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SHORT COMMUNICATION

A checklist of metazoan parasites of fish from Tres Palos Lagoon, Guerrero, Mexico

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Abstract An extensive survey of helminth parasites in fish species from Tres Palos Lagoon, in Guerrero, Mexico, resulted in identification of 39 metazoan parasite species (37 helminth and 2 crustaceans) in 13 fish species (n= 1,498). Specimen collection in this coastal lagoon was done between April 2000 and November 2003. Digenean species (18, 8 adult and 10 metacercariae) dominated the parasite fauna. The most widespread species of parasite were: *Contracaecum* sp. (Nematoda), *Pseudoacanthostomum panamense*, *Austrodiplostomum compactum*, *Ascocotye* (*Phagicola*) *longa* (Digenea), *Neoechinorhynchus golvani* (Acanthocephala), *Ergasilus* sp. (Copepoda), and *Argulus* sp. (Branchiura). Parasite fauna species composition exhibited a clear freshwater influence as 56.4% (22 of 39) of the identified species have a freshwater distribution in Mexico. For 32 of the parasite species, this report constitutes the first geographical host record for Tres Palos Lagoon, Guerrero, Mexico.

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Introduction

Tres Palos Lagoon (99°47′W; 16°48′N) is one of the most important aquatic resources in the state of Guerrero, Mexico because of its size (55 km^2) and fishery production (approximately 900 tons/year; Sagarpa 2000). Located on the coast, it is predominantly oligohaline (1.5 to 5 ppm) during most of the year but experiences marine influence during the rainy season when seasonal breaches open between the lagoon and the sea. Marine species enter the lagoon during this season and have a strong influence on its ichthyofauna (Violante-González 2006). Its high productivity and the wide variety of fish species from different origin (i.e., freshwater, brackish water, and marine water) make the lagoon an ideal habitat to support a rich local parasite fauna. However, published research on the parasite fauna in the fish species of Tres Palos Lagoon is still limited, consisting of studies of two nematode species (García-Prieto et al. 2003; Gopar-Merino et al. 2005), the parasite community of one fish species (Garrido-Olvera et al. 2004), and more recently some monogeneans species of one centropomid fish (Mendoza-Franco et al. 2006).

Therefore, the aim of the present study was to generate a first inventory of the parasite fauna from fish of different origins in Tres Palos Lagoon to contribute in the development of future research on metazoan parasites from fish in the coastal lagoons of the state of Guerrero, Mexico.

Materials and methods

A total of 1,498 fish were collected from Tres Palos Lagoon between April 2000 and November 2003. The following 13 fish species were examined: Ariidae—*Hexanematichthys guatemalensis* (Günther 1864; blue sea catfish, n=220);

Table 1 Parasite species found in fishes from the Tres Palos Lagoon, Guerrero, Mexico

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
Trematoda (adult)								
Crassicutis cichlasomae (Fw, Au) Manter 1936	Intestine	5011	*C. trimaculatum* (Fw)	24/D00	8.3	13	6.5±7.8	1−12
				72/R00	36.1	567	21.8±40.1	1−207
				48/D01	16.7	32	4.0±3.6	1−12
				63/R02	9.5	17	2.8±2.1	1−7
Magnivitellinum simplex (Fw, Au) Kloss, 1966	Intestine	4907	*A. fasciatus* (Fw)	37/R03	10.8	1	1.0	1−1
Neoapocreadium marina (Mw, Au) Manter, 1947	Intestine	5005	*D. peruvianus*	95/R03	28.4	590	21.8±27.5	1−100
Paracryptogonimus sp. (Mw, Au)	Intestine	4905	*C. nigrescens*	58/R03	50.0	411	14.2±20.7	3−92
			C. robalito	47/R03	55.3	302	11.6±20.8	1−59
			L. argentiventris	24/D04	70.8	749	44.1±72.7	6−230
Pseudacaenodera cristata (Mw, Au) Yamaguti, 1965	Intestine	5006	*D. peruvianus*	95/R03	43.2	116	2.8±3.1	1−19
Pseudoacanthostomum panamense (Bw, Au) Caballero, Bravo-Hollis and Grocott, 1953	Intestine	4909	*H. guatemalensis*	24/D00	16.7	17	4.2±2.6	2−7
				87/R00	11.5	69	6.9±10.8	2−37
				48/D01	12.5	18	3.0±1.8	1−6
				48/D02	27.1	181	1398±15.8	2−59
Saccocoelioides sp. (Fw, Au)	Intestine	4906	*D. latifrons* (Fw)	24/D00	12.5	6	2.0±1.0	1−3
				73/R00	37.0	489	18.1±18.1	1−98
				48/D01	56.3	256	9.5±10.1	2−34
				50/D02	54.0	2134	79.5±102.6	1−426
				12/R02	50.0	234	39.0±19.7	18−72
Saccocoelioides sogandaresi (Fw, Au) Lumsden, 1961	Intestine	4908	*P. sphenops* (Fw)	72/R03	5.6	9	2.2±1.9	1−5
Ascocotye (*Phagicola*) *longa* (Bw, Al) Ransom, 1920	Heart, mesentery, liver	4901	*C. trimaculatum*	24/D00	4.2	2	2.0	2−2
				72/R00	2.8	6	3.0	3−3
				63/R02	6.3	8	2.0±0.8	1−3
			D. latifrons	24/D00	8.3	6	3.0±1.4	2−4
				73/R00	1.4	1	1.0	1−1
				50/D02	4.0	6	3.0±1.4	2−4
				12/R02	8.3	1	1.0	1−1
			E. picta (Fw)	22/D02	45.5	1212	121.2±223.1	2−690
			G. maculatus (Fw)	62/R02	29.0	692	38.4±43.8	1−173
			M. curema	24/D00	100	7643	318.5±95.0	268−562
				72/R00	100	23813	331.0±112.0	174−624
				47/D01	100	16270	346.2±79.4	258−548
				51/R02	100	19982	392±169.0	217−805
			A. fasciatus	37/R03	2.7	2	2.0	2−2
			C. nigrescens	58/R03	5.2	12	4.0±2.7	2−7
			C. robalito	47/R03	2.1	6	6.0	6−6
			D. peruvianus	95/R03	5.3	15	3.0±1.2	1−4
			P. sphenops	72/R03	29.2	92	4.4±2.5	1−9
Austrodiplostomum compactum (Fw, Al) Lutz, 1928	Eyes	5012	*H. guatemalensis*	24/D00	12.5	5	1.7±0.6	1−2
				87/R00	11.5	16	1.6±0.8	1−3
				48/D01	23.0	30	2.7±1.7	1−6
				48/D02	12.5	20	3.3±4.0	1−11
			C. trimaculatum	24/D00	25.0	7	1.2±0.4	1−2
				72/R00	37.5	51	1.9± 0.6	1−3
				63/R02	27.0	59	3.5±2.7	1−10
			E. picta	22/D02	4.6	1	1.0	1−1
			G. maculatus	62/R02	1.6	1	1.0	1−1
			M. curema	24/D00	8.3	3	1.5±0.7	1−2
				72/R00	11.1	11	1.4±0.1	1−2

Table 1 (continued)

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
				47/D01	2.1	1	1.0	1–1
				51/R02	6.0	3	1.0	1–1
			A. fasciatus	37/R03	29.7	11	1.0	1–1
			C. nigrescens	58/R03	3.5	2	1.0	1–1
			C. robalito	47/R03	4.3	7	3.5±2.1	2–5
			D. peruvianus	95/R03	5.3	15	1.2±1.2	1–4
			P. sphenops	72/R03	29.2	92	1.5±2.5	1–9
Centrocestus formosanus (Fw, Al) Nishigori, 1924	Gills	4903	*A. fasciatus*	37/R03	21.6	56	7.0±11.1	1–34
			P. sphenops	72/R03	81.9	1907	32.32±43.0	1–230
Cladocystis trifolium (Fw, Al) Braun, 1901	Gills	4902	*C. trimaculatum*	72/R00	4.2	10	3.3±4.0	1–8
				48/D01	4.2	3	1.5	1–2
				63/R02	25.4	52	3.2±6.4	1–27
Clinostomum complanatum (Fw, Al) Rudolphi, 1814	Liver, mesentery, muscle, body cavity	5007	*E. picta*	68/R00	38.2	368	5.4±23.5	1–99
				35/D01	62.9	759	21.7±46.1	1–162
				22/D02	59.1	276	12.5±26.9	1–93
			C. trimaculatum	24/D00	25.0	35	5.8±4.6	1–13
				72/R00	25.0	129	7.2±8.1	1–30
				48/D01	12.5	35	5.8±7.5	1–21
				63/R02	14.3	163	18.1±47.2	1–144
			D. latifrons	24/D00	29.2	226	32.3±56.6	4–160
				73/R00	16.4	24	2.0±1.8	1–7
				48/D01	12.5	75	12.5±18.8	1–50
				50/D02	26.0	135	10.4±19.7	1–29
				12/R02	8.3	20	20.0	1–20
			M. curema	47/D01	2.8	2	2.0	2–2
			H. guatemalensis	24/D00	4.2	2	2.0	2–2
				87/R00	3.5	6	2.0	1–4
				48/D01	2.1	2	2.0	2–2
				48/D02	8.3	6	1.5±0.6	1–2
			G. maculatus	24/D00	16.7	6	1.5±0.6	1–2
				65/R00	33.8	102	4.6±5.7	1–19
				34/D01	35.3	17	1.4±0.5	1–2
				62/R02	6.4	55	13.8±22.8	1–48
Echinochasmus leopoldinae (Fw, Al) Scholz, Ditrich and Vargas-Vázquez, 1996	Gills, inside stomach wall	4911	*A. fasciatus*	37/R03	94.6	224	6.4±5.4	1–23
			C. nigrescens	58/R03	1.7	2	2.0	2–2
			G. sagittula (Bw)	27/D04	29.6	13	1.6±0.7	1–3
			L. argentiventris	24/D04	20.8	17	3.4±2.5	1–7
			D. latifrons	24/D00	87.5	11439	544.7±180.6	366–1050
				73/R00	30.1	3690	167.7±291.2	2–710
				48/D01	39.6	6233	328.1±399.0	3–1355
				50/D02	76.0	13105	344.9±326.2	3–1050
				12/R02	50.0	4558	759.9±383.6	300–1400
			P. sphenops	72/R03	95.8	9394	136.1±147.6	15–655
Haplorchis sp. (Fw, Al)	Gills	5015	*D. peruvianus*	95/R03	10.5	27	2.7±2.7	1–10
Metadena sp. (Bw, Al)	Liver	4913	*G. sagittula*	27/D04	55.6	37	2.5±2.2	1–9
	Stomach		*H. guatemalensis*	24/D00	8.3	4	2.0±1.4	1–3
				48/D01	4.2	8	4.0±2.9	2–6
				48/D02	6.3	22	7.3±4.2	4–12
Posthodiplostomum minimum (Fw, Al) MacCallum, 1921	Muscle, behind eye	5013	*C. nigrescens*	58/R03	10.3	11	6.0±0.7	3–9
			P. sphenops	72/R03	37.5	105	3.9±5.7	1–22
			C. trimaculatum	72/R00	13.9	35	3.5±0.8	2–5
				48/D01	16.7	37	4.6±1.4	3–7
				63/R02	36.5	129	5.6±6.8	1–27
Pseudoacanthostomum panamense (Bw, Au)	Gills, muscle, inside intestine wall	4904	*D. latifrons*	24/D00	54.2	95	7.3±6.8	1–25
				73/R00	14.0	65	6.5±4.0	1–25

Table 1 (continued)

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
Caballero, Bravo-Hollis and Grocott, 1953				48/D01	16.7	40	5.0±5.0	1–13
				50/D02	50.0	197	7.8±6.1	1–16
				12/R02	25.0	11	3.7±5.0	1–9
			C. nigrescens	58/R03	10.3	11	1.8±0.7	1–3
			C. robalito	47/R03	6.4	7	2.3±2.3	1–5
			C. trimaculatum	48/D01	27.1	56	4.3±4.3	1–15
				63/R02	15.9	72	7.2±9.6	1–30
			L. argentiventris	24/D04	8.3	257	128.5±177.5	3–254
			G. maculatus	24/D00	25.0	54	9.0±5.3	3–15
				65/R00	26.1	99	5.8±3.0	2–12
				34/D01	44.1	172	11.5±11.4	2–47
				62/R02	77.4	3736	77.8±118.4	1–516
			D. peruvianus	95/R03	15.8	187	12.5±25.7	1–91
			E. picta	68/R00	4.4	26	8.7±5.5	5–15
				35/D01	14.3	15	3.0±3.1	1–8
				22/D02	27.3	60	10.0±11.7	2–33
			G. sagittula	27/D04	70.4	109	5.7±5.3	1–19
			P. sphenops	72/R03	2.8	131	65.5±79.9	9–122
Tylodelphys sp. (Fw, Al)	Eyes	5014	*E. picta*	22/D02	4.6	2	2.0	2–2
Monogenea								
Aristocleidus hastatus (Mw, Au) Mueller, 1936	Gills		*D. peruvianus* (Mw)	95/R03	42.1	1015	25.4±26.6	4–126
Cornutohaptor nigrescensi (Mw, Au) Mendoza-Franco et al. 2006	Gills	5432	*C. nigrescens* (Mw)	58/R03	13.8	81	10.1±11.9	2–37
Ligophorus mugilinus (Mw, Au) Hargis, 1955	Gills	5010	*M. curema* (Mw)	24/D00	16.7	15	3.7±2.0	2–6
				72/R00	15.3	28	2.5±1.4	1–6
				47/D01	6.4	9	3.0±1.0	2–4
				51/R02	4.0	22	11.0±11.3	3–19
Microcotyloides incisa (Mw, Au) Linton, 1910	Gills		*L. argentiventris* (Mw)	24/D04	12.5	28	9.3±6.5	3 − 16
Neotetraonchus sp. (Bw, Au)	Gills	5009	*H. guatemalensis* (Bw)	24/D00	29.2	10	1.4±0.8	1–3
				87/R00	18.4	66	4.1±4.3	2–19
				48/D01	18.7	19	2.1±0.8	1–3
				48/D02	48.0	88	3.8±4.3	1–15
Rhabdosynochus sp. (Mw, Au)	Gills		*C. robalito* (Mw)	47/R03	44.7	151	7.2±7.9	1–32
Cestoda (adult)								
Proteocephalus sp. (Mw, Au)	Intestine	5036	*C. nigrescens*	58/R03	39.7	72	3.1±2.4	1–9
Proteocephalus chamelensis (Fw, Au) Pérez, Brooks and Berman, 1995	Intestine	5035	*E. picta*	68/R00	79.4	542	10.0±10.4	1–54
				35/D01	91.4	233	7.3±7.1	1–33
				22/D02	59.1	231	17.8±31.4	1–121
Cestoda (larvae)								
Parvitaenia cochlearii (Fw, Al) Coil, 1955	Liver	4915	*E. picta*	22/D02	13.6	17	5.7±2.3	3–7
			D. latifrons	24/D00	8.3	7	3.5±0.7	3–4
				73/R00	52.0	1238	32.6±41.1	5–200
				48/D01	33.3	229	14.3±22.7	1–80
				50/D02	58.0	422	14.5±21.0	1–92
				12/R02	58.3	53	7.6±4.0	4–11
			G. maculatus	62/R02	8.1	42	8.4±16.0	1–37
Acanthocephala (adult)								
Floridosentis mugilis (Mw, Au) Bullock, 1962	Intestine	4919	*M. curema*	24/D00	33.3	15	1.9±0.1	1–3
				72/R00	11.1	21	2.6±2.0	1–6
				47/D01	34.0	38	2.4±3.0	1–11
				51/R02	63.0	89	2.8±2.0	1–11

Table 1 (continued)

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
Neoechinorhynchus golvani (Fw, Au) Salgado-Maldonado, 1978	Intestine	4920	*C. nigrescens*	58/R03	37.9	153	6.9±13.1	1–56
			C. robalito	47/R03	42.5	140	7.0±10.3	1–47
			D. latifrons	24/D00	100	1376	57.3±64.0	4–30
				73/R00	92.0	1539	23.0±22.0	1–98
				48/D01	94.0	1090	24.2±35.0	1–200
				50/D02	100	2959	59.2±47.2	9–269
				12/R02	100	207	17.3±11.1	2–32
			D. peruvianus	95/R03	32.6	705	22.7±33.3	1–145
			C. trimaculatum	24/D00	4.2	2	2.0	2–2
				72/R00	2.8	69	34.5±40.3	6–63
				48/D01	2.1	1	1.0	1–1
				63/R02	7.9	17	3.4±1.1	2–5
			G. maculatus	24/D00	29.2	13	1.9±1.6	1–3
				65/R00	27.7	58	3.2±3.0	1–13
				34/D01	35.3	25	2.1±1.5	1–6
				62/R02	11.3	35	5.0±6.0	1–17
			E. picta	22/D02	22.7	14	2.8	1–8
			G. sagittula	27/D04	7.4	2	1.0	1–1
			L. argentiventris	24/D04	45.8	69	6.3±6.9	2–26
Pseudoleptorhynchoides lamothei Bw, (Au) Salgado-Maldonado 1976	Intestine	4918	*G. sagittula*	27/D04	29.6	13	5.9±0.7	1–26
			A. fasciatus	37/R03	94.6	224	1.8±1.1	1–4
			H. guatemalensis	24/D00	21.0	24	4.8±4.2	2–12
				87/R00	46.0	591	14.8±22.0	1–94
				48/D01	48.0	215	9.3±14.0	1–54
				48/D02	91.7	887	20.2±36.5	1–179
Acanthocephala (larvae)								
Southwellina hispida (Fw, Al) Van Cleave, 1916	Liver, mesentery	4917	*C. trimaculatum*	72/R00	5.6	8	2.0±1.4	1–4
				48/D01	8.3	5	1.2±0.5	1–2
				63/R02	22.2	50	3.6±5.0	1–19
			G. maculatus	65/R00	13.8	30	3.3±5.3	1–17
				34/D01	23.5	11	1.4±0.5	1–2
				62/R02	11.3	13	1.9±1.2	1–4
			E. picta	68/R00	22.1	48	3.2±2.8	1–9
				35/D01	22.8	19	2.4±1.5	1–5
				22/D02	13.6	3	1.0	1–1
			A. fasciatus	37/R03	8.1	4	1.3±0.6	1–2
			C. nigrescens	58/R03	3.4	3	1.5±0.7	1–2
			L. argentiventris	24/D04	12.5	8	2.7±2.9	1–6
Nematoda (adult)								
Hysterothylacium perezi (Bw, Au) Gopar-Merino et al. 2005	Intestine	4916	*H. guatemalensis*	24/D00	45.8	22	2.0±1.4	1–5
				87/R00	44.8	319	8.2±9.0	1–44
				48/D01	23.0	64	5.8±9.1	1–30
				48/D02	73.0	775	22.1±49.0	2–239
Philometra sp. (Mw, Au)	Skin	4917	*C. robalito*	47/R03	70.2	241	7.3±7.0	1–35
Rhabdochona mexicana Caspeta-Mandujano, Moravec, and Salgado-Maldonado 2000	Intestine	5008	*A. fasciatus*	37/R03	27.0	17	1.7±0.9	1–4
Nematoda (larvae)								
Contracaecum sp. (Fw, Al)	Intestine, mesentery, liver	4910	*P. sphenops*	72/R03	6.9	7	1.4±0.6	1–2
			C. trimaculatum	24/D00	25.0	9	1.5±0.8	1–3
				72/R00	11.1	29	3.6±4.3	1–14
				48/D01	12.5	12	2.0±1.1	1–4
				63/R02	63.5	305	7.6±8.2	1–39
			D. latifrons	24/D00	8.3	17	8.5±11.0	1–16

Table 1 (continued)

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
				73/R00	8.2	16	2.7±1.4	1–5
				48/D01	8.3	6	1.5±0.6	1–2
				50/D02	18.0	30	3.3±4.6	1–15
			G. maculatus	24/D00	25.0	13	2.2±1.6	1–5
				65/R00	55.4	147	4.1±8.9	1–45
				34/D01	76.5	91	3.5±5.2	1–26
				62/R02	74.2	400	8.7±9.2	1–36
			C. nigrescens	58/R03	17.2	17	1.7±1.6	1–6
			G. sagittula	27/D04	51.8	23	1.6±1.2	1–5
			C. robalito	47/R03	31.9	48	3.2±4.3	1–17
			D. peruvianus	95/R03	14.7	36	2.6±2.7	1–11
			H. guatemalensis	24/D00	8.0	11	2.0±0.8	1–3
				48/D01	12.5	14	3.1±1.2	1–4
			L. argentiventris	24/D04	25.0	15	2.5±1.8	1–5
			M. curema	24/D00	33.3	21	2.6±2.3	1–7
				72/R00	75.0	301	5.6±7.2	1–39
				47/D01	81.0	194	5.1±4.4	1–17
				51/R02	75.0	126	3.3±2.4	1–9
Gnathostoma sp. (Fw, Al)	Muscle	4912	*E. picta*	68/R00	13.2	14	1.6±0.7	1–3
				35/D01	14.3	5	1.0	1–1
			G. maculatus	65/R00	3.1	2	1.0	1–1
Procamallanus gobiomori (Fw, Al) Moravec, Salgado-Maldonado and Caspeta-Mandujano, 2000	Intestine, mesentery, liver, muscle	4914	*E. picta*	68/R00	88.2	4802	71.7±134.4	16–657
				35/D01	91.4	1614	50.4±72.8	12–341
				22/D02	86.4	280	14.8± 22.9	3–97
Crustacea								
Argulus sp. (Fw, Au)	Skin, fins		*C. nigrescens*	58/R03	3.4	2	1.0	1–1
			D. latifrons	73/R00	4.1	3	1.0	1–1
				50/D02	2.0	1	1.0	1–1
			E. picta	68/R00	14.7	86	8.6±15.3	1–40
				35/D01	17.1	9	1.5±0.5	1–2
				22/D02	18.1	5	1.2±0.5	1–2
			G. maculatus	62/R02	2.2	8	2.0	1–2
			H. guatemalensis	24/D00	4.2	1	1.0	1–1
				87/R00	2.3	5	2.5±0.7	2–3
				48/D02	2.0	1	1.0	1–1
			A. fasciatus	37/R03	5.4	1	1.0	1–1
			C. trimaculatum	72/R00	4.2	3	1.0	1–1
				63/R02	3.2	2	1.0	1–1
			D. peruvianus	95	2.1	3	1.5±0.7	1–2
			L. argentiventris	24/D04	8.3	2	1.0	1–1
			M. curema	72/R00	5.6	5	1.2±0.4	1–2
				51/R02	4.0	5	2.5±2.1	1–4
			P. sphenops	72	4.2	3	1.0	1–1
Ergasilus sp. (Fw, Au)	Gills		*H. guatemalensis*	24/D00	4.2	5	1.2±0.5	1–2
				87/R00	2.3	8	1.6±0.9	1–3
				48/D01	2.1	18	2.6±2.5	1–8
				48/D02	4.2	2	1.0	1–1
			C. nigrescens	58/R03	91.4	4716	89.0±109.2	2–428
			C. robalito	47/R03	29.8	74	5.3±9.2	1–31
			L. argentiventris	24/D04	58.3	2876	205.4±133.9	2–396
			D. latifrons	24/D00	75.0	329	18.3±17.0	1–62
				73/R00	70.0	646	12.7±11.1	1–51
				48/D01	48.0	314	13.6±16.0	1–56
				50/D02	74.0	522	14.1±12.4	1–47

Table 1 (continued)

Parasite	Site	CNHE	Hosts	*N*/Season	*P*(%)	Total	Intensity	Range (min–max)
				12/R02	83.3	356	35.6±19.0	11–67
			E. picta	68/R00	100	11033	162.3±42.7	102–289
				35/D01	100	6350	181.4±84.3	100–551
				22/D02	100	3753	170.6±84.7	112–515
			C. trimaculatum	24/D00	100	4244	176.8±74.7	102–440
				72/R00	100	11715	162.7±89.2	89–698
				48/D01	100	11017	229.5±116.1	101–557
				63/R02	100	11963	189.9±78.7	65–525
			P. sphenops	72/R03	1.4	1	1.0	1–1
			M. curema	24/D00	41.7	80	8.0±6.0	2–19
				72/R00	75.0	420	7.8±8.0	1–47
				47/D01	64.0	580	19.3±21.0	1–77
				51/R02	92.2	691	14.7±17.3	1–88
			D. peruvianus	95/R03	12.6	39	3.2±5.6	1–21
			G. maculatus	24/D00	4.2	2	2.0	2–2
				65/R00	53.8	80	2.3±2.9	1–18
				34/D01	52.9	39	2.2±2.5	1–12
				62/R02	14.5	154	17.1±15.4	1–50
			G. sagittula	27/D04	59.7	18	1.1±0.3	1–2

Distribution of parasite and host: *Fw* Freshwater, *Bw* brackish water, *Mw* marine water
Colonization strategy: *Au* autogenic species, *Al* allogenic species
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; Intensity=mean number of parasites per infected host± standard deviation)

Characidae—*Astyanax fasciatus* (Cuvier 1819; banded astyanax, *n*=37); Centropomidae—*Centropomus nigrescens* (Günther 1864; black snook, *n*=58), *Centropomus robalito* (Jordan and Gilbert 1882; yellowfin snook, *n*=47); Cichlidae—*Cichlasoma trimaculatum* (Günther 1867; three-spot cichlid, *n*=207); Eleotridae—*Dormitator latifrons* (Richardson 1937; Pacific fat sleeper, *n*=207), *Eleotris picta* (Kner and Steindachner 1864; spotted sleeper, *n*=125), *Gobiomorus maculatus* (Günther 1859; Pacific sleeper, *n*=185); **Gobiidae**—*Gobionellus sagittula* (Günther 1865; estuary goby, *n*=27); Gerridae—*Diapterus peruvianus* (Cuvier 1839; Peruvian mojarra, *n*=95); Mugilidae—*Mugil curema* (Cuvier and Valenciennes 1836; white mullet, *n*=194); Lutjanidae—*Lutjanus argentiventris* (Peters 1869; yellow snapper, *n*=24); and Poeciliidae—*Poecilia sphenops* (Cuvier and Valenciennes 1846; molly, *n*=72).

The fish were collected at San Pedro Las Playas using gill nets and angling and transported to the Autonomous University of the State of Guerrero (Universidad Autónoma de Guerrero) laboratory. All fish specimens were examined no more than 5 h after collection, without having been previously frozen. A complete necropsy was done of the specimens, including all tissues and organs: skin, fins, gills, eyes, muscle, brain, heart, liver, kidney, spleen, mesentery, intestine, and stomach.

Internal and external metazoan parasites collected from the fish hosts were counted and processed according to Vidal-Martinez et al. (2001). Infection parameters included prevalence (% infected) and mean intensity (number of parasites per infected host), expressed as the mean±standard deviation and followed by the range of intensity (Bush et al. 1997). Autogenic parasite species 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 avian or mammalian definitive hosts, giving them a wider geographic distribution due to their hosts' migrations (Esch and Fernandez 1993). A conservative approach was done from parasite species distribution (i.e., freshwater, brackish water, and marine water) based on review of published records in Mexican fish species. Voucher specimens of most taxa were deposited in the National Helminth Collection (CNHE), Institute of Biology, National Autonomous University of Mexico, Mexico City.

Results

Thirty-nine species of metazoan parasite (37 helminth and 2 crustaceans) were recovered and identified from 13 fish species (1,498 host specimens) collected from Tres Palos Lagoon between April 2000 and November 2003. Of these 39, 6 were monogeneans, 18 digeneans (8 adults and 10 metacercariae), 3 cestodes (2 adults and 1 metacestode), 6 nematodes (2 adults and 4 larvae), 4 acanthocephalans (3 adults and 1 cystacanth), and 2 crustaceans (Table 1).

Sixteen helminth species were recovered as larval stages from the total parasite fauna. Twelve intestinal species were recovered in adult stage and three in both larval and adult stages (*Pseudoacanthostomum panamense*, *Pseudolepto-rhynchoides lamothei* and *Neoechinorhynchus golvani*).

Seven of the parasites are widely distributed among the lagoon's fish species. The crustaceans *Ergasilus* sp. and *Argulus* sp. were recovered from 12 and 11 fish species, respectively, the nematode *Contracaecum* sp. and the digenean *P panamense* infected 11 fish species, while the digeneans *Ascocotye* (*Phagicola*) *longa* and *Austrodiplostomum compactum* were found in 10, and the acanthocephalan *N. golvani* was recovered from 9 fish species.

Three species of parasite numerically dominated the local parasite fauna: *Ergasilus* sp. (72,045 individuals), which represented 31% of the total parasites collected (232,992), *A.* (*P.*) *longa* (69,769 individuals=30%), and *Echinochasmus leopoldinae* (48,675 individuals=21%). Each one of these three parasite species exhibits a preferred host, from which reflect higher prevalences. While the prevalences of *E. leopoldinae* reached more than 90% in the characid *A. fasciatus* and the poeciliid *P. sphenops*, *Ergasilus* sp. and *A.* (*P.*) *longa* showed prevalences of 100% in the cichlid *C. trimaculatum* and mugiliid *M. curema*, respectively (Table 1).

Of the 39 species of parasite, 24 were classified as autogenic (life cycle completed in the lagoon) and 15 as allogenic (mature in piscivorous birds living in the lagoon). Twenty-two of the species have a freshwater distribution, 6 are estuarine (brackish water), and 11 marine.

The fish species with the highest parasite species richness were: *C. nigrescens* and *E. picta* (13 parasite species), *C. trimaculatum* (12 species), as well as *G. maculatus* and *D. peruvianus* (11 parasite species). The other fish species harbored from seven to ten parasite species. Five hosts *C. trimaculatum*, *E. picta*, *P. sphenops, G. maculatus* and *A. fasciatus* had a higher number of allogenic species than autogenic. In contrast, the hosts *H. guatemalensis*, *L. argentiventris*, *D. peruvianus*, *C. nigrescens*, and *C. robalito* had a higher number of autogenic species, while the other three hosts had the same number.

Discussion

The parasite fauna of the 13 fish species collected from Tres Palos Lagoon is composed of 39 parasite species (37 helminths and 2 crustaceans). The mean number of species of parasite per examined fish species (three species of parasites) 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 richness reported in this paper for Tres Palos Lagoon is probably due to the long-term (4-year) sampling effort extending through different seasons (dry and rainy), which allowed detection of a higher number of rare species within the parasite communities of each host species (Zander 2005). The parasite fauna is probably much richer, however, as the lagoon's ichthyofauna includes 38 fish species from 30 genera and 18 families (Yañez-Arancibia 1978), of which only 34.2% of the species (50% of all reported families) were examined in this paper.

Most of the species of parasite identified in this paper (32 species), have been previously reported in the same or different host species from other geographical areas in Mexico (Salgado-Maldonado 1976; Pineda-López et al. 1985, 2005; Pineda-López 1994; Lamothe-Argumedo et al. 1997; Moravec 1998; Pérez-Ponce de León et al. 1999; Scholz et al. 1999, 2001; Scholz and Salgado-Maldonado 2000, 2001; Salgado-Maldonado et al. 2001a, b, 2004a, b, 2005a, b; Vidal-Martinez et al. 2001; Montoya-Mendoza et al. 2004; Caspeta-Mandujano 2005; Salgado-Maldonado 2006). Thirty-two of the 39 species of parasite are first geographical host records for Tres Palos Lagoon, Guerrero, Mexico (Table 1). The remaining seven species (*Clinostomum complanatum*, *P. panamense*, *Saccocoelioides* sp., *Gnathostoma* sp., *Contracaecum* sp., *Hysterothylacium perezi* and *N. golvani*), have been reported for Tres Palos Lagoon, although not necessarily in the host from which they were recovered in this paper (García-Prieto et al. 2003; Garrido-Olvera et al. 2004; Gopar-Merino et al. 2005).

Digenean species (eight adults and ten metacercariae) dominated the identified parasite fauna, which is similar to the pattern reported for freshwater fish parasite communities in Mexico (Pineda-Lopez 1994; Salgado-Maldonado et al. 2001a, b, 2004a, b; Pineda-Lopez et al. 2005). Monogeneans (six species) were recorded only in marine and brackish water fish species. Cestodes (three species), nematodes (six species), and acanthocephalans (four species) were less abundant, which for the acanthocephalans is probably due to their being very rare in freshwater fish in Mexico (Salgado-Maldonado et al. 1992, 2004a, b). Nonetheless, the presence of as many as four acanthocephalan and three cestode species from a single location is notable. This may result from the lagoon's high productivity, which favors the development of large crustacean populations that act as intermediary host to these helminths (Marcogliese 1995). This high productivity may also explain the very high abundance (31% of all identified parasite individuals) of the copepod parasite *Ergasilus* sp. in the lagoon.

Parasite species composition included a higher number of autogenic species (24). In contrast, the number of allogenic species recovered was smaller (15), but this group of parasites was more broadly distributed among hosts of different origin and represented a higher proportion of the total individual parasite count (56%). The allogenic helminths *A. compactum, C. complanatum*, *Posthodiplostomum minimum* and *Contracaecum* sp., four of the six parasite species more widely shared among the collected fish, 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; Salgado-Maldonado and Kennedy 1997; Salgado-Maldonado et al. 2001a, b, 2004a, b, 2005a, b; Pineda-Lopez et al. 2005; Salgado-Maldonado 2006). Most of these allogenic helminth species are widely distributed in North America and are cosmopolitan (Hoffman 1999; Yamaguti 1971; Gibson 1996).

The allogenic species' dominance in number of individuals can be attributed to the lagoon's high productivity (the result of extensive eutrophication) and the abundance of resident and migratory piscivorous birds that act as definitive host to all these parasite species. The high productivity favors the existence of herbivores and detritivores, helminth species' preferred intermediate hosts (Zander and Reimer 2002), while the lagoon's shallow bottom (Violante-González 2006) and abundant fish species provide excellent feeding conditions for piscivorous birds, which form dense colonies along the lagoon banks. This dynamic is common in many tropical and temperate eutrophic environments (Esch and Fernandez 1993; Pineda-Lopez 1994; Salgado-Maldonado and Kennedy 1997; Zander and Reimer 2002).

The parasites identified in this paper also include an anthropogenically-introduced species, the metacercariae of *Centrocestus formosanus*, and one with public-health repercussions, the nematode *Gnathostoma* sp. Introduction of *C. formosanus* metacercariae into Mexico probably occurred along with the imported thiarid snail *Melanoides tuberculata* (Müller 1774), its first intermediary host (Scholz and Salgado-Maldonado 2000). In Tres Palos Lagoon, *C. formosanus* was only recorded co-occurring with *E. leopoldinae* in the gills of *P. sphenops* (Poecilidae) and *A. fasciatus* (Characidae), although it did reach very high prevalence and abundance in *P. sphenops* (Table 1).

The zoonotic nematode larvae *Gnathostoma* sp. has been recorded previously in the fish species *H. guatemalensis*, *C. trimaculatum*, *D. latifrons*, *E. picta*, and *G. maculatus* (García-Prieto et al. 2003). In the present study, however, it was only recovered from *E. picta* and *G. maculatus*, which suggests that *E. picta* is its preferred host in Tres Palos Lagoon and that it reaches its highest prevalence and abundance levels in this host (García-Prieto et al. 2003).

The Tres Palos Lagoon parasite fauna composition has a high freshwater influence as 22 (56.4%) of the 39 identified species have a freshwater distribution in Mexico. This probably reflects the lagoon's oligohaline condition (1.5 to 5 ppm), which is the consequence of greater freshwater contribution from rainfall and its only seasonal connection with the sea during the rainy season (Violante-Gonzalez 2006). A similar situation has been reported in low salinity (0.5–3.5 ppm), temperate, brackish water environments in which marine species of parasites represented only 12.69% of the species recovered from 31 fish species, and freshwater species dominated community composition (Valtonen et al. 2001). This, however, is a preliminary effort at classifying the parasite fauna of this location by distribution range. Exact determination of some parasite species could not be done because some specimens were larval stages and others, such as *Saccocoeliodes* sp. and *Metadena* sp., are new species, and their classification may therefore be incorrect.

Finally, the overall results suggest that parasite fauna richness could be higher than reported in this paper (39 species of parasite), if a greater number of fish species were examined. Study of other fish species in the lagoon will help generate a more complete inventory of the parasite fauna in Tres Palos Lagoon.

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