Fly away home? Ice age may have clipped bird migration

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A study led by Nebraska's Robert Zink proposes that many bird species, such as the Canada warbler, may have completely stopped migrating during the last ice age. Credit: University of Nebraska-Lincoln

The onset of the last ice age may have forced some bird species to abandon their northerly migrations for thousands of years, says new research led by a University of Nebraska-Lincoln ornithologist.

Published Sept. 20 in the journal *Science Advances*, the study challenges a long-held presumption that birds merely shortened their migratory flights when glaciers advanced south to cover much of North America and northern Europe about 21,000 years ago.

The study concluded that the emergence of glaciers in those regions instead acted as an "adaptive switch" that turned off migratory behavior, transforming the tropics from a cold-weather resort into a long-term residence for certain bird species.

Of the 29 long-distance migrant species examined in the study, 20 likely saw their northern breeding grounds become uninhabitable, according to models developed by the researchers. When the climate again warmed and glaciers retreated back to the Arctic, those species presumably resumed their seasonal migrations.

Lead author Robert Zink said the conclusions could alter how scientists reconstruct the history of bird migration.

"It fundamentally changes the way we study the evolution of migration and think about the migratory behavior of birds," said Zink, professor of natural resources and biological sciences at Nebraska.

Putting migration on ice

Researchers generally agree that, millions of years ago, many birds did not migrate from the tropics. But as the global climate began to warm, some species ventured beyond their native habitats to capitalize on better breeding and feeding opportunities afforded by the longer days and insect-rich environments of northern latitudes.

Those species eventually ventured farther and farther from their habitats, finally stopping when they reached environments that could not sustain

them during the autumn and winter. They continued to migrate south when seasonal temperatures dropped and food sources waned.

In that context, Zink said his hypothesis suggests that the origin story of bird migration simply underwent multiple reboots, with the "migratory machinery" of birds halting for each of the 20 or so ice ages that have glazed Earth during the past 2.5 million years.

"Migrations are costly and risky," said Zink, curator of zoology at the University of Nebraska State Museum. "They're costly in terms of safety, energy - anything you can think of."

Rather than paying those costs to reach breeding grounds that the encroaching glaciers had shrunk to tiny fractions of their former size, he said, birds instead resorted to their ancestral state: tropical homebodies.

"Some of them were forced so far south that it was no longer a fitness advantage to migrate, because the extra young they could produce south of the glacier wasn't enough to compensate for the cost of migration," Zink said, "and then coming back to the tropics and re-establishing their territory.

The University of Nebraska-Lincoln's Robert Zink has authored a new study suggesting that the last ice age completely halted the northerly migrations of some bird species from about 21,000 to 12,000 years ago. Credit: Craig Chandler, University of Nebraska-Lincoln

"To some people, that's so completely off the wall that they may have trouble wrapping their heads around it - except that it's the way they would explain to their classes the evolution of migration in the first place. So, in a sense, what I'm proposing is nothing novel. What's novel about it is that (the advent of migration) probably occurred many times."

Redrawing the map

Zink and his co-author, the University of Minnesota's Aubrey Gardner, conducted their study using a computer model that linked the modern-day distribution of bird species with climate variables - temperature, precipitation, seasonality - that characterize their habitats. By comparing those climates with conditions that existed during the last ice age, the model mapped the regions that likely could have supported each of those species from about 21,000 to 12,000 years ago.

In many cases, Zink said, the model either found no habitable regions beyond the tropics or located habitats so miniscule that they would have struggled to support sizable populations of the species.

"Some species were probably just forced (slightly) south of the glaciers, and their habitats were extensive enough that they would maybe maintain some migratory ability," he said. "But for others, I think there was so little predicted habitat that they just ceased migration all together.

"This evolution of migration is a very (variable) thing. Normally, when we think of evolution, we think of singular, unique events in evolutionary history. But in this case, the ability to migrate is entrenched in birds. They have the ability to navigate using the sun, the stars, the (Earth's) magnetic field. They have the ability to put on large amounts of fat and sustain trans-gulf migrations. Birds are (adaptive) enough in their behavior and physiology that this wasn't a reinvention of some incredible phenomenon."

And if some species did transition back and forth from sedentary to migratory states, researchers should consider pruning certain evolutionary trees accordingly, Zink said. Many evolutionary trees currently treat migration as an irreversible trait rather than a variable behavior, he said, and that assumption could be misinforming discussions of when and where it evolved.

"I wanted to point out that this was a real danger and fallacy that's being committed: mapping something onto an evolutionary tree where the feature - migration or sedentariness - changes faster than new species evolved," he said. "You would have constructed the history of migration totally differently."

More information: "Glaciation as a migratory switch" *Science Advances* (2017). DOI: 10.1126/sciadv.1603133 , advances.sciencemag.org/content/3/9/e1603133

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