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# METAZOAN PARASITES OF *HIMANTOPUS MEXICANUS* MULLER (AVES) FROM SOUTHWESTERN TEXAS, WITH A CHECKLIST OF HELMINTH PARASITES FROM NORTH AMERICA

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**ABSTRACT:** Nineteen species of helminths were recovered from 34 of 35 black-necked stilts, *Himantopus mexicanus* Muller, collected from the Fort Bliss ponds, El Paso County, Texas. New host records are marked with an \*. The species identified were: *Acoelus vaginatus*, *Davainea himantopodis*, *Diplophallus polymorphus*, \**Eurycestus avoceti*, *Hymenolepis himantopodis*, *Hymenolepis* sp. 1, *Infula macrophallus*, *Cloacitrema michiganensis*, *Cyclocoelum lanceolatum*, *Notocotylus* sp., *Parastrigea mexicanus*, \**Tanaisia fedtschenkoi*, *Capillaria* sp., \**C. anatis*, \**C. contorta*, \**C. mergi*, \**Chevreuxia americana*, *Eustrongyldes mergorum*, and \**Splendidofilaria* sp. Six species of mallophagan lice and 1 species of nasal mite, *Rhinonyssus himantopus*, were recovered.

Helminths showed little concentration for dominance (0.09), were not very evenly distributed ( $0.49 \pm 0.08$ ) nor very diverse ( $0.73 \pm 0.14$ ), and most species were highly aggregated. The helminth community consisted of an unusually large number of core species (10). Three large species of tapeworms exhibited mostly paired infections, were mutually exclusive, and were negatively associated (-1).

The family Recurvirostridae is comprised of stilts and avocets. They are cosmopolitan, medium-sized shore birds with long, slender bills that are straight or recurved (Johnsgard, 1981). The stilts, genus *Himantopus* Brisson, 1760, include approximately 10 species with representatives on all continents except Antarctica (Clements, 1974). *Himantopus mexicanus* Muller, the black-necked stilt, is found in North America and ranges from southwestern Canada and western and southeastern United States south through Mexico and Central America to Peru and Brazil (Blair et al., 1968). Black-necked stilts migrate along the Rio Grande Valley, U.S.A. Small populations utilize river edges, desert ponds, and man-made impoundments in the southwestern United States from April to September, and a few birds nest in this area. Black-necked stilts eat a wide range of foods, according to Pough (1953). Aquatic beetles, bugs, and fly larvae are staple foods, with snails and crustaceans less common in the diet. Young birds sometimes take considerable numbers of beetle and fly larvae (Johnsgard, 1981).

There have been some reports of parasites harbored by the black-necked stilt. McIntosh (1938) described a philopthalmid trematode, *Cloacitrema michiganensis*, from stilts in Florida, and Coil (1955) described a new species of cestode, *Infula macrophallus*, from a stilt collected in Oaxaca, Mexico. Burt (1978, 1980) recovered the tapeworm *Diplophallus polymorphus* Rudolphi,

1819, from both the black-necked stilt and the American avocet, *Recurvirostra americana* Gmelin, 1789, collected from several localities in the United States and discussed the taxonomic status of *D. polymorphus* and related tapeworms. Strandtmann (1951) described the nasal mite *Rhinonyssus himantopus* from *H. mexicanus* collected in Texas, and subsequently it was reported from Cuba and Louisiana (Cerny and Dusbabek, 1971; Pence, 1972).

This paper presents information about metazoan parasites recovered from *H. mexicanus* collected in southwestern Texas and compares our findings to those for the American avocet, the Eurasian stilt (*H. himantopus himantopus* L.), and 2 species collected in South Africa: *Himantopus himantopis meridionalis* L. and *Recurvirostra avocetta* L. Observations and comments pertaining to exclusion among the cestodes also are given.

## METHODS AND MATERIALS

Thirty-five black-necked stilts, *H. mexicanus*, were shot at the Fort Bliss ponds, El Paso County, Texas, from 10 May 1979 to 24 May 1984. Several juvenile American avocets and black-necked stilts were collected in the summer of 1984 from the same locality and examined only for the number and state of development of the 3 large species of tapeworms observed in the completed study. Birds were placed in individual plastic bags and those not examined within 2 hr were frozen and examined at a later date for metazoan parasites.

Trematodes and cestodes were fixed in alcohol-formalin-acetic acid (AFA), stained in Semichon's acid carmine, and mounted in Canada balsam or permount. Nematodes were fixed in 70% ethanol and cleared in temporary lactophenol mounts. Ectoparasites and na-

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sal mites were fixed in 70% ethanol, cleared in 10% KOH, and mounted in Lipshaw's mounting media.

Abundance data were used for most of the analyses. Standard measures of central tendency (means) and dispersion (variance, standard deviation, standard error), distributions (uniform, random, contagious), interspecific associations, correlation coefficients ( $r$ ), and Spearman's rank coefficient for helminths were calculated with the aid of Microstat (Ecosoft, Inc., Indianapolis, Indiana) and Ecological Analysis—PC, Ecological Analysis Vol. 2—PC (Oakleaf Systems, Decorah, Iowa).

Clustering methods (group average with Euclidean distance, Euclidean distance squared, and Manhattan distance) for elucidation of helminth parasite community structure and for comparison to the helminth "core and satellite" species concept of Hanski (1982) as utilized for parasites by Bush and Holmes (1986a, 1986b) were done with the aid of Biostat II, A Multivariate Statistical Toolbox (Sigma Soft, Placentia, California). Helminth parasites from the black-necked stilt were classified into 4 groups based on their importance in the parasite community as determined by the second method ( $I_2$ ) = percent prevalence  $\times$  mean intensity. The groups were: (1) dominant species were those species characteristic of the community ( $I > 1.0$ ); (2) codominant species were those contributing significantly to the community composition, but which do well in other habitats ( $0.1 < I < 1.0$ ); (3) successful immigrant species were those species that occur infrequently and, although characteristic of the community, belong to another habitat ( $0 < I < 0.1$ ); and (4) unsuccessful immigrant species were those species that gain access to the habitat but do not mature or reproduce, contribute little to the community, and were always characteristic of another community ( $I = 0$ ). Data were also arranged in terms of their classification of importance in the helminth community using the  $I_2$  method of Pence and Eason (1980). The  $I_2$  results were used to help interpret clustering results and for comparison to the core-satellite community results.

When the variance/mean ratio for a species of helminth indicated its distribution was significantly contagious (clumped, aggregated), the degree of overdispersion was obtained by calculating the negative binomial parameter  $k$ , which is an inverse measure of the degree of overdispersion. Statistical significance was assumed when  $P < 0.05$ .

Simpson's index for concentration for dominance was calculated for helminths and ectoparasites, and Sorenson's index of similarity was used to compare helminth parasite faunas among *H. mexicanus*, *H. h. himantopus*, and *R. americana* according to the methods of Stone and Pence (1978). Mean diversity ( $H$ ) and mean evenness ( $J$ ), with confidence limits, were calculated for helminth parasites using Shannon's index as modified by Pielou (Zar, 1974).

Representative slides, numbers 78871–78880, have been deposited with the USNM Helm. Coll. API, USDA, BARC-East 1180, Beltsville, Maryland 20705.

## RESULTS AND DISCUSSION

Of the 35 black-necked stilts, *H. mexicanus*, 97% were infected with at least 1 species of hel-

minth parasite. Nineteen species of helminths were recovered: 7 Cestoidea, 5 Trematoda, and 7 Nematoda (Table I). No additional species of helminth parasites were observed after the 22nd bird was examined. Sixty-three percent of the hosts were infected with mallophagan lice and 6 species were recovered; 9% of the birds were infected with the nasal mite *Rhinonyssus himantopus* (Table I).

### CESTOIDEA

Among the 3 groups of helminths, the cestodes showed the highest abundances. A pattern of infection was observed among the 3 largest species of cestodes. All *Diplophallus polymorphus*, *Acoelus vaginatus*, and *Infula macrophallus* inhabited the proximal one-third of the small intestine of the black-necked stilt and were mutually exclusive. They were mostly in pairs (*D. polymorphus* 89.5% of the time, *A. vaginatus*, 89.0%, and *I. macrophallus*, 50.0%). If not in pairs, the infections were predominantly of a single worm. In 1 instance, 3 *D. polymorphus* were recovered, but the sizes indicated they were immature. Burt (1978) also observed the occurrence of paired *Diplophallus polymorphus* from *R. americana* and *H. mexicanus* collected from 3 flyways in North America. Ahern and Schmidt (1976) noted this pattern of infection for *Diplophallus coili* from American avocets whereby 34 of 37 hosts had paired tapeworm infections. The occurrence of paired cestode infections in the American avocet was also observed by Garcia and Canaris (1987) from south-central Colorado and southwestern Texas. They reported that the cestode *D. coili* always occurred in pairs in the upper one-third of the small intestine and with a very high prevalence (93.9%). Ten black-winged stilts, *H. h. meriodinalis*, and 10 avocets, *R. avocetta*, collected from the southwestern Cape Province, South Africa, also showed this same pattern of paired infections for the 2 large species of tapeworms recovered, *A. vaginatus* and *D. polymorphus* (Canaris and Hinojos, pers. obs.). Ahern and Schmidt (1976) related the large size and pattern of infection of *D. coili* to competition for nutrients. They noted that in a more recent infection of 13 specimens, all were small and approximately the same size, but in an older infection of 16 specimens, 2 were larger than the others. This same pattern of multiple infections of a single species, *Diplophallus* sp. in both the black-necked stilt and American avocet and *In-*

TABLE I. Parasites of the black-necked stilt, *Himantopus mexicanus*, from El Paso County, Texas.

Birds examined	Number infected	Prevalence (%)	Intensity			Abundance			
			$\bar{x} \pm SE$	SD	Range	$\bar{x} \pm SE$	SD		
Cestodea (7)									
<i>Hymenolepis himantopodis</i>	26	74.3	42.8	9.8	47.9	1-253	31.8	7.6	45.2
<i>Davainea himantopodis</i>	25	71.4	159.8	43.7	218.6	4-845	114.1	33.4	197.7
<i>Diplophallus polymorphus</i>	19	54.3	2.0	0.08	0.3	1-3	1.1	0.2	1.0
<i>Acoelus vaginatus</i>	9	25.7	1.9	0.01	0.4	1-2	0.5	0.1	0.9
<i>Hymenolepis</i> sp. 1	8	22.9	9.5	3.5	9.8	1-31	2.2	1.0	6.0
<i>Infula macrophallus</i>	6	17.1	1.5	0.2	0.5	1-2	0.3	0.1	0.6
<i>Eurycestus avoceti</i> *	1	2.9	—	—	—	—	0.9	0.9	5.2
Trematoda (5)									
<i>Cyclocoelum lanceolatum</i>	8	22.9	3.4	0.8	2.4	1-8	0.8	0.3	1.8
<i>Parastrigea mexicanus</i>	8	22.9	6.1	3.4	9.5	1-29	1.4	0.9	5.0
<i>Tanaisia fedtschenkoi</i> *	3	8.6	19.3	8.0	13.9	4-31	1.7	1.1	6.4
<i>Cloacitrema michiganensis</i>	1	2.9	—	—	—	—	0.5	0.5	3.0
<i>Notocotylus</i> sp.	1	2.9	—	—	—	—	0.1	5.7	0.3
Nematoda (7)									
<i>Chevreuxia americana</i> *	16	45.7	4.2	1.2	4.2	1-20	1.9	0.7	4.0
<i>Capillaria</i> sp.	10	28.6	2.6	0.7	2.6	1-7	0.7	0.3	1.7
<i>Capillaria contorta</i> *	8	22.9	5.6	2.0	7.4	1-17	1.7	0.7	4.0
<i>Capillaria anatis</i> *	6	17.1	4.5	1.8	6.2	2-12	1.0	0.5	2.9
<i>Capillaria mergi</i> *	6	17.1	8.7	3.6	6.7	1-24	1.1	0.7	4.2
<i>Eustrongyldes mergorum</i>	3	8.6	8.1	7.0	5.7	1-25	0.5	0.4	2.5
<i>Splendiofilaria</i> sp.*	1	2.9	—	—	—	—	—	—	—
Mallophaga (6)									
<i>Quadriceps semifissus mexicanus</i>	11	31.4	1.6	0.1	0.9	1-6	0.5	0.2	0.8
<i>Actornithophilus mexicanus</i>	8	22.9	1.9	0.2	0.9	1-3	0.4	0.4	1.0
<i>Quadriceps hemichrons</i>	6	17.1	1.0	0.1	0.4	1	0.2	0	0
<i>Actornithophilus himantopi</i>	3	8.6	2.0	0.1	0.6	1-3	0.2	0.7	1.2
<i>Quadriceps semifissus semifissus</i>	3	8.6	1.3	0.1	0.4	1-2	0.1	0.3	0.3
<i>Austromenopon himantopi</i>	2	5.7	1.5	0.1	0.4	1-2	0.1	0.5	0.7
Acarina (1)									
<i>Rhinonyssus himantopus</i>	3	8.6	5.0	2.0	3.5	3-9	0.4	0.3	1.7

\* New host record.

*fula macrophallus* in the stilt, was observed in a sample of juveniles collected in El Paso County, Texas. Ahern and Schmidt further stated that as infections continued, the competition between worms was greater as they increased in size, hence only 2 worms survived. They also explained that the occurrence of more than a pair of large or average size tapeworms (80-280 mm long and 2.5-6.2 mm wide) might cause blockage, and further, that the nutrient requirements with more than 2 large tapeworms might decrease the chances for survival of both host and parasite. There are, then, at least 4 large species of tapeworms that showed predominantly paired infections in the upper one-third of the small intestine in adults of the Recurvirostridae: *A. vaginatus*, *D. coili*, *D. polymorphus*, and *I. macrophallus*.

According to the Association Analysis test, all possible pairings of the 3 large species of tapeworms in the black-necked stilt showed negative association (-1), and all were significant except *A. vaginatus* with *I. macrophallus*. It is not clear

how these large tapeworm species are excluding each other, but they do appear to be limiting their own intensities by intraspecific competition.

A very unusual cestode, *Eurycestus avoceti* Clark, 1954, had been described and reported only from the American avocet from Nebraska (Clark, 1954). Ours was the second recovery of this tapeworm. The strobila consisted of extremely short, but very wide, proglottids, and a functional scolex was absent. These worms may be overlooked easily because of their nonworm-like appearance and small size.

#### TREMATODA

Five species of trematodes were collected (Table I). *Cyclocoelum lanceolatum* Wedl, 1858, and *Parastrigea mexicanus* Coil, 1957, had the highest prevalences. *Parastrigea mexicanus* was described from the American avocet from the Gulf of Mexico by Coil (1957) and was also reported from the black-necked stilt in Cuba (Dubois and Macko, 1972). *Tanaisia fedtschenkoi* Byrd and

Denton, 1950, had the highest mean intensity (19.3). This trematode has been reported as a parasite of the genitourinary tract of many aquatic and semiaquatic birds including the common snipe *Capella gallinago* L. collected from southwestern Texas and south-central Colorado (Leyva et al., 1980). Only 1 stilt was infected with *Cloacitrema michiganensis* McIntosh, 1938, and a total of 18 specimens was recovered from the small intestine. *Cloacitrema michiganensis* was originally described from specimens recovered from the black-necked stilt and spotted sandpiper *Actitis macularia* L. from Florida and Michigan, respectively (McIntosh, 1938). This is the first observation of this parasite from a stilt collected in the southwestern U.S.A.

### NEMATODA

Seven species of nematodes were recovered (Table I). The nematode *Chevreurxia americana* Schmidt, 1968, had the highest abundance (1.9) and is a new host record. This nematode was described from an American avocet in Colorado by Schmidt (1968), and was recovered under the koilon of the gizzard. The black-necked stilt's infections were also under the koilon. The genus *Capillaria* was represented by 4 species: *Capillaria* sp., *C. contorta*, *C. anatis*, and *C. mergi*, and these were new host records. One specimen of *Splendidofilaria* sp. was recovered from the subdermal fascia in the neck region, and this was a new host record.

### MALLOPHAGA

Six species of mallophagan lice were recovered, and all 6 have previously been reported from the black-necked stilt (Table I). *Quadriceps semifissus mexicanus* had the highest abundance (0.5) followed by *Actornithophilus mexicanus* (0.4).

### COMMUNITY STRUCTURE

The helminth parasite fauna, by Simpson's index, showed little concentration for dominance (0.09). The index was higher for the mallophagan ectoparasites (0.22), with *Actornithophilus mexicanus* and *Quadriceps semifissus mexicanus* contributing the most to the concentration for dominance. Shannon's test for mean diversity (H) and evenness (J) indicated that the helminth parasites were not very diverse ( $0.73 \pm 0.14$ ) and not very evenly distributed among the hosts ( $0.49 \pm 0.08$ ).

Sorenson's index of similarity indicated the

TABLE II. Classification and importance values ( $I_2$ ) of helminths from the black-necked stilt, *Himantopus mexicanus*, from El Paso County, Texas.

Helminth species	$I_2$ values
Dominant species*	
<i>Davainea himantopodis</i>	114.10
<i>Hymenolepis himantopodis</i>	31.80
<i>Hymenolepis</i> sp. 1	2.18
<i>Chevreurxia americana</i>	1.91
<i>Capillaria contorta</i>	1.69
<i>Tanaisia fedtschenkoi</i>	1.66
<i>Parastrigea mexicana</i>	1.40
<i>Capillaria mergi</i>	1.14
<i>Diplophallus polymorphus</i>	1.09
<i>Capillaria anatis</i>	1.06
Codominant species†	
<i>Cyclocoelum lanceolatum</i>	0.77
<i>Capillaria</i> sp.	0.74
<i>Eustrongylodes mergorum</i>	0.49
<i>Acoelus vaginatus</i>	0.46
<i>Infula macrophallus</i>	0.26
Successful immigrant species	
None	
Unsuccessful immigrant species†	
<i>Cloacitrema michiganensis</i>	0
<i>Eurycestus avoceti</i>	0
<i>Notocotylus</i> sp.	0
<i>Splendidofilaria</i> sp.	0

\* Core species.

† Satellite species.

black-necked stilt's helminth fauna was more similar to that of the American avocet (27.9%) than to that of the Eurasian black-winged stilt (22.5%), and the American avocet's helminth fauna was more similar to its North American relative, the black-necked stilt, than to the Eurasian black-winged stilt (12.7%). Comparison could not be made to other species of stilts in the family Recurvirostridae because not enough information about their helminth parasite faunas has been reported.

Thirteen of the 14 most prevalent helminths were significantly contagious (clumped, aggregated) according to the variance to mean ratio, and  $k$  values for these were low, indicating a high degree of overdispersion (Table III).

In terms of classification of importance in the helminth parasite community, there were 10 dominant, 5 codominant, no successful immigrant, and 4 unsuccessful immigrant species (Table II). All of the dominant species from the  $I_2$  method also included all the core species from the clustering methods (Table II).

Clustering techniques indicated there were 10 core and 9 satellite species (Table II). Community structure for helminths from the black-

TABLE III. *Overdispersion analysis and measure of degree of aggregation in the 14 most prevalent helminths from black-necked stilts, Himantopus mexicanus, collected in El Paso County, Texas.*

Helminth species	Variance/ mean ratio	Signifi- cantly clumped	k
<i>Davainea himantopodis</i>	342.5*	†	0.22
<i>Hymenolepis himantopodis</i>	64.3*	†	0.38
<i>Tanaisia fedtschenkoi</i>	25.0*	†	0.02
<i>Parastrigea mexicanus</i>	18.1*	†	0.09
<i>Hymenolepis</i> sp. 1	16.6*	†	0.08
<i>Eustrongyldes mergorum</i>	13.2*	†	0.03
<i>Capillaria contorta</i>	9.7*	†	0.09
<i>Chevreuxia americana</i>	8.2*	†	0.30
<i>Capillaria anatis</i>	8.0*	†	0.07
<i>Cyclocoelum lanceolatum</i>	4.2*	†	0.36
<i>Capillaria</i> sp.	3.9*	†	0.09
<i>Acoles vaginatus</i>	1.5*	†	0.43
<i>Infula macrophallus</i>	1.5*	†	0.36
<i>Diplophallus polymorphus</i>	1.0	Uniform distribution	

\* Variance to mean ratio significantly greater than 1.

† Significant.

necked stilt was more similar to that of the more closely related American avocet, *Recurvirostra americana*, from El Paso County, Texas (Garcia and Canaris, 1987), than to that of the common snipe, *Capella gallinago*, from the same locality (Leyva et al., 1980). Nineteen species of helminths were recovered from both the stilt and avocet, but only 14 from the common snipe.

Three (21%) of the helminths from the snipe were considered to be core species as compared to 10 (53%) and 8 (42%), respectively, for the stilt and avocet. Out of 38 species of helminths recovered from the stilt and avocet, 4 were common to both birds, and 3 of these were core species if *D. polymorphus* and *D. coili* are considered synonymous (Burt, 1978, 1980). The stilt shared 2 species of helminths, *Capillaria contorta* and *Tanaisia fedtschenkoi*, with the snipe. They were core species in the stilt and a satellite and core species in the snipe. The avocet shared 1 species with the snipe, the ubiquitous *Echinostomum revolutum*, which was a satellite species in both species of birds (Garcia and Canaris, 1987).

Apparently in southwestern Texas, there is a much larger number of species of helminths better adapted to the stilt and avocet than to the snipe. Snipe in southwestern Texas are transitory migrants and absent in the summer. Both stilt and avocet may linger during migration and both species nest in southwestern Texas; therefore, the opportunity to establish infective pools of helminths in this locality are more likely for these 2 species of recurvirostrids.

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TABLE IV. *Checklist of helminth parasites of the black-necked stilt, Himantopus mexicanus, from North America.*

Parasite group	Geographic region	Citation
Trematoda (6)		
<i>Cloacitrema michiganensis</i>	Florida	McIntosh, 1938
<i>Hofmonostomum himantopodis</i>	Puerto Rico	Yamaguti, 1971
<i>Notocotylus</i> sp.	Texas	This study
<i>Parastrigea mexicanus</i>	Cuba	Dubois and Macko, 1972
<i>Tanaisia fedtschenkoi</i>	Texas	This study
<i>Zygodontolepis lunata</i>	U.S.A.	Yamaguti, 1971
Cestoidea (7)		
<i>Acoles vaginatus</i>	U.S.A.	Yamaguti, 1959
<i>Davainea himantopodis</i>	Texas	This study
<i>Diplophallus polymorphus</i>	N. America	Burt, 1978
<i>Eurycestus avoceti</i>	Texas	This study
<i>Hymenolepis himantopodis</i>	Texas	This study
<i>Hymenolepis</i> sp.	Texas	This study
<i>Infula macrophallus</i>	Mexico and Texas	Coil, 1955, 1963, 1968
Nematoda (10)		
<i>Capillaria anatis</i>	Texas	This study
<i>Capillaria contorta</i>	Texas	This study
<i>Capillaria mergi</i>	Texas	This study
<i>Capillaria obsignata</i>	Cuba	Barus and Hernandez, 1971
<i>Capillaria</i> sp.	Texas	This study
<i>Chevreuxia americana</i>	Texas	This study
<i>Chevreuxia revolta</i>	Cuba	Barus and Hernandez, 1971
<i>Eustrongyldes mergorum</i>	Texas	This study
<i>Splendidofilaria</i> sp.	Texas	This study
<i>Tropisurus noveli</i>	Cuba	Barus and Hernandez, 1971

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