

## Box 4.4 Land snails of the Socotra Archipelago

Eike Neubert, Senckenberg Research Institute, Frankfurt, Germany

Molluscs are often among the first of Socotra's invertebrates to be spotted by visitors, and are of particular interest to studies of phylogeny – the evolutionary relationships among species, biogeography, nature conservation and management. Socotra's terrestrial malacofauna is highly endemic at both species and generic levels, with some 95 % and 75 % endemism respectively. Some species are abundant and widespread, at least on the main island, although others are rare or have very restricted local distributions and are only occasionally seen. There is virtually no overlap in species distribution ranges among the different islands, with important evolutionary and biogeographic implications relating to the geological genesis of the islands and its position in central Gondwana.

The malacofauna of the archipelago is dominated by the radiation of three major groups, i.e. the operculate family Pomatiidae and the two pulmonate families Cerastidae and Subulinidae, representing about 80 % of the total record of species. Today, pomatiid snails are found in Europe, South-western Arabia, East Africa and its offshore island groups, Madagascar, and a small area in North-west India. The shell characteristics of the Socotran genus *Socotra* illustrate the close relationship with the mainland Pomatiidae, like *Revoilia* and *Rochebrunia* still living in Arabia and Somalia. All other pomatiid genera and species recorded from Socotra are endemic to the archipelago. They probably have evolved after the separation from Arabia; or their mainland ancestors could not survive the enormous environmental changes affecting the area since the Miocene.

The members of the pulmonate families seem to be more distantly separated from their continental relatives, probably related to a faster evolutionary rate when compared with the operculates. The family Cerastidae, with almost 40 species present, is the most speciose molluscan family on the island. Species of the enigmatic cerastid genus *Passamaella* are characterized by the major narrowing of their aperture in combination with a multitude of teeth. This particular form of aperture may help to protect this ground-dwelling species against carnivorous ground beetles like the big carabids. Another predator-avoidance strategy is to climb trees, and the keen observer will

easily notice the big clumps of snails aestivating on the trunks of *Adenium*, *Dracaena*, *Croton* and other shrubs. These species survive unfavourable climatic periods in well shaded and temperate positions, but are then target of larger birds like starlings which have learned to exploit this water- and protein-rich food source. The tree-climbing strategy is mainly employed by species of *Achatinelloides*, the zig-zag pattern on their shell surface providing an excellent form of camouflage when the wind moves the foliage of the trees.

The third group, family Subulinidae, is represented by some 10–15 species, characterized by multi-whorled, turreted to needle-like shells. The archipelago has given rise to at least two endemic genera – *Riebeckia* and *Balfouria*. Every visitor of the island will remember the large whitish turreted shells of *Riebeckia*, which range among the largest shells in the family, reaching a height of up to 100 mm.



Kay Van Damme

*"Tropidophora" socotrana*, a land snail (1–1.5 cm) found on Socotra Island.

Much more difficult to detect are the smaller species of *Balfouria*, as their shell surface is covered by a dense pattern of ribs in combination with a periostracum forming a "fur" of bristles and hairs. The purpose of this very unusual "fur" became obvious at the recovery of *Balfouria samhaensis*: We found small 'clumps of clay' actively crawling over the moist ground at a cave entrance in the escarpment of Samha. Peeling off the clay clump, a small shell appeared as its core! The dense cover of bristles was used as anchor structure for the clay, thus protecting the animal against predators and desiccation.

Currently, the terrestrial molluscs are intensively studied and recent taxonomic revisions will lay the foundation for future research on phylogeny, biogeography and nature conservation. At present, the number of continental species (including freshwater) is about 100-110 taxa. Because the malacology of large areas of Socotra Island and the satellite islands is still unknown, the discovery of additional species can be expected. As far as is known, the islands share almost no species with the only exception being *Socotra albicans* from Socotra, Samha and Darsa. At generic level, only the pomatiid genus *Lithidion* occurs on all the islands, the other genera are more or less restricted to one or two islands. Although this observation is not fully established, it sheds light on the separation history of the archipelago. The islands separated very early from each other and, from the snails' perspective at least, have remained isolated over the complete period until today. The same holds true for the hypothesized land-bridges with either Arabia or Africa. None of the more "modern" molluscan groups was able to use such connections. Overall, the Socotran malacofauna is of central Gondwanan origin, and there are no palaearctic or asiatic elements present. *Indoplanorbis exustus* from India is an introduction to the lagoon of Hadiboh by sailors while refilling water barrels.

Even on Socotra itself, areas of microevolution can be identified. According to the current state of knowledge, the Haggeher Mountains with the surrounding high limestone plateau (> 1000 m alt.) and the Wadi Qalansiyah with its frame of steep limestone hills are two centres of radiation. In all islands, the arid and crystalline basement rock harbours a particular endemic type of species which can withstand these environmental conditions. The thick limestone layer is occupied by a different set of species or genera. Habitats of some species can be very small, covering a patch of land with a diameter of 1-2 km or even less<sup>161</sup>. Being highly susceptible to landscape transformation, mollusc species are a useful monitoring tool, and can serve as an instrument in nature conservation arguments. To fulfill these functions, precise data on species composition, distribution and autecology are required<sup>162-165</sup>.

Captions for facing plate:

- 1) *Achatinelloides hadibuensis*: Socotra, coastal road ca 5 km in direction to east, small canyon with a running creek, Ficus-wetlands, Adenium and Croton, contact zone limestone/granite, 12°37.93'N 54°9.26'E, 4.2.1999, shell height 22.0 mm.
- 2) *Passamaella mirabilis*: Socotra, Haggeher Granite Peak, 12°35'30.5''N 54°05'24.6''E, 987 m alt., 22.01.2003, leg. K.Van Damme, shell height 23.2 mm.
- 3) *Socotra naticoides*: Socotra, Wadi Qalansiyah, eastern end in the mountains, 12°37,087N 53°37,227E, 333 m alt., IV.1999, leg. R. Janssen, shell diameter 39.5 mm.
- 4) *Lithidion lithidion*: "Yemen", Syntype Natural History Museum London (1843.10.2.122), shell diameter 9.6 mm.
- 5) "Tropidophora" *socotrana*: Socotra, en route between Homhil and Kilisan, limestone boulders with low and dense shrubs, ca 200 m alt., 12°33.85'N 54°20.08'E, 9.2.1999, leg. E. Neubert, shell diameter 10.2 mm.
- 6) *Riebeckia sokotorana*: Socotra, under limestone boulders at the entrance of the cave of Hoq, 50-320 m alt., 5.-6.2.1999, leg. E. Neubert, shell height 64.0 mm.
- 7) *Balfouria* sp.: Socotra, hills and meadows in the eastern part of the plain of Homhil, 12°34.17'N 54°19.53'E, 540 m alt., 9.2.1999, leg. E. Neubert, 540 m alt., 9.2.1999, shell height 22.4 mm.

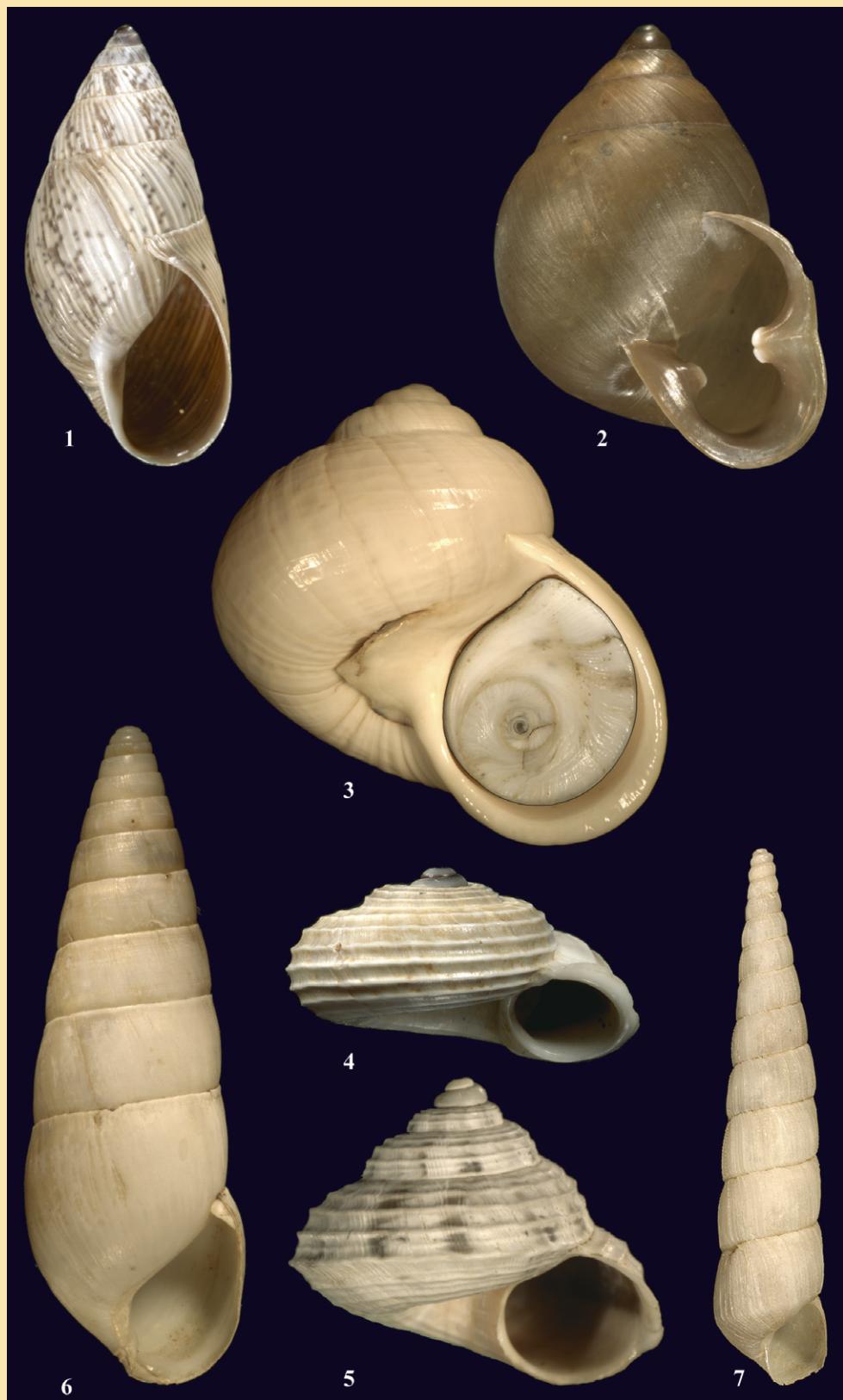


Plate courtesy of Eike Neubert.