

DRYLAND FOREST RESTORATION at KA`UPULEHU (MAUKA), HAWAI`I
Summary of Final Report to U.S. Fish and Wildlife Service
By Hawai'i Forest Industry Association
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THREATENED FOREST: Dryland forests are among the most biologically diverse and heavily impacted ecosystems in the Hawaiian Islands. Approximately 90% of the dryland forests in Hawai'i have been lost, and the remaining 10% have been heavily degraded. One of the largest remaining areas of the dryland forest is in the North Kona region on the island of Hawai'i.

The major threats to the dryland forest in the North Kona area are fountain grass, fire, ungulates and rodents. Additional threats include insect predation and competition from other alien plants. Fountain grass is a highly invasive species that suppresses native vegetation and greatly increases the risk of fires. Ungulates such as cattle, feral sheep and pigs are also a serious threat because they browse native plants and seedlings, trample plants and aid in the spread of alien plants. Our previous work has shown that without aggressive intervention, most of the remaining native dryland forests in North Kona will eventually be replaced by weedy, invasive, alien species.

In addition, many endangered dry forest species were used by native Hawaiians. Kauila wood was used to make weapons, agricultural tools, and fishing lures. Other culturally important endangered plants that are still found in North Kona include halapepe, koki`o and uhiuhi. Thus, the preservation of these plants is critical for both biological and cultural reasons.

KA`UPULEHU SITE: The mauka (upland) Ka`upulehu site is leased by the National Tropical Botanical Garden (NTBG) from Kamehameha Schools. It is a 5-acre fenced enclosure located north of Kailua-Kona on the west side of Hawai'i island. It was designated a state forest reserve in the early 1950s, at which time it was fenced to prevent further damage from grazing. The site has underlying lava flows with a geologic age of 1,500 to 3,000 years, ranges from 2,050 to 2,100 feet in elevation, and has an average annual rainfall of 21 inches. It is made up of remnant dryland forest dominated by lama, and it occurs on pahoehoe and a`a lava with relatively shallow soils 11 to 18 inches deep, with occasional soil pockets 2 to 3 feet deep.

RESTORATION PROJECT: Demonstrating the feasibility of economically restoring and regenerating the dryland forest is the intent of this project. Many partners are involved, including the State DLNR Division of Forestry and Wildlife, Hawai'i Forest Industry Association (HFIA), Hualalai Ranch, Kamehameha Schools, Kukui`ohiwai, NTBG, The Nature Conservancy, PIA Kona Limited Partnership, U.S. Army Pohakuloa Training Area, U.S. Fish and Wildlife Service (USFWS), and the U.S.D.A. Forest Service. The project is coordinated by HFIA with major funding from USFWS. The project's management objectives are to:

1. Maintain the existing fence to control ungulates. The site is adjacent to an active cattle ranch, and goats are also common throughout the area.

2. Control alien plants. Fountain grass is controlled throughout the site by weedeating and herbicide treatments. It was first cleared of fountain grass in December 1995 by weedeating and hand weeding. The site was then sprayed quarterly with Fusilade and occasionally with Roundup, and by the last treatment in March 1997 about 96% of the fountain grass had been killed. Fusilade was chosen because it is grass specific and does not harm native plants. Eradication of fountain grass with Fusilade is slow, requiring supplemental spot sprayings and hand clearing. Other alien plants considered for

removal are lantana, pine, cypress, silk oak, and Christmas berry. These will be controlled only after native seedlings have established in their shade. Alien trees will be girdled and treated with Garlon to prevent resprouting, and wood and branches will be removed to reduce risk of fire.

3. Control fire. Wildfires occur regularly in the Ka'upulehu area and controlling fountain grass, as described above, plays an important role in preventing fire. A fire break surrounding the property was established to keep fire from spreading into the site. A 40 foot wide perimeter was cut and herbicide applied on the west boundary because the property was more likely to be threatened by a fast running head fire from this direction; a 20 foot wide strip was cut on the south boundary. A highway and barren lava flow served as a natural fire break along the other boundaries. Annual herbicide treatments of Roundup will continue in order to prevent regeneration of weeds in the fire break. Cattle grazing on the neighboring property also helps to reduce the fire hazard within the project area.

4. Control rodents. Rats and mice are known to destroy seeds and seedlings of native plants. Diphacinone bait bars were placed in 24 rodent bait stations which were distributed at 50 meter intervals throughout the site in October 1996. The stations were continuously monitored and rebaited every 7 to 10 days. In this period, 350 pounds of bait had been used, and, based on consumption, it is estimated that 800 rodents were killed. After baiting, there was no evidence of damage to fruits and seeds of native species. This suggests that rodent density within the project area had declined; however ongoing control will be needed to discourage rodents moving into the site from surrounding areas.

5. Determine regeneration success. Monitoring played a vital role in determining whether removal of alien weed species had any effect on the regeneration of dryland forest plants. An initial survey conducted in 1995 counted 928 native trees and shrubs, of these 885 (95.4%) were adult plants and 43 (4.6%) were juvenile plants. Further surveys in April 1996 showed that the regeneration of native species was minimal, with the exception of mamane. The two primary factors for lack of regeneration appeared to be competition from fountain grass and seed predation by rodents. By May 1997, native trees, sedge, shrubs, vines and herbs had spread in areas once dominated by fountain grass. This was most likely because of the fountain grass control and the wetter winter in which rainfall was almost twice the average. Seedlings of other alien species were also found, notably petty spurge, lantana and roving sailor.

6. Outplanting of native species. A variety of native plants were grown from seed collected within or near the project area and were planted on the site in October 1996. An irrigation system was installed, and the plants were watered with about 2 gallons each, twice per week. In November 1997, about 81% of the plants had survived, looked healthy and displayed signs of growth. Survival rates were highest in areas with relatively deep soils and a forest canopy, and they were lowest in areas with very little soil and no canopy.

CONCLUSION: Efforts to control alien species within the site appear to have assisted the regeneration of native species as well as new alien plants such as lantana. It is unclear whether simply continuing to control fountain grass and rodent populations will be sufficient for the long-term preservation and restoration of the dryland forest. Intensive management techniques and concurrent research efforts contributed to the high cost of the project, which totaled about \$55,130 or \$9,505 per acre. Fountain grass control, rodent control and monitoring will continue at the site. The potential threat of new alien plants is being evaluated on a case by case basis. Supplemental water and sowing experiments to determine how best to facilitate native plant regeneration are being evaluated. Other efforts of dryland forest restoration are being implemented on a 70-acre parcel adjacent to and makai (seaside) of the mauka property. This project is focused on protecting the dryland forest on a larger scale.

To obtain a full report of the work done at Ka'upulehu or for more information, call the HFIA office at 933-9411.