

# Two new copepod species of the genus *Pseudotaeniacanthus* Yamaguti and Yamasu, 1959 (Poecilostomatoida: Taeniacanthidae), parasitic on moray eels in the Red Sea

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**Abstract:** Two new species of *Pseudotaeniacanthus*, *P. margolisi* n.sp. and *P. septemsetigerus* n.sp. (Copepoda, Poecilostomatoida, Taeniacanthidae), described and illustrated herein, are parasitic on the gills of unidentified species of moray eels (family Muraenidae) in the Gulf of Aqaba, Red Sea. *Pseudotaeniacanthus margolisi* differs from its closest congener in armature of the terminal segment of its fourth exopod and unique sexually dimorphic armature of its second leg. *Pseudotaeniacanthus septemsetigerus* is distinguished by the armature of its endopods, as well as by the proportions and armature of its caudal rami. A revised key to the species of the genus is appended.

**Résumé :** Deux nouvelles espèces de *Pseudotaeniacanthus*, *P. margolisi* n.sp. et *P. septemsetigerus* n.sp. (Copepoda : Poecilostomatoida : Taeniacanthidae), décrites et illustrées ici, parasitent les branchies d'espèces non identifiées de murènes (Muraenidae) dans le golfe d'Aqaba, en mer Rouge. Le *Pseudotaeniacanthus margolisi* diffère de son congénère le plus proche par l'armature du segment terminal de son quatrième exopodite et par le caractère particulier du dimorphisme sexuel de l'armature de sa deuxième patte. Le *Pseudotaeniacanthus septemsetigerus* se distingue par l'armature de ses endopodites ainsi que par les proportions et l'armature de ses rames caudales. On trouve en annexe une clé révisée des espèces du genre.

[Traduit par la Rédaction]

The genus *Pseudotaeniacanthus* Yamaguti and Yamasu, 1959, comprises five species of very small copepods, all parasitic on the gills of anguilliform fishes. The species are: *P. congeri* Yamaguti and Yamasu, 1959; *P. coniferus* Dojiri and Cressey, 1987; *P. longicauda* Pillai and Hameed, 1974; *P. muraenosocis* Uma Devi and Shyamasundari, 1980; and *P. puhii* Lewis, 1967. Lewis (1968) described also an unnamed male *Pseudotaeniacanthus*, which he found on *Acanthurus gahhm* (= *A. nigricans*), a perciform fish unrelated to anguilliforms. As a genus, *Pseudotaeniacanthus* is distinguished from its taeniacanthid confamilials by its unique rostral sclerites, Y-shaped, richly equipped with transverse rows of hooklets (or ridges), and in some species also with well-developed furca.

Judging from the fact that hitherto described species of *Pseudotaeniacanthus* are widespread among anguilliform fishes (members of four families: Congridae, Muraenidae, Muraenosocidae and Ophichthidae) and that their geographic range also appears extensive (Hawaii, Japan, India, and the Red Sea), it is easy to conjecture that more species

of this genus are yet to be discovered. Their elusiveness is attributable to the relative inaccessibility of their hosts.

Examining the gills of unidentified moray eels (family Muraenidae), captured in the Gulf of Aqaba, Red Sea, in 1974, Dr. Ilan Paperna found some pseudotaeniacanthids, which he kindly sent us for examination. We were unable to place them in any of the previously known five species and are thus compelled to establish for them two new taxa, which herein are described and incorporated in a revised key to the genus.

Owing to the small size of these copepods, most of the handling and examinations had to be carried out under compound microscope. The study of the mouth parts required oil immersion lens. Berlese's fluid was used as a clearing agent and mounting medium. Drawings were made with the aid of a drawing tube. The excellent compendium of Dojiri and Cressey (1987) proved invaluable in our studies. We also consulted papers by Lewis (1967, 1968), Pillai and Hameed (1974), and Uma Devi and Shyamasundari (1980).

## Descriptions

*Pseudotaeniacanthus margolisi* n.sp. Figs. 1–19  
*Record of specimens:* Twenty five females and 11 males were taken by Dr. I. Paperna on 24 April 1974. A holotype female is deposited in the collections of the Smithsonian Institution (USNM cat. No 259705); an allotype male is

Received February 12, 1994. Accepted May 19, 1994  
 J12492

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deposited in the same collection (USNM cat. No. 259706), as are 15 paratype females and 10 paratype males (USNM cat. No. 259707).

*Host*: Unidentified moray eel (family Muraenidae).

*Location*: Gills.

*Locality*: Gulf of Aqaba, Red Sea.

*Etymology*: The specific name honors Dr. Leo Margolis of the Pacific Biological Station, Nanaimo, B.C.

### Female (Fig. 1)

Cephalothorax wider than long, rounded anteriorly, with projecting, pointed, posterolateral corners and slightly concave posterior margin. Segmental boundaries between second and third, as well as third and fourth pedigerous segment not very distinct; second pedigerous segment about as long and wide as cephalothorax, third shorter, both with concave posterior margins; fourth narrower than preceding two, wider than long, suboval; fifth small, wider than long, with lateral papilliform processes forming bases of fifth legs; genital complex wider than long. Abdomen four-segmented, segments tapering caudad. Dimensions (in  $\mu\text{m}$ , based on nine specimens): total length 1122 (1030–1223); prosome length 714 (640–798), width 435 (394–492); genital complex length 90 (78–104), width 155 (129–172); abdomen length 408 (346–459), width 161 (123–196), caudal rami length 28 (24–31), width 28 (25–30).

First antenna (Fig. 2) six-segmented, boundaries between second and third segment indistinct; setal formula 6, 11, 7, 3, 2 + aesthete, 7 + aesthete. Second antenna (Fig. 3) four-segmented, with cubital joint between first and second segment; first segment with small seta at distal border, second with long, slender seta in distal half, third with row of spinules along outer margin, unciform spine and two pectinate processes at distal border, fourth with three setae and four claw-like spines at apex. Rostral area (Fig. 4) with Y-shaped sclerite, upper arms of Y bearing 11–12 transverse rows of spinules. Labrum membranous, without ornamentation. Mandible (Fig. 5) with two distal blades denticulated along one margin. Paragnath not observed. First maxilla (Fig. 6) small, lobate, with two long and three short setae, all unarmed. Second maxilla not observed. Maxilliped (Fig. 7) apparently three-segmented, basal segment (corpus) robust, bearing long unarmed seta, second segment fused with third, latter with two subequal, subapical setae.

Four pairs of biramous legs, all rami (except for two-segmented first exopod) three-segmented. Armature of rami as shown below:

	Exopod			Endopod		
	1	2	3	1	2	3
First leg	1–0	10	—	0–1	0–1	5
Second leg	1–0	I–1	III, 5	0–1	0–2	I, 4
Third leg	1–0	I–1	III, 5	0–1	0–2	I, 4
Fourth leg	1–0	I–1	III, 5	0–1	0–1	III

First leg (Fig. 8) with membranous fringe along lateral margin of sympod; segmentation of exopod indistinct. Second and third legs identical (Fig. 9), with short rows

of needle-like spinules along distal margins of coxa and basis, fringes of spinules on lateral margins (except for basal segment of endopod, with fringe of fine setules), additional longitudinal rows of spinules on three segments of endopod; exopod spines with spinulated margins and whip-like tips, but distalmost spine semipinnate. Fourth leg differing from preceding two in having one seta less on second segment of endopod, as well as in armature of distal segment of that ramus (Fig. 10). Fifth leg (Fig. 11) two-segmented, uniramous, basal segment with short pinnate seta in distolateral corner, second segment with four naked setae at distal margin, row of fine spinules on distal half of medial margin and close to posterior margin. Sixth leg (Fig. 12) small, papilliform, with two longer and one very short naked setule. Caudal ramus (Fig. 13) subquadrate, bearing five setae, four on distal margin (second and third counting from medial side much longer than first and fourth), fifth seta short, distolateral.

### Male (Fig. 14)

Cephalothorax about equally long and wide, with rounded anterior and slightly concave posterior margin, with rounded posterolateral corners. Second pedigerous segment wider than cephalothorax, wider than long, with concave posterior margin; third narrower than second, fourth narrower than third, with convexly rounded posterior margin, fifth much smaller than fourth, wider than long. Genital complex subquadrate. Abdomen four-segmented, segments subquadrate, narrowing caudad. Dimensions (in  $\mu\text{m}$ , based on five specimens): total length: 1075 (991–1207); prosome length 666 (605–731), width 414 (372–448); genital complex length 100 (83–122), width 139 (131–146); abdomen length 410 (362–476), width 140 (101–150); caudal rami length 33 (30–36), width 28 (26–31).

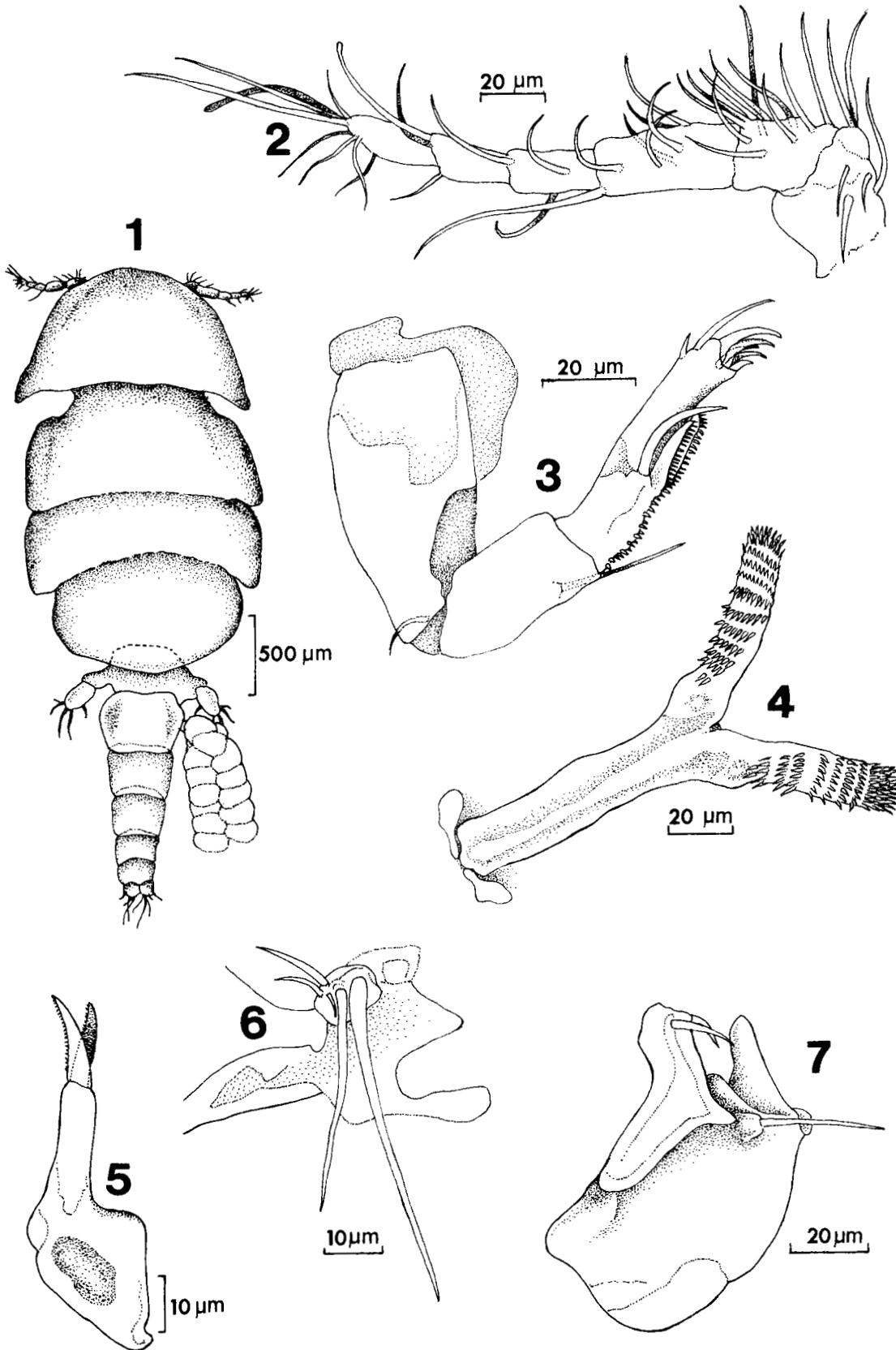
Antennae and rostral sclerite as in female. Mandible (Fig. 15) differing from female appendage in having only one unarmed terminal blade and one subterminal, slender but stiff seta. Other buccal appendages as in female, but second maxilla not found. Maxilliped (Fig. 16) four-segmented, basal segment narrowing distally, with one long seta near mid-length; second segment (corpus) with powerful myxal outgrowth, concave at apex, bearing corrugated patch and two setae; third very small, unarmed; distal uncinatate claw with truncated tip and two setae on proximal half.

First four pairs of legs as in female, but with enlarged spines of second exopod (Fig. 17), spine of first segment with spinulated margins, remaining four spines unarmed, but with whip-like tips. Fifth leg (Fig. 18) with all setae naked and only short row of spinules in distolateral corner. Sixth leg (Fig. 19) represented by single seta. Caudal ramus as in female.

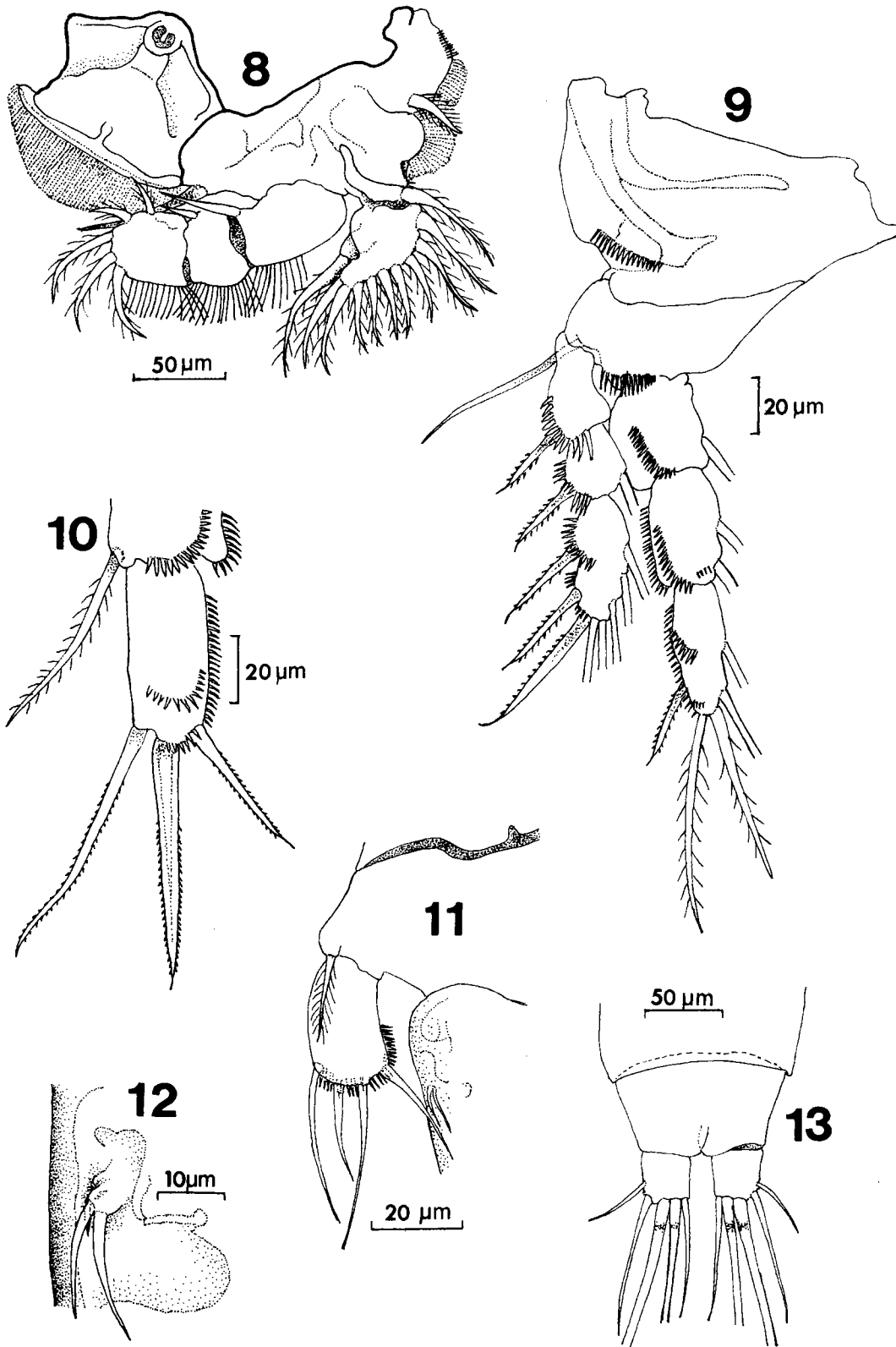
### Comments

To establish specific identity of this species one must compare it with those of its congeners, with which it shares the following characteristics: (i) rostral sclerite with rows of spinules but without furca and (ii) subquadrate caudal ramus bearing five setae. Only one such species is known at present: *Pseudotaeniocanthus puhii* Lewis, 1967. The first

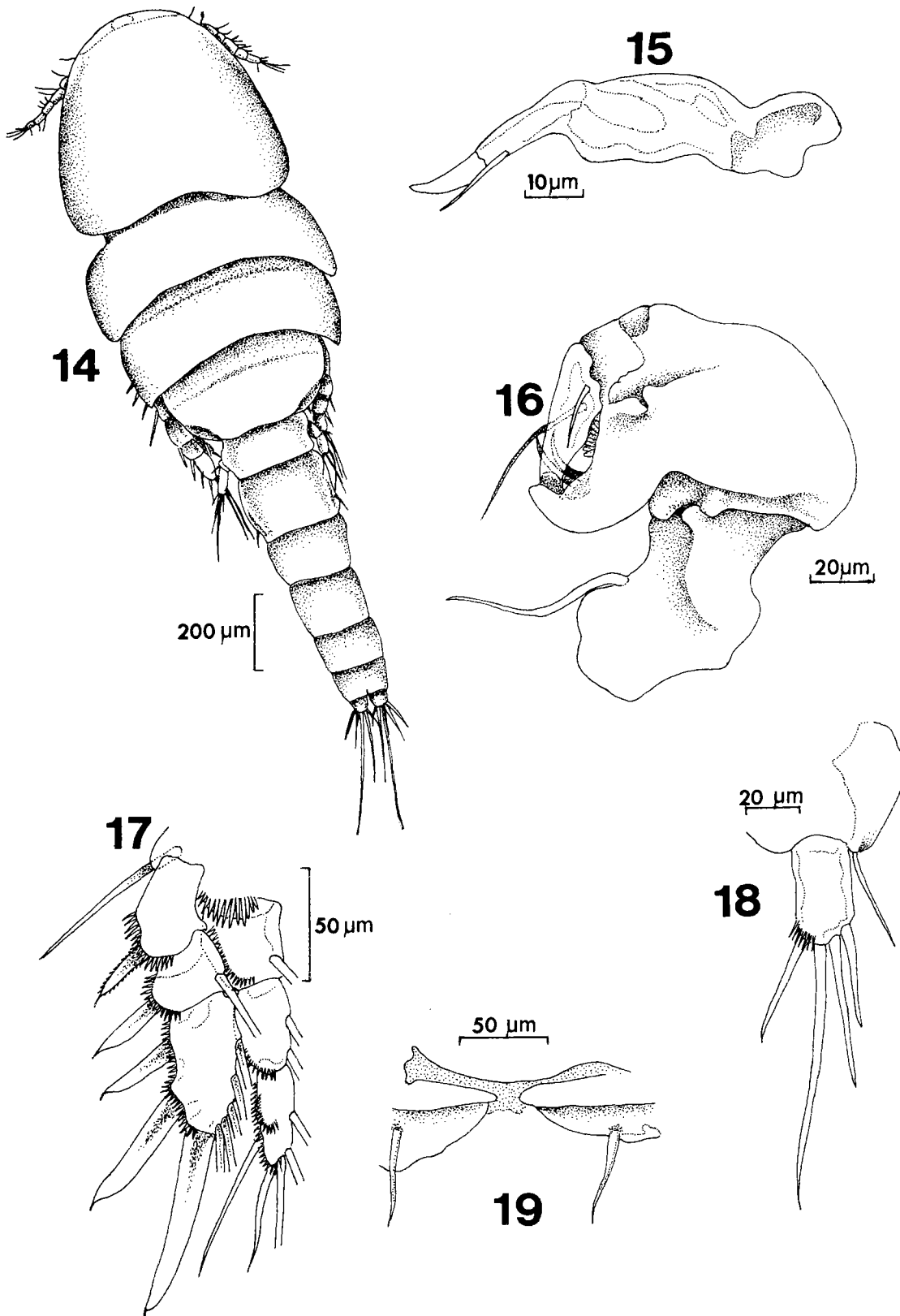
**Figs. 1–7.** *Pseudotaeniacanthus margolisi* n.sp. Fig. 1. Female, entire, dorsal. Fig. 2. First antenna, ventral. Fig. 3. Second antenna, ventral. Fig. 4. Rostral sclerite, ventral. Fig. 5. Mandible, ventral. Fig. 6. First maxilla, ventral. Fig. 7. Maxilliped, ventral.



**Figs. 8–13.** *Pseudotaeniacanthus margolisi* n.sp. Fig. 8. First leg, anterior. Fig. 9. Second leg, anterior. Fig. 10. Fourth leg, distal half of endopod, anterior. Fig. 11. Fifth leg, ventral. Fig. 12. Sixth leg, ventral. Fig. 13. Caudal rami and extremity of abdomen, ventral.



**Figs. 14–19.** *Pseudotaeniacanthus margolisi* n.sp. Fig. 14. Male, entire, dorsal. Fig. 15. Mandible, ventral. Fig. 16. Maxilliped, ventral. Fig. 17. Rami of second leg, anterior. Fig. 18. Fifth leg, ventral. Fig. 19. Sixth leg, ventral.



obvious difference between these two species is in their habitus; *P. puhi* is more slender than the specimens described above. The rostral sclerite of *P. puhi* bears 9–10 transverse rows of spinules on its diverging arms, that of *P. margolisi* bears 11–12. The two species differ also in some details of the armature of the second to fourth legs. Terminal setae of the fifth leg of *P. puhi* are pinnate, those of *P. margolisi* are unarmed. Finally, the armature of the second leg of *P. margolisi* shows sexual dimorphism unique for the genus. Enlarged spines of the exopod of this leg occur in the male, but not in the female of this species. In *P. puhi* they are enlarged in both sexes.

In view of these differences, we deem it justifiable to accord to *P. margolisi* the status of an independent taxon.

It should also be noted that in spite of assiduous search in several specimens we were unable to locate the second maxilla of this species, although this appendage is usually easier to see than the first maxilla, which we did find without difficulty. While our inability to find it might be attributable to our inadequate powers of observation, it is at least possible that *P. margolisi* is devoid of the second maxilla. Its absence would make this species unique in its genus. The fact that the absence of the second maxilla could not be established beyond doubt prompted us to exclude this apparent characteristic from the key to the species of the genus.

***Pseudotaeniacanthus septemsetigerus* n.sp.** Figs. 20–34

**Record of specimens:** Thirteen females were taken by Dr. I. Paperna on 24 April 1974. A holotype female is deposited in the collections of the Smithsonian Institution (USNM cat. No. 259708); eight paratype females (USNM cat. No. 259709) are deposited in the same collection.

**Host:** Unidentified moray eel (family Muraenidae)

**Location:** Gills.

**Locality:** Gulf of Aqaba, Red Sea.

**Etymology:** The specific name combines two Latin words, *septem* = seven, and *setigerus* = bearing setae. It alludes to the presence of seven setae on the caudal rami of this species.

**Female (Fig. 20)**

Cephalothorax wider than long, rounded at anterior end, with bluntly subtriangular posterolateral corners (in Fig. 20 damage in the left anterolateral corner area indicated by an arrow). Second pedigerous segment about as wide as cephalothorax, its length less than half its width; third segment narrower but equally short; fourth suboval, narrower than third; fifth small, wider than long; genital complex subquadrate. Abdomen four-segmented, segments subquadrate, narrowing caudad. Dimensions (in  $\mu\text{m}$ , based on five specimens): total length 1441 (1323–1516); prosome length 929 (849–982), width 605 (577–620); genital complex length 125 (108–144), width 208 (186–236); abdomen length 541 (474–608), width 245 (221–276); caudal rami length 51 (49–57), width 34 (32–37).

First antenna (Fig. 21) six-segmented, indistinct boundaries between first three segments, with geniculate flexion between first and second segments; setal formula 6, 10, 7, 3, 2 + aesthete, 7 + aesthete. Second antenna (Fig. 22)

apparently three-segmented (terminal segment probably representing fused third and fourth), with cubital joint between first and second segment, each bearing single seta; terminal segment with denticulated inner margin, two pectinate processes denticulated on one margin and unciform claw at midlength, four claw-like spines and two setae at apex. Rostral sclerite (Fig. 23) without furca, bearing seven rows of hooklets on each anterior divergent branch. Labrum membranous, its rounded posterior margin bearing row of spinules, labial area unarmed. Mandible (Fig. 24) with distal half flexed caudad and two terminal blades denticulated along posterior margins. Paragnath (Fig. 25) roughly semicircular, with crescentic row of denticles close to apex. First maxilla (Fig. 26) small lobe, with two long setae bearing minute denticles, and two short setules. Second maxilla (Fig. 27) two-segmented, basal segment robust, second slender, tipped with acuminate blade and short, unarmed seta. Maxilliped (Fig. 28) three-segmented, basal segment bearing long naked seta, second unarmed, third very small, conical, with two long subequal setae, one apical and one subapical.

Four pairs of biramous legs, all rami (except for two-segmented first exopod) three-segmented. Armature of rami as shown below:

	Exopod			Endopod		
	1	2	3	1	2	3
First leg	1-0	10	—	0-1	0-1	5
Second leg	I-0	I-1	III, 5	0-1	0-2	I, 4
Third leg	I-0	I-1	III, 5	0-1	0-2	I, 4
Fourth leg	I-0	I-1	III, 5	0-1	0-1	III

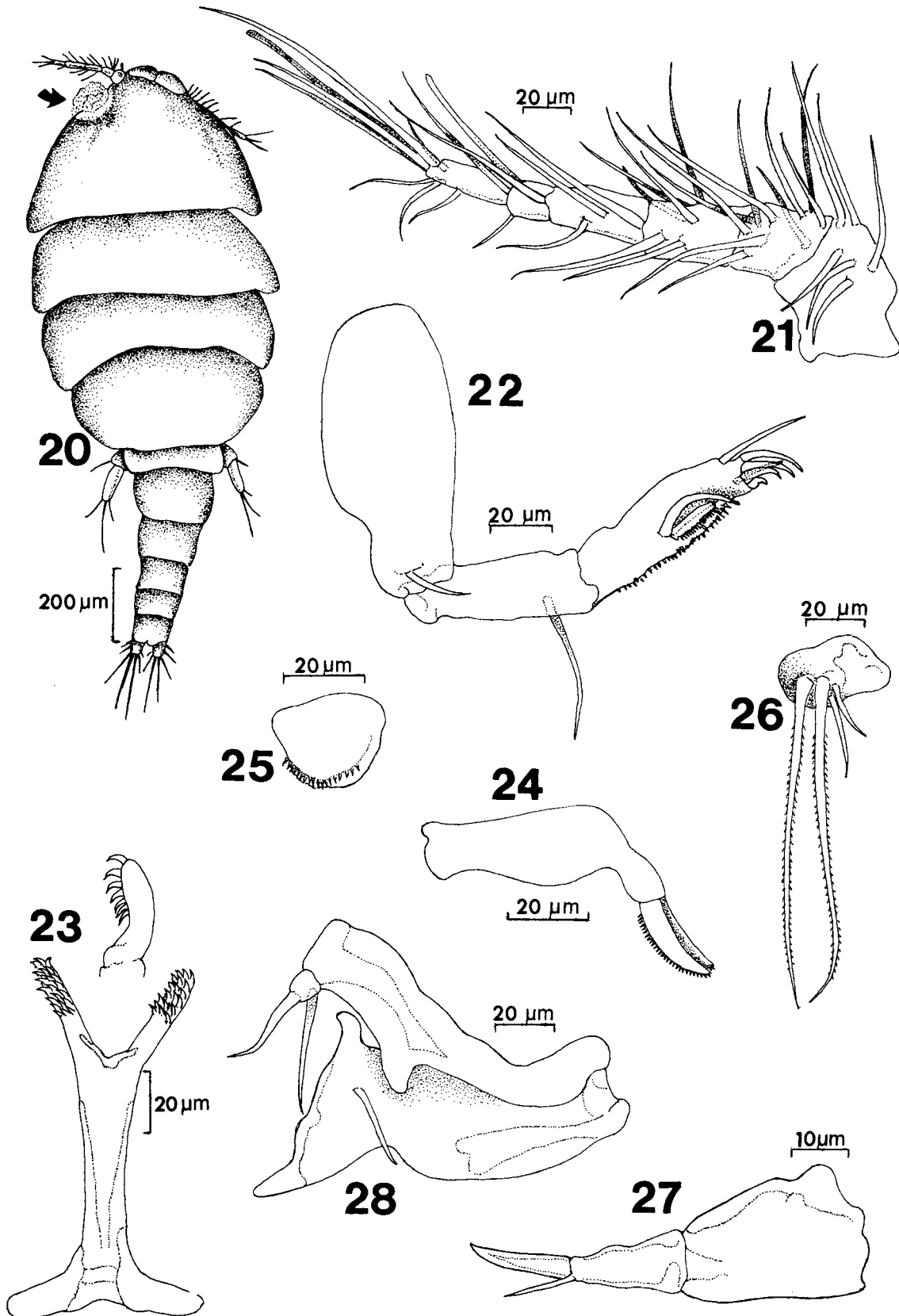
Segmentation of first exopod indistinct (Fig. 29). First leg with fringe of spiniform setules along lateral margin, except in its distal part with membrane and fine setules. Second and third legs identical (Fig. 30), with fringes of spiniform setules on lateral margins of all exopod and distal endopod segments; first two endopod segments with fringes of fine setules; rows of spiniform setules also on ventral surfaces of distal exopod segment and all three endopod segments; exopod spines with rows of fine spinules on margins. Fourth leg (Fig. 31) differing from preceding two in having one seta less on second segment of endopod, as well as in armature of its distal segment. Fifth leg (Fig. 32) two-segmented, uniramous, first segment with pinnate seta in distolateral corner, second with four such setae on distal margin and two short rows of spinules in distolateral corner and close to distal margin. Sixth leg (Fig. 33) represented by three short naked setae. Caudal rami (Fig. 34) bearing seven setae; two on lateral margin, one close to medial margin, four on distal margin (two central ones much longer than other two).

**Male: Unknown**

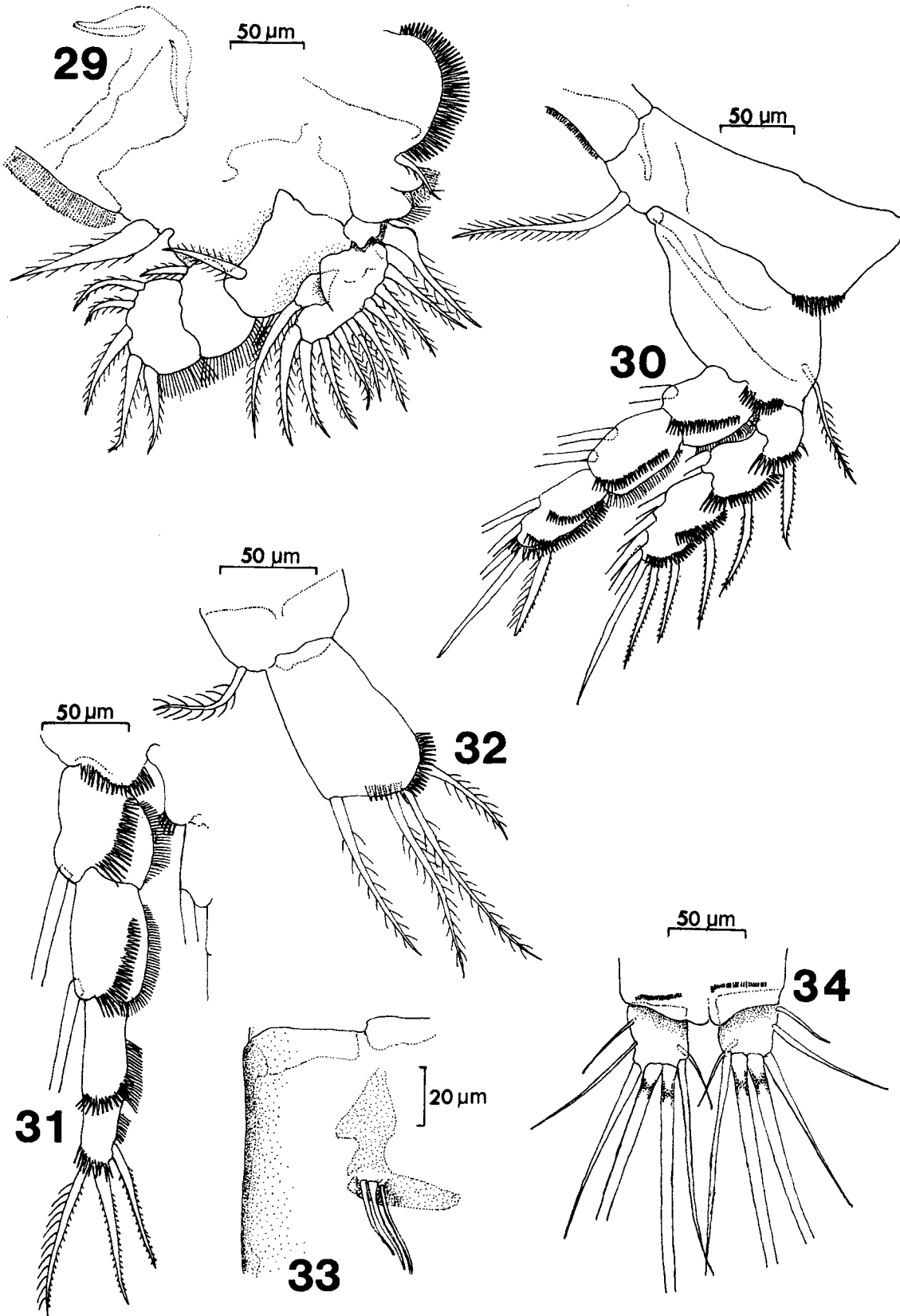
**Comments**

The presence of seven setae on the caudal rami of this species (Fig. 34) distinguishes it from all other species of *Pseudotaeniacanthus*, except *P. longicauda*. That species,

**Figs. 20–28.** *Pseudotaeniacanthus septemsetigerus* n.sp. Fig. 20. Female, dorsal (damaged area indicated by arrow). Fig. 21. First antenna, ventral. Fig. 22. Second antenna, ventral. Fig. 23. Rostral sclerite, ventral. Fig. 24. Mandible, ventral. Fig. 25. Paragnath, ventral. Fig. 26. First maxilla, ventral. Fig. 27. Second maxilla, ventral. Fig. 28. Maxilliped, ventral.



**Figs. 29–34.** *Pseudotaeniacanthus septemsetigerus* n.sp. Fig. 29. First leg, anterior. Fig. 30. Second leg, anterior. Fig. 31. Fourth leg, endopod, anterior. Fig. 32. Fifth leg, ventral. Fig. 33. Sixth leg, ventral. Fig. 34. Caudal rami, ventral.





however, has caudal rami almost as long as the terminal segment of the abdomen, whereas the length of these structures in *P. septemsetigerus* does not exceed twice their own width; i.e., they are much shorter than the terminal segment of the abdomen. The two species differ from each

other also in the setation of the second, third and fourth endopods. These characteristic differences, as well as differences in general habitus, suffice to postulate for *P. septemsetigerus* the status of an independent taxon.

#### Key to the species of *Pseudotaeniacanthus*

1. Caudal rami bearing five setae . . . . . 2  
Caudal rami bearing more than five setae . . . . . 4
2. Rostral sclerite with rows of hooklets and furca . . . . . *P. muraenosocis*  
Rostral sclerite with rows of hooklets, furca absent . . . . . 3
3. Terminal segment of fourth exopod with three spines; exopod spines enlarged in males only . . . *P. margolisi*  
Terminal segment of fourth exopod with one spine and two pinnate setae; exopod spines enlarged in both sexes . . . . . *P. puhi*
4. Caudal rami bearing six setae . . . . . 5  
Caudal rami bearing seven setae . . . . . 6
5. Prosome shorter than urosome; length of caudal ramus more than five times greater than its width . . . . . *P. coniferus*  
Prosome slightly longer than urosome; length of caudal ramus not exceeding twice its width . . . *P. congeri*
6. Prosome shorter than urosome, length of caudal ramus more than four times greater than its width . . . . . *P. longicauda*  
Prosome longer than urosome, length and width of caudal ramus subequal . . . . . *P. septemsetigerus*

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