

## Helminths of the Virginia Opossum *Didelphis virginiana* (Mammalia: Didelphidae) in Mexico

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**ABSTRACT:** The goal of this study was to provide further information about helminth parasites of Virginia opossum *Didelphis virginiana* Kerr, 1792 from Mexico. During routine faunal investigations between 1958 and 2001, 101 opossum were necropsied. Nineteen taxa of helminths were collected, representing 13 genera from hosts in 27 localities from Mexico. There are 58 new locality records, with 6 species recorded in Mexico for the first time: *Brachylaima virginiana* Dickerson, 1930; *Cruzia americana* Mapleston, 1930; *Didelphonema longispiculata* (Hill, 1939); *Didelphostrongylus hayesi* Prestwood, 1976; *Viannaia didelphis* Travassos, 1914; and *Viannaia viannai* Travassos, 1914. This increases the number of helminth taxa previously known for this host in Mexico to 28.

The opossum, *Didelphis virginiana* Kerr, 1792, occurs from southern Canada through the United States and Mexico, down to Costa Rica (Gardner, 1982). Its helminth fauna has been the subject of extensive investigation mostly in North America, where 75 taxa have been described (Potkay, 1977; Harris, 1983; Alden, 1995). However, helminthological studies of this host in Mexico are limited, making available information scarce and fragmentary (Lamothe, 1981; Prado, 1993; Cañeda, 1997; Salgado and Cruz, 2002). Thus far, 18 taxa have been reported from Mexico. The aim of this study was to compile and provide further information concerning helminth parasites of *D. virginiana* in several localities of Mexico.

The specimens studied were collected during routine faunal investigations developed in the Laboratorio de Helminología, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM) over several years (1958–2001) and localities from Mexico. In total, 101 opossum were examined. Most of the hosts were captured using Tom-

ahawk traps under permission number FAUT.0056, Secretaría de Medio Ambiente y Recursos Naturales, México. A few road-kills were necropsied, as well as several animals shot by local hunters. Trapped opossum were killed with an overdose of sodium pentobarbital and examined by standard procedures. Platyhelminths were relaxed with hot tap water, fixed in Bouin's fluid for 8 hr under cover glass pressure, and then placed in vials containing 70% alcohol; they were stained with Mayer's paracarmine, Delafield's hematoxylin, or Gomori's trichrome and mounted in permanent slides with Canada balsam. Acanthocephalans were placed in cold physiological saline solution to evert the proboscis. These helminths and the nematodes were fixed with hot 4% formalin and studied without the aid of a permanent mount. Voucher specimens were deposited in the Colección Nacional de Helmintos (CNHE), Biology Institute, Mexico City, and in the Harold W. Manter Laboratory of Parasitology (HWML), Lincoln, Nebraska. Prevalence, mean intensity, and range of intensity follow the definitions outlined by Margolis et al. (1982).

Nineteen taxa of helminths, including 5 digeneans, 1 cestode, 2 acanthocephalans, and 11 nematodes were collected from opossum from 10 states of Mexico. The most widely distributed species were: *Turgida turgida* (Rudolphi, 1819) (in 9 states) and *Cruzia americana* Mapleston, 1930, and *Cruzia tentaculata* (Rudolphi, 1819) (in 4 states); these 3 species reached the highest levels of prevalence and mean abundance (Table I).

There were 58 new locality records. Six species are recorded in Mexico for the first time: *Brachylaima virginiana* Dickerson, 1930; *C. americana*; *Didelphonema longispiculata* (Hill, 1939); *Didelphostrongylus hayesi* Prestwood, 1976; *Viannaia didelphis* Travassos, 1914; and *Vian-*

TABLE I. Helminths collected from 101 opossum *Didelphis virginiana* in 10 states of Mexico.\*

Species	Geographic distribution									
	Chiapas (n = 7) %/MI (Range)	Colima (n = 16) %/MI (Range)	Guerrero (n = 14) %/MI (Range)	Jalisco (n = 3) %/MI (Range)	México (n = 4) %/MI (Range)	Michoacán (n = 7) %/MI (Range)	Nayarit (n = 6) %/MI (Range)	Oaxaca (n = 22) %/MI (Range)	Veracruz (n = 20) %/MI (Range)	Yucatán (n = 2) %/MI (Range)
<i>Brachylaima virginiana</i>			7.1/1 (1)		50/10 (8–12)					
<i>Brachylaima</i> sp.										
<i>Paragonimus mexicanus</i>		19/1.6 (1–3)								
<i>Rhopalium coronatus</i>										
<i>Rhopalium macracanthus</i>										
<i>Mathevoaenia</i> sp.	14/3 (3)						14/1.3 (1–2)	35/7.6 (6–27) 20/7 (4–10)		
<i>Oligacanthorhynchus tortuosa</i>							32/1.6 (1–3)			
<i>Oncicola luehei</i>							—			
<i>Didelphostromylus hayesi</i>			14/8.5 (8–9)				4.5/0.4 (1)			
<i>Cruzia</i> sp.			7/14 (14) 21/13.3 (1–23)							
<i>Cruzia americana</i>		56/22.4 (4–70) 62/28.3 (5–31)		33/12 (12)				68.1/22 (6–94)	79/168 (3–315)	50/22 (22)
<i>Gnathostoma turgidum</i>	57/36.5 (7–60)		7/1 (1)							
<i>Turgida turgida</i>		94/20 (7–43)	93/19.8 (4–32)	33/6 (6)	100/7 (3–11)	28/8.5 (3–14)	82/16.3 (2–54)	65/6 (5–13)	50/8 (8)	
<i>Didelphonema longispiculata</i>			14/1.5 (1–2) 7/5 (5)							
<i>Trichuris</i> sp.			7/1 (1)							
<i>Viannata</i> sp.									5/7 (7)	
<i>Viannata didelphis</i>		12.5/6 (1–11)								
<i>Viannata viannai</i>			14/2.5 (1–4)							

\* n, sample size; %, prevalence; MI, mean intensity; (Range), range of infection.

TABLE II. Helminthological record of the Virginia opossum *Didelphis virginiana* in Mexico.

Helminth	Locality	Georeference	CNHE Coll. No.	HWML Coll. No.	Reference
<b>Digenea</b>					
<b>Brachylaemidae</b>					
<i>Brachylaima virginiana</i> *	Estado de México Tequesquihuac**	19°32'30"N, 99°12'02"W	3687		This study
<i>Brachylaima</i> sp.*	Guerrero Laguna Tres Palos** Zacatula**	16°49'22"N, 99°43'50"W 18°00'38"N, 102°10'42"W	4658 4657		This study This study
<b>Paragonimidae</b>					
<i>Paragonimus mexicanus</i> †	Colima Coahuayana** Comala La Barragana La Esperanza Madrid Michoacán Agua Blanca Nayarit El Guayabito El Mamey Veracruz Laguna Escondida Los Tuxtlas	18°44'32"N, 103°42'17"W 19°19'37"N, 103°45'31"W 19°23'04"N, 103°39'00"W 19°10'20"N, 103°52'00"W 19°05'11"N, 103°52'19"W 19°28'52"N, 100°29'43"W 21°32'00"N, 105°06'30"W 21°26'15"N, 105°10'10"W 18°35'38"N, 95°05'16"W 18°37'17"N, 95°05'35"W	4650		This study Lamothe et al. (1981) Lamothe et al. (1981) Lamothe et al. (1981) Lamothe et al. (1981) Lamothe (1981) Lamothe et al. (1986) Lamothe et al. (1986) Cañeda (1997) Lamothe et al. (1997)
<b>Rhopaliasidae</b>					
<i>Rhopalias coronatus</i> *	Veracruz Alvarado** Ejido Lázaro Cárdenas Laguna Escondida Los Tuxtlas Los Tuxtlas	18°47'05"N, 95°45'35"W 18°36'10"N, 95°06'10"W 18°35'38"N, 95°05'16"W 18°37'17"N, 95°05'35"W	4620		This study Cañeda (1997) Cañeda (1997) Cañeda (1997) This study
<i>Rhopalias macracanthus</i> *	Veracruz Alvarado** Ejido Lázaro Cárdenas Laguna Escondida Los Tuxtlas Los Tuxtlas Playa Escondida Playa Escondida Oaxaca Temascal**	18°47'05"N, 95°45'35"W 18°36'10"N, 95°06'10"W 18°35'38"N, 95°05'16"W 18°37'17"N, 95°05'35"W 18°35'12"N, 95°03'47"W	4622 4625 4624 4623		This study Cañeda (1997) Cañeda (1997) Cañeda (1997) This study Cañeda (1997) This study This study
<b>Strigeidae</b>					
<i>Duboisella proloba</i> *	Veracruz Playa Escondida	18°35'12"N, 95°03'47"W			Lamothe et al. (1997)
<b>Cestoda</b>					
<b>Anoplocephalidae</b>					
Anoplocephalidae gen. sp.*	Colima 				Lamothe et al. (1981)
<i>Mathevotaenia</i> sp.*	Chiapas Lagos de Colón**	15°50'00"N, 91°52'47"W	4600		This study
<b>Proteocephalidae</b>					
Proteocephalinae gen. sp.*	Veracruz Laguna Escondida Los Tuxtlas	18°35'38"N, 95°05'16"W 18°37'17"N, 95°05'35"W			Cañeda (1997) Cañeda (1997)
<b>Acanthocephala</b>					
<b>Oligacanthorhynchidae</b>					
<i>Oligacanthorhynchus tortuosa</i> *	Chiapas Cascadas Agua Azul Michoacán Agua Blanca Morelos Progreso Oaxaca Temascal**	17°15'17"N, 92°07'30"W 19°28'52"N, 100°29'43"W 18°53'00"N, 99°09'26"W 18°16'01"N, 96°24'39"W			Prado (1993) Prado (1993) Lamothe et al. (1997) 4497 This study

TABLE II. Continued

Helminth	Locality	Georeference	CNHE Coll. No.	HWML Coll. No.	Reference
<i>Oncicola luehei</i> *	Veracruz				
	Balzapote	18°36'39"N, 95°05'02"W			Cañeda (1997)
	Los Tuxtlas	18°37'17"N, 95°05'35"W			Prado (1993)
	Playa Escondida	18°35'12"N, 95°03'47"W			Cañeda (1997)
	Oaxaca				
	Mixtequilla**	16°32'00"N, 94°34'00"W		45821	This study
<i>Pachysentis gethi</i> *	Veracruz				
	Ejido Lázaro Cárdenas	18°36'10"N, 95°06'10"W			Cañeda (1997)
	Los Tuxtlas	18°37'17"N, 95°05'35"W			Prado (1993)
	Playa Escondida	18°35'12"N, 95°03'47"W			Cañeda (1997)
	Colima				
	La Esperanza	19°10'20"N, 103°52'00"W			Lamothe et al. (1981)
Plagiorhynchidae					
<i>Porrorchis nickoli</i> *‡‡	Chiapas				
	Cascadas Agua Azul	17°15'17"N, 92°07'30"W			Salgado & Cruz (2002)
	Cascadas Agua Azul				Prado (1993)
	Veracruz				Salgado & Cruz (2002)
	Balzapote	18°36'39"N, 95°05'02"W			Salgado & Cruz (2002)
	Catemaco	18°24'05"N, 95°06'34"W			Salgado & Cruz (2002);
	Ejido Lázaro Cárdenas	18°36'10"N, 95°06'10"W			Cañeda (1997)
	Ejido Lázaro Cárdenas				Prado (1993)
	Las Cabañas	18°36'00"N, 95°03'15"W			Salgado & Cruz (2002)
	San Andrés Tuxtla	18°27'00"N, 95°12'43"W			Salgado & Cruz (2002)
	Sontecomapan	18°31'18"N, 95°01'38"W			
Nematoda					
Angiostrongylidae					
<i>Didelphostrongylus hayesi</i> †	Guerrero				
	Laguna Tres Palos**	16°49'22"N, 99°43'50"W	4206		This study
	Taxco El Viejo**	19°28'38"N, 99°35'12"W	4270		This study
	Oaxaca				
	Temascal**	18°16'01"N, 96°24'39"W	4271		This study
Cruziidae					
<i>Cruzia</i> sp.*	Guerrero				
	Coyuquilla**	18°00'33"N, 102°01'45"W	4596		This study
<i>Cruzia americana</i> ‡	Colima				
	Colima**	19°13'45"N, 103°43'10"W	4593		This study
	Comala**	19°19'37"N, 103°45'31"W		45802	This study
	Madrid**	19°05'11"N, 103°52'19"W		45804	This study
	La Esperanza**	19°10'20"N, 103°52'00"W		45807	This study
	Guerrero				
	Laguna Tres Palos**	16°49'22"N, 99°43'50"W	4204		This study
	La Estancia**	—		45803	This study
	Taxco El Viejo**	19°28'38"N, 99°35'12"W	4537		This study
	Oaxaca				
	Mixtequilla**	16°32'00"N, 94°34'00"W		45810	This study
	Nizanda**	16°39'30"N, 95°00'25"W	4594		This study
	Temascal**	18°16'01"N, 96°24'39"W	4590		This study
	Veracruz				
	Las Cabañas**	18°36'00"N, 95°03'15"W		45811	This study
<i>Cruzia tentaculata</i> ‡,§	Chiapas				
	Cascadas Agua Azul**	17°15'17"N, 92°07'30"W		45812	This study
	Colima				
	‡‡				Lamothe et al. (1981)
	Comala**	19°19'37"N, 103°45'31"W		45813	This study
	Dos Amates**	19°19'50"N, 103°45'30"W		45814	This study
	Jalisco				
	Autlán-Melaque**	20°18'00"N, 104°30'00"W	ND		This study
	Juntas-Palmas**	20°45'00"N, 105°06'00"W		ND	This study
	Veracruz				
	Balzapote	18°36'39"N, 95°05'02"W			Cañeda (1997)
	Ejido Lázaro Cárdenas	18°36'10"N, 95°06'10"W			Cañeda (1997)
	Laguna Escondida	18°35'38"N, 95°05'16"W			Cañeda (1997)
	Los Tuxtlas	18°37'17"N, 95°05'35"W			Cañeda (1997)
	Playa Escondida	18°35'12"N, 95°03'47"W		45815	This study

TABLE II. Continued

Helminth	Locality	Georeference	CNHE Coll. No.	HWML Coll. No.	Reference
	Rancho Tebanca Yucatán	18°24'57"N, 95°00'17"W			Cañeda (1997) Cañeda (1997)
	Mérida**	20°58'52"N, 89°36'36"W		45816	This study
Gnathostomatidae					
<i>Gnathostoma</i> sp.	Tabasco Villahermosa	18°00'28"N, 92°55'58"W			Lamothe (1997)
<i>Gnathostoma procyonis</i>	Morelos Cuernavaca	18°55'15"N, 99°14'33"W			Lamothe (1997)
	Tepoztlán	18°59'03"N, 99°07'00"W			Lamothe (1997)
	Guerrero Laguna Tres Palos**	16°49'22"N, 99°43'50"W	4261		This study
<i>Gnathostoma turgidum</i>   ,#	Oaxaca Temascal	18°16'01"N, 96°24'39"W			Lamothe et al. (1998) Almeyda et al. (2000)
	Temascal				
Gongylonematidae					
<i>Gongylonema mexicanum</i> ¶	Veracruz Balzapote	18°36'39"N, 95°05'02"W			Cañeda (1997)
	Ejido Lázaro Cárdenas	18°36'10"N, 95°06'10"W			Cañeda (1997)
	Laguna Escondida	18°35'38"N, 95°05'16"W			Cañeda (1997)
Physalopteridae					
<i>Turgida turgida</i> ‡,	Colima Colima**	19°13'45"N, 103°43'10"W	4589		This study
	Comala**	19°19'37"N, 103°45'31"W	3421		This study
	Dos Amates**	19°19'50"N, 103°45'30"W	3419		This study
	La Barragana**	19°23'04"N, 103°39'00"W	3420		This study
	La Esperanza**	19°10'20"N, 103°52'00"W	4573–4574		This study
	‡				Lamothe et al. (1981)
	Madrid**	19°05'11"N, 103°52'19"W	4575		This study
	Estado de México Tequesquihuac**	19°32'30"N, 99°12'02"W	4585		This study
	Guerrero Coyuquilla**	18°00'33"N, 102°01'45"W	4586		This study
	Laguna Tres Palos**	16°49'22"N, 99°43'50"W	4208		This study
	Taxco El Viejo**	19°28'38"N, 99°35'12"W	4541		This study
	Jalisco Autlán-Melaque**	20°45'00"N, 105°06'00"W		45817	This study
	Michoacán El Ortígal**	19°26'30"N, 102°03'55"W	4582		This study
	Nayarit Peñitas**	21°02'00"N, 105°15'00"W	4592		This study
	Oaxaca Mixtequilla**	16°32'00"N, 94°34'00"W		45818	This study
	Nizanda**	16°39'30"N, 95°00'25"W	4591		This study
	Temascal**	18°16'01"N, 96°24'39"W	5037		This study
	Veracruz Ejido Lázaro Cárdenas	18°36'10"N, 95°06'10"W			Cañeda (1997)
	Laguna Escondida	18°35'38"N, 95°05'16"W			Cañeda (1997)
	Las Cabañas**	18°36'00"N, 95°03'15"W	4584		This study
	Los Tuxtlas**	18°37'17"N, 95°05'35"W			This study
	Playa Escondida	18°35'12"N, 95°03'47"W		45819	Cañeda (1997)
	Playa Escondida		4580		This study
	Yucatán Mérida**	20°58'52"N, 89°36'36"W		45820	This study
Spirocercidae					
<i>Didelphonema longi- spiculata</i>	Guerrero Taxco El Viejo**	19°28'38"N, 99°35'12"W	4538		This study
Trichuridae					
<i>Trichuris</i> sp.‡	Guerrero Taxco El Viejo**	19°28'38"N, 99°35'12"W	4540		This study

TABLE II. Continued

Helminth	Locality	Georeference	CNHE Coll. No.	HWML Coll. No.	Reference
<i>Trichuris didelphis</i> †,§	Veracruz				
	Laguna Escondida	18°35'38"N, 95°05'16"W			Cañeda (1997)
	Los Tuxtlas	18°37'17"N, 95°05'35"W			Cañeda (1997)
	Rancho Tebanca	18°24'57"N, 95°00'17"W			Cañeda (1997)
Viannaiidae					
<i>Viannia</i> sp.*	Guerrero				
	Laguna Tres Palos**	16°49'22"N, 99°43'50"W	4205		This study
	Veracruz				
	Balzapote	18°36'39"N, 95°05'02"W			Cañeda (1997)
	Los Tuxtlas**	18°37'17"N, 95°05'35"W	4652		This study
<i>Viannia didelphis</i> *	Playa Escondida	18°35'12"N, 95°03'47"W			Cañeda (1997)
	Colima				
	La Esperanza**	19°10'20"N, 103°52'00"W	4651		This study
<i>Viannia viannai</i> *	Madrid**	19°05'11"N, 103°52'19"W	4649		This study
	Guerrero				
	Taxco El Viejo**	19°28'38"N, 99°35'12"W	4543		This study

\* Intestine.

\*\* New locality record.

† Lungs.

‡‡ Locality not specified.

‡‡ Recorded by Prado (1993) and Cañeda (1997) as *Longisoma marsupialis* Prado, 1993, specific name only published in a Bachelor thesis. CNHE, Accession number to Colección Nacional de Helmintos; HWML, Accession number to Harold W. Manter Laboratory of Parasitology; ND, voucher specimens not deposited.

‡ Caecum.

|| Stomach.

# Liver.

¶ Esophagus.

§ Rectum.

*naia viannai* Travassos, 1914, increasing the number of helminth taxa known for this host in Mexico to 28 (Table II).

It was not possible to identify 5 of the 19 helminth taxa found in this study because of several reasons, i.e., the poor conditions of the material (*Cruzia* sp., *Brachylaima* sp.), the small number of specimens collected (*Viannia* sp.), or immaturity (*Mathevotaenia* sp.). *Trichuris* sp. is similar in some ways to the 5 species described in American marsupials, i.e., *Trichuris minuta* Rudolphi, 1819; *Trichuris marsupialis* Foster, 1939; *Trichuris urichi* Wolfgang, 1951; *Trichuris reesali* Wolfgang, 1951; and especially *Trichuris didelphis* Babero, 1960. However, the analysis of paratypes of this species (USNPC 039038) showed that our specimens could not be assigned to *T. didelphis* because of the shape of the spicular sheath (tubular in our material vs. pear shaped in Babero's [1960] specimens) and the egg size (0.062–0.069 × 0.030–0.031 vs. 0.070–0.108 × 0.035–0.045, respectively). Records of *Paragonimus rudis* (Diesing, 1850) from Mexico, attributed by Alden (1995) to Lamothe (1981) and Lamothe et al. (1986), are erroneous. In both records, the specimens were assigned originally to *Paragonimus mexicanus* Miyazaki & Ishii, 1968. Moreover, *P. rudis* is now considered as species inquirenda (Tongu et al., 1995).

The Mexican helminthological record for *D. virginiana*, constituted by 28 taxa (10 recorded in this study and 18 reported previously), reflects the same trend as the one reported by Alden (1995); thus, nematodes are the most prevalent group of helminths in both studies (15 and 38 taxa, respectively). Digeneans are the second most prevalent group represented in both regions (22 taxa in Alden's study vs. 6 from Mexico); in North America, the other 2 groups (cestodes and acanthocephalans) comprise 9 and 7 taxa, respectively, whereas in Mexico these possess 3 and 4 taxa.

The helminth parasites recorded in this host from Mexico add 7 taxa to the helminth fauna of *D. virginiana* in North America: *Duboisella proloba* Baer, 1938 and *Rhopalias coronatus* (Rudolphi, 1819) (Digenea); *Mathevotaenia* sp., (Cestoda); *Porrorchis nickoli* Salgado and Cruz, 2002, *Oncicola luehei* (Travassos, 1917), and *Pachysentis gethi* (Machado, 1950) (Acanthocephala); and *Gongylonema mexicanum* (Caballero and Zerecero, 1944) (Nematoda) (Table II). In addition, 6 helminth species have been registered in several localities from Mexico

from hosts identified as *Didelphis mesamericana tabascensis* (Allen, 1901); *Aspiododera raillieti* Travassos, 1913, *C. tentaculata*, *Globocephalus marsupialis* (Teixeira de Freitas and Lent, 1936), *R. coronatus*, *Rhopalias macracanthus* Chandler, 1932, and *T. turgida* (Caballero, 1937, 1951; Caballero and Zerecero, 1944; Caballero et al., 1944). Because the name *D. mesamericana tabascensis* has been used indistinctly for *Didelphis marsupialis* Linnaeus and *D. virginiana* (see Gardner, 1973) and because there are no host voucher specimens, these records cannot be considered as part of Mexican helminth fauna of *D. virginiana*.

Of the 28 taxa reported in Mexico, 20 were identified to specific level. The distribution of this 20 species includes 7 Pan-American species (*R. macracanthus*; *D. hayesi*; *Gnathostoma turgidum* Stossich, 1902; *T. turgida*; *Trichuris didelphis*; *V. didelphis*; and *V. viannai*), 6 from South America (*P. mexicanus*; *R. coronatus*; *D. proloba*; *O. luehei*; *P. gethi*; and *C. tentaculata*), 5 from North America (*B. virginiana*; *Oligacanthorhynchus tortuosa* (Leidy, 1850); *C. americana*; *Gnathostoma procyonis* Chandler, 1942; and *D. longispiculata*), and 2 endemic species (*P. nickoli* and *G. mexicanum*). This mixed composition can be explained on one hand by the confluence of the Nearctic and Neotropical biogeographical zones in Mexico. On the other hand, the generalist character of all 20 helminth species could promote their exchange among different hosts (other marsupials, felids, mustelids, and procyonids, indiscriminately), thereby enriching the helminth fauna of the Virginia opossum in Mexico. However, scarce knowledge regarding the helminth fauna of *D. virginiana* in Mexico makes both hypotheses premature. Further studies are necessary to make more accurate generalizations.

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