

## Revista Mexicana de Biodiversidad 89 (2018): 22-28

Taxonomy and systematics

### Description of a new species of *Pseudopecoelus* (Trematoda: Opecoelidae) with new records of trematodes of marine fishes from the Pacific coast of Mexico

*Descripción de una especie nueva de Pseudopecoelus (Trematoda: Opecoelidae) con registros nuevos de tremátodos de peces marinos de la costa del Pacífico de México*

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Received: 04 October 2016; accepted: 17 July 2017

#### Abstract

As a part of the revision of unidentified specimens harbored by the Colección Nacional de Helmintos of the Instituto de Biología, Universidad Nacional Autónoma de México, we studied several specimens of trematodes collected and processed between 1950 and 1980 in marine fishes from several localities along the Pacific coast of Mexico. Among these specimens, we found 1 undescribed species of the genus *Pseudopecoelus* von Wicklen, 1946 (*Pseudopecoelus ibunami* n. sp.) of the intestine of the spotted grouper *Epinephelus analogus* Gill, 1863 (Actinopterygii: Serranidae) from Bahía de La Paz, Baja California Sur. This species is the number 40 known for this genus worldwide and the fifth registered parasitizing fishes from Mexico. The new species differs from the 17 species of *Pseudopecoelus* with vitelline follicles distributed anteriorly to ventral sucker by having a combination of the following traits: 1) body elongate, narrow, with irregular posterior end, 2) testes and ovary deeply-lobed, and 3) external seminal vesicle reaching only the anterior margin of ventral sucker. In addition, in this study we present new host and geographical records for 6 species of trematodes in marine fishes from Mexico and *Pachycreadium gastrocotylum* (Manter, 1940) Manter, 1954 is recorded for the first time in this country.

**Keywords:** Marine fishes; Platyhelminthes; Endoparasites; Tropical Oriental Pacific

#### Resumen

Como parte del proceso de revisión de ejemplares no identificados del acervo de material depositado en la Colección Nacional de Helmintos del Instituto de Biología de la Universidad Nacional Autónoma de México, estudiamos un lote de tremátodos recolectados y procesados entre 1950 y 1980 en varias localidades de la costa del Pacífico mexicano. Entre dicho material, encontramos 1 especie no descrita del género *Pseudopecoelus* von Wicklen, 1946 (*Pseudopecoelus ibunami* n. sp.) en el intestino de la cabrilla pinta *Epinephelus analogus* Gill, 1863 (Actinopterygii: Serranidae) de la bahía de La Paz, Baja California Sur. Esta especie es la número 40 para

el género en todo el mundo y la quinta registrada parasitando peces de México. La nueva especie difiere de las 17 especies de *Pseudopecoelus* que presentan los folículos vitelinos distribuidos anteriormente a la ventosa ventral, por la combinación de las siguientes características: 1) cuerpo alargado, estrecho, con el extremo posterior irregular, 2) testículos y ovario profundamente lobulados y 3) vesícula seminal externa alcanzando solamente el borde anterior del acetábulo. Adicionalmente, en este trabajo se amplía la distribución geográfica y el registro de hospederos para 6 especies de tremátodos de peces marinos del país y *Pachycreadium gastrocotylum* (Manter, 1940) Manter, 1954 se registra por primera vez en México.

*Palabras clave:* Peces marinos; Platyhelminthes; Endoparásitos; Pacífico oriental tropical

## Introduction

The Colección Nacional de Helmintos (CNHE) housed in the Instituto de Biología, Universidad Nacional Autónoma de México in México City, is the most important reference collection on helminth diversity in Mexico (Lamothe-Argumedo et al., 2010). The collection is composed by 10,000 specimen lots, 95% of them identified to generic or specific level, whereas the remaining specimens are completely processed, but not yet identified. As a part of an ongoing project in order to update the information harbored in the CNHE, we studied several trematodes collected in marine fishes between 1950 and 1980 in localities along the Pacific coast of Mexico. Among these specimens, we detected an undescribed species of the genus *Pseudopecoelus* von Wicklen, 1946. Thus, the main objective of this work is to describe and compare the new species with other congeners including those previously recorded in Mexican fishes.

## Materials and methods

Unidentified trematodes of fishes deposited in the CNHE were obtained for their taxonomic study. All specimens had been previously processed (stained with Meyer's paracarmin and Gomori's trichromic and mounted permanently in Canada balsam). Generic identification of trematodes follows Bray et al. (2008), Gibson et al. (2002), and Jones et al. (2005). Drawings of the holotype were made with the aid of a drawing tube attached to a microscope. Measurements were obtained with a calibrated ocular adapted to an optical microscope; all of them are given in millimeters (mm). We present length range, followed by mean and standard deviation in parentheses. Type and voucher specimens were deposited at CNHE; accession numbers are indicated in table 1.

## Results

A total of 8 species of trematodes were identified, including a new species of *Pseudopecoelus*. They were collected in the intestine of 7 species of fishes distributed in 4 localities along the Pacific coast of Mexico. The species

registered belong to 4 families: Diplangiidae: *Diplangus mexicanus* Bravo-Hollis & Manter, 1957; Haemiuridae: *Genolinea laticauda* Manter, 1925, *Opisthadena dimidia* Linton, 1910 and *Lecithochirium microstomum* Chandler, 1935; Lepocreadiidae: *Hypocreadium myohelicatum* Bravo-Hollis & Manter, 1957 and finally, Opecoelidae: *Opecoelina scorpaenae* Manter, 1934, *Pachycreadium gastrocotylum* (Manter, 1940) Manter, 1954, and one undescribed species, whose description is presented here (Table 1).

## Description

*Pseudopecoelus ibunami* n. sp. (Fig. 1)

Description (based in 5 specimens): Opecoelidae, Opecoelinae. Body elongate, narrow, with irregular end, 2.68-4.67 (3.61 ± 0.80) long × 0.5-1.2 (0.96 ± 0.26) wide. Forebody 0.84-1.37 (1.05 ± 0.23) long and hindbody 1.54-2.98 (2.27 ± 0.56) long. Forebody/hindbody ratio 1:2.16. Pre-oral lobe not seen. Tegument smooth. Oral sucker subterminal, 0.17-0.23 (0.20 ± 0.02) long × 0.16-0.25 (0.21 ± 0.03) wide. Pre-pharynx short, pharynx globular, 0.08-0.11 (0.10 ± 0.01) long × 0.07-0.12 (0.10 ± 0.02) wide. Esophagus 0.30-0.53 (0.39 ± 0.10, n = 4) long × 0.01-0.02 (0.02 ± 0.01, n = 4) wide. Ventral sucker larger than oral sucker, 0.21-0.34 (0.29 ± 0.05) long × 0.17-0.34 (0.28 ± 0.07) wide. Sucker ratio 1:1.37. Intestinal bifurcation between pharynx and ventral sucker, at 0.23-0.47 (0.33 ± 0.10) from ventral sucker. Caeca long, narrow, reach close to posterior end of body, and end blindly. Testes 2, deeply-lobed (anterior and posterior testes with 3-6 lobules), oval with long axes oriented transversely, located contiguously in tandem, in the second third of hindbody. Anterior testis 0.25-0.56 (0.40 ± 0.13) long × 0.19-0.54 (0.37 ± 0.13) wide, at 0.52-1.11 (0.78 ± 0.24) from ventral sucker; posterior testis 0.24-0.55 (0.41 ± 0.14) long × 0.24-0.48 (0.36 ± 0.09) wide. Post-testicular area 0.57-1.01 (0.82 ± 0.19) long, approximately 25% of body length. Genital atrium not distinguished. Genital pore slightly sinistral, near to mid-body line, approximately halfway between pharynx and intestinal bifurcation. External seminal vesicle uncoiled, widened proximally, 0.17-0.34 (0.27 ± 0.07, n = 4) long × 0.06-0.13 (0.09 ± 0.03, n = 4) wide; does not invade hindbody, reaching the anterior margin

Table 1

Intestinal species of trematodes recorded in this study in marine fishes from the Pacific coast of Mexico.

Trematode species	Host species	Site of collection	CNHE
<i>Diplangus mexicanus</i> Bravo-Hollis & Manter, 1957	Gerreidae: <i>Gerres cinereus</i>	Mazatlán, Sinaloa (23°14'3" N, 106°27'40" W)	9650
<i>Genolinea laticauda</i> Manter, 1925	Kyphosidae: <i>Girella nigricans</i>	Ensenada, Baja California (31°51'14" N, 116°37'45" W)	9652
<i>Hypocreadium myohelicatum</i> Bravo-Hollis & Manter, 1957	Balistidae: <i>Sufflamen verres</i>	Mazatlán, Sinaloa (23°14'3" N, 106°27'40" W)	9655
<i>Lecithochirium microstomum</i> Chandler, 1935	Scombridae: <i>Katsuwonus pelamis</i>	Puerto Ángel, Oaxaca (15°39'35" N, 96°29'45" W)	9656
<i>Opecoelina scorpaenae</i> Manter, 1934	Sciaenidae gen. sp.	Puerto Ángel, Oaxaca (15°39'35" N, 96°29'45" W)	9653
<i>Opisthadena dimidia</i> Linton, 1910	Kyphosidae: <i>G. nigricans</i>	Ensenada, Baja California (31°51'14" N, 116°37'45" W)	9651
<i>Pachycreadium gastrocotylum</i> (Manter, 1940) Manter, 1954	Sparidae: <i>Calamus brachysomus</i>	Mazatlán, Sinaloa (23°14'3" N, 106°27'40" W)	9657
<i>Pseudopecoelus ibunami</i> n. sp.	Serranidae: <i>Epinephelus analogus</i>	La Paz Baja California Sur (24°14'30" N, 110°28'08" W)	9658-9659

of ventral sucker. Pars prostatica poorly developed, with few gland-cells. Cirrus-sac absent. Ovary deeply-lobed, with 4-5 lobes, pre-testicular, median, contiguous with anterior testis, 0.18-0.32-(0.26 ± 0.05) long × 0.24-0.48 (0.37 ± 0.10) wide, at mid-hindbody 0.34-0.91-(0.61 ± 0.23) from ventral sucker. Uterine seminal receptacle round, antero-lateral to ovary; Mehlis' gland and Laurer's canal not seen. Uterine coils mostly pre-ovarian, in intercaecal space between ovary and ventral sucker, passes laterally to ventral sucker. Metraterm not distinguished. Eggs 0.04-0.05 (0.05 ± 0.004) long × 0.017-0.02 (0.02 ± 0.003) wide. Vitelline follicles extend from intestinal bifurcation to posterior end, some follicles overlapping caeca dorsally; vitelline fields mainly lateral to caeca, confluent in post-testicular region. Excretory pore terminal. Excretory vesicle I-shaped, partially hidden by the testes and ovary.

#### Taxonomic summary

*Type host:* *Epinephelus analogus* Gill, 1863

*Type locality:* La Paz, Baja California Sur (24°14'30" N, 110°28'08" W), Mexico.

*Site of infection:* intestine.

*Material deposited:* CNHE 9658 (holotype); 9659 (4 paratypes).

*Etymology:* this species is named after the Instituto de Biología of the Universidad Nacional Autónoma de México (IB-UNAM) where the Colección Nacional de Helmintos is housed.

#### Remarks

*Pseudopecoelus* was erected by von Wicklen (1946) to contain *Pseudopecoelus vulgaris* (Manter, 1934) von Wicklen, 1946; currently, this genus is composed by 39 nominal species distributed worldwide (Blend et al., 2017), parasitizing a wide range of marine fishes of many families (Cribb, 2005). Specific differentiation within the genus is difficult; for practical purposes, Bray (1987) divided it artificially into 6 morphological groups (A-F). Based on the extent of the vitelline follicles, which are distributed anteriorly to ventral sucker, our specimens are included in group A, along with 17 species (Table 2). *Pseudopecoelus ibunami* n. sp. can be differentiated of all the species included in group A by having a combination of the following traits: 1) body elongate, narrow, with irregular posterior end, 2) testes and ovary deeply-lobed, and 3) external seminal vesicle reaching only the anterior margin of ventral sucker. Particularly, the extension of the external seminal vesicle of the new species allows to distinguish it from 13 of the 17 species included in the group A: in *Pseudopecoelus ariusi* Parukhin, 1983, *Pseudopecoelus brayi* Madhavi & Lakshmi, 2010, *Pseudopecoelus dollfusi* Ahmad & Dhar, 1987, *Pseudopecoelus umbrinae* Manter & van Cleave, 1951, and *Pseudopecoelus vitellozonatus* Pritchard, 1966 the external seminal vesicle reaches the posterior end of ventral sucker (Ahmad & Dhar, 1987; Madhavi & Lakshmi, 2010; Manter & van Cleave, 1951; Parukhin, 1983; Pritchard, 1966), while in *Pseudopecoelus bilqeesae*

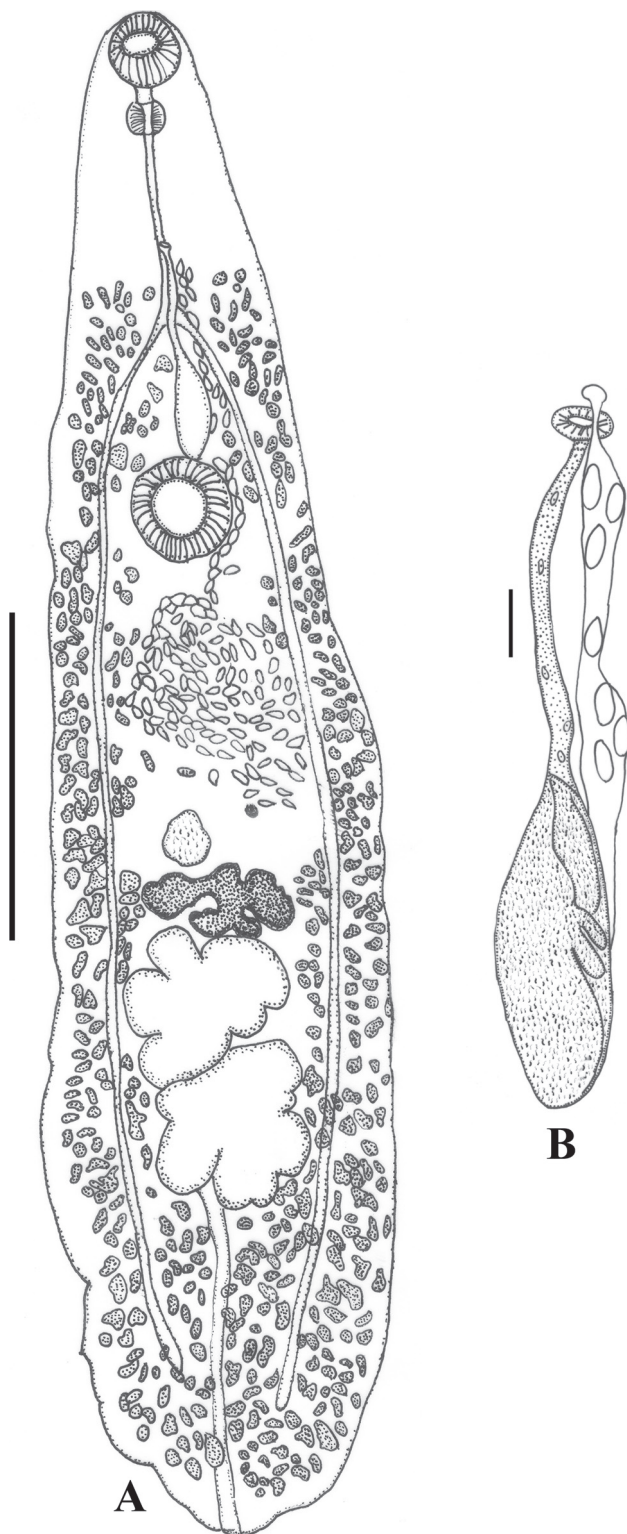


Figure 1. *Pseudopecoelus ibunami* n. sp. A, Ventral view of the holotype (scale 1 mm); B, detail of terminal part of reproductive apparatus in a paratype (scale 0.25 mm).

Ahmad & Dhar, 1987, *Pseudopecoelus gibbonsia* Manter & van Cleave, 1951, *Pseudopecoelus gymnothoracis* Nahhas & Cable, 1964, *Pseudopecoelus manteri* Sogandares-Bernal & Hutton, 1959, *Pseudopecoelus minutus* Nahhas & Cable, 1964, *Pseudopecoelus pritchardae* Gupta & Sayal, 1979, *Pseudopecoelus pyriformis* Prudhoe & Bray, 1973, and *Pseudopecoelus sewelli* Bray, 1990 overpass this structure (Ahmad & Dhar, 1987; Bray, 1990; Gupta & Sayal, 1979; Manter & van Cleave, 1951; Nahhas & Cable, 1964; Prudhoe & Bray, 1973; Sogandares-Bernal & Hutton, 1959). In addition, the body of *P. pyriformis* and *P. umbrinae* is pyriform (Manter & van Cleave, 1951; Prudhoe & Bray, 1973) (vs. elongate in the new species) and *P. bilqeesae*, *P. dollfusi*, *P. manteri*, and *P. sewelli* have pedunculated ventral sucker (Ahmad & Dhar, 1987; Bray, 1990; Sogandares-Bernal & Hutton, 1959) in contrast with the sessile ventral sucker of *P. ibunami*. Testes of *P. gibbonsia* and *P. minutus* are smooth (Manter & van Cleave, 1951; Nahhas & Cable, 1964) and medially constricted in *P. gymnothoracis* (Nahhas & Cable, 1964) rather than deeply-lobed as in our specimens. Genital pore is submedian at level of intestinal bifurcation in *P. ariusi* and *P. pritchardae* (Gupta & Sayal, 1979; Parukhin, 1983) and is located to left of pharynx or at anterior end of esophagus in *P. vitellozonatus* (Pritchard, 1966), whereas in *P. ibunami*, the genital pore is situated at mid-body line, approximately halfway between pharynx and intestinal bifurcation. Finally, *P. brayi* also differs of *P. ibunami* by having a sinuous external seminal vesicle (instead of a straight vesicle, widened proximally as in the new species) and by having ovary and testes separated by vitelline follicles and not contiguous as in *P. ibunami* (Madhavi & Lakshmi, 2010).

The remaining 4 species of *Pseudopecoelus* included in the group A of Bray (1987), have the external seminal vesicle reaching only the anterior margin of ventral sucker as the new species described herein. Nonetheless, body of *Pseudopecoelus littoralis* Caballero & Caballero-Rodríguez, 1976, *Pseudopecoelus acanthuri* Yamaguti, 1970 and *Pseudopecoelus puhipaka* Yamaguti, 1970 is pyriform rather than elongated as in *P. ibunami* and testes in *P. littoralis*, *P. acanthuri* and *P. puhipaka* are trapezoidal, indented and irregularly lobed, respectively (Caballero & Caballero-Rodríguez, 1976; Yamaguti, 1970), in contrast with the testes deeply-lobed of the new species. *Pseudopecoelus ibunami* most closely resembles *Pseudopecoelus brevivesiculatum* Hanson, 1955 in general morphology of body and internal organs arrangement. Notwithstanding, genital pore of *P. brevivesiculatum* is sinistral, located mid-way between esophagus and body wall and in the new species, genital pore is close to mid-body line, approximately halfway between pharynx and intestinal bifurcation. In addition, external seminal vesicle

Table 2

Species of *Pseudopecoelus* included in the group A according to Bray (1987).

<i>Pseudopecoelus</i> species	Host family/distribution	Reference
<i>P. ibunami</i> n. sp.	Serranidae/Mexico	Present study
<i>P. acanthuri</i> Yamaguti, 1970	Acanthuridae/Hawaii	Yamaguti (1970)
<i>P. ariusi</i> Parukhin, 1983	Ariidae/Oman	Parukhin (1983)
<i>P. bilqeesae</i> Ahmad & Dhar, 1987	Carangidae/India	Ahmad & Dhar (1987)
<i>P. brayi</i> Madhavi & Lakshmi, 2010	Holocentridae/India	Madhavi & Lakshmi (2010)
<i>P. brevivesiculatum</i> Hanson, 1955	Monacanthidae/Hawaii	Hanson (1955)
<i>P. dollfusi</i> Ahmad & Dhar, 1987	Therapontidae/India	Ahmad & Dhar (1987)
<i>P. gibbonsia</i> Manter & van Cleave, 1951	Clinidae/California	Manter & Van Cleave (1951)
<i>P. gymnothoracis</i> Nahhas & Cable, 1964	Muraenidae/Curaçao	Nahhas & Cable (1964)
<i>P. littoralis</i> Caballero & Caballero-Rodríguez, 1976	Sciaenidae/California	Caballero & Caballero-Rodríguez (1976)
<i>P. manteri</i> Sogandares-Bernal & Hutton, 1959	Sciaenidae/Florida	Sogandares-Bernal & Hutton (1959)
<i>P. minutus</i> Nahhas & Cable, 1964	Carangidae/Curaçao	Nahhas & Cable (1964)
<i>P. pritchardae</i> Gupta & Sayal, 1979	Holocentridae/India	Gupta & Sayal (1979)
<i>P. puhipaka</i> Yamaguti, 1970	Muraenidae/Hawaii	Yamaguti (1970)
<i>P. pyriformis</i> Prudhoe & Bray, 1973	Callanthiidae/Tasmania	Prudhoe & Bray (1973)
<i>P. sewelli</i> Bray, 1990	Trachichthyidae/Tasmania	Bray (1990)
<i>P. umbrinae</i> Manter & van Cleave, 1951	Sciaenidae/California	Manter & Van Cleave (1951)
<i>P. vitellozonatus</i> Pritchard, 1966	Acanthuridae/Hawaii	Pritchard (1966)

in the new species is uncoiled and widened proximally, while in the species described by Hanson (1955), external seminal vesicle has a sharp curve in the posterior half.

In addition to *P. umbrinae* collected in *Umbrina xanti* Gill, 1862 (Sciaenidae) from the Pacific coast of Mexico, which was compared with the new species above, *Pseudopecoelus* is represented in this country by 3 other species: *Pseudopecoelus elongatus* (Yamaguti, 1938) Von Wicklen, 1946 parasitizing *Caranx* sp. (Carangidae), *Pseudopecoelus scorpaenae* (Manter, 1947) Overstreet, 1969 in *Scorpaena plumieri* Bloch, 1789 (Scorpaenidae) and *Pseudopecoelus priacanthi* (MacCallum, 1921) Manter, 1947 recorded in *Caranx caballus* Günther, 1868 and *Trachinotus rhodopus* Gill, 1863 (Carangidae) (Pérez-Ponce de León, García-Prieto, & Mendoza-Garfias, 2007). However, *P. elongatus* and *P. scorpenae* are included in the group F of Bray (1987), characterized by having smooth testicular margins (rather than deeply-lobed as in *P. ibunami*) and external seminal vesicle extending posteriorly to ventral sucker (instead of only reaching the anterior margin of the ventral sucker, as in the new species); *P. priacanthi*, included in the group E by Bray (1987), also have smooth testicular margins and a large ventral sucker pedunculated and with lateral notches, characteristics not presented by our material.

Previous to the present study, the only species of *Pseudopecoelus* recorded in serranid fishes of the genus *Epinephelus* Bloch, 1793 was *Pseudopecoelus epinepheli* Wang, 1982, parasitizing *Epinephelus akaara* (Temminck & Schlegel, 1842) from Fujian, China (Wang, 1982). The slightly sinistral position of the genital pore of this species, included in the group B of Bray (1987), is similar to that observed in the new species described herein; however, in our material the genital pore is situated approximately halfway between pharynx and intestinal bifurcation, whereas in *P. epinepheli* it is located just before the division of the intestine. In addition, *P. epinepheli* can be distinguished from *P. ibunami* because vitelline field does not reach into the forebody and the external seminal vesicle surpasses extensively the posterior end of the ventral sucker (Wang, 1982).

## Discussion

Studies on trematodes associated with marine fish from Mexico began almost 70 years ago; the first species of trematode described from marine fishes from this country was *Homalometron mexicanum* (Manter, 1937) Cribb & Bray, 1999 (= *Apocreadium mexicanum* Manter, 1937) as a parasite of *Labrisomus xanti* Gill, 1860 from Oaxaca

State, on the Mexican Pacific coast (Manter, 1937). Since a great amount of information has been accumulated according to García-Prieto, Mendoza-Garfias, and Pérez-Ponce de León (2014), these platyhelminthes are the most well-known group of helminths in this country. Only for Actynopterigians, these authors listed 305 nominal species  $\pm$  95 unnamed taxa collected in 395 fish species of marine, brackish and freshwater environments. The majority (205) of these 305 nominal species have been recorded parasitizing marine fishes (data not published). With the present study we add 2 species to the inventory of the trematodes associated with marine fishes distributed in Mexican waters: *P. ibunami* n. sp., and *P. gastrocotylum*. For 3 of the remaining 6 registered species of trematodes (*H. myohelicatum*, *O. scorpaenae*, and *L. microstomum*) their geographical distribution range is extended. Finally, fish species parasitized by *Diplangus mexicanus*, *Opisthadenia dimidia*, and *Genolinea laticauda* in this study represent new host records for those species in Mexico (see Pérez-Ponce de León et al., 2007).

#### Acknowledgements

To Leopoldo Andrade-Gómez and David Hernández Mena for improving the figures; Charles K. Blend and Georgina Ortega-Leite for providing important bibliographic references. This work is part of the Bachelor thesis of MAEG, who received a scholarship from the PAPIIT IN220113 project.

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