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VERSITA

Pseudorhabdosynochus bacchus sp. nov. (Monogenea, Diplectanidae) from *Epinephelus coeruleopunctatus* (Perciformes, Serranidae) off New Caledonia

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Abstract

Pseudorhabdosynochus bacchus sp. nov. (Diplectanidae) is described from the gills of the whitespotted grouper *Epinephelus coeruleopunctatus* collected off New Caledonia, South Pacific, and is the first monogenean reported from this fish. It has a characteristic quadriloculate male organ, with both cone and tube of similar short length (10–12 µm). The morphology of its sclerotised vagina, with two chambers of equal size, differentiates it from all other species of the genus. Other rare *Pseudorhabdosynochus* species and specimens of an undescribed species of *Haliotrema* (Ancyrocephalidae) were also found, but in insufficient number to allow description.

Résumé

Pseudorhabdosynochus bacchus sp. nov. (Diplectanidae) est décrit des branchies de la loche à taches blanches *Epinephelus coeruleopunctatus* pêchée en Nouvelle-Calédonie, Pacifique Sud, et est le premier monogène mentionné de ce poisson. L'espèce a un organe tétraloculé caractéristique, avec un cône et un tube tous deux courts (10–12 µm). La morphologie du vagin sclérifié, avec deux chambres de taille égale, différencie l'espèce de toutes les espèces du genre. D'autres espèces de *Pseudorhabdosynochus* et des spécimens d'une espèce non décrite d'*Haliotrema* (Ancyrocephalidae) ont aussi été trouvés, mais en nombre insuffisant pour permettre une description.

Key words

Monogenea, Diplectanidae, *Pseudorhabdosynochus bacchus* sp. nov., Serranidae, *Epinephelus coeruleopunctatus*, biodiversity, New Caledonia

Introduction

The Epinephelinae, or groupers, harbour a rich monogenean fauna, including more than 50 species of diplectanids, the majority of which belong to *Pseudorhabdosynochus* Yamaguti (see Justine 2007). Species of *Pseudorhabdosynochus* appear to be strictly specific, and the study of a previously unexamined species of grouper, *Epinephelus coeruleopunctatus* (Bloch, 1790) (whitespotted grouper) in New Caledonia has revealed several new species of this genus. In this paper, we describe one of these. Adult whitespotted grouper are found on the barrier reef in New Caledonia (Laboute and Grandperrin 2000) and the species has a wide distribution from the Persian Gulf and east coast of Africa to Fiji and Micronesia, and in the western Pacific from Japan to New South Wales (Randall 2005).

Materials and methods

A single whitespotted grouper, *Epinephelus coeruleopunctatus* was spear fished in shallow waters around the barrier reef off Nouméa, New Caledonia (10 July 2006, Fausse Passe de Uitoé, 22°17′00″S, 166°11′00″E, fork length 493 mm, weight 1650 g). Measurements of the host are indicated for possible future comparison of parasite prevalence and host age in other localities, and because the monogenean fauna of serranids has been showed to change according to fish size (Hinsinger and

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Justine 2006). The fish was kept in a container with seawater and immediately brought back to the laboratory. Gills were extracted and examined in seawater with a dissecting microscope. Live monogeneans were individually picked off the gills with fine needles and immediately prepared. Specimens were routinely processed for carmine staining, including initial flattening between a slide and a coverslip in ethanol (referred to as 'carmine') or with ammonium picrate-glycerine (referred to as 'picrate') (Justine 2005). 'Picrate' slides were made with a single or several worms; carmine slides were made with a single worm per slide for the preparation of the different monogenean species. Gills which could not be processed immediately were preserved in formalin made up with hot seawater (4% final concentration), and monogeneans were later collected and stained with carmine; these are designated as 'unflattened carmine' and were not used for description. Monogeneans were drawn with a microscope equipped with a camera lucida and differential interference contrast optics. Measurements were taken on the pencil drawings with the help of a custom-made transparent rule, previously calibrated with a stage micrometer. Drawings were scanned and redrawn on a computer with Adobe Illustrator. Methods of measurement of haptoral hard-parts are as in Justine (2005, 2007); measurements of sclerotised vagina as in Figure 1D; measurements of the right-hand haptoral hard-parts and left-hand equivalents were pooled. All measurements are given in micrometres. The first measurement is taken from the holotype and is followed by the mean of the whole sample of specimens (except for the number of rodlets), then in parentheses the range and the number of measurements. Measurements of ammonium picrate preparations and of specimens flattened in ethanol may vary significantly (Justine 2005) and are separated when indicated.

Abbreviations: MNHN, Muséum National d'Histoire Naturelle, Paris; BMNH, Natural History Museum, London; USNPC, United States National Parasite Collection, Beltsville; HCIP, Helminthological Collection, Institute of Parasitology, Biology Centre, Academy of Sciences of the Czech Republic, České Budějovice; c – carmine, p – picrate, uc – unflattened carmine.

Results

Family Diplectanidae Bychowsky, 1957
Genus *Pseudorhabdosynochus* Yamaguti, 1958

***Pseudorhabdosynochus bacchus* sp. nov.** (Figs 1–2)

Description: Measurements are separated for 'carmine' (c) and 'picrate' (p) specimens. Body length 440, c 410 ± 49 (300–480, n = 30), width 230, c 230 ± 32 (170–280, n = 30). Tegument scaly in posterior region; scales on ventral and dorsal faces from squamodiscs to level of ovary and testis. Anterior region with 3 pairs of head organs and 2 pairs of eyespots; distance between outer margins of anterior eye-spot pair 30, c 31 ± 3.5 (25–38, n = 30), of posterior eye-spot pair 30, c 30 ± 4.1 (20–38, n = 30).

Haptor differentiated from rest of body, width 220, c 217 ± 21 (170–260, n = 30), provided with 2 similar squamodiscs, 2 pairs of lateral hamuli, 3 bars and 14 marginal hooklets. Squamodiscs made up of rows of rodlets; rodlets progressively thinner from the first (internal) row to periphery; rodlets of last row extremely thin; ventral and dorsal squamodiscs similar, but ventral slightly larger; central rows sometimes forming closed ovals; ventral squamodisc round in shape, length 58, c 58 ± 5.7 (48–70, n = 28), width 67, c 65 ± 3.5 (58–70, n = 28), with 11, c 11 (10–12, n = 28) rows of rodlets and 0–1 closed oval; dorsal squamodisc round in shape, length 55, c 53 ± 5.0 (44–62, n = 28), width 59, c 57 ± 4.1 (48–64, n = 28), with 12, c 12 (11–12, n = 28) rows of rodlets and 0–1 closed oval. Ventral hamulus width thick handle and distinct guard, outer length 52, c 50 ± 2.0 (45–53, n = 50), p 54 ± 1.3 (51–55, n = 24), inner length 40, c 39 ± 2.8 (36–52, n = 35), p 40 ± 1.4 (37–43, n = 24). Dorsal hamulus with indistinct guard, outer length 45, c 43 ± 1.9 (39–50, n = 60), p 44 ± 1.1 (41–46, n = 24), inner length 27, c 27 ± 1.18 (23–32, n = 47), p 28 ± 1.1 (25–30, n = 24). Dorsal (lateral) bars straight, with flattened medial extremity and thick cylindrical lateral extremity with posteriorly directed protuberance, length 82, c 82 ± 2.9 (75–88, n = 60), p 86 ± 4.6 (75–93, n = 24), maximum width 18, c 17 ± 2.0 (12–22, n = 58), p 18 ± 1.3 (15–20, n = 23). Ventral bar flat, elongate, with slightly constricted median portion and blunt extremities, length 112, c 116 ± 5.3 (110–127, n = 30), p 122 ± 6.8 (109–132, n = 12), maximum width 17, c 15 ± 1.6 (10–17, n = 29), p 16 (14–17, n = 11); groove visible on its ventral side.

Pharynx subspherical, length 35, c 37 ± 2.9 (30–40, n = 30), width 35, c 34 ± 4.0 (27–45, n = 30). Oesophagus apparently absent, such that intestinal bifurcation immediately follows pharynx. Caeca simple, terminate blindly at level of posterior margin of vitelline field.

Testis subspherical, intercaecal, length 56, c 53 ± 9.2 (37–70, n = 29), width 60, c 60 ± 14.8 (40–110, n = 29). Vas deferens emerges from antero-sinistral part of testis, enlarges into seminal vesicle; seminal vesicle inconspicuous, in middle region of body, transforms into duct; duct reflexes along seminal vesicle, forms bend then joins quadriloculate organ. Prostatic reservoir inconspicuous, connects with quadriloculate organ. Quadriloculate organ (nomenclature of parts in Fig. 1B) with fourth (posterior) chamber slightly more sclerotised than 3 anterior chambers; anterior wall of anterior chamber very thin; fourth chamber ends in elongate sclerotised cone, prolonged by short sclerotised tube; tube with regular diameter, wall curved distally to partly close extremity; end of tube prolonged by thin unsclerotised filament (= 'unsclerotised internal tube' of Zeng and Yang 2007). In contrast to many species, the filament is very constant in length and shape. Inner length of quadriloculate organ 50, c 51 ± 3.3 (44–58, n = 29), p 78 (65–83, n = 12); cone length 12, c 10 ± 0.7 (9–12, n = 29), p 11 (10–12, n = 12); tube length 10, c 10 ± 0.7 (9–12, n = 29), p 10 (9–11, n = 10); tube diameter 5, c 5.0 ± 0.7 (4–7,

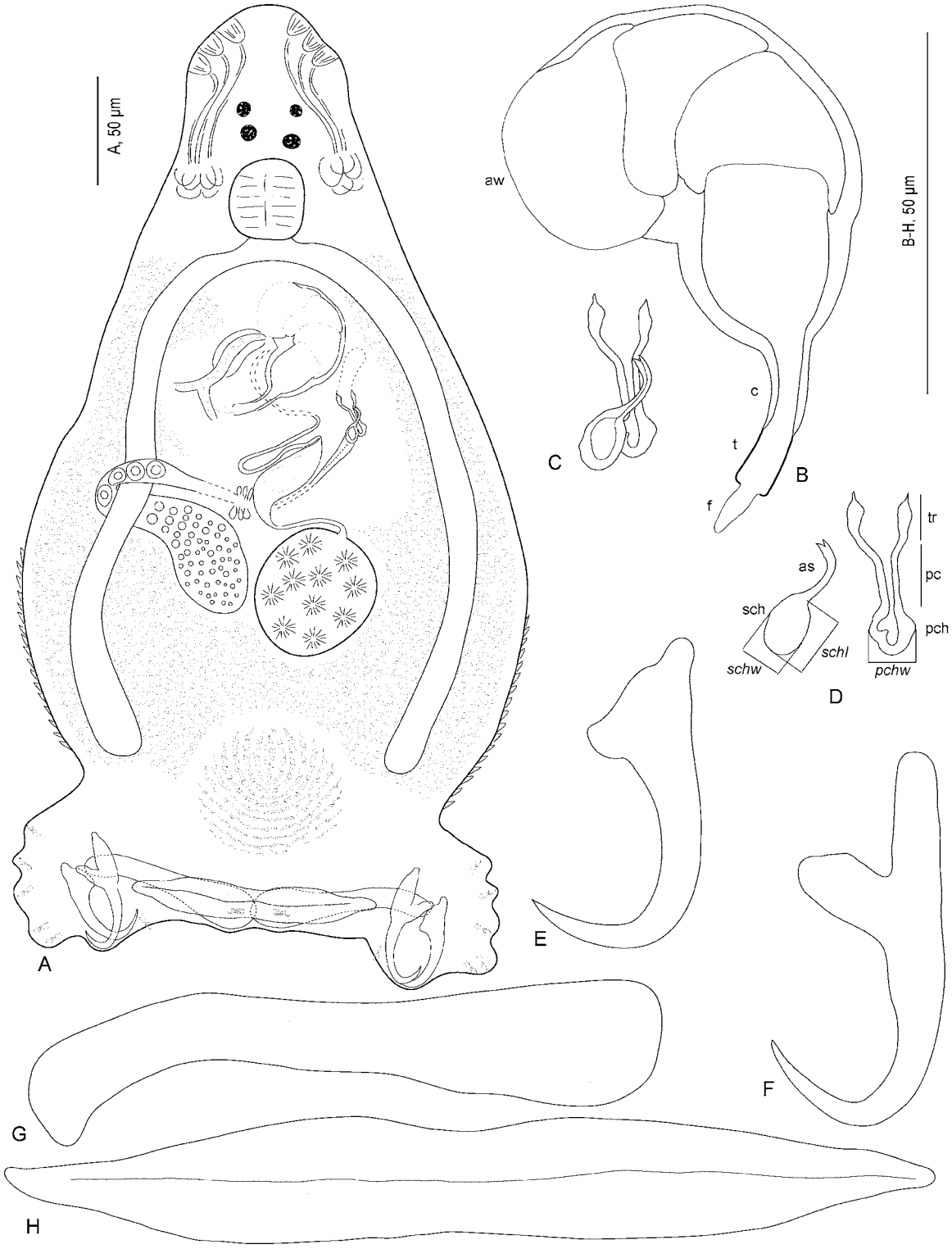

Fig 1. *Pseudorhabdosynochus bacchus* sp. nov. from *Epinephelus coeruleopunctatus*. **A.** Composite view of body, mainly from holotype, ventral view. **B.** Male quadriloculate organ, carmine, holotype; aw – anterior wall of anterior chamber, c – cone, f – filament, t – tube. **C.** Sclerotised vagina, carmine, holotype. **D.** Nomenclature and measurements of the sclerotised vagina, diagrammatically represented with the two chambers separate: as – accessory structure, pc – primary canal, pch – primary chamber, *pchw* – width of primary chamber, sch – secondary chamber, *schl* – length of secondary chamber; *schw* – width of secondary chamber, tr – trumpet. **E-H.** Haptoral hard parts, picrate, paratype. **E.** Dorsal hamulus. **F.** Ventral hamulus. **G.** Dorsal bar. **H.** Ventral bar

n = 29), p 5 (5–6, n = 10); filament length 7, c 7 ± 1.0 (5–10, n = 26), p 5 (5–6, n = 9).

Ovary subequatorial, intercaecal, encircles right caecum. Ovary width 70, c 66 ± 10.4 (50–90, n = 30). Oviduct passes medially to form ootype, surrounded by Mehlis' gland; ootype short, opens into uterus. Uterus dextral. Unsclerotised vagina generally inconspicuous, elongate (Fig. 2I). Duct from sclerotised vagina to ootype straight. Vitelline fields extend posteriorly from posterior to pharyngeal level in 2 lateral bands, confluent in post-testicular region and terminate anterior to peduncle. Bilateral connections from vitelline fields to ootype inconspicuous. Egg elongate with long filament; measurements of eggs *in utero* 91 × 47 (80–100 × 38–63).

Sclerotised vagina (nomenclature of parts according to Justine 2007; see Fig. 1D). Sinistral, a complex sclerotised structure; aspect changes slightly according to specimen and orientation (Fig. 2). Sclerotised vagina comprises anterior trumpet, followed by short primary canal, primary chamber, secondary chamber, and accessory structure. Anterior trumpet heavily sclerotised, in continuity with unsclerotised vagina; primary canal straight and short, sclerotised; primary chamber in continuity with primary canal, heavily sclerotised, with roundish external shape and bifurcate cavity; secondary chamber always ventral and generally dextral to primary chamber, larger than primary chamber, with simple ovoid cavity and ovoid external shape; sometimes spines on external surface of

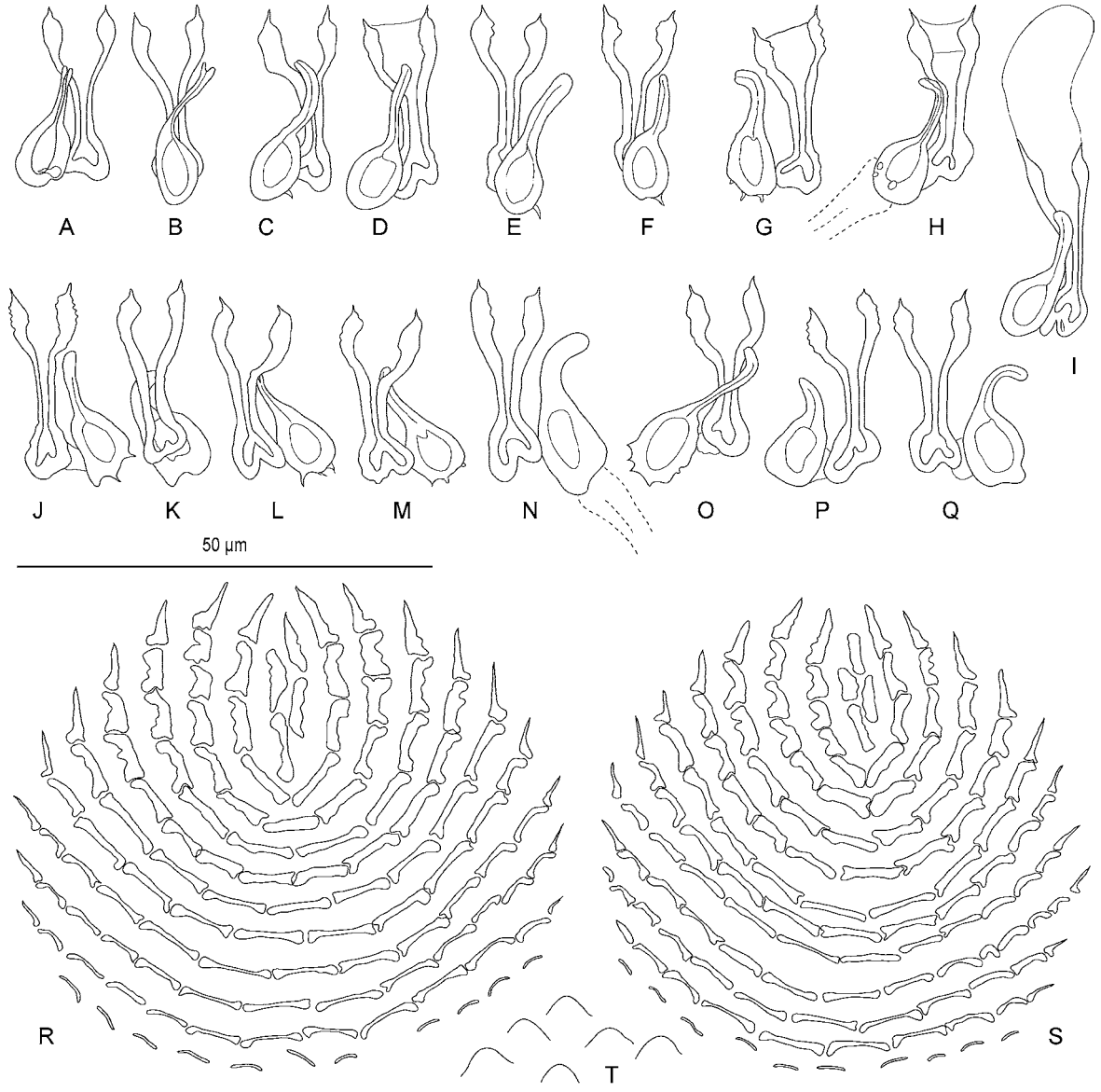

Fig. 2. *Pseudorhabdosynochus bacchus* sp. nov. from *Epinephelus coeruleopunctatus*. **A-Q.** sclerotised vagina, paratypes. **A-I.** Carmine, ventral view. **J-M.** Carmine, dorsal view. **N.** Picrate, dorsal view. **O-Q.** Picrate, ventral view. **R.** Ventral squamodisc, holotype, ventral view. **S.** Dorsal squamodisc, holotype, ventral view. **T.** Tegumental scales of ventral side, holotype, ventral view

posterior part of secondary chamber; accessory structure, a sclerotised canal connected to anterior part of secondary chamber, directed anteriorly, often curved toward left. Unsclerotised duct from sclerotised vagina to ootype connects to posterior part of secondary chamber (Fig. 2H, N). Secondary canal (between primary chamber and secondary chamber) never seen, but continuity between the walls of the two chambers always observed, even in highly flattened (picrate) specimens (Fig. 2N-Q). In picrate specimens, which are very flattened, the two chambers are not superposed but side by side. Total length of sclerotised vagina (measured from extremity to extremity) 27, c 24 ± 1.8 (22–28, n = 30), p 27 (25–31, n = 12); external width of primary chamber 6, 6 (4–6, n = 18); external length of secondary chamber 8, 8 (7–8, n = 18); external width of secondary chamber 6, 6 (5–7, n = 18) (see Fig. 1D). Orientation of sclerotised vagina: trumpet always anterior.

Type-host: *Epinephelus coeruleopunctatus* (Bloch) (Serranidae).

Type-locality: Barrier reef off Nouméa, New Caledonia.

Site: Between secondary gill lamellae.

Type-specimens: Holotype, JNC1905A6, 10 July 2006, Fausse Passe de Uitoé, off Nouméa, New Caledonia.

Material examined: 93 specimens: 64 'carmine' (c), 15 'picrate' (p), 14 'unflattened carmine' (uc).

Material deposited: Holotype (c) and 90 paratypes (61 c, 15 p, 14 uc); MNHN, 1 paratype (c), BMNH 2006.12.13.1, 1 paratype (c), USNPC 99435, 1 paratype (c), HCIP M-429.

Intensity: hundreds of specimens per fish.

Etymology: *Bacchus* (Latin) is the mythological God of wine; chosen according to the shape of the primary chamber of the sclerotised vagina, which resembles a glass of wine. Indeclinable.

Differential diagnosis: *P. bacchus* sp. nov. can be distinguished from all known species of *Pseudorhabdosynochus* by the morphology of its sclerotised vagina, which has the following combination of characters: robust trumpet, straight robust primary canal, presence of primary and secondary chambers and accessory structure. The vagina of *P. duitoe* Justine, 2007 is similar but *P. bacchus* can be easily differentiated from *P. duitoe* by the shape of its trumpet and by the relative size and shape of the chambers. The secondary canal is visible in *P. duitoe* but not in *P. bacchus*.

*Pseudorhabdosynochus bacchu*s is also characterised by the very special morphology of its quadriloculate organ, with cone and tube of similar length, both relatively short, and a filament with very constant morphology and length; no other species with this combination of characters is known.

Other parasites of Epinephelus coeruleopunctatus

In the fish mentioned in this study, we found two specimens of another species of *Pseudorhabdosynochus*, probably new. We could examine gills from other fish, unfortunately collected in suboptimal conditions, and observed that at least three other species of *Pseudorhabdosynochus* were present in addition to *P. bacchus* sp. nov. *E. coeruleopunctatus* is an uncommon fish and description of these rare monogenean species will await collection of additional material in sufficient number. Specimens of a species of *Haliotrema* (Ancyrocephalidae) were also present on the gills. These had a penis in form of a long sclerotised cylinder, about 150 µm in length, and probably belong to an undescribed species, close to *Haliotrema cromileptis* Young, 1968. Copepods were also collected from the gills. The opecoelid digenean *Cainocreadium epinepheli* (Yamaguti, 1934) was collected from the caeca (Bray and Justine 2007).

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