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Survey of Blood Parasites in Two Forest Owls, Northern Saw-whet Owls and Flammulated Owls, of Western North America

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ABSTRACT: Except for a few studies in the eastern United States, little has been published on hemoparasites in owls. We surveyed the blood parasites of 108 Northern Saw-whet Owls (*Aegolius acadicus*) and 24 Flammulated Owls (*Otus flammeolus*) in Idaho during autumn migration in 1999 and 2000. We also surveyed 15 Flammulated Owls (FLOW) during breeding season in Utah from 2000. *Leucocytozoon ziemanni, Haemoproteus syrnii, Haemoproteus noctuae,* and *Trypanosoma avium* were identified. The overall prevalence of infection was 53% (78/147) and for the combined species, prevalences of *Haemoproteus*, *Leucocytozoon*, and *Trypanosoma* species were 20%, 39%, and 4%, respectively. Northern Saw-whet Owls (NSWO) had an overall prevalence of 51% (55/108), with prevalences of 6%, 47%, and 4% by hemoparasite genus, respectively. Flammulated Owls had an overall prevalence of 59% (23/39), with prevalences of 56%, 18%, and 5% by genus, respectively. This study provides baseline hematozoa information for two boreal owl species.

Key words: *Aegolius acadicus*, breeding, Flammulated Owl, *Haemoproteus*, hemoparasites, Idaho, *Leucocytozoon*, migration, Northern Saw-whet Owl, *Otus flammeolus*, Strigidae, *Trypanosoma*.

We studied the prevalence of hematozoa infection in two small forest owls common throughout North America. Flammulated Owls (*Otus flammeolus*) are primarily insectivorous and migrate long distances over a period of weeks from Canada to Mexico and South America (McCallum, 1994). In contrast, Northern Saw-whet Owls (*Aegolius acadicus*) mostly prey on small mammals and migrate latitudinally or altitudinally over a period of days (Cannings, 1993).

Avian hemoparasites are transmitted by insect vectors and some stages infect circulating red blood cells, where they can decrease the overall quantity of hemoglobin, the oxygen-carrying molecule (Stevens, 1996). Detrimental effects, such as an inability to fly long distances and decreased hunting success, may occur as a result of high parasitemias, possibly due to a reduced oxygen carrying-capacity of the host (Dufva, 1996; Appleby and Redpath, 1997).

Hemoparasite infections may delay the onset of migration or even prevent infected birds from migrating altogether (Valkiunas, 1989). However, the intensity of circulating blood parasites fluctuates seasonally with changes in body condition and hormone levels. Parasitemias will be very low during fall migration (Apanius, 1991; Allander and Sundberg, 1997), whereas breeding season parasitemias will be high (Deviche et al., 2001a). Age also contributes to parasitemia level, since older birds often have an increased prevalence of hemoparasites but at a lower intensity, possibly resulting from acquired immunity (Allander and Bennett, 1994; Boal et al., 1998). Immature birds may be particularly sensitive to the detrimental physiologic effects of hemoparasites and occasionally die from increased hemoparasite intensity or acute infection at fledging or first migration (Hunter et al., 1997; Evans and Otter, 1998).

There are a few studies of blood parasites in migrating boreal owl species in the eastern United States (Taft et al., 1996, 1997; Brinker et al., 1997). However, no studies have been published for

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these owl species along western North American migration flyways (Bishop and Bennett, 1989). This discrepancy is partly due to the fact that, until recently, few migration stations concentrated on owls. Our study examined hemoparasites of Northern Saw-whet Owls (NSWO) and Flammulated Owls (FLOW) migrating through southwest Idaho during the fall. For seasonal comparison, we sampled FLOW adults during the breeding season in Utah, USA.

In 1999 and 2000, NSWO and FLOW were captured during fall migration at the Idaho Bird Observatory located on Lucky Peak in the Boise National Forest, Ada County, Idaho, USA (longitude −116.06028°, latitude 43.60528°). Owls were captured using audio lures and mist nets (Whalen and Watts, 1999). Five nets were positioned around two speakers at each of two stations. Vocalizations of male owls of each species were broadcast from a tape loop from 8 PM to 8 AM nightly during peak migration season (for further details see Hamilton, 2002). In 2000, owls were captured in nest boxes during the breeding season at a study site near Snow Basin, Utah (Oleyar, 2000).

Each owl was banded with a unique aluminum U.S. Geological Survey leg band and morphologic measurements were taken. Approximately 40–80 µl of blood was collected from the brachial vein using heparinized Caraway tubes. Using a cover slip-slide method, two thin blood smears were made and air dried. The blood smears were fixed within 24 hr of collection and stained with a quick Wright-Giemsa (Volu-Sol, Salt Lake City, Utah, USA). A modified staining protocol recommended for avian blood was used: 5 min immersed in stain, 5 min immersed in buffer, and ten 1-sec dips in rinse.

Blood smears were made from 30 NSWO captured mostly during September 1999 and from 74 owls captured mostly in October of 2000. Blood smears were made from 19 FLOW in 1999 and from five Idaho and 15 Utah owls in 2000. Flammulated Owls in Idaho were caught in September, while FLOW in Utah were caught in July.

We examined each smear on high power (100×) to locate a monolayer of cells and to detect the presence of *Trypanosoma* spp. We scanned the monolayer area under oil immersion (1,000×) while performing a differential white blood cell count and identified all hemoparasites to species using Peirce (2005) and Valkiunas (2005) as references. Voucher specimens of all parasite species have been deposited at Queensland Museum; accession numbers G464989, G464899, G464900, G464901, G464902, G464904, G464905, and G464906. We report prevalence and mean intensity values; prevalence is the number of infected individuals divided by the total number of individuals sampled (Bush et al., 1997). Prevalence of *Trypanosoma* spp., using only blood smear examination, was likely underestimated (Bennett, 1962). Parasite prevalences by avian sex were compared by chi-square test. A *P*-value of 0.05 or less was considered significant (JMP 4.0, SAS Institute, Cary, North Carolina, USA).

Leucocytozoon ziemanni, Haemoproteus syrnii, Haemoproteus noctuae, and *Trypanosoma avium* were identified on the blood smears. The overall prevalence of infection was 53%. Prevalences of *Haemoproteus* (20%), *Leucocytozoon* (39%), and *Trypanosoma* (4%) were recorded. There was no effect of sex on parasite prevalence in either owl species ($P=0.09$ NSWO; $P=0.77$ FLOW); therefore sexes were grouped for all later analyses.

Overall, NSWO prevalence was 51% (55/108); prevalence by parasite genus was *Haemoproteus* 6% (7/108), *Leucocytozoon* 47% (51/108), and *Trypanosoma* 4% (4/108; Table 1). Thirteen percent (7/55) of the infected owls had concurrent infections with two genera of hemoparasites over both years; *L. ziemanni* was more prevalent in NWSO than was *H. syrnii.*

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TABLE 1. Parasite prevalence by year, season, and location.

Species	Season (State)	Year	Parasitized % (*n*)	Parasitized with two genera % (*n*)	Parasite species
Northern Saw-whet Owl	Migration (ID)	1999	53% (16)	6% (2)	*Leucocytozoon danilewskyi Haemoproteus syrnii Trypanosoma avium*
Northern Saw-whet Owl	Migration (ID)	2000	53% (39)	7% (5)	Same as above
Flammulated Owl	Migration (ID)	1999	37% (7)	5% (1)	*H. syrnii H. noctuae L. danilewskyi*
Flammulated Owl	Migration (ID)	2000	40% (2)	20% (1)	Same as above
Flammulated Owl	Breeding (UT)	2000	93% (14)	27% (4)	Same as above

Overall, hemoparasite prevalence in FLOW was 59% (23/39); prevalence by parasite genus was *Haemoproteus* 56% (22/39), *Leucocytozoon* 18% (7/39), and *Trypanosoma* 4% (2/39; Table 1). As expected, there was an effect of season on parasite prevalence ($P=0.0002$). More birds were infected with *Haemoproteus* spp. (22/39) than with *L. ziemanni* (7/39). Seventy-eight percent (18/23) of the infected birds had concurrent infections of *H. noctuae* and *H. syrnii*.

It is well documented that hemoparasite levels are near their lowest levels in fall migrants (Valkiunas, 2005). However, migration is an ideal time of year to obtain large sample sizes since many banding stations are handling birds. With these larger sample sizes, it is possible to assess the normal ranges of many blood parameters and the minimum parasitemia levels. While this study may not provide data for acute infections, since acutely infected birds were most likely unable to migrate (Valkiunas, 2001), it does provide a snapshot of the chronic infection levels in both NWSO and FLOW.

Northern Saw-whet Owls were primarily infected with *L. ziemanni*, while FLOW were primarily infected with *Haemoproteus* spp. The difference in hemoparasite fauna between these host species may be related to differences in migration strategies (latitudinal vs. long-distance) or to other life history traits that need further investigation. Taft (1994) hypothesized that owls had higher prevalences of *Leucocytozoon* spp. because blackfly vectors are present during the day when owls are roosting. Both owl species in our study have similar activity patterns, as well as roosting and nesting habitats, so their exposure to parasite vectors is probably similar; even so, FLOW hosted predominantly *Haemoproteus* spp. while NSWO hosted predominantly *Leucocytozoon*.

Deviche et al. (2001b) found that different species of birds vary in susceptibility to different parasites, all other variables being equal. Similarly, Galeotti and Sacchi (2003) noted that different color morphs of the same species vary in their susceptibility to parasites. Clearly, additional comparative studies of breeding populations are needed to examine acute infections and accurately characterize host-parasite interactions in these boreal owl species.

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