

Revista Ciencias del Mar UAS



Julio - Septiembre 2026

Núm. 4 Vol. 3

U N I V E R S I D A D A U T Ó N O M A D E S I N A L O A

Parasitología y Sanidad Acuícola

Número Especial
EDICIÓN 1

Dr. Víctor Vidal-Martínez

Parasitólogo

ISSN 3061-8959



Artículo Científico

Metazoan Parasites of *Lagodon rhomboides* (Sparidae) in La Carbonera Lagoon, Yucatán Peninsula

Metazoarios parásitos de *Lagodon rhomboides* (Sparidae) en la Laguna la Carbonera, Península de Yucatán



CREATIVE COMMONS



Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

1. Betzi Fernanda Pérez-Ortega
ID 0000-0001-5414-6329

Universidad Autónoma de México, Escuela Nacional de Estudios Superiores (ENES-Mérida), Yucatán, México.

3. Brenda Solórzano-García
ID 0000-0002-6367-477X

Universidad Autónoma de México, Escuela Nacional de Estudios Superiores (ENES-Mérida), Yucatán, México.

2. Juan Francisco Espinola-Novelo
ID 0000-0003-0773-3744

Universidad Autónoma de México, Escuela Nacional de Estudios Superiores (ENES-Mérida), Yucatán, México.

4. Gerardo Pérez-Ponce de León
ID 0000-0001-6472-5113

Universidad Autónoma de México, Escuela Nacional de Estudios Superiores (ENES-Mérida), Yucatán, México.

Corresponding author: ppdleon@enesmerida.unam.mx



Metazoan Parasites of *Lagodon rhomboides* (Sparidae) in La Carbonera Lagoon, Yucatán Peninsula

Metazoarios parásitos de *Lagodon rhomboides* (Sparidae) en la Laguna la Carbonera, Península de Yucatán

► ABSTRACT

Coastal lagoons are highly diverse ecosystems because they are transition zones between marine and terrestrial environments; in some cases, they serve as nursery sites for certain fish species. The pinfish, *Lagodon rhomboides*, locally known as “xlavita” or “sargo”, is a member of the family Sparidae and is distributed in coastal lagoons across the Western Atlantic, from Massachusetts, USA to the Northern Yucatán Peninsula and the West Indies. The parasite fauna of *L. rhomboides* across its distributional range has been partially studied. Here, we sampled 29 individuals of *L. rhomboides* from La Carbonera lagoon in the Yucatán Peninsula using seine nets. Fish were euthanized and studied for ecto and endoparasites. Metazoan parasites were identified using molecular and morphological data. Sixteen parasite taxa were found. Of these, 37.5% were larval forms and 62.5% were adults, indicating the role of this fish species in the trophic network in coastal lagoons. Seven taxa were added to the list of parasite species of *L. rhomboides* across its distributional range, raising the total number to 38. The prevalence and mean intensity of infection were calculated for each parasite taxon, and community attributes such as species richness, mean abundance, and diversity indices were calculated at the infracommunity and component community levels.

Key words: Parasites, taxonomy, ecology, DNA, Yucatán, Mexico



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

► RESUMEN

Las lagunas costeras son ecosistemas con una alta diversidad de especies porque representan zonas de transición entre los ambientes marinos y terrestres; en ocasiones, estas zonas sirven de hábitat para algunas especies de peces. La “xlavita” or “sargo”, *Lagodon rhomboides*, pertenece a la familia Sparidae; se distribuye desde Massachusetts, USA hasta la península de Yucatán y las Indias Occidentales. La fauna de parásitos de esta especie de pez ha sido poco estudiada a lo largo de su distribución. Durante el verano de 2022, se recolectaron 29 ejemplares de *L. rhomboides* en la laguna de La Carbonera, Yucatán, mediante chinchorro playero. Los peces fueron eutanizados y estudiados en busca de ecto y endoparásitos. Los metazoarios parásitos fueron identificados mediante caracteres morfológicos y moleculares. Se reporta la presencia de 16 taxa de los cuales, el 37.5% fueron larvas y el 62.5% adultos, mostrando el papel de esta especie en las redes tróficas de los ecosistemas costeros. Se agregan siete taxa a la lista de especies de metazoarios parásitos de esta especie a lo largo de su rango de distribución, aumentando el número a 38. Se presentan los valores promedio de prevalencia e intensidad de la infección para cada especie de parásito y, de manera general, se describen los atributos de las comunidades de parásitos, tales como la riqueza, la abundancia y la diversidad, tanto a nivel de infracomunidad como de componente de comunidad.

Palabras clave: Parásitos, taxonomía, ecología, ADN, Yucatán, México

► INTRODUCTION

The family Sparidae Rafinesque, 1818, comprises 39 genera and 163 valid species (Froese et al., 2026). In the Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea, only 21 species are known (Kritsky and Bakenhaster, 2019). Sparids are coastal, demersal fishes that occur in brackish waters, such as estuaries and coastal lagoons, where they serve as nurseries. Juvenile specimens commonly form shoals and live in shallow waters, in contrast to adults, which are less sociable (Pavlidis and Mylonas, 2011).



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

The pinfish, *Lagodon rhomboides* (Linnaeus, 1766), locally called “sargo” or “xlavita”, is a member of the family Sparidae. It is distributed along the Western Atlantic coast, from Massachusetts, USA, to the Yucatán Peninsula, Mexico, including the West Indies (Spitzer et al., 2000; Canto-Maza and Vega-Cendejas, 2008; Eaton et al., 2022); juveniles inhabit estuarine and brackish waters (Canto-Maza and Vega-Cendejas, 2008). In the Yucatán Peninsula, *L. rhomboides* is a resident of coastal lagoons such as Celestún, La Carbonera, Chelem, Dzilam, las Coloradas, and Río Lagartos (Vega-Cendejas and Hernández de Santillana, 2004; Canto-Maza & Vega-Cendejas, 2008; Arceo-Carranza et al., 2010; Vega-Cendejas et al., 2012; Bonilla-Gómez et al., 2014). The diet of *L. rhomboides* comprises mostly phytoplankton, zooplankton, macrophytes, amphipods, and other crustaceans (Spitzer et al., 2000; Canto-Maza and Vega-Cendejas, 2008; Bonilla-Gómez et al., 2011, 2014).

Parasites of *L. rhomboides* have been studied mostly in estuaries of the northern part of the Gulf of Mexico. Previous studies recorded 31 metazoan parasite taxa (Table 1) across its distribution range. Digeneans were the most common parasite group, with 20 of the 31 taxa present in both larval and adult stages. In Mexico, only three studies have partially described this sparid's parasite fauna. For instance, Bonilla-Gómez et al. (2014) reported the isopod *Cymothoa excisa* Perty, 1833 in La Carbonera lagoon. In contrast, Sosa-Medina et al. (2015) studied the parasitofauna of *L. rhomboides* in Celestún lagoon and recorded 14 parasite taxa. Recently, Pérez-Ortega et al. (2026) described a new copepod species, *Clavellotis mayae*, from the gills of *L. rhomboides* in both La Carbonera and Celestún lagoons.

The main objective of this study was to report the composition of the metazoan parasite fauna of *L. rhomboides* in La Carbonera coastal lagoon, in the Yucatán Peninsula, to describe the ecological parameters of the infection at the population and community levels, and to update the checklist of the parasites of this fish species across its distributional range.

**OPEN ACCESS**

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

Table 1. Previous records of metazoan parasites of *Lagodon rhomboides* along its distribution range (in alphabetical order by parasite group).

Taxa	Locality	Reference
Trematoda		
<i>Acanthostomidae</i> gen. sp.	Celestún lagoon, Mexico	Sosa-Medina et al., 2015
<i>Atrophecaecum astorquii</i> (Watson, 1976) Lamothe-Argumedo & Ponciano-Rodríguez, 1986	Celestún lagoon, Mexico	Sosa-Medina et al., 2015
<i>Bucephalidae</i> gen. sp.	Celestún lagoon, Mexico	Sosa-Medina et al. 2015
<i>Diptherostomum americanum</i> Manter, 1947	USA	Hutton and Sogandares, 1960; Hutton, 1964; Overstreet, 1969
<i>Diplomonorchis leistomi</i> Hopkins, 1941	USA	Hutton and Sogandares, 1960; Hutton, 1964; Nahhas and Powell, 1965; Overstreet, 1969
<i>Alloinfundiburictus beauforti</i> (Hopkins, 1941) Wee, Cutmore, Pérez-del-Olmo & Cribb, 2020	USA	Nahhas and Powell, 1965
<i>Alloinfundiburictus lintoni</i> (Manter, 1931) Wee, Cutmore, Pérez-del-Olmo & Cribb, 2020	USA	Nahhas and Powell, 1965
<i>Lecithaster confusus</i> Odhner, 1905	USA	Nahhas and Short, 1965
<i>Lecithochirium musculus</i> (Looss, 1907) Nasir & Diaz, 1971	Celestún lagoon, Mexico	Sosa-Medina et al. 2015
<i>Brachyphallus parvus</i> (Manter, 1947) Skrjabin & Guschanskaja, 1955	USA	Overstreet, 1969
<i>Lepocreadium floridanum</i> Sogandares-Bernal & Hutton, 1959	USA	Hutton and Sogandares, 1960; Hutton, 1964; Nahhas and Short, 1965; Overstreet, 1969
<i>Megasolena hysterospina</i> (Manter, 1931) Overstreet, 1969	USA	Hutton and Sogandares, 1960; Hutton, 1964
<i>Mesostephanus appendiculatoides</i> (Price, 1934) Lutz, 1935	Celestún lagoon, Mexico	Sosa-Medina et al. 2015
<i>Mesostephanus</i> sp.	Celestún lagoon, Mexico	Sosa-Medina et al. 2015
<i>Oligogonotylus manteri</i> Watson, 1976	Celestún lagoon, México	Sosa-Medina et al. 2015
<i>Parahemius merus</i> (Linton, 1910) Manter, 1940	USA	Nahhas and Short, 1965; Overstreet, 1969
<i>Proctoeces lintoni</i> Siddiqi & Cable, 1960	USA	Overstreet, 1969
<i>Stephanostomum</i> sp.	Celestún lagoon, México	Sosa-Medina et al. 2015
<i>Steringotrema corpulentum</i> (Linton, 1905) Manter 1931	USA	Hutton and Sogandares, 1960; Hutton, 1964; Overstreet, 1969
<i>Tabascotrema</i> sp.	Celestún lagoon, México	Sosa-Medina et al., 2015
Monogenea		
<i>Ancyrocephalinae</i> gen. sp.	Celestún lagoon, México	Sosa-Medina et al., 2015



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Microcotylidae gen. sp.	Celestún lagoon, México	Sosa-Medina et al., 2015
Cestoda		
Tetraphyllidae gen. sp.	Celestún lagoon, México	Sosa-Medina et al., 2015
Nematoda		
<i>Contracaecum</i> sp.	Celestún lagoon, México	Sosa-Medina et al., 2015
Copepoda		
<i>Argulus funduli</i> Kroyer, 1863	USA	Bere, 1936
<i>Caligus praetextus</i> Bere, 1936	USA	Creseey, 1991
<i>Caligus rufimaculatus</i> Wilson C.B., 1905	USA	Creseey, 1991
<i>Clavellotis mayae</i> Pérez-Ortega, Espinola-Novelo, Castro-Romero, Montes & Pérez-Ponce de León, 2026	Celestún lagoon, México	Pérez-Ortega et al., 2026
<i>Ergasilus</i> sp.	Celestún lagoon, México	Sosa-Medina et al., 2015
<i>Lernanthropus longilamina</i> Pearse 1951	Bahamas Island	Pearse, 1952
Isopoda		
<i>Cymothoa excisa</i> Perty, 1833	Celestún lagoon, México	Bonilla-Gómez et al., 2014

MATERIALS AND METHODS

Study site

Twenty-nine juvenile individuals of *L. rhomboides* (TL= 17.73 ± 4.69) were collected from La Carbonera coastal lagoon (21°13'- 21°14' N; 89° 52' - 89° 54' W) (Figure 1) between June and August, 2022. Fish were obtained using seine nets and kept alive in containers with salt water and constant aeration until necropsy; fish were euthanized by spinal severance (pithing), following the procedures accepted by the American Veterinary Medical Association (AVMA, 2020). All individuals were dissected. Parasitological examination included the gills, brain, gastrointestinal tract, heart, and liver, which were placed in Petri dishes with 0.85% saline and examined for parasites under a stereomicroscope. The collected metazoan parasites were preserved in 100% ethanol for

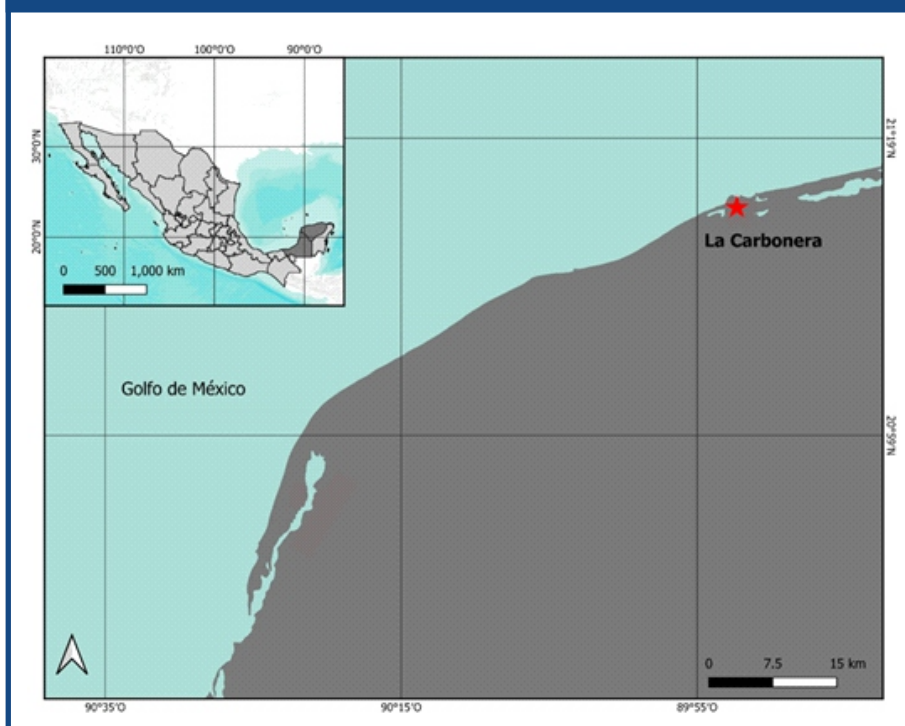


OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

further morphological and molecular analysis. Fish were sampled under the collecting permit No. PPF/ DGOPA-001/20 issued to Alfredo Gallardo by the Comisión Nacional de Acuacultura y Pesca.

Figure 1. Locality of La Carbonera coastal lagoon, Yucatán Peninsula, México



Morphological identification

Digeneans, monogeneans, and acanthocephalans were stained with Mayer's paracarmine and mounted as permanent slides with Canada balsam. Copepods and nematodes were mounted in semi-permanent slides with 50% glycerol for morphological examination (Lamothe-Argumedo, 1997). Original descriptions or redescrptions were used to identify most of the metazoan parasites morphologically. Specimens were deposited in the Colección Nacional de Helmintos, Mexico City with accession numbers 12698-19702.

Molecular analysis

Total genomic DNA was extracted from individuals of 15 taxa using DNAzol (Molecular Research Center, Cincinnati, OH) following manufacturer's instructions. The target genes were amplified via Polymerase Chain Reaction (PCR). For most taxa the Large Subunit of



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



the Ribosomal RNA gene (28S) was amplified using the forward primer 391 (5'-AGCGGAGGAAAAGAACTAA -3') (Nadler and Hudspeth, 1998) and reverse primer 536 (5'- CAGCTATCCTGAGGGAAAC -3') (García-Varela and Nadler, 2005). Sequencing internal primers were 502 plus 503 (Stock et al., 2001; García-Varela and Nadler, 2005). Cycling conditions: 4 min initial denature at 95°C followed by 30 cycles of 94°C for 30 sec, 50°C for 45 sec and 72°C for 2 min; and a final extension phase at 72°C for 7 min. The Internal Transcribed Spacer region 1 (ITS1) was also amplified using the forward primer BD3 (5'-GAACATCGACATCTTGAACG -3') (Hernández-Mena et al., 2014) and reverse primer BD2 (5'- TATGCTTAAATTCAGCGGGT -3') (Lutton et al., 1992), with an internal primer, BD4 (Hernández-Mena et al., 2014). Cycling conditions were: 5 min initial denature at 95°C followed by 30 cycles of 95°C for 30 sec, 55°C for 30 sec, and 72°C for 30 sec; and a final extension phase at 72°C for 7 min.

For copepods, the partial cytochrome c oxidase subunit I gene (*cox1*) was amplified using the forward Primer LCO1490 (5'-GGTCAACAAATCATAAAGATATTG -3') and reverse primer HCO2198 (5'-TAAACTTCAGGGTGACCAAAAATCA-3') (Folmer et al., 1994). For the monogenean, *cox1* was amplified using the forward primer JB3 (5'- TTTTTTGGGCATCCTGAGGTTTAT -3') and reverse primer JB4.5 (5'- TAAAGAAAGAACATAATGAAAATG -3') (Bowles et al., 1995). For *cox1*, the cycling conditions were: 4 min initial denaturation at 94°C, followed by 34 cycles of 94°C for 30 sec, 44–48 °C for 1 min, and 72 °C 1 min; and a final extension phase at 72 °C for 7 min. Sequences were compared to the GenBank library content using the Basic Alignment Search Tools (BLAST) at the National Center for Biotechnology Information (NCBI), and were deposited at the GenBank database. We established an arbitrary sequence identity value of $\geq 99\%$ for the 28S rRNA gene and ITS1 as a valid threshold to achieve a species-level identification, and $\geq 95\%$ for the mitochondrial gene *cox1*. In a few cases when the number of specimens was optimal, after conducting the BLAST search, identifications were corroborated by a morphological analysis.



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

Population analysis and community description

The infection parameters: prevalence, mean abundance, and mean intensity were estimated following Bush et al. (1997). A parasite species accumulation curve was constructed to determine whether the sample size was adequate for ecological analyses; species richness estimators (Chao 1 and Jackknife 2) were calculated in PRIMER v6 (Anderson et al., 2008), to estimate the expected number of species. The quantitative analysis was carried out at the component community level (all parasite species in a host sample at a given location) and at the infracommunity level (all parasite species in an individual host). At the component community level, the total species richness, total abundance, and diversity through the Shannon-Wiener index were calculated; whereas, at the infracommunity level, the species richness (number of parasite species per examined host), mean abundance (mean number of individual parasites per examined host), and diversity through Brillouin index were calculated. These analyses were performed using PRIMER v6 (Anderson et al., 2008).

► RESULTS

Only three of the 29 specimens examined of *L. rhomboides* from La Carbonera lagoon were not infected with metazoan parasites. In total, 448 parasites were collected and belonged to 16 taxa, including five digeneans, one monogenean, two cestodes, one acanthocephalan, four nematodes, and three copepods (Table 2).

Table 2. Sequence identity of the metazoan parasite from *Lagodon rhomboides* sampled in La Carbonera coastal lagoon, Yucatán Peninsula, Mexico.

TAXA		Gene	Matching sequence	Identity Percentage (%)	GB Accession
Trematoda					
<i>Cardiocephaloides</i> sp.*	Brain	28S	<i>Cardiocephaloides longicollis</i>	98.8	PZ618334
<i>Diptherostomum americanum</i> Manter, 1947	Intestine	ITS1	<i>Diptherostomum flavum</i>	98.1	PZ618332
<i>Diplomonorchis leiostomi</i> Hopkins, 1941	Intestine	28S	<i>Diplomonorchis leiostomi</i>	99.9	PZ618335
<i>Megasolena hysterospina</i> (Manter, 1931) Overstreet, 1969	Intestine	28S	<i>Megasolena hysterospina</i>	99.9	PZ618336
<i>Proctoeces</i> sp.	Intestine	28S	<i>Proctoeces maculatus</i>	98.1	PZ618337
Monogenea					
<i>Microcotyle</i> sp.	Gills	Cox1	<i>Microcotyle visa</i>	92.9	PZ610132
Cestoda					
<i>Dasyrhynchus giganteus</i> *	Mesentery	28S	<i>Dasyrhynchus giganteus</i>	99.6	PZ618338
<i>Matticestus</i> sp.*	Caeca	28S	<i>Matticestus kathleenae</i>	96.4	PZ618339



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Acanthocephala

Dolifusentis mayae García-Varela, Sereno-Urbe, Solórzano-García & Pérez-Ponce de León, 2024

Nematoda

*Contracaecum rudolphii** Hartwich, 1964

*Cosmocephalus obvelatus** (Creplin, 1825) Seurat, 1919

Cucullamus pargi González-Solis, Tuz-Paredes & Quintal-Loria, 2007

Pseudoterranova sp.*

Copepoda

Caligus praetextus Bere, 1936

Clavellotis mayae Pérez-Ortega, Espinola-Novelo, Castro-Romero, Montes & Pérez-Ponce de León, 2026

*Specimens representing larval stages

Intestine	28S	<i>Dolifusentis mayae</i>	99.7	PZ618340
Mesentery	Cox1	<i>Contracaecum rudolphii</i>	98.8	PZ610133
Mesentery	28S	<i>Cosmocephalus obvelatus</i>	99.9	PZ618341
Mesentery	28S	<i>Cucullamus opisthoporus</i>	86.57	PZ618342
	28S	<i>Pseudoterranova</i> sp.	100	PZ618343
Gills	28S	<i>Caligus elongatus</i>	92.9	PZ619134
Gills	Cox1	<i>Clavellotis mayae</i>	100	PX830993

Ten of the 16 taxa were identified to species level using molecular and morphological data; three taxa were not identified to species level because they were recovered as larval stages and their sequence did not match with any identified congeneric species, i.e., *Matticestus* sp., *Cardiocephaloides* sp., and *Pseudoterranova* sp. (Table 2); two taxa may represent new species, although a more detailed taxonomic work is required to corroborate this hypothesis, as well as collecting more specimens, i. e., *Microcotyle* sp., and *Proctoeces* sp. One taxon, the copepod *Lernanthropus* sp., was identified using morphological data because DNA amplification was unsuccessful. The parasite fauna of *L. rhomboides* in La Carbonera lagoon included 12 endoparasites and four ectoparasites; of the 12 endoparasite taxa seven were adults and five were larval forms (Table 2); the endoparasites were: *Cardiocephaloides* sp., *D. americanum*, *D. leiostomi*, *M. hysterospina*, *Proctoeces* sp., *D. giganteus*, *Matticetus* sp., *D. mayae*, *C. rudolphii*, *C. obvelatus*, *C. pargi*, and *Pseudoterranova* sp. (Figure 2), whereas the ectoparasites (all adults) were: *Microcotyle* sp., *C. praetextus*, *C. mayae* and *Lernanthropus* sp. (Figure 3).



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

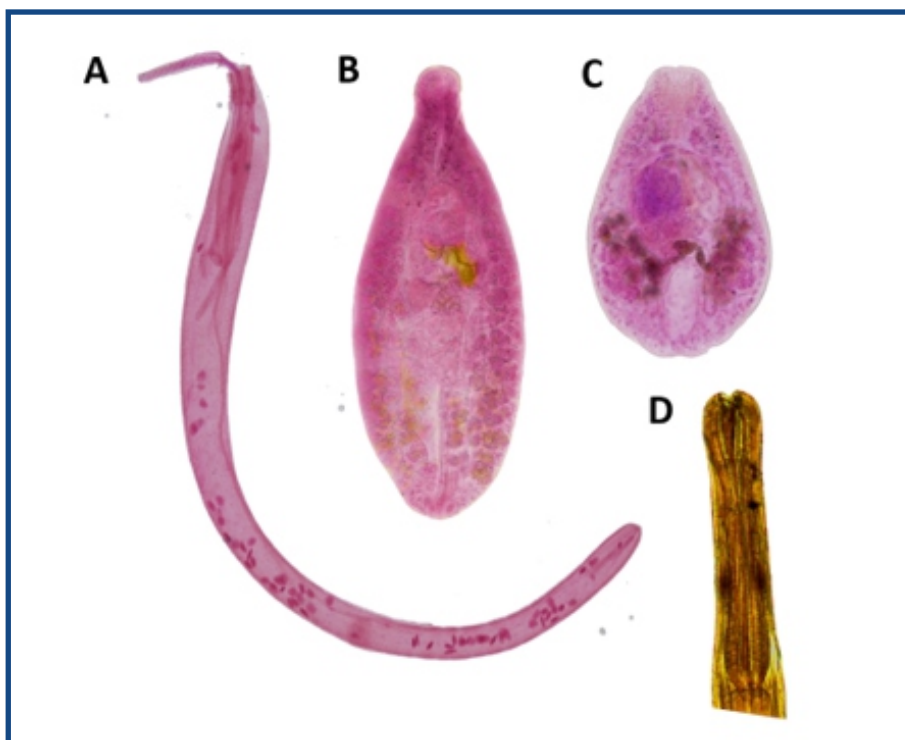


Figure 2. Photomicrographs of representative endoparasites collected from *Lagodon rhomboides* in La Carbonera coastal lagoon, Yucatán Peninsula, México. A) *Dollfusentis mayae*, lateral view, stained with Mayer's paracarmine. B) *Megasolena hysterospina*, ventral view, stained with Mayer's paracarmine. C) *Diplomonorchis leiostomi*, ventral view, stained with Mayer's paracarmine. D) *Cucullanus pargi*, dorsal-ventral view.

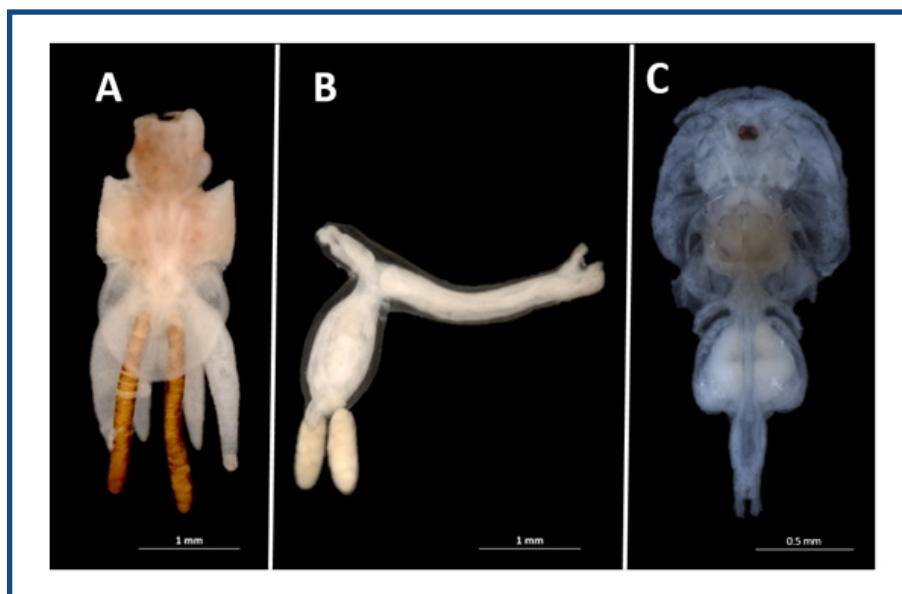


Figure 3. Photomicrographs of representative ectoparasites collected from *Lagodon rhomboides* in La Carbonera coastal lagoon, Yucatán Peninsula, México. A) *Lernanthropus* sp., dorsal view. B) *Clavellotis mayae*, lateral view. C) *Caligus praetextus*, dorsal view.



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

Figure 4 shows the parasite species accumulation curve; because the curve tends to reach an asymptote, the sample size is considered adequate for further ecological analyses. The richness estimators expected the number of parasite species to range between 16.7 (Chao) and 24.7 (Jackknife2). At the population level, the highest prevalence of infection (66%) was reached by the monogenean *Microcotyle* sp., followed by the copepod *C. mayae* and the nematode *C. pargi*, with 31% and 28%, respectively. The monogenean also had the highest mean abundance of infection and the larval tapeworm *Matticestus* sp. showed the second highest mean abundance (Table III).

The Shannon-Wiener diversity index was 2.13. At the infracommunity level, every host was parasitized by 15 ± 35 parasites. The richness value was 2.3 ± 1.9 taxa of parasites per analyzed fish and the Brillouin index was 0.43 ± 0.4 .

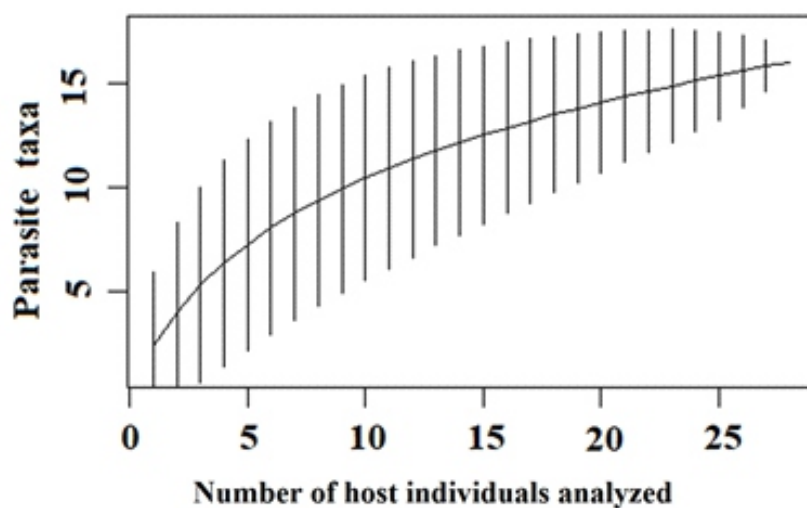


Figure 4. Parasite species accumulation curve of *Lagodon rhomboides* sampled in La Carbonera coastal lagoon, Yucatán, Peninsula, Mexico.



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

Table 3. Prevalence (%), mean abundance and mean intensity $\pm$ standard deviation ($\pm$ SD) of metazoan parasites of *Lagodon rhomboides* from La Carbonera coastal lagoon, Yucatan Peninsula.

Taxa	Prevalence	Mean abundance	Mean intensity
Trematoda			
<i>Cardiocephaloides</i> sp.	3%	0.1 $\pm$ 0.4	2.0 $\pm$ 0.0
<i>Diptherostomum americanum</i>	14%	2.7 $\pm$ 10.0	19.8 $\pm$ 21.8
<i>Diplomonorchis leiostomi</i>	3%	2.2 $\pm$ 12.1	65.0 $\pm$ 0.0
<i>Megasolena hysterospina</i>	14%	0.3 $\pm$ 0.8	2.0 $\pm$ 1.4
<i>Proctoeces</i> sp.	3%	0.0 $\pm$ 0.2	1.0 $\pm$ 0.0
Monogenea			
<i>Microcotyle</i> sp.	66%	3.4 $\pm$ 5.1	5.2 $\pm$ 5.5
Cestoda			
<i>Dasyrhynchus giganteus</i>	7%	0.2 $\pm$ 0.9	3.5 $\pm$ 0.7
<i>Matticestus</i> sp.	14%	2.9 $\pm$ 13.2	20.8 $\pm$ 33.8
Acanthocephala			
<i>Dollfusentis mayae</i>	7%	0.7 $\pm$ 3.3	9.5 $\pm$ 12.0
Nematoda			
<i>Contracaecum rudolphii</i>	3%	0.1 $\pm$ 0.7	4.0 $\pm$ 0.0
<i>Cosmocephalus obvelatus</i>	3%	0.0 0.2	1.0 0.0
<i>Cucullanus pargi</i>	28%	0.6 $\pm$ 1.2	2.0 $\pm$ 1.6
<i>Pseudoterranova</i> sp.	3%	0.1 $\pm$ 0.4	2.0 $\pm$ 0.0
Copepoda			
<i>Caligus praetextus</i>	10%	0.1 $\pm$ 2.2	1.0 $\pm$ 0.7
<i>Clavellotis mayae</i>	31%	1.1 $\pm$ 2.2	3.7 $\pm$ 2.6
<i>Lernanthropus</i> sp.	21%	1.0 $\pm$ 2.7	4.7 $\pm$ 4.5

DISCUSSION

Previous studies reported the composition of the metazoan parasite fauna of *L. rhomboides* as a host of 31 parasite taxa along its distribution range (Bere, 1936; Pearse, 1952; Hutton and Sogandares, 1960; Overstreet, 1960; Hutton, 1964; Nahhas and Powell, 1965; Nahhas and Short, 1965; Hall and Iversen, 1967; Creese, 1991; Bonilla-Gómez et al., 2014; Sosa-Medina et al., 2015; Pérez-Ortega et al., 2026). However, only nine of the 31 taxa were recovered in this study, i.e., *Diptherostomum americanum*, *Diplomonorchis leiostomi*, *Megasolena hysterospina*, *Parahemiurus merus*, *Proctoeces* sp., *Microcotyle* sp., *Contracaecum rudolphii*, *Caligus praetextus*, and *Clavellotis mayae*. Seven parasite taxa were recorded for the first time in the present study: *Cardiocephaloides* sp., *Dasyrhynchus giganteus*, *Matticestus* sp., *Cosmocephalus obvelatus*, *Cucullanus pargi*, *Pseudoterranova* sp., and *Lernanthropus* sp., increasing the metazoan parasite records in *L. rhomboides* along its distribution range to 38 taxa. In a previous study,



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Sosa-Medina et al. (2015) reported the presence of 14 parasite taxa in *L. rhomboides* from Celestún lagoon in the Yucatán Peninsula. However, only four were identified to species level, and none corresponded to any species reported in the present study for La Carbonera lagoon. The only two previous studies in this locality (Bonilla-Gomez et al., 2014; Pérez-Ortega et al., 2026) reported the presence of the isopod *Cymothoa excisa*, which was not found in this study, and described a new species of the copepod *Clavellotis mayae*.

The most common and abundant parasite taxon was *Microcotyle* sp. This monogenean reached a prevalence of 66% and a mean abundance of 3.4 parasites per analyzed host. Interestingly, this monogenean may represent a new species, but a more detailed analysis is required to test this hypothesis. *Microcotyle* Van Beneden & Hesse, 1863, is a large genus comprising 76 known species, of which only 42 are considered valid, whereas the remaining 31 are considered a taxon inquirendum (WoRMS, 2026); some of them have been reported as parasites of sparid fishes. In recent years, at least four species were described as parasites of sparids in the Mediterranean Sea: *M. erythrini* Van Beneden & Hesse, 1863, *M. visa* Bouguerche, Gey, Justine & Tazerouti, 2019, *M. isyebi* Bouguerche, Gey, Justine & Tazerouti, 2019, and *M. whittingtoni* Villora-Montero, Pérez-del-Olmo, Georgieva, Raga & Montero, 2020 (Bouguerche et al., 2019; Villora-Montero et al., 2020). In the Gulf of Mexico, only one species, *M. archosargi* MacCallum, 1913, has been recorded as a parasite of two sparids, *Archosargus probatocephalus* (Walbaum, 1792) and *A. rhomboidalis* (Linnaeus, 1758) (MacCallum, 1913; Montoya-Mendoza et al., 2015; Mendoza-Garfias et al., 2017; Mendoza-Franco et al., 2018), however no genetic data are available for comparison in the GenBank other than a very short sequence of 28S from Campeche, in the Gulf of Mexico (Mendoza-Franco et al., 2018) although this sequence is not useful because is too short; additionally, the status of this species needs to be clarified since it is considered as a species inquirenda in Worms (2026). More detailed analyses are needed to determine the taxonomic identity of the monogenean recorded in this study, but it seems to represent a new species.



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



In La Carbonera coastal lagoon, *L. rhomboides* is the definitive host of 62.5% of the parasite fauna; the remaining percentage (37.5%) includes parasites for which *L. rhomboides* acts as the second intermediate host; that includes one digenean, two cestodes, and two nematodes which mature in marine mammals, fish-eating birds, elasmobranchs or fishes from a higher trophic level (González-Solís et al., 2006; D'Amelio et al., 2007; Olson et al., 2010; Caira et al., 2014). The larval cestode *Matticestus* sp. is particularly interesting. Caira et al. (2018) hypothesized that, as adults, this tapeworm is exclusively a parasite of sawfishes of the genus *Pristis* (Rhinopristiformes: Pristidae). The sawfish, *Pristis pectinata* Latham, 1794 is a threatened marine species which occurs in coastal lagoons of the Gulf of Mexico (Bonfil et al., 2024). The presence of metacestodes of *Matticestus* sp., suggests the occurrence of specimens of *P. pectinata* in the area even though this elasmobranch has not been observed in the last few decades; in this context, *Matticestus* sp. could be useful as a bioindicator of ecosystem health because both intermediate and final hosts must occur in the lagoon.

In terms of parasite diversity, digeneans were the most species-rich group with five taxa recorded in this study, including four adults and one metacercaria. A similar pattern was observed in other estuarine fishes in the Yucatán Peninsula. For instance, the metazoan parasite communities of *Mugil curema* Valenciennes, 1836 and that of three species of killifishes, *Floridichthys polyommus* Hubbs, 1936, *Fundulus grandissimus* Hubbs, 1936, and *F. persimilis* Miller, 1955, were also dominated by digeneans (Espínola-Novelo et al., 2023, 2025; Andrade-Gómez et al., 2026). This general pattern agrees with some authors who have suggested that digeneans are the dominant parasite group in both freshwater and marine fish (Sanchez-Ramirez and Vidal-Martínez, 2002; Poulin, 2016).

Overall, ectoparasites showed higher infection prevalence, whereas endoparasites showed higher mean intensity. In the southern Gulf of Mexico, several studies have analyzed the parasite component communities of marine fishes. For instance, *Trachinotus carolinus* (L. 1776) was parasitized by 24 taxa (Sánchez-Ramírez and Vidal-



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original

Martínez, 2002); *Lutjanus griseus* (L. 1758) harbored 20 taxa (Argáez-García et al, 2010); *Mycteroperca bonacci* (Poey 1860) was parasitized by 25 taxa (Espínola-Novelo et al., 2013), and *Haemulon aurolineatum* Cuvier, 1830 harbored 52 taxa (García-Teh et al., 2022). In contrast, fish species in coastal lagoons of the Yucatán Peninsula harbor parasite communities with fewer species. Just considering La Carbonera lagoon, *F. grandissimus* was parasitized by 4 taxa, *F. persimilis* by 7 taxa (Espínola-Novelo et al., 2025), *F. polyommus* by 16 taxa (Espínola-Novelo et al., 2023), and *M. curema* was parasitized by 8 taxa (Andrade-Gómez et al., 2026).

In the present study, the parasite fauna of *L. rhomboides* was also analyzed at infracommunity level to contrast the diversity with other studies conducted in coastal lagoons of the Yucatán Peninsula. In the cichlid *Mayaheros urophthalmus* (Günther, 1862) from Celestún lagoon, the Brillouin index was 0.31 ± 0.42 (Salgado-Maldonado and Kennedy, 1997); in *F. polyommus* from La Carbonera lagoon, the Brillouin index was 0.15 ± 2.3 (Espínola-Novelo et al., 2023); whereas the diversity of *Sphoeroides testudineus* (Linnaeus, 1758) in four coastal lagoons was even lower and ranged between 0.04 ± 0.08 and 0.15 ± 0.14 (Pech et al., 2008). The parasite fauna of the pinfish, *L. rhomboides*, in La Carbonera, however, reached a higher Brillouin index 0.43 ± 0.4 . The differences shown among *L. rhomboides*, *F. polyommus*, *M. urophthalmus*, and *S. testudineus* could be attributed to differences in their feeding habits. Aguilar-Medrano et al. (2020) analyzed the trophic index of fish assemblages in coastal lagoons of the Yucatán Peninsula. These authors identified *L. rhomboides* as a fish species with a high trophic index (4.4) in contrast with *F. polyommus* and *S. testudineus* which reached values of 2.9 and 3.4, respectively. Differences in index values can be attributed to the distinct diet of these species. The diet of *L. rhomboides* is based on zooplankton and zoobenthos; in contrast, *F. polyommus* is an omnivorous species, whereas the feeding habits of *S. testudineus* is mostly based on zoobenthos.

In conclusion, the results of this study show the importance of *L. rhomboides* as a final and intermediate host of metazoan parasites in coastal environments of the Yucatán Peninsula; the pinfish parasite

**OPEN ACCESS**

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



fauna included a wide array of metazoan parasites, including digeneans, monogeneans, acanthocephalans, cestodes, nematodes, and copepods. DNA sequence data are provided for the first time for seven parasite taxa, expanding the genetic library of parasites occurring in coastal lagoons. Since parasites have been proposed as long-term bioindicators of environmental stress, particularly in aquatic environments, the data provided herein represents base line information that might be useful in future conservation and ecosystem management initiatives. More detailed studies are required to fully understand host-parasite interactions in coastal lagoons and the effects of environmental perturbations on the ecological parameters of parasites as indicators of environmental stress.

► ACKNOWLEDGMENTS

We thank Dra. Mayra Grano Maldonado for the invitation to contribute to this special issue. We also thank Edith Gamez and the team from the Revista de Ciencias Marinas UAS for their support. We also thank Leopoldo Andrade for their help during fieldwork. JEN thanks SECIHTI for the postdoctoral fellowship 'Estancias Posdoctorales por México Modalidad Académica' (CVU 351170). We also thank Maribel Badillo and Alfredo Gallardo from BioCon (Laboratorio de Biología de la Conservación, F.C., UNAM) for lab facilities, technical support, and identifying hosts. We thank Norberto García Colín for access to the Molecular Laboratory at ENES-UNAM. We also thank Laura Márquez and Nelly López, LaNaBio, for the sequencing service. This research was funded by a grant from the Programa de Apoyo a Proyectos de Investigación e Innovación Tecnológica (PAPIIT- UNAM IN200824) to GPPL.

► REFERENCES

Aguilar-Medrano R, Hernández de Santillana M and Vega-Cendejas ME (2020). Using fish assemblages to understand environmental connectivity and usage. A contribution to the conservation of the Yucatan Wetland. *Estuarine, Coastal and Shelf Science*, 239, 106766. <https://doi.org/10.1016/j.ecss.2020.106766>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Anderson MJ, Gorley RN and Clarke KR (2008). PERMANOVA for PRIMER: Guide to Software and Statistical Methods. PRIMER-E, Plymouth, UK.

Andrade-Gómez L, García-Varela M, Badillo-Alemán M, Chiappa-Carrara X and Pérez-Ponce de León G (2026). Metazoan parasite fauna of *Mugil curema* from the Yucatán Peninsula based on novel DNA sequence data, with updated checklist of the host across its distributioal range. *Journal of Helminthology*, 100, 1-16. <https://doi.org/10.1017/S0022149X25101065>

Arceo-Carranza D, Vega-Cendejas ME, Montero-Muñoz J and Hernández de Santillana M (2010). Influencia del hábitat en las asociaciones nictimerales de peces en una laguna costera tropical. *Revista Mexicana de Biodiversidad*, 81, 823-837. https://www.scielo.org.mx/scielo.php?pid=S1870-34532010000300022&script=sci_arttext

Argáez-García N, Guillén-Hernández S and Aguirre-Macedo L (2010). Intestinal helminths of *Lutjanus griseus* (Perciformes: Lutjanidae) from three environments in Yucatan (Mexico), with a checklist of its parasites in the Gulf of Mexico and Caribbean region. *Revista Mexicana de Biodiversidad*, 81, 903-912. https://www.scielo.org.mx/scielo.php?pid=S1870-34532010000300030&script=sci_arttext&tlng=en

AVMA (American Veterinary Medical Association) (2020). Guideline for the euthanasia of animals. Schaumburg, Illinois: American Veterinary Medical Association

Bere R (1936). Parasitic copepods from Gulf of Mexico fish. *The American Midland Naturalist*, 17, 577-625. <https://www.jstor.org/stable/2419936>

Bonfil R, Díaz-Jaimes P, Palacios-Barreto P, Mendoza-Vargas OU and Ricaño-Soriano M (2024). Improved eDNA assay evidence further regudia for critically endangered smalltooth sawfish (*Pristis pectinata*) in Mexico. *Frontiers in Marine Science*, 1290661. <https://doi.org/10.3389/fmars.2024.1290661>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Bonilla-Gómez J, López-Rocha J, Badillo-Aleman MB, Tzeek-Tzu J and Chiappa-Carrara (2011). Growth and mortality of *Lagodon rhomboides* (Pisces: Sparidae) in a tropical coastal lagoon in northwestern Yucatan, Mexico. *Revista Ciencias Marinas y Costeras*, 3, 99-109. <https://www.redalyc.org/articulo.oa?id=633766718007>

Bonilla-Gómez J, Ramírez-Rojas A, Badillo-Aleman M and Chiappa-Carrara X (2014). Nuevo registro de *Lagodon rhomboides* (Pisciformes: Sparidae) como hospedero de *Cymothoa excisa* (Isopoda: Cymothoidae) en la costa noreste de la Península de Yucatán. *Revista Mexicana de Biodiversidad*, 85, 633-637. <https://doi.org/10.7550/rmb.38768>

Bouguerche C, Gay C, Justine JL and Tazerouti F (2019). Towards the resolution of the *Microcotyle erythrini* species complex: description of *Microcotyle isyebi* n. sp. (Monogenea, Microcotylidae) from *Boops boops* (Teleostei, Sparidae) off the Algerian coast. *Parasitology Research*, 118, 1417-1428. <https://doi.org/10.1007/s00436-019-06293-y>

Bowles J, Blair D and McManus DP (1995). A molecular phylogeny of the human schistosomes. *Molecular Phylogenetics and Evolution*, 54, 103-109. <https://doi.org/10.1006/mpev.1995.1011>

Bush AO, Lafferty KD, Lotz JM, and Shostak AW (1997). Parasitology meets ecology on its own terms: Margolis et al., revisited. *Journal of Parasitology*, 83, 575-583. <https://www.jstor.org/stable/3284227>

Caira JN, Jensen J and Fyler CA (2018). A new genus of tapeworm (Cestoda: Onchoproteocephalidae) from sawfish (Elasmobranchii: Pristidae). *Journal of Parasitology*, 104, 133-144. <https://www.jstor.org/stable/44810404>

Caira JN, Jensen K, Waeschenbach A, Olson PD and Littlewood TJ (2014). Orders out of chaos-molecular phylogenetics reveals the complexity of shark and stingray tapeworm relationships. *International Journal of Parasitology*, 44, 55-73. <https://doi.org/10.1016/j.ijpara.2013.10.004>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



- Canto-Maza WG and Vega-Cendejas M (2008).** Hábitos alimenticios del pez *Lagodon rhomboides* (Perciformes: Sparidae) en la laguna costera de Chelem, Yucatán, México. *Revista de Biología Tropical*, 56, 1837-1846. https://www.scielo.sa.cr/scielo.php?pid=S0034-77442008000400020&script=sci_arttext
- Creese R (1991).** Parasitic copepods from the Gulf of Mexico and Caribbean Sea, III: *Caligus*. *Smithsonian Contributions to Zoology*, 497, 1-53. <http://dx.doi.org/10.5479/si.00810282.497>
- D'Amelio S, Barros NB, Ingrosso S, Fauquier DA, Russo R and Paggi L (2007).** Genetic characterization of members of the genus *Contracaecum* (Nematoda: Anisakidae) from fish-eating birds from west-central Florida, USA, with evidence of new species. *Parasitology*, 134, 1041-1051. <https://doi.org/10.1017/S003118200700251X>
- Eaton K, Hallaj A, Stoeckel JA and Bernal M (2022).** Ocean warming leads to increase in aerobic and changes to gene expression in the pinfish (*Lagodon rhomboides*). *Frontiers in Ecology and Evolution*, 809375. <https://doi.org/10.3389/fevo.2021.809375>
- Espínola-Novelo JF, González-Salas C, Guillén-Hernández S and Mackenzie K (2013).** Metazoan parasites of *Mycteroperca bonacci* (Epinephelidae) off the coast of Yucatan, Mexico, with a checklist of its parasites in the Gulf of Mexico and Caribbean region. *Revista Mexicana de Biodiversidad*, 84, 1111-1120. <https://doi.org/10.7550/rmb.27989>
- Espínola-Novelo JF, Solórzano-García B, Badillo-Alemán M Chiappa-Carrara X, Guillén-Hernández S and Pérez-Ponce de León G (2025).** Metazoan parasites of two endemic species of killifishes, *Fundulus grandissimus* and *F. persimilis* (Cyprinodontiformes: Fundulidae), in coastal lagoons of northern Yucatán Peninsula, México. *Marine Biodiversity*, 55, 1-9. <https://doi.org/10.1007/s12526-024-01485-x>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



- Espínola-Novelo JF, Solórzano-García B, Guillén-Hernández S, Badillo-Alemán M, Chiappa-Carrara X and Pérez-Ponce de León G (2023).** Metazoan parasites of the Ocellated killifish, *Floridichthys polyommus* (Cyprinodontidae) in La Carbonera coastal lagoon, Yucatán, Mexico. *Regional Studies of Marine Science*, 67, 103223. <https://doi.org/10.1016/j.rsma.2023.103223>
- Folmer O, Black M, Hoch W, Lutz R and Vrijenhock R (1994).** DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3, 294-299
- Froese R and Pauly D (Eds.) (2026).** FishBase. Sparidae Rafinesque, 1818. Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=125564> on 2026-06-02
- García-Teh JG, Vidal-Martínez VM, Mariño-Tapia I, Árcega-Cabrera F, Ordoñez-Lopez U and Aguirre-Macedo ML (2022).** Metazoan parasite infracommunities of the Tomato Grunt (*Haemulon aurolineatum*) as potential bioindicators of environmental conditions in the Yucatan Continental Shelf, Mexico. *Bulletin of Environmental Contamination and Toxicology*, 108, 49-54. <https://doi.org/10.1007/s00128-021-03305-5>
- García-Valera M and Nadler SA (2005).** Phylogenetic relationships of Palaeacanthocephala (Acanthocephala) inferred from SSU and LSU rDNA gene sequences. *Journal of Parasitology*, 91, 1401-1409. <https://doi.org/10.1645/GE-523R.1>
- González-Solís D, Vidal-Martínez VM, Antochiw-Alonso DM and Ortega-Argueta A (2006).** Anisakid nematodes from stranded pygmy sperm whales, *Kogia breviceps* (Kogiidae), in three localities of the Yucatan Peninsula, Mexico. *Journal of Parasitology*, 92, 1120-1122. <https://doi.org/10.1645/GE-3553RN.1>

**OPEN ACCESS**

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Hernández-Mena ID, Garcia-Prieto L and Garcia-Varela M (2014).

Morphological and molecular differentiation of *Parastrigea* (Trematoda: Strigeidae) from Mexico, with description of a new species. *Parasitology International*, 63, 315-323.
<https://doi.org/10.1016/j.parint.2013.11.012>

Hutton RF and Sogandares-Bernal F (1960). A list of parasites from marine and coastal animals of Florida. *Transactions of the American Microscopical Society*, 79, 287-292.
<https://doi.org/10.2307/3223735>

Hutton RF (1964). A second list of parasites from marine and coastal animals of Florida. *Transactions of the American Microscopical Society*, 83, 439-447. <https://doi.org/10.2307/3224765>

Kritsky D and Bakenhaster M (2019). *Lamellodiscus* spp. (Monogenoidea: Diplectanidae) infecting the gill lamellae of porgies (Perciformes: Sparidae) in the Gulf of Mexico off Florida U.S.A., with descriptions of *Lamellodiscus occiduus* n. sp. and *Lamellodiscus vesperus* n. sp. from *Calamus* spp. *Comparative Parasitology*, 86, 79-88.
<https://doi.org/10.1654/1525-2647-86.2.79>

Lamothe-Argumedo R (1997). Manual de técnicas para preparar y estudiar los parásitos de animales silvestres. A. G. T. Editor S.A. México D.F.

Lutton K, Walker D and Blair D (1992). Comparisons of ribosomal internal transcribed spacers from two congeneric species of flukes (Platyhelminthes: Trematoda: Digenea). *Molecular and Biochemical Parasitology*, 56, 323-7.
[https://doi.org/10.1016/0166-6851\(92\)90181-I](https://doi.org/10.1016/0166-6851(92)90181-I)

MacCallum GA (1913). Further notes of the genus *Microcotyle*. *Zoologische Jahrbücher*, 35, 389-4020

Manter HW (1947). The digenetic trematodes of marine fishes of Tortugas, Florida. *American Midland Naturalist*, 38, 257-416



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Mendoza-Franco EF, Rosado-Tun MC, Duarte-Anchevida AJ and del Río-Rodríguez RE (2018). Morphological and molecular (28s rRNA) data of monogeneans (Platyhelminthes) infecting the gills lamellae of marine fishes in the Campeche Bank, Southwest Gulf of Mexico. *Zookeys*, 783, 125-161. <https://doi.org/10.3897/zookeys.783.26218>

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

Montoya-Mendoza J, Castañeda-Chávez M and Lango-Reynoso F (2015). Helminths of sheepshead *Archosargus probatocephalus* (Pisces: Sparidae) from Alvarado, Veracruz, México. *Global Journal of Biology, Agriculture and Health Science*, 4, 45-47.

Nadler SA and Husdspeth DSS (1998). Ribosomal DNA and phylogeny of the ascaridoidea (Nemata: Secernentea): implications for morphological evolution and classification. *Molecular Phylogenetics and Evolution*, 10, 221-236. <https://doi.org/10.1006/mpev.1998.0514>

Nahhas FM and Powell EC (1965). *Monorchiiidae* (Trematoda) from fishes of Apalachee Bay, Gulf of Mexico. *Journal of Parasitology*, 51, 16-20. <https://doi.org/10.2307/3275637>

Nahhas FM and Short RB (1965). Digenetic trematodes of marine fishes from Apalachee Bay, Gulf of Mexico. *Tulane Studies in Zoology and Botany*, 12, 39-50. <https://doi.org/10.5962/bhl.part.20210>

Olson PD, Caira JN, Jensen K, Overstreet RM, Palm HW and Beveridge I (2010). Evolution of the thrypanorhynch tapeworms: Parasite phylogeny supports independent lineages of shark and rays. *International Journal of Parasitology*, 40, 233-242. <https://doi.org/10.1016/j.ijpara.2009.07.012>

Overstreet RM (1969). Digenetic trematodes of marine teleost fishes from Biscayne Bay, Florida. *Tulane Studies in Zoology and Botany*, 15, 119-176



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



Overstreet RM, Cook JO and Heard RW (2009). Trematoda (Platyhelminthes) of the Gulf of Mexico. In *Gulf of Mexico-Origins, Waters, and Biota Biodiversity* (419-486). Felder DL and Camp DK (Eds.) *Texas A&M, University Press, College Station, Texas*

Pavlidis MA and Mylonas CC (Eds.) (2011). Sparidae: biology and aquaculture of gilthead seabream and other species. *John Wiley-Blackwell*. <https://doi.org/10.1002/9781444392210>

Pearse AS (1952). Parasitic crustacean from Alligator, Harbor, Florida. *The Quarterly Journal of the Florida Academy of Science*, 187-243. <https://www.jstor.org/stable/24313568>

Pech D, Vidal-Martinez VM, Aguirre-Macedo ML, Gold-Bouchot G, Herrera-Silveira J, Zapata-Pérez O and Marcogliese DJ (2008). The checkered puffer (*Sphoeroides testudineus*) and its helminths as bioindicators of chemical pollution in Yucatan coastal lagoons. *Science of the Total Environment*, 407, 2315-2324. <https://doi.org/10.1016/j.scitotenv.2008.11.054>

Pérez-Ortega BF, Espínola-Novelo JF, Castro-Romero R, Montes MM and Pérez-Ponce de León G. (2026). Morphology and DNA sequences reveal a new species of *Clavellotis* (Copepoda: Lernaepodidae) as a parasite of three species of sparids in the Yucatan Peninsula, Mexico. *Parasitology*, 1-14. <https://doi.org/10.1017/S0031182026101735>

Poulin R (2016). Greater diversification of freshwater than marine parasites of fish. *International Journal of Parasitology*, 46, 275-279. <https://doi.org/10.1016/j.ijpara.2015.12.002>

Salgado-Maldonado G and Kennedy DR (1997). Richness and similarity of helminth communities in the tropical fish *Cichlasoma urophthalmus* from the Yucatan Peninsula, Mexico. *Parasitology*, 47, 581-590. <https://doi.org/10.1017/S0031182097008810>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



- Sánchez-Ramírez C and Vidal-Martínez VM (2000).** Metazoan parasite infracommunities of Florida pompano (*Trachinotus carolinus*) from the coast of the Yucatan Peninsula, Mexico. *Journal of Parasitology*, 88, 1087-1094. [https://doi.org/10.1645/0022-3395\(2002\)088\[1087:MPIOFP\]2.0.CO;2](https://doi.org/10.1645/0022-3395(2002)088[1087:MPIOFP]2.0.CO;2)
- Sosa-Medina T, Vidal-Martínez VM and Aguirre-Macedo L (2015).** Metazoan parasites of fishes from the Celestún coastal lagoon, Yucatán, Mexico. *Zootaxa*, 4007, 529-544. <https://doi.org/10.11646/zootaxa.4007.4.4>
- Spitzer P, Mattila J and Heck K (2000).** The effects of vegetation density on the relative growth rates of juvenile pinfish, *Lagodon rhomboides* (Linnaeus), in Big Lagoon, Florida. *Journal of Experimental Marine Biology and Ecology*, 244, 67-86. <https://doi.org/10.1016/j.scitotenv.2008.11.054>
- Vega-Cendejas ME and Hernández de Santillana M (2004).** Fish community structure and dynamics in a coastal hypersaline lagoon: Rio Lagartos, Yucatan, Mexico. *Estuarine Coastal and Shelf Science*, 60, 285-299. <https://doi.org/10.1016/j.ecss.2004.01.005>
- Vega-Cendejas ME, Hernandez de Santillana M and Arceo-Carranza D (2012).** Length-weight relationships for selected fish species from a coastal lagoon influenced by freshwater seeps: Yucatan Peninsula, Mexico. *Journal of Applied Ichthyology*, 28, 140-182. <https://doi.org/10.1111/j.1439-0426.2011.01875.x>
- Villora-Montero M, Pérez-del Olmo A, Georgieva S, Raga JA and Montero FE (2020).** Considerations on the taxonomy and morphology of *Microcotyle* spp.: redescription of *M. erythrini* van Beneden & Hesse, 1863 (sensu stricto) (Monogenea: Microcotylidae) and the description of a new species from *Dentex dentex* (L.) (Teleostei: Sparidae). *Parasites & Vectors*, 13, 1-13. <https://doi.org/10.1186/s13071-020-3878-9>



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original



WoRMS (2026). *Microcotyle* Van Beneden & Hesse, 1863. Accessed at:
<https://www.marinespecies.org/aphia.php?p=taxdetails&id=119381> on 2026-05-20



OPEN ACCESS

Este es un artículo de acceso abierto distribuido bajo los términos de la Licencia Creative Commons Atribución-No Comercial-Compartir igual (CC BY-NC-SA 4.0), que permite compartir y adaptar siempre que se cite adecuadamente la obra, no se utilice con fines comerciales y se comparta bajo las mismas condiciones que el original