

## ***Pseudorhabdosynochus venus* n. sp. (Monogenea: Diplectanidae) from *Epinephelus howlandi* (Perciformes: Serranidae) off New Caledonia**

Damien D. Hinsinger & Jean-Lou Justine\*

*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*

Accepted for publication 8th June, 2005

### **Abstract**

*Pseudorhabdosynochus venus* n. sp. is described from specimens collected from the gills of *Epinephelus howlandi* off Nouméa, New Caledonia, South Pacific. The male sclerotised quadriloculate organ of *P. venus*, 61–101  $\mu\text{m}$  in internal length, has an anterior chamber with a thin anterior wall, a very short cone and a short posterior tube. The sclerotised vagina, 50–67  $\mu\text{m}$  in total length, is composed of an anterior open trumpet, an S-shaped canal, a tear-shaped principal chamber and a spherical accessory chamber; all parts are heavily sclerotised. The two squamodiscs have 10–11 rows of separate rodlets and no central closed row of rodlets. *P. venus* is differentiated from all other species of *Pseudorhabdosynochus* by the spectacular morphology of its sclerotised vagina. It is the first diplectanid described from *E. howlandi*.

### **Résumé**

*Pseudorhabdosynochus venus* n. sp. est décrit à partir de spécimens collectés sur les branchies de *Epinephelus howlandi*, pêché au large de Nouméa, Nouvelle-Calédonie, Pacifique Sud. L'organe tétraloculé sclérifié mâle de *P. venus* (longueur interne 61–101  $\mu\text{m}$ ), possède une chambre antérieure avec une fine paroi antérieure, un cône très court, et un tube postérieur court. Le vagin sclérifié, long de 50–67  $\mu\text{m}$ , est composé d'une trompette antérieure ouverte, d'un canal en S, d'une chambre principale en larme, et d'une chambre accessoire sphérique; toutes les parties sont fortement sclérifiées. Les deux squamodisques ont 10–11 rangées d'osselets séparés, sans rangée centrale fermée. *P. venus* se différencie de toutes les autres espèces de *Pseudorhabdosynochus* par la morphologie spectaculaire de son vagin sclérifié. Il s'agit du premier Diplectanidae décrit chez *E. howlandi*.

### **Introduction**

*Pseudorhabdosynochus* Yamaguti, 1958 is characterised by the presence of a quadriloculate organ. More than 20 species have been described, mostly from members of *Epinephelus* (Epinephelinae) (review by Santos, Buchmann & Gibson, 2000, and species described by Bu et al., 1999, Zhang et al., 2001, and Justine, 2005a, 2005b). We describe here a new species from *Epinephelus howlandi*, an epinepheline in which apparently no

diplectanid has previously been described (Oliver, 1987).

### **Materials and methods**

Specimens of *Epinephelus howlandi* (Günther) ('blacksaddle grouper'; local name 'loche à selle noire'; sometimes 'loche grisette' at the fish market) were caught with hand-lines on board the R/V 'Coris', or spear fished, in various places off Nouméa, New Caledonia (see list of stations). Live fish were kept in a container with seawater

\*Author for correspondence (E-mail: justine@ird.nc)

and immediately brought back to the laboratory. All fish were measured, weighed and photographed. A unique number (JNC) was assigned to each fish; for hosts with JNC number  $\geq 1438$ , only the right gills were collected and the fish specimens were examined and identified by J.E. Randall (Bishop Museum, Hawaii) and later deposited in the ichthyological collection of the Muséum National d'Histoire Naturelle, Paris (MNHN) under the numbers 2004–2168, 2004–2169, 2005–0778 and 2005–1360 to 2005–1372. The parasitological material was then assigned a corresponding JNC linked to the respective fish host. In the list of material examined, measurements of hosts are abbreviated as FL (fork length) in millimetres and W (weight) in grams, for possible future comparison of parasite prevalence and host age in other localities.

*Station list.* Stations are along the barrier reef, at a distance of about 20 km from the shore, with a depth of 20–40 m, or along the shore in Nouméa city, with a depth of 0.5–3 m. Stn C1: Récif Le Sournois, 22°31'33"S, 166°26'29"E, 27 May, 2004; Stn C2: Côte Blanche, Nouméa, 22°18'06"S, 166°26'00"E, 9 July, 2004; Stn C3: Côte Blanche, Nouméa, 6 October, 2004; Stn C4: Côte Blanche, Nouméa, 17 February, 2005; Stn C5: Anse Vata, Nouméa, 22°18'25"S, 166°25'51"E, 24 February, 2005; Stn C6: Récif Le Sournois, 1 March, 2005; Stn C7: Centre of Récif Toombo, 22°33'12"S, 166°27'00"E, 14 March, 2005; Stn C8: Côte Blanche, Nouméa, 16 March, 2005; Stn C9: Îlot aux Goélands, 22°22'53"S, 166°23'26"E, 12 April, 2005.

Gills were extracted and examined in seawater under a dissecting microscope. Live monogeneans were individually picked off the gills with fine needles and immediately prepared. For carmine staining (referred to as 'Carmine' – see Justine, 2005a), specimens were routinely processed according to Justine (2005a). A few specimens were prepared with ammonium picrate-glycerine (referred to as 'Picrate' – see Justine, 2005a) according to Malmberg (1957).

Monogeneans were drawn with a BH2 microscope equipped with a camera lucida and DIC optics, which greatly helps with the observation of unstained sclerotised parts. 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. Measurements for the parts of the quadriloculate organ (internal length, cone, tube) follow Justine (2005a). All measurements are given in micrometres as: holotype, mean of paratypes  $\pm$  standard deviation, with range and number in parentheses. Measurements in ammonium picrate preparations and in specimens flattened in ethanol vary for the hollow sclerotised organs, the quadriloculate organ and sclerotised vagina (Justine, 2005a), and are presented separately for these organs.

***Pseudorhabdosynochus venus* n. sp.**

*Type-host:* *Epinephelus howlandi* (Günther) (Serranidae).

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

*Site:* Gill filaments.

*Type-specimens:* Holotype, slide JNC1120A3; paratypes, 14 specimens, from hosts JNC1120, JNC1451 and JNC1478.

*Material examined:* Seven specimens stained with carmine in Canada balsam, 8 specimens preserved in ammonium picrate-glycerine, and live specimens.

*Type-material:* Muséum National d'Histoire Naturelle (MNHN), Paris, holotype, slide JNC1120A3 and 12 paratypes on 10 slides (carmine and picrate); Natural History Museum, London, BMNH No. 2005.7.20.1, paratype (carmine, from host JNC1120); United States Parasite National Collection, Beltsville, USA, USNPC 97110, paratype (carmine, from host JNC1120).

*Prevalence:* 4/19 (21%); in large hosts (>300 mm) 4/4 (100%).

*Intensity:* JNC 1119, FL 330, W 634, Stn C1: 4; JNC 1120, FL 410, W 1210, Stn C1: 11; JNC 1451, FL 310, W 444, Stn C6: 4 (only right gills examined); JNC1478, FL 350, W617, Stn C7: 5 *P. venus* and 3 other diplectanids, not described here (only right gills examined). Hosts uninfected by *P. venus*: JNC1194, FL 162, W 59, Stn C2; JNC1195, FL 182, W 83, Stn C2; JNC1377, FL 205, W 128, Stn C3; JNC1378, FL 220, W 148, Stn C3; JNC1438, FL 255, W 264, Stn C4; JNC1439, FL 195, W 76, Stn C4; JNC1445, FL 165, W 57, Stn C5; JNC1487, FL 230, W 167, Stn C8; JNC1488, FL 250, W 218, Stn C8; JNC1489, FL

250, W 236, Stn C8; JNC1490, FL 240, W 189, Stn C8; JNC1491, FL 180, W 84, Stn C8; JNC1518, FL 240, W 222, Stn C9; JNC1519, FL 240, W 200, Stn C9; JNC1520, FL 260, W 306, Stn C9. Total intensity: 4–11 *P. venus* per fish (both sides). Small hosts (FL < 300–350 mm) harboured only a *Pseudorhabdosynochus* species close to *P. cupatus* (Young, 1969); large hosts harboured only *P. venus*. Only host JNC1478 (FL 350 mm) harboured both species.

*Remarks on the host:* *E. howlandi* is known from the tropical western central Pacific and is considered a rare species by Heemstra & Randall (1993). Mentioned and pictured in Laboute & Grandperin (2000) but not listed in Rivaton et al. (1990), it is not a rare but rather an uncommon species in New Caledonia and occasionally seen at the fish market in Nouméa.

*Etymology:* Named for Venus, the mythological goddess of love and beauty, as a reference to the spectacular and beautiful sclerotised vagina. This is treated as a noun in apposition.

#### *Description* (Figures 1–2)

Diplectanidae. Body length 710, 774 (525–1150,  $n = 15$ ); width 290, 277 (200–350,  $n = 15$ ). Tegument smooth. Anterior region with 3 pairs of head organs and 2 pairs of eye-spots; width (external) of anterior eye-spot pair 50, 49 (35–63,  $n = 14$ ), of posterior eye-spot pair 35, 32 (23–43,  $n = 14$ ).

Haptor differentiated from rest of body, width 235, 205 (160–235,  $n = 14$ ), provided with 2 almost similar squamodiscs, 2 pairs of lateral hamuli, 3 bars and 14 marginal hooklets. Squamodiscs made up of rows of rodlets; central rows V-shaped, not forming closed circles; rodlets in all rows similar in width; ventral squamodisc round in shape, length 57, 60 (52–70,  $n = 12$ ), width 66, 64 (55–80,  $n = 12$ ), with 10, 10 (10–11,  $n = 11$ ) rows of rodlets; dorsal squamodisc slightly more elongate than ventral squamodisc, length 63, 62 (55–80,  $n = 13$ ), width 63, 61 (52–75,  $n = 13$ ), with 11, 11 (10–12,  $n = 13$ ) rows of rodlets. Ventral hamulus with handle and distinct guard, outer length 43, 44 (42–46,  $n = 28$ ), inner length 26, 27 (25–29,  $n = 28$ ). Dorsal hamulus with indistinct guard, outer length 46, 49 (46–54,  $n = 28$ ), inner length 41, 41 (39–43,  $n = 28$ ). Dorsal (lateral) bars massive, with thin flattened medial extremity

and roughly cylindrical lateral extremity with posteriorly directed protuberance, length 60, 62 (56–70,  $n = 28$ ), maximum width 16, 16 (11–22,  $n = 28$ ). Ventral bar flat, with constricted median portion and pointed extremities, length 66, 67 (59–73,  $n = 28$ ), maximum width 11, 12 (7–18,  $n = 14$ ); groove visible on its ventral side.

Pharynx subspherical, 70, 62 (50–75,  $n = 14$ )  $\times$  62, 58 (45–75,  $n = 14$ ). Oesophagus apparently absent, such that intestinal bifurcation immediately follows pharynx. Intestinal caeca simple, terminate blindly at level of posterior margin of vitelline field.

Testis subspherical, intercaecal, 80, 108 (50–167,  $n = 10$ )  $\times$  110, 137 (87–175). Vas deferens emerges from antero-sinistral part of testis, enlarges to form seminal vesicle; seminal vesicle in middle region of body, forms bend, then transforms into coiled duct; duct enlarges slightly then penetrates quadriloculate organ; no real ejaculatory bulb. Prostatic glands sinistral and dextral, converge towards base of prostatic vesicle; prostatic vesicle 54 long ( $n = 4$ ), opens into quadriloculate organ near sperm duct. Quadriloculate organ with fourth (posterior) chamber more sclerotised than 3 anterior chambers; first (anterior) chamber with very thin anterior wall; fourth chamber ends in very short sclerotised cone, prolonged by sclerotised tube; distal extremity of cone slanted; distal extremity of tube slightly enlarged, with thinner wall; end of tube prolonged by thin unsclerotised filament of variable length. Inner length of quadriloculate organ 65, 71 (61–76,  $n = 6$ ) (Carmine), 92 (81–101,  $n = 8$ ) (Picrate); cone length 9, 9 (6–12,  $n = 14$ ); tube length 21, 17 (9–21,  $n = 14$ ); filament length 6–48 ( $n = 12$ ).

Ovary subequatorial, intercaecal, pre-testicular, encircles right caecum. Ovary width 100, 101 (75–175,  $n = 9$ ). Oviduct passes medially to form oötype, surrounded by Mehlis' gland; oötype short, opens into uterus. Uterus dextral. Unsclerotised vagina inconspicuous. Sclerotised vagina sinistral, a spectacular and complex sclerotised structure, very constant among various specimens. Sclerotised vagina comprises anterior trumpet, followed by heavily sclerotised S-shaped canal; canal widens into principal chamber; principal chamber elongate, tear-shaped, heavily sclerotised; accessory chamber, spherical, heavily sclerotised, communicates with principal chamber by short canal located at one third of principal chamber

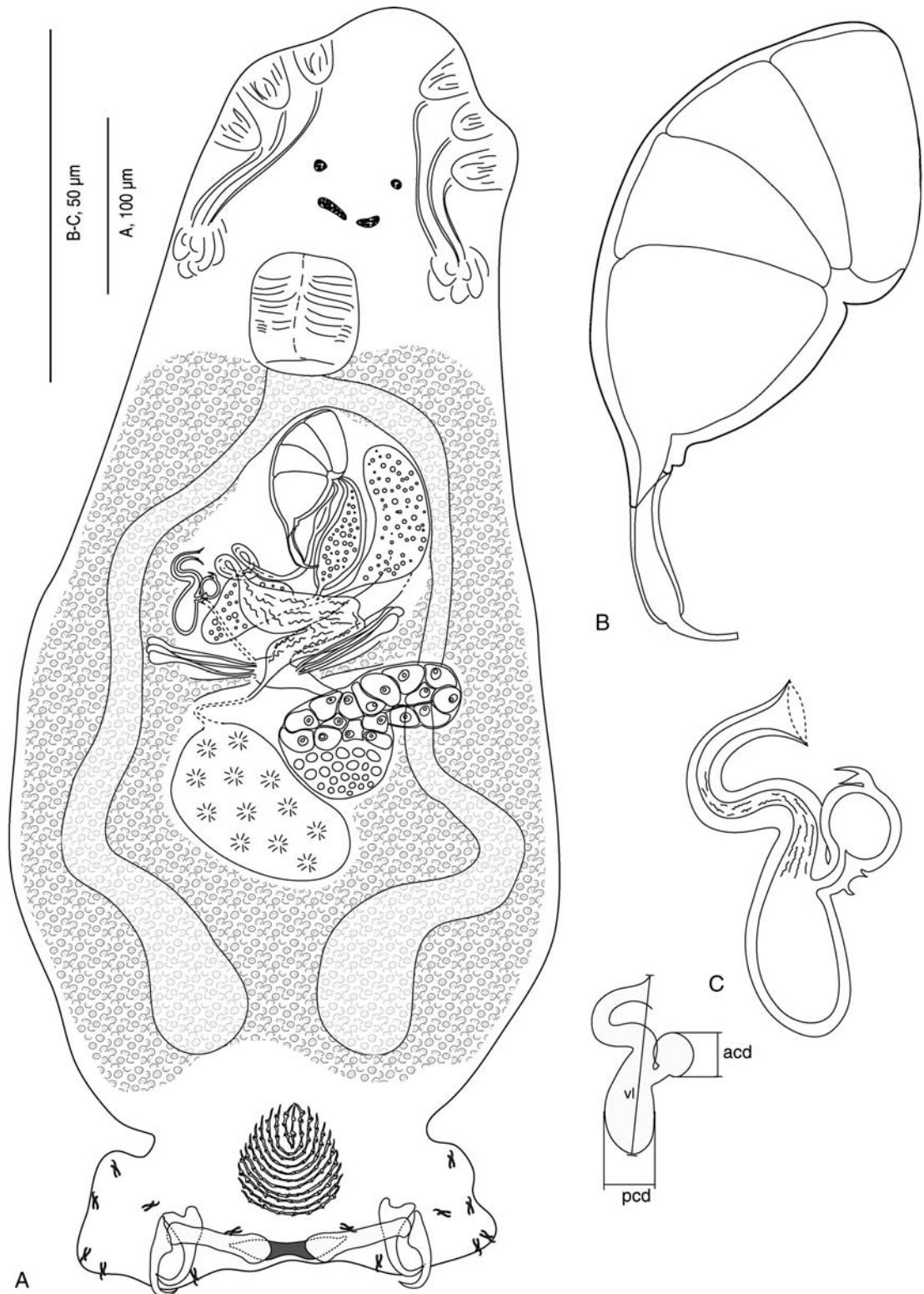


Figure 1. *Pseudorhabdosynochus venus* n. sp.: A. Habitus (dorsal view; composite drawing from holotype, paratypes, and living specimens); B. Quadriloculate organ; C. Sclerotised vagina; *measurements*: vl, vagina length; acd, accessory chamber diameter; pcd, principal chamber diameter. B,C. Holotype.

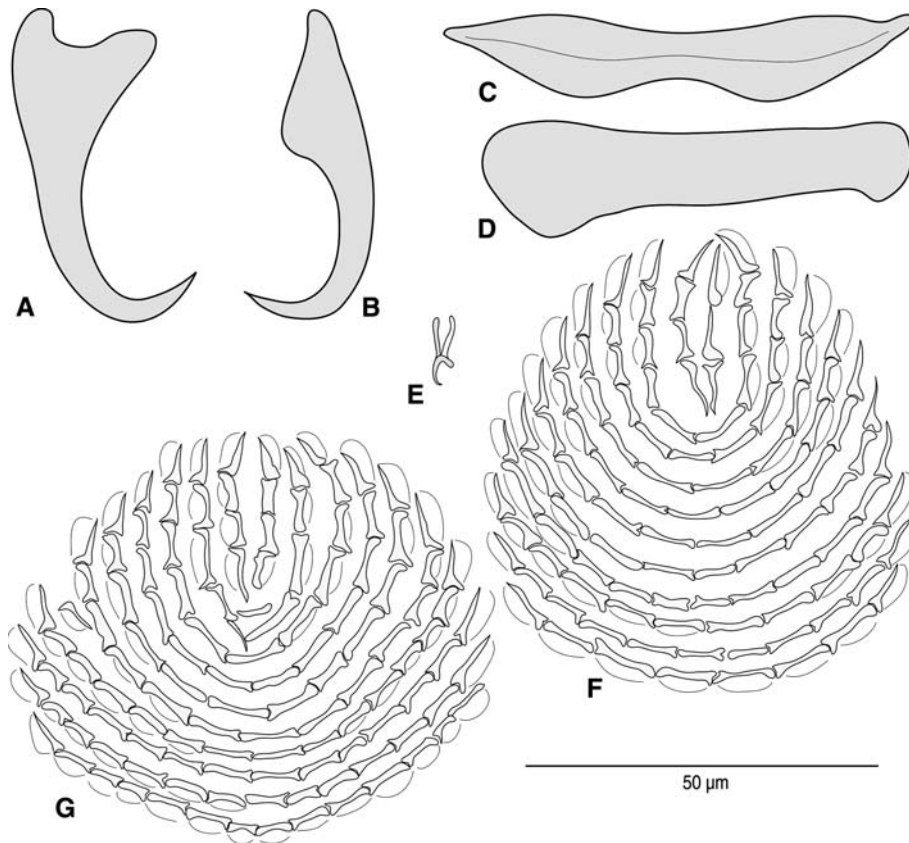


Figure 2. *Pseudorhabdosynochus venus* n. sp.: A. Ventral hamulus; B. Dorsal hamulus; C. Ventral bar; D. Dorsal bar; E. Hooklet; F. Dorsal squamodisc; G. Ventral squamodisc, dorsal view. A-G. Holotype.

length. External surface of sclerotised vagina smooth; internal surface with longitudinal striations visible in posterior part of S-shaped canal and anterior part of principal chamber; external short spiny protuberances on posterior side of canal between principal and accessory chambers, and on anterior side of accessory chambers. Total length of sclerotised vagina 50, 55 (50–57,  $n = 6$ ; Carmine), 61 (54–67,  $n = 7$ , Picrate); diameter of principal chamber 14, 14 (12–16,  $n = 5$ ; Carmine), 19 (16–22,  $n = 7$ ; Picrate); diameter of accessory chamber 11, 12 (11–13,  $n = 5$ ; Carmine), 15 (12–17,  $n = 7$ ; Picrate). Orientation of sclerotised vagina: trumpet always anterior; in flattened preserved specimens, trumpet oriented towards body centre in most (13/15) specimens, and towards left side in others. Duct from sclerotised vagina to oötype emerges at level of accessory chamber; no seminal receptacle. 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 oötype inconspicuous; left between testis and vaginal sac; right anterior to oviduct. Egg not known.

#### Differential diagnosis

*P. venus* n. sp. can be distinguished from other species of *Pseudorhabdosynochus* by the morphology of the sclerotised vagina and also by characteristics of the squamodiscs. No species of *Pseudorhabdosynochus* has a sclerotised vagina similar or even close to that of *P. venus*. The vagina of *P. vagampullum* (Young, 1969) has heavy walls, but the shape is very different and no accessory chamber is present. The vaginae of *P. kritskyi* Dyer, Williams & Bunkley-Williams, 1995 and *P. capurroi* Vidal-Martinez & Mendoza-Franco, 1998 both have a heavily sclerotised chamber, but both lack the S-shaped canal and the spherical accessory chamber of *P. venus*, and

the squamodiscs of these two species have closed central rows of rodlets. The vagina of *P. chinensis* Zhang, Yang & Liu, 2001 has a sclerotised chamber but its shape is very different from that of *P. venus*.

The other species of *Pseudorhabdosynochus* that we found in certain specimens of *E. howlandi* is close to *P. cupatus* Young, 1969 and thus is very different from *P. venus* for characters of the quadriloculate organ, vagina, haptor hard parts and squamodiscs.

### Remarks

The distinction of species within *Pseudorhabdosynochus* generally uses the following characters: the sclerotised vagina, the quadriloculate organ and the haptor parts, including the squamodiscs. Although the quadriloculate organ is homogeneous within the genus, Justine (2005a) commented upon a possible distinction based on the relative wall thickness of successive chambers. *P. venus* has a very thin anterior wall, a character described only in *P. caledonicus* Justine, 2005. No phylogenetic value can presently be attributed to this character.

### Other gill parasites of *E. howlandi*

Surprisingly, in contrast to other epinephelines of New Caledonia which often have a rich parasitic fauna on the gills, most specimens of *E. howlandi* harboured only the diplectanid described here; no ancycrocephalid, capsalid, copepod or isopod was found. The intensity of infestation by *P. venus* was low. Another species of *Pseudorhabdosynochus* is present on small but not large hosts.

### Acknowledgements

John E. Randall (Bishop Museum, Hawaii) kindly examined and identified our fish specimens. Gérard Mou Tham and Adeline Collet (IRD, Nouméa), and the students Eric Bureau, Maya Robert and Stéphanie Pedron, participated to the

fishing operations. Angelo di Matteo (IRD, Nouméa) provided technical help. Sam Tereua, captain of the R/V 'Coris', provided safe navigation, counsel and assistance. Michel Kulbicki (IRD, Nouméa) helped with the initial fish identification.

### References

- Bu, S.S.H., Leong, T.S., Wong, S.Y., Woo, Y.S.N. & Foo, R.W.T. (1999) Three diplectanid monogeneans from marine finfish (*Epinephelus* spp.) in the Far East. *Journal of Helminthology*, **73**, 301–312.
- Heemstra, P.C. & Randall, J.E. (1993) *FAO Species Catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date*. Rome: FAO. FAO Fisheries Synopsis, No. 125, Volume 16, 382 pp.
- Justine, J.-L. (2005a) 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 with different methods and a description of *P. caledonicus* n. sp. *Systematic Parasitology*, **62**, 1–37.
- Justine, J.-L. (2005b) *Pseudorhabdosynochus hirundineus* n. sp. (Monogenea, Diplectanidae) from *Variola louti* (Perciformes, Serranidae) off New Caledonia. *Systematic Parasitology*, **62**, 39–45.
- Laboute, P. & Grandperrin, R. (2000) *Poissons de Nouvelle-Calédonie*. Nouméa, New Caledonia: Éditions Catherine Ledru, 520 pp.
- Malmberg G. (1957) Om förekomsten av *Gyrodactylus* på svenska fiskar. *Skrifter Utgivna av Södra Sveriges Fiskeriförening, Årsskrift*, **1956**, 19–76. (in Swedish).
- Oliver, G. (1987) *Les Diplectanidae* Bychowsky, 1957 (Monogenea, Monopisthocotylea, Dactylogyridea). *Systématique. Biologie. Ontogénie. Écologie. Essai de phylogénèse* Thèse d'État: Académie de Montpellier, Université des Sciences et Techniques du Languedoc, Montpellier, 433 pp.
- Rivatton, J., Fourmanoir, P., Bourret, P. & Kulbicki, M. (1990) *Catalogue des poissons de Nouvelle-Calédonie* Rapport provisoire, Sciences de la Mer, Biologie Marine. Nouméa: Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM), 170 pp.
- Santos, C.P., Buchmann, K. & Gibson, D.I. (2000) *Pseudorhabdosynochus* spp. (Monogenea: Diplectanidae) from the gills of *Epinephelus* spp. in Brazilian waters. *Systematic Parasitology*, **45**, 145–153.
- Young, P.C. (1969) Some monogenoideans of the family Diplectanidae Bychowsky, 1957 from Australian teleost fishes. *Journal of Helminthology*, **43**, 223–254.
- Zhang, J.Y., Yang, T.B. & Liu, L. (2001) *Monogeneans of Chinese marine fishes* (in Chinese). Beijing: Agriculture Press, 400 pp.