Tabernaemontana rotensis
(no common name)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai‘i

5-YEAR REVIEW

Species reviewed: *Tabernaemontana rotensis* (no common name)

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1.0 GENERAL INFORMATION

1.1 Reviewers:

Caitlin Shishido, Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

Lead Regional Office:
Interior Region 12, Portland Regional Office

Lead Field Office:
Pacific Islands Fish and Wildlife Office

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 (Service), beginning in October 2019. The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation by Caitlin Shishido, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

1.3.2 Listing history:

Original Listing
FR notice: [USFWS] U.S. Fish and Wildlife Service. 2015. Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia; final rule.

Department of the Interior, Federal Register 80 (190): 59423-59497, October 1, 2015.

Date listed: October 1, 2015
Entity listed: *Tabernaemontana rotensis*
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:
N/A

1.3.4 Review History:
This is the first 5-year review for *Tabernaemontana rotensis*.

1.3.5 Species' Recovery Priority Number at start of this 5-year review:
8

1.3.6 Current Recovery Plan or Outline:
Name of plan or outline: Recovery Outline for 23 Mariana Island Species
Date issued: February 3, 2020
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**
____**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
__X_ 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?

____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.

The recovery plan is currently being drafted. However, the Hawai‘i and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and

goals for stages leading towards recovery (2011). These stages are described below.

Current information is lacking for many plant species in the Commonwealth of the Northern Mariana Islands (CNMI) and Guam on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. The following downlisting and delisting criteria for plants have therefore been adopted from the revised recovery objective guidelines developed by the HPPRCC (2011). Many of the CNMI and Guam plant species are at very low numbers or in decline, so the Service also developed criteria for avoiding imminent extinction and an interim stage before downlisting, based on the recommendations of the HPPRCC, to assist in tracking progress toward the ultimate goal of recovery. These criteria are assessed on a species-by-species basis, especially as additional information becomes available.

In general, long-lived perennials are those taxa either known or believed to have life spans greater than 10 years; short-lived perennials are those known or believed to have life spans greater than one year but less than 10 years; and annuals are those known or believed to have life spans less than or equal to one year. When it is unknown whether a species is long- or short-lived, the Service has erred on the side of caution and considered the species short-lived. This will be revised as more is learned about the life histories of these species. Narrow extant range and broad contiguous range are recognized as not needing different numbers of individuals or populations, but that the populations will be distributed more narrowly or more broadly, respectively, across the landscape. Obligate outcrossers are those species that either have male and female flowers on separate plants or otherwise require cross-pollination to fertilize seeds, and therefore require equal numbers of individuals contributing to reproduction as males and females, doubling the number of mature individuals. Species that reproduce vegetatively may reproduce sexually only on occasion, resulting in the majority of the genetic variation being between populations, therefore requiring additional populations. Species that have a tendency to fluctuate in number from year to year require a larger number of mature individuals on average to allow for decline in years of extreme habitat conditions and recuperation in numbers in years of more normal conditions.

Preventing Extinction

Stabilizing (interim), downlisting, and delisting objectives have been updated according to the draft revised recovery objective guidelines developed by the HPPRCC (2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of populations and reproducing individuals for each stage. The goals for each stage

remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Tabernaemontana rotensis is a long-lived perennial tree. To prevent extinction, which is the first milestone in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 25 individuals (or the total number of individuals if fewer than 25 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections. In addition, a minimum of three populations should be documented on Guam and Rota where they now occur or occurred historically. Each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings), with a minimum of 25 mature individuals per population.

There are two populations on Guam that are estimated to total over 500 individuals each; however, threats such as nonnative plant and animal control and are not being adequately addressed. In addition, almost all known trees occur within one location which makes this population extremely vulnerable to catastrophic events and disease. While seed collection and propagation has been documented, it is unknown how many of individuals are naturally reproducing as *T. rotensis* trees have been previously plagued with problems thought to be the result of low pollinator density. Therefore, this recovery objective has not been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Tabernaemontana rotensis*, 100 mature individuals are needed in each of three populations and all major threats must be controlled around the populations designated for recovery at this stage. There should also be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the target populations. The populations must be adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation's guidelines Guerrant et al. 2004) that is secured and well managed. At least one of the populations must be located on each of the islands from which the species was known historically, as long as suitable habitat exists. Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

This recovery objective has not been met (see Table 1).

Downlisting Criteria

In addition to achieving 5 to 10 populations with 200 mature individuals per population and all of the goals of the interim stage, all target populations must be stable, secure, and naturally reproducing for a minimum of 10 years. Multi-island species should be represented by at least three populations on each of the islands from which they were known historically, as long as suitable habitat exists. Species-specific management actions are not ruled out. Downlisting should not be

considered until an adequate population viability analysis (PVA) has been conducted to assess needed numbers more accurately based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to downlist. Information necessary for the PVA that should be available through monitoring (ideally annually) includes major limiting factors, breeding system, population structure and density, and proven management methods for major threats.

This recovery objective has not been met (see Table 1).

Delisting Criteria
In addition to achieving 5 to 10 populations with 200 mature individuals per population and all of the goals of the interim and downlisting stages, all target populations must be stable, secure, naturally reproducing, and within secure and viable habitats for a minimum of 20 years. Species-specific management actions must no longer be necessary, but ecosystem-wide management actions are not ruled out if there are long-term agreements in place to continue management. These numbers are initial targets, but may be revised upward as additional information is available, including adequate PVAs for individual species based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to delist. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis.

This recovery objective has not been met (see Table 1).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

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

Tabernaemontana rotensis, a medium-sized tree (26 to 33 feet (ft); 8 to 10 meters (m) tall) in the dogbane family (Apocynaceae) (Stone 1970, p. 485). Its leaves are thin, light green, opposite (a pair of leafs at each node, opposite each other), elliptic to oblong in shape, 6 to 12 inches (in) (15 to 30 centimeters (cm)) long, 2 to 4 in (5 to 10 cm) wide, and contain a copious milky sap. Flowers are white, elongate, slender, and branch from the tree (Stone 1970, p. 485; UOG 2007, p. 6; GPEPP 2015, Appendix 2).

Tabernaemontana rotensis typically flowers between August and October, followed by the production of immature fruit (UOG 2007, pp. 4, 23). The fruit reaches full size approximately 30 to 35 days after flowering, and is twinned or single (single or double fruit), beaked, almost 1 in (3 cm) long,

and 0.4 in (1 cm) thick (Stone 1970, p. 485; UOG 2007, pp. 4, 24). Fruit color changes from bright green to dull green in subsequent months, turning to a dull orange color 50 to 60 days after flowering (UOG 2007, pp. 4, 24; USFWS 2017b, pp. 80-82). Currently, *T. rotensis* is generally found in a clustered spatial distribution; seedling establishment has been restricted to the vicinity of the parent tree, which is thought to be a consequence of the loss of frugivore bird species on Guam (UOG 2007, pp. 4, 28; USFWS 2017b, pp.80-82). Because of the close proximity in establishment, seedlings develop in extreme competition with each other, and many of them become stunted or die (UOG 2007, pp. 6, 28).

The average age at sexual maturity of naturally occurring *Tabernaemontana rotensis* plants has not been documented. However, the Guam Plant Extinction Program (GPEPP) noted that propagated plants in GPEPP's nursery were seen flowering after a year on 4 ft (1.2 m) tall trees (GPEPP 2019b, in litt.). Mature plants may live a few decades. Pollinators of *T. rotensis* are not well documented but in general, the large majority of pollinators on Guam and in the Marianas have been eliminated by invasive species.

In typhoon conditions, *Tabernaemontana rotensis* develops a synchronized pulse of flowering about one month after the typhoon. This pulse of flowering leads to a mass seeding event about four months after the typhoon (UOG 2007, pp. 6, 21). Typhoons may actually open canopy space to germinate *T. rotensis* seeds and promote growth in the population; however, for a successful regeneration to occur following a typhoon, a viable seed bank must be present and, if there is regeneration, it will still likely result in a clustered spatial distribution because of the loss of frugivore bird species on Guam (UOG 2007, pp. 6, 21; USFWS 2017b, pp. 80-82). This species may behave like a pioneer species since germination and seedling emergence have been shown to be maximized in full sun conditions (i.e., after typhoon damage) (UOG 2007, p. 14).

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:

When listed as endangered in 2015, *Tabernaemontana rotensis* was known from seven populations within the forest habitat and totaling approximately 21,000 individuals (including seedlings, immature and mature plants) on Guam (M and E Pacific Inc. 1998, p. 61; UOG 2007, pp. 32-42) and nine individuals on Rota (USFWS 2015, p. 59438). Additional individuals have recently been located on Guam due to surveys by GPEPP and surveys funded by the U. S. Department of Defense (DoD) as military activities increase on this island.

The current known abundance of *Tabernaemontana rotensis* on both Guam and Rota is approximately 15,341 naturally occurring individuals, including seedlings, immature and mature plants. *T. rotensis* occurs in eight locations on Guam. *Tabernaemontana rotensis* occurs in two locations on the southern half of the island and at six locations on the northern half. Despite a slight increase in the estimate of the number of populations, population size estimates appear to be in decline. On Rota there are nine individuals spread across six locations around the western, southern, and eastern parts of the island (CNMI DLNR 2015, in litt). Additionally, there are 30 surviving outplanted individuals spread across Rota (J. Manglona, T. Reyes, R. Ulloa, pers. comm. 2014 cited in CNMI DLNR 2015, in litt.) Three of these locations (AAFB-HMU, US Naval Magazine and Ipan) have a limited number of individuals (≤5 individuals). Reports for several locations do not specify the growth stages of these individuals. The species may be subject to predation by ungulates, rodents, and invertebrates. Individual plants seem to be growing in clusters, which compete for resources such as sunlight and space.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):
In 2011, a genetic study was conducted on *Tabernaemontana pandacaqui* from Rota, Guam, Asia, and the Pacific, to determine if those individuals on the Mariana Islands are a monophyletic lineage. The study determined that *Tabernaemontana rotensis* is a valid species, distinct from the widespread *T. pandacaqui* (Reynaud 2012, p. 3).

2.3.1.4 Taxonomic classification or changes in nomenclature:
Tabernaemontana rotensis is in the dogbane family (Apocynaceae). This plant was first described by Kanehira (1936) as *Ervatamia rotensis*. However, Stone (1965, 1970) recognized the species from the Rota and Guam collections as *T. rotensis*. *T. rotensis* at one point was also thought to be part of the Pacific-wide *Tabernaemontana pandacaqui*; however, recent studies showed that *T. rotensis* is endemic to Guam and Rota.

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.):
See section 2.3.1.2 and 2.3.1.4, above, for spatial distribution of the species.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):
Tabernaemontana rotensis occurs in the native limestone forest habitat on Guam and Rota. Forests in the Marianas are characterized by a closed

canopy of broadleaf trees with an understory of younger trees, vines, epiphytic ferns, and orchids (Stone 1970, p. 485; Vogt and Williams 2004; Willsey, et al. 2019, p. 3). These forests are usually composed of tall trees (33+ ft; 10+ m) that comprise the upper canopy, small to mid-size trees (3 to 33 ft; 3 to 10 m) as a mid-story, and shrubs and herbs that form the understory (Falanruw, et al. 1989, pp. 6, 8). Undergrowth can be sparse in densely shaded areas but may contain ground herbs, shrubs, ferns, and small trees of varying heights in areas with more open canopy (Willsey, et al. 2019, p. 3).

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson and Rinehard 1991, pp. 1-2) and is able to colonize sites that occur in full sun or in deep shade (UOG 2007, pp. 4, 14). Raulerson and Rinehart (1991) found *T. rotensis* to be very edge tolerant, with preferences for open patches within limestone forests and occurrences along forest edges. The species has primarily been found in areas of little to no slope (<15%) (UOG 2007, p. 10; JRM 2016, entire). *T. rotensis* has been found in forest habitats most often co-occurring with *Cycas micronesica*; however, it is not found in areas that are dominated by alien tree species (UOG 2007, p. 4).

For a complete review of the limestone forest habitat on Guam and Rota, including current condition, please refer to "Marina Islands Forest" Willsey et al. 2019.

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 (Factor A):

Human destruction and modification by development, military training, and urbanization — The Department of the Navy (DON) is in the process of relocating U.S. Marine Corps (USMC) personnel from Okinawa, Japan to Guam, which includes related infrastructure construction and military training activities. Project activities for this relocation include the construction of a main cantonment area, family housing, a live fire training range complex and a variety of other training activities on Department of Defense (DoD) property on Guam. Post-completion of the project, it is expected that the population on Guam will increase by approximately 7,400 people. Additionally, approximately 1,219 acres of limestone forest, 613 acres of herbaceous scrub and 3,221 acres of developed/barren land will be permanently modified as a result of this action. Due to this large project and the potential to impact a variety of threatened and endangered species on Guam, the DON proposed a number of conservation measures to reduce the impacts to such species and habitats. The DON proposed and agreed to translocate healthy individual

plants or collect available seed for a proportion of the populations that are destroyed during construction. Moreover, because this species prefers edge habitat, it is at risk to roadside widening activities. One of the two remaining individuals on Rota was nearly destroyed by a bulldozer.

Habitat destruction and modification by nonnative animals— Since most of the islands in the Mariana archipelago are small (Guam being the largest at 210 sq mi (544 km^2)), the negative impacts associated with a destructive nonnative animals species can affect the entire island (USFWS 2015, p. 59453). The mild climate of the islands, combined with the lack of competitors or predators, has led to the successful establishment of large populations of invasive species and subsequent destruction of native flora and fauna (USFWS 2015, p, 59453).

Invasive animals pose a threat to *Tabernaemontana rotensis*. Feral ungulates such as introduced pigs (*Sus scrofa*), Philippine deer (*Rusa marianna*), and water buffalo (*Bubalus bubalis*) (on Guam) are a significant cause both habitat destruction and direct mortality to *T. rotensis*, particularly to seedlings and immature plants (Kessler 2011, entire; Rubinoff and Holland 2018, p. 224, USFWS 2015, p. 59453). These feral ungulates are major vectors for the establishment and spread of competing invasive and other nonnative plant species by dispersing seeds on their hooves, fur, and in their feces (Dion 1982, pp. 169-170, 196-197; USFWS 2015, p. 59453). In addition, rooting, wallowing, and trampling by these feral ungulates contributes to erosion by clearing vegetation and creating large areas of disturbed soil (USFWS 2015, p. 59453). Some other invasive species have less direct impacts to *T. rotensis* but their effects are still profound. For example, the introduction of the brown tree snake has had a significant effect on *T. rotensis* on Guam by decimating the forest bird population. The brown tree snakes directly predate upon forest birds, which serve as important pollinators and seed dispersers for plants like *T. rotensis* (Egerer, et al. 2018, p. 655). Therefore these plants, which depend on birds for dispersal, are no longer being moved. Instead, the seeds fall directly from the parent tree and sprout beneath, but the high density of seedlings creating intense competition, which leads to almost complete mortality (Rogers, et al. 2017, p. 2; Egerer, et al. 2018, pp. 655-656).

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive plants pose a significant threat to *Tabernaemontana rotensis*. Nonnative plants are known to degrade native habitat in the Mariana Islands by: (1) modifying the availability of light through alterations in the canopy structure; (2) altering soil-water regimes; (3) modifying nutrient cycling; (4) altering the fire regime affecting native plant communities; and (5) ultimately converting native-dominated plant communities to nonnative plant communities (USFWS 2015, p. 59456). In

2004, more than one third of all trees on Rota were infested with invasive vines such as *Antigonon leptopus* (chain of hearts) and *Coccinia grandis* (ivy or scarlet gourd) (Liske-Clark 2015, entire; USFWS 2015, p. 59456). These vines can grow into dense patches that eventually smother and kill host trees by blocking out sunlight. Invasive vines also reduce light availability under the canopy, affecting understory plant species composition and the rate of forest regeneration (Willsey, et al. 2019, p. 17). The colonization of nonnative plants into the native forests has led to the establishment of secondary mixed forests, currently found on large portions of Guam, which threatens the resilience and redundancy of native forests (Willsey, et al. 2019, p. 17).

Habitat destruction and modification by fire— Although forest fires are rare in the tropics due to the high relative humidity, the forests in southern Guam and Rota Sabana are adjacent to the savanna/grasslands where wildfires occur almost every dry season. Approximately 80 percent of these wildfires are anthropogenically influenced (USFWS 2015, p. 59457). Local hunters intentionally set fires to clear sightlines and draw pigs and deer into the open. Farmers also set fires to clear their fields and some homeowners burn grasslands to create firebreaks (National Park Service 2019, p. 2). Other potential wildfire sources include military activities such as live-fire training. More information on impacts from wildfires is discussed in "Mariana Islands Forest" (Willsey et al. 2019, p. 18).

Fire can destroy dormant seeds of native species as well as plants themselves. As the remaining forests lose more canopy cover from the fire, the increased sunlight produces higher ambient temperature and lower air moisture levels, affecting the health of *Tabernaemontana rotensis*. Moreover, as the forest becomes more fragmented, the elevated ambient temperature, and decrease in moisture, can make the forest more susceptible to future wildfires. While native woody plants may eventually recover to some degree, fire shifts the competitive balance toward alien species (Cuddihy and Stone 1990, p. 93). A common invader of post-wildfire areas are grasses which provides fuels that allow fire to burn areas that would not otherwise easily burn (Cuddihy and Stone 1990, p. 93). Thus, the combination of fires and invasive species creates an endless cycle of destructive habitat destruction that contributes to the decline of *T. rotensis*.

Habitat destruction and modification by typhoons— Catastrophic events such as typhoons have the ability to directly alter or destroy the habitat and can also result in the direct loss of *Tabernaemontana rotensis.* With an annual average of 26 named tropical cyclones between 1951 and 2010, typhoons and super typhoons pose a major risk to forest habitat in the Marianas (USFWS 2015, p. 59458). Intense winds can defoliate trees,

break primary branches, and uproot or topple trees. These winds can also open the native canopy, thus modifying the availability of light, and creating disturbed areas conducive to invasion by nonnative plants and animals. “Dry” typhoons pose a slightly different threat. These typhoons have very little rainfall, causing salt water to be carried by the wind and deposited inland. The excess salt causes the leaves on most dicot trees to wither and fall within days of a storm and can cause mortality (Kerr 2000, p. 895). Although native plants like *T. rotensis* have evolved with typhoons, when species have become greatly reduced in numbers or distribution due to other factors, even a natural disturbance can constitute a significant threat, and can result in local extirpation.

Habitat destruction and modification by climate change— Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g. habitat fragmentation (IPCC 2007, pp. 8-14, 19; USFWS 2015, p. 59458). While it is undoubtable that climate change will affect the plants and animals of the Mariana Islands in some way, there are currently no climate change studies that address impacts specific to the Mariana Island ecosystems related to *Tabernaemontana rotensis*. There are however, climate change studies that address potential changes in the tropical Pacific on a broader scale. Based on the best available information, climate change impacts to *T. rotensis* are likely to be the result of but not limited to, increases in tropical cyclone frequency and intensity, weather regime changes (e.g. droughts, floods) and increases in annual average temperatures.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):
Not a threat.

2.3.2.3 Disease or predation (Factor C):
Vertebrate and Invertebrate Herbivory – The isolation of the Mariana Islands allowed plant species to evolve without defenses such as secondary metabolites and species, making them highly susceptible to herbivory by browsing and grazing animals (Bowen and Van Vuren 1997, p. 1249; Wiles et al. 1999, p. 194; USFWS 2015, p. 59453). Rodents can damage plant propagules, seedlings, and native trees by eating fleshy fruits, seeds, flowers, stems, leaves, roots, and other plant parts (Cuddihy and Stone 1990 p. 67; Atkinson and Atkinson 2000, pp. 23-26). In 2013, green caterpillars were observed effectively defoliating *Tabernaemontana rotensis* plants along the Ritidian cliffline, and other invertebrates, such as the Oleander hawk-moth (*Daphnis nerii),* also may defoliate young saplings (Gurevitch, et al. 2006, entire; Gutierrez, 2017, in litt.; USFWS

2017a, p. 105). Mealy bugs and scale insects have also been known to attack the lower surface of the leaves and fruits (UOG 2019, p. 2).

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):
Tabernaemontana rotensis has been recognized as a species of greatest need by the Guam Division of Aquatics and Wildlife Resources (GDAWR) but has not been recognized as an endangered species in the Endangered Species Act (ESA) of Guam or the CNMI. In addition, besides work regarding the brown tree snake, regulations surrounding the introduction, control, and eradication of other invasive species are lacking. Therefore, existing regulatory mechanisms in both Guam and the CNMI are inadequate to address threats to *T. rotensis* imposed upon the species.

2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):
Ordnance and Live Fire Training— Ordnance and live-fire training were identified as threats to *Tabernaemontana rotensis.* A large population of this species was found near the Northwest Field of Andersen Air Force Base where a live-fire training range complex is currently being constructed as part of the Marine Corps Relocation project. This project may cause damage to individuals outside of the ranges or there is the potential for ordnance to cause fires in the area (USFWS 2015, p. 59426, 59449, 59469-59470).

Current Management Actions:

- Life History and Reproductive Biology Research—Marler et al. (2015, p. 1051) studied short-term seed storage, germination, and early seeding growth of *T. rotensis* which are critical for prescribing optimal nursery protocols to produce plants for use in species recovery efforts.
- Reintroduction and translocation—In 2012, the Guam Plant Extinction Prevention Program (GPEPP) was formed to address conservation concerns for a select group of native Mariana Islands plant species; *Tabernaemontana rotensis* is listed as one of the species that GPEPP is working on. GPEPP's main objectives are monitoring, collecting, surveying, managing, and preserving genetic material. They work with conservation partners to protect wild populations and reintroduce plants to their natural habitat (GPEPP 2014, in litt.). As of May of 2019, GPEPP has propagated 160 individuals of *T. rotensis* in the GPEPP's nursery and translocated 114 of these individuals in various locations: 14 at Inarajan; 20 near the University of Guam Marine Lab; 16 in Yigo OP1; 35 in Yigo OP2; 31 in Yigo OP4; and 12 at the Guam National Wildlife Refuge (GPEPP 2015, in litt.; L. Gutierrez Service, 2016, pers. comm.; GPEPP 2019a, in litt.). Between August 2014 and July 2015, seed storage laboratory activities focused on viability (or germination) of *T. rotensis* (GPEPP 2015, in litt.).
- Ungulate control—

- Rota's Department of Fish and Wildlife constructed exclosures for two occurrences of *T. rotensis* in the Sabana Conservation Area; only one exclosure remains as the other burned in a fire (Hess and Pratt 2006, p. 33). *T. rotensis* was translocated across the island of Rota; the 30 surviving individuals range 4.3 to 23 ft (1.3 to 7 m) (USFWS 2015, p.59438).
- There are also a number of ungulate proof fencing areas around Guam notably in and around AAFB. These include 161 acres (ac) (65 hectares (ha)) of the Habitat Management Unit (HMU) (BTS TWG 2015, entire), approximately 4,400 ft (1,341 m) of coated chain link fence along Route 2A on the perimeter of NBG as an ungulate exclosure for the 3114 ac (1,260 ha) of the main base, a 81.5 ac (33 ha) ungulate exclusion area at Naval Magazine (DoN 2018, *in litt*) and in Area 50, a 59 ac (24 ha) exclosure was created to exclude ungulates and the BTS (Hess and Pratt 2006, pp. 5, 32-33).While the current state of these particular fences are unknown, several fencing projects were outlined in the Ungulate Management Plan of Andersen Air Force Base in 2012 where the majority of *T. rotensis* individuals are located (DoD 2012, p. 33-42). Ungulate proof fencing have also been installed within the Guam National Wildlife Refuge on the Northeast side of Guam near Ritidian Point (USFWS 2013, p. 2).

- Brown Tree Snake Control—The Department of Agriculture, Wildlife Services, in coordination with the National Wildlife Research Center (NWRC), U.S. DoD Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs (U.S. Geological Survey, USFWS), are using variety of control methods for BTS around Guam including fencing, detector dogs, bait and trap, and other chemical methods including the aerial applications of acetaminophen to suppress brown tree snakes over forested areas in AAFB (Phillips 2014, in litt*;* BTS TWG 2015, entire; Dorr et al. 2016, entire; Clark et al. 2018). In addition, repeated and sustained applications could drastically reduce brown tree snake abundance on a landscape scale (Siers, et al. 2018*,* p. 1). This significant development makes reintroduction of the extirpated avian species a real possibility on Guam. Several fences to exclude ungulates and brown tree snakes were installed by the DoD. These include approximately 161 acres (ac) (65 hectares (ha)) of the Habitat Management Unit (HMU) (BTS TWG 2015, entire), approximately 4,400 ft (1,341 m) of coated chain link fence along Route 2A on the perimeter of Naval Base Guam as an ungulate exclosure for the 3114 ac (1,260 ha) of the main base, a 81.5 ac (33 ha) ungulate exclusion area at Naval Magazine (DoN 2018, in litt) and in Area 50, a 59 ac (24 ha) exclosure was created to exclude ungulates and the brown tree snake (Hess and Pratt 2006, pp. 5, 32-33). Several individuals of the *T. rotensis* individuals occur within this enclosure. A check of fences in 2006found the enclosure in a state of neglect, and invaded by nonnative plant species and pigs

(Hess and Pratt 2006, p. 27). The current state of these exact fences are unknown. There are also BTS control efforts including baiting, trapping, and fencing within the Guam National Wildlife Refuge (USFWS 2013, p. 2). In June 2020, the Department of the Interior announced the release of $3,442,389 in fiscal year 2020 grant funding to suppress and control the BTS (DOI 2020, entire).

- Biosecurity prevention—
    - A major biosecurity focus within the Mariana Islands is preventing the spread of brown tree snake to the CNMI from Guam. Federal agencies support local capacity both in Guam and the CNMI. Efforts include inspection of all arriving cargo from Guam to the CNMI by brown tree snake detection dogs as well as specialized trapping around all major ports of entry (DoD 2010, p. 10-7; Dorr et al. 2016, p. 20).
    - *Tabernaemontana rotensis* has been recognized as a species of greatest need by the Guam Division of Aquatics and Wildlife Resources (GDAWR) but has not been recognized as an endangered species in the Endangered Species Act (ESA) of Guam or the CNMI.

Table 1. Status and trends of *Tabernaemontana rotensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2015 (listing)	21,000	0	All threats managed in all 3 locations	No
			Complete genetic storage	No
			3 locations with 25 mature individuals each	Yes
2020 (5-year review)	15,800 (including seedlings)	114 on Guam; 30 on Rota	All threats managed in 3 locations	No
			Complete genetic storage	Partial
			3locations with 25 mature individuals each	Yes

Table 2. Threats to *Tabernaemontana rotensis* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Human mediated habitat destruction and modification	A	Ongoing	Exclosures created on Rota; GPEPP translocations; Navy translocations and seed collections for populations that are destroyed during construction.
Ungulate degradation of habitat	A	Ongoing	Ungulate proof fencing around seveval locations that include *T. rotensis*: However, most have been found in a state of neglect.
Established ecosystem-altering invasive plant and animal modification and degradation of habitat	A	Ongoing	Brown tree snake control
Fire destruction and degradation of habitat	A	Ongoing	None
Habitat alteration and direct mortality from typhoons	A	Ongoing	None
Climate change	A	Ongoing	None
Herbivory and predation by rodents, caterpillars, mealy bugs, scale insects, and snails.	C	Ongoing	None
Lack of adequate regulations	D	Ongoing	Partial; some biosecurity efforts for BTS
Ordnance and Live Fire	E	Ongoing	None; however, range fire management plan in development

2.4 Synthesis

There are approximately 15,341 naturally occurring individuals (including seedlings) of *Tabernaemontana rotensis* in 8 populations on Guam and 6 locations Rota, but the vast majority (14,993 individuals, including seedlings) are in a single population, and there are only 9 individuals total known on Rota. This number includes seedlings, immature, and mature plants. This is An approximate decline of 5,000 individuals from what was reported at the time of listing. However, it is unknown whether some of the historic populations were lost or simply not surveyed. Overall the primary threats to *T. rotensis* are: (1) habitat degradation, destruction, and modification due to urban development and other associated anthropogenic activities (e.g. fire, military activities) (2) predation,

competition, and habitat degradation by non-native plants and animals (including the loss of pollinators from brown tree snake predation), (3) climate change, and (4) lack of population representation, resiliency, and redundancy due to its apparent low abundance. Some current conservation work such as reintroductions and translocations by GPEPP, genetic banking, ungulate and BTS control, and other biosecurity prevention efforts have aided in the effort to meet these recovery goals.

Preventing extinction, interim stabilization, downlisting, and delisting objectives are provided in HPPRCC's Revised Recovery Objective Guidelines (2011). To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations 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 Guam and Rota where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, or saplings) with a minimum of 25 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. Although there are three populations of 25 mature individuals each, 98% of the known individuals are in a single population, which makes species extremely vulnerable to disease and other catastrophic events. In addition, most of the other locations consists of <10 individuals and the nine naturally occurring trees on Rota are scattered throughout the island. Small populations are extremely vulnerable to reduced reproductive success caused by the loss of genetic variation over time due to random genetic drift, which results in a decreased evolutionary potential and ability to cope with environmental change (Lande 1988, p. 1455). Since there is only partial genetic representation (Table 1) and not all threats are being sufficiently managed throughout the range of the species (Table 2), *Tabernaemontana rotensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

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

- Surveys and inventories—Continue to conduct surveys for *Tabernaemontana rotensis* in historical locations and any potentially suitable habitat.
- Fire control—Identify *T. rotensis* populations at risk from wildfires and develop appropriate mitigation strategies.
- Ungulate monitoring and control—Construct and maintain fenced exclosures to protect suitable habitat from the negative impacts of feral ungulates.
- Invasive species monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *T. rotensis* in suitable and historical habitat. This includes brown tree snake control.
- Return pollinators —Facilitate the return and translocation of suitable pollinators to populations of *T. rotensis* in an effort to create and maintain self-sustaining populations.
- Plant propagation and translocation—Collect seeds in an effort to maintain the full genetic diversity of *T. rotensis*. Continue efforts to propagate, translocate, and monitor outplanted *T. rotensis*. Efforts should focus on bolstering the smaller sized populations. Seed banks may also serve as a safeguard in the event of extirpation from a catastrophic event like a typhoon.
- Ordnance and Live Fire Control—Work with DoD to identify vulnerable areas to protect *T. rotensis* from damage.
- Climate change planning—Develop a plan for species recovery that accounts for climate change.
- Regulatory mechanisms—Recognize *T. rotensis* in the ESA of Guam and the CNMI. Implement more protective measures and policies regarding *T. rotensis*.
- Alliance and partnership development—Contribute to planning and implementation of ecosystem-level restoration and management to benefit this taxon.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Tabernaemontana rotensis*

Current Classification: Endangered

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:
Caitlin Shishido, Fish and Wildlife Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

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