

CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Partulina variabilis*

COMMON NAME: Lanai tree snail, Pāpā kani oe

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: February 2003

STATUS/ACTION (Check all that apply):

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: ____

90-day positive - FR date: ____

12-month warranted but precluded - FR date: ____

Is the petition requesting a reclassification of a listed species?

Listing priority change

Former LP: ____

New LP: ____

Latest date species first became a Candidate: _____

Candidate removal: Former LP: ____ (Check only one reason)

A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

F - Range is no longer a U.S. territory.

M - Taxon mistakenly included in past notice of review.

N - Taxon may not meet the Act's definition of "species."

X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Achatinellidae (Snail)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Lanai

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Lanai

LEAD REGION CONTACT (Name, phone number): Scott McCarthy (503/231-6131)

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Pacific Islands Office, Mike Richardson (808/541-3441)

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

The large and colorful *Partulina* tree snails are a major part of the Hawaiian land snail fauna, equaling the diversity of the endangered Oahu genus *Achatinella*. The life histories of both genera are similar, and each genus has radiated into over 40 species. While the Oahu tree snails are perhaps more spectacular in their color patterns, shells of the genus *Partulina* have a very diverse and colorful array of bands and stripes, are generally larger than the Oahu snails, and are more widely distributed, being found on the islands of Maui, Molokai, Lanai, and Hawaii, plus one species on Oahu.

There are three species of *Partulina* endemic to Lanai, *Partulina crassa*, *P. semicarinata*, and *P. variabilis*. They have not been examined since the early 1900s when Pilsbry and Cooke (1912-1914) revised the taxonomy of the genus. Occasional visits to Lanai by malacologists have led to the suspicion that these snail species are either highly threatened or extinct. Predation by alien predators (snails and rats), loss of habitat (to agriculture and the impacts of alien ungulates), and the massive spread of non-native plant species are the major factors contributing to the decline of these snails.

Historic populations of *P. variabilis* were restricted to the wet and mesic ohia forests on the island of Lanai. While there are no historic population estimates, qualitative accounts of tree snails indicate that they were widespread and abundant in their habitat, with any single species probably numbering in the tens of thousands. In 1994, field surveys were conducted throughout the remaining native habitat (820-1,018 meters (m) (2,690-3,339 feet (ft)) in elevation) of the historic range, indicating that there are very few remaining individuals restricted to small isolated populations (Hadfield 1994). *Partulina variabilis* was observed at 16 locations, and a total of 175 individual were seen (28 adult, 111 juvenile, and 36 newborn snails). Some of the sightings occurred in conjunction with a closely related and equally rare sister species, *Partulina semicarinata*. All of the populations of these snails had only 1-2 adults and were found on the following host plants: ohia (*Metrosideros polymorpha*), kanawao (*Broussaisia arguta*), kopiko (*Psychotria* sp.), pilo (*Coprosma* spp.), pelea (*Melicope* sp.), and dead hapuu fern (*Cibotium glaucum*). Alien vegetation used by *Partulina variabilis* includes guava (*Psidium guajava*) and New Zealand ti (*Cordyline australis*).

The decline and disappearance of the Hawaiian tree snails, including the species on Lanai, are the result of many factors acting over an extended period of time (Frick 1856; Baldwin 1887; Pilsbry and Cooke 1912-1914; Bryan 1935; Kondo 1970, 1980; Hart 1975, 1978; Hadfield and Mountain 1980; Hobdy 1993). These factors have been reviewed by Christensen (1984) and Hadfield (1986) and are discussed below.

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change):

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Removal of native forests and the introduction and spread of invasive vegetation began with the prehistoric arrival of the Polynesians and accelerated after the arrival of Europeans in 1778 (Hobdy 1993). Lower elevation lands, now used for pasture, agriculture, or housing, once supported native forests occupied by achatinellid snails including *Partulina variabilis* (Pilsbry and Cooke 1912-1914). Forests not cleared for agriculture were invaded by feral cattle, horses, goats, deer and pigs (Baldwin 1887). The grazing activities of these mammals reduced the forest understory, prevented recovery by native plants, and aided the invasion of exotic plants by spreading their seeds and creating disturbed areas where seeds could germinate (Hobdy 1993). At the present time on Lanai, axis deer (*Axis axis*) remain a serious threat to the native forests and habitat of *Partulina variabilis*. This alien deer is managed by the private landowner and the State of Hawaii as a game species. Human activities such as hiking and road repair and construction are also significant threats on Lanai. Roads and trails contribute to the spread of exotic vegetation. Reforestation with non-native species such as eucalyptus, ironwood, and Norfolk pine has also contributed to the loss of tree snail habitat. Forest fires have a particularly catastrophic effect on snail populations as well as their habitats. Alteration of the forest canopy and understory by all of these agents have resulted in changes in moisture and humidity which further inhibit the recovery of native forests to suitable habitat for native tree snails (Pilsbry and Cooke 1912-1914).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Collecting Hawaiian snails was a popular activity, especially in the late 1800s. Several private collections approached 100,000 specimens each, and many of these collections were donated or sold to museums; the collection at the Bishop Museum contains over half a million shells. Other museums also hold significant collections of these shells, including the Australian Museum, the University of Missouri, the Natural History Museum in London, the Field Museum of Natural History in Chicago, the Academy of Natural Sciences of Philadelphia, and the Museum of Comparative Zoology at Harvard University (Hadfield *et al.* 1989).

Historically, collecting was probably responsible for a decline in ranges and abundance of some species of Hawaiian tree snails (Hadfield 1986). In the mid- to late-1800s, "land shell fever" hit the island, and hundreds of thousands of snails were collected for their shells (Emerson, Ms., undated, post-1900; Hadfield 1986; Solem 1990). By 1914, several species had declined drastically and were considered rare (Pilsbry and Cooke 1912-1914). Collecting of Hawaiian tree snails had abated by about 1940 but may still occur periodically. For the remaining few *Partulina variabilis*, the collection of a single adult snail can remove all or a large percentage of the reproductive population from a bush or tree, thereby driving that population closer to extinction. The collection of tree snails must now be viewed as a threat to the further survival of the species.

C. Disease or predation.

The carnivorous snail (*Euglandina rosea*) and the European black rat (*Rattus rattus*) serve as the two major predators on extant populations of Hawaiian tree snails. In particular, the black rat appears to be a major threat to *Partulina variabilis* on Lanai (Hobdy 1993; Hadfield 1994). Other possible predators that occur on Lanai include the terrestrial flatworm *Geoplana septemlineata*, which has been reported to feed on snails (Mead 1979), the terrestrial snail *Oxychilus alliarius* (Severns 1984), the Norway rat (*Rattus norvegicus*), and the Polynesian rat (*Rattus exulans*). Parasitism and disease, though not documented in *Partulina*, may also contribute to the decline of snail populations (Hadfield 1986; Cunningham and Daszak 1998).

Most recently, the predatory flatworm *Platydemis manokwari*, has been found on the islands of Oahu and Hawaii. It is probably on all of the main islands and may pose a great threat to all of Hawaii's tree snails. Observations on Guam have documented the devastating impact of this predator of the native tree snail fauna of that island (Hopper and Smith 1992; B. Smith, University of Guam, pers. comm., 1995).

Euglandina rosea was introduced to Hawaii between 1955 and 1956 by the Hawaii State Department of Agriculture in an effort to control the African snail, *Achatina fulica* (Hadfield and Kay 1981). *Euglandina rosea* is a voracious predator on other terrestrial and arboreal snails and is responsible for the extinction of all eight species of the *Partula* tree snails on the island of Moorea in French Polynesia (Tillier and Clarke 1983; Clarke *et al.* 1984; Murray *et al.* 1988; Griffiths *et al.* 1993). *Euglandina rosea* follows mucous trails of other gastropods (Cook 1985) and will climb trees and bushes to capture its prey. Since its introduction, *E. rosea* has spread to low and high elevations throughout the Hawaiian Islands and has been the cause of local extinction of many populations of *Achatinella* (field notes of Hadfield, Kondo, Christensen, and Chung). An example of the impact of *Euglandina rosea* follows:

A population of *Achatinella mustelina* occupying a 5 by 5 m (16 by 16 ft) quadrat at an elevation of 730 m (2,394 ft) on Kanehoa Ridge in the central Waianae Range was intensively studied by mark-recapture methods from 1974 to 1976 (Hadfield and Mountain 1980). Among other demographic parameters determined, the population of *A. mustelina* was estimated at 215 snails in the quadrat. Furthermore, the population was stable during the regular mark-recapture censusing, with a low level of mortality due to rat predation. Between 1972 and 1976, *Euglandina rosea* was observed at successively higher elevations along Kanehoa Ridge; they were observed at 300 m (984 ft) in 1974, and near 700 m (2,296 ft) in 1977. In August 1979, shells of *E. rosea* were abundant at the study site, and an intensive search of the quadrat failed to locate a single living individual of *A. mustelina* or any other terrestrial or arboreal snail species, many of which had previously been observed in the area. A broader search of the area around the study site showed that the invasion of once rich tree snail habitat by *E. rosea* had led to the total disappearance of the native snail fauna.

The black rat became widespread on Oahu in the 1870s (Atkinson 1977 and Perkins 1899). In 1887, Baldwin noted that it was not uncommon to find large numbers of shells around the lairs of rats and mice (Baldwin 1887). Kondo mentions in his field notes from the 1950s (Appendix II) that *Achatinella* shells damaged by rats were common beneath the snail trees at many locations. The best documented example of the impact of rats on tree snails comes from Hadfield *et al.* (1993). The study site where rat populations irrupted had been surveyed once a

month for 4.5 years prior to the irruption. On the basis of shells recovered on the ground at each visit, Hadfield and his colleagues estimated that about 10 percent of the shells of *Achatinella mustelina* had been broken by rats. Between January and April 1988, rats increased in this well-studied site and killed about half of the snails in the population. The rats selectively preyed on larger snails, eliminating about 76 percent of the reproductive adults and 72 percent of snails over 15 millimeters (mm) (0.6 inches (in.)) in length. Only 16 percent of the snails under 15 mm (0.6 in.) long were killed by rats. Even if no other disturbances occur at this site, the snail population will take years to recover from this catastrophic surge in rat-caused mortality.

D. The inadequacy of existing regulatory mechanisms.

Currently, no formal or informal protection is given to *Partulina variabilis* by Federal or State agencies or by private individuals or groups.

E. Other natural or manmade factors affecting its continued existence.

Random environmental events (e.g., hurricanes and droughts) could affect the continued existence of the Lanai tree snails due to the small numbers of populations and individuals that remain. This is especially true due to several life-history features of this and all other *Partulina* tree snails (Hadfield 1986; Hadfield and Miller 1989, 1993; Kobayashi and Hadfield 1996): adults require 4-7 years to reach sexual maturity; reproductive rates are low; eggs are not laid as in most terrestrial snails, rather the young emerge fully developed from the parent; dispersal is very limited, with most individuals remaining in the tree or bush on which they were born. All of these traits make these snails very sensitive to any event that could lead to a reduction or loss of reproductive individuals.

FOR RECYCLED PETITIONS:

- a. Is listing still warranted? ____
- b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? ____
- c. Is a proposal to list the species as threatened or endangered in preparation? ____
- d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners): With the exception of a few parcels in the town of Lanai City, the entire island of Lanai is privately owned by Castle and Cooke Land Company.

PRELISTING (Describe status of conservation agreements or other conservation activities):

Currently, there are no conservation actions being carried out that will benefit this species. However, a captive propagation program is currently underway in Hawaii for the closely related Oahu tree snails in the genus *Achatinella* as well as other species of *Partulina*. If the Lanai tree snails are listed as endangered or threatened, they could be included in this captive propagation program. In addition, the Pacific Islands Office and partners (State of Hawaii and Castle and Cooke Land Company) are currently exploring the possibility of a conservation agreement that would protect a number of listed plants on Lanai. It may be possible to include *Partulina variabilis* and another Lanai tree snail (*Partulina semicarinata*) in this agreement.

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

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- Hobdy, B. 1993. Lanai! a case study: the loss of biodiversity on a small Hawaiian island. *Pacific Science*, 47(3):201-210.
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Fretter, V. and Peake, J. (eds.): Pulmonates, 2B. Academic Press, London. 150 pp.
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Moorea. *Pacific Science*, 42:150-153.
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University Press, Cambridge, U.K., I: xv-ccxxviii.
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Vol. 21.
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Bishop Museum Occasional Papers, 3:27-40.
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du mollusques gasteropodes pulmones dans les territoires francais du Pacifique. *Sel.
Evol.*, 15:559-566.

LISTING PRIORITY (* after number)

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|--------|
| THREAT |
|--------|

| Magnitude | Immediacy | Taxonomy | Priority |
|-----------------|--------------|-----------------------|----------|
| High | Imminent | Monotypic genus | 1 |
| | | Species | 2* |
| | | Subspecies/population | 3 |
| | Non-imminent | Monotypic genus | 4 |
| | | Species | 5 |
| | | Subspecies/population | 6 |
| Moderate to Low | Imminent | Monotypic genus | 7 |
| | | Species | 8 |
| | | Subspecies/population | 9 |
| | Non-imminent | Monotypic genus | 10 |
| | | Species | 11 |
| | | Subspecies/population | 12 |

Rationale for listing priority number:

Magnitude:

Imminence:

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Rowan Gould March 6, 2003
Regional Director, Fish and Wildlife Service Date

Concur: _____
Director, Fish and Wildlife Service Date

Do not concur: _____
Director, Fish and Wildlife Service Date

Director's Remarks:

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Date of annual review: 2/03
Conducted by: _____

Comments:

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