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RESEARCH

Dactylogyrids (Monogenoidea) Parasitizing *Microlepidotus brevipinnis* (Haemulidae) from the Pacific Coast of Mexico: *Magnanchor raris* n. gen., n. sp. and Supplementary Taxonomic Information for *Mexicana bychowskyi* Caballero and Bravo-Hollis 1959

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Abstract
As part of a marine ecology study aimed to discover the diversity of fish parasites, we described a new species representing *Magnanchor* n. gen. and provided new and supplementary morphometric information for *Mexicana bychowskyi*, both monogenoidean species collected from the gill lamellae of the humpback grunt *Microlepidotus brevipinnis* (Haemulidae) from the Pacific coast of Mexico. The new genus is proposed for its unique species, *M. raris* n. sp. which is characterized in having overlapping gonads (testis posterodorsal to the germarium), a copulatory complex consisting of counterclockwise coils of the copulatory organ that is unarticulated to the accessory piece, a haptor armed with two pairs of anchors (each with broad base and well differentiated roots), dorsal and ventral bars, a dextral vaginal aperture, and 6 pairs of hooks with uniform shank and upright acute thumb. Data on morphological and biometric variability of the six species of *Mexicana* (including illustrations of the haptoral structures of the present specimens of *M. bychowskyi*) previously described and/or reported parasitizing different haemulid hosts from the Pacific and Atlantic oceans in the Tropics are also provided. Due to the morphological similarities among the amphiamerican species of *Mexicana*, they could represent sister-species pairs in the Tropics. *Magnanchor raris* n. sp. and *M. bychowskyi* (type species of the genus) are the first dactylogyrids described and/or reported on *M. brevipinnis*.

Keywords Platyhelminthes · Marine fishes · Biodiversity · Amphiamerican species · Grunts

Introduction

Haemulidae (Perciformes) with about 137 species belonging 21 genera are known commonly as grunts and represent a conspicuous group, mainly, of marine shorefishes in the tropical West Atlantic, Eastern Pacific, and Indian Oceans (Tavera and Wainwright 2019; Hernández-Gómez et al. 2021). In Mexico, haemulids are well represented along the Pacific and Gulf of Mexico slope, as well as on coral reefs as those from the Caribbean Sea (Torres-Hernández et al. 2016). Currently, these haemulids have been reported to be parasitized by gill lamellae ectoparasitic monogenoids, i.e., species of *Haliotrematoides* Kritsky, Yang and Sun 2009, *Pseudotetrancistrum* Caballero and Bravo-Hollis 1961, *Mexicana*, Caballero and Bravo-Hollis 1961, *Euryhaliotrema* (Kritsky and Boeger 2002) Kritsky 2012 (Dactylogyridae), *Choricotyle* Van Beneden and Hesse, 1863, *Pseudoeurysorchis* Caballero and Bravo-Hollis 1962 (Diclidophoridae), *Paracalceostoma* Parona and Perugia, 1890 (Calceostomatidae), *Cynoscionicola* Price, 1962 (Microcotylidae), *Magniexcipula* Bravo-Hollis, 1981, and *Encotyllabe* Diesing, 1850 (Capsalidae) (Lamothe-Argumedo et al. 1998; Mendoza-Garfías and Pérez-Ponce de León 1998; Mendoza-Franco et al. 2018; Montoya-Mendoza et al. 2022). As part

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of a research project on fish parasite biodiversity as an important component within marine ecosystems (Timi and Poulin 2020) from the Pacific coast of the Guerrero State in Mexico, monogenoidean specimens of *Mexicana bychowskyi* Caballero and Bravo-Hollis 1959 and of an undescribed species of the Dactylogyridae, *Magnanchor raris* n. gen, n. sp. were recovered from the humpback grunt *Microlepidotus brevipinnis* (Steindachner 1869) (Haemulidae). In the present paper, the new species is described and illustrated, and new illustrations and supplemental observations for *M. bychowskyi* as well as comparable data on biometrical variability of other previously described species of the genus from haemulid hosts are provided. Finally, the Amphiamerican occurrence of known species of *Mexicana* from the Atlantic and Pacific American coasts of the tropic is briefly discussed.

Materials and methods

A total of 38 fish specimens of *M. brevipinnis* were caught in the coastal municipality of Acapulco in the Guerrero state (16º51'N; 99º52'W) (Mexican Pacific) from September 2017 to June 2021 by local fishermen and/or purchased at local markets. Gills were excised from fish, immediately placed in Petri dishes with tap water, and then examined for monogenoids by using a dissecting microscope. Then, monogenoids were detached from the gills using fine needles under stereo-microscope and kept within vials containing 4% formaldehyde for fixation of attached helminths. Subsequently, the vials were shipped to the Laboratory of Parasitology of the Instituto EPOMEX (Autonomous University of Campeche, Mexico) for further examination. In the laboratory, parasites were picked from the sediments or gill lamellae using a small probe and dissecting under a stereomicroscope Leica EZ4. Some specimens were mounted unstained in Gray and Wess medium or in a mixture of lactic-acid and glycerin-ammonium picrate, and then remounted in Canada balsam (Mendoza Franco et al. 2013) to obtain measurements and line drawings of haptoral structures and the copulatory complex; other specimens were stained with Gomori's trichrome and mounted whole in Canada balsam for observing and measuring internal soft organs. Illustrations were made with the aid of a drawing tube, using a Leica microscope DM 2500 with Nomarski interference contrast. Measurements, all in micrometers (µm), represent straight-line distances between extreme points of the structures measured and are expressed as the mean followed by the range and number (n) in parentheses. Direction of the coil (when present, i.e., counterclockwise orientation) of the copulatory organ followed Kritsky et al. (1985). The numbering of hook pairs are those of Mizelle (1936). Reference specimens were deposited in the National Helminthological Collection of Mexico (CNHE), Institute of Biology, National Autonomous University of Mexico, Mexico.

Results

Class Monogenoidea Bychowsky, 1937.

Subclass Polyonchoinea Bychowsky, 1937.

Order Dactylogyridea Bychowsky, 1937.

Dactylogyridae Bychowsky, 1933.

Magnanchor n. gen.

Type-species: *Magnanchor raris* n. sp.

Etymology: The generic name is an adjective from Latin (*magna* = prominent, conspicuous + anchor) and refers to the shape of the ventral anchor.

Diagnosis: Body comprising body proper (cephalic region, trunk and peduncle) and haptor. Tegument smooth. Two terminal cephalic lobes, bilateral lobes poorly developed or absent; 3 pairs of bilateral head organs. Eyespots present. Mouth subterminal, midventral, prepharyngeal; pharynx made up of muscular, glandular bulb; esophagus, intestinal ceca 2, confluent posterior to gonads, lacking diverticula. Common genital pore midventral, immediately posterior to intestinal bifurcation. Gonads intercaecal, overlapping; testis dorsal to germarium. Vas deferens, seminal vesicle not observed; prostatic reservoir present. Copulatory complex comprising unarticulated male copulatory organ (MCO), accessory piece. MCO tubular, coiled, with funnel-shaped base; coil with counterclockwise rings. Seminal receptacle not observed; vaginal aperture dextroventral. Vitellaria in trunk, peduncle, absent in regions of other reproductive organs. Haptor bilobed, armed with dorsal, ventral anchor-bar complexes, six pairs of similar hooks, each with upright acute thumb, slender shank comprising of single subunit. Type-and only species: *Magnanchor raris* n. gen., n. sp. from the gills of *Microlepidotus brevipinnis* (Haemulidae).

***Magnanchor raris* n. sp.** (Fig. 1)

Type-host: Humpback grunt *Microlepidotus brevipinnis* (Steindachner 1869) (Haemulidae).

Type locality: Acapulco Bay, Pacific coast of Mexico (16º51' N; 99º52' W).

Site in host: Gill lamellae.

Specimens deposited: Holotype and 1 paratype in CNHE (12851 and 12852, respectively).

Etymology: The specific name (an adjective) is from Latin (*raris* = infrequent) and refers to the fact that this species is relatively rare with only 2 specimens found on 38 examined individuals of *M. brevipinnis*.

Description: Body 425–437 long, fusiform; greatest width 105 (n = 2) usually near mid-length of trunk. Tegument smooth. Cephalic region broad; cephalic lobes poorly developed. Four eyespots; members of respective pairs

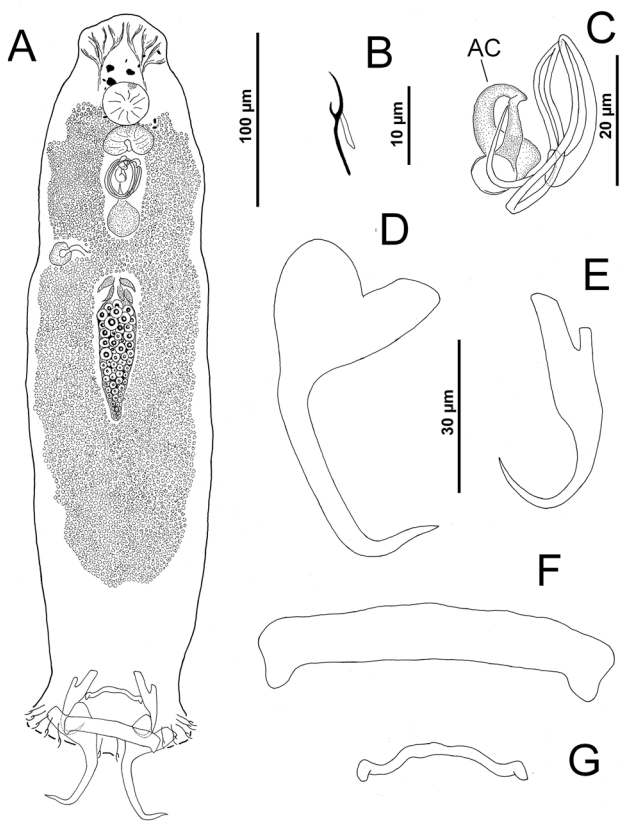

Fig. 1 *Magnanchor raris* n. gen., n. sp. on *Microlepidotus brevipinnis*. **A**, Whole-mount (ventral); **B**, hook; **C**, copulatory complex; **D**, ventral anchor; **E**, dorsal anchor; **F**, ventral bar; **G**, dorsal bar. Abbreviation: **AC**, accessory piece

equidistant; posterior eyespots slightly larger than those of anterior pair; accessory chromatic granules ovate, variable in size, scattered in cephalic, anterior trunk regions. Pharynx subspherical, 24 (n = 2) in diameter. Peduncle broad; haptor 90–97 wide, not distinctly set off from body, with poorly differentiated bilateral lobes containing hook pairs 2–4, 6 and 7. Ventral anchor 62 (60–63 n = 4) long, prominent, with large base and subequal and well-differentiated roots, elongated straight shaft, point with lightly subterminal bent (shaft and point extending posteriorly from haptor); 28 (23–31; n = 4) wide. Dorsal anchor 40 (39–42; n = 4) long, with well-defined tapered superficial root, subrectangular deep root, curved shaft, elongate point; base 10 (9–12; n = 3) wide. Ventral bar 57–70 long, robust, rod-shaped with 2 posteriorly directed thumb-like processes at each end; dorsal bar 33–36 long, slender with posteriorly directed ends. Hook 13 (n = 6) long, with uniform shank, upright acute thumb and recurved point; FH loop about 60% shank length. Sucker-like structure 16 (13–19; n = 2) wide, anterior to genital pore. Copulatory complex, 25–30 long; MCO with funnel shaped base from which arise a shaft in counterclockwise ring, having about 2 rings. Accessory piece tortuous, covering distal portion of MCO. Margin of testis undefined; vas deferens, seminal vesicle not observed; prostatic reservoir subspherical. Germarium 65 long, 25 wide, ovate; oviduct, oötype uterus not observed. Mehlis' gland-cells well developed, in body mid-line. Vaginal pore dextral, submarginal, with small distal vestibule; seminal receptacle not observed. Vitellarium in form of dense follicles in lateral fields; intestinal caeca obscured by dense vitellarium. Egg not observed.

Remarks:

Present specimens exhibit diagnostic features (i.e., posto-varian testis, vagina dextral, and haptor armed with a dorsal, ventral anchor-bar complexes), some of which are also present in other dactylogyrids. However, the suite of features does not fit with the diagnosis of currently known dactylogyrid genera with species infecting Mexican or tropical marine fishes (see the Introduction section). Therefore, although only two specimens were found, they were fixed in good conditions allowing us their description and the proposal of a new genus to accommodate them as *Magnanchor raris* n. gen., n. sp. The new species exhibits a similar haptor morphology (i.e., truncated haptor or not distinctly set off from body) with that of species of *Pseudempleurosoma* (Yamaguti, 1965) Santos, Mourão and Cardenas, 2001 on rectum, gills, esophagus and pharynx of marine fishes of the Hoplichthyidae, Chlorophthalmidae, Carangidae, Holocentridae, Sciaenidae, and Sillaginidae (Mendoza-Franco and Vidal-Martínez 2011). It differs from *Pseudempleurosoma* spp. by having a coiled MCO (slender and/or twisted in *Pseudempleurosoma* spp.) and by lacking a single quadrangular dorsal bar and paired irregular ventral bars (present in *Pseudempleurosoma* spp.). In other features, *M. raris* n. gen., n. sp. also differs from other known dactylogyrids on haemulids in the absence of hook pairs 1, 2, and 3 on the ventral surface of peduncle (present in *Haliotrematoides* spp.), gonads in tandem with horse-shoe shaped germarium (present in *Pseudotetrancistrum*), a sinuous MCO tube (present in *Mexicana* – see this latter in the remarks sections below) and a bulbous base of the MCO (present in *Euryhaliotrema* spp.). With the present recognition of a distinct species of the Dactylogyridae on *M. brevipinnis* from the Mexican Pacific, this latter host has now only two dactylogyrid species: the present one and *M. bychowskyi* (present study). Only it is noteworthy that in present specimens the hook pair 1 were not observed (possibly absent) (see haptor in Fig. 1).

Mexicana bychowskyi Caballero and Bravo-Hollis 1959 **(**Fig. 2**)**

See measurements in Table 1.

Host: Humpback grunt *Microlepidotus brevipinnis* (Steindachner, 1869) (Haemulidae).

Locality: Acapulco Bay, Pacific coast of Mexico (16º51'N; 99º52'W).

Site in host: Gill lamellae.

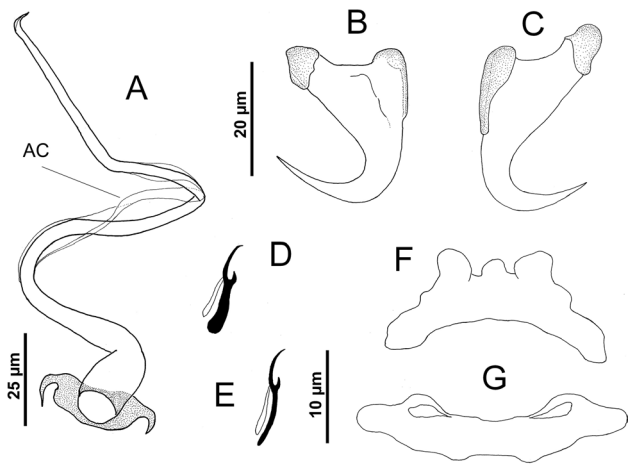

Fig. 2 *Mexicana bychowskyi* Caballero and Bravo-Hollis 1959 on *Microlepidotus brevipinnis*. **A**, Copulatory complex; **B**, ventral anchor; **C**, dorsal anchor; **D**, hook pair 5; **E**, hook pair 4; **F**, ventral bar; **G**, dorsal bar. Abbreviation: **AC**, accessory piece

Specimens deposited: 32 reference specimens in CNHE (12853).

Remarks

The specimens found on humpback grunt *M. brevipinnis* from the Guerrero state correspond in their morphology (bilobed testis, sinuous MCO tube with accessory piece on its midportion, MCO base with bilateral hornlike terminations directed posteriorly, vagina dextral in inverted cone shape, and butterfly-shaped ventral bar [see Fig. 2]) to *M. bychowskyi* as originally described by Caballero and Bravo-Hollis (1959) (see also the emended generic diagnosis provided by Caballero and Bravo-Hollis 1961) from the Pacific coast of Mexico. All measurements of present specimens ranged within those of type specimens of this monogenoidean species, particularly of the dorsal bar length (see Table 1). There are currently 6 described species of *Mexicana* in the Tropics (Pacific coast of Mexico and Peru, and Atlantic coast of Brazil) (*M. bychowskyi*, *M. iannaconi* Chero, Cruces, Sáez and Alvariño, 2014, *M. littoralis*, *M. anisotremum* Cezar, Paschoal and Luque, 2012, *M. atlantica* Luque et al. 1992, and *M. rubra* Camargo et al. 2017), parasitizing haemulid species of *Microlepidotus*, *Haemulon*, *Anisotremus*, and *Orthopristis* (see Table 1). Only, *M. bychowskyi* has originally been described on an unidentified sciaenid host, since then, it has not been formally reported (i.e., based on a published taxonomic work) on a sciaenid or another haemulid host until present study. Even though *M. brevipinnis* is distributed from the Gulf of California to Panama (Eastern Central Pacific) (Gomez-Vanega et al. 2021), it only has previously been reported to host species of *Choricotyle leonilavazquezae* Lamothe-Argumedo et al. 1998 and *Pseudoeurysorchis travassosi* Caballero and Bravo-Hollis 1962 (both Diclidophoridae) from the Pacific coast of Mexico (Caballero and Bravo-Hollis 1962; Lamothe-Argumedo et al. 1998; Paschoal et al. 2015). The taxonomic identification of species of *Mexicana* has mainly been based on morphology of their anchors/bar complexes rather than using metrical data which appear to be overlapped among species (see Table 1 in Chero et al. 2014, Table 2 in Camargo et al. 2017, and Table 1 in the present study). In the present study, morphology of the haptoral structures of *M. bychowskyi* are illustrated in order to clarify them from its original description, i.e., hook pair 5 with expanded shank (see Fig. 2D) (not described and illustrated in the original description) and butterfly-shaped ventral bar (see Fig. 2F) (only described and poorly depicted in the original description, but redrawn as that from photograph of a voucher of this species by Camargo et al. 2017). In fact, measurements of anchors width are not provided in the original description because these structures in the types were in an undefined position (i.e., in longitudinal-lateral view) when mounted onto slides which also precluded well defined line drawings of the anchor/bars (see comments/figures in Caballero and Bravo-Hollis 1959; Table 1 and Fig. 2B,C,F and G). Additionally, the accessory piece, originally described as a sac with very transparent wall covering MCO is herein illustrated (see AC in Fig. 2).

Discussion

The present study on *M. brevipinnis* constitute the third record (the first and second being that of *C. leonilavazquezae* and *P. travassosi*—[Diclidophoridae], respectively) of monogenoidean species on this latter host from the Pacific coast of Mexico. *Mexicana bychowskyi* on *M. brevipinnis*, the type species of the genus, had not been recorded since its original description on an unidentified sciaenid host off the Pacific coast of Mexico (see Caballero and Bravo-Hollis 1959). Whereas the host range may not be completely known for all described and/or reported species of *Mexicana* they appear to be host-specific on haemulid fishes. Mendoza-Garfias et al. (2017) recorded *M. bychowskyi* on *M. brevipinnis* based on unpublished bachelor thesis (see Aranda-Cruz (2006) cited by latter authors). However, revising the content of that thesis available from the internet it does not described and illustrated details of the haptoral structures (i.e., hooks, anchors/bars) of *M. bychowskyi* (sic) as well as any reference specimen deposited in a museum for species confirmation. Thus, we consider the Mendoza-Garfias et al. (2017) an invalid record and the present specimens represent the first valid account of *M. bychowskyi* on *M. brevipinnis*. The morphology of the haptoral sclerites, copulatory complex and internal structures (these latter not herein illustrated) of the newly collected specimens of *M. bychowskyi* from *M. brevipinnis* revealed that it is consistent with that of the

Table 1 Species of *Mexicana* Caballero and Bravo-Hollis 1959 (Dactylogyridae) parasitizing the gill lamellae of haemulid fishes from the Pacific and Atlantic oceans in the Tropics based on their original descriptions

Pacific					Atlantic		
Parasites	*M. bychowskyi**	*M. bychowskyi*	*M. littoralis*	*M. iannaconi*	*M. anisotremum*	*M. atlantica*	*M. rubra*
Hosts	*Microlepidotus brevipinnis*	Unidentified sciaenid host	*Haemulon sexfasciatum*	*Haemulon steindachneri*	*Anisotremus virginicus*	*Haemulon steindachneri*	*Orthopristis ruber*
Body length	847 (700–1075)	576–736	951–1057	934–1084	684–997	745–1058	843 (700–950)
Greatest width	194 (150–240)	96–160	242–287	243–282	142–256	168–270	232 (180–360)
Pharynx length	(47–85)	55–66	70–74	108–130	39–63	42–97	74 (62–90)
Pharynx width	(30–45)	36–40	41–45	49–54	33–54	44–62	56 (47–70)
Haptor width	97 (70–120)	52–88	75–123	112–134	102–165	80–194	122 (80–155)
Ventral anchor length	31 (30–32)	40–42	20–25	36	47–53	22–24	27 (26–28)
Ventral anchor width	22 (20–23)	–	25	–	–	–	–
Dorsal anchor length	35 (31–37)	30–42	20–24	34	38–51	24–27	27 (23–30)
Dorsal anchor width	21 (20–22)	–	20–21	–	–	–	–
Ventral bar length	34 (31–40)	23–28	25	44	29–33	35–44	35
Dorsal bar length	43 (38–47)	38–47	41	62	35–44	33–40	37–40
Hook length	11 (10–13)	10–12	7–12	11.7–12.5	14	14	12 (11–13)
Copulatory c. length	155 (132–170)	–	299–328	–	–	–	–
Germarial length	63 (45–100)	64–88	53–94	44–82	79–197	49–62	87 (73–100)
Germarial width	79 (62–100)	64–80	78–123	95–123	118–256	72–112	50 (48–55)
Testis length	127 (95–150)	80	90–131	101–106	72–144	121–165	120 (100–145)
Testis width	75 (48–95)	45–68	49–123	110–154	42–117	82–119	90 (75–195)
Vaginal tube length	113 (87–125)	80–84	120–143	–	–	–	–
Eggs length/width	187–200/112–125	–	–	–	–	–	–

* Present study

original description of this species (see Figs. 3–7 in Caballero and Bravo-Hollis (1959)). However, while these latter structures are satisfactory for specific identification, others are not clearly identified in the original description, i.e., the morphology of anchors and bars as characters also previously used to identify their congeneric species- see Table 2 in Camargo et al. (2017). Therefore, we provided new morphometrics and illustration of the anchor/bar complex of *M. bychowskyi* to clarify the morphology of this species by including also that of the hooks and accessory piece (see that membranous, shaped like a delicate vane, encircling MCO on its midportion in Fig. 2). The six known species of *Mexicana* on haemulids from the Pacific and Atlantic American oceans in the tropics are in general, nearly identical morphologically based on characteristics of its haptoral and copulatory sclerites (see Table 1 in Chero et al. (2014)). Based on comparative morphology of the sinuous MCO tube and its base, and all other features of the reproductive and digestive systems, for example, *M. bychowskyi* from the Pacific more closely resemble *M. atlantica* on *H. steindachneri* from Brazil (Atlantic) (see Luque et al. (1992)) than they do other congeneric species. That resemblance of these monogenoidean species could represent cryptic sister species or amphiamerican "geminate" species pairs occurring on their respective hosts along the Pacific and Atlantic American oceans. Although exist continuing documented evidence of geminate species pairs among monogenoids as well as within other groups of organisms (i.e., fish parasitic crustaceans) from which their isolation/speciation has been associated with formation of the Panamanian Isthmus (3 mya), there are other tropical monogenoids (i.e., species of *Euryhaliotrema*, *Diplectanocotyla* and *Neohaliotrema*) showing to be morphologically related to their pairs parasitizing lutjanid, megalopid and pomacentrid fishes from the Indo-West Pacific Ocean

associated with the tectonic of Tethys Sea (12–18 mya) (see Kritsky (2012); May-Tec et al. (2022); Mendoza-Franco et al. (2022)). However, not record of species of *Mexicana* to occur on haemulids from the Indo Pacific so far. Finally, although only two dactylogyrid specimens representing a new species of *Magnanchor* n. gen. were collected from *M brevipinnis* off Mexican Pacific, the features of the haptoral structures and copulatory complex allowed us justify proposal of that new genus to accommodate *M. raris* n. sp.

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Data Availability Not applicable.

Declarations

Ethical Approval All applicable institutional, national and international guidelines for the care and use of animals were followed.

Competing Interests Not applicable.

References

Caballero CE, Bravo-Hollis M (1959) Trematodos de peces de aguas mexicanas del Pacífico XVII. Dos nuevos géneros de Monogenoidea Bychowsky, 1937. An Inst Biol Univ Nac Autóm México 30:167–181

Caballero CE, Bravo-Hollis M (1961) Trematodos de peces de aguas mexicanas del Pacífico XX. Tres especies de Monogenoidea Bychowsky, 1937. An Inst Biol Univ Nac Autóm México 32:201–217

Caballero CE, Bravo-Hollis M (1962) Trematodos de peces de aguas mexicanas del Pacífico XXI. Sobre un nuevo género de la familia Diclidophoridae Fuhrmann, 1928. Rev Bras Biol 22:107–114

Camargo ACA, Luque JL, Santos CP (2017) *Mexicana rubra* sp. nov. and *Encotyllabe* cf. *spari* Yamaguti, 1934 (Monogenea) of *Orthopristis ruber* (Cuvier, 1830) from the Brazilian coast off Rio de Janeiro. Helminthol 54:336–347. https://doi.org/10.1515/helm-2017-0046

Chero J, Cruces C, Sáez G, Alvariño L (2014) *Mexicana iannaconi* n. sp. (Monogenea: Ancyrocephalidae) parasite of chere-chere grunt *Haemulon steindachneri* (Perciformes: Haemulidae) (Jordan & Gilbert, 1882) from the Peruvian coast. Neotrop Helminthol 8:429–438. https://www.researchgate.net/publication/270823883

Gomez-Vanega HD, Espino-Barr E, López-Uriarte E (2021) Ichthyofauna composition (Actinopterygii: Teleostei) caught by Jalisco's small-scale fisheries in the Mexican Central Pacific coast. Lat Am J Aquat Res 49:788–803. https://doi.org/10.3856/vol49-issue5-fulltext-2712

Hernández-Gómez RE, Rodiles-Hernández R, Mendoza-Carranza M, Valenzuela-Córdova I, Perera-García MA (2021) Record of *Rhonciscus crocro* (Cuvier, 1830) (Haemulidae: Haemulinae) in the Usumacinta River, Mexico. FishTaxa 22:16–22

Kritsky DC (2012) Dactylogyrids (Monogenoidea: 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 3:227–276. https://doi.org/10.1590/S1984-46702012000300006

Kritsky DC, Boeger WA, Thatcher VE (1985) Neotropical Monogenea. 7. Parasites of the pirarucu *Arapaima gigas* (Cuvier), with descriptions of two new species and redescription of *Dawestrema cycloancistrium* Price and Nowlin, 1967 (Dactylogyridae: Ancyrocephalinae). Proc Biol Soc Wash 98:321–331

Lamothe-Argumedo R, Aranda-Cruz C, Pérez-Ponce de León G (1998) *Choricotyle leonilvazquezae* sp. n. (Monogenea: Diclidophoridae) parasitic on *Microlepidotus brevipinnis* (Osteichthyes: Haemulidae) from Chamela Bay, Jalisco. Mexico J Helminthol Soc Wash 65:24–30

Luque JL, Amato JFR, Takemoto RM (1992) A new species of *Mexicana* (Monogenea: Dactylogyridae) parasitic on *Haemulon steindachneri* (Jordan & Gilbert) (Osteichthyes: Haemulidae) from the Brazilian coast. Rev Bras Parasitol Vet 1(2):85–88

May-Tec AL, Baños-Ojeda C, Mendoza-Franco EF (2022) Parasitic crustaceans (Branchiura and Copepoda) parasitizing the gills of puffer fish species (Tetraodontidae) from the coast of Campeche, Gulf of Mexico. Zookeys 1089:73–92. https://doi.org/10.3897/zookeys.1089.79999

Mendoza Franco EF, Caspeta-Mandujano JM, Salgado-Maldonado G (2013) New species of *Cacatuocotyle* (Monogenoidea, Dactylogyridae) parasitizing the anus and the gill lamellae of *Astyanax aeneus* (Pisces, Ostariophysi: Characidae) from the Rio Lacantún basin in the Biosphere Reserve of Montes Azules, Chiapas. Mexico Parasitol Res 112(1):199–205. https://doi.org/10.1007/s00436-012-3126-0

Mendoza-Franco EF, Vidal-Martínez VM (2011) First records of known endoparasitic species of *Pseudempleurosoma* Yamaguti, 1965 (Monogenoidea: Dactylogyridae) from tetraodontid and rachycentrid fish off the Northern coast of the Yucatan Peninsula. Mexico J Parasitol 97:1020–1025. https://doi.org/10.1645/GE-2727.1

Mendoza-Franco EF, Simöes N, Vidal-Martínez VM, Aguirre-Macedo ML (2022) Rediscovering monogenoids (Platyhelminthes) parasitizing pomacentrid and chaetodontid fishes from Cayo Arcas reef, Gulf of Mexico. Diversity 985:2–24. https://doi.org/10.3390/d14110985

Mendoza-Franco EF, Rosado TMC, Duarte AAD, Rodríguez RER (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 125–161. https://doi.org/10.3897/zookeys.783.26218.

Mendoza-Garfias B, García-Prieto L, Pérez-Ponce de León GP (2017) Checklist of the Monogenea (Platyhelminthes) parasitic in Mexican aquatic vertebrates. Zoosystema 39:501–598. https://doi.org/10.5252/z2017n4a5

Mendoza-Garfías B, Pérez-Ponce de León G (1998) Microcotílidos (Monogenea: Microcotylidae) parásitos de peces marinos de la Bahía de Chamela, Jalisco, México. An Inst Biol Univ Nac Autóm México, Zool 69:139–153

Mizelle JD (1936) New species of trematodes from the gills of Illinois fishes. Amer Midl Naturalist 17:785–806

Montoya-Mendoza J, Salgado-Maldonado G, Blanco-Segovia CR, Mendoza-Franco EF, Lango-Reynoso F (2022) Helminth Community of the Black Margate *Anisotremus surinamensis* (Teleostei: Haemulidae), from Coral Reefs off the Veracruz Coast, Mexico, Southern Gulf of Mexico. Diversity 14:368. https://doi.org/10.3390/d14050368

Paschoal F, Cezar AD, Luque JL (2015) Checklist of metazoan associated with grunts (Perciformes, Haemulidae) from the Neartic and Neotropical regions. Checklist 11:1501. https://doi.org/10.15560/11.1.1501

Tavera JJ, Wainwright PC (2019) Geography of speciation affects rate of trait divergence in haemulid fishes. Proc R Soc B 286:20182852. https://doi.org/10.1098/rspb.2018.2852

Timi JT, Poulin R (2020) Why ignoring parasites on fish ecology is a mistake. Int J Parasitol 50:755–761. https://doi.org/10.1016/j.ijpara.2020.04.007

Torres-Hernández E, Palacios-Morales G, Romero-Gallardo S, Salazar-Araujo P, García-Meraz A, Madrigal-Guridi X, Del Moral-Flores LF, Domínguez-Domínguez O (2016) Annotated checklist of the coastal ichthyofauna from Michoacán State, Mexico. ZooKeys 606:99–126. https://doi.org/10.3897/zookeys.606.9004