



# **Maui Invasive Species Committee**

## **2002 Action Plan**

### **Project Summary**

The Maui Invasive Species Committee (MISC) is a partnership of 16 government, private, and non-profit organizations working to control or eradicate the most threatening incipient invasive plant and animal species. Invasive alien pests threaten native ecosystems, Maui County's most intact federal, state, and private conservation lands, 138 federally-listed endangered or threatened species, watersheds, economy and human health. MISC's goal is to control or eradicate newly established pests before they expand beyond control and to prevent new pests from entering the State.

# 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 in protected areas of Maui. The introduction of alien species has been the predominant cause of biodiversity loss in Hawaii for the past century, with more native species eliminated in this state than anywhere else in the United States. Federal, state, and private managers of protected areas on the island of Maui are struggling, with some success within their narrow jurisdictions, to reduce the impacts of alien species on native biota so as to prevent further ecosystem degradation and loss of biodiversity, but invasions outpace resources and successes are only temporary, given continued invasion from beyond their boundaries.

The Maui Invasive Species Committee (MISC), a federal-state-private partnership, has coalesced to bring about joint action to prevent, contain, or eradicate the most serious incipient plant and animal invasions. MISC formed as a committee in December 1997 and became a funded field operation with staff in November 1999, although the organizations involved in MISC have been working together successfully against alien invasions since 1991. **MISC partners include Haleakala National Park (NPS), 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), Maui Land & Pineapple Co. (ML&P), and Community Development Block Grant Program.** MISC also encourages participation by the Maui Association of Landscape Professionals, Hawaii Nurseryman's Association, Maui County Farm Bureau, Maui Chamber of Commerce, Maui Hotel Association, Maui Visitors Bureau, and similar industry associations, businesses, and trade groups in its committee meetings. A subcommittee of MISC, MoMISC, formed on Molokai in October 2000 to address invasive species concerns specific to Molokai. **MoMISC partners include the USDA Natural Resources Conservation Service, Kalaupapa National Historical Park, DLNR Division of Aquatic Resources and Division of Forestry and Wildlife, University of Hawaii, Molokai-Lanai Soil and Water Conservation District, and The Nature Conservancy of Hawaii.** MoMISC's 2002 Action Plan is attached (Appendix A).

As a multi-sector, island-wide partnership MISC provides a much-needed model that has obtained major state, county, and private funding and has been adopted on three other islands, enhancing conservation efforts statewide. Invasive Species Committees (ISCs) work on several levels: building partnerships on each island to combat the worst invasive pests facing that island; with each other on common goals to prevent the spread of species from island to island; and with the statewide Coordinating Group on Alien Pest Species (CGAPS) in an effort to prevent new pests from entering the state by changing or enacting more effective policies, procedures, and legislation.

In its second funded year, MISC received over \$600,000 and was able to make significant progress in meeting all major priority goals for Maui's most serious plant and animal threats: *Miconia calvescens*, pampas grass (*Cortaderia jubata*), fountain grass (*Pennisetum setaceum*), ivy gourd (*Coccinia grandis*), giant reed (*Arundo donax*), rubber vine (*Cryptostegia grandiflora*), Eleutherodactylus frogs (*Eleutherodactylus coqui* and *E. planirostris*), and parrots and parrot-like birds (Psittacidae). The MISC field crew surveyed and mapped crucial treatment areas of all target species on Maui, conducted significant control work on all major infestations of priority plant pests, mapped frog populations, supported baseline research on flocks of parrots and parrot-type birds, and worked toward the removal of a flock of mottled conures from the wild.

In its 3<sup>rd</sup> year as a trained rapid response team, MISC seeks to continue efforts to control or eradicate invasive species that threaten the numerous ecosystems of Maui, including Haleakala National Park, the most biologically intact summit-to-the-sea reserve in the Hawaiian Islands and among the most important reserve sites in the United States for conservation of biodiversity. Continued financial support of this initiative in its 3<sup>rd</sup> year would help MISC to protect Maui's most intact ecosystems, overall environmental and human health, and the viability of the tourism- and agriculture-based economy from the significant threat of additional alien pest invasions.

# MAUI INVASIVE SPECIES COMMITTEE (MISC) 2002 ACTION PLAN

## PROJECT NEED: WHY SHOULD FEDERAL, STATE, COUNTY AND PRIVATE ENTITIES SUPPORT THIS PROJECT?

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Miconia, pampas grass, fountain grass, ivy gourd, Caribbean frogs, and other species being addressed by MISC pose serious threats to federal, state and private conservation reserves, to county watersheds, agriculture, tourism, and to the quality of life of all Maui residents and visitors. The Maui tourism industry is proud of the fact that Maui has been chosen the "Best Island in the World" for five consecutive years by Conde Nast Traveler magazine. MISC's activities to control the worst pests and prevent the introduction of new invasive pest species protects much of what makes Maui special, and ultimately helps to protect the entire state of Hawaii.

### *HAWAII'S ALIEN SPECIES CRISIS.*

Alien species are increasingly recognized as a threat to biological diversity and human welfare worldwide. A recent article in the journal *Science* stated: "Many fear that another century or so of frenetic international traffic will lead to an 'ecological homogenization' of the world, with a small number of immensely successful species" (Enserink 1999). 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 perhaps 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. More native species have been eliminated in Hawaii than anywhere else in the United States, yet these islands still retain more native biodiversity than the famous Galapagos. 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. The islands of Maui County alone have 138 federally listed threatened and endangered plant and animal species and over 850 additional candidate species and "species of concern." At the same time, invasive species pose huge threats to 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 may be possible to marshal adequate resources to address the problem in the necessary comprehensive fashion. These islands are natural fortresses surrounded by large expanses of ocean. Given rational management based on good science and with the help of informed citizens, this problem can be addressed.

### *EFFORTS TO PROTECT BIODIVERSITY THROUGH A LONG-TERM MANAGEMENT STRATEGY.*

Efforts to protect biodiversity and ecosystem integrity are progressing far better on Maui than on any other Hawaiian Island. Reasons for this are complex, but important factors include survival of outstanding resources, a highly supportive public and press, excellent effort exerted by key landowners/managers, and exceptional interagency cooperation. The term "alien species" is a household word on Maui. Higher elevation ecosystems of both East and West Maui are receiving increasing amounts of active ecosystem management and are important reservoirs for biodiversity. Haleakala National Park is among the most important reserve sites in the United States for conservation of biodiversity and is one of the world's premier reserves for protection of insular biota. Its 45 square-mile area, from sea level to over 10,000 ft elevation, represents a very important slice of the most intact remaining native ecosystems in Hawaii. The park has made impressive advances in conservation over the past 15-20 years. State and private reserves on East and West Maui are of comparable biological importance and complement the park's role in ecosystem protection. As a result of Maui's surviving, diverse, relatively intact ecosystems, it has more to lose from proliferation of alien species than some other islands.

Resource managers recognize that although active on-site vigilance and management are essential to protect native ecosystems, long-term protection of these areas may depend more than anything else on the success of keeping new alien plant and animal species from becoming established and spreading on an island-wide, and state-wide level. Preventing the establishment and spread of new introductions is

not only cost-effective, but also an essential strategy. The management challenges for *Miconia* provide one example of why committed, long-term funding is crucial to an effective control strategy for all Maui's worst pests. Populations of target species remain, established seed banks persist, landowner access is pending in some areas, additional areas remain to be surveyed, and there is a steady stream of new introductions that have the potential to devastate Hawaii's economy, environment, and quality of life. Furthermore, public education about invasive species issues needs to continue and expand, for without the public's support, we will not succeed. The Maui Invasive Species Committee (MISC) is committed to long-term, sustainable efforts to protect Maui and the state from invasive pest disasters. Recognition of the need for a long-term management strategy and the associated sustainable funding is evidenced by the support MISC is receiving on the state, county, and national level.

#### *MICONIA ON MAUI: A GROWING THREAT.*

MISC's primary target continues to be the invasive tree *Miconia calvescens*. This species, native to Neotropical forests from 1000-6000 ft elevation, is now known to be an unusually aggressive invader of moist tropical island habitats. Introduced to Tahiti in 1937, dense thickets of *Miconia* had replaced the native forest over most of the island by the 1980s, with dramatic reduction of biological diversity. A 1997 paper by J. Y. Meyer and J. Florence (*Journal of Biogeography* 23:775-781) states that 40-50 species endemic to Tahiti are on the verge of extinction primarily because of the invasion of *Miconia*. After the late botanist F.R. Fosberg saw this species in Tahiti in 1971, he reported that "it is the one plant that could really destroy the native Hawaiian forest." Yet because of its attractive purple and green foliage *Miconia* had already been brought to Hawaii as an ornamental in the 1960s, and no sustained efforts were made to control it until it was well established on Hawaii Island.

After the detection of *Miconia* on Maui by conservation agencies in 1990, an alarm was raised. Now *Miconia* has become something of a household word on Maui and rapidly increasing efforts are being made to control it. However, despite the considerable progress made, *Miconia* will continue to be a serious and persistent threat for years to come for several reasons. A single mature *Miconia* can produce millions of seeds per year, which can remain dormant in the soil for up to eight years before germinating. *Miconia* has the ability to flower and seed below the forest canopy, unseen during helicopter surveys; and the majority of *Miconia* on Maui grow in areas that are difficult to access even for trained field crews.

#### *AN EXPANDED EFFORT BY MISC: THE NEED FOR A REVISED MICONIA CONTROL PROGRAM.*

*Miconia* now threatens all native rain-forest ecosystems of East Maui. If not contained, *Miconia* will aggressively invade and extinguish biodiversity in all tropical rain-forest areas up to at least 5000 ft elevation as well as severely degrade watersheds by destroying forest understory. The window of opportunity to control *Miconia* on Maui is rapidly closing. Maui resource managers and ecologists agree that the interagency control program to eliminate *Miconia* from Maui is on the verge of failure due to the explosive spread of this weed combined with insufficient and inconsistent funding. A large injection of additional funding, as well as a more ambitious control strategy, is needed and is being pursued by MISC. Maui has much to lose if *Miconia* is not contained.

The battle is not "lost," but as of October 2001 it is clear that the effort must be accelerated sharply if there is to be any hope of control, and sustained management will continued to be required. New tactics and funding must be deployed immediately to deal with this ecological crisis. Like a wildfire that threatens human life, property and natural resources, *Miconia* must be treated as an emergency. Unlike the aftermath of a wildfire, the Hawaiian rain forest and natural resources will never return.

The funding need on Maui is estimated at a minimum of \$2.25 million per year for at least 10 years. MISC is fairly confident that this amount can be raised, given strong public support and recognition of the seriousness of the problem on Maui, good interagency/private cooperation, and the recognition of the threat to federal resources combined with the indication that federal agencies will respond appropriately. The National Park service is presently pursuing an emergency funding initiative, through entrance fee programs, which may provide a significant portion of the support needed for Maui - potentially as much as \$1 million per year. In addition, Maui County's recent commitment of \$400,000 for FY2002 will provide the funding necessary for increased helicopter operations, and is a significant show of support for MISC and it's mission.

The MISC projected budget for CY 2002 is on page 16.

# OBJECTIVES & METHODS

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## 1. *Miconia calvescens*

*Miconia* is MISC's primary target species. Maui *Miconia* control strategy meetings have been held multiple times this past year and included representatives from MISC, Haleakala National Park, Hawaii Department of Land and Natural Resources-Division of Forestry and Wildlife, U.S. Geological Survey-Biological Resource Division, the Tri-Isle Resource Conservation and Development Council, Inc., and The Nature Conservancy of Hawaii. The purpose of the meetings has been to evaluate the effectiveness of the control program to date and plan future strategies. Additionally, realistic cost estimates for *Miconia* control on Maui were derived using all available data. The product of these meetings is a revised multi-faceted strategy for MISC's 3<sup>rd</sup> year plan, and the objective given below.

**Biology:** *Miconia* can produce fruit within 4-5 years, with each tree generating as many as 10 to 20 million seeds per year. Seeds are spread by fruit-eating birds and other animals and in contaminated soil that adheres to hiking shoes, equipment, and vehicles. Recent evidence shows that some seeds are able to remain viable in the soil seed bank for up to eight years before germinating. Experience in Tahiti and Hawaii has shown that some trees, even fruiting trees, are missed by ground crews and aerial surveys during the first pass, necessitating revisits.

**Objective:**

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

MISC's multi-faceted strategy for 2002 includes the following major elements:

- 1) Increase helicopter operations, both reconnaissance and spot spraying;
- 2) Continue and expand ground operations with the addition of more field crews;
- 3) Continue to evaluate strategy and cost estimates to accurately reflect all current data and biological realities;
- 4) Continue to work with Haleakala National Park to pursue the additional Federal funds necessary to expand operations in agreement with current cost estimates.

**Methods:** Specific elements of the strategy include:

- **Management Units** have been established and are being utilized throughout the core and at the periphery with GPS and land markers. These units will assist thorough and systematic coverage with maximum confidence and facilitate progress analysis over time.
- **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. MISC will re-survey and re-treat all areas known to have had *Miconia*.
- **Periphery towards the cores:** Concentration on killing flowering trees around population perimeters, working from the periphery towards the cores as in fighting a fire. The MISC crew, assisted by Haleakala National Park's Exotic Plant Management Team, will focus on all (prioritized) peripheral areas and conduct aerial searches, control, and groundwork.
- **Triple current helicopter reconnaissance:** This will provide for complete exploration of suspect areas for previously undetected mature trees, with repeat at least annually.
- **Sub-canopy *Miconia*:** Follow-up with ground crew survey and control work, with priority to areas that may harbor sub-canopy *Miconia* (seeding trees under the canopy that cannot be seen from the air), particularly in areas around trees spotted by air.
- **Increase aerial spray operations** with flowering trees as the first priority. Helicopter spot-spraying of herbicide as a holding action to limit seed production, is cost effective and essential in inaccessible sites. The herbicide (Garlon 4, ester formulation of triclopyr) is applied with surfactant and dye. The dye allows the pilot to judge application rate with precision and accuracy.
- **"Spray –reconnaissance":** A method that MISC has termed a "spray-con" is being used in target rich management zones. Whenever possible the more efficient approach of spraying trees when first spotted aurally will be used, rather than surveying then going back later to spray.
- **GPS tracking and integrated GIS database generated maps** will guide all aerial and ground strategy, survey, and control work.
- **Continue to contain Hana core:** The Hana (DLNR) crew will assist with working on areas of highest strategic priority as needed but will continue to work primarily in the core area, with emphasis on removal of all trees prior to fruiting on a sustained basis. Low volume and thin-line basal bark herbicide techniques will be used in on-the-ground control whenever feasible.

- **Development of new access routes to allow on-the-ground control:** Access roads developed in 1996-98 by bulldozing through rough lava terrain, to allow on-the-ground control in the Hana core population, will be maintained and a road will be expanded mauka into the Kawaipapa River area. Six miles of 4-wheel-drive roads are in place, subdividing the 2500-acre primary infestation site into management units and allowing efficient access.
- **Develop a new series of helipads** (inland of existing and proposed jeep road systems) to facilitate access to higher elevation areas not conducive to bulldozer roads.
- **Support and assist Hana Ranch** to stem the *Miconia* invasion on their lands. MISC has been successful in enlisting the help of Hana Ranch Corporation. Hana Ranch, with funding assistance from the U.S. Fish and Wildlife Service private lands program and NRCS, is working to clear upper Hana pastures of guava and *Miconia*. Open guava stands in pastures limit the area in which cattle can graze and therefore allow *Miconia* to become established. They are also investigating the feasibility of extending the pastures up slope.
- **Release, monitor, and conduct research on biocontrol fungus:** Biological control is 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 population. MISC will continue to assist with funding and logistical support including 1) releases of biocontrol fungus on monitored mature and non-reproductive *Miconia* plants, 2) evaluation of effect within core and at the periphery, 3) research on fungal impact on *Miconia* seedling survival, and 4) research on potential additional biocontrol agents (already in progress).
- **Continuing public information and surveillance for new locations:** MISC will continue the Nature Conservancy's program of successfully using public outreach/education within the East Maui communities of Keanae, Nahiku, and Huelo to monitor treated areas within known populations and to find *Miconia* in areas not yet surveyed. Solicitation of information from pig hunters, hikers, water supply ditch and electric line workers, road workers, and residents will be continued.
- **Measures to prevent seed dispersal by *Miconia* workers.** Whenever *Miconia* or any other target species control is undertaken, a supervisor oversees adherence to a strict protocol of decontamination safeguards. *Miconia* workers are required to wear conspicuously marked footwear and other gear which are "dedicated," i.e. used only for work involving *Miconia*. Whenever bulldozers and other vehicles are used in *Miconia* areas, they are *always* pressure washed immediately afterwards.

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

This species is recognized as one of the worst invasive weeds in natural areas of California and is also invasive in New Zealand, Tasmania, and South Africa. Pampas grass was added to the Hawaii Noxious Weed List in 1993. It was discovered on Maui by Haleakala/ USGS-BRD in 1989. Pampas grass has the potential to invade Haleakala Crater and the shrubland of Haleakala on a large scale. Distribution data showed that pampas grass has invaded numerous areas of rain forest and bogs on East and West Maui (Kahakaloa Natural Area Reserve). Each plant can produce thousands of seeds that are wind-dispersed, and can remain viable, persisting in the soil seed bank, for at least six years before germinating.

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

**Methods:** The ground crew utilizes chemical and mechanical control methods developed in California and New Zealand. In residential and urban areas, where *Cortaderia* is planted ornamentally and where the use of herbicides is discouraged, plants are dug out of the ground utilizing brushcutters and pulaskis. Aerial reconnaissance is employed where roads are lacking at high elevations. Several serious infestations in both west and east Maui's upper watersheds are being systematically surveyed by helicopter on a seasonal basis. Helicopter spot-spraying will continue to be used as an effective tool for controlling *Cortaderia* populations in areas inaccessible by ground. Incipient populations of pampas grass on Molokai will be controlled or eradicated through the Molokai subcommittee of MISC (MoMISC). The herbicide (Rodeo/glyphosate) is applied with surfactant and dye allowing precision and accuracy of application rate. A conspicuous campaign of public education will be continued in the local media.

## 3. Fountain grass (*Pennisetum setaceum*)

Highly flammable fountain grass, *Pennisetum setaceum* (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.

**Objective:** Treat populations and survey potential habitat. In 2002, populations will be re-treated with the goal of eliminating all persisting individuals. In addition, incipient populations of fountain grass on Molokai will be controlled or eradicated through the Molokai subcommittee of MISC (MoMISC). MISC will pursue assisting the Kahoolawe Island Reserve Commission (KIRC) with the eradication of populations in the former military installation on the island of Kahoolawe.

**Methods:** Ground and aerial surveys are used to locate and map populations, followed with chemical control by the ground crew using Velpar (hexazinone) herbicide. Search-and-control missions will be repeated in areas within a one-mile radius around previously known populations (ground and aerial survey). Follow-up evaluations will be conducted twice yearly in the 6-8 Maui sites known to have had fountain grass. Comprehensive aerial surveys of the Kanaio National Guard Training Area, western leeward Haleakala and lower Ulupalakua Ranch lands will be repeated seasonally when *Pennisetum* is in bloom. Color posters will continue to be distributed to likely sources.

#### 4. Ivy gourd (*Coccinia grandis*)

This 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). Once seeds are set, seed bank persists 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 2002, all sites known to have ever had ivy gourd will be re-treated.

**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 Garlon 4 (triclopyr). 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. It is a major weed in the southern United States where it crowds out native plants and clogs rivers and flood control drainages.

**Objective:** MISC will continue to control giant reed in persistent wild populations and work to secure landowner permission to remove this plant from ornamental situations. Surveillance for new location records will be continued.

**Methods:** Chemical treatment of *Arundo* with Roundup Pro (glyphosate) herbicide or mechanical removal with pulaskis will continue. Control methods obtained from the California Exotic Plant Pest Council have been modified by results from controlled field trials conducted on Maui by the MISC crew.

#### 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. Seeds are primarily wind dispersed.

**Objective:** All known populations will be removed in 2002. Treated sites will be monitored, with re-treatment if necessary, in the following year. Surveillance for new location records 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 need for follow-up, although some re-treatment with is anticipated.

#### 7. Other Invasive Plants

**Objective:** Mapping and assessment of additional plant species for inclusion on the MISC priority control list was conducted by MISC members in 2001 as part of a USGS-BRD project. Five species were added to the MISC priority control list:

1. Jerusalem thorn (*Parkinsonia aculeata*)
2. Malabar melastome (*Melastoma candidum*)
3. Downy rosemyrtle (*Rhodomyrtus tomentosa*)
4. Yellow Himalayan raspberry (*Rubus ellipticus*)

#### 5. Australian Chenopodium (*Aenchaena tomentosa*)

**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.

#### 8. Caribbean Frogs (genus *Eleutherodactylus*)

Two species of small brown Caribbean frogs of the large Neotropical genus *Eleutherodactylus* were introduced to Hawaii approximately 11 years ago. *E. coqui* is colloquially called “coqui”, while *E. planirostris* is referred to as the “greenhouse frog”. Both species reached Hawaii and are being spread around the State in nursery materials--this is the well-documented means of spread of these and related species throughout the Caribbean region as well. *E. coqui* was first reported on Maui and Hawaii in 1997, and has since spread to Oahu and Kauai. *E. planirostris* were present on Hawaii, Oahu and Kauai, and were discovered on Maui in 2001. *E. coqui* is well studied in its native Puerto Rico and from these studies we can readily deduce the problems this and related species could cause in Hawaii should they become widespread. Basic ecological information relevant to determining these effects include the following:

- The frogs can occur at densities up to 12,000 per acre, and may occur at higher densities in Hawaii
- They consume an average of 45,000 prey items per acre per night (approximately 16 million prey items per acre per year)
- They do not require standing water for a tadpole stage, eggs are laid in leaf axils or in leaf litter
- Females produce 4-6 clutches per year, each clutch consisting of 16-41 eggs
- The frogs reach sexual maturity 8 months after being laid as eggs; and
- They can occur from sea level to at least mid-elevation rainforest and mesic forest (ca. 4000 feet).

As a result of these ecological attributes we may expect that, if left unchecked, these frogs will soon spread and establish numbers on Maui too large for control. If so, it is reasonable to expect that they will have the following negative effects on Maui's native species and ecosystems:

- They will exert a tremendous predation pressure on a wide array of native invertebrates, including insects, spiders, and snails, many of which are already stressed to the edge of extinction;
- By removing a large percentage of the insect prey base, they will have a large indirect effect on Maui's remaining native forest birds, most of which are partially or largely insectivorous;
- They may serve as a food source for rats and mongooses, allowing these predators to reach even higher densities than occur now and thereby increasing the predation pressure these alien mammals exert on Maui's native birds, tree snails and plants; and
- They may serve as a potential food source for any snake species that may be introduced to Maui in the future, thereby making it easier for any such snakes to become established and then maintain artificially high population densities, as has occurred with the brown tree snake on Guam.

Another negative consequence of these frogs' establishment on Maui is that their loud calls (emitted at 90-100 decibels) prove very annoying and disturbing to the sleep of many residents and visitors. Visitors at numerous hotels on Maui have complained about the noise at night, and some residents have even threatened to leave Maui if the frogs could not be removed. These complaints have stemmed from areas having no more than 30 – 80 frogs, not the thousands that the species are capable of attaining. It is also possible that the frogs may serve as vectors of plant nematode eggs by having them adhere to their skins, increasing an already significant problem for some sectors of the horticultural industry. Further, if states such as California discover that Hawaiian nurseries are contaminated by these frogs, they may refuse shipments of material not certified to be free of the pests, again increasing costs to the industry generally.

**Objective:** Continue to verify and document distribution and abundance of Caribbean frog populations on Maui. Control new, localized individuals to prevent new infestations, with priority given to locations that sell or rent plants. Eradicate as many established populations as feasible.

**Methods:** Funding has already been secured for MISC to hire two full time technicians dedicated to frog control in 2002. MISC will continue to work with DLNR and NPS to map and slow the spread of Caribbean frogs on Maui, and will help facilitate the newly-approved method of using caffeine as a raticide. MISC will continue to fund or otherwise support research into frog control methods and efforts.

#### 9. Parrots and parrot-like birds

The Hawaiian Islands have no native Psittacines (birds belonging to the family Psittacidae, including parrots, macaws, and parakeets), although several species of parrots have been intentionally or unintentionally released by pet owners. Ten parrot species have established wild populations on Maui, and 18 species have been recorded on the other main Hawaiian Islands. Psittacines are able to naturalize fairly easily in Hawaii due to the relatively benign weather, abundant food sources, and lack of natural predators.

Established breeding populations on Maui are documented for rose-ringed parakeets (*Psittacula krameri*) and mitred conures (*Aratinga mitrata*), the most commonly observed parrot species. The intentional release of a pair of mitred conures in 1986 and the increase of the flock to its present numbers of 150 to 200 birds in 2001 has been documented by DLNR-DOFAW and MISC. The salmon-crested cockatoo (*Cacatua moluccensis*) may be established on West Maui based on repeated sightings of several mature birds. Additionally, an Amazon parrot (*Amazona* sp.), peach-faced lovebirds or a hybrid-form (*Agapornis* spp.), and the Alexandrine parakeet (*Psittacula eupatoria*) have also been occasionally reported, but successful establishment and breeding remain unconfirmed. These four species are persisting in small to moderate numbers.

Parrots present novel threats to Maui's ecological and economic integrity in several ways that previous bird introductions have not. Most parrots eat fruits and release some viable seeds in their droppings, thus spreading plants. They have the potential to spread alien plants over very large areas since most parrots are large, eat large amounts of fruits, and fly greater distances to forage than other alien birds. In their native habitat mitred conures are known to fly distances of 5-10 miles, range to elevations as high as 8300', and tolerate low temperatures. Importantly, on Hawaii Island they have been seen as high as 5000' on Mount Hualalai, and therefore have the potential to reach and alter remaining pristine high elevation areas on Maui. Mitred conures are also known to feed on *Miconia* berries in their home range. The possibility that mitred conures would eat *Miconia* and spread viable seeds needs to be assessed. If proven possible, the conures (and similar parrot species) could be a factor in the long distance spread of this major invasive threat on Maui.

Introduced parrots are effective seed predators of some tree species and eat the crowns of other trees, causing their death. This has resulted in the decimation of native palm trees in Palau, for example. It is possible that they could serve to inhibit reproduction in native tree species whose seeds they might eat, serving to reduce native plant populations. They are also a likely threat to Maui's native, endangered loulou palms (*Pritchardia* spp.). On Maui direct competition with native birds has been observed in the displacement of frigate birds (*Fregata minor palmerstoni*) from roosting areas and in competition with shearwaters (*Puffinus* spp.) and petrels (*Pterodroma* spp.) for nesting sites in cliff-side burrows.

A variety of parrot species are also well-known agricultural pests elsewhere in the tropics, typically targeting fruit and grain crops, and they have reached sufficient numbers that control measures have been required on Kauai. The agricultural impact of parrots on Maui has not been assessed, but the potential for damage by these birds should not be overlooked.

Parrots may also carry several avian bacterial or viral diseases that are potentially transmissible to native bird species. These diseases include adenoviruses, paramyxoviruses, psittacosis, and salmonellosis. A further concern is that large parrot populations, in close proximity to man, and having a preference for human food crops might represent a serious reservoir of zoonotic infections. Psittacosis is one of the most common and most serious bird diseases which infects humans and can be fatal. Other parrot carried diseases commonly affecting humans are giardiasis and salmonellosis. It has not yet been determined if any of the free-ranging parrots on Maui carry these diseases.

**Objective:** Conduct intensive field-based research on mitred conures and rose-ringed parakeets to determine and document the local reproductive biology, demographics, any population fragmentation, the direct and indirect threats to native birds and plants, the threats to agriculture, and the zoonotic disease potential. Other incipient Psittacines populations will be documented and assessed for removal.

**Methods:** MISC will work with DLNR-DOFAW personnel to assess populations and facilitate removal by DLNR or by the Maui Animal Rescue and Sanctuary's (MARS). In 2001 MARS proposed a viable live-capture program for removing the mitred conures using feeding stations and netting and received a permit from DLNR-DOFAW to conduct the project, which culminates in August 2002. MISC will also continue to facilitate research into the possible threat of *Miconia* seed spread by mitred conures with

assistance from USGS-BRD and MARS. MISC will also work to educate the pet industry and community about responsible parrot ownership.

#### **10. Snakes, Rabbits, and other Vertebrates**

A variety of alien vertebrates that are not known to be established on Maui still show up on the island at frequent intervals. These animals, which include snakes, lizards, turtles, frogs, and rabbits, are thought to be animals released by pet owners. Other vertebrate pests, such as bulbuls (*Pycnonotus* spp.) may potentially arrive on Maui from neighboring islands. To avoid having these animals establish populations on Maui, it is imperative that reported sightings of new vertebrate pests be quickly responded to in order to capture the reported animal. Furthermore, the large number of reported sightings of snakes on Maui since August 1997, and the clustering of these sightings in two geographically limited areas raises the concern that some species of moderately large snake may be in the process of establishing a population on Maui. Evaluation of this possibility is currently hampered by the lack of sufficient personnel in HDOA and DLNR to respond effectively to each sighting.

**Objective:** Assist State DLNR personnel in responding to any and all such reports of new alien vertebrates so as to increase the likelihood that these species will be prevented from establishing on Maui.

#### **11. Nursery education by MISC**

**Objective:** To educate nursery and landscape personnel about invasive species, discourage the sale and planting of invasive species, and provide information about the spread of Caribbean frogs.

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

#### **12. 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.
- Continuing 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](http://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.

## **EVALUATION**

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MISC's short- and long-term planning is done by committee members and MISC staff in workshops and regular half-day meetings every 6 weeks. Additionally, regular meetings of sub-committees are convened to review and revise strategy for control work on selected priority target species and crucial issues. *Miconia* strategy workshops were held this spring with another scheduled in November to re-evaluate new data. To date, all decisions have been reached by consensus within this group.

The MISC Coordinator and Public Relations Specialist are responsible for documentation of all MISC activities, monetary expenditures, and accomplishments in terms of area surveyed/treated and plants removed/treated. Maps of known locations of all target species (including annotation with population structure, fertility, and history of control efforts) are being kept and updated as new reports come in. Special attention is given to all populations of target species that appear to have fruited and have persisting seed banks. The MISC Coordinator, with assistance from the Data Specialist, Public Relations Specialist, Field Operations Manager, and Field Crew Supervisor, is responsible for follow-up evaluations and reporting results to the MISC Committee regularly at periodic MISC meetings. Subject matter experts from MISC partner agencies monitor and evaluate results. Short-term and long-term control operations are aimed at exhausting the seed banks established by previously controlled plants. Careful

GPS data archiving and mapping of all of the information gathered is evaluated to generate an effective follow-up schedule for re-treatments.

## **RESULTS: JULY 1, 2000 TO JUNE 30, 2001**

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MISC's objectives are being met by MISC's full-time staff and partners: surveying, treating and controlling or eradicating Maui's most serious plant threats. MISC is fully equipped with computers, office and field equipment, safety gear, radios, and vehicles, and is staffed by ten full-time employees, including six extensively trained Field Crew members. Recruitment of a Field Operations Manager and two additional Field Crew positions has been made possible by County funding and is scheduled for November 2001, increasing the full time staff to thirteen.

Surveys of target species by ground and aerial transects using GPS units are followed by mechanical/chemical removal by workers on the ground or aerial spraying of inaccessible plants. This essential mapping of survey areas and collection of biological data for all target species provides a strategic resource for action and evaluation, guiding day-to-day control work and future revisit schedules. The MISC database and field record system was developed to provide a seamless and compatible link with the largest existing databases in the county and the state, including those maintained by Haleakala National Park Resource Management, the U.S. Geological Survey Biological Resources Division, and agencies on Oahu, Hawaii, Molokai, and Kauai (including the other island ISC's). The mapping products generated are available to all resource management agencies, public and private.

Public awareness objectives are being met by distributing information at community events and through slide- shows and talks given at schools and community meetings. Information on invasive species has been presented through newspaper articles, periodicals, trade journals, and television to a local, statewide, and this past summer, to a national and international audience (ESPN, the Discovery Channel, and the Discovery Channel's European network).

### Results for specific objectives:

#### ***Miconia calvescens*:**

- Increased helicopter operations (approximately doubled) yielded the most complete and accurate distribution and abundance data to-date. This expanded data, combined with updated cost estimates, resulted in a revised multi-faceted strategy for *Miconia*.
- The Hana DLNR crew treated 342 acres within the primary core through aerial and ground operations.
- Thirteen hours of aerial reconnaissance, covering 9,437 acres, were conducted to locate new trees/populations. Data points taken during aerial searches allowed the MISC crew to locate and control new sites on the ground, using a GPS.
- Twenty-one hours of aerial spray operations in peripheral areas controlled 1,012 trees, 153 of which were flowering/seeding.
- The MISC field crew spent a total of 124 person days (1 person day = 8 hrs.) conducting on the ground *Miconia* surveys and transects and performing chemical and mechanical treatment in peripheral populations. Ground coverage over 1,820 acres resulted in the control of 10,040 plants including 88 that were seeding.
- Aerial and ground *Miconia* operations were conducted in partnership with the NPS Exotic Plant Management Team resulting in an efficient coordinated effort.
- *Miconia* management units, areas easily delineated and identified from the air by topographical features, were established as a tool for assessing results.

#### **Pampas grass (*Cortaderia jubata* and *Cortaderia selloana*):**

- Fifteen hours of aerial reconnaissance were conducted to locate new plants/populations in natural areas and watersheds, covering 12,682 acres. Work on the island's most serious infestation in the East Maui Watershed continued. Abundance and distribution data indicate significant progress

towards containment. A previously unknown infestation, which posed a serious threat to West Maui, was discovered and controlled.

- Twelve hours of helicopter spray operations were conducted, killing 495 plants (374 of which were seeding) in both East and West Maui.
- Systematic ground sweeps in natural areas covered close to 140 acres. All known populations in the wild were mapped and potential habitat was surveyed. GPS data taken during aerial searches allowed the MISC crew to find aerially spotted plants and new populations on the ground for control.
- Eighty-three person days of on-the-ground control work in natural and residential areas resulted in 1,603 plants killed including 71 that were flowering/seeding. The majority of plants found and controlled were in residential areas.
- Ongoing cooperation from large landowners (East Maui Irrigation and Haleakala Ranch) greatly assisted control work.

#### **Fountain grass (*Pennisetum setaceum*)**

- Follow-up surveys continue to monitor possible persisting seed banks. Surveys up to one half-mile around known plants were completed again this year. The population on West Maui continues to be monitored and re-treated when necessary. Regeneration appears to be diminishing as time goes on.
- Fifteen person days were spent on survey and control work with thorough coverage of 237 acres. A total of 237 plants were killed including 76 plants that were flowering or seeding.
- A second comprehensive aerial reconnaissance mission is in planning for the Kanaio National Guard Training Area and is scheduled to be completed in the next two months.

#### **Ivy gourd (*Coccinia grandis*):**

- A total of 32 person days were spent on survey and control work with 1,977 plants killed.
- Three known large infestations (Kapalua, Honokahua, and Kihei) were treated and revisited/re-treated every 1-3 months and are under continual monitoring.
- Several new locations were mapped and are currently being controlled.
- Surveys were conducted in susceptible habitat (including door-to-door in residential areas).

#### **Giant reed (*Arundo donax*):**

- Thirty-seven person days of control work resulted in control of 951 plants over a ten-acre area.
- 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*):**

- Ninety-eight plants were controlled of which 13 were flowering/fruitletting. A total of four person days of control work were completed.

#### **Caribbean frogs (*Eleutherodactylus coqui* and *E. planirostris*)**

- Phone calls from the public reporting new frog locations were received and documented. MISC hand-captured frogs at sites of single or small populations of frogs in outlying areas, reducing the possible spread of frogs to new areas.

#### **Mitred conures (*Aratinga mitrata*)**

- MISC conducted baseline research on a flock of mitred conures in the Huelo area of East Maui to determine the numbers, roost sites, feeding activity, and potential for control or capture.
- MISC was approached by the privately-funded Maui Animal Rescue and Sanctuary (MARS) with a proposal for using feeding stations and a trap to remove 50 mitred conures from the wild and house them at the MARS facility in Haiku. A permit from DLNR-DOFAW to conduct the project culminates in the fall of 2002.

#### **Public Awareness:**

A public relations campaign and educational outreach program was conducted utilizing all forms of media and reaching a broad audience. This program publicized MISC's actions, enlisted strong public cooperation and assistance, cultivated a positive organizational image, and ultimately supported funding.

- Information was distributed at legislative offices, county council meetings, community meetings and events, slide shows, school presentations and professional association meetings (e.g.: Maui Association of Landscape Professionals, Hawaii Nurseryman Association).
- Articles on invasive species were printed in newspapers, periodicals, trade journals, and newsletters.
- Television exposure to local, statewide, and, this January and July, to national audiences. Film segments were aired on ESPN and The Discovery Channel in January and July 2001.

- Three community television productions have aired repeatedly since September 1999: broadcasting MISC's mission, and assuring landowner consent, access and minimal controversy.
- An Internet website has been developed (see link at [www.hear.org/misc](http://www.hear.org/misc)) providing access to a wide range of data as well as the MISC committee's plans, strategies, and decisions.
- Informational "Invasive Alien Species" posters and flyers were posted throughout major island towns.

## PROJECT SUPPORT

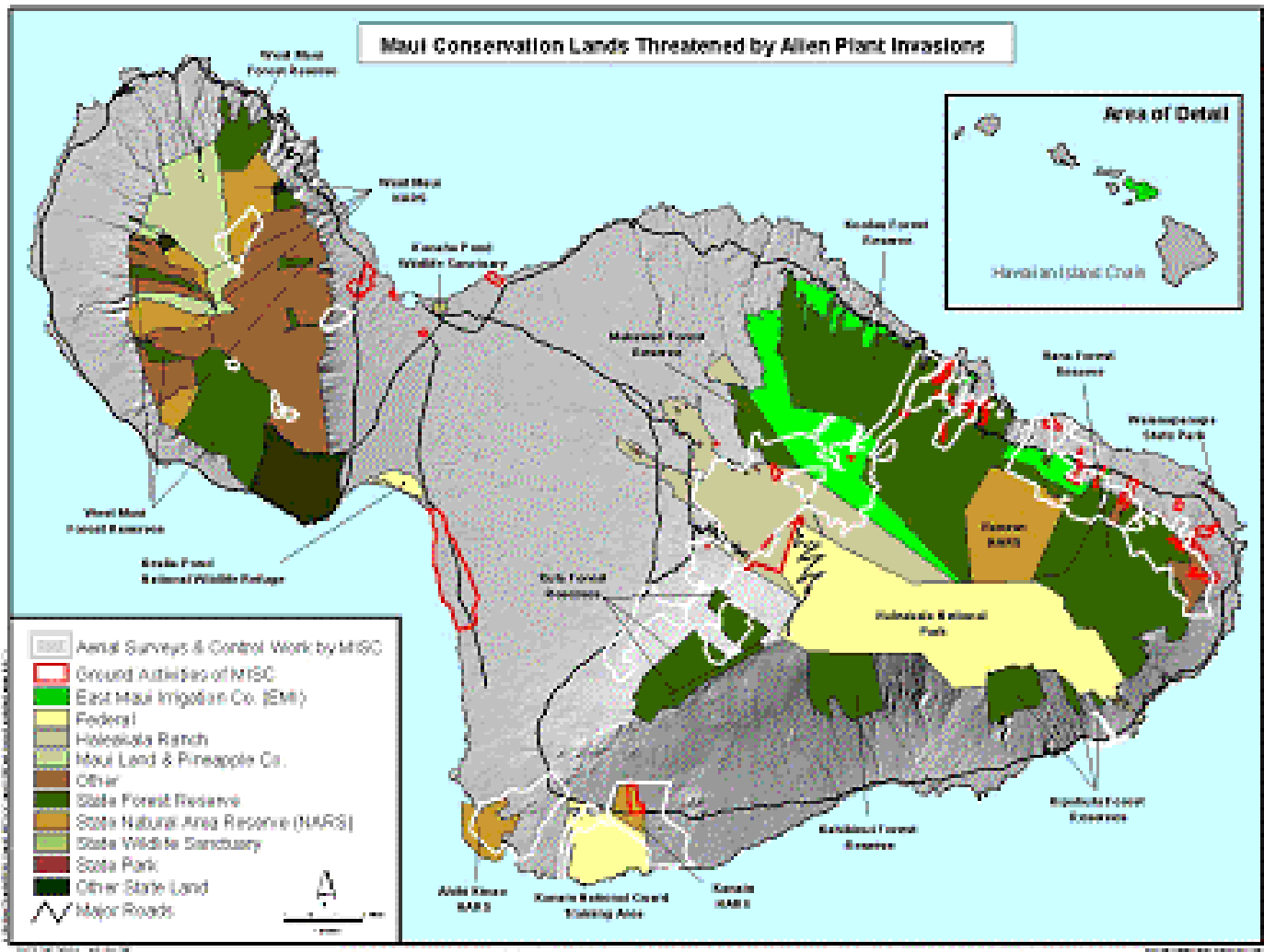
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Funds are actively sought from federal, state, county and private entities. In the past two years MISC has received financial assistance from several sponsors including the National Fish and Wildlife Foundation, The Nature Conservancy-Hawaii, Hawaii Community Foundation, County of Maui, State of Hawaii through the Department of Land and Natural Resources, U.S. Forest Service, and the U.S. Fish and Wildlife Service. Significant in-kind assistance has also been received from all of the 16 partners in MISC.

Maui County's recent commitment of \$400,000 for FY2002 (\$200K through the Maui County Office of Economic Development, \$200K through the Board of Water Supply) will provide the funding necessary for increased helicopter operations, and is a significant show of support for MISC and its mission, though this is just a portion of the 1.5 million needed annually for Maui to address the *Miconia* problem alone.

As a grass-roots partnership that has the capacity to survey, map, and control incipient invasive pests, acting as both a rapid response team and as a long-term invasive species management program, MISC has served as a model for similar efforts on three other islands. The Big Island (Hawaii) established a Melastome Action Committee (BIMAC) in 1995 and expanded its focus to become the Big Island Invasive Species Committee (BIISC) in 1999. Oahu formed the Oahu Invasive Species Committee (OISC), and Molokai formed a subcommittee of MISC- MoMISC, both in the fall of 2000, and Kauai is gathering participants and expects to have an ISC by then end of 2001. Each island has a different mix of agencies, personalities, and interest groups, and each can contribute uniquely toward effective grassroots action against invasive species. The ISCs also work under the umbrella of the statewide Coordinating Group on Alien Pest Species, or CGAPS to affect policy changes for the prevention of new species. The ISCs have not only impacted statewide conservation efforts, but have the potential for contributing to national and world models for such efforts.

## RESOURCES BENEFITED BY THIS PROJECT:



### TABLE OF FEDERALLY-LISTED THREATENED, PROPOSED ENDANGERED, AND ENDANGERED SPECIES BENEFITED BY MISC ACTION PLAN:

These species will have their survival negatively affected by uncontrolled spread of the six primary MISC target pest species. Genus and species names available on file.

#### Island of Maui

	Endangered	Threatened	Candidate	Species of Concern
<b>Plant</b>	76	2	31	84
<b>Animal</b>	17	3	11	?
<b>Total</b>	93	5	42	?

#### Maui County

	Endangered	Threatened	Candidate	Species of Concern
<b>Plant</b>	112	4	34	105
<b>Animal</b>	19	3	15	Several hundred
<b>Total</b>	131	7	49	?

Figure 1: MISC Priority Invasive Species Locations as of July 2001

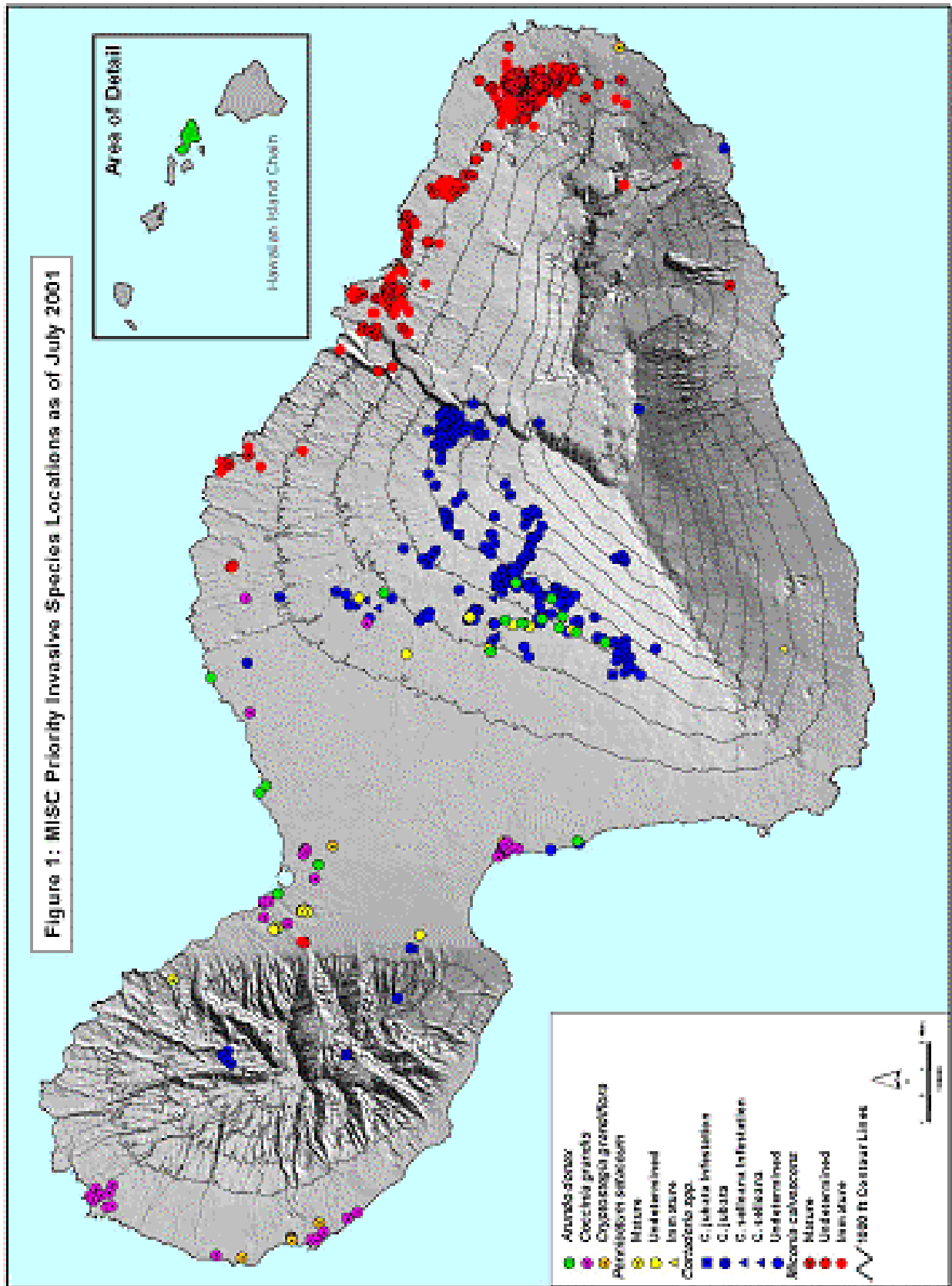


Figure 2: MISC Aerial Reconnaissance & Control Operations as of July 2001

