

Exotic Plants in Hawaii's National Parks: A Major Challenge

By Donald E. Gardner

Exotic plants and the problems they cause are a familiar concern for managers of native areas. Such plants, however, are of particular importance in native ecosystems of islands. In such habitats some exotic species, isolated from those of continental landmasses, released from natural population controls and finding an "empty" niche, may become aggressive weeds. This is a common situation in the characteristically "depauperate" island communities. Because the Hawaiian Islands are regarded as a popular vacationland and have become easily accessible to visitors from all over the world, it is hard to realize that these islands are the most geographically remote of the world's major island groups.

The species of flora and fauna now found in Hawaii can be categorized into three rather clearly defined groups:

1. Endemic – those species that evolved in Hawaii from naturally introduced (without human intervention) ancestral forms and which are now distinct from those forms. It has been said that had Charles Darwin's voyage on H.M.S. Beagle brought him to the Hawaiian Islands rather than the Galapagos, he would have found

even more supportive evidence for his work *On the Origin of Species*.

2. Indigenous – those species naturally occurring in Hawaii as well as elsewhere, having arrived in Hawaii by means other than human introduction.

3. Exotic – those species brought by European civilization beginning with the discovery of the Hawaiian Islands by Captain Cook in 1778. Species brought prior to this date from other Pacific islands by early Polynesian colonizers may also be considered exotic in a strict sense, although these usually are acceptable in practice due to their association with aboriginal cultures.

In general, endemic species are those that originated from life forms adapted for long distance travel or dispersal, whereas it is likely that only a very few of the exotic plants and animals now in Hawaii would have become naturally established there without purposeful or accidental introduction by recent human activity. For example, insect species whose ancestors, while in flight, could have been carried long distances by high altitude winds comprise a major portion of Hawaii's endemic fauna. The only endemic mammals are a fur seal and a bat, both now rare, whose predecessors' means of reaching the islands are appar-

ent. In comparison, the probability that strictly terrestrial mammals could have come without the aid of humans is slight. Likewise, plants that colonized Hawaii were those whose propagules were carried long distances by birds or wind, or whose seeds were capable of withstanding long exposures to sea water.

During the process of evolution, many endemic Hawaiian species lost the ability, by nonselection, to ward off or avoid the natural predators or other enemies they left behind in their locality of origin. Although insular ecosystems may be noted for their resilient internal stability, they are particularly vulnerable to deleterious outside influences, such as the introduction of aggressive plants and animals.

Public awareness of these effects was lacking in the early days of colonization, when many species were freely brought to Hawaii. European immigrants, homesick for their former surroundings, brought favorite plants and animals. Other species were introduced inadvertently due to a lack of proper quarantine inspection procedures. Restrictions on importation of nonnative species have been imposed only relatively recently and are still not completely effective.

Certain exotic plant species in Hawaii (such as the firetree which is an important forest tree in its native environment, the Azores, Madeira, and the Canary Islands), are aggressive and unwelcome encroachers into native Hawaiian habitats. Firetree currently occupies extensive forest and other land use areas throughout the state. In Hawaii Volcanoes NP it occurs on hundreds of acres and is spreading at an alarming rate. Differences of professional opinion exist regarding the extent to which this species is capable of actually invading undisturbed native ecosystems and replacing component species. However, its explosive population growth in areas disturbed by fire or volcanic eruptions has led managers to consider this tree one of the greatest overall threats to the park's integrity.

Several other species of small trees or shrubs, grasses, and vine-like plants also are regarded as equal or more serious threats in both Hawaii Volcanoes and Haleakala NPs. Although it is difficult to reach a consensus regarding the relative dangers posed by each exotic plant species when the "top" 10 to 15 species are considered, managers and researchers generally agree as to the problems created by the "super exotics" in this category.

Control efforts have involved wide scale mechanical removal of young plants and chemical treatment of older plants. However, in the case of well-established grasses, the general disturbance that would result from such efforts tends actually to encourage further establishment of exotics. Managers are increasingly aware that in many instances there is insufficient manpower to keep up with control of exotics, some of which become reestablished faster than they can be eliminated. Prolific seed production and successful dispersal mechanisms, often not yet fully understood but suspected in some cases to involve exotic birds, are characteristic of many of the species. The ability of exotic grasses, such as broomsedge to become rapidly and densely established on burned sites disrupts the native successional sequence and creates an abnormally great fire hazard.

Although the use of chemical pesticides is discour-



Exotic firetree (large arrow) growing in close proximity to a young native ohia tree (small arrow) in Hawaii Volcanoes National Park.

aged in NPS areas if other means of control are available, herbicides continue to represent the only realistic approach, aside from mechanical removal. Herbicidal treatment has resulted in some partial successes, and managers have no apparent alternative at present. No single approach currently shows promise of controlling the problem or even of keeping up with it.

In view of this reality, resources managers have been compelled to set priorities, based on the probability of success, concentrating first on eradication of new invaders, next on containment of recently established populations, and finally on control of existing exotics in small, well defined sites designated for the natural regeneration of endangered species. Except for "cosmetic" removal of exotic plants, such as along roadsides or in campgrounds, well-established populations cannot be contained through present methods and are therefore placed near the bottom of the priority list.

Public awareness and opinion also play a role. The general public is not yet fully sensitive to the NPS mission of preserving environmental processes and features in their native condition. Thus, visitors to Hawaii's national parks expect to see an abundance of "tropical" plant life, a proliferation of fragrant and showy flowers, colorful birds, and similar amenities commonly associated with Hawaii.

While all of these can readily be found in Hawaii, frequently they do not represent Hawaii's endemic flora and fauna, a fact rarely of much consequence to the average visitor. Unlike plants such as the nonnative species of ginger, which grow in thick patches in rain-forest areas and produce attractive, aromatic flowers, few truly native Hawaiian plants have the expected large, showy or fragrant blooms. Native birds may be colorful, but they are small and not readily seen. Too often, visitors fail to appreciate the true "inner beauty" of endemic species, which is the uniqueness of their origins, their adaptation to the environment in which they evolved, and their rarity among the world's flora.



Fuschia sp. bushes (arrow) in a native ohia-tree fern forest in Hawaii Volcanoes National Park.



Broomsedge and other exotic grasses covering extensive acreages of Hawaii Volcanoes National Park.

With the well-intentioned but misguided idea of "beautifying" Hawaii Volcanoes NP, several decades ago a number of colorful South American *Fuschia* sp. bushes were planted in the rain forest among the native tree ferns near a prominent visitor attraction. It is obvious from visitor comments and their photographic activities that *Fuchsia* now represent one of the most memorable "Hawaiian" flowers in the Park. Little regard is given to their exotic origin and great consternation would be expressed if the bushes were removed. Other flowering shrubs, such as glorybush (*Tibouchina urvilleana*), with large, bright purple flowers, may be included in the same category.

Visitors sometimes express surprise or concern at exotic plant eradication efforts and may leave the Park still wondering why the "forest rangers" found it necessary to remove a certain tree or shrub. In response to this problem, the visitor center at Hawaii Volcanoes NP now includes a display explaining NPS policy with regard to exotic species. Public information leading to public awareness of the NPS mission is essential to provide support for NPS management in carrying out its increasingly complex functions.

Insect predators and plant diseases have been and are being used in noxious weed control programs with varying degrees of success. Ideally, such biological control approaches may provide good cost effective control without the disadvantages of polluting residues or byproducts and other side effects.

A biocontrol program may in theory integrate the effects of several beneficial predators and/or parasites which, once established in the region where control is desired, make contact with the target species and continue to provide control indefinitely. In actual practice, several potential limitations must be considered. Complete eradication is not usually achievable through a biocontrol program. The expected result is a reduction of the problem population to a manageable level at which its aggressiveness is significantly mitigated.

For biocontrol programs to be effective, the insect predators or disease agents must possess two important qualities: A high degree of virulence, sufficient to kill or severely affect the host plant, and host specificity – that is, their destructive capability must be limited to the target species. Effective agents must display consistency and stability in both these qualities under the

actual environmental conditions in which they will be used, not only in laboratory or greenhouse tests.

In addition, once biocontrol agents have been released into the environment, they cannot be recalled; they are free to cross political boundaries, such as those of a national park, and may spread to the limits of their potential ecological range. Their probable effect on target, as well as nontarget species throughout this range should therefore be ascertained as accurately as possible prior to their release.

In an effort to prevent further problems such as those created in the past by indiscriminate introduction of exotic species into Hawaii, the State of Hawaii has imposed stringent regulations for importation of insects or plant disease agents for any purpose, including testing for possible use in biocontrol programs. This cautious approach is understandable in view of the number of varying interests that must be considered and the prevailing element of uncertainty regarding unforeseen predatory or parasitic relationships inherent in any such research program.

In Hawaii other prominent interests, most notably those of agriculture, receive prime consideration in conflicts which may arise from native ecosystem preservation efforts. Some exotic plant species which constitute problems and are not at all desirable in NPS areas are widely cultivated or otherwise encouraged outside park boundaries for their ornamental value or their fruit, effectively ruling out biocontrol efforts. Other troublesome exotic species are so closely related to agricultural crops as to severely restrict biocontrol methods. For example, certain aggressive exotic grasses in Hawaii Volcanoes National Park are closely related to sugar cane, Hawaii's most important crop.

Notwithstanding these difficulties, some exotic species appear to be equally undesirable, outside, as well as within NPS areas, presenting no serious conflicts. It is the hope of Hawaiian NPS managers and scientists that these species may serve as the basis for a pilot biocontrol program supported by state as well as NPS concerns, and that such efforts, if successful, may eventually make available more time and manpower to concentrate on the control of other exotics through more direct methods.

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