Study finds birds raise fewer young when spring arrives earlier in a warming world

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Rising global temperatures are making it harder for birds to know when it's spring and time to breed according to a new study published in *Proceedings of the National Academy of Sciences.*

A large collaboration led by scientists at UCLA and Michigan State University has found that birds produce fewer young if they start breeding too early or late in the season. With climate change resulting in earlier spring-like weather, the researchers report, birds have been unable to keep pace.

And, the authors write, the mismatch between the start of spring and birds' readiness to reproduce is likely to become worse as the world warms, which could have large-scale consequences that would be catastrophic for many bird populations. Birds' breeding seasons begin whenever the first green plants and flowers appear, which is happening earlier and earlier as the climate warms.

"By the end of the 21st century, spring is likely to arrive about 25 days earlier, with birds breeding only about 6.75 days earlier," said the study's first author, Casey Youngflesh, who led the research as a postdoctoral researcher at UCLA and is now a postdoctoral fellow at Michigan State. "Our results suggest that breeding productivity may decrease about 12% for the average songbird species."

The authors stress that conservation strategies should address bird species' responses to climate-driven shifts.

Determining if the earlier springs will pose problems for migratory birds has been a major goal of biologists for decades.

"For nearly 30 years, scientists have hypothesized that animals could become mismatched from plants as springs begin earlier," said Morgan Tingley, a UCLA associate professor of ecology and evolutionary biology and the study's senior author. "While there have been a few very good case studies of this phenomenon, it has remained a major mystery whether advancing springs will pose a general problem for the majority of species."

When it comes to raising their young, timing matters for birds. If they breed too early or too late, harsh weather could harm their eggs or newborns. But timing relative to food sources matters too: If birds are looking for food before or after its natural availability, they might not have the resources to keep their young alive.

"Critically, we found evidence for impacts on bird reproduction of both the absolute and the relative timing of birds," Tingley said.

Using data from a large-scale collaborative bird banding program run by the Institute for Bird Populations, the researchers calculated the timing of breeding and the number of young produced for 41 migratory and resident bird species at 179 sites near forested areas throughout North America between 2001 and 2018.

Then, the authors used satellite imaging to determine when vegetation emerged around each site. They found that each species had an optimal time to breed, and that the number of young produced decreased when spring arrived very early, or when breeding occurred early or late relative to when plants emerged.

While the majority of birds were adversely affected by variations in the start of spring, several species—the northern cardinal, Bewick's wren and wrentit among them—countered the trend, demonstrating improved breeding productivity when spring began earlier. Those species are mostly non-migratory species that can respond more quickly to the emergence of spring plants that signal the start of the breeding season.

By breeding earlier and without the time constraints imposed by migration, the study noted, non-migratory species may also be able to reproduce more than once per season.

But those species were the exceptions to the rule. Even most non-

migratory species couldn't keep up with earlier spring arrivals. Overall, for every four days earlier that leaves appeared on trees, species bred only about one day earlier.

For migratory species, that discrepancy means that the time between when they arrive at their breeding sites and breeding itself is likely to get shorter as springlike conditions begin earlier. Birds need time to establish territories and prepare physiologically for egg-laying and rearing their young, so that change could cause even greater disturbances to reproduction.

"North America has lost nearly a third of its bird populations since the 1970s," Tingley said. "While our study demonstrates that the worst impacts of timing mismatch likely won't occur for several decades yet, we need to focus now on concrete strategies to boost bird populations before climate change takes its toll."

The study was supported by researchers from the University of Florida; Pennsylvania State University; University of North Carolina, Chapel Hill; and the Institute for Bird Populations.

More information: Youngflesh, Casey et al, Demographic consequences of phenological asynchrony for North American songbirds, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2221961120. doi.org/10.1073/pnas.2221961120

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