DOI: 10.2478/s11686-009-0038-y

Acta Parasitologica, 2009, 54(3), 205–217; ISSN 1230-2821

VERSITA

Polyopisthocotylean monogeneans from carangid fishes off Queensland, Australia and New Caledonia, with a description of *Heteromicrocotyloides megaspinosus* sp. nov.

Diane P. Barton[1,2], Charles Beaufrère[3], Jean-Lou Justine[3] and Ian D. Whittington[2,4]*

[1]School of Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia; [2]Monogenean Research Laboratory, Parasitology Section, The South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia;
[3]Équipe Biogéographie Marine Tropicale, Unité Systématique, Adaptation, Évolution (CNRS, UPMC, MNHN, IRD), Institut de Recherche pour le Développement, BP A5, 98848 Nouméa Cedex, Nouvelle-Calédonie;
[4]Marine Parasitology Laboratory, School of Earth & Environmental Sciences, DX 650 418, The University of Adelaide, North Terrace, Adelaide, South Australia 5005, Australia

Abstract

Gills of carangid fishes in Australian waters are dominated by a diversity of polyopisthocotylean monogeneans. This study updates current knowledge of polyopisthocotyleans from carangid hosts in waters along the Queensland coast of Australia and also off New Caledonia. The discovery of *Protomicrocotyle celebesensis* Yamaguti, 1953 is the first record for the genus in Australian waters and represents a new geographic location for the species, extending its distribution from Sulawesi, Indonesia and Hawaii to Australia. Furthermore, *Caranx ignobilis* and *Carangoides fulvoguttatus* are reported as new host records for *P. celebesensis*. *Carangoides gymnostethus* is recorded as a new host for *Heteromicrocotyla australiensis* Rohde, 1977 from a new geographic location, namely Lizard Island, Queensland. *Heteromicrocotyloides mirabilis* Rohde, 1977 is reported from the gills of *C. fulvoguttatus* off Lizard Island, Queensland representing a new geographic record. *Heteromicrocotyloides megaspinosus* sp. nov. is described from the gills of *C. fulvoguttatus* from Lizard Island, Queensland and New Caledonia. The new species is distinguished from *H. mirabilis* by the larger number and size of spines in the male genital corona. *Gonoplasius carangis* was collected from *Pseudocaranx dentex* at Heron Island, Queensland. *Gonoplasius longirostri* is synonymised with *G. carangis* due to overlap in measurements and similar morphology. The number of 'dorsal pits' in this taxon may not be a useful character because they can be cryptic and hard to see. Most hosts from which these two *Gonoplasius* species have been collected previously have been synonymised as *Pseudocaranx dentex* except *Caranx ascensionis* which is now considered to be *C. lugubris*. Our report of *G. carangis* from *P. dentex* at Heron Island, Queensland is a new geographic record.

Résumé

Les branchies des poissons Carangidae des eaux Australiennes sont dominées par une variété de monogènes Polyopisthocotylea. Cette étude met à jour notre connaissance actuelle des Polyopisthocotylea des Carangidae des eaux des côtes du Queensland (Australie) et aussi de Nouvelle-Calédonie. La découverte de *Protomicrocotyle celebesensis* Yamaguti, 1953 est la première mention du genre dans les eaux Australiennes et représente une nouvelle mention géographique pour l'espèce, étendant sa distribution depuis le Sulawesi, l'Indonésie et Hawaii jusqu'à l'Australie. De plus, *Caranx ignobilis* et *Carangoides fulvoguttatus* sont rapportés comme nouveaux hôtes pour *P. celebesensis*. *Carangoides gymnostethus* est rapporté comme nouvel hôte pour *Heteromicrocotyla australiensis* Rohde, 1977, d'une nouvelle localité géographique, Lizard Island, Queensland. *Heteromicrocotyloides mirabilis* Rohde, 1977 est rapporté des branchies de *C. fulvoguttatus* de Lizard Island, Queensland, comme nouvelle mention géographique. *Heteromicrocotyloides megaspinosus* sp. nov. est décrit des branchies de *C. fulvoguttatus* de Lizard Island, Queensland et de Nouvelle-Calédonie. La nouvelle espèce est distinguée de *H. mirabilis* par des épines plus nombreuses et plus longues dans la couronne génitale. *Gonoplasius carangis* a été collecté de *Pseudocaranx dentex* à Heron Island, Queensland. *Gonoplasius longirostri* est synonymisé avec *G. carangis* sur la base de recouvrements des mensurations et d'une morphologie similaire. Le nombre de "puits dorsaux" dans ce taxon n'est probablement pas un caractère utile car ces structures peuvent être cryptiques et difficiles à voir. La plupart des hôtes chez lesquels ces deux espèces de *Gonoplasius* ont été précédemment collectées ont été synonymisés avec *Pseudocaranx dentex*, à part *Caranx ascensionis* qui est maintenant considéré comme étant *C. lugubris*. Notre mention de *G. carangis* chez *P. dentex* à Heron Island, Queensland, est une nouvelle mention géographique.

*Corresponding author: whittington.ian@saugov.sa.gov.au

Keywords
Monogenea, Polyopisthocotylea, *Heteromicrocotyloides megaspinosus* sp. nov., Carangidae, Australia, New Caledonia

Introduction

During independent surveys of gill parasites from various species of Carangidae along the Great Barrier Reef and coastal Queensland waters by DPB and IDW, several polyopisthocotylean monogeneans were recovered. Previous records of monogeneans from carangids off Australia have shown the fauna to be dominated by polyopisthocotyleans. Of 11 records from 7 carangid species listed as hosting monogeneans in the checklist of parasites of Australian and Antarctic fishes by Beumer *et al*. (1982), 10 represent polyopisthocotyleans. A subsequent checklist of parasites of fish from Heron Island by Lester and Sewell (1989) added a further 10 records from carangids, of which only one is not a polyopisthocotylean. Klaus Rohde kindly donated parasite specimens from carangids from his personal slide collection for use in our study. This paper enhances the current knowledge of polyopisthocotylean monogeneans from carangid hosts in Queensland waters. We also include records of taxa recovered from some carangids surveyed off New Caledonia by J.-L.J. In New Caledonia (lists in Justine 2007), only 4 species of polyopisthocotylean monogeneans have been recorded. The present paper presents the first records of monogeneans from carangids off New Caledonia.

Materials and methods

In Queensland, Australia, fish were collected opportunistically along the Queensland coast over a number of years (1974 to 2002; Table I) either by hand line or seine net. Most fish were examined fresh; others were examined following thawing after freezing. Gills from most fish collected by the authors were removed and placed in individual Petri dishes of seawater and studied for parasites, or gills were fixed immediately in 10% formalin; all monogeneans were removed and preserved in 70% ethanol. Monogeneans recovered alive were removed using fine needles and then fixed under partial pressure beneath a coverslip on a slide using 10% formalin. Gills of fish collected by Klaus Rohde were removed and fixed in hot 10% formalin; parasites were removed post-fixation. Some specimens were hydrated, stained with acetocarmine or Grenacher's carmine alum, dehydrated through a graded alcohol series, cleared in xylene and mounted in DPX; others were cleared in methyl salicylate and mounted unstained in Canada balsam.

Carangids off New Caledonia were collected in 2003–2005. Each fish was photographed, measured, weighed and assigned a unique number (JNC). Fish were observed fresh and monogeneans were flattened alive between 2 microscope slides and fixed with cold ethanol. Specimens were then stained with carmine or were left unstained and mounted in Canada balsam, according to Justine (2005). One of the specimens of *Carangoides fulvoguttatus* (Forsskål, 1775) was deposited in the ichthyological collections of the Muséum National d'Histoire Naturelle [MNHN], Paris, France with the registration number JNC1577.

Some specimens of *Protomicrocotyle celebesensis* Yamaguti, 1953 removed from frozen and then thawed gills of *Caranx ignobilis* (Forsskål, 1775) caught off Cleveland Bay, Townsville, Queensland were fixed in 10% formalin and processed for scanning electron microscopy (SEM). Seven specimens were post-fixed in ~0.5% aqueous osmium tetroxide for 15 min and dehydrated in a graded ethanol series. All specimens were critical point dried in an atmosphere of ethanol and CO_2, mounted on an aluminium stub, sputter coated with platinum using a Bal-Tec Med 020 coating system and examined with a JEOL 6300F Field Emission SEM operating at 30 kV at The University of Queensland, Brisbane, Queensland, Australia.

Drawings were made with the aid of a drawing tube and measurements were made using an ocular micrometer. Measurements are presented in micrometres, unless otherwise stated. We appreciate that little is known about the functional morphology of the male copulatory organs of many polyopisthocotylean monogeneans. However, we have adopted the terminology of Rohde (1977; 'cirrus', 'cirrus pouch', 'cirrus corona', 'accessory copulatory apparatus') and Mamaev (1988; 'circum-cirrus armature') for *Heteromicrocotyloides* and Heteromicrocotylidae, respectively, for consistency.

The following specimens were borrowed from museum collections for comparison with newly collected material: Australian Museum [AM], Sydney, Australia, AM W15023 *Protomicrocotyle mannarensis* Ramalingam, 1960 from *Caranx melampygus* Cuvier, 1833, Papua New Guinea, AM W9212 *Heteromicrocotyloides mirabilis* Rohde, 1977, holotype from '*Carangoides emburyi*', Heron Island, Queensland; British Museum (Natural History) [BMNH], London, UK, 1987.9.9.5-6 *Gonoplasius carangis* Sandars, 1944 from *Pseudocaranx dentex* (Bloch et Schneider, 1801), Perth, Western Australia; Meguro Parasitological Museum [MPM], Tokyo, Japan, 22909 *Protomicrocotyle celebesensis* Yamaguti, 1953 (holotype) from *Caranx* sp., Macassar, Indonesia; South Australian Museum [SAMA], Parasitology Section, North Terrace, Adelaide, South Australia 5000, Australia, AHC 40848 (V848) *Gonoplasius carangis* Sandars, 1944 (holotype) from *Caranx georgianus* (now *Pseudocaranx dentex*; see Froese and Pauly 2008) Perth, Western Australia; United States National Museum Parasite Collection [USNPC], Beltsville, Maryland, USA, 39435 *Microcotyle longirostri* Robinson, 1961 from

Table I. Fish species infected by monogeneans in this study, including location and collection date

Fish species	Location	Latitude/Longitude	Monogenean species	Collector*	Collection date
Carangoides fulvoguttatus	Lizard Island	14°40´S, 145°27´E	*Heteromicrocotyla mirabilis*	IDW	August 1992
Carangoides fulvoguttatus	Lizard Island	14°40´S, 145°27´E	*Heteromicrocotyloides megaspinosus* sp. nov.	IDW	August 1992
Carangoides fulvoguttatus	Lizard Island	14°40´S, 145°27´E	*Protomicrocotyle celebesensis*	KR	August 1974
Carangoides fulvoguttatus	Nouméa	22°14´S, 166°21´E	*Heteromicrocotyla australiensis*	JLJ-JNC463**	March 2003
Carangoides fulvoguttatus	Nouméa	22°14´S, 166°21´E	*Heteromicrocotyloides megaspinosus* sp. nov.	JLJ-JNC463**	March 2003
Carangoides fulvoguttatus	Nouméa	22°13´S, 166°23´E	*Heteromicrocotyla australiensis*	JLJ-JNC728**	July 2003
Carangoides fulvoguttatus	Nouméa	22°13´S, 166°23´E	*Heteromicrocotyloides megaspinosus* sp. nov.	JLJ-JNC728**	July 2003
Carangoides fulvoguttatus	Nouméa	22°20´S, 166°15´E	*Heteromicrocotyla australiensis*	JLJ-JNC763**	July 2003
Carangoides fulvoguttatus	Nouméa	22°20´S, 166°15´E	*Heteromicrocotyloides megaspinosus* sp. nov.	JLJ-JNC763**	July 2003
Carangoides fulvoguttatus	Nouméa	22°29´S, 166°28´E	*Heteromicrocotyloides megaspinosus* sp. nov.	JLJ-JNC1577**	September 2005
Carangoides gymnostethus	Lizard Island	14°40´S, 145°27´E	*Heteromicrocotyla australiensis*	IDW	August 1992
Caranx ignobilis	Heron Island	23°26´S, 151°54´E	*Protomicrocotyle celebesensis*	KR	July 1975
Caranx ignobilis	Cleveland Bay, near Townsville	19°13´S, 146°55´E	*Protomicrocotyle celebesensis*	DPB	August 2002
Pseudocaranx dentex	Heron Island	23°26´S, 151°54´E	*Gonoplasius carangis*	IDW	November 1992

*DPB – Diane P. Barton, IDW – Ian D. Whittington, JLJ – Jean-Lou Justine, KR – Klaus Rohde; **JNC numbers differentiate these 4 individuals (see Table V).

Longirostrum platessa (now *P. dentex;* see Froese and Pauly 2008) Cook Strait, New Zealand, 71955 *Gonoplasius carangis* from *Caranx nobilis* (now *P. dentex*; see Froese and Pauly 2008) from Ulladulla, New South Wales, Australia.

Type and voucher material of taxa reported in this paper are deposited in the Muséum National d'Histoire Naturelle [MNHN], Paris, France, MPM, the Queensland Museum [QM], Parasitology, Biodiversity Program, Queensland Museum, P.O. Box 3300, South Brisbane, Queensland 4101, Australia, SAMA and USNPC.

Results and discussion

Protomicrocotylidae Poche, 1926
Protomicrocotylinae Johnston et Tiegs, 1922
Protomicrocotyle Johnston et Tiegs, 1922

***Protomicrocotyle celebesensis* Yamaguti, 1953** (Fig. 1, Table II)

Hosts: *Caranx* sp. (see Yamaguti 1953); *Caranx sexfasciatus* Quoy et Gaimard, 1825 (see Yamaguti 1968); *Caranx ignobilis* (Forsskål, 1775) (present study; new host record); *Carangoides fulvoguttatus* (Forsskål, 1775) (present study; new host record).

Geographic localities: Macassar, Sulawesi, Indonesia (Yamaguti 1953); Hawaii (Yamaguti 1968); Heron Island, Great Barrier Reef, Queensland, Australia (present study for *Caranx ignobilis*; new geographic record); Lizard Island, Great Barrier Reef, Queensland, Australia (present study for *Carangoides fulvoguttatus*; new geographic record); Cleveland Bay, Townsville, Queensland, Australia (present study for *Caranx ignobilis*; new geographic record).

Site: Gills, primary gill lamellae (present study).

Specimens studied: Total of 27 whole-mounts and 7 specimens prepared for SEM; 10 whole-mounts measured. Three voucher specimens deposited in the QM (G222341-222343) from *Caranx ignobilis*, Cleveland Bay, Queensland; 6 voucher specimens (6 slides) deposited in the Australian Helminthological Collection [AHC] of SAMA (AHC 29620) from *Caranx ignobilis*, Cleveland Bay, Queensland; 4 voucher specimens (2 slides) deposited in the AHC of SAMA (AHC 29621) from *Carangoides fulvoguttatus*, Lizard Island, Queensland; 8 voucher specimens (2 slides) deposited in the AHC of SAMA (AHC 29622) from *Caranx ignobilis*, Heron Island, Queensland; 2 voucher specimens (2 slides) deposited in MPM (18882) from *Caranx ignobilis*, Cleveland Bay, Queensland; 2 voucher specimens (2 slides) deposited in MNHN (HEL 80-81) from *Caranx ignobilis*, Cleveland Bay, Queensland; 2 voucher specimens (2 slides) deposited in the USNPC (101567) from *Caranx ignobilis*, Cleveland Bay, Queensland.

Table II. Comparative measurements in micrometres of *Protomicrocotyle celebesensis* Yamaguti, 1953 from specimens collected in this study and those reported by Yamaguti (1953, 1968)

Character	Yamaguti (1953) from Macassar, Sulawesi	Yamaguti (1968) from Hawaii	Specimens from Lizard Island (present study)	Specimens from Heron Island (present study)	Specimens from Cleveland Bay (present study)
Number of specimens	n = 6	n = 6	n = 4	n = 4	n = 10
Body length	4000–5100	3000–4000	2100–2920	2920–3480	2854 (2100–3260)
Body width	600–830	370–600	480–620	1120–1200	366 (280–460)
Haptor transverse length	–	200–300	600–680	1040–1300	344–424
Haptor width	–	100–180	180–260	200–300	112–136
Hamulus length	30–35	27–35	28–30	30–36	24–28
Posterior hook length	15–20	15–20	16–18	14–18	14–18
Small hook length	–	10–13	14–16	10–16	13
Clamp diameter or length × width	–	35–45	46–58 × 54–58	48–64 × 70–78	35–40 × 39–44
Buccal sucker length × width	27–45 × 30–48	22–33 × 30–45	60–62 × 40–44	78–86 × 50–60	41 × 25
Pharynx length × width or diameter	39–60 × 37–50	42–50 × 32–50	40–46	46–54	42 × 32
Number of testes	40–55	29–44	56–76	–	40–49
Testes width × length	–	–	40–60 × 20–40	–	–
Number of genital corona spines	16–22	17–20	20–21	18–24	19–21
Length of genital corona spines	16–22	20	10–12	10–20	11
Anterior-genital pore distance	375–630	290–400	310–366	320–540	364
Anterior-vagina distance	500–830	380–550	380–500	420–600	458
Vagina length	–	110–130 × 75–90	110–126	168–206	
Egg length × width	165–210 × 60–80	150–200 × 62–85	130	166–210	44
Egg filament length	240–300	120–180	–	–	52
Host species	*Caranx* sp.	*Caranx sexfasciatus*	*Carangoides fulvoguttatus*	*Caranx ignobilis*	*Caranx ignobilis*

Table III. Comparative measurements in micrometres of *Heteromicrocotyla australiensis* Rohde, 1977 for specimens collected in this study and those reported by Rohde (1977)

Character	Rohde (1977) from Heron Island	Specimen from Lizard Island (present study)	Specimens from New Caledonia (present study)
Number of specimens	n = 3	n = 1	n = 6
Body length	5370 (4900–6000)	5000	5630 (4200–6200)
Body width	740 (650–810)	960	840 (600–1120)
Length of haptor on side of sessile clamps	2330 (2000–2800)	1800	2480 (1850–3100)
Length of haptor on side of pedunculate clamps	1670 (1400–2100)	1600	2110 (1650–3050)
Anterior sessile clamp length × width	45 × 113 (39–58 × 104–120)	59 × 107 (49–69 × 79–128)	70 × 100 (50–100 × 70–110)
Posterior sessile clamp length × width	45 × 72 (42–47 × 72)	49 × 79 (41–54 × 69–85)	50 × 80 (45–60 × 70–90)
Largest sessile clamp length × width	86 × 250 (65–101 × 234–272)	80 × 224	100 × 270 (100–115 × 210–300)
Largest pedunculate clamp length × width	129 × 58	128 × 56	130 × 70 (110–150 × 60–75)
Number of sessile clamps	32–33	28	26–33
Number of pedunculate clamps	33–36	30	29–36
Number of testes	approx. 105–135	approx. 100	76–90
Pharynx length × width	48 × 38 (40–58 × 32–47)	62 × 42	50 × 40 (30–55 × 20–50)
Buccal sucker length × width	62 × 87 (50–75 × 76–101)	81 × 49 (80–82 × 46–52)	70 × 50 (60–80 × 40–65)
Number of small hooks of accessory copulatory apparatus	many	approx. 50	32–53
Length of large hooks of accessory copulatory apparatus	33 (29–36)	25–32	30–35
Number of spines around opening of genital atrium	39–42	42	50–82
Length of spines around opening of genital atrium	19 (18–22)	24–25	20–40
Eggs without filaments	136 × 55	141 (132–150)	–
Host species	*Carangoides fulvoguttatus* (as *C. emburyi*)	*Carangoides gymnostethus*	*Carangoides fulvoguttatus*

Supplementary information for new material: Measurements for *P. celebesensis* collected in this study are presented in Table II for comparison with measurements previously presented in the literature (Yamaguti 1953, 1968). Although there is some variation in measurements, there are no differences in anatomy between specimens described by Yamaguti (1953, 1968) and specimens reported here. Our study presented an opportunity to study the external surface of the 'caudal lobe' of Yamaguti (1953) and haptor of *P. celebesensis* using SEM shown in Figure 1A-E.

Body fusiform (Fig. 1A), maximum width just anterior to ovary (Table II). Posteriorly, pillow-like caudal lobe of Yamaguti (1953) posterior to haptor (Fig. 1A, B). Haptor bears single row of 4 clamps along ventral margin (e.g. Fig. 1B). Three pairs of hooks present posteriorly, tips directed ventrally, on caudal lobe of Yamaguti (1953); largest hooked sclerites forming outer pair (Fig. 1C), second largest hook pair innermost. External surface of caudal lobe of Yamaguti (1953) covered with transverse striations (Fig. 1B, C).

Anterior end rounded, mouth subterminal (Fig. 1D). Common genital pore situated in median line, approximately one-fifth of body length from anterior end. From SEM, ventral region surrounding common genital pore is transversely striated (Fig. 1D, E). Vagina with distal array of numerous long, closely packed sclerotised spines (too densely packed to count and measure); vaginal spines less noticeable in specimens from Cleveland Bay; opens ventro-laterally at posterior edge of striated region (Fig. 1D, E). Vaginal pore may be provided with small, indistinct tegumental (?) spines.

Remarks: *Protomicrocotyle celebesensis* was described by Yamaguti (1953) from the gills of *Caranx* sp. collected in the waters of Sulawesi (formerly Celebes), Indonesia. Yamaguti (1968) redescribed the species from the gills of *Caranx sexfasciatus*, thereby expanding the parasite's distribution to Hawaii.

No species of *Protomicrocotyle* has been reported from fish in Australian waters (Beumer *et al*. 1982, Lebedev 1986). There has, however, been a record of the presence of members of the Protomicrocotylidae from 2 species of trevally (*C. ignobilis* and *C. melampygus*) at Heron Island (Lester and Sewell 1989), but these parasites were neither formally identified nor described.

This is the first record of *P. celebesensis* in Australian waters and extends its distribution from Indonesia and Hawaii. The hosts reported in this study, *C. ignobilis* from Heron Island and Cleveland Bay, Queensland and *Carangoides fulvoguttatus* from Lizard Island, Queensland, are also new host records for *P. celebesensis*. The distributions of *Caranx ignobilis* and *C. sexfasciatus* are almost identical, extending throughout most of the western half of the Pacific Ocean (see Froese and Pauly 2008). The wide distribution of these host species likely accounts for the equally wide distribution of the parasite species. In New Caledonia, four specimens of *Carangoides fulvoguttatus* examined had no *Protomicrocotyle* species. No specimens of *Caranx ignobilis* or *C. sexfasciatus* were examined in New Caledonia.

Heteromicrocotylidae Unnithan, 1961
Heteromicrocotyla Yamaguti, 1953

***Heteromicrocotyla australiensis* Rohde, 1977** (Table III)

Hosts: *Carangoides fulvoguttatus* (Forsskål, 1775) (as *C. emburyi*, see Rohde 1977); *Carangoides gymnostethus* (Cuvier, 1833) (present study).

Geographic localities: Heron Island, Great Barrier Reef, Queensland, Australia (Rohde 1977); Lizard Island, Great Barrier Reef, Queensland, Australia (present study for *C. gymnostethus*; new geographic record); off Nouméa, New Caledonia (present study for *C. fulvoguttatus*; new geographic record).

Site: Primary gill lamellae.

Specimens studied: 1 whole-mount from Australia measured; 1 voucher (AHC 29626) specimen deposited in the AHC of SAMA; 6 specimens from New Caledonia measured; 1 voucher (AHC 29681), 5 vouchers (MNHN JNC463).

Measurements are presented in Table III. There are no differences in the anatomy of specimens described in the original description (Rohde 1977) and the specimens reported here.

Remarks: One specimen of *H. australiensis* was collected in this study from the gills of *C. gymnostethus* from Lizard Island, Queensland and 6 from *C. fulvoguttatus* off New Caledonia. Rohde (1977) described this species from *C. emburyi* at Heron Island; this species was subsequently recorded from *C. fulvoguttatus*, also at Heron Island (Lester and Sewell 1989). *Carangoides emburyi* has been synonymised with *C. fulvoguttatus* (see Froese and Pauly 2008). The measurements of our specimens are within the range given by Rohde (1977) (see Table III). Therefore, our findings represent a new host and geographic record for *H. australiensis* on carangid fishes in Queensland waters and a new geographic record from the type-host in New Caledonia. Only a single specimen of *C. gymnostethus* has been examined in New Caledonia but this parasite taxon was not found.

Heteromicrocotyloides Rohde, 1977

***Heteromicrocotyloides mirabilis* Rohde, 1977** (Fig. 2B, D; Table IV)

Host: *Carangoides fulvoguttatus* (Forsskål, 1775) (as *C. emburyi*, see Rohde 1977; Mamaev 1988; present study); *Carangoides ciliarius* (Rüppell, 1830) (see Mamaev 1988).

Geographic localities: Heron Island, Great Barrier Reef, Queensland, Australia (Rohde 1977); East Coast of Africa (Mamaev 1988); Lizard Island, Great Barrier Reef, Queensland (present study for *C. fulvoguttatus*; new geographic record).

Site: Middle of gill filaments (Rohde 1977); primary gill lamellae (present study).

Specimens studied: 4 whole-mounts measured. Four voucher specimens (4 slides) deposited in the AHC of SAMA (AHC 29627).

There are no differences in the anatomy of specimens described in the original description (Rohde 1977) and specimens reported here (see Table IV and Fig. 2B, D).

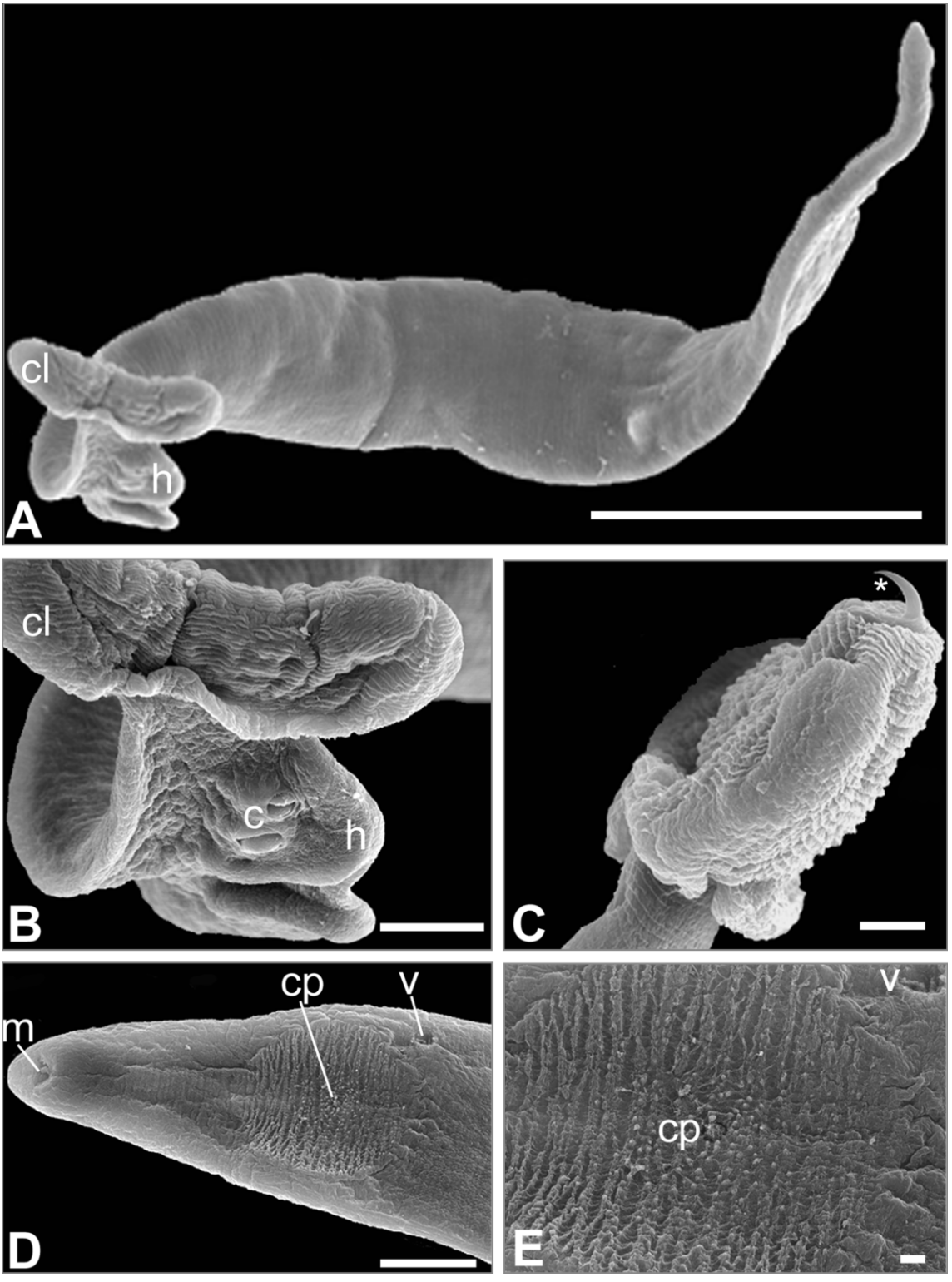

Fig. 1. Scanning electron micrographs of *Protomicrocotyle celebesensis* Yamaguti, 1953 collected from the gills of *Caranx ignobilis*. **A** – whole specimen showing curved, asymmetrical posterior extremity comprising haptor (h) and caudal lobe (cl) of Yamaguti (1953). **B** – ventral surface of posterior extremity showing transversely-striated caudal lobe (cl) of Yamaguti (1953) and haptor (h) on which 2 (of 4 in total) of the posterior-most clamps (c) can be seen in lateral view. **C** – caudal lobe of Yamaguti (1953), lateral view, showing transverse striations along dorsal and ventral surfaces and tip of 1 ventrally-directed large sclerite (asterisk) protruding from posterior edge. **D** – anterior end, ventral view, showing location of mouth (m), common genital pore (cp) surrounded by transversely-striated region and ventro-lateral vaginal opening (v). **E** – transverse striations on ventral body tegument surrounding common genital pore (cp). Vaginal opening (v) is nearby. Scale bars = 500 μm (A), 50 μm (B), 25 μm (C), 100 μm (D), 10 μm (E)

Remarks: In this study, specimens of *H. mirabilis* were found on the gills of *Carangoides fulvoguttatus* from Lizard Island. Rohde (1977) originally described this species from *C. emburyi* (= *C. fulvoguttatus*; see Froese and Pauly 2008) from Heron Island. It was subsequently recorded from *C. fulvoguttatus* from Heron Island in the checklist of Lester and Sewell (1989). A comparison of the measurements of our specimens of *H. mirabilis* with Rohde's specimens shows considerable overlap in most criteria (Table IV). Minor differences in measurements likely relate to intraspecific variation. The present report represents a new geographic record for *H. mirabilis* on carangids in Queensland waters. This species was not found on *C. fulvoguttatus* in New Caledonia.

***Heteromicrocotyloides megaspinosus* sp. nov.** (Figs 2A, C; 3; Table IV)

Host: *Carangoides fulvoguttatus* (Forsskål, 1775).

Geographic locality: Lizard Island, Great Barrier Reef, Queensland, Australia (type-locality); additional type-locality, off New Caledonia.

Site: Primary gill lamellae.

Specimens studied: 12 from Australia, 10 whole-mounts measured; more than 20 examined from New Caledonia, 12 whole-mounts measured. Holotype (AHC 29623) deposited in the AHC of SAMA; paratypes from Australia deposited: 2 in AHC of SAMA (AHC 29624-29625), 3 in MNHN (HEL 82-

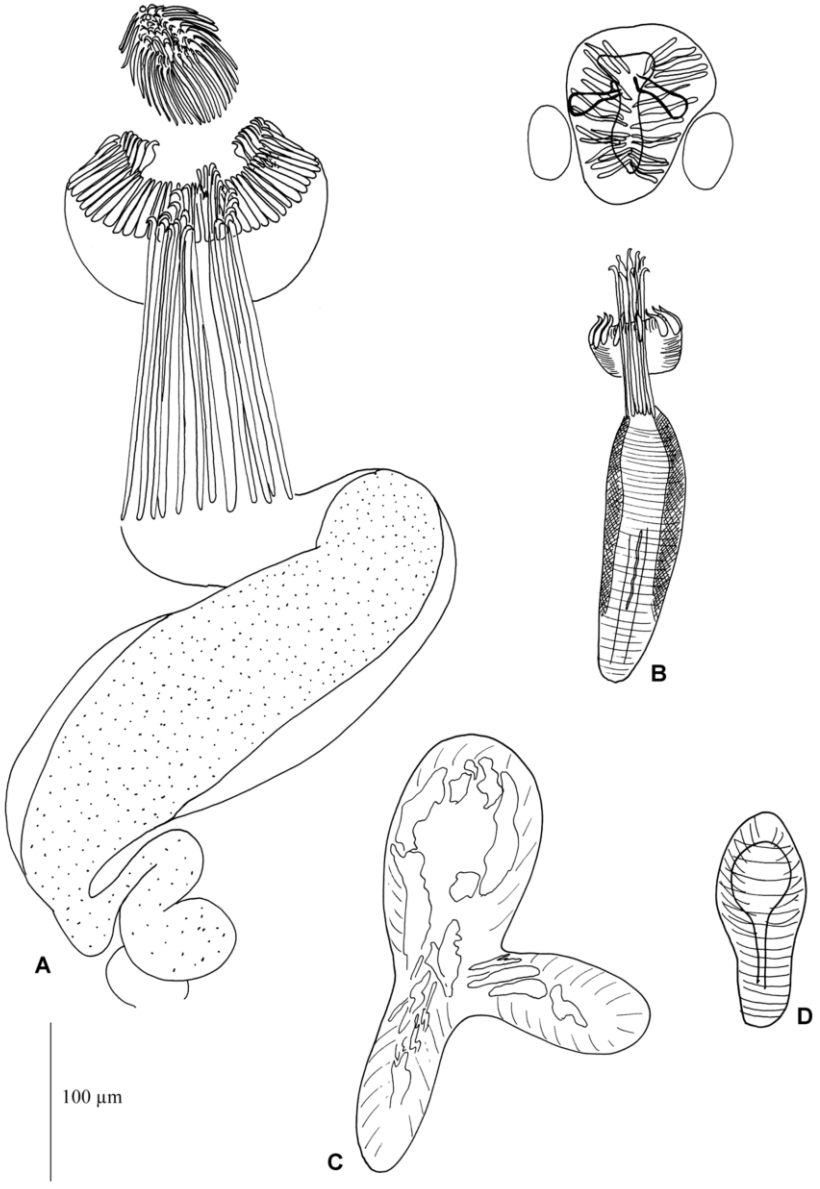

Fig. 2. Comparison of male and female genital parts of *Heteromicrocotyloides megaspinosus* sp. nov. and *Heteromicrocotyloides mirabilis* Rohde, 1977. **A** and **B** – male copulatory apparatus. **C** and **D** – vagina. **A** and **C**. *Heteromicrocotyloides megaspinosus* sp. nov. **B** and **D**. *H. mirabilis*, drawn from holotype AM W9212. All drawings to same scale. Scale bar = 100 µm

Table IV. Comparative measurements in micrometres of *Heteromicrocotyloides* spp. specimens collected in this study and *H. mirabilis* collected by Rohde (1977)

Characteristic	*H. mirabilis* from Rohde (1977)	Holotype of *H. mirabilis* (present study)	*H. mirabilis* from Lizard Island (present study)	*H. megaspinosus* sp. nov. from Lizard Island (present study)	*H. megaspinosus* sp. nov. from Nouméa (present study)*
Number of specimens	n = 3	1 (holotype)	n = 4	n = 10	n = 12
Body length	4830 (4500–5000)	4600	3040 (2720–3320)	2867 (2590–3440)	3580 (2000–5600)
Body width	2250 (2200–2300)	830	1006 (960–1060)	1123 (940–1640)	1510 (350–2800)
1st clamp pad length × width	800 × 180 (730–870 × 180–190)	880 × 190	646 × 220 (540–800 × 200–240)	728 × 164 (560–900 × 131–180)	920 × 270 (480–1800 × 100–500)
2nd clamp pad length × width	590 × 190 (570–620 × 180–210)	600 × 200	566 × 226 (500–680 × 200–240)	492 × 169 (392–540 × 153–200)	700 × 270 (320–1450 × 100–450)
3rd clamp pad length × width	690 (650–740)	750 × 350	686 × 180 (560–860)	656 × 203 (500–860 × 192–220)	870 × 240 (420–1550 × 90–450)
Large sessile clamp length × width	180 × 40 (180 × 39–45)	170 × 50	202 × 64 (184–224 × 56–72)	149 × 36 (128–176 × 32–40)	190 × 50 (110–250 × 40–60)
Number of clamps on 1st pad	17–20	20	11–13	19–25	12–22
Number of clamps on 2nd pad	13–14	13	10–11	14–17	9–15
Number of clamps on 3rd pad	20–24	28	20–22	17–24	21–28
Number of testes	70–90	approx. 75	>60	>60	60–100
Pharynx length × width	48 × 36 (47–50 × 29–43)	40 × 25	47 × 34 (40–58 × 30–40)	47 × 37 (42–52 × 32–40)	60 × 40 (40–100 × 25–80)
Buccal suckers length × width	130 × 83 (120–140 × 80–90)	115–140 × 70–75	98 × 61 (82–104 × 52–68)	127 × 64 (114–140 × 50–86)	115 × 75 (70–190 × 30–140)
Number of spines of accessory copulatory apparatus	approx. 36	approx. 36	approx. 30	approx. 50	approx. 55
Length of spines of accessory copulatory apparatus	41 (36–43)	40	26 (24–30)	42 (39–46)	50 (30–65)
Number of U-shaped hooks of accessory copulatory apparatus	2	2	2	0	0
Number of spines of “cirrus corona”	8–10	8	12–16	40–51	41–53
Length of spines of “cirrus corona”	22	20	27 (26–28)	42 (40–46)	50 (40–50)
Number of circum-cirrus spines	8	8	6–8	18–26	20–26
Length of circum-cirrus spines	120 (110–130)	100	145 (142–148)	213 (200–231)	220 (200–240)
Eggs without filaments length × width	126 × 53 (122–130 × 50–58)	–	147 (140–160)	110 × 32	–
Host species	*Carangoides fulvoguttatus* (as *C. emburyi*)	*Carangoides fulvoguttatus* (as *C. emburyi*)	*Carangoides fulvoguttatus*	*Carangoides fulvoguttatus*	*Carangoides fulvoguttatus*

*All measurements are of specimens from JNC463 (March 2003).

84), 2 in MPM (18883), 2 in USNPC (101568-69); paratypes from New Caledonia deposited: 2 in the AHC of SAMA (AHC 29682-29683), 1 in USNPC (102009); 12 in MNHN (10 slides JNC463, 2 slides JNC1577).

Etymology: This species is named for the large number and size of the various spines present in the armature of the terminal genitalia.

Description: Body triangular, widest posteriorly, tapering anteriorly (Fig. 3A). Haptor not distinctly set off from body, oblique-transverse to longitudinal axis of body, comprising 3 pads of clamps, 2 anterior pads with sessile clamps, 1 posterior pad with pedunculate "fire-tong"-shaped clamps (Fig. 3A). Sessile clamps largest at posterior end of first pad and in middle of second pad, supported by 3 pairs of arcuate marginal sclerites (1 sometimes incomplete, other 2 fused, Fig. 3D, E) and central V-shaped sclerite consisting of several parts. Pedunculate clamps with 2 valves, 1 larger (Fig. 3H) and 1 smaller (Fig. 3I), each valve with single elongate peduncular sclerite and 2 small sclerites at base of peduncle (Fig. 3H, I); each complete clamp armed with 2 narrow marginal, arched sclerites (Fig. 3G) from smaller valve (Fig. 3I); larger valve with additional sclerotised structures (Fig. 3H); smaller valve lacking additional sclerotised structures (Fig. 3I). Between 2nd and 3rd clamp pad, 4–5 minute sessile clamps present (Fig. 3A, F), appearing 'aborted' with no consistently recognisable sclerites within them (Fig. 3F).

Buccal suckers paired, aseptate. Pharynx sub-globular, between suckers. Bifurcation of intestine anterior to level of genital pore. Intestinal caeca with medial and lateral diverticula extending into haptor anterior to clamps, coextensive for most of length with vitellarium (Fig. 3A).

Testes sub-globular, numerous (at least 60), in single layer, in median field running from posterior of ovary to short distance anterior to end of caeca. Vas deferens becomes prominent in mid-body, sinuous, sperm-filled, runs anteriorly, enters muscular cirrus pouch which opens into unarmed genital atrium; opening of cirrus pouch into genital atrium lined ventrally with semicircle of >40 spines ("cirrus corona", Figs 2A; 3B); cirrus thin, unarmed, surrounded by circum-cirrus armature (terminology of Mamaev 1988) of 18–26 long spines. Common genital pore midventral. Opening of accessory copulatory apparatus midventral, anterior to genital pore; accessory copulatory apparatus armed with approximately 50 spines of more or less uniform small size (Figs 2A; 3B).

Ovary forms transverse loop, terminal part directed posteriorly. Ootype not observed. Uterus midventral, runs medial to vas deferens, opens with male duct through common genital pore. Vitellarium follicular, in lateral fields extending posteriorly from some distance behind bifurcation of intestine to end of caeca. Vaginal opening dorsal, at midline, approximately at end of second third of body, two arms directed posteriorly (Figs 2C; 3A, C). Eggs fusiform; filament present at each pole (not measured or drawn).

Remarks: *Heteromicrocotyloides* was proposed by Rohde (1977) for *H. mirabilis* recovered from the gills of *Carangoides emburyi* (now *C. fulvoguttatus*) from Heron Island. The major distinguishing feature for *Heteromicrocotyloides* is that all clamps are arranged in a single row on the haptor, compared to opposite sides of the haptor in *Heteromicrocotyla*, a closely similar genus. The clamps were subdivided into 2 pads of sessile clamps and 1 pad of pedunculate clamps. In addition, the circum-cirrus armature of *Heteromicrocotyloides* consisted of very long spines.

Differential diagnosis: The primary differences between *H. mirabilis* and the new species, *H. megaspinosus*, are the number and length of the spines in the "cirrus corona". There are approximately 4 times as many "cirrus corona" spines in *H. megaspinosus* and they are almost double the length of those found in *H. mirabilis* (compare Fig. 2A, B). In addition, *H. megaspinosus* has approximately 3 times as many spines in the circum-cirrus armature (see comparison in Fig. 2A, B). The vaginal opening of *H. megaspinosus* is more posterior than that in *H. mirabilis*. The presence of a U-shaped hook on each side of the accessory copulatory apparatus in *H. mirabilis* (Fig. 2B, Table IV) which are absent in *H. megaspinosus* (Fig. 2A, Table IV) is noted below in an emended generic diagnosis.

Note about the diagnosis of *Heteromicrocotyloides* Rohde, 1977

The original description of the genus (Rohde 1977, p. 179) includes the presence of 1 U-shaped hook on each side of the accessory copulatory apparatus (see Fig. 2B). Indeed, these are present in the holotype of *H. mirabilis*. The new species has no such U-shaped hooks. We propose to emend the generic diagnosis to "Accessory copulatory apparatus on each side with numerous uniform hooks and 1 or no U-shaped hooks".

Note about prevalences and intensities in *Carangoides fulvoguttatus* in New Caledonia

Table V shows that *Heteromicrocotyla australiensis* was found in 3 of the 4 fish examined and *Heteromicrocotyloides megaspinosus* was found in all 4 fish examined. Curiously, the biggest fish examined hosted the smallest number of monogeneans.

Heteraxinidae Price, 1962
Gonoplasinae Price, 1962
Gonoplasius Sandars, 1944

***Gonoplasius carangis* Sandars, 1944** (Table VI)

New synonym: *Gonoplasius longirostri* Robinson, 1961.

Hosts: *Pseudocaranx dentex* (Bloch et Schneider, 1801) (as *Caranx georgianus*, see Sandars 1944, Dillon *et al*. 1983; *Longirostrum platessa*, see Robinson 1961; *C. lutescens*, *Usacaranx nobilis*, see Dillon *et al*. 1983 following synonyms in Froese and Pauly 2008); *P. dentex*, see Williams (1991) and present study; *C. lugubris* Poey, 1860 (= *C. ascensionis* according to Froese and Pauly 2008 but misspelled as *adscensionis* by Dillon *et al*. 1983).

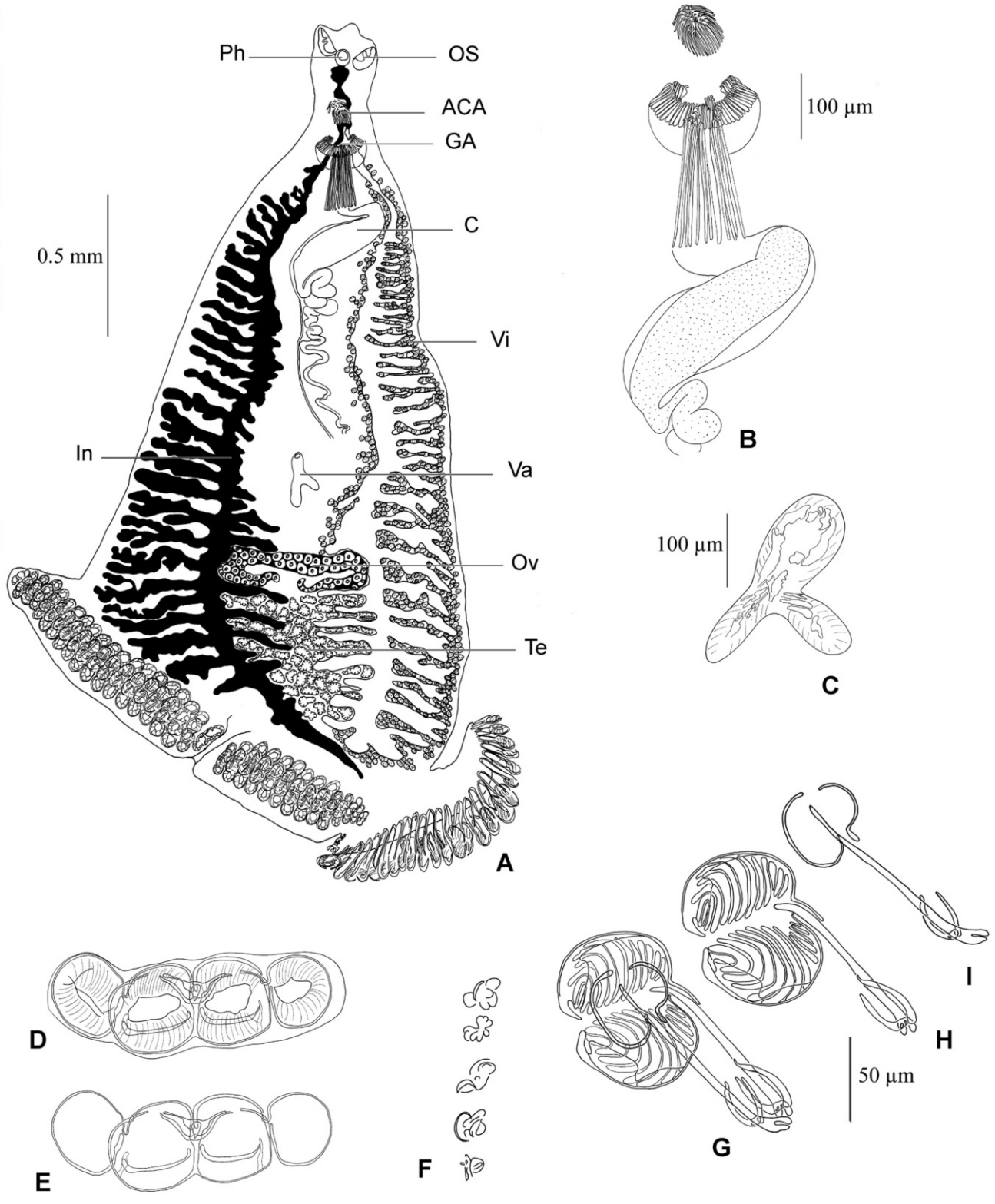

Fig. 3. *Heteromicrocotyloides megaspinosus* sp. nov. **A** – whole worm, ventral view. **B** – male copulatory apparatus. **C** – vagina. **D-I** – clamps: **D** and **E**, sessile clamps; **D**, whole view; **E**, sclerotised elements; **F**, minute sessile clamps; **G-I**, pedunculate clamps; **G**, complete pedunculate clamp comprising larger and smaller valves; **H**, larger valve and **I**, smaller valve drawn separately. In A, intestinal branch shaded black on 1 side and white on other side; vitellarium drawn only on 1 side. ACA – accessory copulatory apparatus; C – cirrus; GA – genital atrium; In – intestine; OS – buccal sucker; Ov – ovary; Ph – pharynx; Te – testes; Va – vagina; Vi – vitellarium. Scale bars = 0.5 mm (A), 100 µm (B-C), 50 µm (D-I)

Table V. Numbers of monogeneans from four specimens of *Carangoides fulvoguttatus* from New Caledonia

	Heteromicrocotyla australiensis	***Heteromicrocotyloides megaspinosus* sp. nov.**	**Date**	**Fork length (mm)**	**Weight (g)**
JNC463	8	17	March 2003	490	1750
JNC728	7	2	July 2003	288	420
JNC763	10	4	July 2003	470	1490
JNC1577	0	2	September 2005	600	2850
Total	25	25			

Geographic localities: North Beach, Rockingham, Western Australia, Australia (Sandars 1944, Williams 1991) (type locality); Ulladulla, New South Wales, Australia (Dillon *et al*. 1983); Cook Strait, New Zealand (Robinson 1961); Cockburn Sound, Perth, Western Australia (Williams 1991); Heron Island, Great Barrier Reef, Queensland, Australia (present study for *P. dentex*; new geographic record).

Site: Gills (Sandars 1944, Robinson 1961, Dillon *et al*. 1983); gill filaments (Williams 1991); primary gill lamellae (present study).

Specimens studied: 21 whole-mounts studied, 10 measured. Twenty one voucher specimens deposited in the following collections: 5 in AHC of SAMA (AHC 29628); 3 in QM (G222346-222348); 5 in MNHN (HEL 85-89); 4 in MPM (18884); 4 in USNPC (101570-73).

Supplementary information for new material: Body elongate, body wider posteriorly, merging with haptor. Haptor subsymmetrical with laterally directed end; armed with clamps in 2 unequal rows; longer clamp row, usually sinistral, armed with 18–25 clamps; shorter clamp row armed with 11–14 clamps. Clamps similar in structure, dissimilar in size. One pair of hamuli and 1 pair of modified marginal hooklets I and 1 pair of marginal hooklets II present on terminal lappet.

Anterior end truncate. Buccal suckers paired, septate. Pharynx bulbous, located between buccal suckers. Oesophagus moderately long with some short diverticula, bifurcating immediately posterior to genital atrium. Intestinal caeca not confluent posteriorly.

Testes elongate to globular, 39–45 in number, postovarian, between crura and extending posteriorly to anterior part of haptor. Vas deferens extending anteriorly in midline to cirrus. Genital atrium located near anterior end, complicated; anterior part with 2 lateral, opposing muscular pads, each armed with intermediate and large spines; posterior part of atrium with 2 lateral opposing muscular pads, armed with intermediate and large sized spines; posterior part of atrium also containing 2 clusters of small spines toward midline. Cirrus bulbous, armed with spines arranged in circle.

Ovary tubular, irregularly coiled in midline. Oviduct expanded, appearing to serve as seminal receptacle. Vitellarium beginning near level of vaginal pits and proceeding posteriorly, coextensive with intestinal caeca. Transverse vitelline ducts fusing medially to form Y-shaped vitelline reservoir. Vaginal pore mid-dorsal, with spine like sclerotisations. Single vaginal duct extending posteriorly for a short distance prior to bifurcating. Two areas, consisting of 2 groups of up to 5 sclerotised pits each, located on dorsal surface, postero-lateral to vaginal pore; body proper occasionally swollen at level of these pits. Eggs not observed in specimens from this study.

Remarks: Specimens of *Gonoplasius carangis* were collected in this study from *Pseudocaranx dentex* at Heron Island. This parasite was originally described by Sandars (1944) from the gills of *Caranx georgianus* from Perth, Western Australia, and redescribed by Williams (1991) from *P. dentex* from the same locality. The type host, *C. georgianus*, is now considered a synonym of *P. dentex* (see Froese and Pauly 2008). A subsequent record of *G. carangis* increased its geographic distribution to the eastern coast of Australia when Dillon *et al*. (1983) recorded it from *Usacaranx nobilis* (now also a synonym of *P. dentex*) from Ulladulla, NSW.

A closely related species, *G. longirostri* (Robinson, 1961) Price, 1962, was described as *Microcotyle longirostri* from the gills of *Longirostrum platessa* from Cook Strait, New Zealand (Robinson 1961). This host species is synonymised with *P. dente*x (see Froese and Pauly 2008). Dillon *et al*. (1983) also listed *G. longirostri* from *Caranx lutescens* ascribed to Lebedev (1968) and *Caranx adscensions* (a misspelling of *C. ascensionis*; see above) ascribed as a personal communication from Mamaev, both of which are now synonyms of *P. dentex* (see Froese and Pauly 2008). The differences between *G. carangis* and *G. longirostri* were for the latter: body swollen at level of vaginal pore; 2 groups of cuticle-lined pits on dorsal surface (as opposed to 2 pairs of dorsal armed suckers as described by Sandars 1944, fig. 19); lacking 2 lateral groups of 17–20 small hooks in anterior half of genital atrium. However, in the description by Dillon *et al*. (1983) for *G. carangis* collected at Ulladulla, they stated that their specimens occasionally had a swollen body at the level of the vaginal pits and the number of pits in each group ranged from 4–5. In addition, their diagram of the spines of the genital atrium lacked the large number of small spines in the genital atrium that was characteristic for *G. carangis* as described by Sandars (1944). In his redescription of *G. carangis*, Williams (1991) recorded fewer small spines in the genital atrium. Neither Dillon *et al*. (1983) nor Williams (1991) made mention of the relationship between *G. carangis* and *G. longirostri*.

Examination of museum specimens of *G. carangis* and *G. longirostri*, as well as specimens of *G. carangis* collected in this study, demonstrated considerable overlap in the features outlined by Robinson (1961) (Table VI). The ‘dorsal pits’ can

Table VI. Comparative measurements in micrometres of *Gonoplasius carangis* Sandars, 1944 for specimens collected in this study and published data

Characteristic	Sandars (1944) from Perth, Western Australia (WA)	Robinson (1961) from Cook Strait, New Zealand as *Microcotyle longirostri*	Dillon *et al*. (1983) from Ulladulla, New South Wales	Williams (1991) from Perth, WA	Present study from Heron Island, Queensland
Number of specimens	n = 5	n = 4	n = 27 (20 immature, 7 adult)	n = 1	n = 10
Body length	4750	6200–8800	3901 (3238–4379)	2735	2851 (2000–3576)
Body width (at ovary)	400	400–590	493 (368–679)	604	377 (288–624)
Number of clamps in row 1	34	37–45	36–38	34	18–25
Number of clamps in row 2	17	17–22	13–15	18	11–14
Width of largest clamps	75	75–110	80 (72–91)	109 (104–117)	83 (68–94)
Buccal organ length	62	70–85	48	103	46 (40–52)
Buccal organ width	150	96–109	69	79	70 (60–80)
Pharynx length	50	53–59	57 (53–60)	63	50 (40–58)
Pharynx width	37	48–55	48 (45–53)	43	37 (34–40)
Number of testes	48	54–75	38–42	40	39–45
Distance: anterior end to genital atrium	387	–	412 (368–460)		329 (250–414)
Length of anterior section of genital atrium		–	251 (221–268)		
Width of anterior section of genital atrium	137	–	178 (163–204)	209	158 (106–204)
Width of central section of genital atrium	75	–	–	114	72 (50–100)
Width of posterior section of genital atrium	125	–	–	140	115 (94–134)
Width of copulatory organ*	–	–	–	48	–
Number of hooks in central section of genital atrium*	–	–	20	11–12 each side	–
Number of genital atrium hooks in additional rows*	–	–	10–12	11–12 (2 rows)	–
Length of longer clamp row	112	–	972 (764–1159)	–	752 (544–1008)
Length of shorter clamp row	560	–	407 (313–505)	–	488 (376–640)
Distance: anterior end to vagina	–	–	948 (920–984)	–	
Egg length	–	–	237 (230–242)	–	–
Egg width	–	–	104 (103–106)	–	–
Host species	*Pseudocaranx dentex* (as *Caranx georgianus*)	*P. dentex* (as *Longirostrum platessa*)	*P. dentex* (as *Usacaranx nobilis*)	*P. dentex*	*P. dentex*

*The complex genital armature in *G. carangis* is difficult to compare clearly between specimens and collections because many genital hooks of different sizes occur in close proximity. Larger hooks or spines obscure smaller sclerites (e.g. see fig. 17 of Sandars 1944, fig. 44 of Robinson 1961 and fig. 8A of Williams 1991). It is especially difficult to count hooks arming the copulatory organ. These reasons account for the lack of data for these characters in this Table, including specimens collected in the present study.

be cryptic and hard to distinguish in some specimens because some individuals appeared to lack them but others had groups of up to 5 on each side of the body. The holotype of Sandars (1944) only has 2 pits on each side; however, the specimens of Dillon *et al*. (1983) were reported to have 4–5 while our specimens had between none and 5. The amount of swelling of the body, as described by Robinson (1961), appears to vary with the number of pits present. These observations suggest that the 'dorsal pits' may not be a particularly useful character. The number and arrangement of the different-sized hooks/spines associated with the complex genital armature of *G. carangis* and *G. longirostri* makes it a major challenge to count the total number present (see footnote to Table VI). Examination of the holotype of *G. carangis*, indicates that the spines may have been viewed by Sandars (1944) at an angle where bends in the spines may have led to an interpretation of two or three smaller spines as depicted in her fig. 17. We found that it was particularly difficult to count hooks arming the copulatory organ in all specimens of *G. carangis* that we studied. Nevertheless, there is considerable overlap in the morphology and morphometrics of *G. carangis* from several locations in Australia, including the current study, and the material of Robinson (1961) from New Zealand. We consider that *G. longirostri* is a synonym of *G. carangis*.

No specimens of *P. dentex* were examined off New Caledonia.

Acknowledgements. The authors thank the students of the 2002 Marine Parasitology class of the School of Tropical Biology, James Cook University for obtaining specimens of *Protomicrocotyle celebesensis* in such good condition. We thank Professor Klaus Rohde for the loan of unidentified specimens for inclusion in this study. We are grateful to Dr Bronwen Cribb, Centre for Microscopy and Microanalysis, The University of Queensland, for help and advice with the scanning electron microscopy. The new species described herein and additional material of *Heteromicrocotyla australiensis* and *Heteromicrocotyloides mirabilis* were collected from Lizard Island and Heron Island by Ian Whittington and Marnie Horton with support to IDW from the Australian Research Council (grant nos. A19130175 for 1992–94 and A19231545 for 1993–95). We would also like to thank the curators of the various parasite collections for their assistance in loaning specimens. In New Caledonia, Julie Mounier, a student, and Sarah Samadi (IRD) participated in the fishing expeditions and parasitological study. Identification of several New Caledonian hosts was kindly confirmed (from photographs) by Ronald Fricke (Staatliches Museum für Naturkunde, Stuttgart, Germany).

References

Beumer J.P., Ashburner L.D., Burbury M.E., Jetté E., Latham D.J. 1982. A checklist of the parasites of fishes from Australia and its adjacent Antarctic Territories. *Commonwealth Agricultural Bureaux Technical Publication* No. 48.

Dillon W.A., Hargis W.J. Jr., Harrises A.E. 1983. Monogeneans from the southern Pacific Ocean. Polyopisthocotyleids from Australian fishes. The subfamilies Polylabrinae and Microcotylinae. *Zoologicheskiy Zhurnal*, 62, 821–828 (In Russian; Translation Series 31, Virginia Institute of Marine Science, 1985).

Froese R., Pauly D. (Eds.). 2008. FishBase. World Wide Web electronic publication. www.fishbase.org., version 11/2008.

Justine J.-L. 2005. Species of *Pseudorhabdosynochus* Yamaguti, 1958 (Monogenea: Diplectanidae) from *Epinephelus fasciatus* and *E. merra* (Perciformes: Serranidae) off New Caledonia and other parts of the Indo-Pacific Ocean, with a comparison of measurements of specimens prepared using different methods, and a description of *P. caledonicus* n. sp. *Systematic Parasitology*, 62, 1–37. DOI: 10.1007/s11230-005-5480-0.

Justine J.-L. 2007. Fish parasites: Platyhelminthes (Monogenea, Digenea, Cestoda) and Nematodes, reported from off New Caledonia. In: (Eds. C.E. Payri & B. Richer de Forges) *Compendium of Marine Species from New Caledonia*. (*Vol. Documents Scientifiques et Techniques* II7, *Deuxième Edition*, 183–198 pp.). Nouméa, New Caledonia: Institut de Recherche pour le Développement, 435 pp. + Color Plates.

Lebedev B.I. 1968. Monogenea from commercial fishes of the Pacific Ocean basin. Family Heteraxinidae Price, 1962. In: *Helminths of the Pacific Ocean*. Izd. Nauka, Akad. Nauk USSR, 38–45 (In Russian).

Lebedev B.I. 1986. Monogeneans of the suborder Gastrocotylinea. Publishing House Nauka, Leningrad, 200 pp. (In Russian).

Lester R.J.G., Sewell K.B. 1989. Checklist of parasites from Heron Island, Great Barrier Reef. *Australian Journal of Zoology*, 37, 101–128.

Mamaev Yu.L. 1988. Monogenea of family Heteromicrocotylidae Unnithan, 1961. *Proceedings of the Zoological Institute, USSR Academy of Sciences, Leningrad*, 177, 35–48.

Robinson E.S. 1961. Some monogenetic trematodes from marine fishes of the Pacific. *Transactions of the American Microscopical Society*, 80, 235–266.

Rohde K. 1977. Habitat partitioning in Monogenea of marine fishes. *Heteromicrocotyla australiensis*, sp. nov. and *Heteromicrocotyloides mirabilis*, gen. and sp. nov. (Heteromicrocotylidae) on the gills of *Carangoides emburyi* (Carangidae) on the Great Barrier Reef, Australia. *Zeitschrift für Parasitenkunde*, 53, 171–182.

Sandars D.F. 1944. A contribution to the knowledge of the Microcotylidae of Western Australia. *Transactions of the Royal Society of South Australia*, 68, 67–81.

Williams A. 1991. Monogeneans of the families Microcotylidae Taschenberg, 1879 and Heteraxinidae Price, 1962 from Western Australia, including the description of *Polylabris sandarsae* n. sp. (Microcotylidae). *Systematic Parasitology*, 18, 17–43.

Yamaguti S. 1953. Parasitic worms mainly from Celebes. Part 2. Monogenetic trematodes of fishes. *Acta Medicinae Okayama*, 8, 203–256.

Yamaguti S. 1968. Monogenetic Trematodes of Hawaiian Fishes. University of Hawaii Press, Honolulu, 287 pp.

(Accepted May 5, 2009)