

Taxonomy and systematics

## Redescription of *Haliotrematoides mediohamides* (Monogenea: Dactylogyridae), a gill parasite of the Pacific porgy *Calamus brachysomus* (Perciformes: Sparidae) from the Eastern Pacific Ocean

### *Redescripción de Haliotrematoides mediohamides* (Monogenea: Dactylogyridae), un parásito branquial del sargo *Calamus brachysomus* (Perciformes: Sparidae) del océano Pacífico oriental

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#### Abstract

The monogenean *Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 (Monogenea: Dactylogyridae) is redescribed based on examination of the type specimen (paratypes) and newly collected specimens parasitizing the gills of the Pacific porgy, *Calamus brachysomus* (Lockington, 1880) (Perciformes: Sparidae) (type host), a neritic fish captured off the coastal zone of Puerto Pizarro, Tumbes, Peru. Even though this monogenean was described 12 years ago, that description did not report some of the unique morphological features of *H. mediohamides* and neither did it offer a whole-mount drawing of this species. The most important characteristics of *H. mediohamides* are: 1) a male copulatory organ with hook-shaped distal end, 2) a non-coiled vaginal duct, 3) numerous secretory gland-cells associated with the peduncle, 4) a chandelier-shaped extrinsic adductor muscles articulated with superficial roots of the anchors, 5) a single tadpole-shaped prostatic reservoir, and 6) a vas deferens anteriorly convoluted. In addition, the first whole-mount drawing of *H. mediohamides*, as well as

morphometric data are provided. *Haliotrematoides mediohamides* represents the first record of *Haliotrematoides* in South America. *Haliotrematoides mediohamides* is the third dactylogyrid species recorded to infect *C. brachysomus* in Peru.

**Keywords:** Dactylogyrids; Fish parasites; Pacific Ocean; Porgies; Sparids; Taxonomy

## Resumen

El monogéneo *Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 (Monogenea: Dactylogyridae) es redescrito con base en la reexaminación de especímenes tipo (paratipos) y de especímenes recién recolectados que parasitan las branquias del pargo, *Calamus brachysomus* (Lockington, 1880) (Perciformes: Sparidae) (hospedero tipo), un pez nerítico capturado frente a la costa de Puerto Pizarro, Tumbes, Perú. A pesar de que este monogéneo se describió hace 12 años, esa descripción no informó algunas de las características morfológicas únicas de *H. mediohamides* y tampoco ofreció un dibujo completo de esta especie. Las características más importantes de *H. mediohamides* son: 1) un órgano copulador masculino con un extremo distal en forma de gancho, 2) un conducto vaginal no enrollado, 3) numerosas células glandulares secretoras asociadas con el pedúnculo, 4) músculos aductores extrínsecos en forma de araña articulados con las raíces superficiales de los ancoras, 5) un reservorio prostático en forma de renacuajo y 6) un conducto deferente convolulado anteriormente. Además, se proporciona el primer dibujo de montaje completo de *H. mediohamides*, así como datos morfométricos. *Haliotrematoides mediohamides* representa el primer registro de este género en América del Sur. *Haliotrematoides mediohamides* es la tercera especie de dactilogirídeo registrada que infecta a *C. brachysomus* en Perú.

**Palabras clave:** Dactilogiridos; Parásitos de peces; Océano Pacífico; Pargos; Espáridos; Taxonomía

## Introduction

The Sparidae (Perciformes) includes 159 species belonging to 38 genera of chiefly marine fishes occurring in tropical and temperate coastal waters, usually along the shore from shallow water (including estuaries) to deeper water as demersal inhabitants of the continental shelf and slope (Chiba et al., 2009; Froese & Pauly, 2021; Parenti, 2019). Commonly known as porgies, sparids are the most diverse group of the sparoid families (Chiba et al., 2009; Nelson, 2006). Most sparids are carnivorous, feeding on benthic invertebrates (Nelson, 1994).

During a parasitological survey of helminths infecting Peruvian marine fishes, monogeneans were collected from the gills of the Pacific porgy, *Calamus brachysomus* (Lockington, 1880) (Teleostei: Sparidae), a neritic teleost endemic to the eastern Pacific. *Calamus brachysomus* inhabits sandy areas from Baja California and the Gulf of California (USA) to Peru, including Galapagos and Malpelo Islands (Chirichigno & Cornejo, 2001; Chirichigno & Vélez, 1998). After detailed examination, the parasites were identified as *Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 (Dactylogyridae). Some diagnostically morphological features in the original description of this species, i.e., details of the male copulatory organ and anchors, were inadequately described and illustrated, indicating the need for a morphological

review. Therefore, *H. mediohamides* is redescribed on the basis of examination of type specimens along with newly collected specimens from its type host *C. brachysomus*.

## Materials and methods

Fish were collected from January 2018 to February 2019 from the coastal zone of Puerto Pizarro, Tumbes, Peru (3°29' S, 80°24' W), using gillnets and were dissected immediately after capture. Gill arches were immediately removed and placed in vials containing heated sea water (60 °C). Each vial was vigorously shaken and formalin was added to obtain a 4% solution. In the laboratory, the contents of each vial were examined under a dissecting microscope and monogeneans were removed from the gills or sediment using small probes. Some dactylogyrid specimens were stained with Gomori's trichrome, cleared in Eugenol and mounted in Canada balsam. Others 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. Body length represents the length of the body proper with the haptor. The numbering of hook pairs follows that recommended by Mizelle (1936) and Mizelle and Price (1963). Fish were identified employing the keys of Peruvian marine fishes of Chirichigno and Vélez (1998) and Chirichigno and Cornejo (2001).

Photomicrographs of paratypes of *Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 (CNHE 6468) and *Haliotrematoides prolixohamus* Kritsky & Mendoza-Franco, 2009 (CNHE 6469) from the Colección Nacional de Helmintos del Instituto de Biología (CNHE), were studied. Voucher specimens were deposited in the Helminthological Collection of the Museum of Natural History at the San Marcos University (MUSM), Peru.

## Description

Dactylogyridae Bychowsky, 1933

*Haliotrematoides* Kritsky, Yang & Sun, 2009

*Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009  
(Fig. 1)

Redescription (based on 13 specimens). Body fusiform (Fig. 1A), 453-469 (463; n = 10) long; greatest width 92-111 (101; n = 10) usually at level of vaginal aperture. Tegument thin, surface smooth. Cephalic region narrow; cephalic lobes moderately developed; 3 bilateral pairs of conspicuous head organs; bilateral pair of cephalic glands at pharyngeal level. Four eye-spots, posterior eyespots with lenses; chromatic granules absent. Pharynx spherical, musculoglandular, 22-27 (24; n = 10) in diameter; esophagus short; intestinal bifurcation postpharyngeal; intestinal ceca confluent posteriorly to gonads, lacking diverticula. Peduncle broad, elongate. Haptor poorly differentiated from body proper, almost subquadrangular, 57-59 (58; n = 8) long; 46-49 (48; n = 8) wide; group of well-developed secretory gland cells lying on peduncle, cluster-shaped. Anchors dissimilar, with fine conspicuous alae (Fig. 1B, C). Ventral anchor 63-68 (65; n = 6) long, base 9-11 (10; n = 6) wide, with elongate superficial root, with conspicuous knob at base; elongate and broad deep root; elongate and narrow shaft, gently curved, with hatchet-shaped distal extension; recurved point, with surface striations (Fig. 1B). Dorsal anchor 51-58 (54; n = 6) long, base 5-7 (6; n = 6) wide, with short superficial root; inconspicuous deep root; elongate and slightly broad shaft, slightly straight, with hatchet-shaped distal extension; recurved point, with surface striations (Fig. 1C). Ventral extrinsic adductor muscle well developed, chandelier-shaped, articulated with superficial roots of the anchors. Ventral bar 28-31 (29; n = 6) long, rod-shaped, with 2 anteromedial delicate

umbelliform membranes and 2 short anteromedial spines, expanded lateral ends (Fig. 1E). Dorsal bar 30-35 (32; n = 6) long, V-shaped, with moderately developed spine at each end, anteriorly directed (Fig. 1D). Fourteen similar hooks, 11-12 (12; n = 5) long, each with upright acute thumb, uniform shank and delicate point (Fig. 1F); filamentous hook (FH) loop about shank length; pairs 2, 3, 4 on muscular digitiform papillae on ventral surface of peduncle; pairs 6, 7 (dorsal) peduncular; pair 1 haptor, associated with middle region of ventral anchor shafts; pair 5 associated with distal ends of ventral anchor shafts (Fig. 1A). Male copulatory organ (MCO) 106-137 (120; n = 8) long, tubular, slightly tapered, with a curvature in first third of shaft, hook-shaped distal tip; base of MCO bell-shaped, with a conical conspicuous medial protuberance (Fig. 1H), 20-25 (22; n = 5) long, 20-23 (22; n = 5) wide; accessory piece absent. Testis ovate, intercecal, dorsal to ovary, 48-54 (51; n = 5) long, 42-62 (52; n = 5) wide; vas deferens anteriorly convoluted, looping left intestinal cecum, dilating to form inconspicuous fusiform seminal vesicle in left side of trunk, posterolateral to curvature of MCO; single elongate tadpole-shaped prostatic reservoir, lateral to MCO. Ovary 30-37 (34; n = 4) long, 24-31 (27; n = 4) wide; almost pyriform, overlapping anterior portion of testis. Vaginal aperture dextralateral, prominent; vaginal vestibule elongates, well developed, muscular, lying obliquely to midline; vaginal duct narrow, running posteriorly to join large subspherical seminal receptacle. Oviduct, oötype and uterus not observed. Vitelline follicles dense throughout trunk, lateral fields of follicles confluent anterior to prostatic reservoir and prostatic glands and posterior to gonads. Egg not observed.

## Taxonomic summary

*Host*: *Calamus brachysomus* (Lockington, 1880) (Perciformes: Sparidae), Pacific porgy.

*Site of infection*: gill filaments.

*Locality*: off coastal zone of Puerto Pizarro (3°29' S, 80°24' W), Tumbes, Peru, South America.

*Voucher specimens deposited*: 9 (MUSM 4850a-i).

## Remarks

The freshly collected dactylogyrid specimens are placed in *Haliotrematoides* Kritsky, Yang & Sun, 2009 by having: 1) an unique hook distribution; 2) dorsal anchors lacking well-developed deep roots, with perforated bases, elongate relatively straight shafts, and points with surface striations; 3) ventral anchors with developed roots, elongate shafts, and points with surface striations; 4) a ventral bar with 2 anteromedial delicate umbelliform membrane; and 5) a MCO lacking an accessory piece (Kritsky & Bakenhaster, 2020; Kritsky et al., 2009). Currently, the genus contains

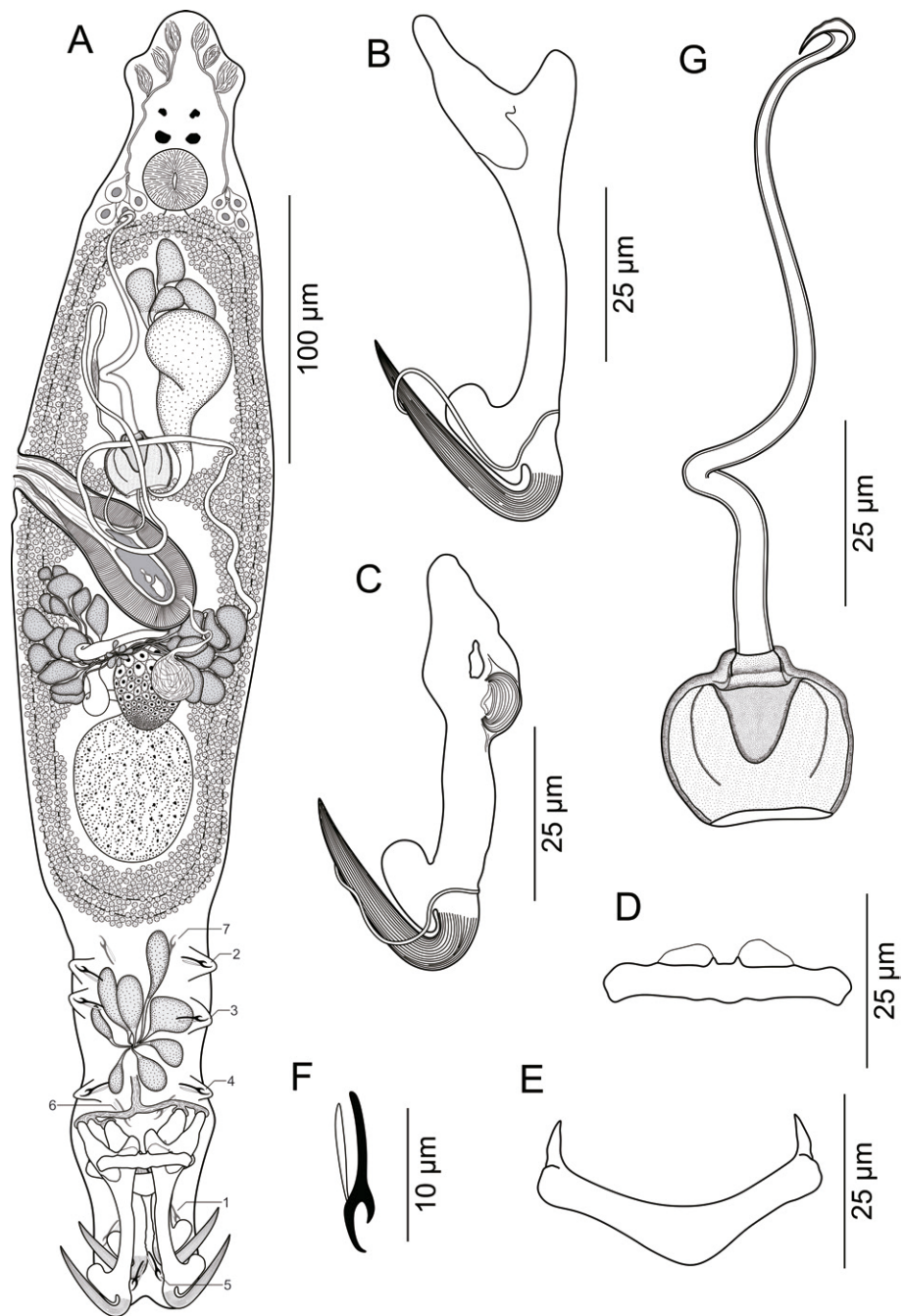


Figure 1. *Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 (Monogenea: Dactylogyridae) from the gills of the Pacific porgy *Calamus brachysomus* (Perciformes: Sparidae). A, Whole mount (composite, ventral view) with respective hook pairs numbered 1-7; B, ventral anchor; C, dorsal anchor; D, ventral bar; E, dorsal bar; F, hook; G, male copulatory organ (ventral view).

33 valid species infecting the gills of perciform fishes of the families Caesionidae, Haemulidae, Lutjanidae and Sparidae (García-Vásquez et al., 2015; Kritsky & Bakenhaster, 2020; Kritsky et al., 2009).

*Haliotrematoides mediohamides* Kritsky & Mendoza-Franco, 2009 was originally described infecting the gills of *C. brachysomus* in Panama (Kritsky et al., 2009). The examination of the type material (CNHE 6468, paratypes)

of *H. mediohamides* and the original description, despite its limited information concerning the soft anatomy and without a whole-mount drawing of this species, enabled us to identify the specimens newly collected in this study from *C. brachysomus* (type host) as *H. mediohamides*. Kritsky et al. (2009) described and illustrated the MCO of *H. mediohamides* as a conical tube with a counterclockwise loop and the straight distal end. However, our observation of the type material and the newly collected specimens revealed that the distal end of the MCO is hook-shaped and not straight as shown in the original description.

Kritsky et al. (2009) noted that the vaginal duct is initially coiled having few rings, but this characteristic could not be confirmed in the available paratype. However, observations in our specimens collected showed that it is not coiled, in fact, the vaginal duct is only a slightly sinuous tube. In newly collected specimens of *H. mediohamides*, we confirmed the presence of secretory gland-cells associated with the peduncle and of chandelier-shaped extrinsic adductor muscles articulated with superficial roots of the anchors, which were not mentioned in the original description of *H. mediohamides*. In addition, a single tadpole-shaped prostatic reservoir, and a vas deferens anteriorly convoluted, were also observed. The redescription presented herein supplements the original description on details of the internal anatomy, sclerotized structures (MCO, anchors and bars) and provide the first whole-mount drawing of *H. mediohamides*, as well as morphometric data.

## Discussion

Members of *Haliotrematoides* have been reported parasitizing marine perciform fishes from Atlantic, Pacific and Indian oceans (García-Vásquez et al., 2015; Kritsky & Bakenhaster, 2020; Kritsky et al., 2009). From the 33 accepted species in this genus, 24 (> 72%) have been described from lutjanid fishes. The remaining species were described from sparids (5 species infecting species of *Calamus* Swainson, 1839), caesionids (2 species from fishes of the genus *Caesio* Lacepède, 1801 and *Pterocaesio* Bleeker, 1876) and haemulids (2 species infecting *Haemulon* Cuvier, 1829 species) (Kritsky, 2012; Kritsky & Bakenhaster, 2020; Kritsky et al., 2009; Mendoza-Franco et al., 2009; Mendoza-Franco et al., 2018).

Among the 5 species of *Haliotrematoides* currently known infecting the gills of sparid fishes (Kritsky & Bakenhaster, 2020; Kritsky et al., 2009), *H. mediohamides* most closely resemble *H. mediohamus* (Zhukov, 1983) Kritsky, Yang & Sun, 2009 and *H. bostryx* Kritsky & Bakenhaster, 2020 based upon in the general morphology of haptor sclerites. However, *H. mediohamides* is easily

distinguished from these 2 species by having a MCO with hook-shaped distal tip. *Haliotrematoides mediohamides* has not been reported previously from the south American Pacific Ocean off Peru (Luque et al., 2016). Its presence in Peru represents a new geographic record for this species. Furthermore, *H. mediohamides* represents the first occurrence of species of this genus in South America.

Thirteen valid species of *Calamus* are known from the Western Hemisphere (Froese and Pauly, 2021). Of these, 7 species are infected with 5 dactylogyrid species of the genus *Haliotrematoides*, i. e., *H. bostryx* from *C. arctifrons* Goode & Bean, 1882, *C. bajonado* (Bloch & Schneider, 1801), *C. nodosus* Randall & Caldwell, 1966, and *C. proridens* Jordan & Gilbert, 1884; *H. mediohamides* from *C. brachysomus*; *H. mediohamus* from *C. bajonado*, *C. calamus* (Valenciennes, 1830), *C. nodosus*, *C. penna* (Valenciennes, 1830), and *C. proridens*; *H. parvicirrus* (Zhukov, 1983) Kritsky, Yang & Sun, 2009 from *C. bajonado*, *C. calamus*, *C. nodosus*, *C. penna* and *C. proridens*; and *H. prolixohamus* Kritsky & Mendoza-Franco, 2009 from *C. brachysomus* (Kritsky & Bakenhaster, 2020; Kritsky et al., 2009). Based on this, species of *Haliotrematoides* from sparid fishes can infect different hosts of the same genus. However, 2 *Haliotrematoides* species, *H. mediohamides* and *H. prolixohamus*, have been collected infecting only the gills of *C. brachysomus*, apparently exhibiting host specificity.

Along its distribution range (Eastern Pacific), *C. brachysomus* is known to be infected by 6 monogenean species (4 dactylogyrid species and 2 mazocraeid species) (Bravo-Hollis, 1981; Carvalho-Azevedo et al., 2021; Cruces et al., 2018; Kritsky et al., 2009; Lamothe-Argumedo et al., 1997). The microcotylid *Magniexcipula lamothei* Bravo-Hollis, 1981 has been reported infecting this host in Mexico and Peru. The chauhaneid *Pseudochauhanea mexicana* Lamothe, 1967 has been registered infecting *C. brachysomus* in Mexico, the dactylogyrids *H. mediohamides* and *H. prolixohamus* infecting *C. brachysomus* in Panama. Finally, the dactylogyrids *Euryhaliotrema luisae* Cruces, Chero & Luque, 2018 and *E. magnopharyngis* Cruces, Chero & Luque, 2018, have been described infecting the gills of *C. brachysomus* in Peru. The dactylogyrid species reported here increases the number of species that infect *C. brachysomus* in Peru to 4, which is considered a poorly studied host in this region (Carvalho-Azevedo et al., 2021; Cruces et al., 2018).

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## References

- Bravo-Hollis, M. (1981). Helmintos de peces del Pacífico mexicano. XXXV. Descripción de un género nuevo de la subfamilia Microcotylinae Monticelli, 1892. *Anales del Instituto de Biología Universidad Nacional Autónoma de México, Serie Zoología*, 51, 29–40.
- Carvalho-Azevedo, A., Huancachoque, E. G., Cuellar, I., Sáez, G. M., Cruces, C. L., Chero, J. D. et al. (2021). New record of monogeneans (Platyhelminthes: Monogenea) infecting some marine fishes from the Peruvian coastal zone. *Revista Peruana de Biología*, 28, e21125. <https://dx.doi.org/10.15381/rpb.v28i3.21125>
- Chiba, S. N., Iwatsuki, Y., Yoshino, T., & Hanzawa, N. (2009). Comprehensive phylogeny of the family Sparidae (Perciformes: Teleostei) inferred from mitochondrial gene analyses. *Genes & Genetic Systems*, 84, 29–40. <https://doi.org/10.1266/ggs.84.153>
- Chirichigno, N., & Vélez, M. (1998). *Clave para identificar los peces marinos del Perú*. Publicación Especial del Instituto del Mar. 2<sup>da</sup>. Ed. Callao, Peru: Instituto del Mar del Perú.
- Chirichigno, N., & Cornejo, R. M. (2001). *Catálogo comentado de los peces marinos del Perú*. Publicación Especial del Instituto del Mar. Callao, Peru: Instituto del Mar del Perú.
- Cruces, C. L., Chero, J. D., & Luque, J. L. (2018). Four new species of dactylogyrids (Monogenea: Dactylogyridae) parasitic on gills of labrid and sparid fishes from Southeastern Pacific Ocean off Peru. *Systematic Parasitology*, 95, 829–840. <https://doi.org/10.1007/s11230-018-9827-8>
- Froese, R., & Pauly, D. (2021). FishBase. World Wide Web electronic publication. <http://www.fishbase.org>. Accessed on 12 January, 2021.
- García-Vásquez, A., Pinacho-Pinacho, C. D., Soler-Jiménez, L. C., Fajer-Ávila, E. J., & Pérez-Ponce de León, G. (2015). *Haliotrematoides* spp. (Monogeneoidea: Dactylogyridae) parasitizing *Lutjanus guttatus* (Lutjanidae) in two localities of the Pacific coast of Mexico, and their phylogenetic position within the Ancyrocephalinae through sequences of the 28S rRNA. *Revista Mexicana de Biodiversidad*, 86, 298–305. <https://doi.org/10.1016/j.rmb.2015.04.027>
- Humason, G. L. (1979). *Animal tissue techniques (4th Edit.)*. San Francisco: W. H. Freeman and Company.
- Kritsky, D. C. (2012). Dactylogyrids (Monogeneoidea: Polyonchoinea) parasitizing the gills of snappers (Perciformes: Lutjanidae): revision of *Euryhaliotrema* with new and previously described species from the Red Sea, Persian Gulf, the eastern and Indo-west Pacific Ocean, and the Gulf of Mexico. *Zoologia (Curitiba)*, 29, 227–276. <https://doi.org/10.1590/s1984-46702012000300006>
- Kritsky, D. C., & Bakenhaster, M. D. (2020). *Haliotrematoides* spp. (Monogeneoidea: Dactylogyridae) parasitizing the gill lamellae of porgies, *Calamus* spp. (Perciformes: Sparidae), in the Gulf of Mexico off Florida, U.S.A., with the description of *Haliotrematoides bostryx* n. sp. and redescription of *Haliotrematoides parvicirrus* (Zhukov, 1983). *Comparative Parasitology*, 87, 33–34. <https://doi.org/10.1654/1525-2647-87.1.33>
- Kritsky, D. C., Yang, T., & Sun, Y. S. Z. (2009). Dactylogyrids (Monogeneoidea, Polyonchoinea) parasitizing the gills of snappers (Perciformes, Lutjanidae): Proposal of *Haliotrematoides* n. gen. and descriptions of new and previously described species from marine fishes of the Red Sea, the eastern and Indo-west Pacific Ocean, Gulf of Mexico and Caribbean Sea. *Zootaxa*, 1970, 1–51. <https://doi.org/10.11646/zootaxa.1970.1.1>
- Lamothe-Argumedo, R., García-Prieto, L., Osorio-Sarabia, D., & Pérez-Ponce de León, G. (1997). *Catálogo de la Colección Nacional de Helmintos*. México D.F.: Instituto de Biología, Universidad Nacional Autónoma de México/ Conabio.
- Luque, J. L., Cruces, C., Chero, J., Paschoal, F., Alves, P. A., Da Silva, A. C. et al. (2016). Checklist of Metazoan parasites of fishes from Peru. *Neotropical Helminthology*, 10, 301–375.
- Mendoza-Franco, E. F., Reyes-Lizama, C., & González-Solís, D. (2009). *Haliotrematoides* spp. (Monogeneoidea: Dactylogyridae) infecting the gills of grunts (Perciformes: Haemulidae) from the southern coast of Quintana Roo, Mexico. *Journal of Parasitology*, 95, 1360–1363. <https://doi.org/10.1645/GE-1893.1>
- Mendoza-Franco, E. F., Rosado, T. M. C., Duarte, A. A. D., & Rodríguez, R. E. R. (2018). Morphological and molecular (28S rRNA) data of monogeneans (Platyhelminthes) infecting the gill lamellae of marine fishes in the Campeche Bank, southwest Gulf of Mexico. *Zookeys*, 783, 125–161. <https://doi.org/10.3897/zookeys.783.26218>
- Mizelle, J. D. (1936). New species of trematodes from the gills of Illinois fishes. *American Midland Naturalist*, 17, 785–806.
- Mizelle, J. D., & Price, C. E. (1936). Additional haptor hooks in the genus *Dactylogyrus*. *Journal of Parasitology*, 19, 785–806.
- Nelson, J. S. (1994). *Fishes of the world. Third edition*. New York: John Wiley & Sons.
- Nelson, J. S. (2006). *Fishes of the world. Fourth edition*. New York: John Wiley & Sons.
- Parenti, P. (2019). An annotated checklist of the fishes of the family Sparidae. *FishTaxa*, 4, 47–98.