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Metazoan parasites of fishes from Coyuca Lagoon, Guerrero, Mexico

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Abstract

A total of 33 species of metazoan parasites were identified (31 helminth and 2 crustaceans) from 10 species of fish (*n* = 1,030) collected from Coyuca Lagoon, Guerrero, Mexico, between May 2001 and February 2003. Digeneans (7 adults and 11 larvae) dominated the parasite fauna. The most widespread species of parasite were: Digenea- *Pseudoacanthostomum panamense*, *Diplostomum* (*Austrodiplostomum*) *compactum*, *Clinostomum complanatum*; Nematoda- *Contracaecum* sp.; Branchiura- *Argulus* sp.; and Copepoda- *Ergasilus* sp. Species composition of the parasite fauna exhibited a clear freshwater influence; 57.5% (19/33) of the identified species have a freshwater distribution. This is the first survey of parasites of fish from this location and all reported species are new geographical host records for Coyuca Lagoon, Guerrero, Mexico.

Key words: Digenea, Nematoda, Crustacea, fish, Coyuca Lagoon, Guerrero, Mexico

Introduction

Coyuca Lagoon is one of the most important aquatic resources in the state of Guerrero, Mexico, because of its size (28.5 Km^2) and fish production (Violante-González 2006). Located 35 km northwest of Acapulco, this lagoon is predominantly oligohaline (1.5 to 5 ppm) during most of the year, but has a marine influence during the rainy season when temporary connections open between it and the Pacific Ocean. This allows entrance of marine species, giving the lagoon's ichthyofauna a strong marine influence. The high productivity of Coyuca Lagoon and the wide variety of species of fish from different origins (i.e. freshwater, brackish water and marine water) provide an ideal habitat for a rich local parasite fauna. However, no research has been done to date on the parasite fauna of the fish in this lagoon. The goal of the present study was to generate an inventory of the parasite fauna from the diverse fish populations in Coyuca Lagoon and to contribute in the development of future research on metazoan parasites of the coastal lagoons of the state of Guerrero, Mexico.

Materials and methods

A total of 1,030 fishes were collected from Coyuca Lagoon (16º57' N; 100º02' W) between May 2001 and February 2003. Ten species of fish were examined: Ariidae_ *Hexanematichthys guatemalensis* (Günther, 1864) (Blue sea catfish, *n* = 223); Centropomidae_ *Centropomus nigrescens* (Günther, 1864) (Black snook, *n* = 35); Cichlidae_ *Cichlasoma trimaculatum* (Günther, 1867) (Three spot cichlid, *n* = 151); Eleotridae_ *Dormitator latifrons* (Richardson, 1937) (Pacific fat sleeper, *n* = 322), *Eleotris picta* (Kner and Steindachner, 1864) (Spotted sleeper, *n* = 31), *Gobiomorus maculatus* (Günther, 1859) (Pacific sleeper, *n* = 73); Gerridae_

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Diapterus peruvianus (Cuvier, 1830) (Peruvian mojarra, *n* = 42); Mugilidae_ *Mugil curema* (Valenciennes, 1836) (White mullet, *n* = 83); Lutjanidae_ *Lutjanus argentiventris* (Peters, 1869) (Yellow snapper, *n* = 28); and Poeciliidae_ *Poecilia sphenops* (Valenciennes, 1846) (Molly, *n* = 42).

Fish were collected using gill nets and angling at the El Embarcadero and transported to the Universidad Autónoma de Guerrero (UAG) laboratory. All fish were examined no more than 5 hours after collection. The complete necropsy included all organs except the blood. Internal and external metazoan parasites were collected, counted and processed according to Vidal-Martinez *et al*. (2001). Infection parameters were calculated and applied according to Bush *et al*. (1997); infection prevalence (% infected) and abundance (number of parasites per examined fish) were expressed as mean ± standard deviation followed by the intensity range. Autogenic species of parasite were defined as those that reach maturity in aquatic hosts and thus have a limited ability to colonize new locations. Allogenic species were those with birds or mammals as definitive hosts whose natural migrations favor dispersion, giving them a wide geographic distribution (Esch and Fernandez 1993). A conservative approach to parasite distribution was taken and based on published records in Mexican species of fish. Voucher specimens of most taxa were deposited in the Colección Nacional de Helmintos (CNHE), Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City, Mexico.

The parasite communities were analyzed at the component community level (Holmes and Price 1986), including all the parasites in all the fish of a single species. Component community parameters included the total number of species of parasite, the total number of individual parasites, the Shannon-Wiener Index (H) as a measure of diversity, and the Berger-Parker Index (BPI) as a measure of numerical dominance.

Results

Thirty-three species of metazoan parasite (31 helminth and 2 crustaceans) were recovered and identified from 10 species of fish (1,030 host specimens) collected from Coyuca Lagoon between May 2001 and February 2003. Of these, 4 were monogeneans, 17 digeneans (7 adults and 10 metacercariae), 3 cestodes (2 adults and 1 metacestode), 3 nematodes (1 adult and 2 larvae), 4 acanthocephalans (3 adults and 1 cystacanth), and 2 crustaceans (Table 1).

Fourteen species of helminth were recovered as larval stages parasitizing different organs, such as the heart, liver, intestine, mesentery, muscles, eyes and gills (see Table 1). Ten species of intestinal parasite were recovered as adults, and 3 species as both larvae and adults (*Pseudoacanthostomum panamense*, *Pseudolepto-rhynchoides lamothei* and *Neoechinorhynchus golvani*). Six of the species were widely distributed among the species of fish in the lagoon. The digenean *Pseudoacanthostomum panamense* and the copepod *Ergasilus* sp. were recovered from 10 species of host, the nematode *Contracaecum* sp. from 9, the digenean *Diplostomum* (*Austrodiplostomum*) *compactum*, as well as the crustacean *Argulus* sp., were found to infect 8 species of fish, and *Clinostomum complanatum* infected 6 species of fish. All other species of parasite were recovered from 1 to 3 species of hosts.

Of the 3 species of parasite that numerically dominated the documented local parasite fauna, *Ergasilus* sp. represented 28.2% (*n* = 37,177) of the total number of parasites (*n* = 132,023) collected from all of the fish. This species was followed numerically by the metacercariae of *Ascocotyle* (*Ph*.) *longa* (29,755 individuals = 22.5%) and *Pseudoacanthostomum panamense* (21,392 individuals = 16.2%).

Nineteen of the 33 species of parasite were classified as autogenic (lifecycle completed in the lagoon) and 14 as allogenic (mature in piscivorous birds visiting the lagoon). In terms from origin, 19 species of parasite had a freshwater distribution, 5 were estuarine, and 9 marine.

The number of species of parasite at the component community level ranged from 8 in *Mugil curema*, to 13 in *Eleotris picta* (Table 2). Three communities, those of *C. trimaculatum*, *G. maculatus* and *E. picta*, had a higher number of allogenic than autogenic species, and a high parasite load (total number of individual parasites). In contrast, the communities of *H. guatemalensis*, *C. nigrescens*, and *D. peruvianus* had a higher number of autogenic species and a lower number of individual parasites. The only exceptions were the communities of *D. latifrons*, *M. curema* and *L. argentiventris*, which had the same number of autogenic and allogenic species, the first two of these species of fish also had the highest parasite loads (Table 2).

TABLE 1. Species of parasite found in fishes from Coyuca Lagoon, Guerrero, Mexico.

Parasite	Site	CNHE	Hosts	N/Season	P(%)	Total	Abundance	Intensity
Monogenea								
Cornutushaptor nigrescens [Mw, Au] Mendoza-Franco, Violante-González & Vidal-Martínez, 2006	Gills	5432	*C. nigrescens* [Mw]	35/R03	33.3	196	5.6 ± 17.8	4–37
Neotetraonchus sp. [Bw, Au]	Gills		*H. guatemalensis* [Bw]	223/D02	56.1	1611	7.2 ± 13.1	1–73
Ligophorus mugilinus [Mw, Au] (Hargis, 1955)	Gills		*M. curema* [Mw]	83/R02	12.1	102	1.2 ± 13.0	1–45
Aristocleidus hastatus [Mw, Au] (Mueller, 1936)	Gills		*D. peruvianus* [Mw]	42/R03	92.9	1014	24.1 ± 26.6	2–126
Digenea (adult)								
Crassicutis cichlasomae [Fw, Au] (Manter, 1936)	Intestine	5011	*C. trimaculatum* [Fw]	118/R02 33/D03	21.2 33.3	72 14	0.6 ± 2.9 0.4 ± 0.5	1–12 1–2
Neoapocreadium marina [Mw, Au] (Manter, 1947)	Intestine	5005	*D. peruvianus*	42/R03	45.2	574	13.7 ± 29.1	1–100
Paracryptogonimus sp. [Mw, Au]	Intestine	4905	*C. nigrescens*	35/R03	77.8	532	15.2 ± 16.5	3–41
			L. argentiventris [Mw]	28/D03	70.8	874	31.2 ± 72.7	2–230
Pseudoacanthostomum panamense [Bw, Au] Caballero, Bravo-Hollis & Grocott, 1953	Intestine	4904	*H. guatemalensis*	223/D02	85.7	1435	6.4 ± 10.7	1–78
Pseudacaenodera cristata [Mw, Au] (Yamaguti, 1965)	Intestine	5006	*D. peruvianus*	42/R03	57.1	75	1.8 ± 3.9	1–19
Saccocoelioides sp. [Fw, Au]	Intestine	4906	*D. latifrons* [Fw]	219/R01 103/D02	39.3 42.7	430 660	2.1 ± 5.0 6.4 ± 15.4	1–27 4–75
Saccocoelioides sogandaresi [Fw, Au] (Lumsden, 1961)	Intestine	4908	*P. sphenops* [Fw]	42/R03	10.7	12	0.3 ± 2.3	1–5
Digenea (larval)								
Ascocotye (*Phagicola*) *longa* [Bw, Al] (Ransom, 1920)	Heart, mesentery, liver	4901	*D. latifrons*	103/D02	0.6	10	0.03 ± 5.7	1–9
			G. maculatus [Fw]	73/R02	2.7	4	0.01 ± 5 1.4	1–3
			C. trimaculatum	118/R02 33/D03	2.5 9.1	147 63	1.2 ± 81.4 1.9 ± 29.5	1–143 1–55
			E. picta [Fw]	31/D01	9.7	147	49.0 ± 62.4	3–120
			C. nigrescens	35/R03	5.2	12	0.2 ± 2.7	2–7
			P. sphenops	42/R03	29.2	105	2.5 ± 2.5	1–9
			D. peruvianus	42/R03	5.26	15	0.1 ± 1.2	1–4
			M. curema	83/R02	100	29584	354.0 ± 239.8	35–1512
Centrocestus formosanus [Fw, Al] (Nishigori, 1924)	Gills	4903	*P. sphenops*	42/R03	96.4	2041	48.6 ± 46.8	2–230

to be continued.

TABLE 1. (continued)

Parasite	Site	CNHE	Hosts	N/Season	P(%)	Total	Abundance	Intensity
Cladocystis trifolium [Fw, Al] (Braun, 1901)	Gills	4902	*C. trimaculatum*	118/R02 33/D03	42.4 42.4	491 38	4.2 ± 11.6 1.2 ± 1.7	1–53 1–6
Clinostomum complanatum [Fw, Al] (Rudolphi, 1814)	Liver, mesen-tery, muscle, body cavity	5007	*D. latifrons*	219/R01 103/D02	41.1 25.2	719 170	3.3 ± 15.9 1.7 ± 10.8	1–97 1–49
			G. maculatus	73/R02	12.3	52	0.7 ± 8.6	1–27
			C. trimaculatum	118/R02 33/D03	11.0 12.1	32 6	0.3 ± 4.1 0.2 ± 0.6	1–16 1–2
			M . curema	83/R02	1.2	2	0.02	2–2
			H. guatemalensis	223/D02	0.9	4	0.02 ± 1.4	1–3
			E. picta	31/D01	32.3	575	57.5 ± 57.4	2–167
Diplostomum (*Austrodiplostomum*) *compactum* [Fw, Al] (Lutz, 1928)	Eyes	5012	*C. nigrescens*	35/R03	11.1	3	0.1	1–1
			P. sphenops	42/R03	35.7	16	0.4 ± 0.4	1–2
			L. argentiventris	28/D03	16.7	6	0.2	1–1
			M . curema	83/R02	10.8	25	0.3 ± 2.4	1–8
			G. maculatus	73/R02	1.4	1	0.01	1–1
			C. trimaculatum	118/R02 33/D03	19.5 18.2	59 31	0.5 ± 4.1 0.9 ± 6.2	1–21 1–15
			H. guatemalensis	223/D02	2.2	5	0.02	1–1
			E. picta	31/D01	6.5	3	1.5 ± 0.7	1–2
Echinochasmus leopoldinae [Fw, Al] Scholz, Ditrich & Vargas-Vázquez, 1996	Gills, inside stomach wall	4911	*D. latifrons*	219/R01 103/D02	24.2 36.9	6966 9538	31.8 ± 327.9 92.6 ± 416.8	11–2200 32–2250
			P. sphenops	42/R03	92.7	2893	68.9 ± 86.8	15–426
			C. nigrescens	35/R03	1.7	2	0.03	2–2
			L. argentiventris	28/D03	20.8	20	0.7 ± 2.5	1–7
Haplorchis sp. [Fw, Al]	Gills	5015	*D. peruvianus*	42/R03	11.9	8	0.2 ± 0.6	1–2
Metadena sp. [Bw, Al]	Liver, Intestine	4913	*L. argentiventris*	28/D03	16.7	36	1.3	8–8
			G. maculatus	73/R02	4.1	41	0.6 ± 4.2	9–17
			H. guatemalensis	223/D02	1.8	76	0.3 ± 24.5	1–54
Pseudoacanthostomum panamense [Bw, Au] Caballero, Bravo-Hollis & Grocott, 1953	Gills, muscle, inside intestine wall	4904	*D. latifrons*	219/R01 103/D02	81.3 89.3	4915 3091	22.4 ± 39.7 30.0 ± 41.6	1–297 1–272
			D. peruvianus	42/R03	26.2	122	2.9 ± 26.6	1–91
			L. argentiventris	28/D03	33.3	1198	42.8 ± 177.5	3–254
			C. nigrescens	35/R03	11.1	7	0.2	2–2
			M. curema	83/R02	3.6	8	0.1 ± 1.5	1–4
			G. maculatus	73/R02	86.3	12932	177.2 ± 470.8	1–2878
			C. trimaculatum	118/R02 33/D03	6.8 12.1	36 9	0.3 ± 4.4 0.3 ± 1.3	1–13 1–4

to be continued.

TABLE 1. (continued)

Parasite	Site	CNHE	Hosts	N/Season	P(%)	Total	Abundance	Intensity
			E. picta	31/D01	12.9	20	5.0 ± 4.6	1–11
			P. sphenops	42/R03	2.8	131	2.9 ± 79.9	9–122
Posthodiplostomum minimum [Fw, Al] (MacCallum, 1921)	Muscle, behind eye	5013	*P. sphenops*	42/R03	46.4	117	2.8 ± 7.8	1–22
			C. trimaculatum	118/R02 33/D03	11.8 30.3	47 39	0.4 ± 3.4 1.2 ± 4.8	1–13 1–17
Tylodelphys sp. [Fw, Al]	Eyes	5014	*E. picta*	31/D01	3.2	1	1.0	1–1
Cestoda								
Parvitaenia cochlearii [Fw, Al] (Coil, 1955)	Liver	4915	*D. latifrons*	219/R01 103/D02	54.3 44.7	2598 347	11.9 ± 56.6 3.4 ± 11.7	1–500 1–64
			G. maculatus	73/R02	32.9	98	1.3 ± 2.7	1–10
			E. picta	31/D01	6.5	10	5.0 ± 2.8	3–7
Proteocephalus chamelensis [Fw, Au] Pérez, Brooks & Berman, 1995	Intestine	5035	*E. picta*	31/D01	77.4	352	14.7 ± 24.7	1–121
Proteocephalus sp. [Mw, Au]	Intestine	5036	*C. nigrescens*	35/R03	44.4	15	1.7 ± 3.6	1–9
Nematoda								
Contracaecum sp. [Fw, Al]	Intestine, mesen- tery, liver, muscle	4914	*C. trimaculatum*	118/R02 33/D03	58.5 36.4	339 59	2.9± 7.1 1.8 ± 5.3	1–47 1–19
			C. nigrescens	35/R03	11.1	24	0.7	6–6
			D. peruvianus	42/R03	2.4	1	0.02	1–1
			P. sphenops	42/R03	7.1	5	0.1 ± 0.7	1–2
			L. argentiventris	28/D03	16.7	19	0.7	4–4
			D. latifrons	219/R01 103/D02	11.0 7.8	92 10	0.4 ± 5.6 0.1 ± 0.5	1–27 1–2
			M . curema	83/R02	50.6	319	3.8 ± 10.1	1–50
			G. maculatus	73/R02	42.5	157	2.2 ± 9.2	1–48
			E. picta	31/D01	93.6	3672	126.6 ± 176.1	1–657
Hysterothylacium perezi [Bw, Au] Gopar-Merino, Osorio-Sarabia & García-Prieto, 2005	Intestine	4916	*H. guatemalensis*	223/D02	37.2	394	1.8 ± 5.4	1–30
Gnathostoma sp. [Fw, Al]	Muscle	4912	*E. picta*	31/D01	16.1	6	1.2 ± 0.5	1–2
			G. maculatus	73/R02	1.4	1	0.01	1–1
Acanthocephala								
Pseudoleptorhynchoides lamothei [Bw, Au] (Salgado-Maldonado, 1976)	Intestine	4918	*H. guatemalensis*	223/D02	18.4	97	0.4 ± 2.2	1–12
Floridosentis mugilis [Mw, Au] (Machado, 1951)	Intestine	4919	*M. curema*	83/R02	9.6	20	0.2 ± 2.0	1–7
Neoechinorhynchus golvani [Fw, Au] (Salgado-Maldonado, 1978)	Intestine	4920	*D. latifrons*	219/R01 103/D02	83.6 84.5	1353 1606	2.2 ± 12.5 15.6 ±20.7	1–112 1–105
			L. argentiventris	28/D03	16.7	20	0.7	4–4
			C. nigrescens	35/R03	11.1	4	0.1	1–1
			G. maculatus	73/R02	16.4	235	3.2 ± 20.3	1–64

to be continued.

TABLE 1. (continued)

Parasite	Site	CNHE	Hosts	N/Season	P(%)	Total	Abundance	Intensity
			C. trimaculatum	118/R02	0.8	2	0.02	2–2
				33/D03	15.2	16	0.5 ± 1.6	2–5
			E. picta	31/D01	3.2	2	2.0	2–2
Southwellina hispida [Fw, Al] (Van Cleave, 1925)	Liver, mesen-tery	4917	*C. trimaculatum*	118/R02	11.0	21	0.2 ± 0.8	1–3
				33/D03	15.2	5	0.2	1–1
			E. picta	31/D01	22.6	19	2.7 ± 2.9	1–9
			G. maculatus	73/R02	4.11	4	0.05 ± 0.6	1–2
			C. nigrescens	35/R03	3.4	3	0.05 ± 0.7	1–2
			L. argentiventris	28/D03	12.5	10	0.3 ± 2.9	1–6
Crustacea								
Argulus sp. [Fw]	Skin, fins		*D. peruvianus*	42/R03	4.8	3	0.1 ± 0.7	1–2
			H. guatemalensis	223/D02	1.3	3	0.01	1–1
			C. trimaculatum	118/R02	3.4	5	0.04 ± 0.5	1–2
				33/D03	9.1	3	0.1	1–1
			D. latifrons	219/R01	5.0	19	0.1 ± 1.7	1–6
				103/D02	1.9	2	0.02	1–1
			G. maculatus	73/R02	1.4	1	0.01	1–1
			P. sphenops	42/R03	7.1	4	0.1	1–1
			L. argentiventris	28/D03	33.3	9	0.3	1–1
			E. picta	31/D01	29.0	47	5.2 ± 11.2	1–35
Ergasilus sp. [Fw]	Gills		*C. nigrescens*	35/R03	88.9	6125	175.0 ± 143.6	2–382
			D. peruvianus	42/R03	11.9	28	0.7 ± 8.6	1–21
			L. argentiventris	28/D03	100	5174	184.8 ± 156.8	8–380
			D. latifrons	219/R01	80.8	2203	10.1 ± 12.1	1–76
				103/D02	87.4	1684	16.3 ± 16.1	1–63
			M . curema	83/R02	81.9	682	8.2 ± 10.3	1–63
			G. maculatus	73/R02	17.8	38	0.5 ± 4.6	1– 18
			C. trimaculatum	118/R02	100	2274	192.8 ± 75.6	74–558
				33/D03	100	8 4784	145.0 ± 33.9	76–254
			H. guatemalensis	223/D02	0.9	2	0.01	1–1
			E. picta	31/D01	100	5434	175.3 ± 127.5	28–551
			P. sphenops	42/R03	1.4	1	0.01	1–1

Distribution of parasite and host. Freshwater (Fw), Brackish water (Bw), Marine water (Mw). Colonization strategy: Au = autogenic specie, Al = allogenic specie. CNHE: National Helminth Collection. N = number of examined host. Seasons: Dry (December–May), Rainy (June–November). P(%) = infection prevalence (% infected). Total = total number of individual parasites. Abundance (number of parasites per examined fish ± standard deviation); Intensity (range as min–max).

The crustacean *Ergasilus* sp. was numerically dominant in 4 of the component communities, and *Echinochasmus leopodinae* in 2. Shannon-Wiener diversity index values ranged from 0.29 in the component community of *Mugil curema* to 2.22 in that of *Dormitator latifrons* (Table 2).

TABLE 2. Characteristics of the metazoan parasite component communities of fishes from Coyuca Lagoon, Guerrero, Mexico.

Host	No. of Host	No. of species	Autogenic	Allogenic	No. of parasites	BPI	Dominant species	H
H. guatemalensis Bw	223	9	5	4	3627	0.44	Neo	1.69
C. trimaculatum Fw	151	12	3	9	25930	0.94	Erga	0.47
G. maculatus Fw	73	12	3	9	13563	0.95	Pseu	0.38
M. curema Mw	83	8	4	4	30542	0.96	Asco	0.29
D. latifrons Fw	322	10	5	5	37412	0.47	Echi	2.22
L. argentiventris Mw	28	10	5	5	7365	0.53	Erga	1.47
P. sphenops Fw	42	10	4	6	5318	0.57	Echi	1.18
C. nigrescens Mw	35	11	6	5	6943	0.88	Erga	0.70
D. peruvianus Mw	42	9	6	3	1825	0.56	Aris	1.59
E. picta Fw	31	13	5	8	10288	0.53	Erga	1.60

Distribution of host: Freshwater (Fw), Brackish water (Bw), Marine water (Mw). BPI = Berger-Parker Index; H = Shannon-Wiener diversity index. Asco = *Ascocotye* (*Ph.*) *longa*, Aris = *Aristocleidus hastatus*, Echi = *Echinochasmus leopoldinae*, Neo = *Neotetraonchus* sp., Pseu = *Pseudoacanthostomum panamense*, Erga = *Ergasilus* sp.

Discussion

The parasite fauna of the 10 species of fish collected from Coyuca Lagoon is composed of 33 species of parasite (31 helminth and 2 crustaceans). Mean number of species of parasite per species of fish (2.76 species of parasite) was higher than that reported for Chamela Bay, Jalisco, Mexico (mean = 1.23 species; 92 helminth taxa in 114 host species) (Pérez-Ponce de León *et al*. 1999). The high parasite fauna richness recorded in Coyuca Lagoon is may be the result of longer-term monitoring (2 years) than of the study of Chamela Bay. The present study spanned different climatic seasons (dry and rains), which allowed detection of a higher number of rare species within the parasite communities of each host species (Zander 2005). However, the actual parasite fauna in this lagoon is probably richer than that recorded in the present study because ichthyofauna of Coyuca Lagoon comprises 34 species of fish from 25 genera and 16 families (Yañez-Arancibia 1978), of which only 10 species of fish (29.4% of the ichthyofauna; 50% of all reported fish families) were examined in the present study.

Twenty-eight of the species of parasite recorded in fish from Coyuca Lagoon have been reported previously in the same or different host species from other locations in Mexico (Salgado-Maldonado 1976; Lamothe-Argumedo *et al*. 1997; Pérez-Ponce de León *et al*. 1999; Scholz *et al*. 1999; Scholz and Salgado-Maldonado 2000; Salgado-Maldonado *et al*. 2001a, b; Scholz *et al*. 2001; Scholz and Salgado-Maldonado 2001; Vidal-Martínez *et al*. 2001; Montoya-Mendoza *et al*. 2004; Salgado-Maldonado *et al*. 2004a, b; Pineda-López *et al*. 2005; Salgado-Maldonado *et al*. 2005a, b). However, all the species of parasite identified here represents first zoogeographical host records for Coyuca Lagoon, Guerrero, Mexico.

The digenean (7 adults and 10 metacercariae) dominated the identified parasite fauna of fish from Coyuca Lagoon. This pattern is similar to that reported for freshwater fish parasite communities in Mexico (Salgado-Maldonado *et al*. 2001a, b; Salgado-Maldonado *et al*. 2004a, b; Pineda-López *et al*. 2005). Monogeneans (4 species) were recorded only in marine and brackish water fish. Cestodes (3 species), nematodes (3 species), and acanthocephalans (4 species) were less abundant, which, at least for acanthocephalans, is probably due to their being very rare in freshwater fish in Mexico (Salgado-Maldonado *et al*. 1992; Salgado-Maldonado *et al*. 2004a, b). Nonetheless, the presence of as many as 4 species of Acanthocephala and 3 species of cestode in a single location is noteworthy, and may result from the lagoon's high productivity, which favors production of the zooplankton which act as intermediary hosts for these helminth parasites (Marcogliese 1995). This high productivity may also explain the very high abundance (28.2% of all identified individuals) of the copepod, *Ergasilus* sp.

Parasite fauna species composition included a higher number of autogenic species (19), 8 of which were marine species, 4 estuarine and 7 freshwater (Table 1). Most of the autogenic species exhibited high ecological specificity (Bush *et al*. 2001) since 14 were recovered from a single species of fish: *Aristocleidus hastatus*, *Cornutushaptor nigrescens*, *Ligophorus mugilinus*, *Neotetraonchus* sp., *Crassicutis cichlasomae*, *Neoapocreadium marina*, *Saccocoelioides* sp., *Saccocoelioides sogandaresi*, *Pseudacaenodera cristata*, *Proteocephalus* sp., *Proteocephalus chamelensis*, *Hysterothylacium perezi*, *Floridosentis mugilis* and *Pseudoleptorhynchoides lamothei*. The autogenic species *Pseudoacanthostomum panamense* and *Neoechinorhynchus golvani* were recovered from several species of fish (10 and 6, respectively), but reached maturity only in a single species fish (*Hexanematichthys guatemalensis* and *Dormitator latifrons*, respectively).

Although the number of allogenic species was lower (14) than the number of autogenic species (19), allogenic species were more widely shared among hosts from different origins and were represented by a larger number of individuals (62.3%). *Diplostomum* (*A.*) *compactum*, *Clinostomum complanatum* and *Contracaecum* sp., 3 of the 6 allogenic species more widely shared among the fish that were collected, have been commonly recorded in atherinids, goodeids, cichlids, poeciliids, characids, pimelodids, and other fish families from southern Mexico and the Ayuquila, Balsas, Panuco, Papaloapan and Lerma-Santiago river basins (Pineda-López *et al*. 1985; Osorio-Sarabia *et al*. 1987; Moravec *et al*. 1995; Scholz *et al*. 1995; Salgado-Maldonado and Kennedy 1997; Salgado-Maldonado *et al*. 2001a, b; Salgado-Maldonado *et al*. 2004a, b; Pineda-López *et al*. 2005; Salgado-Maldonado *et al*. 2005a, b). These allogenic helminth species are also widely distributed in North America, and are cosmopolitan (Yamaguti 1971; Gibson 1996; Hoffman 1999). Dominance of allogenic species in Coyuca Lagoon in terms of number of individuals is probably due to the lagoon's high productivity, the result of extreme eutrophication, and an abundance of resident and migratory piscivorous birds, which act as final hosts for all of the allogenic species. High productivity promotes herbivore and detritivore populations, which are the preferred intermediate hosts for allogenic parasites (Zander and Reimer 2002), and the lagoon's shallow depth (Violante-González 2006) and abundant species of fish provide excellent feeding conditions for piscivorous birds, which form dense colonies along the banks of the lagoon. This situation is characteristic of many tropical and temperate eutrophic environments (Esch and Fernández 1993; Pineda-López 1994; Salgado-Maldonado and Kennedy 1997; Zander and Reimer 2002).

The parasite fauna of Coyuca Lagoon fish also includes an anthropogenically-introduced helminth species, the metacercariae of *Centrocestus formosanus*, and 1 with public health repercussions, the nematode *Gnathostoma* sp. Metacercariae of *Centrocestus formosanus* were most likely introduced to Mexico with the imported thiarid snail *Melanoides tuberculata* (Müller, 1774), its initial host (Scholz and Salgado-Maldonado, 2000). In Coyuca Lagoon, *C. formosanus* was only recorded co-occurring with *Echinochasmus leopoldinae* in the gills of *Poecilia sphenops* (Poecilidae). *Gnathostoma* sp. has been recorded in the species of fish (*Hexanematichthys guatemalensis*, *Cichlasoma trimaculatum*, *Dormitator latifrons*, *Eleotris picta* and *Gobiomorus maculates*) from Tres Palos Lagoon (García-Prieto *et al*. 2003). In the present study, however, it was only recovered from *E. picta* and *G. maculatus*.

Composition of parasite fauna in Coyuca Lagoon exhibits a clear freshwater influence given that 19 (57.5%) of the 33 identified parasite species are from freshwater environments. This influence may be linked to the lagoon's oligohaline condition (1.5 to 5 ppm), the result of its predominantly freshwater input from rainfall and only temporary connection with the sea during the rainy season (Violante-González 2006). Similar species composition of parasites has been reported from low salinity (0.5 - 3.5 $^{o}/_{oo}$), temperate, brackish-water environments in which marine species represented only 12.69% of the 31 species of parasite recovered from fish, and freshwater species dominated the community composition (Valtonen *et al*. 2001).

The component communities of parasites in fish from Coyuca Lagoon were generally poor in species (7 to 13 species of parasite), highly numerically dominated, and were of low diversity (0.29 to 2.2) compared to those of tropical cichlids from other Mexican lagoons: *Vieja synspila* (29 species, Santa Anita), *Cichlasoma hellery* (22 species, Las Ilusiones), (Pineda-López 1994) and *Cichlasoma urophthalmus* (23 species, El Vapor) (Salgado-Maldonado and Kennedy 1997). However, the richness at this level was similar to that reported for species of cichlids from other lagoons, such as Chelem (11 species of parasite) and Rio Lagartos (11 species) (Salgado-Maldonado and Kennedy 1997). Finally, the Shannon-Wiener diversity index values were higher than reported for parasite communities of cichlids by Salgado-Maldonado and Kennedy (1997) (0.48 to 0.90).

The overall results suggest that richness of parasite fauna could be higher than reported here (33 species of parasite) if a greater number of species of fish were examined. Study of other species of fish in the lagoon will help generate a more complete inventory of the parasite fauna in Coyuca Lagoon.

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