

Disease Activity 2

Insect Activity 3

Additional Information 4

Forest Health

2019 highlights

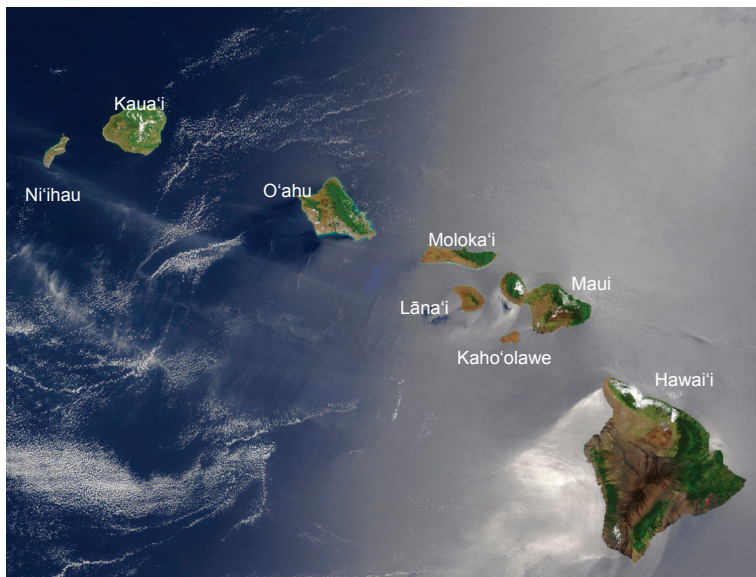
VISIT US ON THE WEB: WWW.FS.USDA.GOV/MAIN/R5/FOREST-GRASSLANDHEALTH

2019 Summary

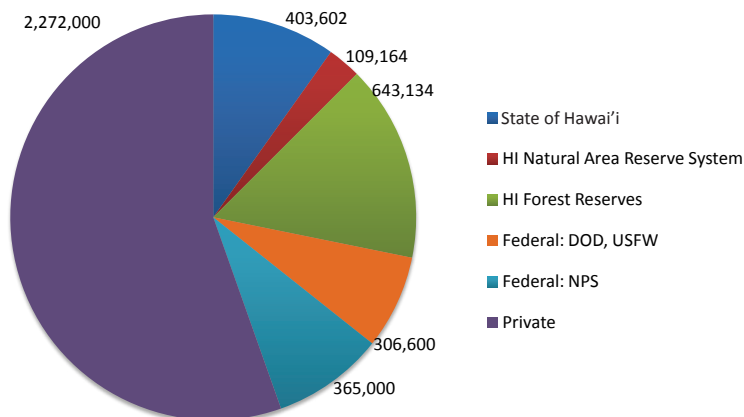
- **Rapid Ōhi'a Death (ROD)** continued spreading on Hawai'i Island and is now established on Kaua'i in low elevation mixed non-native forests. Crews responded to detections on O'ahu and Maui by felling and destroying or tarping infected trees.
- **Myoporum thrips** continues to spread on the island of O'ahu, but Kaua'i and Maui remain free of thrips based on surveys.
- **Coconut rhinoceros beetle (CRB)** eradication efforts continue on O'ahu, with island-wide trapping, survey, and treatment of all known infested sites.
- The Hawaii Agriculture Research Center, in collaboration with Hawai'i Division of Forestry and Wildlife, conducted **disease resistance screening of koa (*Acacia koa*)** and continued monitoring outplantings of screened material.

Forest Resources

This report is for the State of Hawai'i which includes eight main islands (Kaua'i, O'ahu, Moloka'i, Lāna'i, Kaho'olawe, Maui, Hawai'i, and Ni'ihau) totaling 4.1 million acres. Public lands occur on all islands except Ni'ihau and Lāna'i, which are privately owned. Approximately 1.4 million acres of the state are considered forested. Non-forested areas include urban and agricultural areas, recent lava flows,



Land Ownership in Hawai'i



and high elevation sites on Mauna Ke'a and Mauna Loa on Hawai'i and Haleakalā on Maui.

The State of Hawai'i Division of Forestry and Wildlife (DOFAW) manages 1,155,900 acres including 643,134 acres in forest reserves and 109,164 acres in the state's Natural Area Reserve System (NARS), which was created to preserve unique native Hawaiian ecosystems. Hawai'i's state forest acreage ranks as the 11th largest in the nation. Federal lands account for 671,600 acres and are managed by the Department of Defense, National Park Service, and US Fish and Wildlife Service. The National Park Service is the largest federal landowner, managing 365,000 acres. Although there are no National Forests in Hawai'i, the 51,000-acre Hawai'i Experimental Tropical Forest (HETF) on the island of Hawai'i is managed in partnership between the USDA Forest Service and DOFAW.

The remaining land – 2,272,000 acres – is privately owned. Increasing amounts of private forestlands are being managed in concert with publicly-owned lands under public-private partnerships for watershed conservation in order to sustain Hawai'i's water supply. These watershed partnerships manage upland areas comprising a patchwork of federal, state, and private parcels. Eleven island-based Watershed Partnerships have been established on six islands to protect over 2.2 million acres (including non-forested lava flows and alpine areas). The partnerships actively manage approximately 300,000 acres of priority forest by removing invasive plants and animals.

Forest Health Monitoring in Hawai'i

Forest health monitoring occurs throughout the state on All Lands. The spread and impact of invasive plants, invertebrate pests, diseases, ungulates, and biological control agents are monitored using ground surveys, transect monitoring, helicopter surveys, road surveys, photo points, and remote sensing techniques.

Monitoring forest health in Hawai'i presents many challenges associated with its climate and geology. Hawai'i's extremely rugged terrain limits ground access to many areas and increases the difficulty of monitoring due to vertical slopes and shadow effects. Watersheds can have as much as half of total land area in near-vertical slopes. The exceptionally rugged terrain creates extreme temperature and rainfall gradients that result in diverse ecosystems in close proximity. These transitions occur over a very small scale, so monitoring data collected over large scales is not typically representative of widespread conditions. Identifying species and classifying them as diseased or infested is a complex and difficult task. Additionally, a thick layer of clouds present much of the year often limits or prohibits remote sensing and aerial surveys of mountainous areas where much of Hawai'i's forests are located.

The Hawai'i Division of Forestry and Wildlife is working with partners to utilize new technologies to collect forest health data at varying scales. UAS surveys for small areas, high resolution cameras mounted on helicopters, fixed-wing aircraft coupled with computer learning technology, and lidar combined with spectroscopy are examples of different technologies being used in Hawai'i to collect data on pest damage. In addition, the US Forest Service Forest Inventory and Analysis program has installed plots through Hawai'i's forest and is currently conducting the second measurement.

Rapid 'Ōhi'a Death or Ceratocystis Wilt of 'Ōhi'a

Ceratocystis spp.

'Ōhi'a (*Metrosideros polymorpha*) is the most common tree species in Hawai'i's native forests, growing from sea-level to nearly 8,000 feet in dry, mesic, and wet forests. 'Ōhi'a-dominated forests cover 865,000 acres statewide, with 618,000 acres occurring on Hawai'i Island, and 'ōhi'a trees account for 50% of all forest trees in the state. This abundant tree provides habitat to much of the native flora and fauna and also has significant cultural importance. The name 'ōhi'a means 'to gather' in the Hawaiian language, referring to the tree's ability to collect water from the rain and mist, feeding the aquifers that sustain life on this remote archipelago.

Rapid 'Ōhi'a Death arose as a concern in 2010 in the Puna District of Hawai'i island; researchers and managers have since been researching the cause(s) and potential management approaches. Research has resulted in identification of two distinct but related species of *Ceratocystis* which were described as *C. huliohia* and *C. lukuohia* in 2018. The former is a slow spreading canker disease and the latter is an aggressive wilt disease causing most of the mortality seen on Hawai'i Island (Barnes et al. 2018).

In 2019, Rapid 'Ōhi'a Death (ROD) continued to spread on Hawai'i Island, mostly filling in areas where only scattered mortality occurred. Semi-annual aerial surveys of the state's 'ōhi'a forests using the US Forest Service Digital Mobile Sketch Mapping tablet-based app were used to identify new disease outbreaks. On Kaua'i, both *Ceratocystis* species have been detected in multiple areas. However, the disease is limited to fragmented, invaded forests in lowland areas, and managers are working to prevent spread into the island's core 'ōhi'a forests.

Detections of *C. huliohia* on Maui (1) and O'ahu (4) were quickly responded to by crews guided by recently developed rapid response plans. Those trees were felled and either destroyed or covered with tarps to contain the spread. It has been suggested that *C. huliohia*, the less aggressive fungus, may have been in Hawai'i longer than *C. lukuohia*.

Further information can be found in the recently updated Rapid 'Ōhi'a Death Strategic Response Plan for 2020-24 located at www.rapidohiadeath.org.

Austropuccinia psidii

Localized defoliation of ohia forest attributed to the rust fungus *Austropuccinia psidii* was detected in aerial surveys. The rust which affects many species in the Myrtaceae family can defoliate trees entirely leading to death in some cases. Ohia seedlings are especially susceptible but until 2016, stand-level defoliation of mature ohia had not been observed.

The Division of Forestry and Wildlife continued to work with Hawaii Department of Agriculture and USDA Animal and Plant Health Services to establish regulations on Myrtaceae plant material entering the state to prevent other genotypes of the rust disease from establishing in Hawaii.

Koa Wilt

A major leap forward was made in 2019 as several of the Forward Selection Seedling Seed Orchards of *Fusarium oxysporum*-resistant *Acacia Koa* received their final evaluation and roguing. In 2019, these orchards produced over 50,000 seeds. In the future, they will deliver much greater numbers of seed. In addition to being resistant to *F. oxysporum*, trees grown from these seeds can be expected to grow faster, have better form, and produce wood with high-value character. Interest in growing koa for commercial and restoration purposes has been greatly increasing in Hawai'i.



Figure 1. Forward Selection Seedling Seed orchards of *Acacia koa*, like this one at Kokee, Kauai, were established using seed from koa families which had previously been tested and found to be resistant to the wilt fungus *Fusarium oxysporum*.
Photo credit: Phil Cannon, USFS

Coconut Rhinoceros Beetle

Oryctes rhinoceros

The coconut rhinoceros beetle (CRB) is a pest of coconut trees and other palms and is native to South and Southeast Asia. The adult beetles damage trees by boring into tree crowns where they injure young, growing tissue to feed on sap. The subsequent damage can cause tree death. The beetles breed in moist, decomposing organic matter, especially dead coconut material, leading to a destructive cycle if left unmanaged. Although the beetles can fly up to 2 miles, regularly feeding on coconut palms and returning to the breeding site, spread is primarily through human movement of infested breeding material (e.g., green waste, dead trees, etc.).

The first detection of CRB in Hawai'i occurred on Joint Base Pearl Harbor – Hickam on O'ahu in December 2013 in a USDA trap. The amount and location of the infested mulch made destruction of the breeding population extremely challenging and required developing new tools. Currently infested material is being treated through composting or incineration in air curtain burners.

In cooperation with the U.S. Navy and the University of Hawai'i, the project which is housed by Hawai'i Department of Agriculture (HDOA) is using pheromone detection traps around the island to delineate the infestation and detect new satellite populations. Since 2013, there have been over 9,000 beetles trapped. Crews also survey coconut palms for signs of damage by CRB and mulch piles for breeding sites. No beetles have been detected on other islands in the archipelago, and eradication on O'ahu is still the project goal. The infested area expanded into agricultural areas in central O'ahu in 2019. While site-specific eradication has occurred at the original infestation, several infested areas remain. HDOA is utilizing USDA-trained canine teams to detect breeding locations.

Myoporum Thrips

Myoporum thrips (*Klambbothrips myopori*) was detected on the island of O'ahu in November 2018. This pest has been killing native naio (*Myoporum sandwicense*) since 2009 on Hawai'i island, where naio grows in a wide range of ecosystems – from coastal strand to alpine forests on Mauna Ke'a. On O'ahu, natural populations of naio are concentrated in a few coastal locations and include a rare form of the plant, *Myoporum stellatum*, which is only found in southwestern O'ahu.

Both natural populations and landscape plantings were quickly surveyed on O'ahu to determine how widely the insect had spread. Thrips are weak fliers and spread mainly by wind, although they can be great hitchhikers as well. So far, the pest has not been detected infesting natural populations, and the goal of DOFAW and its partners is to treat or remove all known infected plants before the thrips expand to natural areas.

DOFAW and its partners mobilized in response, utilizing the rapid response plan last updated in 2015: http://dlnr.hawaii.gov/hisc/files/2015/07/EDRR_Plan_Naio_Thrips_Oahu.pdf.

Acalolepta aesthetica

There is no common name for *Acalolepta aesthetica*, which has been dubbed the Queensland Longhorn beetle, a reference to its native habitat in that region of Australia. The beetle is damaging trees including cacao, Queen sago palm, citrus, breadfruit, and kukui. A single adult *Acalolepta aesthetica* was first collected on the window screen of a resident of Hawaiian Acres, Puna, Hawai'i in 2009. Additional beetles were not recovered until 2013, and the first signs of damage to host trees were not discovered until 2014. Recently, there have been numerous detections of attacks on trees in some areas of the Big Island. Recent information indicates the beetle may have spread to Pahoia, Hawaiian Beaches and Hilo. The beetle is not a pest in Australia, so there is little information available on its biology and management. Signs and symptoms of infestation include sap oozing at oviposition sites, girdling on the trunk, wood boring particles being pushed out of holes on the trunk, round exit holes about 1/2" across, and branch dieback and breakage.



Figure 2. *Myoporum thrips* and its damage to native naio. Photo credit: Ryan Chang, Oahu Invasive Species Committee, UH



Figure 3. *Acalolepta aesthetica* larva. Photo source: Hawaii Department of Agriculture Quick Pest Fact Sheet



Figure 4. *Acalolepta aesthetica* wood boring particles being pushed out of a tree. Photo source: Hawaii Department of Agriculture Quick Pest Fact Sheet



Figure 5. *Acalolepta aesthetica* adult beetle exit hole. Photo source: Hawaii Department of Agriculture Quick Pest Fact Sheet

Acknowledgements

This report relied on information from many collaborators including: Rob Hauff (DOFAW), Cynthia King (DOFAW), Christy Martin (CGAPS), Sheri Smith (USFS FHP R5), Phil Cannon (USFS FHP R5), Leyla Kaufman (UH), Flint Hughes (US Forest Service, IPIF), Hawai'i Department of Agriculture, J.B. Friday (UH), Janice Uchida (UH), Aileen Yeh, Nick Dudley, and Tyler Jones (HARC).

References

- Barnes, I, A. Fourie, M.J. Wingfield, T.C. Harrington, D.L. McNew, L.S. Sugiyama, B.C. Luiz, W.P. Heller, and L.M. Keith. 2018. New *Ceratocystis* species associated with rapid death of *Metrosideros polymorpha* in Hawai'i. *Persoonia -Molecular Phylogeny and Evolution of Fungi*.
- da Silva, A.C., P.M. de Andrade, A.C. Alfenas, R.N. Graca, P. Cannon, R. Hauff, D.C. Ferreira, and S. Mori. 2014. Virulence and impact of Brazilian strains of *Puccinia psidii* on Hawaiian 'Ōhi'a (*Metrosideros polymorpha*). *Pacific Science* 68; no. 1:47-56.
- Graça, R. N., A. C. Alfenas, A. L. Ross-Davis, N. B. Klopfenstein, M. S. Kim, T. L. Peever, P. G. Cannon, J. Y. Uchida, C. Y. Kadooka, and R. D. Hauff. 2011. Multilocus genotypes indicate differentiation between *Puccinia psidii* populations from South America and Hawaii. In: M.L. Fairweather, compiler, Proceedings of the 58th Western International Forest Disease Work Conference. 4-8 Oct., 2010. Valemount, B.C., Canada. US Forest Service, AZ Zone Forest Health, Flagstaff, AZ.
- Hodges, C. T., K. T. Adee, J. D. Stein, H. B. Wood, and R. D. Doty. 1986. Decline of 'ōhi'a (*Metrosideros polymorpha*) in Hawaii. General Technical Report PSW-86. Pacific Southwest Forest and Range Research Station, USDA Forest Service, Berkeley, CA. 22 pp.
- Hughes, R. F., T. Sowards, L. K. K. Tango, S. Yelenick, S. L. Smith, and R. Hauff. 2014. Ecosystem function and health: effects of *Scotorythra paludicola* on Acacia koa forests. Keith, L. M., R. F. Hughes, L. S. Sugiyama, W. P. Heller, B. C. Bushe, and J. B. Friday. 2015. First Report of *Ceratocystis* wilt on 'ōhi'a. *Plant Disease* <http://dx.doi.org/10.1094/PDIS-12-14-1293-PDN>.
- Mortenson, L., J. B. Friday, R. F. Hughes, N. Friday, Z. Liu, L. Keith, and C. Fettig. 2014. Rapid 'ōhi'a death (ROD), Island of Hawaii. Society of American Foresters, Salt Lake, Utah.
- Mueller-Dombois, D. and H. J. Boehmer. 2013. Origin of the Hawaiian rainforest and its transition states in long-term primary succession. *Biogeosciences*, 10: 5171-5182.

Data Sources

The data sources used for this report include the Division of Forestry and Wildlife, US Forest Service Region 5, Hawai'i Department of Agriculture, University of Hawai'i College of Tropical Agriculture and Human Resources, Hawai'i Agriculture Research Center and other partner organizations.

Hawaii's Watershed Partnerships, the National Park Service, The Nature Conservancy of Hawaii, and DOFAW's Natural Area Partnership System also conduct monitoring of invasive plants and ungulates to improve the effectiveness of their management activities, but those data are not the focus of this report. The USDA Forest Service's Forest Health Forest Inventory and Analysis Program was recently introduced to Hawai'i, but results from the survey are not yet available.

Contacts

Rob Hauff, Forest Health Coordinator, Division of Forestry and Wildlife (DOFAW), Robert.D.Hauff@hawaii.gov
Cynthia King, Entomologist, Division of Forestry and Wildlife (DOFAW), Cynthia.B.King@hawaii.gov

Publication Design

Meghan Woods, GIS Analyst, Mason, Bruce & Girard, Inc, USDA Forest Service, Region 5



United States
Department of
Agriculture



The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.