

Improving water quality could help conserve insectivorous birds

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A new study shows that a widespread decline in abundance of emergent insects—whose immature stages develop in lakes and streams while the adults live on land—can help to explain the alarming decline in abundance and diversity of aerial insectivorous birds (i.e. preying on flying insects) across the USA. In turn, the decline in emergent insects appears to be driven by human disturbance and pollution of water bodies, especially in streams. This study, published in *Frontiers in Ecology and Evolution*, is one of the first to find evidence for a causal link between the decline of insectivorous birds, the decline of emergent aquatic insects, and poor water quality.

Human activities, such as urbanization and agriculture, have adverse effects on aquatic ecosystems. In the US, 46% of streams are in poor condition, while 57% of lakes suffer from strong human disturbance. The immature stages of aquatic insects, especially stoneflies, mayflies and caddisflies, are known to be highly sensitive to pollution, which is why they have often been used as biomonitors for water quality. But the authors of the present study predicted a priori that emergent insects—whose adult flying stages are important sources of food for birds, spiders, bats and reptiles—should likewise be powerful biomonitors for the health of terrestrial ecosystems. This prediction is borne out by the new results.

"The massive decline in bird fauna across the USA requires that we adopt new paradigms for conservation. Currently, most management and conservation agencies and plans are separated into aquatic and terrestrial

divisions. However, aquatic and terrestrial ecosystems are inextricably linked through a suite of ecological connections," says author Dr. Maeika Sullivan, associate professor in the School of Environment and Natural Resources and Director of the Schiermeier Olentangy River Wetland Research Park at Ohio State University.

Sullivan and colleagues analyzed data from multiple open-access surveys monitoring water quality, aquatic invertebrates and 21 species of aerial insectivorous birds from the contiguous United States. "The task of putting together these big data sets, collected by different US agencies with different goals and objectives, revealed several new questions and challenges which will require interdisciplinary thinking to resolve," says corresponding author Dr. David Manning, assistant professor in the Department of Biology, University of Nebraska at Omaha.

First, the authors show that water quality is a good predictor for local relative abundance of emergent insects. Then they show for the first time that water quality and the associated abundance of emergent insects explains a moderate but significant proportion of the variation in local abundance of aerial insectivorous birds in the US, including both upland and riparian (i.e. foraging on river banks) species.

Not all bird species were equally negatively impacted by declines in the abundance of emergent insects, suggesting that factors such the birds' microhabitat and foraging strategy may also play a role. The western wood pewee (*Contopus sordidulus*, an upland bird species), the olive-sided flycatcher (*C. cooperi*, which facultatively lives in riparian zones), and the Acadian flycatcher (*Empidonax virescens*, which almost exclusively occurs near water) depended most strongly on the local abundance of overall emergent insects. The eastern phoebe (*Sayornis phoebe*), violet-green swallow (*Tachycineta thalassina*), tree swallow (*Tachycineta bicolor*), eastern wood-pewee (*C. virens*), barn swallow (*Hirundo rustica*), and chimney swift (*Chaetura pelagica*), were

specifically sensitive to the relative abundance of stoneflies, mayflies and caddisflies.

The authors emphasize the need for interdisciplinary research to develop new conservation and biomonitoring strategies focused on the effects of [water](#) quality on endangered [birds](#) and other terrestrial wildlife.

"We need a better understanding of the common mechanisms that could drive declines in both aquatic insects and many bird species. We would like to explore some of these shared mechanisms in future research, but at a much larger scale than previously. Tackling these questions will require collaboration among freshwater ecologists, ornithologists, landscape ecologists, entomologists, data scientists, and others," says Manning.

More information: David W. P. Manning et al, Conservation Across Aquatic-Terrestrial Boundaries: Linking Continental-Scale Water Quality to Emergent Aquatic Insects and Declining Aerial Insectivorous Birds, *Frontiers in Ecology and Evolution* (2021). [DOI: 10.3389/fevo.2021.633160](#)

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