

Draft Recovery Plan for *Phyllostegia hispida*

*Addendum to the Molokai Plant
Cluster Recovery Plan*



**Draft Recovery Plan for
Phyllostegia hispida: Addendum
to the Molokai Plant Cluster
Recovery Plan**

Prepared by

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: XX

Regional Director
U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXX

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EXECUTIVE SUMMARY

Current Species Status: *Phyllostegia hispida* (no common name) is an endemic Hawaiian plant species and was federally listed as endangered in 2009 (U.S. Fish and Wildlife Service [USFWS] 2009). Currently there are 20 wild and fewer than 300 outplanted individuals on the island of Molokai.

Habitat Requirements and Limiting Factors: *Phyllostegia hispida* is typically found in wet *Metrosideros polymorpha* (ohia)–dominated forest, occurring between 1,112 and 1,280 meters (3,650 and 4,200 feet) elevation.

The major threats to all known populations are habitat degradation and herbivory (consumption of plants) by feral pigs (*Sus scrofa*); competition with invasive introduced plants; and the negative demographic and genetic consequences of extremely small population size, as well as the consequent vulnerability to extinction through deterministic or stochastic (chance) events. Native caterpillar species may also pose a herbivory threat to this species.

Recovery Priority Number: The recovery priority number for *Phyllostegia hispida* is a 5, on a scale from 1 (highest) to 18 (lowest), reflecting its taxonomic position as a full species, a high degree of threat, a moderate potential for recovery, with some threats that are well understood and easily alleviated and others that are currently difficult to alleviate.

Recovery Strategy: The first step toward recovery of *Phyllostegia hispida* is to protect all of the known wild populations. Continuing survey efforts will focus on identifying additional populations that may exist but are currently unknown. In order to reduce the potential for extinction due to the catastrophic loss of the small population on a single island, recovery actions will likely require increasing the area occupied by the existing populations where space and habitat allow, as well as establishing new populations within the estimated historical range of the species. Threats such as habitat degradation, herbivory by feral pigs, and competition with invasive introduced plants must be sufficiently controlled to allow for this population expansion. The effective management and reintroduction of *P. hispida* will require gaining further knowledge about the life

history of the species and the functioning of the ecosystem on which it depends. Therefore, research and monitoring are key components of the recovery strategy.

Recovery Goal: The ultimate goal of recovery planning is to recover species to the point where they no longer require the protections of the Endangered Species Act. Given the current shortage of information about the biology and habitat requirements and the magnitude of current threats where *Phyllostegia hispida* occurs, only tentative criteria for stabilizing, downlisting, and delisting are established here. These criteria were formulated based on recommendations from individuals on 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 knowledgeable biologists and individuals.

Recovery Objectives:

Immediate Recovery Objective: The interim objective is to stabilize all existing populations of *Phyllostegia hispida*. To be considered stable, the species must be managed to control threats (e.g., fenced) and be represented in an *ex situ* population (such as a nursery or arboretum). The long-term objectives leading to downlisting and delisting are an increase in populations and their numbers through outplanting to obtain a viable population size, development of appropriate management and monitoring plans at each site, and conservation agreements with landowners to ensure threats are controlled through perpetuity.

Recovery Criteria:

Phyllostegia hispida may be considered for downlisting to threatened status when all of the following conditions have been met:

Criterion 1: Population size. A total of at least five populations of *Phyllostegia hispida* should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and threats must be managed so that a minimum of 300 mature individuals are maintained per population. Each population should persist, at this level (see page 15), for a minimum of 5 consecutive years before downlisting is considered (Factor E, small population size and limited distribution).

Criterion 2: Management and monitoring plans. Habitat around each population must be managed to ensure that it will support the long-term persistence of *Phyllostegia hispida*. To achieve this, each of the five populations identified in criterion 1 will have a management and monitoring plan that will identify actions and procedures necessary to ensure that all threats are controlled and populations are increasing (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; Factor E, lack of mature reproductive individuals; and Factor E, competition with invasive introduced plants).

Criterion 3: Habitat quality. All of the populations that meet the downlisting criterion 1 above shall be fenced and protected from ungulates, with agreements from conservation partners to maintain those protections in perpetuity. The agreements will also include provisions for invasive introduced plant removal, as appropriate, and adaptive management plans to address herbivory and habitat degradation by feral pigs and caterpillars and other unforeseeable threats. In addition, the agreements will include provisions for maximizing native plant biodiversity in these areas. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; and Factor E, competition with invasive introduced plants).

Phyllostegia hispida may be considered for delisting when all of the following conditions have been met:

Criterion 1: Population size. A total of at least eight populations should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and threats must be managed so that a minimum of 300 mature individuals are maintained per population. Each population should persist, at this level (see page 16), for a minimum of 5 consecutive years (Factor E, small population size and limited distribution).

Criterion 2: Management and monitoring plans. Habitat around each population must be managed to ensure that it will support the long-term persistence of

Phyllostegia hispida. To achieve this, each of the eight populations identified in criterion 1 will have a management and monitoring plan that will identify actions and procedures necessary to ensure that all threats are controlled and populations are increasing. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; Factor E, lack of mature reproductive individuals; and Factor E, competition with invasive introduced plants).

Criterion 3: Habitat quality. All of the populations that meet the delisting criterion 1 above shall be fenced and protected from ungulates, with agreements from conservation partners to maintain those protections in perpetuity. The agreements will also include provisions for invasive introduced plant removal, as appropriate, and adaptive management plans to address herbivory and habitat degradation by feral pigs and caterpillars and other unforeseeable threats. In addition, the agreements will include provisions for maximizing native plant biodiversity in these areas. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; and Factor E, competition with invasive introduced plants).

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 populations.
5. Establish new populations as needed to reach recovery objectives.
6. Validate and revise recovery criteria.

Estimated Date and Cost of Recovery: If all recovery criteria have been met, it is currently estimated that *Phyllostegia hispida* may be eligible for downlisting by the year 2026, and delisting by the year 2031. The estimated cost to recover *Phyllostegia hispida* to the point where it may be delisted is approximately \$6,227,000 (Table 1).

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Table 1. Total Estimated Cost of Recovery through Year 2031 (in \$1,000).

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Total
2011	478	20	136	20	15	15	684
2012	473	20	136	20	24	15	688
2013	460	20	136	20	19	15	670
2014	445	20	136	20	28	-	649
2015	445	20	136	20	15	-	636
2016	161	5	6	8	4	2	186
2017	161	5	6	8	4	-	184
2018	161	5	6	8	4	2	186
2019	161	5	6	8	4	2	186
2020	161	5	6	8	4	2	186
2021	200	2	14	6	4	-	226
2022	200	2	14	6	4	-	226
2023	200	2	14	6	4	-	226
2024	200	2	14	6	4	-	226
2025	200	2	14	6	4	-	226
2026	113	2	14	8	4	-	141
2027	113	2	14	8	4	-	141
2028	113	3	12	8	4	-	140
2029	113	3	12	8	4	-	140
2030	113	3	12	8	4	-	140
2031	113	3	12	8	4	-	140
TOTALS	\$4,784	\$151	\$856	\$218	\$165	\$53	\$6,227.0

I. Background

A. BRIEF OVERVIEW

This document is the second addendum to the Recovery Plan for the Molokai Plant Cluster (RPMPC) (USFWS 1996, first addendum: USFWS 1998), which jointly addressed 19 plant taxa. This addendum covers *Phyllostegia hispida* (no common name), which was added to the Federal List of Endangered and Threatened species on March 17, 2009 (USFWS 2009). Because *P. hispida* occurs in habitats similar to those for plants covered in the original RPMPC, and faces similar threats, many of the recommended recovery actions are similar or identical to those in the RPMPC. This Addendum will therefore refer frequently to sections of the RPMPC.

Phyllostegia hispida is known only from the island of Molokai, Hawaii (Figure 1). *P. hispida* and its habitat have been adversely affected and continue to be threatened by one or more of the following: habitat degradation and herbivory by feral pigs (*Sus scrofa*); competition with invasive introduced plants; herbivory by native caterpillars; and the negative demographic and genetic consequences of extremely small population size, as well as the consequent vulnerability to extinction through deterministic or stochastic (chance) events (USFWS 2009).

This Addendum outlines the strategy and actions needed to recover *Phyllostegia hispida* based on the best available information, including new information obtained since the final rule to list the species. The recovery recommendations in this plan are based on resolving the threats to the species and ensuring the persistence of self-sustaining populations in the wild.

B. STATUS OF THE SPECIES

Phyllostegia hispida was first identified as a candidate for listing in the September 19, 1997, Notice of Review of Plant and Animal Taxa that are Candidates or Proposed for Listing as Endangered or Threatened Species

(USFWS 1997). On May 4, 2004, the Center for Biological Diversity petitioned U.S. Fish and Wildlife Service (Service) to list 225 species of plants and animals as endangered under the provisions of the Endangered Species Act (“Act”; 16 U.S.C. 1531 *et seq.*), including *P. hispida*. In the September 12, 2006, Notice of Review, *P. hispida* was included as a candidate species with a listing priority number of 2 (USFWS 2006). A proposed rule to list *P. hispida* as endangered throughout its range was published on February 19, 2008 (USFWS 2008), and the final rule was published on March 17, 2009 (USFWS 2009).

When a species is listed as endangered or threatened under the Act, it is automatically added to the State of Hawaii’s list of protected species (Hawaii Revised Statutes Chapter [HRS] 195D).

The recovery priority number for *Phyllostegia hispida* is a 5, on a scale from 1 (highest) to 18 (lowest), reflecting its taxonomic position as a full species, a high degree of threat, a moderate potential for recovery, with some threats that are well understood and easily alleviated and others that are currently difficult to alleviate (USFWS 1983a, b).

C. SPECIES DESCRIPTION AND LIFE HISTORY

Phyllostegia is a genus nearly endemic to Hawaii of the Lamiaceae or mint family, consisting of approximately 27 species located in Hawaii and a single species in Tahiti (Wagner *et al.* 1999). *Phyllostegia hispida* Hillebr. was first described by William Hillebrand in 1870 from a specimen collected from an area that he described as the “heights of Mopulehu” on the island of Molokai (see “Synonyms,” Wagner *et al.* 2005), and is recognized as a distinct taxon in Wagner *et al.* (1999). A nonaromatic member of the mint family, *P. hispida* is a loosely spreading, many-branched vine that often forms large, tangled masses. Leaves are thin and flaccid with hispid hairs (rough with firm, stiff hairs) and glands. The leaf margins are irregularly and shallowly lobed. Six to eight white flowers make up each verticillaster (a false whorl, composed of a pair of nearly sessile cymes (a flat-topped or round-topped flower cluster) in the axils of opposite leaves or bracts), and nutlets are approximately 2.5 millimeters (0.1 inches) long (Wagner *et al.* 1999).

The fragrant flowers of *Phyllostegia* species that have distinct lower-lips and mostly white-pink-colored corollas are generally associated with insect pollination (Lindqvist and Albert 2002). *Phyllostegia* species have fleshy fruits (Lindqvist and Albert 2002). *Phyllostegia hispida* has been observed in fruit during April to June (H. Oppenheimer, Maui Plant Extinction Prevention Program, pers. comm. 2008a).

D. HISTORICAL AND CURRENT POPULATION STATUS

From 1910 through 1979, a total of eight populations of *Phyllostegia hispida* were recorded from the wet forests of eastern Molokai (Hawaii Biodiversity and Mapping Program 2007). None of these historical occurrences have been relocated during surveys conducted in the wet forests of east Molokai over the past several years (The Nature Conservancy of Hawaii 1997b; S. Perlman, The National Tropical Botanical Garden, pers. comm. 2006a). In 1996, two adult plants were found in eastern Molokai within The Nature Conservancy of Hawaii's Kamakou Preserve, one next to the Pepeopae Boardwalk, and the other east of Hanalilolilo growing along the fence within the State of Hawaii's Puu Alii Natural Area Reserve. In 1997, a single *Phyllostegia* individual was discovered on the rim of Pelekunu Valley in the Puu Alii Natural Area Reserve (Hawaii Biodiversity and Mapping Program 2005; The Nature Conservancy of Hawaii 1997b). There is some uncertainty, however, as to whether this individual was *P. hispida*, as it was identified as *P. manni* by Hawaii Division of Forestry and Wildlife staff, based upon the size and lobing of its leaves (R. Hobdy, Robert Hobdy Environmental Consulting, pers. comm. 2006; J. Lau, Hawaii Biodiversity and Mapping Program, pers. comm. 2006; T. Nohara, Maui Division of Forestry and Wildlife, pers. comm. 2006). This individual plant was protected from feral ungulates inside a fenced enclosure. Seeds were collected, and seedlings were produced by Hawaii Division of Forestry and Wildlife and outplanted into the enclosure with the wild plant (T. Nohara, pers. comm. 2006).

The Pepeopae Boardwalk individual died in 1998 or 1999 (Hawaii Biodiversity and Mapping Program 2005), and the wild plant and reintroductions in Puu Alii Natural Area Reserve, which may possibly have been *Phyllostegia manni* and not *P. hispida* (see above; the question of taxonomic identity was

never resolved), died several years ago (S. Perlman, pers. comm. 2005; K. Wood The National Tropical Botanical Garden, pers. comm. 2005; G. Hughes, Kalaupapa National Historical Park, pers. comm. 2006b).

Surveys have been conducted in the wet forests of east Molokai, but no additional *Phyllostegia hispida* plants were found. The species was thought to have been extirpated from the wild until 2005, when two seedlings were found in the headwaters of Waikolu stream in Kamakou Preserve, indicating the possible presence of a mature plant, or plants, somewhere in the vicinity (The Nature Conservancy of Hawaii 1997b; S. Perlman, pers. comm. 2005; S. Perlman, pers. comm. 2006a; K. Wood, pers. comm. 2006, H. Oppenheimer, pers. comm. 2009). One of the seedlings has since died (G. Hughes, pers. comm. 2006a; B. Garnett, Kalaupapa National Historical Park, pers. comm. 2006). The other seedling was collected by a botanist with the National Tropical Botanic Gardens. Cuttings were propagated from this seedling and provided to Kalaupapa National Historical Park (S. Perlman, pers. comm. 2006b).

Phyllostegia hispida was again thought to be extirpated from the wild until a single juvenile plant was discovered in May 2006 within Puu Alii Natural Area Reserve along the Puu Alii fenceline at 1,250 meters (4,100 feet) elevation by Natural Area Reserve staff (S. Perlman pers. comm. 2006c). Although protected within a fenced enclosure (B. Stevens, Maui Division of Forestry and Wildlife, pers. comm. 2006), that individual has died for unknown reasons (H. Oppenheimer, pers. comm. 2007). However, 10 new wild plants were discovered in April 2007: 9 within Kamakou Preserve and a single individual within Puu Alii Natural Area Reserve. The individual plant found at the Puu Alii Natural Area Reserve was in a vegetative state when it was last seen in 2009, and it is not known whether this individual produced any seed (H. Oppenheimer, pers. comm. 2009). Four of the individuals found within Kamakou Preserve were seedlings that were closely clustered next to the Puu Alii Natural Area Reserve fenceline. These were protected with temporary emergency fencing by Natural Area Reserve Staff; however, two of these individuals are now dead. Two of the remaining eight wild individuals discovered in April 2007 are mature and have fruited and produced seeds. Seeds and cuttings have been removed from these individuals for attempted cultivation (H. Oppenheimer, pers. comm. 2009).

Since April 2007, 15 additional *Phyllostegia hispida* individuals have been found within Kamakou Preserve while conducting *Rubus argutus* (Florida prickly blackberry) control trips (H. Oppenheimer, pers. comm. 2008a, b). In 2008, there were 24 wild individuals and most of them were located on landslides or in windthrow areas (areas in which trees have been uprooted or overthrown by wind) (H. Oppenheimer, pers. comm. 2008b, c).

A single *Phyllostegia hispida* individual was found in October 2008, on the west rim of Pelekunu Valley in The Nature Conservancy's Pelekunu Preserve (H. Oppenheimer, pers. comm. 2009) in a nonreproductive state (H. Oppenheimer, pers. comm. 2011). Although this individual is located within Pelekunu Preserve, it is more easily accessible and affected by management actions occurring within Kamakou Preserve and Puu Alii Natural Area Reserve. Unfortunately, after a large flowering and fruiting event, this individual was reported dead (Ane Bakutis, Molokai Plant Extinction Prevention Program, pers. comm. 2011).

Currently, there are approximately 20 mature individuals in the wild and an unknown number of seedlings nearby (H. Oppenheimer, pers. comm. 2009). One of these wild individuals is located within the Puu Alii Natural Area Reserve; all of the remaining individuals are located within The Nature Conservancy's Kamakou Preserve. In addition, there are three small naturally occurring populations—containing one to six seedlings each—that are not located next to mature, parent plants. These populations are found in The Nature Conservancy's Kamakou Preserve (two populations) and Puu Alii Natural Area Reserve (one population). In November 2009, the seedlings in Puu Alii Natural Area Reserve were not mature; however, they may be mature enough to produce seed in the near future (H. Oppenheimer, pers. comm. 2009).

Fewer than 300 individuals, grown in propagation from cuttings and seed, have been reintroduced at 30 discrete sites located within the Kamakou Preserve and the Puu Alii Natural Area Reserve on Molokai (H. Oppenheimer, pers. comm. 2009). Most of these individuals are doing well; however, a few have died from unknown causes that appear related to herbivory by native caterpillars, while

others have died after producing seeds. Natural recruitment of the reintroduced individuals is unknown.

E. HABITAT AND ECOSYSTEM CHARACTERISTICS

The few documented specimens of *Phyllostegia hispida* have typically been found in wet *Metrosideros polymorpha* (ohia)–dominated forest, with most occurring at 1,112 and 1,280 meters (3,650 and 4,200 feet) elevation. Associated native species include *Cheirodendron trigynum* (olapa), *Ilex anomala* (aiae), *Cibotium glaucum* (hapuu), *Broussaisia argutus* (kanawao), *Rubus hawaiiensis* (akala), *Sadleria cyatheoides* (amau), *Pipturus albidus* (mamaki), *Nertera granadensis* (makole), *Athyrium microphyllum* (no common name [NCN]), *Elaphoglossum fauriei* (NCN), and various species of bryophytes (Hawaii Biodiversity and Mapping Program 2007).

It appears that *Phyllostegia hispida* is dependent on habitat that has been disturbed through natural processes such as, and colonizes windthrow areas (areas in which trees have been uprooted or overthrown by wind), landslides, and riparian corridors (H. Oppenheimer, pers. comm. 2009). These windthrow areas create openings in the canopy that provide increased sunlight for germination (USFWS 2009). Most of the remaining wild mature individuals, which now number 20, are located on landslides or in windthrow areas (H. Oppenheimer, pers. comm. 2008b, c). Two seedlings are located near a fenceline within the Kamakou Preserve (H. Oppenheimer, pers. comm. 2009).

F. REASONS FOR LISTING AND CURRENT THREATS

As identified in the final listing rule (USFWS 2009), the primary threats to *Phyllostegia hispida* and its habitat are ungulate induced habitat disturbance and invasive introduced plant species. In addition, the negative demographic and genetic consequences of extremely small population size, as well as the consequent vulnerability to extinction through deterministic or stochastic (chance) events are a threat. Unidentified native caterpillar species may also be a threat to this species (H. Oppenheimer, pers. comm. 2009). A description of each of these threats is presented in the final listing rule (USFWS 2009); each is classified

according to the five listing/delisting factors identified in section 4 of the Act (16 USC 1531 *et seq.*).

G. CONSERVATION MEASURES

Conservation measures implemented for *Phyllostegia hispida* have included micropropagation (i.e., tissue culture), outplanting of cuttings and seedlings from wild individuals, seed storage, weed pulling and herbicide treatment within occupied habitat, hunting and trapping of introduced feral ungulates, and temporary and permanent fencing to exclude feral ungulates.

Phyllostegia hispida occurs entirely on public lands or lands that are managed by the State of Hawaii's Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserve System in Puu Alii Natural Area Reserve and The Nature Conservancy's Kamakou and Pelekunu Preserves. All of these areas have some level of management for invasive introduced plants and feral ungulates.

Puu Alii Natural Area Reserve

In 1996, a mature individual *Phyllostegia hispida* plant was found east of Hanalilolilo growing along the fence within the State of Hawaii's Puu Alii Natural Area Reserve. This individual was reported dead in 2003 (S. Perlman, pers. comm. 2005, S. Perlman, pers. comm. 2006a). The University of Hawaii's Lyon Arboretum has propagation material collected from this plant (USFWS 2005).

In May 2006, a single juvenile plant was discovered within the Reserve along the Puu Alii fenceline at 1,250 meters (4,100 feet) elevation by Natural Area Reserve staff (S. Perlman, pers. comm. 2006c). Although protected within a 3-meter (10-foot) diameter fenced enclosure (B. Stevens, pers. comm. 2006), that individual died from unknown causes (H. Oppenheimer, pers. comm. 2007).

Kamakou Preserve

In November 1996, The Nature Conservancy of Hawaii erected an enclosure around a *Phyllostegia hispida* plant growing near the Preserve's Pepeopae Boardwalk and began frequent, recurrent weeding and monitoring within the fenced area (The Nature Conservancy of Hawaii 1997a). They also built an enclosure approximately 200 meters (656 feet) away from this plant for future reintroductions of propagated individuals. Plants grown from leaf buds from this one known plant on the property were reintroduced into the enclosure in December 1997 (The Nature Conservancy of Hawaii 1998a). They survived through 1998 (The Nature Conservancy of Hawaii 1998b), but have since been confirmed dead (S. Aruch, The Nature Conservancy of Hawaii, pers. comm. 2006; E. Misaki, The Nature Conservancy of Hawaii, pers. comm. 2006). The University of Hawaii's Lyon Arboretum has propagation material from this lone individual (USFWS 2005).

In 2005, two seedlings were found in the headwaters of Waikolu Stream, which is part of Kamakou Preserve (S. Perlman, pers. comm. 2005; H. Oppenheimer, pers. comm. 2009). One of the seedlings was collected and given to the Kalaupapa National Historical Park on Molokai for attempted propagation. That plant has since died (G. Hughes, pers. comm. 2006a; B. Garnett, pers. comm. 2006). The other seedling was collected and propagated by the National Tropical Botanical Garden. Cuttings of that seedling were given to the Kalaupapa National Historical Park for propagation (S. Perlman, pers. comm. 2006b). Thirty plants were grown from these cuttings by the National Tropical Botanical Garden and have since been reintroduced into the Preserve (H. Oppenheimer, pers. comm. 2009).

Twelve cuttings of *Phyllostegia hispida* that were grown at The National Tropical Botanical Garden were reintroduced into an enclosure in the Preserve in April 2007 (H. Oppenheimer, pers. comm. 2008a). Eleven of the cuttings that were reintroduced were doing well as of April 2008. Another 12 individuals were reintroduced into a second enclosure in the Preserve in June 2007, all of which remained as of April 2008 (H. Oppenheimer, pers. comm. 2008b). These 24

reintroduced individuals are part of the 30 individuals propagated by the National Tropical Botanical Garden mentioned in the previous paragraph.

In April 2007, seeds were collected from mature *Phyllostegia hispida* plants found within the Preserve, and sent to the Lyon Arboretum and the Olinda Rare Plant Facility for propagation (H. Oppenheimer, pers. comm. 2009). The Olinda Rare Plant Facility had 126 individuals of *P. hispida* representing 6 wild founders in 2009 (Olinda Rare Plant Facility 2009).

In August 2008, 124 individuals of *Phyllostegia hispida* were reintroduced into the Preserve, and 61 more individuals were reintroduced in September 2008 (H. Oppenheimer, pers. comm. 2008b).

Pelekunu Preserve

As noted above, under Section D, Historical and Current Population Status, the single individual found in 2008 at this Preserve has died. The Nature Conservancy has been actively removing feral ungulates, controlling introduced invasive plants, and has constructed several strategic fences to limit the number of ungulates in the Preserve (E. Misaki, pers. comm. 2011). Currently, feral ungulate control is conducted by the staff of Puu Alii Natural Area Reserve and The Nature Conservancy conducts ungulate surveys twice a year (E. Misaki, pers. comm. 2011).

Summary of Reintroduction Efforts

Fewer than 300 individuals have been reintroduced at 30 discrete sites located within the Kamakou Preserve and the Puu Alii Natural Area Reserve (H. Oppenheimer, pers. comm. 2009). Most of these individuals are doing well; however, a few have died from unknown causes that appear related to herbivory by native caterpillars, while others have died after producing seeds.

II. Threats Assessment

The major factors in the decline of *Phyllostegia hispida* are: (1) habitat degradation and herbivory by feral pigs; and (2) competition from invasive, introduced plants (USFWS 2008). In addition to the primary threat factors, species like *P. hispida* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks. For example, a few individuals of *P. hispida* have died for unknown reasons that appear related to herbivory by a native caterpillar species.

An analysis of threats is an essential component of our listing, delisting, and reclassification decisions. We determined the status of *Phyllostegia hispida* by analyzing the following five factors, as required by section 4(a)(1) of the Act:

- A. The present or threatened destruction, modification, or curtailment of habitat or range;
 - B. Overutilization for commercial, recreational, scientific, or educational purposes;
 - C. Disease or predation;
 - D. Inadequacy of existing regulatory mechanisms; and
 - E. Other natural or man-made factors affecting the continued existence of a species.
- **Invasive species (Factors A and E).** Introduced plant species compete with native plants for water, light, and nutrients and may modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, modifying nutrient cycling, and changing the fire characteristics of the native plant community. The most common introduced plant species are *Axonopus fissifolius* (narrow-leaved carpetgrass), *Clidemia hirta* (Koster's curse), *Erechtites valerianifolia* (fireweed), *Juncus effuses*

(Japanese mat), *Rubus rosifolius* (thimbleberry), and *Sacciolepis indica* (Glenwood grass) (USFWS 2008).

- **Feral pigs (Factors A and C).** Feral pigs contribute to the modification and degradation of habitat by disturbing and destroying vegetative cover, trampling plants and seedlings, reducing or eliminating plant regeneration by damaging or eating seeds and seedlings, and increasing erosion by creating large areas of bare soil. Feral pigs are also a major vector for the dispersal of invasive, nonnative plant species (USFWS 2008).
- **Herbivory by unknown caterpillars (Factor C).** Reintroduced individuals were dying from unknown causes possibly related to herbivory by unknown species of native caterpillars (H. Oppenheimer, pers. comm. 2009). Native Lepidoptera species often use plants in the genus *Phyllostegia* as host plants (Zimmerman 1958).
- **Small population size and restricted distribution (Factor E).** A total of about 320 individuals of *Phyllostegia hispida* are currently known to exist, there are only 20 mature individuals in the wild and less than 300 reintroduced individuals. Although, most of the mature individuals of *P. hispida* in the wild have fruited and produced seeds, many of them have died after a large flowering and fruiting event (A. Bakutis, pers. comm. 2011). In addition, survivorship of known wild individuals has been poor, and although reintroductions have been attempted (USFWS 2009), none of these reintroductions have yet recorded natural recruitment of reintroduced individuals. Although propagules of *P. hispida* have been collected on an opportunistic basis and some controlled propagation of the species has taken place, there is no dedicated funding for propagation of the species and no formal plan exists for reintroduction efforts (USFWS 2009).

Deterministic factors, such as habitat alteration or loss of a key pollinator, may have reduced this population to such a small size that it is now susceptible to a stochastic extinction event (Gilpin and Soulé 1986). Species that are known from few wild individuals and are endemic to a single, small island are inherently more vulnerable to extinction than widespread species

because of the higher risks posed to few populations and individuals by genetic bottlenecks, random demographic fluctuations, and localized catastrophes, such as hurricanes and disease outbreaks (Mangel and Tier 1994; Pimm *et al.* 1988). In the case of *Phyllostegia hispida*, the entire population of the species is small and restricted to a highly localized geographic area, rendering it highly vulnerable to the risk of extinction in the wild due to the lack of redundancy in populations. These consequences of small population size (e.g., insufficient natural reproduction, loss of genetic diversity), in conjunction with the risk of losing the entire population in the wild due to factors such as localized events (e.g., hurricanes), render the species highly vulnerable to extinction at any time. Although some species are naturally rare, the poor survivorship of *P. hispida* suggests that the requisite biological or ecological needs of the species are not being met under current conditions. The reasons for the poor survivorship and low reproduction rates observed in the species are not known.

- **Lack of mature reproductive individuals (Factor E).** A total of about 320 individuals of *Phyllostegia hispida* are currently known to exist, there are only 20 mature wild individuals, an unknown number of wild seedlings, and less than 300 reintroduced individuals. The shortage of reproductive individuals and the skewed age-structure of the population toward young plants pose a significant threat to the species, as recruitment and the consequences of small population size may not be sufficient to offset mortality in the population (USFWS 2009). The decline of successful reproduction in *P. hispida* could lead to the extirpation of this species.

III. Recovery

A. RECOVERY STRATEGY

The highest priority for the recovery of *Phyllostegia hispida* is the implementation of immediate recovery actions needed to protect and stabilize the known wild populations. These management actions include controlling introduced plant species and feral ungulates, seed collection and long-term seed

banking to protect the genetic resources of the species, the development and implementation of management plans, and reestablishment of populations within historical suitable habitat. Many of these actions are currently occurring.

Because a major threat to the species is its small population size and restricted distribution, an important component of recovery is increasing the size of the known population, and either finding additional populations or establishing additional populations within the estimated historical range of the species on Molokai. To ultimately recover *Phyllostegia hispida*, habitat must be protected and managed for natural expansion of the current population, and translocations must occur to reintroduce the species into portions of its former range that are unlikely to be naturally recolonized in the near future. Research into the specific habitat needs of *P. hispida*, identification of reintroduction sites, and development of propagation and reintroduction protocols must all take place before new populations are likely to be successful. Research on *P. hispida* is complicated by the small size and vulnerability of the population, and the scarcity of mature reproductive individuals.

Habitat degradation by feral pigs is another serious threat to *Phyllostegia hispida*. While rooting the soil in search of invertebrates and plant material, feral pigs directly affect this species by disturbing and destroying vegetative cover, trampling plants and seedlings, and possibly reducing or eliminating plant regeneration by damaging or eating seeds and seedlings. Feral pigs are also major disseminators of introduced plant seeds by carrying them internally or on their bodies, and they often carry the seeds into more pristine forests, further degrading the native ecosystem. The threat of habitat degradation by feral pigs can be addressed through fencing and/or hunting to control pigs.

A research program is also recommended for *Phyllostegia hispida* to study its growth and reproductive viability, determine the parameters of viable populations, and study the species' reproductive strategy and pollinators. A study should also be conducted on the possible pests and diseases affecting *P. hispida*, including herbivory by native caterpillars. This research should be designed to guide management practices.

B. RECOVERY GOALS AND OBJECTIVES

The goal of the recovery program is to establish a framework within which recovery actions are undertaken to ensure the long-term survival of *Phyllostegia hispida*, and to control or reduce the threats to the species to the extent that they no longer require the protections afforded by the Act and therefore warrant delisting. In order to downlist, the recovery plan identifies ways to protect *P. hispida* and enhance its habitat so that there will be an increased likelihood of the species persisting in the foreseeable future.

Given the current shortage of information about the biology and habitat requirements and the magnitude of current threats where *Phyllostegia hispida* occurs, only tentative criteria for stabilizing, downlisting, and delisting are established here. These criteria were formulated based on recommendations from individuals on 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 knowledgeable biologists and individuals.

Our immediate recovery objective is to stabilize all existing populations of this species. To be considered stable, the species must be managed to control threats (e.g., fenced) and be represented in an *ex situ* population (such as a nursery or arboretum). In addition, a minimum of three populations 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. The long-term objectives leading to downlisting and delisting are an increase in populations through translocation to obtain a viable population size, development of appropriate management and monitoring plans at each site, and conservation agreements with landowners to ensure threats are controlled in perpetuity.

C. RECOVERY CRITERIA

Downlisting or delisting is warranted when a listed species no longer meets the definition of threatened or endangered under the Act. We set recovery

criteria to serve as objective, measurable guidelines to assist us in determining when a species has recovered to the point that the protections afforded by the Act are no longer necessary. However, the actual change in listing status is not dependent solely upon achieving the recovery criteria set forth in a recovery plan; it requires a formal rulemaking process based upon an analysis of the same five factors considered in the listing of a species (see Section I.F., Reasons for Listing and Current Threats). The recovery criteria presented in this recovery plan thus represent our best assessment of the conditions that would most likely result in a determination that downlisting or delisting of the *Phyllostegia hispida* is warranted based on the results of a formal five-factor analysis in a subsequent regulatory rulemaking. Criteria for downlisting and delisting may be revised, as necessary, if additional information provided by the recommended research projects and monitoring programs indicates that a change is appropriate.

1. Downlisting Criteria

Phyllostegia hispida may be considered for downlisting to threatened status when all of the following conditions have been met:

Criterion 1: Population size. A total of at least five populations of *Phyllostegia hispida* should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and threats must be managed so that a minimum of 300 mature individuals are maintained per population. Each population should persist at this level for a minimum of 5 consecutive years before downlisting is considered (Factor E, small population size and limited distribution).

Criterion 2: Management and monitoring plans. Habitat around each population must be managed to ensure that it will support the long-term persistence of *Phyllostegia hispida*. To achieve this, each of the five populations identified in criterion 1 will have a management and monitoring plan that will identify actions and procedures necessary to ensure that all threats are controlled and populations are increasing. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; Factor E, lack of

mature reproductive individuals; and Factor E, competition with invasive introduced plants).

Criterion 3: Habitat quality. All of the populations that meet the downlisting criterion 1 above shall be fenced and protected from ungulates, with agreements from conservation partners to maintain those protections in perpetuity. The agreements will also include provisions for invasive introduced plant removal, as appropriate, and adaptive management plans to address herbivory and habitat degradation by feral pigs and caterpillars and other unforeseeable threats. In addition, the agreements will include provisions for maximizing native plant biodiversity in these areas. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; and Factor E, competition with invasive introduced plants).

2. Delisting Criteria

Phyllostegia hispida may be considered for delisting when all of the following conditions have been met:

Criterion 1: Population size. A total of at least eight populations should be documented on Molokai. Each of these populations must be naturally reproducing, stable or increasing in number, and threats must be managed so that a minimum of 300 mature individuals are maintained per population. Each population should persist at this level for a minimum of 5 consecutive years prior to delisting and expected to remain so into the foreseeable future. (Factor E, small population size and limited distribution).

Criterion 2: Management and monitoring plans. Habitat around each population must be managed to ensure that it will support the long-term persistence of *Phyllostegia hispida*. To achieve this, each of the eight populations identified in criterion 1 will have a management and monitoring plan that will identify actions and procedures necessary to ensure that all threats are controlled and populations are increasing. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar

species; Factor E, small population size and limited distribution; Factor E, lack of mature reproductive individuals; and Factor E, competition with invasive introduced plants).

Criterion 3: Habitat quality. All of the populations that meet the delisting criterion 1 above shall be fenced and protected from ungulates, with agreements from conservation partners to maintain those protections in perpetuity. The agreements will also include provisions for invasive introduced plant removal, as appropriate, and adaptive management plans to address herbivory and habitat degradation by feral pigs and caterpillars and other unforeseeable threats. In addition, the agreement will include provisions for maximizing native plant biodiversity in these areas. (Factor A, habitat degradation by invasive introduced plants and feral pigs; Factor C, herbivory by feral pigs and unknown native caterpillar species; Factor E, small population size and limited distribution; and, Factor E, competition with invasive introduced plants).

D. RECOVERY ACTIONS

Recovery actions are taken from the Molokai Plant Cluster Recovery Plan and are summarized in Appendix A of this Addendum.

See the Molokai Plant Cluster Recovery Plan (USFWS 1996), beginning on page 65, for the outline of recovery actions for *Phyllostegia hispida*.

See the Molokai Plant Cluster Recovery Plan (USFWS 1996), beginning on page 67, for the narrative outline of recovery actions for *Phyllostegia hispida*.

IV. Implementation Schedule

The Implementation Schedule outlines the actions and estimated costs for the recovery program for *Phyllostegia hispida*, as set forth in this recovery plan. It is a guide for meeting the objectives and actions suggested in this plan. The Implementation Schedule includes the following elements:

A. DEFINITION OF ACTION PRIORITIES

Priorities in the Implementation Schedule are assigned according to the following definition for recovery actions:

- Priority 1** an action that must be taken to prevent extinction or to prevent a species from declining irreversibly in the foreseeable future.
- 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 meet the recovery objectives.

B. ACTION NUMBER AND DESCRIPTION

The action number and description are extracted from the recovery action narrative found in the original Molokai Plant Cluster Recovery Plan (USFWS 1996).

C. ACTION DURATION

The action duration column indicates the number of years estimated to complete the action if it is a discrete action, or if it is a continuous or ongoing action. Actions are defined as follows:

- C** Continuous; action will be implemented on an annual basis once it has begun.
- O** Ongoing; action is currently being implemented and will continue until no longer necessary for recovery.

D. RESPONSIBLE PARTIES

Section 7(a)(1) of the Act directs all Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of threatened and endangered species.

Recovery actions identified in this plan imply no legal obligations of State and local government agencies or private landowners. However, the recovery of *Phyllostegia hispida* may require the involvement and cooperation of Federal, State, local, and private interests. For each recovery action described, the column titled “Responsible Parties” lists the primary Federal and State agencies we have identified as having the authority and responsibility for implementing recovery actions and other groups, partners, and partnerships, who are actively involved in recovery implementation. However, the list of possible stakeholders is not limited to those below; other stakeholders are invited to participate. When more than one party has been identified, the proposed lead party is indicated by an asterisk (*). The listing of a party in the Implementation Schedule does not require, nor imply a requirement, that the identified party has agreed to implement the action(s) or to secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and is therefore considered a necessary action for the overall coordinated effort to recover *P. hispida*.

E. COST ESTIMATES

The Implementation Schedule provides total estimated costs of implementing recovery actions for fiscal years 2011 through 2015. Cost estimates for recovery actions are based on estimated time to delisting. The inclusion of estimated costs in this recovery plan does not commit any agency or party to an expenditure of funds. Therefore, initiation and completion of these actions is subject to the availability of funds, as well as other constraints affecting the stakeholders involved.

F. KEY TO ACRONYMS AND RESPONSIBLE PARTIES

BOT	Various Botanical Gardens (e.g., National Tropical Botanical Garden, Lyon Arboretum, Waimea Botanical Garden, etc.)
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Draft Recovery Plan for *Phyllostegia hispida*:
Addendum to the Molokai Plant Cluster Recovery Plan

BRD	U.S. Geological Survey, Biological Resources Discipline
DOFAW	Division of Forestry and Wildlife, Hawaii Department of Land and Natural Resources
HBMP	Hawaii Biodiversity and Mapping Program
HDOA	Hawaii Department of Agriculture
NPS	National Park Service
PEP	Plant Extinction Prevention Program
TNCH	The Nature Conservancy of Hawaii
USFWS	U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
1	111	Collect, propagate, and maintain <i>ex situ</i> genetic stock of taxa facing imminent extinction	O	PEP*	145.0	13	13	13	13	13
				DOFAW	66.0	5	5	5	5	5
				USFWS	50.0	5	5	5	5	5
				BOT	54.0	5	5	5	5	5
				NPS	66.0	5	5	5	5	5
1	112	Protect remaining wild individuals facing imminent extinction from immediate threats	O	DOFAW*	74.0	7	7	7	7	7
				USFWS	74.0	7	7	7	7	7
				TNCH	74.0	7	7	7	7	7
1	12	Identify and map all extant wild populations	O	DOFAW	34.0	5	5	5	2	2
				USFWS*	27.0	5	5	5	2	2
				TNCH	27.0	5	5	5	2	2
				NPS	27.0	5	5	5	2	2
				HBMP	49.0	15	10	5	2	22
1	13	Delineate management units	O	USFWS*	23.0	3	3	3	3	3
				DOFAW	13.0	1	1	1	1	1
				TNCH	13.0	1	1	1	1	1
				NPS	11.0	1	1	1	1	1
1	14	Ensure long-term protection of habitat	O	DOFAW*	31.0	3	3	3	3	3
				NPS	26.0	2	2	2	2	2
				TNCH	26.0	2	2	2	2	2
				USFWS	31.0	3	3	3	3	3

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
1	151	Construct and maintain fencing	C	DOFAW*	445.0	35	35	35	35	35
				NPS	290.0	35	35	35	35	35
				TNCH	290.0	35	35	35	35	35
				USFWS	290.0	35	35	35	35	35
1	152	Conduct introduced plant control	O	DOFAW*	385.0	35	35	35	35	35
				NPS	110.0	9	9	9	9	9
				TNCH	174.0	15	15	15	15	15
				USFWS	104.0	9	9	9	9	9
1	153	Provide fire protection, if necessary	C	DOFAW*	49.0	5	5	5	5	5
				NPS	35.0	3	3	3	3	3
				TNCH	35.0	3	3	3	3	3
				USFWS	35.0	3	3	3	3	3
1	154	Control rodents, if necessary	O	DOFAW*	55.0	7	7	7	7	7
				USFWS	40.0	4	4	4	4	4
				NPS	40.0	4	4	4	4	4
				TNCH	40.0	4	4	4	4	4
1	155	Propagate and maintain genetic stock of <i>P. hispida ex situ</i>	O	DOFAW*	280.0	29	29	29	29	29
				USFWS	82.0	5	5	5	5	5
				NPS	125.0	7	7	7	7	7
				BOT	125.0	7	7	7	7	7
1	156	Ensure availability of pollination vectors	C	DOFAW*	28.0	4	4			
				USFWS	28.0	4	4			

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
1	157	Protect areas from human disturbance	O	DOFAW*	94.0	9	9	9	9	9
				TNCH	68.0	5	5	5	5	5
				NPS	58.0	5	5	5	5	5
				USFWS	48.0	5	5	5	5	5
1	158	Control insects and/or disease, if necessary	O	DOFAW*	55.0	6	6	6	6	6
				TNCH	45.0	4	4	4	4	4
				HDOA	45.0	4	4	4	4	4
				NPS	31.0	4	4	4	4	4
				USFWS	31.0	4	4	4	4	4
1	159	Control all other threats	O	DOFAW*	56.0	6	6	6	6	6
				TNCH	46.0	4	4	4	4	4
				NPS	46.0	4	4	4	4	4
				USFWS	35.0	4	4	4	4	4
2	1512	Evaluate the potential for controlling ungulates through eradication programs or establishment of game preserves	10	DOFAW*	25.0	3	3	3	3	3
				USFWS	24.0	3	3	3	3	3
				NPS	25.0	3	3	3	3	3
				TNCH	26.0	3	3	3	3	3
2	21	Select populations for expansion	O	PEP*	15.0	1	1	1	1	1
				DOFAW	5.0	1	1	1	1	1
				USFWS	5.0	1	1	1	1	1
				NPS	5.0	1	1	1	1	1
				TNCH	5.0	1	1	1	1	1

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
2	22	Prepare sites and plant	0	PEP*	56.0	3	3	3	3	3
				DOFAW	15.0	3	3	3	3	3
				USFWS	15.0	3	3	3	3	3
				NPS	15.0	3	3	3	3	3
				TNCH	15.0	3	3	3	3	3
2	31	Collect diagnostic data on crucial associated ecosystem components	15	BRD*	77.0	13	13	13	13	13
				DOFAW	37.0	5	5	5	5	5
2	32	Map alien vegetation	0	BRD*	59.0	9	9	9	9	9
				DOFAW	30.0	5	5	5	5	5
				TNCH	32.0	5	5	5	5	5
				USFWS	30.0	5	5	5	5	5
2	33	Study various aspects of growth	0	BRD*	59.0	9	9	9	9	9
				DOFAW	25.0	5	5	5	5	5
				USFWS	25.0	5	5	5	5	5
				TNCH	25.0	5	5	5	5	5
2	34	Study reproductive viability	0	BRD*	59.0	9	9	9	9	9
				DOFAW	25.0	5	5	5	5	5
				USFWS	39.0	5	5	5	5	5
				TNCH	25.0	5	5	5	5	5
2	35	Determine parameters of viable populations	0	USFWS*	58.0	9	9	9	9	9
				DOFAW	45.0	9	9	9	9	9
				BRD	49.0	9	9	9	9	9

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
2	36	Determine effective control methods for insects and/or diseases, as needed	O	DOFAW*	39.0	5	5	5	5	5
				USFWS	24.0	4	4	4	4	4
				BRD	24.0	4	4	4	4	4
				TNCH	26.0	4	4	4	4	4
2	37	Evaluate results and use in future management	O	DOFAW*	22.0	1	1	1	1	1
				USFWS	22.0	1	1	1	1	1
3	4	Develop and maintain long-term monitoring program	C	DOFAW*	39.0	5	5	5	5	5
				NPS	24.0	3	3	3	3	3
				TNCH	44.0	3	3	3	3	3
				PEP	44.0	3	3	3	3	3
				BOT	43.0	3	3	3	3	3
				USFWS	24.0	3	3	3	3	3
3	51	Investigate feasibility and desirability of reintroduction, as needed	2	USFWS*	6.0		3		3	
				DOFAW	6.0		3		3	
				BRD	6.0		3		3	
3	52	Develop and implement a plan for reestablishment of <i>P. hispida</i>	O	DOFAW*	48.0	6	6	7	7	6
				USFWS	33.0	3	3	4	4	3
				PEP	33.0	3	3	4	4	3
				BRD	33.0	3	3	4	4	3
3	61	Determine number of populations and individuals needed for long-term survival	10	USFWS*	9.5	2.5	2.5	2.5		
				DOFAW	7.5	2.5	2.5	2.5		
				BRD	9.5	2.5	2.5	2.5		
3	62	Refine downlisting and	10	BRD*	9.5	2.5	2.5	2.5		

Implementation Schedule for <i>Phyllostegia hispida</i>										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties (* = lead)	Total Costs through 2031	Cost Estimate by FY (by \$1,000s)				
						FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
		delisting criteria		DOFAW	7.5	2.5	2.5	2.5		
				USFWS	9.5	2.5	2.5	2.5		
TOTAL	COST				6,227.0	684.0	688.0	670.0	649.0	636.0

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**APPENDIX A. Summary of Threats for *Phyllostegia hispida* and Recommended Recovery Actions
(Action numbers are taken from the Molokai Plant Cluster Recovery Plan).**

LISTING FACTOR	THREAT	RECOVERY CRITERIA	RECOVERY ACTIONS
A	Degradation of habitat by non-native plants species	2, 3	Protect remaining wild individuals facing imminent extinction from immediate threats, identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, map alien vegetation, conduct alien plant control (see Actions 112, 12, 13, 14, 1511, 32, 152)
A	Destruction and degradation of habitat by feral pigs	2, 3	Protect remaining wild individuals facing imminent extinction from immediate threats, identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, evaluate the potential for controlling ungulates through eradication programs or establishment of game preserves (see Actions 112, 12, 13, 14, 1511, 1512)
C	Herbivory by feral pigs	2, 3	Protect remaining wild individuals facing imminent extinction from immediate threats, identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, evaluate the potential for controlling ungulates through eradication programs or establishment of game preserves (see Actions 112, 12, 13, 14, 1511, 1512)
C	Herbivory by unknown native caterpillars	2, 3	Identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, control insects and/or disease, if necessary, determine effect of and control methods for insects and/or diseases, as needed (see Actions 12, 13, 14, 158, 36)

**APPENDIX A. Summary of Threats for *Phyllostegia hispida* and Recommended Recovery Actions
(Action numbers are taken from the Molokai Plant Cluster Recovery Plan).**

LISTING FACTOR	THREAT	RECOVERY CRITERIA	RECOVERY ACTIONS
E	Competition with introduced plants	2, 3	Protect remaining wild individuals facing imminent extinction from immediate threats, identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, conduct alien plant control, map alien vegetation (see Actions 112, 12, 13, 14, 1511, 152, 32)
E	Small population size and restricted distribution	1, 2, 3	Collect, propagate and maintain <i>ex situ</i> genetic stock of taxon facing imminent extinction, protect remaining wild individuals facing imminent extinction from immediate threats, identify and map all extant wild populations, delineate management units, ensure long-term protection of habitat, construct and maintain fencing, conduct introduced plant control, propagate and maintain genetic stock of <i>P. hispida ex situ</i> , control other threats, select populations for expansion, prepare sites and plant, ensure availability of pollination vectors, develop and maintain long-term monitoring programs, develop and implement specific plans for reestablishment, determine number of populations and individuals needed for long-term survival, refine downlisting and delisting criteria (see Actions 111, 112, 12, 13, 14, 151, 152, 155, 159, 21, 22, 156, 4, 52, 61, 62)

**APPENDIX A. Summary of Threats for *Phyllostegia hispida* and Recommended Recovery Actions
(Action numbers are taken from the Molokai Plant Cluster Recovery Plan).**

LISTING FACTOR	THREAT	RECOVERY CRITERIA	RECOVERY ACTIONS
E	Lack of reproductive individuals	1, 2, 3	Protect remaining wild individuals facing imminent extinction from immediate threats, 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, select populations for expansion, prepare sites and plant, ensure availability of pollination vectors, study reproductive viability, develop and maintain long-term monitoring programs, develop and implement specific plans for reestablishment, refine downlisting and delisting criteria (see Actions 112, 12, 13, 14, 1511, 152, 159, 156, 21, 22, 34, 4, 52, 62)

Listing Factors:

- A. Present or threatened destruction, modification, or curtailment of its habitat or range
- B. Overutilization for commercial, recreational, scientific, or educational purposes (not a threat factor for *Phyllostegia hispida*)
- C. Disease or predation
- D. Inadequacy of existing regulatory mechanisms (not a threat factor for *Phyllostegia hispida*)
- E. Other natural or manmade factors affecting its continued existence

**U.S. Department of the Interior
U.S. Fish & Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Blvd, Room 3-122
Honolulu, HI 96850**

<http://www.fws.gov>

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