# Guam Tree Snail
*(Partula radiolata)*

## 5-Year Review
## Summary and Evaluation

**U.S. Fish and Wildlife Service**
**Pacific Islands Fish and Wildlife Office**
**Honolulu, HI**

# 5-YEAR REVIEW
# Guam tree snail/*Partula radiolata*

## 1.0 GENERAL INFORMATION

### 1.1 Reviewers

Toni Mizerek, Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

**Lead Regional or Headquarters Office**
Region 12, Endangered Species Program, Division of Recovery, (503) 231–6868

**Lead Field Office** Pacific Islands Fish and Wildlife Office, 808-792-9400

### 1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning 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 The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations by the USFWS, Territory of Guam and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation completed by Toni Mizerek, Biologist, was reviewed by John Vetter, Animal 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. 2015. 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**: [USFWS] 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, October 1, 2015.

Original Listing
**FR notice** FR 80(190), 59424-59497
**Date listed:** October 1, 2015
**Entity listed:** *Partula radiolata*
**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 this species. The Guam tree snail is a tree snail that was listed as endangered on October 1, 2015 (USFWS 2015). Critical habitat was not designated for this species. The draft recovery plan for this species is in preparation.

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

5

### 1.3.6 Current Recovery Plan or Outline

**Name of plan or outline**: Recovery Outline for 23 Mariana Island Species
**Date issued**: Feb 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[1] containing objective, measurable criteria?**

____ ***Yes***
_*x*__ ***No***

[1] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion.

### 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 criteria?**

____ ***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**
N/A

## 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**:
The Guam tree snail is a member of the Partulidae family that is endemic to Guam. Relatively little is known about the biology and life history of the Guam tree snail. Information about the basic requirements, reproductive output, survival rates, longevity, and feeding behavior is needed. Generally, the Guam tree snail needs cool, shaded forest habitat with high humidity and reduced air movement that prevents excessive water loss. The snails do not appear to require specific host plants, but can be found on many different species of large-leaved plants (trees, shrubs, herbaceous plants, and even ferns), both native and introduced. They need live and decaying plant material, as their diet consists of fungi and microalgae.

Partulidae are relatively slow-growing, long-lived and slow-reproducing land snails (Cowie 1992). Partulids are simultaneous hermaphrodites, meaning they have both male and female reproductive organs, which are functional at the same time. Like most land snails, partulids appear to be predominantly out-breeding hermaphrodites, in other words breeding occurs between unrelated individuals (Tompa 1984).

**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**:
Surveys and records of Guam tree snail have fluctuated across the island for the past century. In 1920, the Guam tree snail was recorded at 37 of 39 locations

(Crampton 1925). In 1989, 16 of 47 sites (including most from Crampton 1920) were occupied by the Guam tree snail (Hopper and Smith 1992). In 2015, at the time of listing, no more than 26 populations of the Guam tree snail were reported on the island (USFWS 2015). Since that time, new surveys have identified more than 50 populations. However, the number of individuals per location has rarely, if ever, been reported and are typically anecdotal or referenced relative to other species or locations. The current populations across the island have between a few individuals and a few thousand individuals per population, though overall numbers have not been quantified.

Changes in number and location of sites occupied may reflect differences of survey effort or differences in definition of population and may not represent changes in abundance. The Service defines Guam tree snail populations based on their geographical regions. Populations are separated by geographical barriers, such as cliffs, and by habitat fragmentation due to human development. Previous studies, particularly those in 1920 (Crampton 1925) and 1989 (Hopper and Smith 1992), as well as recent opportunistic surveys, may have defined populations differently. Therefore, systematic comparisons of abundance over time are not possible.

**2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)**:
The Guam tree snail was found to have low degree of genetic heterogeneity, and no patterns were found associated with colonies or geography, suggesting genetic redundancy across populations (Lindstrom and Benedict 2014).

**2.3.1.4 Taxonomic classification or changes in nomenclature**:
The first *Partula* species were collected by Jean-René Constant Quoy and Joseph Paul Gaimard during the *Freycinet* expedition in 1819 (Kerr 2013). The Guam tree snail was collected by Quoy and Gaimard during the 1828 *Astroble* expedition, as there are descriptions of a variety of *Partula gibba* which were later identified as *P. radiolata* (Crampton 1925). However, the Guam tree snail was not described until 1846 by Pfeiffer. In Pfeiffer's original account the Guam tree snail was mistakenly described as being from the island of New Ireland in the Bismarck Archipelago (Crampton 1925).

**2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.)**:
The most extensive study of Guam tree snails nearly a century ago focused on the ecology, distribution and variation between partulid species in the Mariana Islands (Crampton 1925). Crampton suggested that this species occurred almost everywhere on the island where suitable vegetation was present. A resurvey approximately 70 years later found that Guam tree snails were no longer in many sites where the species had previously been found (Hopper and Smith 1992). In

this study, 16 of the 47 sites surveyed, which included some areas not previously surveyed, were occupied by the Guam tree snail. At some sites, only the Guam tree snail was present, while at other sites other partulid species co-occurred (Hopper and Smith 1992). Currently, the Guam tree snail is distributed across Guam, potentially in more than 50 locations, but its local presence has likely fluctuated in specific locations over the past century (Crampton 1925; Hopper and Smith 1992; Lindstrom and Benedict 2014; Fiedler unpublished data)

**2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)**:
The Guam tree snail needs cool, shaded forest habitat with high humidity and reduced air movement that prevents excessive water loss. Stability of environmental factors (temperature, relative humidity and light) are critical factors for juvenile survival. Excess light and unstable temperatures and humidity had detrimental impacts on the survival of juvenile Guam tree snails bred in captivity (Gouveia 2011). The snails do not appear to require specific host plants. Where they occur they can be found on many different species of large-leaved plants (trees, shrubs, herbaceous plants, and even ferns) both native and introduced.

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

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

The Guam tree snail habitat is altered by the following primary threats: development, military training and urbanization; non-native plants and animals; wildfire; typhoons and climate change.

Development, military training, urbanization – Developed land that is not available habitat for the Guam tree snail represents 23% of Guam (Spies *et al*. 2019). Ongoing military training also contributes to reduced available or less suitable habitat, primarily with the establishment of Marine Corps Base Blaz (USFWS 2015). The buildup associated with establishing this Base will result in a loss of approximately 1,219 acres of limestone forest, 613 acres of herbaceous scrub and 3,221 acres of developed/barren land.

Habitat Destruction from non-native animals – Feral ungulates trample vegetation, contribute to erosion, graze often to the point of clearing understory vegetation and prevent regeneration by damaging or eating seeds or seedlings (USFWS 2015). Recent studies on Guam indicate that while pigs (*Sus scrofa*) and deer (*Cervus mariannus*) consume seed, pigs disperse many seeds while deer did not. Additionally, deer seem to have a disproportionate effect on seedlings compared to pigs (Gawel *et al*. 2018). Plant regeneration is also impacted by rats that eat fleshy fruits, seeds, flowers, stems, leaves, roots, and other plant parts

(USFWS 2015). The introduction of the brown tree snake (*Boiga irregularis*) to Guam resulted in the loss or severe reduction of native birds that dispersed native seeds or pollinated native plants (USFWS 2015).

Habitat modification from non-native plants – Non-native plants degrade native habitats through a variety of processes including modifying: light availability, soil-water regimes, nutrient cycling and fire regimes and converting the plant communities from native to non-native dominated (USFWS 2015). These conversions to non-native dominated communities often shift the micro-habitat conditions that tree snails are dependent upon.

Wildfire – Fire threatens native species and native ecosystems, particularly on Guam (USFWS 2015). As of February 2020, 396 wildfires burned approximately 9,421-acres of private, Government and Federal lands (6.9% total area burned island-wide), which is a 2% increase from the previous year (FSRD 2020).

Typhoons and Climate Change – 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 creates space for invasion by nonnative pest species and nonnative plant species that compete for space, water, and nutrients, and alter basic water and nutrient cycling processes (USFWS 2015). The impacts of climate change on the Guam tree snail 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 the Guam tree snail.

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

Overutilization – The collection of tree snail shells for trade or market was identified as a threat to the Guam tree snail. Given the history of collecting Pacific tree snails and current market for snail shells both from the Marianas and world-wide, overutilization is a threat to the species.

**2.3.2.3 Disease or predation:**

Predation by non-native invertebrates – Predation by the manokwari flatworm (*Platydemus manokwari*) is a threat to the Guam tree snail (USFWS 2015). This predator exists on Guam (Justine et al. 2014). There is also the potential for the aggressive little fire ant (*Wasmannia auropuncta*) to threaten this species on Guam; however, no studies have confirmed the little fire ant as a predator. Rats are also responsible for the extinctions of various snail species and prey upon Pacific island endemic arboreal snails (USFWS 2015).

**2.3.2.4 Inadequacy of existing regulatory mechanisms:**

Guam's Endangered Species Act recognized the Guam tree snail as locally endangered in 2009. However, existing regulatory mechanisms are inadequate to address threats imposed upon the species, especially development and the

manokwari flatworm predator. However, the Service and the Government of Guam's Division of Aquatic and Wildlife Resources (DAWR) meet regularly to improve coordinated efforts to protect endangered tree snails.

**2.3.2.5 Other natural or manmade factors affecting its continued existence:** Limited numbers - It is unknown whether the threat of low numbers to the Guam tree snail is as severe as the time of listing. Since 2015, additional opportunistic rather than systematic surveys across Guam have documented more than 50 populations in sizes ranges from a few individuals to a few thousand individuals. This species may be less likely than originally believed to experience inbreeding depression, reduced genetic variability, or extirpation due to a single catastrophic event or lack of resiliency to other threats because of few populations.

Intensive use of pesticides may negatively impact the Guam tree snail (DAWR 2019).

**2.3.3 Current Management Actions:**

- Surveys and inventories – Listed tree snail species, including the Guam tree snail are searched for in suitable habitat that may be cleared or degraded for various projects.
- Surveys and inventories – Joint Region Marianas surveyed for ESA-listed tree snails at the Naval Munitions Site (NMS) and Naval Base Guam Telecommunication Site. Surveys were conducted to document locations and estimate tree snail population densities in sites that are proposed for ungulate exclusion at NMS and at Haputo Ecological Reserve Area (ERA) (JRM 2019).
- Translocation – As part of the Marine Corps Relocation Biological Opinion, all Guam tree snails found within the Andersen South Complex project footprint that was to be cleared were translocated to three sites in the Haputo ERA. The 3,850 individuals were marked and monitored every two weeks for one year (DON 2020, in litt.).
- Habitat protection – An island-wide Habitat Conservation Plan for Guam that would provide a collaborative and comprehensive approach to endangered species conservation on non-federal lands in Guam is just beginning to be developed (USFWS 2020).
- Habitat protection – A 2020 Memorandum of Understanding between Joint Region Marianas (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 to address conservation of upland vegetation communities for the Guam tree snail as well as other federally listed species on Guam (DON and USFWS 2020).
- Habitat protection – A project to exclude deer and pigs from 165 acres of North Haputo ERA with ungulate fencing has been initiated (JRM 2019).
- Invasive species control – Surveys for little fire ant (LFA) have been conducted at: Andersen South, Andersen South Annex, Naval Munitions

Site, and Haputo trailhead on Naval Base Guam Telecommunication Site. Where LFA are detected, they are delimited, eradicated and monitored (JRM 2019).

- Adequacy of regulatory mechanisms – USFWS and DAWR meet regularly to address any inadequate regulatory mechanisms.

**Table 1: Status and trends of the Guam tree snail from listing through current 5-year review.**

| Date | Information Source | Estimated locations/ populations | Estimated Number | Population Trend |
|---|---|---|---|---|
| 1920 | Crampton 1925 | 37 of 39 sites occupied | "Considerable numbers, sometimes abundant and sometimes scarce" | Unknown* |
| 1989 | Hopper and Smith 1992 | 16 of 47 sites occupied | "Locally common, most abundant of partulids on Guam" | Unknown* |
| 2015 | USFWS 2015 | <26 colonies | Unknown | Continued decline |
| 2020 | Fiedler, unpublished data | >50 populations | Tens to thousands of individuals per population | Unknown* |

*Populations may have been defined differently so population trends cannot be determined by changes in estimated number of locations or populations over time.

**Table 2: Threats to the Guam tree snail and ongoing conservation efforts.**

| Threat | Listing Factor | Current Status | Conservation / Management Efforts |
|---|---|---|---|
| Development, military training, urbanization | A | Ongoing | Surveys at NMS and Haputo ERA, Translocation to Haputo ERA, best management practices applied to avoid impacts, development of HCP for Guam; Live Fire Training Range Complex Management Plan in development |
| Nonnative animals (ungulates) | A | Ongoing | Construction of fenced areas to exclude ungulates |
| Invasive plants | A | Ongoing | None |
| Wildfire | A | Potential | None |
| Typhoons and climate change | A | Ongoing | None |
| Overutilization | B | Potential | None |
| Predation by nonnative | C | Ongoing | None |

| | | | |
|---|---|---|---|
| vertebrates (rats) | | | |
| Predation by nonnative invertebrates (flatworm, little fire ant, predatory snail) | C | Ongoing | Surveys and control of LFA at DOD sites. |
| Inadequate existing regulatory mechanisms | D | Ongoing | Enhanced coordination between USFWS and DAWR |
| Reduced viability due to low numbers | E | Ongoing | Additional surveys are being conducted to determine if the threat remains |

**2.4 Synthesis** -

Downlisting and delisting criteria have not yet been established for this species.

There are populations of the Guam tree snail across many areas of Guam. The number of individuals per population is unknown, but likely ranges from a few individuals to some populations with over 1,000 individuals. It has repeatedly been reported that the Guam tree snail population is in decline (see Hopper and Smith 1992; Smith 2013, Lindstrom and Benedict 2014). However, there have not been systematic, repeated surveys to quantify changes in either population or abundance. Past surveys have differed on methodology and population definitions, making it difficult to compare efforts across years to determine trend.

Threats to the Guam tree snail remain serious. Habitat loss due to development and ungulate damage, as well as predation by the manokwari flatworm, are the most significant threats and remain far from being controlled. There have not been any methods found or even suggested to control the flatworm predator. Development continues on the island with sometimes inadequate oversight over natural resource protection, including the Guam tree snail, through regulatory mechanisms. Few ungulate exclusion areas have been established and others have only been proposed. Establishing ungulate-proof areas can take a significant amount of time and to see benefits to the ecological community within these ungulate-proof areas takes additional time. Thus, the Guam tree snail continues to meet the definition of endangered.

## 3.0 RESULTS

### 3.1 Recommended Classification:

**____ Downlist to Threatened**
**____ Uplist to Endangered**
**____ Delist**
**_x__ No change is needed**

### 3.2 New Recovery Priority Number: No change

### 3.3 Listing and Reclassification Priority Number: N/A

## 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS -

- Determine and establish recovery criteria in a recovery plan for the Guam tree snail.
- Expand the CNMI partulid snail working group to include Guam so that lessons learned are shared and adapted.
- Introduced predators – Survey for manokwari flatworm presence in suitable tree snail habitat. Research and develop methods for flatworm control. Implement control programs for the flatworm in areas where this species is known to or may occur.
- Identify other predators, quantify the impacts and implement control measures.
- Surveys and inventories – Determine the current population size, structure and distribution of the Guam tree snail. Establish long term monitoring sites to understand population trends locally and across the island.
- Captive breeding – Evaluate the feasibility of a captive breeding program for Mariana tree snails, including the Guam tree snail, to be able to restore the population (i.e. reintroduction and translocation) and eliminate any possible extinction throughout the range.
- Research – Perform dietary studies for the Guam tree snail, since it is the most common and widespread native tree snail on Guam, to determine whether microhabitats exist that might influence the species' distribution.
- Determine the degree of diversity within and between populations to assess the genetic connectivity amongst populations. Track individual snails using telemetry to determine their ability to disperse and their activity patterns.
- Determine if life history or behavior (e.g. faster maturation, higher fecundity, predator avoidance) contribute to the Guam tree snail's ability to persist in higher numbers relative to other partulids given the presence of the flatworm.
- Habitat degradation and loss- Control and monitor land clearing and prevent wildfires to preserve the native forest habitat for this species. Reforest native flora and control ungulates in the habitat in areas where snails are found to preserve forest structure.
- Plan and implement protection and enhancement of colonies as appropriate (i.e. ungulate/predator exclosures, rat trapping, and/or vegetation management).

## 5.0 REFERENCES -

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**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of *Partula radiolata***

**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**: N/A

**Review Conducted By**: Toni Mizerek, Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

**FIELD OFFICE APPROVAL**:

for MEGAN LAUT Digitally signed by MEGAN LAUT Date: 2020.08.06 11:24:13 -10'00' _____ Date _____

**Lead Field Supervisor, Fish and Wildlife Service**