

Project Abstract

Hawaii is in the midst of an invasive alien species crisis affecting the archipelago's highly endemic biota, overall environmental and human health, and the viability of its tourism and agriculture based economy. Because of the vulnerability of isolated oceanic islands to invasion, aggressive plant and vertebrate species exploit and modify all but the most resistant native ecosystems. The introduction of alien species has been the predominant cause of biodiversity loss in Hawaii for the past century, with more native species extirpated in this state than anywhere else in the United States. Federal, state, and private land managers struggle to reduce the impacts of alien species on native biota and prevent further ecosystem degradation and biodiversity loss, but invasions typically outpace resources, and successes are only sustainable through dedicated partnerships.

The Maui Invasive Species Committee (MISC), a federal-state-private partnership, has coalesced to bring about cooperative action to prevent, contain, or eradicate the most serious incipient invasions using the 728 square-mile island of Maui as a Weed Management Area (WMA). MISC formed as a committee in December 1997 and became a funded, staffed field operation in November 1999. The organizations involved in MISC have been working together successfully against alien invasions since 1991 and are committed to long-term continuation of this work. MISC partners include Haleakala National Park (NPS), the Pacific Islands Exotic Plant Management Team (NPS-PIEPM), U.S. Geological Survey-Biological Resources Division (USGS/BRD), USDA Forest Service (FS), U.S. Fish and Wildlife Service (FWS), Hawaii Army National Guard, USDA Tri-Isle Resource Conservation and Development Council, Inc., Hawaii Department of Land and Natural Resources (DLNR), Hawaii Department of Agriculture (HDOA), University of Hawaii, Maui County Office of Economic Development, Maui County Board of Water Supply, The Nature Conservancy of Hawaii (TNC), and Maui Land & Pineapple Co. (ML&P).

In its third funded year, MISC received over \$700,000 in funding from federal, state, county, and private sources including the National Fish and Wildlife Foundation. Additionally, over one million dollars of in-kind contributions from partner organizations are focused on the Maui WMA cooperative effort. MISC and its partners continue to make significant progress in surveying, controlling, or eradicating Maui's most serious plant threats: miconia (*Miconia calvescens*), pampas grass (*Cortaderia jubata* and *C. selloana*), fountain grass (*Pennisetum setaceum*), ivy gourd (*Coccinia grandis*), giant reed (*Arundo donax*), rubber vine (*Cryptostegia grandiflora*), Jerusalem thorn (*Parkinsonia aculeata*), malabar melastome (*Melastoma candidum*), downy rose myrtle (*Rhodomyrtus tomentosa*) and a chenopodium (*Aenchylaena tomentosa*).

MISC currently employs 12 full-time staff. Ground and aerial transects are conducted to survey target species. Control objectives are achieved through a multi-tiered integrated pest management strategy. Target species are removed through mechanical and/or chemical means, as appropriate, on the ground by the MISC field crew and through aerial spot-spraying of herbicide on otherwise inaccessible plants. Exploration of bio-control agents to augment control options continues. All survey and control activities are thoroughly documented, and spatial databases guide day-to-day control work and prioritization of future action. MISC's public relations and education program continues to highlight MISC's actions, enlist strong public cooperation, cultivate a positive organizational image, and to help secure funding. MISC also continues to work with local nursery and landscape professionals to minimize the introduction and spread of invasive plants.

Statewide there is strong backing for sustained funding to support the unified efforts of the Island "ISCs" in combating incipient invasions. Recent establishment of a statewide Hawaii Invasive Species Council, preparation of a statewide invasive species report, and hiring of a statewide Invasive Species Information Officer all point towards the gathering momentum for self-sufficiency. The National Park Service is taking the lead on Maui in providing substantial, long-term funding to combat miconia. An "Incident Commander" has been established to coordinate and expand miconia control efforts throughout the Maui WMA.

NFWF's continued support of this initiative in its 4th year would help MISC achieve its goal of protecting Maui's ecosystems, overall environmental and human health, and the viability of the tourism and agriculture based economy from the significant threat of alien plant invasions. Invasive species threaten the numerous intact ecosystems of Maui, including Haleakala National Park, one of the nation's key biodiversity conservation sites. Survival of 79 threatened and endangered plant species and vital state and private conservation lands will be jeopardized unless MISC's target species are contained or eradicated. By way of this proposal MISC is requesting \$100,000 from the National Fish and Wildlife Foundation that will be matched 1:1 by non-federal challenge funds. This funding will help bridge the gap as longer term sources come on-line.

PROJECT DESCRIPTION:

2003 MAUI INVASIVE SPECIES COMMITTEE (MISC) ACTION PLAN

Project Need

Alien species are increasingly recognized as a threat to biological diversity and human welfare worldwide. Oceanic islands are particularly vulnerable to invasive species and Hawaii especially so because of its role as a transportation hub. Because of their evolution in isolation from many forces shaping continental organisms, ecosystems of the Hawaiian Islands are an order of magnitude more vulnerable than most ecosystems of the continental U.S. Hawaii has one-third of the endangered species in the United States, and invasive alien species pose the greatest threats driving these and other native species toward extinction. The island of Maui alone has 79 federally listed threatened and endangered plant species and at least as many additional candidate species and "species of concern" that need to be protected. Three endangered forest bird species now survive only on the island of Maui. More native species have been extirpated in Hawaii than anywhere else in the United States, yet these islands still retain significant biodiversity. Although habitat destruction has been an important cause of extinction and endangerment, the introduction of alien species has been the predominant cause of biodiversity loss in Hawaii for a century.

MISC's six primary target species are all ecosystem-displacing weeds. *Miconia* threatens all native rain forest ecosystems on East Maui up to 5,000 ft. elevation, endangers native biodiversity and will severely degrade watersheds if not contained. Other species targeted by MISC threaten National Park and Fish and Wildlife Service lands. National Guard Training missions could be jeopardized if invasions are left unchecked. Additionally, invasive species negatively impact Hawaii's tourism-based economy, agriculture, health, and general quality of life. The pervasiveness of this issue for society in Hawaii provides hope that it will be possible to marshal adequate resources to address the problem. Given sound management based on scientific research and the backing of an informed public, this problem can be addressed. More and more resources have become available to fight invasive species over the past several years. However, resources remain inadequate to comprehensively address this accelerating problem. NFWF funds over the past three years have served as a catalyst for securing other support.

OBJECTIVES & METHODOLOGY

1. *Miconia* (*Miconia calvescens*)

Miconia is a broad leaf tree from Central America that inhabits wet to temperate forests ranging from 1,000–6,000 feet in elevation. Each tree can produce fruit by the time they are 4-5 years old generating as many as 10 to 20 million seeds per year. Seeds are spread by fruit-eating birds, animals, and in contaminated soil adhering to hiking shoes, equipment, and vehicles. Recent evidence shows that some seeds remain viable in soil for up to eight years before germinating.

Objective: To control miconia on Maui by focusing on the sustained long-term, island-wide goal of "Zero Fruiting Trees."

Methods:

- **Systematic mapping, treatment, re-survey, and re-treatment:** All known populations in the wild are being mapped and treated, and potential habitat is being systematically surveyed by air and ground. Ground operations will be expanded through the addition of more field crews.
- **Continued aerial reconnaissance, increased spot spray operations, & continued combined spray-reconnaissance operations:** MISC will continue exploration of suspect areas for previously undetected mature trees, and stop the spread of peripheral populations through aerial spot spraying. Whenever possible the more efficient approach of spraying trees when first spotted aurally will be used, rather than surveying and returning later to spray.
- **Control of periphery populations towards the cores:** Ground crews will concentrate on eliminating flowering trees around population perimeters, working from the periphery towards the cores as in fighting a wildfire. The Department of Land and Natural Resources' Hana crew will continue to work in the high-density core of the miconia forest.
- **Sub-canopy miconia:** Field crews will follow-up aerial reconnaissance with ground survey and control work. Priority will be given to areas which may harbor reproducing sub-canopy miconia, particularly in areas around trees spotted by air.

- **GPS tracking and integrated GIS database generated maps** will guide all aerial and ground strategy, survey, and control work.
- **Reassessment:** Regular evaluations of strategy and cost estimates will accurately reflect all current data and miconia biology.
- **Release, monitoring, and research conducted on bio-control fungus:** Biological control is regarded as a necessary adjunct to mechanical/chemical efforts. In mid-November 1997, the fungus *Colletotrichum gloeosporoides* f. sp. *miconiae*, was released by Dr. Eloise Killgore (Hawaii Department of Agriculture) within the East Maui Hana miconia population. MISC is now growing the fungus under HDOA's guidance and is responsible for the production and distribution of the fungus on Maui. MISC will continue to assist with funding and logistical support for the research on additional bio-control agents.
- **Participation in the interagency miconia "Incident Command" System:** MISC will continue to work closely with the National Park Service in implementing the expanded miconia control program under the island-wide Incident Command system.
- **Continuing public information and surveillance for new locations:** MISC will continue the Nature Conservancy's successful public outreach/education program within the East Maui communities to monitor treated areas and discover populations not yet surveyed. Solicitation of information from pig hunters, hikers, water supply and electric line workers, road workers, and residents will continue.
- **Measures to prevent seed dispersal by miconia workers.** Whenever miconia or any other target species control is undertaken, a supervisor will oversee gear decontamination. Miconia workers are required to wear conspicuously marked field gear, which is "dedicated" for use only on miconia. Bulldozers and other vehicles used in miconia areas are pressure washed.

2. Pampas grass (*Cortaderia jubata* and *Cortaderia selloana*)

Pampas grass is a large, tussock-forming grass native to South America. Each plant can produce thousands of seeds that are wind-dispersed. The seeds can remain viable in the soil seed bank, for at least six years before germinating. Both species have proved to be aggressive invaders in natural areas of California, New Zealand, and South Africa. *C. jubata* was discovered invading natural areas on Maui in 1989 and was added to the Hawaii Noxious Weed List in 1993. Until recently *C. selloana* was thought to be non-invasive. New evidence suggests *C. selloana* is also extremely invasive and Noxious Weed status is being sought for this species as well. Distribution data shows that pampas grass has invaded numerous areas of rain forest and bogs on East and West Maui and it has been detected and controlled in Haleakala National Park, preventing invasion of Haleakala Crater and the surrounding shrublands.

Objective: Treat all known populations and survey potential habitat. All populations will be re-visited and re-treated as necessary and aerial reconnaissance will be continued over inaccessible watershed areas.

Methods: Chemical and mechanical control methods developed in California and New Zealand will continue to be used by the ground crew. Aerial reconnaissance and helicopter spot-spraying will be used to control *Cortaderia* populations in areas inaccessible by ground. Control work permissions are actively sought for ornamental and cultivated sites on private lands. A conspicuous campaign of public education will be continued.

3. Fountain grass (*Pennisetum setaceum*)

Highly flammable fountain grass (on Hawaii's Noxious Weed List), has been recognized since the 1960s as a threat to agriculture and natural areas of Maui. Fountain grass is readily dispersed by vehicles, humans, wind, and water and can become established at elevations ranging from sea level to over 8000 feet. It has become a major concern in military training grounds such as the Kanaio National Guard Training Area. Training missions on the Big Island of Hawaii or Oahu can easily bring fountain grass seeds to Maui. A native of Africa, fountain grass directly threatens dry forests by out-competing native species for resources, and changing the soil chemistry. It is adapted to a fire regime, unlike native species. Some sources report that the wind-borne seeds remain viable in the soil for up to four years.

Objective: Treat populations and survey potential habitat. In 2003, populations will be re-treated with the goal of eliminating all persisting individuals.

Methods: Ground and aerial surveys are used to locate and map populations, followed with chemical control by the ground crew. Regularly scheduled search-and-control missions will be repeated in areas within a one mile radius around previously known populations. Color posters will continue to be distributed to educate the public to help prevent dispersal.

4. Ivy gourd (*Coccinia grandis*)

This Southeast Asian species (on Hawaii Noxious Weed List) exploded in the 1980s on Oahu and in the Kona area of the Big Island, creating huge problems for agriculture and lowland conservation sites. It was first found on Maui in 1992 and is considered eradicable, because of its dioecious condition (both male & female plants generally necessary for pollination and seed set). Seeds remain viable in the seed bank for at least 3-4 years. Seeds are primarily bird-dispersed.

Objective: Treat all individuals of all known populations and conduct comprehensive surveys of areas near known infestations. In 2003, all known sites will be re-treated. MISC will continue to support the Hawaii Department of Agriculture's ivy gourd bio-control releases.

Methods: MISC will follow-up initial control of known populations and survey nearby areas. Ivy gourd is controlled by removing and bagging all ripe fruits and treating stems with a thin-line basal bark application of herbicide. Records will be kept of populations that appear to have fruited and may therefore have persisting seed banks.

5. Giant reed (*Arundo donax*)

Giant reed is a large, cane-like grass native to India that can grow to over 20 feet in height and form monotypic stands that out-compete other plants. It is a major weed in the southern United States where it crowds out native plants and clogs rivers and flood control drainages. Reproduction is primarily vegetative, through stem and root fragments. The entire population of giant reed appears to be limited to approximately 10 sites on Maui, some in ornamental settings.

Objective: MISC will continue controlling giant reed in persistent wild populations and working to secure landowner permission to remove this plant from ornamental situations. Surveillance for new locations will be continued.

Methods: Chemical treatment and mechanical removal will continue at all known populations.

6. Rubber vine (*Cryptostegia grandiflora*)

Rubber vine is a woody, climbing vine native to Madagascar. It is one of the 20 worst weeds of Northern Australia. Rubber vine can grow in a variety of conditions, forming dense shrubs in open areas, or growing over trees up to 15 meters in height. Rubber vine is a milkweed relative and is extremely toxic to livestock and humans that consume or come in contact with it. Seeds are wind and water borne and seed longevity is unknown at this time.

Objective: All known populations will be removed in 2002. Treated sites will be monitored, with re-treated if necessary, in the following year. Surveillance for new locations will be continued.

Methods: Rubber vine is controlled using Garlon 4 with a cut-stump or basal bark application. Rubber vine is expected to require minimal follow-up, although some re-treatment is anticipated.

7. Other Invasive Plants

Five species were added to MISC's list of priority targets in September 2001 after extensive survey and evaluation: Jerusalem thorn (*Parkinsonia aculeata*), malabar melastome (*Melastoma candidum*), downy rose myrtle (*Rhodomyrtus tomentosa*), yellow Himalayan raspberry (*Rubus ellipticus*), and a chenopodium (*Aenchaena tomentosa*).

Objective: Species added to the MISC priority control list will be controlled or eradicated.

Methods: All known individuals will be controlled using mechanical or chemical means as appropriate.

8. Assessment of Additional Targets

Objective: Mapping and assessment of additional plant species for inclusion in the MISC priority control list will continue on an ongoing basis with new species added based on the recommendations of subject matter experts and the inter-agency MISC Committee.

Methods: Species added to the MISC priority control list will be controlled or eradicated using mechanical or chemical means as appropriate. MISC will continue to monitor incipient plant threats, assess candidates for control, and function as a rapid response team.

9. Nursery surveys and education by MISC

Objective: To educate nursery and landscape personnel about invasive species and discourage the sale and planting of invasive species.

Methods: MISC will continue to do outreach at industry meetings and trade shows and provide articles for industry newsletters.

10. Public Relations and Education

Objective: To educate the public about the threats posed by invasive species and what they can do to help, to make MISC's actions visible, and to cultivate a positive organizational image. With these objectives we intend to directly and indirectly impact legislation and governmental funding in a direction favorable to invasive species control.

Methods: Public awareness objectives will be met by:

- Presentation of invasive species information through all forms of media: newspaper articles; periodicals; trade journals; and television to local, statewide, and national audiences.
- Continued distribution of information at community fairs and events, public forums, and through slideshow presentations at schools and community meetings.
- Continued development of the MISC website (see www.hear.org/misc, maintained by the USGS/BRD Hawaiian Ecosystems at Risk project) to provide access to a wide range of data as well as the committee's plans, strategies, and decisions.

MANAGEMENT IMPLICATIONS & EVALUATION

Invasive species control is an ongoing battle requiring constant planning, evaluation, and adjustment. Each year MISC develops a management Action Plan outlining strategies and goals for the upcoming year. Priority target species and objectives for each are agreed to at an annual planning and assessment workshop. Committee members from cooperating partner agencies contribute strategies and objectives based on their scientific expertise, organizational mandates, and management plans.

The MISC staff then research appropriate control methods for each target species and draft the annual Action Plan. The concept of integrated pest management drives MISC's control methods. Chemical, mechanical, and biological control strategies are tailored for each species, with consideration given to landowner concerns, cultural practices, and environmentally sensitive areas. Ground and aerial strategies, or a combination of both, are evaluated and used appropriately. The final Action Plan is reviewed and agreed to by representatives of MISC partner agencies. MISC is also working closely with the NPS in implementing an Incident Command System and developing a miconia action plan, which will expand miconia control efforts throughout the Maui WMA.

MISC holds regular committee meetings throughout the year to make crucial decisions, guide strategy, and give direction to/receive feedback from the MISC staff. Subject matter experts from MISC partner agencies monitor and evaluate MISC's efforts at each committee meeting. Additionally, regular sub-committee meetings are convened to review and revise strategy for control work on selected priority target species and to discuss issues such as funding and data management.

Constant review of current methods helps to drive MISC's three-tiered long term strategy: 1) Continuation and expansion of field work on priority species, 2) Continual assessment of potential new threats and "Rapid Response" towards those identified, and 3) Development and implementation of improved prevention strategies. The staff from USGS-BRD gather baseline data on alien species distribution and dispersal that aids the assessment of the long-term threats posed by new species and serves as a point of reference for the addition of new species to MISC's target list.

MISC recognizes that although active on-site vigilance and management are key to protecting Maui's ecosystems, long-term protection primarily depends on the success of our efforts to keep new alien plant and animal species from becoming established and spreading on both island-wide and state-wide levels. Preventing the establishment and spread of new introductions is not only cost-effective, but also an essential strategy. MISC is committed to long-term, sustainable efforts to protect Maui and the state from invasive pest disasters. Working closely with the Coordinating Group on Alien Pest Species (CGAPS) and the newly formed Hawaii Invasive Species Council, MISC aims to improve statewide coordination for controlling existing pests and preventing new pest introductions.

The MISC staff is responsible for documentation of all MISC activities, monetary expenditures, and accomplishments. All survey and control activities are thoroughly documented and spatial databases guide day-to-day control work and prioritization of future action. A Geographic Information System of known locations of all target species (including a relational database with population structure, fertility, and history of control efforts) is updated as new reports come in and control work is completed. This data, when analyzed, is the platform on which the annual strategic planning meetings are held. We expect to measure short term success based on shifts in age/size classes (i.e. numbers of reproductive individuals decline while numbers of seedlings and juveniles may rise). Long term success can be seen in the reduction of a population as a whole and a lack of recruitment in satellite populations. Accomplishments in the realm of public relations and education are not readily quantifiable but are seen through shifts in public opinion, support, and awareness and evidenced through the ongoing financial support of the State Legislature and the Maui County Council.

RESULTS TO DATE

Miconia (*Miconia calvescens*):

- Extensive aerial reconnaissance and control work resulted in 42,238 acres surveyed for miconia and 3,087 plants controlled through aerial spot spraying.
- Ground reconnaissance and control work surveyed 5,280 acres and controlled 276,259 individuals.
- The Hana DLNR crew treated 364 acres within the primary core infestation through aerial and ground operations.
- With support from Hawaii Department of Agriculture, MISC began growing the bio-control fungus (*Colletotrichum gloeosporoides* f. sp. *miconiae*) and aerially spraying it on large miconia infestations in East Maui. Research continues on new bio-control agents.

Pampas grass (*Cortaderia jubata* and *C. selloana*):

- Aerial reconnaissance and control work resulted in 52,846 acres surveyed and 951 individuals controlled through aerial spot spraying.
- Ground reconnaissance and control work surveyed 7,547 acres and controlled 4,172 individuals, the majority of which were found in residential areas.

Fountain grass (*Pennisetum setaceum*)

- Aerial reconnaissance resulted in 9,666 acres surveyed in the Kanaio National Guard Training Area and the Kanaio NAR. No fountain grass was found during these surveys.
- Ground reconnaissance and control work surveyed 2,063 acres and controlled 1,030 individuals.

Ivy gourd (*Coccinia grandis*):

- Door to door surveys in residential areas covered 172 acres and resulted in 7,804 individuals controlled.
- In coordination with HDOA, three large infestations (Kapalua, Honokahua, and Kihei) were treated with bio-control agents (*Melittia oepipus* and *Acuthopeus cocciniae*) and revisited/retreated monthly.

Giant reed (*Arundo donax*):

- 1,861 plants have been controlled since the project's inception.
- Field trials using methods obtained from the California Exotic Plant Pest Council, combined with data from site revisits, resulted in modification of field methodology.

Rubber vine (*Cryptostegia grandiflora*):

- 132 plants were controlled, of which 21 were flowering/fruitletting.

New threats added to priority species list:

- Five species were added to MISC's list of priority targets in September 2001, after extensive survey and evaluation: Jerusalem thorn (*Parkinsonia aculeata*), malabar melastome (*Melastoma candidum*), downy rose myrtle (*Rhodomyrtus tomentosa*), yellow Himalayan raspberry (*Rubus ellipticus*), and a chenopodium (*Aenchylaena tomentosa*). Mapping and control work has commenced on each species.

Public Education:

- Information was distributed at community events, the Hawaii Association of Counties Conference, school presentations, and professional association meetings (e.g.: Maui Association of Landscape Professionals, Hawaii Nurseryman Association).
- Articles on the invasiveness of several specific species were printed in newspapers, periodicals, trade journals, and newsletters.
- Informational "Invasive Alien Species" posters and flyers were posted throughout major island towns.
- Five community television productions have aired repeatedly since September 1999: broadcasting MISC's mission, and assuring landowner consent, access and minimal controversy.
- Television exposure expanded to statewide and national audiences. Film segments have been aired on ESPN, The Discovery Channel, and the CBS Evening News.
- An Internet website has been developed (see link at www.hear.org/misc) providing access to a wide range of data as well as the MISC committee's plans, strategies, and decisions.
- Cooperation from nursery and landscape professionals in preventing spread of invasive species continues to increase as a result of outreach efforts.

WHY SHOULD NFWF USE FEDERAL FUNDS FOR THIS PROJECT?

All of MISC's work on non-federal lands benefits the biotic resources on federally managed lands. A proactive approach must be taken on adjacent non-federal lands to control invasive species, otherwise, federal lands and the unique species they support will suffer irreparably from invasions.

NPS: Haleakala National Park (HALE) on Maui is the most biologically intact summit-to-the-sea reserve in the Hawaiian Islands and is among the most important reserve sites in the United States for conservation of biodiversity. A single miconia plant was found and controlled in the park in 2001 (this is the second time this has occurred). While the park is currently free of miconia and pampas grass distribution is limited, the park is extremely vulnerable to invasion by both these species. Pampas grass has the potential to invade approximately one-half the 30,183 acres of HALE, and miconia has the potential to invade most of the other half.

USFWS: The island of Maui alone has 79 USFWS listed threatened and endangered plant species and at least as many additional candidate species and "species of concern." Survival of virtually all these species will be jeopardized unless the weeds addressed by MISC are eradicated or contained. Alien plant species targeted by MISC, especially *Arundo donax*, are also a threat to resources at Maui's Kealia Pond National Wildlife Refuge.

DOD: Travel by military personnel and transport of military equipment from other islands to Kanaio National Guard Training Area (KNGTA) on Maui is a potential vector of dispersal for alien plant species, especially fountain grass and ivy gourd. Fountain grass is a dominant species at Pohakuloa Training Area and elsewhere on the island of Hawaii. Fountain grass could fuel fires that would pose severe threats to the biodiversity of Haleakala National Park and other sites on leeward Haleakala volcano and impact mission-essential training exercises at KNGTA. Invasion of ivy gourd is rampant on Oahu and in the Kona area on the island of Hawaii. Military personnel and their equipment could readily transport both these species to Maui.

US Forest Service mission and goals are furthered by this project through the improvement of forest health conditions and protection of native vegetation. **USGS-BRD's** goal of maintaining island biodiversity ultimately benefits as well.

