



A Unique Region

The Hawaiian Islands, formed over millions of years by volcanic activity in the Pacific Ocean, are comprised of eight major islands and 800 miles of small islands, atolls, and coral reefs that form the Hawaiian Islands National Wildlife Refuge. The most isolated island chain on Earth, the archipelago is one of the world's hotspots of endangered biodiversity. Due to sharp gradations of rainfall based on elevation and windward orientation, the islands contain a tremendous diversity of habitats, from reefs, coasts and marshes to lush mountain forests to drier habitats on the lower islands. The few species that reached the islands, mainly birds and plants, evolved into an array of species found nowhere else. Human colonization destroyed habitats and brought pigs, dogs, rats, invasive plants and diseases that have driven dozens of its endemic bird species to extinction. Many more of Hawaii's native species are endangered, and climate change will add new pressures to the islands' already impaired wildlife.



<http://www.noaa.gov/news/stories/2006/s2644.htm>

Natural Resources at Risk

Forest birds

Introduced diseases, particularly avian malaria, have had a devastating impact on Hawaii's native forest birds. The life cycle of the malaria is strongly dependent on temperature, so the disease struck hardest at lowest,

warmest elevations. Many lowland birds disappeared from forest habitats by the early 1900s. Today, endemic species are only found at higher elevations where conditions are too cool for the disease. Unfortunately, climate change is pushing the "malaria line" uphill, and contracting the safe zone for Hawaii's remaining forest birds.



'Iiwi. Photo: Jack Jeffrey.

<http://www.fws.gov/hakalaforest/wildlife.html>

Coasts and Atolls

The islands comprising the Hawaiian Islands National Wildlife Refuge stretch northwest from the main islands and are nesting grounds for threatened Hawaiian green sea turtles, breeding grounds for endangered Hawaiian monk seals, and home to 14 million seabirds. These low-lying islands are vulnerable to sea level rise: for instance, a 3 foot sea level rise would inundate 40% of French Frigate Shoals and expose another 20% to erosion from extreme high tide events. Furthermore, sex determination in sea turtles is based on temperature during incubation, so high temperatures on beaches where green turtles nest could result in a loss of male turtles.

Climate Change and Florida's Wildlife

Marine

The waters surrounding Hawaii contain coral reefs that are home to thousands of species and provide estimated economic benefits of \$360 million per year. Rising sea temperatures threaten these amazing ecosystems: coral bleaching and disease outbreaks occur more frequently with high temperatures, and high intensity storms can also damage reefs. Ocean acidification, resulting from excess carbon dioxide dissolving in sea water, makes it hard for reef corals and other shellfish to form their shells.



Honu. Photo: Sandra Hall/USFWS
<http://www.fws.gov/pacificislands/fauna/honu.html>

Expected Climate Changes

Rising temperatures

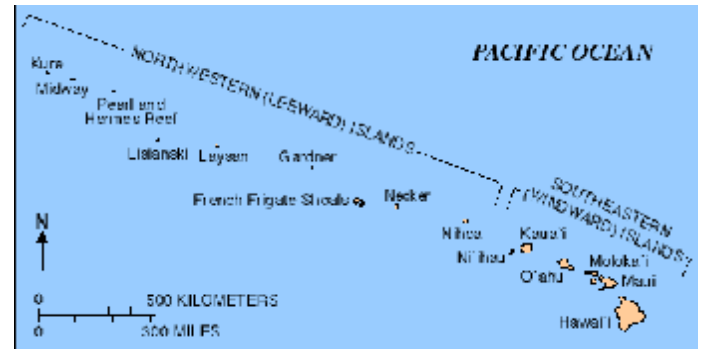
According to the U.S. Global Change Research Program's 2009* report, "Global Climate Change Impacts in the United States," temperatures in the Pacific Islands have already risen by about 0.5° F in the past 100 years, and are projected to rise another 2.5° F under the lowest emission scenario and by up to 5.5° F under the highest emission scenarios. Ocean temperatures are projected to rise as well.

Precipitation Shifts

There is a great deal of uncertainty as to how climate change will impact precipitation patterns in the Pacific Islands in the coming century. Projections vary, but generally point to less precipitation in winter and more in summer, with a larger proportion of precipitation coming as large events, like hurricanes.

Sea Level Rise

Sea level rise is projected to rise by 3 to 4 feet by the end of the century. This gradual level of sea level rise may be occasionally exacerbated by extreme high-tide events, which occur periodically in Hawaii due to combinations of seasonal high tides and ocean circulation patterns. The average interval between extreme high-tide events has shortened from about 20 years to about 5 years.



<http://hvo.wr.usgs.gov/volcanoes/>

References

Baker, J.D., C.L. Littnan, and D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. *Endangered Species Research* 4:1-10.

Delach, A. 2009. A Plague Upon Them: Helping Wildlife Adapt to Climate Changes and Disease. *Defenders of Wildlife Report*.

Global Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo and Thomas C. Peterson (eds.) Cambridge University Press, 2009. Available at www.globalchange.gov/usimpacts