Five monogenean species (Allodiscocotylidae, Heteromicrocotylidae, Microcotylidae) from the Pacific seabream *Acanthopagrus pacificus* (Perciformes: Sparidae) in the Gulf of Tonkin off Vietnam, with descriptions of three new species

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**Abstract:** A total of 52 specimens of the Pacific seabream *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino from the Gulf of Tonkin off Vietnam were examined for monogeneans. Twenty fish were parasitised by 101 individuals of five monogenean species, including two known species *Allodiscocotyla diacanthi* Unnithan, 1962 and *Heterapta chorinemi* (Tripathi, 1956), as well as three new species, *Polylabroides tienyenensis* sp. n., *Polylabroides tonkinensis* sp. n. and *Metacamopia lebedevi* sp. n. *Polylabroides tienyenensis* and *P. tonkinensis* are morphologically more similar to *Polylabroides guangdongensis* Zhang et Yang, 2001 in comparison with other species within the genus, based on the absence of small spines on the cirrus. However, *P. tonkinensis* is distinguished from *P. guangdongensis* by fewer clamps on the haptor and by the different shapes of the large spines on the cirrus. Similarly, *P. tienyenensis* differs from *P. guangdongensis* by vaginal ducts with fewer branches, fewer clamps and smaller egg size. *Metacamopia lebedevi* is distinguished from *Metacamopia chorinemi* (Yamaguti, 1953) by the arrangement of testes (one row vs two rows), diverticula absent in the oesophagus, and the number of anchor parts (one vs two); it differs from *Metacamopia oligoplistes* Takemoto, Amato et Luque, 1996 by the smaller haptor, shape and absence of small sclerotised hooks, the number of ribs in their clamps, and the position of the testes; it can be separated from *Metacamopia indica* (Unnithan, 1962) by having fewer testes and lacking sclerotised structures in the vagina. The present study also provides the measurements for *A. diacanthi*, *H. chorinemi*, and proposes a new key to all species of *Polylabroides*.

**Keywords:** Polypisthocotyleota taxonomy, Monogenea, marine parasites, sparids, western Pacific.

Among the monogenean fauna of marine fishes in Vietnam, *Metacamopia* and *Allodiscocotyla* have been found infecting different carangid hosts, e.g. *Metacamopia indica* (Unnithan, 1962) in *Scomberoides lysan* (Forsskål) (Lebedev 1972, 1986); *Metacamopia chorinemi* (Yamaguti, 1953) in *S. lysan* and *Selar crumenopthalmus* (Bloch) (Lebedev 1970, 1986); *Allodiscocotyla chorinemi* Yamaguti, 1953 in *S. lysan*, *Caranx* sp., and *Decapterus* sp. (Lebedev 1970); *Alloidiscocotyla diacanthi* Unnithan, 1962 in *Decapterus* sp. (Lebedev 1970). There are no previous records of species of *Heterapta* and *Polylabroides* Mamaev et Parukhin, 1976 from the coast of Vietnam.

This study is the first survey of monogeneans from the Pacific seabream, *A. pacificus*, in the Gulf of Tonkin, off Vietnam. Herein, we present the description of one new species of *Metacamopia* and two new species of *Polylabroides*, as well as new host records and measurement for *A. diacanthi* and *H. chorinemi* (Tripathi, 1956).

**MATERIAL AND METHODS**

During a survey of the helminth fauna of marine fishes off the coast of Vietnam between March 2012 and May 2018, we examined 52 individuals of *Acanthopagrus pacificus* collected from five locations in the Gulf of Tonkin, e.g. off Mong Cai (21.4463N, 106.7980E), Quat Lam (20.2016N, 106.3888E), Do Son (20.7211N, 106.7980E), and Cat Ba (20.7252N, 107.0463E).

Fish were purchased alive from fishermens, placed in an ice box and carried fresh to the laboratory. All fishes were euthanised using benzocaine (100 mg/l) within 12 hours before examination. Gills were cut out and gill lamellae were placed separately in Petri dishes with seawater and checked for the presence of monogeneans under an Olympus SZ61 stereomicroscope. Monogeneans were removed from gill filaments and debris with the aid of fine brushes and needles, fixed in hot (70°C) AFA (a mixture of 70% ethanol-formalin-acetic acid in the ratio of 90 : 7 : 3), and preserved in 70% ethanol-formalin-acetic acid in the ratio of 90 : 7 : 3. After one month, half of samples was stained with Mayer's carmine while the other half was stained with Gomori's trichrome. Then all samples were dehydrated using an ethanol series (80–100%), cleared in xylene and mounted in Canada balsam.

The morphological characters of monogeneans were studied using an Olympus BX53 light microscope at magnifications ranging from 40 × to 1,000 ×; and drawings were made with the aid of a camera lucida. All measurements are given in micrometres presenting the range followed by the mean and the number of individuals or structures measured in parentheses.

Type specimens and vouchers are deposited at the Department of Parasitology, Institute of Ecology and Biological Resources, and in the Vietnam National Museum of Nature, Hanoi, Vietnam.

**RESULTS**

Twenty individuals of *Acanthopagrus pacificus* were infected by a total of 101 monogenean specimens. The intensity of infection varied from 1 to 16 worms per fish. Morphological examination of all 101 monogenean specimens revealed that they represented five species. Among them, one dominant species consisted of 95 specimens, while the other four species consisted of only one or two specimens each/species. The details of each species are presented below.

**Polylabroides tiyenensis sp. n.**

Figs. 1, 2

ZooBank number for species: urn:lsid:zoobank.org:act:38F13E50-5B5E-413A-AD0A-3BA560F57545

**Description** (based on one specimen stained in Mayer’s carmine and one specimen stained in Gomori’s trichrome)

Body elongate, subcylindrical, tapering anteriorly and posteriorly, 3.362–3.875 in length, maximum width at level of ovary 205–287. Anterior extremity with three slight protruberances in which cephalic glands open. Haptor symmetrical, distinctly delineated from body proper, armed with 31–36 pairs of clamps (Fig. 1A). Clamps of typical *Microcotyle*-type without accessory sclerite (Figs. 1E, 2C,D), similar in shape, dissimilar in size; the largest clamps in anterior region of haptor, 66–68 × 30–43 (67 × 37) (n = 8); middle clamps 64–66 × 31–37 (65 × 34) (n = 8); posterior clamps 41 × 25–31 (41 × 28) (n = 8).

Buccal suckers two, muscular, oval, without septa, 53–57 × 47–49 (55 × 48) (n = 4). Mouth ventro-subterminal; pharynx subglobular, 39–41 in width (Fig. 1B). Oesophagus slender, 230 in length, bifurcating at posterior end of cirrus, about 272 from anterior extremity. Intestinal caeca two, extending posteriorly but does not enter haptor; right and left caeca equal in length.

Testes 13, postvarian, globular or elongate-oval, large, dissimilar in size, 62–102 × 66–120 (88 × 92) (n = 24); arranged in longitudinal intracaecal row (Fig. 1A). Vas deferens dilating with sperm at base, winding sinuously forward along midline of body, entering at posterior end of cirrus. Genital atrium at prebifurcal, thin walled, oval, 62 × 51 and 68 × 51 in size. Cirrus spherical, 37 × 41 and 41 × 49 in size, armed with two large spines, 39–41 (40) long (n = 4). Cirrus spines elephant’s tusk-shaped with rounded base (Figs. 1C, 2A,B).

Ovary pretestarian, question mark-shaped, intercaecal, equatorial. Seminal receptacle well-defined, round, lies close to distal end of ovary. Oocyte mid-ovarian, oval, surrounded by Melhis’glands, two times smaller than seminal receptacle, connected with genito-intestinal canal (Fig. 1D). Vaginal aperture median, ventral, postbifurcal, about 328 from anterior margin of body. Two narrow vagi-
nal ducts lateral to vagina, embracing intestinal caeca, then connected dorsally, extend backward and again divide before opening into branches of Y-shaped vitelline duct. Vitellarium follicular, coextensive with caeca; common duct joining oötype. Uterus arising from dextral margin of oötype, extends forward and opens at vaginal aperture. Only one small egg in uterus observed; egg ovoid, 50 × 25 in size, with filaments at both ends.

**Type host:** *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino.

**Type locality:** Gulf of Tonkin, off Tien Yen district, Quang Ninh province, Vietnam (21.305278°N, 107.473611°E).

**Site of infection:** Gill.

**Prevalence and intensity of infection:** 2% (n = 52); and 2 specimens/fish.

**Type material:** Holotype (NMH–Microcotylid–2015–1)

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**Fig. 1.** *Polylabroides tienyenensis* sp. n. from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – head region; B – holotype, total view; C – reproductive system; D – cirrus and vagina; E – clamp. *Abbreviations: e* – egg; *ga* – genital atrium; *gi* – genito-intestinal canal; *Mc* – Mehlis’ glands; *ö* – oötype; *ov* – ovary; *t* – testis; *u* – uterus; *vas* – vas deferens; *vi* – duct of vitelline reservoir duct.
is deposited in the Department of Parasitology, Institute of Ecology and Biological Resources and one paratype (NMH–Microcotylid–2015–2) is deposited in the Vietnam National Museum of Nature, Hanoi, Vietnam.

**Etymology:** The specific name refers to the type locality of the parasite (Tien Yen District).

**Remarks.** *Polylabroides* consists of eight species and can be divided into two groups based on the number of large spines on the cirrus (Zhang and Yang 2001). The first group comprises two taxa with numerous large spines on the cirrus; i.e. *Polylabroides quadruspinosus* Byrnes, 1985 (4 large spines) and *Polylabroides longispinosus* Byrnes, 1985 (40–67 large spines). The second group comprises taxa with only two large spines on the cirrus and includes *P. tienyenensis* sp.n. The new species differs from *Polylabroides australis* (Murray, 1931), *Polylabroides biungulatus* Mamaev et Parukhin, 1976, *Polylabroides mylionis* Dillon, Hargis et Harrises, 1985, *Polylabroides multispinosus* Roubal, 1981, and *Polylabroides zini* Mamaev, 1988 by the absence of small spines on the cirrus. *Polylabroides tienyenensis* most resembles *Polylabroides guangdongensis* Zhang et Yang, 2001 in the structure of the genital atrium and cirrus (no small spines; two large spines are straight, curved only at distal end), as well as the number of testes (approximately 13). However, *P. tienyenensis* can be distinguished from the latter species by the narrower body (width 246 µm vs 453 µm), fewer clamps (62–72 vs 96–106) and smaller eggs much (50 × 25 µm vs 205 × 68 µm). This is the first *Polylabroides* species described from *A. pacificus* in the coast of Vietnam.

*Polylabroides tonkinensis* sp. n.

**Description** (based on selected, stained and measured 36 specimens, from totally collected 95 specimens, including 18 specimens stained in Mayer’s carmine and other 18 specimens stained in Gomori’s carmine).

Body elongate, subcylindrical, 2.38–2.81 mm (2.63 mm; n = 12) in length, maximum width 233–394 (310; n = 20) at level of ovary, tapering anteriorly and posteriorly. Haptor symmetrical, distinctly delineated from body proper, armed with 30–40 (36; n = 12) pairs of clamps.

**Fig. 2.** *Polylabroides tienyenensis* sp. n. from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – clampcirrus (specimen stained with Mayer’s carmine); B – cirrus (specimen stained with Gomori’s); C – clamp (specimen stained with Gomori’s); D – clamp (specimen stained with Mayer’s carmine). *Abbreviations:* c – muscular base; csp – cirrus spines.
Clamps of typical Microcotyle-type without accessory sclerite (Figs. 3I, 4C), similar in shape, dissimilar in size; largest clamps in middle region of haptor, 54–63 × 29–31 (58 × 30; n = 12); anterior clamps 38–50 × 26–28 (46 × 29; n = 12); posterior clamps 25–36 × 23–25 (29 × 24; n = 12).

Two buccal suckers, muscular, oval, without septa, 38–58 × 36–52 (50 × 46) (n = 38). Mouth ventrosubterminal; pharynx subglobular, 30–40 (36; n = 20) in diameter. Oesophagus slender, without lateral diverticula, 115–212 (171; n = 16) in length, bifurcating at posterior end of cirrus, about 186–282 (254; n = 16) from anterior extremity. Intestinal caeca two, extending posteriorly but not entering haptor; right and left caecum equal in length.

Testes 7–14 (10; n = 16), postovarian, globular or elongate-oval, large, dissimilar in size, biggest testis in middle of testicular region 87–220 × 68–120 (145 × 95) smallest testis in posterior or anterior end of testicular region 64–123 × 56–101 (87 × 77); arranged in longitudinal row. Vas deferens dilating with sperm at base, winding sinuously forward along midline of body, and entering posterior end of cirrus. Genital atrium situated near intestinal bifurcation, thin-walled, oval, 62–72 × 40–47 (68 × 44; n = 16). Cirrus spherical, 27–40 × 27–41 (35 × 31; n = 16) armed with two large spines, 28–43 (34; n = 16) in length. Each cirrus spine sickle-shaped, with a noticeable knob and forked base forming two deep roots (Figs. 3G, 4A).

Ovary pretesticular, question mark-shaped, intercaecal, just equatorial; distal end leading to rounded seminal receptacle, and short duct to genito-intestinal canal connecting with oötype. Oötype posterior to ovary, oval, surrounded by Mehlis’ glands (Fig. 3E). Vaginal aperture oval, median, ventral, post-bifurcal, 54–56 × 30–32 (55 × 31; n = 12). Two vaginal ducts from lateral regions of vaginal aperture extending backwards and embracing intestinal caeca, connecting dorsally, travelling backwards into the branches of vitelline duct; part of vaginal ducts connected with vaginal aperture sclerotised, about 14 in width; vaginal aperture armed with small sclerotised spine (Figs. 3F, 4B). Vitellarium follicular, coextensive with caeca; vitelline reservoir Y-shaped, common duct joins oötype. Uterus arising from dextral margin of oötype, extending sinuously forward and opening at vaginal aperture. Eggs ovoid, 179–235 × 56–80 (200 × 68; n = 8), with filaments at both ends; filament at one end extremely long and coiling in a knot (Figs. 3H, 4D).

**Type host:** Acanthopagrus pacificus Iwatsuki, Kume et Yoshino.

**Type locality:** Gulf of Tonkin, off Mong Cai district, Quang Ninh province, Vietnam, 21.446389°N, 107.943889°E.

**Site of infection:** Gills.

**Prevalence and intensity of infection:** 35% (18 of 52 examined fish); and 1–16, specimens fish.


**Etymology.** The specific name refers to the type locality of the parasite (Gulf of Tonkin).

**Remarks.** *Polylabroides tonkinensis* differs from *P. quadruspinosus* and *P. longispinosus* by the presence of two large spines on its cirrus, whereas the other two species have four or more spines. Similarly, *P. tonkinensis* can be distinguished from *P. australis*, *P. biungulatus*, *P. mylionis*, *P. multispinosus* and *P. zini* by the absence of small spines on its cirrus. *Polylabroides tonkinensis* is similar to *P. guangdongensis* in size, structure of the genital atrium and cirrus (no small spines; two large spines), as well as the number, size and arrangement of the testes, and size and shape of the eggs. However, *P. tonkinensis* differs in the following characteristics: slender oesophagus lacking lateral diverticula, haptor with fewer clamps (60–80 vs 96–106), and large spines of the cirrus sickle-shaped with a noticeable knob and two deep roots.

*Polylabroides tonkinensis* also differs from *P. tiennyenensis* by the broader body (310 vs 246 µm), shape of the large spines on the cirrus (sickle-shaped, noticeable knob, and two deep roots vs straight), fewer testes (10 vs 13) and larger eggs (200 × 68 µm vs 50 × 25 µm). This is the second *Polylabroides* species described in *A. pacificus* from the coast of Vietnam.

**Metacamopia lebedevi** sp. n.  

Figs. 5, 6


**Description** (based on one specimen stained in Mayer’s carmine and one specimen stained in Gomori’s trichrome)

Body L- or V-shaped, comprises four defined regions, namely forebody consisting of buccal cavity and genital apertures, twisted bulb region in middle, hindbody consisting of reproductive system, and haptor bearing clamps and hooks (Figs. 5A, 6B). Total length 1.89–2.34 mm, maximum width at twisted bulb 205–279. Elongate forebody tapering anteriorly, 918–943 long, 41–45 wide at anterior end, and enlarged at level of posterior end of cirrus, 66–98 wide. Twisted bulb region 370–451 long, abruptly distends at level of its junction with forebody, and its posterior constriction. Hindbody almost same length as forebody, slightly tapering posteriorly.

Haptor asymmetrical, with two dissimilar rows of four gastrocotyloid type clamps. Shorter right row 98–123 long, with equidistant pedunculate clamps, clamp size 26–40 × 21–30 (34 × 27; n = 8). Left row 131–213 long, with sessile clamps, clamp size 23–29 × 29–31 (26 × 30; n = 8). Each clamp has one pair of anterolateral sclerites, one
Fig. 5. *Metacamopia lebedevi* sp. n. from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – anchor; B – cirrus; C – clamp; D – holotype total view. Abbreviations: c – clamp; o – ovary; acs – accessory sclerite; ams – anterior mid-sclerite; ats – anterolateral sclerite; ö – oötype; pts – posterolateral sclerite; t – testis; u – uterus; v – vaginal aperture; vtr – duct of vitelline reservoir; vtr – ventral transverse rib.

Fig. 6. *Metacamopia lebedevi* sp. n. from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – cirrus; B – posterior part. Abbreviations: c – small spines on the cirrus; cl – clamp; h – anchor; o – ovary;
pair of posterolateral sclerites, one anterior mid-sclerite and one pair of accessory sclerites. All clamps with eight pairs of ventral transverse ribs (Fig. 5C). One pair of Hap-toral anchors, 30–39 (35) long (n = 4), sickle-shaped, with rounded base (Fig. 3D), located at terminal end of haptor.

Buccal suckers two, muscular, oval, 20–25 × 22–26 (22 × 24; n = 4). Mouth ventro-subterminal; prepharynx absent; pharynx globular, 25 and 29 wide. Oesophagus slender, without diverticula, 492 and 496 long. Intestinal caeca two, diverticular, running along each side of body, extending posteriorly into haptor and confluent at level of the base of caudal hooks.

Testes 12, smooth, globular, 32–34 (33; n = 16), arranged in two longitudinal intercaecal rows in anterior region of hindbody. Vas deferens winding forward in median field, slightly dilating anteriorly and joining cirrus; seminal vesicle not observed. Cirrus tubular, muscular, eversible and protrusible, 185 × 16 and 189 × 41 in size; entirely lined with numerous closely arranged conical spines (Figs. 5B, 6A, 4.8–5.2 (5; n = 60) in length. Median ventral genital pore unarmed, at 189–215 from anterior end of body.

Ovary post-testicular, question mark-shaped, placed in anterior second half of hindbody. Ootype surrounded by Mehlis’ glands. Vaginal aperture two, wide, tubular, unarmed, opening laterally about 310 from anterior end of body. Two vaginal ducts leading from vaginal pores dilate into small receptacle on each side and extend posteriorly to meet in median line of intestinal bifurcation. Vitellari-um follicular, co-extensive with intestinal caeca; follicles in two lateral non confluent fields extending from poste-rior end of cirrus to distal end of caeca. Vitelline reservoir T-shaped; median vitelline duct extending posteriorly, bending and joining ootype. Uterus arising from anterior margin of ootype, extending forwards ventrally to vas deferens and opening at common genital pore. Genitointestinal canal and eggs not observed.

Type host: Acanthopagrus pacificus Iwatsuki, Kume et Yoshino.

Type locality: Gulf of Tonkin, off Mong Cai District, Quang Ninh Province, Vietnam, 21.446389°N, 107.943889°E.

Site of infection: Gills.

Prevalence and intensity: 4% (2 of 52 examined fish); 1 specimen/fish.

Type material: The holotype (NMH–Allodiscocoty-lid–2012–1) is deposited in the Department of Parasitology, Institute of Ecology and Biological Resources and paratype (NMH–Allodiscocotylid–2012–2) is deposited in the Vietnam National Museum of Nature, Hanoi, Vietnam.

Etymology: The species is named in honour of Boris Lebedev from Vladivostok, Russia, for his great contribution to the classification of the Camopiinae.

Remarks. The new species is considered a member of Metacamopia due to the presence of the generic characteristics proposed by Lebedev (1972), i.e. haptor has two rows of four clamps, including pedunculated on one row and without peduncules on another row; one pair of anchors; testes preovarial in the posterior half of the body; paired dorsolateral vaginae; vaginal ducts dilated into vaginal seminal receptacles.

Only three species of Metacamopia, M. indica, Metaca-mopia oligoplites Takemoto, Amato et Luque, 1996, and Metacamopia chorinemii (Yamaguti, 1953), are known. The new species differs from M. chorinemii in the arrangement of its testes (two longitudinal rows vs one row), number of anchors (one pair vs three pairs) and in having an unbranched oesophagus. Metacamopia lebedevi is smaller in size and its haptor does not have a large heel-like area, and sclerites compared with M. oligoplites. In addition, each clamp of M. lebedevi has eight pairs of ribs whereas M. oligoplites has only three pairs. Metacamopia lebedevi can be distinguished from M. indica in having fewer testes (12 vs 20–50) and vagina lacking sclerotised structures.

**Allodiscocotyla diacanthi Unnithan, 1962**

**Measurements** (based on one specimen stained in Mayer’s carmine).

Total length 927; maximum width across the haptor 221. Buccal suckers 19 × 20; pharynx 16 × 18; oesophagus length 152; distance from anterior extremity to intestinal bifurcation 198. Number of testes 20, testis diameter 30; cirrus length 78, width at the anterior end 14 and maximum width at base 21 (Fig. 7A). Distance from anterior end of body to genital atrium 121. Vaginal size 52 × 16. Number of clamps 8; size of clamps on the left side 49–59 × 33–35; size of clamps on the right side 55–57 × 43 (Figs. 7A,D,8). Anchor length 43 (Figs. 7A, 8).

**Type host:** Chorinemus sanctipetri (Cuvier) (syn. of Scomb-eroides lysan [Forsskål]) (Percoformes: Carangidae).

**Other hosts:** Decapterus sp., Acanthopagrus pacificus Iwatsuki, Kume et Yoshino (new host)

**Type locality:** Trivandrum, India.

**Other localities:** Trivandrum, India; Madras, India, Gulf of Tonkin, Vietnam.

**New locality:** Gulf of Tonkin, off Do Son District, Hai Phong Province, Vietnam (20.721111°N, 106.798056°E).

**Site of infection:** Gills.

**Prevalence and intensity in Vietnam:** 2% (1 of 52 examined fishes); 1 specimen.

**Material:** one voucher specimen (NMH–Allodiscocoty-lid–2012–3).

**Remarks.** According to the description of Unnithan (1962), Allodiscocotyla diacanthi can be identified by the presence of the morphological characteristics, such as the symmetrical haptor bearing four pairs of gastrocotyloid clamps and one pair of anchors; caecal branches not confluent; testes proovarian, 15–21 in number, arranged in two intercaecal longitudinal rows; eversible cirrus Z-shaped, armed with numerous closely arranged spines; ovary in-verted U-shaped; seminal receptacle and genitointestinal canal present; vitellarium follicular, coextensive with caec; vagina muscular, unarmed.

In Vietnam, A. diacanthi was first recorded by Lebedev (1970) from Decapterus sp. (Carangidae). The Pacific sea-bream A. pacificus (Sparidae) is a new host of A. diacanthi.
Fig. 7. *Allodiscocotyla diacanthi* Unnithan, 1962 from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – total view; B – cirrus; C – reproduce system; D – clamp.

**Heterapta chorinemi** (Tripathi, 1956) Unnithan, 1961

*Fig. 9, 10*

**Measurements** (based on one specimen stained in Mayer’s carmine).

Total length 5.21 mm; maximum width 369; length of haptor 2,808; clamps 39 pairs including 30 anterior pairs and nine posterior pairs. The biggest and smallest size of an anterior clamp 86 × 52 and 53 × 49, respectively; posterior clamp size 35–37 × 15–17. Buccal suckers 20 × 18; pharynx 22 × 16. Number of testes 13, testes size 22–24 × 25–27; large cirrus spines 2, 96 in length; small cirrus spines 15 pairs, the biggest spine 24 in length. Distance from anterior end of body to genital atrium 140. Egg size 120–180 × 50–90; n = 8.

**Type host:** *Scomberoides tala* (Cuvier) (Perciformes: Carangidae).
Fig. 8. Allodiscocotyla diacanthi Unnithan, 1962 from Acanthopagrus pacificus Iwatsuki, Kume et Yoshino. Haptor (specimen stained with Mayer’s carmine)

New host: Acanthopagrus pacificus Iwatsuki, Kume et Yoshino
Type locality: Mahanadi estuary, Bay of Bengal, India.
Other localities: Mahanadi estuary, Bay of Bengal, India; Motupore Island, Papua New Guinea.
New locality: Gulf of Tonkin, off Giao Thuy district, Nam Dinh province, Vietnam (20.207778°N, 106.413611°E).
Site of infection: Gill
Prevalence and intensity in Vietnam: 2% (1 of 52 examined fishes); intensity: 1.
Material: one voucher specimen (NMH–Heteromicrocotylid–2012–1)

Remarks. Heterapta chorinemi was described by Tripathi (1956) based on the following generic characteristics: body very long, haptor accounting for more than half of the total length of the body, bearing 39 pairs of clamps of microcotylid type, including 30 anterior pairs (opening-type) and nine posterior pairs (closing-type); testes 13 in number, arranged in two intercecal longitudinal rows, situated in the middle region of the body; the cirrus spiny with two long central spines and surrounded by 15 pairs of small spines; ovary convoluted; the vagina muscular, unarmored; the vitellarium confluent in the end of the haptor region; eggs oval with a long coiled filament at the posterior end.

The Pacific seabream is a new host record for A. diacanthi, being this study the first record of a species of Heterapta from the coast of Vietnam.

DISCUSSION

Metacamopia, which was proposed by Lebedev (1972), includes three species, i.e. Metacamopia indica, M. chorinemi and M. oligoplites. Takemoto et al. (1996) re-examined the type specimen of M. chorinemi and confirmed the presence of sclerotised structures in the vaginal ducts. The same authors described a new species, M. oligoplites without these structures within the vagina. In addition, they described several pairs of hooks in this species, thus greatly expanding the diagnostic characteristics of the genus. Moreover, the host of M. lebedevi belongs to the Sparidae, whereas the hosts of other species of Metacamopia belong to the Carangidae.

The related Vallisia Parona et Perugia, 1890 have an oesophagus with poorly differentiated diverticula as is seen in M. chorinemi. However, since there is still no satisfactory description of it, details of the distal parts of the genital ducts are unclear. However, in the figures of Vallisia striata Parona et Perugia, 1890 it is seen that the proximal parts of the vaginal ducts are markedly expanded. Metacamopia oligoplites and M. lebedevi both lack armament of the vaginal ducts. The only character that distinguishes V. striata from species of Metacamopia remains the rounded shape of the copulatory organ, which also needs confirmation.

Allodiscocotyla diacanthi was first described by Unnithan (1962) from the gills of Chorinemus sanctipetri (syn. of
Fig. 9. *Heterapta chorinemi* (Tripathi, 1956) from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – total view; B – cirrus; C – egg; D – anterior clamp; E – posterior clamp.

*Scomberoides lysan* in Trivandrum, India. Ramasamy et al. (1995) also collected *A. diacanthi* from *Scomberoides tol* (Cuvier) in Madras, India. The first report of *A. diacanthi* outside the Indian Ocean was made by Lebedev et al. (1970), who found this species in the Gulf of Tonkin, Vietnam, from the gills of *Decapterus* sp. However, the authors did not provide measurements. Remarkably, all previous host species of *A. diacanthi* belong to the Carangidae, whereas our present study found it in a new host species, *Acanthopagrus pacificus*, a member of the Sparidae.

*Heterapta chorinemi* was first described as *Diplasiocotyle chorinemi* by Tripathi (1956) from *Scomberoides tala* in the Bay of Bengal, India. This species was transferred to another genus, *Tripathia*, by Yamaguti (1963) and finally to *Heterapta* by Unnithan (1961). Rohde (1979) found *H. chorinemi* on the gills of the same host species from Motupore Island, Papua New Guinea. Later Ramasamy and Hanna (1986) collected this species from the gills of *Scomberoides commersonianus* Lacepède. Both recorded host species belong to the Carangidae. In the present study, *H. chorinemi* was collected for the first time from *A. pacificus* (Sparidae) in Vietnam.

Both families, Sparidae and Carangidae, belong to the superorder Actinopterygii, and both used to belong to the Perciformes. However, Carangidae was moved to a separate order Carangiformes. Additionally, according to a
phylogenetic analysis based on cytochrome b mtDNA sequences, the sparidae and Carangidae are fairly divergent from each other (Nelson 2006). Although these two fish families are phylogenetically distant from each other, it is possible that they share some similarities. The host in our study, *A. pacificus*, is widely distributed and shows region- and site-specific ecology, especially associated with its diet. Given that we only found two specimens of *M. lebedevi* and one specimen each of *A. diacanthi* and *H. chorinemi* on *A. pacificus* in our study, it cannot be ruled out that these are incidental infections. However, in each circumstance, the parasites were fully mature adults. Future sampling efforts focused on *A. pacificus* are needed to further clarify these host associations.

The present study is the first record a species of *Polylabroides* on *A. pacificus* from the coast of Vietnam with the description of two new species, increasing the number of species in the genus to ten. All *Polylabroides* spp. are currently found to only infect members of the Sparidae. A key to five known species of *Polylabroides* was first proposed by Byrnes (1985). The key was expanded to include seven taxa when Mamaev (1988) described a new species, *P. zini*, and, included *P. mylonis* which was described by Dillon et al. (1985). The major characters for identification were the shape and number of the small and large spines on the cirrus. Subsequently, Zhang and Yang (2001) added *Polylabroides guangdongensis* from three fish species; *Sparus macrocephalus* (Basilewsky), *Acanthopagrus latus* (Houttuyn), and *Acanthopagrus berda* (Forsskål) off Guangdong, China. According to the description of *P. guangdongensis*, small spines on the cirrus are absent, as well as in the new species *Polylabroides tienyenensis* and *Polylabroides tonkinensis* described here-in. Zhang and Yang (2001) suggested that the reference to small spines on the cirrus in the diagnosis of *Polylabroides* should be changed to present or absent. Based on the old key and characters of the species recently described, we propose a new key for all species of *Polylabroides*:

1. Cirrus armed with two large spines
2. Cirrus armed with four or more large spines
3. Cirrus armed with two large spines

Fig. 10. *Heterapta chorinemi* (Tripathi, 1956) from *Acanthopagrus pacificus* Iwatsuki, Kume et Yoshino. A – cirrus; B – egg; C – posterior end. Abbreviations: ap – anterior clamps; pp – posterior clamps.)
2. Large spines four; small spines 35–36 P. quadruspinosus 
Large spines 40–67; small spines 25–35 P. longispinosus
3. Small spines on the cirrus absent ........................................... 4
Small spines on the cirrus present ........................................... 6
4. Large spines sickle-shaped with a noticeable knob and 
forked base ................................................................. P. tonkinensis
Large spines two, straight, curving at the distal end ....... 5
5. Clamps 96–106 in number; eggs large 205 × 68 µm .......
............................................................................................ P. guangdongensis
Clamps 62–72 in number; eggs small 50 × 25 µm .......
............................................................................................. P. tienyenensis
6. Genital atrium and vagina with strong musculature; cir-
rus armed with a pair of large claw-like spines and 6–7 small triangular spines; testes 13–17 in number ...... P. biungulatus
Genital atrium and vagina with no developed musculature; 
testes up to 13 in number .................................................... 7
7. Large spines shaped as roe-deer antlers; one pair of 
small sharp spines between them .................................. P. zini
Large spines claw-like ............................................................... 8
8. Small spines 8–10, different in size and shape .............. P. australis
Small spines similar in size and form .............................. 9
9. Small spines eight in number, 9–13 µm long; large 
spines 23–33 µm long; testes 6–9 .................................... P. mylionis
Small spines 30–45 in number; large spines 18–26 µm 
long; testes 10–13 .......................................................... P. multispinosus

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REFERENCES

Al-Daraji S.A.M., Bannai M.A.A., Abbas A.A.K. 2010: Some 
parasites of the yellow-fin sea bream Acanthopagrus latus 
(Houttuyn, 1782) in the Iraqi marine water. Iraqi J. Aquacult. 
7: 115–122.
Byrnes T. 1985: Four species of Polylabroides (Monogenea: Poly-
opisthocotylea: Microcotyliidae) on Australian bream, Acan-
Byrnes T. 1986a: Five species of Monogenea from Australian 
Byrnes T. 1986b: Six species of Lamellodiscus (Monogenea: Di-
plectanidae) collected from Australian bream (Acanthopagrus 
Chauhan B.S. 1945: Trematodes from Indian marine fishes part I. 
on some new monogenetic trematodes of the sub-orders mono-
pisthocotylea Odhner, 1912 and polyopisthocotylea Odhner, 1912. 
Dillon W.A., Hargis W.J., Harrises A.E. 1985: Monogenet-
ic trematodes from the Southern Pacific Ocean. Polyopisthoc-
ottyloids from the Australian fishes, the subfamily Polylabrinae 
number 33 of the Virginia Institute of Marine Science, the Col-
lege of William and Mary, Virginia, 1987).
Hussey C.G. 1986: Some monogenean parasites of marine perci-
Iwatsuki Y., Kume M., Yoshino T. 2010: A new species, Acan-
thopagrus pacificus from the Western Pacific (Pisces, Sparidae).
Johnston T.H., Tieg O.W. 1922: New gyrocladid trematodes from 
Australian fishes, together with a reclassification of the sup-
Ko R.C., Chan W. 2002: A Preliminary Study on the Parasite 
Fauna of Three Common Marine Fish of Hong Kong (Siganus 
fuscescens, Sebastius marmoratus, Epinephelus akeara). The 
University of Hong Kong Occasional Publication, Hong Kong, 71 pp.
Kritsky D.C. 2012: Dactylogyrids (Monogenea: Polygonochein-
ea) parasitizing the gills of snappers (Perciformes: Latijianidae): 
revision of Euryhaliotrema with new and previously described 
species from the Red Sea, Persian Gulf, the eastern and In-
do-west Pacific Ocean, and the Gulf of Mexico. Zoologia 29: 
227–276.
41: New and previously described species of Dactylogyridae 
(Platyhelminthes) from the gills of marine and freshwater per-
cifome fishes (Teleostei) with proposal of a new genus and a hy-
Lebedev B.I. 1970: [Helminths of epipelagic fishes of the South 
China Sea]. In: B.I. Lebedev, Y.L. Mamaev and P.G. Oshmarin 
(Eds.), Helminths of Animals of South-Eastern Asia. Nauka, 
Moscow, pp. 191–216. (In Russian.)
Lebedev B.I. 1972: [Taxonomy of the monogeneans of the subor-
the USSR Academy of Sciences, Vladivostok 11: 121–145. (In 
Russian.)
Lebedev B.I. 1986: [Monogeneidea, Suborder Gastrocotylinae], 
Nauka, Leningrad, 200 pp. (In Russian.)
Lebedev B.I., Parukhin A.M., Roftman V.A. 1970: [Monoge-
netic trematodes, Oligonchoinea (Monogeneidea), parasites of 
horse mackerel fishes of North Vietnam Gulf]. Biol. Morya 20: 
167–187. (In Russian.)
Mamaev Y.L. 1988: Polydorobrady zini sp. n., a new species 
of higher monogenean from a marine fish, Acanthopagrus latus.
Mamaev Y.L., Parukhin A.M. 1976: [On the genus Polylobaris 
Euzet et Cauvet, 1967 and some closely allied species of Micro-
cotylids (Monogeneidea: Microcotylidae)]. Parazitologiya 10: 
Maran B.A., Oh S.Y., Moon H.Y., Kim C.W., Myoung J.G. 2014: Monogeneans (Platyhelminthes) from marine 
Murray F.V. 1931: Gill trematodes from some Australian fishes. 
Parasitology 23: 492–506
Nitta M., Nagasawa K. 2015: A check list of monogeneans (Plat-
ythelemes) parasitic on fishes and invertebrates of the Seto 
Inland Sea, Japan (1894–2015), with new locality records for

Nguyen et al.: Five monogeneans from Acanthopagrus pacificus
Anoplodiscus spari (Anoplodiscidae) and Dactylogyryus gotoi (Dactylogyridae), a monogenean parasite obtained from the Japanese black sea bream, Acanthopagrus schlegelli (Bleeker). Bull. Hiroshima Univ. Mus. 7: 117–127.


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