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Land Snails of Alupat Island, a Fringing Islet of Guam, Mariana Islands [1]

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Abstract— We surveyed the terrestrial gastropods of Alupat Island, a small uninhabited islet located in Hagåtña Bay, Guam. In three days of examining vegetation, leaf litter, and soil, we found 13 species of molluscs representing ten genera and eight families, all previously known from the main islands of the Marianas. We did not find any members of the family Partulidae, of conservation concern across the tropical Pacific. However, neither did we encounter the invasive flatworm *Platydemus manokwari* De Beauchamp, which is currently eliminating native snails in the Marianas and elsewhere. Hence, we suggest that Alupat Island might serve as a sanctuary for transplanting populations of Guam's most endangered snails should a thorough survey confirm the absence of flatworms.

Sumåria— Manmanespiha ham akaleha' siha gi iya Alupat nu i díkike' yan disetto na isla gi i Bakånan Hagåtña gi iya Guåhan. Despues di tres na ha'åni, manmanespiha ham gi i halomtåno' yan kånton tåsi ya en sedda' tresse na klåsen akaleha'. Ti en sedda' i akaleha' nu i mafa'nána'an Partulidae. Put úttemo, ti manmanodda' ham ulo' *Platydemas* nu i ginen Sanlagu ni' manóchocho akaleha' siha gi iya Guåhan yan todu bånda gi i Pasifiku. Puedi ha' i humuyong-ña u fama'deskansåyan akaleha' siha i iya Alupat yanggen magåhet na tåya' ulo' siha gi i isla.

Introduction

Alupat Island is one of at least two dozen islets associated with the fringing and barrier reef platforms surrounding Guam, the largest and southernmost island of the Mariana archipelago in western Micronesia. Some islets are of unconsolidated sandy sediments primarily hosting cosmotropical strand vegetation. However, most islets appear to be emergent remnants of reef facies limestone and a few larger ones, such as Alupat Island, can be heavily forested.

Like the other fringing islets of Guam, Alupat Island has seldom received attention in the scientific literature. Randall and Eldredge (1976) reported on its location and geologic composition in an atlas of Guam's coastlines. Perry et al. (1998) included Alupat in a biogeographic study of the herpetofauna of Guam's fringing islets. There are no published accounts of other components of the

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fauna nor of the apparently diverse vegetation of the island, although botanical surveys of a few other islets around Guam have been performed (Stone 1970; Gardner 1981; Neubauer and Neubauer 1981).

In this note, we report on our recent survey of Alupat for terrestrial molluscs.

Materials and Methods

Alupat (8950 m^2; 13.4928° N, 144.7704° E) is a limestone island with a maximum elevation of about 14 m (Perry et al. 1998) located about 200 m south of the shoreline of eastern Hagåtña (= Agana) Bay, Guam (Fig. 1). It consists of emergent Pleistocene reef (Randall and Eldredge 1976) and appears to be a consolidated *in situ* remnant or spall of an ancient sea cliff, but is now surrounded by a wide subtidal reef platform. There are no human inhabitants and few visitors venture beyond the small beach. Most of the island is covered in Mariana limestone forest (*sensu* Fosberg 1960); the canopy is closed and dominated by *Aglaia mariannensis* Merr. and *Ficus prolixa* Forst. f., among other species. Cliffs 5–10 m high almost surround the island and support sea-spray tolerant plants, such as *Pemphis acidula* J. R. Forst. & G. Forst. The remaining margin consists of a sandy beach backed by cosmotropical strand vegetation.

Snails were collected by one to three persons during the day (19 July 2016, 5 February 2017, and 6 July 2019) for approximately 12 total person-hours of collecting. Collections were made by examining the undersides of leaves, sifting through leaf litter, and digging into the top 5–10 cm of soil, including forest, strand, and karstic habitats. We also searched in these areas for the planarian and snail predator *Platydemus manokwari* De Beauchamp, 1963. Representative specimens of each snail species from Alupat were deposited in the BPBM Malacology Collection (accession number 2019.086; catalogue numbers BPBM 285882–285894).

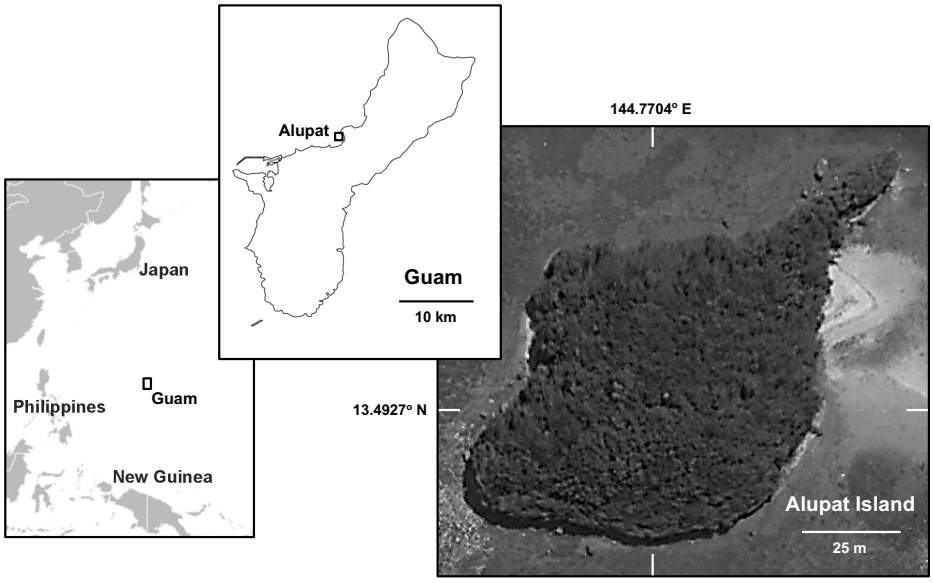

Figure 1. Map of Alupat Island, a fringing islet of Guam, Mariana Islands. Image from Google Earth Pro V 7.1.5.1557; eye altitude 250 m; imagery date 14 April 2018; © DigitalGlobe 2019.

Results

There are now 13 species of terrestrial molluscs reported from Alupat Island (Table 1; Fig. 2), including eight Heterobranchia, four Caenogastropoda, and one Neritomorpha. The species represent ten genera in eight families. Five species are native to the Mariana Islands, but also occur elsewhere, four appear restricted to the archipelago, and another four are certain or probable introductions (Table 1). Twelve species found in our survey were seen as live animals, while the exception, *Melampus luteus*, was seen as fresh but damaged shells (Fig. 2G) typical of predation by hermit crabs (*Coenobita* spp.). No species were recorded as singletons; all were found in abundance.

Some identifications merit comment. Our specimens of *O. elongatula* (Fig. 2B) matched most closely *O. e.* var. *chrysostoma* in their uniform yellow colour and intermediate proportions (Zilch 1967). Live and fresh shells of *O. picta* were subadult or broken, hence our figuring of an old shell (Fig. 2D), which displayed the full seven whorls, and a uniformly thin, blunt peristome lacking a basal expansion. The umbilicus is described as narrow by Quadras and Möllendorff (1894), but to our eye appears wide in the lectotype figure (Zilch 1967) and in our specimens (Fig. 2D).

Table 1. The land snails of Alupat Island, Guam, Mariana Islands.

Taxon	**BPBM[a]**	**Status[b]**	**Survey**
ACHATINELLIDAE			
Pacificella variabilis Odhner, 1922	285882	Introduced	This study
ASSIMINEIDAE			
Omphalotropis elongatula Quadras & Möllendorff, 1894	285883	Endemic	This study
O. granum (L. Pfeiffer, 1854)	285884	Native	This study
O. picta Quadras & Möllendorff, 1894	285885	Endemic	This study
DIPLOMMATINIDAE			
Palaina taeniolata (Quadras & Möllendorff, 1894)	285886	Endemic	This study
ELLOBIIDAE			
Melampus castaneus (Mergerle von Mühlfeld, 1816)	285887	Native	This study
M. luteus (Quoy & Gaimard, 1832)	285888	Native	This study
Pythia scarabaeus (Linnaeus, 1758)	285889	Native	This study
EUCONULIDAE			
Liardetia sculpta (Möllendorff, 1893)	285890	Introduced	This study
HYDROCENIDAE			
Georissa laevigata (Quadras & Möllendorff, 1894)	285891	Endemic	This study
SUBULINIDAE			
Allopeas gracile (Hutton, 1834)	285892	Introduced	This study
Subulina octona H. Beck, 1837	285893	Introduced	This study
TRUNCATELLIDAE			
Truncatella mariannarum (Quadras & Möllendorff, 1894)	285894	Native	This study

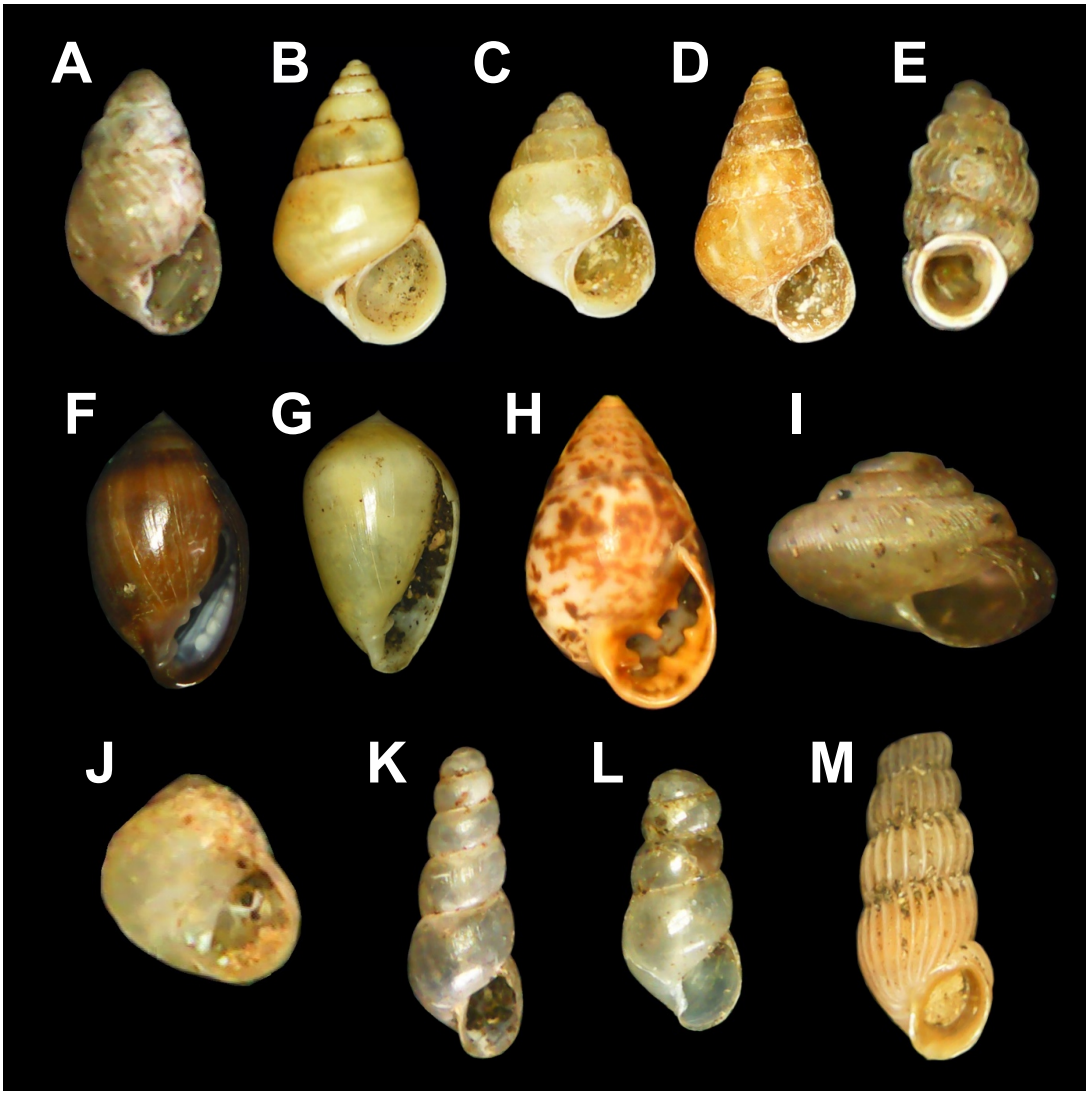

Figure 2. Terrestrial snails of Alupat. Measurements indicate shell heights. A, *Pacificella variabilis* Odhner, 2.7 mm; B, *Omphalotropis elongatula* Quadras & Möllendorff, 7.4 mm; C, *O. granum* (Pfeiffer), 3.6 mm; D, *O. picta* Quadras & Möllendorff, 5.2 mm; E, *Palaina taeniolata* (Quadras & Möllendorff), 2.2 mm; F, *Melampus castaneus* (Megerle von Mühlfeld), 10.9 mm; G, *M. luteus* (Quoy & Gaimard), 11.7 mm; H, *Pythia scarabaeus* (L.), 22 mm; I, *Liardetia sculpta* (Möllendorff), 2.3 mm; J, *Georissa laevigata* (Quadras & Möllendorff), 1.4 mm; K, *Allopeas gracile* (Hutton), 5.0 mm; L, *Subulina octona* (Bruguière) juvenile, 5.6 mm; M, *Truncatella mariannarum* (Quadras & Möllendorff), 6.8 mm.

Discussion

No land snails have been previously reported from Alupat Island, hence all 13 species reported here qualify as new distributional records. With the snail survey of Alupat, an initial comparison of the snail faunas among Guam's fringing islets is now possible. To date, the only other islet surveyed for snails is Dåno' or Cocos Island (Kerr and Fiedler 2018), a much larger (0.33 km^2 *versus* 0.009 km^2), low, sandy atoll near southern Guam. Half of the island is forested in *Casuarina equisetifolia* L., a xeric habitat seldom hosting snails (Kerr and Fiedler 2018). Further, Dåno' is occasionally overwashed by storm waves (McCoid 1996). Perhaps because of these evident differences in vegetation and elevation, species richness appears similar between the islands. The much larger Dåno' has 14 species of snails (Kerr and Fiedler 2018), merely one more than in our current survey of Alupat Island, with ten species present on both.

Certain aspects of the fauna suggested that there is quite low dispersal of snails from Guam's shoreline a mere 200 m distant. The adjacent coast has been extensively developed for commercial purposes beginning in the 1970's. This no doubt has reduced the area's malacofauna from the original native limestone and back-strand forest species to today's primarily invasive garden and disturbed-ground forms. For example, the invasive snails *Drymaeus multilineatus* (Say, 1825) (Bulimulidae) and *Satsuma succincta* (Adams, 1866) (Camaenidae) and the slug *Veronicella cubensis* (Pfeiffer, 1840) (Veronicellidae) are in recent years among the most conspicuous and abundant molluscs of primary and secondary terrestrial habitats throughout Guam (Kerr and Bauman 2013), including Guam's shores adjacent to Alupat Island. However, none of these species were seen on the small island. We also did not find evidence of *Lissachatina fulica* (Bowdich, 1822) (Achatinidae), once extremely abundant on Guam (Mead 1961). Their large, sturdy, albeit heavily eroded shells are still commonly found in Guam's forests, but none were seen on Alupat. Hence, this species has probably never dispersed there, since its introduction to Guam in 1943 (Meade 1961).

Finally, we did not find on Alupat any of the three federally protected native species of Partulidae from Guam. All of these species occurred in abundance on the adjacent shore nearly a century ago (Crampton 1925, p. 31), but are now threatened island-wide by the invasive molluscivorous flatworm *Platydemus manokwari* (see Hopper and Smith 1992) and habitat destruction. Still, we found no flatworms, nor other introduced molluscivores, on Alupat. Hence, should a thorough survey also fail to discover the worm, we suggest that Alupat Island might serve as a refuge for land snails transplanted from Guam, those species either threatened by the predator or by anthropogenic loss of habitat.

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