Cyanea superba
(Haha)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

5-YEAR REVIEW
Cyanea superba (Haha)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the Fish and Wildlife Service between July 2005 and June 2006. The Hawaii Biodiversity and Mapping Program was contracted to provide updated information on the current status of *Cyanea superba*. They also provided recommendations for future actions that may be needed prior to the next 5-year review. The evaluation of the lead PIFWO biologist was reviewed by the Plant Recovery Coordinator, whose comments were incorporated into the draft 5-year Review. The draft 5-year Review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before PIFWO submission to the Regional Office.

B. Reviewers

Lead Region: Region 1

Lead Field Office: Pacific Islands Fish and Wildlife Office

C. Background

1. FR Notice citation announcing initiation of this review:

U.S. Fish and Wildlife Service. July 6, 2005. Endangered and Threatened Wildlife and Plants; Initiation of 5-year Reviews (of 33 species in Region 1). 70 FR 38972-38975.

2. Species status:

Stable (FY 2006 Recovery Data Call)

3. Recovery achieved:

1, meaning 0 - 25 percent of the identified recovery objectives for *Cyanea superba* have been achieved (FY 2006 Recovery Data Call)

4. Listing history

Original Listing

FR notice: U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; determination of endangered status for *Cyanea superba*, an Hawaiian plant. *Federal Register* 56(176): 46235-46239.
Date listed: September 11, 1991
Entity listed: Species
Classification: Endangered

Revised Listing, if applicable
N/A

5. Associated actions:
Critical habitat was designated for *Cyanea superba* in four units totaling 2,186 acres (883 hectares) on Oahu (U.S. Fish and Wildlife Service. 2003. Endangered and threatened wildlife and plants; final designations or nondesignations of critical habitat for 101 plant species from the island of Oahu, Hawaii. *Federal Register* 68(116): 35949-36406).

6. Review History: Just the original listing, designation of critical habitat, and recovery plan development actions.

7. Species' Recovery Priority Number at start of review: 5, meaning a species with a high degree of threat and a low recovery potential.

8. Recovery Plan or Outline
Name of plan: Recovery Plan for the Oahu Plants. 1998. U.S. Fish and Wildlife Service, Portland, Oregon. 207 pp. plus appendices.
Date issued: August 10, 1998
Dates of previous revisions: N/A
Some of the actions outlined in the Recovery Plan have been initiated but not completed (*e.g.*, construct exclosures to protect populations from feral pigs; control nonnative plants within fenced exclosures). Some recovery actions will require long-term commitments (*e.g.*, maintenance of exclosure fences; weed, rat, and slug control) or may only be necessary intermittently (*e.g.*, provide protection against fire).

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) Policy
This Policy does not apply to plant species.

B. Recovery Criteria
1. Does the species have a final, approved recovery plan?

__X__ *Yes*
No

2. Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria?
__X__ *Yes*
No

3. **Adequacy of recovery criteria.**

   a. **Do the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and its habitat?**

   __X__ *Yes*

   ___ *No*

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)?**

   __X__ *Yes.*

   ____ *No*

4. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.**

The threats (Factors A, C, and E) affecting this species are discussed in detail in section II.D. Factors B and D are not considered a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the Recovery Plan for Oahu Plants (Service 1998), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Cyanea superba* is a short-lived perennial, and to be considered stable, must be managed to control threats (e.g. fenced) (Factors A, C, and E) and be represented in an *ex situ* collection. In addition, a minimum of three populations should be documented on the island of Oahu where the species now occurs or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Cyanea superba* should be documented on the island of Oahu where it now occurs or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats (Factors A, C, and E), 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.

This recovery objective has not been met.

A)Present or threatened destruction, modification or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadqequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

For delisting, a total of 8 to 10 populations of *Cyanea superba* should be documented on the island of Oahu where it now occurs or occurred historically. Each of these populations must be naturally reproducing, stable, or increasing in number, and secure from threats (Factors A, C, and E), with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of 5 consecutive years before delisting is considered.

This recovery objective has not been met.

C. Synthesis

Historically, *Cyanea superba* was known from a collection prior to 1870 from the "Gulches of Makaleha on Mt. Kaala" in the Waianae mountains of Oahu (56 FR 46235). *Cyanea superba* includes two subspecies: subspecies *superba* and subspecies *regina*. Subspecies *regina* was documented from the southeastern Koolau mountains in the Honolulu area in 1932. Currently, there are no individuals of subspecies *regina* known to be extant in the wild or in cultivation (U.S. Army 2005). Subspecies *superba* has been documented from the northern Waianae mountains; in Kahanahaiki Valley, Pahole Gulch, Makaleha Valley, and the windward side of Mt. Kaala. After the initial collection from the Waianae mountains, there were no documented sightings of this taxon until its rediscovery in the Waianae mountains in 1971. At the time of listing, *C. superba* was known from 2 small populations in Pahole Gulch and Kahanahaiki Valley, totaling fewer than 20 individuals (56 FR 46235). When the Recovery Plan was published, two small populations were known, one of five individuals on the Makua Military Reservation in the Waianae mountains, and one population of fewer than five plants, which had been recently extirpated from Pahole Gulch in 1994 (Makua Implementation Team 2003). There was one individual extant at Kahanahaiki which was extirpated in 2002 (U.S. Army 2005). Currently, individuals are in cultivation, and some have been reintroduced into its historical range. The State has reintroduced this taxon with success at the Pahole Natural Area Reserve over the last 10 years, and The Nature Conservancy of Hawaii has also outplanted more than 150 individuals into 2 fenced exclosures in Honouliuli Preserve (TNCH 2006). Army outplantings began in 1999, with 251 individuals of *C. superba* outplanted at several sites in Kahanahaiki Valley. In 2005, survivorship varied from 35 to 80 percent. Seventy-eight of the plants were mature and beginning to flower in August 2005. Since 2001, 120 individuals have been outplanted in Pahole Gulch. Survivorship in 2005 was just over 60 percent and at least 12 plants had matured. In Kapuna Gulch, *C. superba* individuals were outplanted in 1997 and 1998 by state of Hawaii's Division of Land and Natural Resources staff, with additional individuals outplanted in 2001 by Army staff (Hawaii Division of Forestry and Wildlife 1996). As of 2005, a total of 45 reintroduced *C. superba* survived at the Kapuna Gulch outplanting sites, with at least 19 of them observed to be mature in 2004 (U.S. Army 2005). Reintroductions of *C. superba* at Central and East Makaleha, and at Makaha, will be initiated when threat controls are in place. Currently, the Army has over 50,000 seeds in storage that were collected from outplanted individuals.

Habitat degradation from and competition with invasive nonnative plant species is a major threat to *Cyanea superba* (Factors A and E) (56 FR 46235). The primary invasive nonnative plant

species impacting *C. superba* include *Aleurites moluccana* (kukui), *Blechnum appendiculatum*, *Clidemia hirta* (Koster's curse), *Eucalyptus* spp. (eucalyptus), *Grevillea robusta* (silk oak), *Melinus minutiflora* (molasses grass), *Paspalum conjugatum* (Hilo grass), *Psidium cattleianum* (strawberry guava), and *Schinus terebinthifolius* (Christmas berry) (Makua Implementation Team 2003, 68 FR 28053). Under the terms of the U.S. Fish and Wildlife Service's Biological Opinions for Routine Military Training at Makua Military Reservation and the subsequent 2003 Makua Implementation Plan, the Army plans to manage four outplanted populations of *Cyanea superba* in the Waianae mountains; one at Kahanahaiki, one between Pahole and Kapuna Gulches, one at Central and East Makaleha, and one at Makaha (Service 2001; Makua Implementation Team 2003; K. Kawelo, U.S. Army Environmental Division, *in litt.* 2006). The Army controls nonnative plants within the fenced areas and will initiate weed control in areas where fence construction is planned (U.S. Army 2005).

Habitat degradation by feral pigs (*Sus scrofa*) is considered one of the major threats to *Cyanea superba* throughout the Waianae mountains (Factor A) (U.S. Army 2005; 68 FR 28053). As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. The pig is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Oahu and inhabit rain forests and grasslands. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Feral pigs are a major vector in the spread of many introduced plant species (Smith 1985; Stone 1985; Medeiros *et al.* 1986; Scott *et al.* 1986; Tomich 1986; Cuddihy and Stone 1990; Wagner *et al.* 1999). Existing outplantings of *C. superba* in Kahanahaiki Valley, and in Kapuna and Pahole Gulches are included within fenced exclosures. Reintroductions in Central and East Makaleha Valleys and in Makaha Valley will commence only after the sites are fenced. The Army's goal is 100 percent exclusion of feral ungulates from these fenced areas (Makua Implementation Team 2003).

Fire is considered a threat to *Cyanea superba*, as this species occurs in mesic forests which often become very dry in the summer months, and *C. superba* is not considered fire tolerant (Factor A) (Service1998, 2004; 56 FR 46235). One potential cause of fire is from military training activities in Makua Military Reservation. The Army has addressed the threat of fire from their training actions by developing and implementing a fire management plan to minimize the number of ignitions in the reservation, to respond rapidly to any ignitions, and to maintain fire breaks to help contain any ignitions away from the endangered species locations (U.S. Army 2003). *Cyanea superba* is also threatened by fires ignited through arson (Makua Implementation Team 2003).

Feral pigs not only degrade the habitat of *Cyanea superba*, but also cause harm to the plants by feeding on them, trampling them, or uprooting them in search of invertebrate food (Factor C) (Service 2001, 2004; U.S. Army 2003; 56 FR 46235). Conservation measures have been initiated at Army and The Nature Conservancy of Hawaii (TNCH) outplantings to reduce the

threat of predation by feral pigs.

Rats (*Rattus* spp.) are considered one of the major threats to *Cyanea superba* (Factor C) (Service 1998; U.S. Army 2005). Rats occur on all the main Hawaiian Islands around human habitations, in cultivated fields, and in dry to wet forests. Rats are known to eat the fruit and strip the bark of some native plants, particularly fruits of plants in the bellflower (Campanulaceae) family with fleshy stems and fruits (Tomich 1986; Cuddihy and Stone 1990). The Army conducts rat control at the Kahanahaki and Honouliuli Preserve (TNCH) outplanting sites (U.S. Army 2005).

Introduced slugs also pose a threat to seedlings and young plants of *Cyanea superba* (Factor C) (Service 1998; U.S. Army 2005). Field experiments conducted by Alvin Yoshinaga and Curt Daehler demonstrated that slugs could reduce the survival of *Cyanea* spp. seedlings by as much as 80 percent (U.S. Army 2005). Graduate student Stephanie Joe has been recently hired by the Army as a Natural Resources Research Specialist, and included among her duties is the investigation of control of slug herbivory. Her research on slug impacts on *Cyanea* seedlings has revealed similar levels of mortality, approximately 53 percent (Joe 2006). There has been no evidence of recruitment of *C. superba* in the wild and this is attributed to very high slug predation levels (Joe 2006).

In addition to all of the other threats, species like *Cyanea superba* that are endemic to single small islands 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 and disease outbreaks (Factor E).

The Army is addressing the threat to this species from the small number of populations and the small population sizes through genetic storage and propagation for eventual reintroduction of individuals throughout its former range in the Waianae mountains (U.S. Army 2005). Propagation for genetic storage and reintroduction is occurring in the Army's baseyard, the University of Hawaii's Lyon Arboretum Micropropagation and Seed Storage Laboratories, the National Tropical Botanical Garden, and at the State of Hawaii's Division of Forestry and Wildlife's Pahole Rare Plant Facility (Service 2005; U.S. Army 2005). The goal for genetic storage of *C. superba* is to collect and store material representing each of the founder plants from which the extant cultivated and outplanted individuals are descended. This goal has been partially met (U.S. Army 2005). Genetic studies were conducted, and even though the genetic variability is low, *C. superba* does not show signs of inbreeding depression, as plants grow vigorously and produce viable seed (U.S. Army 2005). Reintroductions of *C. superba* at Central and East Makaleha, and at Makaha, will be initiated when threat controls are in place. Currently, the Army has over 50,000 seeds in storage that were collected from outplanted individuals.

Native bees tentatively identified as *Hylaeus connectans* have been observed visiting the flowers of *Cyanea superba*, and appear to pollinate the flowers. An introduced bird, the Japanese White-eye (*Zosterops japonicus*), has been observed robbing nectar from *C. superba* flowers, and in doing so, appears to occasionally act as a pollinating agent for the species (U.S. Army 2005).

The goals for genetic storage of *Cyanea superba* have been partially met. While the Army has initiated several actions to protect *C. superba* and the species has reached the stabilization

numbers, the threats have not all been controlled and genetic storage is not complete. The downlisting, and recovery goals for this species have not been met and, therefore, *C. superba* meets the definition of endangered as it remains in danger of extinction throughout all of its range.

III. RESULTS

A. Recommended Classification:

____ Yes, downlist to Threatened
____ Yes, uplist to Endangered
____ Yes, delist
__X__ No, no change is needed

B. New Recovery Priority Number NA

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

In the future, plants descended from under-represented wild founder plants should be used to supplement existing outplantings of *Cyanea superba* in order to maximize genetic diversity of the populations.

- Study *Cyanea superba* populations with regard to flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.

- Reintroduce additional populations of *Cyanea superba* within its historical range.

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EXPERTS CONSULTED

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Cyanea superba* (Haha)

Current Classification __Endangered__

Recommendation resulting from the 5-Year Review

Downlist to Threatened
Uplist to Endangered
____ Delist
_X__ No change is needed

Appropriate Listing/Reclassification Priority Number _N/A_

Review Conducted By

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Approve _____ Date Aug 2 2007
Regional Director, Fish and Wildlife Service