

The Greater Bermuda Land Snail *Poecilozonites bermudensis* – a Lazarus species discovered in the center of an urban environment

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Overview: The genus *Poecilozonites* is endemic to Bermuda. At least twelve different species are known from the fossil record but only two were recorded as being extant in the mid-20th century; the greater Bermuda land snail *Poecilozonites bermudensis* and the lesser Bermuda land snail *P. circumfirmatus*. The former was believed to be extinct by the early 1990s, however a relict population was recently found inhabiting a concrete alley and small courtyard measuring only 200 ft² in area within the city of Hamilton - the most urbanized region of Bermuda. A population assessment revealed that all size classes (2.5 to 22.5 mm shell diameter) were encountered and recruitment was occurring. Abundance was estimated to be 328 snails ≥ 10.0 mm shell diameter. Fifty four hatchlings and small juveniles were collected and taken to the Department of Conservation Services in order to establish a captive colony.

Fig.1 Map showing location of Bermuda in relation to the U.S.A. and Britain

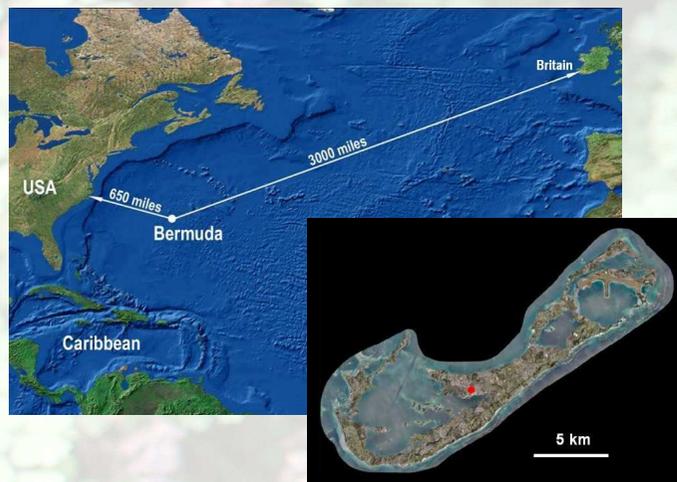


Fig.2 Aerial map of Bermuda showing location where *P. bermudensis* was rediscovered in 2014 (red dot)

Fig.6 Courtyard where extant *P. bermudensis* population was found



Poecilozonites is a highly distinctive genus of zonitid snails that is one of the oldest endemic elements of the land fauna of Bermuda (1) and has spent more than one million years surviving radical changes in land area and ecology on these remote oceanic islands (2). At least twelve different species are known from the fossil record and are believed to represent a single lineage that exhibited pulses in size and shape which correlate with fluctuating sea levels throughout the Pleistocene era (2). Furthermore, historical predation is considered the factor most likely to have selected for gigantism in the anagenetic lineage of *Poecilozonites*. During the last 500,000 years, pulses of gigantism in these snails corresponds with periods when the island was colonized by large vertebrate predators (specifically birds and a species of tortoise) which created selection pressure favoring large size and rapid growth in the snails (3).

Both the lesser Bermuda land snail *P. circumfirmatus* and the greater Bermuda land snail *P. bermudensis* rapidly declined island-wide after the introduction of several species of predatory snails during the 1950s and 1960s (4, 5). By the early 1990s *P. bermudensis* was believed to be extinct (5, 6), although a survey in 1988 revealed several fresh dead specimens (empty shells with intact periostraca) suggesting that there may have been an extant relict population in one location (7).

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On September 16th 2014, a member of the public contacted the Department of Conservation Services saying that he had found an empty snail shell on his business premises in the city of Hamilton (Fig.2) that looked like it might belong to the genus *Poecilozonites*. A live snail was encountered on the following day at the same location. Both were taken to the Bermuda Natural History Museum and subsequently identified as *Poecilozonites bermudensis* (Figs.3 and 4).

Given that previous terrestrial gastropod surveys failed to locate living specimens of *P. bermudensis* in recent decades (7, 8, 9), it was surprising that a prompt examination around the discovery location revealed an extant population of *P. bermudensis* inhabiting approximately 200 ft² of area within the city of Hamilton - the most urbanized region of Bermuda. Population size was estimated via mark-recapture sampling and calculated using the Chapman estimator. The survey results revealed an estimate of 328 snails ≥ 10.0 mm. All size classes were encountered (e.g. hatchlings to adult snails), with shell diameters ranging from 2.5 to 22.5 mm (Fig.5). Snails were particularly abundant in and around a drainage channel running the length of the concrete alley, as well as in a small courtyard at the end of the alley (Fig.6). The majority of the living snails were found at ground level, although a few were encountered on vertical surfaces within three feet of the ground. Those inhabiting the alley appeared to favor longitudinal cracks in the cement while those in the courtyard were found under various pieces of wood, among fern (*Adiantum bellum*), within the moist folds of plastic bags and beneath construction debris (most notably short lengths of metal and PVC piping as well as pieces of insulation material).

It is not known whether *P. bermudensis* colonized the site after it was commercially developed in the past or whether they were always present at that location and persisted in a favorable environment following development. Regardless, it is likely that their urban isolation has offered protection from invertebrate predators (especially the carnivorous snails *Euglandina rosea*, *Gonaxis quadrilateralis* and *Rumina decollata*) that are believed to have decimated *Poecilozonites* populations throughout the rest of Bermuda (4, 5, 6). Additionally, this area appears to have had remained relatively unchanged for many decades thereby providing environmental stability to the snail population.

At the conclusion of the survey, 54 hatchlings and small juveniles were collected and taken to the Department of Conservation Services in order to establish a captive breeding colony. Their care will be based on husbandry protocols developed by the Zoological Society of London (10) for *Poecilozonites circumfirmatus*. Environmental parameters (such as temperature and humidity) for the alley and courtyard are unknown, therefore a HOBO Pro v2 data logger from Onset Computer Corporation was installed to collect data that will help to better inform the care of the captive specimens.

Fig.3 Empty shells of *P. bermudensis*



Photos by Mark Outerbridge

Fig.4 Mature living *P. bermudensis*

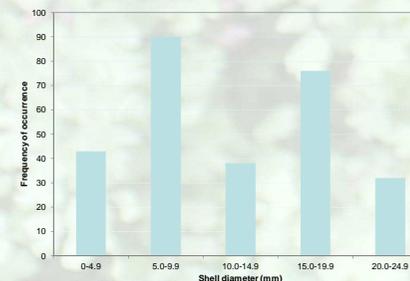


Fig.5 Length-frequency histogram of shell size for 279 *P. bermudensis* snails

Plans are currently being made to send *P. bermudensis* to the Zoological Society of London in order to establish an *ex-situ* breeding colony (this organization already is caring for a captive colony of *P. circumfirmatus*). Furthermore, *P. bermudensis* is now being advocated for inclusion on the Bermuda Protected Species Act (*P. circumfirmatus* is already protected) and both *P. circumfirmatus* and *P. bermudensis* are being considered for IUCN red-listing.

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