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Research note

Helminth fauna of *Lithobates brownorum* (Anura: Ranidae) at three localities in the state of Yucatán, Mexico

Helmintofauna de *Lithobates brownorum* (Anura: Ranidae) en tres localidades del estado de Yucatán, México

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Abstract. Between July 2004 and June 2005, 84 specimens of *Lithobates brownorum* (Sanders, 1973) were collected and examined for helminths. Hosts came from 3 localities in the state of Yucatán, Mexico: Celestún (n= 35), Lagunas de Yalahau (n= 33), and Ría Lagartos (n= 16). Twelve helminth taxa were found: 7 nematodes, 4 digeneans, and 1 acanthocephalan. With the exception of *Haematoloechus floedae* and *Megalodiscus temperatus*, all helminth taxa found have a Neotropical distribution. Our results differ from those obtained in previous studies dealing with amphibians in Mexico because we found higher richness and abundance of nematodes than digenean species. The relatively low mean intensity and mean abundance values reached by digenean species in this study may be related to the generalist host diet and with the vagility of frogs (from the aquatic to the terrestrial environment or vice versa).

Key words: parasites, anurans, infection levels.

Resumen. Entre julio del 2004 y junio del 2005, se recolectaron y examinaron 84 ejemplares de *Lithobates brownorum* (Sanders, 1973) en busca de helmintos en 3 localidades del estado de Yucatán: Celestún (n= 35), Lagunas de Yalahau (n= 33) y Ría Lagartos (n= 16). Los ejemplares estuvieron parasitados por 12 taxa de helmintos, 7 de nematodos, 4 digéneos y 1 acantocefalo. Con excepción de *Haematoloechus floedae* y *Megalodiscus temperatus*, todos los taxa presentan distribución neotropical. Nuestros resultados difieren de los obtenidos por otros autores que han reportado más especies de digéneos que de nematodos en este grupo de hospederos. Los bajos valores de intensidad y abundancia media de los digéneos encontrados en este estudio pueden estar relacionados con la amplia dieta del hospedero y la vagilidad que éste presenta entre el medio acuático y el terrestre.

Palabras clave: parásitos, anuros, niveles de infección.

In southern Mexico, *Lithobates brownorum* (Sanders, 1973) is a widely distributed frog that is commonly found in and around water bodies throughout the Yucatán Peninsula (Zaldívar-Riverón et al., 2004). However, information concerning the helminth parasites associated to this frog species in the Yucatán Peninsula (Moravec, et al. 2002; León-Règagnon et al., 2005), or elsewhere in Mexico (Paredes-León et al. 2008) is scarce. The present work was aimed at characterizing the helminth fauna present in *L. brownorum* specimens collected at 3 different localities in Yucatán.

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From July 2004 to June 2005, *L. brownorum* specimens were collected from the following localities: 1), Celestún, located on the northwest coast of the Yucatán Peninsula (20°46´, 21°06´ N; 90°11´, 90°25´ W); 2), Yalahau, an inland lagoon found in the central portion of the state (20°40´37.3´´, 20°34´59.7´´N, 89°10´49.6´´, 89°15´00.5´´W); and 3), Ría Lagartos (21°32´, 21°34´N; 87°35´, 88°15´W) found on the northeast coast of the Yucatán Peninsula.

Frogs were captured either by hand or with seine nets, and specimens were kept alive until parasitological examination was conducted. Specimens were sacrificed with an overdose of sodium pentobarbital. All organs were examined under a stereo-microscope, and helminths were removed, counted, and identified. Standard techniques were employed to prepare parasite specimens for microscopic examination (see Lamothe-Argumedo, 1997). Parasite voucher specimens were deposited in the Colección Nacional de Helmintos (CNHE) of the Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), Mexico City. Ecological parameters such as prevalence, mean intensity, and mean abundance were calculated following Bush et al. (1997).

A total of 84 *L. brownorum* specimens were collected and examined (Celestún, n= 35; Yalahau, n= 33; and Ría Lagartos, n= 16). Four hundred and forty helminths (296 nematodes, 139 digeneans, and 5 acanthocephalans) were found, representing 12 taxa (3 of them in larval stage). Seven taxa were nematodes, 4 digeneans, and 1 acanthocephalan. Nine of these taxa are recorded for the first time in Yucatán (Table 1), and 9 represent new records for *L. brownorum* (*Langeronia macrocirra* Caballero y Bravo-Hollis, 1949, *Megalodiscus temperatus* (Stafford, 1923), *Aplectana incerta* Caballero, 1949, *Foleyellides striatus* (Ochoterena and Caballero, 1932), *Rhabdias füelleborni* Travassos, 1926, *Subulascaris falcaustriformis* Texeira de Freitas and Dobbin, 1957, *Contracaecum* sp., Physalopteridae gen. sp., and *Oncicola* sp.).

The greatest number of helminth taxa was found in specimens from Celestún, while the lowest numbers of parasites were found in specimens from Ría Lagartos. Overall, more nematode species were found than any other helminth taxonomic group. The greatest prevalence and mean abundance values were observed for the nematodes *S. falcaustriformis* and *A. incerta* in specimens from Celestún and Yalahau, respectively. On the other hand, the digenean *L. macrocirra* showed the highest prevalence and mean abundance values for specimens in Ría Lagartos. Finally, the digeneans *G. brownorumae* and again *L. macrocirra* showed the highest mean intensity values for specimens from Ría Lagartos; *Glypthelmins brownorumae* also was the species with the highest mean intensity value for specimens from Celestún, and *L. macrocirra* had the greatest value for this parameter for specimens from Yalahau (Table 2).

Previous to this work, only 2 helminth species had been recorded for *L. brownorum* in Yucatán (Moravec et al., 2002; León-Règagnon et al., 2005, Paredes-León et al., 2008); our study increased this number to 13. Except for *H. floedae* and *M. temperatus*, all helminth species found have Neotropical distribution. The presence of *H. floedae*

Table 1. Helminth parasites found in *L. brownorum* specimens (n= 84) collected at 3 localities in Yucatán, Mexico. RBC= Reserva de la Biosfera de Celestún, PELY= Parque Estatal Lagunas de Yalahau, RBRL= Reserva de la Biosfera de Ría Lagartos

Helminth	*RBC*	*PELY*	*RBRL*	*Distribution*	*Hábitat*
DIGENEA					
Glypthelmins brownorumae Razo-Mendivil, et al. 2004†	**X**		**X**	Neotropical	Intestine
Haematoloechus floedae Harwood, 1932		**X**		Nearctic	Lungs
Langeronia macrocirra Caballero y Bravo-Hollis, 1949* †	**X**	**X**	**X**	Neotropical	Intestine
Megalodiscus temperatus (Stafford, 1923)*†	**X**			Nearctic	Intestine
ACANTHOCEPHALA					
Oncicola sp.*	**X**		**X**	Neotropical	Mesentery
NEMATODA					
Aplectana incerta Caballero, 1949 *†	**X**	**X**	**X**	Neotropical	Intestine
Contracaecum sp. * †	**X**	**X**	**X**	?	Body cavity
Foleyellides striatus (Ochoterena and Caballero, 1932)* † Caballero, 1935* †	**X**	**X**	**X**	Neotropical	Body cavity
Oswaldocruzia subauricularis (Rudolphi 1819) *		**X**		Neotropical	Intestine
Physalopteridae gen. sp. * †	**X**	**X**			Body cavity
Rhabdias fülleborni Travassos, 1926 *†	**X**	**X**		Neotropical	Lungs
Subulascaris falcaustriformis Texeira de Freitas y Dobbin, 1957 * †	**X**	**X**	**X**	Neotropical	Intestine

* New host record
† New record in the state of Yucatán.

Table 2. Helminth infection levels from *L. brownorum* specimens collected at 3 localities in Yucatán, Mexico. RBC= Reserva de la Biosfera de Celestún, PELY= Parque Estatal Lagunas de Yalahau, RBRL= Reserva de la Biosfera de Ría Lagartos. %= Prevalence, MI= Mean Intensity ± SD, MA=Mean Abundance ± SD

Locality		*RBC (n=35)*			*PELY (n=33)*	
DIGENEA	*%*	**MA (± SE)**	**MI (± SD)**	*%*	**MA (± SD**	**MI (± SD)**
Megalodiscus temperatus	2.0	0.02 (± 0.16)	1 (± 0)	0.0	0.0	0.0
Haematoloechus floedae	0.0	0.0	0.0	3.0	0.03 (± 0.17)	1.0 (± 0.0)
Langeronia macrocirra	14.0	0.54 (± 1.54)	3.80 (± 2.16)	15.0	1.42 (± 6.13)	9.40 (± 14.39)
Glypthelmins brownorumae	20.0	1.17 (± 3.61)	5.85 (± 6.49)	0.0	0.0	0.0
ACANTHOCEPHALA						
Oncicola sp.	8.0	0.11 (± 0.40)	1.33 (± 0.57)	0.0	0.0	0.0
NEMATODA						
Rhabdias fülleborni	20.0	0.80 (± 2.38)	4.14 (± 4.017)	9.0	0.24 (± 0.86)	2.66 (± 1.52)
Aplectana incerta	5.0	0.14 (± 0.69)	2.50 (± 2.12)	39.0	1.54 (± 2.39)	3.92 (± 2.28)
Foleyellides striatus	14.0	0.42 (± 1.24)	3.0 (± 1.87)	6.0	0.09 (± 0.38)	1.50 (± 0.70)
Subulascaris falcaustriformis	25.0	1.48 (± 3.95)	5.77 (± 6.22)	18.0	0.96 (± 3.03)	5.33 (± 5.57)
Contracaecum sp.	2.0	0.02 (± 0.16)	1.0 (± 0)	6.0	0.06 (± 0.24)	1.0 (± 0)
Oswaldocruzia subauricularis	0.0	0.0	0.0	18.0	0.57 (± 1.41)	3.16 (± 1.72)
Physalopteridae gen. sp.	8.0	0.20 (± 0.75)	2.33 (± 1.52)	15.0	1.27 (± 5.41)	8.40 (± 12.64)

Locality		*RBRL (n=16)*	
DIGENEA	*%*	**MA (± SD)**	**MI (± SD)**
Megalodiscus temperatus	0.0	0.0	0.0
Haematoloechus floedae	0.0	0.0	0.0
Langeronia macrocirra	25.0	1.50 (± 2.96)	6.0 (± 2.82)
Glypthelmins brownorumae	6.0	0.37 (± 1.5)	6.0 (± 0)
ACANTHOCEPHALA			
Oncicola sp.	6.0	0.06 (± 0.25)	1.0 (± 0.0)
NEMATODA			
Rhabdias fülleborni	0.0	0.0	0.0
Aplectana incerta	18.0	0.75 (± 2.04)	4.0 (± 3.46)
Foleyellides striatus	12.0	0.43 (± 1.31)	3.50 (± 2.12)
Subulascaris falcaustriformis	6.0	0.12 (± 0.5)	2.0 (± 0)
Contracaecum sp.	12.0	0.56 (± 1.99)	4.50 (± 4.94)
Oswaldocruzia subauricularis	0.0	0.0	0.0
Physalopteridae gen. sp.	0.0	0.0	0.0

in native amphibian species in Yucatán may be due to the introduction of *Lithobates catesbeiana* (Shaw, 1802) in the region for culture purposes (León-Règagnon, et al., 2005). On the other hand, *M. temperatus* has a wide distribution and has been recorded from the southern United States of America to Costa Rica, where it is a common parasite of several genera of anurans (Yamaguti, 1971; Bursey and Golberg, 2005). The widespread distribution of final hosts of *M. temperatus* suggests the presence of a species complex which needs further research.

Numerous studies have shown that in general more digeneans species are found in amphibians with either aquatic or semiaquatic habits, while nematode species are more common in terrestrial amphibians (Aho, 1990; Guillén-Hernández et al., 2000; Pérez-Ponce de León et al., 2000; Paredes-Calderón, et al., 2004; Espínola-Novelo and Guillén-Hernández, 2008). Overall, results from this work contradict these findings; nematode species richness and mean abundance in *L. brownorum* were greater compared to that of digeneans in 2 of the localities (Table 2). This difference in the number of nematode and digenean species and their relative abundances in *L. brownorum* may be due to the specific biotic and abiotic conditions present in those localities. A low richness of suitable invertebrate species acting as intermediate hosts (*e.g.*, snails and insects) throughout the life cycle of digeneans at those localities may explain our results. Nematode species collected in this study are monoxenous and most of them infect their host via skin penetration. Amphibians are generally considered generalist feeders and their diets usually reflect the availability of suitable prey (Duellman and Trueb, 1994). In particular, *L. brownorum* has been shown to feed on a wide variety of terrestrial and aquatic arthropods, although it does not show a special preference for any given item (Ramírez-Bautista and Lemos-Espinal, 2004). Digeneans usually require an aquatic intermediate host species in addition to a snail species in their life cycle. The presence of *M. temperatus* and *G. brownorum* in this amphibian species suggests the possibility that it feeds on its own skin after molting since larval stages (metcercariae) of these parasites occur in amphibian skin (Smith, 1980); another possibility is that adults prey on tadpoles.

The relatively low mean intensity and mean abundance values found for digeneans in this study may be related to this amphibian's generalist diet, as well as its mobility between aquatic and terrestrial habitats. The high prevalence values observed for nematodes relative to digeneans suggests that *L. brownorum* spends a significant amount of time out of the water, resulting in high rates of nematode recruitment via skin penetration.

Results for *L. brownorum*, the mostly aquatic host that we examined in this study and those reported for the terrestrial hosts *C. marinus* and *C. valliceps* in Yucatán (Espinola-Novelo and Guillén-Hernández, 2008) strongly differ from results reported in a study which examined specimens of both terrestrial species and 2 aquatic (*L. berlandieri* and *L. vaillanti*) species closely related to *L. brownorum* from Los Tuxtlas, Veracruz (Guillén-Hernández, 1992; Guillén-Hernández, et al. 2000). These findings suggest that digeneans species are an important component which structures the parasite community of amphibians in Veracruz, while in Yucatán nematodes appear to take their place as we found them to be more species-rich and abundant. Further studies which record helminth species for other species of amphibians in the Yucatan Peninsula are necessary to provide insight on this issue.

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