

Hibiscus brackenridgei
(Ma`o hau hele [= native yellow hibiscus])

**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: *Hibiscus brackenridgei* (Ma`o hau hele [= native yellow hibiscus])

TABLE OF CONTENTS

1.0	GENERAL INFORMATION	1
1.1	Reviewers	1
1.2	Methodology used to complete the review	1
1.3	Background:	1
2.0	REVIEW ANALYSIS	3
2.1	Application of the 1996 Distinct Population Segment (DPS) policy	3
2.2	Recovery Criteria.....	4
2.3	Updated Information and Current Species Status	5
2.4	Synthesis.....	7
3.0	RESULTS	14
3.3	Recommended Classification	14
3.2	New Recovery Priority Number	14
3.3	Listing and Reclassification Priority Number.....	14
4.0	RECOMMENDATIONS FOR FUTURE ACTIONS	15
5.0	REFERENCES	15
	Signature Page.....	19

5-YEAR REVIEW
***Hibiscus brackenridgei*/ Ma`o hau hele (= native yellow hibiscus)**

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,
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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 (PIFWO) of the U.S. Fish and Wildlife Service (USFWS) beginning on March 8, 2007. The Bernice P. Bishop Museum provided most of the updated information on the current status of *Hibiscus brackenridgei* and also provided recommendations for conservation actions needed prior to the next five-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 the 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. 1994. Endangered and threatened wildlife and plants; endangered status for 12 plants from the Hawaiian Islands; final rule. Federal Register 59(217):56333-56351.

Date listed: November 10, 1994

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. 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. 2003b . Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, HI; final rule. Federal Register 68(39):9116-9479.

USFWS. 2003c. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.

USFWS. 2003d. 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. 2003e. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 101 plant species from the island of Oahu, HI; final rule. Federal Register 68(116):35949-35998.

USFWS. 2003f. 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 *Hibiscus brackenridgei* in one unit totaling 661 hectares (1,643 acres) on Oahu (USFWS 2003e), three units totaling 196 hectares

(485 acres) on Hawaii (USFWS 2003f), one unit totaling 107 hectares (264 acres) on Molokai (USFWS 2003c), and two units totaling 879 hectares (2,169 acres) on Maui (USFWS 2003d). These designations include habitat on State and private lands (USFWS 2003c, d, e, f). Critical habitat was not designated on Lanai because that area of occurrence is not essential for the conservation of the species and it lacks sufficient suitable soil (USFWS 2003a), and on Kauai because we were unable to identify physical and biological features (*i.e.*, the primary constituent elements) that are considered essential to the conservation of this species as the species is longer occurs on Kauai (USFWS 2003b).

1.3.4 Review History:

Species status review [FY 2008 Recovery Data Call (September 2008)]:
Declining

Recovery achieved:

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

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 plan for multi-island 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
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Yes
 No

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

Yes
 No

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

Yes

No

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

Yes

No

2.2 Recovery Criteria

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

Yes

No

2.2.2 Adequacy of recovery criteria.

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

Yes

No

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

Yes

No

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

A synthesis of the threats (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. *Hibiscus brackenridgei* 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 not been met.

For downlisting, a total of five to seven populations of *Hibiscus brackenridgei* 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 *Hibiscus brackenridgei* 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 *Hibiscus brackenridgei* (Ma`o hau hele [= native yellow hibiscus]) from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	~ 60	25	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1999 (recovery plan)	311-364	2	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2003 (critical habitat)	> 271	Unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2008 (5-year review)	~ 245	315	All threats managed	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

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

Hibiscus brackenridgei is a short-lived perennial shrub or small tree historically known from the islands of Kauai, Oahu, Molokai, Lanai, Maui, Hawaii, and possibly Kahoolawe, and currently comprising three subspecies: *brackenridgei*, *mokuleianus*, and *molokaianus* (Bates 1990; Wilson 1993; USFWS 1994). At the time the species was listed as endangered, it was already extirpated on Kauai, Kahoolawe, and Molokai (USFWS 1994). On Kauai, subsp. *mokuleianus* was reportedly historically collected in Lihue and Olokele Canyon (Bates 1990). Later, Wilson (1993) examined specimens collected in Lihue by J.F. Rock in the early 1900s and found them quite distinct from Oahu vouchers of *H. brackenridgei* subsp. *mokuleianus*, but declined to give it nomenclatural recognition unless it is rediscovered.

On Oahu, *Hibiscus brackenridgei* subsp. *mokuleianus* and subsp. *molokaianus* (see taxonomic discussion below) were reported as having fewer than 211 individuals in six populations at Kaumokunui, Kawaiu, Palikea, Kihakapu, and Kaimuhole Gulch on State, and private lands (*H. brackenridgei* subsp. *mokuleianus*), and in Makua Valley (*H. brackenridgei* subsp. *molokaianus*) (USFWS 2003e). Currently, the U.S.

Army monitors and manages Oahu populations of both subspecies, which are restricted to the northern Waianae Mountains. Over the past three years, total *in situ* (on-site) numbers (mature individuals, immature individuals, and seedlings) have plummeted from 1,415 in 2005, to 669 in 2006, and to 63 in 2007 (U.S. Army 2006b, 2007). Most of the decline was in the number of immature individuals, which was 1,309 in 2005 and 16 in 2007. Mature individuals increased slightly between 2005 and 2007 (from 33 to 46) due the reintroduction and discovery of new wild individuals, but there was a considerable decline of 60.6 percent in wild individuals (from 33 to 20) due to a fire in 2007 (see details below in the threats discussion). None of the four populations has yet reached their stabilization goal of 50 mature individuals: Makua (10 mature), Haili to Kealia (8 mature), Kaimuhole to Palikea Gulch (1 mature), Kihakapu (one mature). None of these populations have protection from rat predation, and only the Makua population currently has ongoing invasive introduced plant species management and protection from goats (*Capra hircus*), but not pigs (*Sus scrofa*) (U.S. Army 2007). The U.S. Army has had difficulty getting private landowners to agree to management of endangered species on their lands, and therefore has outplanted stock at alternate nearby manageable sites, such as at Dillingham Military Reservation and is pursuing fencing a site in Kaawa Gulch on State land. The U.S. Army also maintains genetic stock at its nurseries and at several *inter situ* (sites not within historical range but within reasonably suitable habitat, used to increase seed sources) sites located throughout Oahu, such as Keaau, the Kaala Learning Center, Koko Crater Botanical Garden, Kaiser High School, and Waimea Audubon Center. These sites serve as backups to ensure that genetic material from wild founder plants is not lost, should they be destroyed in a wildfire, as occurred in 2007 (see details below in the threats discussion).

On Molokai, *Hibiscus brackenridgei* was last collected in 1920 from Laau Point (USFWS 2003c). Upon examination of vouchers, Wilson (1993) decided the material was distinct enough to merit resurrection of infraspecific status, and named it *H. brackenridgei* subsp. *molokaianus*. Although apparently extinct on Molokai, plants fitting the description for this taxon have recently been found on Oahu (USFWS 2003e; J. Lau, botanical consultant, pers. comm. 2008).

Hibiscus brackenridgei subsp. *brackenridgei* is extant on the islands of Lanai, Maui, and Hawaii. The Plant Extinction Prevention Program (2007, 2008), USFWS (2008a), and H. Oppenheimer (Maui Nui Coordinator, Plant Extinction Prevention Program, pers. comm. 2008) estimated seven wild populations totaling about 182 individuals on the three islands, over 60 percent of them on the island of Hawaii. On Lanai, only five or six plants near Keomuku Road on private land were reported to remain (USFWS 1994). Only eight or nine plants were reported years later in the Keomuku Road area, and an unknown number of individuals planted in The Nature Conservancy's Kanepuu Preserve appeared to be naturally reproducing (USFWS 1999). Three seedlings in an enclosure at Kaena Point on Lanai were also reportedly surviving, now down to a single individual (H. Oppenheimer, pers. comm. 2008; Plant Extinction Prevention Program 2008). More recently, USFWS (2008a) and the Plant Extinction Prevention Program (2008) reported at least six plants, all in poor

health, remaining along Keomuku Road. The lineage of these plants was uncertain; there had been speculation that these were wild plants moved closer to the road to facilitate management (Plant Extinction Prevention Program 2007). Further inquiry revealed that all plants are naturally occurring, but have been human-aided by dispersal of seed from *in situ* plants (H. Oppenheimer, pers. comm. 2008). At Kanepuu, 14 outplantings (including seedlings) of uncertain lineage were observed in April 2007, but were all dead by January 2008 and nine new seedlings had germinated from the seed bank.

On Maui, USFWS (2003d) reported that subsp. *brackenridgei* was found in five occurrences containing 40 individuals on State (Lihau section of West Maui Natural Area Reserve and the Hawaii Department of Hawaiian Home Lands) and privately owned lands at Lihau, Kaonohua, Keokea, and near Puu O Kali. The Plant Extinction Prevention Program (2008) reported that the population at the Lihau Natural Area Reserve was unsuccessfully searched for on several occasions in 2008. A devastating fire swept through the area in July 2007; however, *Hibiscus brackenridgei* may still exist in the seed bank there (H. Oppenheimer, pers. comm. 2008). An enclosure in Kaonohua Gulch in the Waikapu area, on privately owned land, was reported to include five mature and four immature individuals and at least 20 seedlings, and there was active management of invasive introduced plant species and axis deer (*Axis axis*) in the vicinity (Plant Extinction Prevention Program 2008). The number of seedlings can vary wildly depending the duration of rainy periods. Hank Oppenheimer (pers. comm. 2008) can confirm only two extant Maui populations: at the Kaonohua enclosure (East Maui) and a population discovered in 2006 in a small gulch downslope from the historically known Keokea population (West Maui). He estimates 10 to 12 total mature individuals on the island, along with the 20 seedlings at the Kaonohua site. Historically known populations at Lihau (both public and private lands), Keokea, and Puu O Kali harbor no currently known individuals. The status of the Keokea site remains unclear because of a lack of specific locality or field data; the recently discovered population downslope in the Palauea ahupuaa consisted of 11 individuals in 2006, with only eight counted in June 2008. Seeds have been collected from five or six of the original 11 individuals. A parcel of over 80 hectares (200 acres) owned by the Hawaii Department of Hawaiian Homes Lands was recently fenced at the Puu O Kali (East Maui) site, providing protected habitat for natural regeneration or reintroduction of plants from this population currently being grown *ex situ*. The last remaining wild plants here had been eaten by axis deer (*Axis axis*).

On the island of Hawaii, USFWS (1994) noted two populations of *Hibiscus brackenridgei* subsp. *brackenridgei* on State and private land, containing no more than five individuals, at Puu Anahulu Homesteads and Puu Huluhulu. A few years later, USFWS (1999) reported two populations on State land: five plants at Lalamilo on leased pastureland, and four mature individuals and about 100 seedlings at Puu Anahulu. USFWS (2002) noted four populations on State and private lands containing fewer than 20 individuals, at Puu Anahulu, Puu Huluhulu, near the Kaupulehu Lava Flow, and outside Waimea town. USFWS (2008a) summarized various recent reports on Big Island populations, both wild and planted: Puu Anahulu

with about 80 individuals, seven or eight of them mature; Lalamilo with two individuals; Puu Iwaiwa with one mature individual and 46 seedlings. The Big Island Plant Extinction Program estimated fewer than 50 wild individuals on the island in 2006 (USFWS 2008a), and Volcano Rare Plant Facility (2006, 2007, 2008) has also reintroduced a total of 137 individuals in Kohala, from 2006 to 2008; 42 individuals in Puu Waawaa from 2006 to 2008; and two individuals in Puu Anahulu in 2007. All sites are on the island of Hawaii.

Altogether, the census reported by U.S. Army (2007), the Plant Extinction Prevention Program (2007, 2008), and the USFWS (2008a) suggest there were 12 extant wild populations of *H. brackenridgei* totaling approximately 245 total individuals at all live stages, supplemented by outplantings, in the Hawaiian Islands. By subspecies, the census breaks down as follows: subsp. *brackenridgei*, eight populations totaling approximately 182 individuals (Lanai, Maui, Hawaii); subsp. *mokuleianus*, four populations, 31 individuals (Oahu); and subsp. *molokaianus*, one population, 32 individuals (Oahu).

Herbarium vouchers at Bernice P. Bishop Museum (C. Imada, Research Biologist, Bernice P. Bishop Museum, pers. comm. 2008), the herbarium database at the National Tropical Botanical Garden (2008a), and data from Hawaii Biodiversity and Mapping Program (2007) reveal that vouchers collected in the wild consistently flowered between March and May. Vouchers from cultivated specimens also flowered in July, October, and November. USFWS (1999) reported flowering continuously from early February through late May, and intermittently at other times of the year, and that intermittent flowering might be tied to day length.

Bates (1990) accepted two principal morphological types of the endemic *Hibiscus brackenridgei*, calling them subsp. *brackenridgei* (including *H. brackenridgei* var. *molokaiana* Rock as a synonym) and subsp. *mokuleianus*. Later, F.D. Wilson (1993) reviewed the taxonomy of members of *Hibiscus* sect. *Furcaria* from the Pacific basin, creating a third subspecies of *H. brackenridgei* (subsp. *molokaianus*) from the resurrected var. *molokaiana*. The primary distinction between subsp. *brackenridgei* and *molokaianus* is the presence of a calyx nectary in the former and its absence in the latter. As it now stands, *H. brackenridgei* subsp. *brackenridgei* is found naturally on Lanai, Maui, and Hawaii; *H. brackenridgei* subsp. *molokaianus* on Oahu and Molokai; and *H. brackenridgei* subsp. *mokuleianus* on Kauai and Oahu.

Joel Lau (pers. comm. 2008) confirmed that a population in Makua Valley on U.S. Army land fits the description of *H. brackenridgei* subsp. *molokaianus*, previously thought to occur only on Molokai (J. Lau, pers. comm. 2008; USFWS 2003e, 2008a); all plants on Oahu were previously assumed to be *H. brackenridgei* subsp. *brackenridgei*. *H. brackenridgei* subsp. *mokuleianus* is a tree characterized by stems bearing spines, each arising from a red pustule, but the Makua plants are not trees and do not have such spines. Cultivated examples of Makua plants can be found at a number of locations (e.g., Waimea Arboretum, Leeward Community College). Currently known populations representing *H. brackenridgei* subsp. *mokuleianus* are

those in the Waialua area in the gulches of Kaumoku Nui, Kaimuhole, Palikea, Kihakapu, and Puulu. The populations in the area of the Kealia Trail and Kawaiu Gulch are intermediate between the Makua and Waialua area populations: some individuals are as spiny as the Waialua plants, while others are only sparsely spiny or completely spineless, and are generally less tree-like than the Waialua plants. The U.S. Army is treating the Oahu populations of *H. brackenridgei* as ranging from *H. brackenridgei* subsp. *molokaiana* at Makua to *H. brackenridgei* subsp. *mokuleianus* in the Waialua area (J. Lau, pers. comm. 2008). Two distinct forms of *H. brackenridgei* have been noted on Lanai: the typical upright habit, as noted for plants at Kanepuu; and a low, sprawling, glabrous (hairless), succulent-leaved form, as seen at Keomuku and in the Kaena enclosure (H. Oppenheimer, pers. comm. 2008). Material has been sent to E. Huppman at the University of Hawaii at Manoa for genetic analysis; results are awaited.

Nothing is known of the threats to *Hibiscus brackenridgei* on the island of Kauai (USFWS 2003b). The primary threats to *H. brackenridgei* subsp. *mokuleianus* and subsp. *molokaiana* on Oahu are habitat degradation and possible predation by pigs, goats, cattle (*Bos taurus*), and rats (*Rattus* spp.) (Factors A, C, and D); competition with introduced invasive plant species such as *Panicum maximum* (guinea grass), *Leucaena leucocephala* (koa haole), *Caesalpinia decapetala* (cat's claw), *Coffea arabica* (coffee), *Grevillea robusta* (silk-oak), *Hyptis pectinata* (Comb hyptis), *Melia azedarach* (Chinaberry), *Neonotonia wightii* (glycine), *Passiflora edulis* (passionfruit), *P. suberosa* (corkystem passionflower), *Schinus terebinthifolius* (Christmasberry), *Spathodea campanulata* (African tulip tree), and *Toona ciliata* (Australian redcedar) (Factor E); road construction (Factor E); and fire (Factor E) (USFWS 2003e, 2007; U.S. Army 2006a, 2007). The primary threats to *H. brackenridgei* subsp. *molokaianus* on Molokai are habitat degradation and predation by pigs and goats (Factor A, C, and D); competition with introduced invasive plant species such as *Ageratum conyzoides* (billygoat weed), *Leucaena leucocephala*, and *Panicum maximum* (Factor E); fire (Factor E); and predation by the Chinese rose beetle (*Adoretus sinicus*) (Factor C (USFWS 2003c).

The primary threats to *H. brackenridgei* subsp. *brackenridgei* on Lanai are habitat degradation; predation by axis deer, mouflon sheep (*Ovis* spp.), and rats (Factor A, C, and D); competition with invasive introduced plant species (Factor E); and fire (Factor E) (USFWS 2003a; 2008a). The primary threats to *H. brackenridgei* subsp. *brackenridgei* on Maui are habitat degradation and predation by pigs, goats, cattle, axis deer, and rats (Factor A, C, and D); competition with introduced invasive plant species (Factor E); and fire (Factor E) (USFWS 2003d). The population discovered in 2006 below Keokea (East Maui) on private lands is currently grazed by cattle and overrun with axis deer (Factor A, C, and D); is dry and prone to fire; and is dominated by an introduced plant landscape of *Prosopis pallida* (kiawe), *Leucaena leucocephala*, and *Cenchrus ciliaris* (buffel grass) (Factor E) (H. Oppenheimer, pers. comm. 2008). The Kaunohua (West Maui) enclosure site has been threatened recently by wildfires approaching to within a quarter mile from both the north and south. The primary threats to *H. brackenridgei* subsp. *brackenridgei* on the island of

Hawaii are habitat degradation and predation by feral pigs, goats, sheep, cattle, or rats (Factor A, C, and D); competition with introduced invasive plant species (Factor E); and fire (Factor E) (USFWS 2002, 2003f). On all islands, there continues to be susceptibility to extinction caused by randomly occurring natural events or reduced reproductive vigor due to small population size and a limited number of populations (Factors E) (USFWS 1994, 1999, 2002, 2003a, b, c, d, e).

In August 2007 a forest fire swept through the northern Waianae Mountains on Oahu from Waialua to Kaukonahua, consuming about 2,288 hectares (5,655 acres) and devastating pockets of native dry forest. A follow-up survey of eight affected gulches (Kaumoku Nui, Kaumoku Iki, Manuwai, Alaiheihe, Kaimuhole, Palikea, Kihakapu, and Puulu) was conducted by Army Natural Resources staff. While other rare taxa in the burn area were adversely affected, populations of *Hibiscus brackenridgei* were especially heavily impacted (Factor E). All 28 extant wild mature individuals, 532 of 546 immature individuals, and 58 of 65 seedlings in the area were either killed outright or damaged enough that survival is doubtful. Altogether, 97 percent of the censused plants in the burn area were negatively affected. The fire also burned fences and displaced both feral ungulates and farmed livestock on burned ranchlands.

Domestic cattle were noted in higher elevation areas distant from their usual pasturage, including burned *Hibiscus* sites, grazing on emerging *Panicum maximum* shoots. While it remained to be seen whether escaped cattle would continue to graze in *Hibiscus* habitat once the *Panicum* grew thick, there were negative impacts on native seedling recruitment from trampling. The post-fire environment saw the quick regrowth of *Panicum maximum*, but it is unclear how the native seed bank will respond. Pockets of native dry forest vegetation burned by the fire consisted of long-lived, slow-growing native canopy species (e.g., *Psydrax odorata* (alahee), *Diospyros sandwicensis* (lama), *Dodonaea viscosa* (aalii), and *Erythrina sandwicensis* (wiliwili)) that are unlikely to replace themselves, given aggressive competition from *Panicum maximum* and *Leucaena leucocephala* (Factor E) (U.S. Army 2007). The Kaukonahua fire highlights the pressing need for better planning of firebreaks and fire suppression techniques in the Waianae Mountains (U.S. Army 2007).

Catastrophic loss by fire was avoided at the Waikapu enclosure on West Maui, where a September 2006 fire in Maalaea failed to advance far enough north to affect the enclosure, just as a fire a few years previous did not advance far enough south (H. Oppenheimer, pers. comm. 2008).

The U.S. Army's 2006 report on the Makua Implementation Plan (U.S. Army 2006a) noted that most of the more than 12,000 seeds of *H. brackenridgei* collected that year proved to be unviable due to predation in which the seed coat was eaten through and the seed itself was rotten. An introduced insect, identified by the Hawaii Department of Agriculture as the scentless plant bug (*Niesthrea louisianica*), was noted on the seed and was the prime suspected predator (Factor C). Army Natural Resources staff selectively pruned plants to reduce plant stress and direct next season's flowering branches, applied slow-release fertilizer, and sprayed with insecticide. In 2007, seeds were collected earlier in the year and there was a much higher percentage of viable

seed (U.S. Army 2007). Speculation was that seed borer levels may have been lower earlier in the fruiting season. No pruning or fertilizer/insecticide treatments were applied in 2007. Plans are for early collection of seed again in 2008; if they prove less viable than in 2007, Army Natural Resources staff will consider fertilizer and insecticide treatments once again (U.S. Army 2007).

The U.S. Army (2006a) reports that *Hibiscus brackenridgei* is easily propagated by cuttings, where success rate is usually 100 percent. Germination of viable seed (those that sink in water) result in 96 to 100 percent success after scarification (artificial breaking of the seed coat). Because of seed predation, however, cuttings are the preferred method of propagation. Seed storage studies under various conditions have shown no aging after four years of storage (U.S. Army 2007). The National Tropical Botanical Garden (2008b) reported 2,010 seeds *H. brackenridgei* subsp. *brackenridgei* in genetic storage and controlled propagation purposes, from a source population on their living collections; six individuals were outplanted at Makauwahi, Kauai for *inter-situ* purposes (Burney and Burney 2007). The Volcano Rare Plant Facility (2007, 2008) reported 36 seeds and 20 plants from the Kohala population source, two plants in controlled propagation from Puu Anahulu, three plants outplanted in the garden for *inter situ* purposes, and 668 seeds and six plants from Puu Waawaa source in genetic storage. Volcano Rare Plant Facility (2006, 2007, 2008) has also reintroduced a total of 137 individuals in Kohala, from 2006 to 2008; 42 individuals in Puu Waawaa from 2006 to 2008; and two individuals in Puu Anahulu in 2007; all sites are on the island of Hawaii. It is assumed all plants were *H. brackenridgei* subsp. *brackenridgei*; however, their current status is not known. Amy B.H. Greenwell Ethnobotanical Garden reported 18 plants from a Hawaii island source in genetic storage (USFWS 2008b). The Harold L. Lyon Arboretum Micropropagation Laboratory (2008) reported five potted plants of *H. brackenridgei* subsp. *mokuleianus* on the grounds and nine plants in micropropagation. The Center for Conservation, Research and Training Seed Storage Laboratory (2008) reported 1,181 seeds of *H. brackenridgei* subsp. *brackenridgei* in storage. The U.S. Army (2008) has 24,138 seeds of *H. brackenridgei* subsp. *mokuleianus* in storage and 254 plants in the nursery for reintroduction purposes. The U.S. Army (2005, 2006b, 2007, 2008) reported reintroducing 46 individuals in Kaluakauila in 2005; 21 individuals in Dillingham Military Reservation in 2006, 28 individuals from Haili to Kawaiu in 2007, and 39 individuals in Kaluakauila and Lower Ohikilolo (Makua) in 2008, all sites were on Oahu. The Waimea Arboretum (2007) reported material of all three subspecies in genetic storage and for research purposes: 66 seeds or cuttings of *H. brackenridgei* subsp. *brackenridgei* representing nine wild individuals from Maui, Lanai, and Hawaii; 44 seeds, plants, and cuttings of *H. brackenridgei* subsp. *mokuleianus* representing nine wild individuals from Oahu; and 17 plants of *H. brackenridgei* subsp. *molokaianus* representing eight wild individuals from Oahu. The Honolulu Botanical Gardens (2008) reported material of two subspecies in their care for genetic storage purposes: 15 plants of *H. brackenridgei* subsp. *brackenridgei* representing seven wild individuals; and 33 plants of *H. brackenridgei* subsp. *mokuleianus* representing 10 wild individuals from Oahu. The Hawaii Division of Forestry and Wildlife, Kauai District (2007) reported controlled propagation of 15

plants of subsp. *brackenridgei* from the Lapa enclosure source material. The Hawaii Division of Forestry and Wildlife, Maui District (2008) reported three individuals of subsp. *brackenridgei* in genetic storage. Maui Nui Botanical Gardens (2008) reported more than 3,000 seeds and 80 plants of *H. brackenridgei* subsp. *brackenridgei* representing 10 wild individuals from Puu o Kali, Maui, and five cuttings from Lanai for genetic storage purposes. David T. Fleming Arboretum (Hobdy 2006) lists five plants of subsp. *brackenridgei* outplanted in 2000 on its grounds. *Hibiscus brackenridgei* has a relatively high profile among endangered plants in the State of Hawaii, having been declared the official State flower by the Hawaii State Legislature in 1988 (Netstate 2008), and widely available in the local nursery trade. Reintroduction efforts account for 181 individuals in the island of Hawaii and 134 individuals in Oahu, totaling 315 individuals. These numbers does not include *ex situ* or *inter situ* individuals.

The stabilization goals for this species have not been met as there are about 245 wild individuals with nearly 70 percent as seedlings, and 315 reintroduced individuals survive, not all of which are reproductive. None of the populations contain more than 50 mature individuals, and not all threats are being managed, especially fire, which is one of the major threats to the species (see Table 1). Therefore, *Hibiscus brackenridgei* 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

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 for future reintroductions.
- Construct enclosure fences to protect individuals from the negative impacts of feral ungulates, and eradicate invasive introduced plant species within the enclosures.
- Develop and implement fire management plans for all wild and reintroduced populations.
- Establish new populations within protected habitats.
- Augment current natural populations.
- Survey geographical and historical range for a thorough current assessment of the species.
- Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit *Hibiscus brackenridgei*.
- Assess genetic variability within extant populations.
- Study *Hibiscus brackenridgei* populations with regard to population size and structure, geographical distribution, flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Hibiscus brackenridgei*
(Ma`o hau hele [= native yellow hibiscus])

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:

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Approved  Date 21 July 2009
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