Historical Perspective

Introduced Avian Diseases, Climate Change, and the Future of Hawaiian Honeycreepers

Carter T. Atkinson, MS, PhD, and Dennis A. LaPointe, MS, PhD

Introduction

The Hawaiian archipelago is isolated in the central Pacific and consists of 7 large islands and a chain of low coral atolls and small rocky islets that extend in a long arc from Hawaii Island in the southeast to Kure Atoll in the northwest. The archipelago is the most isolated island system in the world, separated from the nearest continental landmass by more than 2000 miles of ocean.\(^1\) The islands range in elevation from just above sea level for atolls in the Northwestern Hawaiian Islands to peaks that exceed 4000 m on Hawaii Island. The interaction of extreme topographic relief, trade winds, and local climatic patterns creates a wide diversity of habitats, ranging from alpine deserts on the highest peaks to montane rain forests with precipitation exceeding 7600 mm per year.

The endemic passerine avifauna of the Hawaiian Islands, particularly the endemic Hawaiian honeycreepers (subfamily Drepanidinae) is often heralded as an outstanding example of adaptive radiation, equal to Darwin’s finches from the Galapagos Islands in terms of diversity of bill types and number of species that descended from a common founder.\(^2\) From an initial colonization by only a few individuals of a single ancestral cardueline finch, this group radiated throughout the diverse habitats on the islands, specializing on a variety of food resources that included nectar, fruits, and insects. Based on recent studies of subfossils, the diversity of this group may have reached 20 genera with more than 50 species that descended from a common founder.\(^2\) Remarkably, a new genus and species of honeycreeper, the po’ouli (Melamprosops phaeosoma), was described in the 1970s from remote rain forests on Maui.\(^4\)

Today, the endemic Hawaiian avifauna faces one of the highest rates of extinction in the world. Of 41 species and subspecies of honeycreepers known since historic times,\(^5\) 17 are thought to be extinct and 14 are federally listed as endangered.\(^6\) Only 3 species and subspecies, Hawaii `amakihi (Hemignathus virens virens), Maui `amakihi (Hemignathus virens wilsoni), and `apapane (Himatione sanguinea) are robust enough in terms of geographic range and population size to be of minimal concern (Table 1). Reasons for these declines are complex and include a suite of interacting factors, including habitat degradation and loss from human activities and invasive species, introduced predators, introduced avian competitors, and introduced avian diseases and disease vectors.

Although the interactions among these various limiting factors makes it difficult to determine their relative impacts on native forest bird populations, it is clear that the abundance, diversity, and geographic distribution of Hawaii’s native birds changed significantly after the arrival of mosquitoes, avian malaria, and pox. Other indigenous and introduced pathogens and diseases do not appear to have had the population-level impacts of avian malaria and pox. These include Toxoplasma gondii from `alalā (Corvus hawaiiensis), nēnē (Branta sandvicensis), and wild game birds;\(^7\)–\(^10\) erysipelas (Erysipelothrix rhusiopathiae) from `alalā;\(^11\) echinuriasis (Echinuria uncinata) from Laysan teal (Anas laysanensis);\(^14\); and sporadic outbreaks of avian botulism (Clostridium botulinum) from water birds on O’ahu and Hawaii islands and most recently from Laysan teal on Midway Island (National Wildlife Health Center, unpublished data, December 2008).

History and Origins of Avian Malaria and Pox in Hawaii

Avian malaria is a disease caused by intracellular, mosquito-transmitted protozoan parasites in the genus Plasmodium. These parasites have a