BIOLOGICAL CONTROL OF INVASIVE PLANTS IN NATIVE HAWAIIAN ECOSYSTEMS

PREFACE

The importation of alien insects and pathogens to control invasive alien weeds raises justifiable concern among land managers and conservationists. Do we risk compounding the problem by introducing yet another alien species for which we have only an imperfect assessment of its risk of becoming invasive itself? What is the likelihood that an imported control agent will affect non-target species or expand beyond expected habitats and host species? For the Hawaiian archipelago the dangers are particularly acute.

Hawai'i has many endemic species, a substantial percentage of which are at risk of extinction. The Hawaiian vascular plant flora includes about 1302 taxa (including subspecies and varieties) of which 1158 are endemic (Wagner *et al.* 1990). Some 37% of these taxa are endangered or at risk of becoming extinct, representing 38% of all federally listed endangered species in the United States (Loope 1998). Islands, moreover, appear to be particularly vulnerable to invasive species. Over 900 non-indigenous plant species have become naturalized in Hawai'i, more than 90 of which constitute substantial problems for conservation because they compete with native species or so alter ecosystem processes that whole communities are changed (Vitousek and Walker 1989). In spite of the magnitude of the invasive weed problem in Hawai'i, we are unable to predict with any confidence which new plant introductions are likely to become problems in future years. Beyond those species whose invasive tendencies have been demonstrated elsewhere, our understanding of what combination of species traits and ecosystem characteristics produce explosive, habitat-altering population growth is rudimentary. There are good reasons for caution in the use of alien insects and pathogens as control agents for invasive weeds.

Nevertheless biological control offers one of the most cost-effective and enduring mechanisms for the control of persistent weeds that have become widely invasive in natural habitats. Chemical and mechanical approaches to the control of weed populations require perpetual maintenance, may inflict unwanted side effects on non-target species and communities and are of limited use in large diverse ecosystems. Extensive infestations in poorly accessible terrain require considerable long-term investment in personnel and resources, expenditures that may be difficult to justify when short-term economic returns are not apparent. Biological control offers the possibility for control (rarely eradication) of invasive weeds over extensive acreage and inaccessible terrain in perpetuity. Yet the technique is far from a panacea. Many years of exploration and host-range testing are necessary before a potential control agent can be brought to the point of release. Limitations of quarantine space and personnel mean that only a handful of agents can be under investigation at any one time. While the numbers of releases resulting in unpredicted impacts on non-target hosts have been low in recent times (J. Balciunas this volume, R. Pemberton this volume), many releases have been less than successful because the agent either fails to establish viable populations and/or is ineffective in limiting populations of the target plant over part or all of its range. Financial constraints frequently inhibit our ability to conduct the necessary studies on the biology of a species in its native environment.

Clearly the challenge to the community of scientists and managers seeking to use biological control agents in Hawaii is to make the most efficient use of limited space, personnel, and financial resources in bringing the safest yet most effective insect and

pathogen agents on line. The most productive research strategies for meeting that goal was the topic of the 2000 Conservation Forum of the Hawai'i Secretartiat for Conservation Biology: *Biological Control of Invasive Plants in Native Hawaiian Ecosystems*. Presenters and discussants were invited to provide both breadth of international experience in a diversity of plant-herbivore-predator systems and depth of understanding of the particular idiosyncracies of island ecosystems. They were charged to take from the theory and patterns of evolutionary and population biology and from the experience gained in Hawai'i to recommend a framework of research priorities and strategies. Such strategies should not only improve the efficiency with which we bring new control agents to the point of release, but also increase the likelihood that released agents are both effective at reducing population sizes of target species and unlikely to threaten non-target plants. This volume is a compendium of historical syntheses, examples of effective research strategies, and detailed case studies from the Hawaiian experience in biological control. It is capped by a synthesis that arose from discussions of strategies for exploration and country-of-origin studies, of lessons from Hawaiian releases, of protocols for host-range testing, and of appropriate pre-and post-release assessments of impact.

It was our hope that the forum would be not only a stimulus for discussion and information exchange, but also a source of renewed energy, direction, and cooperation among the diverse community of scientists and managers concerned for the future of native Hawaiian ecosystems. We are thus grateful for the participation of representatives from many state and federal agencies, of land managers, and of community groups and for the contributions of scientists from the US mainland and abroad who contributed enthusiastically in all aspects of the proceedings. All these components were brought together in a smoothly-run meeting through the efforts of the late Nancy Glover, Director of the Secretariat for Conservation Biology, and her assistant, Moani Pai, who oversaw the conference logistics, and through the excellent management of Audrey Haraguchi and her assistant Olivia Rivera of the Institute of Pacific Islands Forestry, who arranged travel for international and mainland participants. The productivity and quality of the meeting would have been much diminished without their dedicated efforts. We are grateful for financial support from US Department of Agriculture Forest Service International Programs and the Institute for Pacific Islands Forestry, from the Secretariat for Conservation Biology, and from the US Geological Service-Biological Resources Division Pacific Cooperative Studies Unit, University of Hawai'i.

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