

VARIAZIONI SUL TEMA I: DESCRIPTION OF *CARCINOCARIS SERRICHELATA*, GEN. NOV. SP. NOV., ASSOCIATED WITH XANTHID CRABS AND NEW DATA ON THE DISTRIBUTION OF *XANTHILAOPHONTE TRISPINOSA* (COPEPODA: HARPACTICOIDA)

V. COTTARELLI, M. C. BRUNO*, R. BERERA

Dipartimento di Scienze Ambientali, Università della Tuscia, Largo dell'Università, 01100 Viterbo, Italy

*Corresponding author: mcbruno@unitus.it

LAOPHONTIDAE
HARPACTICOID
XANTHID-ASSOCIATED

ABSTRACT. – A new genus and species of the family Laophontidae, *Carcinocaris serrichelata*, is described and figured. This genus lives on the carapace of xanthid crabs collected in the intertidal zone along the coasts of some Philippine islands. Several laophontids have been reported as associates of xanthid crabs, however, *Carcinocaris* gen. nov. has several autapomorphies which distinguish it from them: maxilliped very well developed and ornate, forming an uncommon and efficient appendage involved in grasping the host's hairs; P1 exopodite reduced to a short segment; P2 reduced to a small plate; P3 without endopodite and with two-segmented exopodite in both sexes; P4 very reduced, endopodite present only in females where it is reduced to a tubercle with one long seta. Several specimens of *Xanthilaophonte trispinosa* Sewell were collected, which co-occurred on the same decapod host with *Carcinocaris serrichelata* sp. nov. Their morphology differed in few details from Fiers' (1991) description. The Philippine records widen the species' distribution in the Indian Ocean and adjacent seas.

INTRODUCTION

Marine and continental meiobenthic harpacticoids of southeastern Asia have been investigated by our research group for several years (Bruno & Cottarelli 1999 for review). Recently, we started to examine harpacticoids associated with invertebrates in the South China Sea, in particular samples collected in the intertidal zone along the coasts of some Philippine islands. We present here the first results of this research.

Harpacticoids associated with decapod crustaceans were recently examined by Fiers (1991), who established the genus *Xanthilaophonte* to include two species. *Rubus-tunguis*, a second genus associated with decapod crustaceans, containing two species, was subsequently described by Fiers (1992). In the same paper, Fiers presented and discussed a list of laophontids associated with decapods (9 species, belonging to 5 genera). Based on the morphology of first leg and maxilliped, the same author hypothesized that the genus *Raptolaophonte* Cottarelli et Forniz, 1989 is probably living in close association with another invertebrate. *Carcinocaris* gen. nov. belongs to a group of laophontids which live as ecto-associate on intertidal xanthid crabs. *Carcinocaris* gen. nov. has peculiar adaptations enabling it to hold onto the hairs of the crab's carapace. In a personal communication, Huys informed us that TKS Bjornberg & C Santos in 2003 had reported the description of a new genus and species of laophontid found on xanthid crabs from Brazil and Florida. This taxon seems very similar to the new genus described here. However, to our knowledge, the

manuscript has not been published, thus we cannot take into account this taxon here. Several specimens of *Xanthilaophonte trispinosa* (Sewell) were collected together with *Carcinocaris* n. sp. Their morphology differed in a few details from Fiers' description, and we describe some features which were not illustrated before.

All these laophontids and other taxa that we are still studying have a similar habitus, which characterizes them as typically xanthid-associated (see below). For this reason we have used the sentence "*variazioni sul tema*" (i.e. variations on a theme, a sentence used by musicians) in the title. We will use this sentence again when we describe other new species of this group.

MATERIALS AND METHODS

Samples were collected at three locations:

1) Verde Island (small island north of Puerto Galera, Eastern Mindoro Province), on the north beach along the eastern coast (Eastern Mindoro Province), 02-14-04. 13°32'45.6" N, 121°03'94.2" E.

2) Mindoro Island, Big La Laguna beach near Sabang Village (Eastern Mindoro Province), 02-12-2004. 13°31'59.2" N, 120°58'09.2" E.

3) Mindoro Island, mangroves near the town of Puerto Galera (Eastern Mindoro Province), 02-12-2004. 13°30'58.1" N, 120°53'24.3" E.

At each location, xanthid crabs were collected in the intertidal at low tide beneath coral and madreporarian fragments. Crabs were fixed in a mixture of filtered sea-water and 10% for-

malin. Copepods were collected by filtering the residual solution with a 80 µm-mesh plankton net.

Latitude and longitude were determined using a Garmin GPS 38™ (Global Positioning System).

Specimens of the type series were permanently mounted between two coverslips in Fauré's medium. The double-coverslips are attached to a slide but can be removed to allow observation of the specimen from both sides. Several specimens were preserved in 70% alcohol.

Five females, two ovigerous females, one female copepodite, one male, and three pair in amplexus (one male and one copepodite female in pre-mating posture), were prepared for scanning electron microscopy. They were fixed for 24 h in 10% formalin, washed twice in cacodylate buffer (pH 7.2), post-fixed in 1% osmium tetroxide in the same buffer, dehydrated in a graded ethanol series, critical-point-dried in a Balzers Union® CPD 020 apparatus, and coated with gold in a Balzers Union® MED 010 sputter coater. Specimens were examined with a 1200 JEOL JEM® EX II scanning electron microscope.

The descriptive terminology follows Huys & Boxshall (1991). The following abbreviations are used: A1, antennule, enp-1-3, endopodite segments 1-3; exp-1-3, exopodite segments 1-3; P1-6, legs 1-6.

Holotype, allotype and 1 female copepodite are deposited in the National Museum of Natural History, Smithsonian Institution (USNM); one ovigerous female and one male paratype, and one female copepodite are deposited in the Museo Civico di Storia Naturale di Genova (MCSNG); three females (one ovigerous) and one male paratypes, and one female copepodite are deposited in the Natural History Museum, London (NHM). The remaining material of the type series is deposited at the "Dipartimento di Scienze Ambientali, Università della Tuscia", Viterbo (senior author's collection) (DSAUT), the stubs prepared for SEM are deposited in the "Centro Interdipartimentale di Microscopia Elettronica, Università della Tuscia" (CIME).

DESCRIPTION

Family Laophontidae T. Scott, 1904

Genus *Carcinocaris* gen. nov.

Diagnosis

Body stocky; cephalothorax and body somites with smooth posterior margins. Genital double-somite of female with transverse surface ridges on dorsal and lateral surface, indicating original segmentation. Anal operculum well developed, spinulose. Caudal rami longer than wide, with 6 setae; inner terminal seta longest. Sexual dimorphism in antennule, P2-P6, and in genital segmentation.

Rostrum round, not defined at base. Antennule 6-segmented in female, 7-segmented and subchirocer in male; aesthetasc on segment 4 in female, and on segment 5 in male. Antennary exopodite one-segmented, with 4 setae.

Mandibular palp with 5 setae. Maxillule with one seta and one spine on coxa; basis with two setae and one spine; endopodite represented by two setae; exopodite as cylindrical segment with two setae. Maxillary syncoxa with two endites [3, 3]; endopodite represented by a small tubercle with two setae. Maxilliped large, endopodal claw very strong and curved, with strong teeth. Maxillipedal basis with one pinnate seta and one socle bearing a pinnate seta. P1 with elongated basis; exopodite represented by a small segment with 5 setae; endopodite 2-segmented, with long sickle-shaped terminal claw on enp-2. P2-P4 protopodal segments fused. P2 reduced to a small segment with 3 setae. P3 of both sexes, and P4 of males, without endopodite; P4 endopodite of females reduced to small tubercle, fused to protopod and armed with long apical seta. P3 exopodite 2-segmented (exp-1 and exp-2 fused), P4 exopodite 1-segmented. Swimming leg setal formulae:

	Exopodite	Endopodite
P2	2	-
P3	0.022	-
P4	123	1 (V) or absent (m)

P5 female displaced on the lateral side of body with separate exopodite and baseoendopodite; endopodal lobe well developed, with 4 setae, exopod round with 4 setae. P5 male reduced to a tubercle with 1 seta. P6 of male unarmed.

Type species - *Carcinocaris serrichelata* gen. et sp. nov.

Etymology: The generic name is derived from the Greek *karkinós* = crab, and *káris* = shrimp (gender: feminine), alluding to the host association of the new genus.

Notes

All laophontid genera associated with xanthid decapods (*Coullia* Hamond, 1973; *Robustunguis* Fiers, 1992; *Xanthilaophonte* Fiers, 1991; several species of the *setosa* species group of *Laophonte* Philippi, 1840; probably *Raptolaophonte* Cottarelli et Forniz, 1989; and *Carcinocaris* gen. nov.), have a smooth integument, and reduced lateral extensions of the genital and abdominal somites (Fiers 1992). Several of these taxa also have a long and high, bilaterally compressed cephalothorax, which measures one-third of the total body length in *Robustunguis* (Fiers 1992), and is even larger in *Carcinocaris* gen. nov. Another morphological feature characterizing this group is the unusual development of P1 and maxilliped, which are probably both used by the copepod in grasping the hairs on the host's carapace. All features mentioned above give the genera a similar habitus. We consider, however, that those similarities are due to convergence rather than reflecting phylogenetic affinity. Fiers (1992) already demonstrated that *Xanthilaophonte* is close to *Echinolaophonte* Nicholls, 1941,

mainly because the cephalothorax of *Xanthilaophonte trispinosa* (Sewell, 1940) exhibits a mediodorsal rounded process in exactly the same position as the dorsal cephalic thorn found in species of *Echinolaophonte*. *Xanthilaophonte* lost the typical dorsal thorns on the thoracic and abdominal somites (which are important functional attributes of *Echinolaophonte*) which is conceivably an adaptation to life between the hairs on the host's carapace (Fiers 1991). *Robustunguis* has closer relationships with the genera *Coullia*, *Phycolaophonte* Pallares 1975, and *Hemilaophonte* Jakubisiak, 1932 (Fiers 1992). This group of genera shares swimming legs sexually dimorphism, the ovate shape of the female P5, and particularly the reduced size of P2 endopodite, being smaller than the P3 endopodite. Lee & Huys (1999) added *Psammoplatypus* Lee et Huys, 1999 to this group, emphasizing the phylogenetic importance of the reduction of the P2 endopodite, considering *Psammoplatypus* the most primitive genus in the lineage. *Raptolaophonte* is a monotypic genus, probably associated with marine invertebrates (decapods?) (Fiers 1998). According to Fiers (1998) this genus has the following highly specialized features: the morphology of maxilliped and P1, the lack of P2-P3 endopodites, the transformation of female P4 into a lamellar appendage, the fusion of the male P4 which carries a very small segment with a seta, and the reduction of P5 to a small tubercle with a distal seta. Fiers (1998) stated that *Raptolaophonte* is closer to *Xanthilaophonte*, *Coullia*, and *Robustunguis* than to *Laophontina* Norman & Scott T, 1905 and *Indolaophonte* Cottarelli *et al.*, 1986 (as assumed by Cottarelli & Forniz 1989) because of the morphology of the maxilliped and P1. If we accept that *Raptolaophonte* might be associated with marine invertebrates, then Fiers' claim is probably more correct than that proposed by Cottarelli & Forniz (1989). *Carcinocaris* gen. nov. has the following autapomorphies which distinguish it from all other taxa mentioned above: 1) maxilliped very well developed and powerful; basis with a row of strong spinules along the inner margin which fits between the strong teeth of the stout claw, thus creating an uncommon and very efficient structure for grasping the host's hairs; 2) P1 exopodite reduced to a short segment, whereas it is two-segmented in virtually all other xanthid-associated laophontids. Only *Xanthilaophonte trispinosa* has a one-segmented exopodite, but it is not as reduced as in *Carcinocaris* gen. nov., and carries six setae instead of five; 3) P2 reduced to a small plate bearing one lateral seta and two distal (= exopodal) setae on each side; 4) P3 without endopodite and with two-segmented exopodite in both sexes; 5) P4 very reduced, the exopodite of both sexes represented by one flattened segment carrying six setae, the endopodite present only in females where it is reduced to a tubercle with one long seta. On the basis of these autapomorphies, we believe *Carcinocaris* gen. nov. does not have any strong affinities with the other xanthid-related genera, and can

not be related to any of the phylogenetic lines recognized by Fiers (1992). The closest genus could be *Raptolaophonte* because of the following characters: 1) morphology of the maxilliped, 2) the lack of P3 endopodites in both genera, even though in *Carcinocaris* gen. nov. the corresponding exopodites are more reduced (two segments in *Carcinocaris* gen. nov., three segments in *Raptolaophonte*), 3) P4 is reduced to a roundish plate with small setae in the females of *Raptolaophonte*, whereas in *Carcinocaris* it is represented by one segment, not fused with the protopod, and with vestiges of endopodite, 4) P5 of males are extremely reduced in a similar manner in both genera.

The morphology of the new genus is the result of adaptation to their peculiar habitat which appears to be more advanced than in other xanthid-associated laophontids. The body of adult *Carcinocaris* gen. nov., can be subdivided at the level of the first free pedigerous somite (P2) in two functionally different units. In the anterior portion of the body the maxillipeds and P1 anchor the individual to the host, and the movements of P1 change the angle of orientation of the body relative to the "substrate". These laophontids graze on the host, using the strong mouthparts which protrude outward and downward. The P2 are reduced because they are not used for support or locomotion. The posterior portion of the females carries the P3 and P4, which have reduced numbers of segments. However, the number of exopodal setae on P3 and P4 corresponds to the number expected in most laophontids without segmental reduction. In *Carcinocaris* gen. nov. the reduction in segmentation is due to the failure in separation of the ancestral segment. The conservation of all exopodal setae may have a functional meaning. In fact, these pereopods are enlarged and flattened and carry long setae; together with the well developed P5 they form a "container" to hold and protect the eggs, a particularly useful adaptation to their selective habitat. In the posterior portion of the male the retention of P3 and P4 may be the result of coupling-related activities, such as manipulation and transfer of spermatophores. The P5 are extremely reduced and the P6 have lost their armature.

In *Carcinocaris* gen. nov. the IV copepodite stages of females develop an entirely different leg 4 exopodite than in males; this modified leg is grasped by the male antennule prior to mating. This phenomenon was already reported by Fiers (1998) for other laophontids, among which are several xanthid-related genera (*Coullia*, *Laophonte setosa*-group, *Robustunguis*, *Xanthilaophonte*). The modification in the juveniles are thus strongly correlated with precopulatory behaviour (Fiers 1998). However, Fiers (1998) recorded adult males of xanthid-related laophontids grasping even younger copepodites. This behaviour, not related to courtship, is probably meant "to avoid that the copepodids become separated from their host and loose contact with the initial population" (Fiers 1998). We observed males of *Carcinocaris serrichelata*

sp. nov. grasping copepodites II and III, confirming for this species the behaviour reported by Fiers.

Carcinocaris serrichelata gen. et sp. nov.

Type locality – 1) Verde Island, (Eastern Mindoro Province, Philippines), 02-14-04. Additional localities – 2) Mindoro Island, Big La Laguna (Eastern Mindoro Province, Philippines), 02-12-2004. 3) Mindoro Island, Puerto Galera, (Eastern Mindoro Province, Philippines), 02-12-2004.

Material – (a) From type locality: holotype female, dissected, and mounted on slide labeled: “*Carcinocaris serrichelata* holotype: dissected female, Verde Island, Philippines, 02-14-2004” (USNM 1080609). Allotype male, dissected and mounted on slide, together with 1 female copepodite, labeled: “*Carcinocaris serrichelata* allotype: dissected male, and 1 female copepodite, Verde Island, Philippines, 02-14-2004” (USNM 1080610 and 1080611, respectively). 3 females (1 ovigerous) paratypes, dissected and mounted on 1 slide labeled: “*Carcinocaris serrichelata*: 2 females and 1 ovigerous female paratypes, dissected, Verde Island, Philippines, 02-14-2004” (NHM 2005.2089-2091); 1 male paratype and 1 female copepodite pre-mating mounted on 1 slide labeled “*Carcinocaris serrichelata* 1 male paratype and 1 female copepodite pre-mating, Verde Island, Philippines, 02-14-2004” (NHM 2005.2087-2088); 1 male paratype and 1 female copepodite pre-mating and 1 ovigerous female paratype mounted on 1 slide labeled “*Carcinocaris serrichelata* 1 male paratype and 1 female copepodite pre-mating and 1 ovigerous female paratype, Verde Island, Philippines, 02-14-2004” (MCSNG 52538); 3 slides, each with 1 male paratype and 1 female copepodite pre-mating labeled “*Carcinocaris serrichelata* 1 male paratype and 1 female copepodite pre-mating, Verde Island, Philippines, 02-14-2004” (DSAUT); 2 males and 1 female paratypes pre-mating mounted on 1 slide labeled: “*Carcinocaris serrichelata* 2 males and 1 female paratypes pre-mating, Verde Island, Philippines, 02-14-2004” (DSAUT). (b) From additional localities: 1 male paratype and 1 female copepodite pre-mating mounted on 1 slide labeled: “*Carcinocaris serrichelata* 1 male paratype and 1 female copepodite pre-mating, Big La Laguna, Mindoro, Philippines, 02-12-2004” (DSAUT); 4 female paratypes each mounted on 1 slide labeled: “*Carcinocaris serrichelata* paratype female, Big La Laguna, Mindoro, Philippines, 02-12-2004” (DSAUT); 1 ovigerous female paratype mounted on 1 slide labeled: “*Carcinocaris serrichelata* ovigerous female paratype, Big La Laguna, Mindoro, Philippines, 02-12-2004” (DSAUT); 1 female paratype mounted on 1 slide labeled: “*Carcinocaris serrichelata* female paratype, Puerto Galera, Mindoro, Philippines, 02-12-2004” (DSAUT). 5 females, 2 ovigerous females, 1 female copepodite, 1 male, 3 pair of 1 male and 1 copepodite female in pre-mating, prepared for scanning electron microscopy, on 2 stubs labelled: *Carcinocaris serrichelata*, Philippines (CIME). All material collected by V. Cottarelli.

Female – Habitus (Fig. 29, 44). Length measured from anterior margin of rostrum to posterior margin of caudal

rami: 342-435 μm ($n = 6$; mean = 385 μm). Length of cephalothorax about 2/5 of the entire body. Cephalosome smooth without dorsal hyaline window (Fig. 30), hyaline frill slightly denticulate ventrally; hyaline frills of all abdominal somites smooth. Second, third and fourth thoracic somites with a lateral pore. Genital double-somite subdivided dorsally and laterally (Fig. 1, 29) by chitinous band. Ventral side with lateral rows cuticular ridges, two medial pores, and two distal sensillae. Genital field (Fig. 1) with copulatory pore surrounded by thin cuticular ridges (Fig. 31); P6 represented by a small protuberance with 2 bare setae. Anal somite (Fig. 2) with a row of spinules along ventrodorsal margin, extending laterally; a lateral row of shorter spinules extends towards the anal operculum. Anal operculum (Fig. 2) with rows of spinules, flanked by a pair of sensillae; rows of spinules surrounding the anal opening (Fig. 2). Caudal rami (Fig. 2, 3, 32) cylindrical, shorter than the anal somite; ratio of length to width 1.75, with 7 setae. Anterolateral (II) and posterolateral (III) setae and slightly longer than caudal ramus; dorsal seta (VII) composite, 0.86 as long as caudal ramus, inserted at 1/3 distance from the distomedial corner. Inner terminal seta (V) proximally enlarged, outer terminal seta (IV) pinnate, shorter than urosome. Terminal accessory seta (VI) short. A row of spinules near posterolateral seta, anterolateral seta, and terminal accessory seta.

Rostrum (Fig. 30) round and anteriorly not defined at base, not reaching to distal margin of first segment of antennule, bearing 2 sensillae.

Antennule (Fig. 4, 30) 6-segmented, with long aesthetasc on segment 4. First segment with distal row of spinules and 1 short seta at distomedial corner. Second segment with blunt process near posterior margin. Armature formula: 1, 8, 6, 2 + aesthetasc, 1, 11.

Antenna (Fig. 5, 33): coxa small, with a row spinules; allobasis elongate, with rows of spinules. Exopodite 1-segmented, with 2 lateral and 2 apical well developed pinnate setae, and spinules on lateral margin. Endopodite slightly shorter than allobasis, with one row of spinules laterally and one transverse hyaline frill subapically. Lateral armature in distal half, consisting of 2 pinnate spines; apical armature consisting of 2 pinnate spines, 1 normal and 2 geniculate setae.

Labrum ornated apically with spinules and thin setae (Fig. 6, 34).

Mandible: gnathobase of praecoxa with 4 apical teeth and 1 one-side pinnate seta at dorsal corner (Fig. 7a); palp (Fig. 7b) well developed, 1-segmented, with 1 apical and 4 lateral setae, all pinnate.

Maxillule (Fig. 34): praecoxa naked, arthrite with 1 lateral seta, and 6 spines/setae around distal margin (Fig. 8a); one row of 5 longer, and 3 shorter spinules on posterior surface. Coxa with cylindrical endite bearing 1 naked seta and 1 curved pinnate spine (Fig. 8b). Basis with cylindrical endite ending in 1 pinnate spine and 2

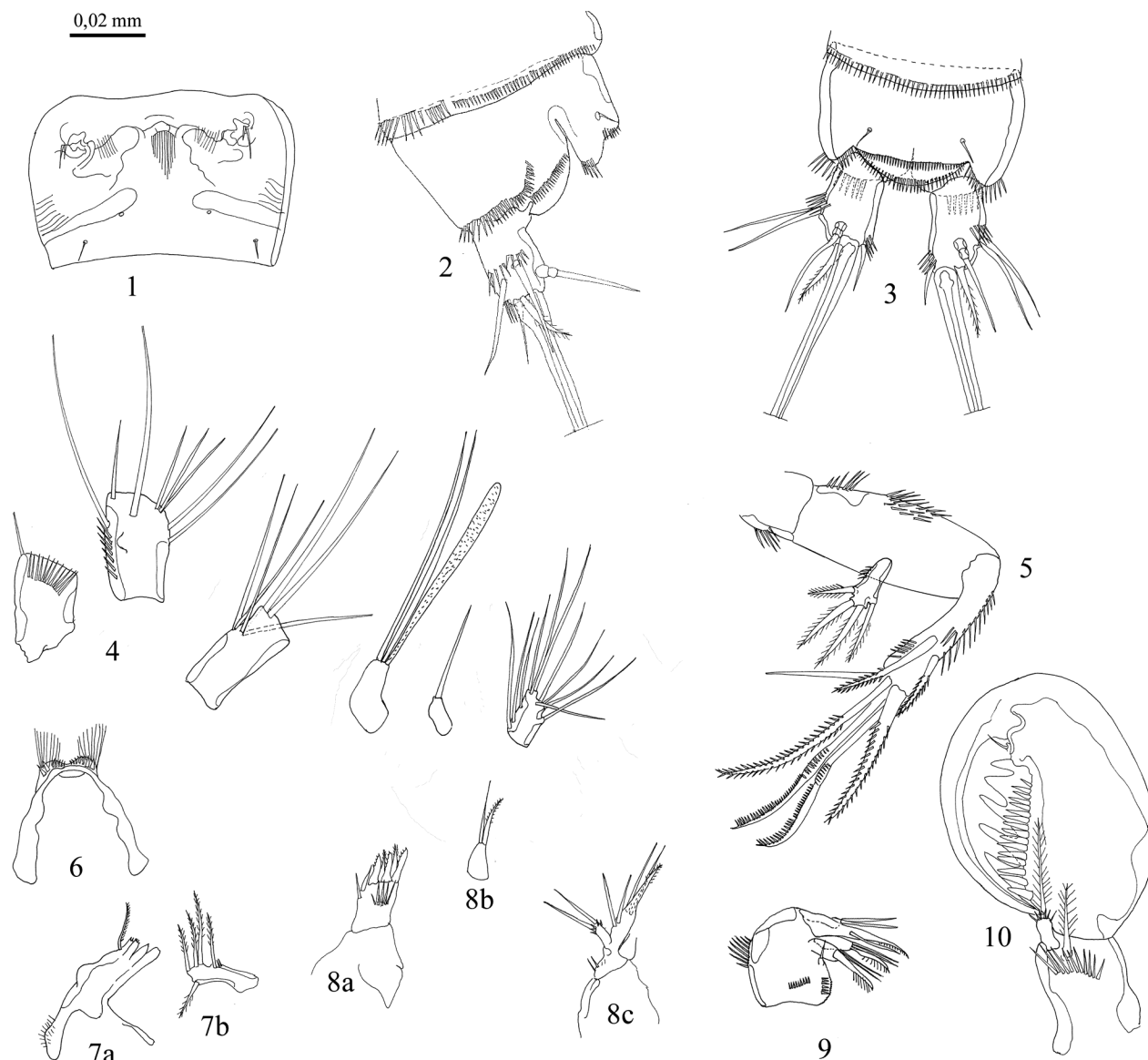


Fig. 1-10. *Carcinocaris serrichelata* sp. nov., female: 1, genital field, ventral view; 2, penultimate somite, anal somite, anal operculum and left caudal ramus, lateral view; 3, penultimate somite, anal somite, anal operculum and caudal rami, dorsal view; 4, antennule (disarticulated); 5, antenna; 6, labrum; 7a, mandibular praecoxa; 7b, mandibular palp; 8a, maxillary praecoxa and arthrite; 8b, maxillary coxal endite; 8c maxillary basis, endopodite and exopodite; 9, maxilla; 10, maxilliped.

setae (Fig. 8c, 34). Endopodite represented by 2 setae (?) (Fig. 8c, 34). Exopodite 1-segmented, with 2 apical setae surrounded at base by spinules (Fig. 8c, 34).

Maxilla (Fig. 34): praecoxa with three rows of spinules, and one small endite carrying a short apical seta (Fig. 9). Syncoxa with 2 endites, each one with 2 normal and 1 enlarged pinnate apical setae (Fig. 9). Allobasis ending in a strong pinnate claw, with one lateral seta (Fig. 9). Endopodite reduced to a small tubercle with 2 apical naked setae (Fig. 9).

Maxilliped (Fig. 10, 35): characteristic, very powerful and robust; syncoxa with a distal row of spinules, one pinnate seta, and one socle bearing an apical pinnate seta. Basis very enlarged, with medial margin bearing a row of

very strong spinules. Endopodal claw very strong and curved, with 4 strong teeth and a long tip. Accessory armature represented by a small proximal naked seta.

P1 (Fig. 11): coxa with short outer spinule, and a medial row of spinules. Basis elongated, with 1 proximal, lateral pinnate seta, a row of medial spinules and 1 seta on the distomedial corner, a group of spinules on the medial surface (Fig. 36). Exopodite (Fig. 36) represented by a small segment with 2 apical and 3 subapical setae. Endopodite 2-segmented, long and strong, first segment bare, second segment with a row of distolateral spinules (Fig. 37) and 1 seta on the distomedial corner. Terminal claw (Fig. 37) long, sickle-shaped, armed with small spinules along the proximal third of the lateral margin,

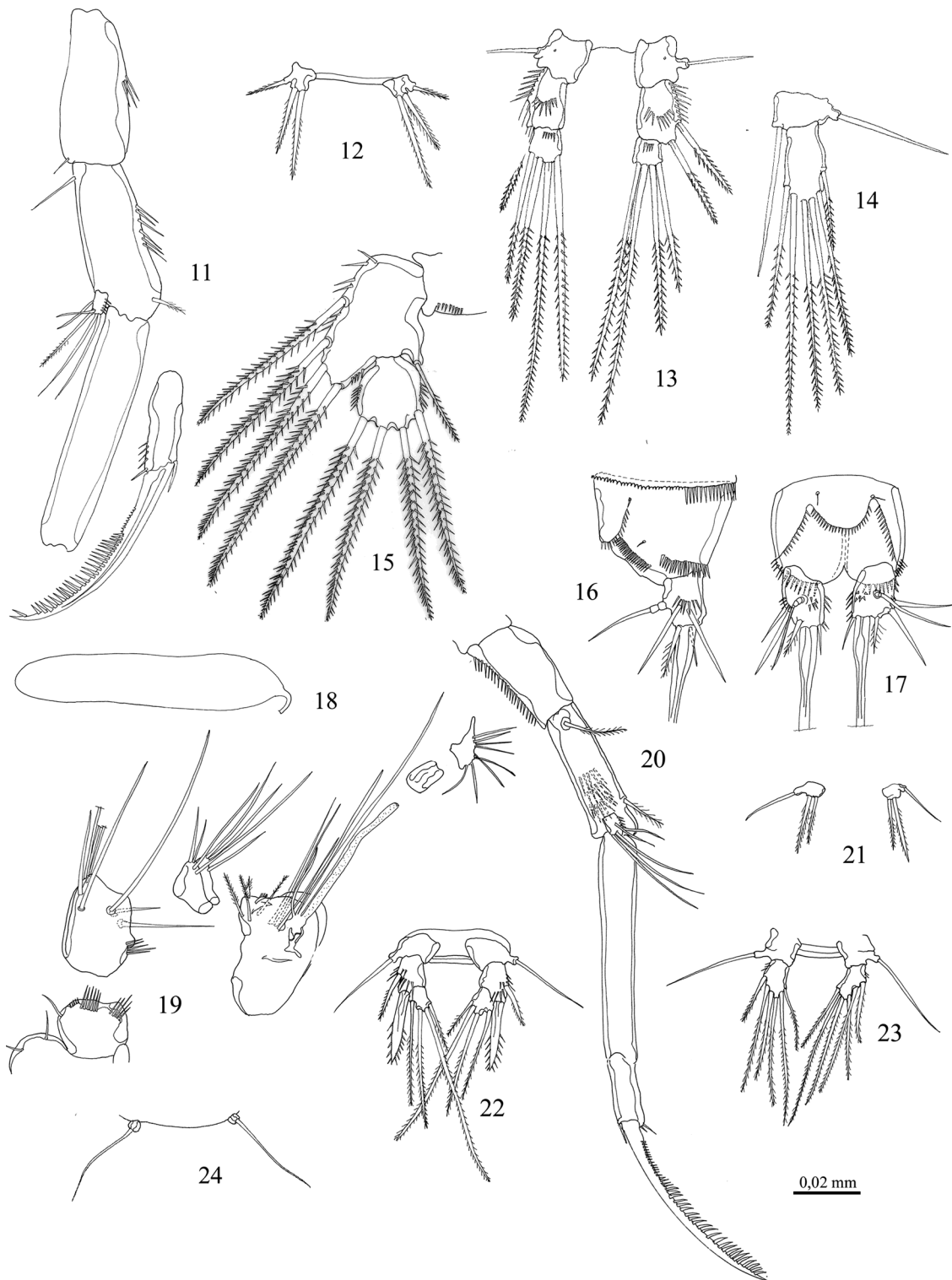


Fig. 11-24. *Carcinocaris serrichelata* sp. nov., female: 11, P1 (enp-2 disarticulated); 12, P2; 13, P3; 14, P4; 15, P5. *C. serrichelata* sp. nov., male: 16, penultimate somite, anal somite, anal operculum and right caudal ramus, lateral view; 17, anal somite, anal operculum and caudal rami, dorsal view; 18, spermatophore; 19, rostrum and antennule (disarticulated) (dorsal view); 20, P1; 21, P2; 22, P3; 23, P4; 24, P5.

and strong spinules along the distal two-thirds of the margin (Fig. 37).

P2 (Fig. 12, 38): endopodite lacking. Unsegmented protopod fused with exopodite, forming small compound

element, with 1 lateral pinnate basal seta and 2 distal (exopodal) pinnate seta, the inner one longest.

P3 (Fig. 13): unsegmented protopod with outer seta and one pore (Fig. 38). Endopodite lacking. Exopodite

(Fig. 38) 2-segmented, proximal (compound) segment with 2 pinnate outer setae, distal segment with 4 apical pinnate setae, the second innermost being the longest.

P4 (Fig. 14, 38, 39): unsegmented protopod with outer seta, inner seta, and 1 pore (Fig. 38). Endopodite reduced to a small tubercle, fused to protopod, armed with 1 long apical seta. Exopodite 1-segmented, flattened and slightly enlarged with 2 apical, 2 lateral subapical, 2 medial sub-lateral, pinnate setae.

P5 (Fig. 15): baseoendopodite enlarged, almost rectangular, and inserted laterally on the somite, with seta on distolateral corner, medial lobe with 4 pinnate setae of which outermost is longest, lengths of remaining 3 setae similar. Few spinules on lateral corner. Exopodite roundish, with 4 apical pinnate setae of subequal length. Lateral and medial margins with spinules.

Male – Habitus as in Fig. 40. Body shape and ornamentation as in female. Length, measured from anterior margin of rostrum to posterior margin of caudal rami: 288-319 μm ($n = 5$; mean = 308 μm). Anal operculum as in female (Fig. 16, 17, 41). Caudal ramus (Fig. 16, 17, 41) similar to that of female but shorter, hence dorsal seta inserting more proximally. Spermatophore as in Fig. 18.

Rostrum (Fig. 19, 42): as in female.

Antennule (Fig. 19, 42): 7-segmented, subchirocer with geniculation between segments 5 and 6. First seg-

ment with 2 distal rows of spinules and 1 short seta at distomedial corner. Second segment with 8 setae of different length and 1 small blunt process. Third and fourth segments small, with 4 and 3 apical setae, respectively. Fifth segment swollen, with a ventral tubercle bearing 1 aesthetasc and 3 long setae; a fourth seta is inserted near the base of the tubercle insertion; two long setae on the dorsal side; remaining segment ornamentation represented by small pinnate setae, thin naked setae, and lamellae as in Fig. 19 and Pic. 14. Sixth segment bare, with 5 spinous processes (Lee & Huys 1999) (Pic. 14), seventh segment with 8 lateral setae, ending in a rounded tip.

Antenna, mouthparts and P1 (Fig. 20): similar to those of female.

P2 (Fig. 21): as in female but proportionally smaller, outer apical exopodal seta longest.

P3 (Fig. 22, 43): protopod as in female, endopodite lacking. Exopodite 2-segmented, first segment with two outer spines, the distal one very strong. Last segment with 2 apical and 2 subapical pinnate setae.

P4 (Fig. 23, 43): protopod as in female, endopodite lacking. Exopodite one-segmented, with 1 apical, 3 lateral subapical, and 2 subapical medial pinnate setae.

P5 (Fig. 24, 43): extremely reduced, represented by a small tubercle with 1 apical naked seta.

P6: unarmed.

Etymology: The specific name is derived from Latin

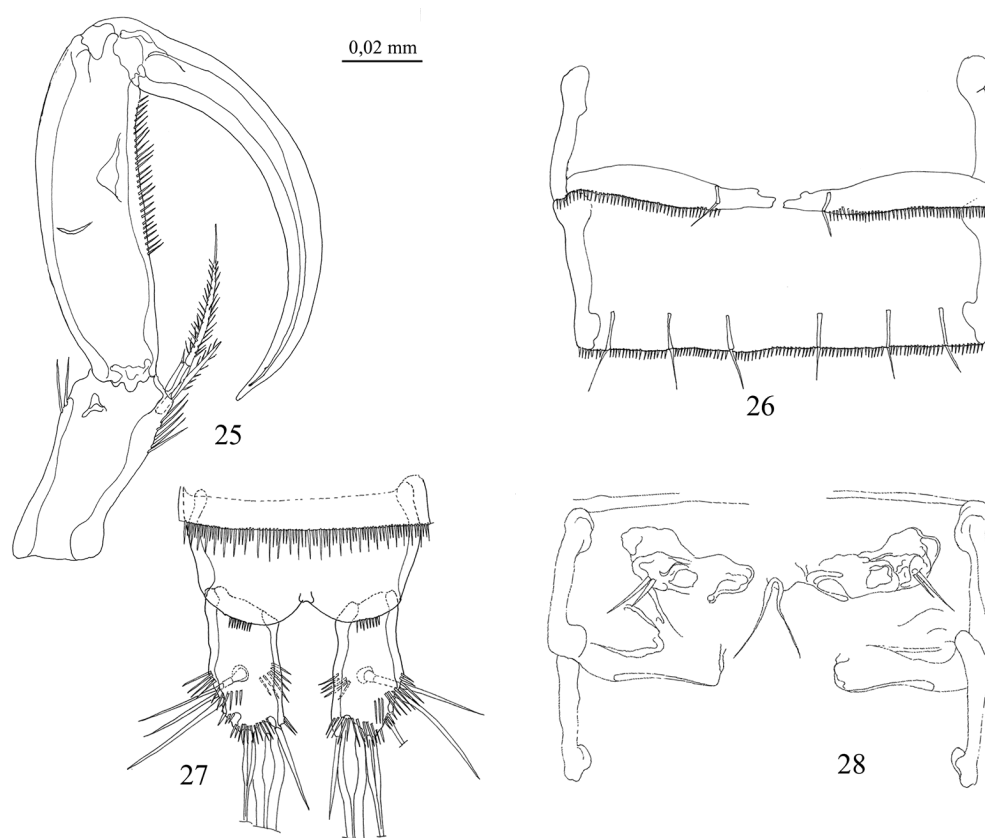


Fig. 25-28. *Xanthilaophonte trispinosa* (Sewell), female: 25, maxilliped; 26, anal somite, and caudal rami, ventral view; 27, genital double-somite, dorsal view; 28, genital somite and genital field, ventral view.

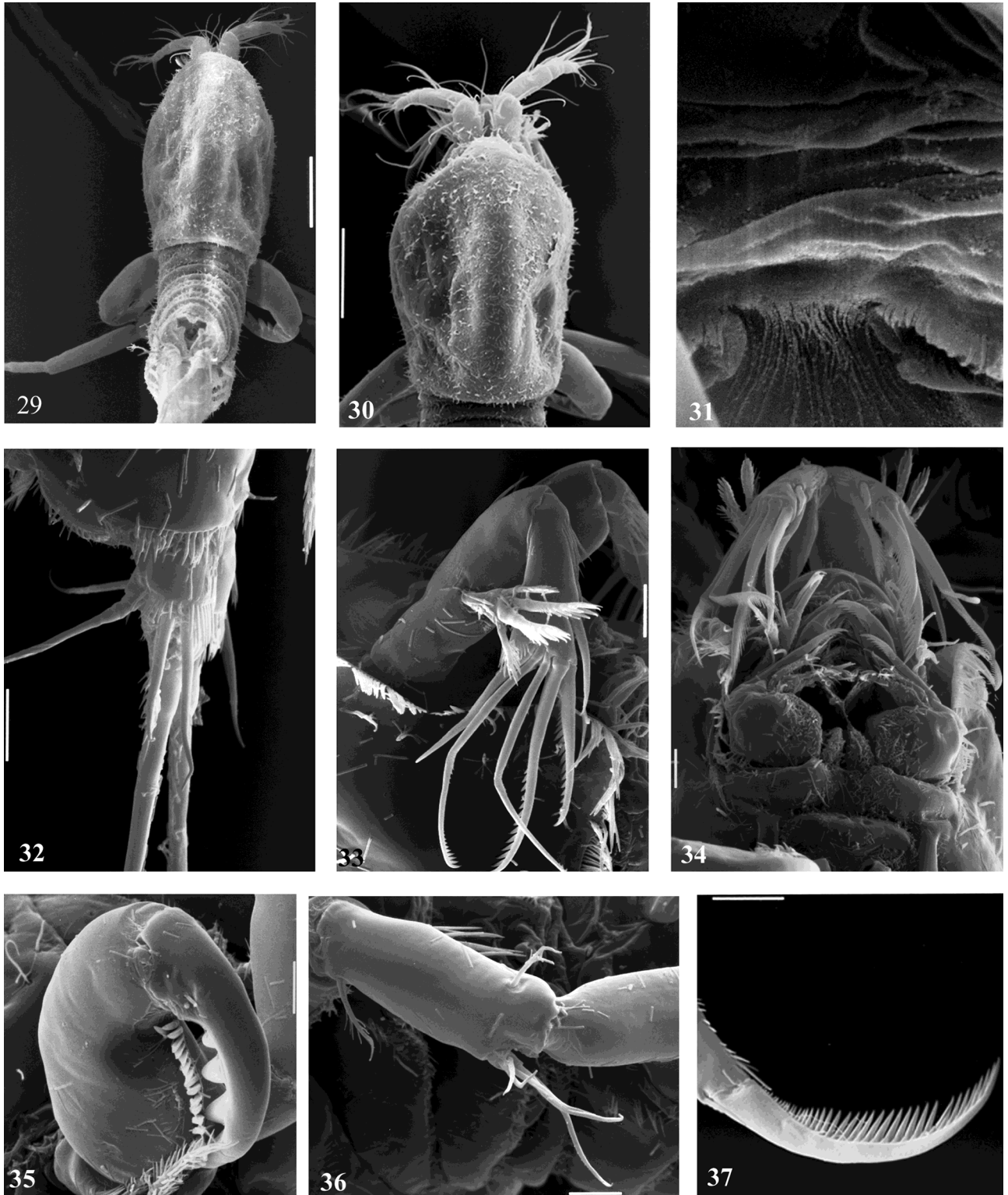


Fig. 29-37. *Carcinocaris serrichelata* sp. nov.: 29, female, habitus, dorsal view; 30, female, cephalosome, rostrum and antennule, dorsal view; 31, female, genital field, medial portion, ventral view; 32, anal somite and caudal ramus, lateral view; 33, female, antenna, lateral view; 34, female, labrum, maxillule, maxillae, ventral view; 35, female, maxilliped, medial view; 36, female, P1 basipodite and exopodite, lateral view; 37, female, P1 endopodite, lateral view.

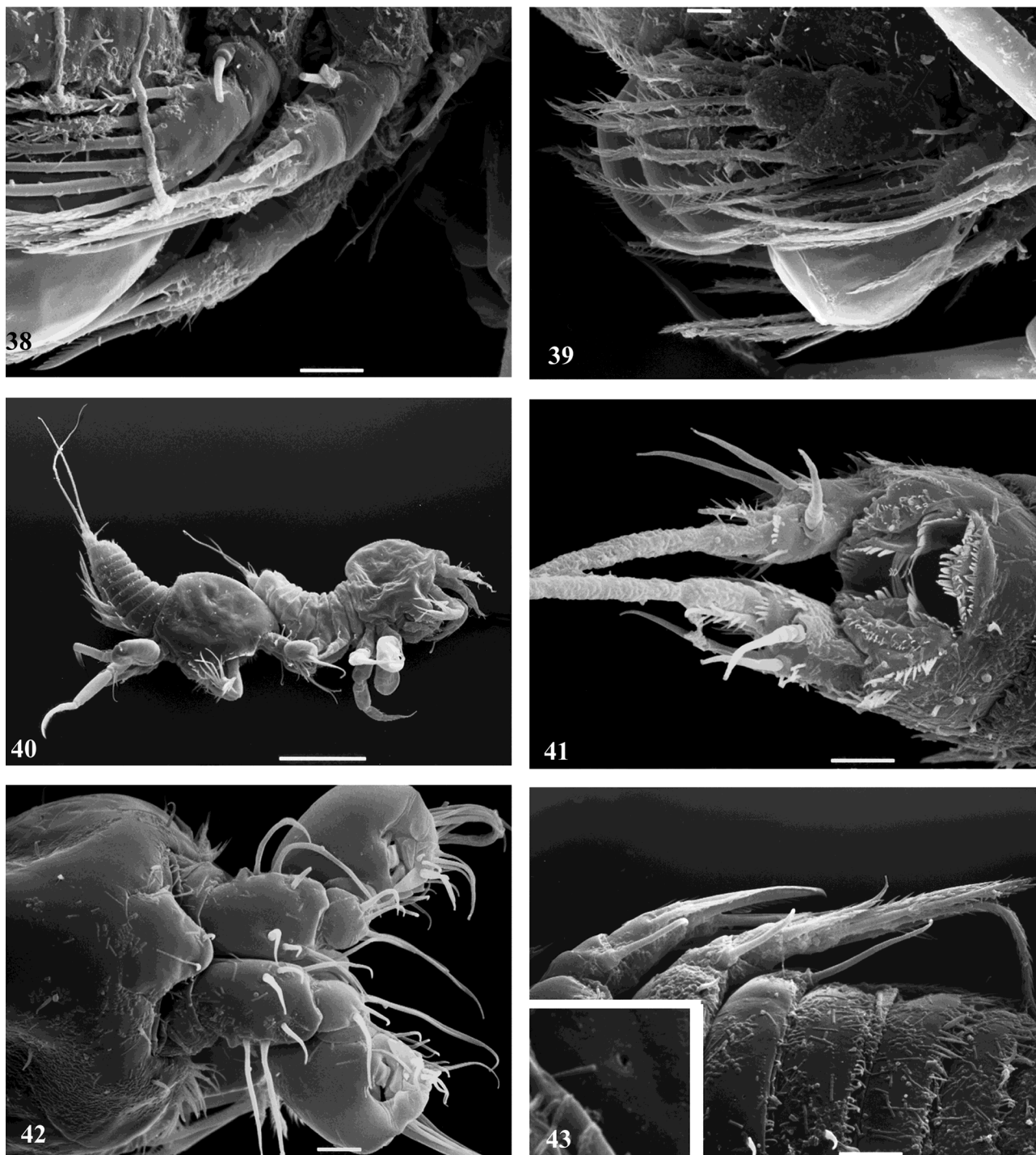


Fig. 38-43. *Carcinocaris serrichelata* sp. nov.: 38, female, P2, P3, and P3, lateral view; 39, female, P4 and P5 with egg-sac, lateral view; 40, male and female copepodite in pre-mating association; 41, male, anal somite, anal operclum, ad caudal rami, dorsal view; 42, male, cephalosome, rostrum and antennule, dorsal view; 43, male, P3, P4 and P5, lateral view (in detail: pore on fourth thoracic segment).

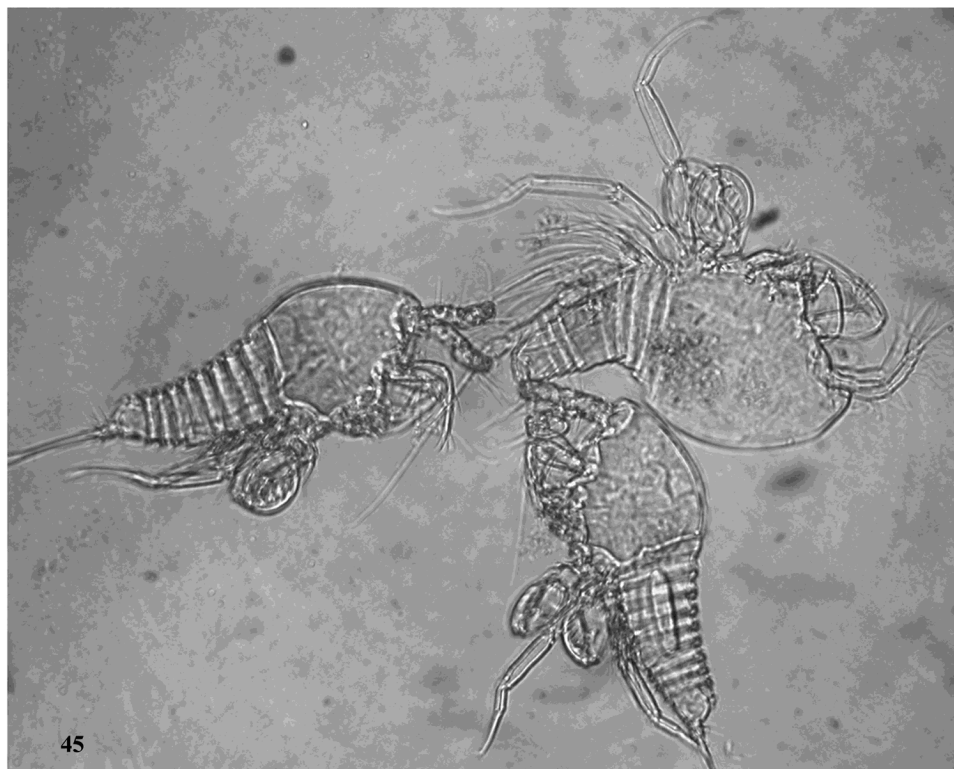
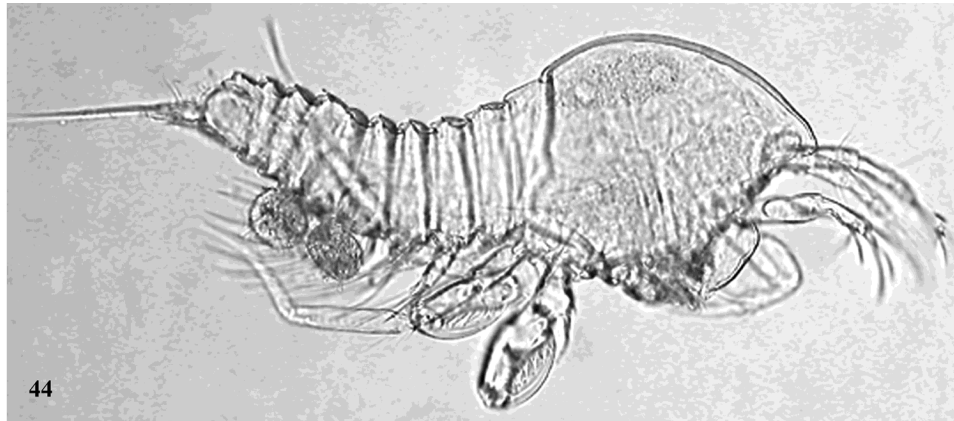


Fig. 44-45. 44, female, habitus lateral view; 45, two males and one female in pre-mating position.

serra = saw, and *chela* = claw. The epithet is feminine singular, meaning “claw possessing a saw”, and refers to the peculiar shape of the maxilliped.

DISCUSSION

The sexual dimorphism in *Carcinocaris* gen. nov. is remarkable, and expressed in: 1) an enlarged seta on the distal lateral corner of P3 exp-1 of males; 2) a vestigial P4 endopodite in females, represented by a tubercle fused to the basis, carrying a strong seta; P4 endopodite lacking in males; 4) P5 very well developed in females, inserted laterally on the somite, with round exopodite carrying four strong apical setae and four strong setae on the medial margin of the baseopodite. P5 very reduced in males,

represented by a tubercle with one seta; 5) P6 of females represented by two short setae fused to the genital field; P6 of males absent.

We collected several specimens of *Carcinocaris serichelata* sp. nov. in copulatory mating position (Pic. 12), and in all couples females were copepodites, with the P4 transformed as described by Fiers (1998), and with the males grasping them with their antennules. The only exceptions were a male attached to the caudal ramus of an ovigerous female, and a female in pre-mating position with two males (Fig. 45). In the latter case, each male is grasping the apical setae of one caudal ramus of the female; the males still have to extrude the spermatophore, and the female has a spermatophore already attached to the copulatory pore. The ovigerous females we examined carried 2-8 large eggs.

The hosts xanthid crab were collected during high and low tide. All specimens collected in dry conditions (low tide), under coral fragments, carried several laophontids, confirming that *Carcinocaris serrichelata* sp. nov. is a real xanthid associate. The same crab often carried not only *Carcinocaris serrichelata* sp. nov., but also other laophontids of other genera, some of which are probably new to science.

Notes on *Xanthilaophonte trispinosa* (Sewell)

Several specimens of *Xanthilaophonte trispinosa* (males, females, and copepodites) were obtained in washings of several xanthid crabs collected in the intertidal, on a beach near the village of Moalboal (Cebu Island, Philippines, 08-05-1989), and on Big La Laguna beach (Mindoro Island, Philippines, 08-11-1992, 08-08-1985); in the latter instance together with *Carcinocaris serrichelata* sp. nov. The morphology of our specimens corresponds very well to the description of Fiers (1991) except for the maxilliped (Fig. 25) which differs from Fiers' description in the following characters: 1) basis with a socle carrying a strong apical seta (as in *C. serrichelata* sp. nov.); 2) endopodal claw proportionally longer; 3) different ornamentation of basis and endopodal segment. The caudal rami of our specimens are slightly longer than in Fiers' description, with the same ornamentation (Fig. 26). The genital somite of females is fused to the first abdominal somite according to Fiers (1991). However, in Fiers' drawings (1991) the genital double-somite has a dorsal and lateral surface ridge, indicating the original segmentation. The ventral portion is not illustrated nor described by Fiers. From the analysis of our specimens, it appears that the genital somite is partially fused on the ventral side (Fig. 27, 28). The genital field was not described by Fiers, and is presented in Fig. 28.

Xanthilaophonte trispinosa was already recorded from two localities in the Philippines (Fiers 1991) but not from Cebu Island. In the same paper Fiers described the second species of the genus, *X. carcinicola*, from the Sula Besi Archipelago, Indonesia. We are studying a third species of this genus collected in Cebu Island which co-exists with *Xanthilaophonte trispinosa* on the same xanthid hosts and will be described elsewhere. The collection of this third species confirms that the genus *Xanthilaophonte* is well represented in the Indo-West Pacific area, as stated by Fiers (1991).

CONCLUSIONS

It has been known for several years that "copepods associated in varying degrees of intimacy with marine invertebrates exhibit an enormous spectrum of structural diversity" (Gotto 1993). This general observation can be applied to xanthid-associated laophontids, which belong

to several genera and species, have different morphological adaptations, and are widely distributed. Thus, the discovery of *Carcinocaris serrichelata* sp. nov. confirms that the harpacticoid taxocoenosis living in this apparently specialized habitat has a higher biodiversity than previously expected. Moreover, we are studying other new laophontids and new harpacticoids belonging to other families, from the same habitat.

As far as the host crabs are concerned, xanthids are the largest family of brachyurans. Species of this family, most of which are of small and medium size, inhabit all marine habitats, as well as brackish and freshwater ones. Several species are intertidal and littoral, and often occur in high abundance. It is conceivable that many of these crabs serve as hosts for as yet undescribed associates, and consequently, continued research related to this peculiar habitat should be encouraged.

ACKNOWLEDGEMENTS - We want to thank Dr R Huys (Natural History Museum, London) for his useful comments and suggestions. Two referees greatly improved the manuscript with their comments. Thanks to Dr A Taddei (Interdepartmental Center for Electron Microscopy) for the assistance at the Scanning Electron Microscope. This research was in part supported with funds MURST-COFIN and ex MIUR 60%.

REFERENCES

- Bruno MC, Cottarelli V 1999. Harpacticoids from groundwaters in the Philippines: *Parastenocaris mangyans*, new species, *Epactophanes philippinus*, new species, and redescription of *Phyllognathopus bassoti* (Copepoda). *J Crust Biol* 19(3): 510-529.
- Cottarelli V, Forniz C 1989. *Raptolaophonte ardua* n. gen., n. sp. (Copepoda, Harpacticoida Laophontidae) from the meiobenthos of the Chagos Islands. *Trop Zool* 2(2): 95-102.
- Fiers F 1991. Allocation of *Laophonte trispinosa* Sewell to *Xanthilaophonte* gen. nov. and the description of *X. carcinicola* spec. nov. (Harpacticoida: Laophontidae). *Zool Med* 65: 287-312.
- Fiers F 1992. *Robustunguis* gen. nov., a genus of decapod associated with laophontids (Copepoda: Harpacticoida). *Zool Med* 66: 399-412.
- Fiers F 1998. Female leg 4 development in Laophontidae (Harpacticoida): a juvenile adaptation to precopulatory behaviour. In Dahms HU, Glatzel T, Hirche HJ, Schiel S, Schminke HK eds, Proceed 6th Intern Conf Copepoda. *J marine Syst, Spec* 15(1-4): 41-51.
- Gotto RV 1993. Commensal and parasitic copepods associated with marine invertebrates (and whales): keys and notes for identification of the species. Synopses of the British Fauna, NS 46:1-264.
- Huys R, Boxshall GA 1991. Copepod Evolution. Ray Society, London, 468 p.
- Lee W, Huys R 1999. *Bathylaophonte* gen. nov. from deep-sea hydrothermal vents and the polyphyly of *Paronychocamptus* (Copepoda: Harpacticoida). *Cah Biol Mar* 40(4): 293-328.

Received February 11, 2005

Accepted July 12, 2005