Humped Tree Snail
(Partula gibba)

5-Year Review
Summary and Evaluation

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

5-YEAR REVIEW
Humped tree snail/*Partula gibba*

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, Portland Regional Office

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 The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations by the USFWS, Territory of Guam and the Commonwealth of the Northern Mariana Islands (CNMI) and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. 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.

FR notice FR 80(190), 59424-59497
Date listed: October 1, 2015
Entity listed *Partula gibba*
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 humped tree snail (*Partula gibba)* 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

8

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 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 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 humped tree snail is a member of the Partulidae family whose range includes Guam, Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan and Pagan. Relatively little is known about the biology and life history of the humped tree snail. Information about the basic requirements, reproductive output, survival rates, longevity, and feeding behavior is needed. Generally, the humped 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:
Humped tree snails have fluctuated in space and time across the islands the species has formerly occupied or currently does occupy for the past century. For example, on Guam in 1920, the humped tree snail was recorded at 32 of 38 locations and was identified as the most abundant of partulids in the Mariana Islands (Crampton 1925). In 1989, only one of 47 sites on Guam (including most of those surveyed by Crampton in 1920) were occupied by the humped tree snail (Hopper and Smith 1992). In 2015, at the time of listing, this was still the only site on Guam where the species was found and had no more than 150 individuals.

The number of individuals per location has rarely been reported and has typically been anecdotal or relative to other species or locations. For example, on Rota in the mid-1990s, the humped tree snail was identified as having drastically declined based on the large number of empty shells found at many sites (Bauman 1996).

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 USFWS defines tree snail populations based on their

geographical regions. Populations are separated by geographical barriers such as cliffs and 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.):
Genetic comparisons of the humped tree snail across multiple islands indicated that almost all individuals within a single population had one or few haplotypes per gene sequenced suggesting little genetic redundancy. The genetic diversity between populations is greater than that within. Additionally, the humped tree snail on Pagan had two colonization events, one of which came directly from Guam relatively recently. Also, even though the islands of Tinian and Sarigan are separated by approximately 200 km with Saipan and Anatahan in between, individuals on these two islands share a recent common ancestor. Finally, genetic data indicates that what was thought to be the humped tree snail on Rota is actually a separate species more closely related to the Guam tree snail (*Partula radiolata*) (Sischo and Hadfield 2017). Because this potentially distinct species on Rota has not yet been described and named, we are still treating the humped tree snail as a single species.

2.3.1.4 Taxonomic classification or changes in nomenclature:
Partula gibba was first collected by the naturalists of the Freycinet expedition of 1819 and described by Ferussac in 1821.

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 humped tree snails occurred nearly a century ago and focused on the ecology, distribution and the variation between all partulid species in the Mariana Islands (Crampton 1925). Since this original study, many sites have become urbanized or have undergone habitat degradation or fragmentation, negatively impacting the distribution of humped tree snails on each island (USFWS 2015). Surveys in the past century have fairly consistently recorded fewer sites occupied by the humped tree snail compared to any previous survey (Crampton 1925; Hopper and Smith 1992; Bauman 1996; Smith 2013; Hadfield 2015).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):
Humped tree snails need 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 humped tree snails bred in captivity (Gouveia 2011). The snails do not appear to require specific host plants. Many sites that the humped tree snail once occupied have been developed, or the habitat degraded, reducing the amount of available, suitable habitat for the species on most islands that is does or has occupied (USFWS 2015).

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:

Development, military training, urbanization – More than 20% of the islands of Saipan and Guam are developed, while approximately 6% of Tinian and Rota are developed (Spies et al. 2019). These are the more developed islands across the species' range, reducing the available habitat for the humped tree snail. 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 humped 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 humped 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 humped tree snail (USFWS 2015). Given the history of collecting Pacific tree snails and current market for snail shells both from the Marianas and world-wide, overutilization is still 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 humped tree snail (USFWS 2015). This predator exists on at least five of the Mariana Islands where the humped tree snail is currently or was historically found including: Guam, Saipan, Tinian, Rota and Aguiguan (Justine et al. 2014). There is also the potential for the aggressive little fire ant (*Wasmannia auropuncta*) to threaten this species on Guam or if it is introduced in the CNMI; 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 (ESA) recognized the humped tree snail as locally endangered in 2009. The CNMI ESA does not include the humped tree snail. However, the CNMI Division of Fish and Wildlife does identify the species as a species of greatest conservation need (Liske-Clark 2015). Regardless, existing regulatory mechanisms in both Guam and the CNMI are inadequate to address threats imposed upon the species, especially development and the manokwari flatworm predator. However, USFWS and the Division of Aquatic and Wildlife Resources (DAWR), Government of Guam 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 – The numbers of humped tree snails on most islands throughout the range are so low or they occur in such restricted ranges that they are, therefore, less resilient to disturbances, rendering them highly vulnerable (USFWS 2015).

Intensive use of pesticides may negatively impact the humped tree snail (DAWR

2019).

2.3.3 Current Management Actions:

- Surveys and inventories – Listed tree snail species, including the humped 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.
- 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 (REPI) to address conservation of upland vegetation communities for the humped tree snail, as well as other federally listed species on Guam (DON and USFWS 2020).
- Habitat protection – Deer and pigs will be excluded from 165 acres of North Haputo Ecological Reserve Area with ungulate fencing (USFWS 2017).
- Habitat protection – Sarigan Island has been set aside for the conservation of terrestrial wildlife in the CNMI. The island, which is owned by the Department of Public Lands, once had ungulates but they were eradicated in 1998 (Liske-Clark 2015).
- 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 – The CNMI government is establishing a working group that would support the development of an adaptive framework for managing extant populations of partulid snails across their ranges in the CNMI. Potential working group topics include recovery planning, colony monitoring, predator control, and other direct management strategies.

Table 1: Status and trends of the humped tree snail per island from listing through current 5-year review.

Island	Information Source	Estimated locations/ populations	Estimated Number	Population Trend

Guam	USFWS 2015	1	<150	Unknown
Rota	USFWS 2015	4	<600	Unknown
Aguiguan	Smith 2013	Unknown	Unknown	Possibly extirpated
Tinian	NAVFAC PAC 2014	2	92	Unknown
Saipan	Hadfield 2010	1	42	Unknown
Anatahan	Kessler 2011	Unknown	Unknown	Possibly extirpated due to volcanic eruptions
Sarigan	Hadfield 2010	In the thousands	abundant	Possibly increasing
Alamagan	Bourquin 2002	Unknown	Unknown	Unknown
Pagan	Hadfield 2010	Unknown	Unknown	Possibly extirpated

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

Threat	Listing Factor	Current Status	Conservation / Management Efforts
Development, military training, urbanization	A	Ongoing	Development of Guam HCP, REPI MOU
Nonnative animals (ungulates)	A	Ongoing	Ungulate fencing and eradication
Invasive plants	A	Ongoing	
Wildfire	A	Ongoing	None
Typhoons and climate change	A	Ongoing	None
Overutilization	B	Potential	None
Predation by nonnative vertebrates (rats)	C	Ongoing	None
Predation by nonnative invertebrates (flatworm, little fire ant, predatory snail)	C	Ongoing	Surveys and eradication
Inadequate existing regulatory mechanisms	D	Ongoing	CNMI establishing working group to address management actions; enhanced coordination between USFWS and DAWR

Reduced viability due to low numbers	E	Ongoing	None

2.4 Synthesis –

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

Populations of the humped tree snail are still known from at least five of the nine Mariana Islands where it had been recorded previously. 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 often been reported that the humped tree snail population is in decline, with the possible exception of Sarigan Island (see Crampton 1925; Hopper and Smith 1992; Bauman 1996; Kessler 2011; Smith 2013; Sischo and Hadfield 2017). 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 humped 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. Development continues on many of the islands that the humped tree snail currently occupies, especially Guam and Rota, with sometimes inadequate oversight over natural resource protection through regulatory mechanisms. Few ungulate exclusion areas have been established and others are only proposed. Establishing ungulate proof areas can take a significant amount of time and to see benefits to the ecological community within ungulate-proof areas takes additional time. Thus, the humped tree snail continues to meet the definition of endangered.

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: N/A

Brief Rationale:

3.3 Listing and Reclassification Priority Number, if reclassification is recommended 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 and establish recovery criteria in a recovery plan for the humped tree snail.
- Expand the CNMI partulid snail working group to include Guam to encompass the entirety of this species' range, 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, especially in areas where reintroduction may be warranted.
- Surveys and inventories – Determine the current population size, structure and distribution of the humped tree snail on each island within the species' current and historical range. 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 humped tree snail, to be able to restore the population (i.e. reintroduction and translocation) and eliminate any possible extinction throughout the range.
- Genetic Research – Genetic studies suggest that the humped tree snail on the island of Rota is a distinct species. To offer sufficient protection to the species, the species would need to be described and named. Molecular genetic analysis indicate that the Pagan populations of humped tree snails are significantly different than those on Guam, Saipan and Sarigan and should be prioritized for protection.
- Conduct research on individual snails using telemetry to determine their ability to disperse and their activity patterns.
- Develop a Habitat Suitability Index or other model to predict habitat suitability.
- 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 were snails are found will allow the required preservation of this species.
- 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 gibba*

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: 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: 2020.08.05 14:46:48 -10'00' _____ Date _____

Field Supervisor, Fish and Wildlife Service