Pleomele hawaiiensis
(Hala pepe)

5-Year Review
Summary and Evaluation

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

5-YEAR REVIEW
Species reviewed: *Pleomele hawaiiensis* (Hala pepe)

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5-YEAR REVIEW
***Pleomele hawaiiensis* (Hala pepe)**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:
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Lead Field Office:
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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 (USFWS), beginning on April 8, 2010. The review was based on the designation of critical habitat for *Pleomele hawaiiensis* and the Big Island II: Addendum to the recovery plan for the Big Island plant cluster (USFWS 2003, 1998), as well as a review of current, available information. The Bernice Pauahi Bishop Museum 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 a recovery biologist and the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

1.3 Background:

1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; 5-year review status of 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1996. Endangered and threatened wildlife and plants; determination of endangered or threatened status for thirteen plant species from the island of Hawaii, State of Hawaii; final rule. Federal Register 61(198):53137-53153.
Date listed: October 10, 1996
Entity listed: Species
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:

USFWS. 2003. Endangered and threatened wildlife and plants; final designation and nondesignation of critical habitat for 46 plant species from the island of Hawaii, Hawaii; final rule. Federal Register 68(127):39624-39761.

Critical habitat was designated for the *Pleomele hawaiiensis* in four units totaling 12,956 hectares (32,010 acres) on Hawaii Island. These designations include habitat on State, private, and Federal lands (USFWS 2003).

1.3.4 Review History:

Species status review [FY 2011 Recovery Data Call (August 2011)]:
Declining

Recovery achieved:
1 (0-25%) (FY 2007 Recovery Data Call)

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: USFWS. 1998. Big Island II: Addendum to the recovery plan for the Big Island cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 80 pages + appendices. Available online at <http://www.fws.gov/pacificislands/recoveryplans.html>.
Date issued: May 11, 1998
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***
__X_ ***No***

2.1.2 Is the species under review listed as a DPS?

____ ***Yes***
__X_ ***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***
__X_ ***No***

2.2 Recovery Criteria

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

__X_ ***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?

__X_ ***Yes***
____ ***No***

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

__X_ ***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, B, C, D, and E) affecting this species is presented in Section 2.3.2 and Table 2.

Stabilizing, downlisting, and delisting objectives are provided in the Addendum to the recovery plan for the Big Island plant cluster (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Pleomele hawaiiensis* 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 the Big Island (Hawaii Island). 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.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Pleomele hawaiiensis* should be documented on the island of Hawaii. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Pleomele hawaiiensis* should be documented on the island of Hawaii. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

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:

Pleomele hawaiiensis is a short-lived perennial species endemic to the island of Hawaii (Wagner *et al*. 1999; USFWS 2003). Based on specimens held at the Bernice Pauahi Bishop Museum in February of 2011, the species flowering period is from February through June, and fruiting occurs from February through December (Bishop Museum 2011). Other life-history information is mostly absent for the species (USFWS 2002).

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:

The first survey for this species encountered 16 individuals, 7 of which were small, suggesting regeneration was occurring at the time (Abbott and Pratt 1996). Additional demographic details were provided by the authors at that time (Abbott and Pratt 1996).

At the time of listing, *Pleomele hawaiiensis* was known from 6 to 8 populations with a total of 300 to 400 individuals (USFWS 1996). When the recovery plan was written, *Pleomele hawaiiensis* was known from an estimated total of 273 to 324 individuals in 9 populations (USFWS 1998). At the time of critical habitat was proposed, the total population was estimated at between 300 to 400 individuals (USFWS 2002). When critical habitat was designated, *P. hawaiiensis* was known from 22 populations with approximately 50 to 100 individuals at Kiholo; five individuals from Manuka Natural Area Reserve System; and approximately nine to ten individuals within Hawaii Volcanoes National Park (USFWS 2003).

As of 2009, there were 6 to 9 populations containing a total of 300 to 400 individuals (USFWS 2010). Most recently, approximately 50 individuals were estimated for *Pleomele hawaiiensis* at a Kaloko site in North Kona, which were mapped according to whether they had been seen in March or May 2010 (J. Zimpfer, USFWS, pers. comm. 2010). Recent estimates of the population size of *P. hawaiiensis* suggest a gradual but sustained downward trend in the total number of individuals (J. Zimpfer, pers. comm. 2010).

Staff of the Hawaii Division of Forestry and Wildlife, Natural Area Reserve System discovered a new and presumably the only extant population of *Pleomele hawaiiensis* in Kipahoehoe Natural Area Reserve (Hawaii Department of Land and Natural Resources 2010). The population consisted of two very old and large adult individuals located within a small Kipuka (forest surrounded by lava). Staff observed substantial damage from girdling and de-barking by goats on both individuals. They planned to construct small protective fences around these individuals in 2010 (Hawaii Department of Land and Natural Resources 2010); no reports have been provided to confirm if the fences were constructed.

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

No new information.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Pleomele hawaiiensis was first mentioned by Degener (1932) but was not validly published until much later (Degener and Degener 1980). As treated most recently for Hawaii (Wagner *et al*. 1999), the species includes *P*. *kaupulehuensis* St. John and *P*. *konaensis* St. John. The genus has been included in the Agavaceae family (Wagner *et al*. 1999), broadly-defined within the Liliaceae family (USFWS 2003), or under the Asparagaceae or Dracaenaceae family (Mabberley 2008). *Pleomele* is sometimes considered by others to be a part of an expanded concept of the genus *Dracaena* (Mabberley 2008), although this taxonomic interpretation has not been followed in Hawaii (Wagner *et al*. 1999).

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.):

No new information.

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

Pleomele hawaiiensis originally occurred from the Kohala Mountains to Kau on Hawaii Island (USFWS 1998). It now typically occurs in dry forest or occasionally in mesic forest between 86 and 892 meters (281 and 2,925 feet) elevation. The critical habitats designated for *P*. *hawaiiensis*

included open aa lava in diverse lowland forest and such forest dominated by *Metrosideros polymorpha* (ohia) and *Diospyros sandwicensis* (lama) (USFWS 1996, 2003). It is known from Naulu Forest Areas I and II and Poliokeawe Pali (Abbott and Pratt 1996) and reported from the lowland dry forest at Puuwaawaa (Giffin 2009). Native plant species associated with *Pleomele hawaiiensis* include *Bidens micrantha* subsp. *ctenophylla* (kookoolau), *Bobea timonioides* (ahakea), *Caesalpinia kavaiensis* (uhiuhi), *Cocculus orbiculatus* (huehue), *Colubrina oppositifolia* (kauila), *Diospyros sandwicensis*, *Dodonaea viscosa* (aalii), *Kokia drynarioides* (hau hele ula), *Metrosideros polymorpha*, *Myoporum sandwicense* (naio), *Nestegis sandwicensis* (olopua), *Nothocestrum breviflorum* (aiea), *Nototrichium sandwicense* (kului), *Osteomeles anthyllidifolia* (ulei), *Psydrax odorata* (alahee), *Reynoldsia sandwicensis* (ohe makai), *Santalum paniculatum* (iliahi), *Sida fallax* (ilima), and *Sophora chrysophylla* (mamane) (USFWS 2002, 2003).

2.3.1.7 Other:

No new information.

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:

Threats:

- Ungulate degradation of habitat (Abbott and Pratt 1996; USFWS 1996, 2002)
    - Feral goats (*Capra hircus*)
    - Pigs (*Sus scrofa*)
    - Sheep (*Ovis aries*)
- Established ecosystem-altering invasive plant species degradation of habitat (Abbott and Pratt 1996; USFWS 1996, 2002; M. Bruegmann pers. comm. 1997)
    - *Lantana camara* (lantana)
    - *Leucaena leucocephala* (koa haole)
    - *Pennisetum setaceum* (fountain grass)
    - *Schinus terebinthifolius* (Christmasberry)
- Lava flows degradation of habitat (USFWS 1996, 2002)
- Agricultural and urban development – Residential and recreational

development (USFWS 1996, 2002)

Current conservation efforts:

- Ungulate control – At Manuka, pigs and mouflon are being controlled by staff of the Hawaii Division of Forestry and Wildlife, Natural Area Reserve System (Hawaii Department of Land and Natural Resources 2010).
- Ungulate exclosures
    - At Puu Waawaa, several fenced exclosures, ranging in size of less than 10 acres to 200 acres, have been constructed and are maintained by staff of the Hawaii Division of Forestry and Wildlife, Natural Area Reserve System for outplanting individuals of rare plant species, including of *P. hawaiiensis* (Hawaii Department of Land and Natural Resources 2010).
    - Kaupulehu Dry Forest Preserve manages a 25 hectare (61 acres) fenced exclosure for the reintroduction of rare and endangered dry forest plant species including *P. hawaiiensis* (Cordell *et al.* 2008).
- Ecosystem-altering invasive species control – At Manuka and Kipahoehoe Natural Area Reserves, *Pennisetum setaceum* is being controlled by staff (Hawaii Department of Land and Natural Resources 2010, 2011).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

None reported.

2.3.2.3 Disease or predation:

Threats:

- Ungulate predation or herbivory – Cattle (USFWS 1996, 2002) and goats (Hawaii Department of Land and Natural Resources 2009).
- Invertebrate predation or herbivory:
    - Weevils have been known to damage the seeds of this species (USFWS 1996, 2002)
    - Insect damage to leaves at Naulu Forest Areas I and II and Poliokeawe Pali (Abbott and Pratt 1996)
- Rodent predation or herbivory – Damage by rats (*Rattus* sp.) at Naulu Forest Areas I and II and Poliokeawe Pali (Abbott and Pratt 1996)

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Threats:

- Lack of adequate hunting regulation in areas with ungulates – The lack of adequate ungulate control and the existence of established hunting programs in areas, outside of National Park Service lands, where *Pleomele hawaiiensis* occurs continue to threaten this species.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Threats:

- Established invasive plant species competition (Abbott and Pratt 1996)
    - *Melinis repens* (natal redtop)
    - *Nephrolepis multiflora* (scaly swordfern)
- Fire (USFWS 1996, 2002; M. Bruegmann pers. comm. 1997)
- Climate change may pose a threat to this species. 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.

Current conservation efforts:

- Captive propagation for genetic storage and reintroduction:
    - In 1996, the National Tropical Botanical Garden had 829 seeds in storage (USFWS 1998).
    - From 2006 to 2007, 15 new accessions of *Pleomele hawaiiensis* were received for propagation (Plant Extinction Prevention Program 2007).
    - The Center for Conservation Research and Training Seed Storage Facility (2009) has 2,158 seeds in storage.
    - The Volcano Rare Plant Facility (2011) reported 26 individuals in storage.
    - In fiscal year 2008, 150 fruits of *Pleomele hawaiiensis* were collected from Puuwaawaa (Hawaii Department of Land and Natural Resources 2009).

- Reintroduction / translocation implementation:
    - During 1999 to 2006, 574 individuals of *Pleomele hawaiiensis* were reintroduced at Kaupulehu Dry Forest Preserve (Cordell *et al.* 2008).
    - A total of 240 individuals were reintroduced during fiscal year 2006 to 2007, including 18 individuals at Puuwaawaa (Plant Extinction Prevention Program 2007).
    - The Volcano Rare Plant Facility (2011) reported reintroducing 29 individuals of *P. hawaiiensis*.
    - In fiscal year 2008, 60 individuals of *P. hawaiiensis* were reintroduced at Puuwaawaa (Hawaii Department of Land and Natural Resources 2009) and in fiscal year 2009, 120 individuals of *P. hawaiiensis* were reintroduced at Puuwaawaa (Hawaii Department of Land and Natural Resources 2010). Similarly, in fiscal year 2010, 30 individuals of *P. hawaiiensis* were reintroduced at Puuwaawaa (Hawaii Department of Land and Natural Resources 2011).
- Reintroduced / translocated population management and monitoring – At Kaupulehu Dry Forest Preserve reported a 55 percent survival rate for *P. hawaiiensis* from 1999 to 2006 (Cordell *et al.* 2008).
- Surveys / inventories – In 2010, a survey of the Kaloko area in North Kona was conducted by staff of USFWS Pacific Islands Fish and Wildlife Office (J. Zimpfer, pers. comm. 2010).
- Fire protection:
    - In fiscal year 2008, firebreaks were maintained around three fenced exclosures in Puuwaawaa through herbicide spraying and weeding around *P. hawaiiensis* (Hawaii Department of Land and Natural Resources 2009).
    - In fiscal year 2009, staff of the Hawaii Division of Forestry and Wildlife, Natural Area Reserve System maintained 1,345 meters (4,414 linear feet) of firebreak around six exclosures in Puuwaawaa through herbicide spraying and weeding around *P. hawaiiensis* (Hawaii Department of Land and Natural Resources 2010).

2.4 Synthesis

The interim stabilization goals for this species have not been met. Only a single population contains more than 50 individuals (Table 1), and all threats are not being

managed (Table 2). Therefore, *Pleomele hawaiiensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

Table 1. Status of *Pleomele hawaiiensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1996 (listing)	300-400	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1998 (recovery plan)	274-324	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2003 (critical habitat)	300-400	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2012 (5-year review)	300-400	479	All threats managed in all 3 populations	Partially (see Table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

Table 2. Threats to *Pleomele hawaiiensis* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A, C, D	Ongoing	Partially: Ungulates controlled at Manuka; fenced exclosures at Puuwaawaa and Kaupulehu
Agricultural and urban development	A	Ongoing	No
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	Partially: Ecosystem-altering invasive plant species controlled at Manuka and Kipahoehoe
Lava flows degradation of habitat	A	Ongoing	No
Invertebrate predation or herbivory	C	Ongoing	No
Rodent predation or herbivory – Rats	C	Ongoing	No
Fire	E	Ongoing	Partially: Fire protection through fire breaks at Puuwaawaa
Established invasive plant species competition	E	Ongoing	No
Climate change	A, E	Increasing	No

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ 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

- Captive propagation for genetic storage and reintroduction:
  - Collect cuttings or seed from tagged individuals, keeping close track of the maternal source for use in *ex situ* propagation.
  - Continue to collect seeds from all existing populations and send to at least two or three different venues for propagation and storage.
  - Increase the number of specimens available for reintroduction in *ex situ* stocks.
- Reintroduction / translocation implementation – Continue to reintroduce the species back into its known historical range.
- Reintroduction / translocation site identification – While surveying for new populations or reintroduced populations, determine which sites are least invaded by invasive introduced plant species and which appear to have the highest likelihood of maintaining new reintroductions.
- Ecosystem-altering invasive plant species control – Continue to control ecosystem-altering invasive plant species around all populations.
- Ungulate exclosures – Continue to construct ungulate-proof fenced exclosures around each population and monitor the fences for any signs of breaching.
- Ungulate control – Continue to control ungulates around all populations to provide protection against disturbances from feral ungulates.
- Competitive invasive plant species control – Control invasive introduced plant species around all populations that compete with the species.
- Predator / herbivore control – Implement effective control methods for rodents.
- Invertebrate control research:
  - Conduct research on the damaging effects of weevils on the seeds of *Pleomele hawaiiensis* and if necessary, develop and implement effective measures to control weevils.
  - Conduct research to identify the species that is causing leaf damage to the species at Hawaii Volcanoes National Park, if necessary develop and implement effective measures to control this insect.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impact of agricultural and urban development and lava flows degradation of habitat.
- Surveys / inventories – Re-survey the known range of the species and other areas with suitable habitat for potentially undiscovered individuals or populations.

- Population biology research – Commence studies in the field to determine flower pollinators and fruit dispersers.
- Threat monitoring and control – Monitor the health of wild populations for evidence of insect damage and plant pathogens that might be reducing viability or contributing to senescence.
- Fire protection:
    - Continue to maintain firebreaks around fenced exclosures at Puuwaawaa.
    - Develop and implement fire management plans for all wild and reintroduced populations.
- Alliance and partnership development – Work with Hawaii Division of Forestry and Wildlife, National Park Service, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Threats research – Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Pleomele hawaiiensis* (Hala pepe)

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

Appropriate Listing/Reclassification Priority Number, if applicable:_____

Review Conducted By:
Chelsie Javar, Fish and Wildlife Biologist
Vickie Caraway, Fish and Wildlife Biologist
Marie Bruegmann, Plant Recovery Coordinator
Jess Newton, Endangered Species Recovery Program Leader
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for Jess Newton

Date 8/28/2012