

Cyanea mauiensis
(hāhā)

**5-Year Review
Summary and Evaluation**

**U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai‘i**

5-YEAR REVIEW
Species reviewed: *Cyanea mauiensis* (hāhā)

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5-YEAR REVIEW

***Cyanea mauiensis* (hāhā)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Cooperating Field Office(s):

N/A

Cooperating Regional Office(s):

N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service), beginning in October 2019. The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation of Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088-20092, May 7, 2018.

1.3.2 Listing history:

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; determination of endangered status for 38 species

on Molokai, Lanai, and Maui; final rule. Department of the Interior, Federal Register 78 (102): 32014–32065, May 28, 2013.

Date listed: May 28, 2013

Entity listed: *Cyanea mauiensis*

Classification: Endangered

Revised Listing, if applicable

FR notice: N/A

Date listed: N/A

Entity listed: N/A

Classification: N/A

1.3.3 Associated rulemakings:

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe; final rule. Department of the Interior, Federal Register 81 (61): 17790–18110, March 30, 2016.

Critical habitat for *Cyanea mauiensis* was found to be undeterminable, as this species had not been collected or observed in more than 100 years.

1.3.4 Review History:

This is the first 5-year review for *Cyanea mauiensis*.

1.3.5 Species' Recovery Priority Number at start of this 5-year review:

2

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: Recovery Outline for the Islands of Maui, Moloka'i, Kaho'olawe, and Lāna'i (Maui Nui)

Date issued: October 2019

Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

Yes

No

2.1.2 Is the species under review listed as a DPS?

Yes

No

2.1.3 Was the DPS listed prior to 1996?

Yes
 No

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

Yes
 No

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

Yes
 No

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

Yes
 No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes
 No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery?

Yes
 No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

A synthesis of the threats (Listing Factors A, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2. Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

The recovery plan is currently being drafted. However, the Hawai'i and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and goals for stages leading towards recovery (2011). These stages are described below.

Current information is lacking for many Hawaiian plant species on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. The following downlisting and delisting criteria for plants have therefore been adopted from the revised recovery objective guidelines developed by the HPPRCC (2011). Many of the Hawaiian plant species are at very low numbers, so the Service also developed criteria for avoiding imminent extinction and an interim stage before downlisting, based on the recommendations of the HPPRCC, to assist in tracking progress toward the ultimate goal of recovery. These criteria are assessed on a species-by-species basis, especially as additional information becomes available.

In general, long-lived perennials are those taxa either known or believed to have life spans greater than 10 years; short-lived perennials are those known or believed to have life spans greater than one year but less than 10 years; and annuals are those known or believed to have life spans less than or equal to one year. When it is unknown whether a species is long- or short-lived, the Service has erred on the side of caution and considered the species short-lived. This will be revised as more is learned about the life histories of these species. Narrow extant range and broad contiguous range are recognized as not needing different numbers of individuals or populations, but that the populations will be distributed more narrowly or more broadly, respectively, across the landscape. Obligate outcrossers are those species that either have male and female flowers on separate plants or otherwise require cross-pollination to fertilize seeds, and therefore require equal numbers of individuals contributing to reproduction as males and females, doubling the number of mature individuals. Species that reproduce vegetatively may reproduce sexually only on occasion, resulting in the majority of the genetic variation being between populations, therefore requiring additional populations. Species that have a tendency to fluctuate in number from year to year require a larger number of mature individuals on average to allow for decline in years of extreme habitat conditions and recuperation in numbers in years of more normal conditions.

Preventing Extinction

Stabilizing (interim), downlisting, and delisting objectives have been updated according to the draft revised recovery objective guidelines developed by the HPPRCC (2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of

populations and reproducing individuals for each stage. The goals for each stage remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Cyanea mauiensis is a short-lived perennial shrub. To prevent extinction, which is the first milestone in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections. In addition, a minimum of three populations should be documented on Maui where they now occur or occurred historically. Each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings and increasing in number, with a minimum of 50 mature individuals per population).

This recovery objective has not been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Cyanea mauiensis*, 300 mature individuals are needed in each of three populations and all major threats must be controlled around the populations designated for recovery at this stage. There should also be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the target populations. The populations must be adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation's guidelines (Guerrant *et al.* 2004). Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

This recovery objective has not been met (see Table 1).

Downlisting Criteria

In addition to achieving 5 to 10 populations with 500 mature individuals per population and all of the goals of the interim stage, all target populations must be stable, secure, and naturally reproducing for a minimum of 10 years. Species-specific management actions are not ruled out. Downlisting should not be considered until an adequate population viability analysis (PVA) has been conducted to assess needed numbers more accurately based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to downlist. Information necessary for the PVA that should be available through monitoring (ideally annually) includes major limiting factors, breeding system, population structure and density, and proven management methods for major threats.

This recovery objective has not been met (see Table 1).

Delisting Criteria

In addition to achieving 5 to 10 populations with 500 mature individuals per population and all of the goals of the interim and downlisting stages, all target populations must be stable, secure, naturally reproducing, and within secure and viable habitats for a minimum of 20 years. Species-specific management actions must no longer be necessary, but ecosystem-wide management actions are not ruled out if there are long-term agreements in place to continue management. These numbers are initial targets, but may be revised upward as additional information is available, including adequate PVAs for individual species based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to delist. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis.

This recovery objective has not been met (see Table 1).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Cyanea mauiensis, a member of the Campanulaceae (bellflower) family, is a branching shrub found on west Maui (Lammers 2004). Features specific to this species (separate from those of *C. grimesiana*) include: a bell-shaped structure formed by fusion of the calyx, corolla and stamens rounded or truncate at the base, a corolla 7.5 to 12 times longer than this structure with lobes as long as the tube or longer, and dorsal anthers 15 to 16 millimeters long (Lammers 2004).

Little is known about the life history of *Cyanea mauiensis*. Its flowering cycles, pollination vectors, seed dispersal agents, specific environmental requirements, and limiting factors are unknown. Some biological characteristics, such as pollination vectors, may be extrapolated from information that is known about other related endemic Hawaiian plants in the genus *Cyanea*. *Cyanea* and other lobelioids coevolved with Hawaiian honeycreeper (Drepanididae) and honeyeater (Melliphagidae) bird species that served as pollinators (Lunau 2004, p. 210).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Historically, *Cyanea mauiensis* was found on east and west Maui (Hillebrand 1888; Rock 1919). At the time of listing in 2013, and

currently, there are no known occurrences (78 FR 32014). There is some hesitation to classify this species as extinct, as no systematic surveys have been conducted in its historic habitat. In addition, a survey in degraded habitat on east Maui revealed at least three other very rare plant species (near the site of an historic collection of *C. mauiensis* at Nāhiku), and a west Maui survey revealed a plant very similar to *C. mauiensis* or *C. magnicalyx*, but as it was vegetative, a determination could not be made (Oppenheimer 2019, in litt.).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

A genetic study was conducted in 2014 to estimate genetic variation and spatial genetic structure in two common Hawaiian lobelioids, *Cyanea pilosa* subsp. *longipedunculata* and *Clermontia fauriei*. The study found a general lack of genetic diversity in these lobelioids that may reflect pre-existing conditions in this group or selfing in response to a decline in native avian pollinators, raising concerns that inbreeding and loss of genetic variation may be occurring in rare species of *Cyanea*, including *C. mauiensis* (Jennings *et al.* 2015, p. 5).

2.3.1.4 Taxonomic classification or changes in nomenclature:

Initially, *Cyanea grimesiana* subsp. *grimesiana* encompassed all occurrences on Moloka‘i, Lāna‘i, Maui, and O‘ahu. In a revision of the genus by Lammers (1998), plants of subspecies *grimesiana* from Lāna‘i and most of those from Moloka‘i were segregated as *C. mauiensis*. Concurrently, *C. grimesiana* subsp. *cylindrocalyx* of the island of Hawai‘i was elevated to *C. cylindrocalyx*, and those occurring on the Wai‘anae mountains of O‘ahu were maintained as *C. grimesiana* subsp. *obatae*. Some specimens from west Maui were referable to the *C. grimesiana* complex, but lacked distinctive features of *C. mauiensis* described above. Those on Moloka‘i and Lāna‘i are now *C. munroi*.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species’ within its historic range, etc.):

See section 2.3.1.2 and 2.3.1.4, above, for spatial distribution of the species.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Cyanea mauiensis may have occurred in lowland mesic to dry cliff habitat on west Maui, and possibly in lowland wet habitat on east Maui; however, this species has not been observed in over 100 years. The species-specific habitat needs for *C. mauiensis* are not known.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range (Factor A):

Ungulate degradation of habitat—Feral ungulates modify and degrade habitat by disturbing and destroying vegetative cover, trampling plants and seedlings, reducing or eliminating plant regeneration by damaging seeds and seedlings, and increasing erosion by creating large areas of bare soil (Loope 1998; van Riper and van Riper 1982). Feral pigs (*Sus scrofa*) and Axis deer (*Axis axis*) and evidence of their activities are observed in the area where *Cyanea mauiensis* was last observed on west Maui (West Maui Mountains Watershed Partnership (WMMWP) 2013).

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive introduced plant species 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 (Cuddihy and Stone 1990). Habitat modification and destruction by invasive nonnative plants negatively affects historic habitat of *Cyanea mauiensis* (WMMWP 2013). Nonnative plants with the greatest impacts on this habitat include *Clidemia hirta* (Koster's curse), *Tibouchina herbacea* (cane tibouchina, glorybush), *Cortaderia* spp. (pampas grass), *Sphaeropteris cooperi* (Australian tree fern), *Psidium cattleianum* (strawberry guava), and *Rubus argutus* (prickly Florida blackberry) (WMMWP 2013, pp. 53–55).

Landslides, erosion, and flooding destruction or degradation of habitat—Landslides are a threat to *Cyanea mauiensis* as the last known habitat of this species was on steep cliffs and along gullies (HBMP 2010). Landslides, including tree falls and erosion associated with them, can have a significant effect on small populations by destabilizing substrate, altering hydrological patterns, and by damaging and destroying individual plants (Stearns 1985).

Fire destruction and degradation of habitat—Fire can destroy dormant seeds as well as individual plants. Successive fires burn farther and farther into native habitat and alter microclimate conditions to further alter habitat conditions to favor nonnative plants. Nonnative plants convert native plant communities to nonnative dominated plant communities (D'Antonio and Vitousek 1992; Tunison *et al.* 2002). Increasing episodes of drought, expansion of invasive grass cover, and temperature increases, have led to an increase in the number of wildfires on Maui (Trauernicht *et al.* 2015). Fire is a potential threat to any possibly existing individuals of *Cyanea mauiensis*.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):

Not a threat.

2.3.2.3 Disease or predation (Factor C):

Herbivory and predation by slugs—Research and field observations indicate that herbivory by slugs is a threat to all species of *Cyanea* in the wild, and is a threat to any possibly remaining individuals of *C. mauiensis* (Joe 2006).

Herbivory and predation by rats—Herbivory and predation by rats is a known threat to other Hawaiian *Cyanea* species, and is a threat to any possibly remaining individuals of *C. mauiensis* (Russell 1980; Cuddihy and Stone 1990).

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

Lack of adequate hunting regulations—The last known historical occurrence of *Cyanea mauiensis* was within a State hunting area (HBMP 2010; Department of Land and Natural Resources (DLNR) 2010).

Nonnative feral ungulates are an ongoing threat to this species through destruction and modification of habitat and direct predation. The area of historic occurrence is not fenced and feral pigs and axis deer have been noted as a threat to this species' habitat (WMMWP 2013). Game mammals have unrestricted access for most areas across the landscape, regardless of underlying land use designation; therefore, any possibly remaining individuals of *C. mauiensis* are at risk (DLNR 2010).

2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):

Reduced viability due to low numbers—Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (Barrett and Kohn 1991; Newman and Pilson 1997). The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic interactions with other threats, such as anthropogenic impacts like habitat loss from human development or predation by nonnative species. Very small plant populations may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression. Currently, there are no known individuals of *Cyanea mauiensis* remaining in the wild (Oppenheimer 2019, in litt.).

Current Management Actions:

- Surveys and monitoring—PEPP regularly surveys areas of west and east Maui (Oppenheimer 2019, in litt.).
- The WMMWP coordinates landowner efforts to protect important watershed areas, including ungulate control, fencing, and nonnative plant control that may benefit any possibly remaining individuals of *C. mauiensis* (WMMWP 2013).

Table 1. Status and trends of *Cyanea mauiensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2013 (listing)	0	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2016 (critical habitat, none designated)	0	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2020 (5-year review)	0	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No

Table 2. Threats to *Cyanea mauiensis* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, exclosures proposed for area
Established ecosystem-altering invasive plant modification and degradation of habitat	A	Ongoing	Partial, exclosures and management proposed for area
Fire destruction and degradation of habitat	A	Ongoing	None

Herbivory and predation by slugs	C	Ongoing	None
Herbivory and predation by rats	C	Ongoing	None
Lack of adequate hunting regulations	D	Ongoing	None
Reduced viability due to low numbers	E	Ongoing	None

2.4 Synthesis

There are no known wild individuals of *Cyanea mauiensis*. No plants were discovered on recent surveys of historical habitat. There is no genetic material in collections or storage.

Preventing extinction, interim stabilization, downlisting, and delisting objectives are provided in HPPRCC's Revised Recovery Objective Guidelines (2011). To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on Maui where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, or saplings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There are no known individuals, no genetic material in storage or propagation (Table 1), and not all threats are being sufficiently managed throughout the historic range of the species (Table 2). Therefore, *Cyanea mauiensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: _____

Reclassification (from Endangered to Threatened) Priority Number: _____

Delisting (regardless of current classification) Priority Number: _____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Surveys and inventories—Continue to conduct surveys for *Cyanea mauiensis* in historical locations and potentially suitable habitat.
- Ungulate monitoring and control—Construct and maintain fenced exclosures to protect suitable habitat from the negative impacts of feral ungulates.
- Invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *C. mauiensis* in suitable and historical habitat.
- Alliance and partnership development—Contribute to planning and implementation of ecosystem-level restoration and management to benefit this taxon.

5.0 REFERENCES

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

Cheryl Phillipson, Fish and Wildlife Biologist, PIFWO
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Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

for _____
Field Supervisor, Pacific Islands Fish and Wildlife Office