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PARASITIC HELMINTHS OF RED-BELLIED WOODPECKERS (*MELANERPES CAROLINUS*) FROM THE APALACHICOLA NATIONAL FOREST IN FLORIDA

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ABSTRACT: Seventy-four red-bellied woodpeckers (*Melanerpes carolinus*) from the Apalachicola National Forest (30°10′N, 84°40′W) in northwest Florida were examined for helminths. The most prevalent parasites were the nematode *Aproctella stoddardi* (11%) and the acanthocephalan *Mediorhynchus centurorum* (11%). New host records include *Pseudaprocta samueli*, *A. stoddardi*, *Tridentocapillaria tridens*, *Diplotriaena americana*, *Dispharynx nasuta*, *Procyrnea pileata*, *Orthoskrjabinia rostellata*, and *Brachylaima fuscatum*. The helminth fauna was characterized by low prevalences and intensities of infection and low numbers of species per bird (1.2). The frequency of prescribed burning and habitat understory flora composition did not influence the prevalences or intensities of helminths in red-bellied woodpeckers collected from 2 similar but differently managed sites within the forest.

Red-bellied woodpeckers, *Mediorhynchus carolinus* (Linnaeus, 1758), range over most of the eastern half of the United States and are common breeding residents in the state of Florida. They live in habitats ranging from river bottomland to open mixed woodlands and urban residential areas. They forage on acorns, seeds, fruit, and insects. Red-bellied woodpeckers usually build nest cavities in dead trees (Stevenson and Anderson, 1994); however, in some areas they nest in cavities excavated by red-cockaded woodpeckers *Picoides borealis* (Vieillot, 1809) (Jackson, 1977).

Little is known about the helminths of the red-bellied woodpecker in Florida or North America. We were unable to find any published reports of complete parasite examinations. The only reports of parasites come from a few parasite species descriptions (Rigney, 1943; Nickol, 1969) and 1 survey for eyeworms (*Oxyspirura* spp.) in birds from Louisiana (Pence, 1972).

The purpose of the present study was to determine the species, prevalences, and intensities of helminths in red-bellied woodpeckers collected from 2 management districts within the Apalachicola National Forest (ANF) in northwestern Florida and to ascertain if current habitat management practices influence the helminth fauna of the woodpeckers.

MATERIALS AND METHODS

Seventy-four red-bellied woodpeckers (35 females and 39 males) were examined for parasites. This included 27 complete carcasses and 47 gastrointestinal tracts that were removed during museum preparation of the birds. Forty-one woodpeckers, which included 20 of the above carcasses along with 21 additional birds stored at the Florida Museum of Natural History (FMNH), Gainesville, Florida, were examined for eyeworms.

Between November 1997 and April 2001, from 2 management districts within the ANF (30°10′N, 84°40′W) in the panhandle of Florida, red-bellied woodpeckers were collected by shotgun or removed from nesting cavities at night and killed with carbon dioxide. All collections were made under Federal, State, and U.S. Forest Service permits.

The woodpeckers were collected from sites (~45 km apart) in either the Apalachicola Ranger District (ARD) (n = 26), in the western half of the forest, or the Wakulla Ranger District (WRD) (n = 48), in the eastern half of the forest. The collection sites in these districts are characterized as flatwoods or sandhill pine stands dominated by mature (60–70 yr old) longleaf pine (*Pinus palustris*) or slash pine (*P. elliotti*), with an understory that consists of wiregrass (*Aristida stricta*), saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra* and *I. coriacea*), fetterbush (*Lyonia lucida*), and rusty staggerbush (*L. ferruginea*) in various combinations and percentages. Understory vegetation variation was dictated by the frequency of prescribed fire management in each district. James et al. (2001) reported a more in-depth description of the collection site habitats.

Habitats within the 2 management districts have been managed independently, with the ARD having prescribed fires every 3–4 yr and the WRD averaging fires every 7 yr (James et al. 1997). As a result of the different histories of the prescribed fires and management, the collection sites in the 2 areas have differing flora compositions. The sites in WRD have a higher density of trees of varying ages and a higher percentage of saw palmetto, gallberry, and other woody vegetation than do the ARD sites. The sites in the ARD, which have more frequent prescribed burns, have the highest percentage of wiregrass and herbaceous components of the understory.

After collection, all woodpeckers were bagged individually and frozen at −20 C until examined. The body cavities and air sacs of the 47 birds prepared at the FMNH were examined for parasites, while the birds were being eviscerated. Parasite-screening techniques for duodenum, small intestine, liver, kidney, and lungs were performed as described by Kinsella and Forrester (1972). All other organs were placed in petri dishes and incised or macerated while being observed under a dissecting microscope. Periorbital sinuses were examined using a dissecting microscope. Cestodes, trematodes, and acanthocephalans were preserved in Roudabush's AFA and nematodes in 70% ethanol with glycerin. Cestodes and trematodes were stained with either Ehrlich's hematoxylin or Semichon's acetocarmine and mounted in neutral Canada balsam. Nematodes were mounted in lactophenol for identification.

Data on parasite prevalence and intensity for the 4 most prevalent helminths were evaluated using Fisher's Exact Test and Mann–Whitney Rank Sum Test, respectively, with regard to host gender and collection site. Because of the collection techniques and the sample size constraints, parasite prevalences and intensities could not be analyzed among years or seasons. Correlations between each parasite intensity and the intensities of the other parasites were determined using the Spearman Rank Order Correlation. SigmaStat for Windows (version 2.03, SPSS, Inc., Chicago, Illinois, 1997) was used for the statistical analyses. Bonferroni 95% confidence interval was calculated for parasite prevalences (Miller, 1966). A binomial distribution was assumed for sample size comparison using standard binomial probability tables. Significance was taken at $P < 0.05$ for all analyses.

The terminology used follows Bush et al. (1997), except for species richness, which follows Poulin (1998). Helminth voucher specimens have been deposited in the Harold W. Manter Collection, University of Nebraska State Museum (Lincoln, Nebraska) (accession numbers HWML 16585–16592, 16597, 16598).

RESULTS

Twelve species of helminths (8 nematodes, 2 cestodes, 1 trematode, and 1 acanthocephalan) were recovered from the 74

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TABLE I. Prevalences and intensities of parasitic helminths of 74 red-bellied woodpeckers from Apalachicola National Forest in Florida, U.S.A.

Helminth species (location in host)*	Pos. birds	Prevalence % (CI)†	Intensity $\bar{x}$	Intensity Range
Nematoda				
Aproctella stoddardi (BC)	8	11 (5.1–21.5)	1	1–2
Pseudaprocta samueli (BC)‡	7	9 (4.2–19.8)	6	1–24
Procyrnea pileata (GL, GZ)‡	6	8 (3.4–18.2)	4	1–10
Tridentocapillaria tridens (SI)‡	2	3 (0.6–10.8)	1	1–2
Diplotriaena americana (BC)‡	1	1 (0.2–8.7)	3	—
Dispharynx nasuta (PR)	1	1 (0.2–8.7)	3	—
Oxyspirura pusillae (EY)§	1	2 (0.4–14.9)	6	—
Acuaria sp. (GZ)	1	1 (0.2–8.7)	1	—
Larval nematode (SI)	1	1 (0.2–8.7)	1	—
Cestoda				
Orthoskrjabinia rostellata (SI)‡	3	4 (1.2–12.7)	1	—
Raillietina centuri (SI)	1	1 (0.2–8.7)	1	—
Trematoda				
Brachylaima fuscatum (SI)‡	1	1 (0.2–8.7)	9	—
Acanthocephala				
Mediorhynchus centurorum (SI)	8	11 (5.1–21.5)	5	1–22

* Abbreviations: BC, body cavity; EY, eye; GL, gizzard lining; GZ, gizzard; PR, proventriculus; SI, small intestine.
† CI, Bonferroni 95% confidence interval for prevalences.
‡ New host record for this parasite.
§ Only 41 birds were examined for *O. pusillae*.

red-bellied woodpeckers (Table I). Although the observed species richness was 12, the number of species per bird was extremely low; 40 (54%) of the 74 red-bellied woodpeckers had no helminths, 27 had 1 species of helminth, and 7 had 2 species.

The helminths with the highest prevalences were *Aproctella stoddardi* Cram, 1931 (11%), *M. centurorum* Nickol, 1969 (11%), *Pseudaprocta samueli* Bartlett and Anderson, 1986 (9%), and *Procyrnea pileata* (Walton, 1928) (8%). There were no significant differences in prevalences or intensities between host genders for any of the helminths analyzed at either ARD or WRD ($P = 0.548$–1.000). Host genders were then combined for each parasite within each collection site for further analyses. There were no significant differences between ARD and WRD for any of the 4 parasites ($P = 0.123$–1.000). Females from ARD and WRD were combined for each parasite, as were males from both sites. There were no significant differences between genders for any of the 4 parasites ($P = 0.353$–0.712). There were no significant relationships in intensity between any pair of parasites ($P = 0.304$–0.651).

Oxyspirura pusillae Wehr et Hwang, 1957 was found in 1 of the 41 birds examined for eyeworms. An adult woodpecker had 1 *O. pusillae* in the left eye and 5 in the right eye.

New host records included *Pseudaprocta* samueli; *A. stoddardi*; *Tridentocapillaria tridens* (Dujardin, 1845); *Diplotriaena americana* Walton, 1927; *Dispharynx nasuta* (Rudolphi, 1819), *P. pileata*; *Orthoskrjabinia rostellata* (Rodgers, 1941); and *Brachylaima fuscatum* (Rudolphi, 1819).

DISCUSSION

Two of the species found here (*Raillietina centuri* and *M. centurorum*) appear to be specialists in red-bellied woodpeckers, 2 (*P. pileata* and *D. americana*) generalists in woodpeckers, and the remaining species generalists in passeriform birds.

Depending on the season, several species of adult and larval insects make up 31–80% of the red-bellied woodpeckers diet, with the remainder consisting of acorns, seeds, fruit, and fruit pulp (Beal, 1911; Jackson and Nickol, 1979). Red-bellied woodpeckers occasionally take a variety of small or young vertebrates, including tree frogs, and nestlings and eggs of several species of birds (Shackelford et al., 2000).

In Florida, red-bellied woodpeckers nest and forage in many habitat types (Shackelford et al., 2000) and, therefore, encounter a wide variety of insects that may serve as intermediate hosts for parasites. The low prevalences and intensities of the helminth fauna in this study may be related to the fact that all these birds nested, foraged, and were collected in similar fire-manipulated mature pine habitats.

Nickol (1969) reported that 23% (12/53) of the red-bellied woodpeckers he sampled in Louisiana were positive for *M. centurorum*. He also reported intensities ranging from 1 to 13, a mode of 2, with only 2 birds having more than 3 *M. centurorum*. The red-bellied woodpeckers sampled here had a much lower prevalence of 11% (8/74) but higher intensities (4 of the 8 infected birds had >5 *M. centurorum*).

Pence (1972) examined 36 red-bellied woodpeckers from Louisiana for the presence of eyeworms and reported 20 (56%) infected with *O. pusillae*. Only 1 of the 41 (2%) birds examined in the present study was infected with *O. pusillae*. Unlike the birds in this study, which came from mature pine habitats, the birds examined by Pence (1972) were collected from various habitats with most of them coming from riparian and lowland areas.

The paucity of helminth surveys of North American Piciformes makes it difficult to draw general conclusions about species diversity in these birds. But considering that 54% of the birds examined here were free of helminths, and the rest had low prevalences, intensities, and mean number of species per bird (1.2), it appears that red-bellied woodpeckers living in mature pine habitats are at the lower end of the spectrum of birds as a host for parasitic helminths.

Only 2 of the helminths caused any effects on the red-bellied woodpeckers. Grossly, there were changes in the texture, color, and integrity of the cornified epithelium (kaolin) of the gizzard associated with the presence of *P. pileata*. There were lesions associated with the attachment sites of *M. centurorum* in the small intestine. Because the woodpeckers had been frozen for 1–2 yr before being necropsied, no histological examination of these lesions was undertaken.

Frequent prescribed burning may have a negative effect on insect species. There are several reports that burning decreases arthropod numbers in North American pine forests when burned and unburned areas are compared (New and Hanula, 1998). In contrast, New and Hanula (1998) reported that a lapse of time after winter burning in longleaf pine forests had little effect on the prey or prey biomass available for red-cockaded woodpeckers; however, summer burning did affect some prey insect species.

Because of the differences in understory flora and microhabitat, the frequency of prescribed burning, and the possible reduction in the numbers and types of arthropod intermediate hosts, it was hypothesized that higher prevalences and intensi-

ties of helminths would be found in the red-bellied woodpeckers sampled in WRD than in ARD. But on analyzing the data for the 4 most prevalent helminths, no differences were observed between the ARD and WRD collection sites. When considering the intermediate hosts for these 4 helminths, they are probably not affected by prescribed burning or flora composition. Species related to *A. stoddardi* have mosquitos as intermediate hosts (Anderson, 2000), which are probably more affected by the availability of water than by the frequency of fires. Species related to *P. pileata* have tenebrionid beetles (Anderson, 2000), which live under loose bark and stones, as intermediate hosts. New and Hanula (1998) found no evidence that the abundance of wood roaches (*Parcoblatta pennsylvanica*), the intermediate host for *M. centurorum*, was affected by prescribed burning.

With such low prevalences and intensities, and unequal sample sizes, which we have reported here, the strength of the statistical analysis attempted may be questionable.

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