

THE ENDEMIC LAND SNAILS OF THE FERNANDO DE NORONHA ARCHIPELAGO, BRASIL

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Fernando de Noronha (henceforth ‘Noronha’) is an oceanic archipelago of volcanic origin, located ~350 km off the northeast coast of Brasil (Fig. 1). The eponymous main island was an important midway port in the Portuguese exploitation of Brazilian resources during the 16th and 17th centuries (Lins & Silva, 2013). The island was also briefly occupied by the British, French and Dutch. It also served as a prison until the mid-20th century (Pessoa, 2014).

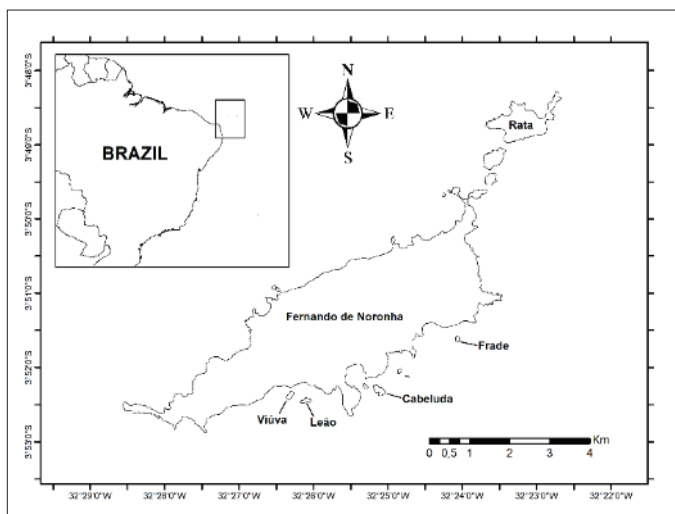


Fig. 1. Location of the Fernando de Noronha archipelago off the Brazilian coast.

Noronha still had much of its natural cover when Darwin visited it in 1832 (Darwin, 1839), but most of that had already been cut down by the end of the 19th century (Ridley, 1890). Today, most of its area is a national marine reserve and the archipelago is a UNESCO World Heritage Site (Fig. 2).

Noronha’s terrestrial snail fauna is a mix of mainland species (including possibly introduced ones) and endemics. Similar to what is seen on other archipelagos around the world, Noronha’s endemic species are very distinct from the rest of the Brazilian land snails.



Fig. 2. Aerial view of Noronha (source: Wikimedia Commons, GNU-FDL, 2004; CC BY-SA 3.0).

Systematics

Historically, the three endemic species from Noronha have been classified in three monospecific genera, as *Bonnanius ramagei* (Smith, 1890), *Hyperaulax ridleyi* (Smith, 1890) and *Ridleya quinquelirata* (Smith, 1890). However, all of them have recently gone through taxonomic revisions involving morphological and molecular analyses, which have resulted in some important changes.

The genus *Bonnanius* Jousseaume, 1900 is now considered a synonym of *Hyperaulax* Pilsbry, 1897 (Salvador & Cavallari, 2019). Thus, its single species is now classified as *Hyperaulax ramagei* (Fig. 3). Furthermore, molecular data on *H. ridleyi* (Fig. 4) have supported placement of *Hyperaulax* in the Odontostomidae (Orthalicoidea; Salvador & Cavallari, 2019). That analysis also suggested that *Hyperaulax* is closely related to the continental genus *Tomigerus* Spix, 1827.

Ridleya quinquelirata (Fig. 5) is the species that underwent most changes in nomenclature and classification. First, the gastropod genus *Ridleya* Ancey, 1901 was recognized as a junior homonym of the sponge genus *Ridleya* Delage & Hérouard, 1899 (Christensen, 2020). As such, a new name was proposed for the snail genus: *Ridleyconcha* Christensen, 2020.

Throughout the decades, *Ridleyconcha quinquelirata* was classified in several stylommatophoran families: Streptaxidae,



Fig. 3. *Hyperaulax ramagei*, lectotype (NHMUK 1988.6.24.163) in three views. This species was originally described as *Bulimus (Bulimulus) ridleyi* Smith, 1890.



Fig. 4. *Hyperaulax ridleyi*, lectotype (NHMUK 1888.6.27.106) in two views. This species was originally described as *Bulimus (Tomigerus) ramagei* Smith, 1890.



Fig. 5. *Ridleyconcha quinquelirata*, syntype (NHMUK 1988.6.27.135). This species was originally described as *Helix (Ophiogyra?) quinquelirata* Smith, 1890.

Endodontidae, Charopidae and Camaenidae. In a recent review based solely on conchological characters, Salvador (2019a) proposed that it belonged instead in the family Scolodontidae. A new phylogenetic study based on genetic markers has confirmed its placement in Scolodontidae, with *Ridleyconcha* as the sister taxon to *Entodina* Ancey, 1887 (Salvador, 2021).

Finally, there is a fourth possibly endemic species from Noronha, *Gastrocopta solitaria* (Smith, 1890). However, given that species of Pupilloidea have been readily introduced worldwide, a reassessment of the validity of this species is needed.

These latest morphological and molecular analyses have thus permitted revision of Noronha's endemic land snails, resulting in several advances in our knowledge of them.

Conservation

However, there are now issues regarding the conservation of these snails that need to be addressed. Freitas *et al.* (2019) recently conducted a land snail survey in Noronha, reporting on the species' distribution and abundance in the archipelago. Of a total of 20 surveyed sites on the main island, land snails were found at only three, two of them with live snails (Fig. 6) and a third where long-dead or subfossil shells of *H. ridleyi* were recovered from a dune deposit. These authors reported four land snail species on Noronha: *H. ridleyi*, *R. quinquelirata*, *Beckianum beckianum* (Pfeiffer, 1846) and *Allopeas gracile* (Hutton, 1834).

The latter two species are widespread in the neotropics, but both have been widely distributed by human commerce. *Beckianum beckianum* is believed to be native to Central and South America, though it now occurs elsewhere as well (Pilsbry, 1906–1907; Cowie, 1997). *Allopeas gracile* is now pantropical in distribution and even though a neotropical origin has been suggested (e.g. Pilsbry, 1946), its presence in the fossil and pre-modern archaeological record from Africa to the islands of Polynesia indicates an origin in the Old World tropics (Christensen & Weisler, 2013). As such, *A. gracile* has in all likelihood been introduced to Noronha, while *B.*



Fig. 6. Habitat and vegetation on the coastal lowland plains near Cacimba do Padre beach, where Freitas *et al.* (2019) found *A. gracile*, *B. beckianum*, *H. ridleyi* and *R. quinquelirata*.

beckianum may be considered as possibly introduced.

Other notable introduced species in Brasil are thankfully absent from Noronha, such as the giant African snail *Lissachatina fulica* (Bowdich, 1822) and the Asian tramp snail *Bradybaena similaris* (Férussac, 1821). Freitas *et al.* (2019) hypothesised that the arid conditions of the archipelago would act as a deterrent to their establishment.

Hyperaulax ridleyi was the most abundant species reported by Freitas *et al.* (2019), while *R. quinquelirata* was restricted to a single locality (Fig. 7). Despite the good news of finding these endemics alive (and in sites with moderate to high anthropogenic disturbance), their limited distribution might be a reason for concern. Habitat destruction is considered to be the main threat to Noronha's endemic land snails, as the native forests have been widely converted to secondary vegetation over the past two centuries (Freitas *et al.*, 2019).

Freitas *et al.* (2019) did not find the endemic *Hyperaulax ramagei* or the possibly endemic *Gastrocopta solitaria* in their survey. They also did not find *Rhinus pubescens* (Moricand, 1846), a mainland species that had been reported previously



Fig. 7. Left: live *H. ridleyi* found under loose bark of a live shrub. Right: live *R. quinquelirata* under dead bark on the soil.

from Noronha (Simone, 2006). As a confirmed endemic species, *Hyperaulax ramagei* is of particular interest. This species has not been found alive during any collecting efforts since the 1990s (Salvador & Cavallari, 2019). Museum specimens of *H. ramagei* that still have a well preserved periostracum typically date back to the first half of the 20th century (Salvador & Cavallari, 2019), indicating that the species was still alive back then. Either this species still survives in a very restricted range or, more likely, it has become extinct.

Of the ~700 land snail species found in Brasil, only an insignificant number has any sort of protection (Salvador, 2019b). The work done on the endemic snails of Noronha in the past few years will allow assessment of the risks that each species faces and determine their conservation status according to the IUCN guidelines (IUCN, 2012). Vulnerability to extinction is correlated with geographic range on oceanic islands, with less widespread species being the most likely to become extinct (Chiba & Roy, 2011; Chiba & Cowie, 2016). In Noronha, the two endemic land snails are only known from the main island (with museum specimens indicating their former presence on the adjacent Rata Island), which suggests they are in a very vulnerable position.

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