EXPERIMENTAL ERADICATIONS OF POTENTIALLY INVASIVE PLANT SPECIES ON THE ISLAND OF MAUI, HAWAII

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INTRODUCTION

In Hawaii, non-native plant species pose a serious threat to the state's economy, ecology, and way of life. Non-native invasive species over-run and cause eventual loss of native species, complicate agricultural operations, clog waterways, and destroy structures. Invasion and range expansion of many introduced organisms have often been observed to follow a pattern of slow initial spread followed by exponential growth. Different control strategies will have different priorities at different points of the invasion process. Control strategies include quarantine, eradication, containment, and integrated pest management. In general, ease of control decreases over time and cost of control increases over time.

Because of Hawaii's unique biogeography and isolation, many native species evolved without aggressive competitors and are vulnerable to introduced invasive species. At the same time, this isolation coupled with relatively small land mass provides the opportunity for eradication, complete removal of a species from an area, such that the cost to control that organism becomes zero.

The Maui Invasive Species Committee (MISC) was formed in 1997 with the idea of achieving eradications. MISC's experience with other target species has shown that eradication can be difficult to achieve within a relatively short timeframe. Nevertheless, MISC has demonstrated the ability to control all known individuals for several target species, e.g., *Melastoma candidum* (melastoma), *Parkinsonia aculeata* (Jerusalem thorn), and *Rhodomyrtus tomentosa* (downy rose myrtle). These species were all detected early (one to few cultivated sites) and controlled promptly. While there are caveats, such as potential for reintroduction, dormant seed banks, and undetected locations, the removal of these species are currently considered successes.

With funding from the United States Fish and Wildlife Service, MISC and the United States Geological Survey (USGS) attempted a one year project for island-wide eradication of 10 species, and local or regional eradication of 4 species. The target eradication species did not include current MISC target species. For the purposes of this project, "eradication" was defined as removal of all known individuals from a specific geographical area. Species selected for local or regional eradication had relatively small populations in geographically discrete areas and/or threaten high-value natural areas.

METHODOLOGY

The target species for eradication were selected through a process of identifying invasive plants that were present on the island of Maui in limited numbers only. A list of about 300 species was gathered from about 20 local expert botanists. Experts were asked to list a few plant species they felt were high priorities for control and not yet widespread on the island of Maui. For each species on the list it was then estimated how long it would take (1 day, 1 week, 1 month, or 1 year+) to control the all the known individuals based on a five person crew full time. The level of threat posed by each species (low, medium, or high) was also estimated, based on existing literature and expert opintions.

The list of species was then thinned by eliminating species that were considered to be a low threat, or would take more than one year to control, leaving a list of about 30 species. This was still too much to feasibly accomplish with the time and resources available, so the list was trimmed once more by eliminating species that would take greater than one month, leaving only those species that posed either a medium or high threat level and could be controlled by a full time five person crew in one day or one week. The result was a final list of 14 species.

A USGS team worked closely with MISC personnel to achieve the eradications. USGS was responsible for leading collaborative decision-making on priorities for control, surveying for the target species, producing materials to inform the public, generating support, obtaining information on new plant locations, refining methodology for data recording and management in cooperation with relevant invasive species data networks, and synthesizing the results to evaluate feasibility of eradications. MISC staff was responsible for making landowner contacts, obtaining access permissions, removing and treating all known individuals for which access/permission is obtainable, and interfacing with the news media and public.

Surveys for target species were done during roadside vehicle surveys by USGS. All roads on Maui were surveyed at about 5-10 mph recording species locations on a Garmin GPS unit. Follow-up surveys were done briefly to refine locations once control targets were chosen. Information for each species was gathered from literature and field observations. USGS provided the following materials to MISC for each species: 1 page write up giving brief overview, description, potential impact, distribution, and control methods; a more detailed 5-6 page report; island wide distribution maps and close in maps for each location; site information; and photos to help with identification. This information is also available on the internet at http://www.hear.org/starr. USGS also led a one day "weed tour" with the MISC crew to familiarize them with the target species and locations.

MISC hired one extra crew person who was rotated into the regular MISC program. The crew worked on eradication species when they were in the area or when they had time. When in the area of a eradication species, the crew stopped by the property and attained permissions to control the plants. Once permission was granted work days were scheduled and removal was planned and carried out. Further foot surveys of premises helped refine locations. Talking with landowners sometimes revealed the history of the introduction or helped find new locations. Once a plant was removed, monitoring and follow up was done to ensure successful control.

RESULTS

For this project, success was defined as "removal of all known individuals from a geographic area". This did not take seed bank, re-growth, or future influx into account. Another way of stating this is "all the known individuals were controlled once". It is recognized that this "success" is not a true eradication in the traditional sense, where the locations would be monitored and treated as necessary for the life span of the seed bank,

and active surveillance would occur for overlooked locations and new incursions. However, in an attempt to elucidate some patterns in the relative feasibility of successful eradications in relation to a host of potential complicating factors, it was decided to recognize that seed bank and future ingress can not be ignored, but if follow up resources were committed to the species, the current definition could be used for analysis purposes.

During this project, 8 out of 14 (57%) target species had all the known individuals controlled once. Of these 5 were island wide control efforts, *Acacia retinodes* (water wattle), *Macaranga mappa* (bingabing), *Maclura pomifera* (Osage orange), *Melastoma sanguineum* (Melastoma), and *Verbascum thapsus* (common mullein). There were also 3 successful local control efforts, *Caesalpinia decapetala* (cat's claw), *Macaranga tanarius* (parasol leaf tree), and *Morella faya* (firetree).

The other 6 out of 14 (43%) target species have not yet had all the known individuals controlled once. Of these, 5 were island wide, *Acacia auriculiformis* (earpod wattle), *Acacia mangium* (mangium wattle), *Acacia podalyriifolia* (Queensland silver leaf wattle), *Morella cerifera* (wax myrtle), and *Pittosporum viridiflorum* (Cape Pittosporum), and one was local, *Sideroxylon persimile* (bully tree).

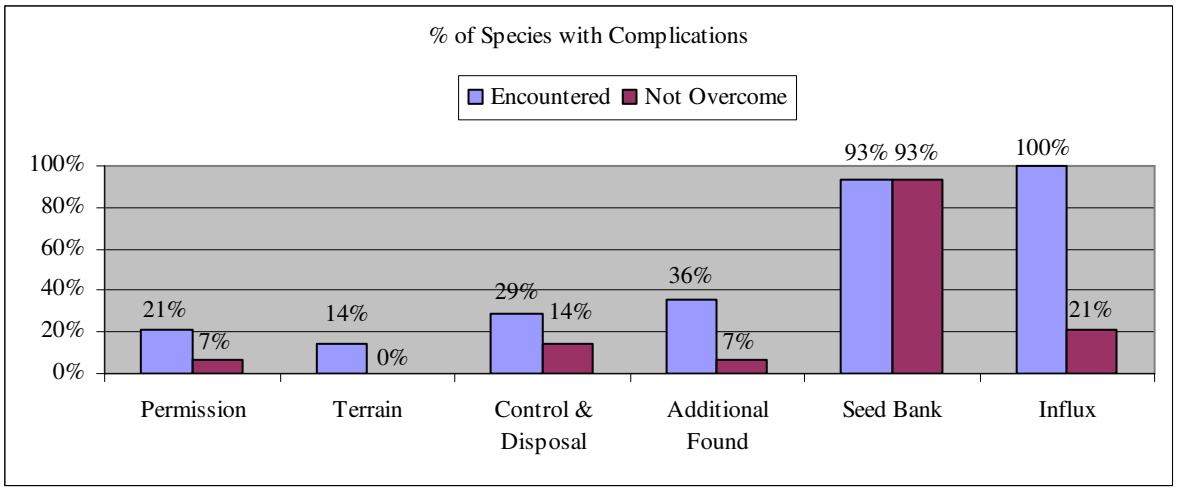
Species that had all the known individuals successfully controlled once shared a few characteristics in common. Most were still in the cultivated stage, showed very little evidence of spread, were restricted to single or few locations, and were on property with a cooperative land owner. Species that did not have all the known individuals controlled once, also had common traits. They were already naturalized, were found in many locations, had large amounts of biomass, or were on properties that had an uncooperative landowner.

Target Species and Their Associated Attributes

Scientific Name	**Controlled?**	**Scale**	**Locations**	**Acreage**	**Status**	**Land Use**
Acacia auriculiformis	No	Island	3	1+	Not sure	Residential
Acacia mangium	No	Island	2	1+	Not sure	Residential
Acacia podalyriifolia	No	Island	3	0.01	Cultivated	Residential
Acacia retinodes	Yes	Island	1	0.1	Naturalized	Residential
Caesalpinia decapetala	Yes	Local	1	0.01	Not sure	Residential
Macaranga mappa	Yes	Island	2	0.001	Cultivated	Residential
Macaranga tanarius	Yes	Local	2	0.01	Cultivated	Residential
Maclura pomifera	Yes	Island	1	0.01	Cultivated	Residential
Melastoma sanguineum	Yes	Island	1	0.001	Not sure	Residential
Morella cerifera	No	Island	2	0.1	Naturalized	Wildland
Morella faya	Yes	Local	1	0.01	Cultivated	Wildland
Pittosporum viridiflorum	No	Island	5	1+	Naturalized	Wildland
Sideroxylon persimile	No	Local	1	0.1	Naturalized	Residential
Verbascum thapsus	Yes	Island	1	0.01	Naturalized	Residential

COMPLICATIONS

When the project commenced, the factors expected to complicate eradication included ability to obtain access to property, site accessibility, incomplete knowledge regarding species distribution of population, established seed banks in the soil, and continued influx or re-establishment. In quantifying the percent of species that actually had complications, there were two categories defined, "encountered" and "not overcome". Encountered means the complication was encountered at least once. Not overcome means the complication had not yet been overcome by the time of this writing. Each one of these potential complications is discussed in detail below.

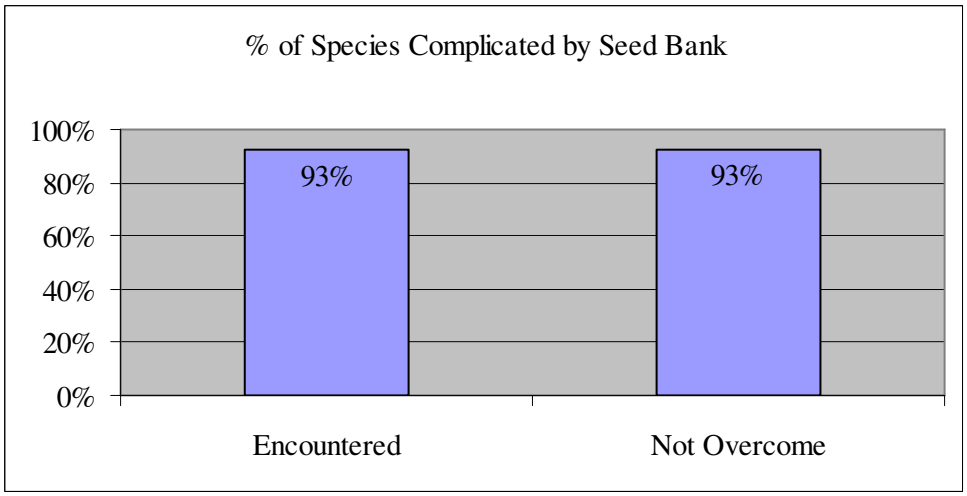


Complications Encountered

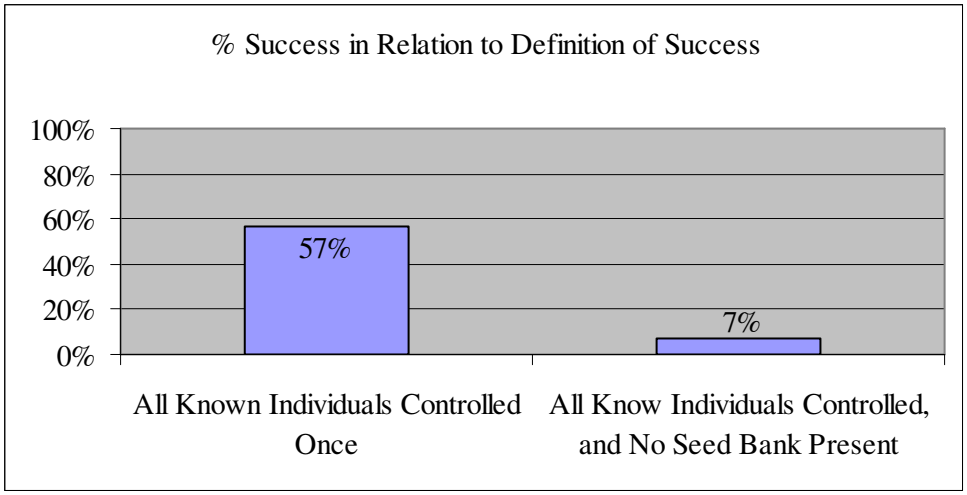
	Permission		Terrain		Biomass		More found		Seed bank		Influx	
Scientific Name	**Encountered**	**Not Overcome**	**Encountered**	**Not Overcome**	**Encountered**	**Not Overcome**	**Encountered**	**Not Overcome**	**Encountered**	**Not Overcome**	**Encountered**	**Not Overcome**
Acacia auriculiformis	--	--	--	--	X	X	--	--	X	X	X	--
Acacia mangium	--	--	--	--	X	X	--	--	X	X	X	--
Acacia podalyriifolia	X	X	--	--	--	--	X	--	X	X	X	--
Acacia retinodes	--	--	--	--	--	--	X	--	X	X	X	--
Caesalpinia decapetala	--	--	--	--	--	--	--	--	X	X	X	--
Macaranga mappa	X	--	--	--	--	--	X	--	X	X	X	X
Macaranga tanarius	--	--	--	--	X	--	X	--	X	X	X	--
Maclura pomifera	X	--	--	--	X	--	--	--	X	X	X	--
Melastoma sanguineum	--	--	--	--	--	--	--	--	X	X	X	X
Morella cerifera	--	--	X	--	--	--	--	--	X	X	X	--
Morella faya	--	--	X	--	--	--	--	--	--	--	X	--
Pittosporum viridiflorum	--	--	--	--	--	--	X	X	X	X	X	--
Sideroxylon persimile	--	--	--	--	X	X	--	--	X	X	X	--
Verbascum thapsus	--	--	--	--	--	--	--	--	X	X	X	X

SEED BANK

A persistent seed bank is one of the most commonly encountered and debilitating complicating factors. Persistent seed bank and root systems as a complicating factor was encountered in 93% of species and was not overcome in 93% of species. Existence and persistence of seed bank and underground growth should factor heavily in control planning.

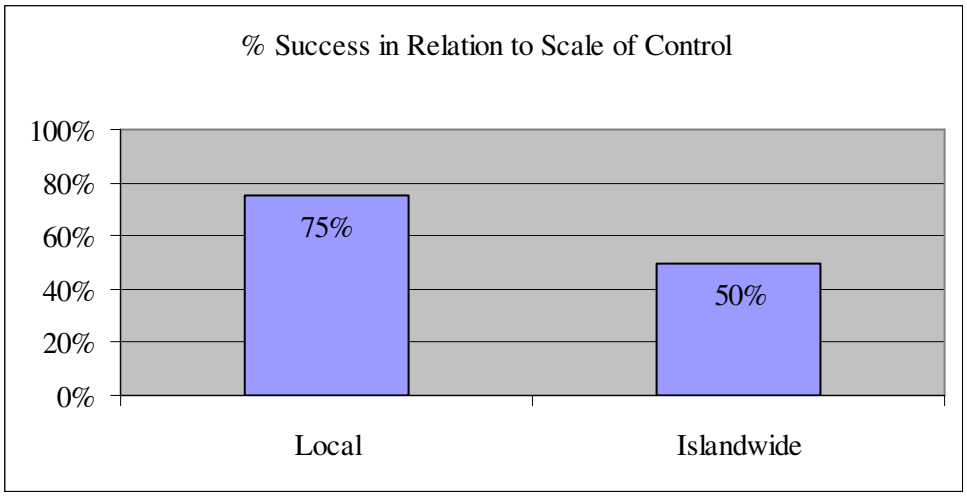


Looking at success in relation to seed bank as a complicating factor, it appears that true eradication success decreases dramatically when there is a seed bank or persistent root system present. Success defined as "controlled all the known individuals once" occurred for 57% of the species. Success defined as "eradication, including seed bank and re-growth" occurred for 7% of the species. Control programs focused on species with a short-lived or preferably non-existent seed bank, and a non-persistent root system, will seemingly be the most successful.



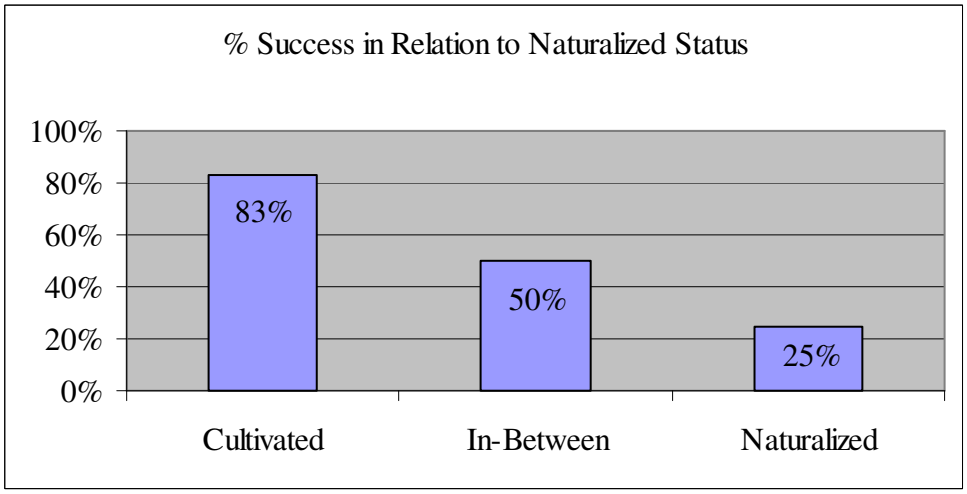
GEOGRAPHIC SCALE OF CONTROL

The success rate appears to decline in relation to increasing scale of control. Species controlled over a local scale were successfully controlled 75% of the time. Species controlled over an island-wide scale were successfully controlled 50% of the time. Local control is less desirable than island-wide control, but is seemingly more attainable.



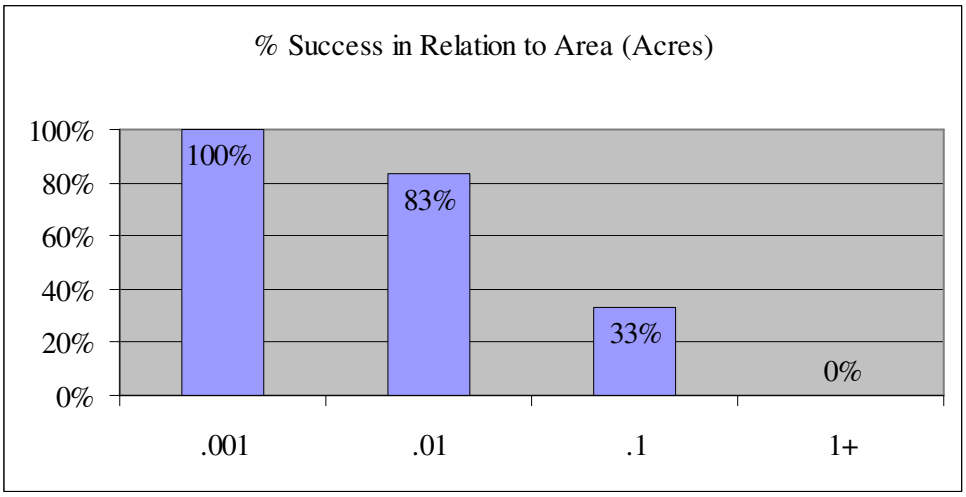
NATURALIZED STATUS

It appears that control efforts targeted on cultivated species will be the most successful. Species considered cultivated were successfully controlled 83% of the time. Species considered in-between cultivated and naturalized were successfully controlled 50% of the time. Species considered naturalized were successfully controlled 25% of the time. Control programs focused on cultivated species will seemingly be the most successful.



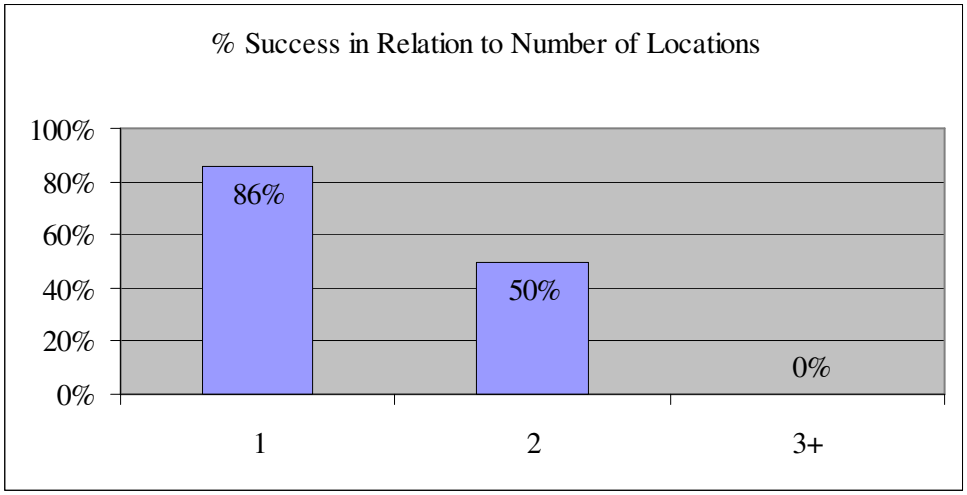
AREA OCCUPIED

The success rate appears to decline in relation to the area occupied by the species. "Net area", the area actually occupied by the species, was calculated for each species. Species that occupied .001 acres were successfully controlled 100% of the time. Species that occupied .01 acres were successfully controlled 83% of the time. Species that occupied .1 acres were successfully controlled 33% of the time. Species that occupied 1+ acres were successfully controlled 0% of the time. The success rates for species that cover more area would likely increase if more resources were available. However, that likely wouldn't change the general trend. Control programs focused on species covering the fewest acres, preferably .001 acres or less, will seemingly be the most successful.



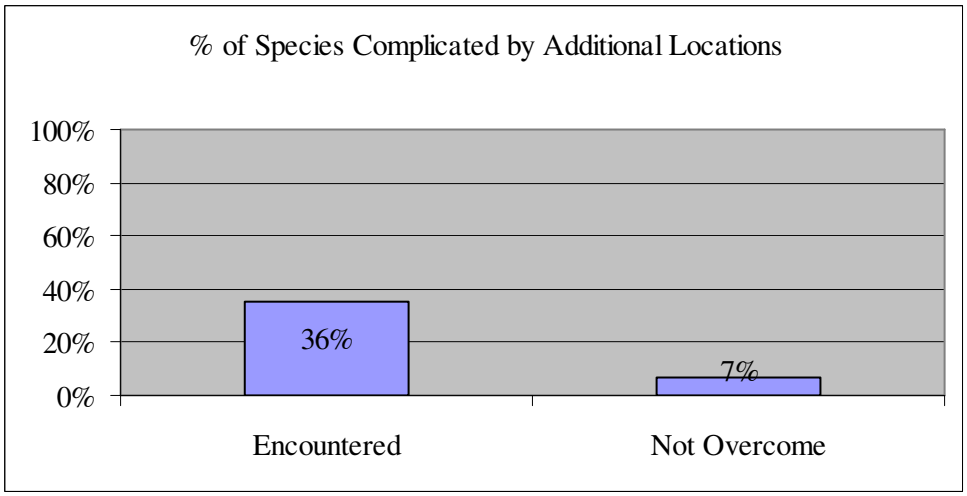
NUMBER OF LOCATIONS

The success rate appears to decline in relation to the number of locations. Species with one location were successfully controlled 86% of the time. Species with two locations were successfully controlled 50% of the time. Species with three or more locations were successfully controlled 0% of the time. Perhaps if more resources were available, the number of locations that could be successfully controlled would increase. Regardless, it appears that control programs focused on species with the fewest locations, preferably one, will seemingly be the most successful.

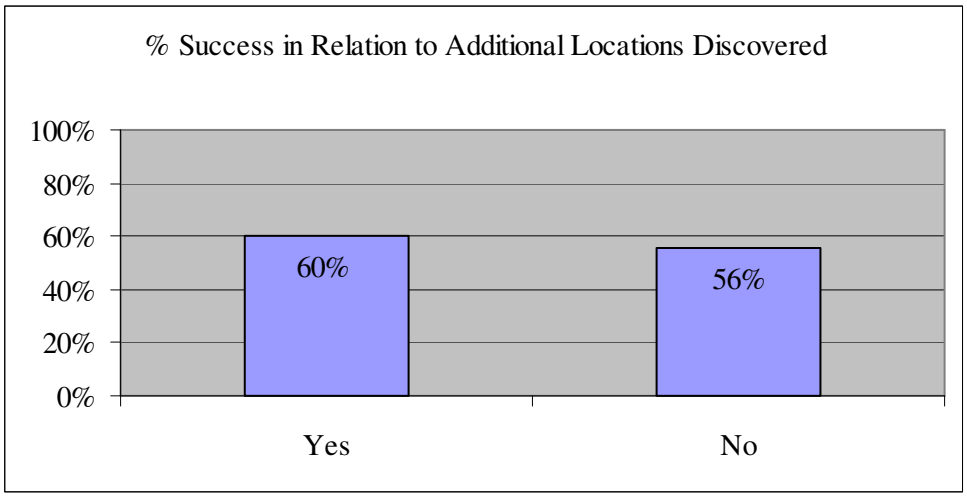


ADDITIONAL LOCATIONS FOUND

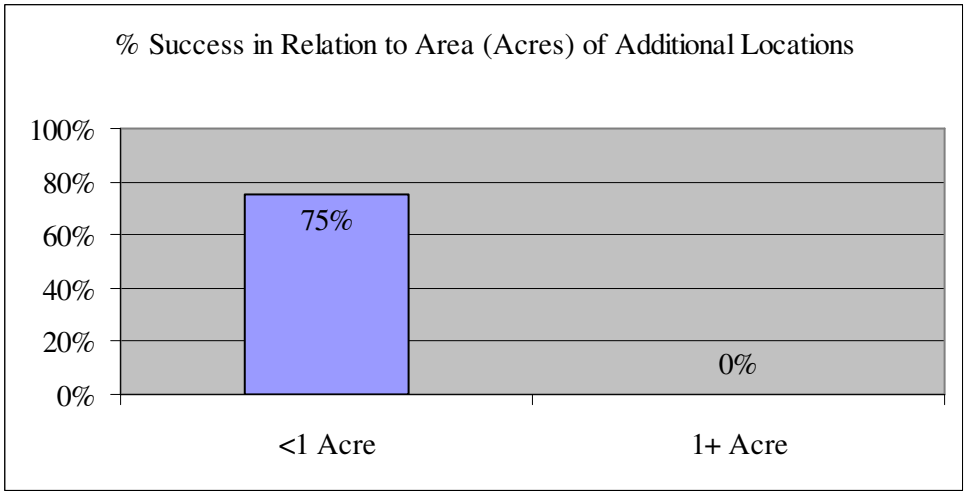
Additional locations were occasionally a complicating factor, but only rarely were they not overcome. Discovery of additional locations as a complicating factor was encountered in 36% of species and was not overcome in 7% of species.



When comparing success between species that had additional locations discovered, and those that didn't, there didn't appear to be a big difference. Species where additional locations were discover were successfully controlled 60% of the time. Species where additional locations were not discovered were successfully controlled 56% of the time. Additional locations didn't seem to inherently help or hinder control efforts.

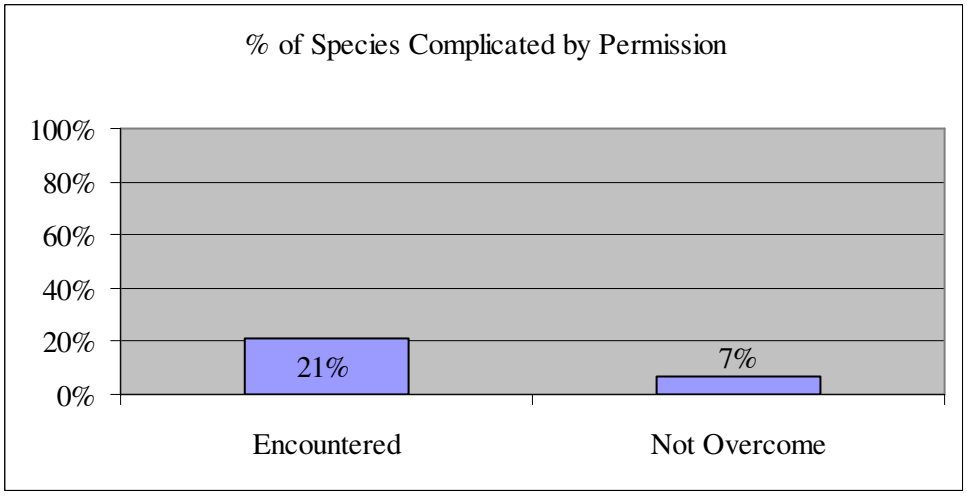


However, when the additional locations are broken down further it appears success is much higher with species whose additional locations cover less area. Species whose additional locations covered <1 acre were successfully controlled 75% of the time. Species whose additional locations covered 1+ acre were successfully controlled 0% of the time. So it appears success depends not as much on whether new locations are found or not, but rather on how much area the new locations occupy. Control programs focused on targets with additional locations covering less than one acre will seemingly be the most successful.

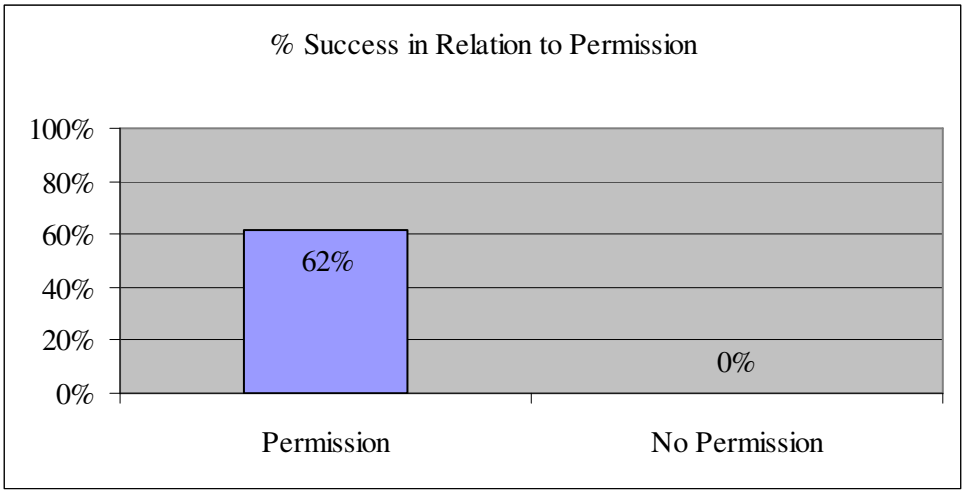


PERMISSION

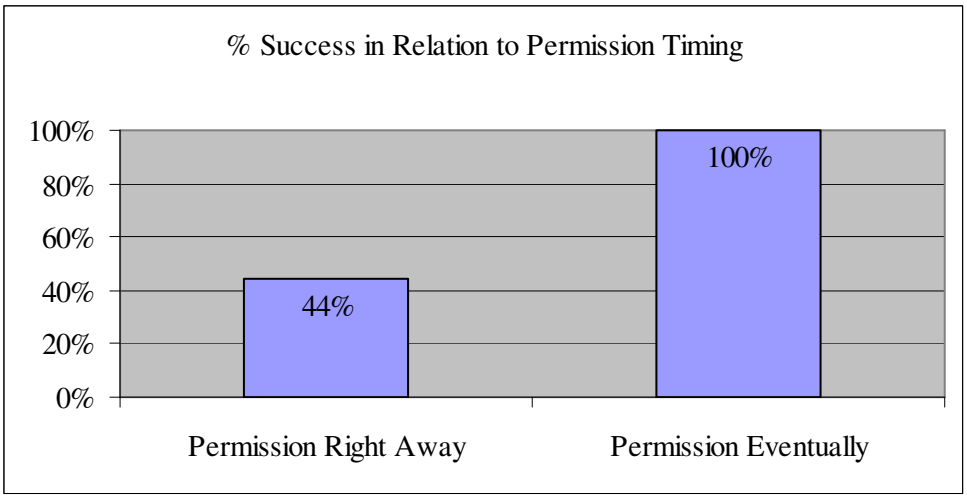
Lack of permission was occasionally encountered, but only rarely was it not overcome. Permission as a complicating factor was encountered in 21% of species and was not overcome in 7% of species.



Though complete lack of permission is rarely encountered, the success rate appears to decline dramatically when permission is not obtainable. Species where permission was obtained were successfully controlled 62% of the time. Species where permission was not obtained were successfully controlled 0% of the time. Control programs that are able to gain permission to enter property and do control work will seemingly be the most successful.



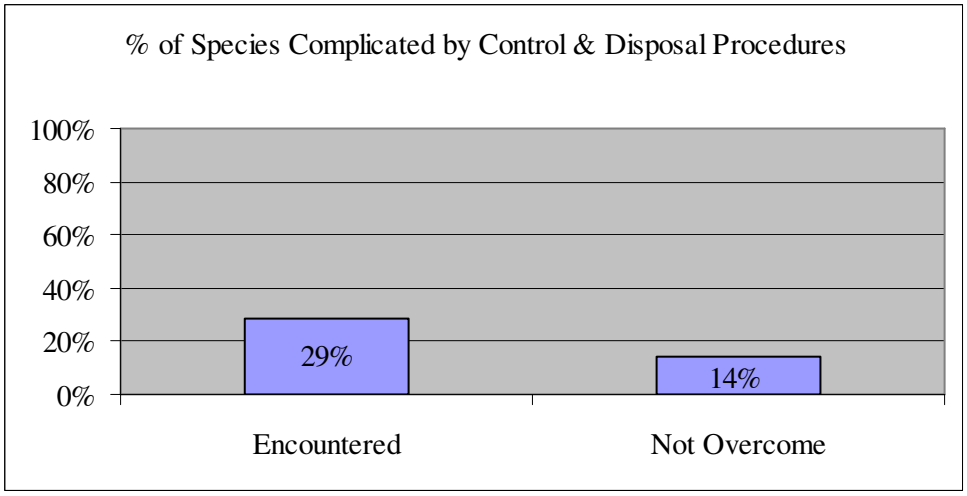
Permission can be broken down even further, into those species where permission was obtained right away, and those species where some landowners originally did not grant permission, but eventually did grant permission. Species that had permission right away were successfully controlled 44% of the time. Species that had permission eventually were successfully controlled 100% of the time. It appears that persistence pays when it comes to asking for permission, especially if the only thing preventing successful control is permission.



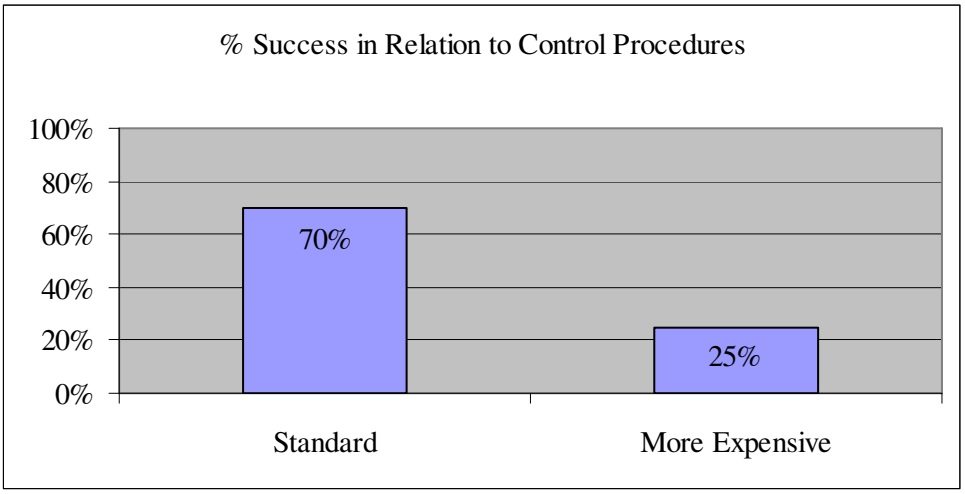
All of the landowner's that had "Hawaii State noxious weeds" on their property were cooperative, and granted permission for access and control. The lone case of continued denial of permission was not a Hawaii State noxious weed. Permission is the only complicating factor that can be 100% resolved through legislation.

CONTROL AND DISPOSAL

Occasionally encountered and sometimes not overcome, control and disposal as a complicating factor was encountered in 29% of species and was not ovecome in 14% of species.

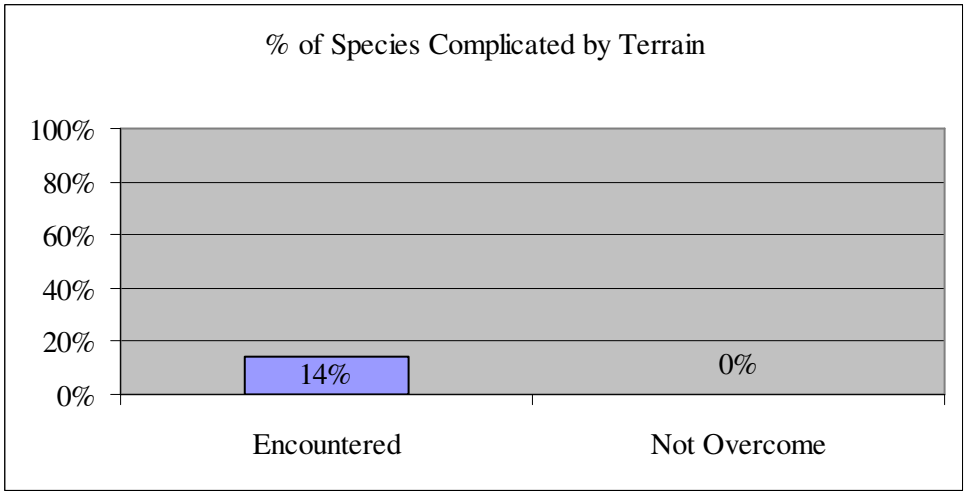


It appears that control efforts targeted on species that can be controlled using standard control procedures will be the most successful**.** When standard control procedures were able to be used there was a greater likelihood of success. Species for which standard control procedures could be used, such as hand tools and herbicide, were successfully controlled 70% of the time. Species for which more expensive control procedures needed to be used, such as chippers and bucket trucks, were successfully controlled 25% of the time. Perhaps additional resources would have allowed for more success using expensive control procedures. Regardless, control programs focused on targets that can be controlled using standard procedures will seemingly be the most successful.

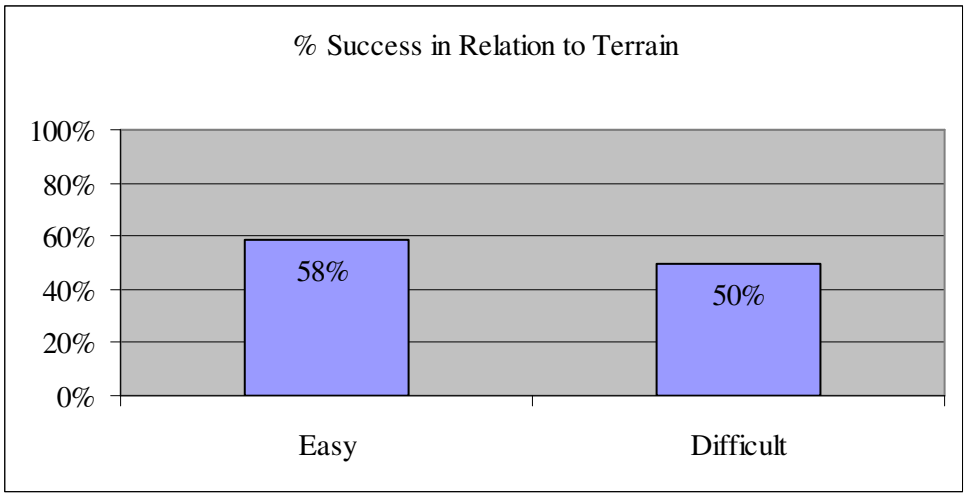


TERRAIN / LAND USE

Rarely encountered and always overcome, difficulty of negotiating terrain as a complicating factor was encountered in 14% of species and was not overcome in 0% of species.

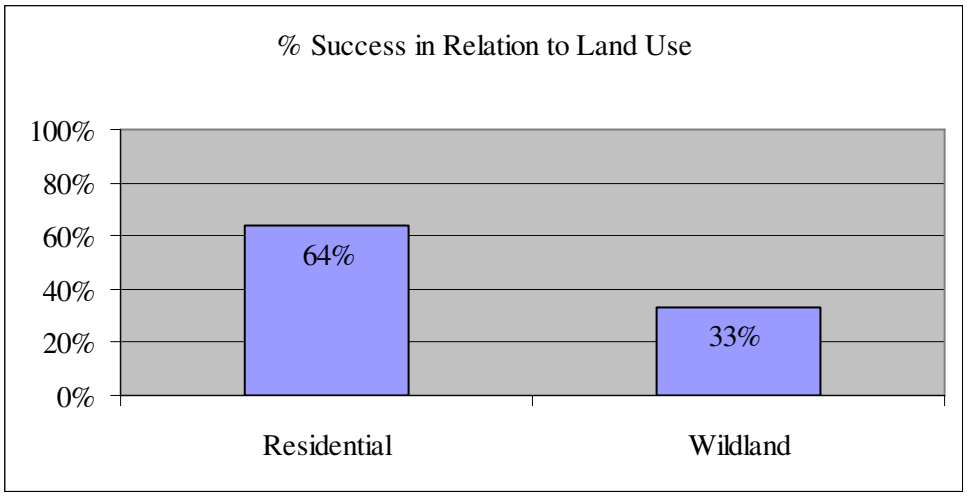


Slightly greater success can apparently be had in areas with easy terrain. However it appears that terrain does not make a significant difference in success rate. Species that occurred in easy terrain were successfully controlled 58% of the time. Species that occurred in difficult terrain were successfully controlled 50% of the time. Though the difference in success rate is slight, control programs focused on targets in more accessible terrain will seemingly be the most successful.



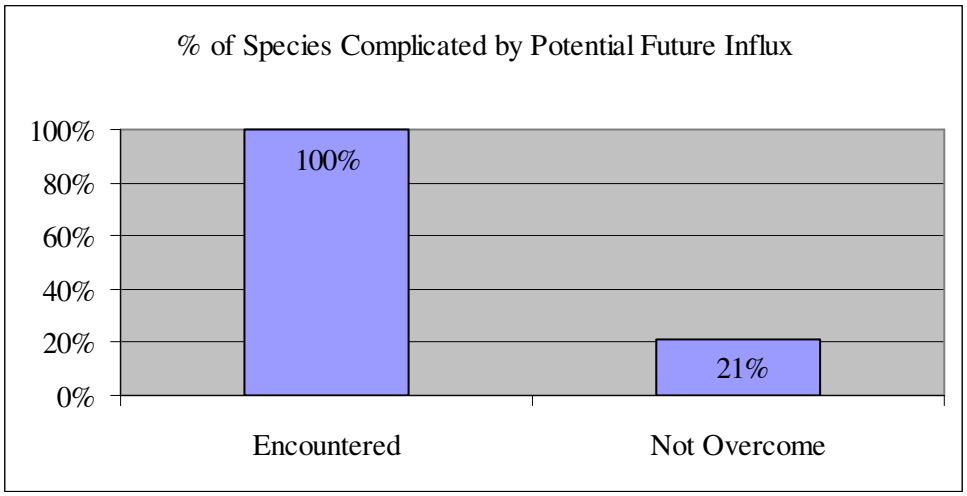
It should be noted the most difficult to access sites were controlled by a cooperating agency. If it were not for this assistance, terrain would have potentially been a greater complicating factor.

Another way to look at terrain is by land use. It appears greater success can be had in residential settings than in wildland settings. Species that occurred in residential areas were successfully controlled 64% of the time. Species that occurred in wildland areas were successfully controlled 33% of the time. Control programs focused on targets in more accessible locations, such as residential areas, will seemingly be the most successful.

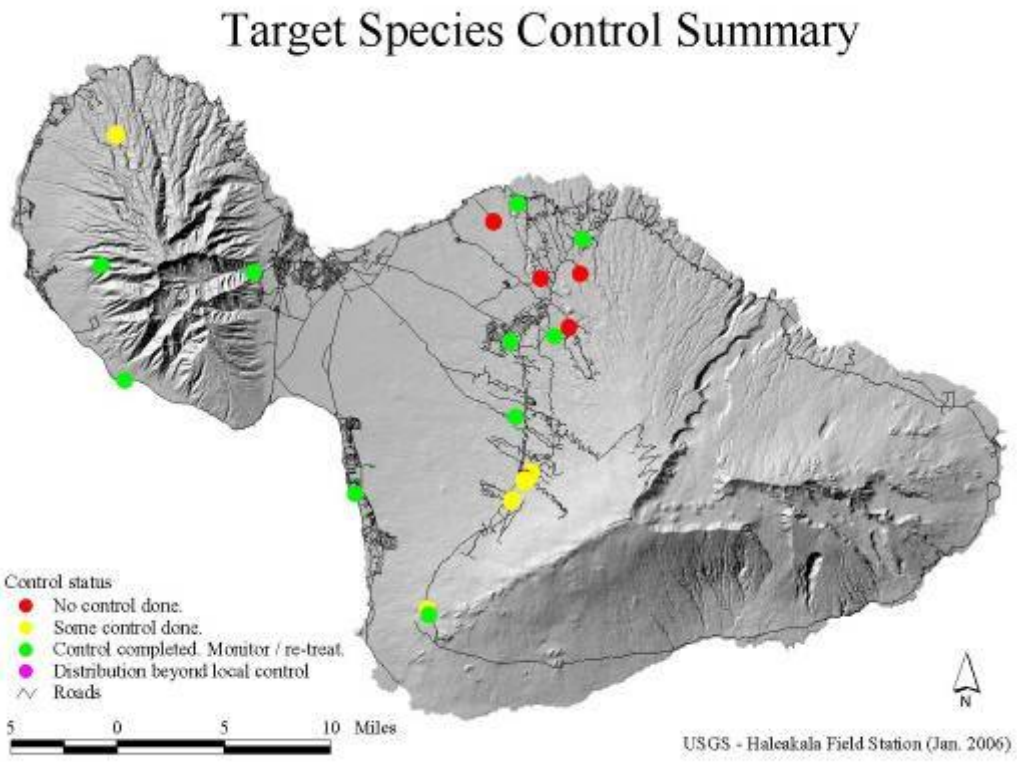


INFLUX

Potential for future influx was the most commonly encountered complication, it is also one of the hardest to adequately address. Potential for future influx as a complicating factor was encountered in 100% of species and known vectors were found to exist for 21% of species. It should be noted that potential for influx in the future is a tough complication to quantify, and there very well could be more species placed in the not overcome category, only time will tell.

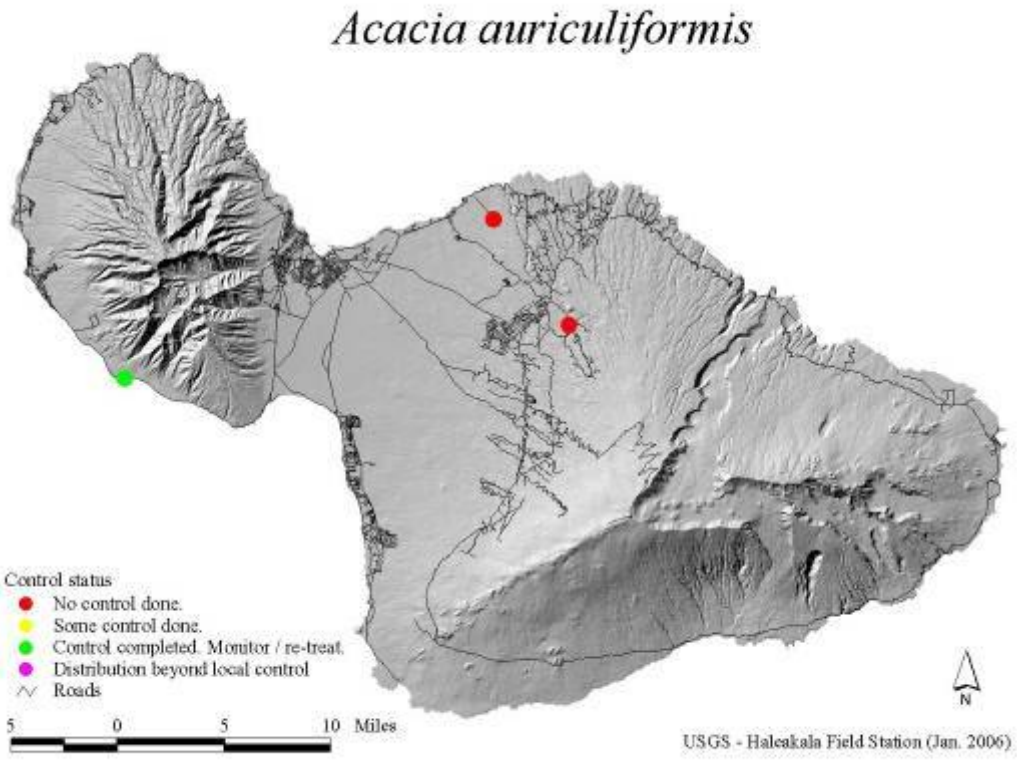


Many of these plants are common in horticultural, forestry, landscaping, and folk remedy circles, and all but three of the fourteen (79%) could be legally imported, propagated, or transported. All but one (93%) of the species were quickly found for sale on the internet. Beyond intentional introduction, three of the fourteen (21%)have been found as unintentional hitchhikers from infested areas into non-infested areas. This generally occurs on hapuu (*Cibotium*) ferns, or in the soils associated with potted plants. Control programs focused on species that do not have known influx vectors will seemingly be the most successful.



Above is a summary map of the control that has been done on the 14 experimental eradication species. It includes all the species in the project, though only locations targeted for control are included here. Red dots indicate locations where no control has been done yet. Yellow dots indicate locations where some control has been done, but more has yet to be done to control all the known individuals once. Green dots indicate locations where all the known individuals have been controlled once, and the location has entered the monitor and re-treat phase.

The following pages contain a summary of control work accomplished, by species. Information includes a map showing the above information plus purple dots which indicate the locations of target species beyond control locations. Each species summary also contains a summary of the island status, updates for each known location, a list of location or species specific advantages, and a list of the obstacles to successful eradication of the target species from the island of Maui.



MAUI - One small planting was controlled. Two large patches remain.

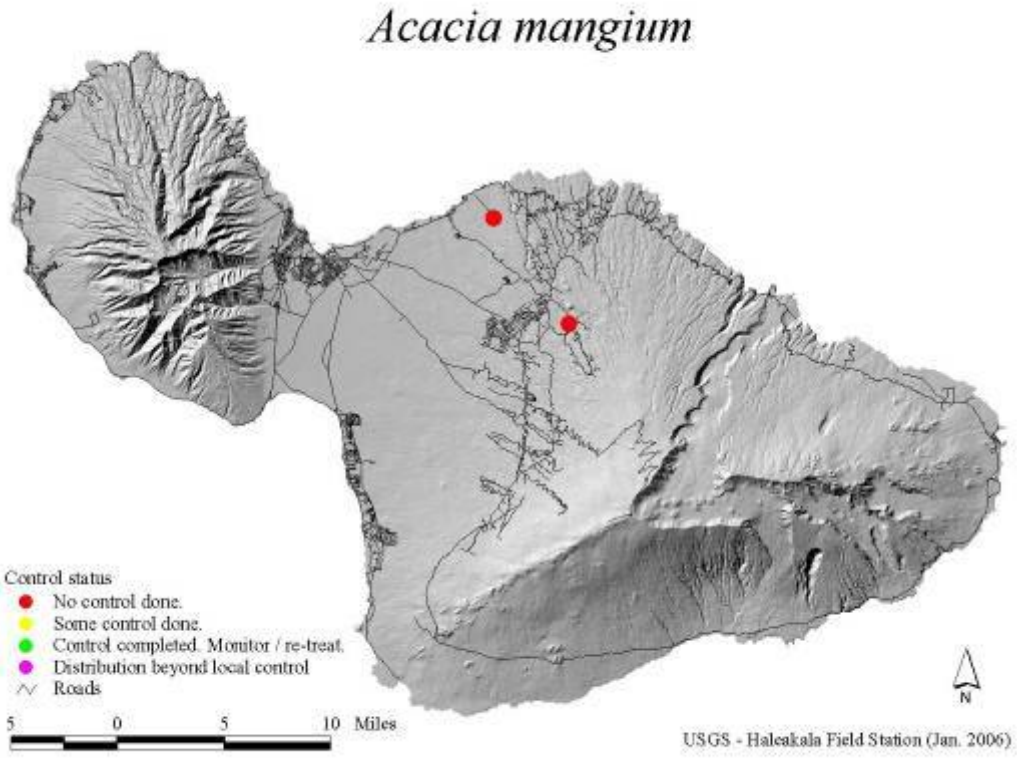
PIIHOLO - No control done. Permission has been obtained. However, biomass and equipment contamination issues have complicated eradication.

H-POKO - No control done. The same complications experienced at Piiholo are also present at this site.

OLOWALU - Control completed. The small tree at this site was removed. Site will be monitored, and re-treated as necessary.

ADVANTAGES
- Good landowner relations for all sites.
- Trees located at MISC's current and old headquarters are easily accessible.
- Only limited spread beyond current locations.

COMPLICATIONS
- Large amounts of biomass requiring chainsaws and chipping.
- Large seed bank.



MAUI - The situation is similar to *A. auriculiformis*, two large patches preclude easy control.

PIIHOLO - No control done. Permission has been obtained. However, biomass and equipment contamination issues have complicated eradication.

H-POKO - No control done. The same complications experienced at Piiholo are also present at this site.

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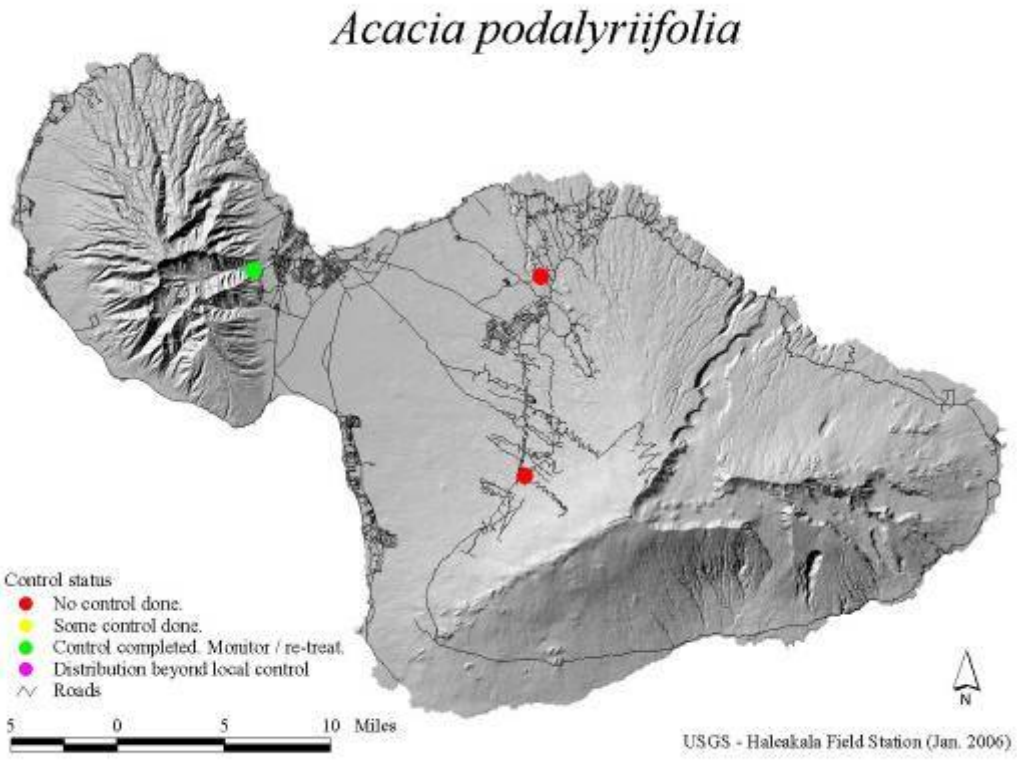
- Trees located at MISC's current and old headquarters are easily accessible.
- Large seed bank.



MAUI - The West Maui plants have been controlled. The East Maui plants remain.

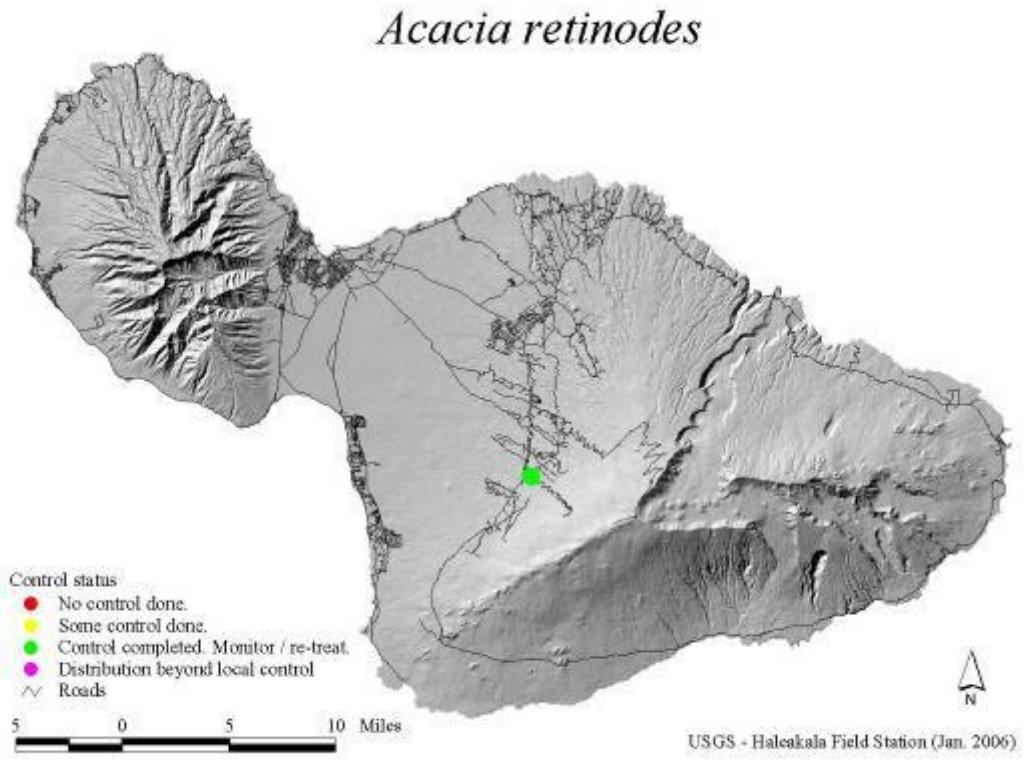
IAO - Control completed. Location now in monitor and re-treat phase. The plants in Iao Botanical have all been controlled by the owner.

HAIKU - No control done. The plant, grown from the Waipoli tree remains.

WAIPOLI - No control done. A large sprawling plant remains by the side of the road. This is the parent plant of the other locations known on Maui. The owner does not want the plant controlled.

ADVANTAGES
- Easy terrain.
- Cultivated.
- Biomass is minimal.
- Only locations known in State.

COMPLICATIONS
- Did not gain permission at one location.
- A seed bank now exists.
- Likely more out there, as plant was accessible and was given away.



MAUI - All the known trees have been controlled once. However, a persistent seed bank necessitates monitoring and control of re-growth.

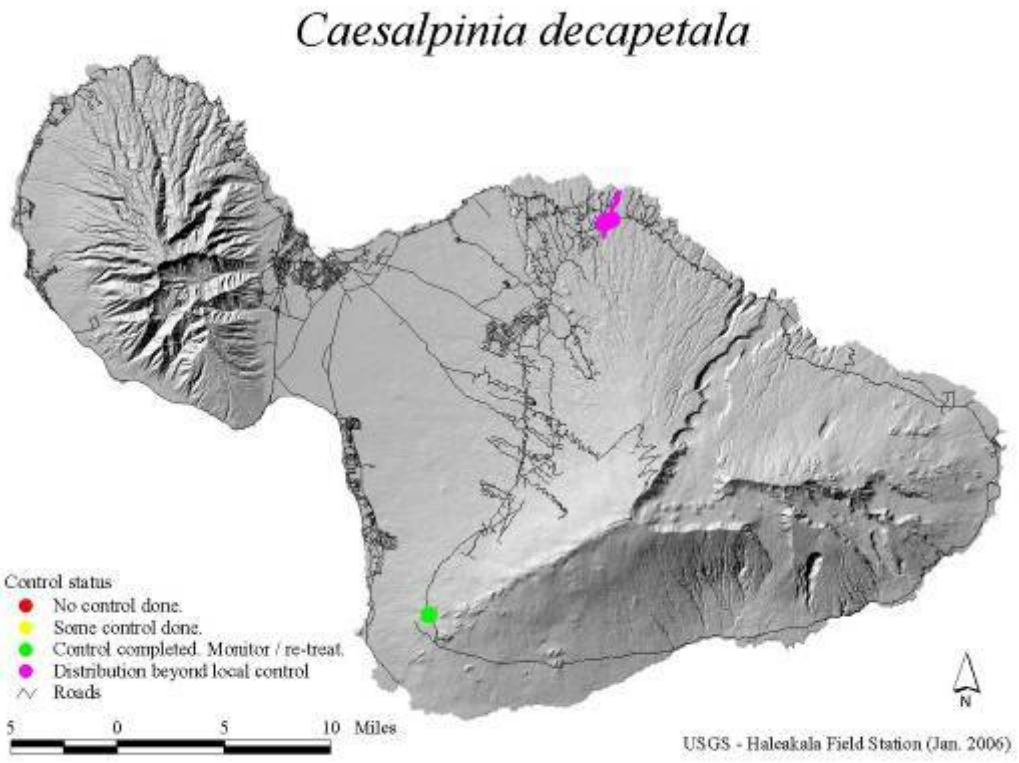
WAIPOLI - Control completed. Location now in monitor and re-treat phase. The landowner of the only known site of this species on Maui was cooperative. All the known plants were controlled, but follow up is necessary due to a seed bank..

ADVANTAGES

- Single cooperative landowner.
- MISC found other target control species on the property and gained permission to monitor and control them also.
- Control relatively easy.
- Just beginning to spread, trees not far from original planting.
- Biomass not a problem.

COMPLICATIONS

- A presumably long-lived seed bank, that continues to germinate.

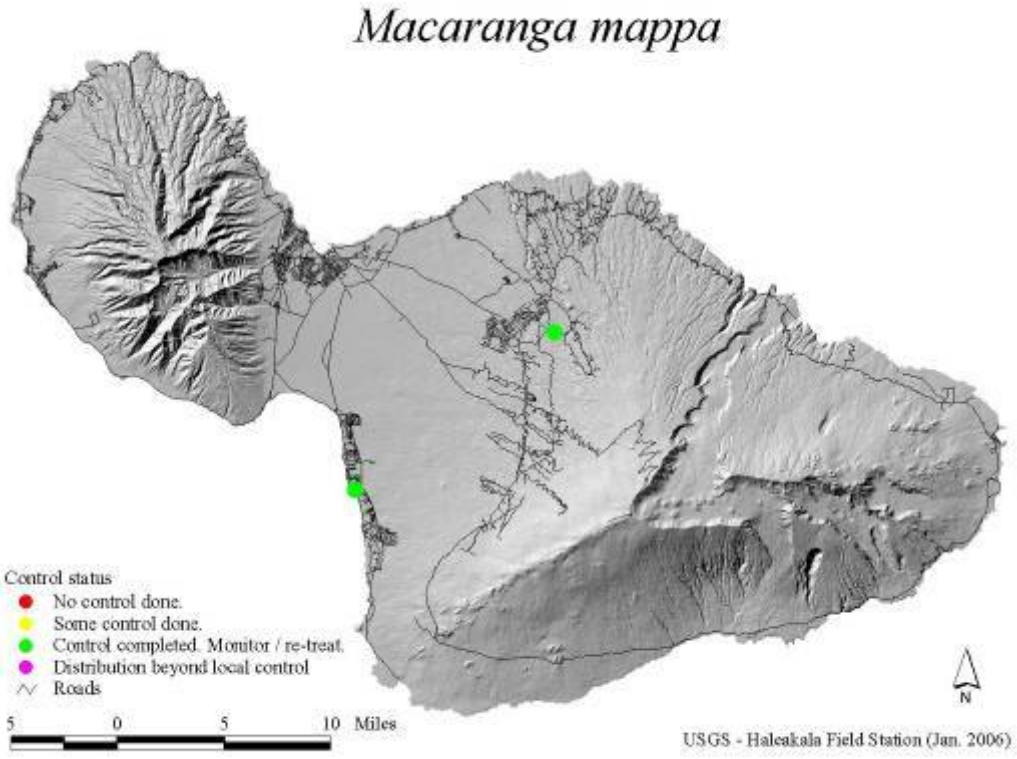


MAUI - The small lone patch in Ulupalakua has been controlled. The large patch in Kakipi Gulch near Haiku still persists.

ULUPALAKUA - Control completed. Location now in monitor and re-treat phase. The small patch was controlled, and has been monitored for re-growth. No signs of regeneration have been observed to date.

ADVANTAGES
- Permission easily obtained, as caretaker of property was an acquaintance.
- Plants had not spread far.
- Terrain was easy.
- Biomass minimal.

COMPLICATIONS
- A seed bank presumably exists.
- Still established on East Maui, and most other Hawaiian Islands.



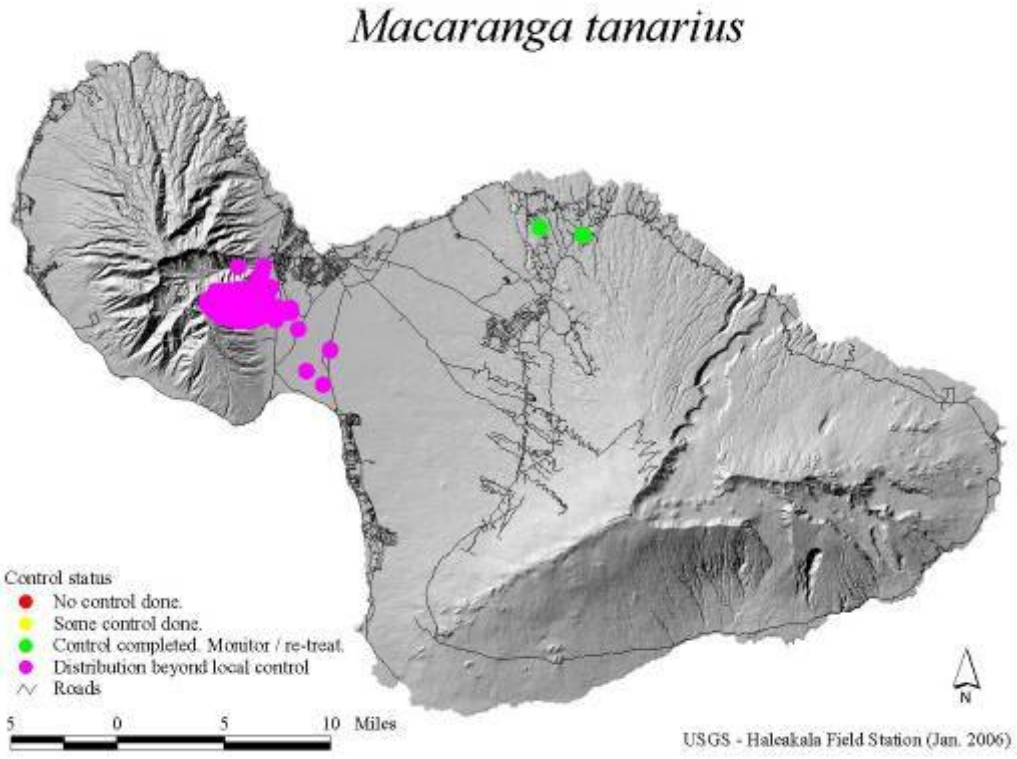
MAUI - The Olinda location has been controlled. However, a recently discovered Kihei location highlighted a persistent import vector for this species, potted plants from Hawaii.

OLINDA - Control completed. Location now in monitor and re-treat phase. After wavering on permission, the lone tree was eventually controlled. No re-growth has been observed.

KIHEI - Control completed. Location now in monitor and re-treat phase. A couple small plants were discovered during the project. The plants at this location were controlled, but it highlighted the fact that *M. mappa* is being shipped to Maui in potted plants from the island of Hawaii.

ADVANTAGES
- Permission was eventually granted at all sites.
- Terrain was easy.
- Biomass was minimum.

COMPLICATIONS
- Lack of permission stalled control at one site for a while.
- With large infestations on other islands, and an established influx vector, re-introduction seems likely.



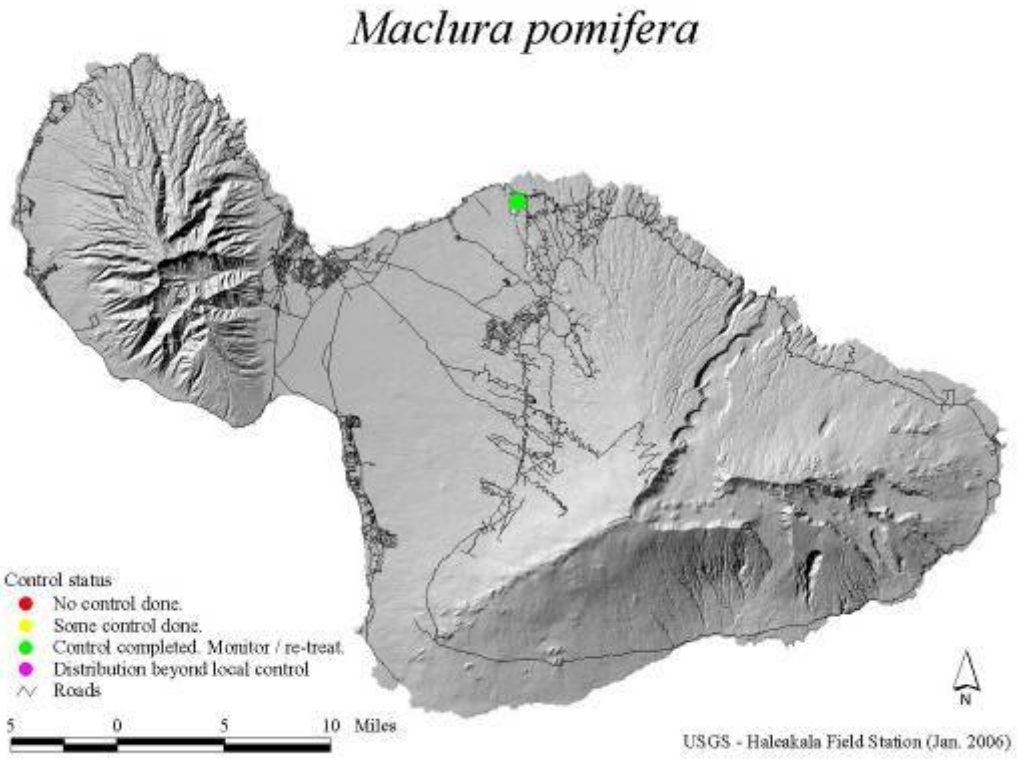
MAUI - The lone tree in Ulumalu was controlled. More trees on East Maui were discovered, and the West Maui population continues to spread.

ULUMALU - Control completed. Location now in monitor and re-treat phase. The lone tree was removed by a professional tree trimming company, as there were sensitive plants under the tree.

HAIKU - Control completed. Location now in monitor and re-treat phase. The landowner of the Ulumalu location mentioned that he had recently planted some plants on a property nearby in Haiku and that *M. tanarius* plants had sprouted from the pots as a contaminant. He considered them a weed, and the plants at this new location were removed.

ADVANTAGES
- Landowner was cooperative.
- Dioecious, male and female parts on different plants, with one plant present.

COMPLICATIONS
- Large tree in landscaped area required extra attention and professional removal.
- High potential for spread from infested areas on West Maui, especially in potted plants.

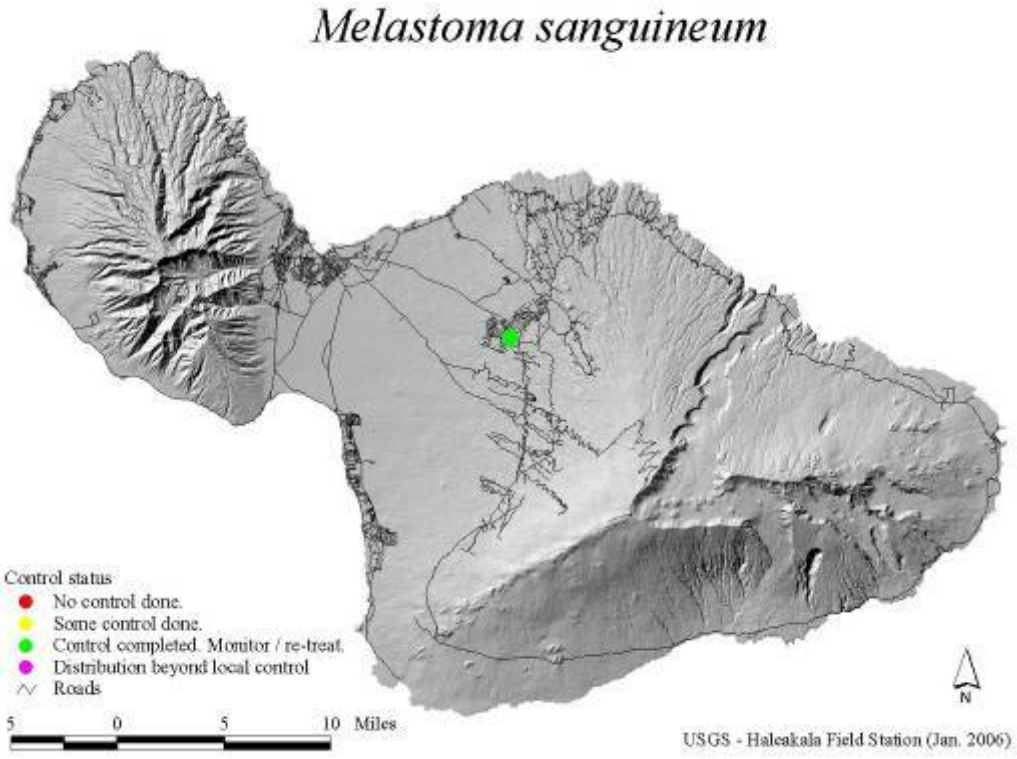


MAUI - The lone hedge in Haiku has been controlled. There is some re-growth.

HAIKU - Control completed. Location now in monitor and re-treat phase. The lone hedge was removed. Half was removed by MISC, and half was removed with a backhoe by the landowner. There is re-growth that requires re-treatment, and the landowner has been assisting with that.

ADVANTAGES
- Easy terrain
- Single location.
- Cultivated plants, with no signs of spread.
- Permission to remove hedge was granted, albeit conditionally.
- Dioecious, male and female parts on different plants, with only males present.
- No seed bank.

COMPLICATIONS
- Plant located along a busy road with fast moving traffic.
- Plant had to be handled carefully because of large thorns.
- Large biomass required extra resources.
- Plant had to be removed over time in sections, at landowner request.

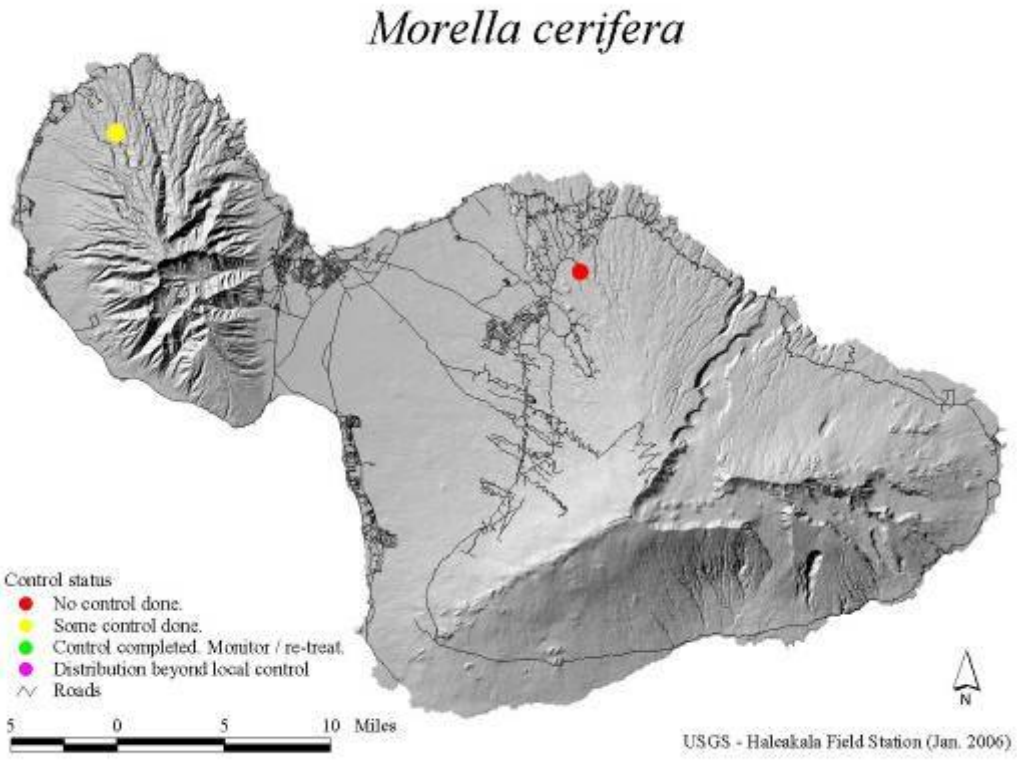


MAUI - All the known plants on Maui have been controlled. However, this species likely is continually being re-introduced to Maui from the island of Hawaii.

PUKALANI - Control completed. Location now in monitor and re-treat phase. The plant was controlled. No signs of re-growth have been noted. This is the last known *Melastoma sanguineum* on the island. The landowner reported that they did not purchase or plant the plant, but that it appeared as a volunteer on her hapuu fern (*Cibotium* sp.) which originally came from the Big Island, where *M. sanguineum* is naturalized.

ADVANTAGES
- Single location with no sign of spread.
- Permission to remove plant was granted.
- Small plant was removed early and did not re-grow.
- The genus is on the Hawaii state noxious weed list.
- A Hawaii State noxious weed.

COMPLICATIONS
- This species is being continually shipped to Maui from the island of Hawaii.



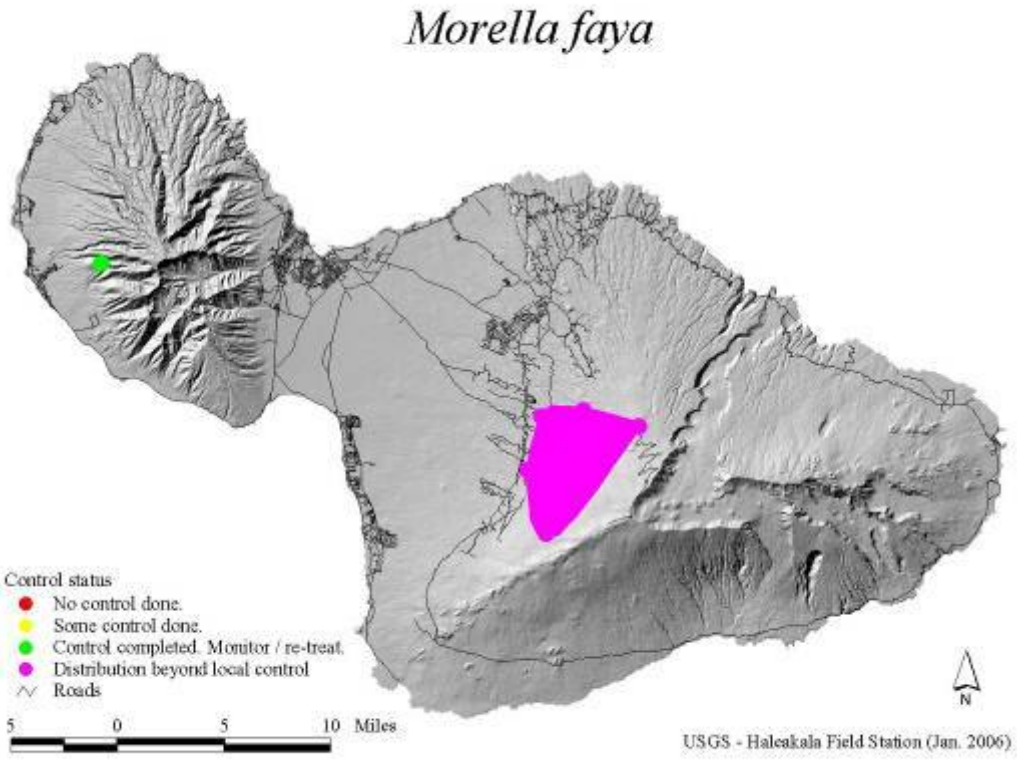
MAUI - The lone hedge in Haiku persists, the West Maui plants also persist.

HAIKU - No control done. The cryptic nature of this species made re-locating the population difficult for the MISC crew, which went out to the Ha'iku site and searched the property but did not find it.

WEST MAUI - Some control done. The original plantings in Fleming Arboretum have been controlled, but there are still plants on the steep walls of Honolua Valley, and there is a seed bank.

ADVANTAGES
- Easy terrain at Haiku site.
- Permission was readily granted.

COMPLICATIONS
- The plant is somewhat inconspicuous, and proved difficult to re-locate.
- Terrain on West Maui is extremely steep, making control difficult.
- Seed banks now exist at both locations.
- This is a popular folk medicine plant, and is easily obtainable.



MAUI - The lone trees on West Maui were controlled. The East Maui population continues to spread.

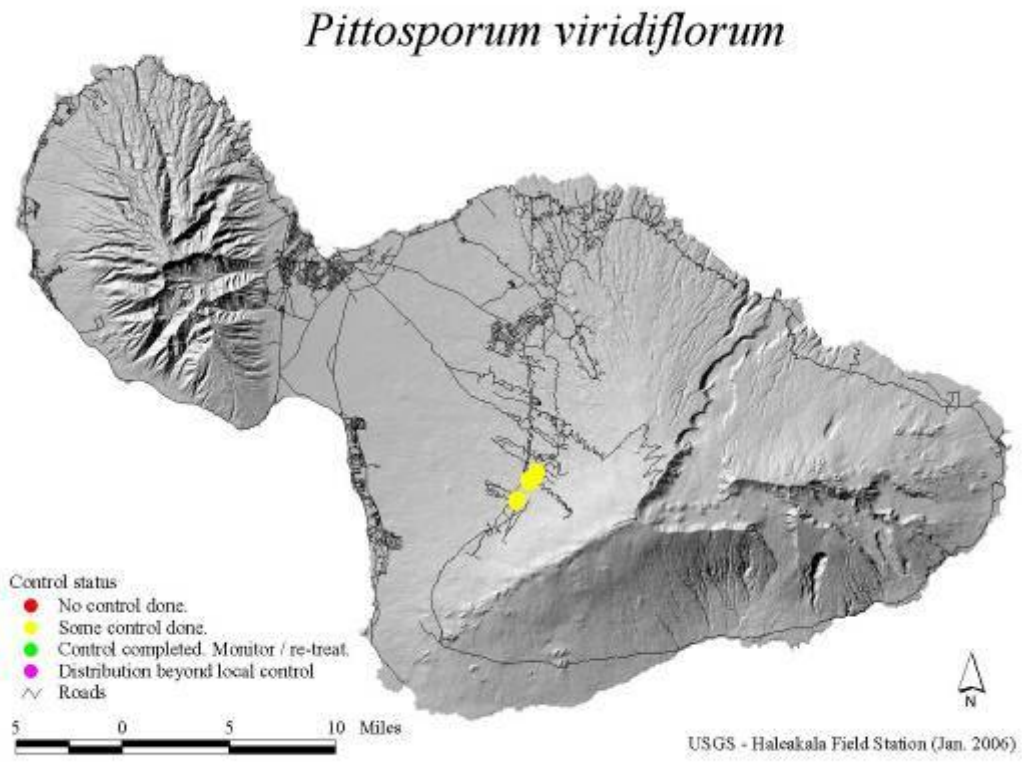
WEST MAUI - Control completed. Location now in monitor and re-treat phase. The lone trees were controlled by Puu Kukui Watershed staff. No one has yet returned to check for re-growth.

ADVANTAGES

- Small population size on West Maui.
- Dioecious, male and female parts on different plants, with only one sex present.
- Apparently no seed bank at West Maui site.
- A Hawaii State noxious weed.

COMPLICATIONS

- West Maui location is remote.
- There is a large population of this species on East Maui.

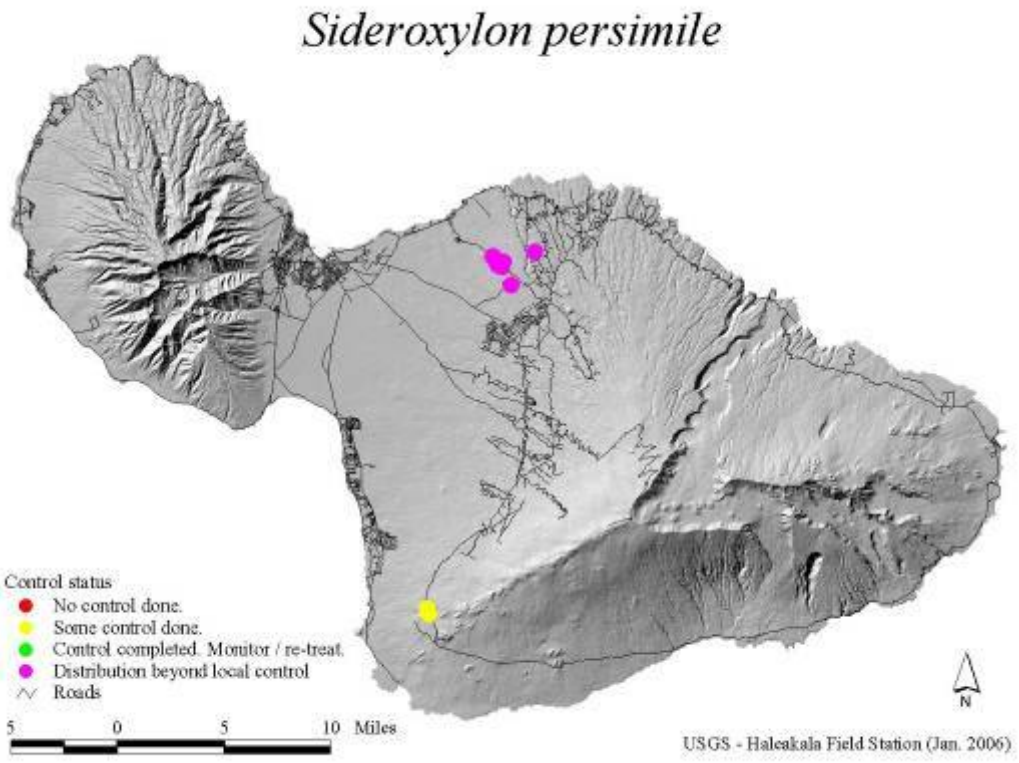


MAUI - This tree is still established in the Waipoli / Keokea area of Kula.

WAIPOLI - Some control done. Permission has been granted to do control work, and control work has been begun, but there are many more trees than originally were known about, and recruitment from a seed bank has been persistent.

ADVANTAGES
- Landowners are cooperative.
- There are many other MISC targets in area, so it is convenient to work on while in the area.

COMPLICATIONS
- Distribution underestimated.
- Fully naturalized.
- Established seed bank.

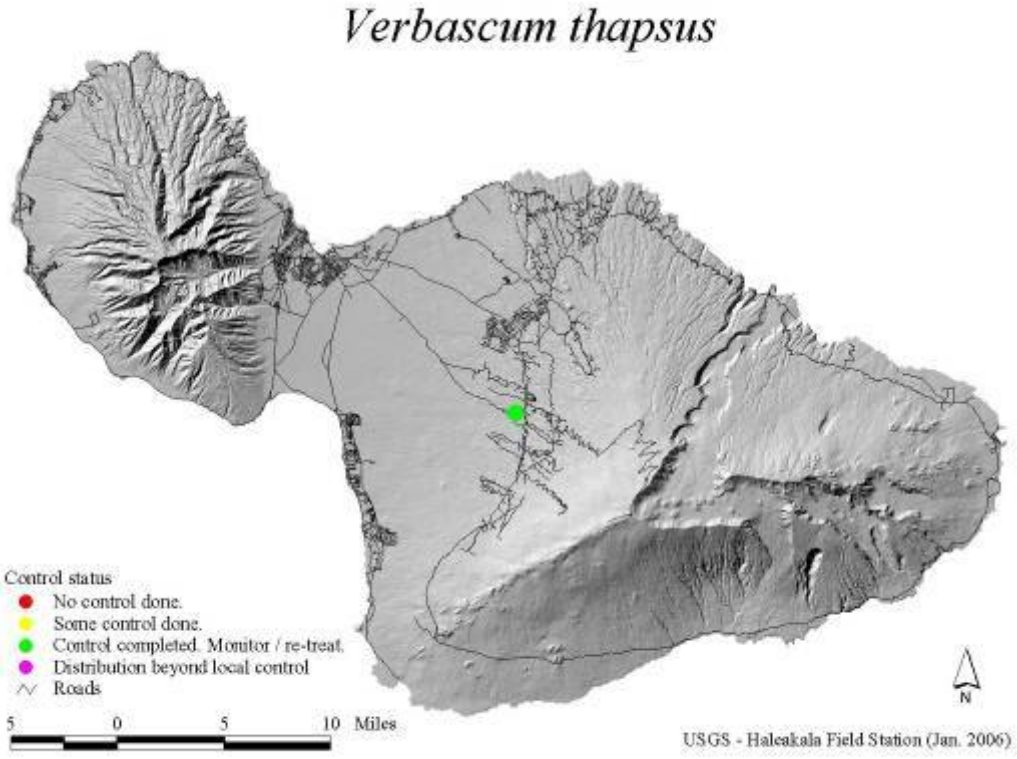


MAUI - The small trees in Ulupalakua have been controlled, but the large tree remains. This species is still well established around the Maunaolu campus.

ULUPALAKUA - Some control done. All the known small saplings in Ulupalakua have been controlled.. However the large tree (over 80 ft) was amongst some buildings, and the precision required to bring this tree down necessitated professional assistance, which has yet to occur.

ADVANTAGES
- Cooperative landowner.
- Easy terrain.

COMPLICATIONS
- Large size tree requiring professional removal.
- Large population still exists on East Maui.



MAUI - All the known plants have been controlled, again. There is a seed bank at the Kula site.

KULA - Control completed. Location now in monitor and re-treat phase. All the plants were controlled. The landowner agreed to control the plants himself by pulling them out and burning them on site. Repeat visits indicate that seedlings were germinating, and being controlled before going to seed.

ADVANTAGES
- Landowner was cooperative.
- Single location known.
- Cultivated plants, that had not yet spread.
- A Hawaii State Noxious Weed.

COMPLICATIONS
- Plant may be hard to detect in backyard gardens.
- Established seed bank present.
- Widespread on the big island of Hawaii.
- This is a popular folk medicine plant, and is easily obtainable.