

Fig. 2. The possible dispersal route of the alien caterpillar slug *L. haroldi* from Natal to Kolkata and elsewhere in India.

- Avhad, S.B., Shinde, K.S. & Hiware, C.J. 2013. Record of molluscan pests in mulberry gardens in Aurangabad district of Maharashtra state, India. *Indian Journal of Sericulture* 52(1): 29-33.
- Barker, G.M. 2001. *The Biology of Terrestrial Molluscs*. CABI Publishing, Wallingford.
- Bouchet, P., Rocroi, J.P., Hausdorf, B., Kaim, A., Kano, Y., Nürzel, A., Parhaev, P., Schrödl, M. & Strong, E.E. 2017. Revised classification, nomenclator and typification of gastropod and monoplacophoran families. *Malacologia* 61(1-2): 1-526.
- Budha, P.B., Naggs, F. & Backeljau, T. 2015. Annotated checklist of the terrestrial gastropods of Nepal. *ZooKeys* 492: 1-48.
- Dundee, D.S. 1980. *Laevicaulis haroldi*, a new veronicellid slug from Natal, South Africa (Gastropoda: Pulmonata). *The Nautilus* 94(3): 18-20.
- Forcart, L. 1953. The Veronicellidae of Africa (Mollusca, Pulmonata). *Annales du Musee Royal du Congo Belge* 23: 1-110.
- Gomes, S.R. & Thomé, J.W. 2004. Diversity and distribution of the Veronicellidae (Gastropoda: Soleolifera) in the Oriental and Australian biogeographical regions. *Memoirs of the Queensland Museum* 49: 589-601.
- Gomes, S.R., Britto da Silva, F., Mendes, I.L.V., Thomé, J.W. & Bonatto, S.L. 2010. Molecular phylogeny of the South American land slug *Phyllocaulis* (Mollusca, Soleolifera, Veronicellidae). *Zoologica Scripta* 39(2): 177-186.
- Govender, V. 2007. *Patterns of Distribution, Diversity and Endemism of Terrestrial Molluscs in South Africa*. PhD Thesis. School of Biological and Conservation Science, University of KwaZulu-Natal. vii + 219 + un-numbered p.
- Gude, G.K. 1914. *The Fauna of British India, including Ceylon and Burma. Mollusca.—II. (Trochomorphidae—Janellidae)*. Taylor and Francis, London. xii + 520 p.
- Herbert, D.G. 1997. The terrestrial slugs of KwaZulu-Natal: diversity, biogeography and conservation (Mollusca: Pulmonata). *Annals of the Natal Museum* 38: 197-239.
- Herbert, D.G. 2013. *Laevicaulis haroldi*. *The IUCN Red List of Threatened Species* 2013: e.T40089A50080884. Downloaded on 30 December 2019.
- Khan, A. 2019. Alien in my garden: a new record of an exotic *Laevicaulis* slug species in northern India. *Zoo's Print* 34(7): 25-28.
- Magare, S.R. 2015. New record of exotic species of slug, *Laevicaulis haroldi* in India. *Records of the Zoological Survey of India* 115(1): 105-107.

- Marambe, B., Silva, P., Ranwala, S., Gunawardena, J., Weerakoon, D., Wijesundara, S., Manawadu, L. Atapattu, N. & Kurukulasuriya, M. 2011. Invasive alien fauna in Sri Lanka: National list, impacts and regulatory framework. In: *Island Invasives: Eradication and Management* (ed. Veitch, C.R., Clout, M.N. & Towns, D.R.), p. 445-450. IUCN, Gland, Switzerland.
- Raheem, D.C., Taylor, H., Ablett, J., Preece, R.C., Aravind, N.A. & Naggs, F. 2014. A systematic revision of the land snails of the Western Ghats of India. *Tropical Natural History Supplement* 4: 1-294.
- Ramakrishna, Mitra, S.C. & Dey, A. 2010. Annotated checklist of Indian land molluscs. *Records of the Zoological Survey of India, Occasional Paper No. 306: 1-359*.
- Runham, N.W. & Hunter, P.J. 1970. *Terrestrial Slugs*. Hutchinson & Co., London. 184 p.
- Tripathy, B., Sajan, S.K. & Mukhopadhyay, A. 2018. Mollusca. In: *Faunal Diversity of Indian Himalaya* (ed. Chandra, K., Gupta, D., Gopi, K.C., Tripathy, B. & Kumar, V.), p. 785-796. Zoological Survey of India, Kolkata.

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POTAMOLITHUS SPP. IN THE ARGENTINE PAMPAS

By Micaela de Lucía & Diego E. Gutiérrez Gregoric

The genus *Potamolithus* is the only native representative of the family Tateidae in South America. It includes small gastropods (up to 7 mm) that inhabit rivers and streams of the Southern Cone of South America (López Armengol, 1996). Most of the species of *Potamolithus* are known only from their shells; only a few have anatomical and molecular information. In Argentina, nine species (out of the 24 present) have anatomical descriptions that include pallial organs, radula, reproductive system and external characters of the soft parts (Pilsbry, 1911; López Armengol, 1996; Miquel, 1998; Núñez, 2016; de Lucía & Gutiérrez Gregoric, 2017a, b). From the genetic point of view, only four species have information available in GenBank. There have been no studies of population level aspects in the genus.

In the [IUCN Red List](#) seven species of *Potamolithus* have been evaluated, all by G. Pastorino and G. Darrigran; four of them were classified as Least Concern and three as Data Deficient. The Argentinean coasts of the Río de la Plata are used for different purposes (port, recreation, source of drinking water and wastewater, for dumping of waste and industrial effluents, sport and commercial fishing, water sports), which could affect species of *Potamolithus*; however, the actual impact of these threats is unknown (Darrigran, 1999). Six species of *Potamolithus* have been recorded from Buenos Aires province: *P. agapetus* Pilsbry, 1911; *P. bisinuatus* Pilsbry, 1896; *P. buschii* (Frauenfeld, 1865); *P. lapidum* (d'Orbigny, 1835); *P. petitianus* d'Orbigny, 1840 and *P. orbignyi* Pilsbry, 1896 (López Armengol & Darrigran, 1998). These records are based on data from malacological collections and sampling carried out in the 1980s. It is noteworthy that in 1991 the presence of the invasive mussel



Fig. 1. Martín García Island, Buenos Aires province, Argentina. *Potamolithus* sp. and *Chilina* sp. in yellow box.

Limnoperna fortunei (Dunker, 1857) (Pastorino *et al.*, 1993) was recorded in the Río de la Plata. This species is considered an ecosystem engineer for its ability to transform the environment it colonises (Darrigran & Damborenea, 2011). The presence and abundance of the golden mussel have led to a decrease of native gastropods, displacing local populations of *Chilina fluminea* (Maton, 1809) and *Uncancylus concentricus* (d'Orbigny, 1835) on the Argentinean coasts of the Río de la Plata (Darrigran *et al.*, 1998).

The objective of this project is to know the conservation status of the genus *Potamolithus* on the Pampean region along the coast of the Río de la Plata. For this, seasonal sampling is being carried out at sites with historical records, providing the first population studies (growth and recruitment) of species in this genus and completing anatomical and molecular descriptions. These studies are part of the doctoral thesis of the first author at the Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata.

Samples were taken along the coast from Martín García Island (IMG), which is a protected area (34°11' S, 58°14' W) (Fig. 1), to Atalaya Beach (35°00' S, 57°32' W), during 2018 and 2019. The Argentinean coast of the Río de la Plata has been greatly altered by people and the invasion of *Limnoperna fortunei* (Fig. 2) in recent years, which has made it difficult to find specimens of *Potamolithus*. On IMG, specimens have been observed at various sites, and growth experiments have been carried out both in situ and in the laboratory. The first observations indicate that they reach sexual maturity at 157 days after hatching, as evidenced by a complete peristoma.

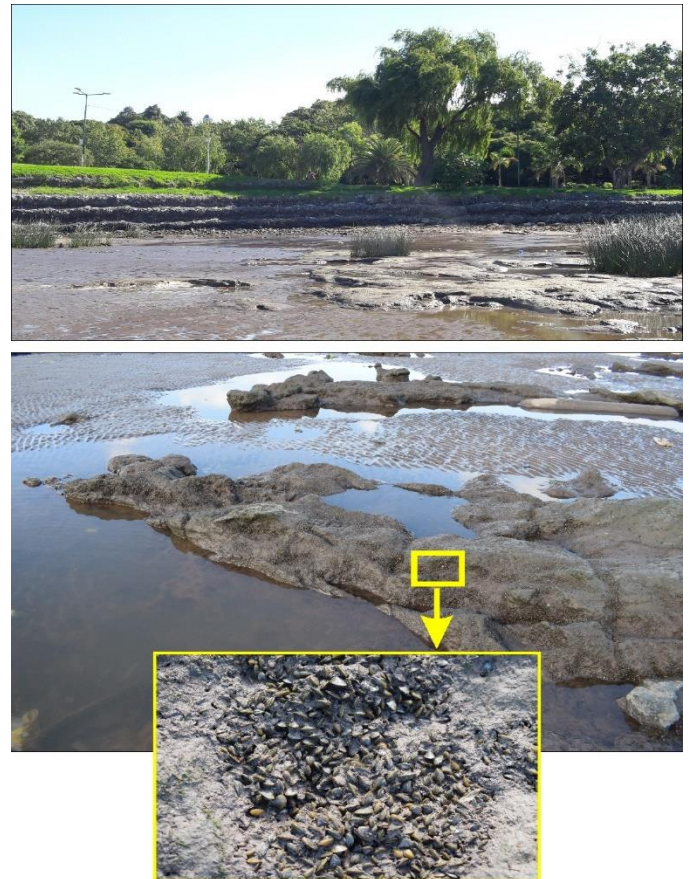


Fig. 2. Anchorena Beach (San Isidro), Buenos Aires province, Argentina. *Limnoperna fortunei* in yellow box.

As a result of the conchological, anatomical and genetic analyses, five taxonomic entities are distinguished: 1) two entities correspond to species already recorded on IMG, and both now have anatomical and molecular descriptions (*P. agapetus* and *P. buschii*); 2) one entity corresponds, based on shell characters, to *P. bisinuatus*, previously recorded on IMG but for which only conchological data are as yet available; and 3) two entities that do not correspond to any of the species recorded on IMG.

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Darrigran, G. 1999. Longitudinal distribution of molluscan communities in the Río de la Plata estuary as indicators of environmental conditions. *Malacological Review* Supplement 8: 1-12.

Darrigran, G., Martín, S.M., Gullo, B. & Armendariz, L. 1998. Macroinvertebrados asociados with *Limnoperna fortunei* (Dunker, 1857) (Pelecypoda, Mytilidae) in Río de la Plata, Argentina. *Hydrobiologia* 367: 223-230.

- Darrigran, G. & Damborenea, C. 2011. Ecosystem engineering impacts of *Limnoperna fortunei* in South America. *Zoological Science* 28: 1-7.
- de Lucía, M. & Gutiérrez Gregoric, D.E. 2017a. The genus *Potamolithus* Pilsbry, 1896 (Gastropoda: Tateidae) on the Somuncurá Plateau, Patagonia, Argentina. *Molluscan Research* 37: 202-211.
- de Lucía, M. & Gutiérrez Gregoric, D.E. 2017b. Redescrípción de *Potamolithus supersulcatus* Pilsbry, 1896 (Gastropoda, Tateidae) del sur de la cuenca Del Plata. *Papeis Avulsos de Zoologia* 57(17): 207-219.
- López Armengol, M.F. 1996. Taxonomic revision of *Potamolithus agapetus* Pilsbry, 1911, and *Potamolithus buschii* (Frauenfeld, 1865) (Gastropoda: Hydrobiidae). *Malacologia* 38: 1-17.
- López Armengol, M.F. & Darrigran, G. 1998. Distribución del género Neotropical *Potamolithus* Pilsbry y Rush, 1896 (Gastropoda: Hydrobiidae) en el estuario del Río de la Plata. *Iberus* 16(2): 67-74.
- Miquel, S.E. 1998. Una nueva especie de *Potamolithus* de la Patagonia (Gastropoda, Prosobranchia, Hydrobiidae). *Biociencias* 6: 145-157.
- Núñez, V. 2016. Redescription of *Potamolithus paranensis* (Pilsbry, 1911) and *Potamolithus simplex* (Pilsbry, 1911) (Gastropoda: Tateidae). *Molluscan Research* 37: 17-30.
- Pastorino, G., Darrigran, G., Martín, S.M. & Lunaschi, L. 1993. *Limnoperna fortunei* (Dunker, 1857), nuevo bivalvo invasor en aguas del Río de la Plata. *Neotrópica* 39(101-102): 34.
- Pilsbry, H.A. 1911. Non-marine Mollusca of Patagonia. In: *Reports of the Princeton University Expeditions to Patagonia, 1896-1899, Vol 3, Zoology, Part V* (ed. Scott, W.B.), p. 513-633. Princeton University, USA, Princeton, NJ.

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FURTHER SPREAD OF THE ALIEN GASTROPOD *OTALA PUNCTATA* (MÜLLER, 1774) IN MALTA

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The helicid *Otala punctata* (Müller, 1774), native to the western Mediterranean (Martinez-Orti & Robles, 2001), was introduced into a plant nursery near Mosta, in central Malta, with imported horticultural material sometime around 2003 (Mifsud *et al.*, 2003). From here it dispersed to establish a breeding population in the area surrounding the nursery (Barbara & Schembri, 2008, 2010)

A second population of *Otala punctata* (Fig. 1) subsequently established itself at Bahrija, a rural agricultural area, some 7 km distant from the original site of introduction. The authors investigated the distribution and abundance of *Otala punctata* at the Bahrija site, as well as that of the native helicid *Eobania vermiculata* (Müller, 1774), which has a similar ecology to that of the alien species under study and which, therefore, may be negatively affected by the introduction.



Fig. 1. *Otala punctata* from Bahrija, Malta. Scale bar 10 mm. (Photo: S. Camilleri)

Otala punctata was noted to have colonised three sectors along the Bahrija valley system, and, at the time of survey, the species occupied an overall area of approximately 0.6 km², with a mean abundance of 0.4 individuals per m². It now appears that the alien helicid has not, thus far, affected the population of *Eobania vermiculata*, as the population density of the native species remained more or less constant within the plots investigated along the valley watercourse (seasonal run-off conduit), regardless of incidence and abundance of the alien species. The density of *Otala punctata* was highest (1.98 individuals per m²), close to the presumed site of initial introduction at Bahrija (35°53'28"N, 14°20'40"E), where the first individuals were recorded (Cilia, 2012). We estimate that the yearly rate of expansion of the area of occupation of *Otala punctata* at Bahrija is 0.075 km² per year. This was calculated in terms of area at the end of a time period (T) divided by the number of years since its first occurrence (Y); therefore, T/Y = rate of expansion per year.

Otala punctata was most abundant in low virescent vegetation. In contrast, *Eobania vermiculata* was most abundant in areas where dry vegetation, mostly grasses, were predominant. This suggests a degree of habitat segregation between the alien and native snails. *Otala punctata* also showed a preference for aestivating attached to tree stumps (Fig. 2) and trunks, as well as to vines (*Vitis vinifera*), presumably to avoid predation and to evade the scorching heat at ground level (Albrecht, 2001; Herbert, 2010).

Shell measurements indicated a higher abundance of juvenile *Otala punctata* at the extremities of its distribution at Bahrija. This could indicate that the snails are actively dispersing outwards, possibly as population density increases and therefore intraspecific competition increases at the centre of the area of occurrence. The outward expansion of the *Otala punctata* population also appears to have been hindered by physical barriers, including steep escarpments, country roads, fallow or abandoned agricultural land where extensive tracts of xerophytic vegetation occur and built-up areas. It was further noted that vegetables grown at Bahrija for the local market, including cabbage (*Brassica oleracea* var. *capitata*) and broccoli (*Brassica oleracea* var. *botrytis*), often had juvenile *Otala punctata* attached. This suggests that the alien stands a good chance of being transported with agricultural produce from Bahrija to markets elsewhere, and therefore there is a high potential for the alien species to colonise new areas in the Maltese Islands.