

# **The partulid tree snails (Partulidae: Stylommatophora) of the Mariana Islands, Micronesia**

by

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*Dankulu na Saina Ma'āse!*



## SUMMARY

This paper provides a systematic review, extended descriptions and illustrations of the six species of Partulidae recorded from the Mariana Islands. Four species of *Partula* have been described from the archipelago, *P. gibba* Férussac, 1821 is the most widely distributed; *P. radiolata* (Pfeiffer, 1846), is endemic to the island of Guam; *P. salifana* Crampton, 1925, another Guam endemic is extinct, as is *P. langfordi* Kondo, 1970, only collected from Aguihan. A fifth and undescribed species, *Partula* sp., is known only from archaeological material from Rota. A sixth Marianas partulid, *Samoana fragilis* (Férussac, 1821), is known from Guam and Rota. Most species are either extinct or in strong decline on most islands.



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## INTRODUCTION

The purpose of this report is to provide a review of the land snails from the Partulidae Pilsbry, 1900 inhabiting the Mariana Islands of western Micronesia. While the systematics of this fauna is uncontroversial, there exists no single account of these animals' descriptions, taxonomic history, ecology and conservation biology. Given the current worry over their decline, I assemble this review of the species' systematics, geographic range and ecology to aid conservation biologists.

### *Geographical setting*

The Mariana Islands (Fig. 1) are a north-south oriented, arc-shaped archipelago of small (10 to 540 km<sup>2</sup>) islands in the western tropical Pacific Ocean (13° to 20° N, 142° to 144° W), approximately 2400 km east of the Philippines. Of the 14 main islands, seven are currently inhabited by people, most quite sparsely. The climate is tropical maritime with marked wet and drier seasons, influenced by the Asian monsoons and frequent typhoons, especially between June and November.

The Mariana archipelago formed by the volcanism resulting from the tectonic subduction



**Figure 1.** Plate 14 from Crampton's (1925) *Studies on the Variation, Distribution, and Evolution of the Genus Partula* showing the variation in shell form of *Partula gibba* from Saipan. (From Biodiversity Heritage Library.)

of the Pacific plate under the Philippine plate. The largest and southernmost islands (Saipan, Tinian, Rota, Guam) are the oldest (ca. 40 my), volcanically quiescent, and of volcanic rocks or tectonically uplifted limestone. The islands to the north are much younger (to 5 my) and volcanically active, and entirely of volcanic composition. As a result of this geologic history, terrestrial habitats in the Mariana Islands include two main types of forests, typified by different communities of plants. Limestone forest is a forest type found only rarely worldwide. The limestone forests unique to the Mariana Islands are found in the southern and older, Mariana Islands with tectonically uplifted limestone members. Ravine forests, by contrast are found on the volcanic soils of most islands in the archipelago, and as the name implies tend to be restricted to ravines and river basins. The more exposed areas are usually of savanna and covered in tall grasses. Guam and Saipan also possess minor, but significant areas of mangrove and seagrass, as well as estuarine areas receiving significant terrigenous input. The tallest mountains of Rota are just high enough to possess patches of another habitat, cloud forest, a forest type more common in highest islands of the neighbouring Caroline archipelago. The geographic distribution and areal extent of terrestrial habitats across the archipelago largely influence the distribution and species richness of terrestrial organisms, including that of the subjects in this treatise, the land snails.

### *The land snails of the Mariana Archipelago*

Land snails belong to two main evolutionary *cum* taxonomic groups, the informal group Pulmonata (formerly a taxonomic order), that is, the lung-bearing snails, and the clade Caenogastropoda (formerly a taxonomic superorder), a large group of primarily

marine snails that all retain the ancestral gills of their marine gastropod cousins. The shell-less slugs are all members of the air-breathing pulmonates, but several slug groups have independently evolved through the partial or complete loss of their shell. The slugs of the oceanic Pacific islands are all recent introductions (Cowie 2001).

The land snails of the Indo-west Pacific are not at all well documented. In the Mariana Islands, there are about 110 known distinct species, and even some of these still require formal description. Many of the Mariana Island species have only been collected from the southern islands, Saipan, Tinian, Rota and Guam. The fauna of the northern islands remains the least known.

The Chamorro, the indigenous inhabitants of the Mariana archipelago, arrived about 4000 BCE. In the Chamorro language, land snails in general are called *akaleha'*. Land snails appear not to have been used as food or otherwise in material culture, given their absence from the archaeological record and oral culture. The only known use for land snails in the Mariana Islands was to bead partulid snails, particularly the more colourful form of *Partula gibba*, into purses and jewelry, largely for commercial sale to tourists, especially following World War II. This practice is of uncertain origin, but one that appears to have continued into the 1950's, but ceased as the Marianas switched to a wider market economy by the early 1960's, and certainly before partulids became rarer on human populated islands after the mid-20th century.

The land snails from the Mariana Islands were first described and reported by Jean-René Constant Quoy and Joseph Paul Gaimard, the naturalists aboard the French naval vessel *Uranie*, Captain L. Freycinet commanding, which stopped on Guam in April of 1819 during its circumnavigation of the world during the years 1817 to 1820. The

next important addition to the fauna was by J. F. Quadras and O. F. von Möllendorff (1894a-b), who added substantially to the tally of endemic forms. Important work in the 20th century includes that of Henry E. Crampton (1925), H. Barrington Baker, beginning in 1938, as well as C. Montague Cooke, Jr., Yoshio Kondo and others beginning in the 1960s, Alan Solem in the 1980s, and later, David R. Hopper and Barry D. Smith (1992), Taiji Kurozumi (1994) and Scott Bauman (1996a-b). The most recent and authoritative checklists for land snails from the Mariana Islands are Smith (2003) for the Assimineidae and Bauman (1996a-b) who provided an annotated list of all Mariana species then known.

#### *The Partulidae of the Mariana Islands*

The tropical, largely arboreal snail family Partulidae consists of about 130 species in three genera, all endemic to single islands or a few adjacent islands on the western Pacific Plate. The smallest genus *Eua* Pilsbury & Cooke, 1934 of four species is found only in Samoa and Tonga. The genus *Samoana* Pilsbury, 1909, of about 23 species, has an interesting, disjunct distribution. Most species of Partulidae inhabit single or a few adjacent islands occur from Samoa to the Marquesas Islands in Polynesia, while a single species occurs nearly 1500 km to the north-east in the southern Mariana Islands. The largest genus *Partula* Férussac, 1821 is also the most widely distributed, with about 100 described species, ranging from the Society Islands, French Polynesia, where species richness is highest at 61 species, to the Palauan Archipelago in westernmost Micronesia with just three species. About 1300 km

northeast of Palau lie the Mariana Islands, also in Micronesia, with four endemic species.

The first *Partula* described from the Mariana Islands, *P. gibba* Férussac, 1821, is the most widely distributed in the archipelago. Another species, *P. radiolata* (Pfeiffer, 1846), is endemic to, and still widely distributed within, the largest and southernmost island of Guam. A third species, *P. salifana* Crampton, 1925, was discovered in the forests surrounding the summit of Mt. Alifan of Guam. The fourth species, *P. langfordi* Kondo, 1970, is restricted to the tiny island of Aguiguan. A fifth Marianas partulid *P. fragilis* Férussac, 1821 was transferred to *Samoana* by Kondo (1968). Adult shells of a sixth conchologically distinct *Partula* sp. from the Marianas were collected from unconsolidated Late Holocene deposits on the island of Rota, Commonwealth of the Northern Mariana Islands. This species has been figured and briefly discussed by Bauman (1996) as *P. c.f./aff. gibba*.

### *Current decline*

Across the Pacific, there is an on-going and unprecedented rate of extinctions documented for native snail species (Cowie 1992; Lydeard et al. 2004). Sadly, the same holds true for the snail fauna of the Mariana Islands, where the numbers of nearly all species have declined precipitously during the latter half of the 20th century (Hopper and Smith, 1992; Bauman 1996b). Many species have not been seen alive in half a century, some in fact not since the publication of their original descriptions. The cause of the declines in the Marianas are primarily due to habitat destruction and the, at best, naive introductions of generalist predators, such as the gastropods *Gonaxis* spp. and

*Euglandina rosea* (Férussac, 1821) to control yet another invasive gastropod, the agricultural pest *Lissachatina fulica* (Bowdich, 1822). In unparalleled biological irony these predators, as well as their endemic prey, have themselves now fallen prey to another introduced generalist predator, the bipaliid flatworm *Platydemus manokwari* De Beauchamp, 1962. The worm appears to have eliminated the *Gonaxis* and *Euglandina*. In over three decades of collecting, we have not seen a living specimen of these species.

Regardless, the upshot is that the forests of the southern Marianas are becoming nearly devoid of most native snail species, including on the southern-most islands the iconic and once prolific *Partula*. Declines of partulids have been of the order that the two Marianas *Partula* having the most restricted distributions, *P. salifana* and *P. langfordi*, are now undoubtedly extinct (Hopper & Smith 1992; Smith 2008a), and even *P. gibba* no longer occurs in vast areas of its former broad range (Bauman 1996; Smith 2008b). The faded, pocked and empty shells of these and other snails now litter the forest floors and crunch underfoot.

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## SYSTEMATICS

Below is a systematic account of the Mariana Partulidae. Species are given alphabetically by genus, then species. Following the species' full scientific name, taxonomic authority and date, is included an abbreviated synonymy. Scientific names are in italics, which by convention consists first of the genus name, always capitalized, the specific epithet, which is not, followed by the name of the person who first scientifically described the species, a comma, and the publication date of the description. Higher taxonomy generally follows Bouchet and Rocroi (2005), except when contraindicated by Bruere et al. (2010, 2012). Each species' description includes reference to figures illustrating the shell from, when possible, apical, apertural and basal views, and when available, the live animal.

No English common names are included here, since none exist. As well, these species lack species-specific Chamorro names. Following each scientific name is a brief description of notable and diagnostic aspects of the animal's morphology, color, diurnal activity pattern, habitat, depth, and lifestyle followed by its geographic distribution and occurrence in the archipelago, and finally, information on the specimen shown in the figures.

### **Clade *Stylommatophora sensu* Bouchet & Rocroi (2005)**

#### **Family *Partulidae* Pilsbry, 1900**

### **Genus *Partula* Férussac, 1821**

Type species: *Helix faba* Gmelin, 1791 via suppression of *Limax faba* Martyn, 1784 (see ICZN 1957). Type locality: Raiatea, Society Islands, French Polynesia.

### ***Partula gibba* Férussac, 1821**

(Figs. A-B)

**Taxonomy:** *Partula mastersi* Pfeiffer, 1857; *Partula bicolor* Pease, 1872.

**Description:** Shell dextral or, quite rarely, sinistral, conic-ovate, perforate, pellucid. Spire acute, 4 to 4½ whorls, the last gibbous. Sculpture of spiral striae, crossed by weak longitudinal growth striae; suture slightly adpressed, various shades of white or brown. Aperture oblong-ovate, subquadrangular; peristome reflexed, broadly dilated, white. Background color variable, chestnut brown to whitish-yellow; also purple. Adult length 14 to 18 mm, width 10 to 14 mm. (Description from Smith et al. 2008.)

**Biology:** Ovoviviparous. Once the most commonly encountered *Partula* on Guam.

**Range:** *Partula gibba* is the most widely distributed partulid in the Mariana Islands, occurring on Guam, Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan (Kurozumi 1994; Smith et al. 2008). Still common on some northern islands, such as Pagan and Sarigan.

**Photos:** D. Sischo, primary forest, Rota, 2010, no scale bar.

### ***Partula langfordi* Kondo, 1970**

(Fig. C)

**Taxonomy:** None.



**Description:** Much smaller and with whorls less convex than *P. gibba*. Dextral shell described by Kondo (1970) as ovate-conic and moderately thin, a spire of five, slightly convex whorls, and an obtuse apex, aperture oblong-ovate with a white peristome thickened and expanded, background color buff superimposed by maroon. A band on whorls two and three also maroon. The band begins at whorl one and a half as a faint brown marking one-third the width of the whorl and gradually widens to one-half width of the whorl deepening to maroon at whorl three. The band expands to three-fourths width of whorl four and dissipates into a vague blend of buff-maroon at the beginning of whorl five to the end of the shell. The holotype has a length of 14.0 mm, a diameter of 9 mm, and a aperture length of 8 mm. (Description from Kondo 1970).

**Biology:** Hermaphroditic. Ovoviviparous. *P. langfordi* prefers cool, shaded forest (Smith 2008a). Likely extinct.

**Range:** An endemic of Aguiquan. A survey conducted there in 1995 found no live *P. langfordi* and only fresh, dead shells (Bauman 1996b), while a survey in 2006, also found no live animals, but only old, degraded shells. This is compelling evidence that the species on this very small island is extinct (Smith 2008a).

**Photo:** Y. Kondo, Aguiquan, 1952, holotype?, no scale bar, fig. 2 in Kondo (1970).

### ***Partula radiolata* (Pfeiffer, 1846)**

(Fig. D)

**Taxonomy:** *Bulimus (Partula) radiolatus* Pfeiffer, 1846.

**Description:** Shell dextral, oblong-tapering, subperforate, thin. Spire obtuse, whorls typically 5, slightly convex, the last about equal to the spire. Sculpture of faint,

impressed lines. Aperture obliquely oval; peristome simple, thin, white, expanded, the right margin somewhat straightened, columellar margin dilated above, spreading above the umbilicus. Background color pale straw with darker axial rays and brown lines. Adult length 13 to 18.5 mm, width 8 to 12 mm. (Description from Smith et al. 2008.)

**Biology:** Ovoviviparous. The most commonly encountered *Partula* on Guam. Found in bushes on the undersides of leaves.

**Range:** Endemic to Guam. Crampton (1925) indicates that the species been erroneously reported to occur on the island of New Ireland in the Bismarck Archipelago by Pfeiffer (1846), Hartman (1881), and Parkinson et al. (1987).

**Photo:** A. M. Gawel, on *Alocasia macrorrhiza* leaf, Guam, 2010, no scale bar.

### ***Partula salifana* Crampton, 1925**

(Fig. E-F)

**Taxonomy:** None.

**Description:** Shell dextral, ovate-conic, thick and heavy. Umbilicus open, slightly flattened. Spire somewhat protracted, whorls 5 to 5¼, slightly impressed below the suture. Sculpture of spiral striae on embryonic whorls becoming weaker on postembryonic whorls. Aperture elongate, interior purplish and shining, peristome expanded and flattened, gradually narrowing as it approaches contact with body whorl, color variable from white to yellowish brown or purple. Background color is a rich chestnut-brown or seal-brown to yellowish or olive; the apex color is often purple as a result of decortication. Adult length 17 to 19 mm, width 10.5 to 11.7 mm. (Description from Crampton 1925.)

**Biology:** Ovoviviparous. Probably extinct.

**Range:** *Partula salifana* is the most geographically restricted of the partulids in the Mariana Islands. It was known only from the summit of Mount Alifan and two adjacent peaks on the southwest coast of Guam.

**Photo:** M. and J. Coltro, *P. salifana*, on bushes after rain, Mt. Alifan, Guam, collected by E. Hailey, 1946, scale bar = 5 mm, © M. and J. Coltro (www.femorale.com) with permission.

### ***Partula* sp.**

(Fig. G)

**Taxonomy:** *Partula* sp. cf./aff. *gibba* of Bauman 1996b. An apparently undescribed species.

**Description:** Shells 17-19 mm in height, dextral, spire conical, whorls nearly flat, numerous prosoclinic growth striae, fine appressed spiral striae, suture distinct, emarginate, aperture slightly oblique, auriculate, peristome thick, flattened, polished, parietal callus, undenticulate, umbilicus deep, partially eclipsed by reflexed columellar margin. Similar shells are not mentioned in Crampton's (1925) monograph on variation in Partulidae of Saipan or Guam, or Kondo's (1970) analysis of *Partula* on Aguiguan.

**Biology:** Known only from a few subfossil specimens in association with other still extant native snails, including *P. gibba*. Uncalibrated radiocarbon dates of presumably anthropogenic charcoal associated with some shells ca. 400 years old (Bauman 1996b; Steadman 1999). This species apparently went extinct during late prehistoric times.

**Range:** Four shells of this distinctive *Partula* were collected from archaeological test pits in caves on both the northern and southern coasts of Rota (Bauman 1996b).

**Photo:** S. Bauman, subfossil, cave deposits, Rota, 1995, scale bar = 5 mm.

### ***Samoana fragilis* (Férussac, 1821)**

(Fig. H)

**Taxonomy:** *Partula fragilis* Férussac, 1821; *Partula quadrasi* Möllendorff, 1894.

**Description:** Shell dextral, ovate-conic, narrowly and half-covered perforate, fragile, pellucid. Spire conic, apex somewhat obtuse; whorls typically four, slightly convex, separated by adpressed, margined suture; last whorl distinctly convex, nearly tumid. Sculpture of delicate spiral striae intersected by transverse growth striae. Aperture oblique, oval; peristome thin, well expanded, columella dilated above, recurved, forming distinct angle with parietal wall. Background color buff; narrow darker maculations and whitish banding due to viscera visible through the shell. Adult length 12 to 16 mm, width 10 to 12 mm. (Description from Smith et al. 2008.)

**Biology:** Usually in the northern half of Guam in limestone forest. Unique among Mariana Islands partulids, the eggs are large (4.2 mm × 3.3 mm) and encapsulated by a calcareous shell. Further, *S. fragilis* reaches sexual maturity before growing a reflexed peristome, a trait not reported for any other partulid species (Crampton 1925).

**Range:** The only species of *Samoana* to occur outside of southeastern Polynesia. Reported from Guam and Rota in the Mariana Islands (Kondo 1970; D. Sisco, pers. comm.).

**Photo:** A. M. Gawel, northern Guam, 2007, no scale bar. The lectotype and paratype are figured in Zilch (1962).

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## PLATES

## Plate I

Figure A. *Partula gibba* Férussac, 1821, live animal, approx size, 2 cm.

Figure B. *Partula gibba* Férussac, 1821, live animal, approx size, 2 cm.

Figure C. *Partula langfordi* Kondo, 1970, shell, apertural view, approx. size, 1.6 cm.

Figure D. *Partula radiolata* (Pfeiffer, 1846) , live animal, approx size, 1.7 cm.



## Plate II

Figure E. *Partula salifana* Crampton, 1925, shell, apertural view, scale bar = 5 mm.

Figure F. *Partula salifana* Crampton, 1925, shell, adapertural view, scale bar = 5 mm.

Figure G. *Partula* sp., shell, apertural view, scale bar = 5 mm.

Figure H. *Samoana fragilis* (Férussac, 1821), live specimen, approx. size, 1.6



