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# How long would it take to recover the number of bird species lost due to humans in New Zealand?

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## Abstract

People sometimes believe that, if left undisturbed, nature will quickly recover to its original state. If ecosystems on islands were left alone, how long would it take to recover the number of species lost due to anthropogenic activities? While the number of extinct or threatened avian species has often been quantified, the macroevolutionary consequences of human impact on island biodiversity have rarely been measured. We estimate the time it takes to regain the bird diversity that has been lost or is under threat due to anthropogenic activity in a classic example, New Zealand. Half of its bird species have gone extinct since humans arrived and a large proportion are threatened, including entire lineages forming highly distinct branches in the avian tree of life. Using paleontological and ancient DNA data, we compiled the first complete phylogenetic dataset of a large insular terrestrial avifauna. We extend the maximum-likelihood method DAISIE developed for island biogeography to allow for the conspicuous fact that many of New Zealand's birds are evolutionarily isolated, and use it to estimate natural rates of speciation, extinction and colonization. Simulating under a range of extinction scenarios, we find that it would take at least 40 million years (Myr) to recover the diversity lost since human colonization of New Zealand and up to 10 Myr to return to today's levels if currently threatened species go extinct. This study puts into macroevolutionary perspective the impact of humans in an isolated fauna and reveals how conservation decisions we take today will have repercussions for million years to come.

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