

*Partulina semicarinata*  
(Lāna‘i tree snail)

**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: *Partulina semicarinata*  
(Lāna‘i tree snail)

**TABLE OF CONTENTS**

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers:.....	3
1.2	Methodology used to complete the review .....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>5</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy.....	5
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	17
<b>3.0</b>	<b>RESULTS</b> .....	<b>18</b>
3.1	Recommended Classification:.....	18
3.2	New Recovery Priority Number:.....	18
3.3	Listing and Reclassification Priority Number: .....	18
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>18</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>19</b>

**5-YEAR REVIEW**  
***Partulina semicarinata* (Lāna‘i tree snail)**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers:**

Diane Sether, Ph.D., Invertebrate and Wildlife Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)

John Vetter, Animal 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on the final rule listing this species; the final critical habitat designation; peer reviewed scientific publications; unpublished field observations by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information.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 completed by Diane Sether, Ph.D., Invertebrate and Wildlife 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. 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. 2013. Endangered and threatened wildlife and plants; determination of endangered status for 38 species on Molokai, Lanai, and Maui; final rule. Department of the Interior, Federal Register 78: 32014-32065, May 28, 2013.

**Date listed:** May 28, 2013

**Entity listed:** *Partulina semicarinata*

**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:

**FR notice:** [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; Final Rule. Federal Register 81: 17790-18110.

Critical habitat for the species was considered on Lāna‘i in the historical lowland wet forest, montane wet forest and wet cliff habitats, but was not designated as a consequence of exclusions under section 4(b)(2) of the Endangered Species Act (USFWS 2016). The decision to exclude Lāna‘i from critical habitat designation was based on landowner cooperation to conserve the species. Ownership of Lāna‘i is about 98 percent private and 2 percent by the State of Hawai‘i. As a result of the critical habitat exclusion, a Memorandum of Understanding was signed in 2015 between the Service, Pūlama Lāna‘i (Lāna‘i Resorts, LLC) and Castle & Cooke Properties, Inc. to work together to contribute to the conservation, protection and management of endangered plant species and Lāna‘i tree snail species on the island. Conservation of the Lāna‘i tree snails requires control of threats from nonnative plant and animal species, fire prevention, proactive construction of predator-proof enclosures, and translocation of species into their historical range where they no longer occur. Pūlama Lāna‘i cooperates with the Service, the State of Hawai‘i, and other organizations to implement voluntary conservation activities on their lands that result in conservation benefits to the tree snail species and its habitat.

### 1.3.4 Review History:

This is the first 5-year review for *Partulina semicarinata*.

**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 the Islands of Maui, Moloka'i, Kaho'olawe, and Lāna'i (Maui Nui).

**Date issued:** October 31, 2019

**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

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

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:**

The draft recovery plan that includes *Partulina semicarinata* is currently under review and is expected to be finalized in 2020.

## 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:**

*Partulina semicarinata*, a member of the family Achatinellidae and the endemic Hawaiian subfamily Achatinellinae, is known only from Lānaʻi (Pilsbry and Cooke 1912–1914b, p. 86). The oblong to ovate shells of adult *Partulina semicarinata* are 0.6 to 0.8 inches (in) (16 to 20 millimeters [mm]) long, have 5 to 7 whorls, and range in color from rusty brown to white, with some individuals having bands around the shells (Pilsbry and Cooke 1912-1914b, 83-86). The shell has a distinctive keel that runs along the last whorl, which is more distinctive in juvenile snails than it is in adults (Pilsbry and Cooke 1912-1914b, pp. 84-86). The shell may coil to the right (dextral) or the left (sinistral), and both types of shells can be found in a single population. Only snails with the same coil type can mate. *Partulina* tree snails reach adult size in 4 to 7 years. Upon reaching adult size, the snails stop growing and form a thickened edge or lip along the opening of the shell. A tree snail may attain an age that exceeds 15 years.

Lānaʻi tree snails are simultaneous hermaphrodites, meaning they have both male and female reproductive organs, which are functional at the same time. Hermaphroditism is a form of sexual reproduction in which the snail can act as the female or male during mating. The species is not known to self-fertilize. After mating, the Hawaiian tree snails can store sperm and may produce live young for a year or more without breeding

(Sischo 2019 in litt., entire). In the case of the closely related *Partulina redfieldi*, production of offspring by an isolated adult snail in captivity continued for 4 years (Kobayashi and Hadfield 1996, pp. 346, 351); birth rate and birth size remained constant and comparable with those estimated for field populations of this species (Hadfield 1986, pp. 330-332). Reproductive maturity for Lāna‘i tree snail is believed to be 4 to 7 years of age based on other *Partulina* species (Hadfield and Miller 1989, p. 10). *Partulina semicarinata* gives birth to live young about 0.18 in (4.5 mm) in size. Reproductive output is low with an adult snail giving birth to four to six live young per year (Hadfield and Miller 1989, pp. 5-7). *Partulina* spp. obtain adult size in 4 to 7 years (Hadfield *et al.* 1993, p. 620). The longevity of the Lāna‘i tree snail, based on other *Partulina* species, may be greater than 15 years (Hadfield and Miller 1989 p. 12).

The habitat of *Partulina semicarinata* includes the wet *Metrosideros polymorpha* (‘ōhi‘a) forests of the Mount Lāna‘ihale summit, the surrounding wet cliffs, and the lowland wet forest that extends below Lāna‘ihale (Pilsbry and Cooke 1912-1914b, pp. 83-87; Hadfield 1994b, entire; Hadfield 2005, entire). The montane wet ecosystem, where populations of *P. semicarinata* occur, is found at elevations ranging from 3,300 feet (ft) (1,000 meters [m]) up to the summit of Mount Lāna‘ihale at 3,660 ft (1,116 m), in areas where annual precipitation is greater than 75 in (190 centimeters [cm]). The wet cliff ecosystem is generally composed of shrublands on near vertical slopes (greater than 65 degrees). The wet cliffs provide suitable habitat for *Partulina semicarinata*, though surveys have not been conducted on the cliffs because of the access constraints of the terrain. The lowland wet ecosystem is generally found below 3,300 ft (1,000 m) elevation (Gagne and Cuddihy 1999, p. 85). This lowland habitat includes a variety of wet grasslands, shrublands, and forests that receive greater than 75 in (190 cm) annual precipitation. On Lāna‘i, this ecosystem is best developed in wet valleys and on slopes.

Distribution of *Partulina semicarinata* is correlated with habitat quality (Thacker and Hadfield 1998, p. 9). Cool, shaded forest habitat with high humidity and low air movement that prevents excessive water loss are critical factors. Adults can estivate to survive temporary drier periods but juveniles are vulnerable to desiccation because of the greater shell-surface to air ratio. *Partulina semicarinata* are found in a variety of native vegetation including *Broussaisia arguta* (kanawao), *Dicranopteris linearis* (uluhe fern), *Psychotria* spp. (kōpiko), *Coprosma* spp. (pilo), *Melicope* spp. (‘alani), *Scaevola* sp. (mountain naupaka), and dead *Cibotium glaucum* (hapu‘u fern), in addition to ‘ōhi‘a. The tree snails are frequently found on *Phormium tenax* (New Zealand flax) growing in wet soil or on bushy ‘ōhi‘a between 1.6 ft (0.5) and 9.8 ft (3 m) tall (Hadfield 1994b). Occasionally, *Partulina variabilis*, a sister species of *P. semicarinata*, is found on the nonnative species *Psidium guajava* (guava)

and *Cordyline australis* (ti) (Hadfield 1994b, p. 2), but it is unknown if *P. semicarinata* utilizes those hosts.

In general, tree snails subsist entirely by grazing throughout the night on microbes that live on the leaf and trunk surfaces of plants (Pilsbry and Cooke 1912–1914a, p. 103; O'Rorke et al. 2016, p. 177). This microbial ecosystem on the plant surfaces above the ground is called the phyllosphere and is comprised of a variety of microorganisms including fungi, algae, bacteria, protists, etc. The tree snails feed by scraping the surface they are on with their specialized radula. This does not appear to damage the plant host.

### **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:**

Historic populations of *Partulina semicarinata* were restricted to the wet 'ōhi'a forests on Lāna'i (Pilsbry and Cooke 1912–1914a, p. 103, Pilsbry and Cooke 1912–1914b, pp. 84-84). Snails were reported on the windward ridges above Wai'apa'a, behind Koele, and Lāna'ihale. In 1994, field surveys were conducted throughout the remaining native habitat in the historic range from 2,690-3,339 ft (820-1,018 m) in elevation (Hadfield 1994b, entire). The few remaining individuals were restricted to four small isolated populations with a total of 55 individuals observed (Hadfield 1994b, entire; Hadfield 2005, entire). Two of the sites supported only *P. semicarinata* and two sites supported both *P. semicarinata* and *P. variabilis*. Any one population did not appear to extend beyond a 16 x 16 ft (5 x 5 m) area of host plants (Hadfield 1994b, entire). The habitat of the populations was a mix of New Zealand flax, uluhe fern, mountain naupaka, and 'ōhi'a, kanawao, kōpiko, pilo, pelea, hapu'u fern, and guava (Hadfield 1994b, entire).

In 2005, Hadfield resurveyed the sites evaluated in 1994 and located three small isolated *Partulina semicarinata* populations with a total of 23 individuals observed (Hadfield 2005, entire). Two of the populations were at sites that supported *P. semicarinata* in 1994. *Partulina variabilis* was also found at one of these two sites. *Partulina semicarinata* had not been observed at the third site in 1994, but was now present in a mixed population with *P. variabilis*. *Partulina semicarinata* was not observed at two sites that had supported the species in 1994, suggesting the species had been extirpated at those sites. The number of snails observed does not represent a census of the population because of the cryptic nature of the snails.

From 2017-2019, surveys for *Partulina semicarinata* on Lāna'ihale identified three isolated populations. One of those populations was small

at the time, and was not re-discovered in subsequent surveys. This population is assumed to be extirpated, likely due to rat predation. Neither of the two remaining known populations have a complete population estimate; however, each of the two populations appear to be small. No viable representatives of the wild *P. semicarinata* populations are maintained in captive rearing by the Snail Extinction Prevention Program (Sischo 2019, entire). Construction of a predator-proof snail enclosure, completed by Pūlama Lāna‘i in 2019, protects one of the two known populations of *P. semicarinata*. Another predator-proof snail enclosure was completed in 2018 around a population of *P. variabilis* by Pūlama Lāna‘i. This enclosure may serve as a translocation site for *P. semicarinata*.

The *Partulina semicarinata* remaining in the wild that are not within an enclosure may benefit from ongoing rat control efforts across Lāna‘ihale, but continue to be at high risk of predation from rats, *Euglandina* spp., Jackson’s chameleons (*Chamaeleo jacksonii*), habitat-related threats, and catastrophic and stochastic events. The population within the enclosure is also at risk should the barriers fail or catastrophic or stochastic events damage the enclosure or habitat inside.

Although surveys of many areas of suitable habitat have been conducted in recent years, it is possible that other populations persist on Lāna‘ihale, especially in habitats such as steep cliffs where surveys have not been conducted and where the terrain would have provided some protection from threats. Rat control and habitat management, including removal of ungulates and fencing to protect endangered plants and seabirds, occurs on the mountain, thus, it is possible unknown tree snail populations will benefit from these activities.

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

Genetic analysis has not been conducted on the known *Partulina semicarinata* populations and it is unclear how closely these populations mimic the historic genetic diversity the species. The distance between remaining populations suggests the populations likely represent distinct geographic population units that do not presently interbreed.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

Pilsbry and Cooke’s 1912-1914 taxonomic description of *Partulina semicarinata* is the most recent and accepted taxonomy for this species (Pilsbry and Cooke 1912-1914b, pp. 83-86).

#### **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 above for historic and current spatial distribution of the species. Only two *Partulina semicarinata* population are known to remain in the wet forests of Lāna‘ihale, though the existence of individuals or small populations in unsurveyed areas is possible. The species has drastically declined throughout its historical range due to loss of habitat, fragmentation, and introduction of nonnative species that have either resulted in direct tree snail mortality or have altered the habitat, making it unsuitable for the tree snail. See section 2.3.2 for habitat altering threats.

In 2000, the Hawaiian Tree-Snail Conservation Program (Hadfield 2007 p. 4) established a captive population of *Partulina semicarinata* from eight adults collected on Lāna‘i. The population increased to 26 by 2002 and continued to increase each year, reaching 45 in 2005 after which the population began to decline (Hadfield 2007). No viable *Partulina semicarinata* are currently in the State of Hawai‘i, Division of Forestry and Wildlife, Snail Extinction Prevention Program captive rearing program. Recent technology and efforts to rear *Partulina variabilis*, a sister species of *Partulina semicarinata*, in captivity have been successful by the Snail Extinction Prevention Program (Sischo 2019, entire; Snail Extinction Prevention Program 2019, entire). However, capacity of the captive rearing facility presently precludes the addition of *P. semicarinata* into the program.

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

Predation, habitat loss, and habitat degradation have decimated the once abundant snail on Lāna‘ihale. The remaining wild populations face imminent threats from rats, nonnative predatory snails (*Euglandina* spp.) and Jackson’s chameleon present or encroaching on their habitat.

**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):**

Habitat loss and degradation have contributed significantly to population declines of the Lāna‘i tree snail. Land use conversion to non-lowland wet forest, invasive nonnative species, fire, and climate change all contribute towards habitat loss and degradation. Habitat loss for *Partulina semicarinata* began when humans first settled Lāna‘i and wet lowland forests were cleared to make way for agriculture and development.

In addition to direct habitat destruction by humans, ungulates were introduced for hunting and consumption. Forests not cleared for

agriculture were invaded by feral cattle (*Bos taurus*), mouflon sheep (*Ovis gmelini musimon*), horses (*Equus ferus caballus*), goats (*Capra hircus*), axis deer (*Axis axis*) and pigs (*Sus scrofa*) (Cuddihy and Stone 1990, pp. 63-67). The browsing, grazing, and trampling by these mammals degraded native forests and facilitated the invasion of exotic plants by spreading their seeds and creating disturbed areas where seeds could germinate (Hobdy 1993, pp. 205-208). Specific threats to the *Partulina semicarinata* habitat posed by introduced ungulates, particularly axis deer and goats include trampling and grazing of the host plants used by Lāna‘i tree snails for food, shelter, and reproduction. Ungulate paths increase soil disturbance and cause mechanical damage of host plant roots leading to erosion and possible entry points for plant disease organisms. Ungulates also create openings and disturbed areas, which facilitate weedy plant invasion and disperse fruits and seeds resulting in the conversion of a native community to one dominated by nonnative vegetation.

New Zealand flax, a nonnative plant, is a known host of *Partulina semicarinata*. However, other nonnative plants represent a serious and ongoing threat to the Lāna‘i tree snail because they adversely affect microhabitat by modifying the availability of light, alter soil-water regimes, modify nutrient cycling processes, alter fire characteristics of native plant habitat; and outcompete, and possibly directly inhibit the growth, of native plant species. Each of these threats can convert native-dominated plant communities to nonnative plant communities (Cuddihy and Stone 1990, p. 74; Vitousek 1992, pp. 33–35). This conversion has negative effects on the host plants that the Lāna‘i tree snail feeds upon. Changes of the plant community can destroy continuity of the phyllosphere created by overlapping canopies. While Lāna‘i tree snails have been observed on invasive species such as guava, this invasive plant changes the hydrology, canopy structure, and microclimate needed for the habitat of the tree snail. Changes to the native plant communities effect the availability of the tree snail’s alternate native plant hosts via environmental changes in water, canopy and shading structure.

#### **2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):**

Achatinellidae tree snails were extensively collected for scientific as well as recreational purposes in the 18th to early 20th centuries (Hadfield 1986, p. 320-321). These impacts may have been especially severe to some species and populations within the genera of *Achatinella* and *Partulina* (Hadfield 1994a, pp. 320, 322). Lee et al. (2007, pp. 2,908–2,910) found evidence that *Partula hyalina* had been traded as far away as the southern Cook Islands by early Polynesians. During the 1800s, collectors observed 500 to 2,000 snails per tree, and sometimes collected over 4,000 snails in just several hours (Hadfield 1986, p. 322). Repeated collections of hundreds to thousands of individuals by early collectors certainly resulted

in decreases in population sizes and reductions in reproduction potential. Collection, possession, and sale of the tree snail shells is legally prohibited.

### **2.3.2.3 Disease or predation (Factor C):**

Predation by nonnative species is a well-documented threat to tree snails throughout Hawai‘i and the Pacific islands (Cowie 1992, entire; Hadfield and Mountain 1980, p.355; Hadfield 1986, p. 327; Hadfield and Saufler 2009, entire). Predation by rats has been linked with the dramatic declines of populations of native tree snails (Hobdy 1993, p. 208; Hadfield and Saufler 2009, p. 1; Meyer and Shields 2009, p. 344). Rats decimated a large population of a related species, *Partulina splendida*, on Maui (Thacker and Hadfield 1998). In addition, rat damage has been observed on the empty shells of *Partulina variabilis* indicating rats likely caused their mortality (Hadfield 1994b, p. 5). *Partulina semicarinata* and *P. variabilis* are known to occur together and thus, *P. semicarinata* is just as vulnerable. Rats appear to selectively prey on large snails rather than juveniles. Because larger sized tree snails may represent breeding adults, this predation poses the most serious threat to *Partulina semicarinata*. Three rat species (black rat [*Rattus rattus*], Norway rat [*R. norvegicus*], and Polynesian rat [*R. exulans*]) are present on Lāna‘i, but the black rat appears to be the most important threat to the Lāna‘i tree snails (Hobdy 1993, p. 208; Hadfield 1994a, entire; Hadfield 1994b, p. 5; Thacker and Hadfield 1998, entire; Hadfield 2007, entire).

An imminent threat to *Partulina semicarinata* is predation by the nonnative *Euglandina* spp. These predatory snail species were purposefully introduced to the main islands of Hawai‘i in a failed attempt to control the giant African snail, *Achatina fulica* (Davis and Butler 1964, entire; Cowie 2001b, pp. 66-67). Not only did *Euglandina* spp. fail to reduce giant African snail populations, the species decimated endemic tree snails and are a major cause of the decline and extinction of native tree and terrestrial snails throughout Hawai‘i, Moorea (French Polynesia) and other tropical and subtropical regions (Cowie 2001a, entire; Cowie 2001b, pp. 66-67; Hadfield 1986, p. 327; Hadfield et al. 1993, entire). The introduced predatory snails, initially identified as *Euglandina rosea* in Hawai‘i, was recently shown to be a mixture of *Euglandina* species (Meyer III et al. 2017 pp. 1402-1404). These predatory snail species actively hunt by following the slime trails of their prey (Clifford et al. 2003, entire; Holland et al. 2018, entire). The predatory snails will climb the host tree to find its tree snail prey and can decimate a tree snail population (Hadfield 1986, p. 327). *Euglandina* spp. are known from Lāna‘i (Hadfield 2005; Sprague 2020 in litt. entire).

The nonnative terrestrial garlic snail, *Oxychilus alliarius*, present on Lāna‘i, poses a threat to smaller Lāna‘i tree snails (Hadfield 2007, p. 8).

Jackson's chameleon is known to prey on tree snails. Currently, there are established Jackson's chameleon populations on all of the main Hawaiian Islands, with the greatest number of individuals on the islands of Hawai'i, Maui, and O'ahu (Holland et al. 2010, entire). Several dozen Jackson's chameleons, native to Kenya and Tanzania, were introduced to Hawai'i in the early 1970s through the pet trade (Holland et al. 2010, p. 1,438). Inter-island transport of Jackson's chameleons for the pet trade was unrestricted until 1997, when they were classified as "injurious wildlife," and export, as well as inter-island transport, was prohibited (State of Hawai'i 1996, Hawai'i Administrative Rule 13-124-3; Holland et al. 2010, entire). The occurrence of *Partulina semicarinata* at high elevations on Lāna'i may reduce the predation risk by Jackson's chameleon because the chameleon has only been observed in Lāna'i City. It is possible that the chameleon also occurs in the wild on Lāna'i at higher elevations, and as its populations grow, it is expected that it will eventually inhabit the montane elevations where the Lāna'i tree snails occur.

Terrestrial flatworms (*Geoplanea septemlineata* and *Platydemus manokwari*) have been reported to feed on terrestrial and tree snails (Hadfield 2007, entire; Sugiura 2010, entire). The flatworm is able to climb wet trees and locate arboreal snails via scent (Sugiura and Yamaura 2009, p. 740-741). *Platydemus manokwari* decimated populations of native tree snails on Guam (Hopper and Smith 1992, entire). Although *P. manokwari* has been found on the islands of O'ahu and Hawai'i and is likely on all of the main islands, the flatworm has not been documented in the wet forest habitats of the Lāna'i tree snail.

The plant disease, rapid 'ōhi'a death (ROD), is an ongoing threat to *Metrosideros polymorpha*, an important host for *Partulina semicarinata*. This lethal disease of 'ōhi'a is caused by two fungal pathogens, *Ceratocystis lukuohia* and *Ceratocystis huliohia* (Barnes et al., 2018, entire). *Ceratocystis lukuohia* is highly aggressive and has been identified on the islands of Hawai'i and Kaua'i (Friday et al. 2020, entire; Heller et al. 2019, entire). The impacts of ROD on Lāna'i tree snail will depend on the movement of the fungi, distribution of the disease, and ability of the snails living on a dying tree to find a new food source. The multiple plant hosts used by this tree snail may reduce the effects of ROD on the wild populations.

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

Existing State and Federal regulatory mechanisms are not effectively preventing the introduction and spread of nonnative species from outside the State of Hawai'i or within the State between islands and watersheds. Predation by nonnative species such as predatory snails, rats, Jackson's chameleon, flatworms, and habitat-altering, nonnative plant species and

ungulates pose major ongoing threats to the Lāna‘i tree snail. The State’s current management of nonnative game mammals is inadequate to prevent the degradation and destruction of habitat of the tree snail.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):**

Drought is a significant threat to juvenile Lāna‘i tree snails (Kobayashi and Hadfield 1996; Sisco 2019 in litt., entire; Snail Extinction Prevention Program 2019, entire). Adults can create a seal between the opening of their shell and the plant surface to minimize moisture loss during times of drought or high temperatures. However, juveniles have a shell-surface area to body mass ratio that makes them far less tolerant to drought. In addition, drought can cause habitat degradation and loss of host tree(s) as well as an increase in forest and brush fires. Because of the limited dispersal capability of the tree snail, drought conditions are lethal to juveniles and can be lethal to adults in wild population if the drought is prolonged. Neither juveniles nor adults can survive a fire.

High winds and intense rains from hurricanes can dislodge snails from host plants and deposit them on the forest floor where they may be crushed by falling vegetation or exposed to predation by rats and predatory snails (Hadfield et al. 1993, p. 620). Damage by future hurricanes could further decrease the remaining native plant-dominated habitat that can support *Partulina semicarinata*. Lāna‘i tree snail requires a shaded, high humidity habitat. Hurricanes adversely impact Lāna‘i tree snail habitat by destroying native vegetation, opening the canopy and thus modifying the availability of light, and creating disturbed areas conducive to invasion by nonnative species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Wind storms can disperse tree snails, but it can also result in isolation of individuals. Adults require several years to reach sexual maturity, have low reproductive rates and limited dispersal, with most individuals remaining in the bush, tree, or tree complex on which they were born. All of these traits and the few populations remaining make these snails very sensitive to any stochastic or catastrophic event, which could lead to a reduction or loss of reproductive individuals and an imbalance in demographic distribution (Lande 1988).

Climate change has the potential to adversely affect *Partulina semicarinata*. Lāna‘i tree snails occupy the highest elevations on the island. The remaining wet forests on which the snail depends may be affected by changes in temperature, humidity, precipitation and the frequency and severity of storms. These stressors may change the forest habitat rendering it unsuitable, as described in Clark et al. 2019.

The threat to *Partulina semicarinata* from limited numbers of populations and number of individuals is ongoing and is expected to increase into the

future. As a result, the species may experience reduced reproductive vigor due to inbreeding depression, reduced levels of genetic variability leading to diminished capacity to adapt and respond to environmental changes, and increased vulnerability to a catastrophic event (e.g., hurricane, drought) (Hadfield 1986, entire; Hadfield and Miller 1989, pp. 7-15; Hadfield et al. 1993, entire; Hadfield 1994a, entire; Hadfield 2005, entire; Kobayashi and Hadfield 1996, entire). Together these may result in population extirpation and potentially to the extinction of this species.

Persistence of *Partulina semicarinata* populations is hampered by the severely limited number of known wild populations and shrinking geographic range of the species. These circumstances make this species vulnerable to extinction due to a variety of natural and anthropogenic caused factors. Though the tree snails are hermaphrodites and can store sperm for a limited time, small or limited populations are particularly vulnerable to reduced mating encounter, reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic diversity over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988).

### **Conservation Actions**

The wet forest at the summit of Mount Lāna‘ihale, surrounding cliffs, and what remains of the wet lowland forest, benefits from the dedicated conservation efforts of the Pūlama Lāna‘i (**Table 2**). Lāna‘i tree snails occur solely on lands managed by Pūlama Lāna‘i. Additional, unknown populations of *Partulina semicarinata* may persist on the cliffs. These populations may be afforded limited protection from rat control, fencing, removal of ungulates, and habitat management to protect endangered plants and endangered seabirds that also occur on the mountain. Because staff that conduct these management actions are trained in tree snail identification, these management actions may lead to locating previously undocumented *P. semicarinata* populations.

Controlling the principal threats of rats and *Euglandina* spp. in *Partulina semicarinata* natural habitat is difficult, if not impossible. Predator-proof tree snail enclosures have proven successful for protecting other tree snail species (Rohrer et al. 2016) in Hawai‘i. A tree snail enclosure is constructed around tree snail habitat and when completed, excludes *Euglandina* spp., rats, and Jackson’s chameleons. Enclosures are sited based on the tree snails’ habitat requirements, known occupancy, and construction constraints of the terrain. Habitat within the snail enclosures must be suitable to support the tree snails for the foreseeable future, including being free of all tree snail predators. Enclosures can provide a protected habitat for tree snail translocation when a nearby wild population is in imminent danger of being extirpated. Enclosures are vulnerable to the same environmental risks as is the surrounding habitat

including storms and vegetation senescence, and require targeted, iterative management and maintenance inside and outside of the fence in perpetuity to ensure they continue to provide effective barriers against *Euglandina* spp., rats, and chameleons.

One such predator-proof snail enclosure, completed by Pūlama Lāna‘i in 2019, is supporting *Partulina semicarinata* in a natural, but protected, environment (**Table 2**). The enclosure may serve as a destination for translocation of tree snail populations that are in immediate peril in the wild and meet translocation criteria. The enclosure is maintained by Pūlama Lāna‘i with guidance from the USFWS and the Snail Extinction Prevention Program. Changes in threats and tree snail population inside the enclosure are monitored by Pūlama Lāna‘i and the Snail Extinction Prevention Program and reported to the USFWS. A second enclosure has been constructed around a population of the closely related *Partulina variabilis*, and may serve as a future translocation site for *Partulina semicarinata*.

**Table 1** – Known populations of *Partulina semicarinata* from listing to this 5-year review.

Date	Populations	Individuals	Recovery Criteria
2013 listing	3	<50	N/A
2020 5-year review	2	<50	N/A

**Table 2** – Status of threats to *Partulina semicarinata* from listing through the current 5-year review.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Agriculture and urban development	A	Ongoing	Partial—land management has reduced the threat of development
Ungulates	A	Ongoing	Partial— some strategic fencing is in place and maintained; some ungulate removal has occurred
Invasive nonnative plants	A	Ongoing	Partial—land management and invasive plant removal by Pūlama Lāna‘i
Fire	A	Ongoing	Partial— general fire management plans developed by Pūlama Lāna‘i are in place
Stochastic events (drought, hurricane)	A	Ongoing	None
Disease	C	Ongoing	None
Predation by rats	C	Ongoing	Partial—two predator-proof snail enclosures are built by Pūlama Lāna‘i and one is occupied by <i>Partulina semicarinata</i> ; other extant tree snail populations may be afforded limited protection from rat control to protect

Threat	Listing Factor	Current Status	Conservation/Management Efforts
			endangered plants and endangered seabirds that also occur on Lāna‘ihale.
Predation by Jackson’s chameleon	C	Ongoing	Partial—predator-proof snail enclosure built on private land in the tree snails habitat;
Predation by predatory snails	C	Ongoing	Partial—predator-proof snail enclosure built on private land in the tree snails habitat;
Predation by flatworms	C	Ongoing	None
Inadequate existing regulatory mechanisms	D	Ongoing	Partial—restrictions on transport of invasive species to the island and inspections at the dock and airport are conducted
Loss of plant hosts	E	Ongoing	Partial—some landscape-scale plant and pathogen management
Limited numbers	E	Ongoing	Partial—one population protected by a predator-proof enclosure; staff conducting other management actions are trained in tree snail identification and may locate previously undocumented <i>Partulina semicarinata</i> populations.
Treefall	E	Ongoing	None
Climate change	E	Ongoing	None

## 2.4 Synthesis

*Partulina semicarinata* is an endangered tree snail endemic to the wet forests of Lāna‘ihale, on Lāna‘i, in areas where annual precipitation is greater than 75 in (190 cm). Lāna‘i tree snail feeds on microbes living on the leaf, branch and trunk surfaces of its plant hosts that include ‘ōhi‘a, New Zealand flax, kanawao, kōpiko, pilo, ‘alani, and dead hapu‘u fern. The species exhibits the late maturity and low reproductive rate characteristic of other Hawaiian tree snails belonging to the family Achatinellidae.

Rats and habitat degradation have decimated the once abundant snail. Remaining wild populations face imminent threats from rats, nonnative predatory snails (*Euglandina* spp.), and Jackson’s chameleons present or encroaching on Lāna‘ihale. There are 2 known wild Lāna‘i tree snail populations, all of which are located on Lāna‘ihale. Additional, unknown populations may persist in unsurveyed areas including cliffs.

Conservation measures that benefit Newcomb’s tree snail focus on protecting the species from predation by rats and *Euglandina* spp., trampling by ungulates, and destruction and loss of host plants. One *Partulina semicarinata* population may be afforded limited protection from rat control, fencing, removal of ungulates, and

habitat management to protect endangered plants and endangered seabirds that Pūlama Lāna‘i conducts throughout Lāna‘ihale. Because staff that conduct these management actions are trained in tree snail identification, these management actions may lead to locating previously undocumented *P. semicarinata* populations. The other *P. semicarinata* population is protected by a predator-proof snail enclosure constructed in 2019 by Pūlama Lāna‘i. An enclosure constructed in 2018 around an existing population of *Partulina variabilis* may also be used as a future translocation site for *P. semicarinata*. All remaining wild populations are at imminent risk from predation and extirpation.

With only two wild populations of *Partulina semicarinata* known, extremely low numbers of individuals, no populations in captivity, and most threats still remaining across its natural habitat, this species 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*

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

- Finalize the recovery plan with measurable downlisting and delisting criteria for the recovery of *Partulina semicarinata*.
- Conduct surveys for extant populations throughout the range of *Partulina semicarinata*.
- Monitor and assess abundance of individuals and growth trend of populations.

- Protect existing populations in the wild from threats.
- Expand the capacity of the captive rearing program and increase the number of captive-reared individuals and populations.
- Identify and prepare suitable habitats for translocation of captive-reared Lāna‘i tree snail.
- Construct and maintain tree snail predator-proof enclosures to protect extant populations or to protect translocated Lāna‘i tree snails.
- Increase numbers of populations and individuals in suitable habitat through translocation to build resilient populations with redundancy and representation.
- Control invasive, nonnative plant species that degrade the wet forest habitat of *Partulina semicarinata*.
- Implement effective control methods for nonnative *Euglandina* spp. at all *Partulina semicarinata* populations in habitats.
- Expand and continue to implement effective control methods for rats in all *Partulina semicarinata* populations.
- Implement effective control methods for Jackson’s chameleon at all *Partulina semicarinata* populations.
- Control any new threats to *Partulina semicarinata* before they become widespread.
- Develop fine-scale climate models to identify future suitable habitat based on existing and historical distributions and determine potential future climate conditions.
- Identify, develop, and support alliances and partnerships to plan and implement *Partulina semicarinata* habitat restoration, protection from predators, and management to benefit and recover the species.

## 5.0 REFERENCES

- Asner, G.P., and G. Goldstein. 1997. Correlating stem biomechanical properties of Hawaiian canopy trees with hurricane wind damage: *Biotropica* 29:145-150.
- Barnes, I, A. Fourie, M. J. Wingfield, T. C. Harrington, D. L. McNew, L. S. Sugiyama, B. C. Luiz, W. P. Heller, and L. M. Keith. 2018. New *Ceratocystis* species associated with rapid death of *Metrosideros polymorpha* in Hawai‘i. *Persoonia - Molecular Phylogeny and Evolution of Fungi* 40:154-181.
- Clark, M., M.K. Reeves, F. Amidon, and S.E. Miller. 2019. Hawaiian Islands Wet Forests. *In Encyclopedia of the Worlds Biomes*. M. I. Goldstein and D. A. DellaSala. Elsevier. <https://doi.org/10.1016/B978-0-12-409548-9.11920-7>
- Clifford, K.T., L. Gross, K. Johnson, K.J. Martin, N. Shaheen, and M.A. Harrington. 2003. Slime-trail tracking in the predatory snail, *Euglandina rosea*. *Behavioral Neuroscience* 117:1086–1095.
- Cowie, R. 1992. Evolution and extinction of Partulidae, endemic Pacific Island land snails. *Philosophical Transactions: Biological Sciences* 335: 167-191.

- Cowie, R.H. 2001a. Can snails ever be effective and safe biocontrol agents? *International Journal of Pest Management* 47:23–40.
- Cowie, R.H., 2001b. Mollusks. Pages 66-67. *In* Hawaii's Invasive Species. G.W. Staples and R.H. Cowie (Eds). Mutual Publishing and Bishop Museum Press. Honolulu.
- Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation: effects of humans, their activities and introductions. Cooperative National Park Resources Unit. University of Hawaii, Honolulu. 138 pp.
- Davis, C.J., and G.D. Butler. 1964. Introduced enemies of the giant African snail *Achatina fulica* Bowdich, in Hawaii (Pulmonata: Achatinidae). *Proceedings of the Hawaii Entomological Society* 18: 377–389.
- Friday, J. B, C. Yanger, and A. Mokiao-Lee. 2020. Rapid 'ōhi'a death, website. University of Hawai'i, College of Tropical Agriculture and Human Resources. <https://cms.ctahr.hawaii.edu/rod/> Accessed June 10, 2020.
- Gagné W.C. and L.W. Cuddihy. 1999. Vegetation. Revised Edition Pages 45-115. *In* Wagner WL, Herbst DR, and Sohmer SH (eds.) *Manual of Flowering Plants of Hawai'i*. Honolulu: University of Hawai'i Press, Bishop Museum Press.
- Hadfield, M.G. 1986. Extinction in Hawaiian Achatinelline snails. *Malacologia*, 27: 67-81.
- Hadfield, M.G. 1994a. Extinction in Hawaiian Achatinelline Snails. pp. 320-334, *In* A Natural History of the Hawaiian Islands. Alison Kay (Ed.) University of Hawaii Press. Honolulu.
- Hadfield, M.G. 1994b. Final report: USFWS grant no. 14-48-0001-93715, "A preliminary survey of the *Partulina* tree snails on Lanai": University of Hawaii. 9 pp
- Hadfield, M.G. 2005. A survey of the *Partulina* tree snails on Lāna'i. Report to U.S. Fish and Wildlife Service, Honolulu. 8 pp.
- Hadfield, M.G. 2007. Annual report to the U.S. Fish and Wildlife Service, permit period 2006, Hawaiian tree-snail conservation program: University of Hawaii at Manoa, 10 pp.
- Hadfield, M.G., and S.E. Miller. 1989. Demographic studies on Hawaii's endangered tree snails *Partulina proxima*. *Pacific Science* 43: 1-16.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist* 33:610-622.

- Hadfield, M.G. and B.S. Mountain. 1980. A field study of a vanishing species, *Achatinella mustelina* (Gastropoda, Pulmonata), in the Waianae Mountains of Oahu. *Pacific Science* 34: 345-358.
- Hadfield, M.G., and J.E. Sauffler. 2009. The demographics of destruction: isolated populations of arboreal snails and sustained predation by rats on the island of Moloka'i 1982-2006. *Biological Invasions* 11: 1595-1609.
- Harrington, R.A., J.H. Fownes, P.G. Scowcroft and C.S. Vann. 1997. Impact of hurricane Iniki on native Hawaiian *Acacia koa* forests: damage and two-year recovery. *Journal of Tropical Ecology* 13:539-558.
- Heller, W.P., M.A. Hughes, B.C. Luiz, E. Brill, J.B. Friday, A.M. Williams, and L.M. Keith. 2019. First report of *Ceratocystis huliohia* causing mortality of *Metrosideros polymorpha* trees on the Island of Kaua'i, Hawai'i USA. *Forest Pathology* 2019:e12546. <https://doi.org/10.1111/efp.12546>.
- Hobdy, R. 1993. Lāna'i – A case study: The loss of biodiversity of on a small Hawaiian island. *Pacific Science* 47: 201-210.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2010. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation of native Hawaiian species. *Biodiversity Conservation* 19: 1437-1441.
- Holland, B.S., M. Gousy-Leblanc, and J.Y. Yew. 2018. Strangers in the dark: behavioral and biochemical evidence for trail pheromones in Hawaiian tree snails. *Invertebrate Biology* 137:1-7.
- Hopper, D.R., and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Cramptom in 1920. *Pacific Science* 46:77-85.
- Kobayashi, S.R., and M.G. Hadfield. 1996. An experimental study of growth and reproduction in the Hawaiian tree snails *Achatinella mustelina* and *Partulina redfieldii* (Achatinellinae). *Pacific Science* 50: 339-354.
- Lande, R. 1988, Genetics and demography in biological conservation: *Science* 241:1455-1460.
- Lee, T., J.B. Burch, T. Coote, B. Fontaine, O. Gargominy, P. Pearce-Kelly, and D. Ó Foighil. 2007. Prehistoric inter-archipelago trading of Polynesian tree snails leaves a conservation legacy. *Proceedings of the Royal Society B* 272: 2907-2914.

- Meyer III, W.M., and A.B. Shiels. 2009. Black Rat (*Rattus rattus*) Predation on nonindigenous snails in Hawai'i: Complex management implications. *Pacific Science* 63:339-347.
- Meyer III, W.M., N.W. Yeung, J. Slapcinsky, K.A. Hayes. 2017. Two for one: inadvertent introduction of *Euglandina* species during failed bio-control efforts in Hawaii. *Biological Invasions* 19:1399–1405. DOI 10.1007/s10530-016-1354-4
- O'Rorke R, B.S. Holland, G.M. Cobian, K. Gaughen, and A.S. Amend 2016. Dietary preferences of Hawaiian tree snails to inform culture for conservation. *Biological conservation* 198: 177–182.
- Pilsbry, H.A. and C.M. Cooke, Jr. 1912-1914a. Achatinellidae. *Manual of Conchology*, 2nd Ser., Vol. 21.
- Pilsbry, H.A., and C.M. Cooke. 1912-1914b. Series of *Partulina variabilis*. Lāna'i. In, *Manual of Conchology, Structural and Systematic: Philadelphia, Academy of Natural Sciences of Philadelphia Conchological Department*, pp. 83-86.
- Rohrer, J, V. Costello, J. Tanino, L. Bialic-Murphy, M. Akamine, J. Sprague, S. Joe and C. Smith. 2016. Development of tree snail protection enclosures: From design to implementation. *Pacific Cooperative Studies Unit Technical Report 193*. University of Hawai'i at Mānoa, Department of Botany. Honolulu, HI. 58 pp.
- Sischo, D. 2019. Expert elicitation on the status of *Partulina semicarinata* with the USFWS, August 14, 2019.
- Sischo, D. 2019. Report to the U.S. Fish and Wildlife Service for native endangered species recovery permit, tree snail section: Reporting period: January 1, 2018 – December 31, 2018. Department of Land and Natural Resources, Division of Forestry and Wildlife. Honolulu, HI. 12 pp.
- Snail Extinction Prevention Program. 2019. Snail Extinction Prevention Program Captive Rearing Facility Standard Operating Procedures, Version 1.3. State of Hawai'i Department of Land and Natural Resources. Division of Forestry and Wildlife. Snail Extinction Prevention Program. 15 pp.
- Sprague, J. 2020. Confirmation that *Euglandina* species are present on Lāna'i provided to USFWS January 2020.
- State of Hawaii. 1996. Hawai'i Administrative Rule 13–124–3 <https://dlnr.hawaii.gov/dofaw/rules/> Accessed May 12, 2020.
- Sugiura, S. 2010. Prey preference and gregarious attacks by the invasive flatworm *Platydemus manokwari*. *Biological Invasions* 12:1499-1507.

- Sugiura, S., and Y. Yamaura. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions* 11:737-742.
- Thacker, R.W. and M.G. Hadfield. 1998. The status of Newcomb's Tree Snail, *Newcombia cumingi*, on West Maui. Report to U.S. Fish & Wildlife Service.
- [USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; Determination of endangered status for 38 species on Molokai, Lanai, and Maui; Final Rule. *Federal Register* 78: 32014-32065.
- [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; Designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; Final Rule. *Federal Register* 81: 17790-18110.
- [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: 20088-20092.
- [USFWS] U.S. Fish and Wildlife Service. 2020. Recovery Outline for the islands of Maui, Moloka'i, Kaho'olawe, and Lāna'i (Maui Nui). 32 pp.
- Vitousek, P. M. 1992. Effects of alien plants on native ecosystems. Pages 29-41 *in* B. C. Stone, C. W. Smith, and J. T. Tunison, editors. *Alien Plant Invasions in Native Ecosystems of Hawaii*. University of Hawaii Press, Honolulu, Hawaii.

**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Partulina semicarinata***  
**(Lāna‘i tree snail)**

**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:** \_\_\_\_\_

**Review Conducted By:**

Diane Sether, Ph.D., Invertebrate and Wildlife Biologist, PIFWO  
John Vetter, Animal Recovery Coordinator, PIFWO  
Megan Laut, Conservation and Restoration Team Manager, PIFWO

**FIELD OFFICE APPROVAL:**

for

\_\_\_\_\_

**Field Supervisor, Pacific Islands Fish and Wildlife Office**