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Haemoproteus greineri in Wood Ducks from the Atlantic Flyway

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ABSTRACT: Thin smears of blood were examined from 157 wood ducks (*Aix sponsa*) trapped at Savannah National Wildlife Refuge (South Carolina, USA) and Harris Neck National Wildlife Refuge (Georgia, USA) during spring and summer, 1994 and 1995. Thirteen wood ducks (8%) were infected with blood parasites. Eleven of these birds were infected with *Haemoproteus nettionis*, seven with *Leucocytozoon simondi*, and five with unidentified microfilariae. Additionally, eight wood ducks (5%) were infected with *Haemoproteus greineri*. This is the first record of *H. greineri* in anatids trapped along the Atlantic Flyway south of Labrador and the first record of this species in wood ducks. To further characterize the distribution of *H. greineri* in the wood duck, blood smears were examined from hatching year ducks trapped at 10 different Atlantic flyway locations during spring and summer, 1980 to 1983. *Haemoproteus greineri* was found in wood ducks trapped in all 10 locations which extend from 46°N latitude in New Brunswick to 37°N latitude in Virginia. These findings indicate that *H. greineri* is not exclusively boreal in distribution, but also is found, at least in wood ducks, along much of the Atlantic Flyway.

Key words: Wood duck, *Aix sponsa*, hematozoa, *Haemoproteus greineri*, *H. nettionis*, *Leucocytozoon simondi*, microfilariae, survey.

Haemoproteus nettionis, the common haemoproteid parasite of many species of anatids from around the world, is characterized by halteridial gametocytes that laterally displace the host cell nucleus (Williams and Bennett, 1980; Bennett and Peirce, 1988). *Haemoproteus greineri*, a less common haemoproteid of waterfowl, is readily distinguishable from *H. nettionis*. The gametocytes of *H. greineri* are circumnuclear, may displace the host cell nucleus slightly, contain more pigment granules than those of *H. nettionis*, and occasionally distort the infected cell into a nearly circular shape (Bennett et al., 1984; Bennett and Peirce, 1988). Morphologically, *H. greineri* more closely resembles the haemoproteids of woodpeckers and hummingbirds than it does *H. nettionis*. *Haemoproteus greineri* has been reported in relatively few species of waterfowl in the northern parts of Labrador and the prairie provinces of Canada, suggesting a boreal distribution (Bennett et al., 1984, 1991). The parasite has not been observed in wood ducks and has not been reported in other anatids in the southern part of the Atlantic Flyway.

The economic importance of wood ducks has risen steadily in recent years to the point where they now represent over 20% of the total waterfowl harvest in the Atlantic Flyway (Serie and Chasko, 1990). Consequently, diseases and other factors that could have an effect on wood duck populations are of interest to wildlife managers. There are several studies on hematozoan infections of wood ducks trapped along the Atlantic Flyway (reviewed by Thul and O'Brien, 1990). Blood parasites reported from the wood ducks include *H. nettionis*, *Leucocytozoon simondi*, *Plasmodium* spp., and unidentified onchocercid microfilariae (Roslien and Haugen, 1964; Herman et al., 1971; Bennett et al., 1974; Thul et al., 1980).

The present study was undertaken as part of a survey of avian hematozoa in southeast Georgia and South Carolina. Wood ducks were captured and banded by U.S. Fish and Wildlife Service personnel from August, 1994 through September, 1995. Blood was collected from 126 wood ducks trapped in a rocket net at Savannah National Wildlife Refuge (NWR) (Jasper County, South Carolina, USA; 32°11′N, 81°06′W) and 31 birds trapped in a Y-trap at Harris Neck NWR (McIntosh County,

TABLE 1. Prevalence of hematozoa in wood ducks from Savannah National Wildlife Refuge, South Carolina and Harris Neck National Wildlife Refuge, Georgia.

	Number examined	Number infected (%)				
		Hemaproteus nettionis	*Hemaproteus greineri*	*Lenkocytozoon simondi*	Microfilariae	Total
After hatching year						
Male	61	11 (18.0)	8 (13.1)	7 (11.4)	4 (6.6)	12 (19.7)[a]
Female	36	0	0	0	1 (2.8)	1 (2.8)
Hatching year						
Male	32	0	0	0	0	0
Female	28	0	0	0	0	0
Total	157	11 (7.0)	8 (5.1)	7 (4.5)	5 (3.2)	13 (8.3)[b]

[a] Eight male wood ducks were infected with two or more parasites.
[b] All 13 infected birds were trapped at Savannah National Wildlife Refuge, South Carolina.

Georgia, USA; 31°37′N, 81°17′W). Birds were bled at the capture sites by pricking the tarsometatarsal vein with a sterile lancet. Bleeding was stopped prior to releasing the bird by applying gentle pressure to the puncture site with a sterile cotton pad. Blood was used to make thin smears which were air dried, fixed in 100% methanol, stained with Wrights and Giemsa stain (Sigma Chemical Co., St. Louis, Missouri, USA), and examined with a brightfield microscope. An initial 5 min scan of each slide for large parasites was performed that consisted of several swaths across the smear at 100×. Next, the oil immersion lens (1,000×) was used to examine a minimum of 10,000 blood cells in randomly selected fields (200 to 500 cells/field) for at least 15 min. Representative slides of blood from infected birds are deposited in the Harold W. Manter Laboratory (University of Nebraska, Lincoln, Nebraska, USA; HWML 38603–38617). Frequencies of infected and uninfected birds were compared using Chi-square tests.

The prevalence of hematozoan parasites in wood ducks trapped in two southeastern NWR was low (Table 1). There were significant differences between the prevalences of infected birds with regard to season ($\chi^2 = 10.7$, df = 1, $P = 0.001$), age ($\chi^2 = 8.0$, df = 1, $P = 0.005$), and sex ($\chi^2 = 8.9$, df = 1, $P = 0.003$), but not location ($\chi^2 = 3.2$, df = 1, $P = 0.07$). Twelve of 73 birds trapped at Savannah NWR during the spring of 1995 were infected with blood parasites. Eleven of these infected birds were after hatching year (AHY) males. Eight of the infected males were infected with two to four different blood parasites including *L. simondi, H. greineri, H. nettionis,* and an unidentified short type of microfilariae. One AHY female trapped at the same time was infected with an unidentified species of a long type of microfilariae. In contrast, during the summers of 1994 and 1995 blood parasites were found in only one of 84 wood ducks trapped in both refuges. This duck, an AHY male trapped at Savannah NWR during July 1994, was infected with *H. nettionis.* None of the 31 ducks trapped at Harris Neck NWR were infected.

Our observation that hatching year (HY) birds were not infected with hematozoa and that the prevalence of infection in adult birds was lowest during the summer is consistent with results of previous studies (Thul and O'Brien, 1990; O'Dell and Robbins, 1994). The wood duck is unusual among waterfowl in that it has migratory populations which winter in the southern United States and breed as far north as Nova Scotia, and other populations that reside throughout the year in the south (Bellrose, 1980). Suitable vectors of the hematozoa that infect wood ducks may not be present in the southern portions of ei-

ther the Atlantic or Mississippi Flyways (Thul and O'Brien, 1990; O'Dell and Robbins, 1994). This is reflected by the lack of parasite transmission to sentinel ducks in Florida and by the observation that hematozoa are only occasionally found in adult wood ducks examined during the summer months in the south (Thul and O'Brien, 1990). All of the birds we examined from Harris Neck NWR were trapped during the summer. Perhaps this explains the lack of infected birds at that location.

The prevalence of hematozoa in wood ducks in the south is greatest during winter and spring, when populations consist of both migratory and resident birds (Thul and O'Brien, 1990; O'Dell and Robbins, 1994). Thul et al. (1980) proposed that the southern limits for the transmission of *H. nettionis* and *L. simondi* are 37°N and 43°N latitude, respectively. Because hematozoan infections in wood ducks can remain patent through the summer (Thul and O'Brien, 1990), it is unlikely that the birds we examined during those months had undetectable latent infections. Blood smears from three birds contained trophozoites; although this could indicate recently acquired infections, it also might be due to relapse of infections acquired in the north. All three of these birds were trapped prior to spring migration when relapse should be maximal (Worms, 1972).

Most of the infected birds observed in the present study were males, but no significant differences between the prevalence of infection in male and female ducks were observed in other studies (Thul and O'Brien, 1990; O'Dell and Robbins, 1994). We have no explanation for the sexual disparity in prevalence.

None of the previous studies on blood parasites of wood ducks in the Atlantic Flyway reported *H. greineri* infections (Herman et al., 1971; Bennett et al., 1974; Thul et al., 1980; Thul and O'Brien, 1990). In the present study *H. greineri* was observed in 13% of the birds trapped in South Carolina. The parasite was present in 73% of the birds infected with *Haemoproteus* spp. that we examined. In these, the circumnuclear gametocyte characteristic of *H. greineri* was easily observed, comprising approximately three to 17% of the mature gametocytes present. Since most of the earlier wood duck studies were performed prior to the initial description of *H. greineri* by Bennett et al. (1984), the parasite was probably identified as *H. nettionis*. To resolve this issue and to characterize the distribution of *H. greineri* in Atlantic Flyway wood ducks, we examined blood smears from 57 *Haemoproteus* spp. infected HY wood ducks collected during the spring and summer, 1980 to 1983, at 10 different locations extending from 46°N to 37°N latitude in the Atlantic Flyway. Three to 12 blood smears from birds trapped at each site were examined. These smears had been collected and determined to contain *Haemoproteus* spp. as part of an earlier investigation of wood duck hematozoa (Thul and O'Brien, 1990). We found *H. greineri* in 40 of 57 (70%) blood smears examined and the parasite was observed in blood from wood ducks trapped at study sites in Canada (New Brunswick, 45°45′N, 66°10′W; Ontario, 45°05′N, 74°45′W and 44°50′N, 78°10′W) and the United States (Maine, 44°55′N, 68°40′W, New York, 43°00′N, 73°50′W; Massachusetts, 42°30′N, 71°20′W; Pennsylvania, 42°00′N, 80°00′W; New Jersey, 40°40′N, 74°30′W; West Virginia, 38°55′N, 82°05′W; Delaware, 38°45′N, 75°20′W; Virginia, 36°45′N, 82°00′W). Representative slides of blood from these birds are deposited in the Harold W. Manter Laboratory (HWML 39047–39056). Since all of the smears were from HY ducks trapped prior to migration, it is likely that *H. greineri* was transmitted to the birds at the study sites. Our findings indicate that *H. greineri* is not exclusively boreal in distribution but also can be found along much of the Atlantic Flyway.

In addition, we observed that all of the *H. greineri* infected birds also were infected with *H. nettionis*. In another study,

mixed infections of *H. nettionis* and *H. greineri* were observed in only 9% of infected anatids from Alberta (Bennett et al., 1984). A similar situation occurs in mourning doves (*Zenaida macroura*) infected with *Haemoproteus* spp. Mixed infections of *H. columbae* (reported as *H. maccallumi*) and *H. sacharovi* are common in some dove populations, whereas solo infections of *H. columbae* occur in others (Greiner, 1975; Shamis and Forrester, 1977).

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