Addendum to the Recovery Plan for the Multi-Island Plants

Region 1

U.S. Fish and Wildlife Service

Portland, Oregon

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Date: 9/19/02

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The Addendum to the Recovery Plan for the Multi-Island Plants was prepared by Clyde Imada of the Bernice Pauahi Bishop Museum. Modifications have been made by the U.S. Fish and Wildlife Service.

DISCLAIMER PAGE

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Costs indicated for task implementation and/or time for achievement of recovery are only *estimates* and are subject to change. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than our own. They represent our official position *only* after they have been signed by the Regional Director or Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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An electronic version of this recovery plan will also be made available at http://www.r1.fws.gov/ecoservices/endangered/recovery/default.htm.

EXECUTIVE SUMMARY

Current Species Status: This Addendum to the Recovery Plan for the Multi-Island Plants covers 10 plant taxa that were listed as endangered in September 1999. Numbers of known remaining populations and individuals are as follows:

TAXON	POPULATIONS	INDIVIDUALS
Clermontia samuelii	4	309
Cyanea copelandii ssp. *haleakalaensis*	3	204
Cyanea glabra	1	12
Cyanea hamatiflora ssp. *hamatiflora*	7	12
Dubautia plantaginea ssp. *humilis*	1	60 to 65
Hedyotis schlechtendahliana var. *remyi*	4	13
Kanaloa kahoolawensis	1	1
Labordia tinifolia var. *lanaiensis*	3	300 to 800
Labordia triflora	1	10
Melicope munroi	2	300 to 800

Distribution: All 10 plant taxa, hereafter referred to as the "Multi-Island Addendum plants," are endemic to the Maui Nui group of islands in the Hawaiian Islands. This group includes Maui, Molokai, Lanai, and Kahoolawe.

Habitat Requirements and Limiting Factors: The 10 plants grow in a wide range of vegetation communities (shrublands, lowland forest, and montane forest), elevational zones (coastal to montane), and moisture regimes (dry to wet). The 10 plant taxa and their habitats have been variously affected or are currently threatened by one or more of the following: competition, predation or habitat degradation from alien species, natural disasters, and random environmental events.

Recovery Objectives: Delisting. Interim and downlisting objectives are provided to stabilize extremely rare plants and downlist the endangered plants to threatened status. Management units should be delineated to conserve not only these taxa, but their habitats as well.

Recovery Criteria:

• Interim Objective

The interim objective is to stabilize all existing populations of the Multi-Island Addendum plants. To be considered stable, each taxon[1] must be managed to control threats (*e.g.*, fencing, weeding, etc.) and be represented in an *ex situ*[2] collection. In addition, a minimum of three populations of each taxon should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with the following minimum numbers of mature individuals: 25 for long-lived perennials and 50 for short-lived perennials. There are no annual plants in this addendum.

• Downlisting Objectives

For downlisting, a total of five to seven populations of each taxon should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure, with the following minimum numbers of mature individuals per population: 100 for long-lived perennials and 300 for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered.

• Delisting Objectives

For delisting, a total of 8 to 10 populations of each taxon should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with the following minimum numbers of mature individuals per population: 100 for long-lived perennials and 300 for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years.

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[1] **Taxon**, plural **taxa**. A term used in biological classification (taxonomy), meaning a group of organisms at any rank (in this recovery plan, the ranks are variety, subspecies, and species).

[2] ***Ex situ.*** Off-site, as in a botanical garden, as opposed to *in situ*, in a plant's native habitat.

Actions Needed:

1. Protect habitat and control threats.
2. Expand existing wild populations.
3. Conduct essential research.
4. Develop and maintain monitoring plans.
5. Reestablish wild populations within historic range.
6. Validate and revise recovery criteria.

Total Estimated Cost of Recovery (in thousands of dollars):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
2002	2,087	0	487	0	0	0	2,574
2003	2,365	0	487	0	0	0	2,852
2004	3,434	0	487	0	0	0	3,921
2005	3,434	18	487	81	0	0	4,020
2006	3,400	18	487	81	0	0	3,986
2007	3,177	0	109	81	21	72	3,460
2008	3,177	0	109	81	21	72	3,460
2009	3,177	0	109	81	0	0	3,367
2010	3,177	0	109	81	0	0	3,367
2011	3,177	0	109	81	0	0	3,367
2012	3,177	0	109	81	0	0	3,367
2013	3,177	0	109	81	0	0	3,367
2014	3,177	0	109	81	0	0	3,367
2015	3,177	0	109	81	0	0	3,367
2016	3,177	0	109	81	0	0	3,367
2017	3,177	0	109	81	0	0	3,367
Totals	**49,667**	**36**	**3,525**	**972**	**42**	**144**	**54,386**

* Recovery costs for the taxa in this Addendum are based on a ratio of 10/26 from the original estimates of the Recovery Plan for the Multi-Island Plants. Original estimates were provided by cooperators currently implementing similar actions. Some costs are yet to be determined.

Date of Recovery: Downlisting and/or delisting may be considered in 2017, if recovery objectives have been met.

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INTRODUCTION

A. Brief Overview

This document supplements the original Recovery Plan for the Multi-Island Plants (Recovery Plan) (U.S. Fish and Wildlife Service 1999a), which dealt with 26 plant taxa. Because these 10 additional listed taxa covered in this addendum occur in similar habitats as the taxa covered in the original Recovery Plan and face similar threats, many of the recommended recovery actions are similar or identical to those in the Recovery Plan. This addendum will, therefore, refer frequently to sections of the Recovery Plan.

This addendum covers 10 Hawaiian plant taxa that are endemic to the Maui Nui group of islands in the Hawaiian Islands (Figure 1). This group includes Maui, Molokai, Lanai, and Kahoolawe. We, the U.S. Fish and Wildlife Service, listed *Clermontia samuelii* (oha wai), *Cyanea copelandii* ssp. *haleakalaensis* (haha), *Cyanea glabra* (haha), *Cyanea hamatiflora* ssp. *hamatiflora* (haha), *Dubautia plantaginea* ssp. *humilis* (naenae), *Hedyotis schlechtendahliana* var. *remyi* (kopa), *Kanaloa kahoolawensis* (kohe malama malama o Kanaloa), *Labordia tinifolia* var. *lanaiensis* (kamakahala), *Labordia triflora* (kamakahala), and *Melicope munroi* (alani) as endangered on September 3, 1999 (U.S. Fish and Wildlife Service 1999b). The current and former distributions of each taxon are described in the individual species accounts. Their habitats are summarized in Table 1 (page 8).

The introductory section of this addendum has been constructed in a species-by-species format, allowing the reader to find all information about a particular species in one section. The aim of this effort is to produce a comprehensive analysis of the threats to these taxa as well as a species-by-species analysis of recovery actions needed for stabilization and recovery. As ecosystem management units are identified, multiple populations and species may be managed in a coordinated fashion in order to make recovery actions as efficient as possible.

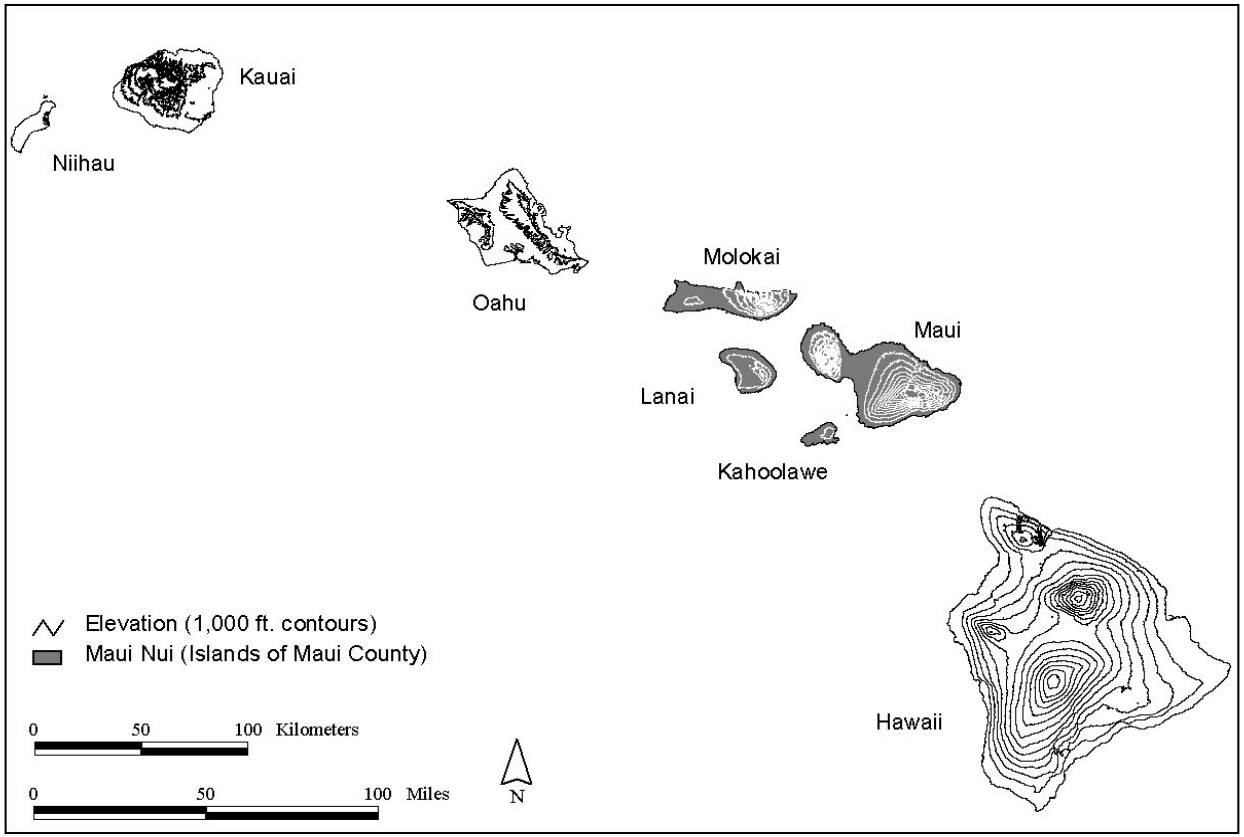

Figure 1. Map of the Main Hawaiian Islands

In addition, critical habitat has been proposed for the Multi-Island Addendum plants. Critical habitat includes occupied habitat on which are found those physical or biological features essential to the conservation of the species which may require special management considerations or protection; or, unoccupied habitat that is essential for the conservation of the species (U.S. Fish and Wildlife Service 2002a, 2002b, 2002c). Proposed critical habitat includes both currently occupied areas and areas not currently occupied by one or more of the Multi-Island Addendum plants but identified as essential for their conservation.

The objective of this addendum is to provide a framework for the recovery of the Multi-Island Addendum plants so that their protection by the Endangered Species Act is no longer necessary.

This addendum summarizes available information about each taxon, reviews the threats posed to their continued existence, and lists management actions that are needed to remove these threats. Management units should be delineated to conserve not only these taxa, but their habitats as well.

B. General Description of Habitat

The Hawaiian Islands are located over 3,846 kilometers (2,390 miles) from the nearest continent, making them the most isolated high islands on earth (Department of Geography 1998). This isolation has allowed the few plants and animals that arrived here to evolve into many varied and highly endemic species. Many of these species have lost their defenses against threats such as mammalian predation and competition with aggressive, weedy plant species that are typical of continental environments (Carlquist 1974).

The four islands of Maui, Molokai, Lanai, and Kahoolawe constitute a geological complex known collectively as Maui Nui (Greater Maui). During the last Ice Age about 12,000 years ago, when sea levels were about 160 meters (525 feet) below their present level, these four islands were connected by a broad lowland plain. This land bridge allowed the movement and interaction of each island's flora and fauna and contributed to the present close relationships of their biota (Department of Geography 1998).

The Islands of Maui, Kahoolawe, Molokai, and Lanai

Maui

Maui is the second largest island in Hawaii, but it has less than 30 percent of the area of Hawaii Island. The island is formed from the remnants of two large shield volcanoes, the older West Maui volcano (1.3 million years) on the west and the larger but much younger Haleakala volcano on the east. These two volcanoes and the connecting isthmus formed by lava flows comprise an island 1,888 square kilometers (729 square miles) in area. Stream erosion has cut deep valleys and ridges into the originally shield-shaped West Maui volcano. The highest point on West Maui is Puu Kukui at 1,764 meters (5,787 feet) elevation, with an average rainfall of 1,020 centimeters (400 inches) per year, making it the second wettest spot in Hawaii (Department of Geography 1998). Having erupted as recently as 200 years ago, East Maui's Haleakala volcano, reaching 3,055 meters (10,023 feet) in elevation, has retained its classic shield shape. While younger than West Maui, East Maui has fairly old surfaces that harbor quite diverse vegetation, and the rain forest is much larger than on West Maui. Rainfall on the slopes of Haleakala averages about 890 centimeters (35 inches) per year, varying from about 250 millimeters (10 inches) in the driest leeward locations to almost 10,000 millimeters (400 inches) at Big Bog in Haleakala National Park (Tom Giambelluca, University of Hawaii Department of Geography, personal communication 2002). However, Haleakala's crater is a dry cinder desert, primarily because of the porosity of the cinder substrate and not due to extremely low rainfall; the lowest rainfall in the crater is probably no less than 750 to 850 millimeters (30 to 35 inches) (Lloyd Loope, USGS Biological Resources Division (BRD), personal communication 2002).

The native vegetation on Maui has been adversely affected in various degrees by one or more of the following: trampling, grazing, and habitat destruction by introduced ungulates; habitat degradation and competition for space, light, water, and nutrients by alien vegetation; habitat loss from fires; insects and disease; predation by rodents and slugs; and loss of pollinators (U.S. Fish and Wildlife Service 1996a).

Kahoolawe

Kahoolawe Island measures about 17.7 kilometers (11 miles) long by 11.3 kilometers (7 miles) wide comprising some 11,655 hectares (28,800 acres).

Located in the lee of Haleakala, the island is the smallest of the eight main Hawaiian Islands and lies approximately 11 kilometers (6.7 miles) south of East Maui. The highest point is the rim of an extinct volcano at 450 meters (1,477 feet) above sea level. The estimated annual precipitation is approximately 5 centimeters (20 inches), with most of it falling from November through March. In addition to the low precipitation, Kahoolawe is the windiest of the Hawaiian Islands (Gon *et al.* 1992).

The disturbance of native vegetation on Kahoolawe probably began with slash-and-burn agriculture practiced by early Hawaiians. In 1779, the crew of Captain Cook described the island as "barren," "desolate," and an "altogether poor island". After the introduction of goats (*Capra hircus*) in 1793, the vegetation of the island began to decline precipitously. Beginning in 1859, ill-fated ranching of sheep (*Ovis aries*) and cattle (*Bos taurus*) exacerbated the declining condition of the island. By 1916, approximately a third of the island was completely denuded and from 1 to 3 meters (3 to 10 feet) of topsoil had been blown or washed into the surrounding Pacific Ocean, leaving behind a wind-swept hardpan. With the entrance of the United States into World War II, Kahoolawe was acquired by the U.S. military and became a target for offshore gunnery and aerial bombing practice (Gon *et al.* 1992). Feral goats were eradicated from the island in the early 1990's, and in 1993 Congress authorized the conveyance of the island of Kahoolawe from the U.S. Navy to the State of Hawaii. Legislation also provided for the removal of unexploded ordnance from the island and environmental restoration. The Kahoolawe Island Reserve Commission was established by the State of Hawaii as primary stakeholder and landowner to oversee cleanup of the island by the Navy, and is responsible for the long-term restoration and management of Kahoolawe for appropriate cultural, historical, archaeological, and educational purposes (U.S. Fish and Wildlife Service 1999b).

A biological survey of the island in 1992 described five distinct native plant communities: Ma`o (*Gossypium tomentosum*) Coastal Dry Shrubland, `Aki`aki (*Sporobolus virginicus*) Coastal Dry Grassland, `Ilima (*Sida fallax*) Coastal Dry Shrubland, Hawaiian Mixed Shrub Coastal Dry Cliff, and Pili (*Heteropogon contortus*) Lowland Dry Grassland; and an alien-dominated plant community estimated to cover nearly 90 percent of the island hardpan (Gon *et al.* 1992).

Molokai

The island of Molokai, the fifth largest in the Hawaiian Islands chain, is approximately 61 kilometers (38 miles) long, up to 17 kilometers (10 miles) wide, and encompasses an area of about 688 square kilometers (266 square miles). Three shield volcanoes make up most of the land mass of Molokai: West Molokai mountain, East Molokai mountain, and a volcano that formed Kalaupapa Peninsula (U.S. Fish and Wildlife Service 1996b).

The taller and larger East Molokai mountain rises 1,813 meters (4,970 feet) above sea level and comprises roughly 50 percent of the island's area (U.S. Fish and Wildlife Service 1996b). Topographically, the windward side of East Molokai differs from the leeward side. Precipitous cliffs line the northern windward coast with deep, inaccessible valleys dissecting the coastal area. The annual rainfall on the windward side is 200 to over 375 centimeters (75 to over 150 inches), distributed throughout the year. The soils are poorly drained and high in organic matter. The gulches and valleys are usually very steep, but sometimes gently sloping. Much of the native vegetation on the northern part of East Molokai is intact because of its relative inaccessibility to humans and animals, although destructive ungulates have begun to enter the coastline in recent years (U.S. Fish and Wildlife Service 1996b).

Molokai has lost a tremendous amount of its native vegetation because of past and present land management practices including ranching activities, deliberate animal and alien plant introductions, and agricultural development (Cuddihy and Stone 1990).

Lanai

Lanai is a small island totaling about 361 square kilometers (139 square miles) in area. It is hidden from the trade winds in the lee or rain shadow of the more massive West Maui mountains. Lanai was formed from a single shield volcano built by eruptions at its summit and along three rift zones. The principal rift zone runs in a northwesterly direction and forms a broad ridge whose highest point, Lanaihale, has an elevation of 1,027 meters (3,370 feet). The entire ridge is commonly called Lanaihale, after its highest point. Annual rainfall on the summit of Lanaihale is 760 to 1,015 millimeters (30 to 40 inches), but considerably less

(250 to 500 millimeters [10 to 20 inches]) over much of the rest of the island (Department of Geography 1998).

Changes in Lanai's ecosystem began with the arrival of the first Polynesians about 1,500 years ago. In the 1800's goats and sheep were first introduced to the island. Native vegetation was soon decimated by these alien ungulates, and erosional processes from wind and rain caused further damage to the native forests (Cuddihy and Stone 1990). Formal ranching was begun in 1902, and by 1910 the Territory forester began a revegetation program on the island. In 1911, George Munro, ranch manager for Lanai Company (the major landowner on Lanai), instituted a forest management practice to recover the native forests and bird species, including fencing and eradication of sheep and goats from the mountains. By the 1920's Castle and Cooke had acquired more than 98 percent of the island and established a 6,500-hectare (16,000-acre) pineapple plantation surrounding its company town, Lanai City. In the early 1990's the pineapple plantation closed, and luxury hotels were developed by the private landowner, sustaining the island's economy today (Department of Geography 1998).

The lowland, montane, and subalpine forest types on Maui Nui extend from sea level to above 3,000 meters (9,800 feet) in elevation (Table 1). Coastal and lowland forests are generally dry or mesic, rarely wet, and may be open- or closed-canopied. The stature of lowland forests is generally under 10 meters (30 feet). Three of the Multi-Island Addendum plants (*Cyanea copelandii* ssp. *haleakalaensis*, *Labordia tinifolia* var. *lanaiensis*, and *Labordia triflora*) have been reported from lowland mesic forest habitat on Maui, Molokai, and Lanai. Montane forests, occupying elevations between 915 and 1,830 meters (3,000 to 6,000 feet), occur on the windward slopes and summits of the islands of Molokai and Maui (U.S. Fish and Wildlife Service 1999b). The forests may be open- to closed-canopied, and may exceed 20 meters (65 feet) in stature. Montane wet forests are usually dominated by several species of native trees and tree ferns. Four taxa (*Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, and *Cyanea hamatiflora* ssp. *hamatiflora*) have been reported from montane wet forest habitat on Maui and Molokai. None of the Multi-Island Addendum plants occur in subalpine areas.

Table 1. Summary of habitat types and associated plant species for the Multi-Island Addendum plants.

SOC – Species of Concern – may require special management in the future but is not presently a candidate for listing. E-Endangered. Current and/or former habitats of the Multi-Island Addendum plants overlap with a majority of other native and alien plant species found in Hawaii, including most other endangered, threatened, and rare species. Associated species listed below are limited to those that best characterize the immediate habitats of current Multi-Island Addendum plants.

Habitat Type	Multi-Island Addendum Plants	Associated Native Species	Associated Alien Species
Coastal Dry Shrubland elevation: below 300 meters (below 980 feet) rainfall: less than 500 millimeters (less than 20 inches) per year	*Kanaloa kahoolawensis*	*Senna gaudichaudii* (kolomona) *Bidens mauiensis* (kookoolau) (SOC) *Melanthera (Lipochaeta) lavarum* (nehe) *Portulaca molokiniensis* (ihi) (SOC) *Capparis sandwichiana* (maiapilo) (SOC) *Sida fallax* (ilima)	*Emilia fosbergii* (pualele) *Chloris barbata* (swollen finger grass) *Nicotiana glauca* (tree tobacco)
Lowland Mesic Shrubland elevation: 30–850 meters (98–2,805 feet) rainfall: 1,000–2,000 millimeters (40–79 inches) per year	*Hedyotis schlechtendahliana* var. *remyi*	*Metrosideros polymorpha* (ohia lehua) *Dicranopteris linearis* (uluhe) *Styphelia tameiameiae* (pukiawe) *Dodonaea viscosa* (aalii) *Odontosoria chinensis* (palaa) *Sadleria* spp. (amau) *Myrsine* spp. (kolea)	*Psidium cattleianum* (strawberry guava) *Morella (Myrica) faya* (fire tree) *Leptospermum scoparium* (New Zealand tea) *Schinus terebinthifolius* (Christmasberry)

Habitat Type	Multi-Island Addendum Plants	Associated Native Species	Associated Alien Species
<u>Lowland Mesic Forest</u> elevation: 30–1,600 meters (100–5,250 feet) rainfall: 1,200–3,800 millimeters (47–150 inches) per year	*Cyanea copelandii* ssp. *haleakalaensis* *Labordia tinifolia* var. *lanaiensis* *Labordia triflora*	*Metrosideros polymorpha* (ohia lehua) *Acacia koa* (koa) *Cibotium* spp. (hapuu) *Perrottetia sandwicensis* (olomea) *Psychotria hawaiiensis* (kopiko ula) *Broussaisia arguta* (kanawao) *Hedyotis acuminata* (au) *Scaevola chamissoniana* (naupaka kuahiwi) *Pouteria sandwicensis* (alaa) *Dicranopteris linearis* (uluhe) *Cyanea mannii* (haha) (E) *Tetraplasandra* spp. (oheohe)	*Rubus argutus* (prickly Florida blackberry) *Leptospermum scoparium* (New Zealand tea) *Psidium cattleianum* (strawberry guava) *Psidium guajava* (common guava) *Schinus terebinthifolius* (Christmasberry) *Morella faya* (firetree) *Hedychium coronarium* (white ginger)

Habitat Type	Multi-Island Addendum Plants	Associated Native Species	Associated Alien Species
Lowland Wet Shrubland elevation: 200–900 meters (660–2,970 feet) rainfall: 3,800–6,000 millimeters (150–240 inches) per year	*Dubautia plantaginea* ssp. *humilis* *Melicope munroi*	*Metrosideros polymorpha* (ohia) *Pipturus albidus* (mamaki) *Eragrostis variabilis* (kawelu) *Carex* spp. *Hedyotis formosa* (SOC) *Lysimachia remyi* (kolokolo kuahiwi) *Bidens* sp. (kookoolau) *Pritchardia* spp. (loulu) *Plantago princeps* (ale) (E) *Diplopterygium pinnatum* *Dicranopteris linearis* (uluhe) *Cheirodendron trigynum* (olapa) *Coprosma* spp. (pilo) *Broussaisia arguta* (kanawao) *Machaerina angustifolia* (uki)	*Leptospermum scoparium* (New Zealand tea) *Psidium guajava* (common guava) *Casuarina equisetifolia* (ironwood) *Sporobolus africanus* (smutgrass) *Pluchea carolinensis* (sourbush) *Paspalum conjugatum* (Hilo grass) *Psidium cattleianum* (strawberry guava)

Habitat Type	Multi-Island Addendum Plants	Associated Native Species	Associated Alien Species
<u>Montane Wet Forest</u> elevation: 1,200-2,200 meters (3,960-7,260 feet) rainfall: more than 2,500 millimeters (100 inches) per year	*Clermontia samuelii* *Cyanea copelandii* ssp. *haleakalaensis* *Cyanea glabra* *Cyanea hamatiflora* ssp. *hamatiflora*	*Metrosideros polymorpha* (ohia) *Acacia koa* (koa) *Cibotium* spp. (hapuu) *Dubautia* spp. (naenae) *Clermontia* spp. (oha wai) *Hedyotis* spp. (pilo) *Vaccinium* spp. (ohelo) *Carex alligata* *Melicope* spp. (alani) *Cheirodendron trigynum* (olapa) *Perrottetia sandwicensis* (olomea) *Psychotria hawaiiensis* (kopiko ula) *Broussaisia arguta* (kanawao) *Hedyotis acuminata* (au) *Dicranopteris linearis* (uluhe) *Cyanea* spp. (haha)	*Clidemia hirta* (Koster's curse) *Rubus argutus* (prickly Florida blackberry) *Miconia calvescens* (velvet tree) *Paspalum conjugatum* (Hilo grass) *Ageratina adenophora* (Maui pamakani) *Psidium cattleianum* (strawberry guava) *Psidium guajava* (common guava) *Hedychium coronarium* (white ginger) *Hedychium gardnerianum* (kahili ginger) *Tibouchina herbacea* (glorybush) *Holcus lanatus* (common velvet grass) *Juncus planifolius* (rush) *Paspalum urvillei* (Vasey grass)

Hawaiian shrublands are also found from coastal to alpine elevations. The majority of Hawaiian shrubland types are in dry and mesic settings, or on cliffs and slopes too steep to support trees. One taxon, *Kanaloa kahoolawensis*, has been reported from coastal dry shrubland on Kahoolawe. Two taxa, *Dubautia plantaginea* ssp. *humilis* and *Melicope munroi*, have been reported from lowland wet shrublands on Maui, and *Hedyotis schlechtendahliana* var. *remyi* has been reported from lowland mesic shrublands on Lanai.

C. Overall Reasons for Decline and Current Threats

Native vegetation on all of the main Hawaiian Islands has undergone extreme alteration because of past and present land management practices, including ranching, deliberate alien animal and plant introductions, and agricultural development (Cuddihy and Stone 1990; Wagner *et al.* 1985). The primary threats facing the 10 plant species covered in this addendum include destruction and degradation of habitat by feral animals and competition with alien plants. Threats facing each of the Multi-Island Addendum plants are summarized in Table 2.

Feral Ungulate Animals

See discussion in U.S. Fish and Wildlife Service (1999a). Eight of the 10 taxa in this addendum are variously threatened by introduced (alien) ungulate animals, including pigs (*Sus scrofa*), goats, and axis deer (*Axis axis*).

Evidence of current predation on eight of the taxa by ungulates (pigs, deer, goats) is documented on Maui, Molokai, and Lanai. On Maui, evidence of predation on *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, and *Cyanea hamatiflora* ssp. *hamatiflora* by feral pigs has been documented (U.S. Fish and Wildlife Service 1999b). On Lanai, *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, and *Melicope munroi* are threatened by herbivory and trampling from axis deer. Depredation of *Labordia triflora* on Molokai by pigs and goats has been observed (U.S. Fish and Wildlife Service 1999b). Predation is therefore a probable threat to species growing at sites where those animals have been reported.

Table 2. Summary of threats to the Multi-Island Addendum plants.

SPECIES	Alien Animal Activity						Other			
	Pigs	Goats	Deer	Rodents	Slugs/ Snails	Two-spotted Leafhopper	Alien Plants	Substrate Loss or Flooding	Human Impacts	Limited Numbers
Clermontia samuelii	X			P	P		X		P	X[2]
Cyanea copelandii ssp. *haleakalaensis*	X			P	P		X	X	P	X[2]
Cyanea glabra	X			X	X	X	X	X	P	X[1,2]
Cyanea hamatiflora ssp. *hamatiflora*	X			X	X		X	X	P	X[1,2]
Dubautia plantaginea ssp. *humilis*							X	X	P	X[1,2]
Hedyotis schlechtendahliana var. *remyi*			X				X		P	X[1,2]
Kanaloa kahoolawensis				P			X	X	P	X[2,3]
Labordia tinifolia var. *lanaiensis*			X				X		P	X[2]
Labordia triflora	X	X		X			X		P	X[2,3]
Melicope munroi			X				X		P	X[2]

KEY: X=Immediate and significant threat
P=Potential threat

[1] No more than 100 individuals
[2] Fewer than 10 populations
[3] No more than 10 individuals

Rodents

See discussion in U.S. Fish and Wildlife Service (1999a). Rats prey on the seeds of *Labordia triflora* (U.S. Fish and Wildlife Service 1999b). Additionally, there is potential for rat predation on Maui and Kahoolawe of *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, and *Kanaloa kahoolawensis*.

Invertebrates

See discussion in U.S. Fish and Wildlife Service (1999a) on slugs. Slugs are known to prey on *Cyanea glabra* and *Cyanea hamatiflora* ssp. *hamatiflora* and potentially prey on *Clermontia samuelii* and *Cyanea copelandii* ssp. *haleakalaensis*. The two–spotted leafhopper (*Sophonia rufofascia*) was introduced into Hawaii in the late 1980's and has been found on all of the major Hawaiian Islands. The two-spotted leafhopper injects toxins while feeding, which causes yellowing and wilting around the feeding area on the plant. It appears to feed on almost all plant species, native and introduced (U.S. Fish and Wildlife Service 1998). The only known population of *Cyanea glabra* is threatened by predation by the two-spotted leafhopper (U.S. Fish and Wildlife Service 1999b).

Alien Plants

All 10 Multi-Island Addendum plants are threatened by competition with one or more alien plant species. The most significant of these species appear to be *Psidium cattleianum* (strawberry guava), *Schinus terebinthifolius* (Christmasberry), *Clidemia hirta* (Koster's curse), *Miconia calvescens* (velvet tree), *Morella (Myrica) faya* (fire tree), *Paspalum conjugatum* (Hilo grass), *Psidium guajava* (common guava), *Casuarina equisetifolia* (ironwood), *Leptospermum scoparium* (New Zealand tea), *Ageratina adenophora* (Maui pamakani), and *Rubus argutus* (prickly Florida blackberry). Other alien plant taxa also pose significant threats to populations of the plants in this addendum (U.S. Fish and Wildlife Service 1999b).

***Psidium cattleianum* (Strawberry guava)**

See discussion in U.S. Fish and Wildlife Service (1999a). This species is a threat on Maui to one of three known populations of *Cyanea copelandii* ssp. *haleakalaensis* and the only known population of *Cyanea glabra* (U.S. Fish and

Wildlife Service 1999b). On Lanai, this invasive alien plant threatens all populations of *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, and *Melicope munroi* (U.S. Fish and Wildlife Service 1999b).

***Schinus terebinthifolius* (Christmasberry)**

See discussion in U.S. Fish and Wildlife Service (1999a). This species is a threat to one population of *Hedyotis schlechtendahliana* var. *remyi*, the only known population of *Labordia triflora* and populations of *Labordia tinifolia* var. *lanaiensis* (U.S. Fish and Wildlife Service 1999b).

***Clidemia hirta* (Koster's curse)**

See discussion in U.S. Fish and Wildlife Service (1999a). On Maui, this prolific alien plant is a threat to *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, and *Cyanea hamatiflora* ssp. *hamatiflora,* and a potential threat to *Clermontia samuelii* (U.S. Fish and Wildlife Service 1999b).

***Miconia calvescens* (Velvet tree)**

This recently naturalized species from tropical America has become invasive in the Hamakua coast and Pahoa areas of the island of Hawaii, the islands of Oahu and Kauai, and was first discovered on Maui near Hana in 1990. *Miconia calvescens* is now recognized as the most invasive and ecosystem-modifying of all tropical weed species. First introduced into Tahiti in 1937, this large-leaved tree has displaced native forests over two-thirds of the island. Forty to 50 of the 107 plant taxa endemic to Tahiti are believed to be on the verge of extinction primarily because of invasion of *Miconia* (Meyer and Florence 1996). Interagency control efforts over the past decade on East Maui have substantially reduced the spread of *Miconia,* but have chronically suffered from inadequate though gradually increasing resources. Since each fruiting tree potentially produces millions of bird-dispersed seeds, spread is rampant unless fruiting is prevented. If *Miconia* is not contained on East Maui and elsewhere in the Hawaiian Islands, it is believed that it will aggressively invade and extinguish biodiversity up to 1,525 meters (5,000 feet) elevation in all rain forest areas, including Haleakala National Park (which arguably contains some of the most biologically diverse and intact rain forest in the United States) and the adjacent East Maui watershed (L. Loope, personal communication 2002). On East Maui,

Miconia poses a major threat to *Cyanea copelandii* ssp. *haleakalaensis* and *Cyanea hamatiflora* ssp. *hamatiflora* and a potential threat to *Clermontia samuelii*, as it does to all native rain forest ecosystems on East Maui, including Haleakala National Park's Kipahulu Valley. If *Miconia* becomes established in all of its potential habitat on Maui, all endangered plant species and many unlisted plant species within these rain forest ecosystems would be threatened with extinction (U.S. Fish and Wildlife Service 1999b; L. Loope, personal communication 2002).

***Morella faya* (Fire tree)**

Morella (Myrica) faya, native to the Azores, Madeira, and the Canary Islands, was introduced to Hawaii before 1900 for wine-making and firewood, or as an ornamental. By the mid-1880's, *M. faya* had occupied over 34,000 hectares (84,000 acres) throughout the State, with the largest infestations on the island of Hawaii. This species was planted in forest reserves in the 1920's. It is now considered a noxious weed (Cuddihy and Stone 1990, Wilbur 1994).

Morella faya can form a dense stand with no ground cover beneath the canopy. This lack of ground cover may be due to dense shading or to chemicals released by *M. faya* that prevent other species from growing. This species fixes nitrogen and increases nitrogen levels in Hawaii's typically nitrogen-poor volcanic soils. This effect may encourage the invasion of other alien plants that would not otherwise grow as well as native species in Hawaii's low-nitrogen soils (Cuddihy and Stone 1990). On Lanai, this species threatens *Hedyotis schlechtendahliana* var. *remyi* and *Labordia tinifolia* var. *lanaiensis* (U.S. Fish and Wildlife Service 1999b).

***Paspalum conjugatum* (Hilo grass)**

See discussion in U.S. Fish and Wildlife Service (1999a). In Maui's Kipahulu Valley, *Paspalum conjugatum* threatens the only known population of *Cyanea glabra*, one of the three populations of *Cyanea copelandii* ssp. *haleakalaensis*, and *Clermontia samuelii*. On West Maui, this grass threatens the only known population of *Dubautia plantaginea* ssp. *humilis* (U.S. Fish and Wildlife Service 1999b).

***Psidium guajava* (Common guava)**

See discussion in U.S. Fish and Wildlife Service (1999a). On Maui, this species threatens the only known population of *Dubautia plantaginea* ssp. *humilis* (U.S. Fish and Wildlife Service 1999b).

***Casuarina equisetifolia* (Ironwood)**

A large, fast-growing tree that reaches up to 20 meters (65 feet) in height (Wagner *et al.* 1999). This large tree shades out other plants, takes up much of the available soil nutrients, and possibly releases a chemical agent that prevents other plants from growing beneath it. On Maui, *Casuarina equisetifolia* is invading the wet cliffs of Iao Valley and is a threat to the only known population of *Dubautia plantaginea* ssp. *humilis* (U.S. Fish and Wildlife Service 1999b).

***Leptospermum scoparium* (New Zealand tea)**

Brought to Hawaii as an ornamental plant and now naturalized in disturbed mesic to wet forests on three islands. This species threatens *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, and *Melicope munroi* (U.S. Fish and Wildlife Service 1999b).

***Ageratina adenophora* (Maui pamakani)**

See discussion in U.S. Fish and Wildlife Service (1999a). On Maui, the only known population of *Cyanea glabra*, one of the three known populations of *Cyanea copelandii* ssp. *haleakalaensis*, as well as *Cyanea hamatiflora* ssp. *hamatiflora*, are threatened by this species (U.S. Fish and Wildlife Service 1999b).

***Rubus argutus* (Prickly Florida blackberry)**

See discussion in U.S. Fish and Wildlife Service (1999a). The only known population of *Cyanea glabra* and one of three known populations of *Cyanea copelandii* ssp. *haleakalaensis* are threatened by this species (U.S. Fish and Wildlife Service 1999b).

A number of other alien plant species pose a significant threat to populations of the Multi-Island Addendum plants. ***Hedychium coronarium*** (**White ginger**) was introduced to Hawaii in the late 1800's, probably by Chinese immigrants. It

escaped from cultivation and is now found in wet and mesic forests on most of the main Hawaiian islands. The large, vigorous herbs mainly reproduce vegetatively, forming very dense stands that prevent regeneration of native plants. ***Hedychium gardnerianum*** **(Kahili ginger)** was introduced to Hawaii before 1940 from the Himalayas, and there are now major infestations on the islands of Hawaii, Maui, and Kauai. This species is considered a more serious threat to native forests because it produces abundant fruit (Cuddihy and Stone 1990, Wagner *et al.* 1999). Both species of ginger threaten *Clermontia samuelii* on Maui, while on Lanai *Labordia tinifolia* var. *lanaiensis* is threatened by *H. coronarium* (U.S. Fish and Wildlife Service 1999b). ***Tibouchina herbacea*** **(Glorybush)**, a relative of *Clidemia hirta*, first became established on the island of Hawaii in the late 1970's, and by 1982 was collected in Lanilili on West Maui (U.S. Fish and Wildlife Service 1999b). Although the disruptive potential of this alien plant is not fully known, *T. herbacea* appears to be invading mesic and wet forests of Hawaii and Maui (Cuddihy and Stone 1990), and is considered a threat to *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, and the only known population of *Cyanea glabra* (U.S. Fish and Wildlife Service 1999b). ***Sporobolus africanus*** **(Smutgrass)** was introduced from Africa and has become naturalized on all the main Hawaiian Islands except Niihau and Kahoolawe. It is typically found in disturbed areas such as road sides and pastures, and on Maui is a threat to the only known population of *Dubautia plantaginea* ssp. *humilis* (U.S. Fish and Wildlife Service 1999b). ***Pluchea carolinensis*** **(Sourbush)** is native to Mexico, the West Indies, and northern South America. This species is naturalized in dry forests and ranges into mesic and wet forests on all the main Hawaiian Islands (Wagner *et al.* 1999). It is a fast-growing shrub and can form dense thickets. This species is a threat to the only known population of *Dubautia plantaginea* ssp. *humilis* on West Maui (U.S. Fish and Wildlife Service 1999b). ***Emilia fosbergii*** **(Pualele)** is a pantropical weed of unknown origin. In Hawaii, it is a common weed in disturbed lowland dry habitats on all the main islands (Wagner *et al.* 1999). *Emilia fosbergii* is a threat to the only known population of *Kanaloa kahoolawensis* (Lorence and Wood 1994). ***Nicotiana glauca*** **(Tree tobacco)** was brought to Oahu as an ornamental from Argentina in the 1860's. It is now naturalized in all warm temperate regions of the world. On Oahu, Lanai, Maui, and Kahoolawe, this species is naturalized in disturbed open, dry habitats (U.S. Fish and Wildlife Service 1999b). *Nicotiana glauca* is a threat to the only known

population of *Kanaloa kahoolawensis* (Lorence and Wood 1994). ***Chloris barbata* (Swollen finger grass)** is native to Central America, the West Indies, and South America. In Hawaii, it is naturalized in disturbed dry areas on all the main islands, and is a threat to the only known population of *Kanaloa kahoolawensis* (U.S. Fish and Wildlife Service 1999b).

Substrate Loss

Erosion, landslides, rockslides, and flooding due to natural weathering result in the death of individual plants as well as habitat destruction. This substrate loss especially affects the continued existence of taxa or populations found on cliffs, steep slopes, and stream banks that have limited numbers and/or narrow ranges, such as the only known populations of *Cyanea glabra* (threatened by flooding) and *Dubautia plantaginea* ssp. *humilis*, the West Maui population of *Cyanea copelandii* ssp. *haleakalaensis*, and the only known individual of *Kanaloa kahoolawensis* (threatened by landslides) (U.S. Fish and Wildlife Service 1999b).

Human Impacts

Unrestricted collecting for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants is a potential threat to any species identified as imperiled. This threat applies to all of the taxa treated in this addendum, as their low numbers and/or few populations make them especially vulnerable to disturbances.

Random Events and Small Numbers

The small number of populations and of individual plants of all 10 taxa increase the potential for extinction from random, naturally occurring events. The limited gene pool may depress reproductive vigor, or a single human-caused or natural environmental disturbance could destroy a significant percentage of the individuals or the only known extant population. For example, *Kanaloa kahoolawensis* is known from only 1 individual on Kahoolawe, while *Labordia triflora* is known from only 10 plants in 1 population, respectively.

D. Overall Conservation Efforts

Federal and State

All 10 taxa covered by this addendum were added to the Federal list of endangered and threatened plants on September 3, 1999 (U.S. Fish and Wildlife Service 1999b). When a species is listed as endangered or threatened under the Endangered Species Act, it is automatically added to the State of Hawaii's list of protected species (Hawaii Revised Statutes 1997, Chapter 195D). Hawaii State law prohibits taking of endangered flora unless a habitat conservation plan is developed, and encourages conservation by State government agencies. ("Take" as defined by Hawaii State law means "to harass, harm . . . , wound, kill . . . , or collect endangered or threatened . . . species . . . or to cut, collect, uproot, destroy, injure, or possess endangered or threatened . . . species of . . . land plants, or to attempt to engage in any such conduct" (Hawaii Revised Statutes 1997, Chapter 195D). The Endangered Species Act offers additional protection to these taxa since it is a violation of the Endangered Species Act for any person to remove, cut, dig up, or damage or destroy an endangered plant in an area not under Federal jurisdiction in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law [Section 9(a)(2) of the Endangered Species Act].

We determined that designation of critical habitat was prudent for all 10 taxa at the time of their listing as endangered species in 1999 (U.S. Fish and Wildlife Service 1999b). On February 16, 2000, the United States District Court for the District of Hawaii ordered us to publish proposed critical habitat designations for 10 Maui Nui (Maui, Molokai, Lanai, Kahoolawe) species by November 20, 2000, and to publish final critical habitat designations by November 20, 2001. On March 28, 2000, the court's order was amended to publish proposed critical habitat designations for these 10 Maui Nui species by November 30, 2000, and to publish final critical habitat designations by November 30, 2001 (*Conservation Council for Hawaii v. Babbitt*; Civ. No. 97-00098; order setting timetable for determination of critical habitat designations or non-designations). On December, 18, 2000, we published proposed critical habitat designations for *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Dubautia plantaginea* ssp. *humilis*, and

Kanaloa kahoolawensis, as well as for 44 other listed plants on Maui and Kahoolawe. On December 27, 2000, we published proposed critical habitat designations for *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, and *Melicope munroi*, as well as for 15 other listed plants on Lanai. On December 29, 2000, we published proposed critical habitat designations for *Labordia triflora*, as well as for 31 other listed plants on Molokai. In early October 2001, we submitted a joint stipulation with Earth Justice Legal Defense Fund requesting extension of the court order for the final rules to designate critical habitat for plants from Maui and Kahoolawe (August 23, 2002), Lanai (September 16, 2002), and Molokai (October 16, 2002), citing the need to revise the proposals to incorporate or address new information and comments received during the comment periods on the published proposals. The joint stipulation was approved and ordered by the court shortly thereafter. On March 4, 2002, we published revised proposed critical habitat designations for *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, and *Melicope munroi*, as well as for 29 other listed plants reported from Lanai. On April 3, 2002, we published revised proposed critical habitat designations for *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Dubautia plantaginea* ssp. *humilis*, and *Kanaloa kahoolawensis*, as well as 55 other listed plants from Maui and Kahoolawe. On April 5, 2002, we published revised proposed critical habitat designations for *Labordia triflora*, as well as 45 other listed plants reported from Molokai. Final critical habitat designations have not yet been published.

Those taxa growing on lands managed by the National Park Service and some lands managed by the State (land ownership is summarized in Appendix D) have benefitted from ongoing management programs, which include alien species control, research, and species-specific management.

Haleakala National Park on East Maui was established by Congress in 1916 as the Haleakala Section of Hawaii National Park. In 1960, an Act of Congress established Haleakala as an independent unit of the National Park System to preserve for visitor enjoyment and scientific study the outstanding scenic, geological, and biological resources and the natural environment of Haleakala Crater. Management programs, objectives, and their implementation schedules

are documented in the Park's 1999 draft *Resources Management Plan*. Extensive rain forest additions to the Park, including the biologically important Kipahulu Valley and the rain forest and bogs of the northeast rift, were made in the 1960's. This plan details the management issues and strategies used by the Park to protect, restore, and enhance the rare and native plants and their habitats within the Park. These management strategies address factors that led to the listing of *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, and *Cyanea hamatiflora* ssp. *hamatiflora*, including control of, or research on, nonnative species of ungulates, rodents, invertebrates, and weeds. In addition, habitat restoration (including propagation and outplanting of native and endangered plants) and monitoring are also included in this plan. All of these actions will help to stabilize and recover these plant taxa. (Resources Management Division 1999).

The Hanawi Natural Area Reserve on East Maui was established in 1986, and comprises 3,035 hectares (7,500 acres) of diverse native ecosystems and endangered forest bird habitats. The primary goals of the Hanawi Natural Area Reserve are to 1) protect the upper areas of the reserve by fencing smaller manageable units to restrict pig movements; 2) prevent degradation of native forest by reducing feral ungulate damage; and 3) improve or maintain the integrity of native ecosystems in selected areas of the preserve by reducing the effects of nonnative plants. *Clermontia samuelii* and *Cyanea copelandii* ssp. *haleakalaensis* are found within Hanawi Natural Area Reserve, and these management actions will help to stabilize and recover these plant taxa.

Specific management actions to address feral ungulate impacts include the construction of fences, including strategic fencing of smaller manageable units, and staff hunting. Currently, the upper 8,100 hectares (20,000 acres) has been fenced and pigs removed. Fences are constructed along the western boundaries of the Hanawi Natural Area Reserve, along the 1,585-meter (5,200-foot) contour to the east up to the Haleakala National Park boundary on State land. The Haleakala National Park fence serves as the upper fence boundary for Hanawi Natural Area Reserve. Additionally, fences have been constructed to separate three distinct management units: Puu Alaea Unit, Poouli Unit, and Kuhiwai/Waieleele Unit. Since the removal of pigs in these upper forest units of the Hanawi Natural Area

Reserve, vegetation monitoring has been implemented to determine recovery of native plant species. Currently, a fence is being constructed along the 1,100-meter (3,600-foot) contour of the Hanawi Natural Area Reserve, which will comprise the "middle forest unit" (Bill Evanson, Division of Forestry and Wildlife, personal communication 1999).

The alien plant control program within Hanawi Natural Area Reserve focuses on habitat-modifying nonnative plants (weeds). A weed priority list has been compiled for Hanawi Natural Area Reserve, and control and monitoring of the highest priority species are ongoing. Weeds are controlled manually, chemically, or through a combination of both. Monitoring transects will help locate developing populations of other priority weed species and, if necessary, removal of these populations will be conducted (Department of Land and Natural Resources 1989).

While seeds of *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Kanaloa kahoolawensis*, *Labordia tinifolia* var. *lanaiensis*, and *Labordia triflora* have been collected by personnel at the University of Hawaii at Manoa's Lyon Arboretum in Manoa Valley, Oahu, no seed accessions for these taxa were reported as of April 2001. Micropropagation or tissue culture information has been collected by Lyon Arboretum personnel for *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Kanaloa kahoolawensis*, *Labordia tinifolia* var. *lanaiensis*, and *Labordia triflora*; currently, tissue culture material of *Cyanea hamatiflora* ssp. *hamatiflora* and *Labordia tinifolia* var. *lanaiensis* are still being maintained at Lyon (Harold L. Lyon Arboretum 2001) (see Table 3).

While there is no seed storage information on any of the *Clermontia* or *Cyanea* species described in this addendum, other species, such as *Clermontia kakeana* and *Cyanea angustifolia* are known to have seeds that can be stored for many years under controlled conditions. *Dubautia plantaginea* ssp. *humilis* is known to

Table 3. Seeds, cultures, and plants of the Multi-Island Addendum plants in storage/propagation at botanical gardens, nurseries, or research facilities*.
NTBG = National Tropical Botanical Garden. LA = Lyon Arboretum. (+) = exact numbers unavailable.

Taxon	Seed accessions/total number of seeds in storage		Tissue accessions/total number of cultures		Number of plants in nursery	
	NTBG	LA	NTBG	LA	NTBG	LA
Clermontia samuelii						
Cyanea copelandii ssp. *haleakalaensis*						
Cyanea glabra	+					
Cyanea hamatiflora ssp. *hamatiflora*	95			2		
Dubautia plantaginea ssp. *humilis*	400					
Hedyotis schlechtendahliana ssp. *remyi*					+	
Kanaloa kahoolawensis					3	
Labordia tinifolia var. *lanaiensis*	1,000+			1	+	
Labordia triflora	+					
Melicope munroi						

*None of the Multi-Island Addendum plants are stored at Waimea Arboretum, Pahole mid-elevation plant propagation facility, Honolulu Botanical Garden, or the Volcano mid-elevation plant propagation facility. No plants of these species are planted on the grounds of any botanical gardens, nurseries, or research facilities.

store well for at least 4 years at room temperature if desiccated, and the seeds can last for at least a decade if stored in sub-zero conditions (*e.g.*, frozen). There is no information on seed storage for *Labordia tinifolia* var. *lanaiensis*. However, seeds collected from *Labordia tinifolia* on Oahu are known to last many years under controlled conditions (Alvin Yoshinaga, Lyon Arboretum, personal communication 2000).

Private

Seeds of *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Dubautia plantaginea* ssp. *humilis, Kanaloa kahoolawensis*, *Labordia tinifolia* var. *lanaiensis*, and *Labordia triflora* have been collected by personnel at the National Tropical Botanical Garden at Lawai, Kauai; although seed accessions of *Kanaloa* were no longer reported in April 2001. National Tropical Botanical Garden also reports the following species in their greenhouse nursery: *Hedyotis schlechtendahliana* ssp. *remyi*, *Kanaloa kahoolawensis,* and *Labordia tinifolia* var. *lanaiensis* (National Tropical Botanical Garden 2001) (see Table 3).

The Nature Conservancy of Hawaii's Waikamoi (East Maui) and Kapunakea (West Maui) Preserves were established by grants of perpetual conservation easements from the private landowners to The Nature Conservancy of Hawaii, and they are included in the State's Natural Area Partnership Program, which provides matching funds for the management of private lands that have been permanently dedicated to conservation (The Nature Conservancy of Hawaii 1997, 1998). Management actions in Kapunakea Preserve will help in the conservation of *Cyanea glabra*, while actions in Waikamoi Preserve will benefit *Clemontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, and *Cyanea hamatiflora* ssp. *hamatiflora*, and will help to stabilize and recover these plant taxa.

Management programs within the preserves are documented in long-range management plans and yearly operational plans. These plans detail management measures that protect, restore, and enhance the rare plants and their habitats within the preserves and in adjacent areas (The Nature Conservancy of Hawaii 1997, 1998, 1999). These management measures address factors that led to the listing of *Clemontia samuelii*, *Cyanea glabra*, *Cyanea copelandii* ssp.

haleakalaensis, and *Cyanea hamatiflora* ssp. *hamatiflora*, including control of nonnative species of ungulates, rodents, and weeds. In addition, habitat restoration and monitoring are also included in these plans. These actions will help to stabilize and recover these plant taxa.

The primary management goals for both Kapunakea and Waikamoi Preserves are to: 1) prevent degradation of native forest by reducing feral ungulate damage; 2) improve or maintain the integrity of native ecosystems in selected areas of the preserve by reducing the effects of nonnative plants; 3) increase the understanding of threats posed by small mammals and reduce their negative impact, where possible; 4) prevent extinction of rare species in the preserve; 5) track the biological and physical resources in the preserves and evaluate changes in these resources over time; 6) identify new threats to the preserves before they become established pests; and 7) build public understanding and support for the preservation of natural areas, and to enlist volunteer assistance for preserve management (The Nature Conservancy of Hawaii 1997, 1998). These management measures address factors that led to the listing of *Clemontia samuelii*, *Cyanea glabra*, *Cyanea copelandii* ssp. *haleakalaensis*, and *Cyanea hamatiflora* ssp. *hamatiflora*, and will help to stabilize and recover these plant taxa.

The goal of the ungulate program is to bring pig populations to zero as rapidly as possible. Specific management actions to address feral ungulate impacts include the construction of fences, including strategic fencing (fences placed in proximity to natural barriers such as cliffs), annual monitoring of ungulate presence transects, and trained staff and volunteer hunting. Since axis deer may also pose a threat to the preserves, The Nature Conservancy of Hawaii is a member of the Maui Axis Deer Group, and staff meet regularly with other Maui Axis Deer Group members to seek solutions. In Waikamoi Preserve, the management actions also include working with community hunters in conjunction with the East Maui Watershed Partnership (see Multiple Agency Partnerships below). In Kapunakea Preserve, a system of transects extend the length of the preserve to monitor resource threats, including ungulate presence. By monitoring ungulate activity within the preserve, the staff is able to assess the success of the hunting program. If increased hunting pressure does not reduce feral ungulate

activity in the preserves, the preserve staff works with the hunting group to identify and implement alternative methods (The Nature Conservancy of Hawaii 1997, 1998).

The nonnative plant control program within both preserves focuses on controlling habitat-modifying nonnative plants (weeds) in intact native communities and preventing the introduction of additional alien plants. Based on the degree of threat to native ecosystems, a weed priority list has been compiled for the preserves, and control and monitoring of the highest priority species are ongoing. Weeds are controlled manually, chemically, or a through a combination of both. Preventative measures (prevention protocol) are required by all (volunteers, riders, and hiking participants) who enter the preserves. This protocol includes such things as brushing footgear before entering the preserves to remove seeds of nonnative plants. Weeds are monitored along transects annually, weed priority maps are maintained, and staff participate as members of the Maui Invasive Species Committee and cooperate with the Division of Conservation and Resources Enforcement in marijuana control, as needed.

Multiple Agency Partnerships

Kapunakea Preserve is adjacent to two areas that are also managed to protect natural resources: Puu Kukui Watershed Management Area and the Honokawai section of the State's West Maui Natural Area Reserve. The Nature Conservancy of Hawaii currently acts as a consultant to Maui Land and Pineapple Company Ltd., managers of Puu Kukui Water Management Area, and has a Master Cooperative Agreement with the State Division of Forestry and Wildlife (Maui Land and Pineapple Company Ltd., undated). These agreements are used to coordinate management and sharing of staff, equipment, and expertise to maximize management efficiency.

Waikamoi Preserve is adjacent to three other large areas that are also managed to protect natural resources: Haleakala National Park, the State's Koolau Forest Reserve, and the State Hanawi Natural Area Reserve. An agreement between the Division of Land and Natural Resources, East Maui Irrigation Company, Keola Hana Maui Incorporated, Haleakala Ranch Company, County of Maui, The

Nature Conservancy of Hawaii, and Haleakala National Park was approved in 1991 to implement a joint management plan (East Maui Watershed Partnership Plan) for the entire East Maui Watershed. Management efforts at Waikamoi will, as much as possible, complement the objectives of the addendum. The active partnership agreement is being used to coordinate management and sharing of staff, equipment, and expertise to maximize management efficiency (The Nature Conservancy of Hawaii 1998). The current focus of the East Maui Watershed Partnership includes control of *Miconia calvescens* (in concert with the Maui Invasive Species Committee) and fencing and removal of feral pigs across the upper elevations (above 1,065 to 1,220 meters [3,500 to 4,000 feet]) of the watershed (L. Loope, personal communication 2002). These management actions address factors that led to the listing of *Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, and *Cyanea hamatiflora* ssp. *hamatiflora*, and will help to stabilize and recover these plant taxa.

At just over 3,480 hectares (8,600 acres), the Puu Kukui Watershed Management Area (Puu Kukui Water Management Area) on West Maui is the largest privately-owned preserve in the State. In 1993, the Puu Kukui Water Management Area became the first private landowner participant in the Natural Area Partnership Program. In the ninth fiscal year (2002) of the Natural Area Partnership Program with the Hawaii Division of Land and Natural Resources, Puu Kukui Watershed Management Area staff is pursuing four management programs stipulated in their Long Range Management Plan, with an emphasis on reducing nonnative species that immediately threaten the management area (Maui Land and Pineapple Company Ltd. undated).

The primary management goals within Puu Kukui Water Management Area are to: 1) eliminate ungulate activity in all Puu Kukui management units; 2) reduce the range of habitat-modifying weeds and prevent introduction of nonnative plants; 3) reduce the negative impacts of nonnative invertebrates and small animals; 4) monitor and track biological and physical resources in the watershed in order to improve management understanding of the watershed's resources; and 5) prevent the extinction of rare species within the watershed. These management measures address factors that led to the listing of *Cyanea glabra* and *Dubautia plantaginea* ssp. *humilis*, including the control of nonnative ungulates and weeds.

Specific management actions to address feral ungulates include the construction of fences surrounding 10 management units, and allowing public hunting with State permit holders within the Puu Kukui Water Management Area.

The nonnative plant control program within Puu Kukui Water Management Area focuses on habitat-modifying nonnative plants (weeds), prioritizing them according to the degree of threat to native ecosystems, and preventing the introduction of new weeds. The weed control program includes mapping and monitoring along established transects, and manual/mechanical control. Biological control of the melastome plant, *Clidemia hirta* has been attempted by releasing *Antiblemma acclinalis* moth larvae.

Natural resource monitoring and research address the need to track biological and physical resources of the Puu Kukui Water Management Area and evaluate changes to these resources in order to guide management programs. Vegetation is monitored through permanent photo points; alien species are monitored along permanent transects; and rare, endemic, and indigenous species are monitored. Additionally, logistical and other support for approved research projects, interagency cooperative agreements, remote survey trips within the watershed are provided.

E. Species Accounts

1. *Clermontia samuelii*

(Hawaiian name: Oha wai) Recovery Priority Number 2

(Recovery Priority Number system is described in Appendix E)

a. Description

No line drawing is available for this plant.

Clermontia samuelii, a short-lived perennial in the bellflower family (Campanulaceae), is a terrestrial shrub 1.2 to 5 meters (4 to 16 feet) tall. The leaves are elliptical, sometimes broader at the tip, with blades 5 to 10 centimeters (2 to 4 inches) long and 1.8 to 4.5 centimeters (0.7 to 1.8 inches) wide. The upper surfaces of the leaves are dark green, often tinged purplish, and may be sparsely hairy. The lower surfaces of the leaves are pale green, and sparsely to densely hairy. The leaf margins are thickened, with shallow, ascending, rounded teeth. The tips and bases of the leaves are typically sharply pointed. The inflorescences (flowering clusters) bear two to five flowers on a main stem that is 4 to 18 millimeters (0.2 to 0.7 inch) long. The stalk of each individual flower is 12 to 28 millimeters (0.5 to 1.1 inches) long. The hypanthium (cup-like structure at the base of the slower) is widest on the top, 8 to 14 millimeters (0.3 to 0.6 inch) long, and 5 to 10 millimeters (0.2 to 0.4 inch) wide. The sepals and petals are similar in color (rose or greenish white to white), curved, and tubular. The flowers are 36 to 44 millimeters (1.4 to 2.2 inches) wide). The lobes of the sepals and petals are erect, and extend 0.2 to 0.5 times beyond the tube. Berries of this species have not yet been observed. *Clermontia samuelii* ssp. *hanaensis* is differentiated from *C. samuelii* ssp. *samuelii* by the greenish white to white flowers; longer, narrower leaves with the broadest point near the base of the leaves; and fewer hairs on the lower surface of the leaves. The species is separated from other members of this endemic Hawaiian genus by the size of the flowers and the hypanthium (Lammers 1999; U.S. Fish and Wildlife Service 2002b).

b. Taxonomy

Clermontia samuelii, was first described by C. N. Forbes from a collection he made in 1919 (Degener and Degener 1958; Forbes 1920). Harold St. John described *C. hanaensis* in 1939, based on a specimen collected by C. N. Forbes in 1920 (Degener and Degener 1960; St. John 1939). Later, St. John formally described *C. gracilis, C. kipahuluensis,* and *C. rosacea* (St. John 1987a). In the most recent treatment of this endemic Hawaiian genus, Lammers considers all four species to be synonymous with *C. samuelii*, and divides the species into two subspecies – ssp. *hanaensis* (including the synonyms *C. hanaensis* and *C. kipahuluensis*) and ssp. *samuelii* (including *C. gracilis* and *C. rosacea*) (Lammers 1988, 1999).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), *Clermontia samuelii* has been reported from Haleakala, East Maui, and from Keanae Valley on the windward (northeastern) side to Manawainui on the more leeward (southeastern) side of Haleakala (Hawaii Natural Heritage Program Database 2001; Medeiros *et al.* 1998). Currently (since 1970), *Clermontia samuelii* is known from Papanalahoa Point, Kuhiwa Valley, the ridge north of Palike Stream, Kawaipapa Gulch, and Mokulehua Gulch. There are a total of four populations with 309 individual plants on State and Federal lands within Haleakala National Park, Hanawi Natural Area Reserve, the Hana Forest Reserve, and within the East Maui Watershed Partnership (Medeiros *et al.* 1998; Warshauer 1998; U.S. Fish and Wildlife Service 1999b; Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001; Robert Hobdy, Division of Forestry and Wildlife *in litt.* 2000; Ken Wood, National Tropical Botanical Garden, *in litt.* 2000; U.S. Fish and Wildlife Service 2002b).

d. Life History

Little is known about the life history of *Clermontia samuelii*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental

requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

Clermontia samuelii is found at elevations between 725 and 2,245 meters (2,380 to 7,365 feet). *Clermontia samuelii* ssp. *hanaensis* is found in wet *Metrosideros polymorpha* (ohia) and *Metrosideros polymorpha-Dicranopteris linearis* (uluhe) forest containing one or more of the following associated native plant species: *Adenophorus tamariscinus* (wahine noho mauna), *Broussaisia arguta* (kanawao), *Carex alligata* (no common name), *Cheirodendron trigynum* (olapa), *Cibotium* spp. (hapuu), *Diplazium sandwichianum* (hoio), *Dubautia* spp. (naenae), *Hedyotis hillebrandii* (manono), *Hedyotis terminalis* (manono), *Melicope clusiifolia* (kolokolo mokihana), *Melicope* spp. (alani), *Peperomia obovatilimba* (ala ala wai nui), *Psychotria mariniana* (kopiko), *Tetraplasandra oahuensis* (ohe ohe), or *Vaccinium* spp. (ohelo). *Clermontia samuelii* ssp. *samuelii* is found in wet *Metrosideros polymorpha* and *Metrosideros polymorpha-Cheirodendron trigynum* forest containing one or more of the following native plant species: *Hedyotis hillebrandii, Hedyotis* spp. (no common name), *Cibotium* spp., *Broussaisia arguta, Dubautia* spp., *Diplazium sandwichianum, Rubus hawaiiensis* (akala), *Clermontia arborescens* ssp. *waihiae* (oha wai), *Clermontia* spp. (oha wai), *Vaccinium* spp., *Carex alligata*, or *Melicope* spp. (U.S. Fish and Wildlife Service 1999b, 2002b; K. Wood *in litt.* 2000; Hawaii Natural Heritage Program Database 2001; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

Threats to *Clermontia samuelii* ssp. *hanaensis* include habitat degradation and/or destruction by feral pigs, and competition with alien plant taxa such as *Tibouchina herbacea* (glorybush), *Paspalum urvillei* (Vasey grass), *Paspalum conjugatum* (Hilo grass), *Juncus* sp. (no common name), *Hedychium coronarium* (white ginger), and *Hedychium gardnerianum* (Kahili ginger) (U.S. Fish and Wildlife Service 1999b; K. Wood, *in litt*. 2000). In addition, two extremely invasive alien plant taxa, *Miconia calvescens* (velvet tree) and *Clidemia hirta*

(Koster's curse), are found in nearby areas and may invade this habitat if not controlled (U.S. Fish and Wildlife Service 1999b). The habitat of *Clermontia samuelii* ssp. *samuelii* was extensively damaged by pigs in the past, and pigs are still a major threat to the populations on State-owned lands. The population within the National Park has been fenced and pigs have been eradicated. However, due to the large populations of pigs in adjacent areas, the park populations must constantly be monitored to prevent further ingress. Competition with alien plant taxa such as *Holcus lanatus* (common velvet grass) and *Juncus planifolius* (rush) is a major threat to this subspecies (K. Wood, *in litt*. 2000). In addition, rats (mainly the black rat [*Rattus rattus*]) and slugs (mainly *Milax gagetes*) are known to eat leaves, stems, and fruits of other members of this genus, and therefore are a potential threat to both subspecies. In addition, unrestricted collecting or excessive visits by individuals interested in seeing rare plants are potential threats to this species (U.S. Fish and Wildlife Service 1999b, 2002b; K. Wood *in litt.* 2000).

g. Conservation Efforts

The population within Haleakala National Park has been fenced and pigs have been eradicated. Due to the large populations of pigs in adjacent areas, the park populations must constantly be monitored to prevent further ingress (U.S. Fish and Wildlife Service 1999b). In 2000, an unspecified number of plants were being grown at National Tropical Botanical Garden (Melanie Chapin, National Tropical Botanical Garden, personal communication 2000); as of 2001, none remain in cultivation (National Tropical Botanical Garden 2001). General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against feral ungulates.

Exclosures should be constructed around known populations of *Clermontia samuelii* to reduce impacts from ungulates. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control alien plant species such as *Miconia* and *Clidemia* in the Hana and Koolau forest reserves should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Clermontia samuelii* in areas free from the impacts of feral ungulates and alien plants.

2. *Cyanea copelandii* ssp. *haleakalaensis*
(Hawaiian name: Haha) Recovery Priority Number 6

a. Description

No line drawing is available for this plant.

Cyanea copelandii ssp. *haleakalaensis*, a short-lived perennial member of the bellflower family, is a vine-like shrub 0.3 to 2 meters (1 to 7 feet) tall, with sprawling stems. The sap of this species is a tan latex. Stems are unbranched or sparingly branched from the base. The leaves are elliptical, 10 to 19 centimeters (4 to 7 inches) long, and 3.5 to 8.5 centimeters (1.4 to 3.3 inches) wide. The

upper surfaces of the leaves have no hairs, while the lower surfaces are hairy. The margins of the leaves are thickened, with small, widely spaced, sharp teeth. The leaf stalks are 2.5 to 10 centimeters (1 to 4 inches) long. The inflorescences are 5 to 12-flowered and hairy. The main inflorescence stalks are 20 to 45 millimeters (0.8 to 1.8 inches) long. The hypanthium is oval and widest at the top, 6 to 10 millimeters (0.2 to 0.4 inches) long, about 5 millimeters (0.2 inches) wide, and hairy. The corolla (petals collectively) is yellowish but appears pale rose in color due to a covering of dark red hairs. The corolla is 37 to 42 millimeters (1.4 to 1.6 inches) long and about 5 millimeters (0.2 inch) wide. The corolla tube is gently curved and the lobes spread about 0.25 times beyond the tube. The berries are dark orange, oval, and 7 to 15 millimeters (0.3 to 0.6 inch) long. This subspecies is differentiated from the other subspecies by its shorter elliptical leaves. This species differs from others in this endemic Hawaiian genus by the vine-like stems and the yellowish flowers that appear red due to the covering of hairs (U.S. Fish and Wildlife Service 2002b; Lammers 1999).

b. Taxonomy

Cyanea haleakalaensis was first described in 1971 by St. John from a collection made by G.Y. Kikudome in 1951 (St. John 1971). In 1987, St. John (1987b) merged the two genera *Cyanea* and *Delissea*, formally recognizing only *Delissea*, the genus with priority. This change resulted in the combination *D. haleakalaensis*. Lammers retains both genera in the currently accepted treatment of the Hawaiian members of the family, and in 1988 he recognized *C. haleakalaensis* as a subspecies of *C. copelandii*, publishing the new combination *C. copelandii* ssp. *haleakalaensis* (Lammers 1988, 1999).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), *Cyanea copelandii* ssp. *haleakalaensis* was reported from the windward side of Haleakala and from Waikamoi to Kipahulu Valley on the island of Maui. Currently (since 1970), this taxon is known from three populations with a total of 204 individuals on Federal, State, and privately owned lands within the East Maui Watershed Partnership in Haiku Uka, the ridge above Kuhiwa Valley, and Kipahulu Valley within Haleakala National Park and

Hanawi Natural Area Reserve (Lammers 1999; U.S. Fish and Wildlife Service 1999b, 2002b, Warshauer 1998; Hawaii Natural Heritage Program Database 2001; Geographic Decision Systems International 2001; Medeiros *et al*. 1998).

d. Life History

Little is known about the life history of *Cyanea copelandii* ssp. *haleakalaensis*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

Cyanea copelandii ssp. *haleakalaensis* is found on stream banks and wet scree (a sloping mass of rocks at the base of a cliff) slopes and forest understory in montane wet or mesic forest dominated by *Acacia koa* (koa) and/or *Metrosideros polymorpha* (ohia) at elevations between 615 and 1,410 meters (2,015 to 4,625 feet). Associated species include *Broussaisia arguta* (kanawao), *Cibotium* spp. (hapuu), *Hedyotis acuminata* (au), *Perrottetia sandwicensis* (olomea), or *Psychotria hawaiiensis* (kopiko ula) (U.S. Fish and Wildlife Service 1999b, 2002b; Hawaii Natural Heritage Program Database 2001; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

The major threats to this species are habitat degradation and/or destruction by feral pigs; competition from several alien plant taxa such as *Rubus argutus* (prickly Florida blackberry), *Psidium cattleianum* (strawberry guava),*Clidemia hirta* (Koster's curse), *Paspalum conjugatum* (Hilo grass), *Miconia calvescens* (velvet tree), *Ageratina adenophora* (Maui pamakani), and *Tibouchina herbacea* (Glorybush); and landslides. In addition, *Cyanea copelandii* ssp. *haleakalaensis* is potentially threatened by predation by rats and slugs, unrestricted collecting or excessive visits by individuals interested in seeing rare plants, and by extinction due to random environmental and human events because of the small population sizes (U.S. Fish and Wildlife Service 1999b, 2002b).

g. Conservation Efforts

Cuttings of this taxon have been collected and propagated by the Lyon Arboretum, although none were reported alive as of April 2001 (Harold L. Lyon Arboretum 2001). No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against feral ungulates.

Exclosures should be constructed around known populations of *Cyanea copelandii* ssp. *haleakalaensis* to reduce impacts from ungulates. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control alien plant species such as *Miconia* and *Clidemia* in the Hana and Koolau forest reserves should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Cyanea copelandii* ssp. *haleakalaensis* in areas free from the impacts of feral ungulates and alien plants.

3. *Cyanea glabra*
(Hawaiian name: Haha) Recovery Priority Number 5

a. Description
No line drawing is available for this plant.

Cyanea glabra, a member of the bellflower family (Campanulaceae), is a short-lived, perennial, branched shrub. The leaves of juvenile plants are deeply pinnately lobed, while those of the adult plants are more or less entire and elliptical. Adult leaves are 23 to 36 centimeters (9 to 14 inches) long and 7 to 12 centimeters (3 to 5 inches) wide. The upper surfaces of the leaves are green and hairless, while the lower surfaces are pale green and hairless to sparsely hairy. The margins of the adult leaves are thickened and shallowly toothed to irregularly lobed. Six to eight flowers are borne in each inflorescence. The main inflorescence stalk is 20 to 55 millimeters (0.8 to 2.2 inches) long, while the individual flower stalk is 12 to 25 millimeters (0.5 to 1.0 inches) long. The hypanthium is widest at the top, 7 to 10 millimeters (0.3 to 0.4 inch) long, and about 5 millimeters (0.2 inch) wide. The corolla is white, often with a pale lilac tinge, 50 to 60 millimeters (2 to 2.4 inches) long, and about 8 millimeters (0.3 inch) wide. The tube of the corolla is curved. The lobes are spreading, 0.25 to 0.33 times as long as the tube, and are covered by small, sharp projections. The berries are yellowish orange, elliptical, and 10 to 15 millimeters (0.4 to 0.6 inch) long. The calyx (sepals collectively) persist on the berry. This species is differentiated from others in this endemic Hawaiian genus by the size of the flower and the pinnately lobed juvenile leaves (U.S. Fish and Wildlife Service 2002b; Lammers 1999).

b. Taxonomy

Cyanea glabra was first collected on East Maui in 1920 by C.N. Forbes and described by F.E. Wimmer in 1943 as *C. knudsenii* var. *glabra* (Wimmer 1943). In 1981, St. John elevated *C. knudsenii* var. *glabra* to full species status as *C. glabra* (St. John 1981). Lammers, in the most recent treatment of the Hawaiian members of the family, upheld the species name, and included as a synonym *C. holophylla* var. *obovata*, a taxon originally collected on West Maui by William Hillebrand and later formally named by Joseph Rock (Rock 1919). Other synonyms of *Cyanea glabra* include *C. scabra* var. *variabilis*, *Delissea glabra*, *D. holophylla* var. *obovata*, and *D. scabra* var. *variabilis* (Lammers 1999; Rock 1919).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), *Cyanea glabra* has been reported from West Maui and on Haleakala, East Maui. Currently (since 1970), this species is known from a single population of 12 individual plants on privately owned land in Kauaula Valley (U.S. Fish and Wildlife Service 1999b; Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001).

d. Life History

Little is known about the life history of *Cyanea glabra*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

Cyanea glabra is found on soil and rock stream banks in wet lowland or montane forest dominated by *Acacia koa* (koa) and/or *Metrosideros polymorpha* (ohia) at elevations between 415 and 1,570 meters (1,360 to 5,150 feet). Associated native plants include *Xylosma hawaiiense* (maua), *Dodonaea viscosa* (aalii), *Psychotria* spp. (kopiko), *Pipturus albidus* (mamaki), *Touchardia latifolia*

(olona), *Boehmeria grandis* (akolea), *Clermontia kakeana* (oha wai), *Cyanea elliptica* (haha), *Perrottetia sandwicensis* (olomea), *Hedyotis* spp. (pilo), *Cibotium* spp. (hapuu), *Dubautia plantaginea* (naenae), *Cheirodendron trigynum* (olapa), *Thelypteris cyatheoides* (palapalaia), *Diplazium* spp. (no common name), and *Sadleria* spp. (amau) (Hawaii Natural Heritage Program Database 2001; Joel Lau, Hawaii Natural Heritage Program, personal communication 2001; U.S. Fish and Wildlife Service 1999b, 2002b; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

The threats to this species are slugs; habitat degradation and/or destruction by feral pigs; flooding; competition with several alien plant taxa such as *Rubus argutus* (prickly Florida blackberry), *Psidium cattleianum* (strawberry guava), *Clidemia hirta* (Koster's curse), *Paspalum conjugatum* (Hilo grass), *Ageratina adenophora* (Maui pamakani), and *Tibouchina herbacea* (glorybush); rats; the two-spotted leafhopper; unrestricted collecting or excessive visits by individuals interested in seeing rare plants are potential threats to this species; and extinction caused by random environmental events due to the small number individuals in the only remaining population (U.S. Fish and Wildlife Service 1999b, 2002b).

g. Conservation Efforts

An unspecified number of seeds have been collected and stored at National Tropical Botanical Garden. Two plants were being grown at the National Tropical Botanical Garden greenhouses in 2000 (M. Chapin, personal communication 2000), but a 2001 inventory lists no greenhouse specimens (National Tropical Botanical Garden 2001). No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect the single remaining wild population against feral ungulates.

An exclosure should be constructed around the single known population of *Cyanea glabra* to reduce impacts from ungulates. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of ungulates from this area will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of this area once it has been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control alien plant species such as *Rubus argutus* in Kauaula Valley should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Cyanea glabra* in areas free from the impacts of feral ungulates and alien plants.

5) Reduce threats from rodent and slug predation.

A management plan to control rats should be developed. This plan should include the use of the currently approved Diphacinone bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide. Methods to control slug predation on this species need to be determined and implemented.

6) Conduct research into, and implement, control methods for the two-spotted leafhopper.

Methods to control the two-spotted leafhopper predation on this species need to be determined and implemented.

4. *Cyanea hamatiflora* ssp. *hamatiflora*
(Hawaiian name: Haha) Recovery Priority Number 6

a. Description
No line drawing is available for this plant.

Cyanea hamatiflora ssp. *hamatiflora*, a short-lived perennial and member of the bellflower family, is a palm-like tree 3 to 8 meters (10 to 26 feet) tall. The latex is tan in color. The leaves are elliptical with the broadest point at the tip, or they may be narrowly oblong. The leaf blades are 50 to 80 centimeters (20 to 30 inches) long, 8 to 14 centimeters (3 to 5.5 inches) wide, and have no stem. The upper surface of the leaf is sparsely hairy to hairless and the lower surface is hairy, at least along the midrib and veins. The leaf margins are minutely round-toothed. The inflorescence is 5 to 10 flowered with main stalks 15 to 30 millimeters (0.6 to 1.2 inches) long. The stalks of individuals flowers are 5 to 12 millimeters (0.2 to 0.5 inch) long. The hypanthium is widest at the top, 12 to 30 millimeters (0.5 to 1.2 inches) long, and 6 to 12 millimeters (0.2 to 0.5 inch) wide. The corolla is magenta in color, 60 to 80 millimeters (2 to 3 inches) long, 6 to 11 millimeters (0.2 to 0.4 inch) wide, and hairless. The tube of the corolla is slightly curved, with lobes 0.25 to 0.5 times as long as the tube. The corolla lobes all curve downward, making the flower appear one-lipped. The anthers (pollen-bearing structures) are hairless except for the lower two, which have apical tufts of white hairs. The fruit is a purplish red berry 30 to 45 millimeters (1.2 to 1.8 inches) long and 20 to 27 millimeters (0.8 to 1.1 inches) wide. The berry is crowned by persistent calyx lobes. This subspecies is differentiated from the

previously listed subspecies (*C. hamatiflora* ssp. *carlsonii*) by its longer calyx lobes and shorter individual flower stalks. This species is separated from others in this endemic Hawaiian genus by fewer flowers per inflorescence and narrower leaves (U.S. Fish and Wildlife Service 2002b; Lammers 1999).

b. Taxonomy

Cyanea hamatiflora was first collected by Joseph Rock in 1910 and described in 1913 (Rock 1913). In 1987, St. John (St. John 1987b) merged the two genera *Cyanea* and *Delissea*, formally recognizing only *Delissea*, the genus with priority. This change resulted in the combination *D. hamatiflora*. In 1988, Lammers upheld *Cyanea* as a separate genus and combined *C. carlsonii* with this species, resulting in two subspecies: *C. hamatiflora* ssp. *carlsonii* and the nominative *C. hamatiflora* ssp. *hamatiflora* (Lammers 1988, 1999).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), *Cyanea hamatiflora* ssp. *hamatiflora* was known from the windward (northeastern) side of Haleakala, stretching from Puu o Kakae to Manawainui on the island of Maui. Currently (since 1970), this taxon is known from 7 populations with a total of 12 individuals within the East Maui Watershed Partnership in Honomanu, Wailuaiki, Kipahulu Valley, Koukouai, and Puu Ahulili on State (Koolau and Kipahulu forest reserves), Federal (Haleakala National Park), and privately owned lands (U.S. Fish and Wildlife Service 1999b, 2002b; Warshauer 1998; Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001; Medeiros *et al.* 1998).

d. Life History

Little is known about the life history of *Cyanea hamatiflora* ssp. *hamatiflora*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

Typical habitat for this taxon is montane wet forest dominated by *Metrosideros polymorpha* (ohia), with a *Cibotium* spp. (hapuu) and/or native shrub understory or closed *Acacia koa* (koa)-*Metrosideros polymorpha* wet forest containing one or more of the following associated native plant species: *Dicranopteris linearis* (uluhe), *Cheirodendron trigynum* (olapa), *Broussaisia arguta* (kanawao), *Cyanea aculeatiflora* (haha), *Cyanea kunthiana* (haha), *Vaccinium* spp. (ohelo), *Melicope* spp. (alani), *Athyrium microphyllum* (akolea), *Diplazium sandwichianum* (hoio), or *Myrsine* spp. (kolea) at elevations between 765 and 1,555 meters (2,510 to 5,100 feet) (U.S. Fish and Wildlife Service 1999b, 2002b; Hawaii Natural Heritage Program Database 2001; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

The threats to this species are habitat degradation and/or destruction by feral pigs; landslides; competition with the alien plants *Miconia calvescens* (velvet tree), *Clidemia hirta* (Koster's curse), and *Ageratina adenophora* (Maui pamakani); rats; and slugs. In addition, unrestricted collecting or excessive visits by individuals interested in seeing rare plants are potential threats to this species (U.S. Fish and Wildlife Service 1999b, 2002b).

g. Conservation Efforts

At least 95 seeds have been collected and stored at National Tropical Botanical Garden (M.Chapin, personal communication 2000; National Tropical Botanical Garden 2001), and 2 specimens are in tissue culture at Lyon Arboretum (Harold L. Lyon Arboretum 2001). General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against feral ungulates.

Exclosures should be constructed around known populations of *Cyanea hamatiflora* ssp. *hamatiflora* to reduce impacts from ungulates. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, the current program of propagation and maintenance of *ex situ* genetic stock should be expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control *Ageratina adenophora* in the Koolau Forest Reserve and Kipahulu Valley should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Cyanea hamatiflora* ssp. *hamatiflora* in areas free from the impacts of feral ungulates and alien plants.

5) Reduce threats from rodent and slug predation.

A management plan to control rats should be developed. This should include the use of the currently approved Diphacinone bait blocks and ultimately a more

broad-scale method such as aerial dispersal of rodenticide. Methods to control slug predation on this species need to be determined and implemented.

5. *Dubautia plantaginea* ssp. *humilis*
(Hawaiian name: Naenae) Recovery Priority Number 8

a. Description
No line drawing is available for this plant.

Dubautia plantaginea ssp. *humilis*, a short-lived perennial of the aster family (Asteraceae), is a dwarf shrub less than 80 centimeters (30 inches) tall. The stems are hairless or occasionally strigillose (bulbous-based hairs, all pointing in the same direction). The leaves are opposite, narrow, 8 to 15 centimeters (3 to 6 inches) long, and 0.7 to 4.5 centimeters (0.3 to 1.8 inches) wide. The leaves usually have five to nine nerves, and are hairless or moderately strigillose. The leaf margins are toothed from the apex to near the middle. Between 20 to 90 flowering heads are found in each inflorescence, which is about 20 centimeters (8 inches) long and 28 centimeters (11 inches) wide. Eight to 20 florets (small flower that is part of a dense cluster) are found in each head, borne on a flat receptacle. The bracts on the receptacle are about 5 millimeters (0.2 inch) long, sharply toothed, and fused together. The corolla is yellow, and may purple with age. The fruit is an achene (a dry, one-celled, indehiscent fruit) 2.5 to 4 millimeters (0.08 to 0.2 inch) long. The taxon is self-incompatible, meaning flowers must be pollinated by pollen from a different plant. This subspecies differs from the other two subspecies *(D. plantaginea* ssp. *magnifolia* and *D. plantaginea* ssp. *plantaginea*) by having fewer heads per inflorescence, but more florets per head. The species differs from other Hawaiian members of the genus by the number of nerves in the leaves and by the close resemblance of the leaves to the genus *Plantago* (U.S. Fish and Wildlife Service 2002b; Carr 1985, 1999).

b. Taxonomy

Dubautia plantaginea ssp. *humilis* was first described in 1985, from specimens collected by Gerald Carr, Robert Robichaux, and Rene Sylva in Black Gorge in

Iao Valley on West Maui (Carr 1985, 1999; U.S. Fish and Wildlife Service 1999b).

c. Current and Historic Ranges and Population Status

Dubautia plantaginea ssp. *humilis* has only been reported from Iao Valley, on West Maui. This population with 60 to 65 individuals occurs on privately-owned land (Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 1999b, 2002b).

d. Life History

Little is known about the life history of *Dubautia plantaginea* ssp. *humilis*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

The typical habitat of the species is wet, barren, steep, rocky, wind-blown cliffs between 265 and 1,595 meters (870 and 5,230 feet) elevation, containing one or more of the following associated native plant species: *Metrosideros polymorpha* (ohia), *Pipturus albidus* (mamaki), *Eragrostis variabilis* (kawelu), *Carex* spp. (no common name), *Hedyotis formosa* (no common name), *Lysimachia remyi* (kolokolo kuahiwi), *Bidens* spp. (kookoolau), *Pritchardia* spp. (loulu), or the endangered species *Plantago princeps* (laukahi kuahiwi) (U.S. Fish and Wildlife Service 1999b, 2002b; Hawaii Natural Heritage Program Database 2001; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

Threats to *Dubautia plantaginea* ssp. *humilis* include landslides and competition from alien plant taxa such as *Sporobolus africanus* (smutgrass), *Pluchea carolinensis* (sourbush), *Paspalum conjugatum* (Hilo grass), *Psidium guajava* (common guava), and *Casuarina equisetifolia* (ironwood). Random

environmental events are also a threat because of the limited number of individuals and populations and their narrow distribution. Potential threats include unrestricted collecting or excessive visits by individuals interested in seeing rare plants (U.S. Fish and Wildlife Service 1999b, 2002b).

f. Conservation Efforts

At least 400 seeds have been collected and stored at National Tropical Botanical Garden and in 2000, 12 plants were growing at the National Tropical Botanical Garden greenhouses (M. Chapin, personal communication 2000); an April 2001 inventory update no longer reported any greenhouse plants (National Tropical Botanical Garden 2001). No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

g. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

2) Control competing alien plant species.

A long-range management plan to control *Sporobolus africanus*, *Pluchea carolinensis* (sourbush), *Paspalum conjugatum*, *Psidium guajava*, and *Casuarina equisetifolia* in Iao Valley should be developed and implemented.

3) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Dubautia plantaginea* ssp. *humilis* in areas free from the impacts of alien plants.

6. *Hedyotis schlechtendahliana* var. *remyi*
(Hawaiian name: Kopa) Recovery Priority Number 6

a. Description
No line drawing is available for this plant.

Hedyotis schlechtendahliana var. *remyi*, a short-lived perennial of the coffee family (Rubiaceae), is a few-branched subshrub from 60 to 600 centimeters (24 to 240 inches) long, with weakly erect or climbing stems that may be somewhat square, smooth, and glaucous (with a fine waxy coating that imparts a whitish or bluish hue to the stem). The leaves are opposite, glossy, thin or somewhat thickened, egg-shaped or with a heart-shaped base and a very pointed tip, and 3 to 6 centimeters (1.2 to 2.4 inches) long. The margins of the leaves curl under. The veins of the leaves are impressed on the upper surface with hairs along the veins and raised on the lower surface. The lower surface of the leaves are usually glaucous, like the stems. The leaf stalks are up to 1 centimeter (0.4 inch) long, slightly fused to the stem, and bear stipules (appendages on the base of the leaf stalks). The inflorescence stalks are 2 to 15 millimeters (0.1 to 0.6 inch) long, square, usually glaucous, and borne at the ends of the stems. The flowers have either functional male and female parts or only functional female parts. Leaf-like bracts are found at the base of each flower. The hypanthium is top-shaped and 1.5 to 2.2 millimeters (0.06 to 0.09 inch) wide. The calyx lobes are usually leaf-like and oblong to broadly egg-shaped, 2 to 8 millimeters (0.08 to 0.3 inch) long, and 1.5 to 2.5 millimeters (0.08 to 0.09 inch) wide, enlarging somewhat in fruit. The corolla is cream-colored, fleshy, usually glaucous, trumpet-shaped, with a tube 6 to 17 millimeters (0.2 to 0.7 inch) long and lobes 1.5 to 10 millimeters (0.06 to 0.4 inch) long when the anthers are ripe. The stamens reach only to 1 to 3 millimeters (0.04 to 0.1 inch) below the sinuses of the corolla lobes. The styles are woolly on the lower portions, and 2 to 4-lobed. The fruits are top-shaped to

subglobose capsules 2 to 4 millimeters (0.1 to 0.2 inch) long and 3 to 7 millimeters (0.1 to 0.3 inch) in diameter. The fruits break open along the walls of the cells within the fruit. Seeds are dark brown, irregularly wedge-shaped and angled, and darkly granular. This variety is distinguished from var. *schlechtendahliana* by the leaf shape, narrow flowering stalks, and flower color. The species is distinguished from others in the genus by the distance between the leaves and the length of the sprawling or climbing stems (Wagner *et al.* 1999).

b. Taxonomy

Hillebrand described a new species, *Kadua remyi*, based on collections on Lanai and East Maui by Reverend John Lydgate (Hillebrand 1888). F. Raymond Fosberg combined the genus *Kadua* with *Hedyotis* in 1943, and combined *K. remyi* with *Hedyotis schlechtendahliana* (Fosberg 1943). Fosberg considered the Lanai plants different enough from the Maui plants to create a separate variety, *H. schlechtendahliana* var. *remyi*. This variety has been upheld in the most recent revision of the Hawaiian members of this genus (Wagner *et al.* 1999).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), *Hedyotis schlechtendahliana* var. *remyi* was known from five locations on the northwestern portion of Lanaihale on the island of Lanai (Hawaii Natural Heritage Program Database 2001; Wagner *et al*. 1999; U.S. Fish and Wildlife Service 1999b, 2002a). Currently (since 1970), this species is known from 13 individuals in 4 populations on Kaiholeha-Hulupoe Ridge, Kapohaku drainage, and Waiapaa drainage on Lanaihale on privately-owned land (Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 2002a).

d. Life History

Pollination vectors, seed dispersal agents, longevity of plants and seeds, specific environmental requirements, and other limiting factors are unknown for *Hedyotis schlechtendahliana* var. *remyi* (U.S. Fish and Wildlife Service 2002a).

e. Habitat Description

Hedyotis schlechtendahliana var. *remyi* typically grows on or near ridge crests in mesic windswept shrubland at elevations between 730 and 900 meters (2,400 to 3,000 feet). Associated native plant species include *Metrosideros polymorpha* (ohia), *Dicranopteris linearis* (uluhe), *Styphelia tameiameiae* (pukiawe), *Dodonaea viscosa* (aalii), *Odontosoria chinensis* (palaa), *Sadleria* spp. (amau), or *Myrsine* spp. (kolea) (Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 1999b, 2002a; R. Hobdy, personal communication 2001).

f. Reasons for Decline and Current Threats

The primary threats to *Hedyotis schlechtendahliana* var. *remyi* are habitat degradation and destruction by axis deer; competition with alien plant taxa such as *Psidium cattleianum* (strawberry guava), *Morella faya* (fire tree), *Leptospermum scoparium* (New Zealand tea), and *Schinus terebinthifolius* (Christmasberry); and random environmental events or reduced reproductive vigor due to the small number of remaining individuals and populations. A potential threat includes unrestricted collecting or excessive visits by individuals interested in seeing rare plants (Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 1999b, 2002a).

g. Conservation Efforts

Three plants were growing at the National Tropical Botanical Garden greenhouses in 2000 (M. Chapin, personal communication 2000); a 2001 inventory reports an unknown number of greenhouse plants (National Tropical Botanical Garden 2001). No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against axis deer.

Exclosures should be constructed around known populations of *Hedyotis schlechtendahliana* var. *remyi* to reduce impacts from axis deer. Subsequent control or removal of deer from the areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, the current program of propagation and maintenance of *ex situ* genetic stock should be expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control *Psidium cattleianum*, *Morella faya*, *Leptospermum scoparium*, and *Schinus terebinthifolius* at Lanaihale should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Hedyotis schlechtendahliana* var. *remyi* in areas free from the impacts of axis deer and alien plants.

7. *Kanaloa kahoolawensis*
(Hawaiian name: Kohe malama malama o Kanaloa) Recovery Priority Number 4

a. Description
Appendix B contains a line drawing of *Kanaloa kahoolawensis*.

Kanaloa kahoolawensis, a short-lived perennial and a member of the legume family (Fabaceae), is a densely branched shrub 0.75 to 1 meters (2.5 to 3.5 feet) tall. The branches are sprawling and 0.75 to 1.5 meters (2.5 to 5 feet) long. New growth is densely covered with brown and white hairs. The twigs are brown, ribbed or angled, and become whitish gray with corky fissures. The leaves are clustered near twig tips and have two persistent stipules. The leaf stalk is 6 to 24 millimeters (0.2 to 0.9 inch) long. The leaves are divided into three pairs of leaflets, with a leaf nectary (nectar-bearing gland) at the joint between each pair of leaflets. The leaflet pairs are 22 to 55 millimeters (0.8 to 2 inches) long. The main stalk of the leaf terminates in a short, brown appendage. The leaflets are egg-shaped, unequal-sided, 1.4 to 4.2 centimeters (0.6 to 1.7 inches) long, and 0.9 to 3.2 centimeters (0.4 to 1.3 inches) wide. One to three inflorescences are found in the leaf axils (joint between leaf and stem), developing with the flush of new leaves. The main stalk of the inflorescence is 8 to 30 millimeters (0.3 to 1.2 inches) long. The inflorescence is a globose head 6 to 8 millimeters (0.2 to 0.3 inch) in diameter, with small bracts 1 to 1.5 millimeters (0.04 to 0.06 inch) long at the base. Each inflorescence has 20 to 54 white flowers. The calyx of the male flowers has limbs that are wider at the tip; densely covered with long, white hairs; and have lobes that overlap when the flower is in bud. The corolla lobes also overlap when the flower is in bud, and the petals are 1.5 to 1.8 millimeters (0.06 to 0.07 inch) long. The petals are hairy on the outside at the tip, and are not fused at the base. Ten stamens are found in the male flowers, fused at the base. Male flowers have only vestigial female parts. Female flowers have not been observed. The fruit is borne on a stalk about 5 millimeters (0.2 inch) long. Up to four fruit develop in each flowering head. The fruit is egg-shaped to subcircular, compressed, hairy at the base, and open along two sides. One slender, heart-shaped, brown seed, 1.0 to 1.4 centimeters (0.4 to 0.5 inch) by 1.1 to 1.6 centimeters (0.4 to 0.6 inch), is found in each fruit. There is no other species of

legume in Hawaii that bears any resemblance to this species or genus (Lorence and Wood 1994; U.S. Fish and Wildlife Service 2002b).

b. Taxonomy

Kanaloa kahoolawensis was unknown to science until its discovery by Steve Perlman and Ken Wood in 1992 on a steep, rocky spire on the coast of Kahoolawe. David Lorence and Wood have determined that this plant represents a new genus, and have named the species *Kanaloa kahoolawensis* (Lorence and Wood 1994).

c. Current and Historic Ranges and Population Status

Kanaloa kahoolawensis was unknown to science until its discovery by Steve Perlman and Ken Wood of National Tropical Botanical Garden in 1992 on a steep rocky spire (Aleale) on the southern coast of Kahoolawe, which is owned by the State of Hawaii. While there are no previous records of the plant, pollen core studies on the island of Oahu revealed a legume pollen that could not be identified but is most likely this species. The pollen cores, dating from before 1210 B.C. to 1565 A.D., indicate that a species much like *K. kahoolawensis* was a codominant with *Dodonaea viscosa* and *Pritchardia* spp. until approximately 900 to 1200 A.D, when *K. kahoolawensis* disappeared from the pollen record and both *D. viscosa* and *Pritchardia* declined dramatically (Athens *et al.* 1992). Only one population with a single living individual is known (Athens *et al.* 1992; Athens and Ward 1993; Lorence and Wood 1994; Paul Higashino, Kahoolawe Island Reserve Commission, personal communication 2000; U.S. Fish and Wildlife Service 1999b, 2002b); a second plant on the sea stack recently died (David Lorence, National Tropical Botanical Garden, personal communication 2002).

d. Life History

Little is known about the life history of *Kanaloa kahoolawensis*. Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 1999b, 2002b).

e. Habitat Description

The only known habitat is steep rocky talus slopes in mixed coastal shrubland at elevations between 45 to 60 meters (150 to 200 feet) and containing one or more of the following associated native plant species: *Sida fallax* (ilima), *Senna gaudichaudii* (kolomona), *Bidens mauiensis* (kookoolau), *Melanthera (Lipochaeta) lavarum* (nehe), *Portulaca molokiniensis* (ihi), or *Capparis sandwichiana* (maiapilo) (U.S. Fish and Wildlife Service 1999b, 2002b; Wagner and Robinson 2001; R. Hobdy *et al.*, personal communication 2001).

f. Reasons for Decline and Current Threats

The major threats to *Kanaloa kahoolawensis* are landslides and the alien plant species *Emilia fosbergii* (pualele), *Chloris barbata* (swollen finger grass), and *Nicotiana glauca* (tree tobacco). Goats played a major role in the destruction of vegetation on Kahoolawe before they were removed, and *K. kahoolawensis* probably survived only because the rocky stack is almost completely separated from the island and inaccessible to goats. Rats are a potential threat to *K. kahoolawensis* because the species has seeds similar in appearance and presentation to the seeds of the federally endangered *Caesalpinia kavaiensis* (uhiuhi), which are eaten by rats. Rats may have been the cause of the decline of this species 800 years ago. Trampling and habitat degradation by introduced cats and native seabirds are also potential threats. Random environmental events and/or reduced reproductive vigor are also a threat to this species because only one individual is known. Potential threats include unrestricted collecting or excessive visits by individuals interested in seeing rare plants (P. Higashino, personal communication 2000; Cuddihy and Stone 1990; Lorence and Wood 1994; U.S. Fish and Wildlife Service 1999b, 2002b).

g. Conservation Efforts

Three individuals are in cultivation at National Tropical Botanical Garden in Lawai, Kauai (D. Lorence, National Tropical Botanical Garden, personal communication 2002). Two of the plants were grown from seeds collected in

1994. They are now large shrubs (1 to 1.5 meters [3.3 to 4.9 feet] broad and 50 centimeters [20 inches] tall). A third plant was grown from seed collected in 1997 and is in healthy condition at National Tropical Botanical Garden. Unsuccessful attempts have been made using vegetative propagation methods from cuttings, micropropagation, and airlayering on all three *ex-situ* plants at different times of the year. Previous attempts at vegetative propagation from wild material have also been unsuccessful (Wood 1998). No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Maintain adequate genetic stock.

To prevent extinction of this species, the current program of propagation and maintenance of *ex situ* genetic stock should be expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

2) Control competing alien plant species.

A long-range management plan to control *Emilia fosbergii*, *Chloris barbata*, and *Nicotiana glauca* at Aleale should be developed and implemented.

3) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Kanaloa kahoolawensis*, if determinable, in areas free from the impacts of feral ungulates and alien plants.

8. *Labordia tinifolia* var. *lanaiensis*
(Hawaiian name: Kamakahala) Recovery Priority Number 6

a. Description
No line drawing is available for this plant.

Labordia tinifolia var. *lanaiensis*, a short lived perennial in the logan family (Loganiaceae), is an erect shrub or small tree 1.2 to 15 meters (4 to 49 feet) tall. The stems branch regularly into two forks of nearly equal size. The leaves are medium to dark green, oval to narrowly oval, 3.8 to 21 centimeters (1.5 to 8.3 inches) long, and 1.4 to 7.3 centimeters (0.6 to 2.9 inches) wide. The leaf stalks are 2.2 to 4 centimeters (0.9 to 1.6 inches) long. The stipules are fused together, forming a sheath around the stem that is 1 to 4 millimeters (0.04 to 0.2 inch) long. Three to 19 flowers are found in each inflorescence, and the entire inflorescence is pendulous and has a stalk 9 to 22 millimeters (0.4 to 0.8 inch) long. The flowers have a semen-like fragrance, and are borne on stalks 8 to 11 millimeters (0.3 to 0.4 inch) long. The corolla is pale yellowish green or greenish yellow, narrowly urn-shaped, and 6.5 to 19 millimeters (0.2 to 0.7 inch) long. The fruit is broadly oval, 8 to 17 millimeters (0.3 to 0.7 inch) long, 2- to 3-valved, and has a beak 0.5 to 1.5 millimeters (0.02 to 0.06 inch) long. The seeds are brown and about 1.8 millimeters (0.06 inch) long. This taxon differs from the other two subspecies and other species in this endemic Hawaiian genus by having larger capsules and smaller corollas (Motley 1995; Wagner *et al.* 1999).

b. Taxonomy

Hillebrand determined, but did not name, a new variety of *Labordia tinifolia* based on specimens he collected on the islands of Kauai, West Maui, Lanai, and Hawaii. E.E. Sherff named the variety *L. tinifolia* var. *lanaiensis* in 1938 (Sherff 1938). In the revision of the Hawaiian members of this family, Wagner *et al.* (1999) retained the nomenclature, but included only those plants from Lanai and Mapulehu on Molokai (previously considered *L. triflora*) as *L. tinifolia* var. *lanaiensis*. This endemic Hawaiian genus has since been revised so that only the Lanai populations are included in *L. tinifolia* var. *lanaiensis*, while *L. triflora* has

been resurrected for the Molokai population (see discussion of the next taxon, below) (Motley 1995).

c. Current and Historic Ranges and Population Status

Labordia tinifolia var. *lanaiensis* was historically (prior to 1970) known from the entire length of the summit ridge of Lanaihale on the island of Lanai (Hawaii Natural Heritage Program Database 2001). Currently (since 1970), *L. tinifolia* var. *lanaiensis* is known from only three populations at the southeastern end of the summit ridge of Lanaihale on privately owned land (Hawaii Natural Heritage Program Database 2001). These populations total 300 to 800 scattered individuals (Geographic Decision System International 2001).

d. Life History

Flowering time, pollination vectors, seed dispersal agents, longevity of plants and seeds, specific environmental requirements, and other limiting factors are unknown (U.S. Fish and Wildlife Service 1999b).

e. Habitat Description

The typical habitat of *Labordia tinifolia* var. *lanaiensis* is lowland mesic forest associated with the native species *Dicranopteris linearis* (uluhe) and *Scaevola chamissoniana* (naupaka kuahiwi), at elevations between 710 and 1,020 meters (2,330 to 3,350 feet) (Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 1999b, 2002a; R. Hobdy, personal communication 2001).

f. Reasons for Decline and Current Threats

Labordia tinifolia var. *lanaiensis* is threatened by axis deer and several alien plant taxa such as *Psidium guajava* (common guava), *Schinus terebinthifolius* (Christmasberry), *Morella faya* (fire tree), *Leptospermum scoparium* (New Zealand tea), and *Hedychium coronarium* (white ginger). The species is also threatened by random environmental factors because of the small number of populations. Potential threats include unrestricted collecting or excessive visits

by individuals interested in seeing rare plants (U.S. Fish and Wildlife Service 1999b, 2002a).

g. Conservation Efforts

Though seeds of *Labordia tinifolia* var. *lanaiensis* have not been propagated at any of the local nurseries or botanical gardens, seeds of *Labordia tinifolia* var. *lanaiensis* have been stored at Lyon Arboretum for many years in the past and this species is well suited for micropropagation (A. Yoshinaga, personal communication 2000). Currently, one sample is in tissue culture at Lyon Arboretum (Harold L. Lyon Arboretum 2001), while National Tropical Botanical Garden has over 1,000 seeds in storage and an unknown number of plants in the greenhouse (National Tropical Botanical Garden 2001). General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against axis deer.

Exclosures should be constructed around known populations of *Labordia tinifolia* var. *lanaiensis* to reduce impacts from axis deer. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of deer from the areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control *Psidium cattleianum*, *Schinus terebinthifolius*, *Morella faya*, *Leptospermum scoparium*, and *Hedychium coronarium* at Lanaihale should be developed and implemented.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Labordia tinifolia* var. *lanaiensis* in areas free from the impacts of deer and alien plants.

9. *Labordia triflora*
(Hawaiian name: Kamakahala) Recovery Priority Number 5

a. Description

No line drawing is available for this plant.

Labordia triflora, a short-lived perennial member of the logan family, is very similar to *L. tinifolia* var. *lanaiensis*, described above, except in the following characteristics: the stems of *L. triflora* are climbing; the leaf stalks are only 1 to 3 millimeters (0.04 to 0.1 inch) long; inflorescence stalks are 40 to 50 millimeters (1.6 to 2 inches) long; and each flower stalk is 10 to 25 millimeters (0.4 to 1 inch) long (Motley 1995).

b. Taxonomy

Hillebrand named *Labordia triflora* based on a specimen he collected on Molokai in the early 1800's (Hillebrand 1888). In the 1990 "Manual of the Flowering Plants of Hawaii" (Manual) (Wagner *et al*. 1990), this species was considered to be synonymous with *L. tinifolia* var. *lanaiensis*. Timothy Motley

recently revised this endemic Hawaiian genus, and resurrected *L. triflora* as a valid species (Motley 1995). In their 1999 supplement to the Manual, Wagner and Herbst recognized Motley's 1995 treatment of this species (Wagner and Herbst 1999).

c. Current and Historic Ranges and Population Status

Until 1990, *Labordia triflora* was known only from the type collection at Mapulehu on the island of Molokai, and was believed to be extinct. In 1990, Joel Lau rediscovered the species in Kua Gulch on Molokai. Currently (since 1970), only 10 individuals are known from 1 population on privately owned land (Geographic Decision Systems International 2001; Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 2002c; Motley 1995).

d. Life History

The flowers of this species are functionally unisexual (Motley 1995; Hawaii Natural Heritage Program Database 2001). No additional life history information is available at this time.

e. Habitat Description

This species occurs on gulch slopes in mixed mesic *Metrosideros polymorpha* (ohia) forest between 190 and 1,145 meters (625 to 3,755 feet) elevation. Associated species include *Pouteria sandwicensis* (alaa), *Sadleria cyatheoides* (amau), *Nephrolepis exaltata* (swordfern), *Hedyotis* spp. (pilo), *Myrsine lessertiana* (kolea lau nui), or *Tetraplasandra hawaiensis* (oheohe) (Motley 1995; J. Lau *in litt.* 2001; U.S. Fish and Wildlife Service 2002c).

f. Reasons for Decline and Current Threats

The threats to *Labordia triflora* include habitat degradation and destruction by feral pigs and goats; predation by rats that eat seeds; competition with the alien plant species *Schinus terebinthifolius* (Christmasberry); and catastrophic extinction through environmental events and reduced reproductive vigor due to

the small number of individuals remaining in the only known population. Potential threats include unrestricted collecting or excessive visits by individuals interested in seeing rare plants (U.S. Fish and Wildlife Service 1999b, 2002c; Motley 1995).

g. Conservation Efforts

Lyon Arboretum has collected micropropagation information for this species (A. Yoshinaga, personal communication 2000), while National Tropical Botanical Garden has a unknown number of seeds in storage (National Tropical Botanical Garden 2001). General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against feral ungulates.

Exclosures should be constructed around known populations of *Labordia triflora* to reduce impacts from ungulates. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species.

A long-range management plan to control *Schinus terebinthifolius* at Kua Gulch should be developed and implemented.

4) Reduce threats from rodent predation.

A management plan to control rats should be developed. This plan should include the use of currently approved Diphacinone bait blocks and ultimately a more broad-scale method, such as aerial dispersal of rodenticide.

5) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Labordia triflora* in areas free from the impacts of feral ungulates and alien plants.

10. *Melicope munroi*
(Hawaiian name: Alani) Recovery Priority Number 5

a. Description

No line drawing is available for this plant.

Melicope munroi, a long lived perennial of the citrus family (Rutaceae), is a sprawling shrub up to 3 meters (10 feet) tall. The new growth of this species is minutely hairy. The leaves are opposite, broadly elliptical, 6 to 11 centimeters (2.4 to 4.3 inches) long, and 3.5 to 7.5 centimeters (1.4 to 3.0 inches) wide. The veins of the leaf are parallel, in 8 to 12 pairs, and are connected by arched veins near the margin of the leaf. The margins of the leaves are sometimes rolled under. The leaf stalks are 4 to 12 millimeters (0.2 to 0.5 inch) long. The inflorescence is found in the axil of the leaf and contains one to three flowers. The inflorescence stalk is 10 to 15 millimeters (0.4 to 0.5 inch) long, and the individual flower stalk is 15 to 35 millimeters (0.6 to 1.4 inches) long. Male flowers have not been reported. Female flowers have ovoid sepals about 2.5 millimeters (0.1 inch) long and deltate petals about 8 millimeters (0.3 inch) long. The fruit is about 18 millimeters (0.7 inch) wide, and the 4 carpels (egg-bearing

structures) are fused about one-third of their length. This species differs from other Hawaiian members of the genus in the shape of the leaf and the length of the inflorescence (a flower cluster) stalk (Stone *et al.* 1999).

b. Taxonomy

In 1944, St. John described *Pelea munroi*, based on a collection by George C. Munro in 1915 (St. John 1944). The genus *Pelea* has since been submerged with *Melicope*, creating the combination *M. munroi* (Hartley and Stone 1989).

c. Current and Historic Ranges and Population Status

Historically (prior to 1970), this species was known from the Lanaihale summit ridge of Lanai and above Kamalo on Molokai. This species was last collected on Molokai in 1910 from Kamalo by J.F. Rock. Currently (since 1970), *Melicope munroi* is only known from the Lanaihale summit ridge on Lanai on private land. Currently, there are two populations totaling an estimated 300 to 800 individuals on privately owned land on the Lanaihale summit, head of Hauola gulch, Waialala gulch, and the ridge of Waialala gulch (Hawaii Natural Heritage Program Database 2001; Geographic Decision Systems International 2001; U.S. Fish and Wildlife Service 1999b, 2001, 2002a).

d. Life History

Little is known about the life history of *Melicope munroi*. Its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (U.S. Fish and Wildlife Service 2002a).

e. Habitat Description

Melicope munroi is typically found on slopes in lowland wet shrublands at elevations of 790 to 1,020 meters (2,600 to 3,350 feet). Associated native plant taxa include *Diplopterygium pinnatum*, *Dicranopteris linearis* (uluhe), *Metrosideros polymorpha* (ohia), *Cheirodendron trigynum* (olapa), *Coprosma*

spp. (pilo), *Broussaisia arguta* (kanawao), other *Melicope* (alani) species, and *Machaerina angustifolia* (uki) (Hawaii Natural Heritage Program Database 2001; U.S. Fish and Wildlife Service 2002a).

f. Reasons for Decline and Current Threats

The major threats to *Melicope munroi* on Lanai are axis deer and the alien plant taxa *Leptospermum scoparium* (New Zealand tea) and *Psidium cattleianum* (strawberry guava) (Hawaii Natural Heritage Program Database 2001). Random environmental events also threaten the remaining populations. Potential threats include unrestricted collecting or excessive visits by individuals interested in seeing rare plants (U.S. Fish and Wildlife Service 1999b).

g. Conservation Efforts

No species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Multi-Island Addendum plants can be found in the section on overall conservation efforts (page 32) of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a).

h. Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 165 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a); however, the following actions are felt to be particularly urgent.

1) Construct exclosures to protect populations against axis deer.

Exclosures should be constructed around known populations of *Melicope munroi* to reduce impacts from axis deer. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Subsequent control or removal of deer from the areas will alleviate their impact on native ecosystems. Commitments should be developed for long-term stewardship and conservation of these areas once they have been enclosed.

2) Maintain adequate genetic stock.

To prevent extinction of this species, a program of propagation and maintenance of *ex situ* genetic stock should be developed and expanded, following the Center for Plant Conservation Guidelines (Falk and Holsinger 1991).

3) Control competing alien plant species

A long-range management plan should be developed and implemented to control alien plants such as *Psidium cattleianum* and *Leptospermum scoparium*.

4) Enhance wild populations and establish new populations.

Outplanting to enhance the remaining wild populations should begin after they have been protected from ungulates and weed control is under way. When adequate propagated material is available, new populations should be established within the historic range of *Melicope munroi* in areas free from the impacts of axis deer and alien plants.

F. Overall Recovery Strategy

A discussion relevant to the overall recovery strategy for the Multi-Island Addendum plants can be found on page 162 of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a). To ultimately recover the listed plant taxa in Hawaii, habitat must be protected and managed for natural expansion of the current populations, as well as reintroduction of these taxa into portions of former range. Habitats that are potentially important for the recovery of listed species in Hawaii are shown in Appendix F of the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a). These maps may be used by land owners and managers to identify priority areas for management and restoration, and for wide-range planning purposes. In addition, critical habitat has been proposed for the Multi-Island Addendum plants (U.S. Fish and Wildlife Service 2002a, 2002b, 2002c).

Finally, the recovery objectives should be refined and revised as new information becomes available.

RECOVERY

A. Objectives

See page 165 of the Recovery Plan for the Multi-Island Plants for a general overview of the recovery objectives for these taxa and definitions of endangered and threatened species and populations (U.S. Fish and Wildlife Service 1999a).

The interim objective is to stabilize all existing populations of the Multi-Island Addendum plants. To be considered stable, each taxon must be managed to control threats (*e.g.*, fenced) and be represented in an *ex situ* collection (such as a nursery or arboretum). In addition, a minimum total of three populations of each taxon should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population for long-lived perennials (*Melicope munroi*) and a minimum of 50 mature individuals per population for short-lived perennials (*Clermontia samuelii*, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Dubautia plantaginea* ssp. *humilis*, *Hedyotis schlechtendahliana* var. *remyi*, *Kanaloa kahoolawensis*, *Labordia tinifolia* var. *lanaiensis*, and *Labordia triflora*).

For downlisting, a total of five to seven populations of each taxon should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials and a minimum of 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered.

For delisting, a total of 8 to 10 populations of each taxon should be documented on the island where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 100 mature individuals per population for long-lived perennials, and a minimum of 300 mature individuals per population

for short-lived perennials. Each population should persist at this level for a minimum of 5 consecutive years.

Because we have only limited knowledge of the life history of each of these taxa with respect to specific requirements for their short-term and long-term survival, this plan establishes only tentative criteria for stabilizing, downlisting, and delisting (Table 4). These criteria were formulated based on recommendations by the Hawaii and Pacific Plants Recovery Coordinating Committee, as well as the International Union for Conservation of Nature and Natural Resources' draft red list categories (Version 2.2) and the advice and recommendations of various biologists and knowledgeable individuals.

Additional information is needed about each of the Multi-Island Addendum plants so that more specific recovery criteria can be quantified.

B. Step-down Outline

See the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a), beginning on page 168.

C. Step-down Narrative

See the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a), beginning on page 169. Table 5 provides a summary of the factors that led to the listing of the plants included in the Recovery Plan for the Multi-Island Plants as well as the Multi-Island Addendum plants.

Table 4. Current status, recovery objectives, and needed actions for the Multi-Island Addendum plants

Species/Status	Interim	Downlisting	Delisting
Clermontia samuelii Current Status 4 populations 309 individuals	Objective 3 populations 50 mature plants each 150 total mature plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 1-3 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4-6 populations Increase total plants
Cyanea copelandii ssp. *haleakalaensis* Current Status 3 populations 204 individuals	Objective 3 populations 50 mature plants each 150 total mature plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 2–4 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 5–7 populations Increase total plants

Table 4. Continued

Species/Status	Interim	Downlisting	Delisting
Cyanea glabra Current Status 1 population 12 individuals	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Establish 2 populations Increase total plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4–6 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 7–9 populations Increase total plants
Cyanea hamatiflora ssp. *hamatiflora* Current Status 7 populations 12 individuals	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Increase total plants	Objective 5-7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 1–3 populations Increase total plants

Table 4. Continued

Species/Status	Interim	Downlisting	Delisting
Dubautia plantaginea ssp. *humilis* Current Status 1 population 60–65 individuals	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Establish 2 populations Increase total plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4–6 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 7–9 populations Increase total plants
Hedyotis schlechtendahliana var. *remyi* Current Status 4 populations 13 individuals	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Increase total plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 1–3 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4–6 populations Increase total plants

Table 4. Continued

Species/Status	Interim	Downlisting	Delisting
Kanaloa kahoolawensis Current Status 1 population 1 individual	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Establish 2 populations Increase total plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4–6 populations Increase total plants	Objective 8–10 populations
Labordia tinifolia var. *lanaiensis* Current Status 3 populations 300–800 individuals	Objective 3 populations 50 mature plants each 150 total mature plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 2–4 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 5–7 populations Increase total plants

Table 4. Continued

Species/Status	Interim	Downlisting	Delisting
Labordia triflora Current Status 1 population 10 individuals	Objective 3 populations 50 mature plants each 150 total mature plants Needed Increases Establish 2 populations Increase total plants	Objective 5–7 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 4–6 populations Increase total plants	Objective 8–10 populations At least 300 mature plants each Sustained for 5 years Needed Increases Establish 7–9 populations Increase total plants
Melicope munroi Current Status 2 populations 300–800 individuals	Objective 3 populations 25 mature plants each 75 total mature plants Needed Increases Establish 1 population	Objective 5–7 populations At least 100 mature plants each Sustained for 5 years Needed Increases Establish 3-5 populations Increase total plants	Objective 8–10 populations At least 100 mature plants each Sustained for 5 years Needed Increases Establish 6-8 populations Increase total plants

Table 5. Summary of Threats and Recommended Recovery Actions.

LISTING FACTOR	THREAT	RECOVERY CRITERIA	TASK NUMBERS
A	Destruction and degradation of habitat by feral ungulates	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, determine and implement game management preserves (see Tasks 11, 12, 13, 1411, 1412)
A	Destruction of habitat by fire	2	Provide necessary fire protection (see Task 143)
B	Potential for unrestricted collecting for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants	2	Protect areas from human disturbance (see Task 147)
C	Predation by feral ungulates	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, determine and implement game management preserves (see Tasks 11, 12, 13, 1411, 1412)
C	Predation by introduced rats	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, develop aerial rodent control methods, control rodents (see Tasks 11, 12, 13, 144, 37, 38)
C	Predation by introduced slugs	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, develop and implement control method for slugs (see Tasks 11, 12, 13, 1411, 148, 36, 37, 38)
C	Predation by introduced two-spotted leafhopper	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, develop and implement control method for two-spotted leafhopper (see Tasks 11, 12, 13, 1411, 148, 36, 37, 38)

LISTING FACTOR	THREAT	RECOVERY CRITERIA	TASK NUMBERS
D	Lack of existing State laws or regulatory mechanisms to protect or prevent further decline of these plants on private land, except for minimal protection offered to those that occur on land classified as a conservation district. [Note: Federally listed species are automatically protected under the State endangered species law, but this protection is removed if the species is federally delisted.]	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, determine and implement game management preserves, control alien plants, rodents, slugs, and other threats, develop monitoring program, research and develop reintroduction program, refine recovery objectives (see Tasks 11, 12, 13, 1411, 1412, 142, 144, 148, 149, 31, 32, 33, 34, 35, 36, 4, 51, 52, 61)
E	Competition with alien plants	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, conduct alien plant control (see Tasks 11, 12, 13, 1411, 142, 32, 37, 38)
E	Erosion, landslides, rockslides, and flooding due to natural weathering	2	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, (see Tasks 11, 12, 13, 1411)
E	Potential for extinction from a single human-caused or natural environmental disturbance	1, 3	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, conduct alien plant control, propagate and maintain genetic stock of each taxon *ex situ*, expand existing populations, develop monitoring program, research and develop reintroduction program, refine recovery objectives (see Tasks 11, 12, 13, 141, 145, 21, 22, 31, 33, 34, 35, 4, 51, 52, 61)

LISTING FACTOR	THREAT	RECOVERY CRITERIA	TASK NUMBERS
E	Small gene pool may depress reproductive vigor	1, 3	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, conduct alien plant control, control other threats, ensure availability of pollination vectors, develop monitoring program, research and develop reintroduction program, refine recovery objectives (see Tasks 11, 12, 13, 1411, 142, 143, 144, 146, 31, 33, 34, 35, 4, 51, 52, 61)

Listing Factors:

A. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range

B. Overutilization for Commercial, Recreational, Scientific, Educational Purposes

C. Disease or Predation

D. The Inadequacy of Existing Regulatory Mechanisms

E. Other Natural or Manmade Factors Affecting its Continued Existence

Recovery Criteria to Consider Delisting

1. A total of 8 to 10 populations of each taxon should be documented on islands where they now occur or occurred historically.

2. Each of the populations must be naturally reproducing, stable or increasing in number, and secure from threats,

3. Each population must have a minimum of 100 (for long-lived perennials) or 300 (for short-lived perennials) mature individuals per population, and must persist at that level for at least 5 years.

Recovery criteria are tentative and may be changed if knowledge about life history and survival requirements of these taxa improves in the future.

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IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and estimated cost for the Multi-Island Plants and the Multi-Island Addendum plants, as set forth in the recovery plan and this addendum. It is a guide for meeting the objectives discussed in Part II of the Recovery Plan for the Multi-Island Plants. This schedule indicates task priority, task numbers, task descriptions, durations of tasks, the agencies responsible for committing funds, and lastly, estimated costs. The agencies responsible for committing funds are not, necessarily, the entities that will actually carry out the tasks. When more than one agency is listed as the responsible party, an asterisk is used to identify the lead entity.

The actions identified in the Implementation Schedule, when accomplished, should protect habitat for the taxa, stabilize the existing populations, and increase the population sizes and numbers. Monetary needs for all parties involved to reach this point are identified whenever feasible. Costs of ensuring pollinator availability, controlling threats from rodents, insects, and disease, augmentation of existing populations, and establishment of new populations have not yet been determined and will require additional research or development of specific introduction plans to estimate.

Priorities in Column 1 of the Implementation Schedule are assigned as follows:

Priority 1	-	An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
Priority 2	-	An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
Priority 3	-	All other actions necessary to provide for full recovery of the species.

Abbreviations Used in the Implementation Schedule:

Cont.	—	Task will need to be performed continuously or repeatedly once it is begun.
Ongoing	—	Task is currently being implemented and will continue until no longer necessary for recovery
†	—	Continued implementation of task expected to be necessary after delisting
‡	—	Task expected to be necessary until delisting of species (possible by 2017)
TBD	—	Funding or timing of the task has not been determined
*	—	Party with lead responsibility

Agencies and Organizations

BOT	—	Various Botanical Gardens (*e.g.*, National Tropical Botanical Garden, Lyon Arboretum, Waimea Botanical Garden, etc.)
BRD	—	Biological Resources Division, U.S. Geological Survey
DLNR	—	Hawaii Department of Land and Natural Resources
DOD	—	U.S. Department of Defense
FWS-PIE	—	U.S. Fish and Wildlife Service, Pacific Islands Ecoregion, Honolulu, Hawaii
HDOA	—	Hawaii Department of Agriculture

NPS — National Park Service

OTHER — Various private landowners

TNCH — The Nature Conservancy of Hawaii

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MULTI-ISLAND AND MULTI-ISLAND ADDENDUM PLANTS

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
1	11	Identify and map all extant wild populations	5	DLNR*	725.0	145	145	145	145	145
				FWS-PIE	70.0	14	14	14	14	14
				DOD	125.0	25	25	25	25	25
				NPS	70.0	14	14	14	14	14
				TNCH	125.0	25	25	25	25	25
1	12	Delineate management units	3	FWS-PIE*	21.0	-	7	7	7	-
				DLNR	18.0	-	6	6	6	-
				TNCH	TBD	-	-	-	-	-
1	13	Ensure long-term protection of habitat	Ongoing†	DLNR*	224.0	14	14	14	14	14
				NPS	64.0	4	4	4	4	4
				DOD	128.0	8	8	8	8	8
				OTHER	176.0	11	11	11	11	11
				TNCH	128.0	8	8	8	8	8
				FWS-PIE	112.0	7	7	7	7	7
1	1411	Construct and maintain fencing, wherever possible	Cont.†	DLNR*	4,046.0	-	-	289	289	289
				DOD	3,500.0	-	-	250	250	250
				NPS	1,932.0	-	-	138	138	138
				TNCH	3,542.0	-	-	253	253	253
				OTHER	TBD	TBD	-	-	-	-
				FWS-PIE	1,946.0	-	-	139	139	139

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
1	142	Conduct alien plant control	Ongoing †	DLNR*	4,624.0	289	289	289	289	289
				DOD	1,984.0	124	124	124	124	124
				NPS	12,000.0	750	750	750	750	750
				TNCH	2,016.0	126	126	126	126	126
				OTHER	TBD	TBD	-	-	-	-
				FWS-PIE	448.0	28	28	28	28	28
1	143	Provide necessary fire protection	Cont.†	DLNR*	1,260.0	-	84	84	84	84
				DOD	1,125.0	-	75	75	75	75
				TNCH	825.0	-	55	55	55	55
				NPS	300.0	-	20	20	20	20
				FWS-PIE	150.0	-	10	10	10	10
1	144	Control rodents, if necessary	TBD	DLNR*	TBD	TBD	-	-	-	-
				FWS-PIE	TBD	TBD	-	-	-	-
				TNCH	TBD	TBD	-	-	-	-
				NPS	TBD	TBD	-	-	-	-
				DOD	TBD	TBD	-	-	-	-
1	145	Propagate and maintain genetic stock of each taxon *ex situ*	Ongoing‡	DLNR*	3,696.0	231	231	231	231	231
				FWS-PIE	224.0	14	14	14	14	14
				DOD	592.0	37	37	37	37	37
				BOT	736.0	46	46	46	46	46
				NPS	336.0	21	21	21	21	21
1	146	Ensure availability of pollination vectors	Cont.†	DLNR*	TBD	-	-	-	TBD	TBD
				FWS-PIE	TBD	-	-	-	TBD	TBD
				DOD	TBD	-	-	-	TBD	TBD
				NPS	TBD	-	-	-	TBD	TBD

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
1	147	Protect areas from human disturbance	Ongoing †	DOD	400.0	25	25	25	25	25
				DLNR*	912.0	57	57	57	57	57
				NPS	224.0	14	14	14	14	14
				TNCH	400.0	25	25	25	25	25
				OTHER	288.0	18	18	18	18	18
				FWS-PIE	112.0	7	7	7	7	7
1	148	Control insects, slugs, snails, and/or disease, if necessary	TBD	DLNR*	TBD	TBD	-	-	-	-
				DOD	TBD	TBD	-	-	-	-
				NPS	TBD	TBD	-	-	-	-
				TNCH	TBD	TBD	-	-	-	-
				FWS-PIE	TBD	TBD	-	-	-	-
1	149	Control all other identified threats	TBD	DLNR*	TBD	TBD	-	-	-	-
				DOD	TBD	TBD	-	-	-	-
				NPS	TBD	TBD	-	-	-	-
				TNCH	TBD	TBD	-	-	-	-
				OTHER	TBD	TBD	-	-	-	-
				FWS-PIE	TBD	TBD	-	-	-	-
2	1412	Evaluate the potential for eradication programs for control of ungulates or establishment of game preserves	3	DLNR*	42.0	-	14	14	14	-
				OTHER	TBD	TBD	-	-	-	-
				FWS-PIE	21.0	-	7	7	7	-
NEED 1 (Protect habitat and control threats) cost subtotals					**49,667+**	**2,087+**	**2,365**	**3,434**	**3,434+**	**3,400+**
2	21	Select populations for expansion	2	DLNR*	10.0	-	-	-	5	5
				OTHER	14.0	-	-	-	7	7
				TNCH	6.0	-	-	-	3	3
				FWS-PIE	6.0	-	-	-	3	3

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
2	22	Prepare sites and plant	TBD	DLNR*	TBD	-	-	-	-	TBD
				TNCH	TBD	-	-	-	-	TBD
				OTHER	TBD	-	-	-	-	TBD
				FWS-PIE	TBD	-	-	-	-	TBD
NEED 2 (Expand existing wild populations) cost subtotals					**36+**	**0**	**0**	**0**	**18**	**18+**
2	31	Collect diagnostic data on crucial associated ecosystem components	5	BRD*	450.0	90	90	90	90	90
				DLNR	140.0	28	28	28	28	28
2	32	Map alien vegetation	Ongoing †	BRD*	885.0	59	59	59	59	59
				DLNR	420.0	28	28	28	28	28
				FWS-PIE	210.0	14	14	14	14	14
2	33	Study various aspects of growth	5	BRD*	295.0	59	59	59	59	59
				DLNR	140.0	28	28	28	28	28
				FWS-PIE	70.0	14	14	14	14	14
2	34	Study reproductive viability	5	BRD*	295.0	59	59	59	59	59
				DLNR	140.0	28	28	28	28	28
				FWS-PIE	70.0	14	14	14	14	14
2	35	Determine parameters of viable populations	5	FWS-PIE*	140.0	28	28	28	28	28
				BRD	150.0	30	30	30	30	30
2	36	Determine effects of insects and/or diseases, and develop control methods, as needed	TBD	DLNR*	TBD	-	-	-	-	-
				FWS-PIE	TBD	-	-	-	-	-
				BRD	TBD	-	-	-	-	-

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
2	37	Identify and test potential biocontrol agents for host specificity and efficacy of control	TBD	HDOA	TBD	-	-	-	-	-
2	38	Evaluate results and use in future management	Ongoing †	DLNR*	75.0	5	5	5	5	5
				FWS-PIE	45.0	3	3	3	3	3
NEED 3 (Conduct essential research) cost subtotals					**3,525+**	**487**	**487**	**487**	**487**	**487**
3	4	Develop and implement long-term monitoring programs for all species	Cont.†	DLNR*	336.0	-	-	-	28	28
				NPS	84.0	-	-	-	7	7
				DOD	144.0	-	-	-	12	12
				BOT	180.0	-	-	-	15	15
				TNCH	144.0	-	-	-	12	12
				FWS-PIE	84.0	-	-	-	7	7
NEED 4 (Develop and maintain monitoring plans) cost subtotals					**972.0**	**0**	**0**	**0**	**81**	**81**
3	51	Investigate feasibility and desirability of reintroduction	2	FWS-PIE*	14.0	-	-	-	-	-
				DLNR	28.0	-	-	-	-	-
				BRD	TBD	-	-	-	-	-
3	52	Develop and implement specific plans for reestablishment	TBD	FWS-PIE*	TBD	TBD	-	-	-	-
				DLNR	TBD	TBD	-	-	-	-
				BRD	TBD	TBD	-	-	-	-
				TNCH	TBD	TBD	-	-	-	-
				OTHER	TBD	TBD	-	-	-	-
NEED 5 (Reestablish wild populations within the historic range) cost subtotals . .					**42+**	**0+**	**0**	**0**	**0**	**0**

Priority #	Task #	Task Description	Duration (Yrs)	Responsible Party	Total cost, 2002-2017	Cost estimates, by fiscal year, in thousands of dollars.				
						2002	2003	2004	2005	2006
3	61	Determine number of populations and individuals needed for long-term survival	2	FWS-PIE*	14.0	-	-	-	-	-
				DLNR	28.0	-	-	-	-	-
				BRD	30.0	-	-	-	-	-
3	62	Refine/revise downlisting and delisting criteria	2	FWS-PIE*	14.0	-	-	-	-	-
				DLNR	28.0	-	-	-	-	-
				BRD	30.0	-	-	-	-	-
NEED 6 (Validate recovery criteria) cost subtotals					**144.0**	**0**	**0**	**0**	**0**	**0**
TOTAL ESTIMATED COST					**54,386+**	**2,574+**	**2,852**	**3,921**	**4,020+**	**3,986+**

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Lanai Public and School Library
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Lanai City, HI 96763

Wailuku Regional Library
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Wailuku, HI 96793

Maui Community College Library
310 Kaahumanu Avenue
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Kailua-Kona Public Library 75-138
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Kailua-Kona, HI 96740

Hilo Public Library
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(*) - Persons and Agencies who provided information necessary for the development of the Addendum

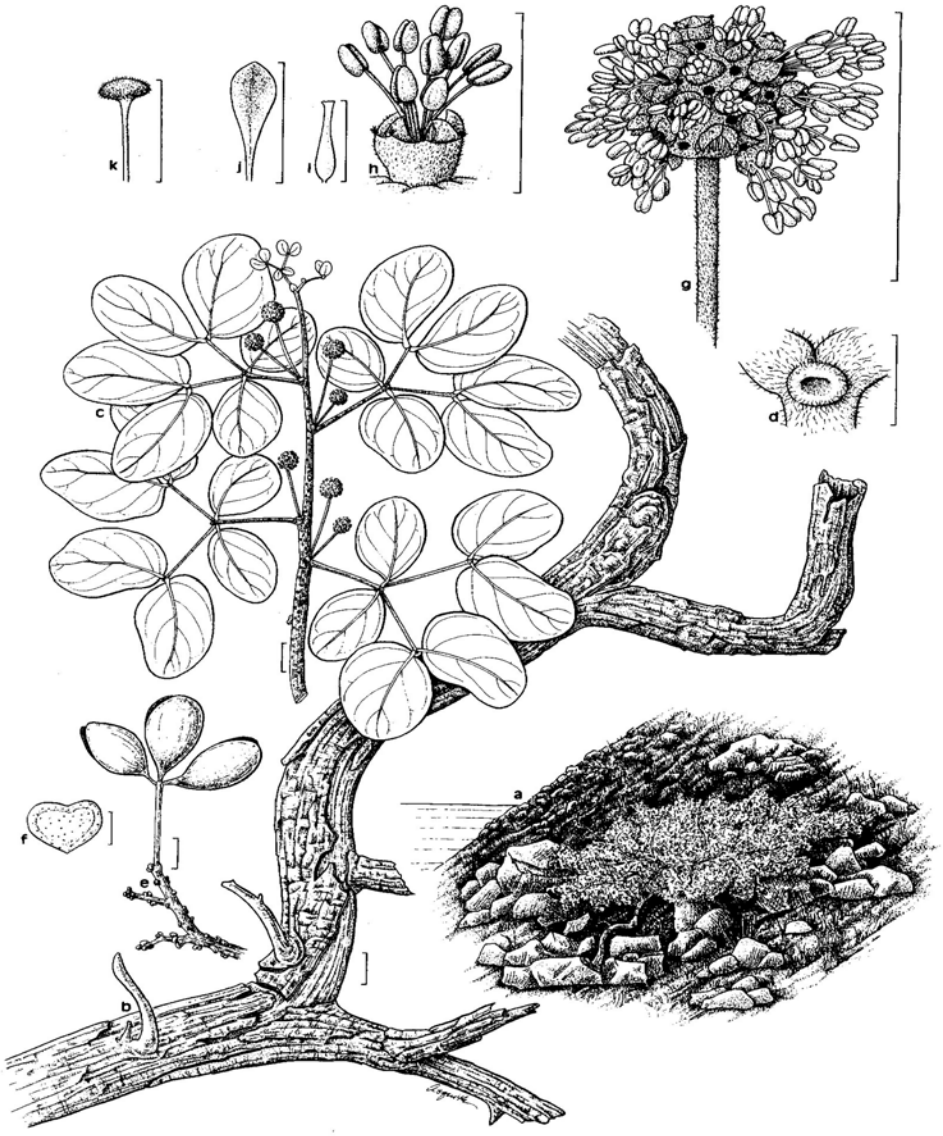
(**) - Personal communication received

APPENDIX B. Line Drawings

Illustration Acknowledgment

Drawing B-2 (*Kanaloa kahoolawensis*)

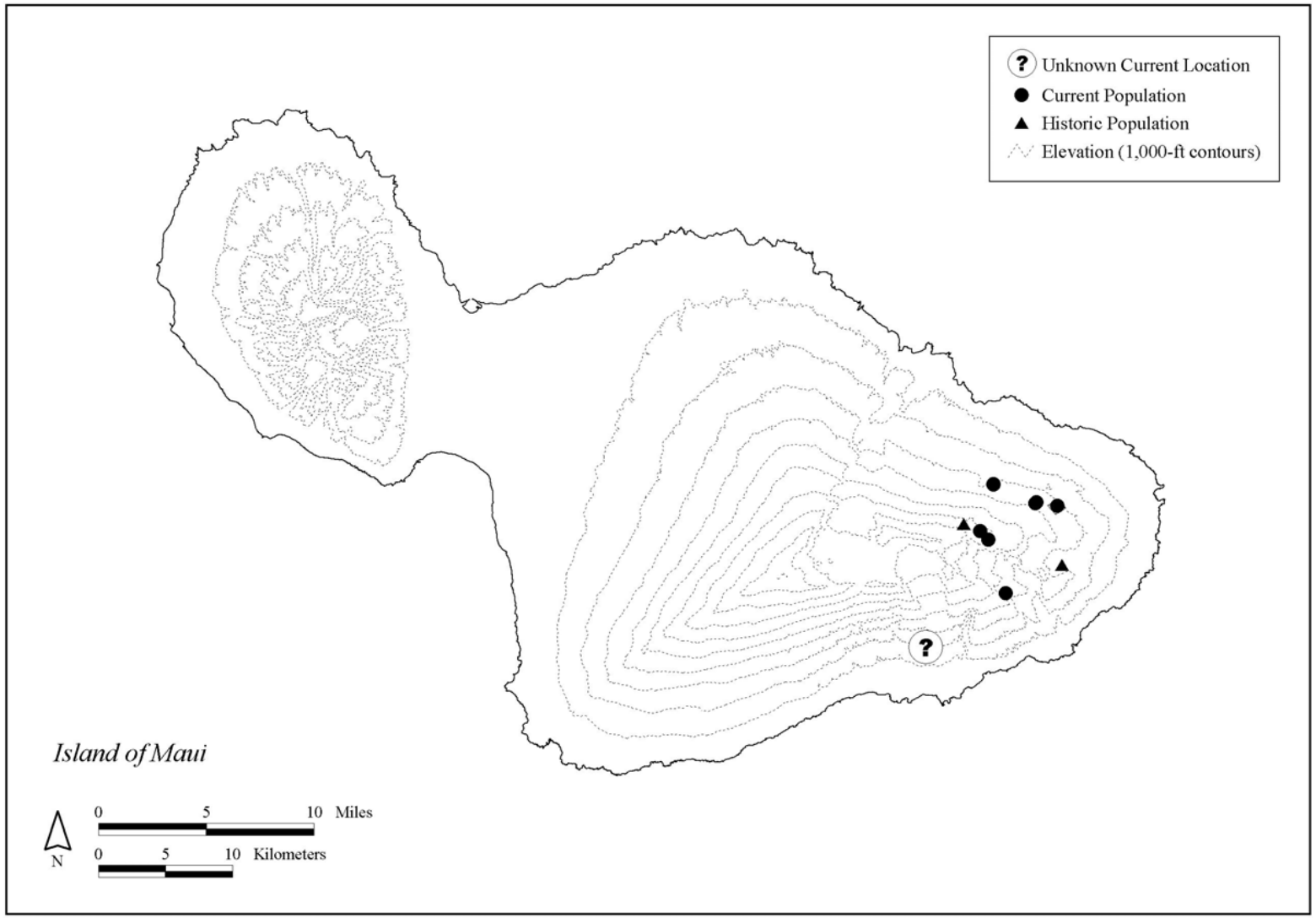
Lorence, D. H. and K. R. Wood, Novon 4:137-145. Drawing by Anna Stone.
Reproduced by permission of Novon.



Line Drawing of *Kanaloa kahoolawensis* from Lorence and Wood (1994).

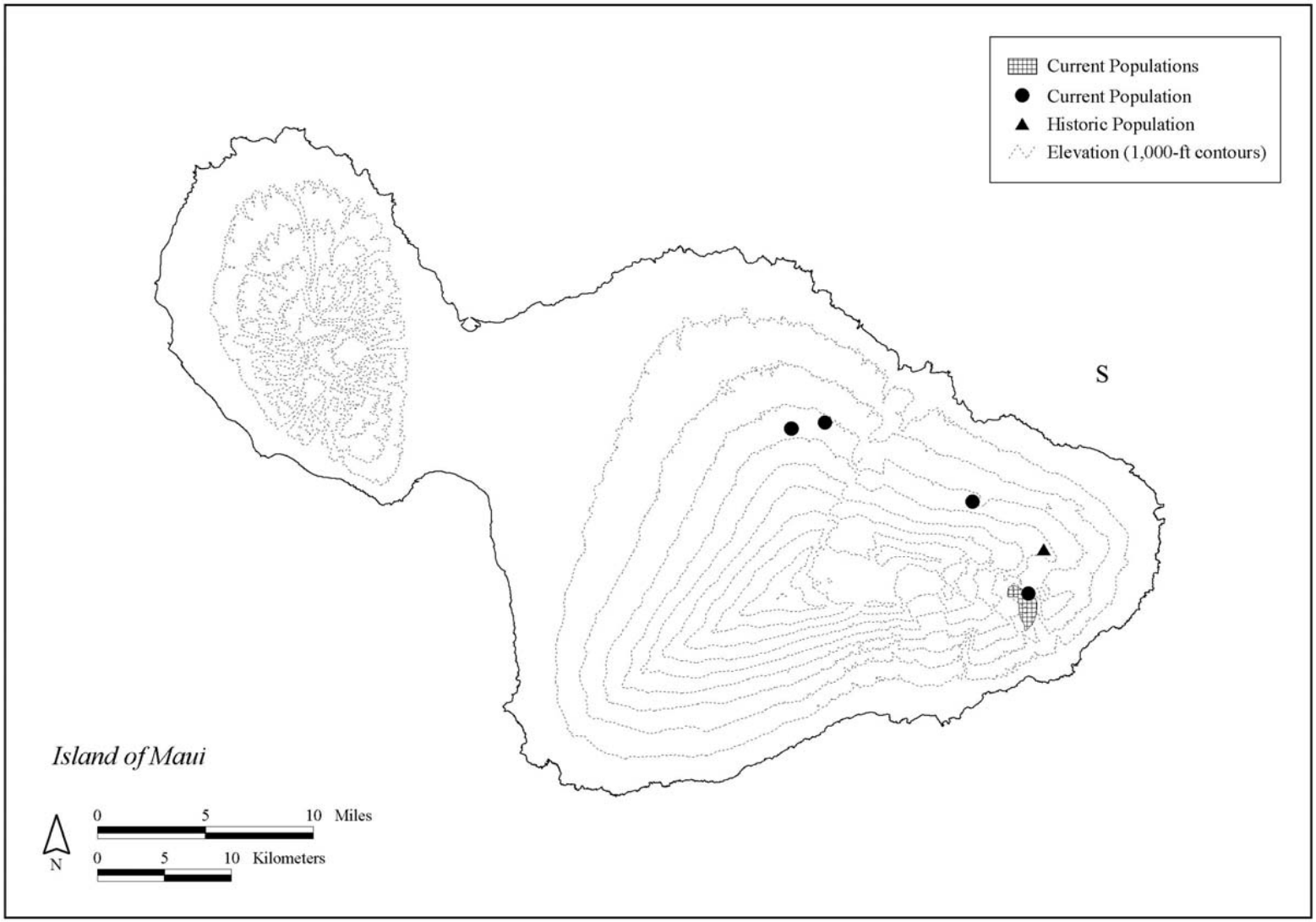
APPENDIX C. Historic and Current Distribution Maps

The following distribution maps are based on U.S. Fish and Wildlife Service geographical data on current and historic occurrences of the ten species addressed in this addendum. The number of occurrences shown on the distribution maps may not equal the number of extant populations, due to a poor understanding of the biological definition of a population and the fact that there may be more than one occurrence mapped for any given population. Populations described in this recovery plan addendum are defined as any individual plants within 1,000 meters distance of each other, based on current literature regarding gene flow and interactions between individual plants.



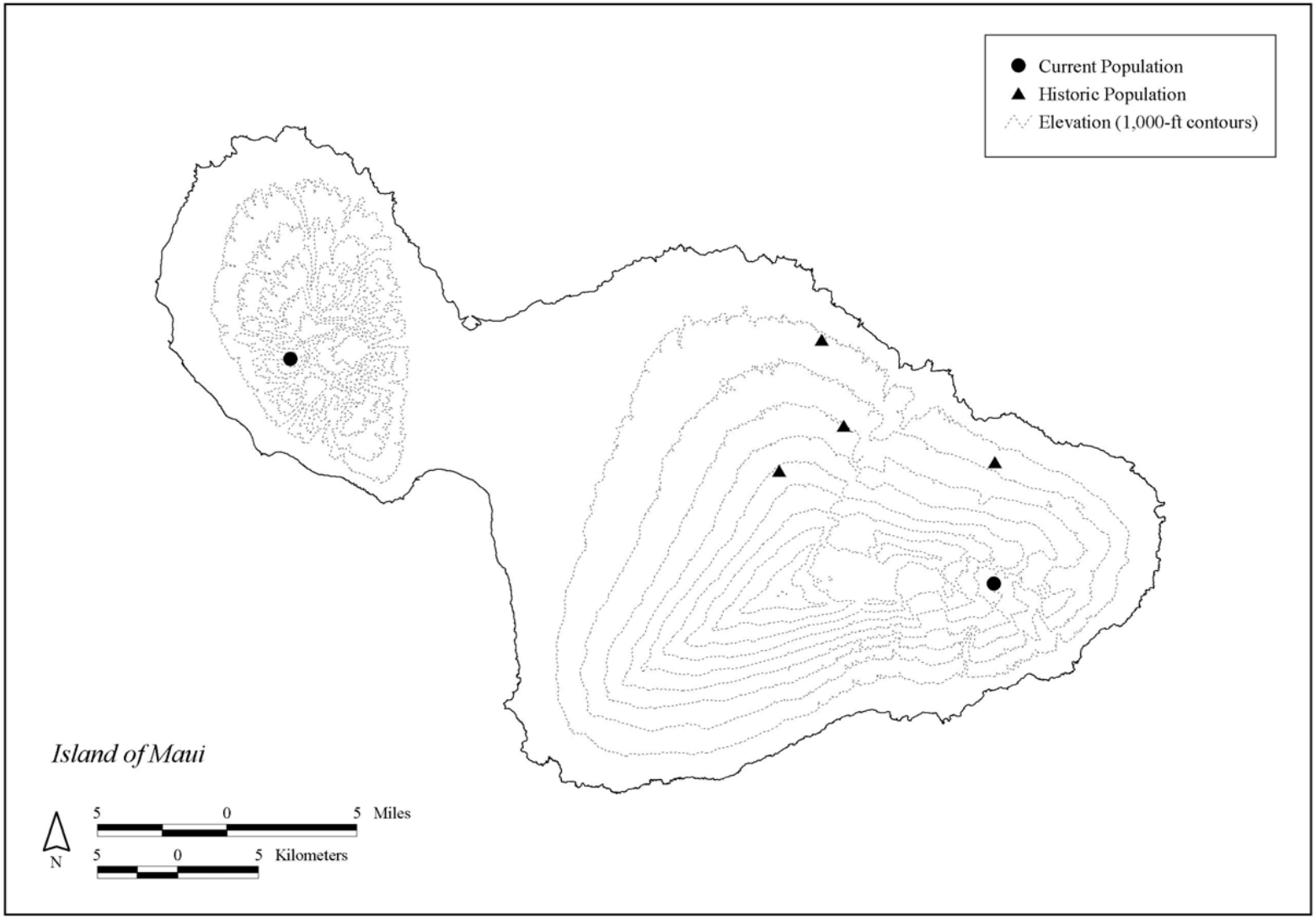
Distribution of *Clermontia samuelii*

Map No. 2002-018



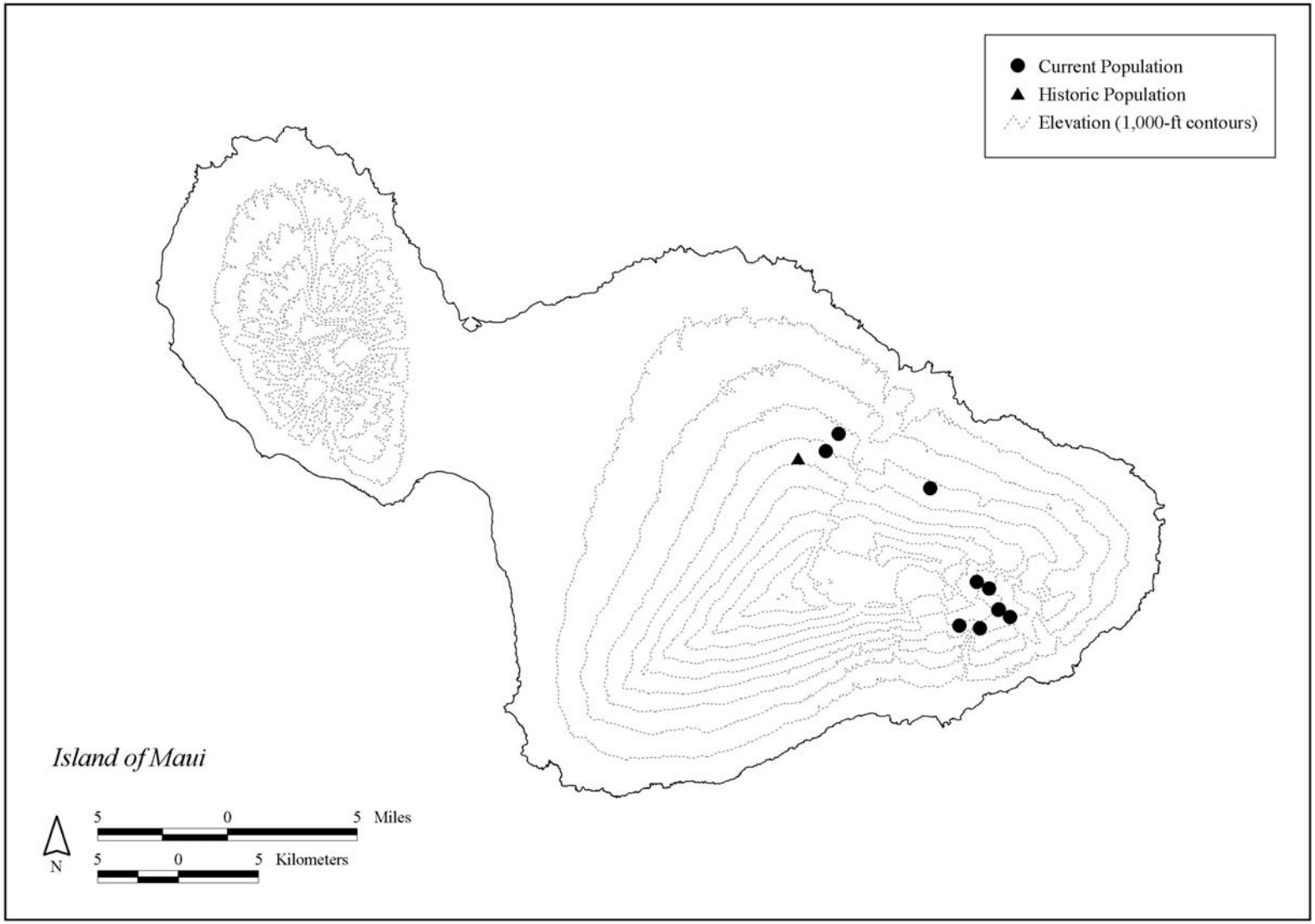
Distribution of *Cyanea copelandii* ssp. *haleakalaensis*

Map No. 2002-018



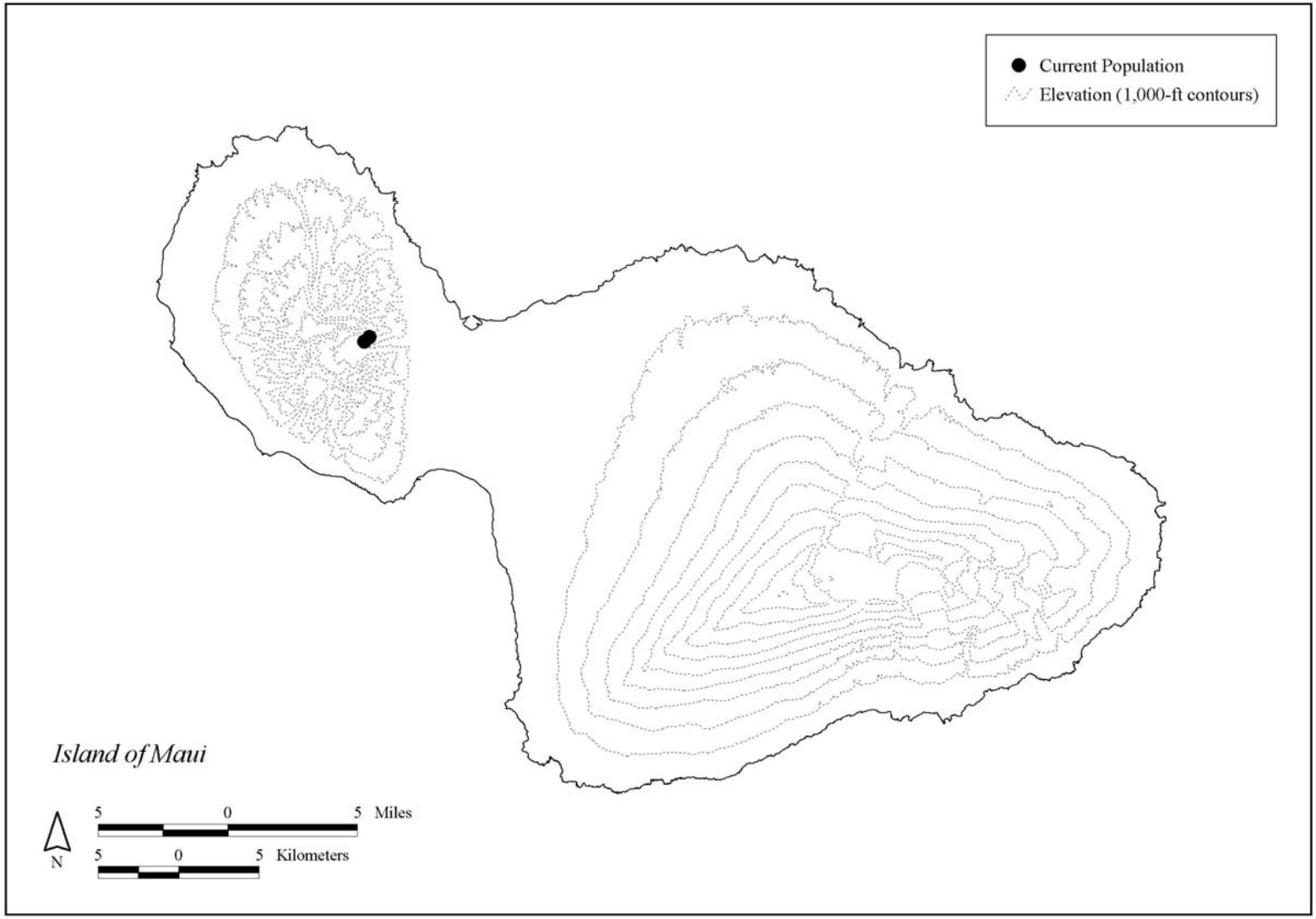
Distribution of *Cyanea glabra*

Map No. 2002-018



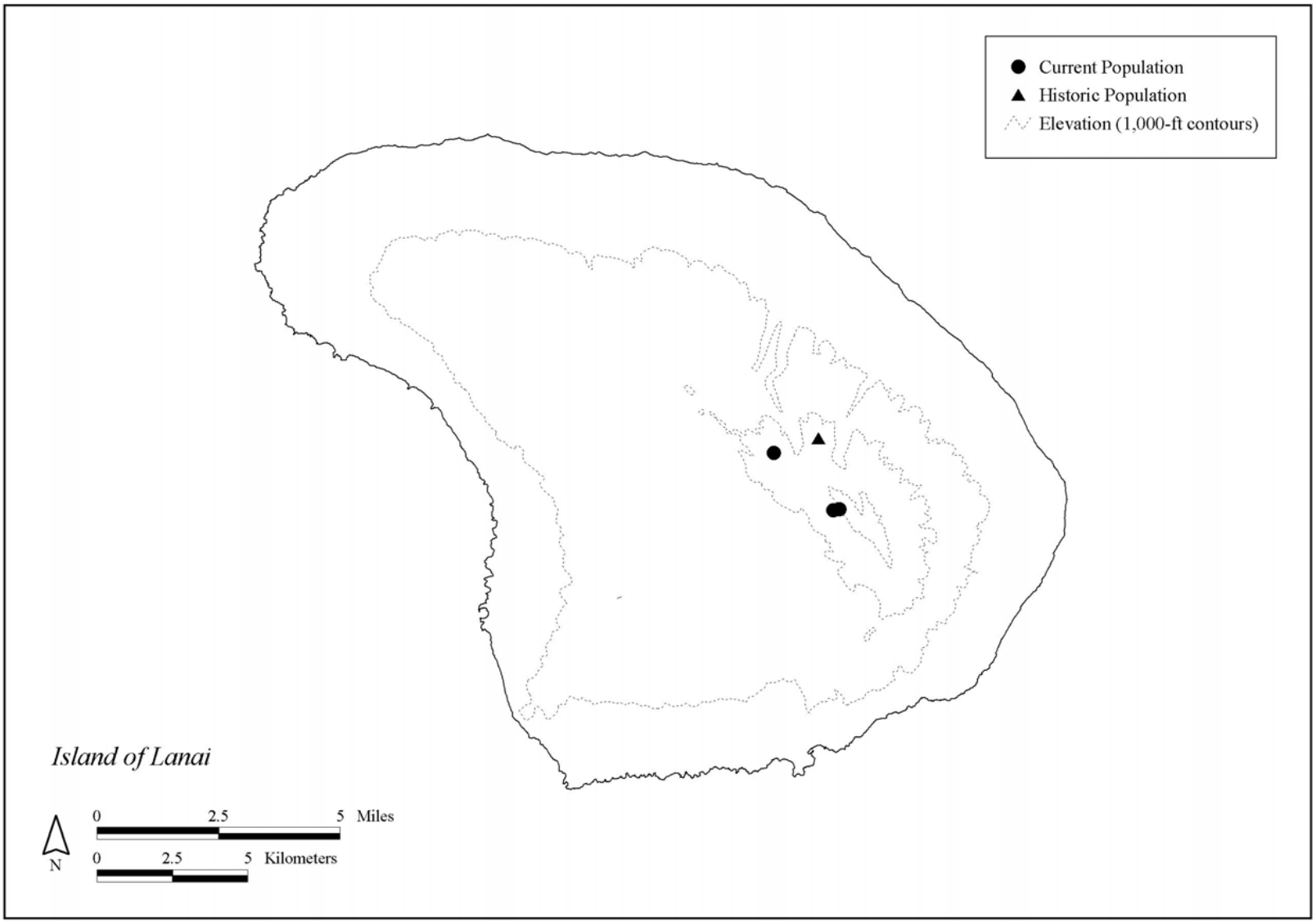
Distribution of *Cyanea hamatiflora* ssp. *hamatiflora*

Map No. 2002-018



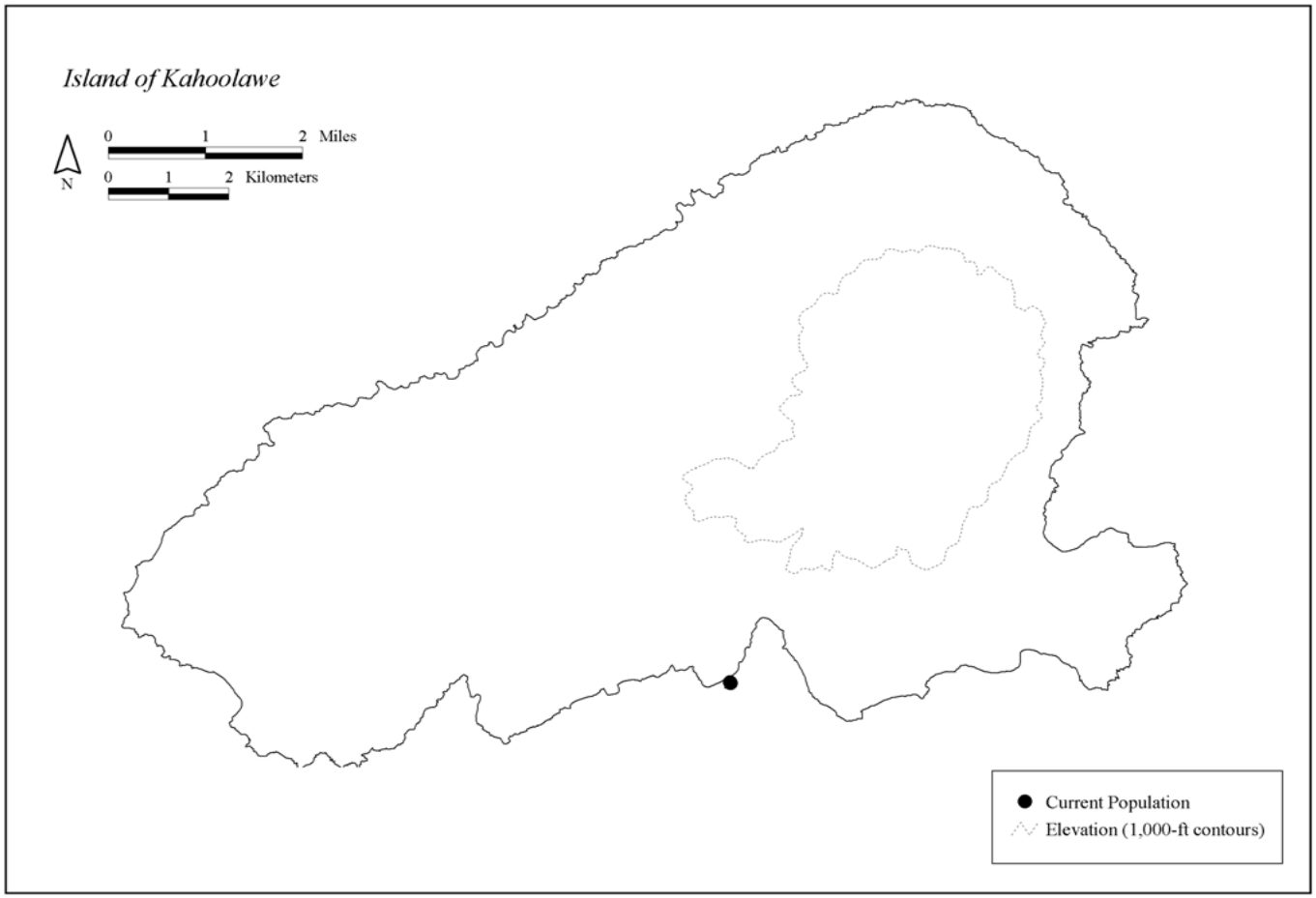
Distribution of *Dubautia plantaginea* ssp. *humilis*

Map No. 2002-018



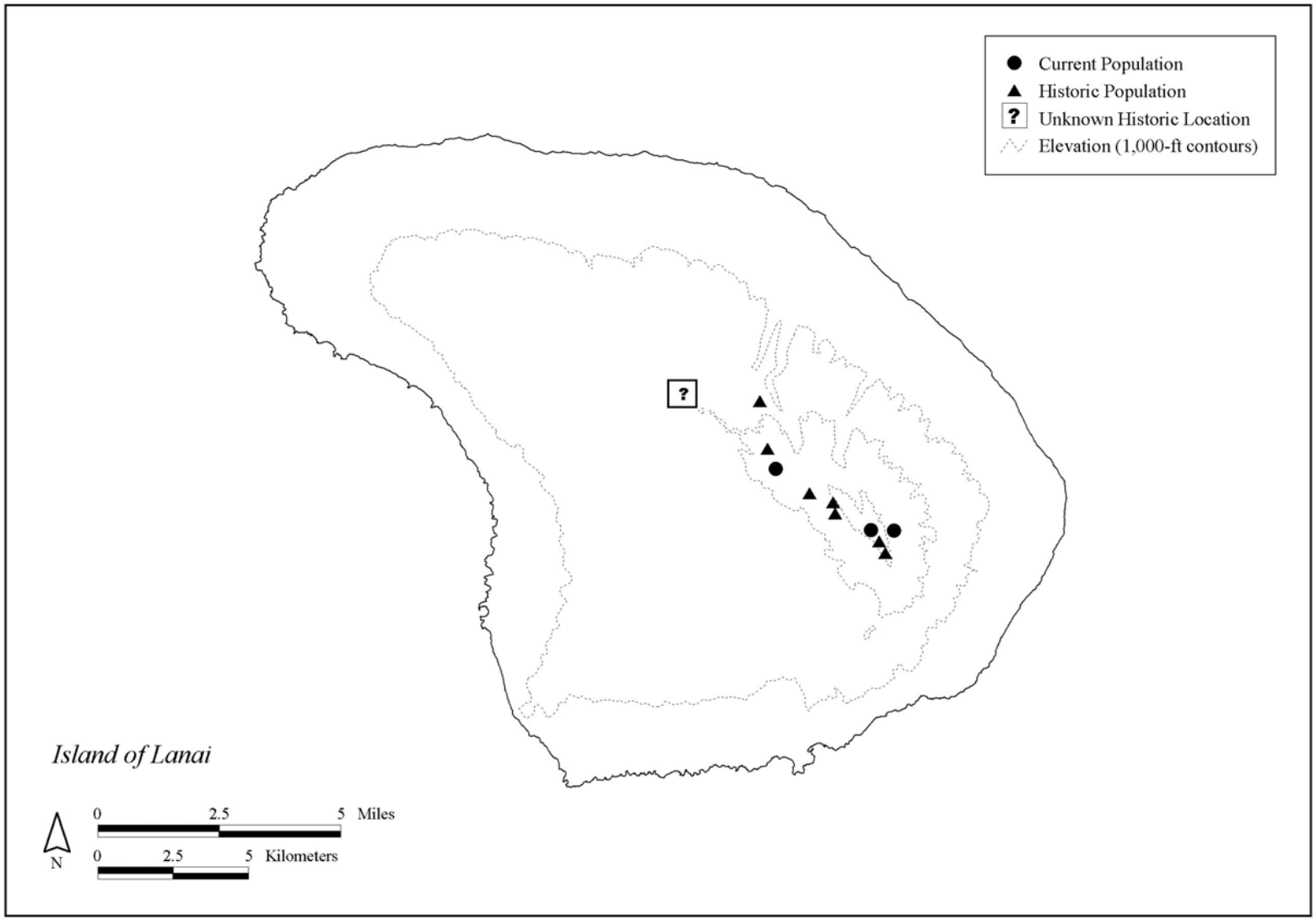
Distribution of *Hedyotis schlechtendahliana* var. *remyi*

Map No. 2002-018



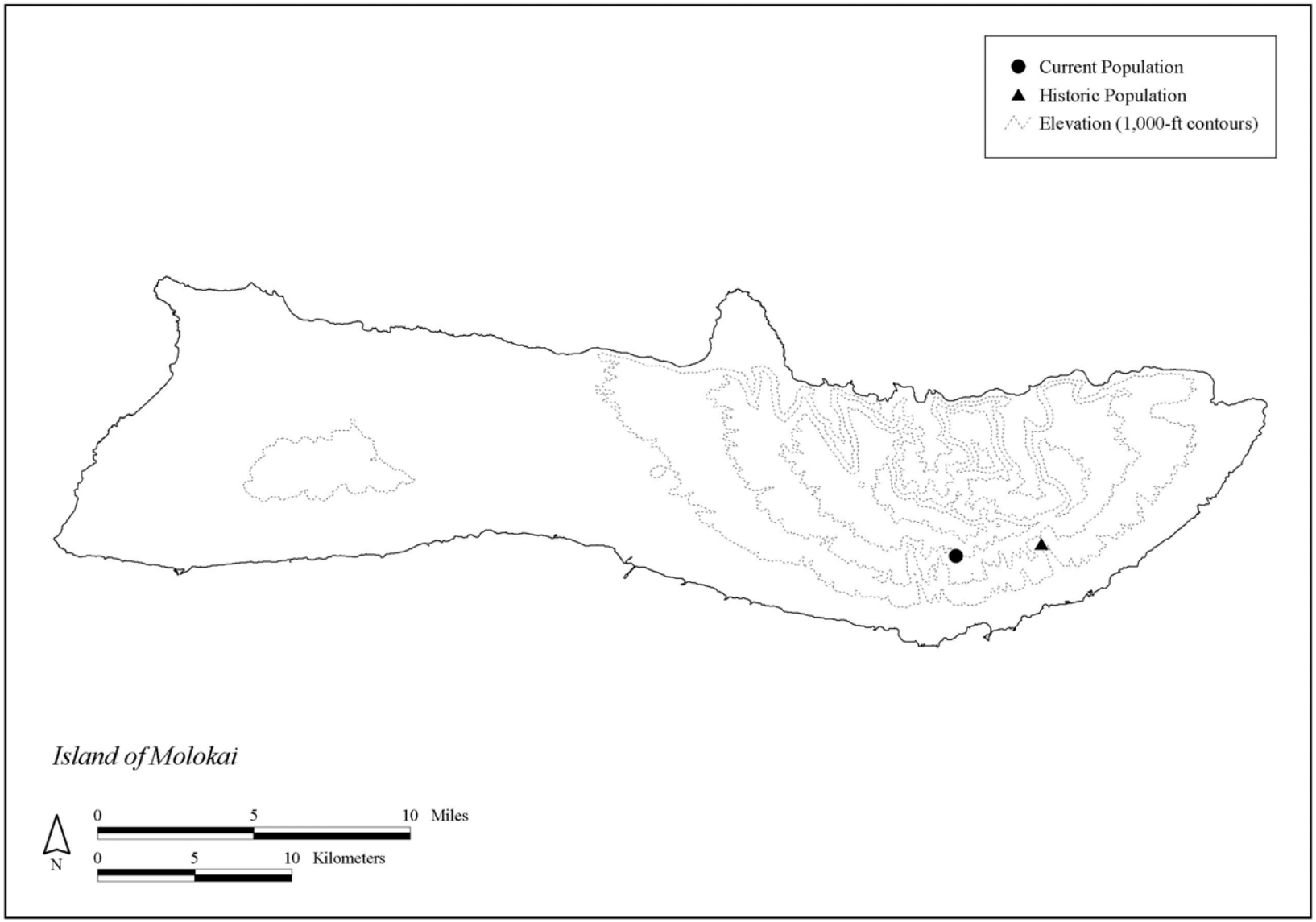
Distribution of *Kanaloa kahoolawensis*

Map No. 2002-018



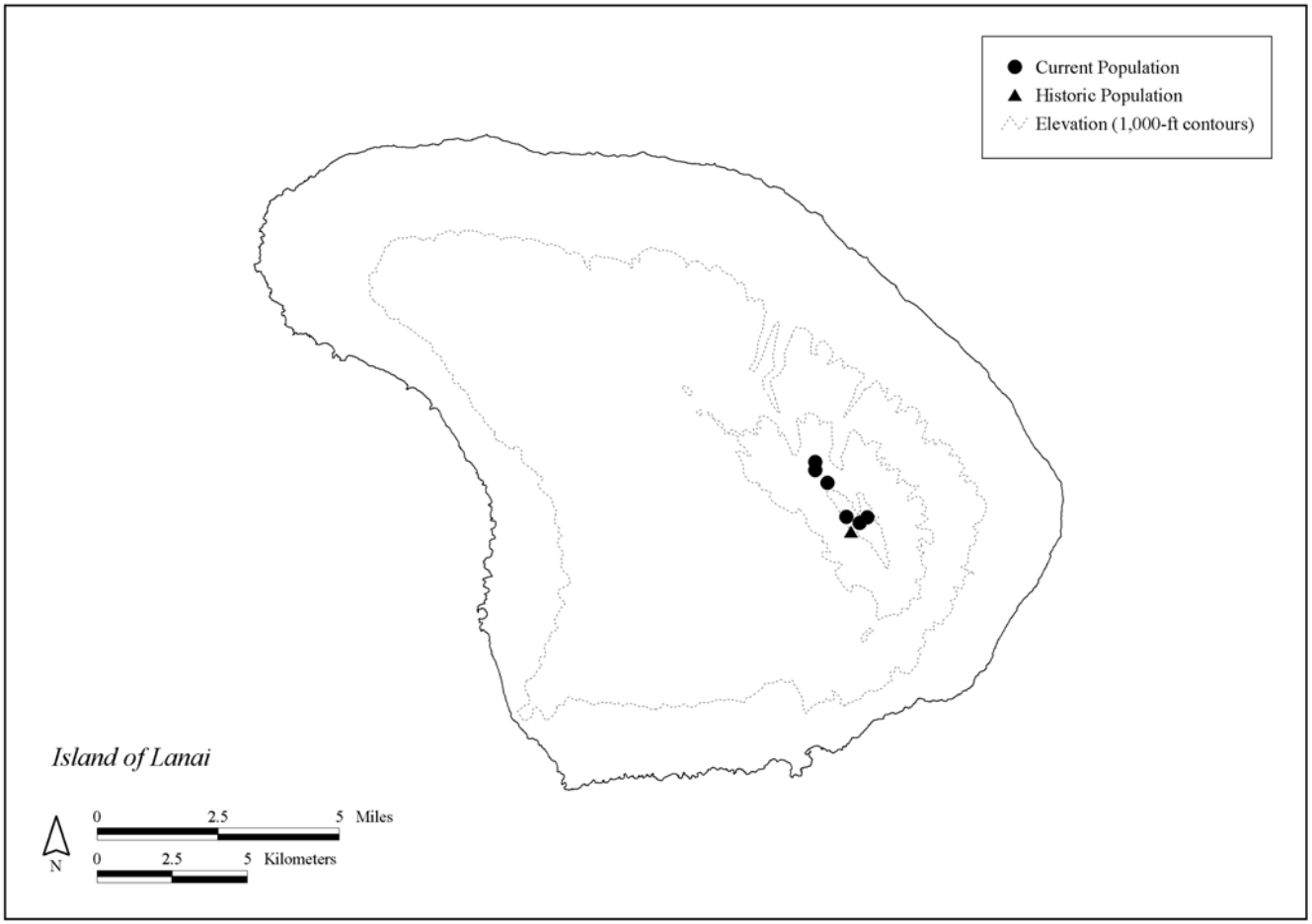
Distribution of *Labordia tinifolia* var. *lanaiensis*

Map No. 2002-018



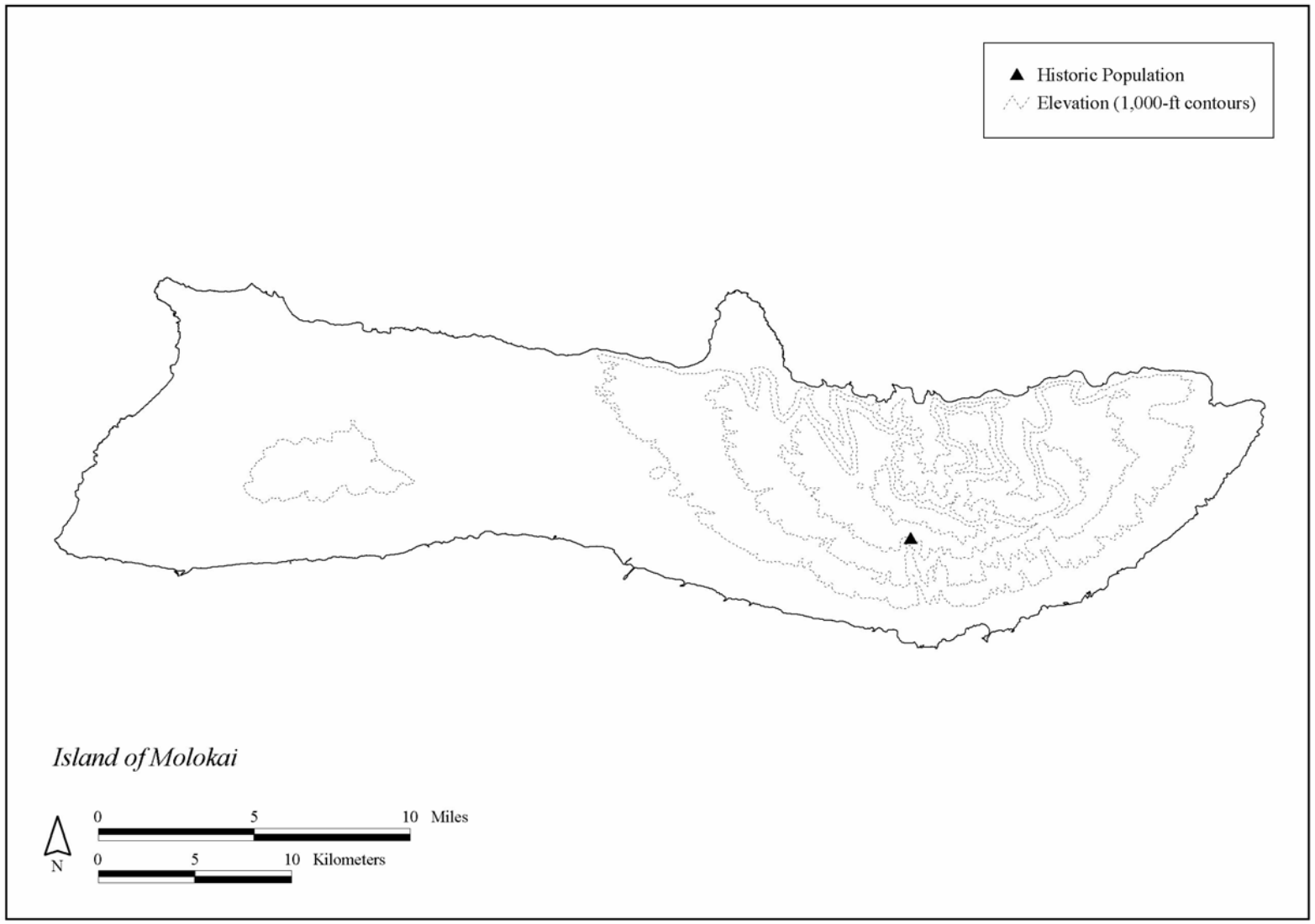
Distribution of *Labordia triflora*

Map No. 2002-018



Distribution of *Melicope munroi* (1 of 2)

Map No. 2002-018



Distribution of *Melicope munroi* (2 of 2)

Map No. 2002-018

APPENDIX D. Summary of Landownership/Management

National Park Service:

Clermontia samuelii, *Cyanea copelandii* ssp. *haleakalaensis*, *Cyanea hamatiflora* ssp. *hamatiflora*

State of Hawaii:

Clermontia samuelii, *Cyanea hamatiflora* ssp. *hamatiflora*, *Kanaloa kahoolawensis*

Private Landowners:

Cyanea copelandii ssp. *haleakalaensis*, *Cyanea glabra*, *Cyanea hamatiflora* ssp. *hamatiflora*, *Dubautia plantaginea* ssp. *humilis*, *Hedyotis schlechtendahliana* var. *remyi*, *Labordia tinifolia* var. *lanaiensis*, *Labordia triflora*, *Melicope munroi*

APPENDIX E. Recovery Priority System

The Recovery Priority System uses the criteria of degree of threat, recovery potential, and taxonomy (level of genetic distinctiveness). By applying these criteria, all listed species are assigned a species priority number of 1 through 18. A fourth factor, conflict, is a supplementary element in determining what actions are to be implemented for recovery of a species. In addition, the fourth factor gives priority, within each category, to those species that are or may be in conflict with construction or development projects. Thus, the species retains its numerical rank and acquires the letter designation of "C," indicating conflict (1C-18C).

A detailed discussion of the Recovery Priority System can be found in FR Vol. 48, No. 221, Pg. 51985 of the issue Tuesday, November 15, 1983.

Recovery Priority Table in Federal Register Vol. 48, No. 221, p. 51985 (Tuesday, November 15, 1983).

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic genus	1	1C
	High	Species	2	2C
	High	Subspecies	3	3C
	Low	Monotypic genus	4	4C
	Low	Species	5	5C
	Low	Subspecies	6	6C
Moderate	High	Monotypic genus	7	7C
	High	Species	8	8C
	High	Subspecies	9	9C
	Low	Monotypic genus	10	10C
	Low	Species	11	11C
	Low	Subspecies	12	12C
Low	High	Monotypic genus	13	13C
	High	Species	14	14C
	High	Subspecies	15	15C
	Low	Monotypic genus	16	16C
	Low	Species	17	17C
	Low	Subspecies	18	18C

APPENDIX F. Summary of Comments

We requested review of the Draft Addendum to the Recovery Plan for the Multi-Island Plants from three scientific peer reviewers, and sent copies of the Draft Addendum to various government agencies, libraries, and other interested parties during the public comment period (Appendix A). We received comments from the State of Hawaii Division of Forestry and Wildlife; State of Hawaii Department of Transportation; State of Hawaii Office of Hawaiian Affairs; U.S. Geological Survey, Biological Resources Division; U.S. Department of the Navy; and one private individual. Most of these comments provided additional information on threats to the 10 treated taxa, changes to cost estimates for tasks in the Implementation Schedule, and editorial changes. These comments have been incorporated into the text of this document. Additional comments are addressed below.

Comment: More guidance is needed regarding the term "wild." If endangered plants in an area are irrigated, fenced, or treated with an insecticide, could they be considered to be "in the wild?" It appears that the difference between a "wild" and "cultivated" environment may not always be precise and discernible.

Response: We define a reintroduced individual of a plant species as "wild" once it has become established within its native habitat. We agree that species are not fully recovered to the point of delisting until the threats no longer need to be intensively controlled. However, with the numerous threats affecting Hawaii's endangered plant species, we recognize a need for intensive management initially to allow the plants to survive and reproduce.

Comment: Five to 7 populations of an endangered species for downlisting and 8 to 10 populations for delisting may be excessive; the number of populations per island and the total number of multi-island populations should be limited and/or reduced.

Response: The downlisting and delisting guidelines we used were developed in 1998 by the Hawaii and Pacific Plants Recovery Coordinating Committee, a group of botanical experts who advise us on plant recovery needs. By adopting the recovery objectives enumerated in this addendum, the adverse effects of genetic inbreeding and random environmental events and catastrophes, such as landslides, hurricanes, or tsunamis, that could destroy a large percentage of the species at any one time, may be reduced. While these recovery objectives are expected to be further refined as more information on the population biology of each species becomes available, the justification for these objectives is found in the current conservation biology literature addressing the conservation of rare and endangered plants and animals. In general, the larger the number of populations and larger the size of each population, the lower the probability of extinction. This basic conservation principle of redundancy applies to Hawaiian plant species.

Comment: The recovery plan should in some way recognize cultivated populations of endangered plants in its evaluation for downlisting or delisting.

Response: The cultivation of endangered plants is a vital step in their recovery. We have identified collection and propagation of endangered plants as a priority to prevent short-term extinction and to provide plants for reintroduction and eventual recovery of the species. However, the presence of plants in cultivation in itself does not provide for the long-term recovery of the species within their native habitat.

Comment: There seems to be no basis whatsoever for the dollar figures in the Implementation Schedule for ensuring the availability of pollination vectors, since no one knows what the pollinators are.

Response: We agree that it is difficult to assign a dollar figure to ensuring the availability of pollination vectors, and have changed the implementation schedule

to reflect that these values need to be determined. The dollar figures for all of the implementation costs will be refined as additional information becomes available.

Comment: None of the taxa slated for recovery actions in this Addendum occur on lands owned by the Department of Defense, so it is inappropriate for Department of Defense's share of Implementation Schedule expenses to be raised to account for the additional taxa.

Response: Projected expenses for the Department of Defense remain the same as given in the Recovery Plan for the Multi-Island Plants (U.S. Fish and Wildlife Service 1999a). Additional costs for the 10 Multi-Island Addendum plants have been removed.