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Some Helminth Parasites of Sandhill Cranes from Mid-Continental North America[1]

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There is little information on the helminth fauna of sandhill cranes (*Grus canadensis*) from mid-continental North America. The present study presents data on selected helminth parasites recovered from sandhill cranes that nest throughout Canada, coastal Alaska, and Siberia; migrate through the Great Plains and winter in Texas. A major proportion of this population consists of lesser sandhill cranes (*G. c. canadensis*). Canadian sandhill cranes (*G. c. rowani*) and a small percentage of greater sandhill cranes (*G. c. tabida*) also occur in the area (Lewis, 1974, Ecology of the sandhill crane in the southeastern Central Flyway, Ph.D. Dissertation, Oklahoma State University, Stillwater, Oklahoma, 340 pp.; Lewis, 1977, *In* Management of Migratory Shore and Upland Game Birds in North America, Sanderson (ed.), Int. Assoc. Fish and Wildl. Agencies, Washington, D.C., pp. 5–43; Lewis, 1978, *In* Proc. 1978 Crane Workshop, Lewis (ed.), Colorado State University Press, Fort Collins, Colorado, pp. 21–28). Helminth parasites were collected from 320 sandhill cranes that died during trapping operations, as incidental deaths, or collected as part of another study. Cranes were obtained during winter in western Texas, and during spring in the Platte River Valley in Nebraska, 1979, and during late fall to spring, 1979–1980 from Oklahoma, Texas, Nebraska, Saskatchewan, and Alaska.

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Nematodes were cleared in lactophenol. Trematodes were stained in Harris' hematoxylin. Because the study of parasites was not the major purpose of the collection, all birds did not receive the same parasitologic examination.

Sex of the cranes was determined by examination of gonads. Juveniles (young-of-the-year) were identified by the presence of brown feathers on the occiput (Lewis, 1979, J. Wildl. Manage. 43: 211–214). Subspecies of adults were classified using discriminant analysis procedures based upon morphometric measurements (Tacha, 1981, Behavior and taxonomy of sandhill cranes from mid-continental North America, Ph.D. Dissertation, Oklahoma State University, Stillwater, Oklahoma, 112 pp.). The Chi-square test (χ^2) was used for all statistical analyses. Representative helminth specimens have been deposited in the U.S. National Parasite Collection, Beltsville, Maryland, as USNM Helm. Coll. Nos. 76514–76517.

Three species of helminths (two species of trematodes and one nematode) were found in the sample of 320 cranes examined (Table 1). The prevalence of each parasite did not differ significantly ($P > 0.10$) between collecting years (January–April 1979, October–May 1979–1980), therefore, data were pooled for subsequent statistical analyses.

The distribution of subspecies among 262 adult cranes examined for helminth parasites included 194 (74%) lesser sandhill cranes, 66 (25%) Canadian sandhill cranes, and two (0.8%) greater sandhill cranes. The greater sandhill cranes were deleted from analyses involving subspecies because of the small sample size.

Orchipedum jolliei, the most common trematode encountered, was recovered from the trachea in 129 (40%) cranes. There was a significant difference ($\chi^2 = 3.56$, df = 1, $P < 0.05$) in

TABLE 1. Prevalence and intensity of infection of helminth parasites recovered from sandhill cranes collected in Texas and Nebraska during winter and spring 1979, and late fall to spring 1979–1980 in Oklahoma, Texas, Nebraska, Canada, and Alaska.

Parasite	No. cranes examined[a]	No. cranes positive	Prevalence (%)	Intensity of infection		
				Mean	SE	Range
Orchipedum jolliei	320	129	40	6.0	0.5	1–21
Pyohyptiasmus grusi	319	32	10	5.6	1.5	1–21
Tetrameres grusi	203	54	27	5.4	1.2	1–50

[a] Because of the condition of the birds at necropsy and variation in collection schedule, the number of birds examined for each parasite varied.

the prevalence of *O. jolliei* between juveniles (29%) and adults (43%). This trematode was recovered from juvenile birds in Oklahoma during fall migration in October. No differences in prevalence were detected between male and female cranes ($P > 0.16$). The prevalence of *O. jolliei* was significantly ($\chi^2 = 8.00$, df = 1, $P < 0.005$) higher among adults classified as *G. c. rowani* (58%) than among *G. c. canadensis* (37%) and was greatest in the sample obtained in October and least in January (Table 2). However seasonal variations in prevalence of *O. jolliei* are confounded because of differences in geographical distributions of subspecies between Texas and Oklahoma. There was a significantly higher proportion of *G. c. rowani* in Oklahoma (88%) than in Texas (27%), while *G. c. canadensis* was more prevalent in Texas (73%) than in Oklahoma (12%) ($\chi^2 = 41.3$, df = 1, $P < 0.0001$). Adult cranes from Oklahoma had a higher ($\chi^2 = 15.9$, df = 1, $P < 0.0001$) prevalence of *O. jolliei* (70%) than cranes obtained from Texas (30%). Further analysis within each subspecies revealed a significantly higher prevalence of *O. jolliei* in *G. c. canadensis* in March along the Platte River and a lower prevalence during January and February in Texas ($\chi^2 = 9.04$, df = 3, $P < 0.03$). A higher than expected prevalence of *O. jolliei* was detected among *G. c. rowani* in Oklahoma in October during fall migration, and a lower than expected prevalence occurred during January and February in Texas ($\chi^2 = 7.05$, df = 3, $P < 0.07$).

Orchipedum jolliei was first reported in sandhill cranes by Schell (1967, J. Parasitol. 53: 1000–1004). Forrester et al. (1975, J. Parasitol. 63: 547–548) reported it in 55% (19 of 34) of migratory greater sandhill cranes (*G. c. tabida*) in Florida, but recovered *O. jolliei* in only 6% (1 of 15) of non-migratory Florida sandhill cranes (*G. c. pratensis*). *Orchipedum jolliei* occurred in 46% ($n = 117$) of the greater sandhill cranes obtained from Wisconsin and Indiana (Windingstad and Trainer, 1977, *In* Eastern greater sandhill crane symposium, Feldt (ed.), Indiana Div. Fish and Wildlife, Indianapolis, Indiana, pp. 48–53).

The lower prevalence of *O. jolliei* among juveniles may reflect the shorter period of time that juveniles were exposed to infection or may be related to the maturation period of the parasite. However, *O. jolliei* was recovered in juveniles as early as October when juveniles were only 4–5 mo old. Since grain was the primary food of cranes migrating through southern Canada during fall migration (Stephen, 1967, Can. Wildl. Serv. Rep. Ser. 2, 48 pp.), larval stages of *O. jolliei* may be obtained on northern breeding grounds where invertebrates, which are likely to serve as intermediate hosts, would constitute a greater portion of the diet.

A second trematode, *Prohyptiasmus grusi*, was found in the thoracic cavity in 32 (10%) of the sandhill cranes examined (Table 1). Juveniles had a significantly lower prevalence (2%) of this parasite than adults (12%) ($\chi^2 = 5.42$, df = 1, $P < 0.02$). There were no differences in the prevalence of *P. grusi* in birds collected in different months of the year (Table 2) or between sexes ($P > 0.28$). The prevalence of *P. grusi* was not significantly different between *G. c. canadensis* (11%) and *G. c. rowani* (14%) ($P > 0.63$)

The presence of *P. grusi* in sandhill cranes was recently reported for the first time in North America (Kocan et al., 1982, Proc. Helminthol. Soc. Wash. 49: 28–30). The prevalence of *P. grusi* did not differ between males and females, between subspecies, nor between months of the year. These data suggest that larval stages of *P.*

TABLE 2. Percentage of sandhill cranes infected with *Orchipedum jolliei*, *Prohyptiasmus grusi*, and *Tetrameres grusi* during different months of collection.

Helminth parasite	Oct	Nov	Jan	Feb	Mar	Apr	May	Total
	Oklahoma		Texas		Nebraska	Canada	Alaska	
O. jolliei[a]	66	30	27	30	47	41	42	40
	(41)[d]	(17)	(45)	(74)	(66)	(51)	(26)	320
P. grusi[b]	15	6	9	7	12	10	12	10
	(41)	(17)	(45)	(74)	(66)	(51)	(25)	319
T. grusi[c]	30	24	23	26	27	30	28	27
	(10)	(17)	(30)	(54)	(30)	(11)	(25)	203

[a] $\chi^2 = 20.15$, $P < 0.003$.
[b] $\chi^2 = 2.66$, $P = 0.85$.
[c] $\chi^2 = 0.53$, $P = 0.99$.
[d] Sample size.

grusi are distributed throughout the entire range of all sandhill cranes from mid-continental North America or are acquired during periods and in locations where there is an equal opportunity for both sexes and both subspecies of cranes to be infected. It is possible that *P. grusi* is obtained during the spring staging period in the Platte River Valley where a homogeneous composition of cranes occurs. Food ingested by cranes during winter in western Texas consists almost entirely of cereal grains (Iverson et al., 1981, *In* Proc. 1981 Crane Workshop, Lewis (Ed.), Nat. Audubon Soc. pp. 95–98), while migrating cranes in Nebraska feed on a more diverse diet of earthworms, beetles, cutworms, and snails as well as corn (Lewis, 1974, op. cit.; Iverson et al., 1981, op. cit.). The findings of this study along with the apparent absence of *P. grusi* in both the largest cranes (*G. c. tabida*) and the non-migratory Florida sandhill cranes suggest that larval stages of *P. grusi* do not occur within the range of those two more easterly subspecies.

The only nematode encountered, *Tetrameres grusi*, was recovered from the proventriculus of 54 (27%) sandhill cranes among the 1979–1980 sample (Table 1). Eight of 43 (19%) juveniles and 46 of 160 (29%) adults were infected with *T. grusi*, but the difference between age classes was not significantly different ($P > 0.18$). No difference in the prevalence of this nematode was found between months of the year (Table 2). No significant difference ($P > 0.67$) in the prevalence of *T. grusi* was found between males (28%) and females (25%) among all cranes or between subspecies ($P > 0.68$) (*G. c. rowani* = 26%) (*G. c. canadensis* = 29%).

Tetrameres grusi was first reported in North America in greater sandhill cranes collected in Florida (Bush et al., 1973, J. Parasitol. 59: 788–792). Forrester et al. (1974, Proc. Helminthol. Soc. Wash. 41: 55–59) found 23 of 34 (67%) of the greater sandhill cranes from wintering grounds in Florida infected with *T. grusi*, but found none in the non-migratory Florida sandhill cranes (Forrester et al., 1975, op. cit.). Seventy-three percent of the greater sandhill cranes from Wisconsin and Indiana examined for parasites were infected with *T. grusi* (Windingstad and Trainer, 1977, op. cit.). Burnham (1972, Southwest. Nat. 17: 200–201) collected specimens from the genus *Tropsiuris* (=*Tetrameres*) in 20 of 57 (35%) lesser sandhill cranes from western Texas. These specimens were probably *T. grusi* (Forrester et al., 1974, op. cit.). In a separate study, 33 of 59 cranes from Texas, Oklahoma, Kansas, and Nebraska were reported to be infected with an unidentified species of *Tetrameres* (Lewis, 1974, op. cit.) which were also probably *T. grusi*. Because of the limited variety of foods available during winter in western Texas and the apparent absence of *T. grusi* in Florida sandhill cranes, it appears that larval forms of *T. grusi* are acquired by cranes while in more northerly locations.

The findings of this study indicate that helminth parasites may be useful as indicators for speciation at the subspecific level for sandhill cranes from mid-continental North America. For example, since *G. c. rowani* had a significantly higher prevalence of infection with *O. jolliei* (58%) than did *G. c. canadensis* (37%) the acquisition and the resulting infections may be related to the fact that the Canadian subspecies breeds in the interior of Canada while

the lesser subspecies breeds farther north along the Siberian and Alaskan coasts and into northern Canada (Aldrich, 1978, *In* Proc. 1978 Crane Workshop, Lewis (ed.), Colorado State University Press, Fort Collins, Colorado, pp. 139–148). Elucidation of the life cycle of this parasite will be necessary, however, before definitive statements can be made regarding its use as an indicator for speciation of cranes from mid-continental North America.

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Parasites of Fishes in the Gila River Drainage in Southwestern New Mexico

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There are no published reports on the parasites of fishes from mountain streams in the Gila River drainage of New Mexico, although Amin (1979, Am. Midl. Nat. 82: 188–196) studied the parasites of certain fishes in the lower Gila River in Arizona. This study was therefore undertaken to determine the prevalence of parasites of fishes in the Gila River drainage of New Mexico.

Between February 1977 and August 1978, 178 fishes were collected with electrofishing gear and by hook and line methods from Black Canyon Creek, White Creek, Turkey Creek, Little Creek and the East Fork of the Gila River in Grant County, New Mexico. All the areas except the East Fork of the Gila River have been stocked historically with fry of *Salmo gairdneri*. The East Fork of the Gila River had been stocked periodically with catchable-sized *S. gairdneri*.

Sex was recorded and scale samples were taken at necropsy for aging hosts. The external surfaces of the fishes were examined for ectoparasites. Fecal samples from the cloaca were stored in 2.5% potassium dichromate and later examined by flotation techniques. Tissue smears from liver, intestine, kidney, and swim bladder were examined for protozoa. The body cavity and visceral surfaces were examined grossly for parasites. The digestive tract was removed, incised longitudinally and the contents examined. Trematodes and cestodes were stained with Semichon's acetocarmine, and mounted in permount. Nematodes were cleared in glycerine.

Where sample size permitted, data were tested for significance ($P < 0.05$) by Student's t-test or Chi-square analysis. No significant difference between sexes existed, so data for sexes were combined.

Ectoparasites, including monogenic trematodes, were not recovered from any of the fishes examined. The data on the internal parasites are presented in Table 1.

Crepidostomum farionis was the most prevalent parasite found in trout and was found in fishes at all locations except Little Creek and the East Fork of the Gila. This parasite was more prevalent in 2 and 3 yr old *S. gairdneri* than in 1 yr old fishes. In *S. trutta*, however, this trend was reversed and *C. farionis* was more prevalent in 2 yr old than in 3 yr old fishes. The prevalence of infection for both species may be due to food habits. *Salmo gairdneri* tends to

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