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Parasitic copepods of the family Taeniacanthidae (Crustacea) from triggerfishes (Teleostei, Balistidae) and filefishes (Teleostei, Monacanthidae) collected in the Indo-West Pacific region, with descriptions of two new species of *Taeniacanthus* Sumpf, 1871

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Abstract

Two new species of *Taeniacanthus* Sumpf, 1871 (Copepoda, Taeniacanthidae) are described from filefishes (Monacanthidae) caught in the Indo-West Pacific region: *T. brayae* **n. sp.** from *Pervagor melanocephalus* (Bleeker) collected from five localities within the Central Indo-Pacific realm and *T. mcgroutheri* **n. sp.** from *Monacanthus chinensis* (Osbeck) and *Paramonacanthus choirocephalus* (Bleeker) caught off the Australian coast. *Taeniacanthus brayae* **n. sp.** and *T. mcgroutheri* **n. sp.** are distinguished from their congeners by the presence of an elongate terminal endopodal segment of the antenna, a spinulated terminal process and one seta on the maxillary basis, six elements on the terminal exopodal segment of legs 2–4 and an armature of II, I, 2 and II, I, 1 on the terminal endopodal segments of legs 2 and 3, respectively. *Taeniacanthus brayae* **n. sp.** can be readily distinguished from *T. mcgroutheri* **n. sp.** by having one row (rather than multiple rows) of spinules on the large pectinate process of the antenna, four setae (rather than three) on the maxillule and a 3-segmented (rather than 2-segmented) endopod on legs 2–4. New host and/or locality records for the taeniacanthids *Cirracanthus monacanthi* (Yamaguti, 1939), *C. spinosus* Dojiri & Cressey, 1987, *Nudisodalis acicula* Dojiri & Cressey, 1987 and *Taeniacanthus aluteri* (Avdeev, 1977) parasitic on triggerfishes and filefishes, as well as supplementary morphological information for the females and the first descriptions of the males of *C. monacanthi*, *C. spinosus* and *N. acicula*, are also included.

Key words: Copepoda, Tetraodontiformes, host-specificity, ectoparasite

Introduction

Representatives of the tetraodontiform fish families Balistidae (triggerfishes) and Monacanthidae (filefishes) occur in the Atlantic, Indian and Pacific Oceans (Nelson 2006). The former family contains 12 genera and 42 species whilst the latter comprises 26 genera and 106 species (Froese & Pauly 2011). Although both families are speciose, fewer than 25 triggerfish and filefish species combined are known to host only seven parasitic copepod species from the family Taeniacanthidae C. B. Wilson, 1911. These are: *Cirracanthus monacanthi* (Yamaguti, 1939) from the monacanthids *Monacanthus chinensis* (Osbeck), *Stephanolepis cirrhifer* (Temminck & Schlegel), *S. setifer* Bennett and *Stephanolepis* sp.; *C. spinosus* Dojiri & Cressey, 1987 from the monacanthid *Chaetodermis penicilligerus* (Cuvier); *Nudisodalis acicula* Dojiri & Cressey, 1987 from the monacanthid *Pervagor spilosoma* (Lay & Bennett) (as *P. spilosomus*); *Taeniacanthus aluteri* (Avdeev, 1977) from "*Alutera seriola*" and the balistid *Abalistes stellatus* (Anonymous); *T. balistae* (Claus, 1864) from the balistids *Balistes capriscus* Gmelin (as *Balistes carolin-*

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ensis), *B. vetula* Linnaeus, *Balistes* sp. and *Canthidermis maculata* (Bloch) and the monacanthids *Aluterus heudelotii* Hollard (as *Alutera heudelotii*), *A. monoceros* (Linnaeus) (as *Alutera monoceros*), *Aluterus* sp. (as *Alutera* sp.), *Cantherhines pullus* (Ranzani), *Stephanolepis hispidus* (Linnaeus), *S. setifer* and *Thamnaconus modestoides* (Barnard) (as *Cantherhines modestus*); *T. occidentalis* (C. B. Wilson, 1924) from the monacanthids *Aluterus heudelotii* (as *Alutera heudelotii*) and *A. schoepfi* (Walbaum) (as *Alutera schoepfi*); and *T. similis* Dojiri & Cressey, 1987 from the monacanthids *Aluterus scriptus* (Osbeck) (as *Alutera scripta*), *Meuschenia australis* (Donovan) (as *Meuschenia convexirostris*) and *Meuschenia hippocrepis* (Quoy & Gaimard) (as *Cantherhines hippocrepis*) (Dojiri & Cressey 1987; Dojiri & Ho 1987; Lin & Ho 2006; Ho & Lin 2007). In this study we describe two new copepod species in the genus *Taeniacanthus* Sumpf, 1871 collected from filefishes captured in the Indo-West Pacific region. New host and/or locality records for *C. monacanthi*, *C. spinosus*, *N. acicula* and *T. aluteri*, as well as ancillary morphological information for the females and the first descriptions of the males of *C. monacanthi*, *C. spinosus* and *N. acicula*, are also provided.

Material and methods

Freshly caught fish samples off Okinawa-jima Island, Okinawa Prefecture, Japan, were obtained by spear fishing, while those from the Seto Inland Sea (off Imabari and Itsukaichi, Japan), the western North Pacific Ocean (off Tosasaga, Japan), the Sulu Sea (Philippines) and Thailand were purchased at fishing ports. Preserved triggerfish and filefish specimens accessioned at the Western Australian Museum (WAM), Perth, Australia; Australian Museum (AM), Sydney, Australia; Museum and Art Gallery of the Northern Territory (MAGNT), Darwin, Australia; California Academy of Sciences (CAS), San Francisco, U.S.A.; Natural History Museum of Los Angeles County (LACM), Los Angeles, U.S.A. and the Faculty of Science of the University of the Ryukyus (URM), Nishihara, Japan were also inspected for parasitic copepods. Copepods were removed from the hosts with fine forceps and preserved in 70% ethanol. Type material of *Cirracanthus spinosus* Dojiri & Cressey, 1987 and *Nudisodalis acicula* Dojiri & Cressey, 1987 were also borrowed from the National Museum of Natural History (USNM), Smithsonian Institution, U.S.A., for comparative purposes.

Preserved copepod specimens were soaked in lactic acid for a minimum of 24 h prior to examination using an Olympus SZ60 dissection microscope and Olympus BX50 compound microscope. Selected specimens were measured intact using an ocular micrometer and/or dissected and examined according to the wooden slide procedure of Humes & Gooding (1964). Measurements given are the mean. Selected intact specimens and dissected appendages were also drawn with the aid of a drawing tube. Morphological terminology follows Dojiri & Cressey (1987) and Huys & Boxshall (1991), fish names conform to FishBase (Froese & Pauly 2011) and biogeographic realms of the Indo-West Pacific (IWP) region used herein follow those of Spalding *et al*. (2007).

Type and/or voucher material is deposited at WAM, AM, MAGNT, LACM, CAS and the National Museum of Nature and Science (NSMT), Tokyo, Japan.

Results

Family Taeniacanthidae C. B. Wilson, 1911

Genus *Cirracanthus* Dojiri & Cressey, 1987

Cirracanthus monacanthi (Yamaguti, 1939)
(Figs 1–2)

Taeniacanthus monacanthi Yamaguti 1939: 402; Shiino 1959: 372; Yamaguti 1963: 21.
Cirracanthus monacanthi: Dojiri & Cressey 1987: 153; Dojiri & Ho 1987: 42.

Material examined. 1 ♀ (WAM C38638), ex *Chaetodermis penicilligerus* (Cuvier) (WAM P.31950.001), Point Quobba, Western Australia, Australia, 13 April 1976; 1 ♀ (AM P65262), ex *Meuschenia trachylepis* (Günther) (AM I42573-008), Port Stephens, New South Wales, Australia, 20 January 2000; 1 ♀ (NSMT-Cr 21648), ex *Monacanthus chinensis* (Osbeck), Seto Inland Sea, Imabari, Ehime Prefecture, Japan, August 2005; 5 ♀, 1 ♂ and 1 copepodid (WAM C38643, C38711–C38712), ex 3 *M. chinensis* (WAM P.2139.001), Shark Bay, Western Australia, Australia, 1940; 25 ♀, 9 ♂ and 9 copepodids (WAM C38673–C38674, C38735), ex 2 *M. chinensis* (WAM P.25095.025), Exmouth Gulf, Western Australia, Australia, October 1974; 5 ♀ (AM P65266), ex 1 *M. chinensis* (AM I41214-001), Lake Macquarie, New South Wales, Australia, 1 February 2000; 1 ♀ (AM P65265), ex *M. chinensis* (AM I40864-011), White Bay, New South Wales, Australia, 17 May 2001; 1 ♀ (AM P65264), ex *M. chinensis* (AM I20754-022), Lizard Island area, Queensland, Australia, 8 February 1979; 1 ♀ and 1 ♂ (AM P65267), ex 1 *M. chinensis* (AM I41434-011), Port Hacking, New South Wales, Australia, 6 April 2000; 4 ♀ (AM P65263), ex 1 *M. chinensis* (AM IA7819), Melville Island, Northern Territory, Australia, 1938; 1 ♀ (AM P69680), ex *M. chinensis* (AM I20230-004), Cockburn Sound, Western Australia, Australia, 27 March 1978; 3 ♀ (CAS 175285), ex 1 *M. chinensis* (CAS 207327), Gulf of Thailand, 5 April 1960; 18 ♀ (CAS 175484), ex 1 *M. chinensis* (CAS 27547), Gulf of Thailand, 9 December 1968; 5 ♀ (CAS 175466), ex 1 *M. chinensis* (CAS 36124), Java Sea, 5 December 1975; 1 ♀ (MAGNT Cr014947), ex *M. chinensis* (MAGNT S.13273-005), Booby Island, Australia, 29 November 1991; 4 ♀ (MAGNT Cr014949), ex 1 *M. chinensis* (MAGNT S.12962-001), Arafura Sea, 26 October 1990; 2 ♀ (WAM C38679–C38680), ex 2 *Paramonacanthus arabicus* Hutchins (WAM P.32051.001), Persian Gulf, collection date unknown; 1 ♀ (WAM C38580), ex *Paramonacanthus choirocephalus* (Bleeker) (WAM P.12091.001), Shark Bay, Western Australia, Australia, 1960; 10 ♀, 1 ♂ and 2 copepodids (WAM C38625, C38693–C38694), ex 3 *P. choirocephalus* (WAM P.23426.001), Learmonth, Western Australia, Australia, June 1973; 11 ♀ and 2 copepodids (WAM C38559, C38629, C38639, C38719), ex 3 *P. choirocephalus* (WAM P.30239.003), Exmouth Gulf, Western Australia, Australia, 24 March 1991; 36 ♀, 1 ♂ and 4 copepodids (WAM C38579, C38612, C38647, C38689, C38701–C38702, C38754), ex 6 *P. choirocephalus*, Shark Bay, Western Australia, Australia, 1 March 2003; 8 ♀ and 3 ♂ (WAM C38569, C38627–C38628, C38642, C38690), ex 5 *P. choirocephalus*, Shark Bay, Western Australia, Australia, 6 March 2003; 1 ♀ (WAM C38615), ex *Paramonacanthus filicauda* (Günther) (WAM P.26220.002), Lacepede Island, Western Australia, Australia, 23 June 1978; 4 ♀ (WAM C38609, C38652), ex 2 *P. filicauda* (WAM P.26701.001), Bomparte Archipelago, Western Australia, Australia, 31 January 1979; 4 ♀ (AM P65270–P65271), ex 2 *P. filicauda* (AM I B2976), off Sydney, Australia, February 1953; 6 ♀ (AM P65272), ex 1 *P. filicauda* (AM I21831-026), Arafura Sea, 14 November 1980; 11 ♀ (1 damaged) (AM P65273), ex 1 *P. filicauda* (AM I 34389-021), Island Head entrance, Queensland, Australia, 25 October 1993; 4 ♀ (MAGNT Cr014955), ex 1 *P. filicauda* (MAGNT S.11794-007), North Cape Wessels, Northern Territory, Australia, 6 February 1986; 1 ♀ (MAGNT Cr014956), ex *P. filicauda* (MAGNT S.13361-002), Arafura Sea, 28 October 1990; 72 ♀ (4 damaged), 38 ♂ (2 damaged) and 16 copepodids (2 damaged) (WAM C38602, C38606, C38699–38700, C38727–C38731), ex 3 *Paramonacanthus japonicus* (Tilesius) (WAM P.32055.001), Sea of Japan, off Fukutsu, Fukuoka Prefecture, Japan, 13 September 1999; 10 ♀ (1 damaged) (MAGNT Cr014957), ex 1 *P. japonicus* (MAGNT S.12989-001), Arafura Sea, 2 November 1990; 1 ♀ (MAGNT Cr014958), ex *P. japonicus* (MAGNT S.13273-006), W. Booby Island, Queensland, Australia, 29 November 1991; 1 ♀ (MAGNT Cr014959), ex *P. japonicus* (MAGNT S.14363-005), NW Bassett-Smith Shoals, Western Australia, Australia, 12 June 1996; 10 ♀, 5 ♂ and 5 copepodids (AM P65275), ex 1 *Paramonacanthus otisensis* Whitley (AM I23883-001), Manly, New South Wales, Australia, 10 October 1976; 3 ♀ (AM P65274), ex 1 *P. otisensis* (AM E1608), Fraser Island, Queensland, Australia, 29 June 1910; 15 ♀ and 1 ♂ (AM P65277–P65279), ex 4 *P. otisensis* (AM I 25938-001), Point Quobba, Western Australia, Australia, April 1976; 1 ♀ and 1 copepodid (AM P65276), ex 1 *P. otisensis* (AM I33364-002), Iluka, New South Wales, Australia, 15 February 1991; 5 ♀ (NSMT-Cr 21649–21650), ex 2 *Stephanolepis cirrhifer* (Temminck & Schlegel), Seto Inland Sea, Itsukaichi, Hiroshima Prefecture, Japan, 11 November 2005; 8 ♀ (NSMT-Cr 21656–21657), ex 2 *S. cirrhifer*, Seto Inland Sea, Imabari, Ehime Prefecture, Japan, 1 May 2005; 3 ♀ (NSMT-Cr 21655), ex 1 *S. cirrhifer*, Seto Inland Sea, Imabari, Ehime Prefecture, Japan, August 2005; 4 ♀ (NSMT-Cr 21651), ex 1 *S. cirrhifer*, Seto Inland Sea, Imabari, Ehime Prefecture, Japan, 1 March 2006; 8 ♀ (NSMT-Cr 21654), ex 1 *S. cirrhifer*, western North Pacific Ocean, Tosasaga, Kochi Prefecture, Japan, 18 June 2007; 1 ♀ (WAM C38633), ex *S. cirrhifer* (WAM P.30260.020), Wakasa Bay, Japan, 10 November 1988; 1 ♀ (WAM C38649), ex *S. cirrhifer* (WAM P.30055.021), Wakasa Bay, Japan, August 1989; 24 ♀ (1 damaged) (WAM C38633, C38646, C38667–C38670, C38748), ex 4 *S. cirrhifer* (WAM P.30260.020), Wakasa Bay, Japan, 10 November 1988; 29 ♀ (MAGNT Cr014963–Cr014964, Cr014966–Cr014968), ex 5 *S. cirrhifer* (MAGNT S.12729-014), Wakasa Bay, Japan, 10 November 1987; 2 ♀ (CAS 175265), ex 1 *S. cirrhifer* (CAS 56599), Hong Kong, 20 August 1958; 2 ♀ (CAS 175300), ex from 1 *Stephanolepis hispidus* (Linnaeus) (CAS 31459), Cape Colony, South Africa, 1934; 7 ♀ (CAS 175276 and 175518), ex 2 *Stephanolepis setifer* (Bennett) (CAS 61084), Hong Kong fish market, 25 February 1958.

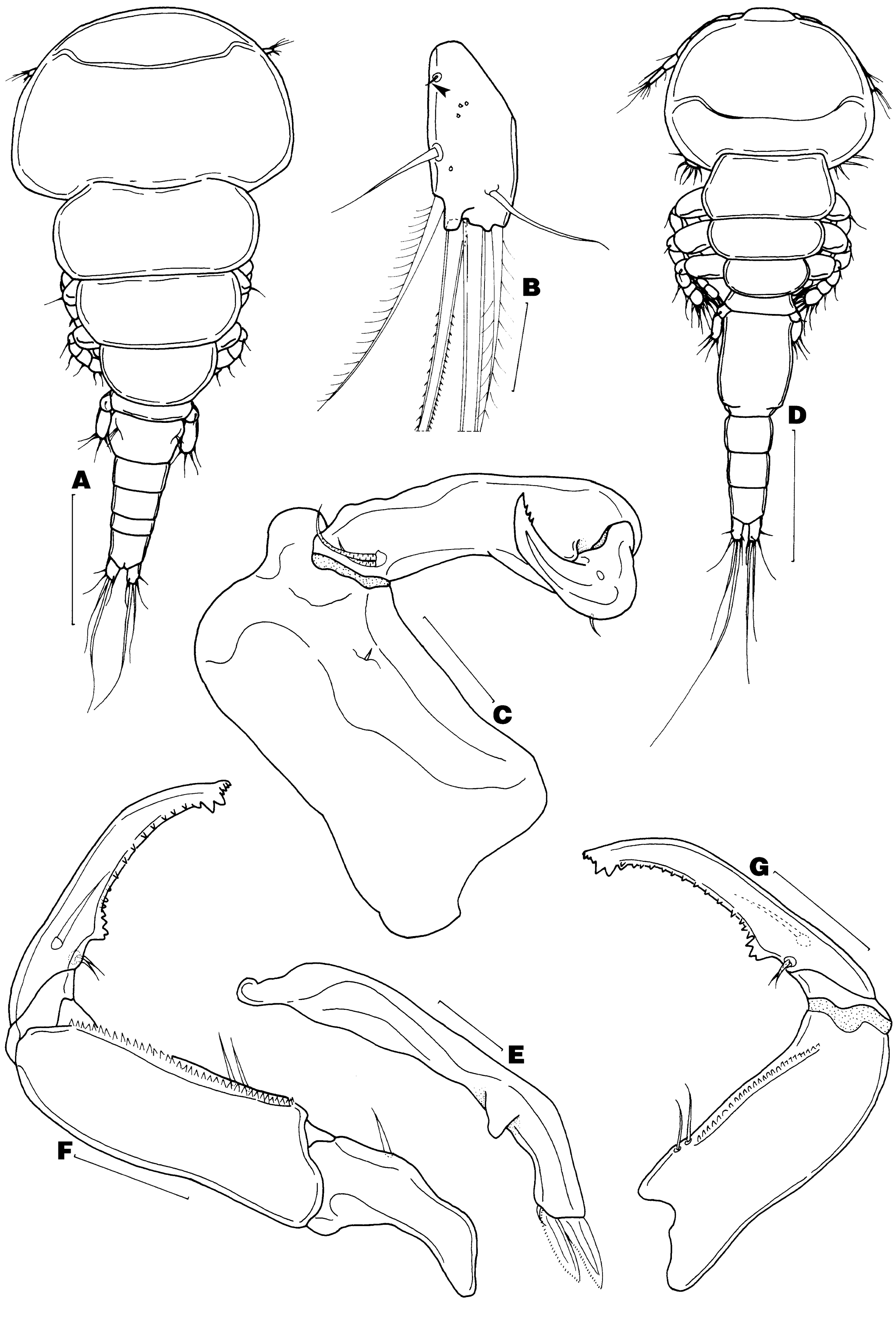

FIGURE 1. *Cirracanthus monacanthi* (Yamaguti, 1939), female (A–C) and male (D–G). (A) habitus, dorsal; (B) caudal ramus (seta I indicated by arrowhead), dorsal; (C) maxilliped, posteromedial; (D) habitus, dorsal; (E) mandible, anterior; (F) maxilliped, posterior; (G) same (syncoxa omitted), anterior. Scale bars: A = 0.25 mm; B–C, F–G = 25 µm; D = 0.15 mm; E = 12.5 µm.

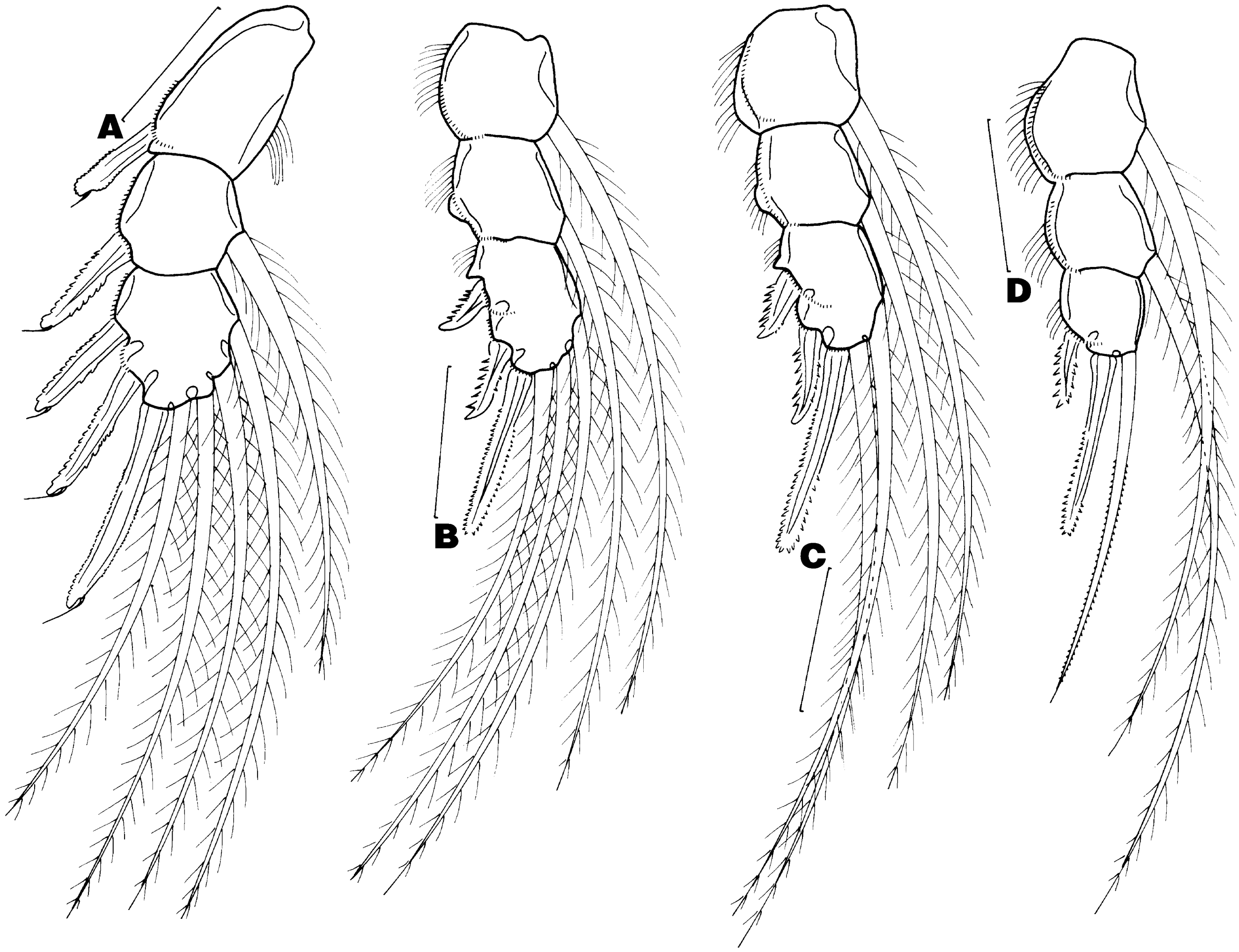

FIGURE 2. *Cirracanthus monacanthi* (Yamaguti, 1939), male. (A) leg 2 exopod, anterior; (B) leg 2 endopod, anterior; (C) leg 3 endopod, anterior; (D) leg 4 endopod, anterior. Scale bars: A–D = 25 µm.

Supplemental description of adult female. Body 1.14 mm long (excluding caudal setae) and 0.56 mm wide (n = 3) (Fig. 1A). Caudal ramus (Fig. 1B) with 7 setae (seta I minute) and posterodorsal flap. Some specimens with 3 accessory teeth and lacking basal knobs on third segment of maxilliped (Fig. 1C).

Description of adult male. Body 0.65 mm long (excluding caudal setae) and 245 µm wide (n = 8) (Fig. 1D). Second pedigerous somite 168 µm wide; remaining pedigerous somites decreasing in width posteriorly. Genital double-somite longer (110 µm) than wide (84 µm). Abdomen 126 µm long and 55 µm wide; composed of 3 free somites. Caudal ramus longer (29 µm) than wide (15 µm), bearing similar elements as in female.

Mandible (Fig. 1E) with 2 spinulate blades and small accessory seta. Maxilliped (Fig. 1F–G) 4-segmented; first segment (syncoxa) two-thirds length of second segment (basis), bearing naked medial seta; basis elongate, armed with 2 proximomedial setae and longitudinal row of spinules on posteromedial and anteromedial surfaces; first endopodal segment small, unarmed; second endopodal segment represented by elongate claw, bearing long seta on posterior surface, 2 subequal setae on anterior surface and row of denticles along concave margin (denticles larger at proximal and distal ends). Legs 2 and 3 exopodal spines (only leg 2 exopod illustrated – Fig. 2A) serrate along both margins, each bearing terminal flagellum. Spines on third endopodal segment of legs 2–4 (Fig. 2B–D) serrate.

Attachment site. Branchial cavity wall.

Remarks. This species was originally described as *Taeniacanthus monacanthi* from *Stephanolepis cirrhifer* (Temminck & Schlegel) captured in the Seto Inland Sea off Tarumi, Japan by Yamaguti (1939). Dojiri & Cressey (1987) transferred *T. monacanthi* to their newly erected genus *Cirracanthus* based on the redescription of material collected from *S. cirrhifer* from Japan and *Monacanthus chinensis* (Linnaeus) from Hong Kong. *Cirracanthus monacanthi* and *C. spinosus* Dojiri & Cressey, 1987 are the only valid members of this genus (see Discussion section below for further details).

The specimens in the present study conform to the descriptions and illustrations provided by Dojiri & Cressey (1987). However, some female specimens examined in this study lacked basal knobs and had three accessory teeth on the maxilliped claw rather than one or two basal knobs and one or two accessory teeth as reported by Dojiri & Cressey (1987). Female *C. monacanthi* differs from *C. spinosus* in the shape of the mandibular accessory element (pyriform process *vs*. attenuate seta), presence of a distal process on the maxilliped basis, armature of the third exopodal segment of leg 3 (II, I, 4 *vs*. II, I, 5), shape of the third endopodal spines of legs 2 and 3 (stout and blunt vs. attenuate), absence of a terminal flagellum on each exopodal spine of leg 4 and the ornamentation pattern on the free exopodal segment of leg 5 (rows *vs*. patches). Additional differences include the relative length of the row of denticles on the maxilliped claw (denticles extending from near the base to the tip *vs*. row of denticles not extending to tip) and relative lengths of the third endopodal spines of leg 3 (innermost spine longest of three *vs*. middle spine longest of three) between the males.

Cirracanthus spinosus **Dojiri & Cressey, 1987**
(Fig. 3)

Cirracanthus spinosus Dojiri & Cressey 1987: 157; Dojiri & Ho 1987: 42.

Material examined. 4 ♀, 2 ♂ and 2 copepodids (WAM C38665–C38666, C38740), ex 2 *Chaetodermis penicilligerus* (Cuvier) (WAM P.9098.001), Shark Bay, Western Australia, Australia, 21 September 1964; 20 ♀, 5 ♂ (1 damaged) and 3 copepodids (WAM C38654, C38741–C38742), ex 1 *C. penicilligerus* (WAM P.9132.001), Shark Bay, Western Australia, Australia, 8 October 1964; 138 ♀, 176 ♂ and 125 copepodids (WAM C38631, C38663–C38664, C38743–C38746), ex 1 *C. penicilligerus* (WAM P.31951.001), unknown locality, 31 May 1983; 1 ♀ (WAM C38651), ex *C. penicilligerus* (WAM P.6257.001), Shark Bay, Western Australia, Australia, 1958; 81 ♀, 12 ♂ and 5 copepodids (AM P65253), ex 1 *C. penicilligerus* (AM I 20788-004), Carnarvon, Western Australia, Australia, May 1972; 8 ♀ (AM P65254), ex 1 *C. penicilligerus* (AM I15557-275), Gulf of Carpentaria, Australia, 27 November 1963; 9 ♀ (1 damaged) (MAGNT Cr014944), ex 1 *C. penicilligerus* (MAGNT S.12333-001), Ashmore Reef, Timor Sea, 29 September 1987; 11 ♀ (2 damaged) (MAGNT Cr014945), ex 1 *C. penicilligerus* (MAGNT S.13272-002), Booby Island, Queensland, Australia, 29 November 1991; 3 ♀ paratypes (USNM 228421), ex *C. penicilligerus* (USNM 176890), Great Barrier Reef, Queensland, Australia.

Supplemental description of adult female. Body 0.93 mm long (excluding caudal setae) and 0.31 mm wide (n = 4) (Fig. 3A). Caudal ramus (Fig. 3B) bearing 7 setae (seta I minute) and posterodorsal flap. Third endopodal segment of leg 4 (Fig. 3C) armed with 2 unequal spines and 1 intermediate spine.

Description of adult male. Body 0.57 mm long (excluding caudal setae) and 233 µm wide (n = 5) (Fig. 3D). Genital double-somite wider (88 µm) than long (69 µm). Abdomen 88 µm long and 61 µm wide, composed of 3 free somites. Caudal ramus longer (22 µm) than wide (16 µm), bearing similar elements as in female.

Maxilliped (Fig. 3E) 4-segmented; syncoxa with short, distomedial seta; basis elongate, armed with 2 proximal setae and 2 inner longitudinal rows of spinules (spinules on anterior surface shorter than on posterior surface); first endopodal segment short, unarmed; second endopodal segment elongate, bearing long seta on posterior surface, 2 short setae on anterior surface, short row of denticles at mid-point of concave margin and minute teeth at distal end. Middle spine on third endopodal segment of leg 3 (Fig. 3F) longer than adjacent spines. Outer margin of first 2 spines on third endopodal segment of leg 4 (Fig. 3G) serrate and distally tapered.

Attachment sites. Predominantly on gill filament lamellae; rarely on branchial cavity wall.

Remarks. This species was described by Dojiri & Cressey (1987) from *Chaetodermis penicilligerus* (Cuvier) (as *Chaetoderma penicilligera*) captured from the Great Barrier Reef, Australia. This species is the only tetraodontiform-parasitising taeniacanthid known thus far that attaches almost exclusively to the gill filament lamellae of its host, with its body nestled between the gill filaments and its anterior end pointed toward the gill arch.

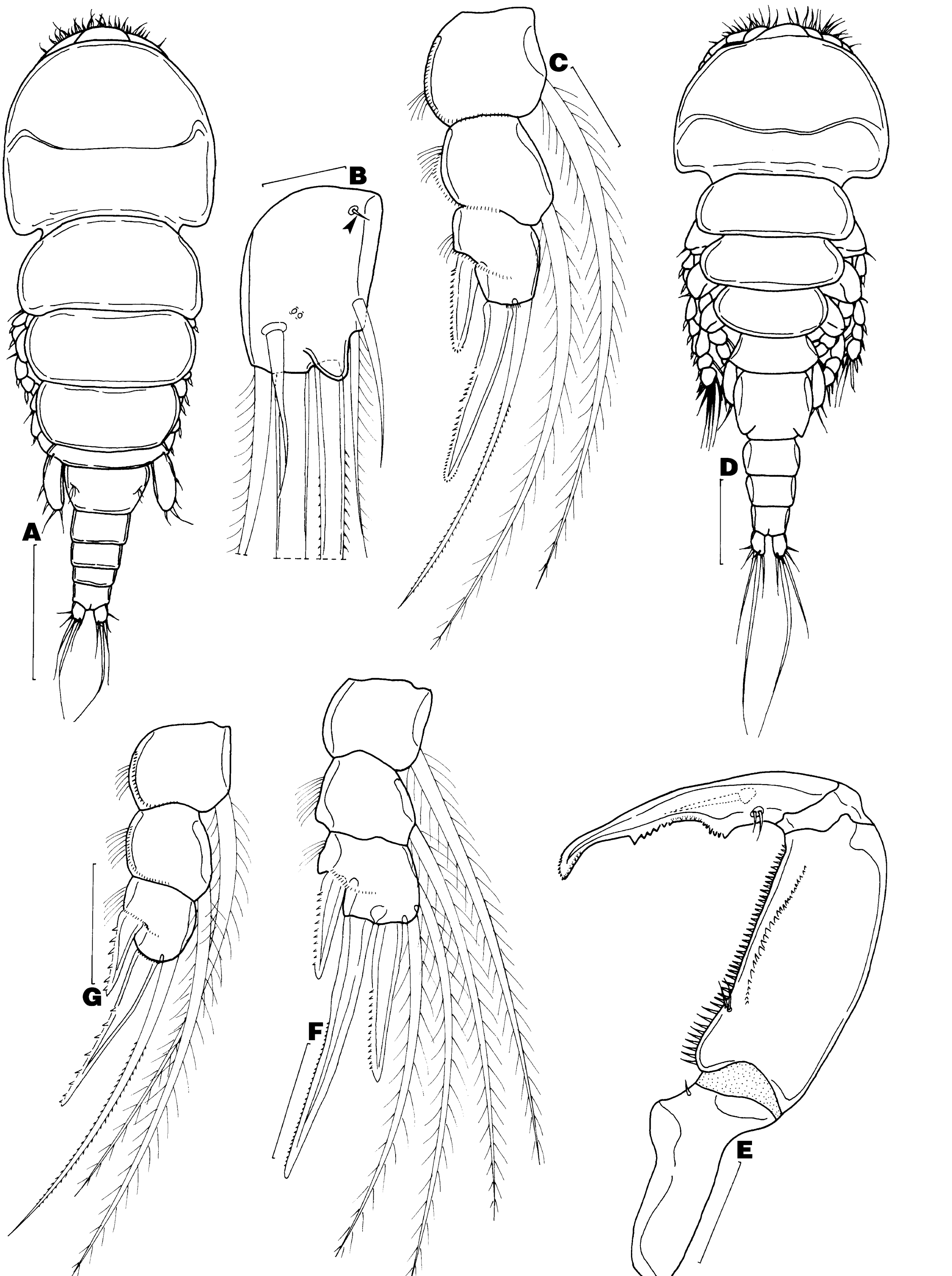

FIGURE 3. *Cirracanthus spinosus* Dojiri & Cressey, 1987, female (A–C) and male (D–G). (A) habitus, dorsal; (B) caudal ramus (seta I indicated by arrowhead), dorsal; (C) leg 4 endopod, anterior; (D) habitus, dorsal; (E) maxilliped, anterior; (F) leg 3 endopod, anterior; (G) leg 4 endopod, anterior. Scale bars: A = 0.20 mm; B = 12.5 µm; C, E–G = 25 µm; D = 0.10 mm.

Comparisons between our material and three *C. spinosus* paratype females revealed that Dojiri & Cressey (1987) had overlooked seta I and the posterodorsal flap on the caudal rami, as well as incorrectly reported two spines and one seta on the third endopodal segment of leg 4 when in fact there are two spines and an intermediate spine. *Cirracanthus spinosus* may be readily distinguished from *C. monacanthi* by having an armature formula of II, I, 5 rather than II, I, 4 on the third exopodal segment of leg 3. For additional distinguishing characters, see "Remarks" section of *C. monacanthi*.

Genus *Nudisodalis* Dojiri & Cressey, 1987

Nudisodalis acicula Dojiri & Cressey, 1987
(Figs 4–5)

Nudisodalis acicula Dojiri & Cressey 1987: 190.

Material examined. 16 ♀ (NSMT-Cr 21653), ex 1 *Pervagor aspricaudus* (Hollard) (URMP33884), East China Sea, Manza, Okinawa-jima Island, Okinawa Prefecture, Japan, 1 July 1995; 5 ♀ (WAM C38582, C38749), ex 1 *P. aspricaudus* (WAM P.29641.011), Juliette Cay, Coral Sea, 14 November 1987; 5 ♀, 2 ♂ and 46 copepodids (AM P65283), ex 1 *P. aspricaudus* (AM I20779-197), Cape York, Queensland, Australia, 22 February 1979; 1 ♀ (WAM C38691), ex *Pervagor janthinosoma* (Bleeker) (WAM P.25542.002), Northwest Cape, Western Australia, Australia, 20 May 1976; 1 ♀ (WAM C38588), ex *P. janthinosoma* (WAM P.30652.065), Norwegian Bay, Western Australia, Australia, 19 June 1993; 2 ♀ (WAM C38618), ex 1 *P. janthinosoma* (WAM P.27970.038), Point Quobba, Western Australia, Australia, 26 April 1983; 3 ♀ (WAM C38608, C38736), ex 1 *P. janthinosoma* (WAM P.25813.009), S. Muiron Island, Western Australia, Australia, 5 June 1977; 9 ♀, 5 ♂ and 3 copepodids (WAM C38653, C38657–C38658, C38737–C38738), ex 3 *P. janthinosoma* (WAM P.31290.009), S. Muiron Island, Western Australia, Australia, 18 May 1996; 1 ♀ (AM P65285), ex *P. janthinosoma* (AM I33703-047), Reef 11-102, Queensland, Australia, 14 January 1993; 1 ♀ (AM P65286), ex *P. janthinosoma* (AM I37320-017), Vanuatu, 31 May 1996; 2 ♀ (1 damaged) (AM P65284), ex 1 *P. janthinosoma* (AM I20983-038), Lizard Island, Queensland, Australia, 28 November 1978; 20 ♀, 3 ♂ and 1 copepodid (CAS 175477), ex 1 *P. janthinosoma* (CAS 57272), Palau Island, 11 September 1957; 5 ♀ (CAS 175277), ex *P. janthinosoma* (CAS 57280), Nha Trang Bay, Vietnam, 31 January 1961; 4 ♀ (CAS 175260), ex *P. janthinosoma* (CAS 57268), Ngakarak Reef, Palau Island, 12 July 1956; 1 ♀ and 2 ♂ (CAS 175259), ex 1 *P. janthinosoma* (CAS 57276), W. Caroline Island, 14 April 1959; 6 ♀ (CAS 175485), ex 1 *P. janthinosoma* (CAS 57271), Aitaburai Pt., Palau Island, 30 October 1956; 6 ♀ (1 damaged) (CAS 175514), ex 1 *P. janthinosoma* (CAS 57273), Ngakarak Reef, Palau Island, 12 September 1957; 2 ♀ (MAGNT Cr014960), ex 1 *P. janthinosoma* (MAGNT S.13589-041), Pandora Wreck, Queensland, Australia, 14 January 1993; 4 ♀ and 2 ♂ (NSMT-Cr 21647), ex 1 *Pervagor melanocephalus* (Bleeker), East China Sea, Manza, Okinawa-jima Island, Okinawa Prefecture, Japan, 1 July 2007; 3 ♀ and 2 ♂ (NSMT-Cr 21652), ex 1 *P. melanocephalus*, East China Sea, Seragaki, Okinawa-jima Island, Okinawa Prefecture, Japan, 4 July 2007; 14 ♀ and 2 ♂ (AM P69679), ex 1 *P. melanocephalus* (AM I33744-020), Boot Reef, Coral Sea, 26 January 1993; 3 ♀, 4 ♂ and 10 copepodids (1 damaged) (AM P65292), ex 1 *P. melanocephalus* (AM I39040-012), Solomon Island, 29 September 1998; 3 ♀, 1 ♂ and 1 copepodid (AM P65289), ex 1 *P. melanocephalus* (AM I 21915-017), Sombrero Island, Philippines, 24 April 1980; 3 ♀ (AM P65287–P65288), ex 2 *P. melanocephalus* (AM I18354-090), Bird Island, Fiji, 9 July 1974; 3 ♀ and 1 damaged ♂ (AM P65290), ex 1 *P. melanocephalus* (AM I21422-040), Lizard Island area, Queensland, Australia, 27 January 1975; 12 ♀, 3 ♂ and 21 copepodids (LACM CR1981-092.2), ex 1 *P. melanocephalus* (LAC 42491-19), Mindoro Island, Philippines, 13 July 1981; 9 ♀ (LACM CR1950-002.1 and 1950-002.3), ex 2 *Pervagor spilosoma* (Lay & Bennett) (LAC 1270), Oahu, Hawaii, 18 July 1950; 2 ♀ paratypes (USNM 228425), ex *P. spilosoma*, Oahu, Hawaii.

Supplemental description of adult female. Body 0.74 mm long (excluding caudal setae) and 0.38 mm wide (n = 7) (Fig. 4A). Several specimens with considerably wider cephalothorax and second pedigerous somite (Fig. 4B). Caudal ramus (Fig. 4C) armed with 7 setae (seta I minute) and posterodorsal flap. Terminal spinulate process of maxilla (Fig. 4D) bearing 2 minute, unequal elements.

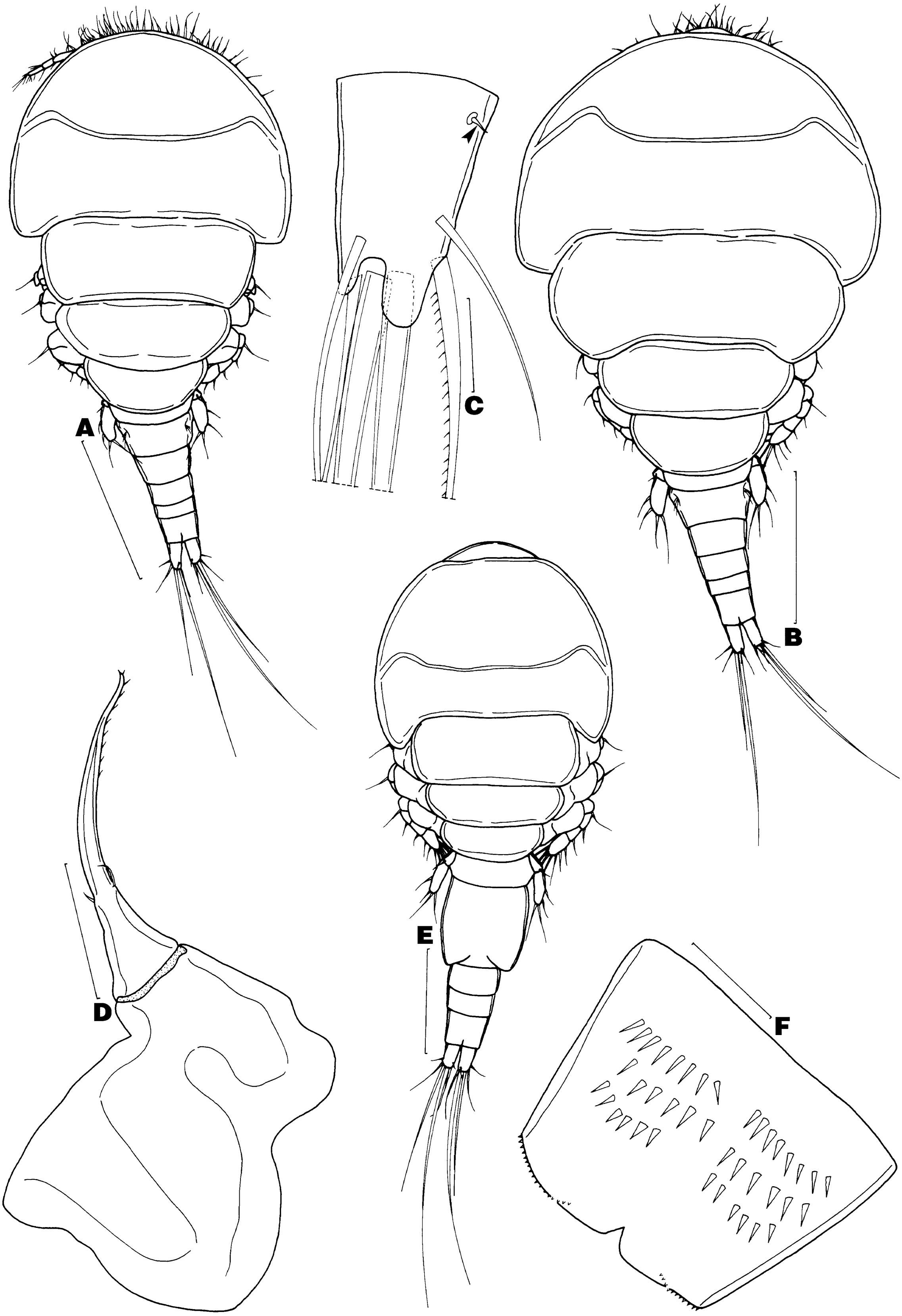

FIGURE 4. *Nudisodalis acicula* Dojiri & Cressey, 1987, female (A–D) and male (E–F). (A) habitus, dorsal; (B) same, dorsal; (C) caudal ramus (seta I indicated by arrowhead), dorsal; (D) maxilla, anterior; (E) habitus, dorsal; (F) anal somite, ventral. Scale bars: A–B = 0.20 mm; C, F = 12.5 µm; D = 25 µm; E = 0.10 mm.

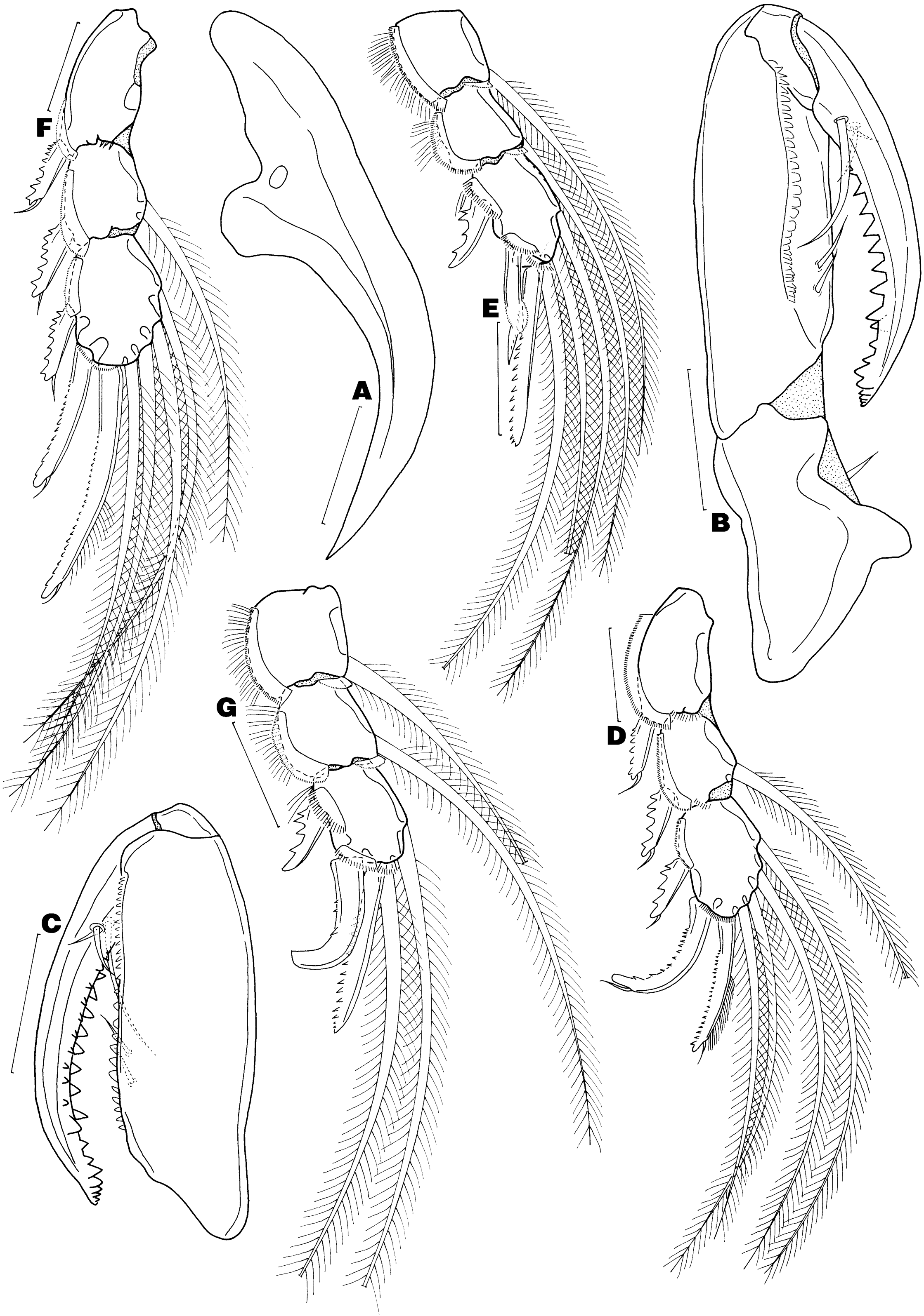

FIGURE 5. *Nudisodalis acicula* Dojiri & Cressey, 1987, male. (A) postantennal process, medial; (B) maxilliped, posterior; (C) same (syncoxa omitted), anterior; (D) leg 2 exopod, anterior; (E) leg 2 endopod, anterior; (F) leg 3 exopod, anterior; (G) leg 3 endopod, anterior. Scale bars: A = 12.5 µm; B–C = 25 µm; D–G = 20 µm.

Description of adult male. Body 0.50 mm long (excluding caudal setae) and 217 µm wide (n = 2) (Fig. 4E). Second pedigerous somite 153 µm wide; remaining pedigerous somites decreasing in width posteriorly. Genital double-somite nearly equal in length (78 µm) and width (77 µm). Abdomen 75 µm long and 47 µm wide, composed of 3 free somites; ventral surface of anal somite (Fig. 4F) with fewer rows of spinules (3 *vs*. 5) than in female. Caudal ramus longer (23 µm) than wide (15 µm), bearing similar elements as in female.

Postantennal process (Fig. 5A) slimmer and more elongate than that in female. Maxilliped (Fig. 5B–C) 4-segmented; syncoxa bearing naked inner seta; basis elongate, armed with 2 naked setae and 2 longitudinal rows of denticles; first endopodal segment small, unarmed; second segment elongate, curved, bearing long seta on posterior surface, 2 setae on anterior surface and 2 rows of large denticles along concave margin. Exopodal spines of leg 2 (Fig. 5D) bearing large teeth along outer margin; outer distal spine on third segment strongly curved, about as long as apical spine. Outer proximal spine on third endopodal segment of leg 2 (Fig. 5E) slightly curved; outer distal spine appearing slightly bent due to fringe of spinules near midlength. Leg 3 exopod (Fig. 5F) similar to that of leg 2, except outer distal spine straight, about two-thirds length of apical spine. Middle spine on third endopodal segment of leg 3 (Fig. 5G) robust, strongly curved.

Attachment site. Branchial cavity wall.

Remarks. *Nudisodalis acicula* was established by Dojiri & Cressey (1987) for specimens found on *Pervagor spilosoma* (Lay & Bennett) (as *Pervagor spilosomus*) collected from Oahu, the Hawaiian Islands. Comparisons between our material and two *N. acicula* paratype females (one left intact, the other with cephalothoracic appendages removed) revealed that Dojiri & Cressey (1987) had overlooked seta I and the posterodorsal flap on the caudal rami and an additional element on the terminal process of the maxilla. *Nudisodalis acicula* can be distinguished from all other taeniacanthid species by the combination of the lanceolate terminal process of the maxilla and the non-prehensile terminal segment of the maxilliped.

Genus *Taeniacanthus* Sumpf, 1871

Taeniacanthus aluteri (Avdeev, 1977)

Anchistrotos aluteri Avdeev 1977: 132.
Taeniacanthus aluteri: Dojiri & Cressey 1987: 16; Ho & Lin 2007: 153.

Material examined. 4 ♀ (CAS 175507), ex 1 *Abalistes stellaris* (Bloch & Schneider) (CAS 40834), Bangkok, Thailand, 15 February 1960; 1 ♀ (CAS 175472), ex *A. stellaris* (CAS 40840), Philippines, 5 April 1978; 34 ♀ and 1 copepodid V ♀ (NSMT-Cr 21658), ex 1 *Abalistes stellatus* (Anonymous), Songkhla, Thailand, 27 July 2008; 24 ♀ (NSMT-Cr 21659), ex 1 *A. stellatus*, Sulu Sea, Iloilo, Panay Island, Philippines, 26 September 2003; 6 ♀ (2 damaged) (CAS 175275 and 175283), ex 2 *A. stellatus* (CAS 34014), Madras, India, April 1975; 1 ♀ (AM P69684), ex *A. stellatus* (I 22806-013), Northwest Shelf, Western Australia, Australia, 1 April 1982; 1 ♀ (MAGNT Cr014941), ex *A. stellatus* (MAGNT S.13326-005), W. Shepparton Shoal, Timor Sea, 6 December 1990.

Attachment site. Branchial cavity wall.

Remarks. This species was originally placed in *Anchistrotos* by Avdeev (1977) for female specimens presumably collected from a monacanthid species named "*Alutera seriola*" in the Gulf of Carpentaria, Australia (see Discussion section below for further details on the binomen of the type host). Dojiri & Cressey (1987) subsequently transferred this species into *Taeniacanthus* based on a redescription of samples removed from *Abalistes stellatus* [(Lacepède)] collected from the Philippines.

The specimens collected in this study are identical to the description of *T. aluteri* provided by Dojiri & Cressey (1987) and Ho & Lin (2007). This species can be distinguished from all other congeners infecting tetraodontiform fishes by the possession of numerous rows of spinules on *both* pectinate processes of the antenna and a flagellum on the distal end of each exopodal spine of legs 2–4.

***Taeniacanthus brayae* n. sp.**
(Figs 6–8)

Type material. ♀ holotype (AM P65291) and 4 ♀ paratypes (AM P69674–P69676), ex 1 *Pervagor melanocephalus* (Bleeker) (AM I33744-020), Boot Reef, Coral Sea, 26 January 1993.

Other material examined. 1 ♀ (AM P65108), ex *P. melanocephalus* (AM I20445-012), Christmas Island, Australia, 25 May 1978; 2 ♀ (WAM C38655), ex 1 *P. melanocephalus* (WAM P.30629.008), Madang, Papua New Guinea, 6 February 1993; 1 ♀ (WAM C38763), ex *P. melanocephalus* (WAM P.30406.013), Sibuan Island, Malaysia, 13 February 1992; 1 ♀ (WAM C38622), ex *P. melanocephalus* (WAM P.29047.004), Ashmore Reef, Timor Sea, 14 September 1986; 1 ♀ (MAGNT Cr014961), ex *P. melanocephalus* (MAGNT S.13676-062), Table Island Reef, Madang, Papua New Guinea, 14 October 1992.

Description of adult female. Body 471 µm long (excluding caudal setae) and 227 µm wide (n = 3) (Fig. 6A). Prosome composed of cephalothorax (first pedigerous somite combined with cephalosome) and 3 free pedigerous somites. Urosome short, comprised of 5th pedigerous somite, genital double-somite and 3 free abdominal somites; last prosomal somite completely overlapping fifth pedigerous somite and partially obscuring genital double-somite. Genital double-somite wider (80 µm) than long (40 µm). Abdomen 37 µm long and 48 µm wide; first 2 abdominal somites naked; anteroventral surface of anal somite (Figure 6B) with 3 interrupted, transverse rows of spinules. Caudal ramus (Fig. 6B) longer (16 µm) than wide (14 µm), bearing posterodorsal flap and 6 setae (seta I not observed); ventrolateral and outer and middle terminal setae bearing longitudinal row of minute spinules on outer margin; middle terminal seta longest, at least 3 times longer than outer terminal seta.

Rostral area (Fig. 6A, C) highly protuberant, lacking sclerotised structure on ventral surface. Antennule (Fig. 6D) 6-segmented (articulation between ancestral segments XIV–XVII and XVIII–XX not expressed); armature formula: 5, 15, 8, 4, 2 + 1 aesthetasc, and 7 + 1 aesthetasc. Antenna (Fig. 6E) indistinctly 4-segmented; coxobasis bearing usual distal seta; first endopodal segment with inner seta; second endopodal segment bearing 2 unequal pectinate processes (each process armed with seta and ornamented with row of minute spinules) and claw-like spine; third endopodal segment elongate, extending beyond pectinate processes and bearing 2 claw-like spines and 4 unequal setae (innermost seta broken). Postantennal process (Fig. 6F) with wide base and pointed tine.

Labrum (Fig. 6G) with spinules along posterior margin and crescentic row of spinules on ventromedian surface. Mandible (Fig. 6H) with terminal and subterminal blades, each spinulate along inner margin. Paragnath (Fig. 7A) unornamented. Maxillule (Fig. 7B) lobate, bearing 3 naked setae (2 setae broken in figure), spinulate seta and anterior knob-like process. Maxilla (Fig. 7C) 2-segmented; syncoxa unarmed; basis armed with spinulate terminal process and naked seta. Maxilliped (Fig. 7D–E) 3-segmented; syncoxa bearing small seta; basis armed with 2 proximal naked setae; terminal (endopod) segment a curved claw, bearing 2 naked basal setae (posterior seta minute), basal protrusion and transverse flanges at distal end.

Legs 1–4 biramous (Figs 7F–I, 8A–E), with 2-segmented rami on leg 1 and 3-segmented rami on legs 2–4. Armature on rami of legs 1–4 as follows (Roman numerals = spines; Arabic numerals = setae; int. = intermediate spine):

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-1	1-0; 8	0-1; 7
Leg 2	0-0	1-0	I-0; I-1; II, I, 3	0-1; 0-0; II, I, 2
Leg 3	0-0	1-0	I-0; I-1; II, I, 3	0-1; 0-0; II, I, 1
Leg 4	0-0	1-0	I-0; I-0; II, I, 3	0-1; 0-0; II, int.

Leg 1 (Fig. 7F) coxa, basis and rami flattened and expanded. Intercoxal sclerite squat, armed posteriorly with small and large spinules. Coxa with lateral row of spinules; basis ornamented with rows of small spinules on ventral surface and row of large spinules on posterior border; posterior margin of leg 1 exopod bearing row of spinules. Leg 2 intercoxal sclerite (Fig. 7G) rectangular, with rows of spinules along posterior margin; coxa with spinules scattered on ventral surface and bordering posterolateral margin; basis with spinules along posterior and inner margins. Leg 2 exopodal spines (Fig. 7H) spinulate along outer margin and bearing terminal flagellum; usual row of spinules along outer margin of segments not observed. First 2 endopodal segments of leg 2 (Fig. 7I) ornamented

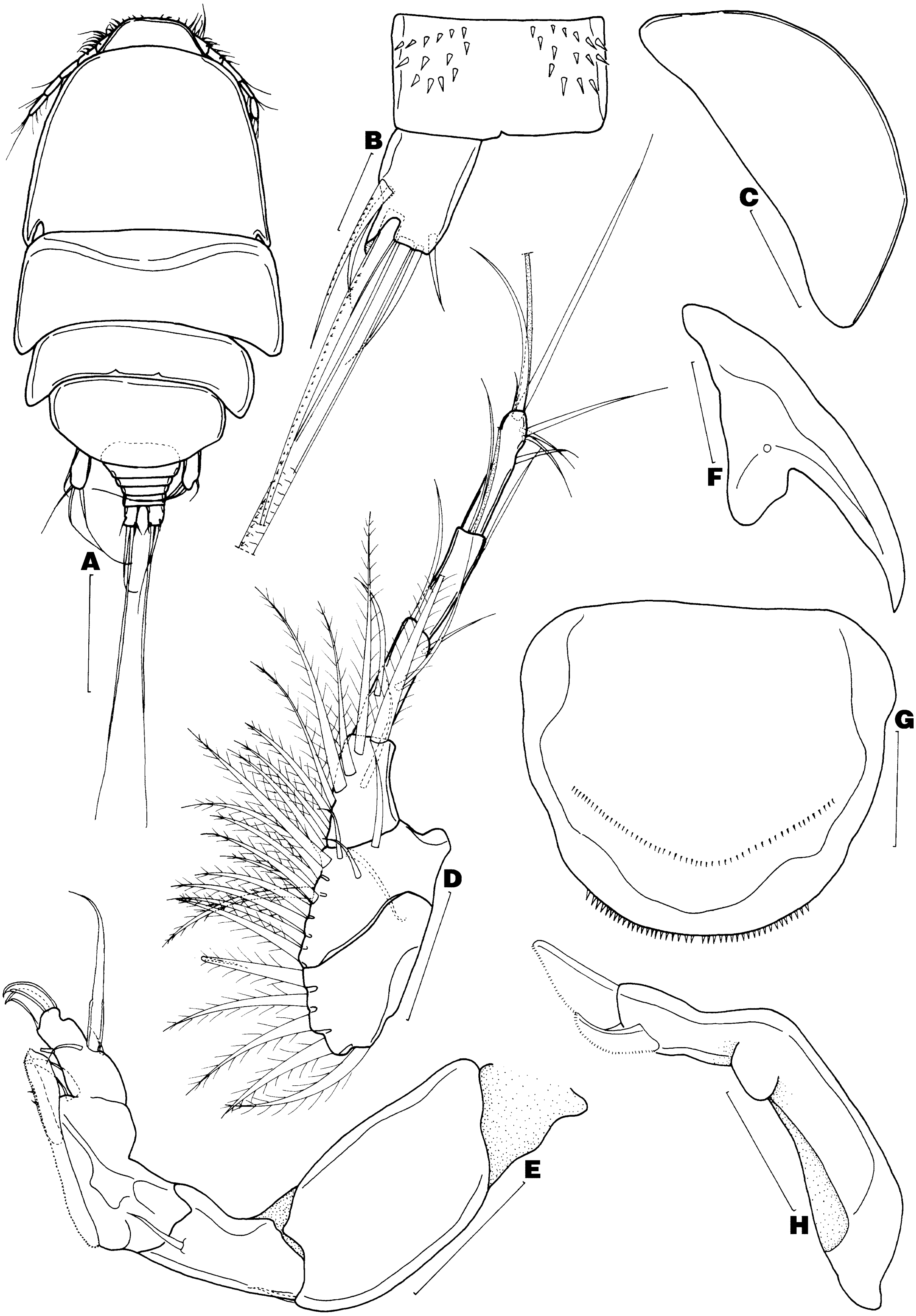

FIGURE 6. *Taeniacanthus brayae* **n. sp.**, female. (A) habitus, dorsal; (B) anal somite and caudal ramus, ventral; (C) rostral area, ventral; (D) antennule, ventral; (E) antenna, medial; (F) postantennal process, medial; (G) labrum, ventral; (H) mandible, anterior. Scale bars: A = 0.10 mm; B–C, F–H = 12.5 µm; D–E = 25 µm.

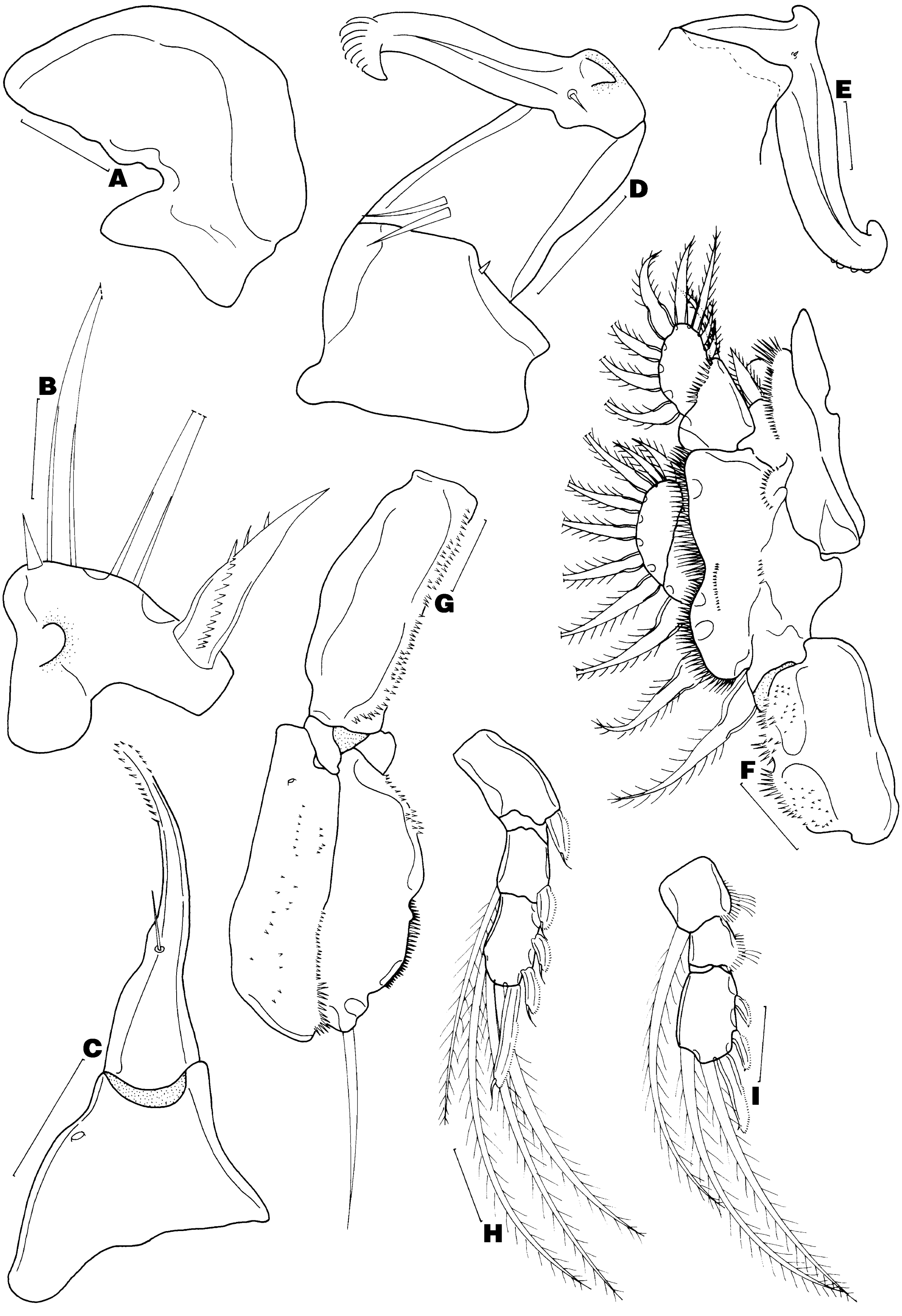

FIGURE 7. *Taeniacanthus brayae* **n. sp.**, female. (A) paragnath, ventral; (B) maxillule, anterior; (C) maxilla, posterior; (D) maxilliped, medial; (E) distal end of maxilliped, posterior; (F) leg 1, anterior; (G) leg 2 intercoxal sclerite, coxa and basis, anterior; (H) leg 2 exopod, anterior; (I) leg 2 endopod, anterior. Scale bars: A–B, E = 6.25 µm; C–D, F–I = 12.5 µm.

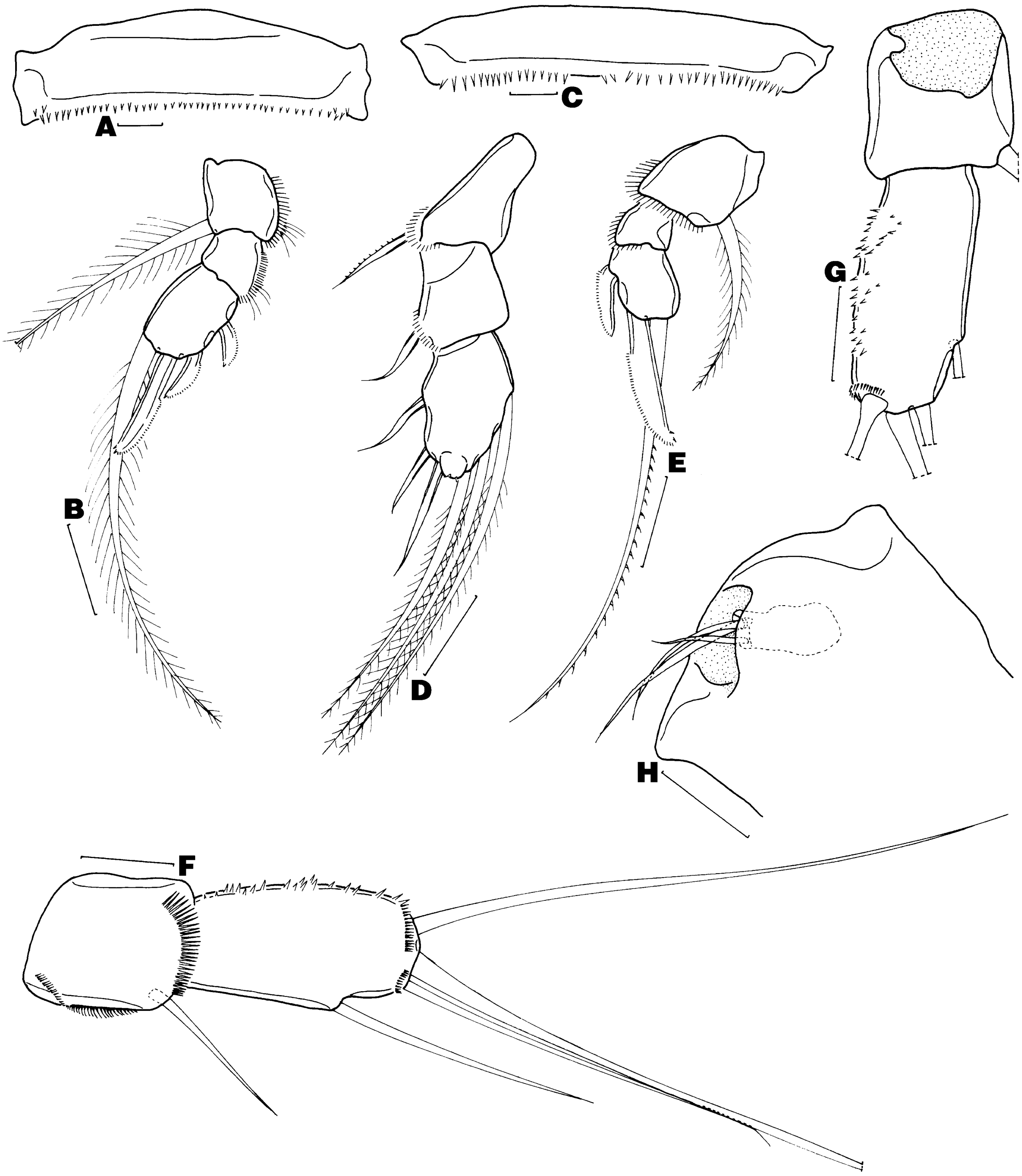

FIGURE 8. *Taeniacanthus brayae* **n. sp.**, female. (A) leg 3 intercoxal sclerite, anterior; (B) leg 3 endopod, anterior; (C) leg 4 intercoxal sclerite, anterior; (D) leg 4 exopod, anterior; (E) leg 4 endopod, anterior; (F) leg 5, lateral; (G) leg 5, medial; (H) leg 6, dorsal. Scale bars: A, C = 6.25 µm; B, D–H = 12.5 µm.

with lateral row of setules and spinules; spines on third endopodal segment spinulate along lateral margin and bearing small distomedial tooth. Leg 3 intercoxal sclerite (Fig. 8A) wider than that of leg 2, with spinules along posterior margin. Leg 3 coxa, basis and exopod similar to those of leg 2, except inner margin of basis lacking spinules. Leg 3 endopodal segments and spines (Fig. 8B) ornamented as in leg 2, except innermost spine with 2 distal teeth rather than 1. Leg 4 intercoxal sclerite (Fig. 8C) 4 times wider than long; coxa and basis similar to those of leg 3. First 2 exopodal segments of leg 4 (Fig. 8D) with lateral row of spinules; all exopodal spines weakly sclerotised, attenuate; first spine bristled along outer margin; third exopodal segment with distal protrusion armed with 2 minute elements. First 2 endopodal segments of leg 4 (Fig. 8E) with row of spinules; first 2 spines spinulate along outer margin (second spine with several distomedial teeth); intermediate spine spinulate along inner margin. Leg 5 (Fig.

8F–G) uniramous, 2-segmented. Protopodal segment armed with dorsolateral naked seta and row of spinules on lateral and posterior borders; free exopodal segment with patches of spinules along inner margin and armed with 1 subterminal and 3 terminal setae; row of spinules present at base of outer and inner terminal setae; middle terminal seta longest of 4 exopodal setae. Leg 6 (Fig. 8H) vestigial, represented by 3 unequal naked setae at egg sac attachment area.

Adult male. Unknown.

Attachment site. Orbit.

Etymology. This species is named in honour of Dianne Bray, Collection Manager (Ichthyology and Herpetology) at Museum Victoria.

Remarks. This is the second record of a copepod infecting *Pervagor melanocephalus*

(Bleeker). *Taeniacanthus brayae* **n. sp.** resembles the new species described immediately below. For the distinguishing features of *T. brayae* **n. sp.**, see the 'Remarks' section of the following taxon.

***Taeniacanthus mcgroutheri* n. sp.**
(Figs 9–11)

Type material. ♀ holotype (WAM C38683) and 24 ♀ paratypes (1 damaged) (WAM C38555, C38605, C38610, C38684, C38773–C38774), ex 4 *Monacanthus chinensis* (Osbeck) (WAM P.25095.025), Exmouth Gulf, Western Australia, Australia, October 1974.

Other material examined. 27 ♀ (AM P69677), ex 1 *M. chinensis* (AM I20230-004), Cockburn Sound, Western Australia, Australia, 27 March 1978; 12 ♀ (WAM C38677–C38678, C38762), ex 2 *M. chinensis* (WAM P.24985.001), Cockburn Sound, Western Australia, Australia, August 1974; 1 ♀ (WAM C38590), ex *M. chinensis* (WAM P.31985.001), Cockburn Sound, Western Australia, Australia, 1975; 1 ♀ (MAGNT Cr014946), ex *M. chinensis* (MAGNT S.12894-001), Broome, Western Australia, Australia, 20 May 1987; 2 ♀ (MAGNT Cr014948), ex 1 *M. chinensis* (MAGNT S.13917-006), Darwin Harbour, Northern Territory, Australia, 5 April 1994; 35 ♀ (1 damaged) (MAGNT Cr014950–Cr014954), ex 1 *M. chinensis* (MAGNT S.10352-003), Shoal Bay, Northern Territory, Australia, 5 April 1977; 1 ♀ (MAGNT Cr015005), ex *Paramonacanthus choirocephalus* (Bleeker) (MAGNT S.12768-001), Darwin Harbour, Northern Territory, Australia, 30 May 1989; 5 ♀ (MAGNT Cr015006), ex 1 *P. choirocephalus* (MAGNT S.13735-009), Darwin Harbour, Northern Territory, Australia, 9 September 1993; 4 ♀ (MAGNT Cr015007), ex 1 *P. choirocephalus* (MAGNT S.13736-011), Darwin Harbour, Northern Territory, Australia, 9 September 1993.

Description of adult female. Body 0.60 mm long (excluding caudal setae) and 254 µm wide (n = 11) (Fig. 9A). Several specimens with second pedigerous somite broader (290 µm) than cephalothorax (280 µm) (Fig. 9B). Prosome 487 µm long, composed of cephalothorax (cephalosome plus first pedigerous somite) and 3 free pedigerous somites. Second pedigerous somite 244 µm wide; 3rd and 4th pedigerous somites decreasing in width posteriorly. Urosome comprised of 5th pedigerous somite, genital double-somite and 3 free abdominal somites. Genital double-somite wider (89 µm) than long (52 µm). Abdomen 54 µm long and 67 µm wide; first 2 abdominal somites unornamented; ventral surface of anal somite (Fig. 9C) with 3 interrupted rows of spinules. Caudal ramus (Fig. 9C) longer (17 µm) than wide (14 µm), bearing 6 naked setae (seta I not observed).

Rostral area (Fig. 9A, D) highly protuberant, lacking ventromedian sclerotised structure. Antennule (Fig. 9E) 6-segmented (articulation between ancestral segments XIV–XVII and XVIII–XX not expressed); armature formula: 5, 14, 8, 4, 2 + 1 aesthetasc, and 7 + 1 aesthetasc. Antenna (Fig. 9F) indistinctly 4-segmented. Coxobasis robust, bearing minute spinules on outer border and distal seta. First endopodal segment with long inner seta. Second endopodal segment bearing 2 unequal pectinate processes and claw-like spine; large pectinate process with multiple rows of spinules (usual seta not observed, possibly broken off); small pectinate process with row of spinules and minute seta. Third endopodal segment elongate, extending well-beyond pectinate processes, armed with 4 setae and 2 claw-like spines. Postantennal process (Fig. 9G) with wide base and sharply curved tine.

Labrum (Fig. 9H) spinulate along posterior margin. Mandible (Fig. 10A) with 2 unequal spinulate blades. Paragnath (Fig. 10B) with nipple-like protuberance at tip. Maxillule (Fig. 10C) lobate, bearing 2 long naked setae, spinulate seta, lateral protrusion and small anterior ridge. Maxilla (Fig. 10D) 2-segmented; syncoxa naked; basis armed with spinulate terminal process and naked seta. Maxilliped (Fig. 10E–F) 3-segmented; syncoxa with naked

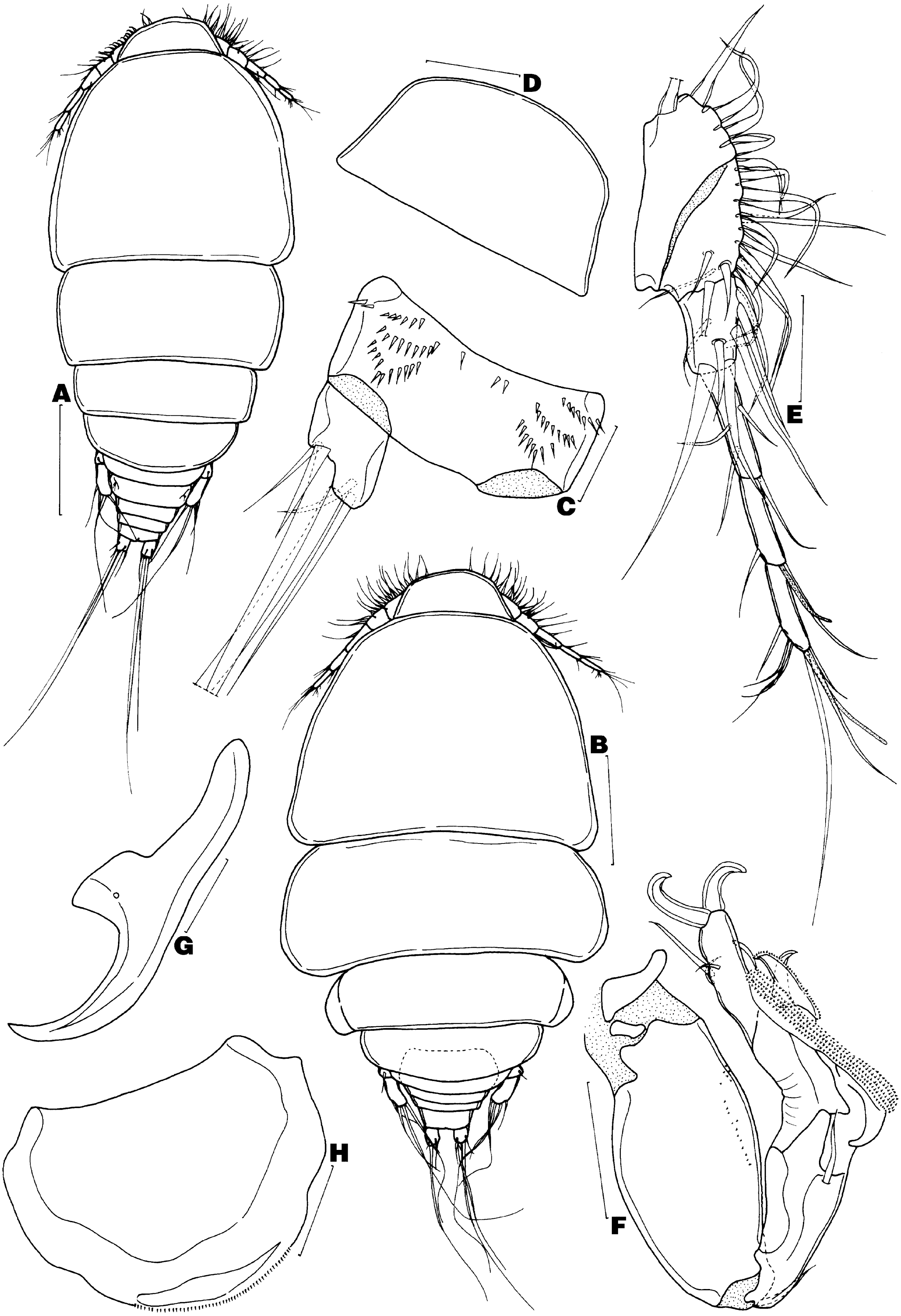

FIGURE 9. *Taeniacanthus mcgroutheri* **n. sp.**, female. (A) habitus, dorsal; (B) same, dorsal; (C) anal somite and caudal ramus, ventral; (D) rostral area, ventral; (E) antennule, ventral; (F) antenna, medial; (G) postantennal process, medial; (H) labrum, ventral. Scale bars: A–B = 0.10 mm; C–D, G–H = 12.5 µm; E–F = 25 µm.

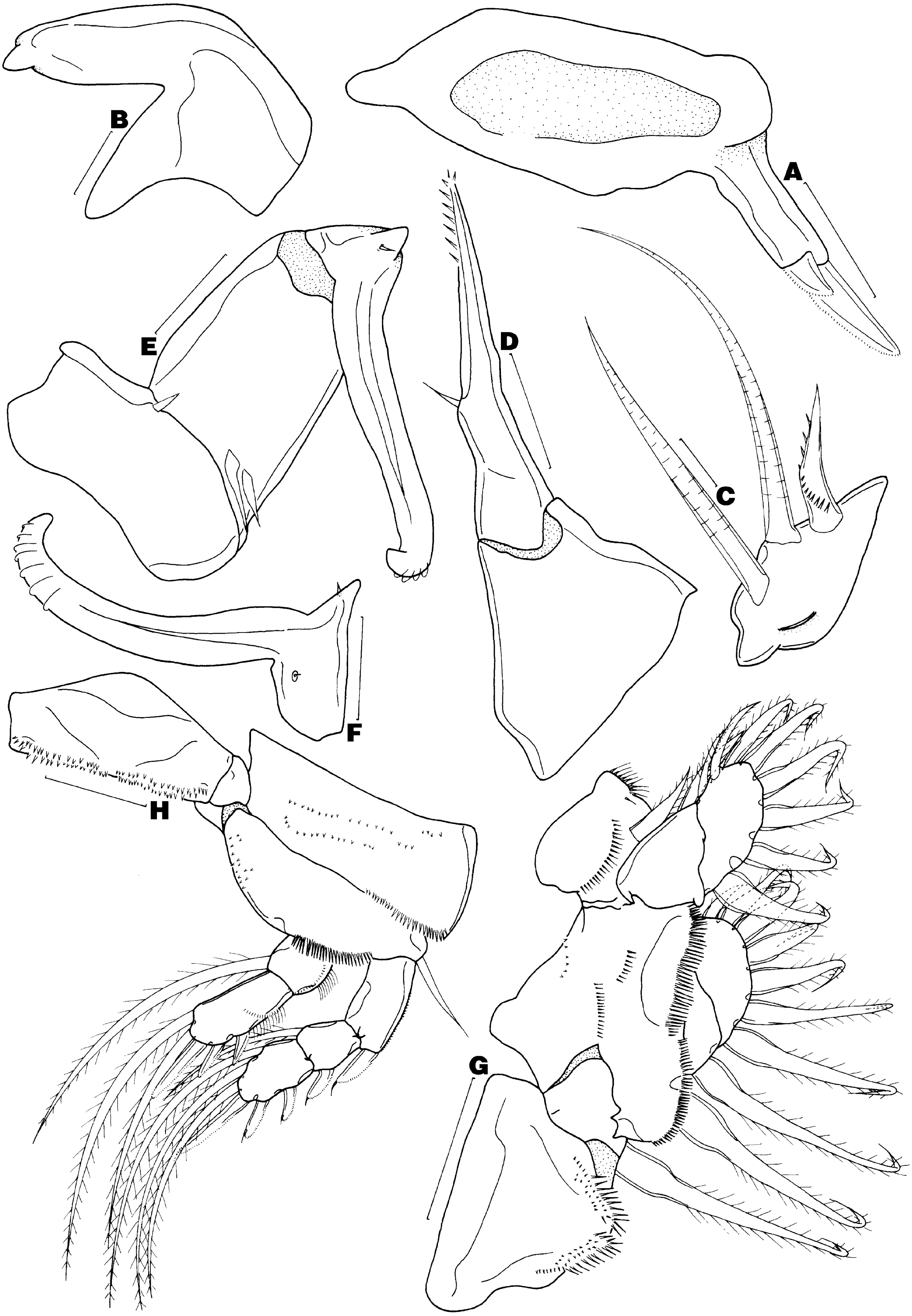

FIGURE 10. *Taeniacanthus mcgroutheri* **n. sp.**, female. (A) mandible, anterior; (B) paragnath, ventral; (C) maxillule, anterior; (D) maxilla, posterior; (E) maxilliped, anteromedial; (F) terminal segment of maxilliped, posterior; (G) leg 1, anterior; (H) leg 2, anterior. Scale bars: A, D–F = 12.5 µm; B–C = 6.25 µm; G–H = 25 µm.

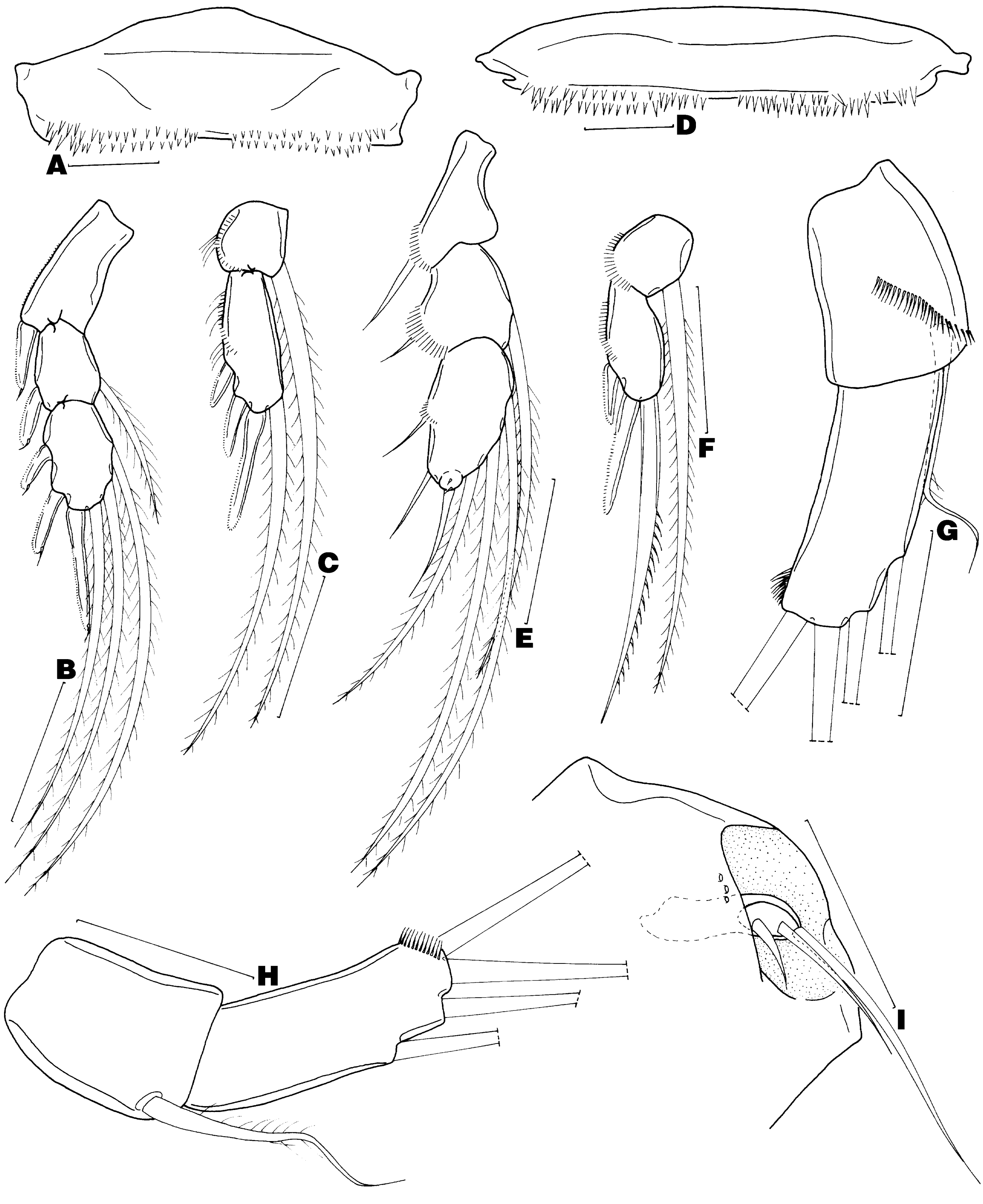

FIGURE 11. *Taeniacanthus mcgroutheri* **n. sp.**, female. (A) leg 3 intercoxal sclerite, anterior; (B) leg 3 exopod, anterior; (C) leg 3 endopod, anterior; (D) leg 4 intercoxal sclerite, anterior; (E) leg 4 exopod, anterior; (F) leg 4 endopod, anterior; (G) leg 5, medial; (H) same, dorsolateral; (I) leg 6, dorsal. Scale bars: A–B = 12.5 µm; C–I = 25 µm.

seta; basis armed with 2 proximal naked setae; endopod segment a curved claw, bearing 2 minute setae, basal conical protrusion and transverse flanges along inner distal margin.

Legs 1–4 biramous (Figs 10G–H, 11A–F), with 2-segmented rami on leg 1 and 3-segmented exopod and 2-segmented endopod on legs 2–4. 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; 8	0-1; 7
Leg 2	0-0	1-0	I-0; I-1; II, I, 3	0-1; II, I, 2
Leg 3	0-0	1-0	I-0; I-1; II, I, 3	0-1; II, I, 1
Leg 4	0-0	1-0	I-0; I-1; II, I, 3	0-1; II, int.

Leg 1 (Fig. 10G) flattened and expanded. Intercoxal sclerite with short and long spinules posteriorly. Coxa and basis with several rows of spinules. Intercoxal sclerite of legs 2–4 (Figs 10H, 11A, D) with several rows of spinules on posterior edge; leg 4 intercoxal sclerite widest. Leg 2 coxa (Fig. 10H) with row of long spinules on posterolateral margin and several rows of spinules on ventral surface; basis with row of large spinules on posterior border and patch of small spinules along inner margin. Leg 2 exopod (Fig. 10H) with outer row of spinules on first segment; exopodal spines spinulate along lateral margin and armed with terminal flagellum; inner seta on second segment relatively short. Leg 2 endopod (Fig. 10H) with outer row of setules and spinules; terminal spines spinulate. Coxa and basis of legs 3 and 4 similar to those of leg 2, except spinules along inner margin of basis absent. Leg 3 exopod (Fig. 11B) identical to leg 2 exopod. Leg 3 endopod (Fig. 11C) similar to that of leg 2, except with 1 fewer seta on terminal segment. Leg 4 exopodal segments (Fig. 11E) each with outer row of spinules; spines weakly sclerotised; inner seta on second segment longer than that of legs 2 and 3; third segment with distal protrusion bearing 2 minute spinules. Leg 4 endopod (Fig. 11F) with outer row of spinules; first 2 spines spinulate along outer border; intermediate spine with row of large spinules along inner margin. Leg 5 (Fig. 11G–H) uniramous, 2-segmented. Protopodal segment armed with dorsolateral, weakly pinnate seta and row of long spinules. Free exopodal segment with distomedial row of long spinules and 2 subterminal and 2 terminal naked setae (outer terminal seta longest of 4). Leg 6 (Fig. 11I) vestigial, represented by 3 unequal naked setae at egg sac attachment area.

Adult male. Unknown.

Attachment site. Orbit.

Etymology. This species is named in honour of Mark McGrouther, Collection Manager (Ichthyology) at the Australian Museum.

Remarks. *Taeniacanthus mcgroutheri* **n. sp.** resembles *T. brayae* **n. sp.** in the protuberant rostrum without a ventromedian plate, the 6-segmented antennule, structure of the third endopodal segment of the antenna, spinulate seta on the maxillule, maxilla with a spinulated terminal process and one seta, armature formula of II, I, 3 on the third exopodal segment of legs 2–4 and leg 5 armed with four long setae on the free exopodal segment. Both species are also parasitic on the external surface of the eyes of several monacanthid hosts. *Taeniacanthus mcgroutheri* **n. sp.** can be differentiated from *T. brayae* **n. sp.** by having 14 setae (rather than 15) on the second antennulary segment, numerous rows of spinules (rather than one) on the large pectinate process of the antenna, three setae (rather than four) on the maxillule and a bimerous (rather than trimerous) endopod on legs 2–4. Comparisons of the ornamentation and setation patterns of the endopod of legs 2–4 between these two species indicates that the 2-segmented condition exhibited by *T. mcgroutheri* **n. sp.** is most likely derived from the fusion of the middle and terminal segments (or failure of the middle and terminal segments to separate) rather than the amalgamation of the first and middle segments (or failure of the first and second segments to divide).

Discussion

Taxonomy. Dojiri & Cressey (1987) established *Cirracanthus* to accommodate *Taeniacanthus monacanthi* Yamaguti, 1939 and *Cirracanthus spinosus* Dojiri & Cressey, 1987, both of which are parasites of monacanthid hosts. The maxilliped claw (endopod) of the females of species of *Cirracanthus* curves toward the preceding segment (basis) resulting in a subchelate appendage. This contrasts with the maxilliped claw in most, but not all, other female taeniacanthids, which predominantly curves away from the basis. We note here that a subchelate maxilliped is also possessed by females of the species of *Taeniacanthodes* C. B. Wilson, 1935. Dojiri & Ho (1987) later transferred *Taeniacanthus inimici* (Yamaguti & Yamasu, 1959) to *Cirracanthus* based on examination of new material collected from the type host *Inimicus japonicus* (Cuvier) (Scorpaeniformes: Synanceiidae) captured off Sado

Island, Japan. The maxilliped claw in this species does not point away from the basis as in other species of *Taeniacanthus*. Despite this feature, we believe that *C. inimici* should be transferred back to *Taeniacanthus* because it shares more characteristics (i.e. elongate urosome as well as similar structure and armature of legs 2–4) with *Taeniacanthus* species, such as *T. miles* (Pillai, 1963) and *T. rotundiceps* (Shiino, 1957), parasitic on other scorpaeniform fishes than with *C. monacanthi* and *C. spinosus*. The relatively broad, corrugated maxilliped claw of *T. inimici* is considered to be a derived condition within the group of taeniacanthid species infecting scorpaeniform fishes.

Taeniacanthus brayae **n. sp.** and *T. mcgroutheri* **n. sp.** are two of the most derived members of *Taeniacanthus* based on the atypical structure of the antenna, the reduced armature on the maxilla and legs 2–4 and the extremely long setae on the free exopodal segment of leg 5. The terminal segment of the antenna in *T. brayae* **n. sp.** and *T. mcgroutheri* **n. sp.** is elongate and extends beyond the pectinate processes on the penultimate segment as compared to the short terminal segment, with the distal border not extending past the pectinate processes, of their congeners. Furthermore, the setal elements on the terminal antennal segment are dispersed from the claw-like spines in *T. brayae* **n. sp.** and *T. mcgroutheri* **n. sp.** rather than being tightly clustered with the claw-like spines as characterised in their congeners. *Taeniacanthus brayae* **n. sp.** and *T. mcgroutheri* **n. sp.**, along with *Taeniacanthus williamsi* Dojiri & Cressey, 1987 and *T. lagocephali* Pearse, 1952, each possess a spinulated terminal process and one other element on the maxillary basis rather than a terminal process and two elements as in the remaining congeners. However, the structure of the maxilla of *T. brayae* **n. sp.** and *T. mcgroutheri* **n. sp.** is not homologous with that of *T. lagocephali* and *T. williamsi*. In the former two species the free spinulate spine is absent on the maxillary basis whereas in the latter two species the short seta is lost. *Taeniacanthus brayae* **n. sp.** and *T. mcgroutheri* **n. sp.** have six elements on the terminal exopodal segment of legs 2–4 and an armature of II, I, 2 and II, I, 1 on the terminal endopodal segment of legs 2 and 3, respectively. Other congeners have, in contrast, 7 or 8 elements on the terminal exopodal segment of legs 2–4 and II, I, 3 and II, I, 2 on the terminal endopodal segment of legs 2 and 3, respectively. The four elements on the free exopodal segment of leg 5 are typically shorter than the segment itself in *Taeniacanthus* spp., but they are dramatically longer than the segment in *T. brayae* **n. sp.** and *T. mcgroutheri* **n. sp.**

Host-specificity and geographic distribution. The six taeniacanthid species reported herein exhibit variable levels of host-specificity and geographic distributions within the Indo-West Pacific (Table 1). *Cirracanthus monacanthi* is regarded as a low host-specific and widely distributed parasite species as it was reported from 12 host species belonging to five genera of Monacanthidae collected in the Western and Central Indo-Pacific realms of the IWP. In contrast, *C. spinosus* and *T. brayae* **n. sp.** were each found on a single host species of Monacanthidae collected from the Central Indo-Pacific realm. *Taeniacanthus mcgroutheri* **n. sp.** was collected from two host species each belonging to a different genus of Monacanthidae caught along the Australian coastline. *Nudisodalis acicula* was collected from the Central and Eastern Indo-Pacific realms of the IWP from four species of the genus *Pervagor* Whitley, which suggests that it has a predilection for this monacanthid genus. *Taeniacanthus aluteri* was reported from two species belonging to one genus of Balistidae as well as from “*Alutera seriola*” collected from the Western and Central Indo-Pacific realms of the IWP. The latter host name is anomalous, as no species in the monacanthid genus *Aluterus* Cloquet has ever been described under that binomen (Dr. J. B. Hutchins, pers. comm.). The only species of *Aluterus* that have been reported by Allen (1999) from the northern coast of Australia, where the Gulf of Carpentaria (type locality of *T. aluteri*) is located, are *A. scriptus* (Osbeck) and *A. monoceros* (Linnaeus). In the present work, *T. aluteri* was collected from the balistid *Abalistes stellatus* ([Lacepède]) in the general vicinity (i.e., Timor Sea) of the type locality. The type host of *T. aluteri* remains a mystery, but it is most likely a member of Balistidae rather than Monacanthidae given that *T. aluteri* has not been reported from any other host group (Dojiri & Cressey 1987; Ho & Lin 2007; present study). Among the 18 host species listed in Table 1, 11 represent new host records and the following four were reported to harbour two taeniacanthid species: *C. monacanthi* and *C. spinosus* on *Chaetodermis penicilligerus* (Cuvier), *C. monacanthi* and *T. mcgroutheri* **n. sp.** from *Monacanthus chinensis* (Osbeck) and *Paramonacanthus choirocephalus* (Bleeker) and *N. acicula* and *T. brayae* **n. sp.** on *Pervagor melanocephalus* (Bleeker). We must add, however, that only one individual of *C. monacanthi* was collected in the present account from one of 19 *C. penicilligerus* (5% prevalence) and one of 15 *Meuschenia trachylepis* (Günther) (7% prevalence), which may indicate these fishes are uncommon hosts of *C. monacanthi*.

TABLE 1. Triggerfish (Balistidae) and filefish (Monacanthidae) hosts and localities of species of Taeniacanthidae C. B. Wilson, 1911.

Copepod	Host	Locality	Reference
Cirracanthus monacanthi (Yamaguti, 1939)	*Chaetodermis penicilligerus* (Cuvier)[1]	Australia	Present study
	Meuschenia trachylepis (Günther)[1]	Australia	Present study
	Monacanthus chinensis (Osbeck)[1]	Asia	Dojiri & Cressey (1987)
		Hong Kong	Dojiri & Cressey (1987)
		Japan	Present study
		Australia	Present study
		Gulf of Thailand	Present study
		Java Sea	Present study
		Arafura Sea	Present study
	Paramonacanthus arabicus Hutchins[1]	Persian Gulf	Present study
	Paramonacanthus choirocephalus (Bleeker)[1]	Australia	Present study
	Paramonacanthus filicauda (Günther)[1]	Australia	Present study
		Arafura Sea	Present study
	Paramonacanthus japonicus (Tilesius)[1]	Japan	Present study
		Arafura Sea	Present study
		Australia	Present study
	Paramonacanthus otisensis Whitley[1]	Australia	Present study
	Stephanolepis cirrhifer (Temminck & Schlegel)[1] (as *Monacanthus cirrhifer* Bennett)	Japan	Yamaguti (1939)
	Stephanolepis cirrhifer (Temminck & Schlegel)[1]	Japan	Dojiri & Cressey (1987); Present study
		Hong Kong	Present study
	Stephanolepis hispidus (Linnaeus)[1]	South Africa	Present study
	Stephanolepis setifer Bennett[1]	Japan	Dojiri & Cressey (1987)
		Hong Kong	Present study
	Stephanolepis sp.[1]	Japan	Dojiri & Cressey (1987)
Cirracanthus spinosus Dojiri & Cressey, 1987	*Chaetodermis penicilligerus* (Cuvier)[1]	Australia	Dojiri & Cressey (1987); Present study
		Timor Sea	Present study
Nudisodalis acicula Dojiri & Cressey, 1987	*Pervagor aspricaudus* (Hollard)[1]	Japan	Present study
		Coral Sea	Present study
		Australia	Present study
	Pervagor janthinosoma (Bleeker)[1]	Australia	Present study
		Vanuatu	Present study
		Palau Island	Present study
		Vietnam	Present study
		West Caroline Island	Present study
	Pervagor melanocephalus (Bleeker)[1]	Japan	Present study
		Coral Sea	Present study

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TABLE 1. (continued)

Copepod	Host	Locality	Reference
		Solomon Island	Present study
		Philippines	Present study
		Fiji	Present study
	Pervagor spilosoma (Lay & Bennett)[1] (as *Pervagor spilosomus* (Bleeker))	Hawaiian Islands	Dojiri & Cressey (1987)
	Pervagor spilosoma (Lay & Bennett)[1]	Hawaiian Islands	Present study
Taeniacanthus aluteri (Avdeev, 1977)	*Alutera seriola*[3]	Australia	Avdeev (1977)
	Abalistes stellaris (Bloch & Schneider)[2]	Thailand	Present study
		Philippines	Present study
	Abalistes stellatus ([Lacepède, 1798])[2]	Philippines	Dojiri & Cressey (1987)
		Taiwan	Ho & Lin (2007)
		Thailand	Present study
		India	Present study
		Australia	Present study
		Timor Sea	Present study
Taeniacanthus brayae **n. sp.**	*Pervagor melanocephalus* (Bleeker)[1]	Coral Sea	Present study
		Christmas Island	Present study
		Papua New Guinea	Present study
		Malaysia	Present study
		Timor Sea	Present study
Taeniacanthus mcgroutheri **n. sp.**	*Monacanthus chinensis* (Osbeck)[1]	Australia	Present study
	Paramonacanthus choirocephalus (Bleeker)[1]	Australia	Present study

[1]Species of Monacanthida; [2]Species of Balistidae; [3]Species name is erroneous—see Discussion section for further details

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