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Metazoan parasite fauna of *Mugil curema* from the Yucatán Peninsula based on novel DNA sequence data, with an updated checklist of the host across its distributional range

Research Paper

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Abstract

The white mullet, *Mugil curema* (Mugilidae), is a catadromous euryhaline fish with an omnivorous diet, and is distributed mainly along the Pacific and Atlantic coasts of the Americas. Mullets represent an important economic resource for the artisanal fisheries in Mexico. In this study, 73 individuals of *M. curema* were analysed; specimens were sampled in 4 coastal lagoons of the Yucatán Peninsula, Mexico, between 2022 and 2024. Parasite identification was accomplished by using DNA sequences. Nineteen parasite taxa were found, including 1 monopisthocotylan, 1 copepod, 1 acanthocephalan, 1 nematode, and 15 trematodes. Specimens were sequenced for a nuclear or mitochondrial molecular marker. Ten taxa are reported for the first time in this host species, including the adult trematodes *Saccocoelioides olmecae*; *Schikhobalotrema* sp. 1 and sp. 2, Hemiuridae gen. sp., the larval trematodes *Mesostephanus microbursa*, *M. cubaensis*, *Cardiocephaloides medioconiger, Saccularina* sp., *Bucephalus* sp., as well as the larval nematode *Contracaecum fagerholmi.* Of the 21 metazoan parasites recorded, 58% were adults and 42% were larval stages. The checklist of the metazoan parasites of *M. curema* was updated. Our study contributes to the understanding of the parasite diversity of an economically important fish species with a wide distribution range and corroborates the usefulness of combining morphological and molecular data for species identification and for linking larval forms with adults to complete parasite life cycles. Our results will be useful in further studies of parasites as bioindicators of ecosystem health, and studies of the role of parasites in food webs in coastal lagoons.

Introduction

The white mullet, *Mugil curema* Valenciennes (Mugilidae), is a widely distributed fish species occurring on both the Pacific and Atlantic coasts of the Americas, with some records from the west coast of Africa (Crosetti *et al.* 2016; Durand *et al.* 2012; Froese and Pauly 2025). This euryhaline mugilid species is thought to spawn offshore with its larvae migrating for nursing from the ocean to coastal environments, such as rivers, lagoons, and estuaries, where they remain until reaching sexual maturity (Barletta and Dantas 2016; da Silva *et al.* 2018). This species has commercial value and is captured in different parts of Mexico along with the grey mullet, *Mugil cephalus* Linnaeus. Both species constitute an important economic resource for the artisanal fisheries in coastal lagoons and offshore areas of Mexico and are considered as secondary consumers (Ibáñez-Aguirre and Gallardo-Cabello 2004). The position of *M. curema* in the food web has been proposed as one of the major factors determining the diversity of their parasite fauna (Paperna and Overstreet 1981; Whitfield 2016).

Metazoan parasites are typical components of marine and estuarine fishes and play a major role in ecosystem functioning and energy flow; furthermore, parasites are known to regulate host populations, and they provide information about their hosts (Giari *et al.* 2022; Lafferty *et al.* 2008; Williams *et al.* 1992; Wood and Johnson 2015). Some studies have addressed the parasite fauna of the white mullet in particular geographical regions. Up to the present time, the parasitological record of this host species across its distributional range contains 88 taxa including myxozoans, monogeans, digeneans, cestodes, acanthocephalans, nematodes, malacostracans, copepods, and hirudineans (Falkenberg *et al.* 2022). However, information on the parasite fauna of *M. curema* in the Yucatán Peninsula is very scarce (Andrade-Gómez and Pérez-Ponce de León 2024).

As a part of a research project aimed at describing the metazoan parasite fauna of marine and estuarine fishes of the coast of Yucatán, we studied specimens of *M. curema* from four coastal lagoons, with the objective of reporting the taxonomic composition of the parasites of this host species by using newly generated molecular data contrasted with some morphological features of the specimens. Additionally, we updated the checklist of the metazoan parasite fauna of *M. curema* along its distributional range.

Materials and methods

Host and parasite collection

Seventy-three specimens of *M. curema* (7–33 cm, mean 17.1) were collected between May 2022 and January 2024, in four coastal lagoons of northern Yucatán that are not connected, i.e., Celestún (20° 50′ 53″N, 90° 24′ 22″W), La Carbonera (21° 08′ 01″N, 90° 07′ 55″W), Dzilam de Bravo (21° 23′ 39″N, 88° 53′ 20″W), and Ría Lagartos (21° 35′ 47″N, 88° 08′ 44″W) (Figure 1). Specimens were sampled under the collecting permit No. PPF/DGOPA-001/20, using seine and cast nets, kept alive, and transported to the laboratory for examination. Hosts were identified according to Gallardo *et al.* (2014). Individuals were euthanized by spinal severance (pithing) following the procedures accepted by the American Veterinary Medical Association (AVMA, 2020). The parasitological survey included the examination of the external surface. The eyes, gills, brain, gastrointestinal tract, heart, and liver were removed and placed in Petri dishes with 0.85% saline solution and examined for parasites using a stereomicroscope. The body cavity and muscle were thoroughly scrutinized for encysted parasites. Metazoan parasites were collected from each individual host except for myxozoans. Helminths were fixed in near-boiling saline and transferred to vials with 100% ethanol, whereas copepods were fixed in 70% ethanol.

Morphological study

In the laboratory, trematodes were stained with Mayer's paracarmine and mounted on permanent slides with Canada balsam. Monopisthocotylans were mounted in Hoyer or Gray & Wess medium to study the sclerotized structures. Copepods were mounted in semi-permanent slides with 50% glycerine for morphological examination (Lamothe-Argumedo 1997). Mounted specimens were examined and photographed under a bright-field Nikon DS-Ri1 microscope. Original descriptions or redescriptions were used to identify morphologically most of the metazoan parasites, i.e., Overstreet (1971); Ho and Lin (2009); Andrade-Gómez *et al.* (2017, 2023, 2025); Louvard *et al.* (2022); González-García *et al.* (2023); Andrade-Gómez and Pérez-Ponce de León (2024). Voucher specimens of 10 helminth species were deposited at the Colección Nacional de Helmintos (CNHE), and a voucher specimen of copepod species at the Colección Nacional de Crustaceos (CNAR), Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City. Finally, the infection parameters, i.e., prevalence, mean intensity, and intensity range, were estimated following Bush *et al.* (1997).

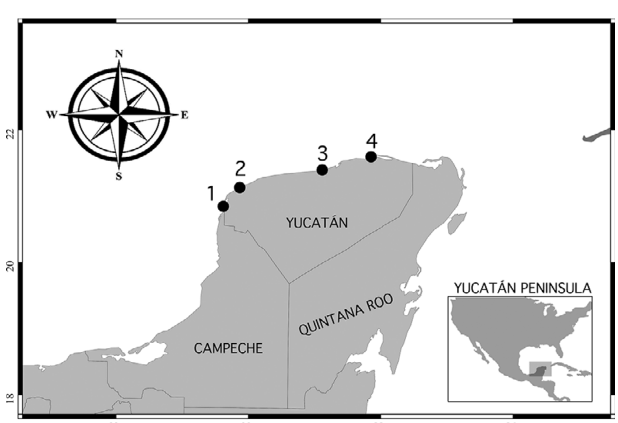

Figure 1. Map indicating the sampled localities of *Mugil curema* collected in coastal lagoons in Yucatán Peninsula, Mexico.

Molecular analysis

To confirm the morphological identifications, the 19 sampled taxa were processed for molecular analyses including some *hologenophores* (Pleijel *et al.* 2008). Genomic DNA was isolated using the protocol of Andrade-Gómez *et al.* (2023). For most taxa, the D1-D3 domains of the 28S rRNA were amplified by Polymerase Chain Reaction (PCR) using the primers 391 (5′-AGCGGAGGAAAAGAA ACTAA-3′) and 536 (5′-CAGCTATCCT GAGGGAAAC-3′) (García-Varela and Nadler 2005). For the nematode, the cytochrome oxidase subunit II (COII) was amplified using 210 (5′-CAC CAACTCTTAAAATTATC-3′) and 211 (5′-TTTTCTAGTTA TATAGATTGRTTYAT-3′) (Nadler and Hudspeth 2000). For the copepod the cytochrome oxidase subunit I (COI) was amplified using LCO1490 (5′-GGT CAA CAA ATC ATA AAG ATA TTG G-3′) and HCO2198 (5′-TAA ACT TCA GGG TGA CCA AAA AAT CA-3′) (Folmer *et al.* 1994). PCRs (13 μL) consisted of 0.5 μL of each primer (10 μM), 2.5 μL of 10 m PCR Rxn buffer, 7.92 μL of water, 2 μL of genomic DNA, and 0.08 μL of MyTaq™ DNA Polymerase. PCRs were carried out in a MiniAmp Thermal Cycler using an amplification protocol that included an initial denaturation at 94ºC for 1 min, followed by 30 cycles at 94ºC for 1 min for denaturation; 50ºC for 28S and 44ºC for COI and COII for 1 min for annealing; and 72ºC for 2 min for extension, and post-amplification extension for 7 min at 72ºC. PCR products were visualized on a 1% agarose TAE gel using 6X TriTrack DNA Loading Dye. PCR products were treated with Exo-SAP (Thermo Scientific) according to the manufacturer's instructions and were sequenced by the Sanger method at the Instituto de Biología, Universidad Nacional Autonoma de México. Sequences obtained in this study were deposited in GenBank. Molecular identification was tested through a BLAST search (Basic Local Alignment Search Tool) at NCBI (https://www.ncbi.nlm.nih.gov/).

In this study, an arbitrary sequence identity value for the 28S rRNA gene ≥99% was considered valid to achieve a species-level designation. For COI and COII, a similarity threshold of ≥95% was applied for species-level identification. For those parasite taxa not identified to species-level based on the BLAST search, phylogenetic tree was built to show the phylogenetic position with respect to other members of their families. Five databases were constructed separately, four of them for 28S rDNA, i.e., Didymozoidae Monticelli, 1888; Haplosplanchnidae Poche, 1926; Hemiuridae Looss, 1899; and Bucephalidae Poche, 1907, and one for COI mtDNA, i.e., Bomolochidae Claus, 1875. The best-fit model of molecular evolution for each dataset was calculated with the jModel Test version 0.1.1 program (Posada 2008) using the Akaike information criterion (AIC). The phylogenetic analyses were performed using maximum likelihood (ML) on CIPRES Science Gateway v3.3 (Miller *et al.* 2010). The ML was carried out with the RAxML-HPC2 on ACCESS (8.2.12) (Stamatakis 2014), using

1,000 bootstrap replicates. Trees were drawn using FigTree v.1.3.1 (Rambaut 2012).

Parasite checklist

The checklist reported in the present study contains information from Falkenberg et al. (2022), and also, we included additional information published for *M. curema* since then, including Andrade-Gómez *et al.* (2021, 2023, 2025); Andrade-Gómez and Pérez-Ponce de León (2024); Fuentes-Olivares *et al.* (2024); González-García *et al.* (2023); Minaya *et al.* (2021); Morales-Martínez *et al.* (2022); Morales-Serna and Camacho-Zepeda (2024); Rosas-Valdez *et al.* (2020); Santos-Gueretz *et al.* (2022); Vieira *et al.* (2022, 2024); Warren *et al.* (2024). Moreover, we incorporated records from two parasite databases of *M. curema*, i.e., the World Register of Marine Species (WoRMS), and the Colección Nacional de Helmintos (CNHE), Instituto de Biología, UNAM, Mexico City; finally, we added to the checklist all the new records of the present study.

Results

A total of 1,588 specimens of metazoan parasites were recovered from *M. curema* in 4 coastal lagoons of Yucatán, Mexico. These specimens represented 19 taxa including 1 monopisthocotylan, 15 trematodes, 1 acanthocephalan, 1 nematode, and 1 copepod (Table 1). Twelve of the 19 taxa were identified to species level using molecular and morphological data. In the BLAST search, sequenced specimens reached a percentage identity value ≥99% for LSU for most taxa, and ≥95% for COII in the nematode. The species identified were the monopisthocotylan *Ligophorus yucatanensis* Rodríguez-González, Míguez-Lozano, Llopis-Belenguer & Balbuena, 2015; the trematodes *Sinistroporomonorchis minutus* Andrade-Gómez, Ortega-Olivares, Solórzano-García, García-Varela, Mendoza-Garfias & Pérez-Ponce de León, 2023; *S. yucatanensis* Andrade-Gómez, Ortega-Olivares, Solórzano-García, García-Varela, Mendoza-Garfias & Pérez-Ponce de León, 2023; *S. glebulentus* (Overstreet, 1971); *Parasaturnius maurepasi* (Overstreet, 1977); *Saccocoelioides olmecae* Andrade-Gómez, Pinacho-Pinacho, Hernández-Orts, Sereno-Uribe & García-Varela, 2016; *Mesostephanus cubaensis* Alegret, 1941; *M. microbursa* Caballero y C., Grocott & Zerecero, 1953; *Ascocotyle (Phagicola) longa* Ransom, 1920; *Cardiocephaloides medioconiger* (Dubois & Vigueras, 1949); the acanthocephalan *Floridosentis mugilis* (Machado Filho, 1951); and the nematode *Contracaecum fagerholmi* D'Amelio, Cavallero, Dronen, Barros & Paggi, 2012 (Table 1). In addition, in the BLAST search, the copepod showed an identity value of 85% for COI with *Nothobomolochus gerresi* Pillai, 1973 (MK643338); therefore, we built a phylogenetic tree to define their phylogenetic position; the specimens of copepods were also studied morphologically and closely resemble *Bomolochus* aff. *nitidus* Wilson C.B., 1911.

Six taxa were not identified to species level, i.e., Hemiuridae gen. sp., *Schikhobalotrema* sp. 1; *Schikhobalotrema* sp. 2; *Saccularina* sp.; *Bucephalus* sp.; and *Scaphanocephalus* sp. (Table 1). With the exception of the latter, the phylogenetic position of these species was further tested through ML analyses. The 28S ML tree of the two new isolates of Hemiuridae gen. sp. formed an independent clade as the sister group of two major clades of hemiurids with strong nodal support. The first clade contained species of *Hemiurus, Parahemiurus*, and *Myosaccium*; and the second clade included species of *Aphanurus, Lecithocladium, Elytrophalloides, Ectenurus*, and *Dinurus* (Figure 2A). Regarding the adult haplosplanchnid trematodes, the four isolates of 28S were nested within the genus *Schikhobalotrema* in two independent clades, with high support values, suggesting two putative species. Two isolates (*Schikhobalotrema* sp. 1) were nested as the sister group of *S. minuta* + *S. acutum*, whereas the other two isolates (*Schikhobalotrema* sp. 2) were nested as the sister group of the clade formed by *S. minuta* + *S. acutum* + *Schikhobalotrema* sp. 1 (Figure 2B). Lastly, the three COI sequences of the adult copepod *Bomolochus* aff. *nitidus* were nested as the sister group of *Bomolochus cuneatus*, even though the genus *Bomolochus* resulted paraphyletic (Figure 2C). For the larval forms, the newly sequenced 28S isolates of the didymozoid trematode *Saccularina* sp. were nested as the sister group of *Saccularina magnacetabulata* (OL336033) with strong nodal support (Figure 3A). Finally, the newly sequenced isolate of the larval bucephalid trematode (*Bucephalus* sp.) was nested as the sister group of *Bucephalus margaritae* (Figure 3B).

Overall, in this study, the parasite fauna included 2 ectoparasite taxa, i.e., the copepod *Bomolochus* aff. *nitidus*, and the monopisthocotylan *Ligophorus yucatanensis*, whereas 17 endoparasites were recovered from different organs of their hosts. The monopisthocotylan *L. yucatanensis* was present in the four sampled localities, and it is one of the most abundant; still, a low similarity of the parasite fauna of *M. curema* was found among localities (Supplementary Table S1). Of the 17 endoparasite taxa, 9 were adults, and 8 were larval forms. The adult endoparasites included one acanthocephalan (*F. mugilis*), and eight trematodes (*P. maurepasi*, *Sa. olmecae, Si. minutus*, *Si. yucatanensis*, *Si. glebulentus*, two putative species of *Schikhobalotrema*; and one taxon identified as Hemiuridae gen. sp). The larval endoparasitic forms corresponded to the nematode *C. fagerholmi*, and seven trematodes (*C. medioconiger*, *A.* (*P.*) *longa, M. cubaensis, M. microbursa, Saccularina* sp., *Scaphanocephalus* sp., and *Bucephalus* sp.) (Table 1). Overall, trematodes were the most species-rich group with 15 taxa recorded, including 8 adults and 7 metacercariae (Table 1; Figure 4).

Discussion

In this study, 10 metazoan parasite taxa of *M. curema* were recorded for the first time, i.e., the trematodes *Sa. olmecae, M. microbursa*, *M. cubaensis*, *C. medioconiger, Saccularina* sp., *Bucephalus* sp., *Schikhobalotrema* sp. 1 and sp. 2, Hemiuridae gen. sp., as well as the nematode *C. fagerholmi.* In contrast, of the nine taxa previously recorded in *M. curema*, six were previously reported in Yucatán, i.e., *Si. minutus, Si. yucatanensis, Si. glebulentus, L. yucatanensis, P. maurepasi*, and *Scaphanocephalus* sp. (Andrade-Gómez *et al.* 2023; 2025; Andrade-Gómez and Pérez-Ponce de León 2024; González-García *et al.* 2023). Furthermore, the copepod *B.* aff. *nitidus*, the acanthocephalan *F. mugilis*, and the metacercariae of *Ascocotyle (Phagicola) longa* represent a new locality record for this host (Morales-Serna *et al.* 2012; Rosas-Valdez *et al.* 2020; Scholz *et al.* 2001).

Species identification

Thirteen of the 19 metazoan parasite taxa recorded in this study were identified at the species level using morphological and molecular characters (Table 1). The only identified species that did not reach ≥95% for COI was the copepod *Bomolochus* aff. *nitidus.* Morphologically, the copepod resembles *B. nitidus* according to the key species proposed by Ho and Lin (2009). This copepod was originally described from *M. cephalus* in Beaufort, USA, and was also recorded in *M. curema* from two estuaries in northeastern Brazil (Golzio *et al.* 2017; Wilson 1911). However, it is possible that

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Table 1. Parasite species composition for *Mugil curema* in Yucatán Peninsula, Mexico

Taxa	SI	DS	LC	GB	BLAST ID match	%	CNHE/ CNAR
Monogenea							
Ligophorus yucatanensis	Gills	Adult	Auto	PQ634774**	–	–	12490
Trematoda							
Sinistroporomonorchis minutus	Gastrointestinal tract	Adult	Auto	PX646776	*Sinistroporomonorchis minutus* OQ672305	99.9	12491
S. yucatanensis	Gastrointestinal tract	Adult	Auto	OQ672303**	–	–	–
S. glebulentus	Gastrointestinal tract	Adult	Auto	PX646777	*S. glebulentus* OQ672285	100	12492
Parasaturnius maurepasi	Gastrointestinal tract	Adult	Auto	PX646778	*Parasaturnius maurepasi* OR831227	99.7	–
Hemiuridae gen. sp.	Gastrointestinal tract	Adult	Auto	PX646779–80	*Brachyphallus crenatus* MH628299	90.9	12493
Schikhobalotrema sp. 1	Gastrointestinal tract	Adult	Auto	PX646781–82	*Schikhobalotrema acutum* KY852464	95.4	12494
Schikhobalotrema sp. 2	Gastrointestinal tract	Adult	Auto	PX646783–84	*S. acutum* KY852464	95.1	12495
Saccocoelioides olmecae	Gastrointestinal tract	Adult	Auto	PX646785	*Saccocoelioides olmecae* KU061130	100	12496
Scaphanocephalus sp.	Mesentery	Larvae	Allo	OR794154**	–	–	–
Mesostephanus cubaensis	Mesentery	Larvae	Allo	PX646786	*Mesostephanus cubaensis* MK650445	99.7	–
M. microbursa	Mesentery	Larvae	Allo	PX646787	*M. microbursa* OR482655	100	–
Bucephalus sp.	Mesentery	Larvae	Auto	PX646788–91	*Bucephalus margaritae* KT273395	97	12497
Ascocotyle (Phagicola) longa	Heart	Larvae	Allo	PX646792	*Ascocotyle (Phagicola) longa* MF980613	99.6	–
Saccularina sp.	Mesentery	Larvae	Auto	PX646793	*Saccularina magnacetabula* OL336033	94.6	–
Cardiocephaloides medioconiger	Brain	Larvae	Allo	PX646794	*Cardiocephaloides medioconiger* OR482648	99.9	12498
Acantocephala							
Floridosentis mugilis	Gastrointestinal tract	Adult	Auto	PX646795	*Floridosentis mugilis* JQ436480	99.8	–
Nematoda							
Contracaecum fagerholmi	Mesentery	Larvae	Allo	PX637340	*Contracaecum fagerholmi* JF727881 (COII)	98.8	12499
Copepoda							
Bomolochus aff. *nitidus*	Gills	Adult	Auto	PX637242–44	*Nothobomolochus gerresi* MK643338 (COI)	85.4	

**Published either in Andrade-Gómez *et al.* (2023, 2025) or González-García *et al.* (2023).
Abbreviations: DS, Developmental stage; LC, life-cycle; GB, Genbank accession number; Identity BLAST, percent identity in BLAST; SI, site of infection; Specimens deposited either at the Colección Nacional de Helmintos (CNHE) or Colección Nacional de Crustaceos (CNAR).

the newly sampled specimens represent a new species since they exhibit some characteristics not reported previously, such as the presence of nonplumose setae in the basal joint of the fifth leg; this trait was not described by Wilson (1911) in the original description. Still, a proper description of the species will require sampling and sequencing specimens of *B. nitidus* from the type locality to corroborate whether the specimens of the present study are conspecific. Interrelationships within the Bomolochidae Claus, 1875 also need a further assessment as recently suggested by Swaraj *et al.* (2025).

The three unidentified trematodes (Hemiuridae gen. sp., and *Schikhobalotrema* sp. 1 and sp. 2) may represent new species, but more detailed taxonomic work is required to test the hypothesis, and formal species descriptions of these taxa will be presented separately. Interestingly, the hemiurid trematode morphologically resembles species in the genus *Hysterolecitha* Linton, 1919, which currently is considered a member of the family Bunocotylidae Dollfus, 1950 (WoRMS, 2025, *Hysterolecitha* Linton, 1910. Accessed at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=108770 on 2025-09-11) but see Duong *et al.* (2023) who considered the genus belongs to the family Lecithasteridae Odhner, 1905. The type species, *H. rosea* Linton, 1910, was described from an acanthurid in the Gulf of Mexico, and one species, *H. elongata* Manter, 1931, was described from *M. cephalus* also from the Gulf of Mexico (see Overstreet *et al.* 2009). Currently, no 28S rDNA sequences are available for any of the 22 species included in the genus. Even though the specimens sampled in the present morphologically resemble members of *Hysterolecitha*, the BLAST analysis of 28S surprisingly yielded a similarity with the hemiurid *Brachyphallus crenatus* (Rudolphi, 1802), and not even with any bunocotylid (nor a lecithasterid) deposited in GenBank; this was corroborated through the phylogenetic analysis, which showed that the specimens nest within the clade containing species of Hemiuridae (Figure 2A). Furthermore, the two lineages of *Schikhobalotrema*

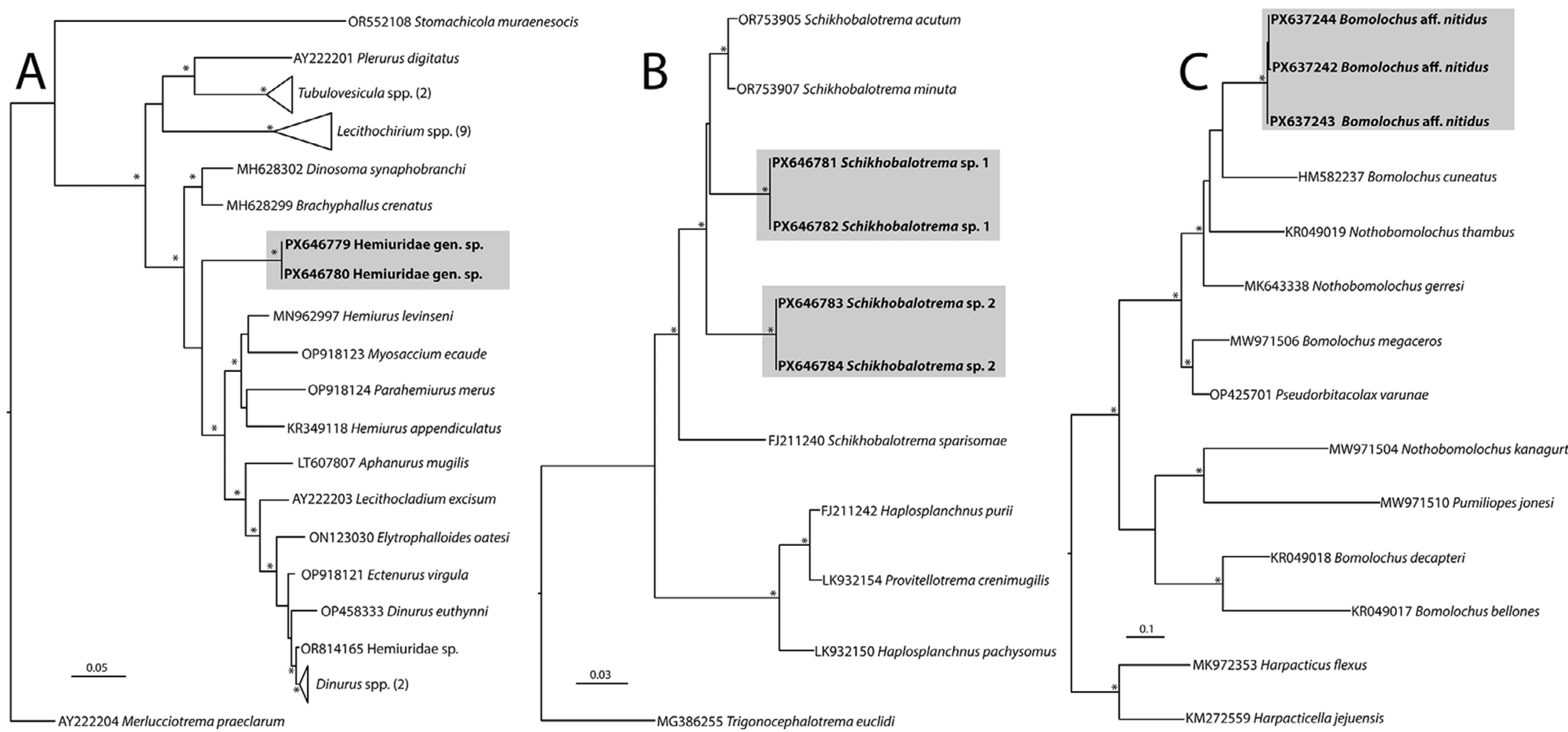

Figure 2. Maximum likelihood trees showing the phylogenetic position of adult parasites of *M. curema* from Yucatán. (A) Hemiuridae gen sp.; (B) *Schikhobalotrema* spp. inferred with 28S rDNA. (C) *Bomolochus* aff. *nitidus* inferred with COI. Bootstrap support values >80 are indicated (*). Scale-bar = number of nucleotide substitutions per site.

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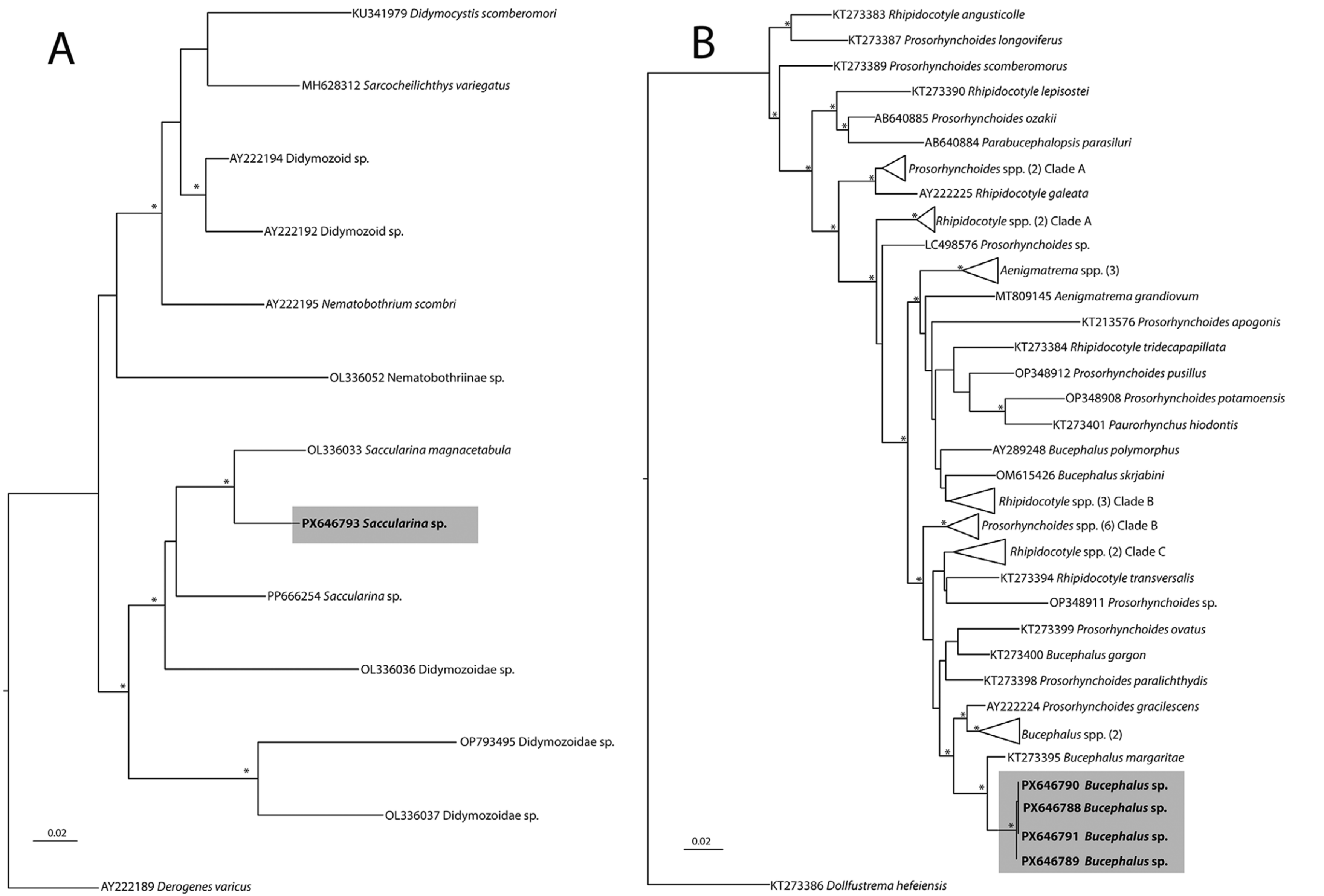

Figure 3. Maximum likelihood trees inferred with 28S rDNA showing the phylogenetic position of metacercaria of *M. curema* from Yucatán. (A) *Saccularina* sp.; (B) *Bucephalus* sp. Bootstrap support values >80 are indicated (*). Scale-bar = number of nucleotide substitutions per site.

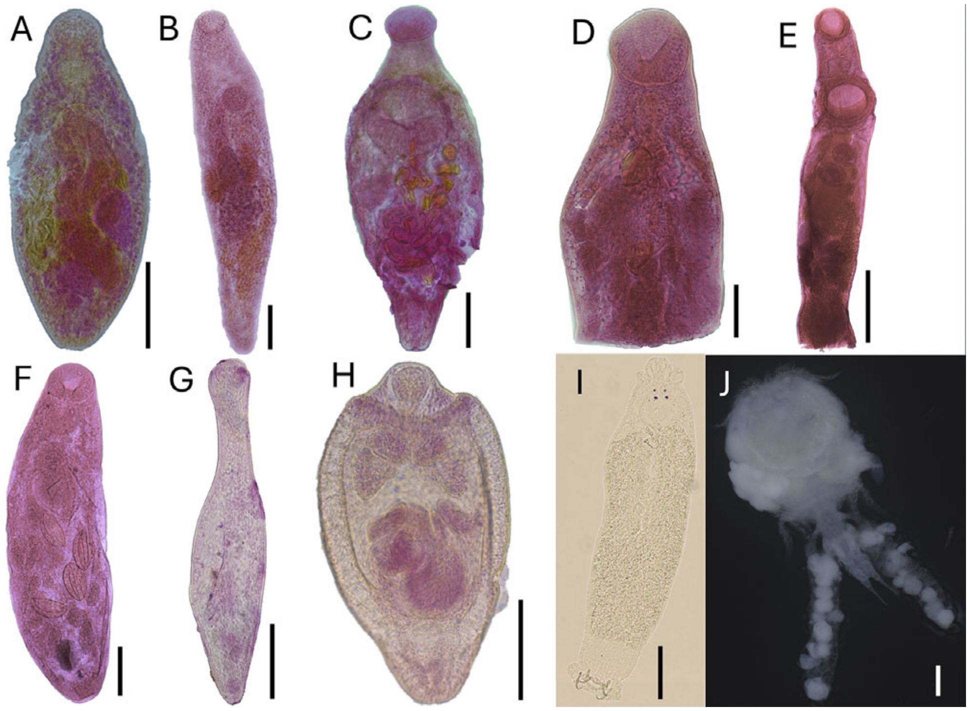

Figure 4. Photomicrographs of some representative metazoan parasites of *M. curema* of the coasts of Yucatán Peninsula. Adult trematodes (A) *Sinistroporomonorchis minutus*; (B) *Sinistroporomonorchis glebulentus*; (C) *Schikhobalotrema* sp. 2; (D) *Schikhobalotrema* sp. 1 *Hologenophore*; (E) Hemiuridae gen sp. *Hologenophore*; (F) *Saccocoelioides olmecae*; Larval trematodes (G) *Bucephalus* sp.; (H) *Cardiocephaloides medioconiger*; Monopisthocotyla (I) *Ligophorus yucatanensis*; Copepoda (J) *Bomolochus* aff. *nitidus.* Scale bars: (A–D, F–I) 100 µm; (E) 500 µm; (J) 200 µm.

uncovered in this study differed 5% from *S. acutum* (Linton, 1910), a species widely distributed from the Gulf of Mexico to the Indo-West Pacific (Pérez-Ponce de León *et al.* 2023, KY852464). The phylogenetic analyses showed that they actually represent two independent lineages, and it is possible that they also represent undescribed species.

For some of the larval forms reported in the present study, including *Saccularina* sp., *Bucephalus* sp., and *Scaphanocephalus* sp., sequence data did not match any 28S rDNA sequence available in the GenBank dataset, and, morphologically, adult forms are required to accomplish the identification to species level. Instead, five larval forms were identified because their sequences matched those available in GenBank. Our findings corroborate the importance of using morphological and molecular data for the correct identification of parasite larval forms, as pointed out previously by Grano-Maldonado *et al.* (2023) and Espínola-Novelo *et al.* (2023, 2025).

Infection parameters and comparison among localities

The prevalence of infection of parasite populations was relatively low in all sampled localities, with most taxa having prevalence less than 50%, although we acknowledge that host sample size is variable among localities. Irrespective of the fact that a relatively low similarity in species composition was found among localities. Two parasite taxa were recorded in the four localities analysed, whereas six taxa were recorded in only one locality. *Ligophorus yucatanensis*, one of the more frequent and abundant parasites, was sampled in all four localities. Overall, in each of the sampled localities, a different species reached the highest prevalence and mean intensity values (Supplementary Table S1). A similar pattern was observed in other fish species studied in the same coastal lagoons of Yucatán, such as the checkered puffer, *Sphoeroides testudineus* (Linnaeus, 1758) (Pech *et al.*, 2009). This cannot be considered as a general pattern because in other studies conducted in fundulids and cyprinodontids in the same coastal lagoons (see Espínola-Novelo *et al.*, 2023, 2025), parasite communities are dominated by two species, which occur in all localities and exhibit the highest prevalence and abundance values. This might be a result of the position that species occupy in the food web in these ecosystems. Fundulids and cyprinodontids are small-sized fish that are highly consumed by fish-eating birds. The two common and abundant parasite species in these hosts close their life cycle when birds feed on them, and this may disperse the infection more effectively among coastal lagoons (Espínola-Novelo *et al.* 2023, 2025). Instead, parasite larval forms of *M. curema* and *S. testudineus* are not dispersed among localities at the same rate since they are not highly consumed by fish-eating birds.

Species composition

The white mullet is a secondary consumer in the food web (Paperna and Overstreet 1981; Whitfield 2016). The composition of the parasite fauna corroborates that position of the host in the food webs of coastal ecosystems; 68% of the species represented autogenic species, i.e., adult forms whose life cycle is completed in the aquatic ecosystem, whereas 32% were allogenic species, i.e., larval forms that require the fish to be consumed either by a mammal or a fish-eating bird to complete their life cycle. Two parasite species of the white mullet, *Saccularina* sp. and *Bucephalus* sp., complete their life cycle when the fish is eaten by a larger fish species, whereas the remaining larval forms complete their life cycle when the fish is eaten by a bird or a mammal (Costa-Marchiori *et al.* 2010; Cribb *et al.* 1995; D'Amelio *et al.* 2012; Ebert *et al.* 2020; González-García *et al.* 2023; Hernández-Mena *et al.* 2014; Louvard *et al.* 2022; Nadler *et al.* 2005; Ondračková *et al.* 2015; Pina *et al.* 2009).

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Some previous studies have documented the diversity of metazoan parasites of *M. curema* in coastal lagoons in distant geographical areas across the Americas; at least three studies have been conducted in Brazil, three in Mexico, and one in Peru. The findings of our study are compared with those of other studies. For instance, Fajer-Ávila *et al.* (2006) reported the presence of seven parasite taxa in 292 specimens of *M. curema* (mean length 21.2 cm) sampled in 2 costal lagoons in Northwestern Mexico; Minaya *et al.* (2021) studied 25 specimens of the species (mean length 30 cm) from one locality of Peru, and reported only four taxa; Morales-Martínez *et al.* (2022) studied 122 specimens of *M. curema* (mean length 19.3 cm) from a lagoon in the Southwestern Pacific coast of Mexico, and reported only two species. Santos-Gueretz *et al.* (2022) studied 282 specimens of *M. curema* in one locality of the northern coast of Brazil and reported 5 taxa. Falkenberg *et al.* (2022) studied 60 individuals of this host species (mean length 22.8 cm) also in one locality of Brazil, reporting 16 parasite taxa. Lastly, Fuentes-Olivares *et al.* (2024) analysed 131 individuals of this mugilid (mean length 31.7 cm) from one locality of Veracruz, in the Gulf of Mexico, and reported six parasite taxa (see Table 2).

In the present study, 19 metazoan parasite taxa were found in 73 individuals of *M. curema* (mean length 17.1, 7–33 cm) (Table 2). The parasite species richness herein reported is similar to that reported by Falkenberg *et al.* (2022) in one locality in Brazil (n = 60; mean length 22.8 cm), although they differ overall in the species composition. For example, these authors reported the presence of eight copepod species, whereas the present study reported only one species (*B.* aff. *nitidus*). Instead, here 15 trematode taxa were reported, whereas Falkenberg *et al.* (2022) reported only two. Interestingly, the taxonomic composition of the parasite fauna of *M. curema* of this study also differs from that of a study conducted in a relatively closer locality in the Gulf of Mexico, not only in species richness but also in species composition. Fuentes-Olivares *et al.* (2024) analysed *M. curema* from Tuxpan, Veracruz, but they only reported the presence of six taxa, and the acanthocephalan *Floridosentis mugilis* is the only parasite species shared between both studies (Table 2). Only seven out of 48 metazoan parasite taxa listed on Table 2 are recorded in two or more localities, i.e., *Ascocotyle* (*Phagicola*) *longa, Floridosentis mugilis, Ergasilus lizae, Ergasilus* sp., *Caligus* sp., Lernaeopodidae gen. sp., and *Contracaecum*

Table 2. Comparison of the metazoan parasites of *Mugil curema* based on studies conducted in estuarine environments across the Americas

Source	Present work	Fajer-Ávila *et al.* (2006)	Minaya *et al.* (2021)	Santos-Gueretz *et al.* (2022)	Falkenberg *et al.* (2022)	Morales-Martínez *et al.* (2022)	Fuentes-Olivares *et al.* (2024)
Country	Mexico	Mexico	Perú	Brazil	Brazil	Mexico	Mexico
Geographical distribution	Yucatán Peninsula	Northwest Pacific (Sinaloa)	Wetlands Lima	Northern coast	Northern coast	Southwest Pacific (Guerrero)	GoM (Veracruz)
Number of localities	4	2	1	1	1	1	1
n (mean TL cm)	73 (17.1)	292 (21.2)	25 (30)	282	60 (22.8)	122 (19.3)	131 (31.7)
No. of parasite taxa found	19	7	4	5	16	2	6
Monogenea							
Benedenia sp.	–	–	–	–	–	–	X
Ligophorus sp. 1	–	–	–	–	X	–	–
Ligophorus sp. 2	–	–	–	–	X	–	–
Ligophorus brasiliensis	–	–	–	–	X	–	–
L. mugilinus	–	X	–	–	–	–	–
L. yucatanensis	X	–	–	–	–	–	–
Metamicrocotyla macracantha	–	X	–	–	–	–	–
Trematoda							
Ascocotyle (Phagicola) longa	X	–	X	X	–	–	–
Bucephalidae gen. sp.	–	–	–	–	X	–	–
Bucephalus sp.	X	–	–	–	–	–	–
Cardiocephaloides medioconiger	X	–	–	–	–	–	–
Dicrogaster sp.	–	–	–	–	–	–	X
Fellodistomidae gen. sp.	–	–	–	–	X	–	–
Haploporidae gen. sp.	–	–	–	X	–	–	–
Hemiuridae gen. sp.	X	–	–	–	–	–	–
Mesostephanus cubaensis	X	–	–	–	–	–	–

(*Continued*)

Table 2. (*Continued*)

M. microbursa	X	–	–	–	–	–	–
Parasaturnius maurepasi	X	–	–	–	–	–	–
Saccularina sp.	X	–	–	–	–	–	–
Saccocoelioides olmecae	X	–	–	–	–	–	–
Scaphanocephalus sp.	X	–	–	–	–	–	–
Sinistroporomonorchis minutus	X	–	–	–	–	–	–
S. yucatanensis	X	–	–	–	–	–	–
S. glebulentus	X	–	–	–	–	–	–
Schikhobalotrema sp. 1	X	–	–	–	–	–	–
Schikhobalotrema sp. 2	X	–	–	–	–	–	–
Acantocephala							
Floridosentis mugilis	X	–	–	–	X	X	X
Neoechinorhynchus curemai	–	–	–	X	–	–	–
Nematoda							
Contracaecum sp.	–	X	X	–	–	–	X
C. multipapillatum	–	–	–	–	–	X	–
C. fagerholmi	X	–	–	–	–	–	–
Pharyngodonidae gen. sp.	–	–	–	–	X	–	–
Copepoda							
B. nitidus	X	–	–	–	X	–	–
Holobomolochus sp.	–	X	–	–	–	–	–
Ergasilus sp.	–	X	–	–	–	–	X
E. atafonensis	–	–	–	–	X	–	–
E. bahiensis	–	–	–	–	X	–	–
E. caraguatatubensis	–	–	–	–	X	–	–
E. lizae	–	–	X	X	X	–	–
E. versicolor	–	–	X	–	–	–	–
Caligus sp.	–	X	–	–	–	–	X
C. praetextus	–	–	–	–	X	–	–
C. minimus	–	–	–	–	X	–	–
Lernaeenicus longiventris	–	–	–	X	–	–	–
Lernaeopodidae gen. sp.	–	X	–	–	X	–	–
Hirudinea							
Piscicolidae gen. sp.	–	–	–	–	X	–	–

sp. This might suggest that only these parasites possess a strong association with *M. curema* regardless of the location, although only three are identified up to species level (Fajer-Ávila *et al.* 2006; Falkenberg *et al.* 2022; Fuentes-Olivares *et al.* 2024; Minaya *et al.* 2021; Morales-Martínez *et al.* 2022; Santos-Gueretz *et al.* 2022); it is uncertain whether or not the lernaeopodid copepod and the larval *Contracaecum* represent a single and widely distributed species. At this time, it is not possible to describe a general pattern.

Moreover, Falkenberg *et al.* (2022) performed the first checklist of the metazoan parasites of *M. curema.* These authors compiled all the available information until 2022 and listed 88 parasite taxa. The bibliographical search conducted in the present study yielded 44 additional records of metazoan parasite taxa. These records, plus the additional 10 provided in the present study from Yucatán coastal lagoons, raised the known number of metazoan parasites of *M. curema* to 142 taxa (Table 3). An updated checklist was then

Table 3. List of metazoan parasites recorded in *Mugil curema* across its distributional range

Taxa	Locality	1	2	3	4
Myxozoa					
Ceratomyxidae Doflein, 1899					
1. *Ellypsomixa* sp.	Bra	X	–	–	–
Kudoidae Meglitsch, 1960					
2. *Kudoa* sp.	Mex: CS	X	–	–	–
Myxobolidae Thélohan, 1892					
3. *Hanneguya* sp.	Bra	X	–	–	–
4. *Myxobolus hani* Faye, Kpatcha, Diebakate, Fall & Toguebaye, 1999	Sen	X	X	–	–
5. *Myxobolus* sp.	Bra; Sen	X	–	–	–
6. *M. curemae* Vieira, Agostinho, Negrelli, da Silva, de Azevedo & Abdallah, 2022	Bra	–	–	X	–
7. *M. maceioensis* Vieira, Agostinho, Negrelli, da Silva, de Azevedo & Abdallah, 2022	Bra	–	–	X	–
8. *M. patriciae* Vieira, Osaki-Pereira, Abdallah, Oliveira, Duarte, da Silva & Kozlowiski de Azevedo, 2024	Bra	–	–	X	–
9. *M. mundauensis* Vieira, Osaki-Pereira, Abdallah, Oliveira, Duarte, da Silva & Kozlowiski de Azevedo, 2024	Bra	–	–	X	–
Trematoda					
Aporocotylidae Odhner, 1912					
10. *Mugilitrema labowskiae* Warren & Bullard, 2024	USA: GoM	–	–	X	–
Bucephalidae Poche, 1907					
11. Bucephalidae gen. sp.	Bra	X	–	–	–
12. *Bucephalus* sp.	Mex: CS	–	–	–	X
13. *Rhipidocotyle lepisostei* Hopkins, 1954	USA: GoM	X	X	–	–
Bunocotylidae Dollfus, 1950					
14. *Parasaturnius maurepasi* (Overstreet, 1977)	Mex: GoM; USA: GoM	–	X	X	X
15. *Saturnius belizensis* Fischthal, 1977	Bel	–	X	–	–
Clinostomidae Lühe, 1901					
16. *Clinostomum complanatum* (Rudolphi, 1814)	Mex: PC	X	X	X	–
Cryptogonimidae Ward, 1917					
17. *Pseudoacanthostomum panamense* Caballero y C., Bravo-Hollis & Grocott, 1953	Mex: PC	X	–	X	–
Cyathocotylidae Mühling, 1898					
18. *Mesostephanus appendiculatoides* (Price, 1934)	USA: GoM	X	X	–	–
19. *M. cubaensis* Alegret, 1941	Mex: CS	–	–	–	X
20. *M. microbursa* Caballero y Caballero, Grocott & Zerecero, 1953	Mex: CS	–	–	–	X
Didymozoidae Monticelli, 1888					
21. *Saccularina* sp.	Mex: CS	–	–	–	X
Diplostomidae Poirier, 1886					
22. *Austrodiplostomum compactum* (Lutz, 1928)	Mex: PC	X	X	X	–
23. *Diplostomum* sp.	Mex: GoM	–	–	X	–
24. *Posthodiplostomum minimum* (Maccallum, 1921)	Mex: GoM	–	–	X	–
Fellodistomidae Nicoll, 1909					
25. Fellodistomidae gen. sp.	Bra	X	–	–	–
Haploporidae Nicoll, 1914					
26. *Dicrogaster* sp.	Mex: GoM	–	–	X	–
27. *Ekuarhuni mexicanus* Andrade-Gómez, González-García & García-Varela, 2021	Mex: GoM	–	X	X	–
28. *E. papillatus* Andrade-Gómez & García-Varela, 2020	Mex: PC	–	X	X	–

(*Continued*)

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Table 3. (*Continued*)

Taxa	Locality	1	2	3	4
29. *Forticulcita isabelae* Andrade-Gómez & García-Varela, 2020	Mex: PC	–	X	X	–
30. *F. macropharyngis* Andrade-Gómez, González-García & García-Varela, 2021	Mex: GoM	–	X	X	–
31. *F. minuta* Andrade-Gómez & García-Varela, 2020	Mex: PC	–	X	X	–
32. *F. venezuelensis* Andrade-Gómez, González-García & García-Varela, 2021	Ven	–	X	X	–
33. Haploporidae gen. sp.	Bra	–	X	–	–
34. *Intromugil mugilicola* (Shireman, 1964)	Ven	X	X	–	–
35. *I. simonei* (Travassos, Texeira de Freitas & Buhrnheim, 1965)	Bra	X	X	–	–
36. *Overstreetoides pacificus* Andrade-Gómez & García-Varela, 2020	Mex: PC	–	X	X	–
37. *Overstreetoides* sp.	Mex: GoM	–	–	X	–
38. *Saccocoelioides beauforti* (Hunter & Thomas, 1961)	Ven; Bra	X	X	X	–
39. *S. carolae* Lunaschi, 1984	Bra	X	X	–	–
40. *S. macrospinosus* Andrade-Gómez, Sereno-Uribe & García-Varela, 2019	Mex: GoM	–	X	X	–
41. *S. olmecae* Andrade-Gómez, Pinacho, Hernández-Orts, Sereno-Uribe & García-Varela, 2016	Mex: CS	–	–	–	X
42. *S. orosiensis* Curran, Pulis, Andres & Overstreet, 2018	Mex: GoM	–	–	X	–
43. *Xiha fastigata* (Thatcher & Sparks, 1958)	Ven; Bra	X	X	–	–
44. *Xiha* sp.	Bra	X	–	X	–
Haplosplanchnidae Poche, 1926					
45. *Haplosplanchnus mugilis* Nahhas & Cable, 1964	Cur	X	X	–	–
46. *Haplosplanchnus* sp.	USA: GoM	X	–	–	–
47. *H. vinodae* Ahmad, 1985	Mex: PC	–	X	X	–
48. *Hymenocotta manteri* Overstreet, 1969	Ven; USA: GoM	–	X	–	–
49. *Schikhobalotrema elongatum* Nahhas & Cable, 1964	PR; Jam	X	X	–	–
50. *S. magnum* Skinner, 1975	Bra: AC	X	X	–	–
51. *S. robustum* Pritchard & Manter, 1961	Mex: GoM	–	X	X	–
52. *Schikhobalotrema* sp.	Ven; Bra; Mex: GoM	X	–	X	–
53. *Schikhobalotrema* sp. 1	Mex: GoM	–	–	–	X
54. *Schikhobalotrema* sp. 2	Mex: GoM	–	–	–	X
Hemiuridae Looss, 1899					
55. *Mecoderus oligoplitis* Manter, 1940	Bra	X	X	–	–
56. Hemiuridae gen. sp.	Mex: CS	–	–	–	X
Heterophyidae Leiper, 1909					
57. *Ascocotyle (Phagicola) longa* Ransom, 1920	Mex: PC; CS; USA: GoM; Pe: PC	X	X	X	X
58. *Ascocotyle* sp.	Bra	X	–	X	–
59. *Centrocestus formosanus* (Nishigori, 1924)	Mex: GoM	–	–	X	–
60. *Heterophyes heterophyes* (von Siebold, 1852)	MS	X	–	–	–
Lecithasteridae Odhner, 1905					
61. *Alloopistholecithum helodes* (Overstreet, 1973)	USA: GoM	X	X	–	–
62. *Aponurus galeatus* (Looss, 1907)	MS	–	X	–	–
63. *Hysterolecitha rosea* Linton, 1910	USA: GoM	–	X	–	–
64. *Lecithophyllum botryophoron* (Olsson, 1868)	Bra	X	X	–	–
Monorchiidae Odhner, 1911					
65. *Alloinfundiburictus haemuli* (Overstreet, 1969)	Mex: GoM	–	X	–	–
66. *Hurleytrema* sp.	Mex: GoM	X	–	–	–
67. *Paralasiotocus mugilis* (Overstreet, 1969)	PR	X	X	–	–

(*Continued*)

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Table 3. (*Continued*)

Taxa	Locality	1	2	3	4
68. *Sinistroporomonorchis glebulentus* (Overstreet, 1971)	Ven; Mex: GoM	X	X	X	X
69. *S. mexicanus* Andrade-Gómez, Ortega-Olivares, Solórzano-García, García-Varela, Mendoza-Garfias & Pérez-Ponce de León, 2023	Mex: GoM	–	X	X	–
70. *S. minutus* Andrade-Gómez, Ortega-Olivares, Solórzano-García, García-Varela, Mendoza-Garfias & Pérez-Ponce de León, 2023	Mex: GoM	–	X	X	X
71. *S. yucatanensis* Andrade-Gómez, Ortega-Olivares, Solórzano-García, García-Varela, Mendoza-Garfias & Pérez-Ponce de León, 2023	Mex: GoM	–	X	X	X
Opisthorchiidae Looss, 1899					
72. *Scaphanocephalus* sp.	Mex: GoM	–	–	X	X
Strigeidae Railliet, 1919					
73. *Cardiocephaloides medioconiger* (Dubois & Vigueras, 1949)	Mex: CS	–	–	–	X
74. Strigeidae gen. sp.	Mex: GoM	–	–	X	–
Monogenea					
Ancyrocephalidae Bychowsky, 1937					
75. *Ligophorus brasiliensis* Abdallah, Azevedo & Luque, 2009	Bra	X	X	–	–
76 *L. mugilinus* (Hargis, 1955)	Ven; Bra; PR; Mex: PC	X	X	X	–
77. *Ligophorus* sp. 1	Bra	X	–	–	–
78. *Ligophorus* sp. 2	Bra	X	–	–	–
79. *L. vanbenedenii* (Parona & Perugia, 1890)	Mex: PC	X	X	X	–
80. *L. yucatanensis* Rodríguez-González, Míguez-Lozano, Llopis-Belenguer & Balbuena, 2015	Mex: CS	–	–	X	X
81. *Aristocleidus* sp.	Mex: GoM	X	–	X	–
Axinidae Monticelli, 1903					
82. Axinidae gen. sp.	Mex: PC	X	–	X	–
Capsalidae Baird, 1853					
83. *Neobenedenia pacifica* Bravo-Hollis, 1971	PR; USA: AC	X	X	X	–
84. *Benedenia* sp.	Mex: GoM	–	–	X	–
Dactylogyridae Bychowsky, 1933					
85. Dactylogyridae gen. sp.	Bra	X	–	–	–
86. *Dactylogyrus* sp.	Mex: PC	X	–	X	–
Gyrodactylidae Cobbold, 1864					
87. *Gyrodactylus curemae* Conroy & Conroy, 1985	Ven	X	X	–	–
Microcotylidae Taschenberg, 1879					
88. *Metamicrocotyla chamelensis* Bravo-Hollis, 1983	Mex: PC	X	X	X	–
89. *M. macracantha* (Alexander, 1954)	Ven; Bra; Mex: PC	X	X	X	–
90. *M. pacifica* Bravo-Hollis, 1982	Mex: PC	X	X	X	–
91. *Metamicrocotyla* sp.	Mex: GoM	X	–	X	–
92. *Solostamenides pseudomugilis* (Hargis, 1957)	Mex: PC	X	X	X	–
Cestoda					
Lacisthorhynchidae Guiart, 1937					
93. *Dasyrhynchus pacificus* Robinson, 1959	Mex: GoM	X	X	–	–
Onchoproteocephalidae Caira, Jensen, Waeschenbach, Olson & Littlewood, 2014					
94. Proteocephalidea gen. sp.	Bra	X	–	–	–
Acanthocephala					
Leptorhynchoididae Witenberg, 1932					
95. *Illiosentis* sp.	Mex: GoM	–	–	X	–

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Table 3. (*Continued*)

Taxa	Locality	1	2	3	4
Neoechinorhynchidae Ward, 1917					
96. *Floridosentis mugilis* (Machado Filho, 1951)	Mex: PC; PR; Bra; USA, Mex: GoM	X	X	X	X
97. *F. pacifica* Bravo-Hollis, 1969	Mex: PC	–	X	X	–
98. *Floridosentis* sp. L2	Ven	–	–	X	–
99. *Floridosentis* sp. L4	Mex: PC	–	–	X	–
100. *Neoechinorhynchus curemai* Noronha, 1973	Bra	X	–	–	–
Nematoda					
Anisakidae Railliet & Henry, 1912					
101. *Anisakis* sp.	Ven	–	–	X	–
102. *Contracaecum multipapillatum* (Drasche, 1882)	Mex: PC	X	–	X	–
103. *C. fagerholmi* D'Amelio, Cavallero, Dronen, Barros & Paggi, 2012	Mex: CS	–	–	–	X
104. *Contracaecum* sp.	Mex: PC, GoM; Bra; Pe; Ven	X	–	X	–
105. *Pseudoterranova* sp.	Ven	X	–	–	–
Cucullanidae Cobbold, 1864					
106. *Cucullanus djilorensis* Ndew, Diouf, Ba & Morand, 2014	Sen	X	X	–	–
107. *Cucullanus* sp.	Bra	X	–	–	–
Gnathostomatidae Railliet, 1895					
108. *Gnathostoma binucleatum* Almeyda-Artigas, 1991	Mex: PC	–	–	X	–
Pharyngodonidae Travassos, 1919					
109. Pharyngodonidae gen. sp.	Bra	X	–	–	–
Hirudinea					
Piscicolidae Johnston, 1865					
110. *Myzobdella lugubris* Leidy, 1851	PR	X	–	X	–
111. Piscicolidae gen. sp.	Bra	X	–	–	–
Copepoda					
Bomolochidae Claus, 1875					
112. *Acanthocolax* sp.	Bra	X	–	–	–
113. *Bomolochus bellones* Burmeister, 1835	PR	X	X	–	–
114. *B. nitidus* Wilson C.B., 1911	Bra; Mex: GoM	X	–	–	X
115. *Holobomolochus* sp.	Mex: PC	X	–	–	–
Caligidae Burmeister, 1835					
116. *Caligus bonito* Wilson C.B., 1905	Bra	X	X	–	–
117. *C. minimus* Otto, 1821	Bra	X	–	–	–
118. *C. pomacentrus* Cressey, 1991	Bra	X	–	–	–
119. *C. praetextus* Bere, 1936	Bra	X	–	–	–
120. *Caligus* sp.	Bra; Mex: GoM, PC	X	–	X	–
Ergasilidae Burmeister, 1835					
121. *Ergasilus arthrosis* Roberts, 1969	Mex: GoM	X	–	–	–
122. *E. atafonensis* Amado & Rocha, 1996	Bra	X	X	–	–
123. *E. bahiensis* Amado & Rocha, 1996	Bra	X	X	–	–
124. *E. caraguatatubensis* Amado & Rocha, 1996	Bra	X	X	–	–
125. *E. congoensis* El-Rashidy	Sen:	X	–	–	–
126. *E. ecuadorensis* El-Rashidy & Boxshall, 2002	Ecu:	X	X	–	–

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Table 3. (*Continued*)

Taxa	Locality	1	2	3	4
127. *E. guayanensis* El-Rashidy	Nig; SLE	X	–	–	–
128. *E. indistinctus* El-Rashidy	Sen: AC	X	–	–	–
129. *E. lizae* Krøyer, 1863	Bra: PR; Pe; Mex: PC	X	X	X	–
130. *E. mugilis* Vogt, 1877	USA: AC	–	X	–	–
131. *E. parabahiensis* El-Rashidy & Boxshall, 1999	Guy: AC	X	–	–	–
132. *E. paralizae* El-Rashidy	NGR: AC	X	–	–	–
133. *Ergasilus* sp.	Mex: PC, GoM	X	–	X	–
134. *E. versicolor* Wilson C.B., 1911	Bra; Pe	X	X	X	–
135. *Therodamas* sp.	Bra	X	–	–	–
Lernaeopodidae Milne Edwards, 1840					
136. *Naobranchia lizae*	Mex: PC, GoM	–	–	X	–
137. Lernaeopodidae gen. sp.	Mex: PC; Bra	X	–	–	–
Pennellidae Burmeister, 1835					
138. *Lernaeenicus longiventris* Wilson, 1917	Bra; PR	X	X	–	–
Malacostraca					
Corallanidae Hansen, 1890					
139. *Excorallana* sp.	Bra	X	–	–	–
Cymothoidae Leach, 1814					
140. *Cymothoa spinipalpa* Thatcher, de Araújo, de Lima & Chellapa, 2007	Bra	X	–	–	–
Gnathiidae Leach, 1814					
141. *Gnathiidae* sp.	Bra	X	–	–	–
Ichthyostraca					
Argulidae Leach, 1819					
142. *Argulus* sp.	Mex: PC	–	–	X	–

Abbreviations: AC, Atlantic Coast; Bra, Brasil; CS, Caribbean Sea; Cur, Curazao; Ecu, Ecuador; GoM, Gulf of Mexico; Mex, Mexico; MS, Mediterranean Sea; Nig, Nigeria; PC, Pacific coast; Pe, Perú; PR, Puerto Rico; Sen, Senegal; SLE, Sierra Leone; USA, United States; Ven, Venezuela.
Sources: (1) Falkenberg *et al.* (2022); (2) WoRMS (2025); (3) CNHE (2024); (4) Present work.

performed, including the novel information provided in this study. The list includes 9 myxozoans, 65 trematodes, 18 monogeneans, 2 cestodes, 6 acanthocephalans, 9 nematodes, 2 hirudineans, 27 copepods, 3 malacostracans, and 1 ichthyostraca (Table 3). Considering the wide distribution range of the white mullet and the number of studies published describing their parasite fauna, it seems possible to postulate that more species will be found in further studies. The use of several sources of information, including molecular markers, will be useful to increase the number of species records for this host species. Here, the use of molecular data in combination with some morphological characteristics (Figure 4) was fundamental to identify 10 taxa, which are reported for the first time in this host species (one nematode and nine trematodes). In that context, our study contributes to the understanding of the parasite diversity of an economically important fish species with a wide distribution range. We pose that studies designed to provide baseline information for the analysis of data regarding the ecosystems where hosts and parasites live are very important, as it is now highly recognized that parasites play an important role in all ecosystems, and they provide valuable information about aquatic ecosystem health within the context of environmental parasitology (see Sures *et al.* 2023); the information we have generated in this study will be useful in further studies of parasites as bioindicators of the ecosystem health, and studies of the role of parasites in food webs in coastal lagoons.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0022149X25101065.

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