

## Candidate Petition Project

### HAWAIIAN PLANTS

#### PETITIONS TO LIST AS FEDERALLY ENDANGERED SPECIES

The following document contains the individual petitions for the 86 Hawaiian plant species to be listed as federally endangered species under the federal Endangered Species Act.

Pa'iniu	<i>Astelia waialealae</i>
Ko'oko'olau	<i>Bidens campylotheca ssp. pentamera</i>
Ko'oko'olau	<i>Bidens campylotheca ssp. waihoiensis</i>
Ko'oko'olau	<i>Bidens conjuncta</i>
Ko'oko'olau	<i>Bidens micrantha ssp. ctenophylla</i>
Reedgrass	<i>Calamagrostis expansa</i>
Reedgrass	<i>Calamagrostis hillebrandii</i>
'Awikiwiki	<i>Canavalia napaliensis</i>
'Awikiwiki	<i>Canavalia pubescens</i>
A'koko	<i>Chamaesyce eleanoriae</i>
A'koko	<i>Chamaesyce remyi var. remyi</i>
A'koko	<i>Chamaesyce remyi var. kauaiensis</i>
Papala	<i>Charpentiera densiflora</i>
Haha	<i>Cyanea asplenifolia</i>
Haha	<i>Cyanea calycina</i>
Haha	<i>Cyanea eleleensis</i>
Haha	<i>Cyanea kuhihewa</i>
Haha	<i>Cyanea kunthiana</i>
Haha	<i>Cyanea lanceolata</i>
Haha	<i>Cyanea obtusa</i>
Haha	<i>Cyanea tritomantha</i>
Ha'iwale	<i>Cyrtandra filipes</i>
Ha'iwale	<i>Cyrtandra kaulantha</i>
Ha'iwale	<i>Cyrtandra oenobarba</i>
Ha'iwale	<i>Cyrtandra oxybapha</i>
Ha'iwale	<i>Cyrtandra sessilis</i>
Na'ena'e	<i>Dubautia imbricata</i>
Na'ena'e	<i>Dubautia plantaginea magnifolia</i>
Na'ena'e	<i>Dubautia waialealae</i>
Hawaiian fescue	<i>Festuca hawaiiensis</i>
Nanu	<i>Gardenia remyi</i>
Nohoanu	<i>Geranium hanaense</i>
Nohoanu	<i>Geranium hillebrandii</i>
Nohoanu	<i>Geranium kauaiense</i>
Kampuaa'a	<i>Hedyotis fluviatilis</i>
'Ohe	<i>Joinvillea ascendens ssp. ascendens</i>
Hulumoa	<i>Korthalsella degeneri</i>

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Kamakahala	<i>Labordia helleri</i>
Kamakahala	<i>Labordia pumila</i>
Lagenifera erici	<i>Lagenifera erici</i>
Lagenifera helenae	<i>Lagenifera helenae</i>
Lehua makanoe	<i>Lysimachia daphnoides</i>
Alani	<i>Melicope christophersenii</i>
Alani	<i>Melicope degeneri</i>
Alani	<i>Melicope hiiakae</i>
Alani	<i>Melicope makahae</i>
Alani	<i>Melicope paniculata</i>
Alani	<i>Melicope puberula</i>
Kolea	<i>Myrsine fosbergii</i>
Kolea	<i>Myrsine mezii</i>
Kolea	<i>Myrsine vaccinioides</i>
Aiea	<i>Nothoestrum latifolium</i>
Holei	<i>Ochrosia haleakalae</i>
Ala'ala'wai'nui'	<i>Peperomia subpetiolata</i>
Bracted phyllostegia	<i>Phyllostegia bracteata</i>
Many-flowered phyllostegia	<i>Phyllostegia floribunda</i>
Hispid phyllostegia	<i>Phyllostegia hispida</i>
Ho 'awa	<i>Pittosporum napaliense</i>
Platydesma cornuta var. cornuta	<i>Platydesma cornuta var. cornuta</i>
Platydesma cornuta var. decurrens	<i>Platydesma cornuta var. decurrens</i>
Remy's pilokea	<i>Platydesma remyi</i>
Pilo kea lau li'I	<i>Platydesma rostrata</i>
Hala pepe	<i>Pleomele forbesii</i>
Loulu	<i>Pritchardia hardyi</i>
'Ena'ena	<i>Pseudognaphalium sandwicense var. molokaiense</i>
Kopiko	<i>Psychotria grandiflora</i>
Kopiko	<i>Psychotria hexandra ssp. oahuensis</i>
Kopiko	<i>Psychotria hobbyi</i>
Kaulu	<i>Pteralyxia macrocarpa</i>
Makou	<i>Ranunculus hawaiiensis</i>
Makou	<i>Ranunculus mauiensis</i>
Ma'oli'oli	<i>Schiedea pubescens</i>
Schiedea attenuata	<i>Schiedea attenuata</i>
Ma'oli'oli	<i>Schiedea salicaria</i>
'Anunu	<i>Sicyos macrophyllus</i>
Popolo	<i>Solanum nelsonii</i>
Stenogyne cranwelliae	<i>Stenogyne cranwelliae</i>
Stenogyne kealiae	<i>Stenogyne kealiae</i>
A'e	<i>Zanthoxylum oahuense</i>
Cyclosorus boydiae var. boydiae	<i>Cyclosorus boydiae var. boydiae</i>
Cyclosorus boydiae var. kipahuluensis	<i>Cyclosorus boydiae var. kipahuluensis</i>
Takeuch's lip fern	<i>Doryopteris takeuchii</i>
Dryopteris tenebrosa	<i>Dryopteris tenebrosa</i>
Wawae 'iole	<i>Microlepia mauiensis</i>
Wawae 'iole	<i>Phlegmariurus stemmermanniae</i>
Ko'oko'olau	<i>Bidens amplexans</i>

# PETITION TO LIST

pa‘iniu  
(*Astelia waialealae*)

## AS A FEDERALLY ENDANGERED SPECIES

### CANDIDATE HISTORY

CNOR 2/28/96: C  
CNOR 9/18/97: C  
CNOR 10/25/99: C  
CNOR 6/13/02: C

### TAXONOMY

The status of *Astelia waialealae* (Liliaceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

### NATURAL HISTORY

*Astelia waialealae* is a perennial rhizomatous herb, with large rosettes of silvery leaves 12-20 cm long and racemes 3-7 cm long. It is endemic to the wet forests of the montane bogs on the central plateau of the island of Kauai in the state of Hawai‘i.

### POPULATION STATUS

*Astelia waialealae* is known from three populations in three bogs within the Alakai swamp region of Kauai, totaling 35 clumps which may represent only 10 - 15 genetically distinct individuals (personal observation 2000 cited in U.S. Fish and Wildlife Service candidate assessment form). Thirty clumps are found in one bog (Perlman and Wood 1995). While the species has always been restricted to the bogs of the Alakai, in the past it may have occurred in more than the current three bogs.

The number of *A. waialealae* individuals has declined and no reproductive individuals remain. Today, the largest individual is less than 30 centimeters in diameter and none have reached

reproductive age (personal observation 2000 cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Astelia waialealae* as a candidate for Endangered Species Act protection with a listing priority number of 2.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Endangered.

## **LISTING CRITERIA**

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Kauai).

Current range: Hawaii (island of Kauai).

Land ownership: All three populations are on State-owned land.

Pigs are the major threat to *Astelia waialealae* (Perlman and Wood 1995). As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Kauai. Feral ungulates trample and eat native vegetation and disturb open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Kauai and four other islands, and inhabit rain forests and grasslands. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (DLNR 1990). While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, and trample plants and seedlings, thereby threatening forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Cuddihy and Stone 1990, Medeiros et al. 1986, Scott et al. 1986, Smith 1985, Stone 1985, Tomich 1986, Wagner et al. 1999).

### ***B. Overutilization for commercial, recreational, scientific, or educational purposes.***

Not applicable.

**C. Disease or predation.**

No mature individuals of *Astelia waialealae* remain due to predation by feral pigs. The basal rosette of the plant is starchy and provides a food source for the feral pigs (Perlman and Wood 1995). Pigs eat the leaves and base of the plant as well as digging up the roots.

**D. The inadequacy of existing regulatory mechanisms.**

There is no current protection for this species.

Current Conservation Efforts: The U.S. Fish and Wildlife Service is working in cooperation with the State of Hawaii, Division of Forestry and Wildlife, to fence the three bogs in which *Astelia waialealae* currently occurs. Funding was made available from the U.S. Fish and Wildlife Service in Fiscal Year 1995 to begin this work. In general, efforts to fence significant bog sites on Kauai to protect them from pigs and other feral animals have been successful (Ken Wood, National Tropical Botanical Garden, *in litt.* August 2002), but the extreme vulnerability of *Astelia waialealae* clearly still warrants its listing as an endangered species.

**E. Other natural or manmade factors affecting its continued existence.**

While introduced plant species are not as large a threat to the *Astelia waialealae* as feral pigs, there are a few species that are invading its bog habitat. Their numbers will increase if the feral pigs are not removed (Perlman and Wood 1995). *Juncus planifolius* (no common name) is a perennial rush which has naturalized in moist, open, disturbed depressions on margins of forests and in bogs on Kauai, Oahu, Molokai, Maui, and Hawaii (Coffey 1999). *Juncus planifolius* is only found in disturbed areas, so the removal of feral pigs will most likely stem the spread of this species (Perlman and Wood 1995, personal communication 1997 cited in U.S. Fish and Wildlife Service candidate assessment form).

*Andropogon virginicus* (broomsedge) is a perennial, tufted grass which is naturalized on Kauai, Oahu, and Hawaii along roadsides and in disturbed dry to mesic forest and shrubland (O'Connor 1999, personal communication 1997 cited in U.S. Fish and Wildlife Service candidate assessment form). While the bogs are not dry to mesic habitat, the saturation of soil in the bogs creates a lack of oxygen which inhibits the uptake of water by plant roots, resulting in drought conditions (personal communication 1996 cited in U.S. Fish and Wildlife Service candidate assessment form). Broomsedge is beginning to establish in the bogs of the Alakai that are most easily accessible to humans and may become a threat to *Astelia waialealae* if disturbance to the bogs continues (Perlman and Wood 1995).

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# PETITION TO LIST

## ko‘oko‘olau (*Bidens campylotheca pentamera*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 2/21/90:

CNOR 9/30/93:

CNOR 10/25/99: C

CNOR 10/30/01: C

CNOR 6/13/02: C

#### TAXONOMY

The status of *Bidens campylotheca pentamera* (Asteraceae) as a taxonomically valid subspecies is uncontroversial (e.g., Wagner et al. 1999).

#### NATURAL HISTORY

Endemic to Maui, the typical habitat of *Bidens campylotheca pentamera* is wet forest. This subspecies is restricted to the island of Maui (two personal communications 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

#### POPULATION STATUS

This subspecies is known from 10 populations with a total of 500 individuals.

The U.S. Fish and Wildlife Service classifies *Bidens campylotheca pentamera* as a candidate for Endangered Species Act protection with a listing priority number of 6.

The Hawaii Natural Heritage Program lists this subspecies as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Rare.



## LISTING CRITERIA

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (East Maui).

Current range: Hawaii (East Maui).

Land ownership: Federal and State lands.

This subspecies is threatened by feral pigs that adversely modify its habitat (two personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Maui. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Maui and five other islands, and inhabit rain forests and grasslands. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (DLNR n.d.-a, n.d.-b, n.d.-c, 1990). While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of any introduced plant species (Cuddihy and Stone 1990, Medeiros et al. 1986, Scott et al. 1986, Smith 1985, Stone 1985, Tomich 1986, Wagner et al. 1999).

### ***B. Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

### ***C. Disease or predation.***

None known.

### ***D. The inadequacy of existing regulatory mechanisms.***

Currently there is no Federal or State protection for *Bidens campylotheca pentamera*. The State of Hawaii will not recognize this subspecies as endangered until it is federally listed as endangered.

Current Conservation Efforts: none.

***E. Other natural or manmade factors affecting its continued existence.***

Several alien plant species threaten this subspecies (two personal communications 1995 cited in U.S. Fish and Wildlife Service candidate assessment form). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons.

Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Many of these introduced alien plant taxa are highly invasive, out-competing and displacing native plants.

## **REFERENCES**

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995 and 1999, with updates by personal communications with Arthur C. Medeiros III of National Biological Service and Robert Hobdy of Hawaii's Division of Forestry and Wildlife.

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# PETITION TO LIST

ko'oko'olau

(*Bidens campylothea waihoiensis*)

## AS A FEDERALLY ENDANGERED SPECIES

### CANDIDATE HISTORY

CNOR 2/21/90:

CNOR 9/30/93:

CNOR 9/19/97: C

CNOR 10/25/99: C

CNOR 10/30/01: C

CNOR 6/13/02: C

### TAXONOMY

The status of *Bidens campylothea waihoiensis* (Asteraceae) as a taxonomically valid subspecies is uncontroversial (e.g., Wagner et al. 1999).

### NATURAL HISTORY

The typical habitat of *Bidens campylothea waihoiensis* is wet forests; it is restricted to the island of Maui (two personal communications 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

### POPULATION STATUS

This subspecies is known from 1 population of 200 individuals.

The U.S. Fish and Wildlife Service classifies *Bidens campylothea waihoiensis* as a candidate for Endangered Species Act protection with a listing priority number of 3.

The Hawaii Natural Heritage Program lists this subspecies as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment

categories, Wagner et al. (1999a) list it as Rare.

## **LISTING CRITERIA**

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Maui).

Current range: Hawaii (the eastern slope of Haleakala on the island of Maui).

Land ownership: State of Hawaii.

This subspecies is imminently and highly threatened by cattle that adversely modify habitat (two personal communications 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factors in altering and degrading vegetation and habitats on the Hawaiian islands. Feral ungulates trample and eat native vegetation and disturb open areas. This causes erosion and allows the entry of alien plant taxa (Cuddihy and Stone 1990, Wagner et al. 1999). Cattle (*Bos taurus*), the wild progenitor of which was native to Europe, northern Africa, and southwestern Asia, was introduced to the Hawaiian Islands in 1793.

Large feral herds developed as a result of restrictions on killing cattle decreed by King Kamehameha I. While small cattle ranches were developed on Kauai, Oahu, and West Maui, very large ranches of tens of thousands of acres were created on East Maui and Hawaii. Much of the land used in these private enterprises was leased from the State or was privately owned and considered Forest Reserve and/or Conservation District land. Hunting of feral cattle is no longer allowed in Hawaii (Hawaii Department of Land and Natural Resources (DLNR) 1985). Cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade, and spread seeds of alien plants in their feces and on their bodies. The forest in areas grazed by cattle becomes degraded to grassland pasture, and plant cover is reduced for many years following removal of cattle from an area. Several alien grasses and legumes purposely introduced for cattle forage have become noxious weeds (Cuddihy and Stone 1990, Tomich 1986), which are invasive, out-competing and replacing native plants.

### ***B. Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

### ***C. Disease or predation.***

Disease is not known to be a significant threat. This subspecies is threatened by cattle that browse the leaves of plants. See factor “A” above.

**D. *The inadequacy of existing regulatory mechanisms.***

There currently is no Federal or State protection for this plant.

Current Conservation Efforts: none.

**E. *Other natural or manmade factors affecting its continued existence.***

With only one remaining population of about 200 individuals, reduced reproductive vigor and extinction due to naturally occurring, random (stochastic) events such as hurricanes, landslides, or floods are major threats (two personal communications 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

## **REFERENCES**

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# PETITION TO LIST

ko'oko'olau  
(*Bidens conjuncta*)

## AS A FEDERALLY ENDANGERED SPECIES

### CANDIDATE HISTORY

CNOR 7/1/75:  
CNOR 12/15/80:  
CNOR 11/28/83:  
CNOR 9/27/85:  
CNOR 2/21/90:  
CNOR 9/30/93:  
CNOR 10/25/99: C  
CNOR 10/30/01: C  
CNOR 6/13/02: C

### TAXONOMY

The status of *Bidens conjuncta* (Asteraceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

### NATURAL HISTORY

***Morphology:***

*Bidens conjuncta* is a perennial herb, slightly woody at the base, erect, 0.7-2 m tall, with horizontal or ascending lateral branches and simple or pinnately compound leaves. Cymes are compound, with terminating lateral branches only, 15-45 heads or more, and 8-15 disk florets per head. Yellow rays, 15-22 mm long.

***Habitat:***

*Bidens conjuncta* is restricted to the wet forests and bogs of West Maui.

### POPULATION STATUS

Although the overall range of the species has not changed, the number of remaining individuals has declined over the last decade or so (personal communication 1995 and two 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). However, additional individuals have been found within the five populations known in 1998, as well as one additional population, increasing the total number known from about 300 individuals to about 2,200 individuals (personal communication 2000 cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Bidens conjuncta* as a candidate for Endangered Species Act protection with a listing priority number of 8.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Rare.

## **LISTING CRITERIA**

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range:       Hawaii (West Maui).

Current range:         Hawaii (West Maui).

Land ownership:       Populations occur equally on State and private land.

This species is threatened by feral pigs that adversely modify habitat ( personal communication 1995 and two 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Maui. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Maui and five other islands, and inhabit rain forests and grasslands. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (DLNR 1990). While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as

through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Cuddihy and Stone 1990, Medeiros et al. 1986, Scott et al. 1986, Smith 1985, Stone 1985, Tomich 1986, Wagner et al. 1999).

**B. *Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

**C. *Disease or predation.***

Of the four species of rodents that have been introduced to the Hawaiian Islands, the species with the greatest impact on the native flora and fauna is probably *Rattus rattus* (black or roof rat), which now occurs on all the main Hawaiian Islands and ranges into the wet forests. Black rats and to a lesser extent *Mus musculus* (house mouse), *R. exulans* (Polynesian rat), and *R. norvegicus* (Norway rat) eat the fruits of some native plants, especially those with large, fleshy fruits. Many native Hawaiian plants produce fruit over an extended period of time, thus producing a prolonged food supply utilized by rodent populations. Black rats strip bark from some native plants, and eat the fleshy stems and fruits of plants in the bellflower and African violet families (Cuddihy and Stone 1990, Tomich 1986; personal communication 1994 cited in U.S. Fish and Wildlife Service candidate assessment form). It is very likely that rats eat the fruits of this species (personal communication 2000 cited in U.S. Fish and Wildlife Service candidate assessment form). While the original threats remain imminent and rats are also now known to be a threat, the overall magnitude of the threat is somewhat reduced with the increase in number of known individuals.

**D. *The inadequacy of existing regulatory mechanisms.***

Currently there is no Federal or State protection for *Bidens conjuncta*.

Current Conservation Efforts: The U.S. Fish and Wildlife Service has made initial approaches toward Maui Land and Pineapple Company regarding a conservation agreement for this and several other species that occur primarily on their lands on West Maui, which they are actively managing for conservation. The outcome of these communications, however, remains uncertain.

**E. *Other natural or manmade factors affecting its continued existence.***

Alien plant species threaten this species. With the six populations remaining in a very restricted area, extinction from naturally occurring events is also a major threat (personal communication 1995 and three 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999).

Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Many of these alien plants are highly invasive, out-competing and displacing native plants.

## REFERENCES

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995 and 1999, with updates by personal communications with Robert Hobdy of Hawaii's Division of Forestry and Wildlife and Steve Perlman of National Tropical Botanical Garden.

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# PETITION TO LIST

## ko'oko'olau (*Bidens micrantha ctenophylla*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 12/15/80:  
CNOR 11/28/83:  
CNOR 9/27/85:  
CNOR 2/21/90:  
CNOR 9/30/93:  
CNOR 2/28/96: C  
CNOR 9/19/97: C  
CNOR 10/25/99: C  
CNOR 10/30/01: C  
CNOR 6/13/02: C

#### TAXONOMY

The status of *Bidens micrantha ctenophylla* (Asteraceae) as a taxonomically valid subspecies is uncontroversial (e.g., Wagner et al. 1999).

#### NATURAL HISTORY

This subspecies is endemic to the island of Hawaii, where it is restricted to an area of less than 10 square miles. Typical habitat is dry forest, most of which has been destroyed in the Hawaiian islands. What remains is highly degraded.

#### POPULATION STATUS

This species is known from four populations totaling approximately 3,000 individuals, the majority of which occur in only two populations (Hawaii Heritage Program 1992, *in litt.* 1994 cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Bidens micrantha ctenophylla* as a candidate for Endangered Species Act protection with a listing priority number of 6.

The Hawaii Natural Heritage Program lists this subspecies as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Vulnerable.

## LISTING CRITERIA

### **A. *The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Hawaii).

Current range: Hawaii (island of Hawaii).

Land ownership: One of the largest populations of *Bidens micrantha ctenophylla*, totaling approximately 1,000 individuals, occurs on private land, representing one third of the known individuals. The remaining individuals occur on State-owned land.

Land development for housing and commercial activities threatens *Bidens micrantha ctenophylla*. The two largest populations, one on private land and one on State land, are in the initial stages of development for residential and commercial purposes (*in litt.* 1994 cited in U.S. Fish and Wildlife Service candidate assessment form).

### **B. *Overutilization for commercial, recreational, scientific, or educational purposes.***

Not applicable.

### **C. *Disease or predation.***

Unknown.

### **D. *The inadequacy of existing regulatory mechanisms.***

There is no current protection for this species.

Current Conservation Efforts: The U.S. Fish and Wildlife Service is attempting a conservation agreement with the private landowner, but the landowner has not yet indicated sufficient interest to preclude listing. The Service is also encouraging the State to develop a preserve for the largest population on State-owned land. However, the State has indicated that it will protest the listing of this taxon because of its effect on their low-income housing development, though an endangered species already occurs at the site. Thus, the prospect of significant progress with conservation

efforts for this taxon appear gloomy in the absence of the increased protection that would be provided by federal listing as an endangered species.

***E. Other natural or manmade factors affecting its continued existence.***

Fire is the major threat to *Bidens micrantha ctenophylla*, and is exacerbated by the presence of several introduced plant species (*in litt.* 1994 cited in U.S. Fish and Wildlife Service candidate assessment form). Because Hawaiian plants were subjected to fire during their evolution only in areas of volcanic activity and from occasional lightning strikes, they are not adapted to recurring fire regimes and do not quickly recover following a fire. Alien plants are often better adapted to fire than native plant species, and some fire-adapted grasses have become widespread in Hawaii. Native shrub land and dry forest can thus be converted to land dominated by alien grasses. The presence of such species in Hawaiian ecosystems greatly increases the intensity, extent, and frequency of fire, especially during drier months or drought. Fire-adapted alien plant taxa can reestablish in a burned area, resulting in a reduction in the amount of native vegetation after each fire. Fire can destroy dormant seeds as well as plants, even in steep or inaccessible areas. Fires may result from natural causes, or they may be accidentally or purposely started by humans (Cuddihy and Stone 1990).

The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Several species of introduced plants threaten *Bidens micrantha ctenophylla*.

*Pennisetum setaceum* (fountain grass) is a fire-adapted bunch grass that has spread rapidly over bare lava flows and open areas on the island of Hawaii since its introduction in the early 1900s. Fountain grass is particularly detrimental to Hawaii's dry forests because it is able to invade areas once dominated by native plants, where it interferes with plant regeneration, carries fires into areas not usually prone to fires, and increases the likelihood of fires (Cuddihy and Stone 1990, O'Connor 1999, Smith 1985). *Lantana camara* (lantana), brought to Hawaii as an ornamental plant, is an aggressive, thicket-forming shrub which can now be found on all of the main islands in mesic forests, dry shrublands, and other dry, disturbed habitats (Wagner et al. 1999). *Leucaena leucocephala* (koa haole) is a naturalized shrub which is sometimes the dominant species in low elevation, dry, disturbed areas on all of the main Hawaiian islands (Geesnick et al. 1999). After escaping from cultivation, *Schinus terebinthifolius* (Christmas berry) became



naturalized on most of the main Hawaiian Islands (Wagner et al. 1999). All of these introduced species are a major threat to *Bidens micrantha ctenophylla* (*in litt.* 1994 cited in U.S. Fish and Wildlife Service candidate assessment form).

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PETITION TO LIST  
reedgrass  
(*Calamagrostis expansa*)

AS A FEDERALLY ENDANGERED SPECIES

**CANDIDATE HISTORY**

CNOR 2/21/90:  
CNOR 9/30/93:  
CNOR 10/25/99: C  
CNOR 10/30/01: C  
CNOR 6/13/02: C

**TAXONOMY**

The status of *Calamagrostis expansa* (Poaceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

**NATURAL HISTORY**

***Morphology:***

A robust, short-rhizomatous perennial. Culms erect or sometimes decumbent, 5-20 dm tall. Blades flat to involute, 15-20 cm long. Inflorescences paniculate, 15-20 cm long.

***Habitat:***

*C. expansa* is limited to wet forests and bogs on the islands of Maui and Hawaii.

**POPULATION STATUS**

*C. expansa* is currently known from 100 populations of 1 or 2 individuals each on Maui, and was recently discovered in 5 populations totaling approximately 300 individuals on Hawaii (four 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Calamogrostis expansa* as a candidate for

Endangered Species Act protection with a listing priority number of 5.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Rare.

## LISTING CRITERIA

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Maui; possibly island of Hawaii).

Current range: Hawaii (islands of Maui and Hawaii).

Land ownership: Private and State lands.

This species is threatened by feral pigs that adversely modify habitat (four 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form).

As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Maui and Hawaii. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Maui and Hawaii, and four other islands, and inhabit rain forests and grasslands.

Pig hunting is allowed on all islands either year-round or during certain months, depending on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources). While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Cuddihy and Stone 1990, Medeiros et al. 1986, Scott et al. 1986, Smith 1985, Stone 1985, Tomich 1986, Wagner et al. 1999).

**B. Overutilization for commercial, recreational, scientific, or educational purposes.**

None known.

**C. Disease or predation.**

None known.

**D. The inadequacy of existing regulatory mechanisms.**

Currently there is no Federal or State protection for *Calamagrostis expansa*. The State of Hawaii will not recognize this species as endangered until it is federally listed as endangered.

Current Conservation Efforts: None.

**E. Other natural or manmade factors affecting its continued existence.**

Alien plant species threaten this species (four 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Numerous weed species threaten *Calamagrostis expansa*. Many of these introduced alien plant taxa are highly invasive, out-competing and displacing native plants.

## **REFERENCES**

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995 and 1999, with updates from a survey conducted by the National Tropical Botanical Garden in late 1995 and by personal communications with Robert Hobdy of the Hawaii Division of Forestry and Wildlife, Arthur C. Medeiros III of the U.S. Geological Survey's Biological Resources Division, and Steve Perlman and Ken Wood of National Tropical Botanical Garden.

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# PETITION TO LIST

## reedgrass (*Calamagrostis hillebrandii*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 10/25/99: C  
CNOR 10/30/01: C  
CNOR 6/13/02: C

#### TAXONOMY

The status of *Calamagrostis hillebrandii* (Poaceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

#### NATURAL HISTORY

##### ***Morphology:***

A perennial with slender, short rhizomes. Culms erect, tufted, 30-50 cm tall. Blades flat to involute, those of midculm 10-15 cm long, 2-4 mm wide, the uppermost ones reduced. Inflorescences paniculate, ovate, 5-15 cm long up to 30 cm long.

##### ***Habitat:***

*Calamagrostis hillebrandii* is endemic to the island of Maui in the Hawaiian Islands. It has been recorded only from montane bogs on the western mountain mass of the island, the West Maui Mountains.

#### POPULATION STATUS

*Calamagrostis hillebrandii* is known from two populations of about 500 individuals, restricted to the bogs of West Maui, although it was formerly found on the island of Molokai as well (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Calamagrostis hillebrandii* as a candidate for

Endangered Species Act protection with a listing priority number of 5.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Vulnerable.

## LISTING CRITERIA

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii, (islands of Maui and Molokai).

Current range: Hawaii (West Maui).

Land ownership: Divided equally between State and Private lands.

This species is threatened by feral pigs that adversely modify habitat (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form). As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Maui. Feral ungulates trample and eat native vegetation and disturb open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Maui and five other islands, and inhabit rain forests and grasslands. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Cuddihy and Stone 1990, Medeiros et al. 1986, Scott et al. 1986, Smith 1985, Stone 1985, Tomich 1986, Wagner et al. 1999).

### ***B. Overutilization for commercial, recreational, scientific, or educational purposes.***

None known



***C. Disease or predation.***

None known.

***D. The inadequacy of existing regulatory mechanisms.***

The State of Hawaii will not recognize this species as endangered until it is federally listed as endangered.

Current Conservation Efforts: Informal discussions have been initiated with private landowners in order to establish a conservation agreement. The outcome of these discussions, however, is uncertain.

***E. Other natural or manmade factors affecting its continued existence.***

Alien plant species threaten this species. With only two populations remaining, extinction from naturally occurring events is also a major threat (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Many of these introduced alien plant taxa are highly invasive, out-competing and displacing native plants.

**REFERENCES**

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995 and 1999, with updates by personal communications with Robert Hobdy of Hawaii's Division of Forestry and Wildlife.

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# PETITION TO LIST

## ‘awikiwiki (*Canavalia napaliensis*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 12/15/80:

CNOR 11/28/83:

CNOR 9/27/85:

CNOR 2/21/90:

CNOR 9/30/93:

CNOR 10/25/99: C

CNOR 10/30/01: C

CNOR 6/13/02: C

#### TAXONOMY

The status of *Canavalia napaliensis* (Fabaceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

#### NATURAL HISTORY

##### ***Morphology:***

A perennial with twining vines. Leaves with 3 leaflets. Flowers 3-16 in pseudoracemes 1-19 cm long. Corollas dark purple.

##### ***Habitat:***

Typical habitat is dry or diverse mesic forest. This species is restricted to a small section of the Na Pali coast of Kauai (Wagner et al. 1999).

#### POPULATION STATUS

*Canavalia napaliensis* is known from 3 populations totaling several hundred individuals (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment

form).

The U.S. Fish and Wildlife Service classifies *Canavalia napaliensis* as a candidate for Endangered Species Act protection with a listing priority number of 5.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Vulnerable.

## LISTING CRITERIA

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Kauai).

Current range: Hawaii (island of Kauai).

Land ownership: All three populations occur on State land.

*Canavalia napaliensis* is threatened by feral goats (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form). As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Kauai. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999). The goat (*Capra hircus*), a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792.

Currently populations exist on Kauai, Oahu, Maui, and Hawaii. On Kauai, feral goats have been present in drier, more rugged areas since the 1820s and they still occur in Waimea Canyon and along the Na Pali Coast, as well as in the drier perimeter of Alakai Swamp and even in its wetter areas during periods with low rainfall. Goats are managed in Hawaii as a game animal, but many herds populate inaccessible areas where hunting has little effect on their numbers (Hawaii Heritage Program 1990). Goat hunting is allowed year-round or during certain months, depending on the area (DLNR n.d.-a, n.d.-b, n.d.-c, 1990).

Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, Cuddihy and Stone 1990, Culliney 1988, Scott et al. 1986, Tomich 1986, van Riper and van Riper 1982). Although many plant species survive on steep cliffs inaccessible to goats, the original range of these plants was

probably much larger. This species is now vulnerable to the long-term, indirect effects of goats, such as large-scale erosion (Corn et al. 1979). The mesic and dry forest habitats were damaged in the past by goats, and these effects are still apparent in the form of alien vegetation and erosion. This species is threatened by direct damage from feral goats, such as trampling of plants and seedlings and erosion of substrate (Clarke and Cuddihy 1980, Culliney 1988, Scott et al. 1986, van Riper and van Riper 1982).

**B. *Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

**C. *Disease or predation.***

None known.

**D. *The inadequacy of existing regulatory mechanisms.***

Currently there is no Federal or State protection for *Canavalia napaliensis*. The State of Hawaii will not recognize this species as endangered until it is federally listed as endangered.

Current Conservation Efforts: none.

**E. *Other natural or manmade factors affecting its continued existence.***

Several alien plant species threaten this species. The original native flora of Hawaii consisted of about 1,000 taxa, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons.

Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott et al. 1986, Wenkam 1969). Many of these introduced alien plant taxa are highly invasive, out-competing and displacing native plants. With only three known populations restricted to a very small area, extinction from naturally occurring events is also a major threat, and this area has been heavily hit by hurricanes twice in the last 15 years (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form).

## REFERENCES

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995 and 1999, with updates by personal communications with Steve Perlman of National Tropical Botanical Garden.

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- Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999b. Manual of the flowering plants of Hawai'i, revised edition. Bishop Museum Special Publication 97. University of Hawai'i Press and Bishop Museum Press, Honolulu. 1919 pp.
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# PETITION TO LIST

## ‘awikiwiki (*Canavalia pubescens*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 7/1/75:

CNOR 12/15/80:

CNOR 11/28/83:

CNOR 9/27/85:

CNOR 2/21/90:

CNOR 9/30/93:

CNOR 9/19/97: C

CNOR 10/25/99: C

CNOR 10/30/01: C

CNOR 6/13/02: C

#### TAXONOMY

The status of *Canavalia pubescens* (Fabaceae) as a taxonomically valid species is uncontroversial (e.g., Wagner et al. 1999).

#### NATURAL HISTORY

##### *Morphology:*

A twining perennial vine. Leaves with 3 leaflets, usually hairy. Flowers usually 8-20 in pseudoracemes 3-5 cm long. Corollas dark red to pink, rarely white.

##### *Habitat:*

The typical habitat of *Canavalia pubescens* is dry forest or open lava fields. This species is found on the islands of Maui, Lanai, Kauai, and is possibly still extant on the island of Niihau (three personal communications cited in U.S. Fish and Wildlife Service candidate assessment form).



## POPULATION STATUS

*C. pubescens* is known from at least 10 populations totaling less than 200 individuals.

The U.S. Fish and Wildlife Service classifies *Canavalia pubescens* as a candidate for Endangered Species Act protection with a listing priority number of 2.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Vulnerable.

## LISTING CRITERIA

### **A. The present or threatened destruction, modification, or curtailment of its habitat or range.**

Historical range: Hawaii islands of Niihau, Kauai, East Maui, and Lanai.

Current range: Hawaii, scattered locations.

Land ownership: Approximately 90% of the populations occur on State land, the remainder are on private land.

This species is threatened by feral goats that adversely modify habitat (two personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). As early as 1778 European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Kauai. Feral ungulates trample and eat native vegetation, disturbing and opening areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The goat (*Capra hircus*), a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently populations exist on Kauai, Oahu, Maui, and Hawaii. On Kauai, feral goats have been present in drier, more rugged areas since the 1820's and they still occur in Waimea Canyon and along the Na Pali Coast, as well as in the drier perimeter of Alakai Swamp and even in its wetter areas during periods with low rainfall.

Goats are managed in Hawaii as a game animal, but many herds populate inaccessible areas where hunting has little effect on their numbers (Hawaii Heritage Program 1990). Goat hunting is allowed year-round or during certain months, depending on the area (DLNR n.d.-a, n.d.-b, n.d.-c, 1990). Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have

a high reproductive capacity (Clarke and Cuddihy 1980, Cuddihy and Stone 1990, Culliney 1988, Scott et al. 1986, Tomich 1986, van Riper and van Riper 1982).

Although this plant species survives on steep cliffs inaccessible to goats, the original range of this plant was probably much larger. This species is now vulnerable to the long-term, indirect effects of goats, such as large-scale erosion (Corn et al. 1979). The habitat of this plant was damaged in the past by goats, and these effects are still apparent in the form of alien vegetation and erosion. One or more populations of this species is currently threatened by direct damage from feral goats, such as trampling of plants and seedlings and erosion of substrate (Clarke and Cuddihy 1980, Culliney 1988, Scott et al. 1986, van Riper and van Riper 1982).

***B. Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

***C. Disease or predation.***

None known.

***D. The inadequacy of existing regulatory mechanisms.***

Currently there is no Federal or State protection for this species.

Current Conservation Efforts: none.

***E. Other natural or manmade factors affecting its continued existence.***

Alien plant species threaten this species (three personal communications cited in U.S. Fish and Wildlife Service candidate assessment form). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999).

Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990, Scott *et al.* 1986, Wenkam 1969). *Canavalia pubescens* is threatened by numerous weed species (personal communication 1995 cited in U.S. Fish and Wildlife Service candidate assessment form), which are highly invasive, out-competing and displacing native plant taxa.

## REFERENCES

The information in this petition is based mainly on the U.S. Fish and Wildlife Service candidate assessment form. The candidate assessment form was in turn based largely on results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December, 1995, with updates by personal communications with Arthur C. Medeiros III of Biological Resources Division, of the United States Geological Survey, Robert Hobdy of Hawaii's Division of Forestry and Wildlife, and Steve Perlman of National Tropical Botanical Garden.

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# PETITION TO LIST

## 'akoko (*Chamaesyce eleanoriae*)

### AS A FEDERALLY ENDANGERED SPECIES

#### CANDIDATE HISTORY

CNOR 10/25/99: C  
CNOR 10/30/01: C  
CNOR 6/13/02: C

#### TAXONOMY

*Chamaesyce eleanoriae* (Euphorbiaceae) was first described in 1996 (Lorence and Wagner 1996; Wagner et al. 1999).

#### NATURAL HISTORY

##### ***Morphology:***

A perennial shrub, 20-40 cm tall, densely branched. Leaves opposite. Leaf blades 10-20 mm long and 6-14 mm wide. Cyathia solitary and terminal at branch tips, bearing 4 or 5 white petal-like glandular appendages. Capsule broadly ovoid, 2.5-2.8 mm long and 2.3-3 mm in diameter.

##### ***Habitat:***

*Chamaesyce eleanoriae* is found only in and around Kalalau Valley rim, along the Na Pali Coast on the island of Kauai. It is restricted to north-facing steep, narrow ridge crests dominated by *Metrosideros polymorpha* (‘ohi‘a) and *Diospyros sandwicensis* (lama). It is found mostly on moist vegetation on narrow ridge crests and outcrops, and less commonly on steep rocky slopes and cliffs.

#### POPULATION STATUS

This species is known from 10 populations totaling less than 500 individuals. Although *Chamaesyce eleanoriae* was only first discovered in 1992, a decline in numbers has already been

observed (Lorence and Wagner 1996, two 1996 personal communications cited in U.S. Fish and Wildlife Service candidate assessment form).

The U.S. Fish and Wildlife Service classifies *Chamaesyce eleanoriae* as a candidate for Endangered Species Act protection with a listing priority number of 5.

The Hawaii Natural Heritage Program lists this species as Critically Imperiled. Using International Union for Conservation of Nature and Natural Resources (IUCN) threat assessment categories, Wagner et al. (1999a) list it as Rare.

## LISTING CRITERIA

### ***A. The present or threatened destruction, modification, or curtailment of its habitat or range.***

Historical range: Hawaii (island of Kauai).

Current range: Hawaii (northwestern side of the island of Kauai).

Land ownership: All populations occur on State land.

This species is threatened by feral goats. Landslides caused by the erosion resultant from feral goat browsing are another major threat to the species (personal communication 1996 cited in U.S. Fish and Wildlife Service candidate assessment form). As early as 1778, European explorers introduced livestock which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Kauai. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990, Wagner et al. 1999).

The goat (*Capra hircus*), a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently populations exist on Kauai, Oahu, Maui, and Hawaii. On Kauai, feral goats have been present in drier, more rugged areas since the 1820's and they still occur in Waimea Canyon and along the Na Pali Coast, as well as in the drier perimeter of Alakai Swamp and even in its wetter areas during periods with low rainfall. Goats are managed in Hawaii as a game animal, but many herds populate inaccessible areas where hunting has little effect on their numbers (Hawaii Heritage Program 1990). Goat hunting is allowed year-round or during certain months, depending on the area (DLNR n.d.-a, n.d.-b, n.d.-c, 1990). Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, Cuddihy and Stone 1990, Culliney 1988, Scott et al. 1986, Tomich 1986, van Riper and van Riper 1982).

Although this plant species survives on steep cliffs inaccessible to goats, the original range of this plant was probably much larger. This species is vulnerable to the long-term, indirect effects of goats, such as large-scale erosion (Corn et al. 1979). The mesic and dry habitats were damaged in the past by goats, and these effects are still apparent in the form of alien vegetation and erosion. This species remains threatened by direct damage from feral goats, such as trampling of plants and seedlings and erosion of substrate (Clarke and Cuddihy 1980, Culliney 1988, Scott et al. 1986, van Riper and van Riper 1982).

**B. *Overutilization for commercial, recreational, scientific, or educational purposes.***

None known.

**C. *Disease or predation.***

Direct browsing by feral goats has been observed on this species (personal communication 1996 cited in U.S. Fish and Wildlife Service candidate assessment form). Rats are also a threat to *Chamaesyce elenoriae* (personal communication 1996 cited in U.S. Fish and Wildlife Service candidate assessment form). Of the four species of rodents that have been introduced to the Hawaiian Islands, the species with the greatest impact on the native flora and fauna is probably *Rattus rattus* (black or roof rat), that now occurs on all the main Hawaiian Islands around human habitations, cultivated fields, and forests. Black rats and to a lesser extent *Mus musculus* (house mouse), *Rattus exulans* (Polynesian rat), and *R. norvegicus* (Norway rat) eat the fruits of some native plants, especially those with large, fleshy fruits. Many native Hawaiian plants produce fruit over an extended period of time, thus producing a prolonged food supply for rodent populations. Black rats strip bark from some native plants, and eat the fleshy stems and fruits of plants in the bellflower and African violet families (Cuddihy and Stone 1990, Tomich 1986; personal communication 1994 cited in U.S. Fish and Wildlife Service candidate assessment form).

**D. *The inadequacy of existing regulatory mechanisms.***

Currently there is no Federal or State protection for *Chamaesyce eleanoriae*. The State of Hawaii will not recognize this species as endangered until it is federally listed as endangered..

Current Conservation Efforts: None.

**E. *Other natural or manmade factors affecting its continued existence.***

Alien plant species *Erigeron karvinskianus*, *Kalanchoe pinnata*, and *Lantana camara* are threats to this species (Lorence and Wagner 1996). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 species, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985, Wagner et al. 1999). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990).