Vulnerability of Hawaiian forest birds to climate change

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Three Hawaiian native honeycreepers- the I'iwi, 'Amakihi, and 'Apapane. Photos courtesy of authors.

The honeycreepers of Hawai'i are one of the world's best examples of adaptive radiation. This is a process by which a single ancestor species arrives in an isolated area and over time differentiates into a number of species, each taking advantage of a different habitat or food source. If those species are located only in Hawai'i, they are called "endemic" to Hawai'i. More than 50 species of endemic honeycreeper once existed in Hawai'i, but currently less than half those species remain and many are imperiled. These birds are particularly susceptible to avian malaria, and so the introduction of mosquitoes and vector-borne avian malaria are important factors in the their historic decline and extinction. As climate warms during the 21st Century temperatures will favor increased mosquito populations and much higher transmission of malaria to endangered honeycreepers existing in high-elevation forests. We used a model of forest birds, mosquitoes, and avian malaria to evaluate future impacts of avian malaria on these Hawaiian birds as a result of climate change. We predict that without significant intervention many native Hawaiian honeycreepers will suffer major population declines or possible extinction before the end of the century due to this increasing risk from avian malaria. Although temperature is a major driving factor for avian malaria transmission, projected changes in rainfall also play an important role, especially in high-elevation forests.

The most successful strategies to protect honeycreepers from avian malaria will likely include mosquito suppression using large-scale releases of sterile/ incompatible or genetically modified male mosquitos. Because predicted future transmission rates of malaria will be higher than currently observed, several conservation strategies including predator removal and feral pig control may be insufficient to maintain these important bird populations at current levels. The predicted higher rate of future disease transmission means that combined strategies will likely be needed to preserve endemic birds at mid-elevation. Future climate changes are likely to have enormous impacts in high-elevation forests where current low rates of malaria transmission create a refuge for highly-susceptible birds. Mitigating malaria transmission will be a primary avian conservation goal, particularly since strategies that maintain highly-susceptible honeycreepers in high-elevation forests will likely benefit many other endangered Hawaiian birds.

I'iwi drinking nectar from an 'Opelu flower. Image from Forest and Kim Starr/ CC BY 4.0

Quick Summary:

- Hawai'i has several endangered or threatened, endemic species of honeycreeper. These species are of extreme ecological and cultural value, but they are very susceptible to avian malaria.
- Temperature and rainfall shifts due to climate change may allow malaria-carrying, non-native mosquitos to invade disease-freehabitat, further imperiling these honeycreepers.
- The most successful landscape-level strategy for decreasing avian malaria transmission in the future appears to be either reducing mosquito populations by introducing non-reproductive males or by introducing mosquitoes that have been genetically modified so they cannot carry avian malaria.

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