

Bidens amplexans
(ko'oko'olau)

**5-Year Review
Summary and Evaluation**

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

5-YEAR REVIEW
Species reviewed: *Bidens amplexans* (ko‘oko‘olau)

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5-YEAR REVIEW
***Bidens amplexans* (ko‘oko‘olau)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Cooperating Field Office(s):

N/A

Cooperating Regional Office(s):

N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning in October 2018. The review was based on the final rule listing this species; the final critical habitat designation; peer reviewed scientific publications; unpublished field observations by the USFWS, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation completed by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

1.3.2 Listing history:

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Endangered status for 23 species on Oahu and

designation of critical habitat for 124 species; final rule. Department of the Interior, Federal Register 77 (181): 57648–57862, September 18, 2012.

Date listed: September 18, 2012
Entity listed: *Bidens amplexans*
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:

N/A

1.3.4 Review History:

This is the first 5-year review for this species. *Bidens amplexans* is an herb that was listed as endangered on September 18, 2012. Critical habitat was designated on O‘ahu for *B. amplexans* at the same time, totaling 10 units in two ecosystems (coastal and lowland dry) (1,508 ac, 607 ha) (77 FR 57648). The draft recovery plan for this species is in preparation.

1.3.5 Species’ Recovery Priority Number at start of this 5-year review: 2

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: Recovery Outline for the Island of O‘ahu
Date issued: July 2018
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Yes
 No

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

Yes
 No

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

Yes
 No

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

Yes
 No

2.2 Recovery Criteria

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

Yes
 No

2.2.2 Adequacy of recovery criteria.

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

Yes
 No

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

Yes
 No

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

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

The recovery plan is currently being drafted. However, the Hawai'i and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and

goals for stages leading towards recovery (2011). These stages are described below.

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

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

Preventing Extinction

Stabilizing (interim), downlisting, and delisting objectives have been updated according to the draft revised recovery objective guidelines developed by the HPPRCC (2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of populations and reproducing individuals for each stage. The goals for each stage remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Bidens amplexans is a short-lived facultative annual or sometimes perennial herb. To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections. In addition, a minimum of three populations should be documented on O‘ahu where they now occur or occurred historically. Each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings) and increasing in number, with a minimum of 100 mature, reproducing individuals per population.

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

Interim Stage

To meet the interim stage of recovery of *Bidens amplexans*, 500 mature, reproducing individuals are needed in each of three populations and all major threats must be controlled around the populations designated for recovery at this stage. There should also be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the target populations. The populations must be adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation’s guidelines (Guerrant *et al.* 2004). Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

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

Downlisting Criteria

In addition to achieving 5 to 10 populations with 1,000 mature, reproducing individuals per population and all of the goals of the interim stage, all target populations must be stable, secure, and naturally reproducing for a minimum of 10 years. Species-specific management actions are not ruled out. Downlisting should not be considered until an adequate population viability analysis (PVA) has been conducted to assess needed numbers more accurately based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to downlist. Information necessary for the PVA that should be available through monitoring (ideally annually) includes major limiting factors, breeding system, population structure and density, and proven management methods for major threats.

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

Delisting Criteria

In addition to achieving 5 to 10 populations with 1,000 mature, reproducing individuals per population and all of the goals of the interim and downlisting stages, all target populations must be stable, secure, naturally reproducing, and within secure and viable habitats for a minimum of 20 years. Species-specific management actions must no longer be necessary, but ecosystem-wide management actions are not ruled out if there are long-term agreements in place to continue management. These numbers are initial targets, but may be revised upward as additional information is available, including adequate PVAs for individual species based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to delist. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis.

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

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

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

Little is known about the life history of *Bidens amplexans*. Flowering was observed in April, May, October, and November (National Tropical Botanical Garden (NTBG) 1987a, b, 2000, 2017; USFWS 2018, in litt.). Its pollination vectors, seed dispersal agents, specific environmental requirements, and limiting factors are unknown.

Bidens amplexans, a member of the sunflower family (Asteraceae), is an herb with branched stems, from 5 to 10 feet (1.5 to 3 meters) tall. Sparsely pubescent leaves are pinnately compound, 14 to 22 inches (in) (9 to 15 centimeters (cm)) long with 3 to 5 leaflets. Diffuse compound cymes with lateral branches have 10 to 30 flower heads. Ray florets are yellow, 7 to 9 per head, and disk florets are 40 to 60 per head with yellow corollas. Achenes are gray, straight, and wingless, 0.2 to 0.3 in (5 to 8 millimeters (mm)) long (Ganders and Nagata 1999).

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

Historically, *Bidens amplexans* was common and ranged from Pu'upueo to Makaleha along the northwestern side (160 to 720 ft; 50 to 220 m) of the Wai'anae mountains on O'ahu (Hawai'i Biodiversity and Mapping

Program (HBMP) 2010). In 2003, the widespread population was estimated to total fewer than 1,000 individuals (Brueggemann and Caraway 2003). Currently, there are about 10 populations at slightly higher elevations (above 600 ft, 180 m) on the windward slopes, ranging from 10 individuals to more than 100 individuals (Takahama 2018, in litt.). In addition, about 30 mature individuals were observed along Pahole road, and about 25 mature individuals were observed at Keālia (Ching 2018, in litt.). In a recent survey at Keālia, at least 56 mature and immature individuals were observed (USFWS 2018, in litt.). In summary, there are currently about 10 populations totaling fewer than 500 individuals.

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

Bidens amplexans hybridizes and intergrades with *B. torta* from near Ka‘ena Point to the head of Mākua Valley on the summit ridges of the Wai‘anae mountains. Pure *B. amplexans* is restricted to the windward cliffs and crests (Ganders and Nagata 1999).

2.3.1.4 Taxonomic classification or changes in nomenclature:

The species was described by Sherff in 1920 from a collection by Forbes at Kawaihāpai, in the Wai‘anae mountains of O‘ahu.

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 for spatial distribution of the species.

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

Typical habitat for this species includes cliffs and talus slopes in lowland dry shrubland dominated by the indigenous plant species *Psydrax odorata* (alahe‘e), *Myoporum sandwicense* (naio), and *Sida fallax* (‘ilima) on the windward side of the Wai‘anae mountains (Ganders and Nagata 1999).

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

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

Degradation of habitat by established ecosystem-altering invasive plant species—Invasive introduced plant species modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, modifying nutrient cycling, and changing the fire characteristics of the native plant community (Cuddihy and Stone 1990). Habitat modification and destruction by invasive introduced plants

negatively affects *Bidens amplexans* at all locations in the Wai‘anae mountains (Bruegmann and Caraway 2003).

Fire destruction or degradation of habitat—Fire is noted as a threat to *Bidens amplexans* (Bruegmann and Caraway 2003). Increasing episodes of drought, expansion of invasive grass cover, and temperature increases, have led to an increase in the number of wildfires on O‘ahu (Trauernicht *et al.* 2015). Fire can destroy dormant seeds as well as individual plants. Successive fires burn farther and farther into native habitat and alter microclimate conditions to further alter habitat conditions to favor nonnative plants. Nonnative plants convert native plant communities to nonnative dominated plant communities (D’Antonio and Vitousek 1992; Tunison *et al.* 2002).

Climate change loss or degradation of habitat—Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawai‘i 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 concluded that *Bidens amplexans* is vulnerable to the impacts of climate change with a vulnerability score of 0.883 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions are needed to conserve this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

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

Not a threat.

2.3.2.3 Disease or predation (Factor C):

Ungulate predation or herbivory—Predation and herbivory by feral pigs and goats is reported to be a threat to *Bidens amplexans* (77 FR 57648, September 18, 2012).

Rodent predation or herbivory—On a survey of a population of *Bidens amplexans* on the cliffs at Keālia, a large mature plant showed evidence of rat chew and had recently broken off as a result of the damage (USFWS 2018, in litt.).

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

Not a threat.

2.3.2.5 Other natural or manmade factors affecting its continued

existence (Factor E):

Hybridization impacts—*Bidens amplexans* can intergrade with *B. torta* to form hybrid swarms from Ka‘ena Point to the Wai‘anae summit ridges and to the head of Mākua Valley resulting in loss of species diversity, local adaptations, and genetic representation (USFWS 2012).

Current Management Actions:

- Surveys and inventories—The Hawaii Division of Forestry and Wildlife (DOFAW) monitors this species (Ching 2018, in litt.; Takahama 2018, in litt.). A survey of the Keālia population was conducted by FWS staff in November, 2018 (USFWS 2018, in litt.).
- Captive propagation for genetic storage and reintroduction—
 - Lyon Arboretum Micropropagation Laboratory reported only 17 inactive explants (*in vitro* containers) of *Bidens amplexans*. The Lyon Seed Conservation Laboratory has almost 37,000 seeds in storage from 27 founders from four locations (Keālia, Kapuna, Ke‘awapilau, and Mokulē‘ia) (Lyon Arboretum 2018, in litt.).
 - The National Tropical Botanical Garden (NTBG) reports over 5,000 seeds in collection from 1996 (NTBG 2017).
 - In 2013, the Pahole Rare Plant Facility reported 108 plants in storage representing 14 wild individuals. In 2018, there are 13 individuals representing the population at Keālia and 7 individuals representing the population at Kapuna, both in the northern Wai‘anae mountains (Pahole Rare Plant Facility 2013 in litt., 2018, in litt.).
- Reintroduction and translocation—
 - In 1999, a population at Kapuna-Kamimi ridge was augmented with and outplanting of 10 to 15 individuals (HBMP 2010).
 - The Division of Forestry and Wildlife (DOFAW) outplanted 363 plants between 2014 and 2015 and plans to outplant 15 more individuals in 2018 (Takahama 2018, in litt.; Ching 2018, in litt.).

Table 1. Status and trends of *Bidens amplexens* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2012 (listing and critical habitat)	<1,000	10–15	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 100 mature individuals each	No
2019 (5-year review)	<500	363	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 100 mature individuals each	Partial, one wild and one reintroduced population > 100 individuals

Table 2. Threats to *Bidens amplexens* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Degradation of habitat by established ecosystem-altering invasive plant species	A	Ongoing	None
Fire destruction or degradation of habitat	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	None
Rodent predation or herbivory	C	Ongoing	None
Stochastic events–Hybridization	E	Ongoing	Partial, seed collection, propagation, and reintroduction efforts ongoing

2.4 Synthesis

There are approximately 10 populations of *Bidens amplexans* totaling fewer than 500 individuals. There are seeds and propagules in collections, and outplanting efforts are ongoing with almost 400 individuals outplanted.

Preventing extinction, interim stabilization, downlisting, and delisting objectives are provided in HPPRCC's Revised Recovery Objective Guidelines (2011). To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on O'ahu where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, or saplings) with a minimum of 100 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met (Table 1), although there is almost complete *ex situ* genetic representation, there is only one wild population possibly totaling 100 individuals. There is one reintroduced population of almost 400 individuals; however, it is unknown if this population is successfully reproducing. In addition, all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Bidens amplexans* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Surveys and inventories—Continue to survey for *Bidens amplexans* in historical locations and potentially suitable habitat.
- Invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *Bidens amplexans*.
- Fire monitoring and control—Develop and implement fire prevention management plans.
- Captive propagation for genetic storage and reintroduction—Continue to collect seeds for storage and propagation efforts for maintenance of genetic stock.
- Ungulate predation or herbivory—Construct ungulate exclosures, or erect strategic fencing, at all populations of *Bidens amplexans* to protect this species from feral ungulates.
- Rodent predation or herbivory—Implement effective control methods for rats.
- Climate change adaptation strategy—Research suitability of habitat in the future due to the impacts of climate change
- Stochastic events—Build resiliency and redundancy—Continue to collect seeds for storage and propagation efforts for maintenance of genetic stock and reintroduction.
- Alliance and partnership development—Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

5.0 REFERENCES

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[USFWS] 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Bidens amplexans*
(ko‘oko‘olau)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

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FIELD OFFICE APPROVAL:

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