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GASTROINTESTINAL HELMINTH PARASITES OF BATS IN ALABAMA

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Gastrointestinal tracts of 324 bats representing 10 species from 27 locations in Alabama were examined. Helminth parasites occurred in 121 (37.3%) of the bats; 14 (4.3%) had cestodes, 47 (14.5%) had nematodes, and 77 (23.8%) had trematodes. Fifteen bats (4.6%) were parasitized by two types of helminths, and one had all three types of helminths. There was no significant difference between numbers of big brown bats *(Eptesicus fuscus)* and Brazilian free-tailed bats *(Tadarida brasiliensis)* that were parasitized, but *E. fuscus* was more likely to have trematodes and *T. brasiliensis* was more likely to have nematodes. Prevalences of parasites (percentage of infected hosts) were: *E. fuscus,* 26.6% (n = 128); red bat *(Lasiurus borealis),* 80.0% (n = 10); evening bat *(Nycticeius humeralis),* 40.0% (n = 15); southeastern myotis *(Myotis austroriparius),* 72.7% (n = 11); eastern pipistrelle *(Pipistrellus subflavus),* 71.1% (n = 45); *T. brasiliensis,* 25.7% (n = 109).

Bats are hosts to many internal parasites (Stiles and Nolan, 1931; Webster, 1973). Ubelaker's (1970) review of endoparasites of bats included one genus of acanthocephalan, 10 genera of cestodes, 24 genera of nematodes, 13 genera of protozoans, and 42 genera of trematodes. Endoparasites have been recorded from carnivorous (Peterson and Kirmse, 1969), frugivorous (Bray, 1984; Ubelaker et al., 1977), insectivorous (Duszynski et al., 1988), piscivorous (Fischthal and Martin, 1978; Zdzitowiecki and Rutkowska, 1980), and sanguivorous (Greenhall and Schmidt, 1988) bats. Despite the long scientific history documenting parasites in bats from throughout the world (Webster, 1973), endoparasites of bats in North America are poorly known (Coggins, 1988). There are only five published reports on internal parasites of bats from the southeastern United States; three are on helminth parasites of bats from Louisiana, Mississippi, Tennessee (Byrd and Macy, 1942), Texas, Louisiana (Martin, 1976), and Florida (Loftin, 1961), and two are on protozoan parasites of bats from Alabama (Wheat, 1975) and Florida (Foster, 1979).

There have been three parasitologic studies of bats in Alabama. White (1959) reported 30 species of acarine mites from 10 species of bats. Wheat (1975) described *Eimeria macyi* (Protozoa: Eimeriidae) from a *P. subflavus* that was collected in Lion's Den Cave, Clarke Co. More recently, Durden et al. (1992) recorded seven species of acarine mites on cohabitating *E. fuscus* and *T. brasiliensis* from Auburn University, Lee Co. None of these studies have involved helminth parasites of bats. Because limited emphasis has been placed on helminthiases of bats in any geographic area (Nickel and Hansen, 1967), we conducted this study to identify species of bats in Alabama that have a parasitic helminthofauna. Additional goals of this study were to examine variations in helminth faunas with respect to species of host, collection locality, sex of host, season, and interrelationships of parasitic helminths.

MATERIALS AND METHODS

A total of 324 specimens representing 10 of the 16 species of bats that occur in Alabama (Best et al., 1993; E. R. Hall, 1981) was examined from 27 locations during this study (Appendix I). Of these specimens, 88 were *E. fuscus* and 105 were *T. brasiliensis* taken from the attic of Samford Hall, Auburn University. Samford Hall is a large, four-story building with a double-roofed design that serves as a year-round residence for both species of bats (Durden et al., 1992; Henry et al., 2000). During each month from February through November 1990, ≤12 *E. fuscus* and *T. brasiliensis* were either collected from their roost sites by hand or trapped with a harp trap. Care was taken not to collect young-of-the-year or females that were caring for young. Other species of bats were collected February 1990-April 1992. Collection methods included mist nets placed over bodies of water, capturing bats in residences, and removal of bats from roosts in caves. Several bats were brought to our laboratory by persons who found the bats in their homes.

Individual bats were placed into 250-ml beakers. Each beaker was sealed with a perforated cardboard top, and placed in a refrigerator (4.4°C) for 6-12 h to allow for passage of ingesta that otherwise may have impeded dissection. Bats were euthanized with chloroform and brushed with a toothbrush to collect external parasites for another study (Durden et al., 1992). The gastrointestinal tract (stomach, small and large intestines, and rectum) of each bat was removed, preserved in 10% formalin, and later inspected for parasites with the aid of a dissecting microscope. Parasites discovered in gastrointestinal tracts were removed using a camel-hair brush or dissecting needle and placed into 70% ethanol for storage. Voucher specimens of bats were prepared and deposited in the Auburn University Museum.

One cestode from each infected bat (n = 14) and one trematode were examined using scanning electron microscopy. Specimens were dehydrated by placing them into microporous specimen capsules (Electron Microscopy Sciences, Fort Washington, PA), which were placed into vials of 70, 80, 90, and 100% ethanol; 15 min for each change. The final change of ethanol was repeated twice. Alcohol was then removed from dehydrated specimens using a DCP-1 Critical-Point Drying Apparatus (Denton Vacuum, Inc., Cherry Hill, NJ), or by treatment with hexamethydisilazane (HMDS). Specimens were prepared with HMDS as follows: 100% ethanol was removed from the vial, HMDS was added, and immediately removed; fresh HMDS was added and allowed to remain for 15 min, the HMDS was removed, and fresh HMDS was added for another 15 min; specimens were then placed onto filter paper in a fume hood to allow for evaporation of the HMDS; fully dried specimens were affixed to carbon tape on aluminum stubs and sputter coated with gold-palladium for 30-50 s. Examination was conducted with a Zeiss DSM 940 digital scanning electron microscope.

Model I contingency table analyses using the G-test of independence were conducted on frequencies of parasitism with respect to taxon of parasite, and species, sex, and collection locality of host. G-test for goodness of fit was used to determine presence or absence of interrelationships in occurrence of parasite taxa (Sokal and Rohlf, 1981).

RESULTS AND DISCUSSION

Of the 324 bats examined, 121 (37.3%) had helminth parasites. Cestodes were found in 14 (4.3%) bats, 47 (14.5%) had nematodes, and 77 (23.8%) had trematodes. Frequency of parasitism and prevalence of parasites for each species of bat are summarized in Table 1. When we compared our results with other surveys of multiple species of bats (Blankespoor and Ulmer, 1970; Nickel and Hansen, 1967; Pistole, 1988), we observed that overall prevalence varied among studies, and that trematodes were the most prevalent helminths, nematodes were next, and cestodes were least prevalent. For example, Nickel and Hansen (1967) surveyed eight species of bats (n = 65) from seven counties in Kansas, Nebraska, and Oklahoma, and found that overall prevalence of parasites was 38.5%. When individual taxa were considered, trematodes (26.2%) were most prevalent, followed by nematodes (24.6%) and cestodes (7.7%). Similar results were seen in a study of

Table 1.—*Frequencies (F) and prevalences in percent (P) of three taxa of gastrointestinal-helminth parasites in 10 species of bats in Alabama.*

Species	n	Cestoidea		Nematoda		Trematoda	
		F	P	F	P	F	P
Eptesicus fuscus	128	0	—	5	3.9	31	24.2
Lasiurus borealis	10	3	30.0	4	40.0	4	40.0
Lasiurus cinereus	1	1	100	1	100	0	—
Lasiurus seminolus	3	3	100	0	—	3	100
Myotis austroriparius	11	2	18.2	2	18.2	6	54.5
Myotis septentrionalis	1	0	—	0	—	1	100
Nycticeius humeralis	15	3	20.0	6	40.0	1	6.7
Pipistrellus subflavus	45	1	2.2	3	6.7	29	64.4
Corynorhinus rafinesquii	1	0	—	0	—	0	—
Tadarida brasiliensis	109	1	0.9	26	23.8	2	1.8

64 bats, representing six species from 16 localities in Iowa (Blankespoor and Ulmer, 1970), and in a more recent study of 888 bats, representing nine species, from 65 counties in Indiana (Pistole, 1988).

Only 16 (4.9%) of the parasitized bats in our study had representatives of more than one phylum or class of helminths; three (<1%) were parasitized by nematodes and trematodes, seven (2.2%) by cestodes and trematodes, five (1.5%) by cestodes and nematodes, and one by cestodes, nematodes, and trematodes (Table 2). Analyses of these data using the *G*-test for goodness of fit showed that bats were most likely to have only cestodes, nematodes, or trematodes, and not a combination of nematode-trematode ($G = 82.89 >> X^2_{0.05[2]}$), cestode-trematode

Table 2.—*Frequencies of Cestoidea (C), Nematoda (N), and Trematoda (T) in bats from Samford Hall, bats from elsewhere in Alabama, and for the two species of bats found in Samford Hall and elsewhere in Alabama.*

	n	C	N	T	C and N	C and T	N and T	C, N, and T	Total
Bats from Samford Hall									
Eptesicus fuscus	88	0	2	18	0	0	0	0	20
Tadarida brasiliensis	105	0	25	2	1	0	0	0	28
Total	193	0	27	20	1	0	0	0	48
Bats from elsewhere in Alabama									
Eptesicus fuscus	40	0	1	11	0	0	2	0	14
Lasiurus borealis	10	1	3	1	0	2	1	0	8
Lasiurus cinereus	1	0	0	0	1	0	0	0	1
Lasiurus seminolus	3	0	0	0	0	3	0	0	3
Myotis austroriparius	11	0	2	4	0	2	0	0	8
Myotis septentrionalis	1	0	0	1	0	0	0	0	1
Nycticeius humeralis	15	0	3	0	2	0	0	1	6
Pipistrellus subflavus	45	0	2	29	1	0	0	0	32
Corynorhinus rafinesquii	1	0	0	0	0	0	0	0	0
Tadarida brasiliensis	4	0	0	0	0	0	0	0	0
Total	131	1	11	46	4	7	3	1	73
Bats from Samford Hall and elsewhere in Alabama									
Eptesicus fuscus	128	0	3	29	0	0	2	0	34
Tadarida brasiliensis	109	0	25	2	1	0	0	0	28
Grand Total	324	1	38	66	5	7	3	1	121

($G = 92.17 >> X^2_{0.05[2]}$), or cestode-nematode ($G = 42.80 >> X^2_{0.05[2]}$). Individual bats typically host a single taxon of parasite, but dual-taxa parasitizations have been recorded for *L. cinereus* in Maryland (Tromba, 1952) and British Columbia (Webster and Casey, 1973), *N. humeralis* in Indiana (Pistole, 1988), *E. fuscus* in Missouri (Adams and Morris, 1971), and *E. fuscus* and *T. brasiliensis* in Cuba (Barus and del Valle, 1967). Pistole (1988) indicated that *E. fuscus, L. borealis, M. septentrionalis,* the little brown bat *(Myotis lucifugus),* and the Indiana myotis *(Myotis sodalis)* can be parasitized by more than one taxon of helminth.

That bats often do not harbor parasites from more than one taxon is expected because some bats are dietary specialists (Buchler, 1976; Kunz, 1973). Parasites are obtained from what bats eat (Holmes, 1964; Phillips, 1966) and being a dietary specialist may predispose a bat to become parasitized by only the type of helminth that uses the prey items as intermediate hosts. Although many species of insectivorous bats have a diversified diet that includes several orders and families of insect prey, some species feed selectively on one type of prey and show specificity to foraging habitat. Thus, mayfly (Ephemeroptera) and beetle specialists, such as *M. lucifugus* (Anthony and Kunz, 1977; Buchler, 1976), and moth (Lepidoptera) specialists, such as *L. borealis, L. cinereus* (Kunz, 1973; Ross, 1967), and *T. brasiliensis* (Ross, 1967) may be less likely to have dual-taxa parasitizations than *E. fuscus,* which has generalistic feeding habits (Kunz, 1973; Ross, 1967). *L. borealis, L. cinereus,* and *M. lucifugus* also exhibit site-specificity of foraging habitats (Kunz, 1973), whereas *E. fuscus* is not site-specific (Furlonger et al., 1987; Geggie and Fenton, 1985; Kunz, 1973).

The only bat in our study that had cestodes, nematodes, and trematodes was a female *N. humeralis* (Table 2) from Fort Rucker, Dale Co. Of parasites of nine adult female and six juvenile *N. humeralis* from Iowa, six adults and one juvenile had cestodes, seven adults and four juveniles had nematodes, and one adult had a trematode (Ubelaker and Kunz, 1971). Two of the taxa must have overlapped and all three may have occurred in one bat. The three taxa do not overlap in any other report of parasites in *N. humeralis* (Alicata, 1932; Chandler, 1938; Chitwood, 1937; Macy and Rausch, 1946; McIntosh, 1932; McIntosh and McIntosh, 1935; Pistole, 1988; Ubelaker, 1966, 1970). Relatively little is known about the biology of *N. humeralis* (Harvey, 1992; Watkins, 1972), but this species may have a wide range of prey types.

Frequencies of parasitism in *E. fuscus* (22.7%) and *T. brasiliensis* (26.7%) from Samford Hall, Auburn University, were not significantly different ($G = 0.40$, *d.f.* $= 1$, $P = 0.53$), but frequencies of occurrence of nematodes and trematodes were significantly different between these species ($G = 37.8$, *d.f.* $= 1$, $P < 0.01$). Of the 20 *E. fuscus* that were parasitized, 10.0% ($n = 2$) had nematodes and 90.0% ($n = 18$) had trematodes (Table 2). Percentages of nematodes and trematodes were opposite for *T. brasiliensis*; 92.8% ($n = 26$) of the 28 parasitized bats had nematodes and 7.1% ($n = 2$) had trematodes (Table 2). Holmes (1964) and Ubelaker (1970) reported that *E. fuscus* is host to more species of trematodes than *T. brasiliensis* and attributed this to differences in feeding habits. Holmes (1964) noted that *T. brasiliensis* feeds heavily on moths and <1% of the diet is composed of insects with aquatic larvae. Conversely, *E. fuscus* primarily feeds on beetles, but >15% of the diet is composed of insects with aquatic larvae. *E. fuscus* also feeds on water scavenger beetles (Coleoptera: Hydrophilidae), mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), nerve-winged insects (Neuroptera—Hamilton, 1933), predatory diving beetles (Coleoptera: Dytiscidae—Phillips, 1966), dixa flies (Diptera: Dixidae —Ross, 1967), tipulid flies (Diptera: Tipulidae), and midges (Diptera: Chironomidae—Whitaker, 1972). All of these insects have aquatic larvae, and metacercaria of trematodes that infect bats have been found in larvae of midges (McMullen, 1937), caddisflies (Brown, 1933; M. C. Hall, 1929; Knight and Pratt, 1955), stoneflies (J. E. Hall, 1960; M. C. Hall, 1929), and mayflies (Etges, 1959; J. E. Hall, 1960; M. C. Hall, 1929). Conversely, Hamilton (1933) examined 2,200 fecal pellets from *E. fuscus* and found no lepidopteran remains, and Whitaker (1972) found that Lepidoptera accounted for only 4.5% of the diet of 184 *E. fuscus.*

The source of the helminth fauna of *T. brasiliensis* from Samford Hall, Auburn University, is more difficult to explain than that of *E. fuscus.* Life cycles of gastrointestinal nematodes from chiropterans have not been described (Blankespoor and Ulmer, 1970; Ubelaker, 1970), but there are no accounts of nematodes that have lepidopterans as intermediate hosts (Skrjabin et al., 1952, 1954; Yamaguti, 1961). Beetles often serve as intermediate hosts for nematodes parasitic in other mammals (Kinsella, 1991; Morgan and Hawkins, 1951; Ubelaker, 1970). However, *T. brasiliensis* feeds almost exclusively

on moths, and not beetles (Bailey, 1931; Holmes, 1964; Ross, 1967; Storer, 1926). There are at least three possible explanations. First, there may be nematodes that have lepidopterans as intermediate hosts. Second, *T. brasiliensis* is not the moth specialist that the literature indicates. Third, the findings in our study are due to sampling bias; 96.3% (n = 109) of *T. brasiliensis* examined by us were collected from one location (Samford Hall, Auburn University). The third possibility may be most likely because *T. brasiliensis* harbors spiurid nematodes (Martin, 1976; Specian and Ubelaker, 1976), which use cockroaches (Blattodea) as intermediate hosts (Specian and Ubelaker, 1976; Ubelaker, 1970). There is a large population of cockroaches on the campus of Auburn University.

Different species of bats from the same collection localities can have dissimilar parasite loads. Font (1978) reported that ca. 80% (n = 35) of *M. lucifugus* he examined from Wisconsin harbored a new species of lecithodendriid trematode, *Ototrema schildti.* However, none of the *E. fuscus* (n = 15) from the same collection localities were parasitized by *O. schildti.* According to Font (1978), *E. fuscus* is either an unsuitable host for this species of trematode or it does not feed upon insects that have the infective stage. Webster and Casey (1973) found that *E. fuscus* (n = 24) and *M. lucifugus* (n = 31) from the same three study sites in British Columbia had little overlap in parasites. Only four of the 12 species of helminths that occurred in *E. fuscus* and *M. lucifugus* were found in both species. There were five species of trematodes that occurred in 15 (62.5%) *E. fuscus* compared with three species occurring in six (19.4%) *M. lucifugus*; two species of trematodes were found in both *E. fuscus* and *M. lucifugus.* Nematodes were represented by two species in 4 (16.7%) *E. fuscus* and three species in 11 (35.5%) *M. lucifugus*; two species of nematodes were shared. One species of cestode was present in one (4.2%) *E. fuscus* and another species was present in two (6.4%) *M. lucifugus* (Webster and Casey, 1973). Webster (1971) examined *T. brasiliensis* (n = 15) from a cave in Jamaica and found two species of trematodes in 12 (80.0%) bats and one species of nematode in 9 (60.0%) bats. Parnell's leaf-lipped bats (*Pteronotus parnelli*; n = 6) from the same cave did not have trematodes, but was parasitized by three species of nematodes, none of which occurred in *T. brasiliensis.* There also was no overlap in parasites in MacLeay's leaf-lipped bats (*Pteronotus macleayi*; n = 29) and *P. parnelli* (n = 6) from another cave in Jamaica. These two species of bats failed not only to have overlapping species of parasites, but *P. macleayi* had only tre atodes and *P. parnelli* had only ne atodes (Webster, 1971).

Of the parasitized bats in our study, 63 (52.1%) were males and 58 (47.9%) were females; frequency of parasitism did not differ by sex (G = 2.31, $d.f.$ = 1, P = 0.13). Sex-specific differences in frequency of parasitism were not apparent for *E. fuscus* (G = 0.01, $d.f.$ = 1, P = 0.95), *P. subflavus* (G = 1.25, $d.f.$ = 1, P = 0.26), or *T. brasiliensis* (G = 0.68, $d.f.$ = 1, P = 0.41; Table 3). Nickel and Hansen (1967) reported that 18 (27.7%) male and 7 (10.8%) fe ale bats were parasitized. Their study included *E. fuscus* (n = 4), *P. subflavus* (n = 10), and *T. brasiliensis* (n = 9), but numbers of males and females of each species were not given. In their study, a male and female *E. fuscus* each had trematodes, one female *P. subflavus* had trematodes, one male *T. brasiliensis* had trematodes, and one female *T. brasiliensis* had nematodes.

Table 3.—*Frequencies of parasitism in three species of bats in Alabama based on sex.*

Species	Sex	Parasitized	Unparasitized	Total
Eptesicus fuscus	Male	11	31	42
	Female	23	63	86
Pipistrellus subflavus	Male	25	8	33
	Female	7	5	12
Tadarida brasiliensis	Male	12	42	54
	Female	16	39	55
Total		94	188	272

Contingency table analysis of their data failed to reveal a significant difference between these frequencies (G = 0.03, $d.f.$ = 1, P = 0.86). Because of small samples analyzed to date, significant differences between sexes may be detected in future research. Anthony and Kunz (1977) demonstrated that female *M. lucifugus* exhibited a significant preference for beetles and mayflies on a seasonal basis. Unfortunately, no other investigations of parasite faunas included comparisons between sexes for any species of bats, and data from these studies do not allow extraction of such information.

Peak prevalence of parasites for *E. fuscus* from Samford Hall, Auburn University, was in April when 40.0% (n = 5) were hosts to helminths. Prevalence declined monthly thereafter until it reached 8.3% (n = 12) in October (Fig. 1a). Prevalences for *T. brasiliensis* from Samford Hall had a more irregular distribution. Greatest prevalence was in November when 50.0% (n = 12) had parasites and lowest prevalence was in September when none of the bats (n = 12) were parasitized (Fig. 1b). Coggins et al. (1982) found that *M. lucifugus* in Wisconsin had lowest prevalences of parasites in summer (July and August) and highest prevalences in spring (April, May, and June) and autumn (September and October). However, Blankespoor and Ulmer (1970) and Nickel and Hansen (1967) found that prevalences were low in spring and increased until the bats entered hibernation in autumn. The authors of both studies suggested that bats lost their parasites during hibernation and were reinvaded by parasites when they came out of hibernation (Blankespoor and Ulmer, 1970; Nickel and Hansen, 1967). According to Coggins et al. (1982), this strategy would work only for parasites of bats that did not undergo long (>3 months) periods of hibernation. Because bats in Wisconsin hibernate for nearly 8 months, the months of activity are not long enough to ensure successful completion of life cycles of parasites (Coggins et al., 1982). Coggins et al. (1982) maintain that parasites of bats from northerly latitudes are adapted to overwintering in their definitive host and not the intermediate host as do most helminths. One would expect prevalences in *E. fuscus* and *T. brasiliensis* in Alabama to follow the scenario proposed by Blankespoor and Ulmer (1970) and Nickel and Hansen (1967). Instead, prevalences in *E. fuscus* were highest in spring and lowest in autumn, and prevalences in *T. brasiliensis* failed to follow a discernable pattern.

Scanning electron micrographs were taken of at least one cestode from every bat that harbored cestodes; a

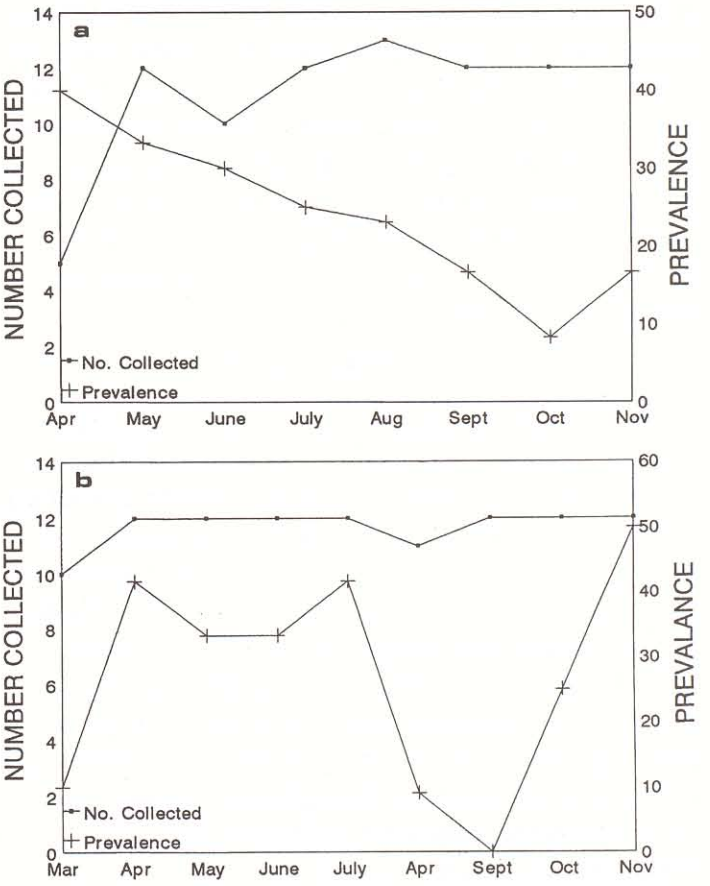

Fig. 1.—Number of a) *Eptesicus fuscus* and b) *Tadarida brasiliensis* from Samford Hall, Auburn University, Lee Co., Alabama, examined and prevalence of parasites by month during 1990.

trematode from one *L. borealis* also was micrographed. Cestodes from *L. seminolus* did not appear to have a rostellum or armed suckers, which suggests that they belong to the Anoplocephalidae (Schmidt, 1986). It was not apparent whether the cestode from *M. austroriparius* had a rostellum or whether the suckers were armed. The cestode from *P. subflavus* appeared to have a rostellum and unarmed suckers, which suggested that it was a member of the Hymenolepididae (Schmidt, 1986). The trematode from *L. borealis* appeared to be a distome, because it had an oral sucker and an acetabulum on the mid-ventral surface (Schmidt and Roberts, 1989). Measurements were not taken of potentially diagnostic features because parasites were fixed in situ. This fixation method causes a layer of mucus to become affixed to specimens, often distorts specimens by causing them to contract, and may result in diagnostic features such as armature becoming

invaginated (M. H. Pritchard, pers. comm.; Pritchard and Kruse, 1982). Consequently, diagnostic features were not visible or were distorted such that there was a significant probability of reaching erroneous taxonomic conclusions. However, Hymenolepididae and Anoplocephalidae are the only families of cestodes to be reported in bats from the United States (Ubelaker, 1970), and the trematodes of bats in the United States are distomes (Schmidt and Roberts, 1989; Yamaguti, 1958).

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APPENDIX I

Specimens Examined

Eptesicus fuscus—Butler Co.: Georgiana, bridge on state road 106 where it passes over West Railroad Avenue (mile marker 12) (6 males, 19 females). *Lee Co.*: Auburn (0, 1); Auburn University, attic of Samford Hall (28, 60); Opelika, 1103 Collinwood Drive (5, 6); Opelika, inside duplex at 709 North 8th Street (1, 0). *Morgan Co.*: Talucah, Talucah Cave (2, 0).

Lasiurus borealis—Dale Co.: Fort Rucker, Ech Lake (0, 3); Fort Rucker, Girl Scout Camp (1, 3). *Lee Co.*: Auburn University, Ralph B. Draughon Library (1, 0); Flake Creek at county road 65, 0.3 mile from state road 169 (0, 1); Pond on state road 169, 0.3 mile from county road 65, teardrop-shaped pond (0, 1).

Lasiurus cinereus—Lee Co.: Farm pond 0.98 mile from state road 169 on county road 81 (1, 0).

Lasiurus seminolus—Dale Co.: Fort Rucker, Ech Lake (0, 1); Fort Rucker, Girl Scout Camp (0, 1); Fort Rucker, headquarters (1, 0).

Myotis austroriparius–Conecuh Co.: Hodges Cave (1, 0); Sanders Cave, 3 miles NW Brooklyn (2, 0). *Covington Co.*: Rock House Cave, 7 miles NE Florala (1, 0). *Monroe Co.*: Locklin Cave, T6N R5E Section 4 (4, 0); Locklin Cave, 5 miles W Perdue Hill (3, 0).

Myotis septentrionalis—Franklin Co.: 9 miles NE Red Bay on county road 88 before the Bear Creek Levee (1, 0).

Nycticeius humeralis—Dale Co.: Fort Rucker, Girl Scout Camp (3, 2). *Lee Co.*: Flake Creek at county road 65, 0.3 mile from state road 169 (1, 0); Opelika, 209 South 4th Street (Bathesda Baptist Church) (0, 3); Opelika, 403 Avenue A (0, 2); Opelika, 403 Avenue A and attic of Bethesda Baptist Church across street from 403 Avenue A (1, 3).

Pipistrellus subflavus—Butler Co.: B. C. Barganier Cave (=Rock Cave) (3, 0). *Clark Co.*: Buzzard's Den Cave, T9N R1E Section 18 (11, 0); Lion's Den Cave, 3 miles SW McEntyre (1, 0). *Conecuh Co.*: Sanders Cave, 3 miles NW Brooklyn (3, 2). *Franklin Co.*: 9 miles NE Red Bay on county road 88 before the Bear Creek Levee (5, 4); Goat Cave (=Belgreen Underground Lake), near Belgreen (2, 1). *Lee Co.*: Flake Creek at county road 65, 0.3 mile from state road 169 (1, 0); Pond on state road 169, 0.3 mile from county road 65, teardrop-shaped pond (1, 0). *Marshall Co.*: Mike's Wolff Cave, Union Grove (4, 0). *Marshall Co.*: Wolff Cave, Union Grove (0, 5). *Morgan Co.*: Talucah Cave, Talucah (2, 0).

Corynorhinus rafinesquii—Clark Co.: Buzzard's Den Cave, T9N R1E Section 18 (1, 0).

Tadarida brasiliensis—Bullock Co.: Union Springs, 304 East Hardaway (0, 1). *Butler Co.*: Georgiana, bridge on state road 106 where it passes over West Railroad Avenue (mile marker 12) (2, 0). *Lee Co.*: Auburn University, attic of Samford Hall (51, 54); Opelika, 1103 Collinwood Drive (1, 0).