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Protecting Endangered Plant Species from Displacement by Invasive Plants on Maui, Hawaii[1]

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Abstract: The Hawaiian island of Maui, with highly diverse habitats and 80 federally endangered plant species, provides a microcosm for addressing the threats of plant invasions to endemic biological diversity through partnerships for research and management. An evolving vision of what is needed involves an accelerated, balanced program involving exclusion of potential new invaders, early detection and rapid response, biological control, control to protect local populations, and public education.

Additional index words: Biological control, *Clidemia hirta*, early detection, *Hedychium gardnerianum*, interagency cooperation, *Miconia calvescens*, *Psidium cattleianum*, public education, rapid response, weed exclusion.

Abbreviation: MISC, Maui Invasive Species Committee.

INTRODUCTION

Because of high vulnerability to biological invasions and highly endangered biological diversity, Hawaii provides a superb laboratory for addressing the challenge of harmful invasive species (Fornwall and Loope 2004). The challenge is illustrated by the task of protecting biodiversity, including about 80 federally endangered plant species (www.hear.org/articles/ipinams2003loopeetal/endangered.htm) on the 1,800-km^2 Hawaiian island of Maui, an island with a relatively strong current public and private commitment to environmental protection. Haleakala National Park, a 130-km^2 summit (3,055 m) to the sea reserve on the eastern portion of the island has served as a worthy model for use of effective landscape-scale management, and conservation science and management have been well integrated. Island-wide, Maui's listed endangered plant species stretch from sea level to high-elevation in rainfall zones from very wet (annual rainfall $>$ 8,000 mm) to very dry (annual rainfall $<$ 300 mm) (www.hear.org/articles/ipinams2003loopeetal/map.htm). Many invasive plant species already present over a wide range of climatic zones on the island are believed to pose eventual threats to rare species and natural areas.

Invasive plant species have come to Maui in waves, with a strong wave occurring in the 1920s and 1930s, when the territorial government supplemented the native flora with massive plantings of nonnatives such as *Melaleuca*, *Eucalyptus*, and *Ficus*. A more recent wave of invasions has come since World War II and statehood (1959). It was only in the 1970s when serious attempts began toward what we know today as conservation biology. The movement toward serious conservation biology was first manifested on Maui in the 1980s through large-scale fencing of Haleakala National Park to exclude feral ungulates (Stone and Loope 1987). Listing of endangered plant species took place mostly in the early 1990s. Statewide, the number of endangered plant species now totals 291 (plus 11 threatened species) (M. Bruegmann, personal communication).

In the 1990s, there was a strong movement toward interagency collaboration in protection of biodiversity combined with watershed protection, manifested in the East and West Maui Watershed Partnerships and the Maui Invasive Species Committee (Loope and Reeser 2002). The East Maui Watershed Partnership, established in 1991, was the first such partnership in Hawaii. The Melastome Action Committee was formed, also in 1991, to address the invasion of *Miconia calvescens*, an invasive Neotropical tree (Melastomataceae) that has the potential to completely shade out all native species throughout island rain forests (Conant et al. 1997; Meyer and Florence 1996). This latter interagency group

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evolved into what is now known as the Maui Invasive Species Committee (MISC, www.hear.org/misc), with the purpose of containment and eradication of *Miconia* and other priority weeds. Over $1 million is being spent in fiscal year 2004 alone on mechanical and chemical control in an attempt to contain *Miconia* until successful biocontrol can be achieved. MISC and its partners have a vision for long-term success in protection of biological diversity of Maui, including endangered and rare plant species, that requires an accelerated, balanced program involving exclusion of potential new invaders, early detection and rapid response, biocontrol, control to protect local populations, and public education.

EXCLUSION OF POTENTIAL NEW INVASIONS

This is currently the weakest part of the vision because Hawaii is still in the same situation as the rest of the United States with rampant continuing plant introductions. However, efforts are underway in Hawaii to institute weed risk assessment (Daehler and Carino 2000). MISC is actively working with the Maui Association of Landscape Professionals and the Maui County Arborist Committee, with the short-term objective of preventing sanctioned planting of pest plants and the long-term objective of exclusion of new invasive introductions to the island and state, similar to what has been done in Western Australia.

EARLY DETECTION AND RAPID RESPONSE

Our United States Geological Survey field station recently conducted a 3-yr project involving early detection. We started with a list of about 100 targeted incipient plant invaders, suspected by us and our colleagues of having the potential to naturalize and invade on Maui. Some of these targets were species known to be rampantly invading other Hawaiian islands but not yet known to be doing that on Maui; others were cultivated plants on Maui known to be invasive elsewhere in the world. We surveyed along nearly 2,000 km of roads, recording over 16,000 records for the targeted species. To help address off-road areas, we interviewed expert field botanists, adding nearly 1,000 locations for 79 species. We also reviewed literature and made opportunistic biological observations. We produced images, maps, and reports, and have posted them on a website (www.hear.org/starr/hiplants). Our work has been a primary impetus for eradication efforts by MISC; at least four species have been eradicated, and a dozen additional species are currently targeted for eradication with funding supplied by U.S. Fish and Wildlife Service.

BIOLOGICAL CONTROL

Hawaii has been and continues to be a battleground of advocates and opponents of biological control. Messing and Purcell (2001) believed that local policy concerning release of biocontrol agents has evolved to become more restrictive than probably anywhere else in the world. There is no question that biocontrol has been at times misapplied and that environmental and economic damage has resulted (Lockwood et al. 2001), and there is increasingly good evidence that the Hawaiian biota has suffered substantially from past biocontrol releases (e.g., Henneman and Memmott 2001). Much of the disagreement relates to how much damage has been and is being done to Hawaii's native biota and ecosystems, and part of the ambiguity is because of the general lack of postrelease monitoring. Biocontrol of invasive plants in Hawaii has not been trouble free but is widely recognized as being more effectively regulated and less problematic than biocontrol targeted at animals (e.g., Howarth 2001).

In general, the record for biocontrol of conservation weeds in Hawaii during the past two decades has shown very limited concrete success, in contrast to some other parts of the world. Hawaii desperately needs accelerated efforts at responsible biocontrol of some of its most damaging invasive plant species to avoid obliteration of large expanses of native ecosystems (Smith 2002). That is most clearly the case in Maui's rain forests, where *M. calvescens* is by far the greatest threat to biodiversity and endangered plant species, but other ominous threats include the shrub *Clidemia hirta*, another member of the Melastomataceae, the shrub–tree strawberry guava (*Psidium cattleianum*), and the large herb kahili ginger (*Hedychium gardnerianum*).

A recent analysis suggests that weed biocontrol projects can be and have largely been conducted in Hawaii with minimal risk on target weeds that lack close native relatives (Pemberton 2002). Pemberton (2002) cautions that given constraints in Hawaii on funding for biological control, the limited quarantine space, and low number of biocontrol researchers, only a small portion of invasive weeds can be subjected to well-managed biological control programs. Postrelease monitoring is clearly an essential part of the biocontrol process. Melastomataceae stand out as a high immediate priority target for biocontrol because there are no native species in that family in Hawaii. Gingers (Zingerberaceae) also have no

native representatives and thus lend themselves well. Strawberry guava (Myrtaceae) is more problematic and will likely require much more scrutiny because of the importance of native members of that family in Hawaiian vegetation. The important points here are that (1) for certain widespread, high-impact weeds, biocontrol has become an essential part of the mix needed for conservation of Hawaii's endangered plant species—given that there appears to be no other conceivable long-term solution, and (2) potential new invasive plants must be excluded and incipient ones eradicated to avoid increasing the need for biocontrol in the future.

CONTROL TO PROTECT LOCAL POPULATIONS

Localized control of invasive plants is conducted on Maui by a number of institutions managing natural areas. For example, Haleakala National Park has an active program of invasive plant control in the park's Kipahulu Valley, and one of their priority efforts is protecting the endangered lobeliad *Cyanea glabra* from kahili ginger through herbicidal control. Another example involves effort by the Native Hawaiian Plant Society, a local nonprofit group that maintains about a dozen fenced exclosures to protect some of the last surviving individuals of certain endangered plant species, including the Hawaii state flower ''mao hau hele'' (*Hibiscus brackenridgei* subsp. *brackenridgei*). Chemical and mechanical control of weeds comprise an important part of the organization's activities.

PUBLIC EDUCATION

''Ho'ike o Haleakala'' is an environmental education curriculum specific to Maui, produced by a partnership of school teachers, agencies, and community organizations, led by Haleakala National Park. Its objective is to promote understanding of island ecosystems, a feeling of shared ownership, and a commitment to active stewardship. A major recognized role of the curriculum is education of local students to understand the overwhelming effects of invasive alien species on biodiversity, agriculture, health, economy, and quality-of-life of an oceanic island ecosystem, and to obtain long-term public support of and participation in invasive species prevention and management efforts. The target group is primarily high-school level. The curriculum is available online (www.hear.org/hoike).

A growing interest of the public on Maui in meaningful hands-on ecological restoration projects is partially related to a growing interest in the heritage of the native Hawaiian people and proliferation of potential volunteer projects (www.hear.org/volunteer/maui/). Volunteers participate in a number of restoration projects, including one involving endangered dry forest plant species on private lands (e.g., Erdman et al. 2000). Obviously, invasive plant management is a crucial part of such efforts. Successful projects foster strong public support for funding and regulations to address invasive plant problems.

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