

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Exocarpos luteolus* (heau)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

Name of Reviewer(s):

Marie Bruegmann, Pacific Islands Fish and Wildlife Office, Plant Recovery Coordinator
Marilet A. Zablan, Pacific Islands Fish and Wildlife Office, Assistant Field Supervisor for Endangered Species
Jeff Newman, Pacific Islands Fish and Wildlife Office, Acting Deputy Field Supervisor

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning on April 29, 2008. The review was based on the final critical habitat designation for *Exocarpos luteolus* and other species from the island of Kauai (USFWS 2003), as well as a review of current available information. The National Tropical Botanical Garden provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The evaluation of Samuel Aruch, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor before submission to the Field Supervisor for approval.

Background:

For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

Application of the 1996 Distinct Population Segment (DPS) Policy:

This Policy does not apply to plants.

Review Analysis:

Please refer to the final critical habitat designation for *Exocarpos luteolus* published in the Federal Register on February 23, 2003 (USFWS 2003) for a complete review of the species' status (including biology and habitat), threats, and management efforts. No new threats and no significant new information regarding the species biological status have come to light since listing to warrant a change in the Federal listing status of *E. luteolus*.

At Kumuwela in the Kokee State Park, at least four mature individuals have been observed (Tangalin 2006a, 2007; N. Tangalin, National Tropical Botanical Garden, pers. comm. 2008a). Mohihi and Circle Bog, and the small bogs between them, Exocarpos Bog, Waikoali bogs, and Eurya Bog, all had populations of *Exocarpos luteolus* in the 1990s. In 2004, one individual was seen at Circle Bog, and in 2007, six individuals were observed 450 meters (1,476 feet) northeast of there (Wood 2008). In 2008, six individuals were observed in Mohihi Bog (Bruegmann 2008). The Ditch Trail, off Mohihi Road; Honopu Rim; Kalalau Valley at Alealau and Kaaalahina Ridge; Waialae, Koaie and Nawaimaka Streams; Pohakuao, on the Na Pali coast just east of Kalalau Valley; and the Wahiawa Drainage all contained populations of *E. luteolus* in the 1990s, but this species was not seen there during recently surveys (Perlman 2008; Wood 2008). In 2008, three individuals were seen in Kawaiiki Valley off Kaluahaula Ridge, in the upper forest and drainage to the south of Koaie and north of Waialae (Wood 2008). At Kalalau rim, near the *Plantago princeps* subsp. *anomala* population, two individuals were seen in 2001. From 1999 to 2001, five individuals were also seen on the Kalalau Rim in the area south of Exocarpos Ridge, between Kalalau and Kilohana lookouts. Up to 13 individuals were observed at the Kalalau Rim's drainage west of Puu o Kila in 2001 and plants were seen there again in 2007 (Wood 2008). In the Hipalau Valley, in a gulch off Koaie, in a stream drainage, two individuals were noted in 2000 (Perlman 2008). In total, approximately 39 individuals are known in 8 populations.

Seeds of what appear to be *Exocarpos luteolus* are abundant fossils at Makauwahi Cave on the southern coast of Kauai (Burney *et al.* 2001) and have also been noted in sediments at Huleia Stream (Burney 2002). These seeds could also be an extinct species not previously described. Burney hopes to clarify this in an ancient DNA project with Alan Cooper (D. Burney, National Tropical Botanical Garden, pers. comm. 2008).

Exocarpos luteolus grows in many habitats including both wet and mesic forests, bogs, stream banks, and wind-swept ridges. Populations in forest habitat include Kumuwela (Tangalin 2006a), Waialae; Honopu Trail; Kawaiiki, off Kaluahaula ridge, in the upper forest and drainage to the south of Koaie and north of Waialae. The habitat is *Metrosideros polymorpha* (ohia) – *Dicranopteris linearis* (uluhe) – *Acacia koa* (koa) montane mixed mesic to wet forest with *Alphitonia ponderosa* (kauila), *Alyxia stellata* (maile), *Antidesma platyphylla* (hame), *Bidens cosmoides* (poolanui), *Bobea brevipes* (ahakea lau lili), *Bobea elatior* (ahakea lau nui), *Boehmeria grandis* (akolea), *Broussaisia arguta* (kanawao), *Chamaesyce atrococca* (akoko), *Charpentiera* sp. (papala), *Cheirodendron trigynum* (olapa, lapalapa), *Cibotium* sp. (hapuu), *Coprosma* sp. (pilo), *Cyanea leptostegia* (haha), *Dianella sandwicensis* (uku uki), *Diospyros* sp. (lama), *Dodonaea viscosa* (aalii), *Dubautia latifolia* (koholapehu), *Dubautia laevigata* (naenae), *Elaeocarpus bifidus* (kalia), *Freycinetia arborea* (ie ie), *Gahnia* sp. (no common name [NCN]), *Gardenia remyi* (nanu), *Ilex anomala* (aiea), *Kadua affinis* (manono), *Kadua cordata* var. *schlechtendahlana* (kopa), *Labordia helleri* (kamakahala), *Leptecophylla tameiameiae* (pukiawe), *Lobelia hypoleuca* (kuhiaikamoowahie), *Machaerina angustifolia* (uki), *Melicope anisata* (mokiha), *M. barbigera* (uahiapele), *Melicope* sp. (alani), *Myoporum sandwicense* (naio), *Nestegis sandwicensis* (olopua), *Peperomia* sp.

(ala ala wai nui), *Perrottetia sandwicensis* (olopua), *Pipturus ruber* (mamaki), *Pisonia sandwicensis* (kaulu), *Pittosporum kauaiensis* (hoawa), *Poa sandwicensis* (NCN), *Pouteria sandwicensis* (alaa), *Psychotria greenwelliae* (kopiko), *P. grandiflora* (kopiko), *P. mariniana* (kopiko), *Pteralyxia kauaiensis* (kaulu), *Sadleria* sp. (amau), *Scaevola procera* (naupaka kuahiwi), *Schiedea membranacea* (NCN), *Schiedea nuttalli* (NCN), *Solanum sandwicense* (popolo aia keakua), *Syzygium sandwicensis* (ohia ha), *Touchardia latifolia* (olona), *Vaccinium* sp. (ohelo), *Wikstroemia oahuensis* (akia), and *Zanthoxylum dipetalum* var. *waimeae* (kawau) (Perlman 2008; Tangalin 2004, 2006a, 2007; Wood 2008).

Bog locations include Circle Bog, north of Mohihi Stream, the Waikoali Bogs, and scattered bogs to the northeast. *Exocarpos luteolus* in bogs are associated with *Metrosideros polymorpha* var. *glaberrima* (ohia) and *M. polymorpha* var. *pumila* (ohia), *Astelia waialealae* (pa iniu), *Broussaisia arguta* (kanawao), *Carex montis-eeka* (NCN), *Dicranopteris linearis* (uluhe), *Dubautia paleata* (naenae pua kea), *Gahnia beecheyi* (NCN), *Leptecophylla tameiameiae* (pukiawe), *Lysimachia daphnoides* (lehua makanoe), *Melicope clusiifolia* (kukaemoa), *Myrsine* spp. (kolea), *Oreobolus* sp. (NCN), *Psychotria mariniana* (kopiko), *Rhynchospora chinensis* (kuolohia), *Scaevola glabra* (ohe naupaka), *Smilax melastomifolia* (pioi, uhi), *Vaccinium dentatum*, *V. calycina* (ohelo), *Viola kauaiensis* (nani Waialeale), and *Wikstroemia* sp. (akia) (Perlman 2008; Wood 2008).

Ridges where *Exocarpos luteolus* occurs include Kalalau Rim and its Exocarpos Ridge, Honopu Rim, and Wahiawa ridge between Hanapepe Valley and the Wahiawa Drainage. The habitats in these areas are *Metrosideros polymorpha* forest with *Acacia koa*, *Artemisia* sp. (ahinahina), *Bidens* sp. (kookoolau), *Boehmeria* sp. (akolea), *Broussaisia arguta*, *Carex* sp. (NCN), *Chamaesyce remyi* (akoko), *Cheirodendron* sp. (olapa), *Dicranopteris linearis* (uluhe), *Ilex anomala* (aiea), *Kadua affinis* (manono), *Kadua* sp. (manono), *Labordia* sp. (kamakahala), *Lepidium* sp. (anaunau), *Leptecophylla tameiameiae* (pukiawe), *Lipochaeta* sp. (nehe), *Lobelia yuccoides* (panaunau), *Lysimachia kalalauensis* (NCN), *Melicope pallida* (alani), *Nestegis sandwicensis* (olopua), *Pittosporum glabrum* (hoawa), *Pleomele* sp. (hala pepe), *Pouteria sandwicensis* (alaa), *Psychotria mariniana* (kopiko), *Syzygium sandwicense* (ohia ha), *Tetraplasandra flynnii* (NCN), *Xylosma* sp. (NCN), and *Zanthoxylum* sp. (kawau) (Perlman 2008; Tangalin 2004; Wood 2008).

Stream banks where *Exocarpos luteolus* has been found include Koaie stream and Nawaimaka Stream in *Diospyros* sp. – *Metrosideros polymorpha* – *Acacia koa* montane mesic forest riparian community, associated with *Alectryon micrococcus* var. *micrococcus* (mahoe), *Bidens cosmoides* (poolanui), *Bobea* sp. (ahakea), *Carex alligata* (NCN), *Claoxylon* sp. (laukea), *Cryptocarya mannii* (holio), *Dodonaea viscosa* (aalii), *Eragrostis* sp. (kawelu, love grass), *Neraudia* sp. (NCN), *Nestegis sandwicensis* (olopua), *Panicum nephelophilum* (NCN), *Pleomele* sp. (hala pepe), *Pittosporum* sp. (hoawa), *Poa sandwicensis* (NCN), *Pritchardia* sp. (loulou), *Schiedea* sp. (NCN), *Tetraplasandra kawaiensis* (ohe ohe), *Urera* sp. (opuhe), and *Xylosma crenatum* (NCN) (Perlman 2008; Wood 2008).

Feral pigs (*Sus scrofa*) degrade the habitat of this species (Factors A and D). The Kalalau Rim population is threatened by invasive introduced plant species including *Rubus argutus* (prickly Florida blackberry), *Passiflora tarminiana* (banana poka), and *Erigeron karvinskianus* (daisy fleabane) (Factor E) (Wood 2008).

The Kalalau Valley habitat is degraded by goats (*Capra hircus*) (Factors A and D), with invasion by the following introduced plant species: *Christella dentata* (paa'i iha), *Lantana camara* (lantana), *Melinis minutiflora* (molasses grass), *Erigeron karvinskianus* (daisy fleabane), *Andropogon glomeratus* (beardgrass), *Hedychium gardnerianum* (kahili ginger), *Rubus rosifolius* (thimbleberry), *Psidium guajava* (common guava), *Melinis minutiflora* (molasses grass), *Bryophyllum pinnatum* (airplant), and *Aleurites moluccana* (kukui). *Clidemia hirta* (Koster's curse) has also been moving into the area (Factor E) (Wood 2008). In Kumuwela, there has been pig rooting near the base of one individual (Factors A and C). Invasive introduced plant species in this area include *Lantana camara*, *Hedychium gardnerianum*, *Rubus argutus*, and *Passiflora mollissima* (Factor E) (N. Tangalin, pers. comm. 2008b). In the Nawaimaka Stream area, threats are invasive introduced plant species including *Psidium guajava*, *Lantana camara*, and *Buddleia* sp. (smoke bush) (Factor E). Pigs were devastating the area in 1993 (Wood 2008) and have increased in numbers since that time (Factors A and D). Seed predation by rats (*Rattus* spp.) is also a threat to *Exocarpos luteolus* (Factor C) (Wood 2008).

Climate change may also pose a threat to *Exocarpos luteolus* (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

In addition to all of the other threats, species like *Exocarpos luteolus* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks (Factor E). The effect of these processes on this single-island endemic is exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (Factor E) (USFWS 1998).

Reduced reproductive vigor may be the result of limited numbers of existing individuals (Factor E). Fruit production is not always good. Tangalin observed a few immature, but never mature fruit at the plants at the Kalalau lookouts. At Kumuwela, which has at least four individuals, one individual in particular produces a lot of seed that ripens on the tree and doesn't seem to be eaten by rats. The National Tropical Botanical Garden has managed to germinate the seeds, but have not been able to keep the young plants alive (Tangalin 2006b). In 2009, five seeds were germinated (National Tropical Botanical Garden 2009). In Mohihi Bog, plants have been monitored since 1996, but only one immature fruit was observed in 2008 (Bruegmann 2008).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for plants from the island of Kauai (USFWS 1995), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial.

Exocarpos luteolus is a short-lived perennial, and to be considered stable, the taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on the island of Kauai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

The interim stabilization goals for this species have not been met (see Table 1), as no population has more than 50 mature individuals and all threats are not being managed. Therefore, *Exocarpos luteolus* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Continue seed collection for genetic storage and reintroduction.
- Control introduced invasive plant species around wild plants.
- Construct large-scale fences around all wild individuals to control feral ungulates.
- Reintroduce individuals into protected suitable habitat within historical range.
- Investigate techniques to improve natural recruitment.
- Assess genetic variability within and between extant populations.
- Study *Exocarpos luteolus* 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.
- Work with Hawaii Division of Forestry and Wildlife and the Kauai Watershed Alliance to contribute to implementation of ecosystem-level restoration and management to benefit this species in the Alakai Swamp.

References:

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Personal Communications

- Burney, David. 2008. Conservation director, National Tropical Botanical Garden, Kalaheo, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated October 12, 2008. Subject: Ancient DNA project.
- Tangalin, N. 2008a. Field botanist, National Tropical Botanical Garden, Kalaheo, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated September 19, 2008. Subject: *Exocarpos luteolus*.

Tangalin, N. 2008b. Field botanist, National Tropical Botanical Garden, Kalaheo, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated October 7, 2008. Subject: *Exocarpos luteolus*.

Table 1. Status of *Exocarpos luteolus* from listing through 5-year review.

Date	No. wild indivs.	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	250	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1995 (recovery plan)	324-349	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	75	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2009 (5-year review)	39	0	All threats managed	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Exocarpus luteolus* (heau)

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

- Delisting
- Reclassify from Endangered to Threatened status
- Reclassify from Threatened to Endangered status
- No Change in listing status

For **Field Supervisor, Pacific Islands Fish and Wildlife Office**



Date **AUG 27 2010**