

## First Records of *Paralaoma servilis* (Shuttleworth, 1852) (Gastropoda: Pulmonata: Punctidae) in the Hawaiian Islands<sup>1</sup>

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We report the establishment of another globally invasive land snail species in the Hawaiian Islands.

### Punctidae

#### *Paralaoma servilis* (Shuttleworth, 1852)      New state record

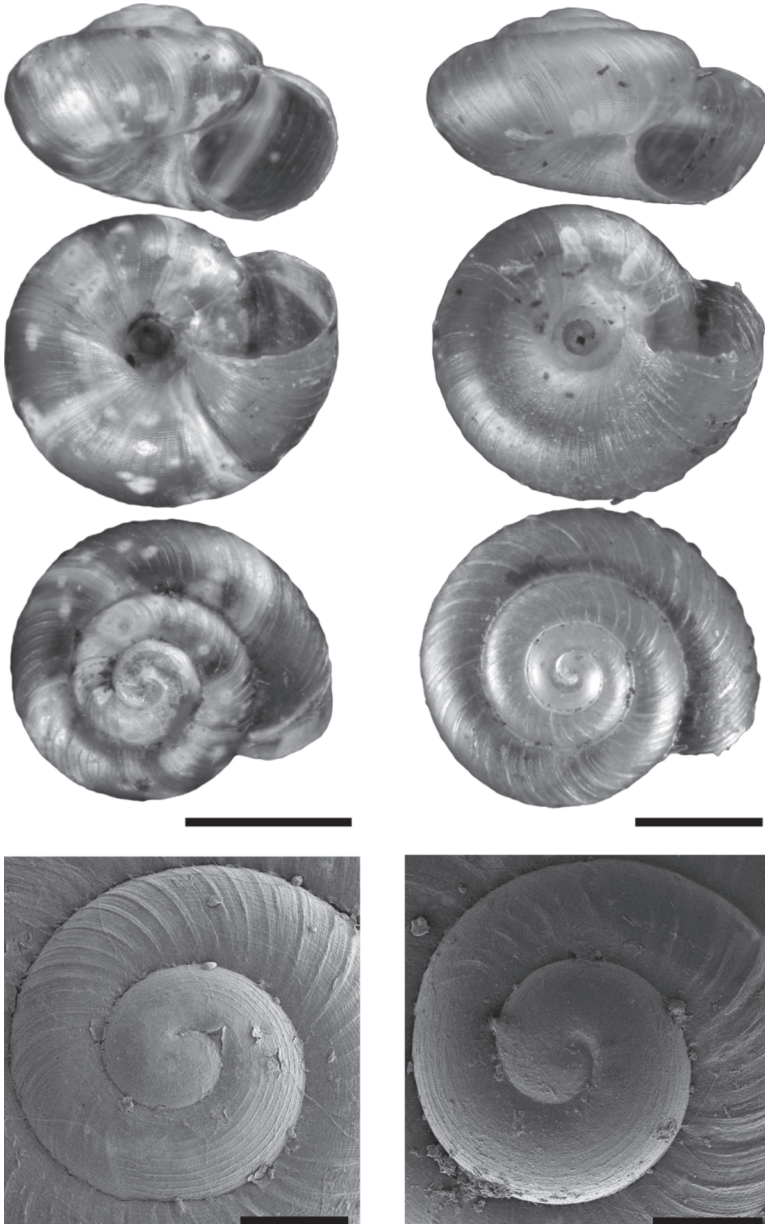
Cowie *et al.* (1995) and Cowie (1997) reported the occurrence on the Island of Hawai'i of an unidentified land snail tentatively assigned to the genus *Striatura* (Family Zonitidae). We now identify this species as *Paralaoma servilis* (Shuttleworth, 1852) (Family Punctidae) and report its occurrence also on the Island of O'ahu (Fig. 1). The



**Figure 1.** Live specimen of *Paralaoma servilis* collected in the Wai'anae Mountains on O'ahu. Scale bar = 1 mm

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**Figure 2.** Shells of *Paralaoma servilis*. Left side - specimen collected on O'ahu (275966); right side - specimen collected from the native range in New Zealand (274825). Images from top to bottom show views of aperture, umbilicus, apex, and scanning electron micrograph of embryonic whorl. Scale bars = 0.5 mm (left side) and 0.2 mm (right side) for SEM images

shells of the Hawaiian specimens were compared with New Zealand material. Preliminary phylogenetic analysis revealed less than 3.8% genetic distance (maximum likelihood corrected) at the 16S rDNA mitochondrial gene between specimens collected on O'ahu and in New Zealand (Yeung & Hayes unpublished data). The apical sculpture of *P. servilis* (Fig. 1 bottom left and right; see also Roth 1986) consists of fine spiral threads, unlike the broader spiral ridges of *Striatura* as exemplified by *S. exigua* (Stimpson, 1850) and *S. milium* (Morse, 1859) (Solem 1977a, 1977b). Specimens in the Bishop Museum collection demonstrate that the species has been present on the Island of Hawai'i since at least 1935.

*Paralaoma servilis* has had a long and complex taxonomic history. It was first described as *Helix pusilla* Lowe, 1831 (not *H. pusilla* Vallot, 1801 or Fleming, 1828), based on material from the Atlantic island of Madeira; subsequently, descriptions appeared for *Helix servilis* Shuttleworth, 1852, and *Helix caputspinulae* Reeve, 1852, based on material from the Canary Islands and New Zealand, respectively. Roth (1985, 1986, 1987) recognized the identity of Lowe's *pusilla* and the North American *Punctum conspectum* (Bland, 1865) with the New Zealand *caputspinulae*, and Falkner *et al.* (2002) demonstrated that Shuttleworth's *servilis* is the oldest available name for this taxon. In addition to the localities mentioned above, the species is now widespread in Australia (e.g., Smith 1992) and South America (e.g., Hausdorf 2002) and is rapidly expanding its range in Europe and elsewhere (e.g., Gittenberger *et al.* 1980; Guntrip 1986; Walbrink *et al.* 2001; Griffiths & Florens 2006). A multitude of synonyms, far too many to consider here, have been erected for populations of *P. servilis* that have become established in Europe, North and South America, and elsewhere. However, notwithstanding its relatively early emigration from New Zealand, it has as yet attained only a modest presence elsewhere in Polynesia; Climo (1981) concluded that *Paralaoma raoulensis* Iredale, 1913, of the Kermadec Islands, type species of *Paralaoma*, is a synonym of *P. servilis*, and Kirch *et al.* (2009) reported the species from Easter Island. Solem (1983) cited no records from this region in his monograph of Pacific Island Punctidae and Charopidae.

The status of *Paralaoma servilis* as indigenous to New Zealand is demonstrated by its presence there in numerous sites of Holocene age (Jones 1984; McFadgen 1997; Brooke 1999a, 1999b, 1999c, 2000; Brooke & Goulstone 1999). It has also been reported from sediments of Pleistocene age from Queensland, Australia (Price & Webb 2006). Although New Zealand is more often a recipient of alien nonmarine mollusks (Barker 1999) than a source of such invaders, *P. servilis* is not the only New Zealand snail to have ventured overseas. *Potamopyrgus antipodarum* (Gray, 1843), a freshwater hydrobiid, invaded Europe and Australia from New Zealand in the nineteenth century and has recently become established in North America (Ponder 1988; Städler *et al.* 2005).

All collected material is deposited in the Bishop Museum (BPBM) Malacology Collection and numbers refer to BPBM Malacology Collection numbers.

*Material examined.* HAWAIIAN ISLANDS: O'AHU: Kahanahāiki, Wahiawā, N21°32.459', W158°11.774', NWY, T.H. Durkan, D.T.B. Ressler, D.R. Sischo, J.R. Kim, P.A. Curry, 4 Jun 2011 (275966); Mt Ka'ala, Wahiawā, N21°30.786', W158°08.960' NWY, T.H. Durkan, D.T.B. Ressler, D.R. Sischo, J.R. Kim, P.A. Curry, 20 May 2011 (275967); HAWAII: Humu'ula, 6400 ft, H.B. Baker, 9 Aug 1935 (161707); Kīlauea, Bird Park, H.B. Baker & C.M. Cooke, Jr., 11 Aug 1935 (161804); Pu'u Wa'awa'a, Hawai'i, M. Anderson, D. Anderson, 26 Dec 1937, (171765, 171766); Pōhakuloa, Hawai'i, R.H. Cowie, G.M. Nishida, 10 Mar 1992 (275968); NEW ZEALAND: Chicken Island, F.J. Brook (274825).

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