ISSN Versión impresa 2218-6425 ISSN Versión Electrónica 1995-1043

Neotropical Helminthology, 2017, 11(2), jul-dic: 387-394

aphia
ASOCIACIÓN PERUANA DE HELMINTOLOGÍA E INVERTEBRADOS AFINES

Neotropical Helminthology

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

OLIVACOTYLE HEMANTHIASI N. GEN. N. SP. (MONOGENEA: DICLIDOPHORIDAE) FROM THE GILLS OF DAMSEL BASS *HEMANTHIAS SIGNIFER* (GARMAN, 1899) (TELEOSTEI: SERRANIDAE) IN THE SOUTH AMERICAN PACIFIC OCEAN

OLIVACOTYLE HEMANTHIASI N. GEN. N. SP. (MONOGENEA: DICLIDOPHORIDAE) DE LAS BRANQUIAS DE LA CABRILLA DONCELLA *HEMANTHIAS SIGNIFER* (GARMAN, 1899) (TELEOSTEI: SERRANIDAE) EN EL OCÉANO PACÍFICO DE AMÉRICA DEL SUR

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ABSTRACT

A new genus and species of Monogenea, *Olivacotyle hemanthiasi* n. gen., n. sp., are proposed to accommodate diclidophorids collected from the gills of damsel bass Hemanthias signifer (Garman, 1899) (Serranidae) in Peru, South American Pacific Ocean (45°54'S, 81°05'W). While clearly a member of the Diclidophorinae Cerfontaine, 1895 that includes parasites of marine teleosts, *O. hemanthiasi* n. sp. differs from the other 15 members of this subfamily by the combination of the following six characteristics: (1) haptoral clamps with the anteromedial sclerite and one anterolateral sclerite fused forming a ring, with other anterolateral sclerite not fused with any sclerites of inner anterior quadrant, lamellate extension partially reduced and distal posterolateral sclerites not fused distally; (2) clamps arranged in a semicircle around the posterior edge of the haptor; (3) testes extend into the haptor; (4) vagina absent; (5) seminal receptacle well developed; and (6) prostatic vesicle absent.

Keywords: damsel bass – Diclidophoridae – ectoparasites – Hemanthias signifer – *Olivacotyle hemanthiasi* – Pacific Ocean – Peru – Serranidae

RESUMEN

Un nuevo género y especie de Monogenea, *Olivacotyle hemanthiasi* n. gen., n. sp., se proponen para acomodar especímenes colectados de las branquias de la cabrilla doncella *Hemanthias signifer* (Garman, 1899) (Serranidae) en el Perú, Océano Pacífico Sudamericano (45°54'S, 81°05'W). Si bien es un miembro de Diclidophorinae Cerfontaine, 1895 que incluye parásitos de teleósteos marinos, *O. hemanthiasi* n. sp. difiere de los otros 15 miembros de esta subfamilia por la combinación de las siguientes seis características: (1) pinzas haptorales con la esclerita anteromedial y una esclerita anterolateral fusionadas formando un anillo, la otra esclerita anterolateral no fusionada con ninguna esclerita del cuadrante anterior interno, extensión lamelar parcialmente reducida y escleritas posterolateral distal no fusionadas distalmente; (2) pinzas dispuestas en semicírculo alrededor del borde posterior del haptor; (3) testículos extendiéndose hacia el haptor; (4) vagina ausente; (5) receptáculo seminal bien desarrollado; y (6) vesícula prostática ausente.

Palabras claves: cabrilla doncella – Diclidophoridae – ectoparásitos – Hemanthias signifer – Océano Pacífico – *Olivacotyle hemanthiasi* – Perú – Serranidae

INTRODUCTION

Currently, 45 species belonging to 18 genera of the Diclidophoridae Fuhrmann, 1928 have been described from several marine South American teleost fishes. From them, only *Hemitagia galapagensis* (Meserve, 1938), has been reported on fishes of the Serranidae: the Peruvian rock seabass *Paralabrax humeralis* (Valenciennes, 1828) and the creole-fish *Paranthias furcifer* (Valenciennes, 1828) (Cohen *et al*., 2013; Eiras *et al.*, 2016; Luque *et al*., 2016; Gómez del Prado-Rosas *et al*., 2017).

The damsel bass *Hemanthias signifer* (Garman, 1899) (Serranidae) is a demersal fish distributed in the Eastern Pacific waters, from southern California and the Gulf of California to northern Peru, including Malpelo Island (Chirichigno & Cornejo, 2001); like other serranids, the damsel bass inhabits rocky reef areas from 25 to 305m in depth (Heemstra, 1995; Anderson & Heemstra, 2012). This species is listed as presenting least concern by International Union for Conservation of Nature and Natural Resources (IUCN Red List) (Smith-Vaniz *et al.* 2010).

During a parasitological survey on monogeneans parasites of demersal fish species off Tumbes, northern Peru, specimens were collected from the gills of *H. signifier*, representing a new species and genus of the Diclidophoridae. The morphology of these specimens was compared to related species of the Diclidophoridae herein.

MATERIALS AND METHODS

Fish were collected between July 2014 to January 2015 off the coast of Puerto Pizarro, Tumbes, Peru (45°54'S, 81°05'W), using gillnets and were dissected immediately after capture. The gills were excised and placed in Petri dishes with sea water and examined for monogeneans with the aid of a stereomicroscope. Monogeneans found were fixed in hot 4% formalin, stained with Semichon's carmine or Gomori's trichrome, clarified in Eugenol and mounted in Canada balsam. Other specimens were mounted in Gray and Wess medium (Humason, 1979) for the study of sclerotized structures. Specimens were examined using a compound Olympus™ BX51 photomicroscope equipped with normal light and differential interference contrast microscopy (DIC) optics and drawings were made with the aid of a drawing tube. Measurements are in micrometers, unless otherwise indicated, using straight-line distances between extreme points of the structures measured and are expressed as the range followed by the mean and number (n) of structures measured in parentheses.

Nomenclature of the clamp sclerites considered its relative position follows Kritsky & Klimpel

(2007). Fishes were identified according to Chirichigno & Vélez (1998) and Anderson & Heemstra (2012). Prevalence and mean intensity of infection were calculated according to Bush *et al*. (1997).

For comparative purposes, the following specimens deposited in the Helminthological Collection of the National Museum of Natural History, Smithsonian Institution (USNM), USA and in the Colección Nacional de Helmintos, Instituto de Biologia, Universidad Nacional Autónoma de México (CNHE), Mexico were examined: *Lampanyctophilus wisneri* Payne, 1986 (USNM 79178, holotype) and *Mamaevicotyle villalobosi* Lamothe, 1984 (CNHE 0205, holotype). Type material was deposited in the Helminthological Collection of the Museum of Natural History, San Marcos University (MUSM), Lima, Peru, and in the Helminthological Collection of Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Brazil.

RESULTS

Diclidophoridae Fuhrmann, 1928
Diclidophorinae Cerfontaine, 1895
***Olivacotyle* n. gen.**

Diagnosis. Body symmetrical, not divided. Haptor not separated from body, bearing 4 pairs of slightly pedunculated clamps, arranged in semicircle around posterior edge of haptor. Clamps asymmetrical with opposable valves. Anterior valve formed by anterolateral sclerite and anterior ring-shape sclerite (fusion of anteromedial sclerite and one anterolateral sclerite); other anterolateral sclerite not fused to distal and proximal ends of anterior ring-shape sclerite, lamellate extension partially reduced; slightly muscular circular pad present in inner anterior quadrant of clamp. Posterior valve formed by posteromedial sclerite, two distal posterolateral sclerites not fused distally and two proximal posterolateral sclerites. Terminal lappet absent. Three pairs of anchors, two outer pairs simple and an inner pair sickle-shaped with long shank, curved shaft and point; arranged in posterior edge of haptor. Buccal suckers paired, not septate. Pharynx present. Ceca diverticulated, extending into haptor, not confluent posteriorly. Testes numerous, postovarian, extend into the haptor. Copulatory organ armed with 6 curved hooks with bifid base. Prostatic vesicle absent. Ovary tubular, elongate, double inverted U–shaped. Seminal receptacle well developed. Vagina absent. Elongated uterus. Eggs with single long, strongly coiled filament at abopercular pole. Parasites on gills of serranids.

Type species: *Olivacotyle hemanthiasi* n. gen. n. sp.

Etymology: The generic epithet is named in honor of Marcelo Enrique Oliva Moreno (Universidad de Antofagasta, Chile) for his contribution to the marine ichthyoparasitology.

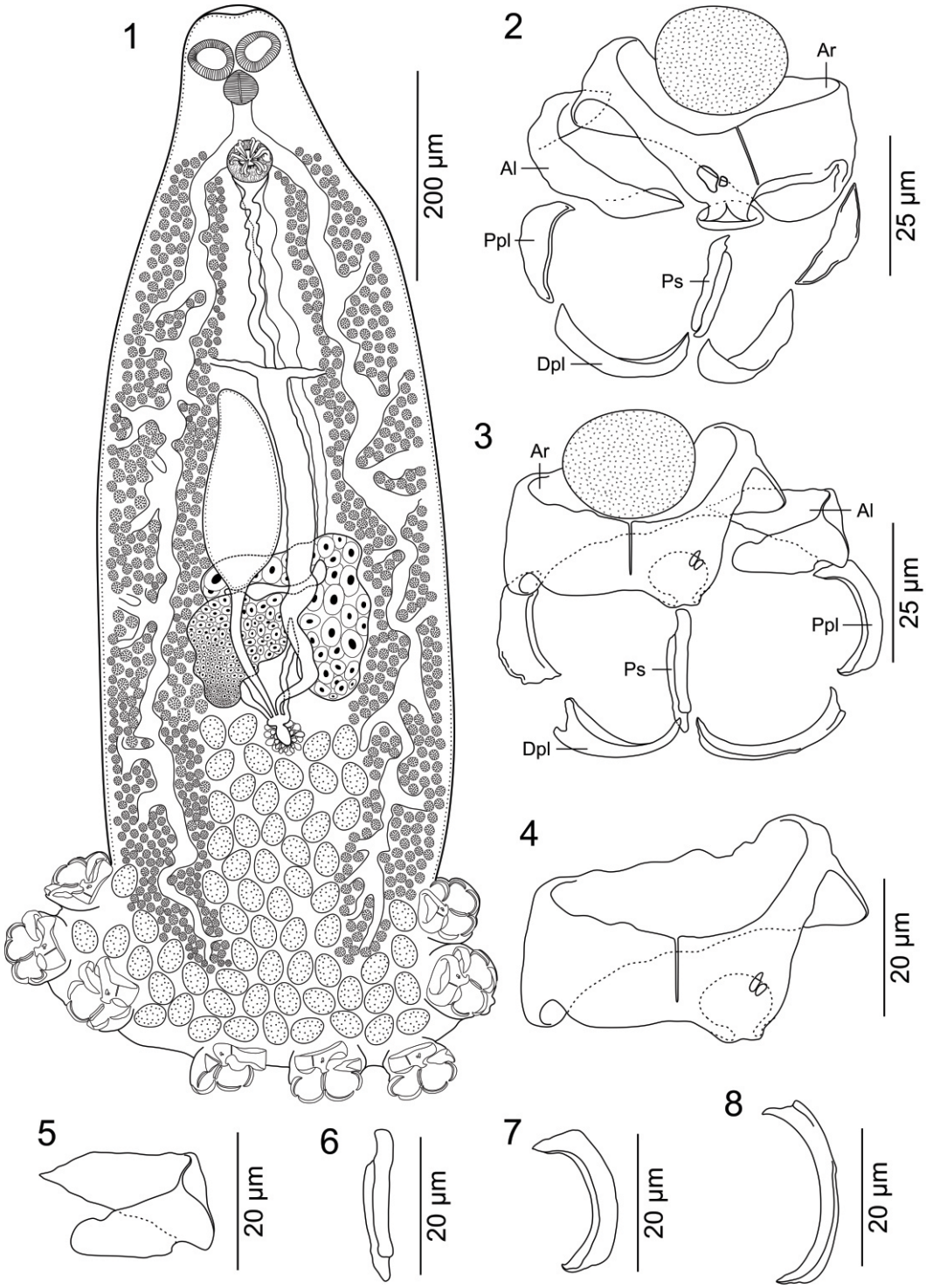
Remarks

Currently, the Diclidophoridae includes 52 recognized genera, 15 of them belonging to the Diclidophorinae, i.e., *Diclidophora* Kroyer, 1838; *Diclidophoroides* Price, 1943; *Osphyobothrus* Yamaguti, 1958; *Flexophora* Prost & Euzet, 1962; *Allotagia* Dillon & Hargis, 1965; *Upenicola* Unnithan, 1966; *Lebboia* Mamev & Paruchin, 1975; *Polyipnicola* Mamaëv & Paruchin, 1975; *Tribuliphorus* Mamaev & Parukhin, 1977; *Inbjumia* Mamaev & Parukhin, 1984; *Mamaevicotyle* Lamothe-Argumedo, 1984; *Campechia* Zhukov & Mamaev, 1985; *Lampanyctophilus* Payne, 1986; *Mamaevodiclidophora* Rubec, 1991 & *Macrouridophora* Rubec & Dronen, 1994 (Mamaev, 1976; Payne, 1986; Rubec & Dronen 1994).

The new genus differs from *Allotagia* because the species of this genus has the posterior valve of the clamp with the distal posterolateral sclerites and the proximal posterolateral esclerites fused to form a single pair of long sclerites (not fused in members of *Olivacotyle* n. gen.).

The species of *Campechia*, *Flexophora*, *Inbjumia* and *Polyipnicola* have the anterior valve of the clamp with the anterolateral sclerites fused distally (these are not fused in members of the new genus).

The new genus differs from *Tribuliphorus* because the species of this genus has the anterolateral sclerites and the distal posterolateral sclerites equipped with large curved teeth (absent in members of *Olivacotyle* n. gen).



Figures. 1–8. *Olivacotyle hemanthiasi* n. gen. n. sp. (Monogenea: Diclidophoridae) from gill filaments of the damsel bass *Hemanthias signifer* (Garman, 1899) (Serranidae), holotype. 1. Body, ventral view. 2. Clamp posterolateral view. 3. Clamp dorsal view. 4. Anterior ring-shape sclerite (Ar). 5. Anterolateral sclerite (Al). 6. Posteromedial sclerite (Ps). 7. Proximal posterolateral sclerite (Ppl). 8. Distal posterolateral sclerite (Dpl).

Olivacotyle n. gen. differs from *Diclidophora* because the species of this genus have the anterior valve of the clamp with complete lamellate extension (lamellate extension partially reduced in member of the new genus). In addition, *Diclidophora* species have a prostatic vesicle (absent in member of *Olivacotyle* n. gen.) and the clamps are arranged in the lateral margins of the haptor (the new genus has the clamps arranged in a semicircle around posterior edge of haptor).

The members of *Mamaevicotyle* have the anterior valve of the clamp with a plate-shape sclerite (ring-shape sclerite in species of the new genus) (confirmed by the study of the holotype of *M. villalobosi*, CNHE 0205). In addition, *Mamaevicotyle* species have two vaginal pores (absent in member of *Olivacotyle* n. gen.).

In the species of *Diclidophoroides*, *Mamaevodiclidophora* and *Macrouridophora* the axial anterolateral sclerite and anteromedial sclerite are not fused distally (fused in *Olivacotyle* n. gen.). Moreover, in *Diclidophoroides* species the posterior pair of clamps is larger than the other clamps (the clamps are similar in size in members of the new genus). In *Mamaevodiclidophora* and *Macrouridophora* species have a prostatic vesicle (absent in member of *Olivacotyle* n. gen.).

According to Mamaev (1976), *Lebboia* is considered the most primitive genus of the Diclidophorinae, and includes species with the morphology of the clamps different from that of *Olivacotyle* n. gen. In the species of *Lebboia* the anteromedial sclerite is not fused to lamellate extension (fused in members of the new genus).

Olivacotyle n. gen. differs from species of *Upenicola*, *Osphyobothrus* and *Lampanyctophilus* (confirmed by the study of the holotype of *L. wisneri*, USNM 79178) by having distal posterolateral esclerites fused distally (not fused in the new genus).

***Olivacotyle hemanthiasi* n. sp.** (Figs. 1-7)
Description (*based on 4 specimens mounted in Gray and Wess medium and 22 fixed in 4% hot formalin and stained with Semichon's carmine or Gomori's trichrome*): Body piriform, symmetrical, not divided (Fig. 1), 0.832–1.098 (1.008; n = 22) mm long, 226–402 (338; n = 22) maximum width at level of ovary. Tegument smooth. Buccal suckers oval, muscular, aseptate, lying in posterolateral wall of buccal cavity, 35–51 (45; n = 16) long, 39–59 (51; n =16) wide. Haptor 106–196 (148; n = 12) long, 344–469 (423; n = 12) wide, with 4 pairs of subequal slightly pedunculate clamps. Clamps slightly asymmetrical, similar in shape (Figs. 2–3), 40–67 (56; n = 15) long, 49–69 (62; n = 15) wide; anterior ring-shape sclerite (Ar) with proximal end subtriangular (Fig. 4); anterolateral sclerite (Al) strongly curved (Fig. 5); posteromedial sclerite (Ps) fluted, rod-shaped (Fig. 6); proximal posterolateral sclerite (Ppl) curved and widened (Fig. 7); distal posterolateral sclerite (Dpl) arced (Fig. 8). Anchors between first pair of clamps, two outer pairs (Fig. 9) 7–8 (8; n = 3) long; inner pair (Fig. 9) 19–21 (20; n = 3) long.

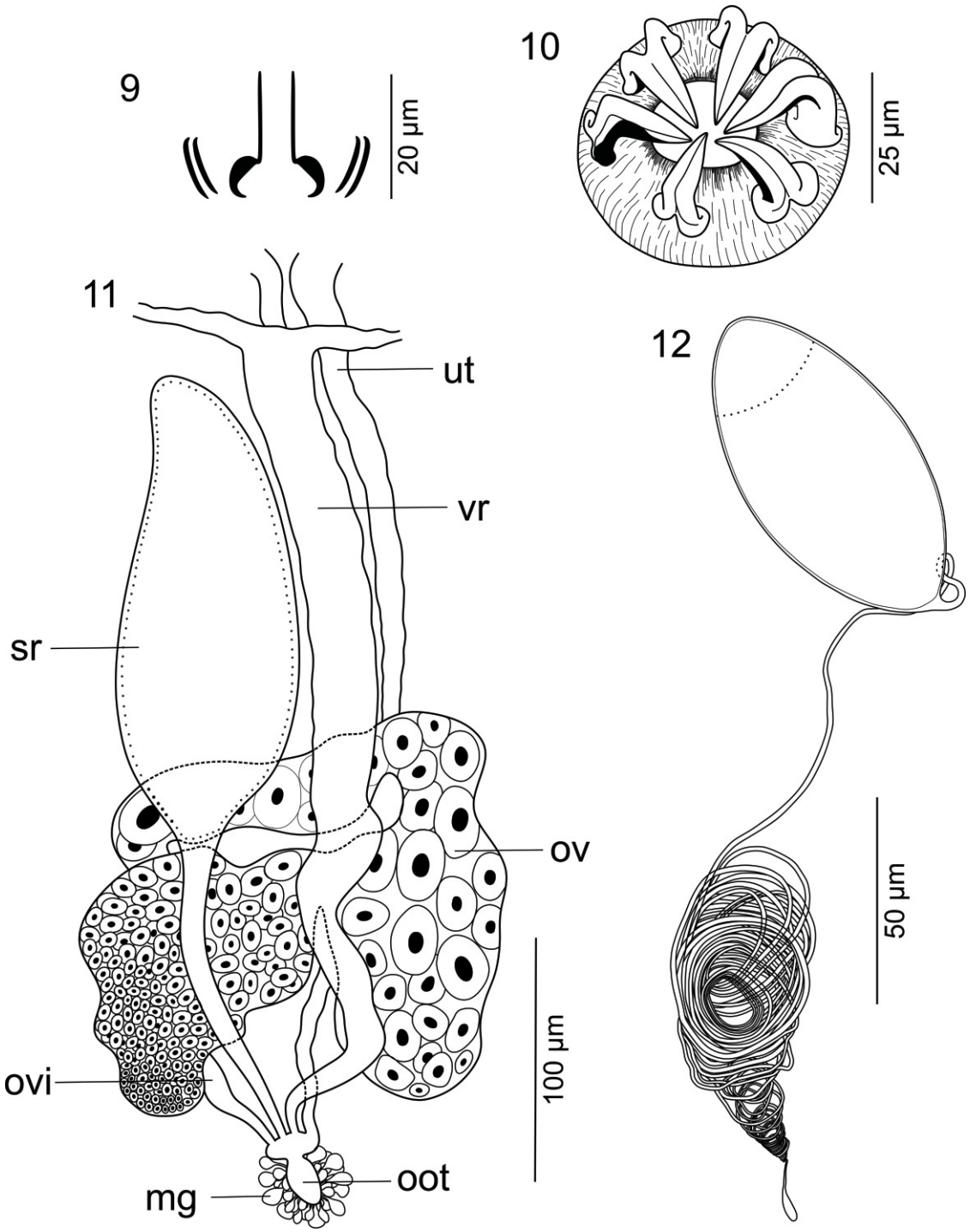
Mouth subterminal. Pharynx ovoid, muscular, immediately posterior to the prohaptoral suckers 36–49 (43; n = 10) long, 37–45 (41; n = 10) wide. Esophagus short. Intestinal bifurcation anterior to male copulatory organ; ceca laterally diverticulate, extending to level of third pair of clamps (Fig. 1).

Testes subspherical, 54–76 in number, intercecal and extracecal, extending into haptor. Vas deferens extending sinuously along median line, dorsal to uterus. Male copulatory organ (Fig. 10) 36–49 (43; n = 15) long, 42–52 (46; n = 12) wide, muscular, 142–221 (161; n = 10) from anterior end; armed with 6 curved hooks (Fig. 10), with bifid base, 13 18 (16; n = 10) long.

Ovary tubular, 102–153 (129; n = 7) long, 136–189 (162; n = 7) wide. Ootype surrounded by Mehlis's gland cells. Seminal receptacle pyriform, 173–222 (195; n = 17) long, 68–101 (83; n = 17) wide, immediately anterior to proximal portion of ovary (Fig. 11). Genito-intestinal canal not observed. Vitelline follicles laterally distributed, extending from level of cecal bifurcation to haptor (Fig. 1). Vitelline reservoir Y-shaped (Fig. 11), 167–298 (224; n =10) long. Eggs oval (Fig. 12), 156–174 (166; n = 11) long, 50–98 (79; n = 11) wide.

Taxonomic summary
Type host: *Hemanthias signifer* (Garman, 1899) (Serranidae), damsel bass.

Site of infection: Gill filaments.



Figures. 9–12. *Olivacotyle hemanthiasi* n. gen. n. sp. (Monogenea: Diclidophoridae) from gill filaments of damsel bass *Hemanthias signifer* (Garman, 1899) (Serranidae), holotype. 9. Anchors. 10. Male copulatory organ. 11. Detail, female reproductive system. Abbreviations: oot, ootype; mg, Mehlis' gland; ov, ovary; ovi, oviduct; sr, seminal receptacle; ut, uterus; vr, vitelline reservoir. 12. Egg.

Type locality: Puerto Pizarro, Tumbes, Peru (45°54'S, 81°05'W), South America.

Prevalence: 4 infected fish of 7 (57%) with a total of 52 worms.

Mean intensity of infection: 13 monogeneans per infected fish (range 9–22).

Specimens deposited: Holotype, MUSM 3300; 4 paratypes, MUSM 3301–3304; 2 paratypes CHIOC 38882a, b.

Etymology: The specific epithet refers to the genus of the fish host.

DISCUSSION

The Diclidophoridae contains several species that are still in a controversial position within the family and their placement into subfamilies. Many of the original descriptions of the genera are absolutely inadequate for comparative purposes and some type specimens are not available or are in poor conditions. Consequently, some species initially classified within of a genus in the Diclidophorinae have been redescribed, or transferred to other genera, or both (Rubec, 1989, 1991; Rubec & Dronen, 1994). For example, species originally accommodated in *Diclidophora* from macrourid and morid fishes have been transferred to *Macrouridophora* on the basis of clamp morphology (Rubec & Dronen, 1994). Therefore, further revision of all species referenced into the Diclidophoridae based on morphological and molecular data (integrative taxonomy) may be required (Oliva *et al*., 2014; Tambireddy *et al*., 2016).

Olivacotyle n. gen. is added to the 15 genera currently recognized in the Diclidophorinae. Species of these genera have been described parasitizing marine fish of the orders Gadiformes, Myctophiformes, Perciformes, Pleuronectiformes and Salmoniformes from different geographical regions, mainly in the Indian and Atlantic Ocean (Mamaev, 1976; Payne, 1986; Rubec & Dronen, 1994). According to Rubec & Dronen (1994) the clamp morphology is considered as a characteristic of generic importance in diclidophorids and warrant the separation of genera. The clamps morphology in *Olivacotyle* n. gen. is readily distinguishable from all other presently know clamp morphology in the subfamily Diclidophorinae by including species with the anteromedial sclerite and one anterolateral sclerite fused forming a ring, the other anterolateral sclerite not fused with any sclerites of inner anterior quadrant, lamellate extension partially reduced and the distal posterolateral sclerites not fused distally.

To date, 4 species belonging to 3 genera of the Diclidophorinae (*Diclidophora*, *Diclidophoroides* and *Tribuliphorus*) have been reported from South American, i.e, *Diclidophora micromesisti* Suriano & Martorelli, 1984 from the Southern blue whiting *Micromesistius australis* Norman, 1937 (Gadidae) in Argentina; *D. minor* (Olsson, 1876) from an unidentified host in Falkland-Patagonian Region; *Diclidophoroides maccallumi* Price, 1943 from the Brazilian codling *Urophycis brasiliensis* (Kaup, 1858) (Phycidae) in Argentina and Brazil; *Tribuliphorus salilotae* Mamaev & Parukhin, 1977 from the tadpole codling *Salilota australis* (Günther, 1878) (Moridae) and *Salilota* sp. (Moridae) in Argentina and Falkland-Patagonian Region, respectively (Cohen *et al*., 2013).

ACKNOWLEDGEMENTS

José L. Luque was supported by a research fellowship from CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil).

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Received September 6, 2017.
Accepted October 31, 2017.