

Study finds health trade-offs for wildlife as urbanization expands

November 18 2020, by Emily Caldwell



A tree swallow perches atop a constructed nest box at Battelle Darby Creek Metro Park in central Ohio. Credit: Joseph Corra

City living appears to improve reproductive success for migratory tree

swallows compared to breeding in more environmentally protected areas, a new five-year study suggests. But urban life comes with a big trade-off—health hazards linked to poorer water quality.

Researchers found that city-dwelling birds bred more nestlings because of warmer local temperatures. But they also had much higher levels of mercury in their blood—presumably from eating insects that spent their larval stages in contaminated water—than their counterparts breeding in less urban areas.

The study was conducted in central Ohio, where scientists observed [tree swallows](#) as a model species to assess their breeding success, diet and health measures in the context of varied temperatures, water quality and land use based on the location of their nests.

Despite those specifics, Ohio State University researchers consider the long-term study a harbinger of what's to come for all sorts of wildlife as urbanization increases while the climate continues to warm, and how land-use changes are likely to harm water quality and threaten biodiversity.

Urban land accounts for about 70 million acres in the contiguous United States, representing a 470% increase since 1945.

"With urbanization expanding worldwide, we are transforming the landscape. And this isn't going away," said lead author Mažeika Sullivan, director of the Schiermeier Olentangy River Wetland Research Park at Ohio State. "My lab is looking at how urbanization affects multiple responses of ecosystems—what those changes are and quantifying them, but also seeing what this tells us about how we can manage and conserve ecosystems and wildlife in this context.

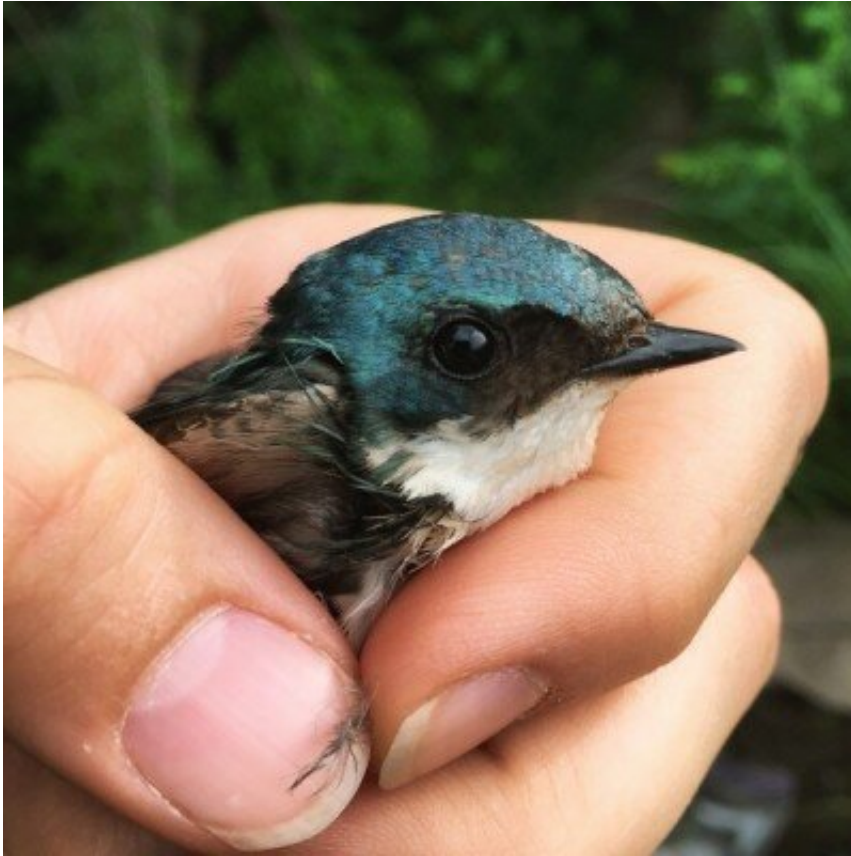
"Our task, knowing wildlife are using urban settings, is to think about

ways to maximize benefits and minimize the risks. There's nature in cities. So how can we make our cities a little more wild?"

Sullivan, also an associate professor in Ohio State's School of Environment and Natural Resources, completed the work with graduate students Joseph Corra and Jeffrey Hayes. The study was published online Nov. 15 in the journal *Ecological Monographs*.

Tree swallows are part of a guild of birds called aerial insectivores, which do all their dining on insects while in flight. Other species of swallows, as well as whip-poor-wills, nighthawks, swifts, martins and flycatchers, are also part of this group, and many of these species rely on ecosystems near water for food and habitat. Previous research has suggested that the number of North American birds has declined by about 3 billion since 1970, and the populations of some species of aerial insectivores have declined by over 50%.

The magnitude of that loss alone is a striking example of biodiversity loss, Sullivan said. But the reduction in this guild of birds can also affect the economy and the quality of human life.



Tree swallow. Credit: Joseph Corra

"These migratory birds are really important not just in and of themselves, but because they're controlling insects—including pest insects that carry disease or damage agricultural crops. So they are very, very important in terms of how ecosystems function and stay in balance," he said.

For research purposes, tree swallows are also useful subjects because they are "cavity nesters" that flocked to the assortment of artificial nest boxes the team constructed along waterways in Columbus, some in developed zones and others in more forested areas.

From 2014-2018, the researchers observed tree swallows during their

breeding season, most of May and June each year, also measuring their body weight and blood glucose and mercury levels and tracking how much of the birds' food source came from insects emerging from water or starting their pre-winged life on land. The scientists also monitored temperature and chemical water quality and quantified percentages of forested or wetland versus developed land at the [breeding sites](#).

Egg-laying occurred significantly earlier (by almost eight days), the clutch sizes were larger, and the number of fledglings that left the nest was higher at the urban sites than at protected sites. This reproductive success was largely attributable to the temperature: The air was warmer in urban sites than in protected sites by an average of 3 degrees Fahrenheit, and city locations had fewer extremely cold days.

"We were looking at urbanization in two different ways—as a category of urban versus not urban, but also as gradients of urbanization. As the amount of urbanization increased, fledgling success increased," Sullivan said. "This tells us local climate is extremely important for [reproductive success](#) of tree swallows, and likely other insectivorous birds."

But that success came with potential health risks related to poorer water quality in urban areas. Insects that emerge from water constituted roughly a third of the tree swallows' diet, and those insects also tend to provide more nutrition and energy than terrestrial flying insects. But the river water in urban areas had higher levels of mercury—likely a proxy for other contaminants—and the adult birds' blood concentration of mercury was 482% higher in city-dwellers than in those who bred in protected sites.

"This is an important warning," Sullivan said. "There's a whole suite of environmental contaminants out there—pesticides, a lot of other heavy metals. So despite the advantage for breeding in these [urban areas](#), there can be a trade-off in individual health."

These findings, and the implications for birds and other wildlife affected by growing urbanization, suggest that productive urban habitats should be factored in to future municipality planning, he said.

Some top considerations for insectivorous birds, as Sullivan sees it, would be establishing protected green ways, creating nesting habitats and structures to replace lost trees and other parts of the natural landscape, lowering the chances for contaminants to stream into waterways, and protecting wildlife food sources by reducing the use of pesticides and insecticides.

"If we had found that urbanization was negatively affecting tree swallows in all the different measures we used, that would be a very different story," Sullivan said. "But I see some rays of hope here."

More information: S. Mažeika P. Sullivan et al. Urbanization mediates the effects of water quality and climate on a model aerial insectivorous bird, *Ecological Monographs* (2020). [DOI: 10.1002/ecm.1442](https://doi.org/10.1002/ecm.1442)

Provided by The Ohio State University

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