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SEAs Successful as Alien Species Controls

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Alien species pose a critical threat to native biota in Hawaii; already they have altered many ecosystems at Hawaii Volcanoes NP. Special Ecological Areas (SEAs) are intensive management units in which alien species control that is not affordable or feasible on a parkwide basis is conducted. (Tunison et al. 1986). An SEA approach has guided alien plant management since 1985 and this report evaluates its success in controlling alien vegetation.

Alien Species Threats

Ecosystems of remote islands such as Hawaii are especially vulnerable to alien species invasions (Loope and Mueller-Dombois 1989). The native biota have evolved free from disturbance factors such as ungulates and fire. Feral ungulates and alien plants have altered much of the natural vegetation of Hawaii Volcanoes NP and feral goats have devastated large portions of the coastal lowland zone by preferentially grazing on native species.

Feral pigs disturb soil, disrupt the understory in wet and mesic forest, and disperse the seeds of exotic plants. Over 35 (of 600) non-native plant species in the park can be considered to be habitat-disruptive. Some of these form mono-specific stands. Others alter fire, nutrient, and soil-moisture regimes (Smith 1985).

The SEA Approach to Management

The Special Ecological Area concept developed out of the need to protect immediately some of the most biologically valuable sites in the park from alien plants while these still were manageable. SEAs were selected largely on the basis of intactness, manageability, species richness, immediacy of alien plant threats, and presence of rare flora. Other factors included potential for research and interpretation, uniqueness, preserve design considerations, and need for experimental management.

An attempt was made to locate SEAs in all six ecological zones in the park, to make them as large as possible, and to link them in some fashion. SEA management demonstrates the park's decision to solve weed problems systematically and incrementally. SEAs are intended as models for management of other areas. As alien species are reduced to management levels and workload requirements drop, SEAs are expanded and new SEAs started.

All disruptive alien plants, even those targeted for biological control research, are controlled by manual, mechanical, or herbicidal means in SEAs. Many of these cannot be controlled parkwide because they are too widespread. Feral ungulates generally are controlled in larger units that include the SEAs.

SEAs also are foci for research and interpretation. An understanding of Hawaiian biota and ecosystems is

(Continued on page 3)



Using a periscope device, Julie Leialoha, Biological Technician, measures canopy cover in a tree-fern dominated rain forest site recovering from feral pig damage and following removal of alien plants. Monitoring is an integral component of alien plant control efforts in SEAs. Population levels of target plants are monitored along extensive belt transects. Intensive plots are located randomly in recovering sites of special interest to evaluate total vegetation changes.

best gained through long-term monitoring and research in the most intact, representative areas. These areas then can be used to educate the public about native ecosystems, alien species threats, and management.

Management Effectiveness

SEA management began in 1985 with alien plant control efforts in six SEAs totalling 3,800 ha (Fig. 1). By 1990, the original six SEAs had been expanded to 12 areas comprising 12,000 ha, and included several sites each in four of the six ecological zones of the park (Fig. 1). SEA management now is beginning to emphasize rain forest ecosystems. SEA expansions were possible because of declining workload requirements resulting from successful control efforts. Approximately 1,019 worker-days were needed for control work and monitoring in the first year in the three representative SEAs. This requirement declined rapidly in the second year, and only one fifth of the original workload was required in the sixth year (Table 1).

Eleven habitat-disruptive exotic plant species were targeted for control in the 12 SEAs. Changes in population levels of eight of these are described for three representative SEAs. These SEAs were used because they have been managed for the longest time, are located in highly disparate environments, and received the greatest management attention. They also represent a broad range of sizes, an important factor for dispersal of alien plant seeds in SEAs.

A Mesic Forest Site

Kipuka Puau is a 100 ha SEA in mesic forest surrounded by a 910 ha buffer zone (Fig. 1). It was selected because of its unique mesic forest vegetation, abundance of rare plant species, manageability, and potential for research and interpretation.

Faya tree, kahili ginger, strawberry guava, Jerusalem cherry, and nasturtium were targeted for control. Faya tree can form monospecific stands and is potentially disruptive at lower densities because it fixes nitrogen in normally nitrogen-poor volcanic soils. Kahili ginger is a rhizomatous herbaceous plant that forms a monospecific understory layer. Jerusalem cherry is a shrub with the same capacity. Strawberry guava forms impenetrable thickets in the understory of native forests from root sprouts and precludes native tree reproduction. Nasturtium grows in single species stands in forest gaps.

All target species declined measurably with control efforts, three of the five by an order of magnitude, and one species by nearly two orders of magnitude. (Table 1).

Fern Dominated Rain Forest

Thurston SEA is a 50 ha site in 'ohi'a/fern dominated rain forest typical of the summit of Kilauea volcano (Fig. 1). It also is the site of a heavily used nature trail and of considerable research in the past. It was selected as an SEA for its relative intactness, representativeness, and potential for research and interpretation. Another consideration was the experimental value of managing an SEA surrounded by areas with high densities of exotic plant species to be managed. High levels of recruitment were anticipated because of seed dispersal into a relatively small area.

Faya tree, strawberry guava, kahili ginger, and palm grass were targeted for removal. Palm grass is a one-meter tall shade tolerant grass that can form dense understory stands. Populations of target alien plant species and workload declined significantly in

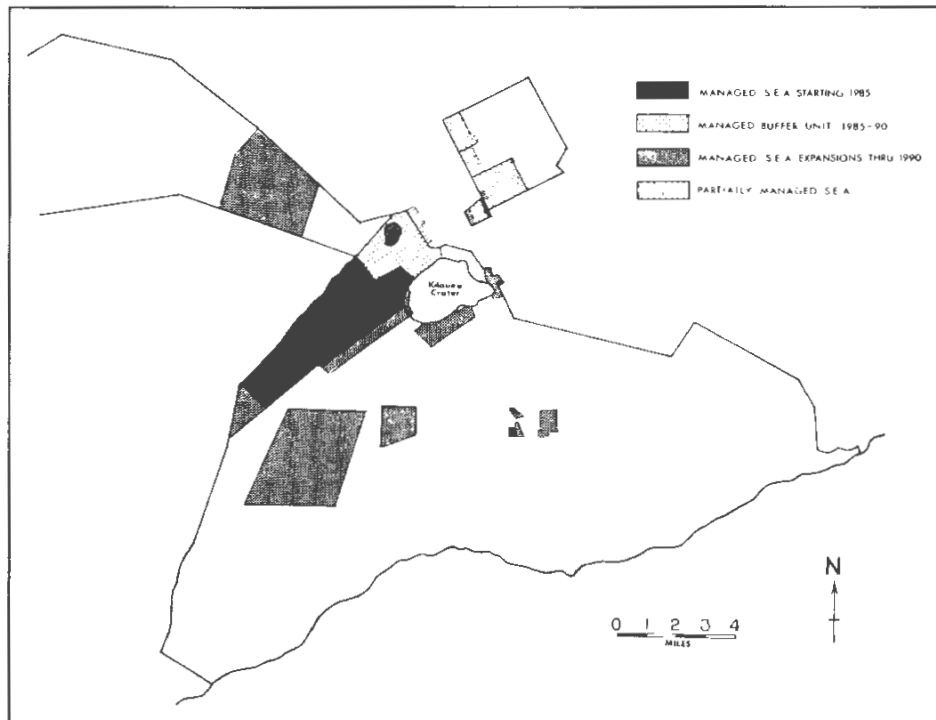


Figure 1. Expansion of Special Ecological Areas in Hawaii Volcanoes NP, 1985-1990.

Thurston SEA. Faya tree and strawberry guava populations decreased even more than they did in Kipuka Puau (Table 1).

Summer-Dry Native Scrub

Keamoku is a 1985 ha SEA characterized by summer-dry native scrub with scattered short statured 'ohi'a or koa (Fig. 1). It was selected mainly for its intactness and representativeness. Faya tree, silky oak, and fountain grass were targeted for control. Silky

oak is an introduced tree that forms dense stands. Fountain grass is a bunchgrass that raises fuel loadings to unnaturally high levels and interferes with primary succession on new lava flows. All target species declined by levels similar to those in other SEAs (Table 1).

Conclusions

Successful control efforts from 1985-1990 demonstrate the value of the SEA approach to alien plant

(Continued on page 4)

Table 1. Population levels of target weed species treated in three representative SEAs, 1985-1990. Unless specified, these data were derived from tallies of alien plants treated in systematic annual control efforts.

SEA/TARGET SPECIES	YEAR					
	1	2	3	4	5	6
Kipuka Puau						
Faya tree*	5,100	12,950	11,647	6,645	6,314	1,425
Kahili ginger**	1,800	1,500	325	130	275	184
Strawberry guava*	600	715	315	90	334	54
Jerusalem cherry***	ND	6,050	325	250	280	50
Nasturtium****	67	44	14	2	ND	<1
Thurston						
Faya tree*	1,493	324	172	32	85	ND
Kahili ginger**	10,913	3,763	1,288	245	204	184
Strawberry guava*	20,572	3,121	5,367	1,480	1,660	54
Palm grass***	180	70	81	17	10	ND
Keamoku						
Faya tree*	5,500	3,975	706	1,363	1,302	585
Silk oak*	960	1	7	3	ND	ND
Fountain grass*	6	4	1	0	0	2
TOTAL WORKLOAD	1,019	486	305	273	274	210

*Number of individuals or stems uprooted or cut and treated with herbicide.

**Total area treated with herbicide.

***Total fresh weight of rhizome uprooted and removed.

****Percent cover in monitoring plots.

management; the approach also has protected the most important sites in the park. Population levels of target species have declined markedly, typically by an order of magnitude, in spite of some recruitment from surrounding areas. Workloads have decreased by a factor of five. Hawaii Volcanoes NP will continue the SEA approach to management, and encourages this incremental, experimental strategy for parks and preserves where alien species or native ecosystem restoration problems are overwhelming.

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"... by applying molecular biology to the study of evolution, taxonomic sleuths have identified two California cousins of the Hawaiian silversword 'alliance,' a grouping of 28 closely related plants. The findings also furnish genetic clues suggesting that all existing silversword species may have evolved from a single seed. Plant evolutionist Bruce G. Baldwin suspects the genealogic evidence he has collected may even inspire new thinking about how plants worldwide 'came to be where they are'."

"From Tarweed to Silversword" is the title of an article by Wendy Gibbons in the April 27, 1991 issue of *Science News*, suggesting that Hawaiian plants with California roots "challenge botanical dogma." Researchers Donald W. Kyhos of U/CA Davis and Gerald D. Carr of U/HI Honolulu attempted to confirm the apparent kinship between a Hawaiian silversword specimen and two California tarweeds with sets of mutations closely resembling those of the Hawaiian plants by crossing them. "We could hardly believe our eyes when the results came in," Kyhos said. The matings produced healthy hybrid plants, suggesting that a single tarweed progenitor established itself on one Hawaiian island and that subsequent generations from that single plant "probably evolved into the diverse group of silverswords now evident in Hawaii."