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Nota científica

Intestinal helminths of *Lutjanus griseus* (Perciformes: Lutjanidae) from three environments in Yucatán (Mexico), with a checklist of its parasites in the Gulf of Mexico and Caribbean region

Helmintos intestinales de *Lutjanus griseus* (Peciformes: Lutjanidae) recolectados en tres ambientes de Yucatán (México), con una lista de sus parásitos en las regiones del golfo de México y el Caribe

Nelly Argáez-García[1], Sergio Guillén-Hernández[2] and M. Leopoldina Aguirre-Macedo[1*]

[1]*Laboratorio de Parasitología, Centro de Investigación y Estudios Avanzados del IPN, Carretera Antigua a Progreso Km. 6, Cordemex 97310 Mérida, Yucatán, Mexico.*
[2]*Departamento de Biología Marina, Campus de Ciencias Biológicas y Agropecuarias, Universidad Autónoma de Yucatán, Mérida, Yucatán, México.*
**Correspondent: leo@mda.cinvestav.mx*

Abstract. A survey of intestinal helminth parasites of the gray snapper, *Lutjanus griseus*, collected at the estuarine coastal lagoon of Celestún and off the coast of the localities of Chelem and Progreso (Yucatán, Mexico) is presented together with a checklist of gray snapper intestinal helminths in the Gulf of Mexico and the Caribben region. Twenty helminth species were found at the Yucatán localities. Eigth of these have previously been reported in the Gulf of Mexico and the Caribbean region and 12 are new records for *L. griseus*, which increases the number of species recorded for gray snapper in the region to 44. Only 8 helminth species were recorded from fishes collected inside the coastal lagoon, while all 20 were found in fishes from offshore. Differences in species composition and infection parameters of each helminth species between both habitats are presented and discussed, together with similarities in species composition of the intestinal helminth fauna of *L. griseus* from Yucatán with those reported for the same host species in the Atlantic coast of USA, the Gulf of Mexico and the Caribbean regions.

Key words: Caribbean Sea, marine fishes, Mexico, parasites.

Resumen. En este trabajo se presentan los resultados del análisis helmintológico de los tractos digestivos de pargos *Lutjanus griseus* colectados en la laguna costera de Celestún y en la zona marina frente a las localidades de Chelem y Progreso (Yucatán, México) junto con una lista de los helmintos intestinales registrados para esta especie de hospedero en el golfo de México y la región del Caribe. Veinte especies de helmintos fueron recuperadas en las localidades de Yucatán. Solamente 8 de éstas se han registrado previamente en el golfo de México y el mar Caribe. Doce especies de helmintos son nuevos registros para *L. griseus*, incrementando así a 44 el número de especies para este hospedero en la región. Solo 8 especies de helmintos se recuperaron de los peces colectados en la laguna costera, mientras que todas las 20 especies se encontraron en peces colectados en la zona marina. Las diferencias en la composición de especies y los parámetros de infección de cada uno de los helmintos intestinales respecto a los peces colectados en los 3 diferentes hábitats son analizadas. Así mismo, se discute la similitud entre la helmintofauna intestinal de *L. griseus* en Yucatán con la registrada para la región del Atlántico de EUA, el golfo de México y el mar Caribe.

Palabras clave: mar Caribe, peces marinos, México, parásitos.

The gray snapper, *Lutjanus griseus* (Linnaeus) (Lutjanidae: Perciformes) is found throughout the Gulf of Mexico and the Caribbean Sea, and is one of the most important species for commercial fisheries in the Yucatán Peninsula (Mexicano-Cíntora et al., 2007). Due to its high market value and low levels of commercial harvest, this species has been considerate a good candidate for aquaculture and stock enhancement since the 1970s (Riley et al., 2008). If the aquaculture of this species is going to be developed, it will be necessary to know which parasites could increase under high density conditions. Unfortunately, information on the helminth parasite fauna

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associated with this species in the Southeast of Mexico is limited to taxonomical records and only 4 published studies exist (Salgado-Maldonado, 1979; Lamothe-Argumedo et al., 1997). In addition, there are no records on the infection parameters for the helminth parasites of this fish species in area.

In this paper, we present a survey of helminth species of the digestive tract of *L. griseus* in specimens collected in Yucatán at the coastal lagoon of Celestún (20º45' to 20º58' N; 90º15' to 90º25' W), a nursery locality, and 2 offshore habitats for adult fish, namely the localities of Chelem (21° 16' 22.72" N; 89° 45' 0.53" W) and Progreso (21° 20' 46.44" N; 89° 40' 33.06" W) as well a survey of published records of intestinal helminthes of the gray snapper in the Gulf of Mexico and the Caribbean Sea. Differences in species composition and the infection parameters of the parasite fauna between the coastal lagoon habitat and the 2 offshore habitats in Yucatán are analyzed and discussed, together with similarities in species composition of the intestinal helminth fauna of *L. griseus* from Yucatán with those reported for the same host species in the Atlantic coast of USA, the Gulf of Mexico and the Caribbean regions.

A total of 114 specimens of *L. griseus* were examined from April 2000 to August 2001; 68 were collected at the coastal lagoon of Celestún, while 21 and 25 offshore of the localities of Progreso and Chelem, respectively (Fig. 1).

Fish specimens from Celestún lagoon were caught with hook and line, while those from Chelem and Progreso were provided by local fishermen, who caught the fish with hook and line at 22 m depth. Fish were transported on ice to the laboratory immediately after being captured, where they were examined for the presence of intestinal helminths. Before examination, each specimen was weighed (g) and measured (mm). All helminths were studied in fresh, counted *in situ* and then preserved in 70% ethanol and processed for subsequent identification following conventional helminthological methods (see Vidal-Martínez et al., 2001). Voucher specimens were deposited at the Colección Nacional de Helmintos (CNHE), Instituto de Biología, UNAM (Mexico City) and at the Colección del Laboratorio de Parasitología (CHCM) CINVESTAV del IPN, Unidad Mérida (Yucatán, Mexico).

One-way ANOVA was used to test for differences in host length among localities. Prevalence and mean abundance values were calculated for each helminth species at each locality following Bush et al. (1997). Similarity in prevalence and mean abundance values between localities were calculated using the percentage similarity index (Magurran, 2004). Intestinal helminth parasite records from the literature were classified in 7 geographical categories: the Atlantic (AT), with records

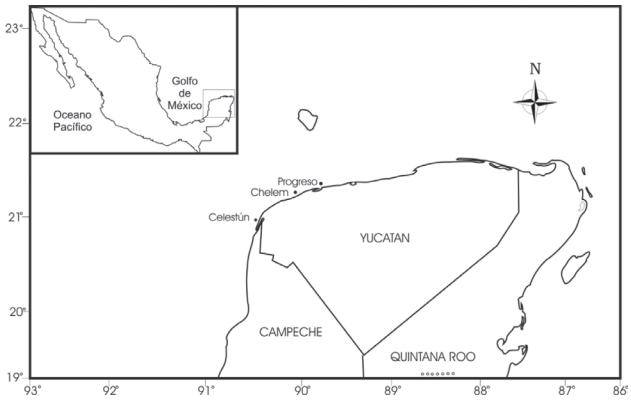

Figure 1. *Lutjanus griseus* specimen sampling localities.

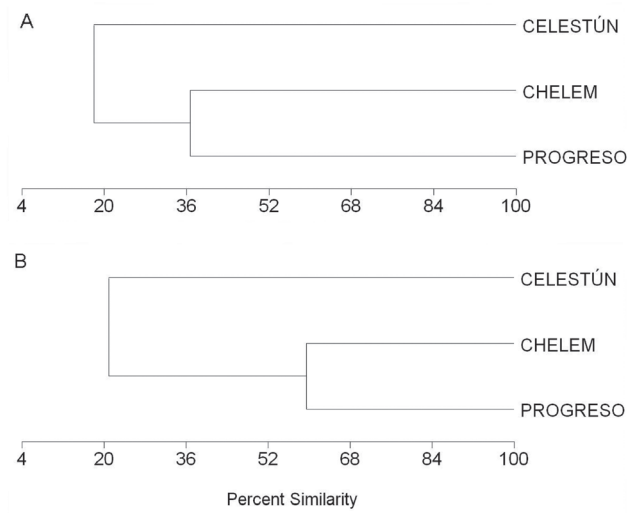

Figure 2. Percentage similarity of the mean abundance (A) and prevalence (B) of intestinal parasites found in *Lutjanus griseus* between sampling localities at Yucatán, Mexico.

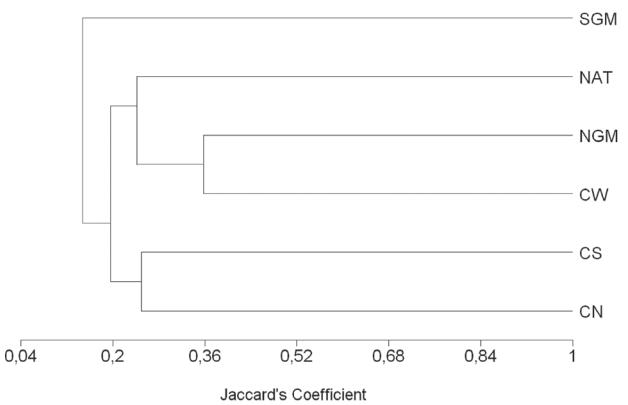

Figure 3. Jaccard similarity index between intestinal helminth fauna of *Lutjanus griseus* in different microregions of the Caribbean Sea, the Gulf of Mexico and the Atlantic Coast of The United States of America.

from Atlantic coast of Florida, Bermudas and Bahamas; the North Gulf of Mexico (NGM), with records from the Gulf of Mexico coast of the Peninsula of Florida to Texas and Tortugas Island; the South Gulf of Mexico (SGM), including Campeche and Yucatán, Mexico; the Caribbean North (CN), records from the Greater Antillas including Puerto Rico, Cuba, Jamaica, Dominican Republic and Haiti; Caribbean West (CW) including records from Costa Rica, Nicaragua, Honduras, Guatemala, Belize and the Mexican Caribbean; Caribbean East (CE) all Lesser Antillas and the Caribbean South (CS), including records from Panama, Venezuela and Colombia. Similarity between intestinal helminth fauna of *L. griseus* reported among regions was calculated using Jaccard similarity index (Magurran, 2004).

Fish lengths from Celestún were significantly smaller on average (133±80 mm) than those from Progreso (346±92 mm) and Chelem (338±71 mm) ($F_{2,93}$= 171.13; $P < 0.05$). A total of 20 species of helminths (18 found as adult stages and 2 as larval stages) were collected from the 114 fish specimens examined; of these species, 11 belonged to Trematoda, 4 to Nematoda, 4 to Acanthocephala, and 1 to Cestoda. All 20 species were present in specimens from Progreso, 10 of the 20 were found in Chelem specimens (1 as larval stage) and 8 were found in Celestún (1 as larval stage) (Table 1).

Prevalence, intensity range, and mean abundance values are presented for each helminth species and locality in Table 1. Only 7 of the 20 helminth species were shared between localities, and for most helminth species the highest prevalence values were found for fish caught off Progreso (Table 1). Although fish specimens from Chelem and Celestún shared 80% of their helminth species composition, prevalence and mean abundance values were more similar between helminth species shared by specimens from Progreso and Chelem (Fig. 2).

A total of 32 intestinal helminth species (21 trematodes, 3 cestodes, six nematodes and 2 acanthocephalans) for *L. griseus* in the North Atlantic, the Gulf of Mexico and the Caribbean Sea records were recovered from the literature, of which only 5 belong to Mexico (Table 2). Only 1 species *(Metadena adglobosa* Manter, 1947) has been recorded for all 6 geographical regions (GR), 2 helminth species were present in 5 GR (*Hamacreadium mutabile* Linton, 1910 and *Stephanostomun casum* (Linton 1910)), 2 more only in 4 GR (*Helicometrina nimia* Linton 1910 and *Metadena globosa* (Linton, 1910)) and all the rest were present in 3 or less GR with 58% of the species being recorded only in just 1 GR each. Overall species similarity between geographical regions was 0.24 ± 0.08. The largest similarity value was found between the helminth fauna of the North Gulf of Mexico and the West Caribbean regions (0.36, Fig. 3).

Prior to this study, 32 helminth species were known to parasitize *L. griseus* in the Gulf of Mexico and throughout the Caribbean Sea (Table 2). Our data indicate that 12 of the 20 species found at the 3 study sites in Yucatán are new records for *L. griseus*, increasing the total number of helminth species recorded for this host species to 4. Similar to intestinal helminth communities of other marine fish species from the region, helminth species composition of *L. griseus* in Yucatán localities is composed mainly of trematodes (11 trematodes, 4 nematodes, 4 acanthocephalans and 1 cestode). For example, 6 of the 11 intestinal parasite species reported for *Epinephelus morio* by Moravec et al. (1997) were trematodes (in addition to 1 cestode, 3 nematodes, and 1 acanthocephalan), and 6 of the 11 species reported in the gut of *Trachinotus carolinus* were also trematodes (including also 1 cestode and 4 nematodes) (Sánchez-Ramírez and Vidal-Martínez, 2002). In addition, 6 of 10 intestinal parasite species reported for *Cichlasoma urophthalmus* at Celestún coastal lagoon were also trematodes (including also 3 cestodes and 1 acanthocephalan) (Salgado-Maldonado and Kennedy, 1997). Such findings agree with an overall pattern of dominance by trematodes in *L. griseus* as shown by the parasites associated to fish in the Gulf of Mexico and Caribbbean sea, since 20 of the 32 helminth species previously recorded were trematodes (Table 2).

Four out of the 7 helminth species shared by the sampled specimens across the 3 localities in Yucatán were specialist trematodes to the fish family Lutjanidae (*M. adglobosa*, *Metadena globosa*, *Paracryptogonimus neoamericanus* and *Stephanostomum casum*), whereas the remaining 3 helminths are generalist species which can be found in fish species belonging to various families (see Yamaguti, 1971; Amin, 1998)

Presently, the only life cycles for helminth parasites of the gray snapper which have been relatively well described are those of the trematodes *M. adglobosa*, *Hamacreadium gullela* and *H. mutabile*, of which the first species uses *Cerithium* snails as first intermediate hosts, while *H. gullela and H. mutabile* use *Astraea* snails (McCoy 1929, 1930). In addition, *Lucania parva* and *Opsanus beta* serve as second intermediate hosts of *M. adglobosa*. Finally, *Cyprinodon variegatus*, *Gambusia affinis* and *Poecilia latipinna* have been successfully used as experimental second intermediate hosts of *M. adglobosa* (Schroeder, 1965).

We expected that the total number of helminth species and helminth species composition in gray snappers from Chelem would be similar to that of snappers from Progreso because specimens from these 2 localities were similar in size (Table 1) and were caught in open coastal waters from sites that are relatively close to each other. However,

Table 1. Intestinal helminth parasites found in *Lutjanus griseus* collected offshore of the localities of Progreso and Chelem and in the coastal lagoon of Celestún, Yucatán. Adult stage, larval stage (P= prevalence; IR= intensity range; MA= mean abundance ± standard deviation)

Species	*Accession no.* *CNHE/CHCM*	*Micro-habitat*	*Progreso (n=21)*			*Chelem (n=25)*			*Celestún (n=68)*		
			P	**IR**	**MA**	**P**	**IR**	**MA**	**P**	**IR**	**MA**
DIGENEA											
[a]*Hamacreadium mutabile* Linton 1910	7079 / 506	Pyloric ceca	62	1-32	4.1±14.3	84	1-66	10.5±13.0	4	1-2	0.1±0.3
[a]*Helicometrina nimia* Linton, 1910	7080 / 507	Pyloric ceca	9.5	1	0.1±2.0	4	1-14	0.6±3.0	1.5	1-2	0.1±0.2
[a]*Metadena globosa* (Linton, 1910)	7081 / 508	Intestine (anterior and medial)	24	1-40	2.1±14.5	8	1-9	0.4±6.0	3	1-3	0.1±0.4
[a]*Metadena adglobosa* Manter, 1947	7082 / 509	Intestine (anterior and medial)	14.3	1-6	0.7±2.4	4	1	0.1±1.3	4.4	1-7	0.2±0.9
[a]*Stephanosthomum casum* (Linton, 1910)	7083 / 510	Intestine (posterior)	14.3	1-8	0.5±3.05	8	1	0.1±1.2			
[a]*Stephanosthomum* sp.	----- /511	Intestine (posterior)	2.28	1-21	0.5±3.0						
[a]*Hemiurus* sp.	----- /512	Stomach and pyloric ceca	38.1	1-29	3.2±5.1				1.5	1-4	0.1±0.5
[a]*Lecithochirium microstomum* Chandler, 1935	7084 / 513	Stomach	4.8	1-4	0.2±0.5						
[a] *Paracryptogonimus americanus* Manter, 1940	7085 / 514	Pyloric ceca	28.6	1-64	4.9±7.9	28	1-7	1± 3.2	17.7	1-31	1.4±4.8
[a] *Neoprosorhynchus* sp.	---- /515	Stomach	4.8	1-29	1.4±5.29						

[a] *Dollfustrema* sp.	---- /516	Stomach	4.8	1-17	0.8±3.05						
NEMATODA											
[a]*Dichelyne bonacii* González-Solis, Argáez-García and Guillen-Hernández, 2002	7086 / 517	Intestine (posterior)	52.4	1-13	1.8±3.2	36	1-3	0.6±2.0	1.5	1	0.1±0.1
[a]*Cucullanus palmeri* Crites & Overstreet, 1997	7087 / 518	Intestine (posterior)	14.3	1-4	0.3±0.7						
[a] Capillaridae gen. sp.	----	Intestine (posterior)	19.0	1	0.2±0.2						
[l] Spirutidae gen. sp.	----	Intestine (posterior)	4.8	1	0.1±0.1						
ACANTHOCEPHALA											
[a] *Serrasentis* sp.	---- / 519	Intestine (anterior) and pyloric ceca	14.3	1-2	0.2±0.4	32	1-2	0.4±0.5			
[a]*Dollfusentis chandleri* Golvan, 1969	7088 / 520	Intestine (anterior)	4.8	1-2	0.1±0.7	4	1	0.1±0.3			
[a] *Dollfusentis* sp.	----	Intestine (anterior and medial)	4	1	0.1±0.2						
[a]*Gorgorhynchoides bullocki* Cable and Mafarachisi, 1970	7089 / ----	Intestine (anterior)	4	1	0.1±0.1						
CESTODA											
[l] Tetraphyllidae gen. sp.	--- /521	Pyloric ceca and stomach	71.4	1-1360	2.2±97	16	1-33	2.2±10.6	1.5	1	0.1±0.1
Total helminth species					**20**			**10**			**8**

Table 2. Intestinal helminth parasites reported for *Lutjanus griseus* in the Caribbean Sea, Gulf of Mexico and the North Atlantic microregions. CN, North Caribbean; CS, South Caribbean; CW, West Caribbean; NGM, North Gulf of Mexico; SGM, South Gulf of Mexico; AT Atlantic. * Helminth species found in this study. 1= present, 0= absent

	CN	*CS*	*CW*	*NGM*	*SGM*	*NAT*	*Source*
DIGENEA							
Brachyphallus parvus (Manter, 1947)	1	1	0	0	0	0	Bosquez-Rodríguez 2004; Zambrano et al. 2003
Cainocreadium gulella (Linton, 1910)	0	0	0	1	0	0	Linton 1910, Manter 1947, Schroeder 1965
***Dolfustrema* sp.**	0	0	0	0	1	0	This study
Gonacanthella lutjani Sogandares-Bernal, 1959					1		Gonzalez-Nava, 1994
***Hamacreadium mutabile* Linton, 1910**	1	0	1	1	1	1	Bosques-Rodríguez 2004; Fischthal 1977; Linton 1910, McCoy 1930, Manter 1947, Schroeder 1965, Overstreet 1969; Siddiqi and Cable 1960, Nahhas and Cable 1964; Siddiqi and Cable 1960, Nahhas and Cable 1964; Dyer et al. 1985, 1992, González-Nava, 1994;1998; Lamothe-Argumedo et al. 1997
Hamacreadium lintoni (Siddiqi and Cable, 1960)	1	0	0	0	0	0	Siddiqi and Cable 1960, Dyer et al. 1985
Helicometra exacta Linton, 1910	0	0	0	0	0	1	Schroeder 1965
Helicometra torta Linton, 1910	1	0	0	0	0	1	Schroeder 1971; Dyer et al. 1992
***Helicometrina nimia* Linton, 1910**	0	1	1	1	0	1	Linton 1910, Manter 1947, Schroeder 1965; Fischthal 1977; Vélez 1987
Hemiurus sp	0	0	0	0	1	0	This study
***Lecitochirium microstomum* Chandler, 1935**	0	0	0	0	1	0	This study
Lecithochirium monticellii (Linton, 1898)	0	0	0	1	0	0	Linton 1910
Lecithochirium parvum (Manter, 1947)	1	0	0	1	0	0	Nahhas and Cable 1964; Manter 1947
Lepocreadium trulla (Linton, 1907)	1	0	0	0	0	0	Dyer et al. 1992
Leurodera decora Linton, 1910		0	0	1	0	0	Linton 1910, Manter 1947
***Metadena adglobosa* Manter,1947**	1	1	1	1	1	1	Hanson 1950; Nahhas and Cable 1964; Fischthal 1977; Manter 1947, Schroeder 1965, Overstreet 1969; Siddiqi and Cable 1960, Dyer et al. 1985, 1992; Lamothe-Argumedo et al. 1997

Table 2. Continues

	CN	*CS*	*CW*	*NGM*	*SGM*	*NAT*	*Source*
***Metadena globosa* Linton, 1910**	0	0	1	1	1	1	Linton 1910; Manter 1947, Schroeder 1965, Overstreet 1969; Fischthal 1977
Metadena obscura Schroeder, 1971	0	0	0	0	0	1	Schroeder 1965
Metadena sp.	0	0	0	0	0	1	Overstreet 1969
Neoprosorhynchus sp	0	0	0	0	1	0	This study
***Paracryptogonimus americanus* Manter, 1947**	0	0	1	0	1	0	Fischthal 1977
Pseudocreadium biminense Sogandares-Bernal, 1959	0	0	0	0	0	1	Bosques-Rodríguez 2004
Siphodera vinaledwardsii (Linton, 1901)	0	1	0	0	0	0	Vélez 1987; Zambrano et al. 2003
***Stephanostomum casum* Linton, 1910**		1	0	1	1	1	Linton 1910, Manter 1947, Schroeder 1965, Overstreet 1969, Dyer et al. 1985; Vélez 1987
Stephanostomum sp	0	0	0	0	1	0	This study
Sterrhurus musculus Looss 1907	0	1	0	0	0	1	Nahhas and Cable 1964; Overstreet 1969
CESTODA							
Callotetrarhynchus gracilis Linton, 1899	0	0	0	1	0	0	Linton 1908
Rynchobothrium microbothrium MacCallum, 1917	0	0	0	0	0	1	MacCallum 1917
Tetraphyllidae	0	0	0	0	1	0	This study
Tetrarhynchus sp.	0	0	0	0	0	1	Bosques-Rodríguez 2004
NEMATODA							
Anisakis simplex (Rudolphi 1809)	1	0	0	0	0	0	Bosques-Rodríguez 2004
***Capillaridae* gen sp.**	0	0	0	0	1	0	This study
Cucullanus pargui Gonzalez-Solis et al., 2007	0	0	0	0	1	0	González-Solis et al. 2007
***Cucullanus palmieri* Crites and Overstreet, 1997**	0	0	0	0	1	0	This study
***Dichelyne bonacii* González-Solis et al. 2002**	0	0	0	0	1	0	González-Solis et al. 2002

Table 2. Continues

	CN	*CS*	*CW*	*NGM*	*SGM*	*NAT*	*Source*
Dichelyne lintoni (Barreto, 1922)	0	0	0	0	0	1	Barreto 1922
Philometra sp.	0	0	0	0	0	1	Rees 1970
**Spiruridae* sp.	0	0	0	0	1	0	This study
Spirocamallanus cricotus Fusco and Overstreet, 1978	0	0	0	1	0	0	Williams 1983
ACANTHOCEPHALA							
**Dollfusentis chandleri* Golvan, 1969	0	0	0	0	1	0	This study
**Dolfusentis* sp.	0	0	0	0	1	0	This sudy
**Gorgorhynchus bullocki* Cable and Mafarachisi, 1970	0	0	1	1	1	0	Cable and Mafarachisi 1970; Salgado-Maldonado 1979; Monks et al., 2009
Gorgorhynchus medius (Linton, 1907)	0	0	0	1	0	1	Linton 1907; 1908
**Serrasentis* sp.	0	0	0	0	1	0	This study

species number and composition were more similar between snapper specimens collected off Chelem and from the Celestún coastal lagoon. Despite this unexpected result, prevalence and abundance values of shared helminth species were more similar between Progreso and Chelem, than between Celestún and Chelem (Figure 2). Although, Schroeder (1965) suggested that the helminth fauna of the gray snapper is replaced by new species after fish leave coastal lagoons, our results show an addition of species for specimens from offshore localities as all the helminth species found in specimens from the coastal lagoon were also present in specimens from Progreso and Chelem. One explanation for this finding is that the offshore specimens sampled had not spent enough time in this habitat to exhibit a replacement of parasite species previously acquired at the coastal lagoon. Given that all parasite species recorded at the coastal lagoon site were also found at the offshore sites, perhaps the most reasonable hypothesis is that the gray snapper specimens sampled offshore are subject to rather slow replacement process of parasite species. On the other hand, it is been reported that as gray snappers increase in size, so do the diversity and volume of items they feed on in coastal lagoons and offshore habitats (Samano-Zapata et al. 1998). This condition may explain the great similarity in prevalence and mean abundance values for parasite species in specimens from Chelem and Progreso, as well as the increase in parasite species richness for specimens from Progreso.

The small values of Jaccard´s similarity between the helminth fauna for the 6 geographical regions suggest that there is either a large component of helminth species associated to each particular area, with only a small percentage (11%) corresponding to helminth species widely distributed in the whole region, or that more extensive studies are needed in each region which would permit a more even comparison among regions. For example, most of the records of some geographical regions come from only 1 or 2 articles were only a particular locality was examined in contrast to our data that come from 3 localities and a larger number of fish.

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