



Mosquitoes in Hawai'i

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Hawaii Conservation Alliance

Position Statement

Mosquitoes spread disease to humans, domestic animals, and wildlife throughout the Hawaiian Islands. The transmission of introduced avian diseases by mosquitoes in natural resource areas is the primary limiting factor for many endemic bird species and the major obstacle to their survival. The preservation and restoration of Hawai'i's native avifauna requires controlling mosquitoes in natural resource areas and preventing future introductions of vectors and diseases into Hawai'i. Biosecurity measures associated with interdiction, emergency response and quarantine at Hawai'i's ports should be strengthened. A mosquito control program for natural resource areas should be developed and implemented. These actions will be mutually beneficial to human health and wildlife conservation.

Vulnerability to mosquito-borne diseases

Before humans arrived there were no black flies, mosquitoes and biting midges in Hawai'i. The isolation of the Hawaiian Islands allowed its native birds to evolve in the complete absence of these insect vectors, and the pathogens they transmit. Consequently, Hawaiian birds do not have well developed immunological resistance to these diseases. Rapid declines in lowland populations of native birds and observations of disease symptoms in those populations were first observed in the 1800s and continue unabated into the present. These mosquito-borne diseases have extirpated bird populations and caused the extinction of bird species throughout the archipelago, especially among the endemic Hawaiian honeycreepers. Disease-free, high elevation refugia (above 1,600 m) exist on the islands of Maui and Hawai'i, but large tracts of otherwise suitable low elevation forest habitat remains largely devoid of native birds due to the presence of mosquitoes and the diseases they transmit (Scott 1986). West Nile virus is the most potentially devastating disease to threaten Hawaiian birds in the last 100 years. Over a 6-year period this mosquito-transmitted disease has spread to all 49 mainland states. The risk of West Nile virus getting into Hawai'i is very high. Hawaiian birds play an important role in maintaining native Hawaiian plant populations through pollination and seed dispersal. The decline of these birds has already had significant effects on Hawaiian biodiversity. Further losses of native Hawaiian birds to mosquito-borne diseases will severely alter native Hawaiian biodiversity and Hawaiian ecosystems.

Human health risks associated with mosquitoes in Hawai'i

Emergent mosquito-borne diseases, such as dengue fever and West Nile virus (WNV), are recognized as an imminent health risk for the people of Hawai'i. Each year the State Department of Health substantially invests in disease surveillance and mosquito control in urban and agricultural areas. However, mosquitoes are now widespread in Hawaiian ecosystems and there is no current strategy or program for their control in remote natural areas. Periodic outbreaks of dengue fever have plagued Hawai'i since the arrival of the Yellow Fever Mosquito and the Asian Tiger Mosquito in the late 1800s. In 1943, an epidemic resulted in 1,672 confirmed cases of dengue fever before being suppressed two years later, largely through the efforts of the military. Dengue fever resurfaced in Hawai'i in 2001, reminding public health officials that Hawaiian mosquitoes are efficient vectors of human disease. West Nile virus has not yet entered Hawai'i, but its mosquito vectors are well established throughout the islands. This disease has resulted in human illness and death on the mainland, and intense WNV activity in California and other western U.S. areas increases Hawai'i's risk of acquiring this mosquito-transmitted disease. Any new introductions of vector mosquitoes or their diseases constitute a significant long-term human health risk in Hawai'i.

Mosquito Species now in Hawai'i

Of the several hundred species of mosquitoes, none are native to the Hawaiian Islands. Six biting mosquito species have become naturalized since the 1820s. All are nuisance pests and four are known or implicated vectors of human and animal diseases. The most ubiquitous mosquito in the Hawaiian Islands is the Southern House Mosquito, *Culex quinquefasciatus*. It had become established in Hawai'i by 1826 and is the vector for avian malaria and avian pox. It occurs on all islands, in residential, agricultural, and natural resource areas from the coast up to 1,800 meters elevation. In wet forests, larvae are often found in the rain-filled tree fern cavities created by the feeding habits of feral pigs. They may also be found in natural and artificial containers as well as ditches, ponds and stream edges. The Yellow Fever Mosquito, *Aedes aegypti*, became established in Hawai'i in 1982, and it is a vector for dengue fever. Its larvae use artificial containers exclusively. It currently occurs in remnant populations on the islands of Moloka'i and Hawai'i. The Asian Tiger Mosquito, *A. albopictus*, is most abundant in the lowland areas. It became established in Hawai'i in 1896 and it is a vector for dengue fever. Its larvae are found in tree holes, rock holes and other natural and artificial containers. The Inland Floodwater Mosquito, *A. vexans nocturnes*, became established in Hawai'i in 1962, and it is found on all the main islands except Maui. It is not known to transmit diseases. Its larvae are found in periodically flooded ground pools like roadside ditches and lawn swales. The Bromeliad Mosquito, *Wyeomyia mitchellii*, became established in Hawai'i in 1981, and it occurs on the islands of Kaua'i, O'ahu and Hawai'i. It has a restrictive larval habitat, the leaf axils of bromeliads and cut bamboo. Its role in disease transmission in Hawai'i is also unknown. *Aedes japonicus japonicus* became established in Hawai'i in 2004 on the island of Hawai'i. It is a known vector for dengue fever. Many of these mosquito species are potential vectors for WNV in Hawai'i.

New Mosquito Introductions

Pacific islands with few or no native mosquitoes and a high volume of commercial or military air traffic are particularly vulnerable to mosquito invasions (Lounibos 2002). Mosquito species became established in Hawai'i in 1826, 1892, 1896, 1962, 1981 and 2004. More than forty different species of mosquitoes have been intercepted by State quarantine officers (Nishida 2002). In Guam, fifteen mosquito species became established between 1940 and 1980. During these years, the practice of disinsection (insect fumigation) on arriving aircraft may have protected Hawai'i from many more mosquito introductions. Disinsection has been discontinued in the United States leaving Hawai'i little defense against potential introductions. Recently the State Department of Health detected two new mosquito species: in 2003 *Anopheles punctipennis*, a human malaria vector, was detected in Honolulu but did not establish permanent breeding populations; in 2004 *Aedes japonicus japonicus*, was found to be established and widespread on windward Hawai'i island. The interception of these mosquitoes serves as a reminder of the continuing potential for arrival of new and unwanted disease vectors.

Mosquito Control Strategies

The major pathway for the arrival of mosquitoes in Hawai'i is through commercial transport. Earlier preventative disinsection measures at ports of entry are not currently permitted in the U.S. Municipal mosquito control today relies on reducing artificial water impoundments and using selective larvicides in source areas. Aerial applications of larvicides over broad natural landscapes would, however, be prohibitively expensive. While these compounds are initially effective, their continued use may have unacceptable effects on non-target native species, and mosquitoes may develop resistance to the larvicides. Larval mosquito habitat in wet forest can be greatly reduced through the removal of feral pigs and the artificial impoundments they create (wallows and tree fern cavities). Mosquito-feeding fish, such as, *Gambusia affinis* (Mosquitofish) and *Poecilia reticulata* (Guppy) were deliberately introduced for mosquito control in 1905 and 1922 respectively. Although controlling mosquito larvae populations to some extent, they are largely responsible for the extermination of 'opae (native shrimp) and are carriers of parasitic nematodes and tapeworms affecting native fish.

Recommendations

The financial, logistical and regulatory obstacles to implementing an effective mosquito control and interdiction program are substantial. The potential cost to human health and natural resources if mosquitoes are not controlled are, however, much greater. Long-term costs of mosquito-transmitted disease inflate health care expenses, divert finite resources and reduce tourism business. The loss of native bird pollinators and seed dispersers will greatly diminish native biodiversity and disrupt native ecosystem functions. The HCA recommends that the following actions be undertaken as soon as possible:

- State and Federal governments, and the private sector transportation industry should take all practical steps to minimize the risk of mosquito introductions into Hawai'i. A well funded and assertive biosecurity program, aimed at detection at ports of entry and eradication of mosquito outbreaks, offers the most cost-effective means of preventing long-term negative consequences to the environment and human health. This program should include quarantine inspections, cargo hold and aircraft disinsection, and the creation of sanitary corridors around port facilities.
- New integrated strategies for mosquito control in natural resource areas should be developed, tested, and implemented. These should include evaluating and implementing the benefits and risks of using biopesticides, biocontrol agents, and transgenic control methods.

Supporting documents and further reading

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