

Hawaii—rich in endemic biodiversity and the U.S. region most susceptible to biological invasions

Oceanic islands are well known to be especially vulnerable to invasive species. The Hawaiian Islands comprise one of the most isolated archipelagoes in the world, with biological endemism at the species level approaching 100% for many native groups. Over all, Hawaii has approximately 10,000 endemic species (found nowhere else on Earth besides Hawaii), out of a total biota of approximately 20,000 native terrestrial and marine species (Eldredge and Evenhuis 2003), comprising a quite significant part of U.S. biodiversity in a very small land area. Hawaii, with far above-average vulnerability to invasions (Loope and Mueller-Dombois 1989, Denslow 2003), is also a major international hub of commerce. It is by far the U.S. region most damaged by invasions, with large numbers of and serious impacts from invasive vertebrates, invertebrates, diseases, and flowering plants (OTA1993).

The stakes are especially high in Hawaii because of the state's world-class biota. Hawaii's conservation biology community argues that Hawaii's biota not only is a major contributor to the beauty and wonder of Hawaii but also is a world treasure because in one archipelago it comprises a unparalleled (even in Galapagos) microcosm of evolutionary processes (e.g., Williamson 1981, Carson, in Juvik and Juvik 1998). Much biological richness is left in Hawaii, mostly at high elevations, even though what is left is threatened by old, new, and future invasions. Exciting new discoveries (e.g., Rubinoff and Haines 2005) and new, elegant understandings of processes (e.g., Gillespie 2004, Vitousek 2004) are nearly as frequent as detection of serious new pests. Furthermore it has an impressive array of federal and state protected areas (Loope and Juvik, in Juvik and Juvik 1998). Yet more native species have been eliminated in Hawaii than anywhere else in the United States. Hawaii has lost about 8% of its native plant species and an additional 29% are at risk (Loope 1998). With just 0.2% of the U.S. land area, Hawaii has about 25% of U.S. endangered species. Although habitat destruction has been an important cause of extinction and endangerment, the introduction and spread of invasive alien species has contributed in a major way in the past and is now the predominant cause of biodiversity loss in Hawaii.

Worldwide, the methods used over the years for assessing and managing the risks posed by alien pests of cultivated plants have tended to differ from actions taken against those alien species that threaten native plants. Internationally, cooperative efforts through the Convention on Biological Diversity and the International Plant Protection Convention have recently resulted in progress in developing improved strategies and tools to concurrently manage risks to global crop reduction and biodiversity (Baker et al. 2005). Nevertheless, Hawaii still receives no special protection to prevent invasive species introductions. Border protection from foreign passengers' baggage and cargo at the Port of Honolulu is essentially identical to that at all other international ports in the United States (CFR, Chapter 7, 319.56-8). Preventive actions are taken based primarily on an approved list of organisms for which specific legal authority is deemed to exist, primarily for protection of U.S. mainstream agriculture. In practice, the actionable list has little to do with organisms that would affect Hawaii's agriculture or native biota. An exception involves a special USDA quarantine action policy for ants moving into or through the

State of Hawaii. This policy, first instituted in 2002, places any ant species not already present in Hawaii (and those present for which active control efforts are underway) on an “actionable list” of species targeted by DHS/USDA inspectors (Krushelnicky et al. 2005). However, no ants have been intercepted by APHIS or DHS since the policy was instituted.

Federal “preemption,” codified by the Plant Protection Act of 2000 (Public Law 106-224), restricts Hawaii’s latitude in defending its borders. Fox (2005) explained preemption as follows: “The Constitution’s Commerce Clause (Art I., Sec. 8, Clause 3) and Supremacy Clause (Art VI, Clause 2) set the stage by giving Congress the authority to regulate commerce with other nations and between the states, and confirming that federal law is the supreme law of the land. In the area of pest prevention, the federal Plant Protection Act takes it a step further by specifically preempting states from being more restrictive than the federal government in regulating the movement of plants and plant products. (7 USC § 7756).. The State of Hawai‘i runs directly into federal preemption if it wishes to strengthen its statutes regarding plants or implement stricter state quarantine regulations. The only available choice is a long and laborious process of securing approval for heightened restrictions on a species-by-species basis from the Secretary of Agriculture. (7 USC § 7756(b)(2)(B)).” This preemption policy has resulted in federal negation of Hawaii quarantine rules for some invasive species and deterred HDOA from promulgating rules for other pests.

Although Hawaii may have better laws for preventing invasive species establishment than most states (OTA 1993), the Hawaii Department of Agriculture has little or no authority for protection from pests from foreign sources and receives limited funding (HDOA 2002). USDA-APHIS has a large program based in Hawaii for airport departure inspections to protect mainstream agriculture on the U.S. mainland from Hawaii’s pests but no reciprocal measures for protecting Hawaii (OTA 1993). Clearly, the quarantine system is not protecting Hawaii. Because of its special vulnerability to invasion, Hawaii’s prevention and management needs are much greater than for the rest of the country. This, combined with Hawaii’s small population and limited tax base, means that effective protection against invasions is not being provided. Hawaii has been one of the most unfortunate locations in the world as far as pest introduction is concerned, and its biodiversity and agriculture have suffered. The state is in the midst of an invasive species crisis affecting not only the archipelago’s highly endemic biota, but also overall environmental and human health, and viability of its tourism- and agriculture-based economy (CGAPS 1996, Choo 2004). The Invasive Species Specialist Group of the World Conservation Union (i.e., IUCN) recently developed a list of “100 of the world’s worst invasive species” (ISSG 2002); Hawaii has 47 of them.

Hawaii has roughly the same total number of nonnative arthropod species as the continental United States. McGregor (1973) speculated on the reason: “Although there is much greater diversity of crops and habitats within the continental United States, these are dispersed over a vastly larger land area. In Hawaii, where the overall diversity is less, the various habitats are more readily accessible from the principal port of entry.” The more moderate and stable climate of Hawaii is also more favorable to an invading species

than the climate in much of the United States. Furthermore, McGregor (1973) recognized this point in relation to agricultural quarantine: “(for insects and mites) in the period 1942–72 the rate of colonization per thousand square miles was 40 species, 500 times the rate of [the] continental United States.” There is no evidence to indicate that this pattern has changed in the years since 1973.

Public concern about biological invasions is gradually producing political traction in Hawaii. The 2006 Hawaii Legislature has passed legislation providing a 60%+ increase in funding for Hawaii Department of Agriculture’s plant quarantine and plant pest control divisions, and there is considerable promise that this will translate within the near future into better legal authority and resources to protect Hawaii’s biodiversity. In the past, largely because of an inadequate quantity of state inspectors (though legal issues may pose a problem as well), there has been limited coordination among federal and state agencies in quarantine inspection, so this would be a particularly good time for initiating federal-state discussions on improving joint ability to protect Hawaii.

The 2006 funding via the Hawaii state legislature may have been partly stimulated by two extremely serious biosecurity breaches in Hawaii in 2005 – *Erythrina* gall wasp (from Taiwan or Singapore) and eucalyptus rust, *Puccinia psidii* (from Florida or a Latin American country) – that are likely to have profoundly negative consequences for Hawaii’s dominant native biota. Eucalyptus rust (Coutinho 1998) is a greater relative threat to Hawaii than sudden oak death is to any area on the U.S. mainland, since it poses a death threat to *ohia lehua*, Hawaii’s dominant tree in 80% of remaining native forest (1 million acres of a small archipelago). HDOA is currently developing emergency regulations to shut down the myrtle family pathway to prevent introduction of new strains of the rust and consequent hybridization (Brasier 2001, Wingfield et al. 2001).

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