

Isodendrion longifolium
(aupaka)

**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: *Isodendrion longifolium* / aupaka

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5-YEAR REVIEW
***Isodendrion longifolium* (aupaka)**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

Region 1, Endangered Species Program, Division of Recovery, Jesse D`Elia, (503) 231-2071

Lead Field Office:

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808) 792-9400

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 March 16, 2009. The review was based on final critical habitat designations for *Isodendrion longifolium* and other species from the islands of Kauai and Oahu (USFWS 2003a, b) 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 Recovery Program Lead and the Assistant Field Supervisor for Endangered Species before submission to the Deputy 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. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

1.3.2 Listing history

Original Listing

FR notice: USFWS. 1996. Endangered and threatened wildlife and plants; determination of endangered status for fourteen plant taxa from the Hawaiian islands. Federal Register 61(198):53108-53124.

Date listed: October 10, 1996

Entity listed: Species

Classification: Threatened

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] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, Hawaii; final rule. Federal Register 68(39):9116-9479.

[USFWS] U.S. Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; final designations or nondesignations of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-36406.

Critical habitat was designated for *Isodendrion longifolium* in five units totaling 1,412 hectares (3,488 acres) on Kauai (USFWS 2003a) and two units totaling 714 hectares (1,762 acres) on Oahu (USFWS 2003b). These designations include habitat on State, Federal, and private lands.

1.3.4 Review History:

Species status review [FY 2010 Recovery Data Call (September 2010)]:
Declining

Recovery achieved:

1 (0-25%) (FY 2007 Recovery Data Call – most recent year reported)

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

8

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: U.S. Fish and Wildlife Service. 1999. Recovery plan for the multi-island plants. U.S. Fish and Wildlife Service, Portland, Oregon. 206 pages + appendices.

Date issued: June 10, 1999.

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 criteria?

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.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the multi-island plants (USFWS 1999), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Isodendrion longifolium* is a short-lived perennial that was listed as threatened. To be considered for delisting, a minimum of eight to ten populations should be documented on islands where they now occur or occurred historically. 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.

This recovery objective has not been met.

2.3 Updated Information and Current Species Status

No new information.

2.3.1 Biology and Habitat

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

Isodendrion longifolium plants are generally shrubs 1 to 2 meters (3 to 6 feet) tall, but in Wainiha on Kauai, this woody violet has been seen as tall as 4 meters (13 feet) (Wood 2009a).

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:

Since 2003, seven populations containing 103 individuals were observed on Kauai and no individuals were observed on Oahu. However, as described below, before 2003, on Kauai an additional six populations contained at least 554 to 674 individuals, and on Oahu four populations contained 32 individuals.

When designating critical habitat in 2003, the U.S. Fish and Wildlife Service identified a total of 804 to 854 *Isodendrion longifolium* individuals on Kauai, in 15 populations on State and private lands in Limahuli Valley, Hanakapiai, Pohakea, Waioli Valley, the left branch of Kalalau Valley, Honopu Valley, Kawaiula Valley, and Haupu (USFWS 2003a).

On Kauai in Limahuli Valley, 100 mature individuals of *Isodendrion longifolium* were seen in 1979 at two different elevations, 503 and 610 meters (1,650 and 2,000 feet) (Hawaii Biodiversity and Mapping Program 2009). It was observed in 1987 at 488 to 628 meters (1,600 to 2,060 feet) elevation

(National Tropical Botanical Garden 2010a), and in 1990, 20 or more individuals including seedlings were reported at “Pritchardia Gulch” west of Limahuli Falls at 579 meters (1,900 feet) elevation (Hawaii Biodiversity and Mapping Program 2009). In 1991, 30 to 50 individuals were seen at 518 to 564 meters (1,700 to 1,850 feet) elevation above the falls. Five individuals were reported in 2002 from 503 meters (1,650 feet) elevation (Perlman 2009) and in 2005, 28 individuals were reported from Upper Limahuli at 518 meters (1,699 feet) elevation (National Tropical Botanical Garden 2010b).

In the Kalalau Valley on Kauai, 10 individuals were seen in 1989 at 488 meters (1,600 feet) elevation (Hawaii Biodiversity and Mapping Program 2009), 30 individuals in 1990, and 4 in 1992 at 457 to 512 meters (1,500 to 1,680 feet) elevation (Perlman 2009).

In Hanakapiai Valley on Kauai, 20 individuals were seen in 1989 on the east side of the falls plunge pools (National Tropical Botanical Garden 2010a). In 1990, 15 individuals were seen at 250 meters (820 feet) elevation at this same site (National Tropical Botanical Garden 2010a). In 1991, one individual was observed at Hanakapiai-Hoolulu Ridge at 610 meters (2,000 feet) elevation (Hawaii Biodiversity and Mapping Program 2009), and 20 individuals at 244 meters (800 feet) elevation at Hanakapiai Falls. In 1999, 10 to 100 individuals were recorded at Hanakapiai (National Tropical Botanical Garden 2010b). In 2001, 8 to 10 individuals were seen on the east side of Hanakapiai Falls, at 213 meters (700 feet) elevation (National Tropical Botanical Garden 2010b), and in 2009, 3 individuals were seen on a rock shelf by Hanakapiai Falls at 259 meters (850 feet) elevation (Perlman 2009).

In the Wahiawa Stream area on Kauai, in the Hanapepe drainage (Wainonoia Stream), 25 individuals of *Isodendron longifolium* were seen at 518 to 603 meters (1,700 to 1,980 feet) elevation in 1980 (Hawaii Biodiversity and Mapping Program 2009). All other observations in this area were made in 1991. In the Wahiawa Mountains above Alexander Dam, two individuals were seen in that year west of Kanaele Bog on banks of the Wahiawa Stream at 570 meters (1,870 feet) elevation (Hawaii Biodiversity and Mapping Program 2009). Also in 1991, 77 individuals were observed at 555 to 658 meters (1,820 to 2,160

feet) elevation, and 80 to 100 scattered individuals were seen northeast of Puu Auuka at 600 to 658 meters (1,969 to 2,158 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009). In the Wahiawa Stream drainage, *Isodendrion longifolium* was also observed between Hulua and Puu Auuka at 630 to 730 meters (2,067 to 2,395 feet) elevation. Since 1991, no observations of *Isodendrion longifolium* were made in the Wahiawa Stream area; however, Ken Wood and Steve Perlman of the National Tropical Botanical Garden believe it may still be there as good habitat still exists, despite damage caused by the hurricane in 1992 (K. Wood, National Tropical Botanical Garden, pers. comm. 2009).

In Waioli Valley on Kauai, Steve Perlman of the National Tropical Botanical Garden saw occasional scattered individuals in 1991 (National Tropical Botanical Garden 2010a). David Lorence, also of the National Tropical Botanical Garden, saw 60 to 80 individuals in 1992 at 410 meters (1,345 feet) elevation (National Tropical Botanical Garden 2010a) and Ken Wood of National Tropical Botanical Garden saw it in the same year at 470 to 530 meters (1,542 to 1,739 feet) elevation. Thirty individuals were observed between 402 and 488 meters (1,320 and 1,600 feet) elevation in 1993 and 100 to 200 individuals between 396 and 579 meters (1,300 and 1,900 feet) elevation (National Tropical Botanical Garden 2010a). Six individuals were also observed in 1993 at 335 to 427 meters (1,100 to 1,400 feet) elevation (National Tropical Botanical Garden 2010a). No observation has been recorded in Waioli Valley since 1993.

On Mt. Haupu on Kauai, 30 individuals were seen at 580 to 680 meters (1,903 to 2,231 feet) elevation in 1992 (National Tropical Botanical Garden 2010a). One 4-meter (13-foot) high individual containing flowers and immature fruits was reported in 2001 at 610 meters (2,000 feet) elevation, on a slope below the summit (National Tropical Botanical Garden 2010a), and in 2005, 10 individuals were noted at the summit at 671 meters (2,200 feet) elevation (Wood 2009b).

In Kauai's Iliiliula Valley in 1994, Perlman estimated there were 1,000 individuals at 585 meters (1,920 feet) elevation. In 2004, only ten individuals were seen in the back of the valley, on a northern slope below the dividing ridge and the flats of Iole

Valley at 610 meters (2,000 feet) elevation (National Tropical Botanical Garden 2010a, 2010b; Wood, 2009b).

On Mt. Kahili summit on Kauai, 100 individuals were seen in 1975 at 762 meters (2,500 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2009b). In 1999, 25 to 50 individuals were seen from the top of the ridge trail from Kahili Mountain Park toward Kahili summit (National Tropical Botanical Garden 2010a). In 2004, observations were made at 536 meters (1,760 feet) elevation by Perlman and Natalia Tangalin (National Tropical Botanical Garden 2010b).

On Kauai at Nualolo in the Kuia Natural Area Reserve, Ken Wood saw 20 individuals at 1,131 meters (3,710 feet) elevation in 1993. In 1994 at Kaahole, *Isodendrion longifolium* was seen again below Nualolo Trail at 640 meters (2,100 feet) elevation (Wood 2009b). *Isodendrion longifolium* was collected in Mahanaloa, in the same general area, in 2009 from at least two individuals (National Tropical Botanical Garden 2010b).

In the Honopu Valley on Kauai, 20 individuals of *Isodendrion longifolium* were seen at 1,152 meters (3,780 feet) elevation in 1995 (Hawaii Biodiversity and Mapping Program 2009) and again in 1996 at 1,067 to 1,128 meters (3,500 to 3,700 feet) elevation. In 2001, 100 mature individuals, 20 juveniles, and 20 seedlings were recorded at 1,082 meters (3,550 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010b; Wood 2009b), 30 mature individuals, 10 juveniles, and 20 seedlings at 1,058 meters (3,470 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2009b), and 50 individuals at 1,100 meters (3,610 feet) elevation (National Tropical Botanical Garden 2010a; Wood 2009b).

Joel Lau observed nine *Isodendrion longifolium* individuals in Kawaiula Valley on Kauai in 1987 at 732 meters (2,400 feet) elevation. In 1996, *Isodendrion longifolium* was observed at 640 meters (2,100 feet) elevation. Three individuals were reported in 2000 at 640 meters (2,100 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2009b).

In Kauai, in Pohakuao Valley in 2001, two mature individuals of *Isodendrion longifolium* were observed at 549 to 610 meters

(1,800 to 2,000 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2009b).

In Wainiha on Kauai, 20 individuals of *Isodendrion longifolium* were seen in 2008, at 732 meters (2,400 feet) elevation (National Tropical Botanical Garden 2010a; Wood 2009b). In 2009, ten individuals were observed at 579 meters (1,900 feet) elevation and seven at 518 meters (1,700 feet) elevation. Extensive observations were made there in 2008 to 2009 at elevations from 472 to 732 meters (1,550 to 2,400 feet) by Ken Wood, and approximately 50 individuals were found (Wood 2009a).

When designating critical habitat in 2003, the U.S. Fish and Wildlife Service identified a total of 30 *Isodendrion longifolium* individuals on Oahu, in seven populations on Federal, State, and private lands in Palikea Gulch, Kaawa Gulch, Makaua Gulch, and Kaukonahua Stream (USFWS 2003b).

In Oahu's Waianae Mountains in the Mt. Kaala Natural Area Reserve at Palikea Gulch, ten individuals were seen in 1986 from 640 to 701 meters (2,100 to 2,300 feet) elevation and at Puu Pane eight individuals were identified in 1987 (National Tropical Botanical Garden 2010a). In West Makaleha Gulch, in the Mokuleia Forest Reserve, 10 to 15 individuals were observed in 1987 at 610 meters (2,000 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010a). In 1998, three individuals were seen there (National Tropical Botanical Garden 2010a), but these had been killed by feral goats (*Capra hircus*) in 1999 (Hawaii Biodiversity and Mapping Program 2009).

In Oahu's Koolau Mountains a few individuals of *Isodendrion longifolium* were seen in Makaua Gulch (Hidden Valley), located above Kaawa, in 1987, growing in shade on the left side of the stream bank in the back of the valley (National Tropical Botanical Garden 2010a). At Kaawa Gulch, in 2002, Joel Lau saw 15 mature, one juvenile, and five dead individuals at 640 to 671 meters (2,100 to 2,200 feet) elevation (Hawaii Biodiversity and Mapping Program 2009). At Schofield Barracks, on Kaukonahua Stream's south fork two individuals were seen in 1993 at 497 to 500 meters (1,630 to 1,640 feet) elevation, but were gone by 1999. A few individuals were seen in 1994 at 457 meters (1,500 feet) elevation (Hawaii Biodiversity and Mapping

Program 2009). In the same year, five mature and three juvenile individuals of *Isodendrion longifolium* were seen at Kaukonahua Stream at 539 meters (1,770 feet) elevation (Hawaii Biodiversity and Mapping Program 2009).

Since 2003, seven populations containing a total of at least 103 individuals have been observed on Kauai; an additional six populations containing between 554 to 674 individuals may exist, but the status of these populations are unknown as they were last observed in 1991, 1992, 1993, 2000, or 2001. Similarly, no individuals of *Isodendrion longifolium* have been observed on Oahu since 2003, however, an additional four populations containing 32 individuals may exist, but the status of these populations are unknown as they were last observed in 1987, 1999, or 2002. The total census for *I. longifolium* statewide is seven populations containing at least 103 individuals.

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:

No new information.

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 above.

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

The habitat in Limahuli Valley on Kauai is closed *Metrosideros polymorpha* (ohia) – *Diospyros sandwicensis* (lama) lowland mesic forest with associated native species including *Antidesma*

platyphyllum (hame), *Bidens forbesii* (kookoolau), *Bohea* sp. (ahakea), *Boehmeria grandis* (akolea), *Cibotium* sp. (hapuu), *Cyanea coriacea* (haha), *Eugenia* sp. (nioi), *Freycinetia arborea* (ie ie), *Gardenia remyi* (nanu), *Hibiscus waimeae* subsp. *hannerae* (kokio ula), *Ilex anomala* (kawau), *Kadua affinis* (manono), *Machaerina angustifolia* (uki), *Perrottetia sandwicensis* (olomea), *Pipturus albidus* (mamake), *Pisonia* sp. (papala), *Pittosporum kauaiense* (hoawa), *Pritchardia* sp. (loulu), *Rauvolfia sandwicensis* (hao), and *Syzygium sandwicensis* (ohia ha), with numerous fern species (Hawaii Biodiversity and Mapping Program, 2009; Perlman 2009; Wood 2009b).

In Upper Limahuli on Kauai, the habitat is *Dicranopteris linearis* (uluhe) – *Clidemia hirta* (Koster's curse) vegetation on stream banks with *Metrosideros polymorpha* – *Dicranopteris linearis* wet forest in gulch bottoms with *Antidesma* sp. (hame), *Bidens* sp., *Bohea* sp., *Cibotium* sp., *Gardenia remyi*, *Hibiscus waimeae* subsp. *hannerae*, *Pisonia* sp., *Pritchardia limahuliensis* (loulu), and *Psychotria mariniana* (kopiko) (National Tropical Botanical Garden 2010b).

The habitat in Hanakapiai on Kauai is lowland mesic forest *Metrosideros polymorpha* wet shrubland and *Metrosideros polymorpha* – *Dicranopteris linearis* wet forest in gulch bottoms with *Aleurites moluccana* (kukui), *Antidesma* sp., *Athyrium microphyllum* (akolea), *Bidens* sp., *Bohea* sp., *Boehmeria grandis*, *Charpentiera densiflora* (olapa), *Christella cyatheoides* (kikawaio), *Cibotium* sp., *Cyrtandra* sp. (haiwale), *Diospyros* sp., *Gardenia remyi*, *Hibiscus waimeae* subsp. *hannerae*, *Isachne pallens* (no common name [NCN]), *Kadua fluviatilis* (kamapuaa), *Machaerina* sp., *Melicope* sp. (alani), *Peperomia* sp. (ala ala wai nui), *Piper methysticum* (awa), *Pipturus albidus*, *Pisonia* sp., *Pleomele* sp. (hala pepe), *Pritchardia limahuliensis*, *Psydrax odorata* (alahee), *Psychotria mariniana*, *Selaginella* sp. (lepelepe a moa), *Streblus pendulinus* (aiiai), and *Wikstroemia oahuensis* (akia) (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010b; Perlman 2009; Wood 2009b).

In Kalalau, the habitat is diverse mesic forest with *Alectryon macrococcus* (mahoe), *Aleurites moluccana*, *Charpentiera densiflora*, *Cyanea hardyi* (haha), *Diospyros sandwicensis*,

Freycinetia arborea, *Hibiscus kokio* ssp. *saintjohnianus*, *Kadua* sp., *Myrsine petiolata* (kolea), *Pipturus albidus*, *Pouteria sandwicensis* (alaa), *Psychotria mariniana*, *Pteralyxia kauaiensis* (kaulu), *Rauwolfia sandwicensis*, and *Syzygium sandwicensis* (Perlman 2009).

Pohakua on Kauai has relict diverse mesic forest habitat dominated by *Aleurites moluccana* (kukui) and with associated species including *Alectryon macrococcus*, *Antidesma platyphyllum*, *Bidens sandwicensis* subsp. *sandwicensis* (kookoolau), *Boehmeria grandis*, *Chamaesyce celastroides* var. *hanapepensis* (akoko), *Charpentiera densiflora*, *Diospyros sandwicensis*, *Flueggea neowawraea* (mehamehame), *Freycinetia arborea*, *Hibiscus kokio* subsp. *saintjohnianus*, *Kokia kauaiensis* (kokio), *Lipochaeta connata* var. *acris* (nehe), *Metrosideros polymorpha* var. *glaberrima*, *Musa x paradisiaca* (maia), *Myrsine lanaiensis* (kolea), *Myrsine lessertiana* (kolea lau nui), *Myrsine petiolata* (kolea), *Nesoluma polynesianum* (*keahi*), *Nototrichium sandwicense* (kului), *Pipturus albidus*, *Pleomele aurea*, *Pleomele sandwicensis*, *Pouteria sandwicensis*, *Pritchardia napaliensis* (loulou), *Psychotria mariniana*, *Psydrax odoratum*, *Pteralyxia kauaiensis*, *Rauwolfia sandwicensis*, *Santalum freycinetianum* var. *pyrularium* (iliahi), *Syzygium sandwicensis*, *Wilkesia gymnoxiphium*, and *Zanthoxylum dipetalum* (kawau kua) (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010a; Perlman 2009).

In the Wahiawa drainage on Kauai, between Hulua and Puu Auuka, the habitat is closed *Metrosideros polymorpha* – *Dicranopteris linearis* lowland mesic to wet forest with *Athyrium microphyllum* (akolea), *Bobea* sp., *Cheirodendron* sp., *Diospyros* sp., *Freycinetia arborea*, *Kadua* sp., *Labordia* spp. (kamakahala), *Pleomele* sp., *Pouteria* sp., *Psychotria* sp., and *Syzygium* sp. (National Tropical Botanical Garden 2010a; Wood 2009b).

In Kawaiula on Kauai, the habitat is *Acacia koa* – *Metrosideros polymorpha* lowland mesic forest with associated native species including *Alphitonia ponderosa* (kauila), *Antidesma platyphyllum*, *Athyrium* sp., *Bobea brevipes*, *Bonamia menziesii* (NCN), *Carex meyenii* (NCN), *Charpentiera elliptica* (papala), *Cheirodendron trigynum* (olapa), *Dodonaea viscosa*, *Diospyros*

sandwicensis, *Diplazium sandwichianum* (hoio), *Elaeocarpus bifidus* (kalia), *Euphorbia haeleeleana* (NCN), *Freycinetia arborea*, *Kadua affinis*, *K. knudsenii* (NCN), *Leptecophylla tameiameiae* (pukiawe), *Lysimachia kalalauensis* (NCN), *Nestegis sandwicensis* (olopua), *Peperomia cookiana* (ala ala wai nui), *P. kokeana* (ala ala wai nui), *Pipturus kauaiensis* (mamake), *Pleomele aurea* (hala pepe), *Polypodium pellucidum* var. *acuminatum* (ae lau nui), *Smilax melastomifolia* (pi oi), *Syzygium sandwicensis*, *Tetraplasandra kawaiensis* (ohe ohe), and *Wilkesia gymnoxiphium* (Hawaii Biodiversity and Mapping Program 2009; Wood 2009b).

In Honopu on Kauai the habitat is *Acacia koa* – *Metrosideros polymorpha* – *Dicranopteris montana* mesic forest with *Alphitonia ponderosa*, *Bobea brevipes*, *Cheirodendron fauriei* (olapa), *Claoxylon sandwicensis* (laukea), *Coprosma kauensis* (koi), *Cyrtandra kauaiensis* (haiwale), *Dianella sandwicensis* (uki uki), *Diplazium* sp., *Dodonaea viscosa*, *Doodia* sp. (okupukupu), *Hillebrandia sandwicensis* (aka aka awa), *Ilex anomala*, *Kadua affinis*, *Labordia degeneri* (kamakahala), *Lysimachia kalalauensis* (NCN), *Melicope anisata* (mokihana), *M. barbigeri* (uahiapele), *Microlepia strigosa* (palapalai), *Myrsine lessertiana*, *Perrottetia* sp., *Platydesma spathulata* (pilo kea), *Pleomele aurea*, *Pouteria sandwicensis*, *Psychotria greenwelliae* (kopiko), *P. hexandra* (kopiko), *P. mariniana*, *Ranunculus mauiensis* (makou), *Tetraplasandra* sp., *Xylosma crenatum* (NCN), *Xylosma hawaiiense* (maua), and *Zanthoxylum dipetalum* (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010b; Wood 2009b).

Mount Kahili on Kauai has *Metrosideros* – *Dicranopteris linearis* wet forest habitat with *Alyxia stellata* (maile), *Antidesma platyphylla*, *Bidens forbesii*, *Boehmeria grandis*, *Broussaisia arguta* (kanawao), *Cheirodendron trigynum*, *Coprosma* sp. (pilo), *Cyanea coriacea*, *Cyanea remyi*, *Cyanea sylvestris*, *Diospyros sandwicensis*, *Dubautia knudsenii* (naenae), *Elaphoglossum crassifolium* (hoe a Maui), *Freycinetia arborea* (ie ie), *Gardenia remyi*, *Ilex anomala*, *Kadua affinis*, *Machaerina* sp., *Pipturus albidus*, *Pittosporum kauaiense*, *Pritchardia flynnii*, *Psychotria mariniana*, *Rauwolfia sandwicensis*, *Scaevola procera* (naupaka kuahiwi), *Syzygium sandwicensis*, and *Tetraplasandra* sp. (Perlman 2009).

On Mt. Haupu on Kauai the habitat is *Diospyros* – *Metrosideros* lowland mixed mesic forest on north facing native cliffs with *Aleurites moluccana*, *Antidesma platyphyllum* var. *hillebrandii*, *Artemisia* sp., *Bidens valida* (kookoolau), *Bohea brevipes*, *Bonamia* sp., *Carex wahuensis*, *Cheirodendron fauriei*, *Cibotium glaucum* (hapuu), *Cyanea coriacea* (haha), *C. fissa* (haha), *C. hirtella* (haha), *Dicranopteris linearis*, *Diplopterygium pinnatum* (uluhe lau nui), *Dubautia laxa* subsp. *pseudoplantaginea* (naenae pua melemele), *Elaeocarpus bifidus*, *Eragrostis variabilis* (kawelu), *Freycinetia arborea*, *Hibiscus kokio* (kokio ula), *Ilex anomala*, *Ipomoea indica* (koali awa), *Kadua acuminata* (au), *K. affinis*, *K. fluviatilis* (kamapuaa), *Lepidium bidentatum* (anaunau), *Lobelia niihauensis* (NCN), *Lycopodiella cernua* (wawae iole), *Machaerina angustifolia* (uki), *M. mariscoides* subsp. *meyenii* (ahaniu), *Cyperus* sp., *Melicope anisata*, *M. feddei* (alani), *M. waialealae* (alani wai), *Myrsine* sp., *Nephrolepis exaltata* subsp. *hawaiiensis* (nianiau), *Pipturus* sp., *Pisonia* sp., *Pittosporum gayanum* (hoawa), *Pleomele* sp., *Pouteria sandwicensis*, *Psychotria mariniana*, *Psydrax odorata*, *Pteridium aquilinum* var. *decompositum* (kilau), *Rhynchospora sclerioides* (kuolohia), *Sadleria pallida* (amau ii), *Schiedea perlmanii* (NCN), *Sida fallax* (ilima), *Sphenomeris chinensis* (palaa), *Syzygium sandwicensis*, *Tetraplasandra bisattenuata* (ohe ohe), *T. oahuensis* (ohe mauka), *Xylosma hawaiiense*, and *Zanthoxylum* sp. (National Tropical Botanical Garden 2010a; Perlman 2009; Wood 2009b).

In Iiiliuila Valley on Kauai, on the northern slope below the dividing ridge and flats of Iole Valley, the habitat is *Metrosideros polymorpha* – *Dicranopteris linearis* wet forest with *Antidesma platyphyllum*, *Bidens forbesii*, *Boehmeria grandis*, *Broussaisia arguta*, *Carex wahuensis* (NCN), *Cheirodendron trigynum*, *Cyanea coriacea*, *Cyanea* spp., *Cyrtandra paludosa* (moa), *Diospyros sandwicensis*, *Diplazium* sp., *Dubautia knudsenii*, *Freycinetia arborea*, *Gardenia remyi*, *Ilex anomala*, *Kadua affinis*, *Labordia* sp. (kamakahala), *Melicope clusiifolia* (kukaemoa), *M. wawraeana* (alani), *Perrottetia* sp., *Pipturus albidus*, *Pisonia* sp., *Pittosporum kauaiense* (hoawa lau nui), *Pritchardia* sp., *Psychotria mariniana*, *P. wawrae* (kopiko), *Rauvolfia sandwicensis*, *Sadleria cyatheoides*, *Sphenomeris chinensis*, *Syzygium sandwicensis*, and *Tetraplasandra* sp. (National Tropical Botanical Garden 2010a; Wood 2009b).

In Nualolo on Kauai in the Kuia Natural Area Reserve the habitat is *Metrosideros polymorpha* – *Dicranopteris linearis* montane mesic forest in a drainage below relic *Acacia koa* – *Metrosideros polymorpha* lowland mesic forest with *Antidesma* sp., *Claoxylon* sp., *Diospyros sandwicensis*, *Dodonaea viscosa*, *Dubautia* sp., *Elaeocarpus* sp., *Eragrostis grandis*, *Labordia hirtella* (kamakahala), *Melicope* sp., *Pittosporum glabrum*, *Pleomele* sp., *Psychotria* sp., *Scaevola* sp., *Xylosma* sp., and *Zanthoxylum* sp. (Wood 2009b).

In the back of Waioli Valley on Kauai, *Isodendron longifolium* grows in *Metrosideros polymorpha* – *Dicranopteris linearis* lowland wet forest with *Adenophorus periens* (palau laau), *Alyxia stellata*, *Antidesma* sp., *Bidens campylotheca* subsp. *campylotheca* (kookoolau), *Boehmeria grandis*, *Bonamia menziesii*, *Broussaisia argutus*, *Cheirodendron* sp., *Cibotium* sp., *Cyanea recta* (haha), *Cyrtandra pickeringii* (haiwale), *C. kealiae* (haiwale), *Diplazium sandwichianum*, *Dubautia* sp., *Freycinetia arborea*, *Hesperomannia* sp. (NCN), *Joinvillea ascendens* (ohe), *Kadua affinis*, *Lindsaea repens* (laukahi), *Melicope* sp., *Panicum lineale* (NCN), *Pisonia* sp., *Pritchardia* sp., *Psychotria* sp., *Scaevola* sp., *Syzygium sandwicensis*, *Tetraplasandra* sp., *Urera* sp. (opuhe), and ferns, which are common in the understory (Wood 2009b).

In Wainiha Valley on Kauai the species occurs on steep slopes with a rich fern and bryophyte (moss and related plant) understory. Associated native species include *Aleurites moluccana*, *Antidesma* sp., *Broussaisia argutus*, *Cheirodendron* spp., *Coprosma waimeae* (olena), *Cyrtandra* spp., *Dicranopteris* sp., *Dubautia* spp., *Ilex anomala*, *Labordia* spp., *Metrosideros polymorpha*, *Microlepia* sp., *Perrottetia* sp., *Pisonia umbellifera* (papala kepau), *Psychotria* spp., *Sphenomeris* sp., *Syzygium* sp., *Tetraplasandra kavaiensis*, and *T. oahuensis* (National Tropical Botanical Garden 2010a; Wood 2009b).

In the Waianae Mountains on Oahu *Isodendron longifolium* grows in mesic or lowland wet *Metrosideros polymorpha* – *Acacia koa* – *Dicranopteris linearis* forest with *Alectryon macrococcus*, *Alyxia stellata*, *Antidesma platyphyllum*, *Bobea brevipes* (ahakea lau lii), *B. elatior*, *Broussaisia arguta*, *Carex* sp., *Charpentiera* sp., *Cibotium* sp., *Clermontia persicifolia* (oha

wai), *Coprosma foliosa* (pilo), *Cyanea angustifolia* (haha), *Cyrtandra* sp., *Diospyros sandwicensis*, *Diplazium sandwichianum*, *Dodonaea viscosa*, *Doodia kunthiana*, *Eugenia reinwardtiana* (nioi), *Flueggea neowawraea*, *Hibiscus arnottianus* subsp. *arnottianus* (kokio keokeo), *Ilex anomala*, *Isachne pallens* (NCN), *Kadua affinis*, *Labordia tinifolia* (kamakahala), *Leptecophylla tameiameiae*, *Melicope peduncularis* (alani), *Morinda trimeria* (noni kuahiwi), *Myrsine lessertiana*, *Neraudia melastomifolia*, *Nestegis* sp., *Ochrosia* sp. (holei), *Peperomia* sp., *Perrottetia sandwicensis*, *Pittosporum* sp., *Pouteria sandwicensis*, *Psychotria* sp., *P. hathewayi* (kopiko), *Psydrax odorata*, *Pteralyxia macrocarpa* (kaulu), *Rauvolfia sandwicensis*, *Scaevola* sp., *Selaginella arbuscula*, *Syzygium sandwicensis*, and *Wikstroemia oahuensis* (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010a, 2010b; Perlman 2009; USFWS 2003).

In the Koolau Mountains on Oahu, *Isodendrion longifolium* grows on wet *Metrosideros polymorpha* – *Dicranopteris linearis* lowland forest stream banks in dark shade with native species *Acacia koa*, *Cordyline fruticosa* (ti), *Charpentiera tomentosa* (papala), *Coprosma foliosa*, *Cyanea acuminata* (haha), *C. crispa* (haha), *Cyrtandra hawaiiensis* (haiwale), *C. propinqua* (haiwale), *Dodonaea viscosa*, *Isachne pallens*, *Leptecophylla tameiameiae*, *Myrsine lessertiana*, *Nothocestrum longifolium* (aiea), *Ochrosia compta* (holei), *Selaginella arbuscula*, *Christella parasitica* (NCN), *Touchardia latifolia* (olona), and *Urera glabra* (opuhe) under heavy canopy of the invasive species *Clidemia hirta* (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010a; Perlman 2009).

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:

On Kauai the threats to *Isodendrion longifolium* are habitat

degradation or destruction by feral goats (*Capra hircus*) and pigs (*Sus scrofa*) and invasive introduced plant species including *Adiantum raddianum* (brittle maidenhair fern), *Ageratina riparia* (spreading mist flower), *Ageratum conyzoides* (billygoat weed), *Andropogon glomeratus* (beardgrass), *Axonopus fissifolius* (narrow leaved carpetgrass), *Blechnum appendiculatum* (NCN), *Bryophyllum pinnatum* (airplant), *Buddleia asiatica* (dog tail), *Christella dentata* (downy wood fern), *Clidemia hirta*, *Colocasia esculenta* (kalo), *Cordyline fruticosa*, *Cyperus meyenianus* (NCN), *Deparia petersenii* (NCN), *Erigeron karvinskianus* (daisy fleabane), *Juncus planifolius* (bog rush), *Hedychium gardnerianum* (kahili ginger), *Lantana camara* (lantana), *Ludwigia octovalvis* (primrose willow), *Cyperus meyenianus* (NCN), *Melastoma septemnerium* (NCN), *Melinis minutiflora* (molasses grass), *Nephrolepis multiflora* (NCN), *Oplismenus hirtellus* (basketgrass), *Paederia foetida* (skunk vine, stinky maile, maile pilau), *Paspalum conjugatum* (Hilo grass), *Passiflora tarminiana* (banana poka), *Pinus elliotti* (slash pine), *Pluchea carolinensis* (sourbush), *Psidium cattleianum* (strawberry guava), *P. guajava* (common guava), *Rhodomyrtus tomentosa* (rose myrtle), *Rubus argutus* (blackberry), *R. rosifolius* (thimbleberry), *Schinus terebinthifolius* (Christmas berry), *Schizachyrium condensatum* (little bluestem), *Setaria parviflora* (yellow foxtail), *Sphaeropteris cooperi* (Australian tree fern), and *Zingiber zerumbet* (shampoo ginger) (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009; Wood 2009b).

On Oahu, the major threats to *Isodendrion longifolium* are habitat degradation or destruction by feral goats and pigs and invasive introduced plant species including *Ageratina riparia*, *Clidemia hirta*, *Oplismenus hirtellus*, *Paspalum conjugatum*, *Psidium cattleianum*, and *Christella parasitica* (USFWS 2003b).

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

Not a threat.

2.3.2.3 Disease or predation:

Goats, pigs, and rats (*Rattus* spp.) eat the fruit, and slugs (unidentified species) presumably also eat the foliage of

Isodendrion longifolium (Hawaii Biodiversity and Mapping Program 2009; National Tropical Botanical Garden 2010b; Wood 2009b).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Not a threat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Fire is considered a threat to *Isodendrion longifolium* on Kauai (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009; Wood 2009b). On Oahu, the Palikea Gulch occurrence is also potentially threatened by fire (USFWS 2003b). On Oahu, there is also the risk of extinction from naturally occurring events due to the small number of occurrences and individuals (USFWS 2003b).

Threats from introduced invasive plant species previously described in Section 2.3.2.1, in addition to degrading habitat, directly compete with *Isodendrion longifolium* for water, light, and nutrients.

Climate change may also 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 has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

The National Tropical Botanical Garden has received funding to construct a 400 hectares (1,000 acres) fence which is currently in progress. The National Tropical Botanical Garden on Kauai is also controlling invasive plants and reintroducing rare and endangered plants in the area (National Tropical Botanical Garden 2006, 2008). This site will benefit towards the recovery of *Isodendrion longifolium*.

There are four seeds collected from the Iliiliula population in storage at the National Tropical Botanical Garden (National Tropical Botanical Garden 2009). The Pahole Rare Plant

Facility reported having six rooted cuttings of *Isodendrion longifolium* from one wild individual (Pahole Rare Plant Facility 2009). The Center for Conservation Research and Training Seed Storage Laboratory (2010) on Oahu has 32 seeds in long-term storage.

2.4 Synthesis

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the multi-island plants (USFWS 1999), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Isodendrion longifolium* is a short-lived perennial that was listed as threatened, and to be considered for delisting, which is the first step in recovering the species, a minimum of 8 to 10 populations should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable and 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.

The delisting goals for this species have not been met. Although there are seven reported populations since 2003 and an additional six known historical populations may still be extant, no current or historic populations have ever been reported to contain 300 mature individuals (Table 1), and all threats are not being managed (Table 2). Therefore, *Isodendrion longifolium* meets the definition of threatened as it remains likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

Table 1. Status of *Isodendrion longifolium* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Delisting Criteria identified in Recovery Plan	Delisting Criteria Completed?
1996 (listing)	<1,000	0	All threats managed in all 8-10 populations	No
			Naturally reproducing, stable or increasing in number	Unknown
			8-10 populations with 300 mature individuals each	No
1999 (recovery plan)	<1,000	0	All threats managed in all 8-10 populations	No
			Naturally reproducing, stable or increasing in number	Unknown
			8-10 populations with 300 mature individuals each	No
2003 (critical habitat)	834-884	0	All threats managed in all 8-10 populations	No
			Naturally reproducing, stable or increasing in number	Unknown
			8-10 populations with 300 mature individuals each	No
2010 (5-year review)	103	0	All threats managed in all 8-10 populations	Partially (Table 2)
			Naturally reproducing, stable or increasing in number	Unknown
			8-10 populations with 300 mature individuals each	No: none of the 7 populations has 300 mature

				individuals
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Table 2. Threats to *Isodendrion longifolium*.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – habitat modification and herbivory	A, C, D	Ongoing	Partially: one population in Limahuli is fenced
Rats – herbivory	C	Ongoing	No
Slugs – herbivory	C	Ongoing	No
Fire	E	Ongoing	No
Small population size on Oahu	E	Ongoing	Partially: seeds collected and propagules growing in nursery
Invasive introduced plants	A, E	Ongoing	Partially: weed control in Limahuli
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

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

- Construct large-scale fences around all naturally occurring and reintroduced individuals to control feral ungulates.
- Control invasive introduced plant species around known populations.
- Collect material for genetic storage and propagation for reintroduction.
- Coordinate fire protection on State Natural Area Reserves, such as Mt. Kaala, where one of three Oahu populations occurs.
- Control rats in the vicinity of these populations.
- Develop and implement methods to control slugs.
- Assess the current status of historic populations, reproductive trends, and threats to the species to determine if downlisting is warranted.
- Work with Hawaii Division of Forestry and Wildlife and Hawaii State Parks to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Isodendrion longifolium* (aupaka)

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: _____

Review Conducted By:

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Date 8/2/11