



A Preliminary Review of Plant Eradications in the Hawaiian Archipelago:

HOW TO STACK THE ODDS IN YOUR FAVOR

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A Preliminary Review of Plant Eradications in the Hawaiian Archipelago: How to Stack the Odds in Your Favor.

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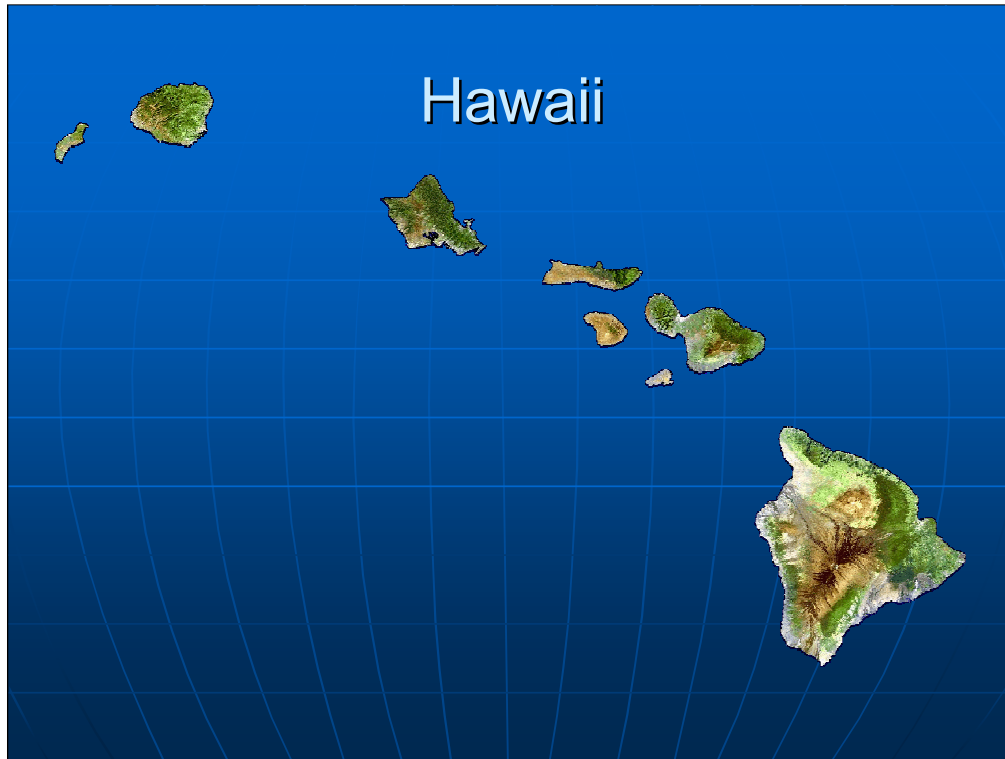
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Eradication

“Elimination of every single individual from areas in which re-colonization is unlikely to occur.”



Eradication is elimination of every single individual from areas in which re-colonization is unlikely to occur. This management approach is highly desirable, yet often frustratingly elusive.



The Hawaiian Archipelago is a string of islands surrounded by thousands of miles of Pacific Ocean. As a result, these islands are strategically positioned to utilize eradication as a management tool.

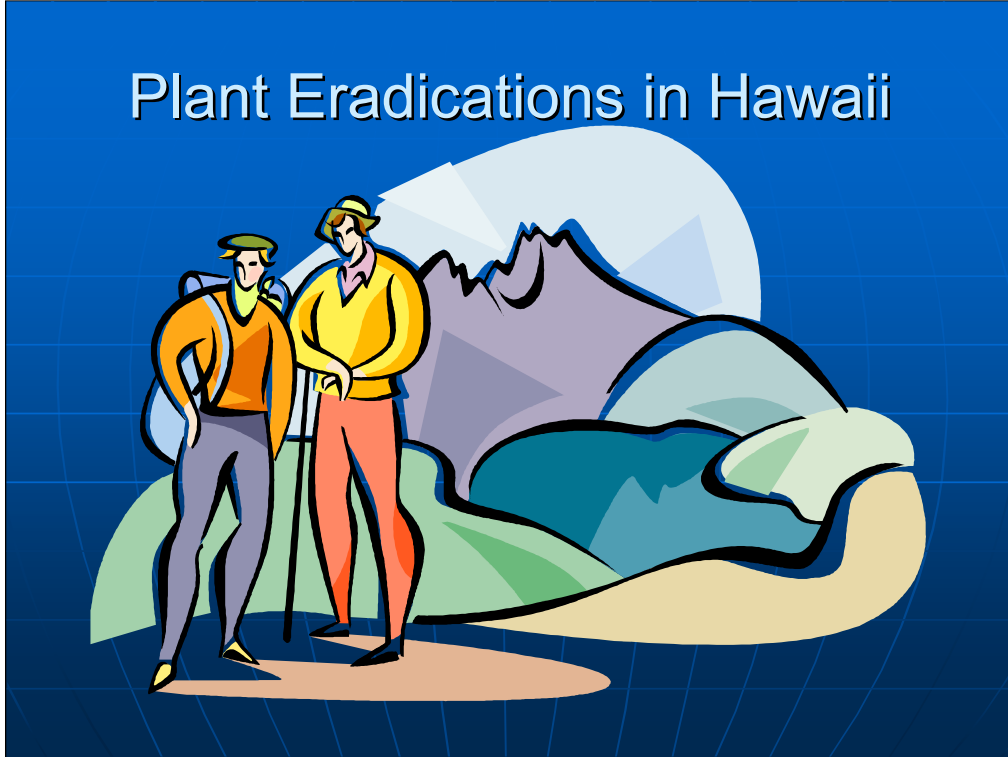


Plant eradication efforts have occurred in Hawaii for some time now. They range from the removal of sand bur (*Cenchrus echinatus*) from the remote island of Laysan in the Northwestern Hawaiian Islands...



To the removal of mullein (*Verbascum thapsus*) from the sub-alpine areas of Haleakala National Park on the island of Maui, home to the endemic Haleakala silversword.

Plant Eradications in Hawaii



As part of our on-going work on plants in Hawaii, we did a preliminary review of plant eradications. The goal was to determine what general patterns were present in successful eradications, as well as common pitfalls that could be avoided.

Sources

- National Park Service
- U.S. Fish and Wildlife Service
- Hawaii Department of Agriculture
- Hawaii Invasive Species Committees
- Others



NPS



USFWS



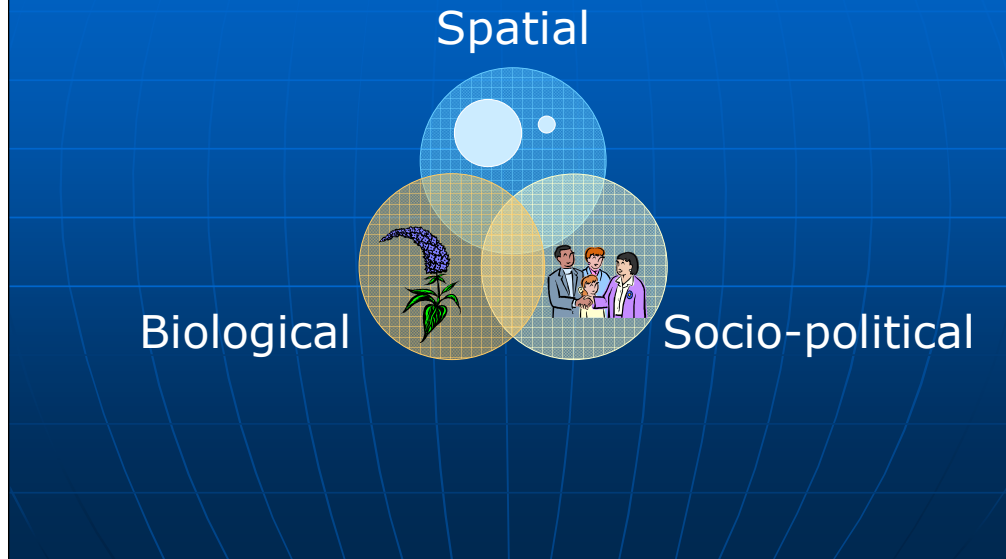
HDOA



ISC's

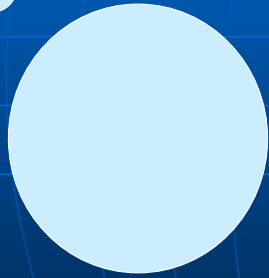
The main sources consulted include work done by the National Park Service, the efforts of the United States Fish and Wildlife Service, the long-standing efforts of the Hawaii Department of Agriculture, and the more recent efforts of the Hawaii Invasive Species Committees. We also looked at published material from elsewhere, mostly New Zealand, Australia, and North America.

Factors Determining Success



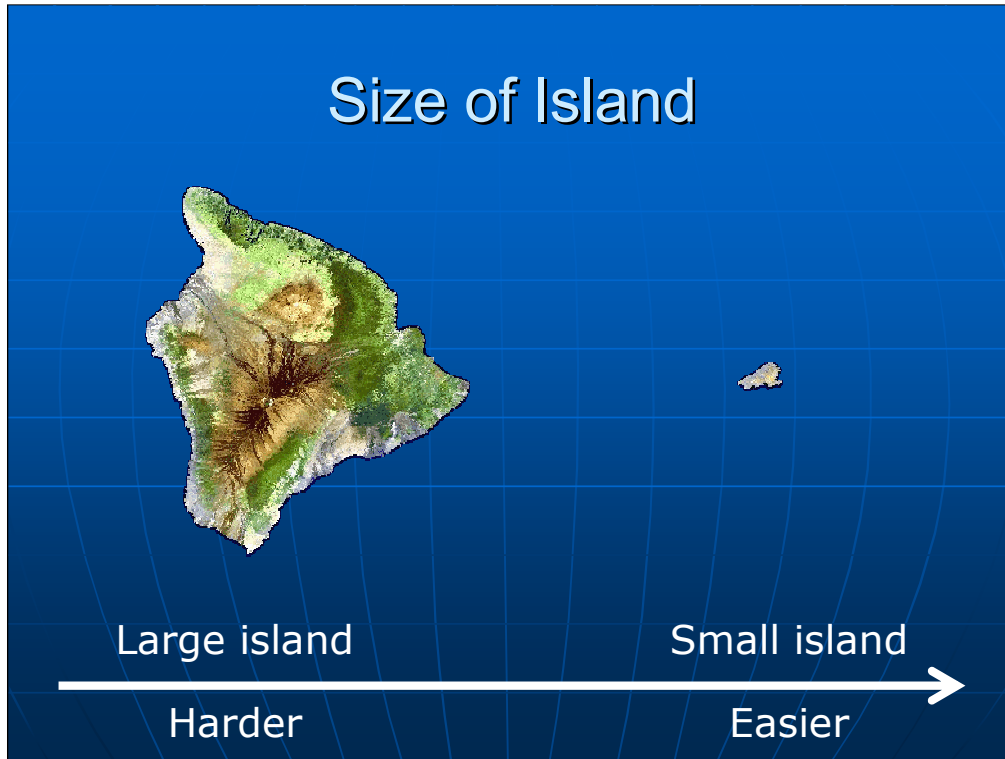
Each situation is unique, but there seems to be several factors determining plant eradication success. They can be broadly placed into three main categories: spatial attributes, biological attributes, and socio-political attributes. All three of these must come together at the same time for successful eradication to occur.

Spatial Attributes



- Size of island
- Size of infestation

Size is one of the more obvious attributes determining eradication success. Specifically the size of the island on which eradication is occurring, and the size of the infestation to be removed. In general, the smaller both can be, the greater the chance for success.



The size of an island has a major impact on eradication success. Islands that are large, such as the 4000 square mile island of Hawaii, will generally be harder to achieve eradication success on than islands that are small, such as the 45 square mile island of Kahoolawe.



The island of Maui is the second largest island in Hawaii, and is one of the largest islands in the Pacific. It stretches from sea level to over 10,000 ft., and covers 727 square miles. Shown here is the south slope of East Maui. Though easier than on a continent, searching for plants on an island of this size takes massive resources, and even in the best of cases, it is impossible to search every nook and cranny of the island.



In contrast is the small island of Mokoli'i, one of Oahu's offshore islets. This island is only 200 ft. high and covers less than 13 acres. The entire island can be searched in a day. Mokoli'i has some challenges with steep terrain and access by boat, but the island is so small, that confidence levels regarding species presence is quite high.



The atolls of the Northwestern Hawaiian Islands are at the extreme end of the size spectrum. None of the atolls are more than a few square miles in size, and get no higher than 20 feet. Shown here is North Island at Pearl and Hermes Atoll. The small size of these islands is so significant, that despite overwhelming logistics required to get to there, some of the easiest and most successful eradication efforts have occurred on these remote atolls.

Size of Infestation



Large infestation



Small infestation



Harder

Easier

The size of an infestation also has a major impact on eradication success. Larger infestations will generally be harder to eradicate than smaller infestations. The smallest infestations, preferably a single individual, will offer the greatest chance for success.



Ivy gourd (*Coccinia grandis*) is an invasive plant causing problems on several of the main Hawaiian Islands. Though prized for its edible shoots, it is a rampant vine that has spread beyond where it is planted, and now covers thousands of acres on the islands of Oahu and Hawaii. Because of the large size of infestations on those islands, eradication is unlikely.



In contrast, in 1999, a single ivy gourd plant was found on Midway Atoll, home to the world's largest breeding population of Laysan Albatross. The lone ivy gourd was found in a residential garden during systematic botanical surveys of the island. The plant had apparently been brought in as seeds from Thailand and had not yet gone to fruit. After discovery, the plant was promptly removed, and to date there has been no re-growth.



This success on Midway, due to the small infestation size, has also been replicated on much larger islands. For example, a similar ivy gourd scenario played out at the commercial harbor on the island of Lanai, where a single plant was found early, removed, and hasn't come back.

Biological Attributes



- Detectability
- Generation time
- Dispersal
- Seed bank

Biological attributes are inherent properties of a plant species. Some of the main biological attributes that relate to eradication success include the ability of the plant to be detected, the time it takes the plant to reach reproductive age, the ability of the plant to spread, and the persistence of plant propagules in the soil.

Detectability



Cryptic



Conspicuous

Harder

Easier

Plants can not be addressed until they have been located. Plants that are cryptic will be harder to eradicate than plants that are conspicuous. Eradication success is highest when searching for easily detectable plants.



This image shows both *Piper aduncum* and *Miconia calvenscens*. The Miconia plant sticks out like a purple flag, whereas just above the Miconia, a large plant of *Piper aduncum* blends into the background. In fact during our road surveys on Maui we drove right past stands of *Piper aduncum* in the jungles of Nahiku. It was only after a concerned landowner called the Hawaii Department of Agriculture that we knew of the presence of this cryptic species on Maui.

Generation Time



Quick to seed



Slow to seed

Harder

Easier

Plants that have a short generation time will be harder to eradicate than those with a long generation time. Plants that are quick to seed require action on the order of weeks, whereas plants that are slow to seed allow action on the order of years.



Fireweed (*Senecio madagascariensis*) is one of the fastest spreading weeds on Maui, due in part to its short generation time. On Maui and the big island, eradication is no longer feasible. However, Kauai and Oahu have limited numbers of this plant, and are actively targeting it for eradication. Successful control will depend on timely repeat visits, due to fireweed's short life span.



Fountain grass (*Pennisetum setaceum*) has covered vast acreage on the big island, but is still found in limited numbers on other islands where it has been targeted for eradication. As with fireweed, timely repeat visits are necessary to assure new propagules are not being added to the landscape.



Pines and other large trees generally take many years to reach maturity, often allowing years rather than weeks or months for control to occur. Along the boundary of Haleakala National Park, many small pine seedlings are pulled each year before they get a chance to set seed. Even though this action will need to occur forever, unless pines on nearby land are removed, it illustrates how a plant species that takes longer to reach reproductive age can be removed from an area.

Dispersal



Wind



Bird



Sterile

Harder

Easier



Plants that spread quickly over long distances will be harder to eradicate than plants that spread slowly or are sterile. The area that must be searched around each plant location is a function of the ability of the plant to disperse. The farther a plant can send propagules, the greater the area that must be searched.



Pampas grass (*Cortaderia*) is capable of spreading up to 20 miles on the wind. As a result, it has spread well beyond ornamental plantings on Maui into the sub-alpine shrublands of Haleakala and the sheer walls of Iao Valley. Because of the ability of this plant to disperse long distances, search and eradication efforts must also cover long distances.



The spread of Kahili ginger (*Hedychium gardnerianum*) is aided by fruit eating birds. Though the spread of this species is slower than wind dispersed species, the ability of birds to disperse kahili ginger seeds to unknown locations greatly complicates control efforts.



Giant reed (*Arundo donax*) only spreads vegetatively. This species does send up flower stalks, but the flower heads are sterile and produce no seeds. The inability of *Arundo* to rapidly spread long-distances was one of the factors that contributed to the successful removal of this species from the island of Molokai.

Seed Bank



Plants that have a long-lived seed bank will be harder to eradicate than those with a short-lived or non-existent seed bank. Once a plant goes to seed, even if all the plants above ground are removed, the site will have to be monitored for re-growth, often for many years. The same is true for species with a persistent root system. Eradication success is highest when addressing species with a short-lived or preferably non-existent seed bank.



Gorse (*Ulex europaeus*) is reported to have seeds viable up to 200 years. This is an image of a gorse thicket near Haleakala National Park where it covers hundreds of acres of native shrublands and prime grazing lands. Gorse is likely beyond the eradication phase on Maui. In contrast, on the nearby island of Molokai, there was much less gorse, and it was removed. However, due to the persistent seed bank, monitoring for re-growth will need to occur for many decades.

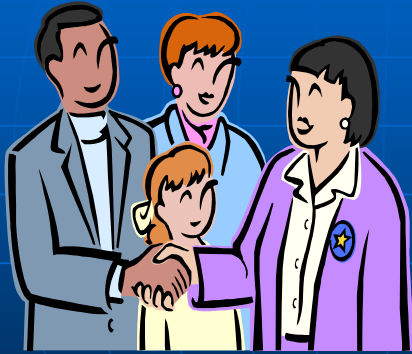


Guinea grass (*Panicum maximum*) has a short lived seed viability in natural conditions. This image shows a lone patch of sprayed guinea grass on Midway Atoll. It was the only known patch on the island, but had gone to seed before it was controlled. Monitoring at this site will need to continue for a few years to be sure the seed bank has been exhausted.



Kikuyu grass (*Pennisetum clandestinum*) very rarely sets seed in Hawaii. As a result, large areas of this plant can be controlled with minimal follow up. Kikuyu grass is too widespread to eradicate over the entire island of Maui, but with it's limited re-sprouting, it has been successfully controlled over large areas such as this native plant enclosure in Auwahi.

Socio / Political Attributes



- Landowners
- Mandate
- Response
- Authority
- Support

Socio / political attributes are just as important as biological and spatial ones. The main socio-political attributes that determine eradication success include number of land owners, mandate of the areas, available response, legal authority, and support of the community. Eradication success is highest when all these socio-political attributes are optimized.

Number of Land Owners



Plants that are found on land with many landowners will be harder to eradicate than plants found on land with just one owner. This is an image of Wailuku on the island of Maui. Due to permission constraints and other issues, plants found within the myriad of land owners on the left are much more challenging to address than species found in the agricultural and natural areas on the right. Eradication success is highest when on land owned by the fewest number of land owners, preferably one.

Mandate to Protect Resources



Plant eradications have a greater chance of success if the infestations are found in areas where the goal is to protect resources from invasive plants, such as in National parks, wildlife refuges, or agricultural lands. This is an image of Kaohikaipu, the southern most of Oahu's windward offshore islets. This islet is designated a seabird sanctuary and already has a weed control program in place. Eradication success is highest on land with an existing mandate to protect resources.

Responsive Control Team



Waiting to address an exploding plant population will generally lead to a decreased chance of eradication success. Eradication efforts that don't respond rapidly can miss irreplaceable windows of opportunity. A responsive control team allows for the most number of control options and minimizes collateral damage.

Clear Legal Authority



Though complete lack of permission is rarely encountered, it does occur, and eradication success declines dramatically when permission is not obtainable. Rubber vine (*Cryptostegia*) is targeted for control by the Maui Invasive Species Committee, but is not yet listed as a Hawaii State Noxious Weed. As a result, rubber vine has been removed from all of Maui, except for a few plants that remain because a couple home owners prefer they not be removed. Eradication success is highest when possessing clear legal authority.

Community Support



The final, and perhaps most important, socio-political attribute is community support. Control programs that lack community support will have a harder time accomplishing their goals. Whereas great hurdles can be overcome if the community is brought together.



In conclusion, there are many resources in Hawaii that are being actively protected. When properly implemented, eradication can be a valuable tool for manager's attempting to address invasive plants that threaten these resources.



We hope this talk has given you insights into some of the plant eradication efforts that have occurred in Hawaii, and how you can stack the odds for eradication success in your favor.



Pau.