Birds outpace climate change to avoid extinction

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A new study has shed light on the potential of birds to survive in the face of climate change. In the analysis, based on more than fifty years' detailed study of a population of great tits near Oxford, UK, a team of scientists were able to make predictions about how the birds could cope with a changing climate in the future. They found that for small, short-lived birds like the great tit, evolution can work fast enough for genetic adaptation to keep pace with a changing environment. However, even for such fast-evolving species, evolution on its own is not enough.

By studying individual birds over multiple years, the team were able to show that individual birds have a built-in flexibility that enables them to adjust their behaviour rapidly in response to short-term changes in the environment. This flexibility—known as phenotypic plasticity—greatly increases the chances that a population can survive in spite of short-term changes, but that possibility depends on how closely they can track the key aspects of their environment, such as the availability of food. As species become longer-lived, and thus slower to reproduce, evolutionary adaptation is far slower and can't on its own save such species from climate change-induced extinction.

The new study, conducted by scientists from the University of Oxford and published July 9 in the open access journal *PLOS Biology*, uses the birds as a model system for understanding responses to climate change, since they rely on a spring peak in caterpillar numbers to feed their young. The team combined their intensive study of the birds with data on how this key caterpillar food source has changed over time, allowing

them to predict how well the birds can track the change in the environment through its effects on the caterpillar population. The data were measured from the same study site over decades of fieldwork.

The scientists looked at when the birds lay their eggs relative to spring temperatures, and how they have tracked the shifts in peak caterpillar numbers caused by the changes in temperature. They found that the birds are now laying their eggs an average of two weeks earlier than they did 50 years ago, primarily as a result of this phenotypic plasticity. The authors' predictions show that this mechanism could allow the birds to survive warming of 0.5°C per year, easily outpacing the current worst-case scenario of 0.03°C from climate models. In the absence of plasticity, however, there's a 60% chance that they would become extinct.

"The key to this study was long-term field work," said lead author Ben Sheldon. "Individuals were identified and tracked over their whole lives, which enabled direct measurement of natural selection, inheritance and phenotypic plasticity."

Previous work on the effects of climate change has overlooked the way that populations can change to match changing environments. "The main reason for this has been the lack of very detailed data to predict how the populations can respond to such circumstances," said Prof. Sheldon.

"Our results show us under what conditions we can expect species to be able to cope with a changing environment, and under what conditions we should be more pessimistic," he said. "We should be particularly concerned about slow-reproducing species, for which the need to show just the right response to the environment is particularly crucial. A key area for future work is to understand why some species respond by the right amount, and others show the wrong response."

More information: Vedder O, Bouwhuis S, Sheldon BC (2013) Quantitative Assessment of the Importance of Phenotypic Plasticity in Adaptation to Climate Change in Wild Bird Populations. PLoS Biol 11(7): e1001605. doi:10.1371/journal.pbio.1001605