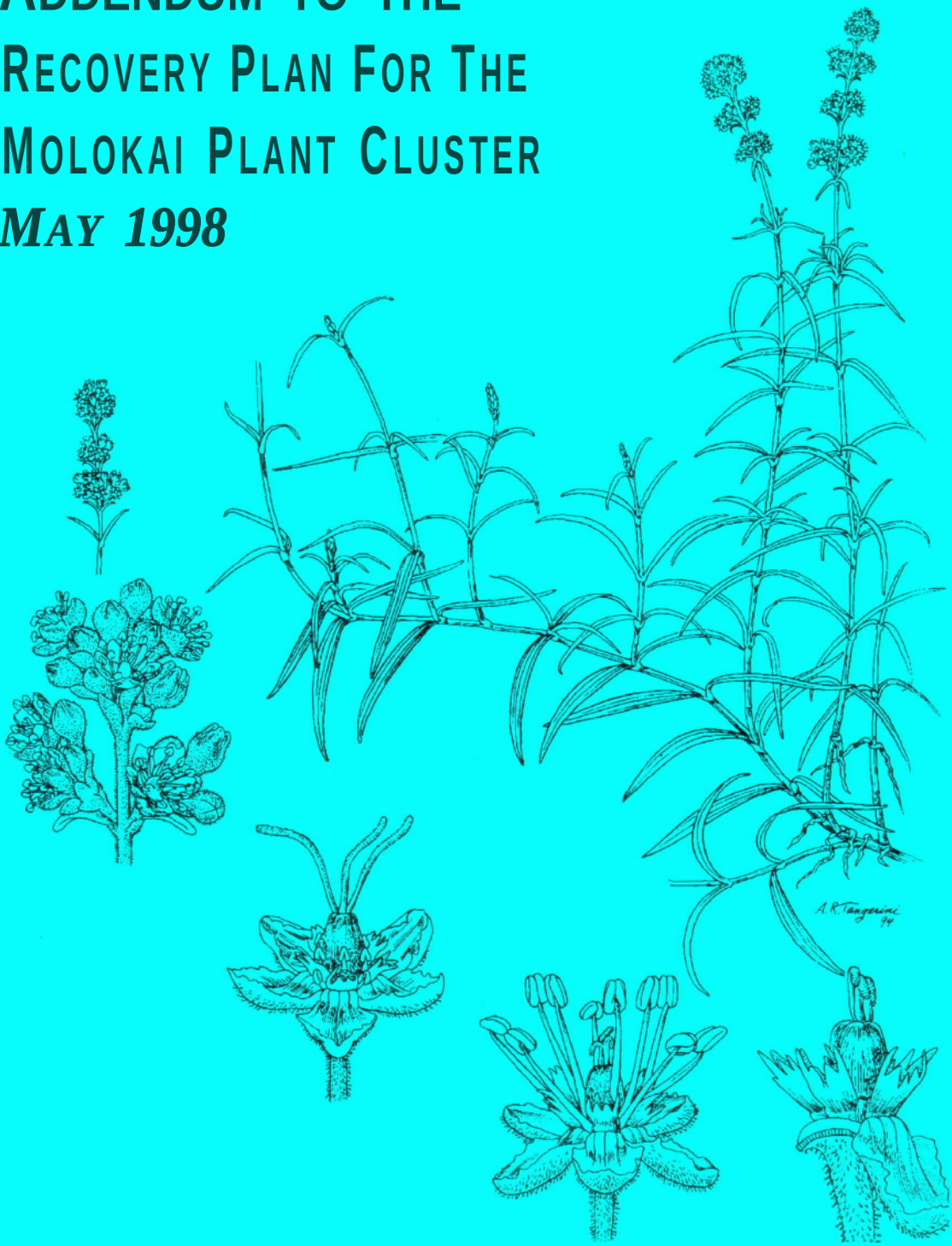
U.S. Fish & Wildlife Service

Molokai II: Addendum to the Recovery Plan For The Molokai Plant Cluster

May 1998



MOLOKAI II:
ADDENDUM TO THE RECOVERY PLAN FOR THE MOLOKAI PLANT CLUSTER

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DISCLAIMER PAGE

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EXECUTIVE SUMMARY

Current Species Status: This Addendum to the Recovery Plan for the Molokai Plant Cluster covers three plant taxa, which have been listed as endangered since publication of the original Recovery Plan for the Molokai Plant Cluster (USFWS 1996a). Numbers of known remaining individuals are as follows (number of populations; number of individuals): *Cyanea dunbarii* (haha) (1; 35-40), *Lysimachia maxima* (no common name) (1; 20-40), and *Schiedea sarmentosa* (no common name) (2; 330-1,000). All of these taxa are endemic to the island of Molokai.

Habitat Requirements and Limiting Factors: The three taxa included in this Addendum grow in a range of vegetation communities (dry shrubland to wet forests) and elevational zones (lowland to montane). These taxa and their habitats have been variously affected or are currently threatened by one or more of the following: habitat degradation by feral or domestic animals (goats, pigs, and axis deer); competition for space, light, water, and nutrients by introduced vegetation; erosion of substrate produced by human- or animal-caused disturbance; mortality and habitat loss from fires; and predation by animals (goats, axis deer, and rats). In addition, due to the small number of existing individuals and their very narrow distributions, these taxa and most of their populations are subject to an increased likelihood of extinction or reduced reproductive vigor from random naturally occurring events.

Recovery Objectives: Delist all taxa. Interim, downlisting, and delisting objectives are provided. Recovery of the Molokai II Plant Cluster taxa should be pursued via the establishment of management units in order to make the most efficient use of available resources in an effort to conserve not only these taxa, but their habitats as well.

Recovery Criteria:
Interim Objectives:
The interim objective is to stabilize all existing populations of these 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 Molokai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population for each of the 3 taxa.

Downlisting Criteria:
A total of five to seven populations of each taxon should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered.

Delisting Criteria:
A total of 8 to 10 populations of each taxon should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of 5 consecutive years.

Actions Needed:

1. Protect habitat and control threats.
2. Expand existing wild populations.
3. Conduct essential research.
4. Develop and implement detailed monitoring plans for all species.
5. Establish new populations as needed to reach recovery objectives.
6. Validate and revise recovery criteria.

Total Estimated Cost of Recovery ($1,000's) For the Molokai and Molokai II Plant Clusters *

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1997	1071	0	224	35	0	0	1330
1998	1422	0	268	42	0	0	1732
1999	1422	0	268	42	0	0	1732
2000	1412	6	268	42	0	0	1728
2001	1400	6	268	42	0	0	1716
2002	1293	0	14	42	18	18	1385
2003	1293	0	14	42	18	18	1385
2004	1293	0	14	42	0	18	1367
2005	1293	0	14	42	0	18	1367
2006	1293	0	14	42	0	0	1349
2007	1293	0	14	42	0	0	1349
2008	1233	0	14	42	0	0	1289
2009	1233	0	14	42	0	0	1289
2010	1233	0	14	42	0	0	1289
2011	1233	0	14	42	0	0	1289
2012	1233	0	14	42	0	0	1289
2013	1233	0	14	42	0	0	1289
2014	1233	0	14	42	0	0	1289
2015	1233	0	14	42	0	0	1289
2016	1233	0	14	42	0	0	1289
2017	1233	0	14	42	0	0	1289
Total	26,815	12	1,520	875	36	72	29,330

*Recovery cost for the taxa in this Addendum are based on a ratio of 3/16 from the original estimates of the Recovery Plan for the Molokai Plant Cluster. Original cost estimates were provided by cooperators currently implementing similar actions. Some costs are yet to be determined.

Date of Recovery: To be determined once more is known about the biology and population dynamics of the Molokai II Plant Cluster.

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INTRODUCTION

1. Brief Overview

This document is meant to supplement the original Recovery Plan for the Molokai Plant Cluster (Recovery Plan) (USFWS 1996a), which dealt with 16 plant taxa. Because the three additional listed taxa covered in this Addendum occur in similar habitats as the taxa covered in the 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 that Recovery Plan.

This Addendum covers three plant taxa that were added to the Federal list of endangered and threatened species in October 1996 (61 FR 53130-53137) (USFWS 1996b). *Cyanea dunbarii* (haha), *Lysimachia maxima*, and *Schiedea sarmentosa* were all listed as endangered. All are endemic to the island of Molokai, and all are known only from East Molokai. The plants and their habitat have been variously affected and are threatened by one or more of the following: habitat degradation and predation by feral or domestic animals (axis deer, goats, and pigs); competition for space, light, water, and nutrients by naturalized, alien vegetation; mortality and habitat loss from fires; and predation by rats. Because of the low numbers of individuals and their severely restricted distributions, populations of these taxa are subject to an increased likelihood of extinction from random naturally occurring events.

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.

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 (Armstrong 1983). 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 mainland environments (Carlquist 1965, 1974).

The objective of this Addendum is to provide a framework for the recovery of these three taxa so that their protection by the Endangered Species Act (ESA) 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. Recovery of these taxa should be pursued via the establishment of management units in order to make the most efficient use of available resources in an effort to conserve not only these taxa but their habitats as well.

Immediate actions necessary for the prevention of extinction of these taxa include controlling or excluding ungulates (where possible); alien plant control; protection from fire; population and plant community monitoring and management; *ex situ* propagation (such as in a nursery or arboretum); and augmentation of populations, as appropriate. Long-term activities necessary for the perpetuation of these taxa in their natural habitats additionally include baseline and long-term research; public education; maintenance of fenced areas, fire breaks and fuel breaks; long-term monitoring and management of populations and communities; and re-establishment of populations within the historic ranges of some taxa. Further research regarding current range, reproduction and reproductive status, pollinators, life history, limiting factors, habitat requirements, and minimum viable population sizes is needed to facilitate appropriate management decisions regarding the long-term perpetuation of each of these taxa.

Appendix I contains a line drawing of *Schiedea sarmentosa*. Appendix J contains illustrations of historic and current distributions, and Appendix K provides a summary of land ownership or management for these taxa.

2. General Description of Habitat

See Figure 1 of this Addendum and the description of the island of Molokai on page three of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a).

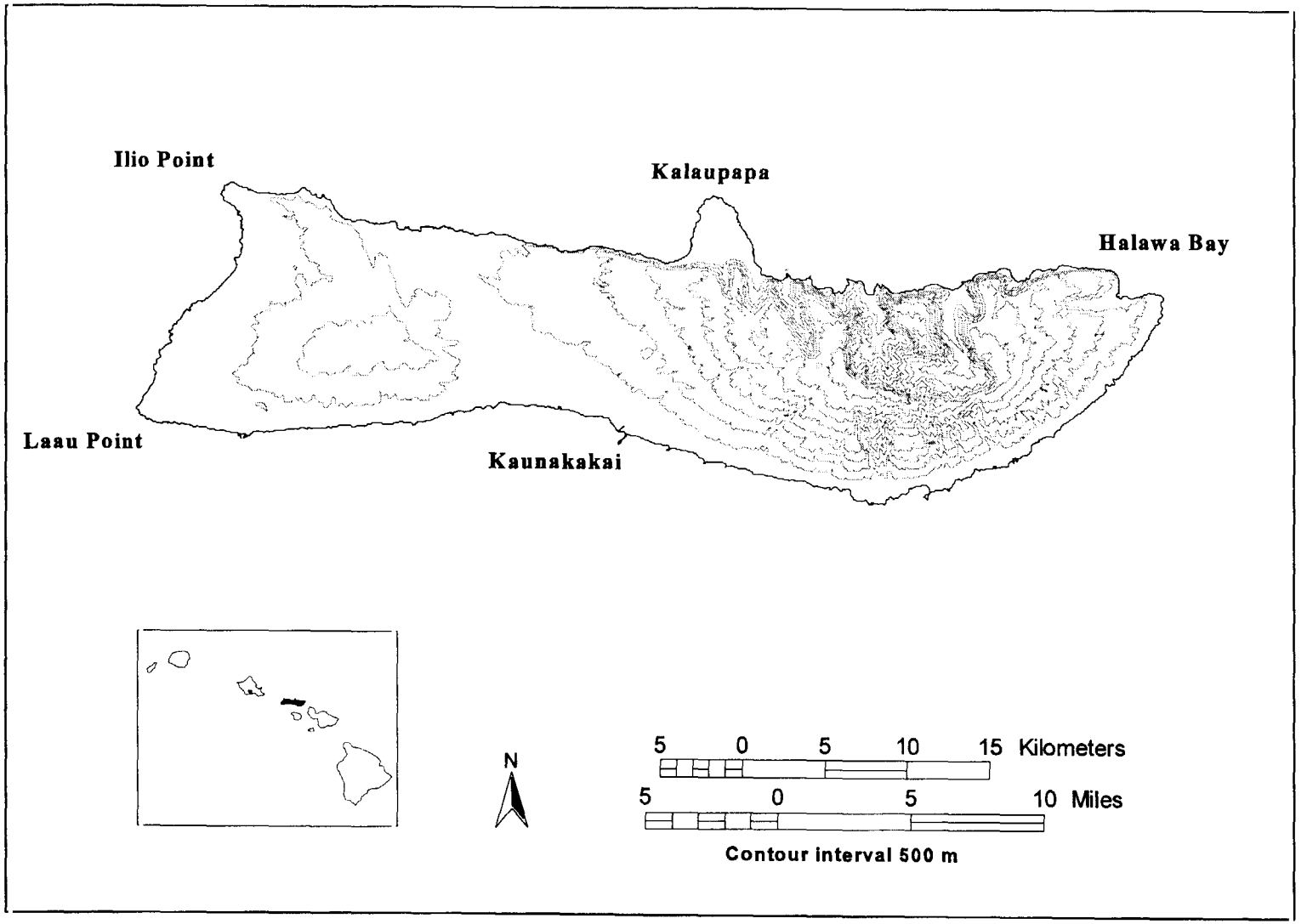

Figure 1. Map of the island of Molokai

Table 1 summarizes the habitat types and associated plant species of the Molokai II Plant Cluster taxa. *Cyanea dunbarii* and *Lysimachia maxima* are found on the ridges and slopes of wet gulches in Montane Wet Forest on East Molokai. *Schiedea sarmentosa* is found in Lowland Dry and Mesic Shrublands on the leeward side of East Molokai.

With the advent of cattle ranching and later pineapple cultivation, most of Molokai, particularly West Molokai and East Molokai's southern section, was converted to pasture land. The only remaining large tracts of native vegetation are found within the Molokai Forest Reserve on the upper elevation portions of East Molokai; the plant taxa in this Addendum are restricted to this forest reserve.

The land that supports the Molokai II Plant Cluster taxa is owned by the State of Hawaii and private entities. The State agency is the Department of Land and Natural Resources (DLNR). Private owners are The Nature Conservancy of Hawaii (TNCH) and a private owner. Land stewardship of current populations of the Molokai II Plant Cluster taxa can be found in Table 2.

Table 1. Summary of Molokai II Plant Cluster taxa habitat types and associated species.

Habitat Type	Molokai II Plant Cluster Taxa	Associated Native Species	Associated Alien Species
Lowland Dry Shrubland and Lowland Mesic Shrubland elevation: 15-850 meters (50-3,200 feet) rainfall: Dry Shrubland less than 170 centimeters (67 inches) per year Mesic Shrubland 120-200 centimeters (48-100 inches) per year	*Schiedea sarmentosa*	*Alyxia oliviformis* (maile) *Bidens menziezii* (kokoolau) *Carex meyenii* *Chamaesyce* sp. (akoko) *Chenopodium oahuense* (aheahea) *Dodonaea viscosa* (aalii) *Lipochaeta rockii* (nehe) *Metrosideros polymorpha* (ohia) *Nestegis sandwicensis* (olopua) *Nothocestrum latifolium* (aiea) *Nototrichium sandwicense* (kului) *Pleomele* sp. (hala pepe) *Sida fallax* (ilima) *Sophora chrysophylla* (mamane) *Styphelia tameiameiae* (pukiawe)	*Melinis minutiflora* (molasses grass) *Ricinus communis* (castor bean)

Table 1. Continued.

Habitat Type	Molokai II Plant Cluster Taxa	Associated Native Species	Associated Alien Species
Montane Wet Forest elevation: 500-2,700 meters (1,600-8,800 feet) rainfall: more than 250 centimeters (100 inches) per year	*Cyanea dunbarii* *Lysimachia maxima*	*Antidesma* sp. (hame) *Broussaisia arguta* (kanawao) *Cheirodendron trigynum* (olapa) *Clermontia kakeana* (oha) *Coprosma ochracea* (pilo) *Cyrtandra* sp. (haiwale) *Dicranopteris linearis* (uluhe) *Dubautia* sp. (naenae) *Freycinetia arborea* (ieie) *Hedyotis hillebrandii* (manono) *Ilex anomala* (kawau) *Labordia* sp. *Machaerina* sp. (uki) *Metrosideros polymorpha* (ohia) *Perrottetia sandwicensis* (olomea) *Pipturus albidus* (mamaki) *Psychotria* sp. (kopiko) *Sadleria* sp. (amau) *Scaevola* sp. (naupaka) *Styphelia* sp. (pukiawe) *Touchardia latifolia* (olana) *Urera glabra* *Vaccinium* sp. (ohelo)	*Commelina diffusa* (honohono) *Hedychium* sp. (ginger) *Kalanchoe pinnata* (air plant) *Musa* sp. (banana) *Rubus rosifolius* (thimbleberry)

Table 2. Land stewards of current populations of the Molokai II Plant Cluster taxa.				
Taxon	Total Populations and (Individuals)	Populations by Land Steward		
		Federal	State	Private
Cyanea dunbarii	1 (35-40)		1	
Lysimachia maxima	1 (20-40)			1
Schiedea sarmentosa	2 (330-1000)			2

3. Overall Reasons for Decline and Current Threats

A general discussion of threats to the native communities upon which the Molokai II Plant Cluster taxa depend is located in section 3 of the Recovery Plan for the Molokai Plant Cluster (1996a), beginning on page 15. Threats specific to each taxon are detailed in the species accounts and summarized in Table 3 of this Addendum.

Table 3. Summary of threats to Molokai II Plant Cluster taxa.

Species	Alien Species	Fire	Natural Disasters
Cyanea dunbarii	Pl, S, (R, D, P)		X
Lysimachia maxima	(P, G)		X
Schiedea sarmentosa	G, P, Pl	X	X

Key: D - deer, G - goats, S - sheep, P - pigs, R - rats, Pl - plants, S - Slugs, ( ) - potential threat.

4. Overall Conservation Efforts

Federal and State

The taxa covered by this Addendum were added to the Federal list of endangered and threatened species on October 10, 1996 (USFWS 1996b). All three taxa are listed as endangered.

The Federal listing of the taxa in the Molokai II Plant Cluster as endangered has afforded each the protection of the Endangered Species Act (ESA). When a species is listed as endangered or threatened under this law, it is automatically added to the State of Hawaii's list of protected species (Hawaii Revised Statutes Chapter [HRS] 195D). Hawaii State law prohibits taking of endangered flora 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" [HRS 195D].) The Endangered Species Act offers additional Federal protection to these taxa since it is a violation of the 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].

Critical habitat was not designated for any of the taxa in the Molokai II Plant Cluster. Designation was not deemed prudent because of the possible increased threat to the plants by vandalism, researchers, curiosity seekers, or collectors of rare plants due to the mandated publication of precise maps and descriptions of critical habitat in local newspapers (USFWS 1992).

The State reduced the numbers of feral pigs, goats and deer by using aerial hunting in the Molokai Forest Reserve. Recently, the State, in coordination with The Nature Conservancy of Hawaii and local residents, helped to organize the Molokai Hunters' Working Group with the intent to control feral ungulates through cooperative hunting efforts (R. Hobdy, State Division of Forestry and Wildlife (DOFAW), personal communication 1995).

Private

The Nature Conservancy of Hawaii operates three preserves on the island of Molokai. The single population of *Lysimachia maxima* is located in the Pelekunu Preserve. One of the two surviving populations of *Schiedea sarmentosa* is located on the boundary of the Kamakou Preserve. In the past (1991-1992),The Nature Conservancy of Hawaii has employed snaring to control feral ungulates in remote sections of Kamakou and Pelekunu, and it is currently working with the State and local hunters to control feral ungulates through cooperative hunting efforts.

Plant cuttings of *Cyanea dunbarii* and *Lysimachia maxima* have been collected and are currently propagated at Lyon Arboretum, Honolulu, Hawaii, and at the National Tropical Botanical Garden (NTBG), Kauai, Hawaii. Plans for these holdings include research into propagation methods, feasibility of long-term seed storage, and eventual outplanting (Table 4). Seeds from *Schiedea sarmentosa,* held at National Tropical Botanical Garden, were recently planted but failed to germinate.

Table 4. Seeds, cultures and plants of the Molokai II Plant Cluster in storage or propagation at botanical gardens. NTBG = National Tropical Botanical Gardens. LA = Lyon Arboretum.

Taxon	Number of stored seeds		Tissue accessions (number of cultures)		Tissue accessions (Plants in nursery)	
	NTBG	LA	NTBG	LA	NTBG	LA
Cyanea dunbarii				3 (10)	1 (2)	
Lysimachia maxima				2 (40)		1 (10)
Schiedea sarmentosa	*					

* - none of these seeds were viable (Kerin Rosenburger personal communication 1998)

5. Species Accounts

The following are individual species accounts for the three taxa of the Molokai II Plant Cluster. Species-specific recovery actions can be found in the account for that species.

Cyanea dunbarii Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix E of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a)

Description and Taxonomy

No line drawing is available for this taxon.

Cyanea dunbarii was first described by Joseph F. Rock, who named it in honor of the collector, L.M. Dunbar (Rock 1919). Harold St. John (1987a, St. John and Takeuchi 1987) merged *Cyanea* with *Delissea*, the genus with priority. Lammers (1990) retained both genera in the currently accepted treatment of the family.

Cyanea dunbarii, a member of the bellflower family (Campanulaceae), is a branched shrub 1.5 to 2 meters (4.9 to 6.6 feet) tall. The oval to broadly elliptic leaves are 10 to 22 centimeters (3.9 to 8.7 inches) long and 6 to 14 centimeters (2.4 to 5.5 inches) wide, with irregularly lobed or cleft margins. The flowers are arranged in groups of six to eight on a stalk, which is 3 to 7 centimeters (1.2 to 2.8 inches) long. The corolla is white, tinged or striped with pale lilac and 30 to 38 millimeters (1.2 to 1.5 inches) long. The corolla is slightly curved, with spreading lobes three-fourths as long as the tube. This species is distinguished from others in this endemic Hawaiian genus by the lack of prickles on the stems and the irregularly lobed and cleft leaf margins (Lammers 1990).

Life History

Cyanea dunbarii was observed in flower, with immature fruit, in September (Hawaii Heritage Program (HHP) 1993b). No additional life history information is currently available.

Habitat Description

Cyanea dunbarii is found in mesic to wet *Dicranopteris linearis* (uluhe)-*Metrosideros polymorpha* (ohia) forest on moderate to steep slopes along a stream (HHP 1993a3; USFWS 1996a). Associated species include *Perrottetia sandwicensis* (olomea), *Pipturus albidus* (mamaki), *Clermontia kakeana* (haha), *Cheirodendron trigynum* (olapa), and *Freycinetia arborea* (ieie) (USFWS 1996a). This species typically grows on the sides of deep gulches in ohia-dominated mesic

to wet forests at elevations of about 600 to 1,220 meters (1,980 to 4,000 feet) (USFWS 1992). See Table 1 for a summary of plant taxa associated with this species.

Current and Historic Ranges and Population Status (Appendix J-1)

Cyanea dunbarii was collected in 1918 at Waihanau and Waialeia valleys, and was not observed again until 1992, when Joel Lau of the Hawaii Heritage Program, Guy Hughes, and J. Lyman Perry of the Nature Conservancy of Hawaii found it in Mokomoko Gulch (HHP 1993a1 to 1993a3, Hughes 1995, Rock 1919, Wimmer 1943). Approximately 35 to 40 mature plants exist in this population, 15 to 20 individuals occur in Mokomoko stream bed and an additional 20 plants occur in the next small gulch to the north, on State-owned land within Molokai Forest Reserve, at an elevation of 685 meters (2,250 feet) (HHP 1993a3; USFWS 1996a, Ken Wood, NTBG, personal communication, 1998).

Reasons for Decline and Current Threats

The major threats to *Cyanea dunbarii* are competition with the alien plants *Rubus rosifolius* (thimbleberry), *Commelina diffusa* (honohono), *Hedychium* sp. (ginger), and *Kalanchoe pinnata* (air plant); and a risk of extinction from naturally occurring events (such as landslides or flooding) and from reduced reproductive vigor due to the small number of individuals in the only known population (HHP 1993a3; USFWS 1996a). Rats (*Rattus* spp.) are a potential threat since they are in the area and are known to eat stems and fruits of other species of *Cyanea* (Cuddihy and Stone 1990). Axis deer (*Axis axis*) and pigs (*Sus scrofa*) are potential threats to this species, since they occur in areas adjacent to the only known population (USFWS 1996a; Ed Misaki, TNCH, personal communication 1991). Slugs (including *Milax gagates*) are widespread in Hawaii and a serious threat to many native plant taxa. Slugs feed preferentially on plants with fleshy leaves, stems, and fruits, including all taxa in the family Campanulaceae in Hawaii (Loyal Mehrhoff, USFWS, *in litt.* 1995). Slugs are the primary threat to *Cyanea glabra,* shown by recent observations of slug damage on both juveniles and adults (Arthur Medeiros, BRD, personal communication, 1995). Slugs have also been observed on *Cyanea kunthiana* plants, which had extremely damaged leaves (Guy Hughes, USFWS, personal communication, 1998).

Conservation Efforts

Cuttings of this species have been collected and propagated by the Lyon Arboretum and the National Tropical Botanical Garden. No additional species-specific conservation efforts have been undertaken. General conservation efforts for the Molokai II Plant Cluster taxa can be found in the Overall Conservation Efforts section beginning on page 25 of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a).

Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 61 of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a); however, the following actions are felt to be particularly urgent.

In order to prevent this species from going extinct, the current programs of propagation and maintenance of *ex situ* genetic stock should be continued and expanded. The remaining wild population should be enclosed with a barbed wire fence to provide protection from the effects of pigs and axis deer. 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. Most important, the potential for competition from alien plant species should be eliminated through an aggressive, long-term alien plant eradication program. Methods employed may include but not be limited to weed pulling, brush clearing, and mowing. Following these immediate preservation measures, long-term recovery actions should be implemented.

Lysimachia maxima Recovery Priority 5

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix E of Recovery Plan for the Molokai Plant Cluster (USFWS 1996a)

Description and Taxonomy

No line drawing is available for this taxon.

William Hillebrand considered a plant he collected in Pelekunu Valley in the 1800's to be a new variety of *Lysimachia hillebrandii* (Hillebrand 1888). In

1905, R. Knuth named Hillebrand's specimen *Lysimachia hillebrandii* var. *maxima* (Pax and Knuth 1905). St. John (1987b) elevated the variety to a species, *Lysimachia ternifolia*. Wagner *et al.* (1990) called this taxon *Lysimachia maxima*. An ongoing revision of the genus has determined that *Lysimachia ternifolia* is an invalidly published name and concurs that *Lysimachia maxima* is the correct name for this species (USFWS 1996a).

Lysimachia maxima, a member of the primrose family (Primulaceae), is a sprawling shrub with reddish brown bark. The leaves, borne in groups of three along the stems, are oval with the broadest portion at the tip of the leaves. The leaves are 3.8 to 8 centimeters (1.5 to 3 inches) long and 1.8 to 5 centimeters (0.7 to 2 inches) wide. The upper surface of the leaves has a few scattered hairs when young, and the lower surface is sparsely covered with long, soft, rusty hairs when young. The corolla is purplish-yellow, bell-shaped, and about 10 to 12 millimeters (0.4 to 0.5 inch) long. This species is differentiated from others in this genus by the leaves borne in groups of three, the broadest portion of the leaf above the middle, and rusty hairs that disappear with maturity (Wagner *et al.* 1990).

Life History

Flowers, buds and immature fruit of *Lysimachia maxima* have been observed in late May through July (Hawaii Plant Conservation Center (HPCC) 1991a; USFWS 1996a). No other life history information is available for this species.

Habitat Description

This species occurs in ohia-uluhe montane wet forest at an elevation of 975 meters (3,200 feet). Associated species include *Psychotria* sp. (kopiko), *Vaccinium* sp. (ohelo), *Hedyotis* sp. (manono), *Dubautia* sp. (naenae), and *Ilex anomala* (kawau) (HPCC 1991a; USFWS 1996a).

Current and Historic Ranges and Population Status (Appendix J-2)

Lysimachia maxima is only known from one population on the rim of Pelekunu Valley near Ohialele, in The Nature Conservancy of Hawaii's Pelekunu Preserve immediately adjacent to State-owned land managed as part of Kalaupapa National Historical Park (HHP 1991a, HPCC 1991a, Hillebrand 1888, Pax and

Knuth 1905, Wagner *et al.* 1990). Approximately 20 to 40 individuals are currently known (USFWS 1996a).

Reasons for Decline and Current Threats

The major threats to *Lysimachia maxima* are landslides, hurricanes, and reduced reproductive vigor due to the small number of individuals in the only known population (HPCC 1991a; USFWS 1996a). Pigs and goats inhabit adjacent areas and pose a potential threat to this species (USFWS 1996a).

Conservation Efforts

Cuttings of this species have been collected and propagated by the Lyon Arboretum and the National Tropical Botanical Garden. No additional species-specific conservation efforts have been undertaken. General conservation efforts applicable to the Molokai II Plant Cluster taxa can be found in the Overall Conservation Efforts section beginning on page 25 of the original Recovery Plan for the Molokai Plant Cluster (USFWS 1996a).

Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 61 of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a); however, the following actions are felt to be particularly urgent.

In order to prevent this species from going extinct, the current program of propagation and maintenance of *ex situ* genetic stock should be continued and expanded. The remaining wild population should be fenced to provide protection from the potential effects of pigs and goats. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Following these immediate preservation measures, long-term recovery actions should be implemented.

Schiedea sarmentosa Recovery Priority 8

(on USFWS scale of 1-18 (USFWS 1983) - See Appendix E of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a)

Description and Taxonomy

A line drawing of this taxon is shown in Appendix I.

In 1928, Otto Degener collected a plant on Molokai that E.E. Sherff (1946) later named *Schiedea sarmentosa*. *Schiedea sarmentosa* was included in *Schiedea menziesii* by Wagner *et al.* (1990). Warren Wagner and Stephen Weller, who are preparing a monograph of the genus, now consider *Schiedea sarmentosa* to be a separate species (USFWS 1996a).

Schiedea sarmentosa, a member of the pink family (Caryophyllaceae), is a many-branched shrub 30 to 45 centimeters (12 to 18 inches) tall. The opposite leaves are slender and threadlike, 1.5 to 4.5 centimeters (0.6 to 1.8 inches) long, and 0.5 to 1.5 millimeters (0.01 to 0.05 inch) wide. The leaves are covered with dense, glandular hairs. There may be as many as 40 to 60 inflorescences on 1 plant, often with 50 to 100 flowers in each inflorescence. The green sepals are egg-shaped, 2 to 3 millimeters (0.07 to 0.12 inch) long, and somewhat hairy. The staminodes (false stamens) are half as long as the sepals and two-branched at the tip. The fruits are oval capsules. This species differs from others in this endemic Hawaiian genus by its densely bushy habit, leaf width, hairiness, and staminode length (Sherff 1946; USFWS 1996a).

Life History

The flowers are female on some plants and bisexual on others. The population in Makolelau Gulch has a frequency of females of 31 percent. Based on analyses of pollen-ovule ratios, pollen size, inflorescence structure, and comparison to other *Schiedea* species tested in a wind tunnel, *Schiedea sarmentosa* could be wind-pollinated (Steven Weller, University of California, Irvine, personal communication 1997). No other life history information for this species is available.

Habitat Description

Schiedea sarmentosa is typically found on steep slopes in ohia-*Dodonaea viscosa* (aalii) lowland dry or mesic shrubland between 610 and 790 meters (2,000 and 2,600 feet) elevation (HHP 1991b, 1993b; HPCC 1991b, 1992). Associated species include *Styphelia tameiameiae* (pukiawe), *Chenopodium oahuensis* (aheahea), *Alyxia oliviformis* (maile), *Pleomele* sp. (hala pepe), and *Chamaesyce* sp. (akoko) (HHP 1993b; HPCC 1991b, 1992).

Current and Historic Ranges and Population Status (Appendix J-3)

Schiedea sarmentosa has been found in Kawela Gulch, Makolelau, and Onini Gulch (HHP 1991b, 1993b; HPCC 1991b, 1992; Sherff 1946; USFWS 1996a). Currently, only two populations are known. One population at the boundary of The Nature Conservancy of Hawaii's Kamakou Preserve in Onini Gulch has approximately 30 individuals (HHP 1993b). The other population occurs on privately owned land in Makolelau, and consists of 4 subpopulations totaling approximately 300 to 400 individuals (Steve Perlman, NTBG, and Stephen Weller, personal communications 1994). Estimates of the total number of individuals have ranged up to 1,000 (Joel Lau, HHP, personal communication 1994). An accurate count is somewhat difficult because this species is interspersed with *Schiedea lydgatei* (S. Perlman and S. Weller, personal communications 1994), with which it hybridizes.

Reasons for Decline and Current Threats

Major threats to *Schiedea sarmentosa* include feral goats and pigs, and the alien plants *Melinis minutiflora* (molasses grass) and *Ricinus communis* (castor bean). The species is also threatened by a risk of extinction from fires and naturally occurring events due to the low number of populations (USFWS 1996a; S. Perlman, personal communication 1994).

Conservation Efforts

Schiedea sarmentosa seeds that have been stored at National Tropical Botanical Garden since 1992 were recently been planted without any successful germination; this suggests that the desiccation of the seeds during storage may have destroyed the seeds (Kerin Rosenburger, NTBG, personal communication 1998). No other species-specific conservation efforts have been undertaken. General conservation efforts for the Molokai II Plant Cluster taxa can be found in the Overall Conservation Efforts section beginning on page 25 of the original Recovery Plan for the Molokai Plant Cluster (USFWS 1996a).

Needed Recovery Actions

The general strategies appropriate for this species are described beginning on page 61 of Recovery Plan for the Molokai Plant Cluster (USFWS 1996a); however, the following actions are felt to be particularly urgent.

In order to prevent this species from going extinct, the propagation and maintenance of *ex situ* genetic stock should be immediately undertaken. The remaining two wild populations should be fenced to provide protection from the documented effects of goats and pigs. If fencing is not feasible due to the local terrain (steep slopes), other means should be employed to control ungulate populations. Fire and fuel breaks should be constructed around the populations to reduce potential loss due to fires. Following these immediate preservation measures, long-term recovery actions should be implemented.

6. Overall Recovery Strategy

A discussion relevant to the overall recovery strategy for the Molokai II Plant Cluster taxa can be found in section 6 of the Recovery Plan for the Molokai Plant Cluster (1996a), beginning on page 61. 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 deemed essential for the recovery of listed species in Hawaii will be published by the U.S. Fish and Wildlife Service in the Recovery Plan for Multi-Island Plants. Maps showing these habitat areas may be used by land owners and managers to identify priority areas for management and restoration and for wide-range planning purposes.

RECOVERY

1. Objectives

See page 62 of the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a) for a general overview of the recovery objectives for these taxa and definitions of endangered and threatened species and populations.

Because we have a limited knowledge of the life history of each of these taxa with respect to specific requirements for their short-term and long-term survival, only tentative criteria for stabilizing, downlisting, and delisting are established here. 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' (IUCN's) draft red list categories (Version 2.2) and the advice and recommendations of various biologists and knowledgeable individuals.

The interim objective is to stabilize all existing populations of the Molokai II Plant Cluster taxa. All three taxa are classified as short-lived perennials. To be considered stable, each taxon must be managed to control threats (e.g., fenced where feasible) and be represented in *ex situ* collections. In addition, a minimum total of three populations of each taxon should be documented on Molokai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

For downlisting, a total of five to seven distinct populations of each taxon should be documented on Molokai 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 300 mature individuals per population. 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 Molokai 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 300 mature individuals per population. Each population should persist at this level for a minimum of 5 consecutive years.

Additional information is needed about each of the Molokai II Plant Cluster species so that more specific recovery criteria can be quantified.

2. Stepdown Outline

See the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a), beginning on page 65.

3. Stepdown Narrative

See the Recovery Plan for the Molokai Plant Cluster (USFWS 1996a), beginning on page 67.

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IMPLEMENTATION SCHEDULE

All agencies, landowners, and land managers with responsibilities for plant species in the Molokai II Addendum were identified in the implementation schedule for the Recovery Plan for the Molokai Plant Cluster. Many of these taxa occur in the same general areas, they suffer from the same threats, and require the same recovery efforts.

The Implementation Schedule that follows outlines actions and estimated cost for the recovery program for the Molokai Plant Cluster and the Molokai II Cluster, as set forth in the Recovery Plan for the Molokai Plant Cluster and this Addendum. It is a guide for meeting the objectives discussed in the Recovery Plan for the Molokai Plant Cluster. This schedule indicates task priority, task numbers, task descriptions, duration 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 species, stabilize the existing populations and increase the population sizes and numbers. Monetary needs for all parties involved are identified to reach this point, whenever feasible.

Priorities in Column 1 of the following 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 or 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.

Key to Acronyms Used in Implementation Schedule

BOT	-	Various Botanical Gardens (e.g., National Tropical Botanical Garden, Lyon Arboretum, Waimea Botanical Garden, etc.)
BRD	-	Biological Resources Division, U.S. Geological Survey
C	-	Task will need to be performed continuously
DOD	-	U.S. Department of Defense
DOFAW	-	Division of Forestry and Wildlife, Hawaii Department of Land and Natural Resources
FWS-PIE	-	U.S. Fish & Wildlife Service, Pacific Islands Ecoregion, Honolulu, Hawaii
HDOA	-	Hawaii Department of Agriculture
HHL	-	Hawaiian Home Lands
NPS	-	National Park Service
O	-	Task is ongoing
OTHER	-	Various Private Landowners
TBD	-	Funding or timing of task to be determined
TNCH	-	The Nature Conservancy - Hawaii

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	111	Collect, propagate, and maintain *ex situ* genetic stock of taxa facing imminent extinction	O	DOFAW*	390.0	30	36	36	36	36
				PIE	130.0	10	12	12	12	12
				BOT	130.0	10	12	12	12	12
1	112	Protect remaining wild individuals of taxa facing imminent extinction from immediate threats	O	DOFAW*	0.0	TBD				
				PIE	0.0	TBD				
				TNCH	0.0	TBD				
				DOD	0.0	TBD				
				OTHER	0.0	TBD				
1	12	Identify and map all extant wild populations	5	DOFAW*	286.0	50	59	59	59	59
				PIE	58.0	10	12	12	12	12
				TNCH	58.0	10	12	12	12	12
				NPS	58.0	10	12	12	12	12
				DOD	58	10	12	12	12	12

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	13	Delineate management units	3	PIE*	17.0	5	6	6		
				DOFAW	6.0	2	2	2		
				TNCH	6.0	2	2	2		
				OTHER	0.0					
1	14	Ensure long-term protection of habitat	O	DOFAW*	125.0	5	6	6	6	6
				NPS	83.0	3	4	4	4	4
				TNCH	83.0	3	4	4	4	4
				DOD	83.0	3	4	4	4	4
				OTHER	83.0	3	4	4	4	4
				PIE	125.0	5	6	6	6	6

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	1511	Construct and maintain fencing, wherever possible	C	DOFAW*	2,480.0	100	119	119	119	119
				NPS	2,480.0	100	119	119	119	119
				TNCH	2,480.0	100	119	119	119	119
				DOD	2,480.0	100	119	119	119	119
				OTHER	0.0	TBD				
				PIE	2,480.0	100	119	119	119	119
2	1512	Consider eradication programs for control of ungulates	3	DOFAW*	18.0		6	6	6	
				OTHER	0.0	TBD				
				PIE	18.0		6	6	6	
1	152	Conduct alien plant control	O	DOFAW*	2,480.0	100	119	119	119	119
				TNCH	500.0	20	24	24	24	24
				DOD	1,230.0	50	59	59	59	59
				NPS	1,000.0	40	48	48	48	48
				OTHER	0.0	TBD				
				PIE	500.0	20	24	24	24	24

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	153	Provide necessary fire protection	C	DOFAW*	960.0		48	48	48	48
				DOD	720.0		36	36	36	36
				NPS	480.0		24	24	24	24
				TNCH	240.0		12	12	12	12
				PIE	240.0		12	12	12	12
1	154	Control rodents	TBD	DOFAW*	20.0	0	1	1	1	1
				PIE	0.0	TBD				
				NPS	0.0	TBD				
				DOD	0.0	TBD				
				OTHER	0.0	TBD				
1	155	Propagate and maintain genetic stock of each taxa *ex situ*	O	DOFAW*	1,980.0	80	95	95	95	95
				PIE	250.0	10	12	12	12	12
				BOT	375.0	15	18	18	18	18
1	156	Ensure availability of pollination vectors	C	DOFAW*	0.0	TBD				
				PIE	0.0	TBD				

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	157	Protect areas from human disturbance	O	DOFAW*	500.0	20	24	24	24	24
				TNCH	250.0	10	12	12	12	12
				NPS	250.0	10	12	12	12	12
				DOD	250.0	10	12	12	12	12
				PIE	250.0	10	12	12	12	12
				OTHER	125.0	5	6	6	6	6
1	158	Control insects and disease, if necessary	TBD	DOFAW*	0.0	TBD				
				TNCH	0.0	TBD				
				DOD	0.0	TBD				
				HDOA	0.0	TBD				
				NPS	0.0	TBD				
				PIE	0.0	TBD				
				OTHER	0.0	TBD				

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
1	159	Control all other identified threats	TBD	DOFAW	0.0	TBD				
				DOD	0.0	TBD				
				TNCH	0.0	TBD				
				NPS	0.0	TBD				
				OTHER	0.0	TBD				
				PIE	0.0	TBD				
NEED 1 (Protect habitat and control threats)					26,815.0	1,071	1,422	1,422	1,412	1,400
2	21	Select populations for expansion	2	DOFAW*	4.0				2	2
				OTHER	4.0				2	2
				PIE	4.0				2	2
2	22	Prepare sites and plant	TBD	DOFAW*	0.0					TBD
				OTHER	0.0					TBD
				PIE	0.0					TBD
NEED 2 (Expand existing wild populations)					12.0	0	0	0	6	6

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
2	31	Collect diagnostic data on crucial associated ecosystem components	5	BRD*	174.0	30	36	36	36	36
				DOFAW	58.0	10	12	12	12	12
2	32	Map alien vegetation	O	BRD*	212.0	20	24	24	24	24
				DOFAW	90.0	10	12	12	12	12
				PIE	90.0	10	12	12	12	12
2	33	Study various aspects of growth	5	BRD*	116.0	20	24	24	24	24
				DOFAW	58.0	10	12	12	12	12
				PIE	58.0	10	12	12	12	12
2	34	Study reproductive viability	5	BRD*	116.0	20	24	24	24	24
				DOFAW	58.0	10	12	12	12	12
				PIE	58.0	10	12	12	12	12
2	35	Determine parameters of viable populations	5	PIE*	116.0	20	24	24	24	24
				DOFAW	116.0	20	24	24	24	24
				BRD	116.0	20	24	24	24	24

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
2	36	Determine effective control methods for insects and diseases, as needed	TBD	DOFAW*	0.0	TBD				
				PIE	0.0	TBD				
				BRD	0.0	TBD				
2	37	Evaluate results and use in future management	O	DOFAW*	42.0	2	2	2	2	2
				PIE	42.0	2	2	2	2	2
NEED 3 (Conduct essential research)					1,520.0	224	268	268	268	268
3	4	Develop and maintain long-term monitoring programs for all species	C	DOFAW*	250.0	10	12	12	12	12
				NPS	125.0	5	6	6	6	6
				TNCH	125.0	5	6	6	6	6
				DOD	125.0	5	6	6	6	6
				BOT	125.0	5	6	6	6	6
				PIE	125.0	5	6	6	6	6
NEED 4 (Develop and maintain monitoring plans)					875.0	35	42	42	42	42

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
3	51	Investigate feasibility and desirability of reintroduction	2	PIE*	12.0					
				DOFAW	12.0					
				BRD	12.0					
3	52	Develop and implement specific plans for reestablishment	TBD	DOFAW*	0.0					
				PIE	0.0					
				BRD	0.0					
				OTHER	0.0					
NEED 5 (Reestablish wild populations within the historic range)					36.0	0	0	0	0	0
3	61	Determine number of populations and individuals needed for long-term survival	2	PIE*	12.0					
				DOFAW	12.0					
				BRD	12.0					

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE MOLOKAI AND MOLOKAI II PLANT CLUSTERS

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000's)				
						FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
3	62	Refine downlisting and delisting criteria	2	PIE*	12.0					
				DOFAW	12.0					
				BRD	12.0					
NEED 6 (Validate recovery objectives)					72.0	0	0	0	0	0
TOTAL COST					29,330.0	1,330	1,732	1,732	1,728	1,716

APPENDIX H
AGENCY AND PEER REVIEWERS

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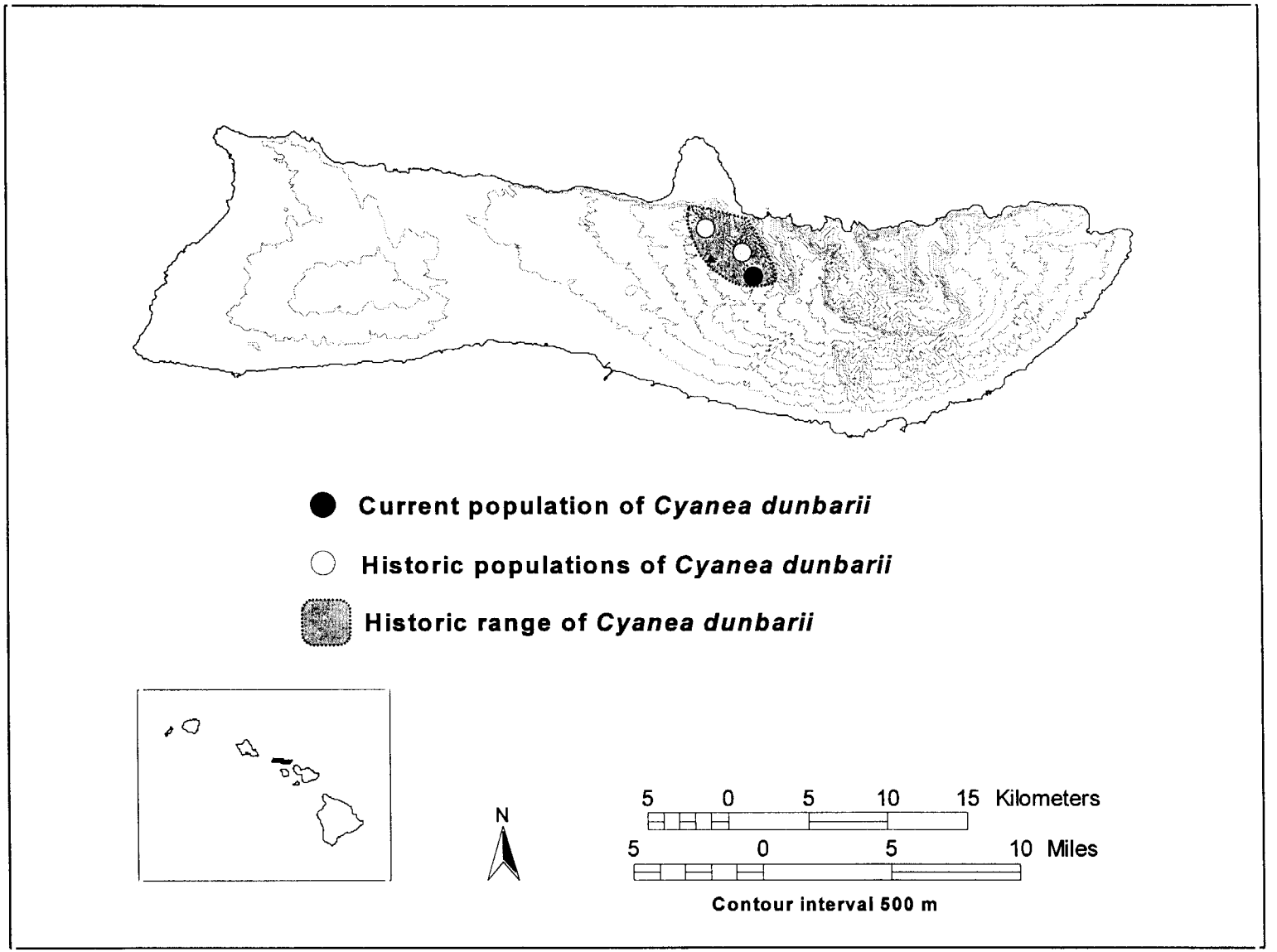
APPENDIX I
LINE DRAWINGS OF PLANTS

No line drawings were available for the following species:

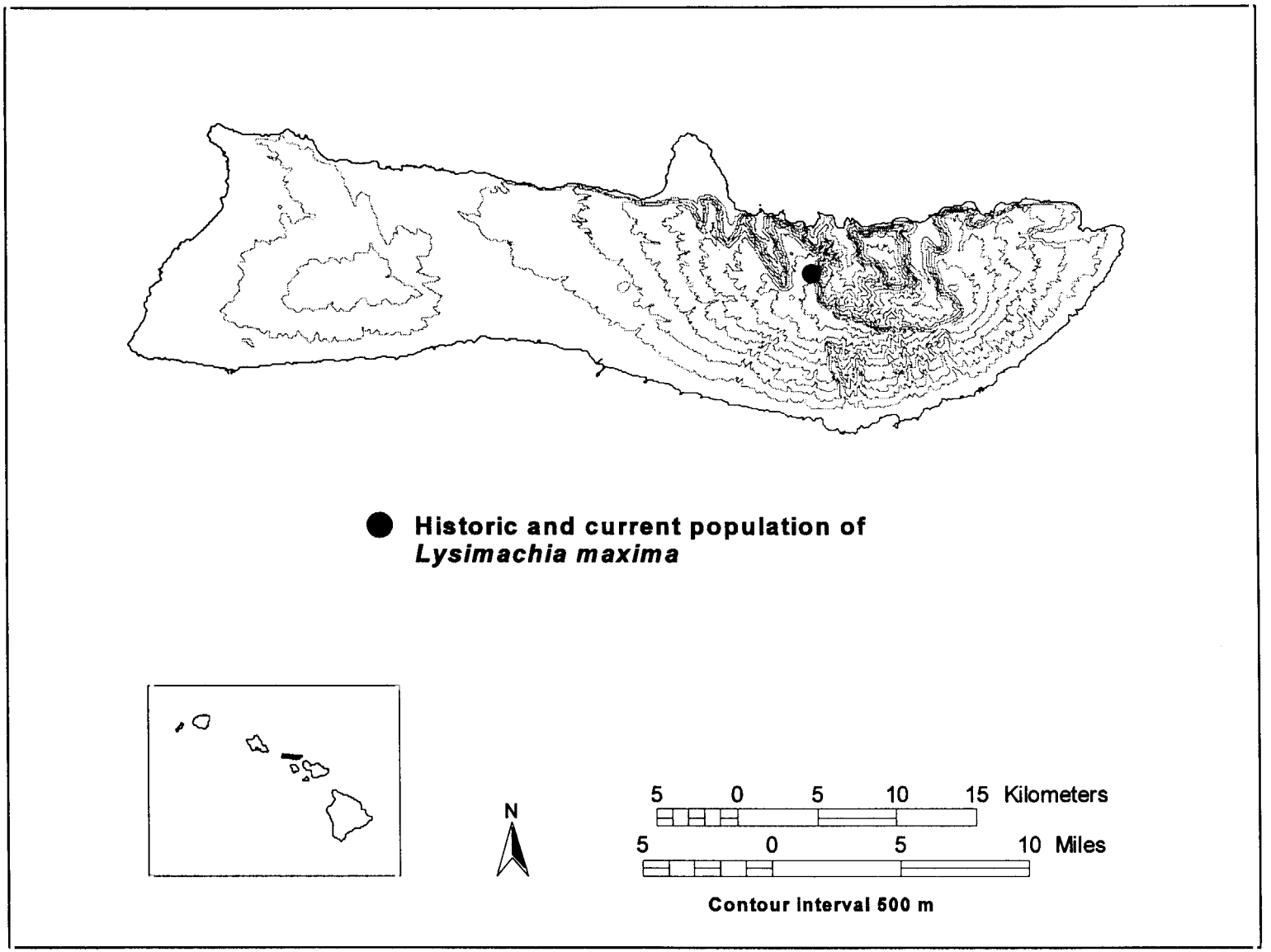
Cyanea dunbarii
Lysimachia maxima

Line drawing of *Schiedea sarmentosa* from Wagner and Weller (in prep).

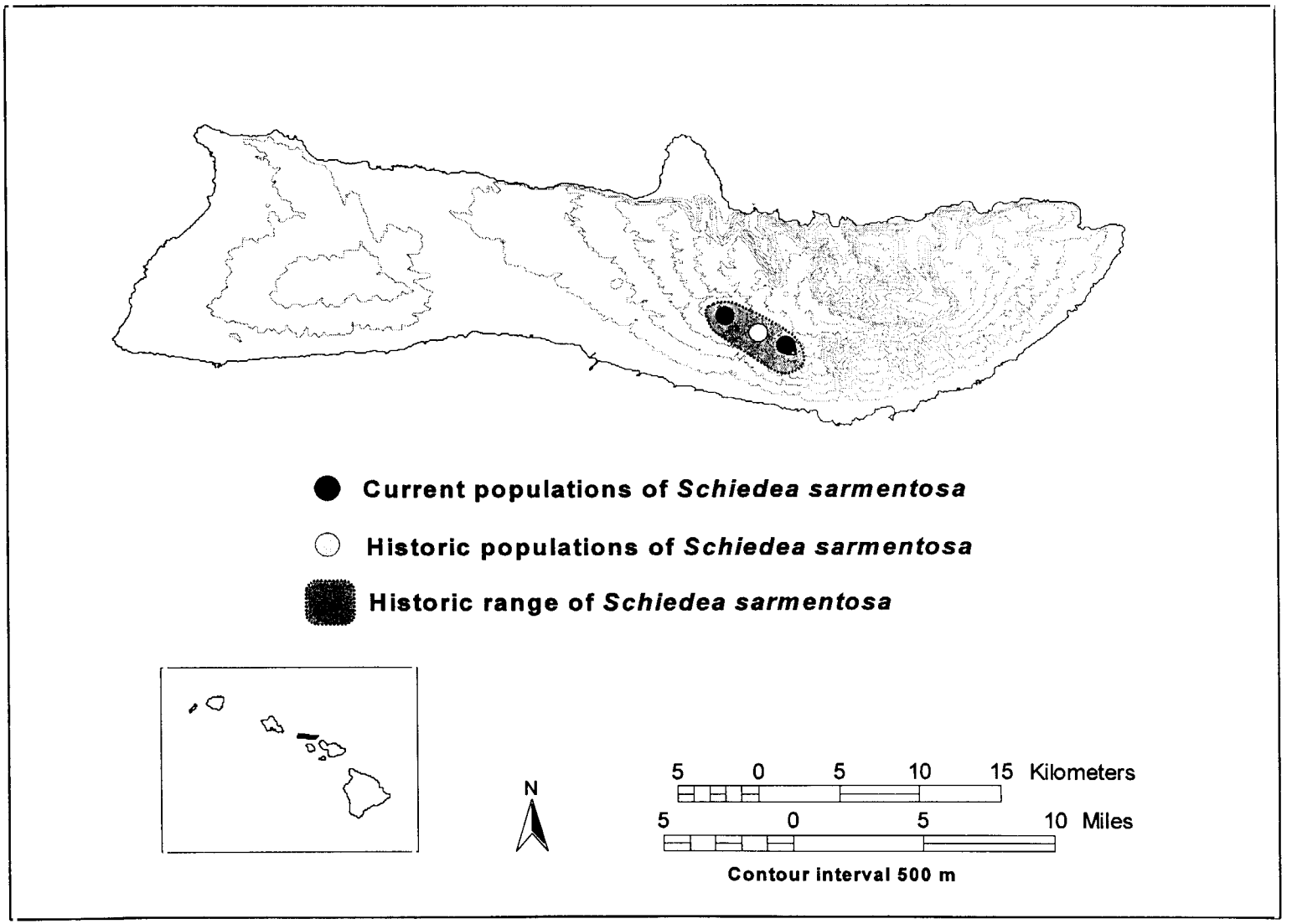
APPENDIX J
HISTORIC AND CURRENT DISTRIBUTION MAPS



Appendix J-1. Current and historic population distribution map for *Cyanea dunbarii.*



Appendix J-2. Current and historic population distribution map for *Lysimachia maxima.*



Appendix J-3. Current and historic population distribution map for *Schiedea sarmentosa.*

APPENDIX K
SUMMARY OF LANDOWNERSHIP OR MANAGEMENT

State of Hawaii
Cyanea dunbarii

Private Landowners
Lysimachia maxima
Schiedea sarmentosa

APPENDIX L
SUMMARY OF COMMENTS

The U.S. Fish and Wildlife Service received comments on the Molokai II: Addendum to the Recovery Plan For The Molokai Plant Cluster from the Hawaii Department of Land and Natural Resources, the Hawaii Department of Agriculture, the Hawaii Department of Transportation, the Hawaii Land Use Commission, the Office of Hawaiian Affairs, the National Tropical Botanical Garden, and the U.S. Marine Corps. Most of these comments provided additional information on numbers of populations/individuals, distribution of certain taxa, changes to cost estimates for tasks in the Implementation Schedule, and editorial changes. These comments have been incorporated into the final plan. The following peer reviewers provided comments on the plan: Ken Wood and Steve Perlman.

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