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# Forest Health *2008 highlights*

## Forest Resource Summary

The State of Hawaii includes eight main islands (Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, Hawaii, and Niihau) totaling 4.1 million acres. Public lands occur on all islands except Niihau and Lanai, 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, and high elevation sites on Mauna Kea and Mauna Loa on Hawaii and Haleakala on Maui.

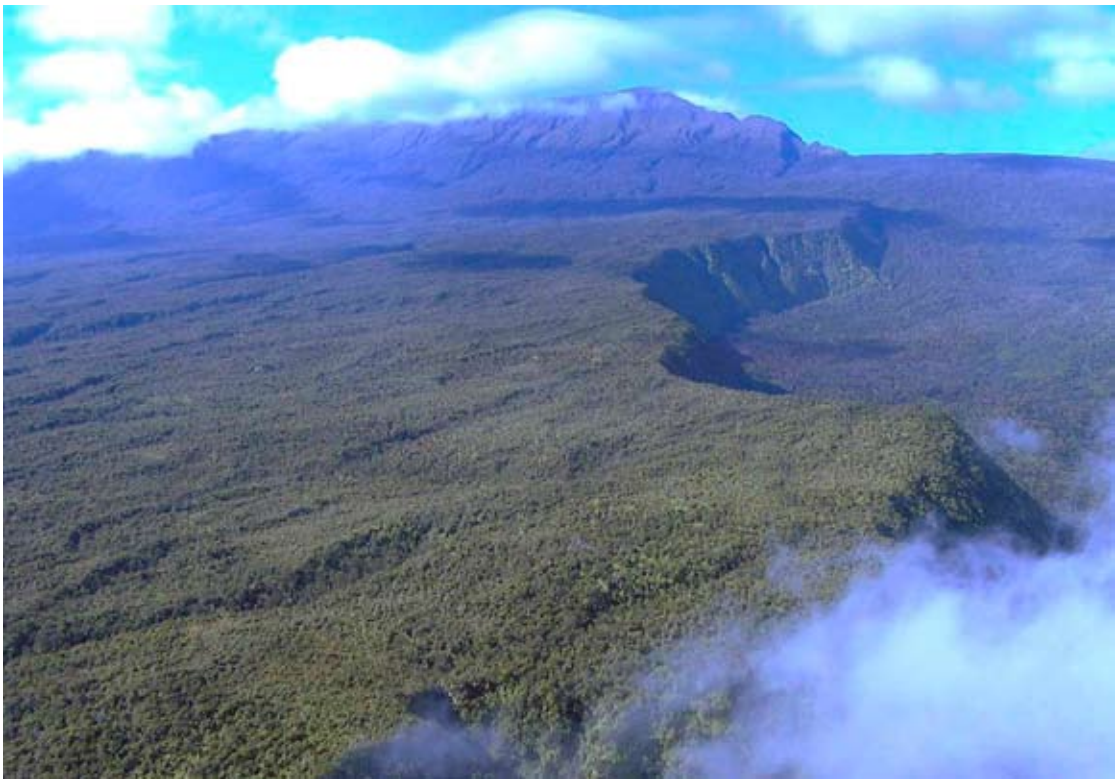
The State of Hawaii manages 1,155,900 acres including 643,134 acres in forest reserves and 109,164 acres in the state's Natural Area Reserve System (NARS) making Hawaii's state forest the 11th largest in the nation. The NARS was created to preserve unique native Hawaiian ecosystems and is managed by the Division of Forestry and Wildlife. 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. There are no lands in Hawaii managed by the US Forest Service.

The remaining land – 2,272,000 acres – is privately owned. Increasing amounts of private forestlands in mountainous areas are being managed for watershed conservation in concert with publicly owned lands under established partnerships. These watershed partnerships manage upland areas comprising a patchwork of federal, state, and private parcels totaling 850,000 acres throughout the state.

### Forest Health Monitoring in Hawaii

Monitoring of forest health conditions occurs throughout the state on private, state, and federal lands. The monitoring objectives include the spread and impact of invasive plants, invertebrate pests, diseases, biological control, and ungulates. These programs use ground surveys, transect monitoring, helicopter surveys, road surveys, photo points, and remote sensing for gathering data.

Monitoring forest health in Hawaii presents many challenges associated with its climate and geology. Hawaii's extremely rugged terrain limits ground access to many areas and increases the difficulty of remote monitoring due to vertical slopes and shadow effects. Watersheds can have as much as half of total



Remote area on Maui requires helicopter flights to monitor for invasive species.

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 making data collection over extensive areas very difficult to interpret. Identifying species, as well as classifying them as diseased or infested, is complex and difficult. 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 Hawaii's forests are located.

**Ohia Rust**

*Puccinia psidii*

A new rust disease on ohia (*Meterosideros polymorpha*) seedlings was detected in a nursery on Oahu in April 2005. The same disease was later found on rose apple (*Syzygium jambos*) growing in forests on Oahu. The disease was eventually identified through DNA analysis as *Puccinia psidii*, commonly known as "guava rust" in Florida and as "eucalyptus rust" in Brazil. The disease is referred to locally as "ohia rust" because of the importance of this native tree, but it infects many species in the Myrtaceae that are present in Hawaii, in addition to ohia. The disease is present on all major islands and is likely to have spread between islands by wind and movement of ornamental plants.

The disease infects young leaf tissue producing bright yellow pustules and causes stunting and shoot dieback. In some species it also infects flowers and fruits, rarely killing its host. Bright yellow-orange pustules develop on plant tissue until the tissue dies. Susceptibility of hosts varies widely among species. In Hawaii the non-native rose apple displays the most


Disease symptoms on an ohia seedling in native nursery.

dramatic symptoms with observations of all new shoots within in a stand being killed by the disease. Infections on ohia have been reported mostly in nurseries where either environmental conditions or abundance of young, susceptible foliage appears to be conducive to outbreaks of the rust. Some ohia varieties do not develop symptoms when growing in infested nurseries. Detections of the disease in native forests have been at very low levels and at elevations under 4000 ft, and it does not appear to be strongly impacting ohia forests at this point.

An Evaluation Monitoring Survey funded by Forest Health Monitoring, USDA Forest Service, was completed by University of Hawaii in 2008. Disease locations in forestlands throughout the state were compiled and disease hosts were documented (see Table). Disease presence has been confirmed on all major islands at elevations as high as 4500 ft where hosts are present (ohia's range extends above 7,000 ft on Hawaii and Maui). The disease was reported on 21 different species, 5 of which are native to Hawaii, including the federally listed endangered species *Eugenia koolauensis*. In addition, several species including *Eucalyptus* have been artificially inoculated using inoculum isolated from rose apple in the laboratory, however eucalypts have not been found infected in the environment.

**Confirmed host species of *Puccinia psidii* in Hawaii**

| Scientific Name | Common Name |
|---|---|
| *Calistemon citrinus* | Bottlebrush |
| *Chamelaucium uncinatum* | Waxflower |
| *Eugenia koolauensis* (H) | Nioi |
| *Eugenia palumbis* | Agatelang |
| *Eugenia reinwardtiana* (H) | Nioi/Beach cherry |
| *Eugenia uniflora* | Surinam cherry |
| *Melaleuca quinqeunervia* | Paper bark |
| *Meterosideros excelsa* | Pohutukawa |
| *Meterosideros kermadecensis* | Kermadec pohutukawa |
| *Meterosideros polymorpha* (H) | Ohia |
| *Meterosideros tremuloides* (H) | Ohia |
| *Myrciaria cauliflora* | Jaboticaba |
| *Myrtus communis* | True myrtle |
| *Pimenta dioica* | Allspice |
| *Psidium guajava** | Common guava |
| *Rhodomyrtus tomentosa* | Downy rosemyrtle |
| *Syzygium cumini* | Java plum |
| *Syzygium jambos* | Rose apple |
| *Syzygium malaccense* | Mountain apple |
| *Syzygium paniculatum* | Australian brush cherry |
| *Syzygium sandwicensis** (H) | Ohia ha |

(H) Native to Hawaii
* Artificially inoculated in laboratory


Forest Service and University of Hawaii scientists sample rust disease for PCR-based analysis.

The disease is potentially a serious threat to Hawaii's native forest. Ohia is the dominant tree species in much of Hawaii's remaining native forests and provides important habitat for endangered plants and birds, as well as vegetative cover for much of Hawaii's watersheds. Adaptation and increased virulence of the rust disease on ohia is a possible development. Commercial eucalyptus plantations could also be threatened, especially as plantations are harvested and replanted. (The island of Hawaii has approximately 20,000 acres in commercial eucalyptus plantations). *Eucalyptus* seedlings of commercial species such as *E. grandis* are very susceptible to damage from *P. psidii* in Brazil, although susceptibility in laboratories in Hawaii to local inoculum was found to be minimal on *E. grandis*.

Preliminary DNA analysis by University of Hawaii and Forest Service researchers suggests that the disease strain in Hawaii is different from strains in Florida and Brazil. Work is underway to create a phylogenetic map of the disease in Hawaii, mainland U.S., the Caribbean and South America in collaboration with Universidade Federal de Vicosa, Brazil, the University of Hawaii, and the USDA Forest Service Rocky Mountain Research Station. Different strains with different host-ranges have been observed and can vary in virulence. Ohia seed was sent to collaborators in Brazil to conduct inoculation tests with strains identified there in the phylogentic mapping project.

The State of Hawaii Department of Agriculture interim quarantine restriction on imported Myrtaceae plant material ended in August 2008. Currently all Myrtaceae material arriving from the mainland U.S. is inspected for disease. Ongoing monitoring will help detect introduction of new disease strains into Hawaii.

**Koa Wilt**

*Fusarium oxysporum* f.sp. koae

Koa wilt disease was first described in 1980 on the island of Hawaii and was attributed to the pathogen *Fusarium oxysporum* f.sp. koae. The pathogen infects trees through their roots and causes damage to the vascular system, sometimes leading to crown dieback and tree death. It is not known where the disease originated or how the disease spreads in the environment. Other areas of koa dieback were reported throughout the state thereafter, but little work had been carried out on the disease until the last few years despite the ecological, cultural, and economic importance of koa to the state of Hawaii.

Although wide-scale dieback has not been observed in forests, there has been a high incidence of the disease causing high mortality rates in koa plantations, especially on former agricultural lands. A survey for koa wilt was conducted in 2004-2005 by the Hawaii Agriculture Research Center and DOFAW with funding from USDA Forest Service Forest Health Protection. The survey located areas with symptomatic trees and collected root, stem, leaf, and seed samples for isolating *F. oxysporum* in the laboratory. Diseased trees were sampled in both plantations and natural forests throughout the state.

Dead or dying trees testing positive for *F. oxysporum* were found on all of the major islands where koa commonly grows. Trees in both planted and natural forests were found infected with koa wilt disease. *F. oxysporum* was found most commonly on roots and soil near diseased trees. Interestingly, other *Fusarium* species were also isolated from sampled tissue, and pathologists are exploring the role of these other species in the disease etiology. Methods of sampling for the disease were refined in this survey facilitating future survey and monitoring for the disease. Outreach materials on koa wilt were developed by the University of Hawaii and can be found at: http://www.ctahr.hawaii.edu/forestry/index.asp.

Many questions remain unanswered regarding koa wilt. The extent of the disease in natural forests is not known, nor is whether the pathogen exists in healthy forests. Knowing how the disease spreads in the environment is also crucial for management. In a 2007 survey of nurseries that provide planting stock to conservation areas, *F. oxysporum* along with other *Fusarium* spp. was found prevalent on koa seedlings.

What appears to be genetic resistance has been observed in koa plantations trials, and efforts to develop genetic resistance for plantations are being pursued. Koa families from each island are being screened for resistance by inoculating seedlings with pathogenic strains of *F. oxysporum*. Resistant families will be planted in seed orchards on respective islands to provide seed for plantings.

Disease resistance trial for koa.

**Erythrina Gall Wasp**
*Quadrastichus erythrinae*
The Erythrina gall wasp (*Quadrastichus erythrinae* Kim) continues to infest native and non-native *Erythrina spp*. Plant injury was first detected in April of 2005; as galls on leaves and stems on ornamental Indian coral trees (*Erythrina variegata*) were observed at the University of Hawaii campus on Oahu. Emergent adult wasps were then positively identified as *Quadristichus erythrinae* Kim, a species only recently described (2004) from specimens from Singapore, Mauritius and Reunion. The current distribution of the Erythrina gall wasp also includes Taiwan, mainland China, India, American Samoa, Guam, and Florida. Adult wasps show a preference for ovipositing in young tissue and galls have been observed on leaves, petioles, young shoots, stems, flowers and seed pods. Generation time is rapid: the life cycle of the wasp (egg to adult) has been observed as short as 21 days in Hawaii; the adult's life span varies from 3-10 days.

Once introduced, the tiny wasps were easily dispersed by wind and the movement of people and goods and spread rapidly to all neighboring islands where host species are present (Hawaii, Kahoolawe, Maui, Molokai, Lanai, Oahu, Kauai, and Niihau). Most *Erythrina variegata* trees have been killed and removed. *Erythrina crista-galli*, also a common landscaping tree, is more resistant and trees continue to survive with minimal infestation.

The native wiliwili (*Erythrina sandwicensis*) is the dominant tree species in most of Hawaii's dry forests. Although still considered abundant, little regeneration of wiliwili is occurring due to widespread seed predation by the bruchid (*Specularis impressithorax*), competition from introduced grasses, fire, and severe browsing pressure by introduced ungulates, in addition to the recent outbreak of Erythrina gall wasp.

The impact of the gall wasp on natural wiliwili populations is variable, with some populations still relatively healthy while others are moderately to highly infested. Wide scale mortality of wiliwili trees has not yet occurred but is imminent at some of the more highly impacted sites such as Puu o Kali on Maui


Dead wiliwili tree in highly infested stand on Maui.


Releasing biocontrol agent for erythrina gall wasp.

and Makua Keaau on Oahu. Seed production was reported at several sites across the state in 2008.

Experimental trials using systemic insecticides such as imidicloprid have had mixed results. Soil drenches are difficult to apply effectively for uptake by the tree's root system and impractical in a forest setting. Several injection systems have been tested with some success but are costly, and infested trees must have leaves in their canopy for the chemical to be translocated. Foliar treatments have been effective but are expensive and less practical.

The Hawaii Department of Agriculture and the University of Hawaii have identified candidates for biological control of the gall wasp during exploratory trips to Africa. A parasitoid wasp in the family Eurytomidae was released in 2008 at several wiliwili populations throughout the state to control the gall wasp. Larvae have been retrieved from the field indicating the eurytomid wasp has established. Ongoing monitoring in collaboration with the Hawaii Department of Agriculture will determine impact of the released biocontrol on the health of the wiliwili trees. Two other agents found in Africa are currently being studied in quarantine facilities in Honolulu.

**Black Twig Borer**
*Xylosandrus compactus*
The black twig borer was first detected in Hawaii in 1931 and has an extremely wide host range. In Hawaii, at least 108 tree and shrub species belonging to 44 plant families are attacked by the black twig borer. Several federally listed threatened and endangered species are impacted by black twig borer damage and its associated fungus *Fusarium solani* including *Flueggea neowawraea*, *Alectryon macroccoccus*, *Melicope saint-johnii*, *Gardenia mannii*, and *Caesalpinia kavaiensis*. The borer also commonly attacks koa, and koa seedlings can suffer high mortality rates in nurseries and outplantings due to the physical disruption of seedlings' vascular system caused by bore holes.

Black twig borer damage is usually worse during drought years but affects plants during wet years as well. The borer is ubiquitous in forested areas under 2500 feet elevation and host species are abundant in all forest types. Monitoring therefore is not a high priority, except for damage on rare and endangered species, which continues to be a problem. Experimentation with trapping using chemical attractants around vulnerable species continues.

## Invasive Species Committees

Hawaii's island-level Invasive Species Committees (ISCs) became active in the 1990s with the goal of being able to respond to threats of alien pest infestations and to control established pest populations on a species by species basis. The Maui Invasive Species Committee (MISC), the Molokai subcommittee of MISC (MoMISC), the Big Island Invasive Species Committee (BIISC), the Kauai Invasive Species Committee (KISC), and the Oahu Invasive Species Committee (OISC) are already well involved in the battle against invasive species. Each ISC is a voluntary partnership of county, state, and federal agencies, private businesses, nonprofit organizations, and individuals united in cooperative efforts to control alien pest species that pose the greatest threats to each island's ecosystems, watersheds, economy, public health, and quality of life.

Invasive species committee crew survey for invasive plants such as miconia.

Hawaii is unique in our extreme isolation from other terrestrial biodiversity centers. Once an invasive species becomes established in the state, individual islands may remain free of pest species through intra-state quarantine practices and constant monitoring followed by effective control leading to island-wide eradication. Island-wide eradication is the most cost-effective, long-term protection for native ecosystems. While several of the highest priority plant species are fairly widespread compared to current eradication strategy reviews, new targets will be prioritized by the level of the threat they pose to native ecosystems and the feasibility of eradication. This strategy will lead to the most cost-effective, long-term protection for Hawaii's forests.

The ISCs work to prevent incipient species from becoming established in Hawaii's watersheds and natural areas. While the ISCs' geographic scope is island-wide, much of their work is focused in the lower elevation areas, at or near the boundaries of the Watershed Partnerships, on residential or rural properties, or on disturbed forest lands where incipient populations of invasive species are found. When the ISCs work in forested mountain areas, they often collaborate with the Watershed Partnerships. ISCs may also work on targeted agricultural pests. ISCs typically do not work on controlling species such as pigs or goats which are both widespread and not good candidates for species-based management.

## Early Detection

Early detection is the best prevention against invasive species. It emphasizes building and refining a target list, performing targeted surveys, and prioritizing species for control based on distribution and risk. The goal is to find an invasive species before it spreads.

Across the state Invasive Species Committees have implemented early detection and rapid response programs as the best way to achieve island-wide eradications. ISC crews survey roads, nurseries and other pathways of introduction to protect the islands from weeds while they are still easy to control. This species-led approach is much more proactive than waiting until introduced species are wide spread and creating negative impacts on forests.

When a new plant species is detected, the Weed Risk Assessment (WRA) (http://www.botany.hawaii.edu/faculty/daehler/wra/) is used to predict the plant's potential to become weedy. The WRA was developed in Australia and New Zealand and modified for use in Hawaii and other Pacific islands by Professor Curt Daehler of the University of Hawaii. The WRA screens plant species and assigns them a score based on their propensity to become weedy. Plants that have a high level of threat to the island and a low level of establishment represent the highest priority for control and become rapid response target species. Once a species is included as a rapid response target, crews begin to systematically survey all known populations to eradicate them from the island.

On Maui, for example, two trained botanists conducted surveys at a select number of nurseries and botanical gardens, recording all plant species at each site. Surveys were conducted at 7 nurseries and botanical gardens. Data from previous surveys were compiled and included in the results. On-line sources provided information for 5 other nurseries and gardens, for a total of 25 surveys at 21 different locations. The combined surveys resulted in 4,990


Botanist surveys nursery on Maui.

identifications for 1,870 species. Information was entered into a database and each species was cross-checked through database queries with other datasets to reveal potential invasiveness and status in Hawaii.

Four of the species were MISC targets, 10 were Hawaii state noxious weeds, 79 were classified as high risk, based on the Hawaii Weed Risk Assessment, 493 were reported as environmental weeds by the Global Compendium of Weeds (GCW), and 910 were reported as general weeds by the GCW. The surveys revealed 314 new species for Hawaii. Of these new state records, 93 were also documented as weeds by the GCW and 29 were listed as environmental weeds by GCW. This information will be useful in directing future eradication and control efforts for Maui County and elsewhere in the Hawaiian Islands.

Maui's early detection efforts also included conducting public workshops. MISC partnered with the U.S. Geological Survey's Pacific Basin Information Node to offer 10 early-detection workshops, which were attended by 116 professionals and members of the public. Each participant received a copy of an informative Early Detection Guide, which featured 12 species with photographs, information about look-alike species, and directions for how to report any sightings. Bingabing (*Macaranga mappa*), which is one of the early-detection species, was reported by an observant community member. Staff responded and controlled plants at the site.

## Priority Target Species

All of the species targeted by the ISCs are able to outcompete or drastically alter existing communities, resulting in a change in ecosystem components, structure and function. Some plants, like fountain grass and bushy beardgrass, also change the fire regime of an area. Animal species like coqui consume large amounts of insects, and veiled chameleons are able to take birds, disrupting pollination services and further jeopardizing threatened and endangered species. Some species also impact ecosystems and human health and quality of life, such as long-thorn kiawe, little fire ants and coqui frogs. The following is a description of several ISC target species, but it is not a comprehensive list of ISC targets.

**Miconia (*Miconia calvescens*)**
- Tree native to Central and South America, introduced as an ornamental.
- Produces millions of seeds per year dispersed by birds, rats, pigs, humans. Seeds remain viable for 10 or more years.
- Potential range is all wet and mesic forests to 6000 ft. elevation.
- Priority Target for BIISC, KISC, MISC, OISC.

**Fountain Grass (*Pennisetum setaceum*)**
- Bunch grass native to Africa, introduced as an ornamental.
- Produces many seeds per year, wind dispersed. Seeds remain viable for 7 or more years. Promotes and fuels wildfires.
- Potential range is all dry and mesic forests.
- Priority Target for KISC, MISC, OISC.

**Plume poppy (*Macleaya cordata* formerly *Bocconia fructescens*)**
- A large shrub to small tree native to tropical America. Introduced as an ornamental.
- Invades dry to mesic forests, forms dense thickets and displaces native plants.
- Priority Target for BISC.

**Bushy Beardgrass (*Schizachyrium condensatum*)**
- Tufted grass native to Central and South America, introduction history unknown.
- Produces many seeds, spread by wind and humans. Promotes and fuels wildfires.
- Priority Target for OISC.

**Rubber Vine (*Cryptostegia grandiflora*)**
- Climbing woody shrub native to Madagascar, introduced and still sold as an ornamental.
- Produces many seeds that are spread by wind.
- Moist forests at risk.
- Priority Target for MISC. Large infestation of ***C. madagascariensis*** on Molokai cannot be controlled by MoMISC with current resources.

**Ivy Gourd (*Coccinia grandis*)**
- Vine native to tropical Asia, introduced as a food crop.
- Produces many seeds that are bird dispersed; spreads vegetatively.
- Potential range is unknown.
- Priority Target for KISC, MISC.

**Giant Reed (*Arundo donax*)**
- Tall reed native to Mediterranean.
- Invades streams and rivers, disrupts flow and displaces native plants and animals.
- Priority Target for MoMISC and MISC.

**Australian Tree Fern (*Cyathea cooperi*)**
- Large tree fern up to 40 feet, native to Australia. Introduced and still sold as an ornamental
- Produces many lightweight spores that are spread long distance by wind.
- Priority Target for MoMISC.

**Miconia**

*Miconia calvescens*

Miconia is the highest priority statewide for invasive weed control and was originally introduced to Hawaii as an ornamental plant. It can displace native flora, negatively impact the water supply, result in a loss of species diversity and cause permanent changes to ecosystem function, such as alteration of primary productivity and nutrient cycling. Miconia completely replaces native vegetation resulting in total loss of native habitats.

Miconia was brought to Hawaii for its beautiful foliage.

Miconia is present at varying levels on Hawaii, Maui, Oahu, and Kauai (listed in order of most severe to least). On Hawaii it is not possible to eradicate the species with the tools and resources available, while on Kauai no mature trees have been found since 2004. Maui and Oahu fall between. Early detection aerial surveys have yet to detect miconia on Molokai, but introduction there is a serious concern.

Because the level of infestation differs on each island, management goals and strategies vary among ISCs. Each ISC uses helicopter surveys combined with ground surveys to locate trees, saplings and seedlings. Helicopter surveys are essential in Hawaii because of the extremely rugged terrain, and they have proved very effective at detecting mature miconia trees. Ground surveys conducted by invasive species technicians and volunteers locate and eliminate miconia plants in accessible areas using a 800 meter buffer around mature trees. The USDA Forest Service Institute of Pacific Islands Forestry and Hawaii Department of Agriculture are conducting host specificity studies on insects and pathogens to release for biological control of miconia.

## Site-led Management

In contrast to the ISCs' "species-led" management, many entities in the state carry out "site-led" management of established invasive species to protect high-value conservation areas. Examples include Hawaii's Watershed Partnerships, the National Park Service, The Nature Conservancy of Hawaii, the Department of Defense, and the Natural Area Reserve System. Target species include established ungulates and invasive plants such as strawberry guava, clidemia, Kahili ginger, and tibouchina. Targets are monitored and controlled using manual, chemical, and sometimes biological control.

Clidemia is one of Hawaii's worst invasive plants.

Banana poka (Passifloraceae) controlled by a leaf spot disease.

Many of these established invasive plants will only be managed effectively in the long-term with the use of biological control. USDA Forest Service and Hawaii Department of Agriculture carry out biological control research essential to weed management in the state. A new biological control agent for strawberry guava, a gall-forming scale, is likely to be released in 2009 by Forest Service researchers on the island of Hawaii. The insect offers hope for reducing the impact of this destructive weed, as well as reducing the amount of resources necessary for controlling it with herbicides in protected areas. The release sites will be monitored for at least two years before releases are made on other islands. Other targets of biological control in development include miconia, clidemia, and tibouchina.

## Feral Ungulates

Feral ungulates are extremely damaging to Hawaii's forest ecosystems. Pigs, cattle, deer, goats, and sheep all damage forests throughout the state by eating and trampling vegetation and causing erosion. They also contribute to the spread of invasive plants by dispersing seeds of aggressive weeds such as guava and by disturbing the forest floor and soil allowing some of the worst invasives such as clidemia to establish. Pigs are widespread on all major islands, but presence of the other animals varies from island to island. While public hunting suppresses animal populations in some areas, many of the more remote areas where native forests are located do not benefit from public hunting. Management activities focus on fencing to keep ungulates out of priority areas and reducing animal populations using public and staff hunters, traps, aerial shooting, and occasionally snares.

Monitoring ungulate populations in Hawaii is very difficult, and no accurate population estimates currently exist for any of the taxa mentioned above. Wildlife managers sometimes survey hunting areas to assess population levels before hunting seasons begin, and hunters are required to report kills at designated hunting stations. Other damaging ungulates killed include mouflon sheep, axis deer, black-tailed deer, and feral sheep.

Pig monitoring in conservation areas typically involves recording signs of animal presence along five meter wide transects. This type of monitoring occurs throughout the state primarily in native forests. These data can be used to direct hunting efforts or to strategically locate fences. Feral cattle in forest reserves on the island of Hawaii are monitored from helicopter. Cattle detected from the air are recorded with GPS and later hunted. Similarly pig damage and pigs are monitored during helicopter surveys in areas such as the Alakai Wilderness Area on Kauai.

# Contacts and Additional Information

**Data Sources**

The data sources used for this report include data gathered by Hawaii's island-based Invasive Species Committees or ISCs (funded in part by USDA Forest Service, Forest Health Protection, Prevention and Suppression Program), Division of Forestry and Wildlife staff, Hawaii Department of Agriculture, University of Hawaii, and partner organizations such as the Hawaii Agriculture Research Center. Survey and monitoring data collected by the ISCs are entered into a statewide database created by the USGS Pacific Basin Information Node, and the data are analyzed at the local and state levels.

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 Aerial Survey Program and Forest Inventory and Analysis Program are not currently active in Hawaii.

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