

Three diplectanid monogeneans from marine finfish (*Epinephelus* spp.) in the Far East

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Abstract

Two new species of diplectanid monogeneans, *Diplectanum grouperi* and *Pseudorhabdosynochus coioidesis* from the marine finfish *Epinephelus coioides* and *E. aeorolatus* (Serranidae), cultured in floating cages in Malaysia, Indonesia and Hong Kong, were described and compared with *P. lantauensis* Beverley-Burton and Suriano, 1981 from the same hosts. There is no other close species sharing the features of *Diplectanum grouperi*. The possession of a copulatory organ with an open cup-like proximal part and a narrow tubular distal part is a main distinguished feature of *D. grouperi*. *Pseudorhabdosynochus coioides* is most closely related to *P. epinepheli* Yamaguti, 1938, but can be distinguished from it by the shape and the size of the haptor, hamuli, copulatory organ, the lack of a muscular bulbous ejaculatorius, a greater number of rows in the squamodiscs and the location of the testis. *Pseudorhabdosynochus lantauensis* from the present hosts differs from that described from the original hosts, *Epinephelus brunneus* and *E. fario* in the shape of the dorsal bar and vagina.

Introduction

Diplectanid monogeneans are found in a variety of serranid fish, particularly *Epinephelus* spp. A number of species of *Pseudorhabdosynochus* and one species of *Diplectanum* have been found parasitizing several species of *Epinephelus* from different geographical localities (Laird, 1958; Yamaguti, 1958, 1968; Euzet & Oliver, 1965; Oliver, 1968, 1984; Young, 1969; Beverley-Burton & Suriano, 1981; Leong *et al.*, 1993).

Groupers are high value marine food fish and are intensively cultured in floating net cages. However, frequent outbreaks of disease have been reported, with a high intensities of monogeneans (Nash *et al.*, 1987; Leong & Wong, 1988, 1990; Ong & Wong, 1988; Chua *et al.*, 1994; Leong, 1994; Danayadol *et al.*, 1995; Boonyaratpalin *et al.*, 1996). During a routine study of the parasite fauna of the estuarine grouper, *Epinephelus coioides* (Serranidae) in

floating net cages in Penang, Malaysia, Medan, Indonesia and Hong Kong, a variety of diplectanid monogeneans were identified. Apart from Leong *et al.* (1993), no taxonomic study on the gill monogeneans of cultured groupers have previously been undertaken.

This paper describes two new species, *Diplectanum grouperi* and *Pseudorhabdosynochus coioidesis* in addition to providing information on *P. lantauensis* from the same fish hosts.

Materials and methods

Groupers from different geographical locations such as Jelutong, Penang; Tanjung Dawai, Kedah in Malaysia, Hong Kong and Medan in Indonesia, were examined for gill monogeneans. The latter were collected and prepared on semipermanent slides with ammonium picrate glycerine particularly for examination of the sclerotized organs such as the copulatory and haptoral organs (Lim, 1991). Some specimens were stained with Masson's trichrome stain, cleared with methyl salicylate and

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Table 1. Comparative measurements (μm) of *Diplectanum grouperi* from the gills of *Epinephelus* spp. in Malaysia, Hong Kong and Indonesia.

Total body (L×W)	641(460–800)×130.7(100–180)	642.7(470–809.9)×133.3(78–168)	553.3(450–650)×114.4(100–140)
Haptor (L×W)	54.3(38.6–63.8)×132.7(105.4–136.4)	47.2(30–60)×118.4(80–134)	50(40–60)×125.6(90–140)
Copulatory organ (L) (proximal)	13.8(12.5–16.3)	15.8(12–17.5)	13.4(12.5–15)
Copulatory organ (L) (distal)	11.3(8.8–15)	9.8(8–12.5)	10.1(7.5–12.5)
Testis (L×W)	31.1(22.5–42.5)×25.7(21.3–30)	26.8(17.5–37.5)×27.9(20–40)	25×18.8(17.5–20)
Ovary (L×W)	60.5(45–75)×32.2(22.5–52.5)	58.8(44–68)×33.8(22.5–36)	52.5(42.5–60)×33.3(25–47.5)
Pharynx (L×W)	39.1(27.5–50)×37.5(25–47.5)	40.6(32.5–50)×37.7(30–44)	36.8(30–47.5)×39.3(32.5–47.5)
Ventral hamuli			
Inner length	29.5(25–37.5)	27.8(25–32.5)	29.9(25–33.8)
Outer length	37.9(34.4–42.5)	41.6(37.5–50)	37.9(30–42.5)
Inner root	8.8(7.5–12.5)	10.7(7.5–12.5)	10.1(7.5–12.5)
Outer root	13.3(9–15)	14.6(12.5–16)	11.8(7.5–15)
Dorsal hamuli			
Inner length	21.9(15–25)	20.8(16.3–22.5)	20.7(17.5–22.5)
Outer length	36.8(27.5–47.5)	36.3(30–40)	36.9(32.5–40)
Ventral bar (L)	62.1(42.5–70)	63.7(62–68)	65.1(52.5–71.3)
Dorsal bar (L)	46.1(40–50)	46.5(42.5–50)	48.2(45–50)
Squamodisc (L×W)	44.2(37.5–52.5)×34.8(25–42.5)	37.5(31.3–45)×32.2(27.5–40)	30(25–35)×26.3(25–27.5)
Squamodisc rows	11(9–13)	11(10–12)	9
Marginal hooklet (L)	8.8(6.3–10)	10.4(7.5–12)	10.8(10–12.5)
No. of specimens measured	15	10	9
Host	<i>E. coioides</i>	<i>E. aeorolatus</i>	<i>E. coioides</i>
Locality	Malaysia	Hong Kong	Indonesia

Measurements in μm ; range in parentheses; L, length; W, width.

Table 2. Comparative measurements (μm) of *Pseudorhabdosynochus lantauensis* from the gills of *Epinephelus* spp. from Malaysia, Hong Kong and Indonesia.

	Present study			From Beverley-Burton & Suriano
	Total body (L×W)	388.7(310–450)×99.3(70–130)	451.1(397–508.2)×146.5(63.5–192)	432.5(360–500)×107.5(80–130)
Haptor (L×W)	46.3(40–50)×171.3(140–210)	40.1(23.8–55.6)×141.8(95.3–164)	48.8(40–60)×156.3(120–180)	60(50–70)×201(175–225)
Copulatory organ (L) (proximal)	38(35–42.5)	29.2(22–36)	40.9(35–45)	45(40–49)
Copulatory organ (L) (distal)	28.2(20–37.5)	22.5(18–28)	24.6(20–30)	39(34–48)
Testis (L×W)	38.1(30–50)×33.7(27.5–45)	44.6(36–52)×39.5(28–52)	26.3(25–30)×26.3(22.5–30)	–
Ovary (L×W)	50×20	41.6(34–50)×39(22–54)	55×27.5	–
Pharynx (L×W)	30.2(25–35)×26.5(20–30)	30.1(24–36)×29.3(24–36)	30(22.5–37.5)×31(27.5–37.5)	–
Vagina (L)	28.6(22.5–37.5)	26.4(20–30)	22.1(20–25)	–
Ventral hamuli				
Inner length	27(25–30)	27.8(25–30)	27.7(25–31.3)	–
Outer length	36.6(33.8–38)	35.3(30–42)	37.9(35–42.5)	36(33–43)
Inner root	10.3(10–12.5)	10	9.5(7.5–12.5))	–
Outer root	13(10–15)	12.9(12.5–15)	12.5(10–15)	–
Dorsal hamuli				
Inner length	19.6(15–22.5)	16.7(12.5–20)	22.2(17.5–23)	–
Outer length	35.4(27.5–40)	33.3(27.5–40)	37.7(35–40)	36(35–41)
Ventral bar (L)	88.2(75–97.5)	73.3(64–84)	79.9(72.5–82.5)	84(74–96)
Dorsal bar (L)	68.2(50–75)	47.2(42–66)	50.3(42.5–55)	57(51–61)
Squamodisc (L×W)	41.3(35–47.5)×33.8(32.5–35)	37.1(32–44)×33.7(28–40)	37.5(25–50)×36.3(25–47.5)	37(30–42)
Squamodisc rows	11	10	11(10–12)	9–12
Marginal hooklet (L)	11.3(8.8–12.5)	10	10.9(10–12.5)	10(9–12)
No. of specimens measured	15	10	8	10
Host	<i>E. coioides</i>	<i>E. aeorolatus</i>	<i>E. coioides</i>	<i>E. brunneus</i> , <i>E. fario</i>
Locality	Malaysia	Hong Kong	Indonesia	South China Sea, Hong Kong

Measurements in μm ; range in parentheses; L, length; W, width.

Table 3. Comparative measurements (μm) of *Pseudorhabdosynochus coiooides* from the gills of *Epinephelus* spp. from Malaysia, Hong Kong and Indonesia.

Total body (L×W)	782.7(590–1050)×123.3(80–180)	754.4(556–952.8)×103.1(64–140)	728.9(580–900)×134.4(70–200)
Haptor (L×W)	56(45–70)×137.1(120–160)	63.3(40–79.4)×127.7(95.3–156)	58.9(50–65)×137.8(120–150)
Copulatory organ (L) (proximal)	33.8(25–40)	33.8(28–36)	41(32.5–50)
Copulatory organ (L) (distal)	49.8(35–60)	36.9(20–52)	47.2(37.5–62.5)
Testis (L×W)	52.9(32.5–70)×41(27.5–57.5)	64.9(52–80)×46.3(40–60)	45.8(32.5–60)×35.8(25–52.5)
Ovary (L×W)	53.9(42.5–75)×31.7(22–50)	52(48–56)×30.7(24–36)	58.3(55–60)×31.7(25–40)
Pharynx (L×W)	41.9(30–55)×37.8(25–55)	38.7(32–48)×36.2(28–48)	46.4(35–55)×43.6(30–57.5)
Vagina (L)	19.8(15–22.5)	28	17.9(10–30)
Ventral hamuli			
Inner length	31.4(27.5–35)	25.5(15–32.5)	29.8(27.5–35)
Outer length	42(37.5–47.5)	41.4(37.5–47.5)	42.5(37.5–50)
Inner root	9.9(7.5–12.5)	10	8.1(7.5–10)
Outer root	12.5(10–13.8)	12.7(12.5–13.8)	13(10–15)
Dorsal hamuli			
Inner length	20.6(18.5–22.5)	21.1(15–25)	39.6(17.5–33.8)
Outer length	36.6(35–37.5)	38.1(30–42.5)	36.8(32.5–42.5)
Ventral bar (L)	67.3(62.5–75)	69.3(60–84)	66.4(62.5–80)
Dorsal bar (L)	47.1(42.5–52.5)	48.6(44–56)	47.8(42.5–52.5)
Squamodisc (L×W)	67.9(60–77.5)×61.4(57.5–67.5)	58.3(40–71.5)×59.8(56–63.5)	66.7(52.5–75)×69.2(62.5–75)
Squamodisc rows	18(16–19)	18(17–19)	18(17–19)
Marginal hooklet (L)	11.5(10–12.5)	11.5(8–12)	11.7(10–12.5)
No. of specimens measured	15	10	9
Host	<i>E. coiooides</i>	<i>E. aeorolatus</i>	<i>E. coiooides</i>
Locality	Malaysia	Hong Kong	Indonesia

Measurements in μm ; range in parentheses; L, length; W, width.

mounted in Canada balsam. For studies on living monogeneans, fresh fish were collected from the Jelutong cage in Penang and transported with aeration to the laboratory. Monogeneans collected from these fish were placed in cavity blocks filled with saline, stained with neutral red for a short time and then transferred to clean glass slides each containing a drop of saline (NaCl 13.5 g l^{-1} , KCl 0.60 g l^{-1} , CaCl_2 0.25 g l^{-1} and MgCl_2 0.35 g l^{-1} after Kennedy, 1979) and covered with a coverslip. Measurements (μm) were taken from stained specimens and given as averages with ranges in parentheses (tables 1–3). Dimensions of the ovary were taken as the greatest diameter whereas techniques for measuring the

sclerotized organs (fig. 1) were carried out as previously described by Oliver (1968). Holotypes and paratypes of the three diplectanid monogeneans are deposited at the Zoological References Collection, National University of Singapore.

Results

Diplectanum grouperi n. sp.

Figs 2–3

Habitat. Gill filaments.

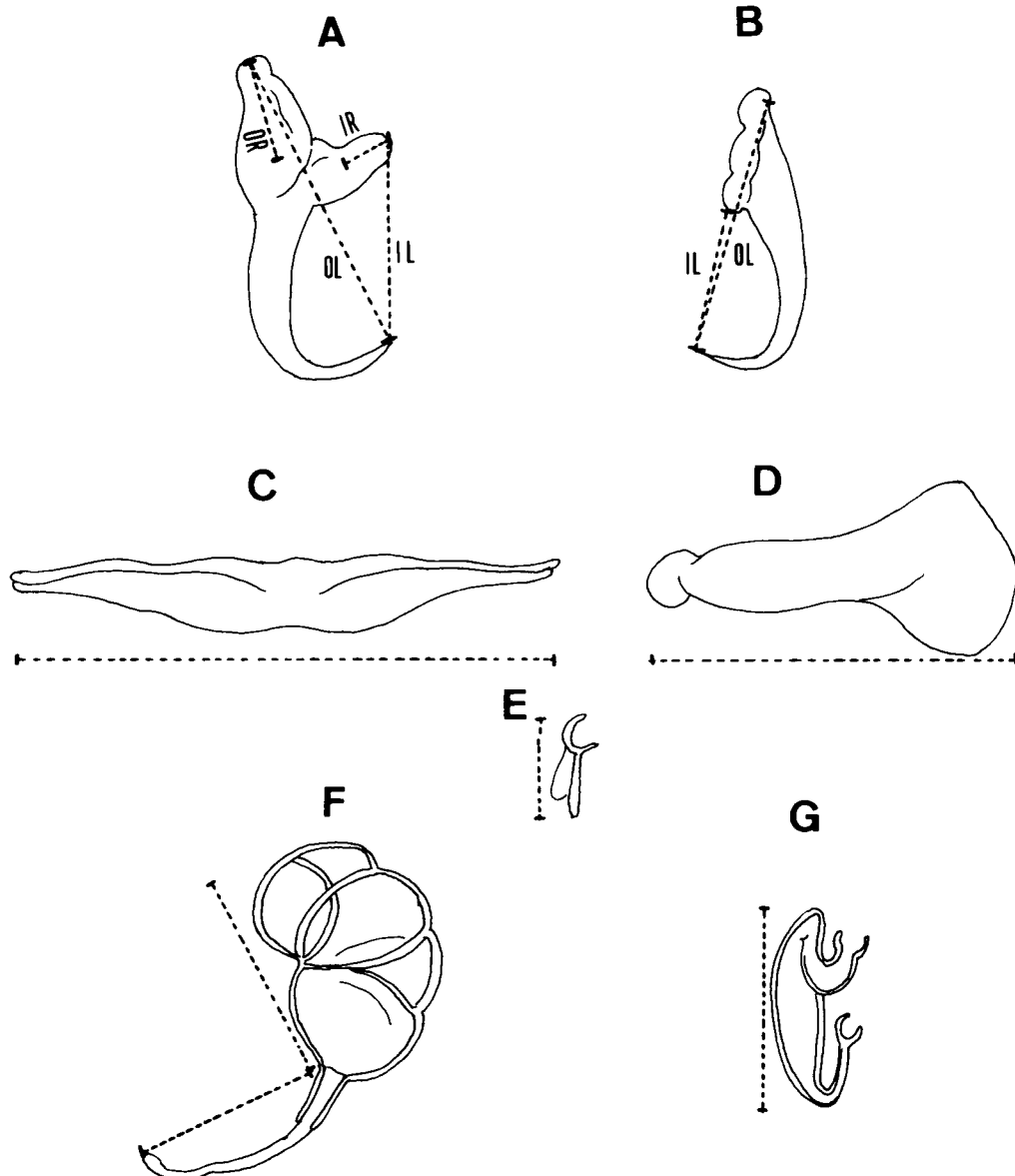


Fig. 1. Measurement techniques for the sclerotized organs in diplectanids. A, ventral hamulus; B, dorsal hamulus; C, ventral bar; D, dorsal bar; E, marginal hook; F, copulatory organ; G, vagina; IL, inner length; OL, outer length; IR, inner root; OR, outer root.

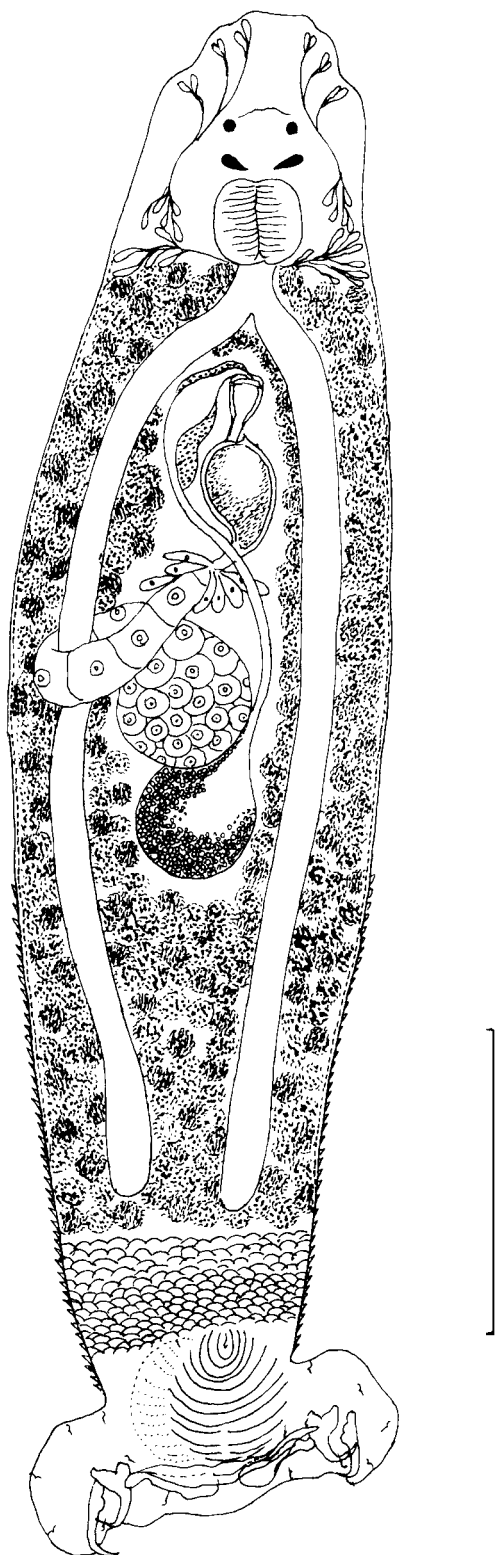


Fig. 2. *Diplectanum grouperi* n. sp. (ventral view). Scale bar = 100 μ m.

Host. *Epinephelus coioides* Hamilton (type host); *E. aerolatus* Forskäl.

Locality. Penang, Kedah, Malaysia; Hong Kong; Medan, Indonesia.

Holotype. ZRC. 1998.957

Paratypes. ZRC. 1998.958–960

No. of specimens studied. 50

Description. Body elongate and lanceolate, with well marked off haptor. Posterior part of body from haptor to testis covered with anteriorly directed scales. Haptor with two pairs of hamuli, single central bar, pair of lateral bars and 14 marginal hooklets. Ventral hamuli (fig. 3.1.i) with two almost equal sized roots and straight shaft; dorsal hamuli (fig. 3.1. ii) with vestigial nodulate roots and straight shaft. Central or ventral connecting bar (fig. 3.1.iii) lip-like with tapering ends, constricted in mid-line. Inner ends of lateral or dorsal bars (fig. 3.1.iv) swollen with a slightly rough area at base; articulate with dorsal hamuli laterally. Two squamodiscs, one on ventral and one on dorsal surface of haptor; each consists of 10–13 partly concentric, partly transverse rows of sclerites; none of the rows form a circle (fig. 3.3).

Head trapezoidal with three pairs of head organs; each of which connects with cephalic glands. Postpharyngeal glands develop laterally on either side of pharynx. Two pairs of eye spots are present in front of pharynx; posterior pair closer to each other and larger than anterior pair. Pharynx globular. Oesophagus short, caeca extend posteriorly behind testis and terminate blindly.

Testis ovoid, situated at midbody. Vas deferens runs anteriorly from left caecum then medially but without looping around the caeca before enlarging to form the seminal vesicle. Ejaculatory duct narrow, arises from anterior end of seminal vesicle, unites with prostatic duct before entering copulatory organ. Copulatory organ sclerotized, funnel-shaped; wide proximal part with four concentric muscular layers; distal part tubular (fig. 3.4).

Ovary lies immediately anterior to testis with tapering distal part, partly overlying right intestinal caecum. Junction of oviduct and ootype receives Mehlis's gland. Ootype passes anteriorly to genital pore near distal end of copulatory organ. Sclerotized vagina and seminal receptacle not observed. Vitellaria extend from oesophagus to slightly behind end of intestinal caeca. Eggs elliptical with long filament attached to tapering polar end (fig. 3.2).

Remarks. No other species shares all of the features of *Diplectanum grouperi*. The presence of scale-like spines on the posterior part of the body and the possession of a copulatory organ with an open cup-like proximal part and narrow tubular distal part are features of *Diplectanum bilobatum* Hargis, 1955 from the freshwater fish *Cynoscion nebulosus* in Florida and Louisiana. However, *D. bilobatum* differs from the present species in its smaller body size and wide, transverse rows of sclerites

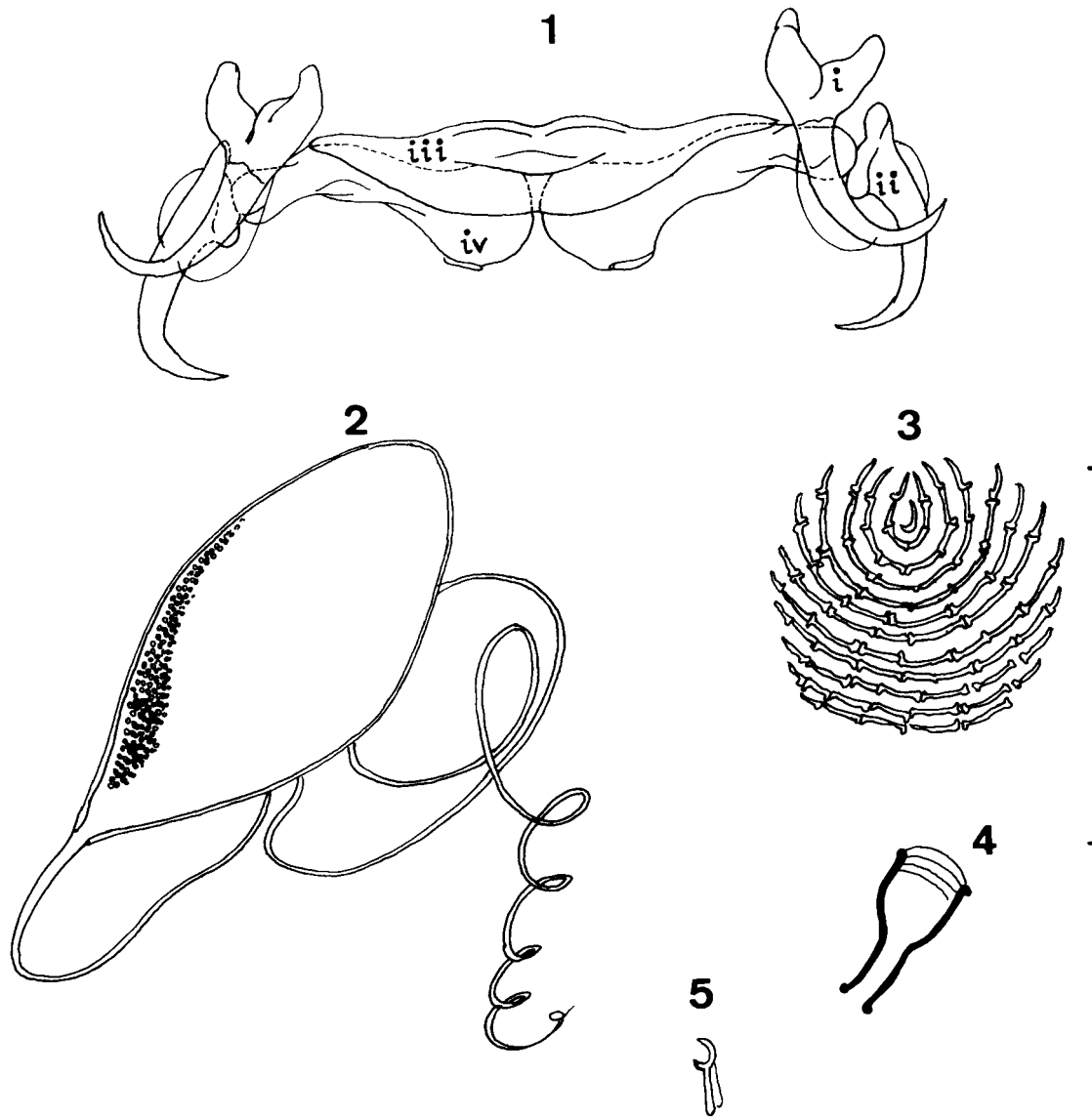


Fig. 3. Sclerotized organs of *Diplectanum grouperi*. 1, Haptoral organs; 2, egg; 3, squamodisc; 4, copulatory organ; 5, marginal hooklet; i, ventral hamulus; ii, dorsal hamulus; iii, ventral bar; iv, dorsal bar. Scale bar = 50 μm .

on the squamodiscs. The four muscular layers in the proximal part of the copulatory organ are similar to those of *Pseudorhabdosynochus latesi* Tripathi, 1955 and *P. monosquamodiscusi* Balasuriya & Leong, 1995 from *Lates calcarifer*. However, the two last named species can be distinguished from *D. grouperi* by the possession of sclerotized female genitalia and different sizes and shapes of the body. Moreover, this type of copulatory organ is also observed but larger, in *Diplectanum echinophallus* Euzet & Oliver, 1965 from *Epinephelus gigas*, which was redescribed by Oliver (1968) as *Cyclopectanum echinophallus* from *E. guaza*. The measurements of *D. grouperi* from *Epinephelus* spp. from Malaysia, Hong Kong and Indonesia are given in table 1. Specimens

from Indonesia are generally smaller than those from Malaysia and Hong Kong.

Etymology. The specific name refers to the common name of the fish host.

***Pseudorhabdosynochus lantauensis*
Beverley-Burton and Suriano, 1981**

Figs 4–5

Habitat. Gill filaments.

Host. *Epinephelus coioides* Hamilton; *E. aerolatus* Forskäl.

Locality. Penang, Kedah, Malaysia; Hong Kong; Medan, Indonesia.

No. of specimens studied. 75

Stained specimens are deposited at the Zoological Reference Centre, National University of Singapore: ZRC. 1998. 953–956.

Remarks. *Pseudorhabdosynochus lantauensis* was described by Beverley-Burton & Suriano (1981), nonetheless, specimens are drawn for further comparison. *Pseudorhabdosynochus lantauensis* from the present hosts is slightly different from that described from the original hosts, *E. brunneus* and *E. fario* from South China Sea in the possession of an overlapping dorsal bar, a longer and differently-shaped vagina, which has a chelate diverticulum. The measurements of *P. coioides* from *Epinephelus* spp. in Malaysia, Hong Kong and Indonesia are given in table 2.

***Pseudorhabdosynochus coioides* n. sp.**

Figs 6–7

Habitat. Gill filaments.

Host. *Epinephelus coioides* Hamilton (type host); *E. arolatus* Forskäl.

Locality. Penang, Kedah, Malaysia; Hong Kong; Medan, Indonesia.

Holotype. ZRC. 1998. 949

Paratypes. ZRC. 1998. 950–952

No. of specimens studied. 50

Description. Body flattened with slightly tapering anterior part, haptor well marked off from body with dorsal and ventral squamodiscs, which consist of 17–20 concentric rows of scales. Second row from anterior end forms a ring (fig. 7.3). Peduncle covered with anteriorly directed scale-like spines. Haptor slightly wider than body. Ventral hamuli (fig. 7.1.i) with two developed equal sized roots, and dorsal hamuli (fig. 7.1.ii) with vestigial roots. Ventral bar (fig. 7.1.iii) concave anteriorly, both extremities gradually taper. Dorsal bar (fig. 7.1.iv) broad internally. Seven pairs of marginal hooklets (fig. 7.2) present. Two small medial and two large lateral haptoral glands present.

Head prominent trapezoidal with three pairs of obvious head organs. Bundle of cephalic glands located at each side of eye spots. Pharyngeal glands develop on lateral sides of globular pharynx which is partly overlapped with eye spots. Second pair of eye spots slightly larger than first pair. Intestinal caeca extend posteriorly well beyond testis.

Testis ovoid, situated at mid body. Vas deferens arises closer to left caecum and runs forward medially. It becomes swollen to form seminal vesicle. Interior side of seminal vesicle lobed; ejaculatory duct narrow, long, convoluted and enters proximal part of sclerotized copulatory organ. Reniform proximal part of copulatory organ is divided into four chambers by sclerotized septa. Long proximal tubular part becomes narrower and ends in a small knob (fig. 7.4). The bulbus ejaculatorius is not described.

Ovary lies immediately anterior to testis and its tapering distal part turns around right intestinal caecum. Vagina, which opens close to left caecum, is

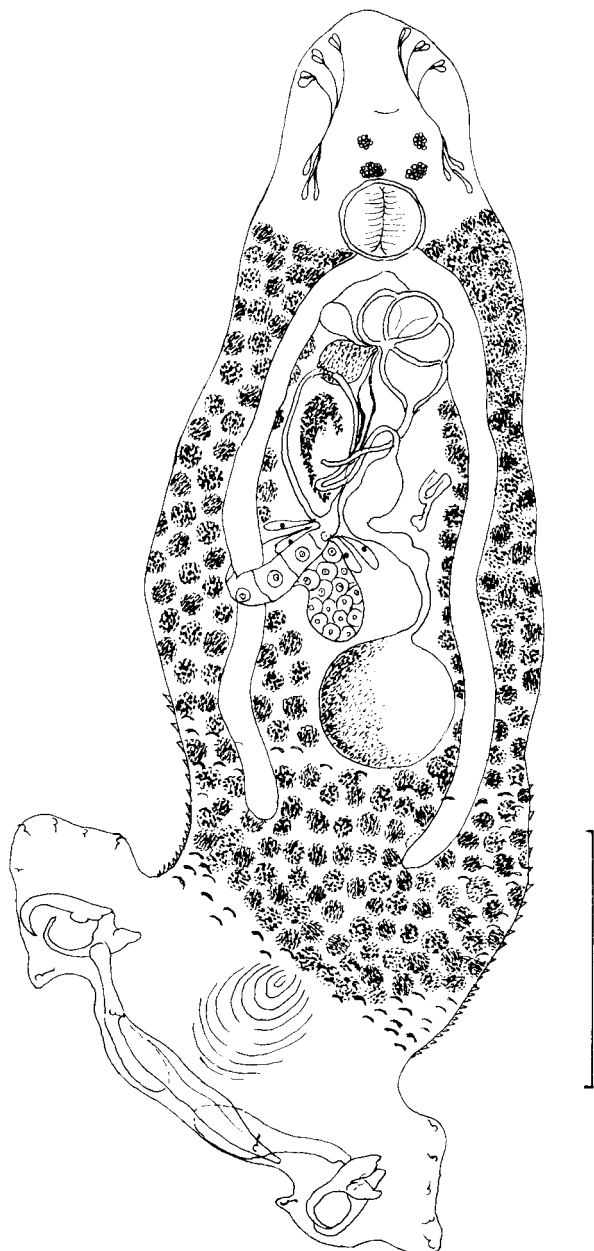


Fig. 4. *Pseudorhabdosynochus lantauensis* Beverley-Burton and Suriano, 1981 (ventral view). Scale bar = 100 μ m.

divided into two parts, the sclerotized proximal part, horseshoe-shaped with slightly wavy margin; and distal part which is somewhat tubular and recurved anteriorly (fig. 7.5). Eggs not observed. The measurements of

P. coioidesis from *Epinephelus* spp. examined from Malaysia, Hong Kong and Indonesia, are given in table 3.

Remarks. Closely related to *Pseudorhabdosynochus coioidesis*

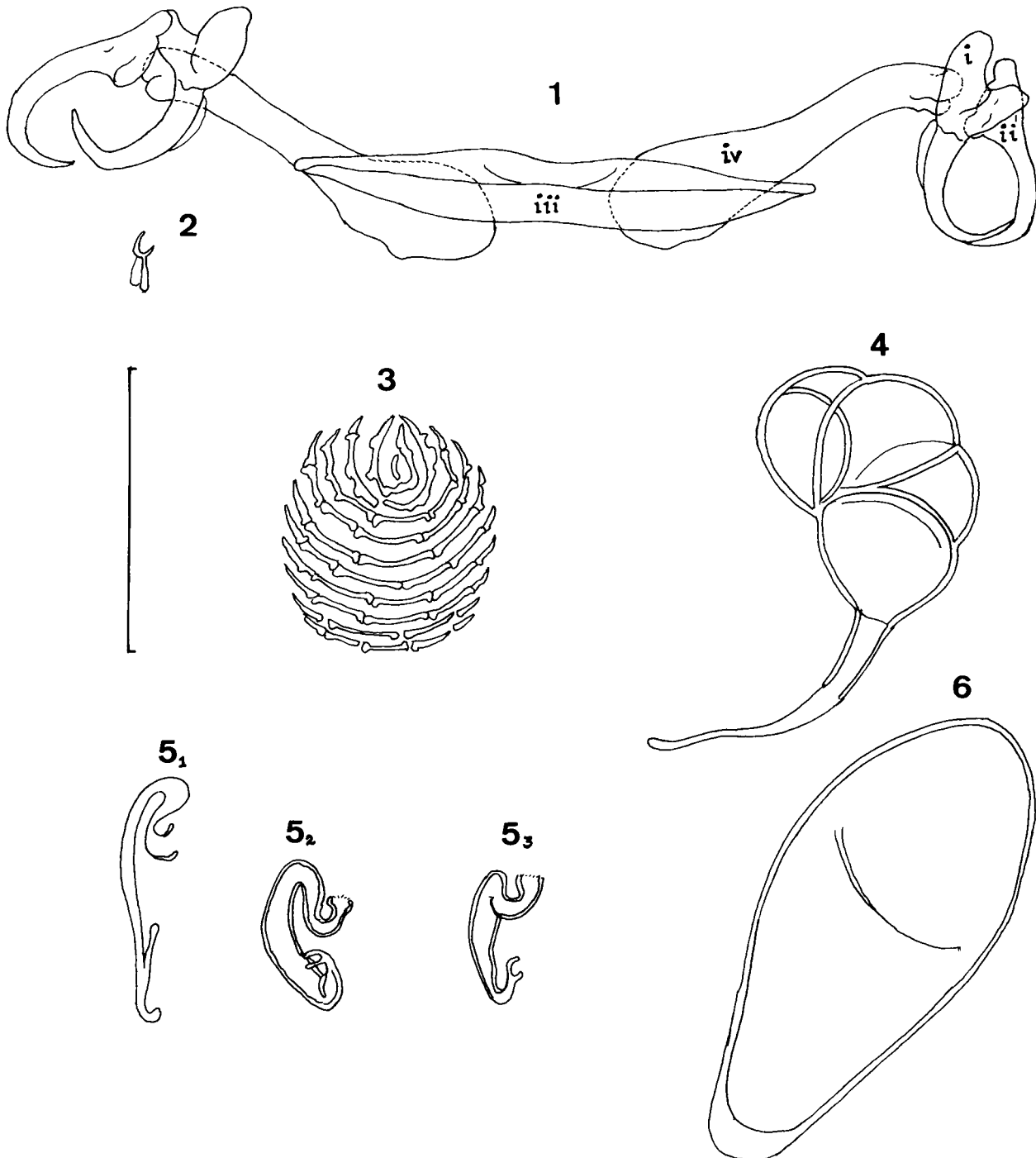
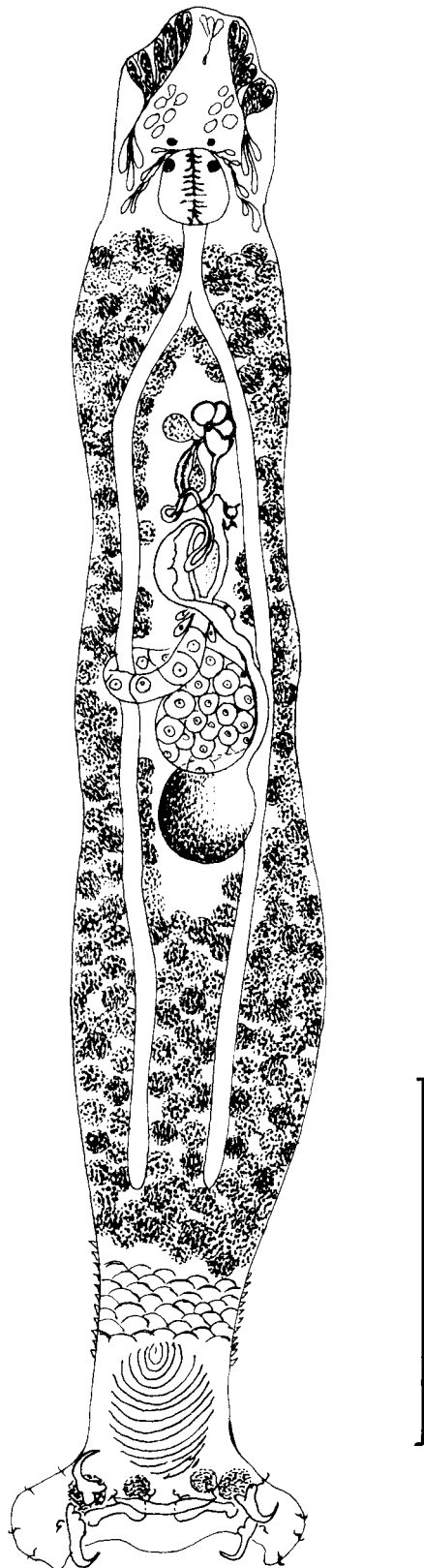


Fig. 5. Sclerotized organs of *Pseudorhabdosynochus lantauensis*. 1, Haptor organs; 2, marginal hooklet; 3, squamodisc; 4, copulatory organ; 5₁-5₃, vagina; 6, egg; i, ventral hamulus; ii, dorsal hamulus; iii, ventral bar; iv, dorsal bar. Scale bar = 50 μ m.



is *P. epinepheli* Yamaguti, 1938 but the latter can be differentiated by many characters, including a shorter and wider body; wider haptor; slightly shorter dorsal and ventral hamuli; different shape and larger proximal part of copulatory organ and shorter distal part; the presence of a muscular bulbus ejaculatorius; 14–16 rows in the squamodiscs and the location of the testis in the posterior part of the body, just anterior to the termination of the intestinal caeca.

Etymology. The specific name of the present species refers to the specific name of its type host, *Epinephelus coioides*.

Discussion

Serranid fish, especially *Epinephelus* spp. are commonly parasitized by diplectanid monogeneans. *Diplectanum* Diesing, 1858 is the type genus of the family Diplectanidae Bychowsky, 1957 and is characterized by the absence of a sclerotized genital cavity on the ventral surface. Subsequently, a new genus *Pseudorhabdosynochus* belonging to the same family was established by Yamaguti, 1958 and the squamodiscs of this genus were reduced to membranous plaques with several curved, transverse ridges. Oliver (1968) also introduced a new genus *Cycloplectanum* for diplectanids and distinguished *Cycloplectanum* from *Diplectanum* in having the first two squamodisc rows forming closed rings with the overlapping pieces as an 's', an evaginable penis and oval shaped eggs each with a long opercular filament.

However, Kritsky & Beverley-Burton, 1986 reviewed the status of diplectanids and several species, belonging to the genera *Diplectanum* and *Cycloplectanum*, were transferred to the genus *Pseudorhabdosynochus*. Based on their revision of the status of these genera, 15 species of *Pseudorhabdosynochus* occurred in marine finfish such as serranids, percichthyids and centropomids. It should be noted that 12 species of *Pseudorhabdosynochus* were reported from serranid hosts (eight species from *Epinephelus* spp.) while two species of *Pseudorhabdosynochus* were reported from centropomids (Balasuriya, 1994).

Diplectanum is thought to be uncommon in *Epinephalus* spp. Only *D. echinophallus* Euzet & Oliver, 1965 from *E. gigas* and the present species *D. grouperi* have been reported. *Diplectanum grouperi* was found to possess more scale-like spines on the posterior half of body than the other two diplectanids, *Pseudorhabdosynochus lantauensis* and *P. coioidesis*. The possession of a tubular copulatory organ and unsclerotized female genitalia in *D. grouperi* indicated that this species belongs to the genus *Diplectanum*. The function of the four concentric muscular layers in the proximal part of the copulatory organ is unknown although the application of pressure to the proximal part of the copulatory organ is likely to cause protrusion of the distal tubular part during copulation (Balasuriya, 1994).

Pseudorhabdosynochus lantauensis from *E. brunneus* and

Fig. 6. *Pseudorhabdosynochus coioidesis* n. sp. (ventral view). Scale bar, 250 μ m.

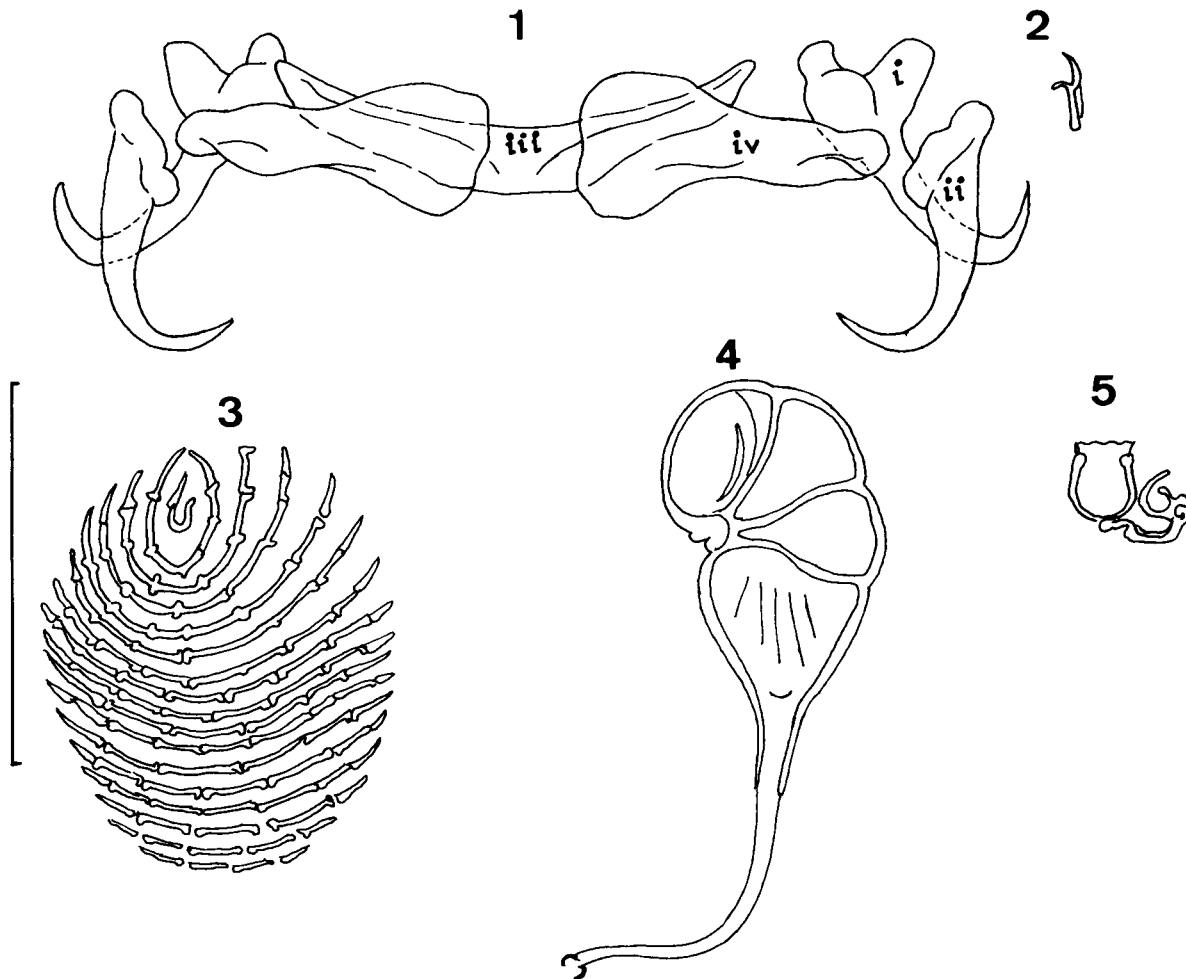


Fig. 7. Sclerotized organs of *Pseudorhabdosynochus coioidesis*. 1, Haptor organs; 2, marginal hooklets; 3, squamodisc; 4, copulatory organ; 5, vagina; i, ventral hamulus; ii, dorsal hamulus; iii, ventral bar; iv, dorsal bar. Scale bar = 50 μ m.

E. fario, described by Beverley-Burton & Suriano (1981) is found to be considerably larger than *P. lantauensis* from the present study (table 2). This may be due to differences in the geographical location of the fish hosts and also to the methods used in measuring fresh and fixed specimens. However, *P. lantauensis* is redescribed here with a complete illustration of the entire worm, not previously figured, hence making it easier to distinguish the present three diplectanids, which parasitize the same host.

As *Pseudorhabdosynochus coioidesis* is similar to *P. epinepheli* in its overall appearance, Leong *et al.* (1993) reported this species as *P. epinepheli* from *E. malabaricus* in Malaysia and compared the morphological differences and measurements of this species. These authors stated that the discrepancy in the length of the dorsal and ventral hamuli was probably due to different methods of measurement. On the other hand, the presence of a considerably larger copulatory organ, a greater number of squamodisc rows and the presence of a bulbus

ejaculatorius in *P. epinepheli* are characteristics which clearly differentiate *P. epinepheli* from *P. coioidesis*. It should be added, however, that two pairs of haptor glands, found in the haptor of *P. coioidesis*, have also been observed in the haptor of *P. epinepheli* from *Epinephelus coioides*. This was not mentioned in the original description of *P. epinepheli* (personal observation) as these glands could only be observed in living specimens.

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