Tetraplasandra gymnocarpa
(‘ohe ‘ohe)

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: *Tetraplasandra gymnocarpa* / ‘ohe ‘ohe

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5-YEAR REVIEW
Tetraplasandra gymnocarpa (‘ohe ‘ohe)

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, Loyal Mehrhoff, 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 of the U.S. Fish and Wildlife Service (USFWS), beginning on March 16, 2009. The review was based on final critical habitat designations for *Tetraplasandra gymnocarpa* and other species from the islands of Oahu (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 Tamara Sherrill, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Lead and the Assistant Field Supervisor for Endangered Species 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] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1994. Endangered and threatened wildlife and plants; endangered status for 11 plant species from the Koolau Mountain Range, island of Oahu, Hawaii; final rule. Federal Register 59(59):14482-14493.
Date listed: March 28, 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. 2003. Endangered and threatened wildlife and plants; final designations or nondesignations of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-36406.

Critical habitat was designated for *Tetraplasandra gymnocarpa* in six units totaling 1,810 hectares (4,527 acres). These designations include habitat on Federal, State, and private lands (USFWS 2003).

1.3.4 Review History:

Species status review [FY 2010 Recovery Data Call (September 2010)]: Declining

Recovery achieved:
1 (0-25%) (FY 2007 Recovery Data Call – most recent year reported)

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

1.3.6 Current Recovery Plan or Outline
Name of plan or outline: U.S. Fish and Wildlife Service. Recovery plan for Oahu plants. U.S. Fish and Wildlife Service, Portland, Oregon. 207 pages, plus appendices.
Date issued: August 10, 1998.
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 (Listing Factors A, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2. Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for Oahu plants (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Tetraplasandra gymnocarpa* is a long-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 Oahu, and if possible, on at least one other island where they occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Tetraplasandra gymnocarpa* 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 100 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 *Tetraplasandra gymnocarpa* 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 100 mature individuals per population for long-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

No new information.

2.3.1 Biology and Habitat

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

Tetraplasandra gymnocarpa is the only species in the family Araliaceae with a superior ovary. This modification in *Tetraplasandra* may be a result of changes in pollination strategy. While the change from an inferior to a superior ovary in *Tetraplasandra* appears to be a transition that occurred over a long period of time, this dramatic change in *T. gymnocarpa* may be the consequence of a single genetic mutation event that occurred at least 2.6 million years ago in the Koolau Mountain range on Oahu (Costello 2001; Costello and Motley 2004).

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:

Tetraplasandra gymnocarpa has been reported from at least 14 populations on Oahu since 1997, totaling at least 92 individuals,

but only one observation of 4 individuals has been made since 2003. There seems to be an ongoing decline in the numbers of individuals (see section 2.3.1.5).

At the Hawaiiloa Ridge Summit area, one mature tree was observed from a distance at 695 to 756 meters (2,280 to 2,480 feet) elevation on Wailupe Summit. In the area of Kaluanui Gulch to Kaipapua Gulch, 24 individuals were observed at 570 to 750 meters (1,870 to 2,460 feet) elevation in 2000. In Kawaiiki Gulch at 680 meters (2,230 feet) elevation, one mature tree was observed in 1999. Two mature individuals were reported in 1997 from Kawaiiki-Opaeula Ridge in the Kawailoa Training Area at 415 to 439 meters (1,360 to 1,440 feet) elevation, and five at 506 to 515 meters (1,660 to 1,690 feet) elevation. On the Kawailoa Trail, one mature tree was visible from the ridgetop at 381 meters (1,250 feet) elevation in 1999 (Hawaii Biodiversity and Mapping Program 2009). Kipapa Stream had four individuals in 2003: one each at 683 meters (2,240 feet), 707 meters (2,320 feet), 686 meters (2,250 feet), and 719 meters (2,360 feet) elevations (Wood 2010). At Manana summit in the Koolau Poko District, in the Waiahole Forest Reserve, Eleao region, windward into Kaalaea, 30 mature individuals were seen in 2000 at 671 to 792 meters (2,200 to 2,600 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Wood 2010). One mature individual was seen on the north side of Peahinaia Ridge in 1999 at 622 meters (2,040 feet) elevation (Hawaii Biodiversity and Mapping Program 2009). At Puu Lanipo and Wiliwilinui Ridge at 732 to 762 meters (2,400 to 2,500 feet) elevation, one mature tree was seen in 1999 (Hawaii Biodiversity and Mapping Program 2009) Twenty-one individual trees were reported at Puu Keahiakahoe in 1997 between 792 to 860 meters (2,600 to 2,820 feet) elevation (Hawaii Biodiversity and Mapping Program 2009). One mature tree was seen at Waikakalaua Gulch at 695 to 771 meters (2,280 to 2,530 feet) elevation in 1999 (Hawaii Biodiversity and Mapping Program 2009). An observation of *Tetraplasandra gymnocarpa* was made at Wailupe Summit area in 1999, but the number of individuals was not noted (Hawaii Biodiversity and Mapping Program 2009).

Tetraplasandra gymnocarpa occurs in the Waiawa and Manana management units of the Kawailoa Training Area, and may still occur in the Schofield Barracks East Range and Kahuku Training Area on Army lands (U. S. Army Garrison 2008).

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

Tetraplasandra, *Reynoldsia*, and *Munroidendron* form a complex of closely related genera (14 species) distributed from Tahiti, Samoa, the Marquesas, and the Hawaiian archipelago. Costello and Motley (2007) investigated evolutionary relationships within this group using morphological and DNA sequence variation to determine if the Hawaiian species originated from a common ancestor (monophyletic origin). Results indicated that *Tetraplasandra*, *Munroidendron*, and *Reynoldsia sandwicensis* formed a single monophyletic group, and that *Reynoldsia* is paraphyletic (including a common ancestor but excluding some or all of its descendants). The data supported combining *Reynoldsia sandwicensis* with *Munroidendron* and treating it as distinct from *Reynoldsia* species outside Hawaii. Changes in floral morphology within *Tetraplasandra* corresponded to monophyletic groupings. Species with superior ovaries (hypogynous flowers) clustered together, and species with floral characters suggestive of bird pollination clustered together (Costello 2001; Costello and Motley 2004; Costello and Motley 2007). Genetic studies revealed that all species within the genera *Tetraplasandra*, *Munroidendron*, *Reynoldsia*, *Arthrophyllum*, *Cuphocarpus*, and *Gastonia* were either paraphyletic (did not contain all the descendants of an ancestor) or polyphyletic (had multiple ancestral sources not common to all members of the group) (Plunkett and Lowry 2010).

2.3.1.4 Taxonomic classification or changes in nomenclature:

The formerly endemic Hawaiian genera *Tetraplasandra* and *Munroidendron*, along with the Pacific genus *Reynoldsia*, two Malesian species formerly assigned to the genus *Gastonia*, and four others that were already in the genus *Polyscias*, have been reassigned to the genus *Polyscias* subgenus *Tetraplasandra* (Lowry and Plunkett 2010; Plunkett and Lowry 2010). The authors subsumed all of the above genera into the single preexisting genus *Polyscias* while retaining several former genera names as subgenera (Lowry and Plunkett 2010; Plunkett and Lowry 2010). For this reason, *Tetraplasandra gymnocarpa*

will be referred to as *Polyscias gymnocarpa* for the remainder of this review.

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.):

The Hawaii Biodiversity Mapping Program lists a total of 29 populations of this species observed between the early 1900's and 2001, all located in the Koolau Mountains of Oahu except for one population, which was last seen in the Waianae Mountains of Oahu in 1954 (Hawaii Biodiversity and Mapping Program 2009; USFWS 1994). In 1998, when the recovery plan was written, 17 populations containing less than 200 individuals were known, scattered along the summit ridges of the Koolau Mountains over a distance of 45 kilometers (28 miles), from the region of Paumalu in the north to Kuliouou and Waimanalo in the south (USFWS 1998). As of 2010, 14 populations are known, containing at least 92 individual trees.

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

The habitat in the Koolau Mountains where *Polyscias gymnocarpa* occurs is *Metrosideros* (ohia) – *Dicranopteris linearis* (uluhe) wet forest with associated native species including *Acacia koa* (koa), *Adenophorus abietinus* (no common name [NCN]), *A. tamariscinus* (wahine noho mauna), *Antidesma platyphyllum* var. *platyphyllum* (hame), *Bidens macrocarpa* (kookoolau), *Bobea elatior* (ahakea lau nui), *Broussaisia arguta* (kanawao), *Cheirodendron trigynum* subsp. *trigynum* (olapa), *Cibotium chamissoi* (hapuu), *C. glaucum*, (hapuu pulu), *Clermontia kakeana* (oha wai), *C. oblongifolia* (oha wai), *Coprosma* spp. (pilo), *Cyanea acuminata* (haha), *C. angustifolia*, *C. humboldtiana*, *C. st. johnii* (all haha), *Cyrtandra garnotiana* (hahala), *C. kalihii* (haiwale), *C. paludosa* (moa), *Diplopterygium pinnatum* (uluhe lau nui), *Doodia lyonii* (kupukupu), *Dubautia laxa* (naenae pua melemele), *D. plantaginea* (naenae), *Elaeocarpus bifidus* (kalia), *Elaphoglossum fauriei* (hoe a Maui), *Euphorbia rockii* (akoko), *Freycinetia arborea* (ie ie), *Grammitis tenella* (kolokolo),

Hibiscus arnottianus (koko kea), *Isachne pallens* (NCN), *Kadua affinis* (manono), *K. fosbergii* (manono), *Labordia hedyosmifolia* (kamakahala), *L. hosakana* (kamakahala), *Lobelia hypoleuca* (liua), *L. oahuensis* (NCN), *Lycopodiella cernua* (wawaeiole), *Machaerina angustifolia* (uki), *M. mariscoides* subsp. *meyenii* (ahaniu), *Mecodium recurvum* (ohia ku), *Melicope clusiifolia* (kolokolo mokihana), *M. hosakae* (alani), *Metrosideros polymorpha* var. *glaberrima* (ohia), *M. rugosa* (lehua papa), *Myrsine fosbergii* (kolea), *Phyllostegia grandiflora* (kapana), *Pipturus albidus* (mamake), *Pittosporum confertiflorum* (hoawa), *P. glabrum* (hoawa), *Platydesma spathulata* (pilo kea), *Pouteria sandwicensis* (alaa), *Pritchardia martii* (loulu hiwa), *Psychotria hathewayi* (kopiko), *P. mariniana* (kopiko), *Sadleria pallida* (amau ii), *Scaevola glabra* (ohe naupaka), *S. mollis* (naupaka), *Sphenomeris chinensis* (palaa), *Syzygium sandwicense* (ohia ha), *Polyscias oahuensis* (ohe mauka), *Trematolobelia* sp. (kolii), *T. oahuensis*, *Vaccinium dentatum* (ohelo), *Wikstroemia oahuensis* var. *oahuensis* (akia), *Xylosma hawaiiense* (maua), and *Zanthoxylum oahuensis* (ae) (Hawaii Biodiversity and Mapping Program 2009; Perlman 2010; Wood 2010).

2.3.1.7 Other:

No new information.

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

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

The main threats to this species and its habitat include habitat degradation and destruction by feral pigs (*Sus scrofa*) and habitat modification and competition with invasive introduced plant species such as *Andropogon glomeratus* (beardgrass), *Ardisia elliptica* (shoebutton ardisia), *Axonopus fissifolius* (narrow-leaved carpetgrass), *Clidemia hirta* var. *hirta* (Koster's curse), *Erigeron karvinskianus* (daisy fleabane), *Falcataria moluccana* (albizia), *Heliocarpus popayanensis* (moho), *Melaleuca quinquenervia* (paperbark), *Paspalum conjugatum* (Hilo grass), *Psidium cattleianum* (strawberry guava), *Pterolepis glomerata* (NCN), *Rubus rosifolius* (thimbleberry), and *Sacciolepis indica* (Glenwood grass). Some of these plants can

spread rapidly and cover large areas in the forest understory or canopy (Hawaii Biodiversity and Mapping Program 2009; Wood 2010).

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

Not a threat.

2.3.2.3 Disease or predation:

Predation has been noted by rats (*Rattus* spp.) that eat seeds and by two-spotted leaf hopper (*Sophonia rufofascia*) (Hawaii Biodiversity and Mapping Program 2009; Wood 2010). The invasive tree, *Morella faya* (fire tree), which has moved into some native Hawaiian ecosystems that were originally dominated by the endemic tree *Metrosideros polymorpha*, will facilitate invasion by the two-spotted leaf hopper. Because of the broad host range characteristic of the two-spotted leafhopper, any increase in their numbers may adversely affect a number of endemic plant species growing in native forests (Alyokhin and Messing 2004).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Not a threat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

The introduced invasive plant species discussed in section 2.3.2.1 above are also a threat to *Polyscias gymnocarpa* because they compete with the species for water, light, and nutrients.

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to all of the other threats, species like *Polyscias gymnocarpa* 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. The extent of these natural processes on this single island endemic are exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (USFWS 2010).

There are currently no *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collections of this species. The Army Environmental program had one accession of 12 seeds of *Polyscias gymnocarpa*, stored at the Center for Conservation Research and Training Seed Storage Facility on Oahu, but the seeds are no longer in storage due to germination testing (Center for Conservation Research and Training Seed Storage Facility 2009, 2010). No other conservation measures specifically for *Polyscias gymnocarpa* are known to have been undertaken by the Army, but it probably benefits from fire protection and other measures which have been used to stabilize and maintain other rare species on Army lands. *Polyscias gymnocarpa* is listed as occurring in the proposed Kaluanui (Sacred Falls) Natural Area Reserve (State of Hawaii Department of Land and Natural Resources 2009).

Another Hawaiian species formerly in the genus *Tetraplasandra*, *Polyscias lydgatei*, has been successfully propagated by tissue culture (Harold L. Lyon Arboretum 2009).

2.4 Synthesis

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Oahu plants (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Polyscias gymnocarpa* is a long-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) and be represented in an *ex situ* (off-site) collection. In addition, a minimum of three populations should be documented on Oahu. For the species to be considered stable, each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

The interim stabilization goals for this species have not been met. Only one population, last observed in 2000, has been reported to have as many as 25

individuals (Table 1), there is no *ex situ* representation of the species, and all threats are not being managed (Table 2). Therefore, *Polyscias gymnocarpa* meets the definition of endangered as it remains in danger of extinction throughout its range.

Table 1. Status of *Polyscias gymnocarpa* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	<40-few hundred	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
1998 (recovery plan)	<200		All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	Unknown
2003 (critical habitat)	<100	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Unknown
			3 populations with 25 mature individuals each	No
2010 (5-year review)	at least 92	0	All threats managed in all 3 populations	Partially (Table 2)
			Complete genetic storage	No
			3 populations with 25 mature individuals each	Partially: only 1 population has 25 mature individuals, rest are spread among 18 populations

Table 2. Threats to *Polyscias gymnocarpa*.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – habitat modification and herbivory	A, C, D	Ongoing	No
Rats – herbivory	C	Ongoing	No
Two spotted leafhopper – herbivory	C	Ongoing	No
Small population size	E	Ongoing	No
Invasive introduced plants	A, E	Ongoing	No
Climate change	A, E	Increasing	No

3.0 RESULTS

3.1 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:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

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

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Collect material for genetic storage and propagation for reintroduction.
- Construct large-scale fences around all naturally occurring and reintroduced individuals to control feral ungulates.
- Control introduced invasive plant species around wild and reintroduced plants.
- Develop and implement legal control methods for two spotted leaf hopper.
- Control rats in the vicinity of these populations.
- Work with Hawaii Division of Forestry and Wildlife, U.S. Army Garrison, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Update the listed entity on 50 CFR 17 to match the currently recognized taxonomy.
- Investigate techniques to improve natural recruitment.
- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Tetraplasandra gymnocarpa* ('ohe 'ohe)

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
__X__ No Change in listing status

Appropriate Listing/Reclassification Priority Number, if applicable:_____

Review Conducted By:
Chelsie Javar, Fish and Wildlife Biologist
Marie Bruegmann, Plant Recovery Coordinator
Jess Newton, Recovery Program Lead
Assistant Field Supervisor for Endangered Species

Field Supervisor, Pacific Islands Fish and Wildlife Office

Date SEP 2 0 2011