Cenchrus agrimonioides
(Kamanomano)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

5-YEAR REVIEW

Species reviewed: *Cenchrus agrimonioides* (Kamanomano)

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Cenchrus agrimonioides/ Kamanomano

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:
Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia, (503) 231-2071

Lead Field Office:
Pacific Islands Fish and Wildlife Office, Gina Shultz, Deputy Field Supervisor, (808) 792-9400

Cooperating Field Office(s):
N/A

Cooperating Regional Office(s):
N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (USFWS) beginning on March 7, 2007. Bernice P. Bishop Museum provided most of the updated information on the current status of *Cenchrus agrimoniodes* and they also provided recommendations for conservation actions needed prior to the next 5-year review. The evaluation of the status of the species was prepared by the lead PIFWO biologist and reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and acting Assistant Field Supervisor for Endangered Species, and Deputy Field Supervisor, before submission to the Field Supervisor for approval.

1.3 Background:

1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:

USFWS. 2007. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 71 species in Oregon, Hawaii, Commonwealth of the Northern Mariana Islands, and Territory of Guam. Federal Register 72(45):10547-10550.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1996. Endangered and threatened wildlife and plants; determination of endangered or threatened status for fourteen plant taxa from the Hawaiian Islands; final rule. Federal Register 61(198):53108-53124.
Date listed: October 10, 1996
Entity listed: Species
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:

[USFWS] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; final designation of critical habitat for three plant species from the island of Lanai, Hawaii; final rule. Federal Register 68(6):1220-1274.

[USFWS] U.S. Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; designation of critical habitat for 60 plant species from the Islands of Maui and Kahoolawe, HI; final rule. Federal Register 68(93):25934-26165.

[USFWS] U.S. Fish and Wildlife Service. 2003c. Endangered and threatened wildlife and plants; designation of critical habitat for five plant species from the Northwestern Hawaiian Islands, Hawaii; final rule. Federal Register 68(99):28054-28075.

[USFWS] U.S. Fish and Wildlife Service. 2003d. Endangered and threatened wildlife and plants; final designations or nondesignations of critical habitat for 101 plant species from the island of Oahu, HI; final rule. Federal Register 68(116):35950-36406.

[USFWS] U.S. Fish and Wildlife Service. 2003e. Endangered and threatened wildlife and plants; final designation and nondesignation of critical habitat for 46 plant species from the island of Hawaii, HI; final rule. Federal Register 68(127):39624-39761.

Critical habitat was designated for *Cenchrus agrimoniodes* in four units totaling 886 hectares (2,190 acres) on Oahu and two units totaling 355 hectares (877 acres) on Maui. This designation includes habitat on State, Federal, and private

lands (USFWS 2003b, e). Critical habitat was not designated on Lanai, Hawaii and the Northwestern Hawaiian Islands as *C. argimonioides* is no longer extant on these islands and we were unable to determine suitable habitat for the recovery of the species (USFWS 2003a, c, d).

1.3.4 Review History:
Species status review [FY 2008 Recovery Data Call (September 2008)]: Improving

Recovery achieved:
1 (0-25%) (FY 2008 Recovery Data Call)

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

1.3.6 Current Recovery Plan or Outline
Name of plan or outline: Recovery plan for Multi-Islands plants. U.S. Fish and Wildlife Service, Portland, Oregon. 206 pages, plus appendices.
Date issued: July 10, 1999.
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?
_____ ***Yes***
__X__ ***No***

2.1.2 Is the species under review listed as a DPS?
____ ***Yes***
__X_ ***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***
__X_ ***No***

2.2 Recovery Criteria

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

__X_ ***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?

__X_ ***Yes***
____ ***No***

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

__X_ ***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 (Factors A, C, D, and E) affecting this species is presented in section 2.4. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Multi-Island plants (USFWS 1999), based on whether the species is an annual, a

short-lived perennial (fewer than 10 years), or a long-lived perennial. *Cenchrus agrimoniodes* is a short-lived perennial, and to be considered stabilized, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced, weeding, etc.) and be represented in an *ex situ* (off-site) collection. In addition, a minimum of three populations should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

This recovery objective has been partially met.

For downlisting, a total of five to seven populations of *Cenchrus agrimoniodes* should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Cenchrus agrimoniodes* should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

2.3 Updated Information and Current Species Status

In addition to the status summary table below, information on the species' status and threats was included in the final critical habitat rule referenced above in section 1.3.3 ("Associated Rulemakings") and in section 2.4 ("Synthesis") below, which also includes any new information about the status and threats of the species.

Table 1. Status of *Cenchrus agrimoniodes* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Downlisting Criteria identified in Recovery Plan	Downlisting Criteria Completed?
1996 (listing)	> 100	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1999 (recovery plan)	> 100	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	~ 113-118	unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Unknown
2008 (5-year review)	185	312	All threats managed	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially

2.3.1 Biology and Habitat [see note in section 2.3]

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

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:

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

2.3.1.4 Taxonomic classification or changes in nomenclature:

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.):

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

2.3.1.7 Other:

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms) [see note in section 2.3]

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

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

2.3.2.3 Disease or predation:

2.3.2.4 Inadequacy of existing regulatory mechanisms:

2.3.2.5 Other natural or manmade factors affecting its continued existence:

2.4 Synthesis

Historically, *Cenchrus agrimonioides* is known to have occurred on the Northwestern Hawaiian Islands, Oahu, Maui, Lanai, and possibly in Hawaii. Two varieties were recognized for this taxon (USFWS 1996, 1999; O'Connor 1999). Variety *agrimonioides* has been collected from four areas: the Waianae Mountains of Oahu,

West Maui (where it was recently discovered in 1996), the south slope of Haleakala on East Maui, and the island of Lanai (USFWS 2003a, b, d, 2007). This variety was also reported from the island of Hawaii in the 1800s, but no specimens from that island are known to exist (USFWS 2003e). When this species was federally listed as endangered in 1996, there were six occurrences known totaling fewer than 100 individuals (USFWS 1996, 1999). More recently, five populations of approximately 144 mature and 14 immature wild individuals and 23 wild seedlings were reported from Oahu and two populations totaling 4 individuals on Maui (U.S. Army 2007; Plant Extinction Prevention Program 2008; USFWS 2008). The Oahu populations have been augmented with 279 mature, 31 immature, and two seedlings (U.S. Army 2008). Populations on Hawaii and Lanai are no longer extant (USFWS 2003a, e). Populations of *C. agrimonioides* recognized as variety *laysanensis* in the Northwestern Hawaiian Islands, formerly collected on Kure Atoll, Midway Atoll and Laysan, were last collected in 1973 and are now considered extinct (Wagner *et al*. 1999; USFWS 2003c).

One individual in the Kanaio Natural Area Reserve on East Maui, while protected from ungulates for 10 years, has continued to decline in cover and is now about 30 centimeters (1 foot) in diameter.

A specimen collected in 1912 from the "Leilehua Plain" on Oahu indicates that the taxon may also have occurred in lower and drier locations than where it is known today (USFWS 2007). On Oahu, it is estimated that more than one-half of the critical habitat for *Cenchrus agrimonioides* var. *agrimonioides* is located in an area with at least 50 percent native plant cover, indicating that habitat quality has declined due to the encroachment of introduced plant species. The species prefers ridgeline areas in mesic forest, moderate to partial shade, mainly north facing slope, in granular soil areas (The Nature Conservancy 2006a). On West Maui the species occurs on shady mid-slope, east facing slopes (H. Oppenheimer, Maui Nui Coordinator, Plant Extinction Prevention Program, pers. comm. 2008). On East Maui it is on South facing, slopes in small gulches on recent aa (rough) lava. All historical locations and suitable habitat on Oahu have been repeatedly surveyed, and no additional populations have been found (The Nature Conservancy 2006a). *Cenchrus agrimonioides* var. *agrimonioides* has been successfully introduced to Kahoolawe (P. Higashino, Restoration Program Manager, Kahoolawe Island Reserve Commission, pers. comm. 2006).

Reproduction of *Cenchrus agrimonioides* var. *agrimonioides* is believed to be mostly sexual as vegetative reproduction is seldom observed (USFWS 2007). *Cenchrus agrimonioides* is wind-pollinated, with flowering occurring between January and July. However, isolated cultivated plants have been observed to self-pollinate and produce high numbers of viable seeds (The Nature Conservancy 2006a; USFWS 2007). Most, if not all, of the Maui individuals do not produce viable seed (H. Oppenheimer, pers. comm. 2008). The spiny burs that contain the seeds of this taxon stick to the fur of mammals or the feathers of birds, and it has been hypothesized that

these burrs may have been dispersed by the many now-extinct species of flightless Hawaiian birds (USFWS 2007).

Seed and cuttings from runner or divisions cut off the root ball are both viable methods of propagation. The species also forms new plants via ramets. Germination rates of fresh seeds average 60 percent, but is dependent on the seed batch; the success of cuttings is about 50 percent survival (U.S. Army 2007). Seeds store well for two years, but then start to decrease in viability. Treatments to break seed dormancy have not proven to be consistent (The Nature Conservancy 2006a). The seed size, related to endosperm development, appears to be a major factor in germination rates. Seeds mature in about four weeks once flowering has finished in nursery conditions. Plants are short-lived in the wild, surviving at least four years and maturing in two years (The Nature Conservancy 2006a). However, in non-ideal habitat they grow very slowly, taking several years to reach maturity.

Major threats to the variety on Oahu include habitat loss due to feral pigs (*Sus scrofa*), and goats (*Capra hircus*) (Factors A and D) and competition from introduced invasive plant species (Factor E) (USFWS 1996; 1999; 2003d, 2007, 2008; The Nature Conservancy 2006a; U.S. Army 2007). Introduced invasive plants species threatening *Cenchrus agrimonioides* at Kanaio on Maui include *Bidens pilosa* (hairy beggarticks), *Bocconia frutescens* (tree poppy), *Passiflora subpeltata* (white passion flower), *Lantana camara* (lantana), *Schinus terebinthifolius* (Christmasberry), *Melinis minutiflora* (molasses grass), *Neotonia whightii* (no common name), and *Petroselinum crispum* (parsley). Huliwai and Ekahanui populations are threatened by *Clidemia hirta* (Koster's corse), *Melinis minutiflora* (molasses grass), *Panicum maximum* (guinea grass), *Passiflora suberosa* (corkystem passionflower), *Psidium guavaja* (guava), *Psidium cattleianum* (strawberryguava), and *Blechnum appendiculatum* (palm fern). Leaf litter of *Grevillea robusta* (silk-oak) is preventing recruitment at the uppermost Ekahanui population (The Nature Conservancy 2006a).

On Maui, cattle (*Bos taurus*), goats, and axis deer (*Axis axis*) grazing and habitat degradation threatens the populations of *Cenchrus agimonioides* (Factors A, C, and D) (USFWS 2003b, 2007; H. Oppenheimer, pers. comm. 2008). However, while no ungulate activity has been noted recently at Hanaula Iki Gulch, due to the hunting of goats by the Division of Forestry and Wildlife on Maui; and the Kanaio population is fenced and protected from pigs (Plant Extinction Prevention Program 2008), axis deer are expanding their range and threaten the populations (H. Oppenheimer, pers. comm. 2008). West Maui plants are threatened by fire (Factor E), invasive introduced plants species such as *Lanatana camara*, *Erigeron karvinskianus* (daisy fleabane), *Adiantum hispidulum* (rough maidenhair fern), *Ageratina adenophora* (Maui pamakani), *A. riparia* (Hamakua pamakani), and *Rubus rosifolius* (thimbleberry).

The majority of individuals in the Kanahaiki population are within an exclosure fence (U.S. Army 2007). All individuals of the Pahole population are within an exclosure fence (USFWS 1999). Fencing is planned for the Kapuna and West Makalaha populations. Hand weeding of *Melins minutiflora* is occurring in areas immediately

surrounding individuals of *Cenchrus agrimonioides*, rather than spraying of herbicide. Removal of *Psidium cattleianum* allows light to penetrate the understory, improving the health and viability of shaded individuals (U.S. Army 2007).

Within the nursery, seedlings are susceptible to fungus gnats and damping off if the media is too wet; ants and mealy bugs can infest crowns if the ants are not controlled. An unknown leaf rust infects nursery plants but is not lethal and Chinese rose beetles, grasshoppers, and katydids feed on the plants in the nursery (Factor C) (The Nature Conservancy 2006a).

The Makaha and Waianae Kai population is found along the edge of a major trail and is threatened by trampling from hikers (Factor E). Approximately 57 percent of all known individuals on Oahu are located with the Army action area, and are threatened by training-related wildfires (Factor E) (USFWS 2007). However, they occur in the low fire-risk zone or very low fire-risk zone. Fire would remove the remaining vegetative primary native elements, further degrading the habitat, potentially allowing introduced invasive plant species to outcompete the native plants and precluding natural recruitment. Drought significantly impacts the wild populations due to their low population sizes (Factor E) (The Nature Conservancy 2006a)

The wild populations of are largely secured in storage or cultivation. Maui Nui Botanical Garden (2008) has 11 individuals of *Cenchrus agrimonioides* in storage representing three wild individuals from Kanaio Natural Area Reserve on Maui. The Center for Conservation Research and Training Seed Storage Laboratory (2008) has 197 seeds from three plants on Maui. Within the Harold L. Lyon Arboretum (2007) explant (living tissue removed for culture) collection, two individuals representing the Hanaula Iki population are in storage. The U.S. Army has 7,250 seeds in storage and 196 plants in their nursery for future reintroductions (U.S. Army 2008). Nearly all mature individuals from the Ekahanui and Huliwai populations have been secured in storage or cultivation (The Nature Conservancy 2006a). Two individuals representing the Hanaula Iki population have been outplanted at Makauwahi, Kauai as living storage (National Tropical Botanical Garden 2007). Reintroduction success rate is high (50 to100 percent) (U.S. Army Garrison 2007). The species has been outplanted on Kahoolawe, but detailed information is not available at this time. Restoration in the Honouliuli Preserve has resulted in the reintroduction of 40 individuals at four sites, but no recruitment has been observed (The Nature Conservancy 2006b)

The stabilization and recovery goals for this species have not been met as only two populations have more than 50 mature individuals and not all threats are being managed (see Table 1). Therefore, *Cenchrus agrimoniodes* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.3 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number: N/A

Brief Rationale:

3.3 Listing and Reclassification Priority Number: N/A

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

- Continue collection of fruit and plant material from extant populations for future population augmentation and the establishment of new populations.
- Construct exclosure fences to protect individuals from the adverse impacts of feral ungulates, and eradicate invasive introduced plant species within the exclosures.
- Establish new populations within protected habitats.
- Continue to augment current natural populations to increase numbers of individuals.
- Botanical surveys on less intensively surveyed islands of the Northwestern Hawaiian Islands (now the Papahanaumokuakea Marine National Monument) to help confirm the status of *Cenchrus agrimonioides* var. *laysanesis*.
- Assess genetic variability within extant and *ex situ* populations.
- Study *Cenchrus agrimoniodes* populations with regard to population size and structure, geographical distribution, factors, life history characteristics and limiting factors

5.0 REFERENCES

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Cenchrus agrimoniodes* (Kamanomano)

Current Classification: E

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:_____

Review Conducted By:
Christian Torres-Santana, Student Trainee Biologist
Marie Bruegmann, Plant Recovery Coordinator
Marilet A. Zablan, Recovery Program Leader and acting Assistant Field Supervisor for Endangered Species
Gina Shultz, Deputy Field Supervisor

Approved _____ Date 21 July 2009
Acting Field Supervisor, Pacific Islands Fish and Wildlife Office