5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Cyanea glabra* (haha)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:
[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

Lead Region/Field Office:
Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii

Name of Reviewer(s):
Marie Bruegmann, Plant Recovery Coordinator, PIFWO
Jess Newton, Recovery Program Lead, PIFWO
Assistant Field Supervisor for Endangered Species, PIFWO

Methodology used to complete this 5-year review:
This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning on March 16, 2009. The review was based on final critical habitat designations for *Cyanea glabra* and other species from the island of Maui (USFWS 2003) as well as a review of current, available information. The National Tropical Botanical Garden provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The evaluation of Samuel Aruch, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Lead and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

Background:
For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

Application of the 1996 Distinct Population Segment (DPS) Policy:
This Policy does not apply to plants.

Review Analysis:
Please refer to the final critical habitat designations for *Cyanea glabra* published in the Federal Register on May 14, 2003 (USFWS 2003) for a complete review of the species' status (including biology and habitat), threats, and management efforts. No new threats and no significant new information regarding the species biological status have come to light since listing to warrant a change in the Federal listing status of *C. glabra*.

At the time of listing in 1999, there were 212 known individuals of *Cyanea glabra* (USFWS 1999). Currently, there are no confirmed *C. glabra*. All populations need further taxonomic study (D. Lorence, National Tropical Botanical Garden, pers. comm. 2010; H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2009, 2010).

On East Maui, 5 individuals in fruit, believed to be *Cyanea glabra*, were observed in 2005 in east Kopiliula within Koolau Forest Reserve at 1,189 meters (3,900 feet) elevation (Wood et al. 2005). During the Koolau Forest Reserve surveys in November 2007, a large population of 400 individuals was seen in the east fork of West Wailua Iki Gulch, which was believed to represent a new island record for this species. The plants were then in flower and both collectors made specimens which went to Bishop Museum and the National Tropical Botanical Garden. Oppenheimer does not believe any of these are *C. glabra*. Further close examination of these specimens and comparison with the type collection is needed (H. Oppenheimer, pers. comm. 2009). So far, no determination has been made.

Haleakala National Park notes collections and reintroductions of a species thought to be *Cyanea glabra* from Kipahulu in annual reports from 2004 through 2007 (Haleakala National Park Resource Management, Vegetation Management 2004, 2005, 2006, 2007), but it is not known if these individuals have been examined to determine if they are actually the newly published species *C. maritae*. Haleakala National Park has been calling these plants *Cyanea* aff. *glabra*, meaning they have affinities to *C. glabra* but do not match the description perfectly. Oppenheimer has visited some of the plants in Kipahulu Valley with National Park staff , and they appear to be closer to *C. maritae* (H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2009, 2010).

On West Maui, *Cyanea glabra* occurs in both forks of Kauaula Valley. Steve Perlman and Natalia Tangalin of the National Tropical Botanical Garden, accompanied by Hank Oppenheimer of the Plant Extinction Prevention Program, observed 10 individuals in the south fork area in 2004 at 823 to 835 meters (2,700 to 2,740 feet) elevation (Perlman 2009). In the north fork area, in 2008, Perlman and Oppenheimer observed about 30 flowering individuals, scattered along the stream, at 866 meters (2,840 feet) elevation (Perlman 2009). In 2009, they saw 45 individuals that they numbered and tagged, and 4 seedlings at 890 meters (2,920 feet) elevation (Perlman 2009). Oppenheimer and David Lorence of the National Tropical Botanical Garden believe this population represents a new, undescribed species related to *Cyanea acuminata* of Oahu (H. Oppenheimer, pers. comm. 2009; D. Lorence, National Tropical Botanical Garden, pers. comm. 2010).

The plants from Kipahulu and Kaapahu that have been previously called *Cyanea glabra* have now been identified as the newly described *C. maritae* (Steve Perlman, National Tropical Botanical Garden. pers. comm. 2009). Perlman saw plants in Kaapahu which had been identified as *C. glabra*, but which he now believes are *C. maritae* (S. Perlman, pers. comm. 2009). Distinguishing this species from *C. glabra* is not possible unless the plants are in flower (Hawaii Department of Land and Natural Resources 2008). The only recent specimens that are annotated as *C. glabra* are a series of collections made by Betsy Gagne in Waihoi Valley, East Maui, in the 1970s, which are deposited in the Bishop

Museum Herbarium (H. Oppenheimer, pers. comm. 2009). Evidently the *C. glabra* collections from Kauaula were annotated as such by Thomas Lammers (a lobeliad expert), but they exactly fit the description of the holotype. Oppenheimer believes it is an undescribed species allied to *C. acuminata* of Oahu. It does not resemble *C. glabra* since the flowers are tubular and 3 to 4 millimeters wide (0.118 to 0.157 inches) and 7 to 8 millimeters (.276 to .315 inches) long and not laterally flattened, and the leaves are not lobed, as well as differing in several other characteristics (H. Oppenheimer, pers. comm. 2009). Oppenheimer and David Lorence of the National Tropical Botanical Garden are organizing the specimens and may describe and publish this population as a new species, *C. kauaulaensis* (D. Lorence, pers. comm. 2009, 2010).

On West Maui in the south fork of Kauaula Valley, the habitat is *Metrosideros polymorpha* (ohia) wet forest with *Cheirodendron trigynum* (olapa), *Clermontia kakeana* (haha), *Coprosma* sp. (pilo), *Cyrtandra grayana* (no common name), *Diplazium sandwichianum* (pohole), *Kadua acuminata* (au), *Myrsine lessertiana* (kolea lau nui), *Pipturus albidus* (mamake), *Psychotria* sp. (kopiko), *Sadleria cyatheoides* (amau), *Wikstroemia oahuensis* (akia), and *Xylosma hawaiiense* (ae) (Perlman 2009).
In the north fork of Kauaula Valley, the habitat is *Metrosideros polymorpha* wet forest with these same species and additionally with *Adiantum capillus–veneris* (iwa iwa), *Boehmeria grandis* (akolea), *Carex meyenii* (no common name), and *Dubautia plantaginea* (naenae) (Perlman 2009). There is good evidence that at least one Kauaula population of *Cyanea* represents a previously undescribed taxon and is not *C. glabra* (D. Lorence, pers. comm. 2009).

The habitat in which *Cyanea glabra* occurs on East Maui is wet forest with *Metrosideros polymorpha* and *Acacia koa* (koa) forming the canopy with an understory of uluhe mat ferns dissected by riparian vegetation. Associated species include *Boehmeria grandis, Broussaisia arguta* (kanawao), *Cheirodendron trigynum* (olapa), *Christella cyatheoides* (palapalai), *Clermontia arborescens* (oha wai nui), *Coprosma* spp., *Cyrtandra* sp. (keokeo haiwale), *Ilex anomala* (kawau), *Kadua acuminata*, *Leptecophylla tameiameiae* (pukiawe), *Melicope* spp. (alani), *Myrsine lessertiana*, *Perrottetia sandwicensis* (olomea), *Rubus hawaiensis* (akala), and *Scaevola chamissoniana* (naupaka kuahiwi). Ferns and bryophytes are common (USFWS 2002; Wood 2009).

Pigs (*Sus scrofa*) (Listing Factor A and D) and flooding (Listing Factor E) are threats to *Cyanea glabra* habitat on East Maui (USFWS 2002). Invasive introduced plants which compete with this species and degrade the habitat include *Ageratina adenophora* (sticky snakeroot), *A. riparia* (spreading mist flower), *Buddleia asiatica* (dog tail), *Clidemia hirta* (Koster's curse), *Coffea arabica* (coffee), *Cordyline fruticosa* (ti), *Erigeron karvinskianus* (daisy fleabane), *Hedychium gardnerianum* (Kahili ginger), *Oplismenus hirtellus* (basketgrass), *Rubus argutus* (blackberry) *R. rosifolius* (thimbleberry), and *Tibouchina herbacea* (glory bush) (Listing Factor A and E) (Perlman 2009; Wood 2009). On West Maui, invasive introduced plants include *Coffea arabica* (coffee) and *Erigeron karvinskianus* (daisy fleabane). In Waihoi, they include *Hedychium coronarium* (white ginger) and *Miconia calvescens* (miconia) (Listing Factor A and E) (H. Oppenheimer, pers. comm. 2009).

Seed predation by rats (*Rattus rattus*), and eating of leaves and stems by slugs (various species) and two-spotted leafhoppers (*Sophonia rufofascia*) are primary threats to this rare species (Listing Factor C) (Perlman 2009; USFWS 2002). Climate change may also pose a threat to this species (Listing Factors A and E). However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to all of the other threats, species like *Cyanea glabra* 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 (Listing Factor E). The extent of these natural processes on this single island endemic are exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (Listing Factor E) (USFWS 2002).

Haleakala National Park has 21 propagules of *Cyanea glabra* in their nursery (Haleakala National Park 2010). The Lyon arboretum seed bank has 1096 seeds in storage (Center for Conservation Research and Training 2009). The Lyon Arboretum Micropropagation Laboratory has 237 propagules in storage (Harold L. Lyon Micropropagation Laboratory 2009) The National Tropical Botanical Garden has 135 seeds collected from Kopiliula, Maui in storage (National Tropical Botanical Garden 2010).

The current focus of the East Maui Watershed Partnership includes control of *Miconia calvescens* (in concert with the Maui Invasive Species Committee), fencing, and removal of feral pigs across the upper elevations of the watershed above 1,065 to 1,220 meters (3,500 to 4,000 feet) (USFWS 2002). Currently, the East Maui Watershed Partnership is building a fence at 914 meters (3,000 feet) elevation across Waihoi Valley in East Maui (H. Oppenheimer, pers. comm. 2009).

Stabilizing, downlisting, and delisting objectives are provided in the addendum to the recovery plan for the Maui plant cluster (USFWS 2002), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Cyanea glabra* is a short-lived perennial, and to be considered stabilized, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and be represented in an *ex situ* (off-site) collection. In addition, a minimum of three populations should be documented on islands where they now occur or occurred historically. For the species to be considered stable, each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

The interim stabilization goals for this species have not been met. No individuals are currently known that match this species' description, although some historical sites have

not been recently surveyed and additional individuals are expected to be found there (Table 1). In addition, all threats are not being managed (Table 2). Therefore, *Cyanea glabra* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Survey Waihoi Valley to relocate plants documented in 1970s.
- Determine taxonomic status of all populations that may be *Cyanea glabra*.
- Collect propagules for reintroduction and genetic storage when true *Cyanae glabra* are found.
- Fence wild populations to exclude ungulates in any discovered populations.
- Control rats within any discovered populations.
- Reintroduce populations within protected suitable habitat.
- Develop and implement an effective control method for slugs.
- Develop and implement effective control methods for the two-spotted leaf hopper.
- Control invasive introduced plants competing with any *Cyanea glabra* found.
- Work with Haleakala National Park, East Maui Watershep Partnership, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

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Table 1. Status of *Cyanea glabra* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1999 (listing)	235	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2002 (recovery plan)	12	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	12	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2010 (5-year review)	0	0	All threats managed in all 3 populations	No (Table 2)
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No

Table 2. Threats to *Cyanea glabra* habitat.

Threat	**Listing factor**	**Current Status**	**Conservation/ Management Efforts**
Ungulates – habitat modification and herbivory	A, D	Ongoing	Partially: Most potential populations are within large scale East Maui Watershed Partnership fences
Rats – herbivory	C	Ongoing	No
Slugs – herbivory	C	Ongoing	No
Two spotted leaf hopper – herbivory	C	Ongoing	No
Invasive introduced plants	A, E	Ongoing	Partially: only *Miconia calvescens* control
Small population size	E	Ongoing	No
Climate change	A, E	Increasing	No

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SIGNATURE PAGE for 5-YEAR REVIEW of *Cyanea glabra* (haha)

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

_____	Delisting
_____	Reclassify from Endangered to Threatened status
_____	Reclassify from Threatened to Endangered status
X	No Change in listing status

Field Supervisor, Pacific Islands Fish and Wildlife Office

Date 6/2/11