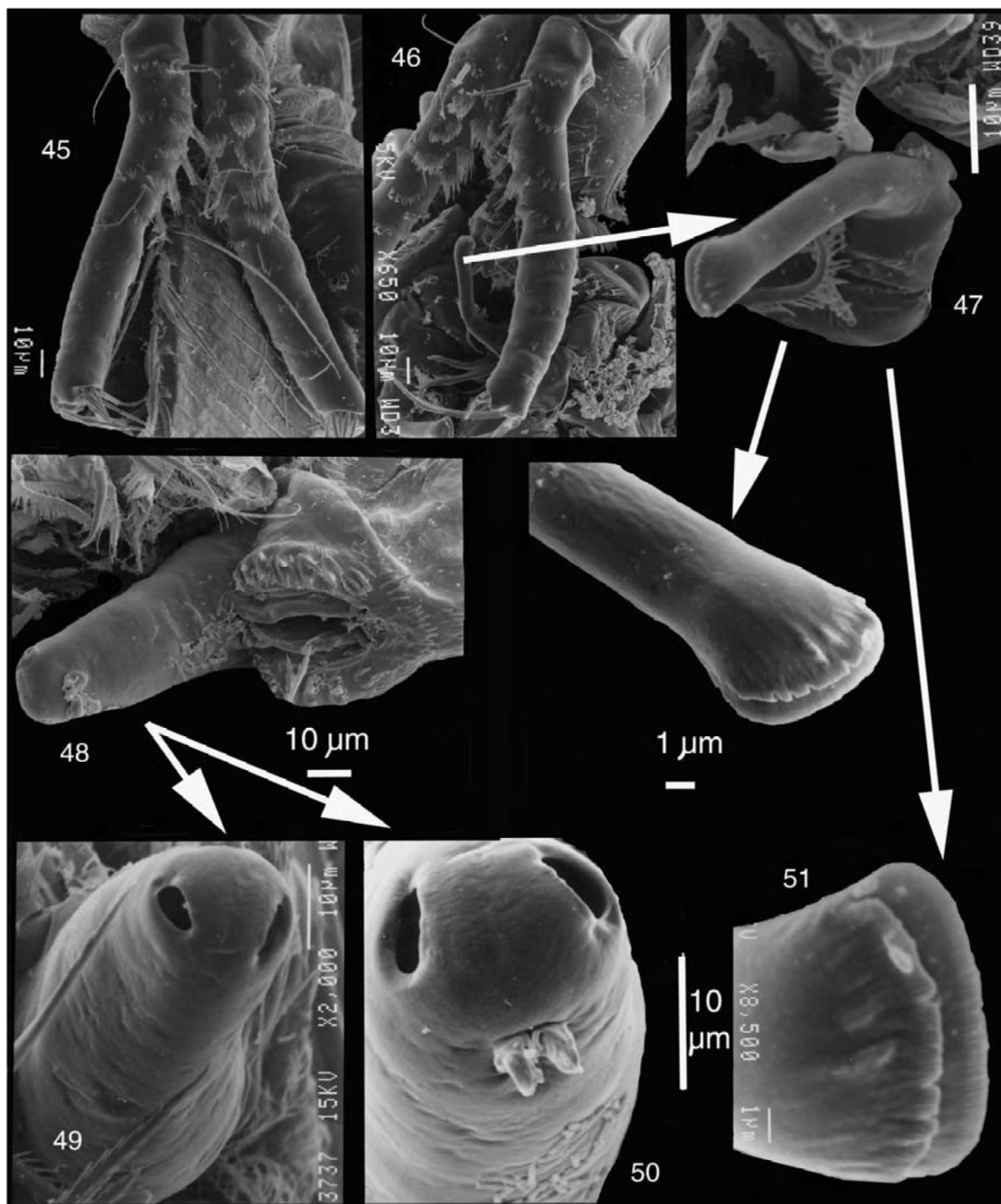
Figures 31–33. *Macrothrix triserialis* from Kerala. Figure 31. Female habitus. Figure 32. First antenna. Figure 33. Second antenna.



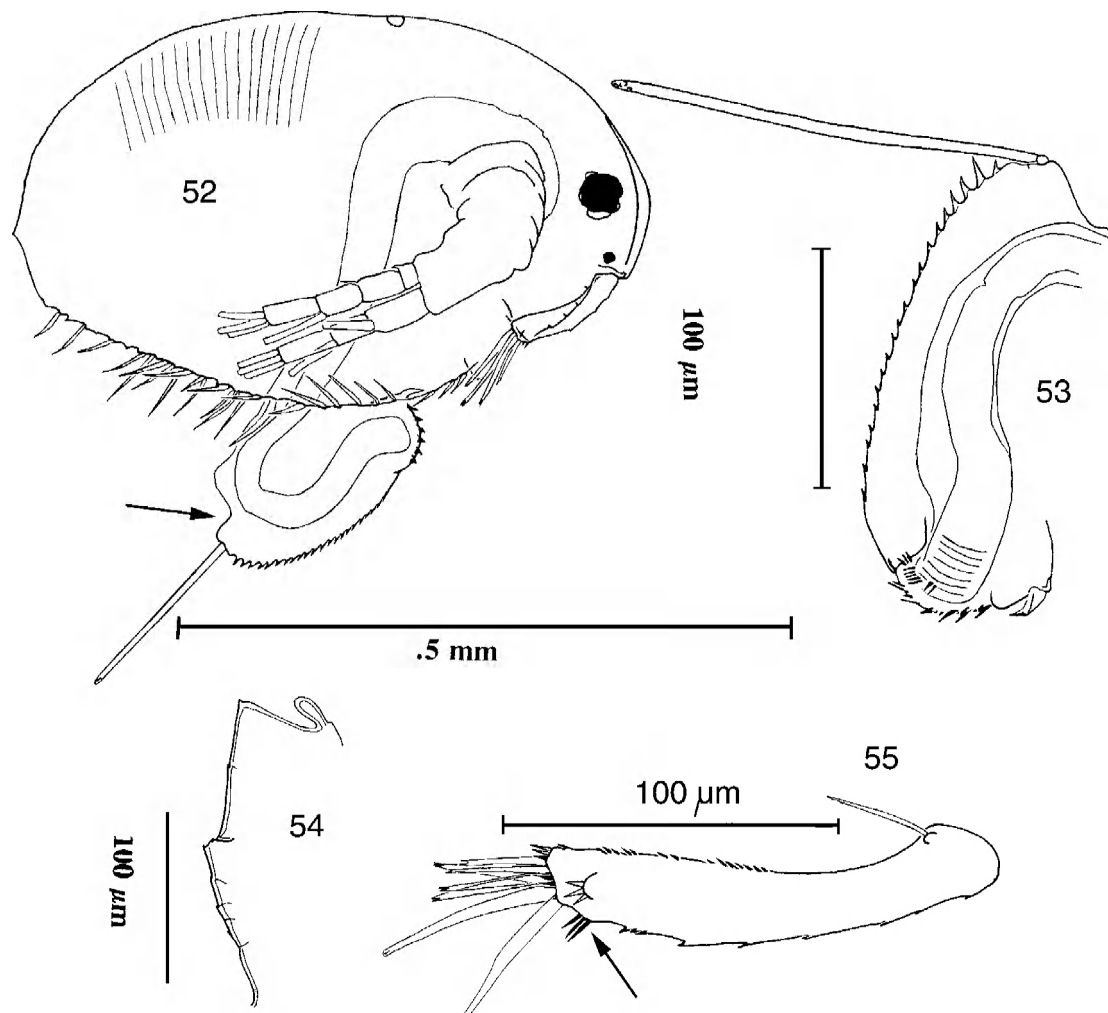
Figures 34–38. *Macrothrix triserialis* from Kerala, female. Figure 34. First trunk limb, complete. Figure 35. Trunk limb two. Figure 36. Trunk limb three. Figure 37. Trunk limb four. Figure 38. Trunk limb five.



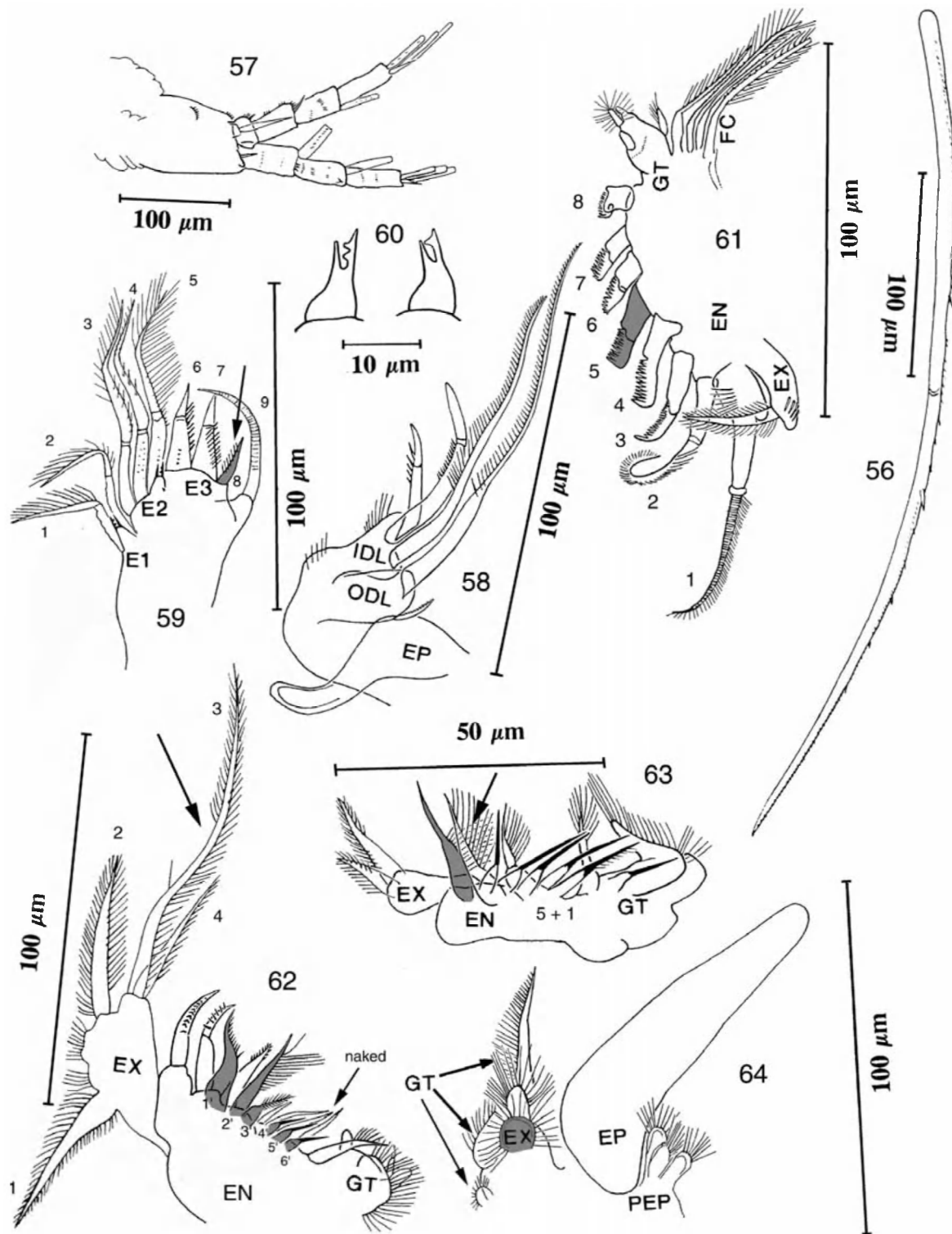
Figures 40–44. *Macrothrix triserialis* from Kerala, male. Figure 40. Habitus. Figure 41. First antenna. Figure 42. Second antenna. Figure 43. First trunk limb with copulatory clasper. Figure 44. Postabdomen.



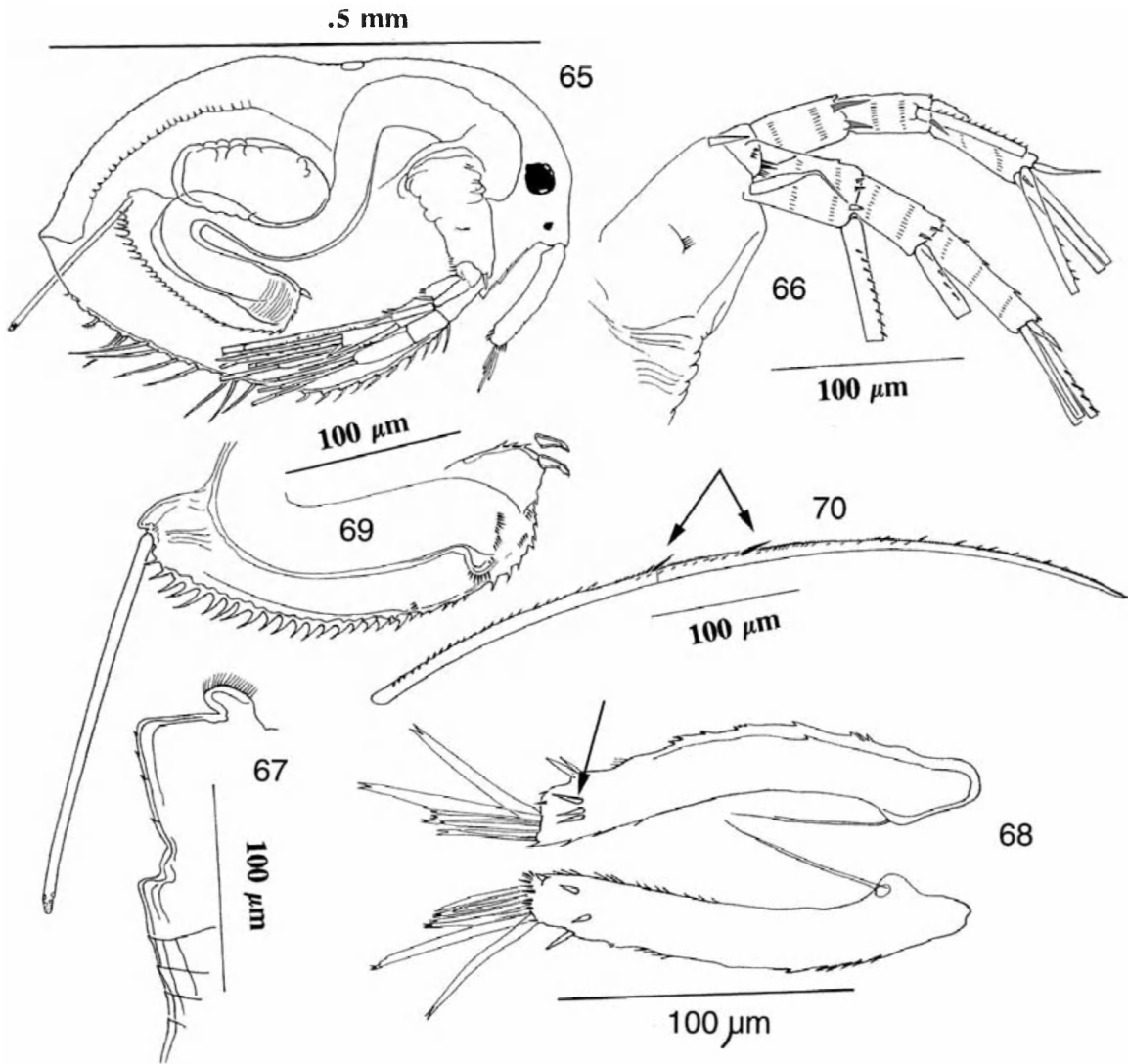
Figures 45–51. SEM's of *Macrothrix triserialis* male, Kerala. *Figure 45*. First antenna of male, showing the spinulation and the sensory setae. *Figure 46*. First antenna of male, showing the sensory setae, and the clasper (arrow). *Figure 47*. Copulatory hook (Clasper) of the male, showing the bifurcate apex. Below, detail of the apex of the clasper, showing small cuts in the edge, making it look like a pair of castanets. *Figure 48*. Postabdomen of the male, showing the anus, the rounded apex, and the two small leaflets below the apex. *Figure 49*. A view of the apex of the postabdomen, showing the openings of the sperm ducts. *Figure 50*. Detail of the same, showing the pseudo-claws below. *Figure 51*. Detail of the bifurcated apex of the copulatory clasper.



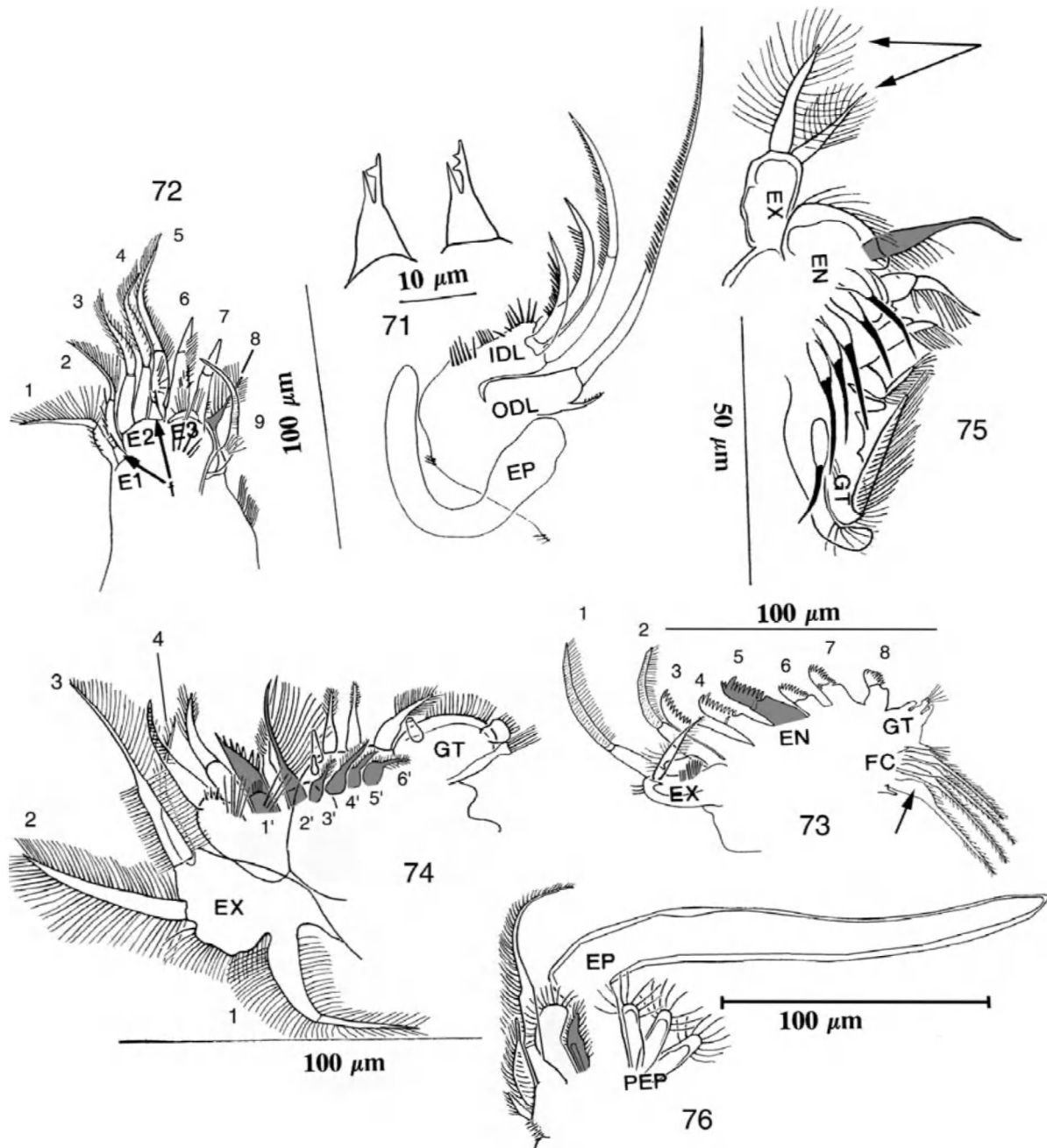
Figures 52–55. *Macrothrix cf. triserialis* from Kenya. Figure 52. Female habitus. Figure 53. Postabdomen. Figure 54. Labrum. Figure 55. First antenna.



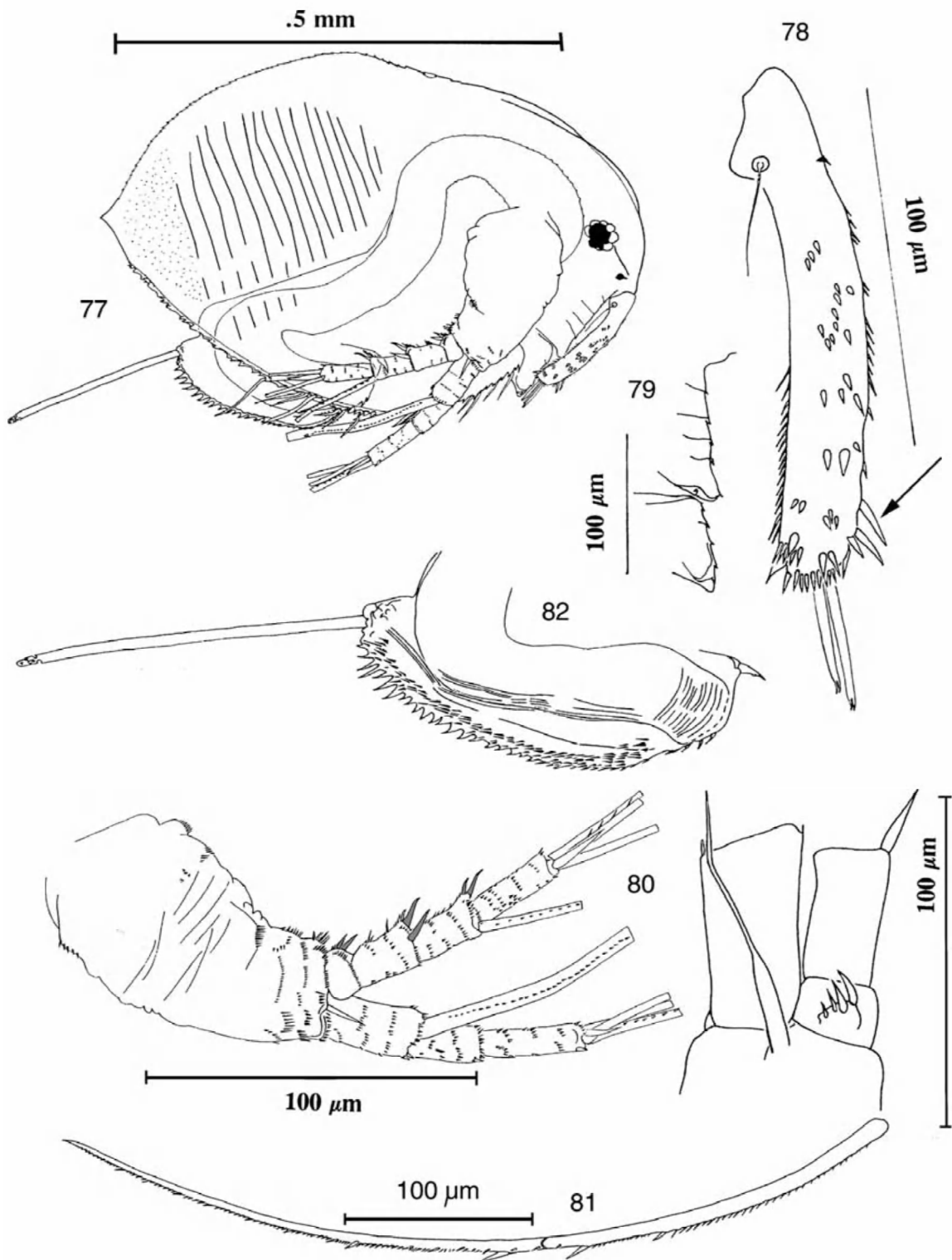
Figures 56–64. *Macrothrix cf. triserialis* from Kenya. Figure 56. Long seta of second antenna. Figure 57. Second antenna. Figure 58. IDL, ODL and epipodite of first trunk limb. Figure 59. Endites 1–3 of first trunk limb. Figure 60. Fryer's forks. Figure 61. Second trunk limb. Figure 62. Third trunk limb. Figure 63. Fourth trunk limb. Figure 64. Fifth trunk limb.



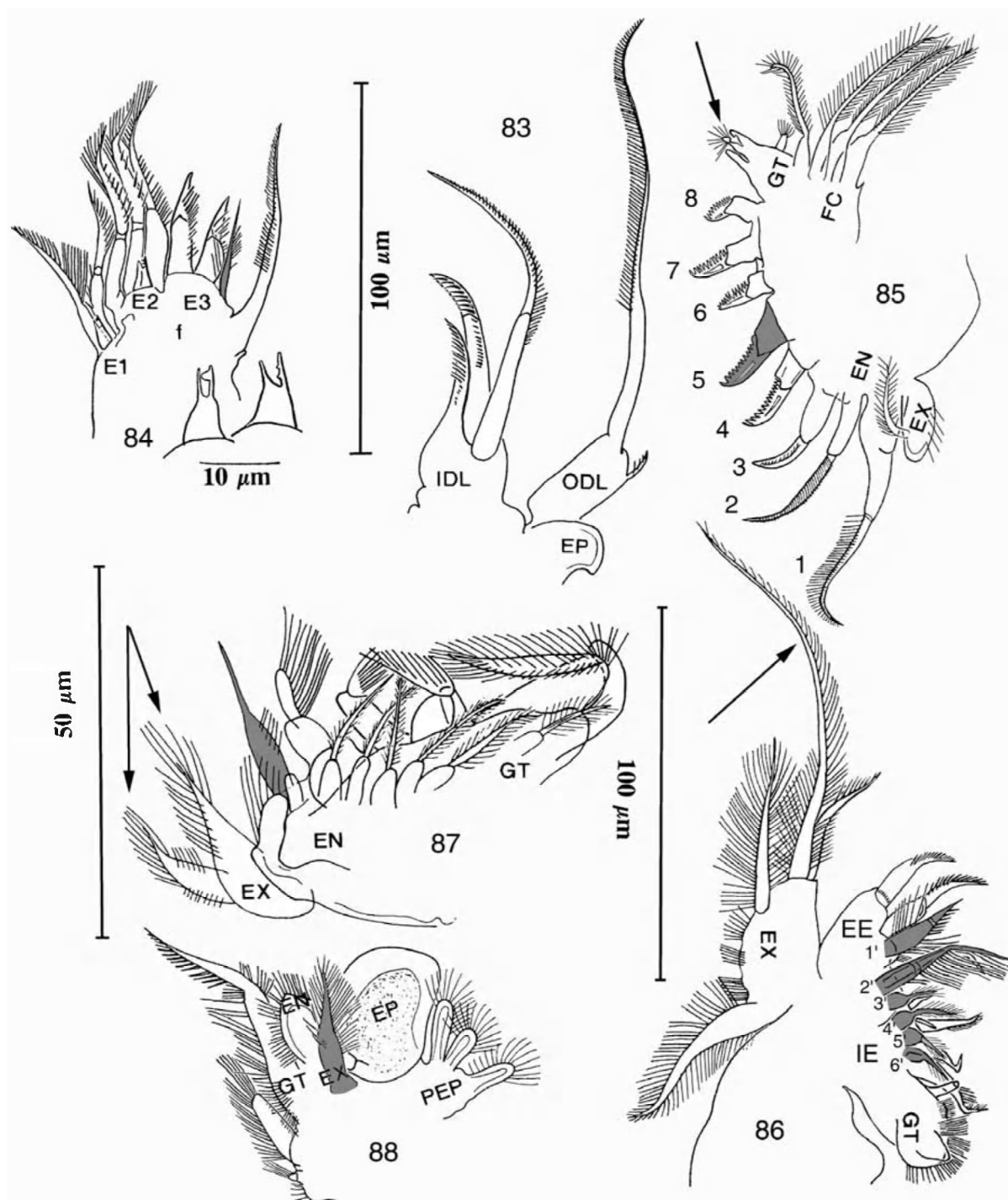
Figures 65–70. *Macrothrix elegans* from Sao Paulo State, Brasil. Figure 65. Female habitus. Figure 66. Second antenna. Figure 67. Labrum. Figure 68. First antenna. Figure 69. Postabdomen. Figure 70. Long seta of second antenna.



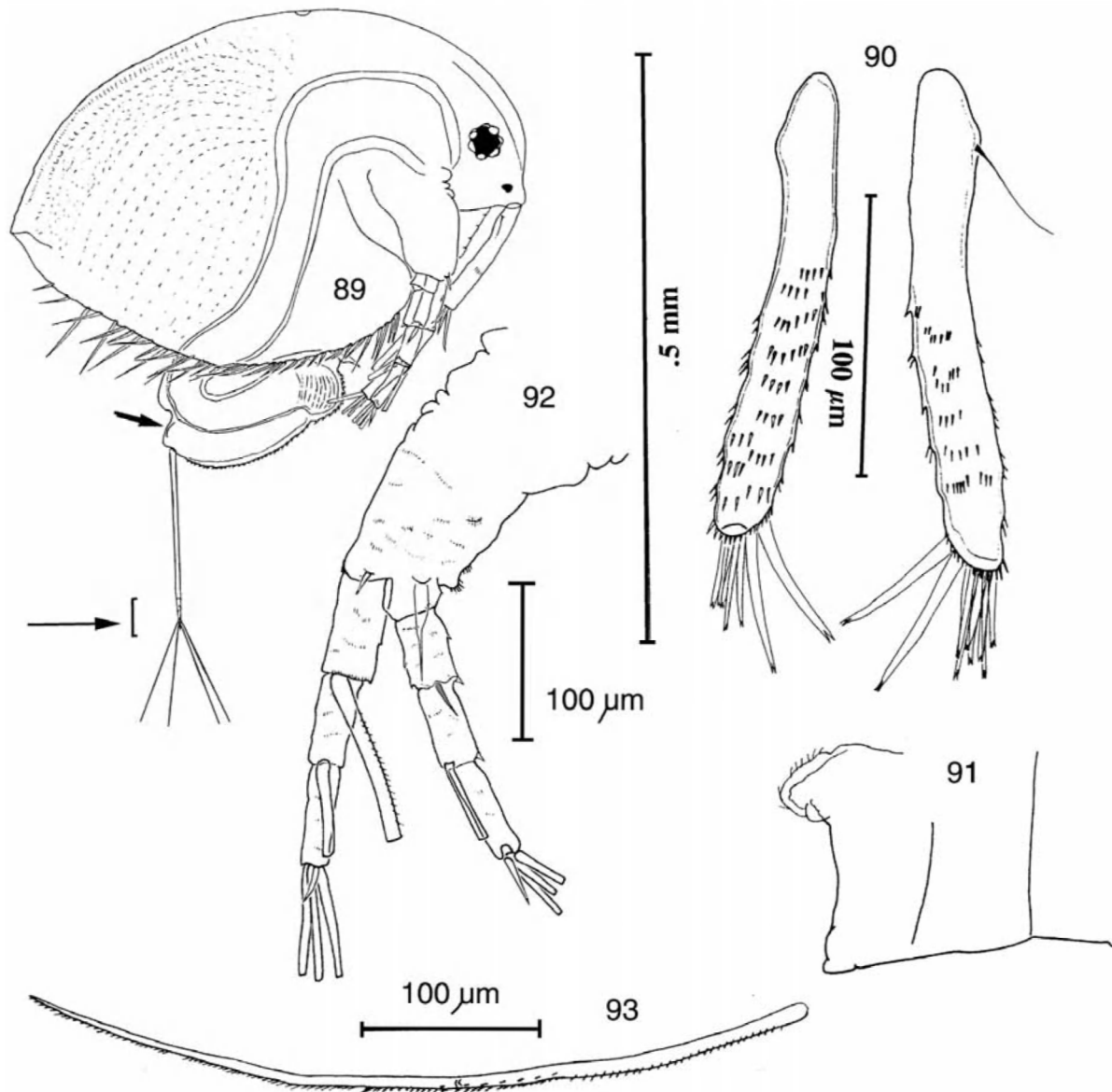
Figures 71–76. *Macrothrix elegans*, Sao Paulo. Figure 71. IDL, ODL, epipodites and Fryer's forks of first trunk limb. Figure 72. Endites 1–3 of first trunk limb. Figure 73. Second trunk limb. Figure 74. Third trunk limb. Figure 75. Fourth trunk limb. Figure 76. Fifth trunk limb.



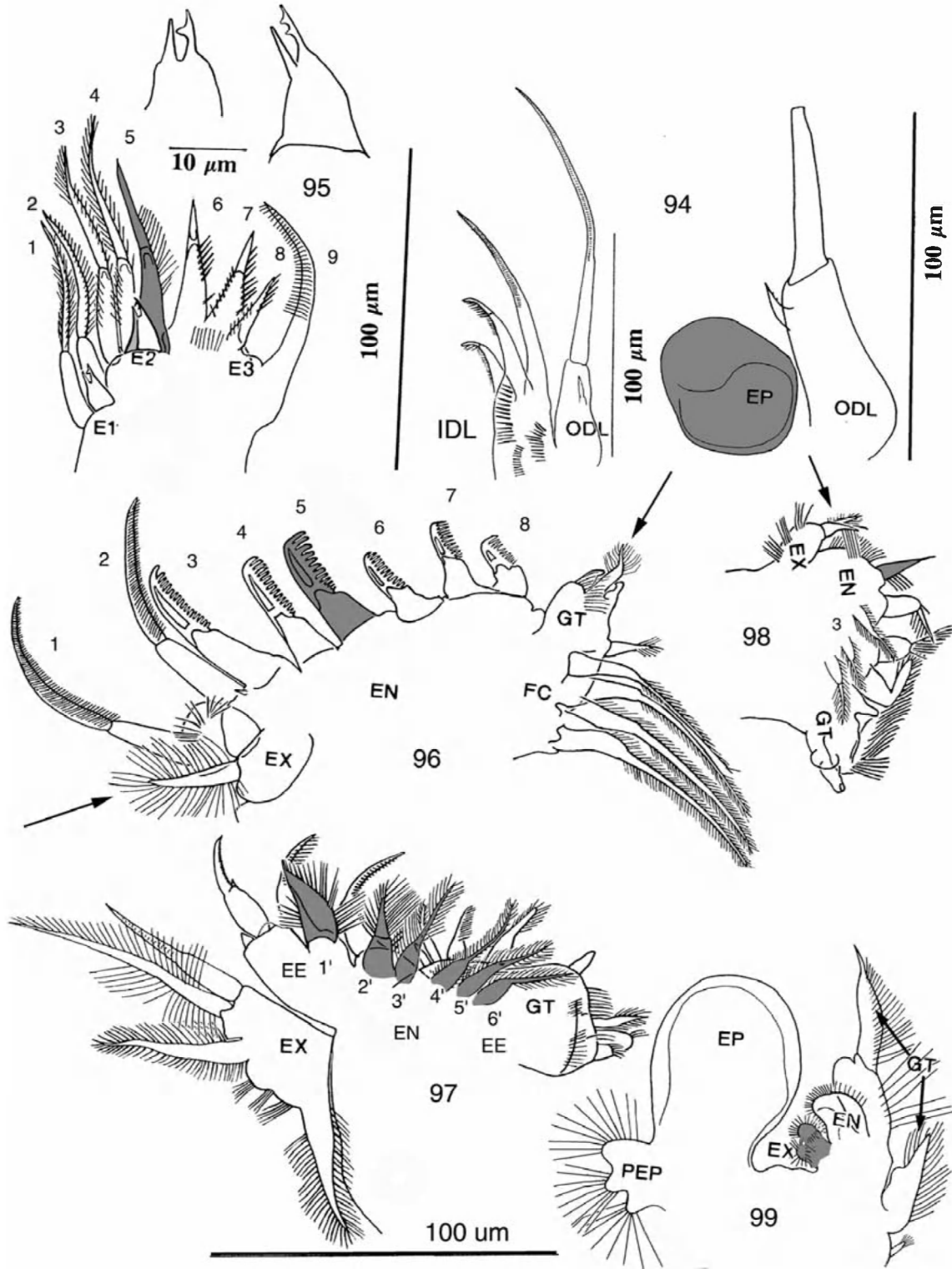
Figures 77–82. *Macrothrix cf. triserialis* from Mexico. Figure 77. Female habitus. Figure 78. First antenna. Figure 79. Labrum. Figure 80. Second antenna. Figure 81. Long seta of second antenna. Figure 82. Postabdomen.



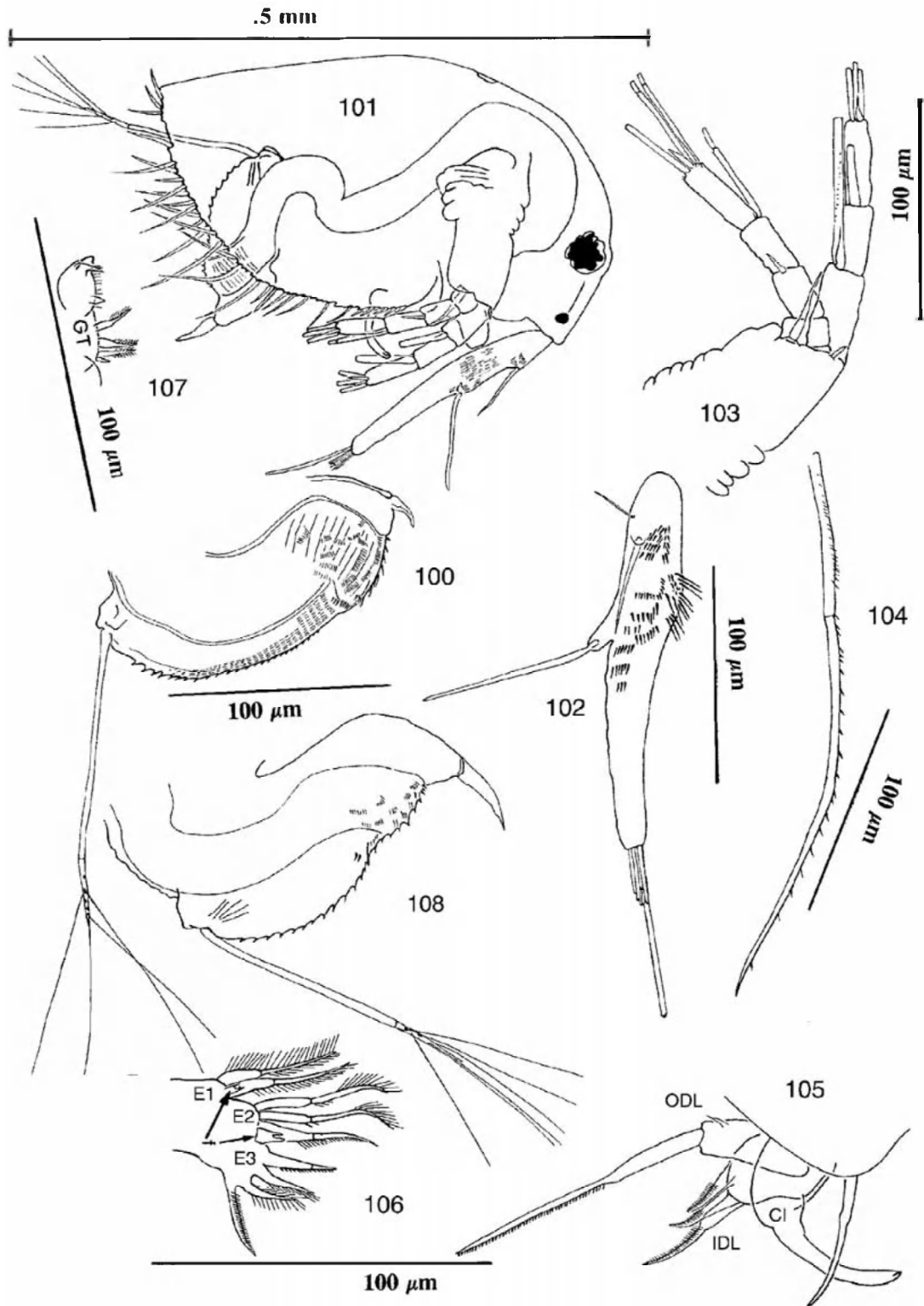
Figures 83–88. *Macrothrix cf. triserialis*, Mexico. Figure 83. IDL, ODL and epipodite of trunk limb one. Figure 84. Endites 1–3 of trunk limb one. Figure 85. Second trunk limb. Figure 86. Third trunk limb. Figure 87. Fourth trunk limb. Figure 88. Fifth trunk limb.



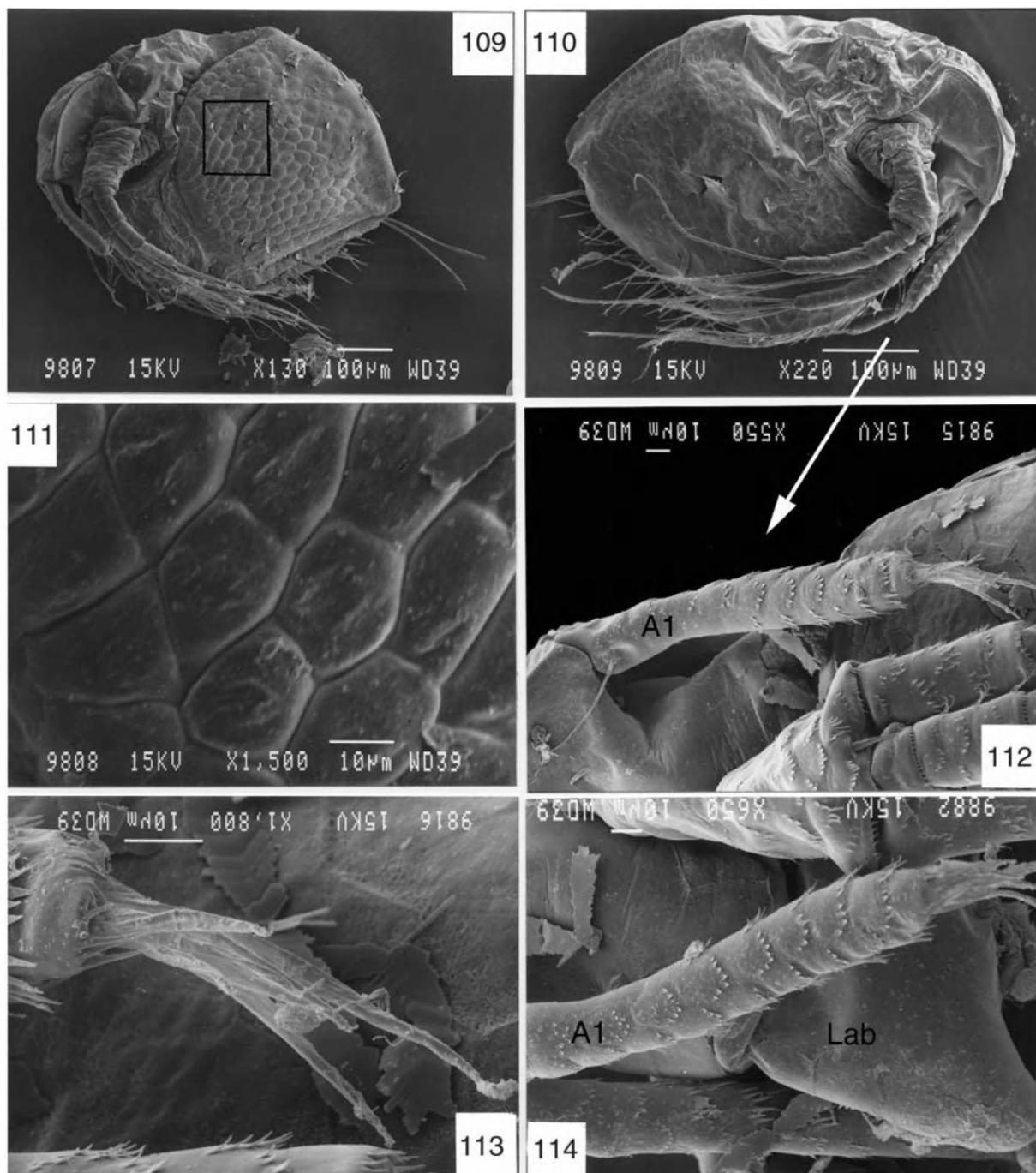
Figures 89–93. *Macrothrix tabrizensis* n. sp. from Iran. Figure 89. Female habitus. Figure 90. First antenna. Figure 91. Labrum. Figure 92. Second antenna. Figure 93. Long seta of second antenna.



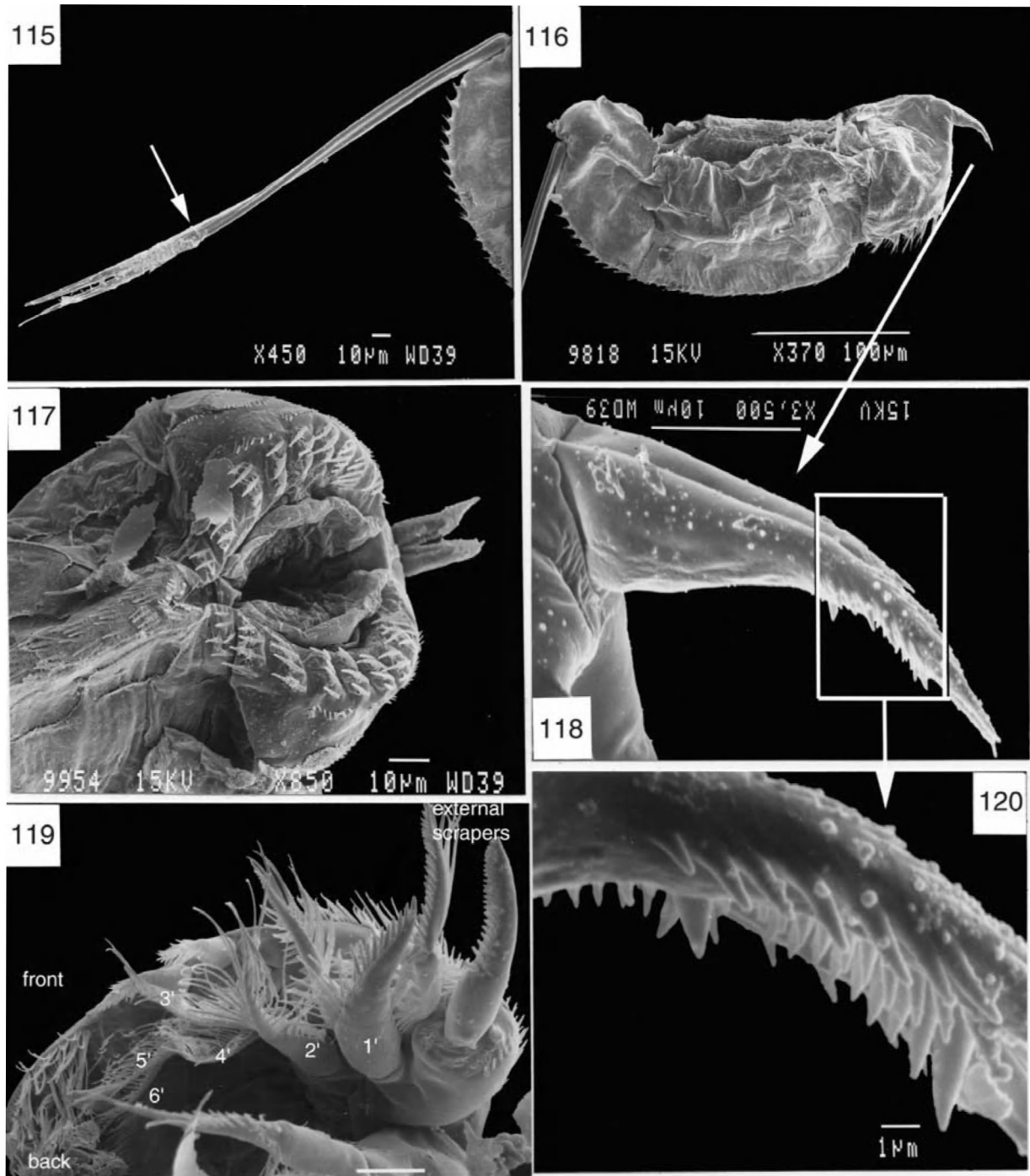
Figures 94–99. *Macrothrix tabrizensis* n. sp., Iran. Figure 94. IDL, ODL and epipodite of trunk limb one. Figure 95. Endites 1–3 and Fryer’s forks on trunk limb one. Figure 96. Second trunk limb. Figure 97. Third trunk limb. Figure 98. Fourth trunk limb. Figure 99. Fifth trunk limb.



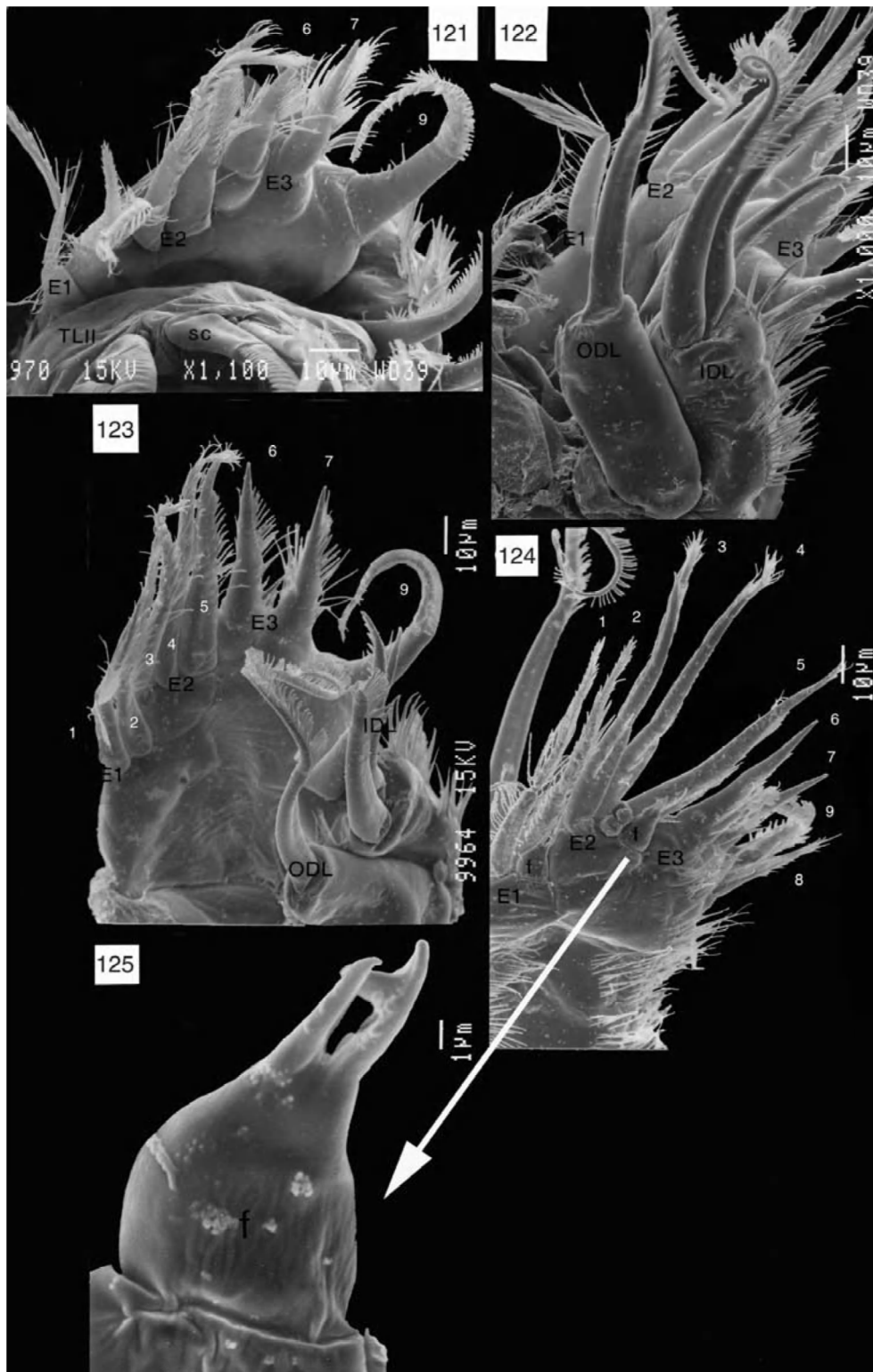
Figures 100–108. *Macrothrix tabrizensis* n. sp., Iran. Figure 100. Female postabdomen. Figure 101. Male habitus. Figure 102. Male first antenna. Figure 103. Female second antenna. Figure 104. Long seta of second antenna. Figure 105. Male IDL, ODL and clasper. Figure 106. Male first trunk limb (endites 1–3). Figure 107. Male third trunk limb, gnathobase and adjacent setae. Figure 108. Male postabdomen.



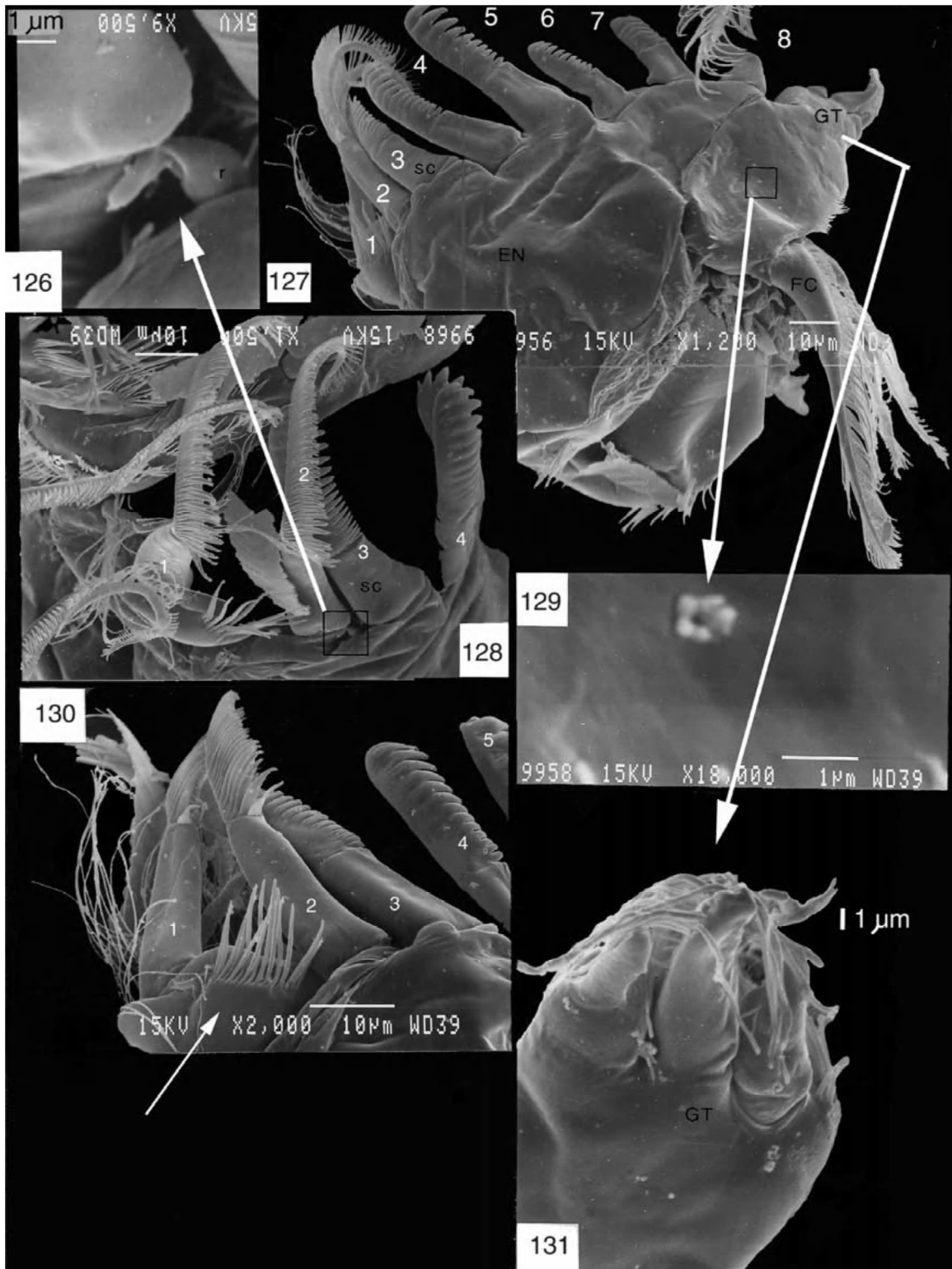
Figures 109–114. *Macrothrix tabrizensis* n. sp. SEM's of gamogenetic female. Figure 110. Habitus. Figure 111. Ornamentation of surface of ephippium. Figure 112. First antenna. Figure 113. First antenna, showing long and short aesthetascs. Figure 114. First antenna and labrum.



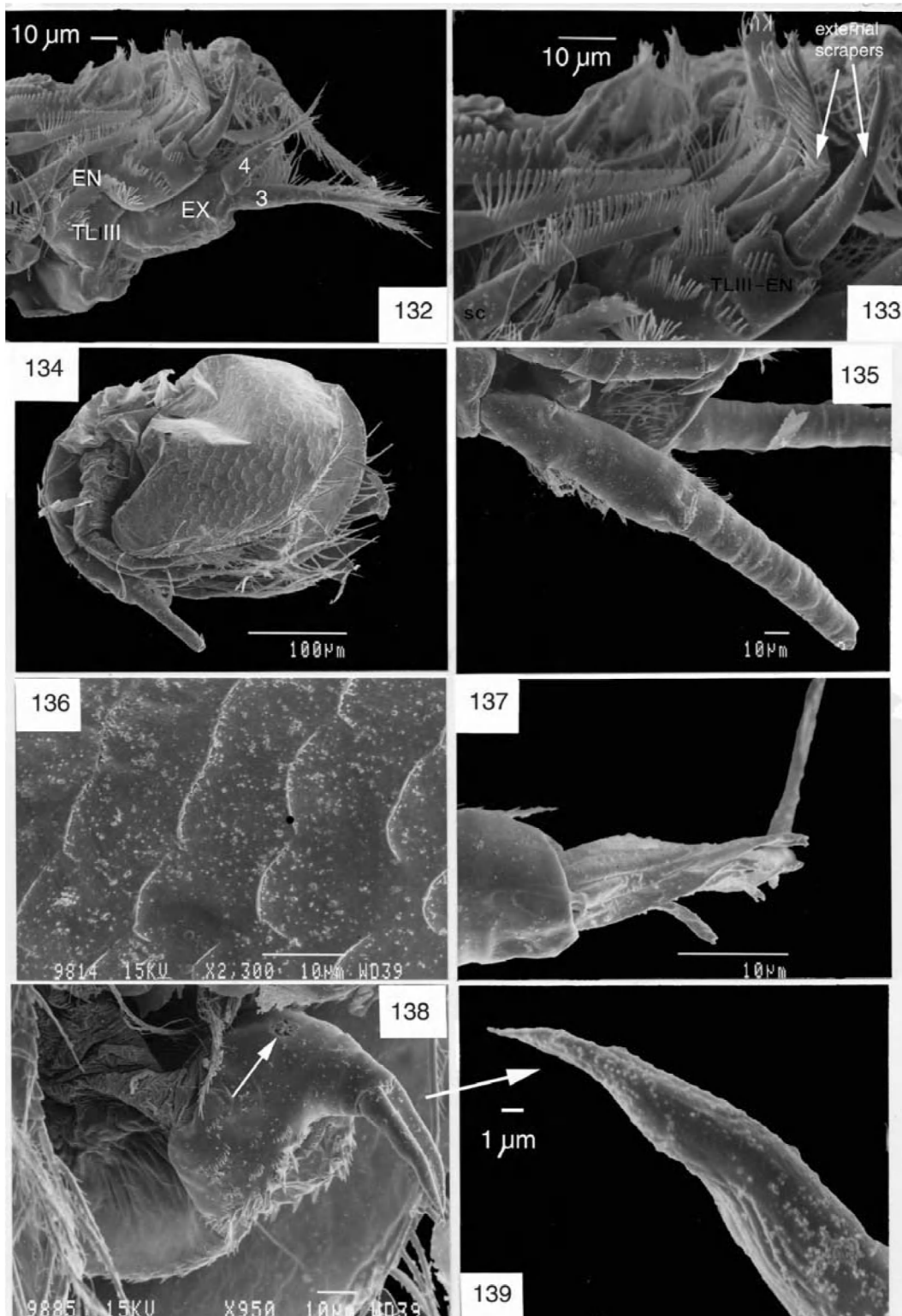
Figures 115–120. *Macrothrix tabrizensis* n. sp. Figure 115. Seta natatoria with articulation of distal segment arrowed. Figure 116. Postabdomen. Figure 117. Apex of postabdomen, showing anus. Figure 118. End-claw, showing lateral row of teeth. Figure 119. External zone of endopodite of trunk limb three, showing scrapers and posterior setae. Figure 120. Detail of lateral row of teeth of end-claw.



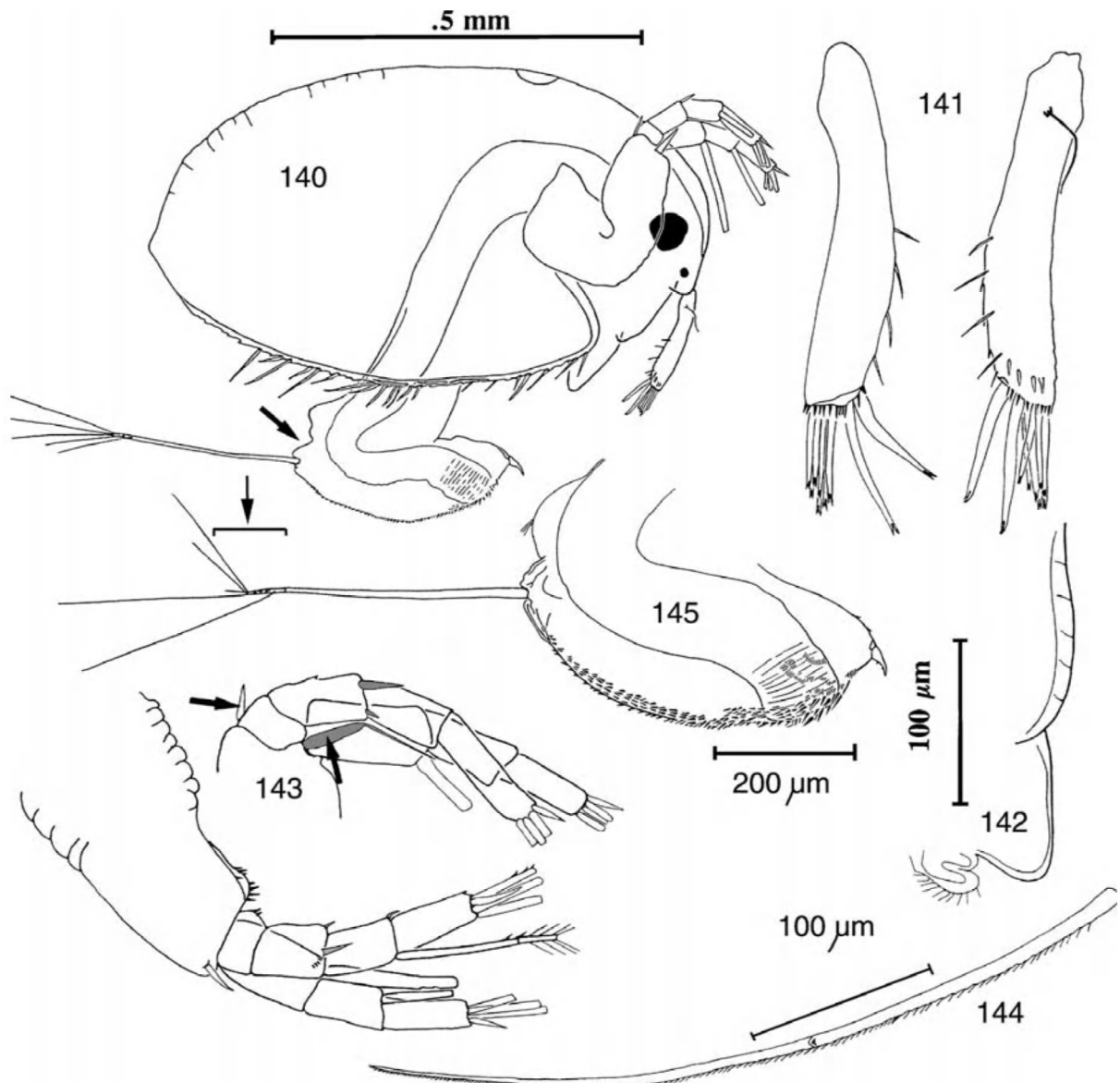
Figures 121–125. *Macrothrix tabrizensis* n. sp., SEM's of trunk limb one. Figure 121. Trunk limb one showing Endites 1–3. Trunk limb two is on the foreground. Seta eight is hidden behind seta seven. Figure 122. Trunk limb one, showing ODL, IDL, and endites 1–3 in the background. Figure 123. Trunk limb one, showing endites 1–3, ODL and IDL. Figure 124. Trunk limb one, showing endites 1–3 and forks (f). Note the shortened seta five. Figure 125. Fryer's fork on endite two, with a single big tooth, enlarged.



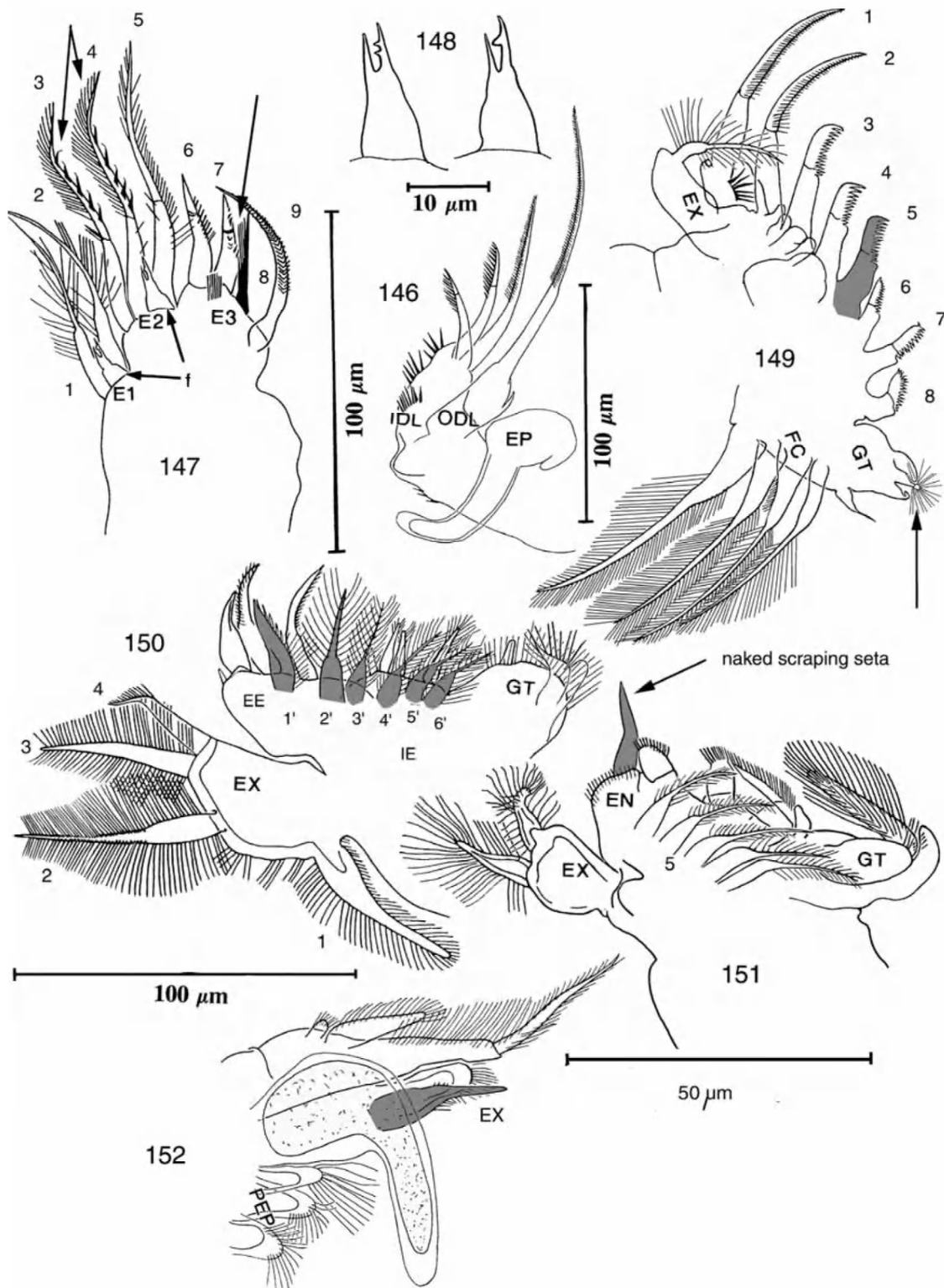
Figures 126–131. *Macrothrix tabrizensis* n. sp., Iran. SEM's of second trunk limb. Figure 126. Small sensory receptor (r) between scrapers 2 and 3 (an unusual location) of second trunk limb. Figure 127. Anterior surface of trunk limb two, showing scrapers, Endopod, Gnathobase, and Filter Comb. The square indicates the location of a cuticular pore. Figure 128. Trunk limb two, showing scrapers 1–4, and the location of the receptor. Figure 129. Pore on gnathobase of trunk limb two, surrounded by a cuticular rosette, detail. Figure 130. Alternative view of trunk limb two, showing scraper one, implanted on a remnant of an apically setulated endital 'segment' (arrowed). Figure 131. Gnathobase of limb two, showing the three apical appendages.



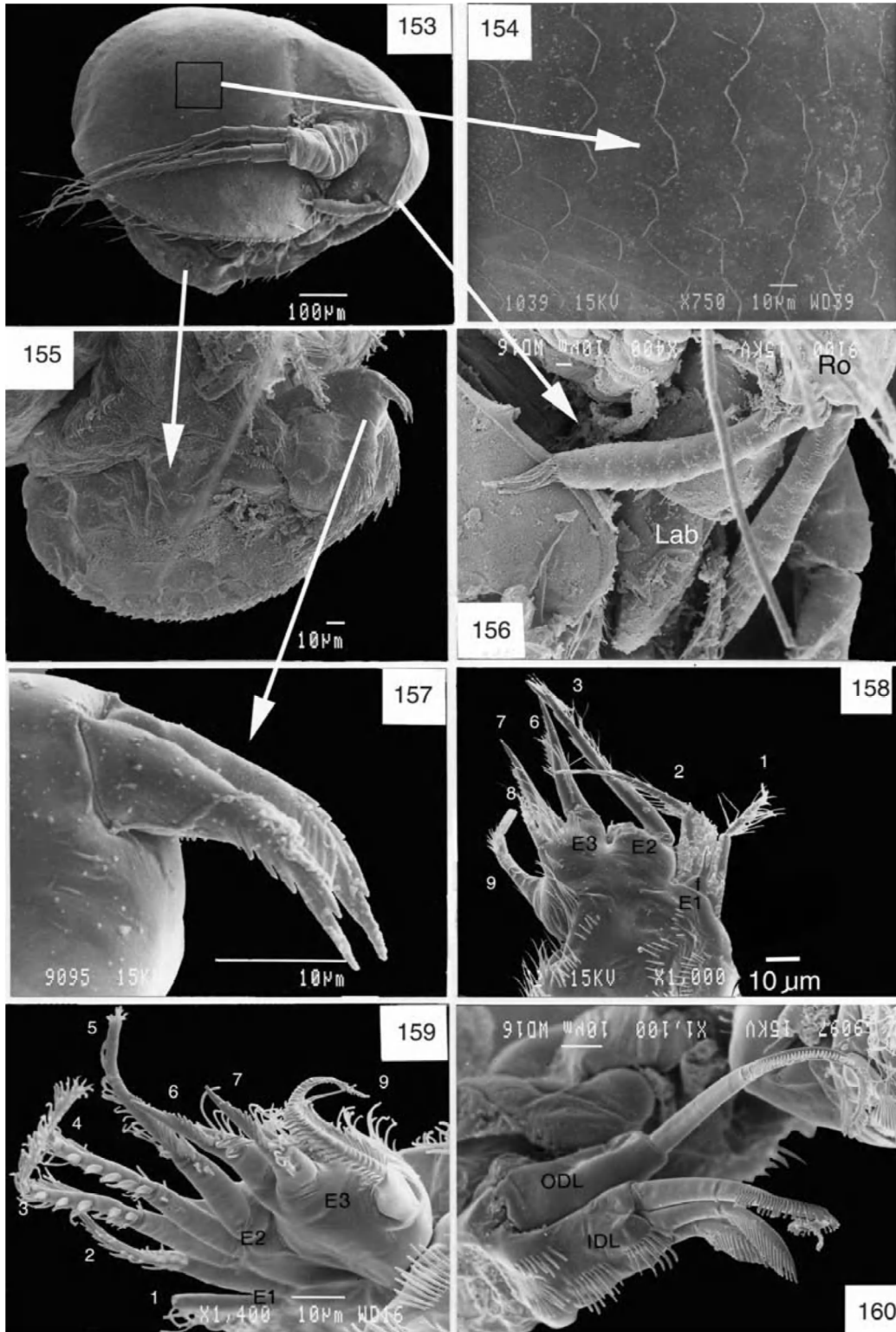
Figures 132–139. *Macrothrix tabrizensis* n. sp., Iran. Figure 132. SEM's of trunk limb 3, showing Endopod (EN), and Exopod (EX) with serrate seta four and plumose seta three. Figure 133. External scrapers of trunk limb three, and some overlaying scrapers of trunk limb two. Figure 134. Male. Habitus. Figure 135. Male, first antenna. Figure 136. Ornamentation of the male valve. Figure 137. Male first antenna, showing bifurcated tips of aesthetascs. Figure 138. Male postabdomen, showing the end-claw, the marginal rows of teeth, and a sperm duct (arrow). Figure 139. Male postabdomen, detail of glabrous end-claw.



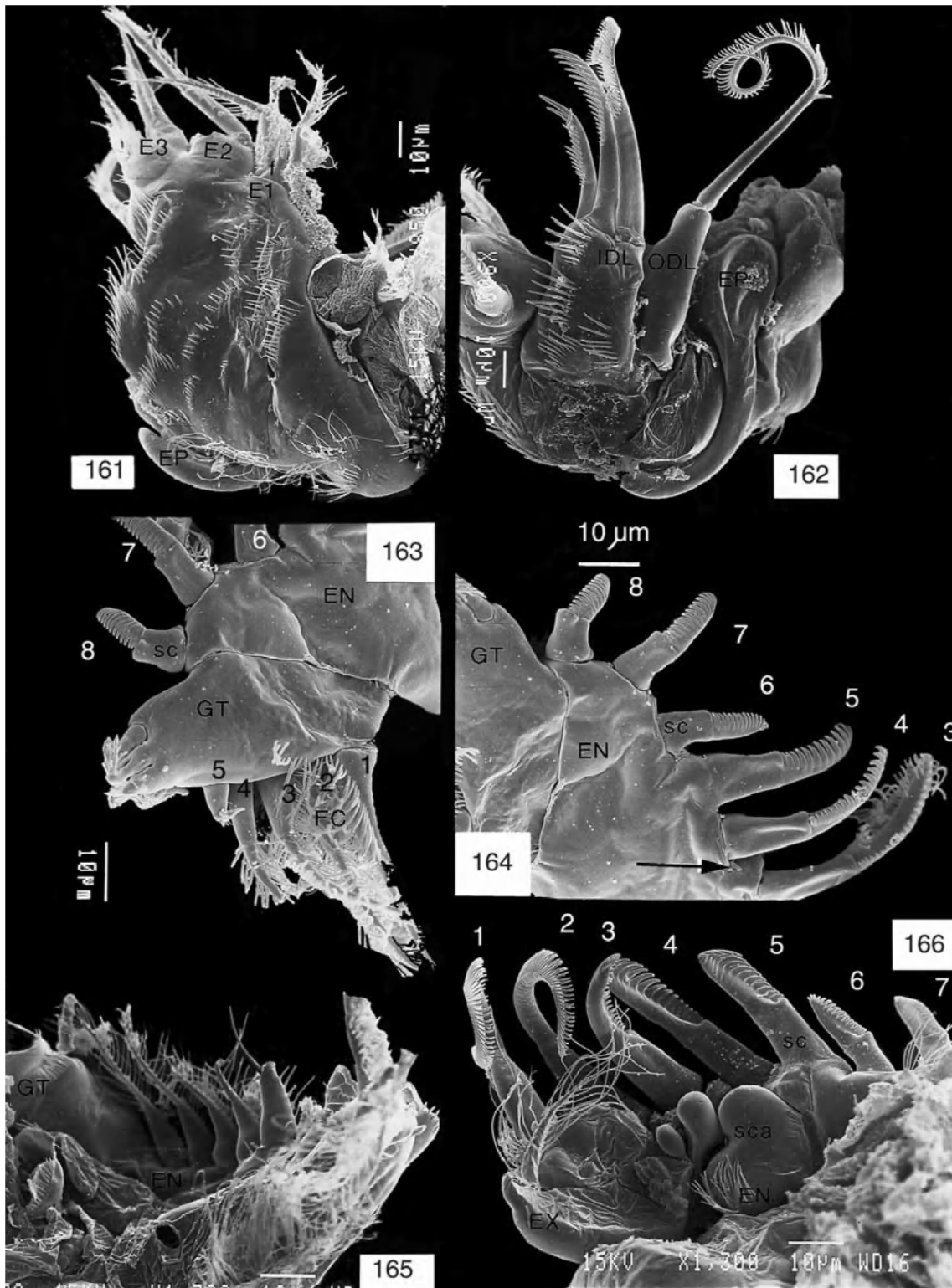
Figures 140–145. *Macrothrix agsensis* n. sp., Mexico. Figure 140. Female habitus. Figure 141. First antenna. Figure 142. Labrum. Figure 143. Second antenna. Figure 144. Long seta of second antenna. Figure 145. Postabdomen.



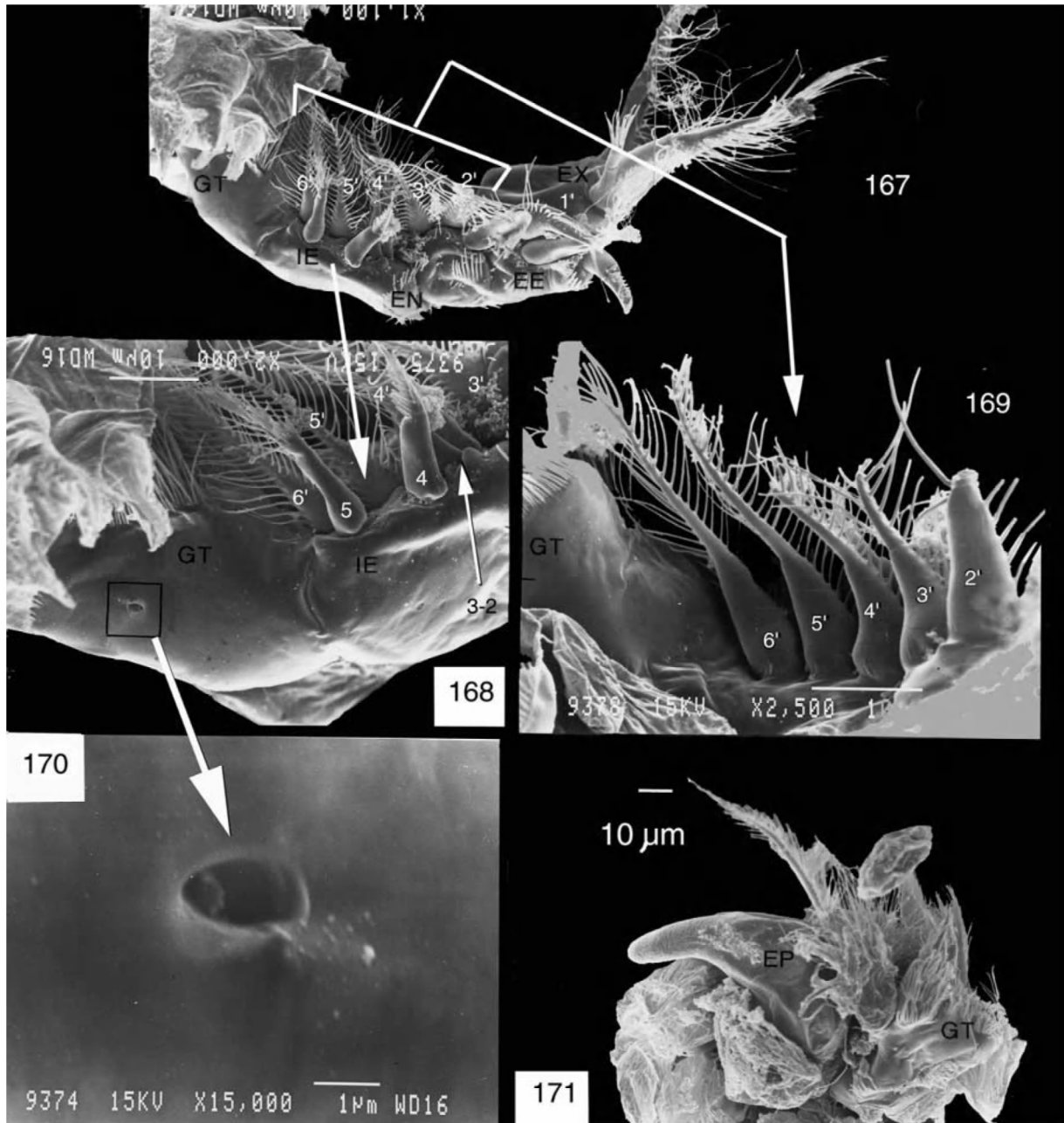
Figures 146–152. *Macrothrix agsensis* n. sp., Mexico. Figure 146. IDL, ODL and epipodite of first trunk limb. Figure 147. Endites 1–3 of first trunk limb. Figure 148. Fryer's forks. Figure 149. Second trunk limb. Figure 150. Third trunk limb. Figure 151. Fourth trunk limb. Figure 152. Fifth trunk limb.



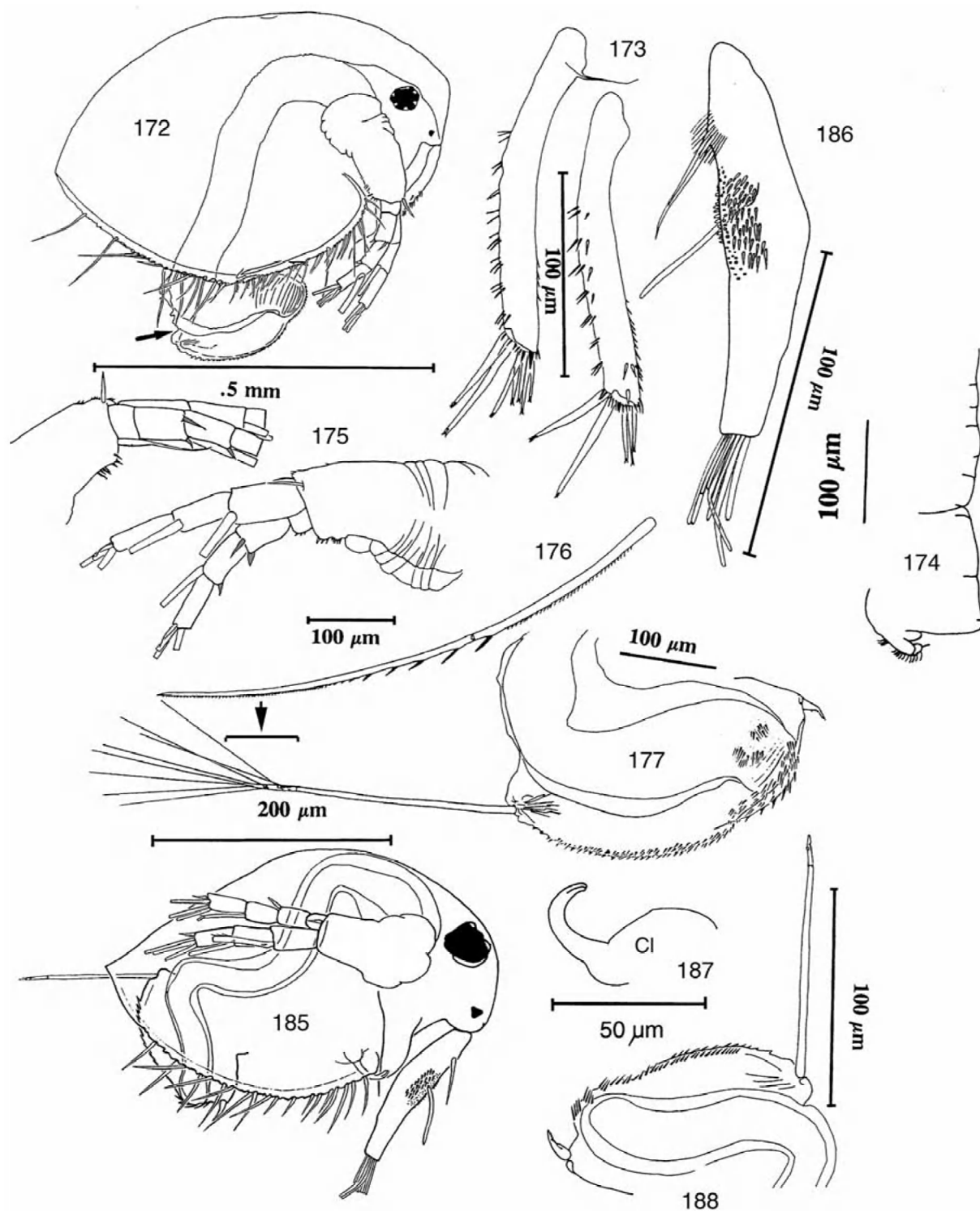
Figures 153–160. *Macrothrix agsensis* n. sp., Mexico. SEM's. *Figure 153*. Habitus of parthenogenetic female. Small square indicates the ornamentation of the valve in lateral view. *Figure 154*. Ornamentation of the valve. *Figure 155*. Postabdomen, lateral view. *Figure 156*. First antenna. *Figure 157*. Postabdomen, showing the end-claw. *Figure 158*. Trunk limb one, showing endites 1–3, and fork (f) on endite one. Two setae of endite two are broken off. *Figure 159*. Trunk limb one, showing endites 1–3 and the specific spines along setae three and four. *Figure 160*. Trunk limb one, showing ODL and IDL.



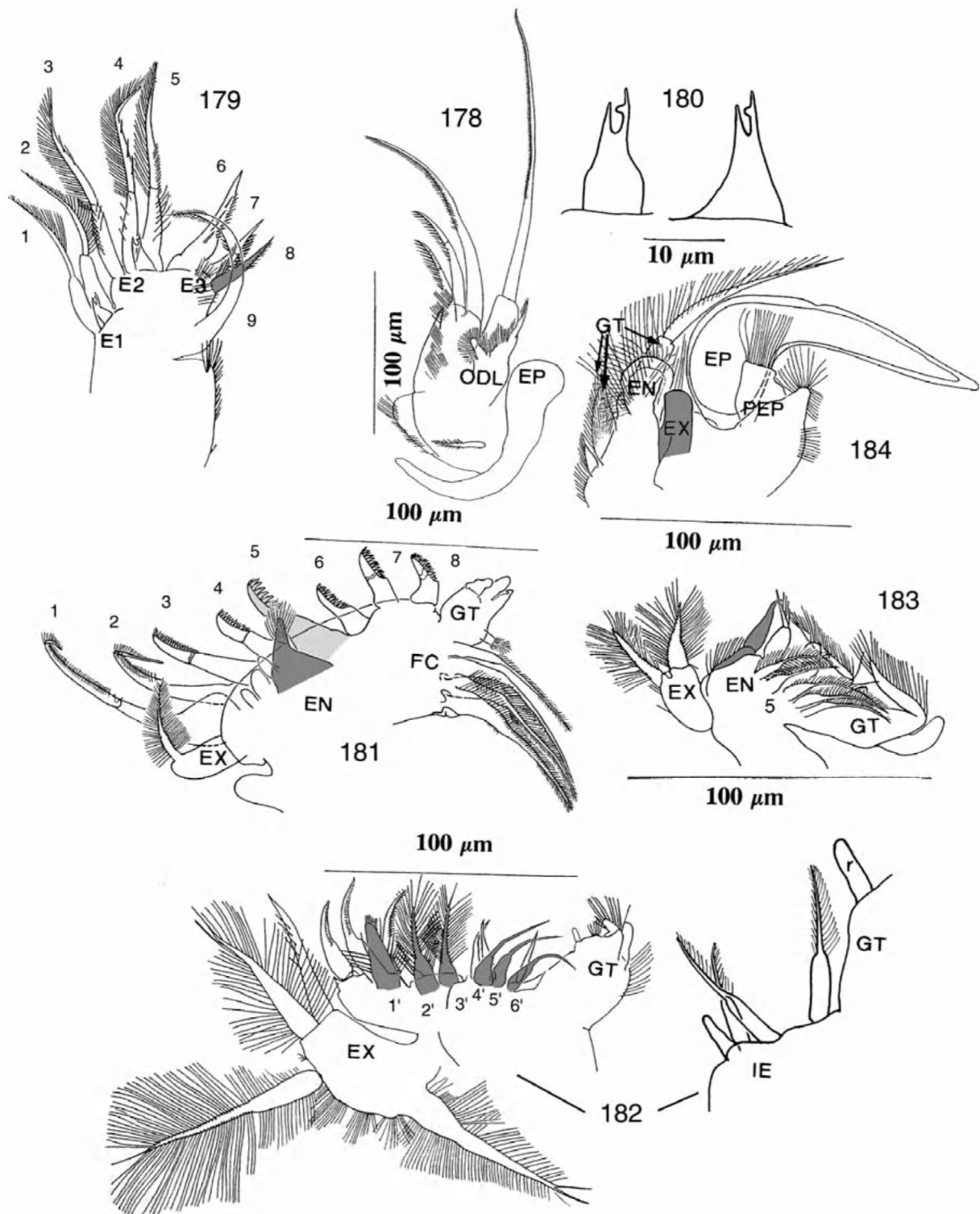
Figures 161–166. *Macrothrix agsensis* n. sp., Mexico. SEM's of trunk limbs. *Figure 161*. Trunk limb one, showing the spinulated corm, the endites 1–3, Fryer's fork (with one tooth) on endite one, and the long epipodite that lies twisted around the corm. *Figure 162*. Trunk limb one, showing IDL, ODL and the twisted epipodite. *Figure 163*. Trunk limb two, showing the Filter Comb, Gnathobase, and Endopod with scrapers. *Figure 164*. Trunk limb two, mainly showing the row of scrapers. Note a small sensillum between scrapers three and four, but no receptor behind scraper eight, and no doublings behind scrapers four and five. *Figure 165*. Trunk limb three, showing gnathobase and five out of the row of six posterior setae; seta 2' is partly broken off. *Figure 166*. Posterior view of trunk limb two, showing the exopod and its inwardly curved plumose seta, the endopod with its row of scrapers, and the three rounded hillocks behind scrapers 2–4.



Figures 167–171. *Macrothrix agsensis* n. sp., Mexico. SEM's of trunk limbs. *Figure 167*. An overview of trunk limb three, showing part of the the gnathobase, and the endopod with internal and external endite (delimitation indicated by an arrow). The exopod is also partly visible. On the endopodite, the two external scrapers, as well as the full line of six posterior setae is visible. Of the anterior setae, the large external curved seta can be seen, and two of the setae on the inner endite. It appears that two small receptors are hidden behind seta four (see arrows on Fig. 168). *Figure 168*. Trunk limb three, showing gnathobase with a pore (inside square) near its basis, and internal endite, with anterior setae 4 and 5 (3–2 possibly hidden behind 4), and posterior plumose setae 3'–6'. *Figure 169*. Trunk limb three, showing the row of posterior setae of limb three, from another specimen (the same as in Fig. 165). *Figure 170*. Pore of gnathobase of trunk limb three, suggesting that some secretion is present. *Figure 171*. Trunk limb five, showing the epipodite and the gnathobase.



Figures 172–177, 185–188. *Macrothrix smirnovi*, Mexico. Figure 172. Female habitus. Figure 173. First antenna. Figure 174. Labrum. Figure 175. Second antenna of female. Figure 176. Long seta of second antenna. Figure 177. Female postabdomen. Figure 185. Male habitus. Figure 186. First antenna of male. Figure 187. Copulatory clasper of male. Figure 188. Male postabdomen.



Figures 178–184. *Macrothrix smirnovi*, Mexico. Figure 178. IDL, ODL and epipodite of first trunk limb. Figure 179. Endites 1–3 of first trunk limb. Figure 180. Fryer's forks. Figure 181. Second trunk limb. Figure 182. Third trunk limb. Figure 183. Fourth trunk limb. Figure 184. Fifth trunk limb.