Hawaiian Birds: Crisis or Opportunity?

(Credits: This article references the U.S. Fish and Wildlife Service’s report “The State of the Birds, United States of America, 2009.”)

On March 19th, the U.S. Fish and Wildlife Service released the first comprehensive analysis of the state of our nation’s birds. First it acknowledges that the health of bird populations is a reflection of the health of our environment. It shows that along with the sobering declines of many bird species across the nation, there is also the heartening recognition that birds can respond positively to conservation actions, and do so quickly.

There are more than 800 species of native birds across the United States, diversified into terrestrial, coastal, and ocean habitats, including Hawaii. Of these 67 are listed federally as endangered or threatened and 184 more are species of conservation concern.

The report indicates that “more bird species are vulnerable to extinction in Hawaii than anywhere else in the United States” and defines Hawaiian bird status as a crisis situation. The Hawaiian Islands once supported 113 bird species unique in the world, but now 71 have become extinct and 31 more are federally listed. Ten of these listed species have gone unseen for 40 years.

The report goes on to state that “Most of Hawaii’s conservation crises result from the introduction of nonnative plants and animals, but climate change is a growing concern. The leading threats to Hawaiian birds include habitat (cont.)
Fish Community Structure in Hawaii’s Coastal Wetlands

Richard A. MacKenzie and Greg Bruland

Over the past two years, wetland scientists from the USDA Forest Service, University of Hawaii at Manoa, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and Ducks Unlimited have been collaborating on an EPA-funded project to assess the status of Hawaii’s wetlands. Initially 40 sites were sampled across Kauai, Maui, Oahu, Molokai, and Hawaii in 2007, collecting information on water quality, plant community structure, sediment characteristics, and fish community structure. Since then, water quality and fish community structure are monitored quarterly on a subset of twenty sites.

Results reveal that 50-90% of the fish community is invasive species. Most of these invasive species were from the live-bearing Poeciliidae family and included mosquito fish (Gambusia affinis), Mexican mollies (Poecilia hybrid sp. complex), guppies (Poecilia reticulata), and swordtails (Xiphophorus helleri); poeciliid densities at some sites were more than 100/m2. Mosquito fish, guppies, and swordtails were first introduced to the Hawaiian Islands in the early 1900’s for mosquito control (despite the fact the swordtails are herbivores), while Mexican mollies are believed to be an unintentional aquarium release. Based upon our research, these species are now well established in coastal wetlands throughout the state of Hawaii, especially on Oahu and Maui.

Poeciliids were introduced to feed on mosquito larvae. This method of mosquito control has been under debate for several years. For example, some studies have shown that poeciliids can actually increase the number of mosquito larvae by preying on predators of mosquito larvae such as beetles or dragonfly larvae. Once poeciliids have established themselves in a wetland, they can quickly spread to nearby aquatic ecosystems via overland flow during the frequent flooding events that occur in Hawaiian watersheds. It may even be possible for poeciliids to migrate from one coastal wetland to another. This is evident from the fact that mosquitofish and Mexican mollies were sampled from wetlands with salinities greater than 60 ‰, nearly twice that of the ocean salinity!

The specialized reproduction of poeciliids makes it possible for a single, fertilized female to successfully colonize a wetland. Female poeciliids can store sperm and fertilize

Above, a male Mexican molly. Below, a male mosquito fish.
several broods throughout the year. Furthermore, poeciliids are live-bearers; fertilized eggs develop within the female and are born as fry. This increases the survival rate of young poeciliids by eliminating the possibility that eggs will be preyed upon. Thus, the colonization of a wetland by a single gravid female can result in a well-established population over a short period of time.

Should we be concerned about the prevalence of poeciliids in our wetlands? Definitely! Despite their small size, these fish can reach densities 10-30 times higher than some native fish such as gobies and flagtails. This suggests that they are worthy adversaries that compete with native fish (and birds) for valuable food sources, such as insect larvae or algae. Poeciliids have also been shown to be the source of exotic parasites that now negatively affect the health of native fish and possibly even native birds. Finally, we have evidence that poeciliids are increasing the nutrient concentrations in wetlands. This is of concern because these nutrients can stimulate algal or microbial growth that can adversely affect wetland health. Because many species of poeciliids are polyphagous, they eat anything including algae and plant material. As a result, these fish break down nutrients that are tied up in plant material (e.g., particulate organic nitrogen). It releases back to the environment in a readily available, dissolved form (e.g., ammonium) that can be utilized by microorganisms and may lead to nuisance algal blooms (or may facilitate the invasion of other exotic algae) such as in anchialine pools on the Kona coast.

Future wetland creation or restoration projects should not include the introduction of invasive poeciliids (or other invasive fish) as they can significantly impact the water quality and ecological value of systems that are beneficial to many native birds and fish. Preventing introductions of fish is the best management technique, as removal of poeciliids can be difficult, costly, and time-consuming. More research is needed to further understand the impacts of these invasive fish (e.g., do they play a role in the transmission of botulism?) Then we can prioritize which species need removal and determine the most effective method to use (e.g., rotenone, clove oil, biological controls).

Richard MacKenzie works with the USDA Forest Service Institute of Pacific Islands Forestry. Greg Bruland is a researcher at the University of Hawaii at Manoa, Natural Resources and Environmental Management Department.

References and Additional Reading:


