

# U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

## Scientific Name:

Gardenia remyi

## Common Name:

nanu

## Lead region:

Region 1 (Pacific Region)

## Information current as of:

06/01/2013

## Status/Action

Funding provided for a proposed rule. Assessment not updated.

Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

New Candidate

Continuing Candidate

Candidate Removal

Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

Range is no longer a U.S. territory

Insufficient information exists on biological vulnerability and threats to support listing

Taxon mistakenly included in past notice of review

Taxon does not meet the definition of "species"

Taxon believed to be extinct

Conservation efforts have removed or reduced threats

\_\_\_ More abundant than believed, diminished threats, or threats eliminated.

## **Petition Information**

\_\_\_ Non-Petitioned

X Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

### **For Petitioned Candidate species:**

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?  
**Yes**

Explanation of why precluded:

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions.

### **Historical States/Territories/Countries of Occurrence:**

- **States/US Territories:** Hawaii
- **US Counties:** Hawaii, HI, Kauai, HI, Maui, HI
- **Countries:** United States

### **Current States/Counties/Territories/Countries of Occurrence:**

- **States/US Territories:** Hawaii
- **US Counties:** Hawaii, HI, Kauai, HI, Maui, HI
- **Countries:**Country information not available

### **Land Ownership:**

Approximately one-half of the populations occur on State lands, and one-half are on private lands. One individual occurs on Federal land.

### **Lead Region Contact:**

ARD-ECOL SVCS, Jesse D'Elia, 5032312349, jesse\_delia@fws.gov

### **Lead Field Office Contact:**

## Biological Information

### Species Description:

*Gardenia remyi* is a tree 10 to 43 feet (ft) (3 to 13 meters (m)) tall with branches that are quadrangular, puberulent and viscid. Leaves are few, clustered towards the tips of the branches, elliptic to broadly elliptic or obovate, 3.5 to 9.5 inches (in) (9 to 24 centimeters (cm)) long, 2 to 4 in (5 to 10 cm) wide, with the upper surface glabrous and the lower surface dull. Flowers are fragrant, solitary, and terminal, with a narrowly funnelform hypanthium and a white corolla that is six to eight-lobed. Fruit are orange, subglobose to broadly ellipsoid, and 0.4 to 1 in (1 to 2.8 cm) in diameter. Seeds are irregularly obovate, 0.07 to 0.08 in (1.8 to 2.1 millimeters) long (Wagner et al. 1999, p. 1,133).

### Taxonomy:

*Gardenia remyi* was described by H. Mann (1867, p. 171). This species is recognized as a distinct taxon in the Manual of Flowering Plants of Hawaii (Wagner et al. 1999, p. 1,133), the most recently accepted Hawaiian plant taxonomy.

### Habitat/Life History:

Typical habitat is mesic to sometimes wet forest at elevations between 197 and 2,493 ft (60 to 760 m) (Wagner et al. 1999, p. 1,133).

### Historical Range/Distribution:

Historically, this species was found on the island of Hawaii at Wao Kele O Puna Natural Area Reserve (NAR), Waiakea Forest Reserve (FR), Pahoa, and Hakalau Nui. On Kauai, this species ranged across the island from Halelea, Kealia, Moloaa, and Lihue-Koloa FRs, including Hanakapiai Valley, Mahaulepu, and east Wahiawa Bog. On Maui, this species was known from Wailuaiki and Waikamoi in the Koolau FR, and from Papaaea and Kipahulu. On Molokai, this species was known from Keopukaloa, Pukoo, Honomuni, Halawa, and Kaluaaha (Hawaii Biodiversity and Mapping Program (HBMP) 2008).

### Current Range Distribution:

Currently, this species is found from northeastern Kohala south to Hawaii Volcanoes National Park on the island of Hawaii; from northern and southern Kauai; from the east and west Maui Mountains; and from Pelekunu Preserve, the Molokai FR, and private property on the southeastern side of Molokai (HBMP 2008).

### Population Estimates/Status:

*Gardenia remyi* is known from 19 populations totaling between 85 and 87 individuals on the islands of Kauai, Molokai, Maui, and Hawaii (HBMP 2008; Wood, in litt. 2005; Oppenheimer 2006, pers. comm.; Perry, in litt. 2006; Welton, in litt. 2008; Agorastos, in litt. 2010; Perlman, in litt. 2010). On Kauai, populations are at Limahuli (6 individuals), Kalalau (below Pihea, 10 individuals, east Kalalau (4 individuals), at Puuauuka (1 individual), at Puu Kolo (2 individuals), at Waioli Valley (1 individual), Mount Kahili (1 individual), and at Waipa (6 individuals) (National Tropical Botanical Garden 2008; Perlman, in litt. 2010). The population in the Molokai FR has been observed to decline from approximately 20 individuals to 4 individuals over the past 5 years (Oppenheimer 2006, pers. comm.). Also on Molokai, there is 1 individual at Manuahi ridge, and possibly one individual remains at Mapulehu. On east Maui there is 1

individual at Kipahulu, and on west Maui there are 2 individuals at Honokohau drainage, a small population at Honolua peak (21 individuals), and 9 individuals at Honokohau-Hononana ridge (Oppenheimer 2006, pers. comm.; Welton, in litt. 2009). Several individuals were recently found on the island of Hawaii, 1 in the Waiakea FR, 3 in Wao Kele o Puna, 6 to 12 in Puu O Umi NAR, and one individual in poor condition and threatened by *Melastoma* sp. in Kohala NAR along the trail to Waikalooa Gulch (Perry, in litt. 2006; Pratt, in litt. 2008; Welton, in litt. 2009; Giffin, in litt. 2009; Agorastos, in litt. 2011; Conry, in litt. 2012; Hadway, in litt. 2013).

## Threats

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

This species is threatened by feral pigs (*Sus scrofa*), goats (*Capra hircus*), and deer (*Axis axis*) that degrade and destroy habitat (PEP 2008, p. 102; HBMP 2008; Perry, in litt. 2006). Pigs are a threat to *Gardenia remyi* populations in the Kohala Mountains and at Wao Kele O Puna on the island of Hawaii; the Halelea and Lihue-Koloa FRs on Kauai; the West Maui FR and Natural Area Reserve, and the Puu Kukui Preserve on Maui; and at the Molokai FR population. Goats are a threat to *G. remyi* on the island of Kauai at the Kalalau Valley population, and on the island of Molokai at the Pelekunu Preserve and Molokai FR populations. Axis deer are reported to be a threat to the Molokai FR population (HBMP 2008).

Pigs of Asian ancestry were introduced to Hawaii by the Polynesians, and the Eurasian type was introduced to Hawaii by Captain James Cook in 1778, with many other introductions thereafter (Tomich 1986, p. 121). Some pigs raised as food escaped into the forests of Hawaii, Kauai, Oahu, Molokai, Maui, and Niihau, formed herds, and are now managed as a game animal by the State to optimize hunting opportunities (Tomich 1986, p. 125; State of Hawaii 2001). A study was conducted in the 1980s on feral pig populations in the Kipahulu Valley on Maui (Diong 1982, 408 pp.). This valley consists of a diverse composition of native ecosystems, from near sea level to alpine, and forest types ranging from mesic to wet, *Acacia koa* (koa) to *Metrosideros polymorpha* (ohia). Rooting by feral pigs was observed to be related to the search for earthworms, with rooting depths averaging 8 in (20 cm) greatly disrupting the leaf litter and topsoil layers and contributing to erosion and changes in ground topography (Diong 1982, pp. 143-150). The feeding habits of pigs created seed beds, enabling the establishment and spread of weedy species such as *Psidium cattleianum* (strawberry guava) (Diong 1982, pp. 164-165). The study concluded that all aspects of the food habits of pigs are damaging to the structure and function of the Hawaiian forest ecosystem (Diong 1982, pp. 166-167). The effects on mesic and wet forest habitat by foraging of feral pigs have also been reported in fencing studies. In a fencing study conducted in the montane bogs of Haleakala, it was found that when feral pigs were fenced out of an area, the cover of native plant species increased from 6 percent to 95 percent within six years of protection (Loope et al. 1991, pp. i, 13).

The goat, a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently, populations exist on Kauai, Oahu, Maui, Molokai, and Hawaii. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, p. C20; van Riper and van Riper 1982, pp. 34-35; Scott et al. 1986, pp. 352-358; Tomich 1986, pp. 150-156; Culliney 1988, pp. 336-337; Cuddihy and Stone 1990, p. 64). *G. remyi* is vulnerable to the long-term, indirect effects of goats, such as large-scale erosion (Cuddihy and Stone 1990, p. 63).

Axis deer were introduced to Molokai in 1868, and within 30 years the population was estimated to be 7,000 animals. By 1996, the deer population at Kalaupapa had resulted in remarkable negative impacts on the vegetation (Dorman 1996). Axis deer eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants, and can jump fences constructed for feral pig control. The interaction of feral pigs and axis deer has reduced the *Metrosideros-Cibotium* (ohia-hapuu) rain forest to a grassy scrubland

(Dorman 1996). Axis deer have moved from their preferred habitat in relatively open, lower elevation shrub areas, into the rain forest above Halawa Valley, likely due to hunting pressure (Dorman 1996). Currently, the axis deer population is estimated to be at least 1,500 on Molokai ranch lands alone and 5,000 to 6,000 animals for Molokai and Lanai combined (Dorman 1996; Nicholas, in litt. 2006).

Hawaiian ecosystems, having evolved without hoofed mammals, are susceptible to large-scale disturbance by pigs, goats, deer, and other introduced ungulates (Loope et al. 1991, p. 3). Because of demonstrated habitat modifications by feral pigs, goats, and deer, such as destruction of native plants, disruption of topsoil leading to erosion, and establishment and spread of nonnative plants, the U.S. Fish and Wildlife Service (FWS) believes they are a threat to *Gardenia remyi*.

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

None known.

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

Herbivory by feral pigs, goats, and deer is a likely threat to *Gardenia remyi*, as they browse on leaves and other parts of any woody or fleshy plant species.

In a study conducted in the 1980s, pigs were observed browsing on young shoots, leaves, and fronds of a wide variety of plants, of which over 85 percent were endemic species (Diong 1982, p. 138). A stomach content analysis in this study showed that the pigs food sources consisted of native plants, 60 percent of which were *Cibotium* spp. (tree ferns), alternating with *Psidium cattleianum* (strawberry guava) when it was available. Pigs were observed felling and removing the bark of *Clermontia*, *Cibotium*, *Coprosma*, *Psychotria*, and *Hedyotis* species herbaceous and woody plants), and causing enough damage to kill larger trees over a few months of repeated feeding (Diong 1982, pp. 138, 144).

Goats browse on introduced grasses and native plants, and are able to reach more remote and inaccessible areas than other ungulates. They thrive on a variety of food plants, and are instrumental in the decline of native vegetation in many areas in Hawaii (Cuddihy and Stone 1990, p. 64).

Deer are primarily grazers but also browse numerous plant species (Waring 1996).

Because Hawaii's native plants evolved without any browsing or grazing mammals present, many lost natural defenses to such impacts (Merlin and Juvik 1992, p. 597). Therefore, even though there are no observations of direct browsing on *G. remyi*, it is likely that pigs, goats, and deer impact this species directly.

As of May 2013, we do not have information to indicate that disease poses a threat to *G. remyi*.

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

*Gardenia remyi* currently receives no protection under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544).

Pigs, goats, and deer are managed in Hawaii as game animals, but many populate inaccessible areas where hunting is difficult, if not impossible, and therefore has little effect on their numbers (Hawaii Heritage Program 1990, p. 3). Pig, goat, and deer hunting is allowed on all islands either year-round or during certain months, depending on the area; however, public hunting does not adequately control the number of ungulates to eliminate this threat to native plant species (Hawaii Department of Land and Natural Resources 1999, 2003).

## E. Other natural or manmade factors affecting its continued existence:

Alien plant species threaten *Gardenia remyi* as they degrade habitat and outcompete native plants (Oppenheimer, pers. comm. 2006; Perry, in litt. 2006; Welton, in litt. 2008).

The nonnative plants that are reported to be the greatest threats to the Hawaii Island populations of *G. remyi* are: *Clidemia hirta* (kosters curse), *Hedychium flavescens* (yellow ginger), *H. gardnerianum* (kahili ginger), *Melastoma candidum* (NCN), *Psidium cattleianum* (strawberry guava), *Setaria palmifolia* (palmgrass), *Sphaeropteris cooperi* (Australian tree fern), and *Tibouchina herbacea* (glorybush) (HBMP 2008; Perry, in litt. 2006; Welton, in litt. 2008; PEP 2008, p. 102; Hadway, in litt. 2012). The nonnative plants that currently pose the greatest threat to the Kauai populations are: *C. hirta*, *Lantana camara* (lantana), *Paspalum conjugatum* (Hilo grass) and *Rubus rosifolius* (thimbleberry) (HBMP 2008). The nonnative plants that currently pose the greatest threat to the Maui populations include *Ageratina adenophora* (Maui pamakani), *C. hirta*, *R. rosifolius*, and *T. herbacea* (HBMP 2008). The nonnative plants that currently pose the greatest threat to the Molokai populations are *C. hirta* and *P. cattleianum* (HBMP 2008).

*Ageratina adenophora* is native to tropical America and has naturalized in dry to wet forest on the islands of Oahu, Molokai, Lanai, and Maui (Wagner et al. 1999, pp. 254-255). *A. adenophora* is a shrub 3 to 5 ft (1 to 1.5 m) tall with trailing branches that root on contact with soil. It forms dense mats which prevent regeneration of native plants (Anderson et al. 1992, p. 315; California Invasive Plant Council 2013). It is considered a serious weed in agriculture, especially in rangeland, because it often replaces more desirable vegetation or native species and is fatally toxic to horses and most livestock. The eupatorium gall fly, *Procecidochares utilis*, was introduced to Hawaii in 1944 for control of *A. adenophora* and has been successful in suppressing most of the infestations (Bess and Haramoto 1959, p. 248).

*Clidemia hirta* is a noxious shrub first cultivated on Oahu prior to 1941. This pest plant forms a dense understory, shading out native plants and hindering their regeneration, and is considered a serious plant threat (Wagner et al. 1985, p. 41; Smith 1989, p. 189). The most promising biological control to date for *C. hirta* is the *Colleotrichum* fungus, *Gloesporioides* f. sp. *clidemiae*, released in 1986. Although there is no quantitative data available, the fungus has an observable negative impact. Other agents tested were a moth (*Antiblemma acclinalis*), a leaf-feeding beetle (*Lius poseidon*), a fruit and flower-feeding insect (*Mompha trithalama*), and a terminal growth-feeding insect (*Liothrips urichi*), all with lesser control success than the fungus (Smith 1989, p. 189).

*Hedychium flavescens*, a perennial herb up to 6.6 ft (2 m) tall, native to northeastern India and the Himalayas, is cultivated as an ornamental plant and is naturalized in Hawaii (Wagner et al. 1999, pp. 1,622-1,623). Yellow ginger forms dense colonies, crowding out all other plants, and reproduces by rhizomes (Pacific Island Ecosystems at Risk (PIER) 2009). We are unaware of any control methods for this species beyond herbicide application (Invasive Species Specialist Group 2013).

*Hedychium gardnerianum* is native to India (Nagata 1999, p. 1,623). This showy ginger was introduced for ornamental purposes, and was first collected in 1954 at Hawaii Volcanoes National Park (Wester 1992, p. 124). *H. gardnerianum* grows over 3 ft (1 m) tall in open light environments, preferring a warm moist climate; however, it will readily grow in full shade beneath a forest canopy. It forms vast, dense colonies, displacing other plant species, and reproduces by rhizomes. The conspicuous, fleshy, red seeds are dispersed by fruit-eating birds as well as by humans (PIER 2006a). Aircraft-based analysis has shown that ginger reduces the amount of nitrogen in the *Metrosideros* forest canopy in Hawaii, a finding later corroborated by ground-based sampling (Asner and Vitousek 2005). This species may also block stream edges, altering water flow (Global Invasive Species Database (GISD) 2006a). *H. gardnerianum* can be controlled by herbicides, but biological control is considered the only practical approach for the long-term management of large infestations in native forests. The ability of the bacterium *Ralstonia* (= *Pseudomonas*) *solanacearum* to cause bacterial wilt in *H. gardnerianum* in the field, together with its lack of virulence in other ginger species, contributes to its potential as a biological control agent (Anderson and Gardner 1999, p. 95; Anderson 2003).

*Lantana camara*, brought to Hawaii as an ornamental plant, is an aggressive, thicket-forming shrub which is now found on all of the main islands in mesic forest, dry shrubland, and other disturbed habitats (Wagner et al. 1999, p. 1,320). The most effective control agents are the lace bug, *Teleonemia scrupulosa* Stal. (Tingidae); the chrysomelid beetles, *Octotoma scabripennis* Guerin-Meneville and *Uroplata girardi* Pic; and the moths, *Hypena strigata* F., *Neogalea sunia* (Guenee) (Noctuidae), and *Salbia haemorrhoidalis* Guenee (Pyralidae). While biological control of *L. camara* by most of the established insects appeared to have reached equilibrium by 1969, the overall impact of the phytophage complex has been a steady and considerable reduction in abundance of the weed, particularly in drought-prone areas. Although lantana is considered generally to be under partial to substantial control in drier areas, it still remains a pest in some other environments, such as national parks (Hawaii Department of Agriculture 2006).

*Melastoma candidum* (now *M. septemnerium*) is a shrub or small tree up to 16 ft (5 m) tall, native to southeastern Asia and southern Japan. It is naturalized in Hawaii in mesic to wet areas, where it is abundant and invasive (Wagner et al. 1999, pp. 910-911). This shrub forms tangled brush which crowds out all other species (Smith 1985, p. 194). The fruit are dispersed by frugivorous birds (Smith 1985, p. 194). We are unaware of any control methods for this species beyond herbicide application (University of Hawaii 2013).

*Paspalum conjugatum* is a grass native to the Neotropics, and was introduced for cattle fodder and quickly spread (Cuddihy and Stone 1990, pp. 82-83). It is naturalized in moist to wet disturbed sites along roadsides and in open fields (OConnor 1999, p. 1,576). It forms a dense ground cover even on acidic, low-nutrient soils (PIER 2006b). Its small hairy seeds are easily transported on humans and animals or are carried by the wind through native forests. No biological control agents have been tested for this species (University of Hawaii 2006).

*Psidium cattleianum*, a tree native to tropical America, is widely naturalized on all the main islands of Hawaii. Found in mesic to wet forests, strawberry guava develops into dense stands in which few other plants can grow, displacing native vegetation. The fruit is eaten by pigs and birds, which then disperse the seeds throughout the forest (Smith 1985, p. 200; Wagner et al. 1999, p. 971). A biological control agent, *Tectococcus ovatus*, has undergone 15 years of testing, and there is a proposal to release this scale insect at O'laa Forest Reserve (ScienceDaily 2008).

*Rubus rosifolius* is native to Asia and is common in Hawaii in disturbed mesic to wet forest on all of the main islands. It is a sparse shrub, covered with prickles, and has edible red fruit. It invades the understory, forming dense thickets and outcompetes native plant species. It easily reproduces from roots left in the ground, and seeds are spread by feral animals and birds. There is no specific management information for *R. rosifolius*, but techniques used for the control of *R. fruticosus* (blackberry), a related species, may be applicable (PIER 2006c; GISD 2006b).

*Setaria palmifolia* is native to tropical Asia, and was first collected on Hawaii Island in 1903 (OConnor 1999, pp. 1,592-1,593). A large-leaved perennial herb, this species attains about 6.5 ft (2 m) in height at maturity, shading out native vegetation. *S. palmifolia* is resistant to fire and recovers quickly after being burned. Feral animals provide new areas for establishment by disturbing and opening areas in native vegetation (Cuddihy and Stone 1990, pp. 82-83). Chemical control methods are used currently, and no known biocontrol research is being conducted for this species (Motooka et al. 2003).

*Sphaeropteris cooperi*, a tree fern native to Australia, is used in landscaping in Hawaii because it is faster growing and more tolerant of warmer, drier conditions than the native Hawaiian tree ferns, and has escaped from cultivation (Medeiros et al. 1992, pp. 30-31). It can achieve high densities in native Hawaiian forest, grows up to 1 ft (0.3 m) in height per year, with maximum known heights of 39 ft (12 m) (Jones and Clemesha 1981, pp. 56-57), and can displace native species. Understory disturbance by pigs facilitates the establishment of *S. cooperi* (Medeiros et al. 1992, pp. 30-32). This species has been known to spread over

seven miles (12 kilometers) by windblown dispersal of spores from plant nurseries (Medeiros et al. 1992, pp. 28-31; Palmer 2003, p. 245). We are unaware of any control methods for this species beyond herbicide application and mechanical control (University of Hawaii 2013).

*Tibouchina herbacea*, an herb or subshrub in the Melastomataceae family, is native to southern Brazil, Uruguay, and Paraguay. In Hawaii, it is naturalized and abundant in disturbed mesic to wet forest on the islands of Hawaii, Maui, and Lanai (Wagner et al. 1999, p. 915). All members of this genus are legally declared noxious in the state of Hawaii (Hawaii Administrative Rules (HAR) Title 4, Subtitle 6, Chapter 68). Research is ongoing for biological controls of this species (Smith 2002, p. 97; The Nature Conservancy 2010, p. 12).

The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the current total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent are introduced species, and nearly 100 species are considered pests (Smith 1985, p. 180; Wagner et al. 1999, p. 45). Confirmed personal observations (Oppenheimer, pers. comm. 2006; Perry, in litt. 2006; Welton, in litt. 2008) and several studies (Cuddihy and Stone 1990, p. 74; Robichaux et al. 1998, p. 4) indicate nonnative plant species may outcompete native plants similar to *G. remyi*. Competition may be for space, light, water, or nutrients, or there may be a chemical produced that inhibits growth of other plants (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smith 1985, pp. 240-241; Loope and Medeiros 1992, pp. 7-8; Medeiros et al. 1992, p. 30; Ellshoff et al. 1995, pp. ii, 3-4; Meyer and Florence 1996, p. 778; Medeiros et al. 1997, pp. 23-24; Loope et al. 2004, p. 1,472). In particular, alien pest plant species degrade habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74; Vitousek et al. 1997, pp. 6-10). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the mesic to wet forest habitat of *G. remyi*, the FWS believes nonnative plant species are a threat to *G. remyi*.

Landslides are a threat to the population of *G. remyi* ranging from Honopue to Waipio in the Kohala mountains on Hawaii Island (Perry, in litt. 2006).

Lack of pollination was suggested as the cause for abortion of immature fruits that were seen among plants at Wao Kele O Puna FR on the island of Hawaii (PEPP 2010, p. 73). Similarly, Agorastos (in litt. 2011) also reported no viable seed production in the wild or within ex situ collections at Volcano Rare Plant Facility; and no recruitment in the wild among the 14 individuals he has observed on the island of Hawaii.

### **Conservation Measures Planned or Implemented :**

Maui Land and Pineapple Company manages the Puu Kukui Preserve area on Maui, including fencing and controlling nonnative plants in the preserve. The West Maui Mountain Watershed Partnership, a non-governmental, non-profit partnership composed of West Maui landowners and managers, received funding from the FWS from 2000 to 2004 for construction of ungulate exclosure fences, including the Kahakuloa Game Management Area, and for ungulate and nonnative plant control (Maui Land and Pineapple Company 2002, p. 8). The partnership has completed construction of the fences. These actions are expected to benefit individuals of *Gardenia remyi* that occur in the west Maui mountain area.

On the island of Kauai, there are 32 *G. remyi* individuals outplanted within an ungulate-proof exclosure at Paaiki on State land (Santos, in litt. 2011); and 22 individuals have been outplanted within an exclosure funded by the FWS's Partners for Fish and Wildlife program at Kanaele Bog on privately-owned land (Clark, in litt. 2011).

This species is represented in ex situ collections at the Volcano Rare Plant Facility (approximately 29 individuals), National Tropical Botanical Garden (NTBG) (unknown number of individuals), Lyon

Arboretum (approximately 251 individuals), and the Pahole Rare Plant Facility (4 individuals) (FWS 2005; Sugii, in litt. 2006; Volcano Rare Plant Facility 2008; NTBG 2008, p. 6; Conry, in litt. 2012; Imoto, in litt. 2013). Cuttings were taken from two of three individuals in the Wao Kele O Pula population on the island of Hawaii; and air layers were made for one individual from each of the Wao Kele O Puna and Puu O Umi populations (Agorastos, in litt. 2011; Hadway, in litt. 2013).

### **Summary of Threats :**

Based on our evaluation of habitat degradation and loss by feral pigs, goats, deer, and nonnative plants, we conclude there is sufficient information to develop a proposed listing rule for this species due to the present and threatened destruction, modification, or curtailment of its habitat and range, and the displacement of individuals of *Gardenia remyi* due to competition with nonnative plants for space, nutrients, water, and light. Herbivory by feral pigs, goats, and deer is a likely threat to *G. remyi*. Landslides are a likely threat to one population on Hawaii Island. Lack of pollination and viable seed production may also threaten this species. We find that this species is warranted for listing throughout all of its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

### **For species that are being removed from candidate status:**

\_\_\_\_\_ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

### **Recommended Conservation Measures :**

- Survey for populations of *Gardenia remyi* in areas of potentially suitable habitat.
- Control feral ungulates by removing these species from areas where *G. remyi* populations exist and preventing reinvasion through the use of exclosures.
- Control alien plants through physical, mechanical, and biological control methods, as well as herbicides when necessary. Continue to conduct research into potential biocontrol species.
- Continue propagation efforts for maintenance of genetic stock.
- Reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species.
- Research the species involved in the pollination process of *G. remyi*.

## **Priority Table**

Magnitude	Immediacy	Taxonomy	Priority
<b>High</b>	<b>Imminent</b>	Monotypic genus	1
		<b>Species</b>	<b>2</b>
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

### **Rationale for Change in Listing Priority Number:**

#### **Magnitude:**

This species is highly threatened by pigs, goats, and deer that degrade and destroy habitat, and by nonnative plants that outcompete and displace it. Herbivory by pigs, goats, and deer is also a likely threat. These threats to the mesic and wet forest habitat of *Gardenia remyi*, and to individuals of this species, occur throughout its range and are expected to continue or increase without their control or eradication. Feral pigs have been fenced out of the west Maui populations of *G. remyi*, but the fences must be continually maintained to prevent incursion. Nonnative plant numbers have been reduced in the populations that are fenced. This species is represented in ex situ collections. Ongoing conservation efforts for this species benefit only the west Maui and two Kauai populations. The remaining populations of this species are still impacted by these threats and will require long-term monitoring and management to maintain threat free areas.

#### **Imminence :**

Threats to *Gardenia remyi* from pigs, goats, deer, and nonnative plants are imminent because they are ongoing in the unfenced populations.

  Yes   Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

#### **Emergency Listing Review**

  No   Is Emergency Listing Warranted?

The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. In addition, the FWS has funded conservation actions that will benefit *Gardenia remyi*, including ungulate exclosures and ungulate and nonnative plant control in the west Maui mountains; fencing in the Kahakuloa Game Management Area; and ungulate exclosures and nonnative plant control at Kanaele Bog in southern Kauai. If it becomes apparent that the routine listing process is not sufficient to prevent further losses that may result in this subspecies' extinction, then the emergency rule process for this species

will be initiated. We will continue to monitor the status of *G. remyi* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

## **Description of Monitoring:**

The information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December 1995. We incorporated additional new information on this species from information in our files and from the Manual of the Flowering Plants of Hawaii (Wagner et al. 1999). In 2004, the Pacific Islands Office contacted the following species experts: Robert Hobdy, retired from the Hawaii Hawaii Division of Forestry and Wildlife (DOFAW); Joel Lau, Hawaii Natural Heritage Program; Arthur Medeiros, U.S. Geological Survey, Biological Resources Division (USGS-BRD); Hank Oppenheimer, resource manager for the Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, NTBG. New information on status and range was provided by Hank Oppenheimer. In 2005 we contacted species experts and confirmation of the status of *Gardenia remyi* was provided by Hank Oppenheimer of the Maui Land and Pineapple Company, and by Ken Wood of the NTBG. In 2006 new status and range information was provided by Hank Oppenheimer, PEP; Lyman Perry, Hawaii DOFAW; and Nellie Sugii, Lyon Arboretum. In 2008 we received new information from Linda Pratt (USGS-BRD) and Patti Welton (NPS) regarding the status of *G. remyi* on Hawaii and Maui. In 2009, we received new information from Jon Giffin (TNC) and Patti Welton (NPS). In 2010, we received new information from Nick Agorastos (DOFAW) and Steve Perlman (NTBG). In 2011, we contacted the species experts listed below, and received information from Nick Agorastos, DOFAW-Hawaii; Michelle Clark, USFWS-Kauai; Wendy Kishida, PEPP-Kauai; and Jeffrey Santos, DOFAW-Kauai.

List all experts contacted in 2011:

Name Date Affiliation

Agorastos, Nick 02/16/11 Division of Forestry and Wildlife, Hawaii  
Bakutis, Ane 02/16/11 Plant Extinction Prevention Program, Molokai  
Ball, Donna 02/16/11 U.S. FWS, Partners Program, Hawaii  
Bily, Pat 02/16/11 The Nature Conservancy, Maui  
Bio, Kealii 02/16/11 Plant Extinction Prevention Program, Hawaii  
Caraway, Vickie 02/22/11 Hawaii Division of Forestry and Wildlife, Oahu  
Ching, Susan 02/16/11 Plant Extinction Prevention Program, Oahu  
Clark, Michelle 02/16/11 U.S. FWS, Partners Program, Kauai  
Duvall, Fern 02/16/11 Hawaii Division of Forestry and Wildlife, Maui  
Fay, Kerri 02/16/11 The Nature Conservancy, Maui  
Garnett, Bill 02/16/11 National Park Service, Kalaupapa, Molokai  
Haus, Bill 02/16/11 National Park Service, Haleakala NP, Maui  
Higashino, Jennifer 02/16/11 U.S. FWS, Partners Program, Maui  
Imada, Clyde 02/16/11 Bishop Museum, Botany Department  
Kawelo, Kapua 02/16/11 U.S. Army, Environmental Division  
McDowell, Wendy 02/16/11 Plant Extinction Prevention Program, Kauai  
Medeiros, Arthur 02/16/11 U.S. Geological Survey  
Moses, Wailana 02/16/11 The Nature Conservancy, Molokai  
Oppenheimer, Hank 02/16/11 Plant Extinction Prevention Program, Maui Nui  
Perlman, Steve 02/16/11 National Tropical Botanical Garden  
Perry, Lyman 02/16/11 Division of Forestry and Wildlife, Hawaii  
Pratt, Linda 02/16/11 U.S. Geological Survey, Biological Resources Division  
Starr, Forest 02/16/11 U.S. Geological Survey  
Stevens, Bryon 02/16/11 DLNR Natural Area Reserves, Maui

Ward, Joe 02/22/11 Puu Kukui Watershed Preserve  
Welton, Patti 02/16/11 National Park Service, Haleakala NP, Maui  
Wysong, Michael 02/16/11 DLNR Natural Area Reserves, Kauai

The Hawaii Biodiversity and Mapping Program identified this species as critically imperiled (HBMP 2006). Based on the International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, this subspecies is recognized as Vulnerable (facing a high risk of extinction in the wild) (Bruegmann and Caraway 2003). *Gardenia remyi* is not included in Hawaii's 2005 Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005).

**Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:**

Hawaii

**Indicate which State(s) did not provide any information or comment:**

none

**State Coordination:**

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. New information was received on March 23 and April 12, 2013, and incorporated into this report.

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### **Personal Communications and In Litteris**

Agorastos, N., DOFAW, Electronic mail message regarding candidate plant status, dated February 9, 2010.

Agorastos, N., DOFAW, Electronic mail message regarding candidate plant status, dated March 15, 2011.

Clark, M., U.S. Fish and Wildlife Service, Electronic mail message regarding candidate plant status, dated March 22, 2011.

Giffin, J. The Nature Conservancy, Electronic mail response to request for Candidate species information, dated February 6, 2009.

Hadway, L. DOFAW, CNOR 2013 request for comments on USFWS species assessment and listing priority assignment forms, April 12, 2013.

Imoto, R. DOFAW, CNOR 2013 request for comments on USFWS species assessment and listing priority assignment forms, March 23, 2013.

Nicholas, P. Molokai Ranch, Interview in Good points squeek out of Laau meeting series article in The Molokai Times, B. Purtzer, June 11, 2006.

Oppenheimer, H., Plant Extinction Prevention Program, Telephone interview regarding plant candidate species information updates, September 15, 2006.

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Perry, L., DOFAW, Response to request for propagation information, September 20, 2006.

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Welton, P., National Park Service, Electronic mail message regarding populations of *Gardenia remyi* on the

island of Maui, dated February 21, 2008.

Welton, P., National Park Service, Electronic mail message regarding populations of *Gardenia remyi* on the island of Maui, dated February 13, 2009.

Wood, K., National Tropical Botanical Garden. 2005. Electronic message to Marie Brueggemann, U.S. Fish and Wildlife Service, regarding potential candidates, June 22, 2005.

**Approval/Concurrence:**

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:



06/13/2013

Date

Concur:



10/28/2013

Date

Did not concur:

\_\_\_\_\_

\_\_\_\_\_

Date

Director's Remarks: