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Crossing boundaries at Haleakala: addressing invasive species through partnerships

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Increasing "globalization," involving proliferation of pathways for potentially invasive species, poses the ultimate threat to Hawaii's parks, jeopardizing their very survival. This same fear is now being voiced for all biodiversity worldwide (e.g., Mooney and Hobbs 2000; Van Driesche and Van Driesche 2000; Campbell 2001). But oceanic island ecosystems in general and the Hawaiian Islands in particular are especially vulnerable (Loope et al. 2001). Hawaii is an evolutionary showcase, with very high local endemism and many textbook examples of adaptive radiation. We at Haleakala National Park are involved in many excellent partnerships, detailed below, to address invasions, but we are increasingly realizing that Hawaii is overwhelmed—more federal and state resources are desperately needed.

Haleakala National Park, encompassing 44 sq mi, or 6% of the 728-sq-mi island of Maui, Hawaii, is one of the most important reserve sites in the USA for conservation of biodiversity. Stretching from the sea to 10,023 ft above sea level, it is still overwhelmingly dominated by native species. Roughly 90% of its plant and invertebrate species are Hawaiian endemics and 20% are single-island endemics. Conservation International recently included Hawaii in its 25 biodiversity hotspots (Mittermeier et al. 1999), and Haleakala is arguably the prime reserve on Maui. Maui has other important state and private reserves, so that the total area of land managed or soon to be managed for biodiversity conservation approaches 15-20% of the island. We believe that Maui is the most intact Hawaiian island and has the most promise for long-term native species and ecosystem protection.

The two of us have focused much effort outside park boundaries in the past decade, working with partners and partnerships which have promise for improving efforts on Maui and statewide for prevention, detection, rapid response, and containment or biocontrol of invasive alien species.

During the 1980s, Haleakala made major progress in resource protection by erecting 40 mi of boundary fencing and eliminating feral goats *(Capra hircus)* and pigs *(Sus scrofa)*, long recognized as the greatest threats to park resources. A shared experience with a rabbit invasion, in 1990, was very influential in shaping our proactive orientation. An incipient and expanding population of European rabbits *(Oryctolagus cuniculus)* was discovered and removed (100 individuals) over a 10-month period (Loope 1992). Through competently dealing with the rabbit invasion, the park and the island had dodged a bullet—at least temporarily. But we were disturbed to learn that no agency in Hawaii is responsible for preventing rabbits from getting established. The Hawaii Department of Agriculture sheepishly confessed that "our mandate is to encourage rabbit raising." Our eyes and those of others were opened to the serious inadequacy of alien species prevention and response efforts. The rabbit experience brought the vision that long-term protection of park ecosystems is possible if and only if new invasions to the island can be prevented or eradicated. It inspired our confidence in our ability to make a difference—as well as spurring fear of what new invasion might crop up next to threaten the park.

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Our worst fears were answered shortly, when, in January 1991, we first realized the presence and the threat of the notoriously weedy tree, *Miconia calvescens*, which was known to have taken over the island of Tahiti (Meyer 1996; Meyer and Florence 1997). Whereas the rabbit outbreak had fortunately been at a very conspicuous site in the park, *Miconia* was centered five miles from the park, but clearly posed just as great or greater a threat as did rabbits (Medeiros et al. 1997). It soon became evident that partnerships were the only opportunity to deal effectively with such enormous shared threats. Although the ultimate effectiveness of these partnerships remains to be fully demonstrated, we suspect that without them the battle would already be lost.

At the same time, invasive species also pose huge threats to Hawaii's tourism-based economy, agriculture, health, and general quality of life, and the state's residents are beginning to recognize the problem (CGAPS 1996; Holt 1996). The pervasiveness of this issue for society in Hawaii provides hope that it may be possible to marshal adequate resources to address the problem. Each one of the partnerships we describe below has interests beyond the protection of natural areas and biodiversity.

East Maui Watershed Partnership

The East Maui Watershed Partnership (EMWP), established in 1991, has the objective of managing 100,000 acres on windward East Maui to maximize water quality, sustained production of water, and protection of Hawaiian biological diversity. It is composed of federal, state, county, and private entities. Although the partnership members have different mandates, priorities, and constituents, all share a common commitment to the long-term protection of the watershed. Since its formation, the EMWP has successfully constructed miles of feral animal fencing, reduced feral pig numbers, and facilitated control of *Miconia*. This partnership provides a highly successful model for combining biodiversity concerns with concerns for watershed protection, including invasive species prevention and management in Hawaii.

Maui Invasive Species Committee (MISC) / Melastome Action Committee

In 1997, agencies and individuals on the island of Maui that had been working together at a grassroots level for six years to deal with invasion of the weed tree *Miconia* formed an interagency working group, the Maui Invasive Species Committee (MISC), to deal with incipient invaders. MISC partners include Haleakala National Park, U.S. Geological Survey Biological Resources Division (USGS-BRD), U.S. Department of Agriculture (USDA) Tri-Isle Resource Conservation and Development Council, USDA Forest Service, U.S. Fish and Wildlife Service, Hawaii National Guard, University of Hawaii, Hawaii Department of Land and Natural Resources, Hawaii Department of Agriculture (HDOA), Maui County Department of Water Supply, Maui Land & Pineapple Company, The Nature Conservancy of Hawaii (TNCH), and Maui Farm Bureau. Public education and publicizing success stories are crucial ingredients of the anti-invasive species strategy. Maui efforts have inspired motivated individuals to form similar partnerships on other islands.

MISC and its partners have made serious headway to date through surveying, treating, and eradicating the most serious invasive plant species that threaten ecosystems of Maui, including those of Haleakala. Other important conservation lands, including Kanaio National Guard Training Area, Kealia National Wildlife Refuge, TNCH's Waikamoi and Kapunakea Preserves, Maui Land & Pineapple Company's Puu Kukui Preserve, several State Natural Area Preserves, and many other as-yet undesignated natural areas will ultimately be jeopardized unless the invasive plant and animal species being addressed by MISC are contained or eradicated.

An island-wide plan establishes categories (exclusion, eradication, containment, large-scale management) and sets priorities and responsibilities for pest management. In 1999-2000, an action plan was launched (funded by $800,000 raised from federal, state, county, and private sources) against top-priority species. The major species

currently being combated are *Miconia calvescens*, pampas grass *(Cortaderia jubata)*, fountain grass *(Pennisetum setaceum)*, ivy gourd *(Coccinia grandis)*, giant reed *(Arundo donax)*, and rubber vine *(Cryptostegia grandiflora)*.

The role of USGS-BRD has properly evolved from large involvement in education, strategy development, planning, and assisting with fundraising for MISC and the Melastome Action Committee to one of information-gathering and research. We see a major role of the Haleakala Field Station as assessing current and future alien species threats, especially plant problems on Maui. In FY2000 funding was received for a three-year National Park Service NRPP (Natural Resource Preservation Program) project, "Information Gathering and Development of Methodology to Address Newly Emergent Alien Plant Species that Threaten Ecosystems of Haleakala National Park." This project is building on previous work to explore the process of invasion on Maui and obtain baseline data on incipient alien plant invasions that may pose severe threats. It is primarily aimed at recognizing and nipping in the bud new plant invasions by detecting situations where new weeds are starting to spread and alerting the interagency control crew of MISC and the new NPS Hawaii Exotic Plant Management Team. The project is mapping cultivated and escaped populations of 110 plant species identified as warranting concern. It is also exploring the more general question of how an early warning system might work.

Hawaii Ecosystems at Risk Project

The Hawaii Ecosystems at Risk (HEAR) project was started in 1996 as an invasive species information system to serve the needs of land managers and the public. In FY2001, funding was received through the National Biological Information Infrastructure (NBII) to provide base-funding for HEAR, in cooperation with the Bishop Museum and the University of Hawaii, as an invasive species-focused component of a Pacific Basin Information Node (Thomas and Loope 2001). A thrust for FY2001 is to work with Rod Randall in southwestern Australia to get the world's best plant risk assessment database (for species that have invaded other parts of the world) into a format which can be made available on the internet. In Hawaii, we will match Randall's database against a list of plant species cultivated in Hawaii (approximately 13,000 spp.) being developed by George Staples of the Bishop Museum. Unfortunately, as of May 2001 this base funding may have been lost as part of FY2002 budgets cuts.

Na Kumu o Haleakala

Na Kumu o Haleakala is a partnership started by Haleakala National Park interpreters and local teachers in 1996 to produce a Maui-specific environmental education curriculum for local public and private high schools, which will, among other things, educate young people about the threat of alien species on Maui. The partnership is working to produce a comprehensive environmental education curriculum specific to Maui to promote understanding of island ecosystems, a feeling of shared ownership, and a commitment to active stewardship. Na Kumu has completed ecosystem-based modules for Haleakala's eolian zone and rainforest and will soon complete modules for the coastal and marine zones. Plans (and fundraising) are in the works for modules on dryland forest, the subalpine zone, watersheds, and a culminating module on alien species. Each ecosystem-based module has one or more units on the effects and future threats of alien species.

Coordinating Group on Alien Pest Species (CGAPS)

The Honolulu-based Coordinating Group on Alien Pest Species (CGAPS) is an innovative statewide group which has been working since 1995 to coordinate efforts among the many agencies responsible for dealing with invasive species and to improve Hawaii's response to the problem. One possible collaborative strategy calls for attempting to establish a federal quarantine for Hawaii for a wide range of pest species

through the USDA Animal and Plant Health Inspection Service, as well as for beefing up the state quarantine with the aid of state funds from airport landing fees or other user fees. (See paper by Reeser, this volume.) CGAPS is also interested in early detection and control of incipient invaders. Holt (1996) stated: "Together with public education, we believe early detection and control of new infestations holds the greatest potential for improved pest management" in Hawaii. Consensus CGAPS priorities for 2001 are as follows:

1. Raise $2 million from the state legislature and private sources to continue and expand funding for the Maui, Big Island, Oahu, and Kauai invasive species committees.
2. Secure $250,000 from the state for *Miconia* biocontrol.
3. Develop a strategy and obtain increased federal assistance to HDOA.
4. Follow-up on the Kahului Airport pest risk assessment to identify the next appropriate actions to improve inspection efforts statewide. Secure $500,000 in discretionary funds for HDOA to continue and expand statewide inspection and quarantine efforts.
5. Significantly increase the level of education and awareness among the legislature and the public regarding the negative impact of invasive species on Hawaii's economy, environment, health, and lifestyle.
6. Enhance HDOA's enforcement capacity.

Hawaii Ant Group and the red imported fire ant

In September 1999, a Hawaii Ant Group was established, comprising scientists from USGS, HDOA, University of Hawaii, and the Bishop Museum. After the red imported fire ant *(Solenopsis invicta)* was first detected in southern California in November 1998, it was realized that invasion of Hawaii is just a matter of time unless heroic prevention, detection, and rapid response efforts are initiated, since huge quantities of goods are shipped to Hawaii from California. Haleakala National Park and its USGS Field Station have been involved for some years in studies of the slowly spreading but destructive Argentine ant (Cole et al. 1992) in an effort to prevent its further invasion of Haleakala's otherwise ant-free high-elevation environment. If the red imported fire ant gets established in Hawaii, its winged queens will quickly spread statewide and very likely invade Haleakala Crater.

Dispersed primarily through human commerce, the red imported fire ant has invaded over 300 million acres in the southern USA in spite of a USDA federal quarantine. It is a serious threat to public health and safety, industry, biodiversity, water quality, economy, and quality of life. Its aggressive nature and powerful sting have caused the deaths of at least 83 people, injury to tens of thousands of people annually, and injury to and death of wildlife, livestock, and pets. Its broad diet, which includes plants and animals, has caused substantial agricultural damage and serious declines in biodiversity (Wojcek et al. 2001). If this ant is allowed to become established in Hawaii, biodiversity impacts can be expected to be particularly severe, since the Hawaiian biota evolved in the absence of native ants and is consequently extremely vulnerable to aggressive ants (Gillespie and Reimer 1993).

Conclusions

The problem of invasive alien species is becoming increasingly recognized as an important issue nationwide and worldwide, but the Hawaiian Islands comprise what is arguably the world's most vulnerable site. Recently published books (Devine 1998; Van Driesche and Van Driesche 2000) zero in on Hawaii's severe problem of continuing invasions, while recognizing that the best hope for improving the situation resides on the island of Maui. In many ways, Hawaii is a model system for dealing with biological invasions, but there is definitely a downside. Financial resources to meet the needs are not proving to be available on a sustained basis. Hawaii was

recently beset by a teachers' strike, and although numerous alien species bills were introduced in the 2001 Hawaii State Legislature, most have failed. Extremely important federal resources are at stake in Hawaii—including several superb national parks and more than 300 endangered species. Good opportunities exist on Maui to protect areas such as Haleakala's Kipahulu Valley, arguably the most biologically diverse and intact tropical rainforest ecosystem in the USA.

We contend that Hawaii is a magnificent testing ground for strategies to deal with biological invasions. U.S. mainland ecosystems, given unabated action of similar forces responsible for continuing degradation—habitat destruction, habitat fragmentation, biological invasion, and cascading effects toward biodiversity loss—will be showing comparable symptoms by the second half of this century. Because of the profound human element in biological invasions, effective intervention will necessarily involve catalyzing changes in human behavior. We are confident that we are on the right track in investing much time and effort in partnerships targeted for dealing with invasive species. Support by state and local governments is crucial to success of this endeavor. But we can also see that much more federal support is warranted and absolutely necessary to allow these partnerships a chance to attain their goals.

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