

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

Authors: Leppert, Lynda L., Dufty, Alfred M., Stock, Sarah, Oleyar, M. David, and Kaltenecker, Greg S.

Source: Journal of Wildlife Diseases, 44(2) : 475-479

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-44.2.475>

---

BioOne Complete ([complete.BioOne.org](https://complete.BioOne.org)) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/terms-of-use](https://www.bioone.org/terms-of-use).

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

---

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

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

Lynda L. Leppert,<sup>1,4,5</sup> Alfred M. Dufty, Jr.,<sup>1</sup> Sarah Stock,<sup>2</sup> M. David Oleyar,<sup>1</sup> and Greg S. Kaltenecker<sup>3</sup>

<sup>1</sup> Boise State University, Biology, 1910 University Drive, Boise, Idaho 83725, USA; <sup>2</sup> University of Idaho, Biology, Mines 321, Moscow, Idaho 83844-3025, USA; <sup>3</sup> Idaho Bird Observatory, Department of Biology, Boise State University, 1910 University Drive, Boise, Idaho 83725, USA; <sup>4</sup> Current address: Alaska Sea Life Center, PO Box 1329, Seward, Alaska 99664, USA; <sup>5</sup> Corresponding author (email: lyndal@alaskasealife.org)

**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

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  $-116.06028^\circ$ , latitude  $43.60528^\circ$ ). 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  $\mu$ l 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 $\times$ ) to locate a monolayer of cells and to detect the presence of *Trypanosoma* spp. We scanned the monolayer area under oil immersion (1,000 $\times$ ) 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 NSWO than was *H. syrnii*.

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)	<i>Leucocytozoon danilewskyi</i> <i>Haemoproteus syrnii</i> <i>Trypanosoma avium</i>
Northern Saw-whet Owl	Migration (ID)	2000	53% (39)	7% (5)	Same as above
Flammulated Owl	Migration (ID)	1999	37% (7)	5% (1)	<i>H. syrnii</i> <i>H. noctuae</i> <i>L. danilewskyi</i>
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 NWSO 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.

We thank the Idaho Bird Observatory for technical and logistic field assistance. Also, thanks to the many field technicians who helped collect data. Funding was provided by Boise State University, the Idaho Chapter of The Wildlife Society,

and the University of Idaho. We thank E. Greiner, University of Florida, Gainesville, for his assistance with verification of hemoparasite species and manuscript development.

#### LITERATURE CITED

- ALLANDER, K., AND G. F. BENNETT. 1994. Prevalence and intensity of hematozoan infection in a population of great tits *Parus major* from Gotland, Sweden. *Journal of Avian Biology* 25: 69–74.
- , AND J. SUNDBERG. 1997. Temporal variation and reliability of blood parasite levels in captive yellowhammer males *Emberiza citrinella*. *Journal of Avian Biology* 28: 325–330.
- APANIUS, V. 1991. Blood parasitism, immunity, and reproduction in American kestrels (*Falco sparverius*). PhD Dissertation, University of Pennsylvania, Philadelphia, Pennsylvania, 291 pp.
- APPLEBY, B., AND S. M. REDPATH. 1997. Indicators of male quality in the hoots of tawny owls *Strix aluco*. *Journal of Raptor Research* 31: 65–70.
- BENNETT, G. F. 1962. Hematocrit centrifuge for laboratory diagnosis of hematozoa. *Canadian Journal of Zoology* 40: 124–125.
- BISHOP, M. A., AND G. F. BENNETT. 1989. The haemoproteids of the avian order Strigiformes. *Canadian Journal of Zoology* 67: 2676–2684.
- BOAL, C. W., K. S. HUDELSON, R. W. MANNAN, AND T. S. EASTBROOK. 1998. Hematology and hematozoa of adult and nestling Cooper's hawk in Arizona. *Journal of Raptor Research* 32: 281–285.
- BRINKER, D. F., K. E. DUFFY, D. M. WHALEN, B. D. WATTS, AND K. M. DODGE. 1997. Autumn migration of northern saw-whet owls (*Aegolius acadicus*) in the Middle Atlantic and northeastern United States: What observations from 1995 suggest. In *Biology and conservation of owls of the Northern Hemisphere*, J. R. Duncan, D. H. Johnson and T. H. Nicholls (eds.). United States Department of Agriculture, Washington, DC, pp. 74–89.
- BUSH, A. O., K. D. LAFFERTY, J. M. LOTZ, AND A. W. SHOSTAK. 1997. Parasitology meets ecology on its own terms: Margolis et. al. revisited. *Journal of Parasitology* 83: 575–583.
- CANNINGS, R. J. 1993. Northern saw-whet owl *Aegolius acadicus*. *Birds of North America* 42: 1–20.
- DEVICHE, P., E. C. GREINER, AND X. MANTECA. 2001a. Seasonal and age-related changes in blood parasite prevalence in dark-eyed juncos (*Junco hyemalis*, Aves, Passeriformes). *Journal of Experimental Zoology* 289: 456–466.
- , ———, AND ———. 2001b. Interspecific variability of prevalence in blood parasites of adult passerine birds during the breeding season in Alaska. *Journal of Wildlife Diseases* 37: 28–35.
- DUFVA, R. 1996. Blood parasites, health, reproductive success, and egg volume in female great tits *Parus major*. *Journal of Avian Biology* 27: 83–87.
- EVANS, M., AND A. OTTER. 1998. Fatal combined infection with *Haemoproteus noctuae* and *Leucocytozoon ziemanni* in juvenile snowy owls (*Nyctea scandiaca*). *Veterinary Record* 143: 172–176.
- GALEOTTI, P., AND R. SACCHI. 2003. Differential parasitemia in the tawny owl (*Strix aluco*): Effects of colour morph and habitat. *Journal of Zoology, London* 261: 91–99.
- HAMILTON, S. L. 2002. A comparative analysis of the ecology and physiology of the flammulated owl (*Otus flammeolus*) and northern saw-whet owl (*Aegolius acadicus*) during fall migration. MSc Thesis, University of Idaho, Moscow, 90 pp.
- HUNTER, D. B., C. ROHNER, AND D. C. CURRIE. 1997. Mortality in fledgling great horned owls from black fly hematophaga and leucocytozoonosis. *Journal of Wildlife Diseases* 33: 486–491.
- MCCALLUM, D. A. 1994. Flammulated owl. *Birds of North America* 93: 1–23.
- OLEYAR, M. D. 2000. Flammulated owl (*Otus flammeolus*) breeding ecology in aspen forests of northern Utah: Including responses to ski area development. MSc Thesis, Boise State University, Boise, Idaho, 58 pp.
- PEIRCE, M. A. 2005. A checklist of the valid avian species of *Babesia* (Apicomplexa: Piroplasmorida), *Haemoproteus*, *Leucocytozoon* (Apicomplexa: Haemosporida) and *Hepatoozoon* (Apicomplexa: Haemogregarinidae). *Journal of Natural History* 39: 3621–3632.
- STEVENS, L. 1996. Avian biochemistry and molecular biology. Cambridge University Press, Cambridge, Massachusetts, 286 pp.
- TAFT, S. J., R. N. ROSENFELD, AND J. BIELEFELDT. 1994. Avian hematozoa of adult and nestling Cooper's hawks (*Accipiter cooperii*) in Wisconsin. *Journal of the Helminthological Society of Washington* 61: 146–148.
- , ———, AND D. L. EVANS. 1996. Hematozoa in autumnal migrant raptors from the Hawk Ridge Nature Reserve, Duluth, Minnesota. *Journal of the Helminthological Society of Washington* 63: 141–143.
- , E. A. JACOBS, AND R. N. ROSENFELD. 1997. Hematozoa of spring- and fall-migrating northern saw-whet owls (*Aegolius acadicus*) in Wisconsin. *Journal of the Helminthological Society of Washington* 64: 296–298.
- VALKIUNAS, G. A. 1989. Characteristics of the distribution of birds infected with hemosporidians (Sporozoa, Haemosporidia) during the fall migration in flight waves. *Parazitologiya* 23: 377–382. Russian with English summary.
- . 2001. Blood parasites of birds: Some

obstacles in their use in ecological and evolutionary biology studies. *Avian Ecology and Behaviour* 7: 87–100.

———. 2005. *Avian malaria parasites and other Haemosporidia*. CRC Press, Boca Raton, Florida, 932 pp.

WHALEN, D. M., AND B. D. WATTS. 1999. The influence of audio-lures on capture patterns of migrant northern saw-whet owls. *Journal of Field Ornithology* 70: 163–168.

*Received for publication 30 July 2007.*