

Tinospora homosepala

**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: *Tinospora homosepala*

TABLE OF CONTENTS

1.0 GENERAL INFORMATION	1
1.1 Reviewers (list primary reviewers of species information below)	1
1.2 Methodology used to complete the review:.....	1
1.3 Background:	1
2.0 REVIEW ANALYSIS.....	2
2.1 Application of the 1996 Distinct Population Segment (DPS) policy.....	2
2.2 Recovery Criteria.....	3
2.3 Updated Information and Current Species Status	6
2.4 Synthesis.....	Error! Bookmark not defined.
3.0 RESULTS	14
3.1 Recommended Classification:.....	14
3.2 New Recovery Priority Number (indicate if no change; see Appendix E):	14
3.3 Listing and Reclassification Priority Number, if reclassification is recommended (see Appendix E)	14
4.0 RECOMMENDATIONS FOR FUTURE ACTIONS.....	15
5.0 REFERENCES -	16

5-YEAR REVIEW

Tinospora homosepala

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Dawn Bruns, Biologist, PIFWO
Jacqueline Flores, Mariana Islands Team Manager, PIFWO
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Lead Regional Office

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Lead Field Office:

Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai'i

Cooperating Field Office(s): N/A

Cooperating Regional Office(s): N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (USFWS), beginning in January 2020. The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations by the USFWS, Territory of Guam and the Commonwealth of the Northern Mariana Islands (CNMI) and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information since the listing of *Tinospora homosepala* (USFWS 2015). The evaluation by Ferdinand Galsim, Biologist, and Dawn Bruns, Biologist, was reviewed by Jacqueline Flores, Mariana Islands Team Manager, Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

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

1.3.1 FR Notice citation announcing initiation of this review:

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 83(88): 20088–20092, May 7, 2018.

1.3.2 Listing history

Original Listing

FR notice: U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia; Final Rule. Department of the Interior, Federal Register 80 (190): 59424-59497.

Date listed: October 1, 2015

Entity listed: *Tinospora homosepala*

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 *Tinospora homosepala*. This species was listed endangered on October 1, 2015 (80 FR 59424, USFWS 2015).

1.3.5 Species' Recovery Priority Number at start of this 5-year review: 2

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery outline for 23 Mariana Island species.

Date issued: February 3, 2020.

Dates of previous revisions, if applicable: N/A

Critical habitat has not been designated for this species. The draft recovery plan for this species is in preparation.

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? N/A

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? N/A

Yes
 No

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

Yes
 No

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

Yes
 No

2.2 Recovery Criteria

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

Yes
 No

2.2.2 Adequacy of recovery criteria.

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

Yes
 No

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

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

The recovery plan for this species is currently in preparation. A synthesis of the threats (Listing Factors A, D, and E) affecting this species is presented in section 2.3.2 and Table 1. Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) and C (predation and disease) are not currently known to be a threat to this species.

The Hawai'i and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and goals for stages leading towards recovery (HPPRCC 2011). These stages are described below. Current information is lacking for many Mariana Island plant species on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. Many of the plant species in the Mariana Islands are at very low numbers or are declining rapidly, so the USFWS 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 USFWS 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 (dioecious 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, Downlisting, and Delisting objectives. 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.

Tinospora homosepala is a short-lived, dioecious perennial vine. To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (e.g., fenced and free of pests) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections that are secure and well managed. In addition, a minimum of three populations should be documented 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 100 mature individuals per population.

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

Interim Stabilization

In addition to meeting the Preventing Extinction goals, to meet the interim stage of recovery of *Tinospora homosepala*, 600 mature, reproducing individuals are needed in each of three populations, and threats are controlled around each population designated for recovery at this stage. There should also be demonstrated regeneration of seedlings, growth to maturity, and documented replacement regeneration within each of the populations. The populations are adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation's guidelines (Guerrant et al. 2004, entire) that is secure and well managed. Adequate monitoring is 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 preventing extinction and interim stabilization targets, there should be 5 to 10 populations with 1000 mature, reproducing individuals per population are stable, secure, and naturally reproducing for a minimum of 10

years. 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 1000 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:

Tinospora homosepala is a woody, climbing, short-lived perennial vine of the moonseed family (Menispermaceae). *Tinospora homosepala* is dioecious, with male and female flowers on separate plants (plants having either male or female flowers) (Costion & Lorence 2012, pp. 92-93; Stone 1970, p. 277). Its yellowish-green male unisexual flowers produce pollen, which is likely to be dispersed by insects. Although *T. homosepala* can be cloned from cuttings, vegetative reproduction has not been documented in the wild (GPEPP 2019; Stone 1970, p. 277).

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:

Tinospora homosepala is likely to have historically occurred on Guam's limestone cliffs and outcroppings prior to human contact. Currently, there are approximately a total of 30 reported individuals (all male) from three populations. Two of the populations have only one individual, and they are growing in undeveloped patches of vegetation near the capital city of Hagatna (USFWS 2019). The largest population (28 individuals) is growing on National Park Service (NPS) property at Asan beach (Gawel *et al.* 2013, in litt.).

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

Because *Tinospora homosepala* is dioecious and only 30 male plants and no female plants have been observed, there is no known sexual reproduction at this moment, greatly limiting the population from maintaining genetic diversity. The population is vulnerable to genetic drift and loss of genetic diversity as individuals die. Because *T. homosepala* can be propagated by cloning vegetative material (vines) to produce new root systems (GPEPP 2019, website; Stone 1970, p. 277), maintenance of current genetic diversity is possible.

2.3.1.4 Taxonomic classification or changes in nomenclature: NA

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.): No changes in the spatial distribution of the species. New populations and individuals have been detected within the species range as described in 2.3.1.2.

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

Tinospora homosepala is endemic to native limestone forest on Guam. The species is only found in central Guam. Historically, *T. homosepala* occurrence has not been reported in southern Guam where majority of the soils are volcanic and more acidic compared to generally alkaline and well drained limestone soils of the northern part of the island. The species occupy a relatively narrow habitat niche and often found in protected limestone forest habitat and requires a canopy for the vine to climb. It is likely that the species needs pollinators, seed dispersers, water availability consistent with native limestone forests, levels of sunlight consistent with the limestone karst forest edge habitat, limestone substrate, and relatively constant temperatures averaging 22.8°C to 30°C and range from 18 to 35 °C (66-95 °F). Along with a relatively constant temperature range, there are seasonal precipitation weather fluctuations, including a drier season from November

through June and a rainy season from July to October with an average 96 in (218 cm) of rain per year (Ohba 1994, pp. 13-16; Mueller-Dombois and Fosberg 1998, p. 241).

Native limestone forests are vulnerable to loss and degradation due to development, non-native animals, invasive plants, typhoons, and effects due to climate change such as increased typhoon frequency and intensity and loss of habitat due to changes in precipitation, hydrology, and temperature. Limestone forest contains a canopy dominated by native tree species which, in most areas, is not regenerating due to ungulate impacts to plant survival and reproduction, brown treesnake impacts to seed dispersal, and habitat loss due to agricultural and urban development. Native forest covers 17% of Guam. Refer to Willsey et al. (2019) for detailed information regarding the structure and composition of limestone forest habitat. The major loss of the native forest in the Marianas likely decreased the amount, distribution, and suitability of *Tinospora homosepala* habitat. Local experts (McConnell, 2019 in litt.) have indicated that lack of suitable habitat is one of the major challenges to this species conservation and rehabilitation.

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:

Tinospora homosepala only occurs in native limestone forested areas in central Guam. *T. homosepala* is therefore vulnerable to loss of its habitat due to development, non-native animals, invasive plants, typhoons, and effects due to climate change.

Agricultural, military training and urban development loss of degradation of habitat—Military, urban, residential, resort, and agricultural development have resulted in the permanent loss of native forest. Native vegetation on the Mariana Archipelago has undergone significant alteration because of past and present land use including ranching, agricultural development, military actions, and war (Ohba 1994, pp. 17, 28, 54–69; Mueller-Dombois and Fosberg 1998, p. 242; Berger et al. 2005, pp. 45, 105, 110, 218, 347, 350). More than 20% of the island of Guam is developed (Spies et al. 2019).

Brown Tree Snake destruction and degradation of habitat—The introduction of the brown treesnake (BTS; *Boiga irregularis*) poses a threat to the persistence of habitat needed for the recovery of *Tinospora homosepala*. The introduction of the brown treesnake to Guam in approximately 1949, has caused the extirpation of a large percentage of bird and small animal species and appears to be responsible for elimination of all or most of the species that disperse seeds and pollinate native plants on Guam (Rodda et al. 1997 p. 565-567, Fritts and Rodda 1998 pp. 115, 131, Savidge 1987 entire, Perry and Morton 1999, p. 137; Rodda and

Savidge 2007, p. 311; USFWS 2015). Almost three quarters of the native tree species on Guam were once dependent on birds to eat their fruits and disperse their seeds and germination of some tree species is reduced when the seed coat is not digested by passing through the gut of a bird (USFWS 2015). The only remaining native avian frugivore on Guam is the Micronesian starling (*Aplonis opaca*) (Pollock et al. 2019). On Saipan, the median dispersal distance modeled by Rehm et al. (2018, pp. 1, 5) for five bird species and 15 tree species was 184 feet (56 meters). In the absence of dispersal, seeds fall under the parent tree resulting in reduced connectivity between disjunct plants and reduced survival of seedlings due to conspecific competition (Nathan and Muller-Landau 2000). Loss of seed dispersers on Guam has resulted in reduced recruitment, altered spatial distribution of native tree species, reduced species richness, and reduced forest regeneration on Guam in comparison to the other islands (Rogers et al. 2017). Elimination of seed dispersers has cascading effects on other trophic levels, and can affect ecosystem stability (Perry and Morton 1999, p. 137; Fricke et al. 2017). The brown treesnake's elimination of native plant seed dispersers is an indirect threat that negatively impacts the habitat of *T. homosepala*.

Rodent destruction and degradation of habitat—Because rodents have caused declines or even the complete elimination of island plant species (Campbell and Atkinson 1999, in Atkinson and Atkinson 2000, p. 24), they may potentially pose a threat to the persistence of the native habitat needed by *Tinospora homosepala*. Rodents can alter species composition of forested areas by reducing plant regeneration by eating fleshy fruits, seeds, flowers, stems, leaves, roots, and other plant parts (Atkinson and Atkinson 2000, p. 23; Cuddihy and Stone 1990, p. 69). Three rat species are found throughout the Mariana Islands: the Polynesian rat (*Rattus exulans*), the Norway rat (*R. norvegicus*), and a putative new southeast Asian *Rattus* line, originally thought to be *R. diardii* (synonymous with *R. tanezumi*) (Kuroda 1938 in Wiewel et al. 2009, p. 208; Wiewel et al. 2009, pp. 210, 214–216). One or more of these rat species are present on all of the Mariana Islands where *T. homosepala* is found (Wiewel et al. 2009, pp. 205–222; Kessler 2011, p. 320). Where rodent populations are currently suppressed where the brown treesnake occurs, rodent threats are expected to increase as brown treesnake suppression is implemented. Degradation of forest habitat by rodents is a threat to recovery of *T. homosepala*.

Invasive invertebrates, such as ants are a potential threat to the habitat of *Tinospora homosepala*. Ants commonly occur in dense numbers on vegetation in the Mariana Islands (Schreiner and Nafus 1996, pp. 3-4). The habitat upon which *Tinospora homosepala* relies may not be able to persist where invasive ants occur in high numbers. Ant species such as the dwarf pedicel ants (*Tapinoma minutum*), tropical fire ants (*Solenopsis geminata*), white-footed ants (*Technomyrmex albipes*), bi-colored trailing ants (*Monomorium floricola*), and little fire ants (*Wasmannia auropunctata*) feed on vertebrate and invertebrate eggs, pupae, larvae, and adults (Wild 2014, p. 1). Several incipient populations of little fire ants occur on Guam and there is a potential for the little fire ant to be moved to

other locations on Guam and to other islands via the movement of green waste and potted plants. Invasive ant occurrence within proximity of populations of *T. homosepala* is likely to reduce the abundance of invertebrates and vertebrates and reduce the reproduction of native habitat plants that are pollinated or dispersed by animals (Willsey et al 2019).

Established ecosystem-altering invasive plant modification and degradation of habitat—The greatest risk posed by invasive plant species in the Marianas is aggressive displacement of native species. Invasive plants threaten the quality and availability of habitat for and can directly outcompete *Tinospora homosepala*. The native flora of the Mariana Islands consists of approximately 500 taxa, 10 percent of which are endemic to the Mariana Islands. Over 100 plant taxa have been introduced from elsewhere, and at least one third of these plants have become invasive (Stone 1970, pp. 18–21; Mueller-Dombois and Fosberg 1998, pp. 242–243, 249, 262–263; Costion and Lorence 2012, pp. 51–100). Invasive plant species are responsible for modifying the availability of light, altering soil-water regimes, modifying nutrient cycling, increasing wildfire threat to native plant communities, and ultimately converting native-dominated plant communities to non-native plant communities (Smith 1985, pp. 180–181 and 217–218; Cuddihy and Stone 1990, p. 74; D’Antonio and Vitousek 1992, p. 73; Ohba 1994, pp. 17, 28, 54–69; Vitousek et al. 1997, p. 6–9; Mueller-Dombois and Fosberg 1998, pp. 242–243, 249, 262–263; Berger et al. 2005, pp. 45, 105, 110, 218, 347, 350). Invasive vines can grow in dense patches that smother and kill native plants following typhoons by encroaching in areas where trees were defoliated or destroyed and covering areas which takes light and water resources needed for the recovery and regeneration of the forest (Marler, 2001, p. 264; Willsey, et al. 2019, p. 17). The colonization of invasive plants within native forests has led to the establishment of secondary forest currently found on Guam (Willsey, et al. 2019, p. 17).

Typhoons and climate change degradation or loss of habitat—The impacts of climate change on *Tinospora homosepala* are not well understood but climate change has had impacts in the tropical Pacific generally. Anticipated weather regime changes are likely to be one of the direct climate change impacts to *T. homosepala*. The Mariana Islands lie in the world's most prolific typhoon basin. Typhoons cause a number of impacts to native species and native ecosystems. Disturbed or destroyed vegetation due to typhoons modifies light availability and facilitates invasion by invasive plant species that compete for space, water, and nutrients, and alter basic soil hydrology and nutrient cycling processes (USFWS 2015, Wilsey et al. 2019). Climate change is expected to increase typhoon frequency and intensity, increase temperatures, and decrease precipitation, which can result in changes to the microclimate of a species (IPCC 2014, pp. 6–11). During typhoons, intense winds can defoliate trees, break primary branches, and uproot or topple trees. Forests can take several years to recover and during this time the habitat is susceptible to encroachment from invasive trees, shrubs, and vines (Marler 2001, p. 1). “Dry” typhoons have very little rainfall, causing salt

water to be carried by the wind and deposited far inland. This causes the leaves on most dicot trees to wither and fall within two days of a storm and can cause mortality (Kerr 2000, p. 895). Droughts and vegetation changes following typhoons can cause an increase in wildfires (Aydlett 2017, in litt.). Such changes may lead to the direct loss of *Tinospora homosepala* or habitat needed for its conservation. These threats can be particularly devastating to species that persist in limited numbers or distribution.

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

2.3.2.3 Disease or predation: NA

2.3.2.4 Inadequacy of existing regulatory mechanisms: Guam's Endangered Species Act does not recognize *Tinospora homosepala* as endangered. 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 imposed upon this species, especially loss of habitat due to development, non-native animals, invasive plants, typhoons, and effects due to climate change.

2.3.2.5 Other natural or manmade factors affecting its continued existence: *Tinospora homosepala* is vulnerable due to limited numbers and particularly at-risk because it is a dioecious plant with no known female plants remaining. Unless female plants are found, reproduction of this short-lived vine will be limited to vegetative reproduction by the 30 remaining male plants. Species with limited numbers have an increased likelihood of extinction due to demographic stochasticity, genetic drift, or other factors (Gilpin and Soule' 1986, pp. 24–34). The lack of genetic diversity resulting from such limited numbers reduces the species resiliency to persist in changing environments (Stebbins 1950, entire, Pimm et al 1988, p. 757).

2.3.3 Current Management Actions:

- Surveys and inventories –
 - The USFWS recommends all sites containing suitable habitat be surveyed for *Tinospora homosepala* prior to implementation of projects entailing vegetation or soil disturbance.
 - Joint Region Marianas (JRM) surveyed for ESA-listed species, including *T. homosepala*, at the Tarague Triangle, MSA Igloos, THAAD, and other projects to document locations and estimate population densities in sites that are proposed for ungulate exclusion and forest restoration (JRM 2019 and 2020).
- Captive propagation for genetic storage and reintroduction –
 - The Guam Plant Extinction Prevention Program (GPEPP) currently holds one *Tinospora homosepala* in their nursery (GPEPP 2018).

- Habitat protection –
 - A major biosecurity focus within the Mariana Islands is preventing the spread of BTS 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 BTS detection dogs as well as specialized trapping around all major ports of entry. 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 aerial applications of acetaminophen to suppress BTS over forested areas in AAFB (Dorr, et al. 2016, in litt.; Phillips 2014, in litt; BTSTWG 2015, entire). In addition, repeated and sustained applications could drastically reduce BTS abundance on a landscape scale (Siers, et al. 2018, in litt.).
 - An island-wide Habitat Conservation Plan for Guam, that would provide a collaborative and comprehensive approach to endangered species conservation on non-federal lands, is beginning to be developed (USFWS 2020).
 - A 2020 Memorandum of Understanding between JRM and the USFWS outlined a mutual understanding regarding the intentions and future considerations of a Department of Defense Readiness and Environmental Protection Integration Initiative (REPI) to address conservation of upland vegetation communities (DON and USFWS 2020).
 - *Tinospora homosepala* is known to occur on one of the National Park units located near Asan, Guam, where the occupied area is not likely to be exposed to development.
 - Suitable habitat for *Tinospora homosepala* occurs at the Guam National Wildlife Refuge (NWR), Ritidian unit. Although *T. homosepala* is not known to occur at Ritidian Point, the Refuge unit receives some protections from invasive animals and plants, so if *Tinospora homosepala* were propagated and planted there, the conservation status of the species may be improved.

Table 1. Status and trend of *Tinospora homosepala* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2015 (listing)	30 male plants	0	All threats managed in three populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
2020	30 male plants	0	All threats managed in three populations	No
			Complete genetic storage	Limited; one wild plant secured
			3 populations with 100 mature reproducing individuals each	No

Table 2. Threats to *Tinospora homosepala* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Agricultural, military training and urban development loss of degradation of habitat	A	Ongoing	Partial. Efforts to assure conservation of native limestone forest initiated: preparation of HCP, REPI habitat protections
BTS degradation of habitat	A	Ongoing	DoD, USGS, USDA-APHIS, DOI, USFWS, and local collaborations to develop and implement brown treesnake control measures.
Rodent degradation of habitat	A	Ongoing	None
Ecosystem altering invasive plant species degradation of habitat	A	Ongoing	None
Typhoons and climate change degradation or loss of habitat	A	Ongoing	None
Inadequate existing regulatory mechanisms	D	Ongoing	None
Limited Numbers	E	Ongoing	None

2.4 Synthesis

There are only three known populations of *Tinospora homosepala* with an estimated overall population size of 30 individuals that are suspected to all be male. None of the three populations of *T. homosepala* are protected from ungulates or other threats to individual plants and their habitat. Only one plant is in genetic storage in the GPEPP nursery.

We assess the status of *Tinospora homosepala* in relation to Preventing Extinction, Interim Stabilization, and Delisting recovery objective guidelines developed by the Hawai‘i and Pacific Plants Recovery Coordinating Committee (HPPRCC 2011). Life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), are included in the calculation of the number of populations and reproducing individuals needed to meet each recovery 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.

Tinospora homosepala is a dioecious short-lived perennial vine. 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 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 with a minimum of 100 mature individuals per population should occur and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings).

The preventing extinction goals for this species have not been met. There are no populations with 100 individuals, the largest population has 30 individuals. Reproduction is limited as no female individuals have been observed. Genetic storage goals have not been met (Table 1), and threats to the three populations are not being controlled (Table 2). Therefore, *Tinospora homosepala* 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 (Indicate reasons for delisting per 50 CFR 424.11)
- No change is needed

3.2 New Recovery Priority Number, N/A

Brief Rationale:

3.3 Listing and Reclassification Priority Number, N/A

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

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Determine population status, current distribution, and availability of sites for plant conservation—Determine the distribution and number of all individuals on each island. Assess the availability of sites for long-term conservation of plant populations. Assess the status and threats to each population to inform prioritization of conservation effort.
- Conduct research to clarify life history information and reproduction within populations
- Conduct research to determine the best way to control the brown treesnake, rodents, and invasive invertebrates. Assess development and land designation and zoning threats to conservation of habitat needed for recovery.
- Ungulate monitoring and control—Construct and maintain fenced exclosures to protect wild and reintroduced individuals from the negative impacts of feral ungulates.
- Invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *Tinospora homosepala* at all populations.
- Captive propagation for genetic storage and reintroduction—Continue to collect propagative materials for storage and reintroduction.
- Reintroduction and translocation—Develop populations via reintroductions to suitable sites and increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of disturbance.
- Develop regulations and policy essential to recover the species and their habitats—Encourage the development of legislation to ensure protection of the listed species under Commonwealth or Territorial law. Develop and support the implementation of biosecurity plans to prevent the influx of new pests and invasive species into the Territory and inter-island movement of pests and invasive species
- Alliance and partnership development—Continue to 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 *Tinospora homosepala*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

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FIELD OFFICE APPROVAL:

for _____ Date _____
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