

## **Survey for Hemoparasites in Imperial Eagles (*Aquila heliaca*), Steppe Eagles (*Aquila nipalensis*), and White-tailed Sea Eagles (*Haliaeetus albicilla*) from Kazakhstan**

Authors: Leppert, Lynda L., Layman, Seth, Bragin, Evgeny A., and Katzner, Todd

Source: Journal of Wildlife Diseases, 40(2) : 316-319

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-40.2.316>

---

The BioOne Digital Library (<https://bioone.org/>) provides worldwide distribution for more than 580 journals and eBooks from BioOne's community of over 150 nonprofit societies, research institutions, and university presses in the biological, ecological, and environmental sciences. The BioOne Digital Library encompasses the flagship aggregation BioOne Complete (<https://bioone.org/subscribe>), the BioOne Complete Archive (<https://bioone.org/archive>), and the BioOne eBooks program offerings ESA eBook Collection (<https://bioone.org/esa-ebooks>) and CSIRO Publishing BioSelect Collection (<https://bioone.org/csiro-ebooks>).

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

Usage of BioOne Digital Library 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 is an innovative nonprofit that 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 for Hemoparasites in Imperial Eagles (*Aquila heliaca*), Steppe Eagles (*Aquila nipalensis*), and White-tailed Sea Eagles (*Haliaeetus albicilla*) from Kazakhstan

Lynda L. Leppert,<sup>1,6</sup> Seth Layman,<sup>2</sup> Evgeny A. Bragin,<sup>3</sup> and Todd Katzner<sup>4,5</sup> <sup>1</sup> Biology Department, Boise State University, Boise, Idaho 83725, USA; <sup>2</sup> Department of Biology, The Colorado College, 14 East Cache La Poudre Rd., Colorado Springs, Colorado 80903, USA; <sup>3</sup> Naurzum Nature Reserve, Kustany Oblast, Naurzumski Raijon, Dokuchaevka, 459730, Kazakhstan; <sup>4</sup> Department of Biology, Arizona State University, Tempe, Arizona 85287, USA; <sup>5</sup> Current address: Renewable Resources Assessment Group, Department of Environmental Science and Technology, South Kensington Campus, Exhibition Road, Imperial College London SW7 2AZ, UK; <sup>6</sup> Corresponding author (email: lleppert@memphis.edu)

**ABSTRACT:** Prevalence of hemoparasites has been investigated in many avian species throughout Europe and North America. Basic hematologic surveys are the first step toward evaluating whether host-parasite prevalences observed in North America and Europe occur elsewhere in the world. We collected blood smears from 94 nestling imperial eagles (*Aquila heliaca*), five nestling steppe eagles (*Aquila nipalensis*), and 14 nestling white-tailed sea eagles (*Haliaeetus albicilla*) at Naurzum Zapovednik (Naurzum National Nature Reserve) in Kazakhstan during the summers of 1999 and 2000. In 1999, six of 29 imperial eagles were infected with *Leucocytozoon toddi*. Five of 65 imperial eagles and one of 14 white-tailed sea eagle were infected with *L. toddi* in 2000. Furthermore, in 2000, one of 65 imperial eagles was infected with *Haemoproteus* sp. We found no parasites in steppe eagles in either year, and no bird had multiple-species infections. These data are important because few hematologic studies of these eagle species have been conducted.

**Key words:** *Aquila heliaca*, *Aquila nipalensis*, *Haliaeetus albicilla*, hemoparasite, imperial eagle, Kazakhstan, *Leucocytozoon*, steppe eagle, white-tailed sea eagle.

Although eagles have been studied extensively in North America and in parts of Europe, research on parasites of large eagles from Asia is sparse. In fact, an extensive literature search that included foreign language papers revealed studies reporting only *Leucocytozoon toddi* in Germany's white-tailed sea eagle (*Haliaeetus albicilla*) and lesser spotted eagles (*Aquila pomarina*; Krone et al., 2001); and *Leucocytozoon* spp. from lesser spotted eagles in the Czech Republic (Svobodova and Votýpka, 1998).

Basic hematologic surveys are the first

step toward evaluating whether host-parasite prevalences observed in North America and Europe occur elsewhere in the world. For example, hemoparasites have been linked to decreased body condition of birds during breeding season in many regions (Dawson and Bortolotti, 2000; Merino et al., 2000). Kazakhstan, in the former Soviet Union, is situated at the borders of Asia and Europe. This area supports a remarkably diverse but poorly known raptor community, and to our knowledge, parasites rarely have been evaluated in raptors in this region (Yakunin, 1972).

We evaluated blood parasites from nestlings of three eagle species (imperial eagles [*Aquila heliaca*], white-tailed sea eagles, and steppe eagles [*Aquila nipalensis*]) that coexist at the Nature Reserve in north-central Kazakhstan. The goal of this research was to survey these species for blood parasites that could be transmitted by arthropod vectors, such as locally common mosquitoes and black flies (*Simulium* spp.), found on the nestlings or in the nest material. Such parasites have been shown to have negative effects on the survival of chicks and fledglings, directly or indirectly (Val'kunas, 1989; McFadzen, 1994; Rohner and Hunter, 1996; Hunter et al., 1997; Evans and Otter, 1998). These data are additionally relevant because each of these species is listed as threatened or endangered on national or international red lists (Kovshar, 1996; IUCN, 2002).

This research was conducted during summers 1999–2000 at the Naurzum Za-

*povednik* (National Nature Reserve) in the Kostanay Oblast of north-central Kazakhstan (51°N, 64°E). The *Zapovednik* is dominated by pine (*Pinus sylvestris*), birch (*Betula* spp.), and aspen (*Populus* spp.) forest surrounded by dry grassland, shrub-steppe, and wetlands. The forest provides primary nesting habitat for tree-nesting eagles, and all species primarily forage throughout the steppe (Katzner, 2002). Nesting biology could affect ectoparasite and vector density (Ashford et al., 1991). In this region, white-tailed sea eagles nest in pine trees; imperial eagles nest in aspen, birch, and pine trees; and steppe eagles usually nest on the ground. Samples were taken in the course of field work on the ecology and coexistence of these eagle species (Katzner, 2002). Field work for this project was generally conducted during daylight between 9:00 AM and 7:00 PM.

At each nest, we took blood by clipping a talon of eagle chicks and made a thin blood smear using the coverslip-slide method (Campbell and Dein, 1984). The slides from 1999 were not fixed and stained until 1 yr after preparation. In 2000, all slides were fixed in methanol within 24 hr of preparation and stained 6 mo later. Slides were stained with a Wrights-Giemsa quick stain kit (Vol-u-Sol, Salt Lake City, Utah, USA). The staining protocol for avian blood smears was 5 min in stain, 5 min in buffer, and ten 1-sec dips in rinse. We scanned the entire slide under low power (10×) for microfilaria and *Trypanosoma* sp. We then scanned the continuous monolayer area for 30 min under oil immersion (100×) for other hemoparasites.

During both years, blood samples were collected from most chicks when they were between the ages of 30 and 50 days. In rare occasions ( $n < 10$ ), we climbed into nests and sampled chicks that were 20–30 days old. During 1999, we bled 29 imperial eagle chicks and four steppe eagle chicks. We also evaluated 18 imperial eagle nests, two steppe eagle nests, and five white-tailed sea eagle nests for ectopara-

sites and potential hemoparasite arthropod vectors. For both types of invertebrates, we closely examined each chick visually for 5 min, scanning the entire body and checking under feathers and down. We also searched for arthropod vectors in the surface layer of the nest substrate (ca. first 5 cm), where they could fall after feeding on the nestlings. During 2000, we sampled blood from 65 imperial eagles, 14 white-tailed sea eagles, and one steppe eagle. Ectoparasites and arthropod vectors were not evaluated in 2000. Samples were collected with the appropriate Arizona State University protocols (00538R) and with the permission of the associated National Park authorities.

The 1999 slides contained a large amount of white blood cell and red blood cell degeneration because of the delayed fixation. The 2000 slides contained intermittent cellular distribution with no continuous monolayer present. For these reasons, no reliable intensity data could be calculated. However, we were able to calculate prevalence data for both years. Six of 29 (21%) imperial eagles were infected with *L. toddi* in 1999. In 2000, five of 65 (8%) imperial eagles were infected with *L. toddi*. Also in 2000, one of 14 (7%) white-tailed sea eagles was infected with *L. toddi*. Additionally, one of 65 imperial eagles was infected with *Haemoproteus* sp. Steppe eagles had no parasites in either year ( $n = 5$ ), although the absence of parasites on a blood smear does not necessarily mean the bird is uninfected because peripheral blood smears can underestimate presence of hemoparasites (Apanius, 1991). No microfilaria were found in either year, although blood smear techniques also can underestimate microfilarial parasite infections (Bennett, 1962).

Individuals of a single species of an unidentified invertebrate ectoparasite were found on the bodies of imperial eagle chicks at nine of 18 (50%) nests surveyed in 1999. Ectoparasites were not found on the bodies of chicks of any other eagle species. However, black flies were found at 15

of 18 (83%) imperial eagle nests, three of five (60%) sea eagle nests, and one of two (50%) steppe eagle nests. It is not known whether this particular black fly species is a vector species for *L. toddi*. Nevertheless, black flies have been reported as a vector for blood parasites in other raptor species (Smith et al., 1998). Black flies were present at each of the four sites where both blood parasites were found and arthropods were evaluated. The unidentified ectoparasites were found at one of those nests.

Typically, chicks have a higher intensity of parasitic infection than adult birds during the initial acute infection period (Garnham, 1966; Davidar and Morton, 1993; Allander and Bennett, 1994; Fedynich et al., 1995; Allander and Sundberg, 1997). Infected adults usually have reached an equilibrium state with the parasite through acquired immunity by previous exposure (Allander and Bennett, 1994). Fatalities attributed to parasitic infections usually occur within the first year of infection (Davidar and Morton, 1993; Evans and Otter, 1998). As such, our results might overestimate the blood parasite prevalence in the postfledgling population of imperial eagles.

Differences in parasitic infection occur for many reasons, including variations in parasite resistance (Bennett and Bishop, 1990; Figuerola et al., 1996), breeding biology (Kucera, 1981; Hollmen et al., 1998), or vector density (Ashford et al., 1991). When variability of resistance has been implicated, molting patterns, immune function, geographic range, and microhabitat use all have been implicated as potential causative agents for this variability (Post and Enders, 1970; Tella et al., 1999; Deviche et al., 2001). These factors also could have contributed to the differences that we observed within this eagle association. However, the small size of our sample of steppe and white-tailed sea eagles should be remembered when interpreting our results.

Others have shown links between arthropod vectors and hemoparasite pres-

ence (Smith et al., 1998). Although those links might exist in this system, we did not find blood parasites in all nests where we observed black flies. Future studies into the immune system, breeding biology, and nesting differences of steppe eagles compared with imperial eagles and white-tailed sea eagles might explain the hemoparasite differences we observed among these Central Asian eagles.

T. Bragina, H. Triplett, R. Shigapov, A. Taran, and others provided field support. A. Taran, F. Crystal, A. Popkov, and A. Sagalov assisted in several phases of the project. T.E.K. was funded by the US Environmental Protection Agency STAR Graduate Research Fellowship Program, the US Geological Survey Biological Resources Division, the Wildlife Conservation Society, Arizona State University Department of Biology, the Frank M. Chapman Memorial Fund, the Hawk Mountain-Zeiss Raptor Research Award, Arizona State University Graduate Research Support Program, The International Osprey Foundation, the World Nature Association, Arizona State University Russian and East European Studies Consortium, and Northwest Airlines. We acknowledge the assistance of the Naurzum *Zapovednik*, the government of Kazakhstan, and Hawk Mountain Sanctuary Association. S. Sterner, University of Nebraska State Museum currently at the National Wildlife Health Center, (Madison, Wisconsin) and E. Greiner, of the University of Florida (Gainesville, Florida) helped to identify blood parasites.

#### 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.
- APANUS, V. 1991. Blood parasitism, immunity, and reproduction in American kestrels (*Falco sparverius*).

- erius). PhD Dissertation, University of Pennsylvania, Philadelphia, 291 pp.
- ASHFORD, R. W., E. E. GREEN, P. R. HOLMES, AND A. J. LUCAS. 1991. *Leucocytozoon toddi* in British sparrowhawks *Accipiter nisus*: Patterns of infection in nestlings. *Journal of Natural History* 25: 269–277.
- BENNETT, G. F. 1962. Hematocrit centrifuge for laboratory diagnosis of hematozoa. *Canadian Journal of Zoology* 40: 124–125.
- , AND M. A. BISHOP. 1990. Change in status of haematozoan infections in wild passeriforms sampled in successive years. *Proceedings of the Zoological Society of Calcutta* 43: 9–18.
- CAMPBELL, T. W., AND F. J. DEIN. 1984. Avian hematology: The basics. *Veterinary Clinics of North America: Small Animal Practice* 14: 223–248.
- DAVIDAR, P., AND E. MORTON. 1993. Living with parasites: Prevalence of a blood parasite and its effect on survivorship in the purple martin. *Auk* 110: 109–116.
- DAWSON, R. D., AND G. R. BORTOLOTTI. 2000. Effects of hematozoan parasites on condition and return rates of American kestrels. *Auk* 117: 373–380.
- DEVICHE, P., E. C. GREINER, AND X. MANTECA. 2001. Interspecific variability of prevalence in blood parasites of adult passerines during the breeding season in Alaska. *Journal of Wildlife Diseases* 37: 28–35.
- EVANS, M., AND A. OTTER. 1998. Fatal combined infection with *Haemoproteus noctuae* and *Leucocytozoon ziemanni* in juvenile snowy owls (*Nyctea scandiaca*). *The Veterinary Record* 143: 172–176.
- FEDYNICH, A. M., D. B. PENCE, AND R. D. GODFREY. 1995. Hematozoa in thin blood smears. *Journal of Wildlife Diseases* 31: 436–438.
- FIGUEROLA, J., R. VELARDE, A. BERTOLERO, AND F. CERDA. 1996. Absence of haematozoa in breeding population of Kentish plover *Charadrius alexandrinus* in northeast Spain. *Journal fuer Ornithologie* 137: 523–525.
- GARNHAM, P. C. C. 1966. *Malaria parasites and other Haemosporidia*. Blackwell Scientific Publications, Oxford, UK, 114 pp.
- HOLLMER, T. E., J. C. FRANSON, L. H. CREEKMORE, J. A. SCHUMUTZ, AND A. C. FOWLER. 1998. *Leucocytozoon simondi* in emperor geese from the Yukon-Kuskokwim Delta in Alaska. *Condor* 100: 402–404.
- 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.
- [IUCN] INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES. 2002. *IUCN Red List of Threatened Species*, www.redlist.org. Accessed 1 November 2002.
- KATZNER, T. E. 2002. Ecology and behavior of four coexisting eagle species at Naurzum *Zapovednik*, Kazakhstan. PhD Dissertation, Arizona State University, Tempe, Arizona, 104 pp.
- KOVSHAR, A. 1996. The red data book of Kazakhstan, Vol. 1. Animals, Part 1: Vertebrates. 3rd Edition, Institute of Zoology, National Academy of Sciences, Almaty, Kazakhstan, 327 pp.
- KRONE, O., J. PRIEMER, J. STREICH, P. SOMMER, T. LANGGEMACH, AND O. LESSOW. 2001. Haemosporidia of birds of prey and owls from Germany. *Acta Protozoologica* 40: 281–289.
- KUCERA, J. 1981. Blood parasites of birds in central Europe. 2. *Leucocytozoon*. *Folia Parasitologica* 28: 193–203.
- McFADZEN, M. E. 1994. Influences of ectoparasites (*Hemiptera: Cimicidae*) on the hematology of nestling prairie falcons. In *Snake River Birds of Prey National Conservation Area, research and monitoring, annual report 1994*, Karen Steenhof (ed.). US Bureau of Land Management unpublished report. Boise District, Idaho, pp. 253–256.
- MERINO, S., J. MORENO, J. J. SANZ, AND E. ARRIERO. 2000. Are avian blood parasites pathogenic in the wild? A medication experiment in blue tits (*Parus caeruleus*). *Proceedings of the Royal Society of London B* 267: 2507–2510.
- POST, W., AND F. ENDERS. 1970. The occurrence of Mallophaga on two bird species occupying the same habitat. *Ibis* 112: 539–540.
- ROHNER, C., AND D. B. HUNTER. 1996. First-year survival of great horned owls during a peak and decline of the snowshoe hare cycle. *Canadian Journal of Zoology* 74: 1092–1097.
- SMITH, R. N., S. L. CAIN, S. H. ANDERSON, J. R. DUNK, AND E. S. WILLIAMS. 1998. Blackfly-induced mortality of nestling red-tailed hawks. *Auk* 115: 368–375.
- SVOBODOVA, M., AND J. VOTYPKA. 1998. Occurrence of blood protists in raptors (Falconiformes). *Buteo* 10: 51–56. [In Czech, English summary.]
- TELLA, J. L., G. BLANCO, M. G. FORERO, A. GAJON, J. A. DONAZAR, AND F. HIRALDO. 1999. Habitat, world geographic range, and embryonic development of hosts explain the prevalence of avian hematozoa at small spatial and phylogenetic scales. *Proceedings of the National Academy of Sciences of the United States of America* 96: 1785–1789.
- VAL'KIUNAS, G. A. 1989. Characteristics of the distribution of birds infected with hemosporeidians (Sporozoa, Haemosporidia) during the fall migration in flight waves. *Parazitologiya* 23: 377–382. [In Russian, English abstract.]
- YAKUNIN, M. P. 1972. Blood parasites of wild birds of southeastern Kazakhstan. *Translations of the Institute of Zoologii Akademii Nauk Kazakhstan SSR* 33: 69–78. [In Russian.]

Received for publication 21 May 2003.