

Scientists analyze dispersal of parasites by birds in the Americas

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Monitoring and understanding the dispersal of potentially pathological microorganisms are constant concerns for sanitary and epidemiological authorities worldwide. The risks involved are evident, given the possibility of outbreaks of emerging diseases in humans or in domestic animals and livestock.

Cross-border transfer of pathological agents can occur not only through human mobility but also through the movement of wild animals. Among the leading suspects to be monitored are [migratory birds](#), which transport parasites over long distances, but little is known about how parasites are transferred by flocks of birds in wintering or breeding sites.

A pioneering study was based on an analysis of malaria parasites in [blood samples](#) taken from more than 24,000 migratory and resident birds in 23 countries throughout the Americas.

"It's the largest study ever performed on the parasitology of migratory birds in the Americas," said biologist Maria Svensson-Coelho, researcher at the Federal University of São Paulo's Environmental, Chemical & Pharmaceutical Science Institute (ICAQF-UNIFESP) in Brazil, where she was responsible for processing some of the samples.

"Hundreds of species of birds leave their tropical or subtropical wintering ranges every year to spend the summer in high-latitude breeding ranges, returning to low latitudes at the end of the mating season," Svensson-Coelho said. "These species are exposed to different

parasites in their boreal or temperate breeding areas and subtropical or tropical wintering areas. They may disperse parasites between these areas."

Knowing how populations of pathogens are distributed over vast geographical areas is essential to understanding the epidemiology of these parasites, the local patterns of virulence, and the evolution of host resistance.

A survey published in 2007 examined the host and geographical distributions of 259 lineages of parasites in birds of Europe and Africa, finding that 31 lineages that infect migratory birds could be transmitted to birds living in both areas. "The aim of our research is to conduct the same type of survey for New World birds," Svensson-Coelho said.

In Brazil, blood samples from migratory and resident birds were collected in the Cerrado at the Águas Emendadas Ecological Station in the Federal District near Brasília and in Cantão and Lajeado State Parks in Tocantins State. Alan Fecchio, a researcher at the Federal University of Bahia, was responsible for collecting blood samples in the Cerrado.

Also in South America, the study analyzed material from the Amazon region of Ecuador and the semi-arid region of Venezuela. In Central America, the areas covered were in Panama and Mexico's Yucatán Peninsula.

Blood samples were also collected from birds in nine states in the eastern United States (Alabama, Connecticut, Illinois, Indiana, Louisiana, Michigan, Missouri, Pennsylvania and Tennessee) and all major Caribbean islands except Cuba (Antigua & Barbuda, Bahamas, Barbados, Cayman Islands, Dominican Republic, Grenada, Guadeloupe, Jamaica, Martinique, Montserrat, Puerto Rico, St Kitts & Nevis, St Lucia, St Vincent, Trinidad & Tobago, and Virgin Islands). The study

did not include birds that migrate along the Pacific Coast west of the Andes.

The species from which blood samples were taken included the house, fox and song sparrows (*Passer domesticus*, *Passerella iliaca* and *Melospiza melodia*); the cocoa, wood, clay-colored, forest, bare-eyed and red-legged thrushes (*Turdus fumigatus*, *Hylocichla mustelina*, *T. grayi*, *T. lherminieri*, *T. nudigenis* and *T. plumbeus*); the American robin (*T. migratorius*); the Baltimore oriole (*Icterus galbula*); the reddish-winged bare-eye (*Phlegopsis erythroptera*); the rufous-tailed antwren (*Epinecrophylla erythrura*); the common yellowthroat (*Geothlypis trichas*); the bananaquit (*Coereba flaveola*); the black-throated blue warbler (*Setophaga caerulescens*); the dark-eyed junco (*Junco hyemalis*); the red-eyed vireo (*Vireo olivaceus*); the northern mockingbird (*Mimus polyglottos*); and the worm-eating and black-and-white warblers (*Helmitheros vermivorus* and *Mniotilta varia*).

Malaria parasites in the blood samples were detected by polymerase chain reaction (PCR) assays and identified by DNA sequencing. The researchers analyzed 24,000 samples and found approximately 4,700 with infections, representing 79 malaria parasites belonging to avian malaria lineages of the genera *Plasmodium* (42 lineages in 1,982 host individuals) and *Haemoproteus* (37 lineages in 2,022 host individuals). The latter is the most common blood parasite in birds.

"Prevalence is normally low," Svensson-Coelho said. "In the area of Ecuador we surveyed, it was 21.6%, or 539 infected birds in a total of 2,488, and in an area of the United States with many samples, it was 37%, or 271 out of 726."

Blood has to be collected from a great many birds in order to obtain a sufficiently large parasite sample size, she explained, since generally speaking, parasites infect only a small fraction of the total bird

population.

"Prevalence may vary not just between localities but also between species in the same place," she said. "In Ecuador, for example, only 5.6% or six of the 107 individuals we collected of *Pipra filicauda* (Pipridae) turned out to have malaria, whereas 91.2% or 31 out of 34 specimens of *Formicarius colma* (Formicariidae) were infected. This information is in the article published in 2013 in *Ornithological Monographs*."

The parasites that cause avian malaria (*Plasmodium* spp.) are responsible for its transmission to every continent except Antarctica. Some 60 species have been described, out of a total of more than 500.

The avian migration system in the Americas involves shorter distances than between Europe and Africa, especially to the Caribbean islands and Central America. In addition, migratory birds are more likely to encounter related resident species in breeding and wintering areas in the Americas than in Europe and Africa.

"The family and even gender affinities between American migratory and resident birds probably increase the likelihood of parasite transmission between migratory and resident hosts," Svensson-Coelho said.

Emerging diseases

One of the most striking differences between the 2007 survey and this one is that only two parasite lineages out of 250 in three genera were found in host birds from both Europe and Africa, compared with 13 of the 79 lineages of *Plasmodium* and *Haemoproteus* detected in American [resident birds](#).

"The role of migratory birds in dispersing these parasite lineages

between temperate and tropical regions appears to be maximized in the Americas, possibly owing to the relatively short distances traveled by several species that winter in Central America and the Caribbean, or because of the taxonomic affinity of most American birds from temperate and tropical regions," Svensson-Coelho said.

Avian malaria parasites are not transmissible to humans, but migratory birds transport many other microorganisms, some of which are responsible for emerging diseases. West Nile virus, which originated in Africa, is one example of a pathogen that infects humans and that has been introduced to North America by migratory birds.

Another example is influenza: the virus is endemic and inoffensive in migratory waterfowl such as ducks, geese and swans, but these [birds](#) are responsible for spreading new lineages around the planet.

More information: Robert E. Ricklefs et al. Avian migration and the distribution of malaria parasites in New World passerine birds, *Journal of Biogeography* (2016). [DOI: 10.1111/jbi.12928](https://doi.org/10.1111/jbi.12928)

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