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Article *in* Zootaxa · October 2005

DOI: 10.5281/zenodo.170310

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Zootaxa 1071: 47–60 (2005)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1071

Biacanthus pleuronichthydis (Yamaguti, 1939) gen. n., comb. n. (Copepoda: Taeniacanthidae), an ectoparasite of flatfishes from Japanese waters

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Abstract

A new taeniacanthid genus, *Biacanthus* **gen. n.**, is proposed for *Taeniastrotos pleuronichthydis* (Yamaguti, 1939) based on a redescription of adult female and male specimens collected from three flatfish hosts captured along the coast of Japan. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.** is distinguished from other taeniacanthid species by a combination of characters that include a horseshoe-shaped sclerotised structure on the ventral surface of the rostrum, an anteromedial projection on the first antennule segment, an uncinate process posterior to each antennule base, a pair of postantennal processes, a sigmoid-shaped maxilliped claw bearing an accessory process, an inner coxal seta on legs 2 and 3, and an inner intermediate spine on the first and second endopodal segments of leg 4. A key to the genera of the Taeniacanthidae females is provided.

Key words: copepod, Taeniacanthidae, flatfishes, parasite, taxonomy

Introduction

Anchistrotos pleuronichthydis was first described by Yamaguti (1939) for a collection of female specimens removed from the body surface of *Pleuronichthys cornutus* (Temminck & Schlegel) and *Verasper variegatus* (Temminck & Schlegel) captured in Tarumi, Japan. Izawa (1986) later provided descriptions of the first two naupliar and all the copepodite stages, except the fifth female copepodite, of *A. pleuronichthydis*. Despite the fact his adult female specimens, including Yamaguti's (1939) material, lacked the characteristic pair of long whip-like setae at the base of the maxilliped claw exhibited by members of

Accepted by G. Walker-Smith: 26 Sept. 2005; published: 28 Oct. 2005

Anchistrotos Brian, 1906, Izawa did not dispute the taxonomic standing of *A. pleuronichthydis*. In their comprehensive revision of the Taeniacanthidae, Dojiri and Cressey (1987) transferred *A. pleuronichthydis* to *Taeniastrotos* Cressey, 1969 since it exhibits a similar body shape, maxilliped, and maxillule to *Taeniastrotos californiensis* Cressey, 1969 and *Taeniastrotos tragus* Dojiri and Cressey, 1987. Their decision was based on the original description and drawings of Yamaguti (1939), so they could not verify the presence of a ventral, corrugated, shield-like rostrum, which is a distinctive synapomorphy for members of *Taeniastrotos*. With the inclusion of another species of *Anchistrotos* (i.e. *A. trachuri* Avdeev, 1977) in *Taeniastrotos* by Dojiri and Cressey (1987) and the discovery of *Taeniastrotos braziliensis* by Montú and Boxshall (1997), the number of *Taeniastrotos* species currently stands at five. In this paper, a redescription of both sexes of *T. pleuronichthydis* is given based on samples collected from three flatfish species captured along the eastern coastline of Japan. In addition, the taxonomic status of *T. pleuronichthydis* is reconsidered, a new genus *Biacanthus* is established, and an updated key to the genera of the Taeniacanthidae is provided.

Materials and methods

Fish hosts were collected from Ise Bay, Mie Prefecture, and Tanabe Bay, Wakayama Prefecture, using seine and set nets. Copepods were removed from the hosts' body surface and preserved in 70% ethanol. All preserved copepods were later soaked in lactic acid, into which several lignin pink crystals had been dissolved, for a minimum of 24 hours prior to examination using an Olympus BX-50 compound microscope. Eight female and three male specimens were measured using a calibrated eyepiece micrometer. One male and three females were dissected and examined according to the wooden slide procedure of Humes and Gooding (1964). Drawings were made with the aid of a camera lucida. Anatomical terminology follows Dojiri and Cressey (1987) and Huys and Boxshall (1991). The identification key to the genera of the Taeniacanthidae is modified from Dojiri and Cressey (1987) and Boxshall and Halsey (2004).

Taeniastrotos pleuronichthydis (Yamaguti, 1939)

(Figs. 1–5)

Anchistrotos pleuronichthydis Yamaguti, 1939: 410; Izawa, 1986: 82
Taeniastrotos pleuronichthydis (Yamaguti, 1939): Dojiri & Cressey, 1987: 230

Material examined. Four adult ♀ from *Pseudorhombus cinnamoneus* (Temminck & Schlegel) captured on 17 April, 1971, in Tanabe Bay, Wakayama Prefecture (33°41'N, 135°20'E), coll. K. Izawa; 11 adult ♀ and 5 adult ♂ from *Kareius bicoloratus* (Basilewsky)

and *Pseudopleuronectes yokohamae* (Günther) collected 2 October, 1971, Ise Bay, Mie Prefecture (34°45'N, 136°35'E), coll. K. Izawa; 3 adult ♀ and 2 adult ♂ from *K. bicoloratus* and *P. yokohamae* captured 15 February, 1979, Ise Bay, Mie Prefecture (34°36'N, 136°35'E), coll. K. Izawa. Voucher specimens (7 ♀ and 3 ♂) are deposited in the Australian Museum (AM P.68816 and P.68817; P.70245–P.70248).

Description. *Female* (Fig. 1A): Total body length (excluding setae on caudal rami) 1.49 ± 0.23 mm. Prosome 0.98 ± 0.15 mm long and 0.57 ± 0.09 mm wide, representing 66% of total body length; composed of cephalothorax (first pedigerous somite fused with cephalosome) and 3 free pedigerous somites. Lateral margins of cephalothorax ornamented with marginal membranes and narrower anteriorly. Second pedigerous somite 0.47 ± 0.08 mm wide; pedigerous somites 3 and 4 decreasing in width posteriorly. Urosome comprised of pedigerous somite 5, genital somite and 4 free abdominal somites. Genital somite wider (0.21 ± 0.03 mm) than long (0.08 ± 0.02 mm). Abdomen (Fig. 1B) 0.30 ± 0.05 mm long and 0.13 ± 0.03 mm wide; first 2 abdominal somites bearing a pair of sensillae on posteroventral margin; ventral surface of anal somite with transverse row of minute spinules posterolaterally. Caudal ramus (Fig. 1C) longer (64 ± 8 µm) than wide (33 ± 3 µm), bearing 1 minute proximolateral element and 1 mid-lateral, 1 dorsal, 2 subterminal and 2 terminal setae. Dorsal seta pinnate; mid-lateral seta naked; outer subterminal seta with barbules on inner margin; outer terminal and inner subterminal setae ornamented with long, fine spinules along margins; inner terminal seta longest, twice length of outer terminal seta, and ornamented with short, fine spinules along margins.

Rostral area (Figs 1A, D) protuberant, with 2 internal, chitinous rods and a ventral, horseshoe-shaped, sclerotised structure; area between horseshoe structure concave. Antennule (Fig. 1E) 7-segmented; armature formula: 5, 15, 5, 3, 4, 2 + 1 aesthetasc and 7 + 1 aesthetasc; first segment bearing rounded projection antero-medially; anterodistal seta on last segment share common base with aesthetasc (Fig. 2A). Strong, uncinate process situated posterior to each antennule base (Fig. 1D). Antenna (Fig. 2B) composed of coxobasis and 2 endopodal segments; coxobasis longer than length of endopodal segments combined, and bearing long, bristled seta distally; first endopodal segment with 1 inner seta; second endopodal segment bearing 2 unequal, pectinate processes, 3 claw-like spines and 4 unequal setae; large, pectinate process with 1 seta and several rows of spinules; short, pectinate process with minute, blunt seta and single row of spinules. Postantennal process (Fig. 2C) with a wide base and curved tine.

Labrum (Fig. 2D) spinulated along posterior margin. Mandible (Fig. 2E) with 1 terminal and 1 subterminal blade; terminal blade spinulated along posterior margin; articulation of subterminal blade with gnathobase indistinct, with 2 proximal rows of spinules and 1 distal row of spinules. Paragnath (Fig. 2F) unornamented. Maxillule (Fig. 2G) lobate bearing 2 long, naked setae, 2 short, naked setae, 1 long, broad seta armed with a distal row of spinules, and anterior knob-like process. Maxilla (Fig. 2H) 2-segmented; syncoxa unarmed; basis armed with 1 spinulated, terminal process and 2 spinulated setae.

Maxilliped (Figs 3A–B) 3-segmented; syncoxa (not illustrated) ring-like, bearing 1 naked seta; basis armed with 2 proximal, naked setae and mediodistal protrusion; terminal claw sigmoid-shaped, bearing 2 naked setae and accessory claw.

Legs 1–4 biramous (Figs 3C–4F) with 3-segmented rami, except leg 1 endopod 2-segmented. Armature on rami of legs 1 to 4 as follows (Roman numerals = spines; Arabic numerals = setae; int. = intermediate spine):

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-1	1-0; 1-1; 7	0-1; 7
Leg 2	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, I, 3
Leg 3	0-1	1-0	I-0; I-1; II, I, 5	0-1; 0-2; II, I, 2
Leg 4	0-0	1-0	I-0; I-1; II, I, 5	0-int.; 0-int.; I, 3 int.

Leg 1 (Fig. 3C) protopod and rami flattened and expanded. Intercoxal sclerite subtriangular; posterior margin rounded, armed with fine spinules. Coxa with patch of setules on outer border; basis ornamented with marginal membrane posteriorly. First 4 outer exopodal setae bristled along margins; 2 outermost setae on terminal endopodal segment shorter than 5 inner setae; outer margin armed with patch of setules. Leg 2 intercoxal sclerite and basis (Fig. 3D) unornamented; coxa bearing large spinules on distolateral margin. Leg 2 exopodal spines (Fig. 3E) weakly sclerotized; first 5 spines spinulated along margins and apical spine on terminal segment finely spinulated on outer edge and armed with pinnules on inner edge; single row of minute spinules at base of most spines; row of setules present on inner margin of first exopodal segment. Leg 2 endopodal segments (Fig. 3F) ornamented with row of setules on outer borders and spinules on posterior margins; second endopodal segment with distolateral spiniform process; spines on terminal segment finely spinulated on margins. Leg 3 intercoxal sclerite (Fig. 3G) spinulated along posterior margin; coxa and basis similar to that in leg 2. Ornamentation of leg 3 exopod (Fig. 4A) and endopod (Fig. 4B) similar to that in leg 2; spines on terminal endopodal segment (Fig. 4B) slightly longer than those in leg 2. Leg 4 intercoxal sclerite (Fig. 4C) wide and short; coxa and basis similar to that in leg 2 except inner coxal seta absent; exopod similar to that in leg 3. Leg 4 endopodal segments (Fig. 4D) with larger spinules on posterior margins than on legs 2 and 3; second segment lacking posterolateral process; terminal segment without outer row of setules. Leg 5 (Figs 4E–F) uniramous, 2-segmented. Protopodal segment armed with 1 dorsolateral, pinnate seta, a row of long spinules and row of short spinules; exopodal segment concave on medial surface and armed with 3 spinulated spines and 1 pinnate seta; spinules present at base of each spine. Leg 6 (Fig. 4G) vestigial, represented by 3 unequal, naked setae at egg sac attachment area.

Male (Fig. 5A): Total body length (excluding setae on caudal rami) 0.90 ± 0.20 mm. Prosome 0.59 ± 0.11 mm long and 0.33 ± 0.04 mm wide. Second pedigerous somite 0.26 ± 0.03 mm wide; remaining pedigerous somites decrease in width posteriorly. Genital somite wider (0.12 ± 0.02 mm) than long (0.08 ± 0.03 mm). Abdomen 0.15 ± 0.06 mm

long and 0.09 ± 0.01 mm wide, composed of 3 free somites; ventral surface of abdominal somites ornamented as in female. Caudal ramus longer (37 ± 3 µm) than wide (22 ± 3µm), bearing similar elements as in female.

Maxilliped (Figs 5B–C) 4-segmented; first segment compact, bearing 1 naked seta; second segment elongate, armed with 2 long, naked setae, patch of minute spinules and single row of spinules on posterior surface, and large patch of spinules and small, truncate denticles on anterior surface; third segment small, unornamented; terminal segment a strongly curved claw, bearing 1 posterior seta, 2 anterior setae, and 1 hyaline process and single row of large, plate-like denticles on inner margin. Leg 5 (Fig. 5D) with dorsolateral pinnate seta and a row of long spinules on protopodal segment; free exopodal segment slimmer than in female, lacking medial concavity; spines on terminal segment slimmer than in female; spinules at base of each spine fewer in number than in female.

Remarks. The specimens in the present study conform to the descriptions and illustrations provided by Yamaguti (1939) and Izawa (1986). However, there are several discrepancies between our observations and those of Yamaguti (1939) and Izawa (1986) in terms of the ornamentation of the anal somite, segmentation and armature of the antennule, armature of the maxillule, maxilla and maxilliped, segmentation of leg 1 exopod, ornamentation of legs 2–4, armature of leg 4 endopod and ornamentation of leg 5 of the adult male and female (Table 1). These differences are minor, and are most likely attributed to variations in the interpretation of fine morphological details by each investigator rather than to intraspecific variation.

Taeniastrotos pleuronichthydis is characterised by the following combination of apomorphies: (1) a horseshoe-shaped sclerotised structure on the ventral surface of the rostrum; (2) an anteromedial projection on the first antennule segment; (3) a robust, uncinate process posterior to each antennule base; (4) pair of postantennal processes; (5) a sigmoid-shaped maxilliped claw bearing an accessory process; (6) an inner coxal seta on legs 2 and 3; and (7) an inner intermediate spine on the first and second endopodal segments of leg 4. Although the female of *T. pleuronichthydis* possesses a broad, spinulated seta on the maxillule, a sigmoid-shaped maxilliped claw and a body shape similar to *T. californiensis* and *T. tragus*, the absence of a ventral, corrugated, shield-like rostral area excludes it from the genus *Taeniastrotos*. The species *T. pleuronichthydis* is also not affiliated with *Anchistrotos*, the genus to which it was originally assigned, as it has five setae on the maxillule rather than six, lacks two long, whip-like setae on the maxilliped claw and the second endopodal segment of leg 1 is armed with seven setae rather than six. Species of *Irodes* Wilson, 1911, *Phagus* Wilson, 1911, *Pseudotaeniacanthus* Yamaguti and Yamasu, 1959 and *Scolecicara* Ho, 1969 possess the plesiomorphic inner coxal seta on legs 2 and 3 similar to *T. pleuronichthydis*. Nonetheless, *T. pleuronichthydis* cannot be placed in any of these genera due to noticeable differences in body tagmosis, the cephalothoracic appendages and armature of leg 4 (Table 2). This species represents a new genus, which is diagnosed below.

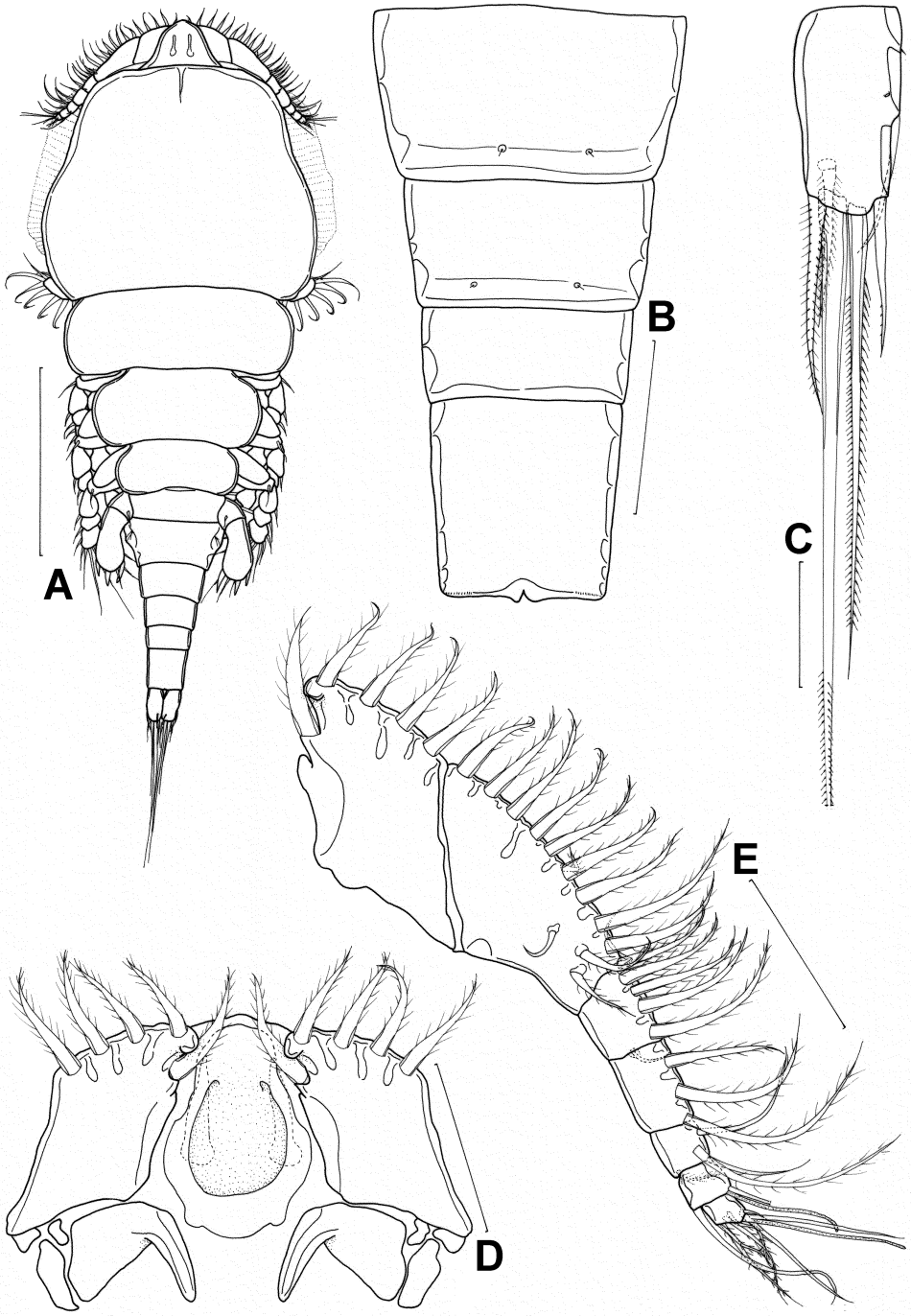

FIGURE 1. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**, adult female, P.68817 (A) and P.70248 (B–E). A, habitus, dorsal view; B, abdominal somites, ventral view; C, caudal ramus, ventral view; D, rostral area, ventral view; E, antennule, ventral view. Scale bars: 500 µm for A; 100 µm for B, D, E; 50 µm for C.

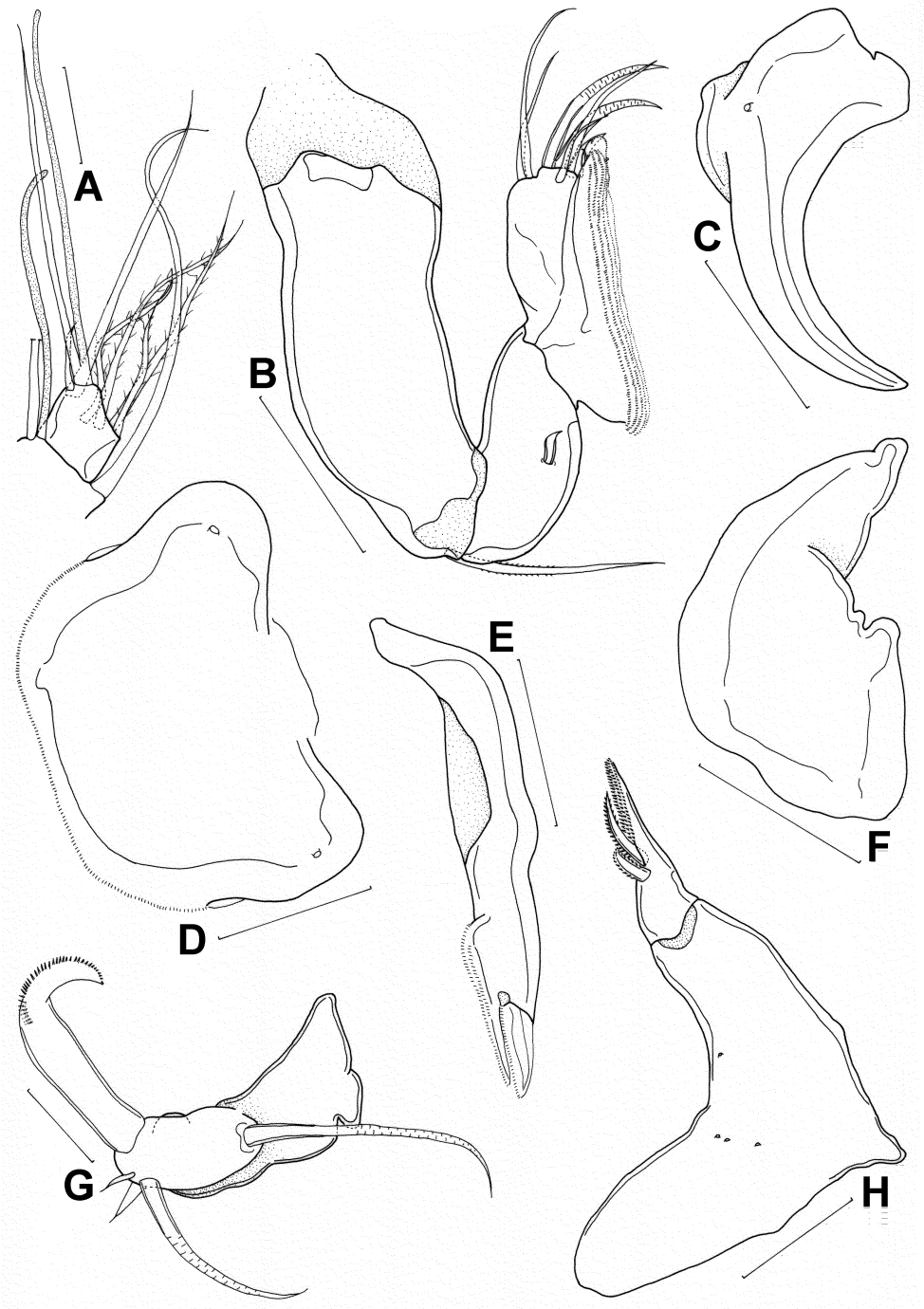

FIGURE 2. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**, adult female, P.70248. A, distal end of antennule, ventral view; B, antenna, medial view; C, postantennal process, medial view; D, labrum, ventral view; E, mandible, posterior view; F, paragnath, ventral view; G, maxillule, ventral view; H, maxilla, posterior. Scale bars: 25 µm for A, F–G; 50 µm for B–E, H.

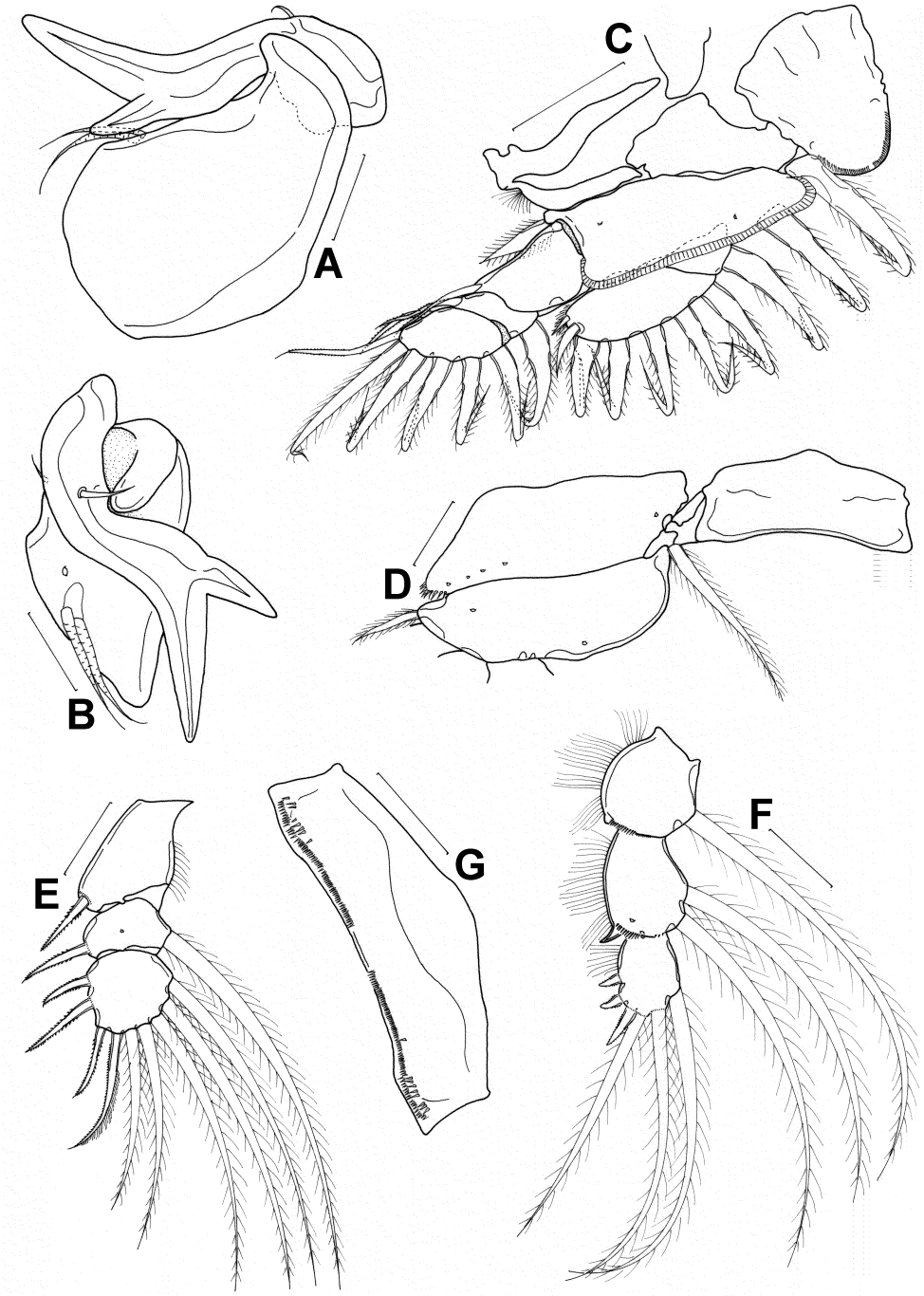

FIGURE 3. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**, adult female, P.70248. A, maxilliped, posterior view; B, maxilliped, medial view; C, leg 1, anterior view; D, leg 2 intercoxal sclerite and protopod, anterior view; E, leg 2 exopod, anterior view; F, leg 2 endopod, anterior view; G, leg 3 intercoxal sclerite, anterior view. Scale bars: 25 µm for A–B; 100 µm for C; 50 µm for D–G.

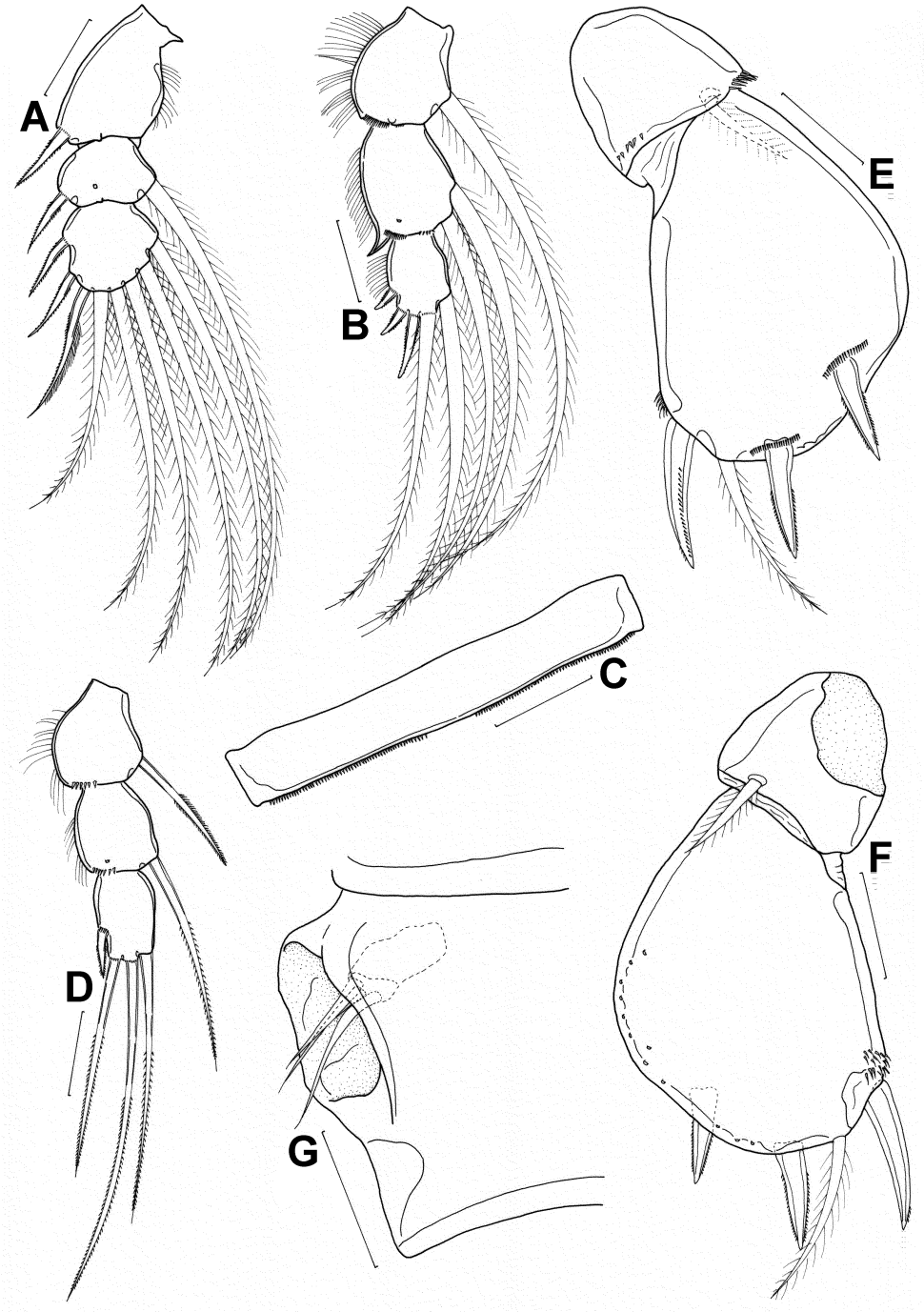

FIGURE 4. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**, adult female, P.70248. A, leg 3 exopod, anterior view; B, leg 3 endopod, anterior view; C, leg 4 intercoxal sclerite, anterior view; D, leg 4 endopod, anterior view; E, leg 5, lateral view; F, leg 5, dorsomedial view; G, leg 6, dorsal view. Scale bars: all 50 µm.

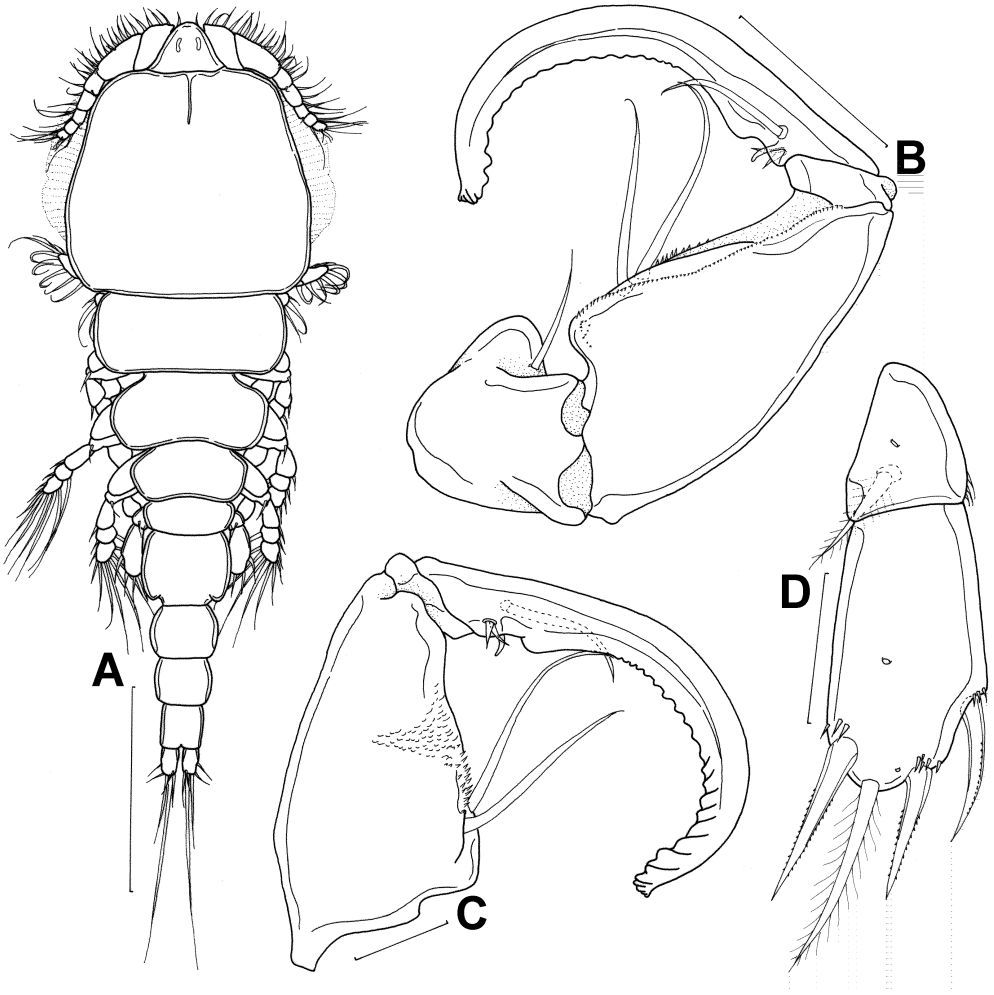

FIGURE 5. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**, adult male, P.68816 (A) and P.70245 (B–D). A, habitus, dorsal view; B, maxilliped, posterior view; C, maxilliped, anterior view; D, leg 5, ventral view. Scale bars: 300 µm for A; 50 µm for B; 25 µm for C, D.

***Biacanthus* gen. n.**

Diagnosis. *Female*: Cephalothorax formed from fusion of cephalosome with first pedigerous somite. Abdomen 4-segmented. Caudal ramus with 7 setae. Rostral area protuberant with horseshoe-shaped structure on ventral surface. Antennule 7-segmented. Antenna 3-segmented. Uncinate process posterior to antennule base present. Postantennal process present. Labrum spinulated on posterior margin. Mandible with 2 spinulated blades. Paragnath present. Maxillule lobate, bearing 5 setae. Maxilla armed with 1

terminal spinulated process and 2 spinulated setae. Maxilliped 3-segmented, last segment with sigmoid claw bearing an accessory tooth. Legs 1–4 biramous. Leg 1 exopod trimerous and endopod bimerous; legs 2–4 trimerous. Inner coxal seta present on legs 2 and 3. Terminal segment of leg 4 endopod with 4 elements. Leg 5 with 3 spines and 1 seta on second segment. Leg 6 vestigial, represented by 3 setae.

Male: Body tagmosis similar to that in female except with 3-segmented abdomen. Maxilliped 4-segmented; second segment ornamented with denticles; last segment forming long recurved claw, denticulated along inner margin. Leg 6 absent.

Type species. *Biacanthus pleuronichthydis* (Yamaguti, 1939) **comb. n.**

Etymology. The generic name is a composite of the Latin *bi* (= two) and *acanthus* (= a common suffix in the Taeniacanthidae, meaning spine), alluding to the powerful uncinate process posterior to the antennule bases.

TABLE 1. Comparison of morphologic characters of *Biacanthus pleuronichthydis* (Yamaguti, 1939) given in Yamaguti (1939), Izawa (1986) and the present study.

	Morphologic feature	Yamaguti (1939)	Izawa (1986)	Present Study
♀	Anal somite	Naked	Naked	Ornamented
	Antennule segmentation	7-segmented	6-segmented	7-segmented
	Antennule armature formula	5, 13, 4, 3, 4, 3, 8	5, 14, 8, 2, 2, 7	5, 15, 5, 3, 4, 2+aes, 7+aes
	Maxillule	4 setae	5 setae	5 setae
	Maxilla, terminal segment	3 elements	2 elements	3 elements
	Maxilliped claw	1 basal seta	1 basal seta	2 basal setae
	Leg 1 exopod	3-segmented	2-segmented	3-segmented
	Legs 2–4 rami	Spinules absent	Spinules absent	Spinules present
	Leg 4 endopod, 1st and 2nd segments	Armed with inner seta	Armed with inner seta	Armed with intermediate spine
	Leg 5, first segment	Naked	Naked	Ornamented
♂	Antennule armature formula	-	5, 16, 4, 4, 4, 2+aes, 7+aes	5, 15, 5, 3, 4, 2+aes, 7+aes
	Maxilliped, 2nd segment (posterior)	-	Spinule patch absent	Spinule patch present
	Maxilliped claw (anterior)	-	1 seta	2 setae

TABLE 2. Morphological comparisons between *Biacanthus pleuronichthydis* (Yamaguti, 1939), *Irodes* Wilson, 1911, *Phagus* Wilson, 1911, *Pseudotaeniacanthus* Yamaguti and Yamasu, 1959 and *Scolecicara* Ho, 1969.

Character	*B. pleuronichthydis*	*Irodes*	*Phagus*	*Pseudotaeniacanthus*	*Scolecicara*
2nd pedigerous somite long and slender	Not expressed	Not expressed	Not expressed	Not expressed	Expressed
3rd and 4th pedigerous somites fused	Not expressed	Not expressed	Not expressed	Not expressed	Expressed
Number of abdominal somites	4	3 or 4	4	4	3
Rostral area	Horseshoe-shaped sclerotised structure	Sclerotised plate	Sclerotised plate	Y-shaped sclerotised structure	Conical with 3 processes
Antennule	7 segments	6 segments	7 segments	6 segments	6 segments
Postantennal process	Present	Present	Absent	Absent	Present
Uncinate process posterior to antennule base	Present	Absent	Absent	Absent	Absent
Mandible	2 blades	2 blades	2 blades + accessory seta	2 blades	2 blades + accessory seta
Maxillule	5 elements	5 elements	5 elements	4, 5 or 6 elements	3 elements
Terminal segment of maxilliped	Sigmoid-shaped claw	Claw absent	Claw absent	Weak, non-sclerotised	Knob-like
Leg 4 endopod (terminal segment)	4 elements	4 elements	4 elements	3 or 4 elements	3 elements

Remarks. The presence of a horseshoe-shaped, sclerotised structure on the ventral surface of the rostrum and a robust uncinate process posterior to each antennule base are the two most distinctive characters of adult *B. pleuronichthydis*. According to Izawa (1986), the ventral side of the rostrum of *B. pleuronichthydis* undergoes considerable morphologic changes throughout the copepodite stages. For instance, a large median hook develops in the first copepodite, but is absent in the next copepodite stage. In the third to

fifth male copepodites, as well as the third and fourth female copepodites, the rostrum bears a small anteroventral sclerotised projection. The projection is lost and the horseshoe-shaped structure develops in the adult stages.

In contrast to the rostral area, the uncinate processes are present in all copepodite stages, except for the first copepodite (Izawa, 1986). It should be noted that male *Taeniacanthodes haakeri* Ho, 1972 and female *Anchistrotos caligiformis* (Gurney, 1927) have one and two pairs, respectively, of small spiniform processes situated posterior to the antennule. However, these structures are not homologous with the uncinate processes of *B. pleuronichthydis*.

Key to the genera of Taeniacanthidae (based on adult females)

1. Leg 2 with inner coxal seta 2
- Leg 2 without inner coxal seta 10
2. Postantennal process absent 3
- Postantennal process present 5
3. Rostral area with posteriorly directed, spiniform process on ventromedian surface ..... *Taeniacanthodes*
- Rostral area otherwise 4
4. Rostral area with Y-shaped, sclerotised structure bearing transverse rows of hooklets or ridges ..... *Pseudotaeniacanthus*
- Rostral area otherwise ..... *Phagus*
5. Second pedigerous somite slender and long, forming elongate neck ..... *Scolecicara*
- Second pedigerous somite not forming elongate neck 6
6. Maxilliped claw absent ..... *Irodes*
- Maxilliped claw present 7
7. Uncinate process posterior to antennule base present ..... *Biacanthus* **gen. n.**
- Uncinate process posterior to antennule base absent 8
8. Rostral area with corrugated shield-like structure on ventromedian surface ..... *Taeniastrotos*
- Rostral area otherwise 9
9. Maxilliped claw with 2 long whip-like setae extending to or beyond distal limit of claw ..... *Anchistrotos*
- Maxilliped claw without 2 long, whip-like setae ..... *Caudacanthus*
10. Rami of leg 1 not flattened and expanded; setae on legs 1–4 spinulated 11
- Rami of leg 1 flattened and expanded; setae on legs 1–4 with long pinnules 12
11. Second pedigerous somite partially or completely fused to cephalothorax; maxilliped present ..... *Clavisodalis*
- Second pedigerous somite free; maxilliped absent ..... *Echinirus*

12. Maxilliped reduced to pear-shaped swelling bearing a slender process armed with 3 setae ..... *Echinosocius*
- Maxilliped with well-developed basis and claw, or with well-developed basis but claw absent on distinct terminal segment 13
13. Cephalothorax with ventrally directed lateral margins ..... *Metataeniacanthus*
- Cephalothorax without ventrally directed lateral margins 14
14. Maxilliped claw absent on terminal segment ..... *Nudisodalis*
- Maxilliped claw present on terminal segment 15
15. Maxilliped with claw curved toward basis ..... *Cirracanthus*
- Maxilliped otherwise ..... *Taeniacanthus*

Acknowledgements

We thank the School of Animal Biology at The University of Western Australia for use of laboratory facilities.

References

Avdeev, G.V. (1977) Two new and one known species of parasitic copepods of the *Anchistrotos* Brian, 1906 genus (Cyclopoida, Taeniacanthidae) from the Indian Ocean. *Izvestiya Tikhookeanskogo Nauchno-Issle-dovatelskogo Instituta Rybnogo Khozyaistva i Okeanografii*, 101, 132–138. [in Russian with English summary]

Boxshall, G.A. & Halsey, S. H. (2004) *An Introduction to Copepod Diversity.* The Ray Society, London, 966 pp.

Cressey, R.F. (1969) Five new parasitic copepods from California inshore fish. *Proceedings of the Biological Society of Washington*, 82, 409–428.

Dojiri, M. & Cressey, R.F. (1987) Revision of the Taeniacanthidae (Copepoda: Poecilostomatoida) parasitic on fishes and sea urchins. *Smithsonian Contributions to Zoology*, 447, 1–250.

Gurney, R. (1927) Report on the Crustacea Copepoda (littoral and semi-parasitic). *Transactions of the Zoological Society of London*, 22, 451–577.

Ho, J.S. (1972) Copepod parasites of California halibut, *Paralichthys californicus* (Ayers), in Anaheim Bay, California. *Journal of Parasitology*, 58, 993–998.

Humes, A.G. & Gooding, R.U. (1964) A method for studying the external anatomy of copepods. *Crustaceana*, 6, 238–240.

Huys, R & Boxshall, G.A. (1991) *Copepod Evolution*. The Ray Society, London, 468 pp.

Izawa, K. (1986) On the development of parasitic Copepoda. IV. Ten species of poecilostome cyclopoids, belonging to Taeniacanthidae, Tegobomolochidae, Lichomolgidae, Philoblennidae, Myicolidae, and Chondracanthidae. *Publication of the Seto Marine Biological Laboratory*, 31, 81–162.

Montú, M.A. & Boxshall, G.A. (1997) A new species of *Taeniastrotos* Cressey (Copepoda: Poecilostomatoida) from southern Brazil. *Systematic Parasitology*, 36, 109–114.

Yamaguti, S. (1939) Parasitic copepods from fishes of Japan. Part 4. Cyclopoida, II. *Volumen Jubilare Pro Professor Sadao Yoshida*, 11, 391–415.

