5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Ischaemum byrone* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

Lead Region/Field Office:

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

Name of Reviewer(s):

Marie Bruegmann, Pacific Islands Fish and Wildlife Office, Plant Recovery Coordinator
Marilet A. Zablan, Pacific Islands Fish and Wildlife Office, Assistant Field Supervisor for Endangered Species
Jeff Newman, Pacific Islands Fish and Wildlife Office, Acting Deputy Field Supervisor

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 April 29, 2008. The review was based on the final critical habitat designation for *Ischaemum byrone* and other species from the islands of Kauai and Niihau, Maui and Kahoolawe, and Molokai (USFWS 2002, 2003a, b, c), 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 Tamara Sherrill, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor 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 proposed and final critical habitat designation for *Ischaemum byrone* published in the Federal Register on May 28, 2002, and February 27, March 18, and May 14, 2003, respectively (USFWS 2002, 2003a, b, c) 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 *I. byrone*.

Historically, *Ischaemum byrone* was reported from Kauai, Oahu, Molokai, East Maui, and the island of Hawaii. At the time of listing in 1994, ten populations containing 1,200 to 2,200 individuals were known on Molokai, Maui, and Hawaii islands (USFWS 1994). When the recovery plan was written in 1996, 17 populations were identified on Kauai, Molokai, Maui, and Hawaii. One small population had been recently discovered on the north shore of Kauai, where approximately 50 plants were growing on wet cliff faces on privately owned land at Kauapea Beach. Two populations were known on the northeastern coast of Molokai. Maui had six known populations on the northeast coast, found in or near Wainapanapa State Park, Pailoa Bay, Keawaiki Bay, and Honokalani. The island of Hawaii had eight populations along the eastern and southern coasts of the island (USFWS 1996). Currently, *I. byrone* is found on Kauai, Molokai, Maui, and Hawaii with at least 352 individuals documented in approximately 14 populations since 2004, although several of these populations do not contain any estimates of numbers of individuals.

On the island of Hawaii, from 1992 to 1997, at least three populations containing at least 500 individuals were known; from 2004 to 2009, four populations containing at least 102 individuals were documented. In Hawaii Volcanoes National Park, the main population of *Ischaemum byrone* was at a site just west of Kamoamoa, which was subsequently covered by lava. It was also found at scattered sites west of Kamoamoa in the Park, and east of there in Puna, at Laeapuki and Panau Iki, but many of these have also been covered by lava (Hawaii Biodiversity and Mapping Program 2009; L. Pratt, USGS Biological Resources Discipline, pers. comm. 2009). *Ischaemum byrone* may still grow in the area between Kaimu and Kehena. Thomas Belfield sighted approximately 500 *I. byrone* individuals along the coast east of the former *I. byrone* site of Kaimu Beach in 1997 (L. Pratt, pers. comm. 2009). It is still found at Richardson Park in Hilo and may still grow at Lehia Park where it was seen in 1992 (Hawaii Biodiversity and Mapping Program 2009; L. Pratt, pers. comm. 2009). *Ischaemum byrone* was observed in 1992 on the coast at Makuu-Holona and Kikala-Keokea in Puna District, south of Hilo. Eighty-two individuals were observed in 2004 at two locations in Malama-Ki Forest Reserve, on the coast near Mackenzie State Park (Hawaii Biodiversity and Mapping Program 2009). In January 2009, Park staff searched for *I. byrone* at two of the Park restoration sites and found about 20 individuals at the site called Holei Sea Arch (L. Pratt, pers. comm. 2009). Appropriate habitat for the species which may or may not still be occupied, exists along most of the east and southeastern shores of the island (J. Price, University of Hawaii at Hilo, pers. comm. 2009).

On the northern coast of Kauai, there have been at least five occurrences of *Ischaemum byrone* identified, with more than 300 individuals documented between 1996 and 1999, and 50 individuals observed in 2008 in one of the previously known locations. Locations with at least two individuals were known from Kaweonui Point and Kauapea Beach in 1993 (USFWS 2003a; Wood 2009). In 1996, a population of *I. byrone* was found in Hoolulu Valley's drainage at 46 meters (150 feet) (Wood 2009); a second population of

50 to 100 individuals was found in that year at Hanakapiai Falls in Hanakapiai Valley, on seeping walls and cliffs at 244 meters (800 feet) elevation (Wood 2009); a third population identified in 1996 with 50 individuals was observed in Princeville, below Punahele Road, at two meters (six feet) elevation (Wood 2009). In 1999, about 200 individuals (150 mature, 25 immature, 25 seedlings) were observed at 1.5 to 3 meters (5 to 10 feet) elevation the Kalalau Valley on the north side of the river along the coastal strand (Hawaii Biodiversity and Mapping Program 2009; Wood 2009). In Kalalau in 2008, 50 individuals were seen and seed was collected at an elevation of 6 meters (20 feet) (Wood 2009).

On Maui, since 2005, a few thousand individuals have been observed. On East Maui in the late 1990s, there were six populations with fewer than 2,000 individuals found on State and privately owned lands at Keopuka Islet, Paupalu Point, Moku Huki, west of Kalahu Point, between Keakulikuli Point and Pukaulua Point, and at Kauiki (USFWS 2003c). In 1991 and 1998, approximately 1,000 individuals were seen at Pukaulua Point, Waianapanapa State Park, at 9 to 10 meters (30 to 33 feet) elevation (National Tropical Botanical Garden 2009b; Wood 2009). In the Nahiku area between Makapipi and Kuhiwa Gulch, *Ischaemum byrone* was seen in 1998 at 6 to 15 meters (20 to 50 feet) elevation (National Tropical Botanical Garden 2009b; Wood 2009). At Kaonohua Gulch, behind Sandalwood Golf Course, in West Maui, *I. byrone* was observed in 1998 at 183 meters (600 feet) elevation (Wood 2009). In the Hana area, west of Hana airport, *I. byrone* was seen in 1998 at 9 meters (30 feet) elevation (Wood 2009). In 2005, 20 scattered patches of *I. byrone* were seen at Moku Huki, at 3 to 4 meter (10 to 13 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2009). In 2007 to 2008 *I. byrone* was seen at Keawaiki Bay, on the way to Waianapanapa Caves at 152 meters (499 feet) elevation (National Tropical Botanical Garden 2009b) and on the shoreline at Kahanu Garden, Kalahu Point, Hana (National Tropical Botanical Garden 2009b). In 2009, Plant Extinction Prevention Program staff reported that there were small populations scattered on East Maui from Hoolawa to Muolea, including Waiohonu, Nuaailua, Ulaino, and Pauwalu, though it is difficult to determine exactly all locations and numbers, as *I. byrone* is relatively short lived, so the numbers probably fluctuate. Also, much of the coast is inaccessible for monitoring, including some offshore islets (H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2009).

On Molokai about 1,000 plants were seen clumping in patches on weathered basalt and black sand on the seacliffs east of Kalaupapa and west of Wailau Valley, at an elevation from 3 to 183 meters (10 to 600 feet) in 1994 (Hawaii Biodiversity and Mapping Program 2009; Wood 2009). In 2009, the species was found to be relatively common from Wailau to Waiehu, with probably 200 individuals (H. Oppenheimer, pers. comm. 2009).

Total numbers of both populations and individuals are difficult to assess. Based on observations since 2004, it appears that currently the species is represented on Hawaii by four populations; by at least seven populations on Maui, and on Molokai and Kauai by at least one. Observations since 2004 have documented at least 352 individuals statewide, with several reported populations containing no estimates of individuals, but the total

numbers are most likely in the range of a few thousand individuals, as the numbers fluctuate with rainfall.

Ischaemum byrone usually grows in close proximity to the ocean, among rocks or frequently on moist or wet basalt cliffs in windward coastal dry shrubland at elevations between 0 and 190 meters (0 and 623 feet) with associated native plant species including *Bidens* spp. (kookoolau), *Fimbristylis cymosa* (mauu aki aki), and *Scaevola taccada* (naupaka kahakai) (USFWS 2003c).

On Maui at Moku Huki, an islet off the north coast, *Ischaemum byrone* grows with low basalt tide-pools and thick vegetation, on an upper knob of a ridge-line covered in *Sphenomeris chinensis* (palaa) and occasional *Sadleria pallida* (amau). Here, *I. byrone* grows interspersed with *Fimbristylis cymosa* ssp. *spathacea* (mauu aki aki), *Phymatosorus grossus* (lauae), *Osteomeles anthyllidifolia* (ulei), and *Scaevola taccada*. *Pandanus tectorius* (hala) is a common tree. Monocots include *Carex wahuensis* (no common name [NCN]), *Cyperus phleoides* (NCN), *Cyperus polystachyos* (NCN), and *Paspalum scrobiculatum* (mauu laiki) (Wood 2009). In the Nahiku area on Maui at Kuhiwa, *I. byrone* grows in a *Fimbristylis cymosa* coastal habitat with *Bacopa monnieri* (ae ae), *Bidens hillebrandiana* (kookoolau), *Pandanus tectorius*, *Scaevola taccada*, and *Sphenomeris chinensis* (National Tropical Botanical Garden 2009b; Wood 2009). At Kaonohua Gulch behind Sandalwood Golf Course, on West Maui, *I. byrone* grows in the *Hibiscus brackenridgei* exclosure with *Achyranthes splendens* var. *splendens* (NCN), *Chamaesyce degeneri* (akoko), *Dodonaea viscosa* (aalii), *Doryopteris decipiens* (kumuniu), *Erythrina sandwicensis* (wiliwili), *Sida fallax* (ilima), *Lipochaeta lobata* (nehe), *Panicum torridum* (kakonakona), and *Schiedea salicaria* (NCN) (Wood 2009). In the Hana area, west of the Hana airport between Makupupu and Lanikele Point, around the falls and pool, *I. byrone* grows with *Scaevola taccada*, *Cyperus javanicus* (ahu awa), *Kadua littoralis* (NCN), and *Lysimachia mauritiana* (NCN) (Wood 2009). At Waianapanapa State Park near Hana, and at Pailoa Bay, Keawaiki Bay, and Pukaulua Point, *I. byrone* grows in *Pandanus tectorius* - *Scaevola taccada* lowland mesic forest with *Cassytha filiformis* (kaunaoa pehu), *Cocculus orbiculatus* (huehue), *Morinda trimera* (noni kauhiwi), and *Osteomeles anthyllidifolia* (National Tropical Botanical Garden 2009b; Wood 2009).

On the northern coast of Kauai, the associated native plant species include *Adiantum raddianum* (NCN), *Chamaesyce celastroides* var. *stokesii* (akoko), *Cyperus javanicus*, *Lipochaeta succulenta* (nehe), *Lysimachia mauritiana*, and *Scaevola taccada* (USFWS 2003a). In Hoolulu Valley, *Ischaemum byrone* occurs in *Metrosideros polymorpha* (ohia) - *Pandanus tectorius* coastal forest with introduced *Adiantum capillus-veneris* (iwa iwa), and native species *Carex wahuensis*, *Charpentiera densiflora* (papala), *Cladium jamaicense* (uki), *Lipochaeta succulenta*, and *Scaevola taccada* (National Tropical Botanical Garden 2009b; Wood 2009). At Hanakapiai, *I. byrone* occurs in *Scaevola taccada – Pandanus tectorius* shrubland and sea cliffs with *Carex wahuensis*, *Lipochaeta succulenta*, and *Lysimachia mauritiana* (National Tropical Botanical Garden 2009b). In Princeville, below Punahele Road, *I. byrone* occurs in *Pandanus tectorius – Scaevola taccada* coastal seeping walls with *Fimbristylis cymosa* (Wood 2009). In Kalalau, *I.*

byrone grows in a *Scaevola taccada* coastal strand community with *Adiantum capillus-veneris*, *Artemisia australis* (ahinahina), *Colocasia esculenta* (taro), *Lysimachia mauritiana*, and *Pilea peploides* (NCN) along seeps from the basalt cliffs (Wood 2009).

On Molokai, *Ischaemum byrone* grows in open and cliff areas in mesic *Pandanus tectorius* coastal forest with *Artemisia australis*, *Bidens molokaiensis* (kookoolau), *Brighamia rockii* (alula), *Chamaesyce* sp., *Cyperus phleoides*, *Eragrostis variabilis* (kawelu), *Fimbristylis cymosa*, *Kadua littoralis*, *Lepidium bidentatum* (anaunau), *Lysimachia mauritiana*, and *Schiedea globosa* (NCN) (Hawaii Biodiversity and Mapping Program 2009; H. Oppenheimer, pers. comm. 2009; Wood 2009).

The most serious threat to *Ischaemum byrone* on Maui, Kauai, and the island of Hawaii is competition with invasive introduced plant species, particularly *Digitaria ciliaris* (Henry's crabgrass), *Ardisia elliptica* (shoebutton ardisia), and *Casuarina equisetifolia* (ironwood) (Factor E). Other introduced plants which compete with and displace *I. byrone* include *Aleurites moluccana* (kukui, candlenut), *Clidemia hirta* (Koster's curse), *Conyza bonariensis* (hairy horseweed), *Cynodon dactylon* (Bermuda grass), *Cyrtomium falcatum* (holly fern), *Emilia fosbergii* (Florida tasselflower), *Ficus microcarpa* (Chinese banyan), *Lantana camara* (lantana), *Nephrolepis multiflora* (NCN), *Plantago major* (broad leaved plantain), *Pluchea carolinensis* (Indian fleabane), *Phymatosorus grossus* (naturalized lauae), *Polypogon viridis* (beardgrass), *Pycreus polystachyos* ssp. *polystachyos* (bunchy sedge), and *Terminalia catappa* (false kamani) (Hawaii Biodiversity and Mapping Program 2009; Wood 2009). Additionally, fire (Factor E) may pose a threat in areas infested with invasive introduced grasses, provided enough fuel is present. Other potential threats include grazing and browsing by goats (*Capra hircus*) and axis deer (*Axis axis*) (Factor C). Disturbance from ungulates (Factor A) promotes the establishment of nonnative weed species. Some populations are also threatened by residential development (Factors A and D) and landslides (Factor E) (USFWS 2003c; Wood 2009). Climate change may also pose a threat to *I. byrone* (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

On the island of Hawaii, another threat to *Ischaemum byrone* is volcanism (volcanic activity) (Factor E). Lava flowing from Kilauea Volcano destroyed about 200 individuals west of Kamoamoa in 1992. A few individuals were rescued. Fire in areas infested with alien grasses (Factor E) may be a potential problem, provided enough fuel is present. Some populations are also threatened from residential development (Factors A and D) (USFWS 1996).

On Molokai, threats are invasive introduced plants (Factor E) *Bryophyllum pinnatum* (airplant), *Ageratina adenophora* (sticky snakeroot), *Ageratina riparia* (spreading mist flower), *Digitaria ciliaris*, and *Rubus rosifolius* (thimbleberry) (Wood 2009) and goats (Factors A and C). In 2009, Natural Area Reserve staff have been aerially shooting goats at Waiehu, so the grazing pressure is much reduced (H. Oppenheimer, pers. comm. 2009). On Maui threats are drought (Factor E), cattle (*Bos taurus*) (Factors A and C),

goats (Factors A and C), trampling (Factor A), trail clearing (Factor E), and the introduced plants *Ardisia elliptica*, *Lantana camara*, *Panicum maximum* (Guinea grass), *Paspalum conjugatum* (Hilo grass), and *Pluchea carolinensis* (sourbush) (Factor E) (Wood 2009).

On Maui in 2006, Haleakala National Park staff reintroduced a total of 24 individuals to the Oheo coastline, propagated from two wild individuals from east Maui (Haleakala National Park 2006). In 2008, seed from 15 wild plants produced 40 individual plants, ten of which were outplanted in Kipahulu District (Haleakala National Park 2008). Maui Nui Botanical Garden has approximately ten individuals from east Maui (Maui Nui Botanical Garden 2009). Seeds from remaining individuals from locations west of Kamoamoa were collected and propagated by Hawaii Volcanoes National Park staff for outplanting at various coastal sites (L. Pratt, pers. comm. 2009). In 2007, the Volcano Rare Plant Facility propagated nine plants from one wild individual which originated at Hawaii Volcanoes National Park (Volcano Rare Plant Facility 2008). At the Waimea Valley Arboretum on Oahu, three individual plants from the island of Hawaii are in cultivation (Waimea Valley Arboretum 2009). On Kauai in 2008, National Tropical Botanical Garden had approximately 1,500 seeds in storage, and outplanted one plant at their Kahanu Garden in East Maui (National Tropical Botanical Garden 2008). As of 2009, they had 858 seeds in storage from Hana, Maui; Kaupea Beach, Na Pali, and Iliiliula, Kauai; and Wailau Beach, Molokai (National Tropical Botanical Garden 2009a). There are also 424 seeds from an unknown source in storage on Oahu at the Lyon Arboretum (Center for Conservation Research and Training Seed Storage Facility 2009). A few individuals of the species have been successfully tissue-cultured (cloned) from both seed and seedlings (Harold L. Lyon Arboretum 2009).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Big Island plant cluster (USFWS 1996), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Ischaemum byrone* is a short-lived perennial, and to be considered stable, the taxon must be managed to control threats (*e.g.*, fenced) and be 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 the island of Hawaii, and if possible, at least one other island where it 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.

The interim stabilization goals for this species have not been met (see Table 1), as none of the islands where this species currently occurs have three populations with 50 documented mature individuals each, and it is not known if the populations are naturally reproducing and increasing in number. In addition, all threats are not being managed. Therefore, *Ischaemum byrone* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Assess whether current populations are naturally reproducing and increasing in number.
- Collect seeds from all populations on each island.
- Propagate for reintroduction, augmentation, and if possible, maintenance of *ex situ* plantings for genetic conservation.
- Store seed for future use.
- Survey historical locations for possible current occurrences.
- Work with Hawaii Division of Forestry, Wildlife and Hawaii State Parks, and other landowners to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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Personal Communications

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Table 1. Status of *Ischaemum byrone* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	1,200-2,200	unknown	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1996 (recovery plan)	Several thousand	unknown	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	5,102-6,002	unknown	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2009 (5-year review)	<5,000		All threats managed in all 3 populations	No
			Complete genetic storage	Yes
			3 populations with 50 mature individuals each	No

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Ischaemum byrone* (no common name)

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

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

_____ Date AUG 2 7 2010