

## 5-YEAR REVIEW

Short Form Summary

**Species Reviewed:** *Kokia drynarioides* (koki'o)

**Current Classification:** Endangered

### **Federal Register Notice announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews of 44 species in Oregon, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 78(24):8185-8187.

### **Lead Region/Field Office:**

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

### **Name of Reviewer(s):**

Chelsie Javar-Salas, Plant Biologist, PIFWO

Marie Bruegmann, Plant Recovery Coordinator, PIFWO

Kristi Young, Programmatic Deputy Field Supervisor, 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 4, 2013. The review was based on a review of current, available information since the last 5-year review for *Kokia drynarioides* (USFWS 2009). The evaluation by Chelsie Javar-Salas, Plant Biologist, was reviewed by the Plant Recovery Coordinator. It was subsequently reviewed and approved by the Programmatic Deputy Field Supervisor.

### **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 at: [http://ecos.fws.gov/tess\\_public](http://ecos.fws.gov/tess_public).

### **Review Analysis:**

Please refer to the previous 5-year review for *Kokia drynarioides* published on July 21, 2009 (available at: [https://ecos.fws.gov/docs/five\\_year\\_review/doc2476.pdf](https://ecos.fws.gov/docs/five_year_review/doc2476.pdf)) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species' biological status has come to light since listing to warrant a change in the Federal listing status of *K. drynarioides*.

*Kokia drynarioides* is endangered and endemic to Hawaii Island (USFWS 1994). It was historically known from Puu Waawaa and Kaupulehu in North Kona on the slopes of Hualalai Volcano (USFWS 1994). The status and trends for *K. drynarioides* are provided in the tables below.

### **New status information:**

- In 2009, there were two populations containing two individuals (Plant Extinction Prevention Program [PEPP] 2009, 2010).

- In 2013, there were two populations containing 2 to 5 mature individuals, 3 immature individuals, and 21 seedlings of *Kokia drynarioides* (PEPP 2014). Research is ongoing as to whether the individuals currently found at Puu Waawaa are wild (natural) or outplanted (PEPP 2014).
- There is a single wild individual remaining on private property at Kaupulehu (J. Wagner, Future Forests Nursery, pers. comm. 2015).
- Overall, the numbers of individuals have remained stable from the two wild individuals reported in the previous 5-year review to approximately 2 to 8 wild individuals in 2015 (PEPP 2014).

#### New threats:

- Climate change destruction or degradation of habitat – Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawaii using high resolution climate change projections. Climate change vulnerability is defined as the relative inability of a species to display the possible responses necessary for persistence under climate change. The assessment by Fortini *et al.* (2013) concluded that *Kokia drynarioides* is highly vulnerable to the impacts of climate change. Therefore, additional management actions are needed to conserve this taxon into the future.

#### New management actions:

- Surveys / inventories – A survey at Puu Waawaa Forest Reserve in 2003 to 2007 detected two mature and two immature individuals (State of Hawaii Department of Land and Natural Resources [DLNR] 2015).
- Ungulate monitoring and control
  - The existing *Kokia* exclosures (I and II) at Puu Waawaa Forest Reserve are monitored annually for the presence of ungulates (DLNR 2014).
  - In 2013, one of the two small 0.4 hectare (1-acre) fenced *Kokia* exclosures at Puu Waawaa was expanded by 0.1 hectares (0.25 acres) to enclose and protect the seed rain produced from the large *K. drynarioides* plant inside the fence (DLNR 2014).
- Invasive plant monitoring and control
  - In 2014, invasive plant species were controlled within the *Kokia* exclosures at Puu Waawaa (PEPP 2014). In 2014, all *Cenchrus setaceus* (fountain grass) was removed from *Kokia* exclosure I (DLNR 2014).
  - During 2013 to 2014 at the Hauaina Reservoir exclosure in Puu Waawaa, weeds were removed around reintroduced plants which included *Cenchrus setaceus*, *Lantana camara* (lantana), *Ricinus communis* (castor bean), and *Chenopodium murale* (nettleleaf goosefoot) (DLNR 2014). Small invasive tree seedlings were also removed including *Grevillea robusta* (silver oak), *Schinus molle* (pepper tree), *Olea europaea* subsp. *europaea* (European olive), and *Jacaranda mimosifolia* (Jacaranda) (DLNR 2014).
- Population viability monitoring and analysis
  - In August 2009, the single individual at Hawaii Volcanoes National Park was monitored and three air layers were created for genetic propagation (PEPP 2010). In January 2010, the plant was monitored again and one of four air layers created

- showed signs of initial growth (PEPP 2010). In February 2010, two of the four air layers were collected and two additional air layers were created (PEPP 2010). In November 2010, the plant and air layers were monitored again (PEPP 2010). During that same visit, a tree fell on the plant and badly damaged the single individual of *K. drynarioides* which may lead to the death of the plant (PEPP 2011). The branches were cleared from the individual *K. drynarioides* plant and it was stabilized then watered. The plant was visited again in July 2010 and January 2011 for collection material; none was collected (PEPP 2011).
- At Puu Waawaa within the *Kokio* exclosures, there were 3 large trees in the upper exclosure and 7 seedlings (PEPP 2014). In the lower exclosure there were 3 immature individuals of *K. drynarioides* and 2 seedlings (PEPP 2014). All plants were tagged to aid in future monitoring efforts.
  - 2013 was a very wet year at Puu Waawaa and thus contributed to regeneration of 127 individuals of *K. drynarioides* in the small unit exclosure called Puu Waawaa 3 (DLNR 2014). Within the two *Kokio* exclosures, 2 large trees of *K. drynarioides* and a couple dozen seedlings were found (DLNR 2014).
  - Captive propagation for genetic storage and reintroduction
    - In 2013, the Volcano Rare Plant Facility (2013) had 89 seeds in storage from three sites. The Facility propagated 6 individuals for outplanting at Puu Waawaa (5) and Hawaii Volcanoes National Park (1). The Facility propagated 8 individuals for reintroductions next year. In 2014, the Volcano Rare Plant Facility (2014) had more than 360 seeds in storage from four locations. The Facility propagated a single individual for reintroduction at Puu waawaa. The Facility propagated 35 individuals for reintroduction next year.
    - The Lyon Arboretum's Seed Conservation Laboratory (2013) has 390 seeds in storage.
    - The National Tropical Botanical Garden (2014) has more than 80 seeds from eight accessions in storage.
    - The Maui Nui Botanical Garden (2014) has hundreds of seeds in storage from a cultivated plant.
    - The Waimea Valley (2013, 2014) has two plants in their garden.
    - Hawaii Volcanoes National Park (2014) has one plant growing in their nursery.
    - In April 2014, more than 200 seeds were collected from the ground in the upper *Kokio* exclosure and more than 100 seeds were collected from two founders (PEPP 2014). All seeds were transferred to the Volcano Rare Plant Facility for storage and propagation.
  - Reintroduction / translocation
    - During 2012 to 2013, 77 individuals of *K. drynarioides* were reintroduced within two sites at Puu Waawaa Forest Reserve (DLNR 2015).
    - During 2013 to 2014, an additional 42 individuals were reintroduced at the Puu Waawaa Forest Reserve (DLNR 2015).
    - There are 15 immature outplanted individuals of *K. drynarioides* at Waikoloa Dry Forest Initiative (J. Lawson, Waikoloa Dry Forest Initiative, pers. comm. 2015).
    - Twenty-nine individuals of *K. drynarioides* were outplanted in a dry forest restoration site on private property in North Kona (J. Wagner, pers. comm. 2015).
  - Reintroduced / translocated population management and monitoring

- Outplanted individuals of *K. drynarioides* at Puu Waawaa were monitored for growth rates, threats, health, and vigor (DLNR 2014). After 16 to 28 months post-planting, approximately 90 percent of the 135 individuals outplanted remained (Parsons *et al.* 2014).
- Over a three day period in April 2014, 17 reintroduced individuals of *K. drynarioides* were monitored for the presence of aphids, scales, mealy bugs, ants, fungi, as well as, exposed roots, dead branches, or signs of herbivory (Parsons *et al.* 2014). Between 41 percent of all reintroduced *K. drynarioides* had ants, which were either tending homopterans (all species), or taking advantage of extrafloral nectaries (Parsons *et al.* 2014). It was also observed that ants (species not identified) excavated the soil from around the roots of reintroduced individuals leading to exposed roots (47 percent of plants). On at least 6 different occasions, wind blew over reintroduced individuals that were poorly rooted.
- There are three reintroduced individuals at Kaupulehu mauka on privately owned property (J. Wagner, pers. comm. 2015).
- Outreach and education – *Kokia drynarioides* along with four other PEPP species were highlighted at the Big Island County Fair held during September 4 to 7, 2014 in Hilo. Visitors to the booth participated in coloring images of PEPP species to create a button for them to take home (PEPP 2015).

### Synthesis:

Downlisting objectives are provided in the recovery plan for the *Caesalpinia kavaiensis* and *Kokia drynarioides* (USFWS 1994). No delisting criteria were identified in the recovery plan for this species. *Kokia drynarioides* may be considered for downlisting when: 1) it is observed and documented that the major threats listed in Part I (ungulates, fire, fountain grass and other nonnative invasive plants, insect control) are greatly reduced; 2) it is observed and documented that following the removal of threats, new trees are being recruited by natural regeneration at a rate adequate to replace individuals lost from the population and preserve long term genetic diversity; 3) recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis (PVA) to estimate minimum population numbers and densities for effective reproduction; 4) a thorough review of the environmental dynamics and human activities within the dry forest habitat is conducted to determine the minimum habitat area needed to give a high probability of survival of the species over the next 200 years; 5) current habitat has been secured in perpetuity; 6) any management practices necessary to maintain the protected habitats have been implemented; 7) the habitat is populated with the numbers and densities of this species indicated by the results of research and the PVA (minimum of 100 naturally reproducing individuals in each of 3 populations in North Kona).

The downlisting goals for this species have not been met, there are only 2 to 5 wild individuals known (Table 1). In addition, all threats are not being sufficiently managed throughout all of the populations (Table 2) and natural regeneration is occurring but not at a rate adequate to replace individuals lost from the population. Therefore, *Kokia*

*drynarioides* meets the definition of endangered as it remains in danger of extinction throughout its range.

**Recommendations for Future Actions:**

- Surveys / inventories – Survey geographical and historical range for a current assessment of the species’ status.
- Captive propagation for genetic storage and reintroduction
  - Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range.
  - Evaluate genetic resources currently in storage to determine the need to place additional genetic resources in long-term storage due to this species’ vulnerability to climate change.
- Ungulate monitoring and control – Maintain existing exclosures and monitor for potential incursions.
- Invasive plant monitoring and control – Eradicate invasive introduced plants within ungulate exclosures and maintain exclosures free of invasive plants.
- Population viability monitoring and analysis – Continue monitoring wild and reintroduced individuals.
- Fire monitoring and control – Develop and implement a fire management plan at the existing exclosures.
- Climate change adaptation strategy – Research the suitability of habitat for reintroducing this species in the future due to the impacts of climate change.
- Alliance and partnership development – Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

**Table 1. Status and trends of *Kokia drynarioides* from listing through current 5-year review.**

<b>Date</b>	<b>No. wild indivs</b>	<b>No. outplanted</b>	<b>Downlisting Criteria identified in Recovery Plan</b>	<b>Downlisting Criteria Completed?</b>
1984 (listing & critical habitat)	15	Unknown	Greatly reduce major threats (ungulates, fire, fountain grass)	No
			Natural regeneration adequate to replace individuals lost from population & preserve genetic diversity	No
			Recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis	No
			Determine the minimum habitat area needed for survival over the next 200 years	No
			Current habitat secured in perpetuity	No
			Implement management practices to maintain protected habitats	No
			Results of PVA for number and densities of species (minimum of 100 individuals in each of 3 populations in North Kona)	No
1994 (recovery plan)	4	21	Greatly reduce major threats (ungulates, fire, fountain grass)	Partially
			Natural regeneration adequate to replace individuals lost from population & preserve genetic diversity	No
			Recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis	No
			Determine the minimum habitat area needed for survival over the next 200 years	No
			Current habitat secured in perpetuity	No
			Implement management	No

<b>Date</b>	<b>No. wild indivs</b>	<b>No. outplanted</b>	<b>Downlisting Criteria identified in Recovery Plan</b>	<b>Downlisting Criteria Completed?</b>
			practices to maintain protected habitats	
			Results of PVA for number and densities of species (minimum of 100 individuals in each of 3 populations in North Kona)	No
2003 (critical habitat)	0	12	Greatly reduce major threats (ungulates, fire, fountain grass)	Partially
			Natural regeneration adequate to replace individuals lost from population & preserve genetic diversity	No
			Recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis	No
			Determine the minimum habitat area needed for survival over the next 200 years	No
			Current habitat secured in perpetuity	No
			Implement management practices to maintain protected habitats	No
			Results of PVA for number and densities of species (minimum of 100 individuals in each of 3 populations in North Kona)	No
2009 (5-yr review)	2	75	Greatly reduce major threats (ungulates, fire, fountain grass)	Partially
			Natural regeneration adequate to replace individuals lost from population & preserve genetic diversity	No
			Recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis	No
			Determine the minimum habitat area needed for survival over	No

<b>Date</b>	<b>No. wild indivs</b>	<b>No. outplanted</b>	<b>Downlisting Criteria identified in Recovery Plan</b>	<b>Downlisting Criteria Completed?</b>
			the next 200 years	
			Current habitat secured in perpetuity	No
			Implement management practices to maintain protected habitats	Partially
			Results of PVA for number and densities of species (minimum of 100 individuals in each of 3 populations in North Kona)	No
<b>2015 (5-yr review)</b>	<b>2-5</b>	<b>~166</b>	<b>Greatly reduce major threats (ungulates, fire, fountain grass)</b>	<b>Partially</b>
			Natural regeneration adequate to replace individuals lost from population & preserve genetic diversity	No
			Recovery proceeds for the time, approximately 13 years, needed to provide demographic data to be used in population viability analysis	No
			Determine the minimum habitat area needed for survival over the next 200 years	No
			Current habitat secured in perpetuity	No
			Implement management practices to maintain protected habitats	Partially
			Results of PVA for number and densities of species (minimum of 100 individuals in each of 3 populations in North Kona)	No



**Table 2. Threats to *Kokia drynarioides* and ongoing conservation efforts.**

<b>Threat</b>	<b>Listing factor</b>	<b>Current Status</b>	<b>Conservation/ Management Efforts</b>
Ungulates – degradation of habitat and herbivory	A, C, D, E	Ongoing	Yes, Puu Waawaa & Kaupulehu is fenced
Invasive introduced plants	A, E	Ongoing	Partially, at Puu Waawaa
Lava flow loss or degradation of habitat	A	Ongoing	None
Agricultural and urban development	A	Ongoing	None
Rodent predation or herbivory – rats	C	Ongoing	None
Invertebrate predation or herbivory – aphids	C	Ongoing	None
Fire	E	Ongoing	None
Drought	E	Ongoing	None
Low numbers	E	Ongoing	Partially, captive propagation for genetic storage and reintroduction
Climate change	A, E	Increasing	None

**References:**

See previous 5-year review for a full list of references (USFWS 2009). Only references for new information are provided below.

Fortini, L., J. Price, J. Jacobi, A. Vorsino, J. Burgett, K. Brinck, F. Amidon, S. Miller, S. Gon II, G. Koob, and E. Paxton. 2013. A landscape-based assessment of climate change vulnerability for all native Hawaiian plants. Technical report HCSU-044. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 141 pages.

Harold L. Lyon Arboretum Seed Conservation Laboratory. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Seed storage access database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

Hawaii Volcanoes National Park. 2014. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Maui Nui Botanical Garden. 2014. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

- National Tropical Botanical Garden. 2014. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.
- Parsons, E., E. Adkins, K. Knoche, T. Seely, J. Crosson, L. Perry, C. Talsma, J. Lawson, and W. Brawner. 2014. Assessing the progress of a dryland forest restoration project at Puuwaawaa, Hawaii. Poster presentation at the Hawai'i Botanical Forum, Honolulu, Hawaii.
- [PEPP] Plant Extinction Prevention Program. 2009. Plant Extinction Prevention Program annual report, fiscal year 2009 (July 1, 2008-June 30, 2009). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.
- [PEPP] Plant Extinction Prevention Program. 2010. Plant Extinction Prevention Program annual report, fiscal year 2010 (July 1, 2009-June 30, 2010). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.
- [PEPP] Plant Extinction Prevention Program. 2011. Plant Extinction Prevention Program annual report, fiscal year 2013 (July 1, 2010-June 30, 2011). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.
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- [DLNR] State of Hawaii Department of Land and Natural Resources. 2014. Department of Land and Natural Resources, Division of Forestry and Wildlife, Section 6 annual performance report for plant restoration and enhancement, threatened, endangered, candidate, and species of concern outplanting, Hawaii (dry and mesic forest restoration). July 1, 2013 – June 30, 2014. Unpublished.
- [DLNR] State of Hawaii Department of Land and Natural Resources. 2015. Department of Land and Natural Resources, Division of Forestry and Wildlife, 2003-2007 botanical survey data updated 16 April 2015. Microsoft Excel worksheet. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1994. Recovery plan for *Caesalpinia kavaiensis* and *Kokia drynarioides*. U.S. Fish and Wildlife Service, Portland, Oregon. 82 pages + 8 pages Appendix B\*.

[USFWS] U.S. Fish and Wildlife Service. 2009. *Kokia drynarioides* 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 13 pages.

Volcano Rare Plant Facility. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

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Waimea Valley. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

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**Personal communication:**

Lawson, Jen. 2015. Project manager, Waikoloa Dry Forest Initiative. E-mail to Chelsie Javar-Salas, Pacific Islands Fish and Wildlife Office, dated April 30, 2015. Subject: Request for info for 5-year reviews.

Wagner, Jill. 2015. Owner and biological services consultant, Future Forests Nursery and Hawaii Forest Initiative. E-mail to Chelsie Javar-Salas, Pacific Islands Fish and Wildlife Office, dated February 14, 2015. Subject: Request for info for 5-year reviews.

**U.S. FISH AND WILDLIFE SERVICE**  
**SIGNATURE PAGE for 5-YEAR REVIEW of *Kokia drynarioides* (koki'o)**

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
- No Change in listing status

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

*for* **Programmatic Deputy Field Supervisor, Pacific Islands Fish and Wildlife Office**

*Maui M. Buegmann*

Date 2015-08-25