The Newsletter of the IUCN/SSC Mollusc Specialist Group
Species Survival Commission • International Union for Conservation of Nature

# TENTACLE

UNITAS MALACOLOGICA

**Editor – Robert H. Cowie**

## EDITORIAL

It is with much sadness that I announce the passing of Dr. Trevor Coote as a result of COVID-19. Trevor was the lynchpin of the partulid reintroduction programme in the Society Islands of French Polynesia. He will be sorely missed by all who knew him, especially for his energy and commitment to conservation.

Some remembrances by his colleagues are on page 2 of this issue of *Tentacle*.

Trevor on Moorea pointing out partulids during the *'Āreho* seminar on island snail conservation in 2019.

On a happier note, we welcome in particular three new members, among others, to the Mollusc Specialist Group: Drs. Hideaki Mori, Mayu Inada and Satoshi Chiba. In last year's issue (*Tentacle* 28) they published an article introducing and summarizing their captive rearing work with endangered land snails of the Ogasawara Islands of Japan. In this new issue of *Tentacle* they report the first reintroductions of ex situ reared Ogasawara land snails, to a tiny island off the main island of Chichijima. We wish them every success in expanding this programme and hope that by publicising their efforts in *Tentacle*, the plight of these endemic and endangered oceanic island snails will receive more of the attention they deserve from the conservation community and others around the world.

Robert H. Cowie

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# IN MEMORIAM TREVOR COOTE (1953–2021)

## From Paul Pearce-Kelly, International *Partula* programme coordinator, Zoological Society of London

Partulid programme consortium field biologist Dr. Trevor Coote.

We are all saddened by the news that our dear colleague Dr. Trevor Coote has passed away. Trevor completed his Ph.D. on *Partula* snail genetics at the Zoological Society of London's Institute of Zoology in the 1990s, where he was also a technician, before eventually taking on the role of the International Partulid Programme's Conservation Field Biologist. Based in Tahiti, with the support of a consortium of international zoos and the French Polynesian Government, Trevor spent almost 20 years advancing conservation efforts for the region's endemic snails and enabling the reintroduction phase of the *Partula* Programme to be realised.

Trevor had only recently retired to the UK when he contracted, and tragically died, from Covid-19. Colleagues across the mollusc and wider conservation community have expressed their sadness and testified to Trevor's outstanding knowledge, experience and conservation achievements and also his kind and helpful nature. In addition to a wealth of fond memories, Trevor's conservation impact is a truly outstanding legacy for which we are all grateful and inspired to carry forward.

## From Mary Seddon, Chair of the Mollusc Specialist Group

It is with great sadness that I heard that Trevor Coote had passed away. I first met him when he was a technician at the Zoological Society of London, where he was happy to share his knowledge of ex situ breeding of partulids with others in the land snail community. His commitment to the conservation of the species was long-term, and with the support of many zoos worldwide and the French Polynesian organisations, Trevor battled to find new ways for reintroducing and maintaining populations in their native habitats. This was ground-breaking work and has become a model for others to use in similar situations. Trevor dedicated his life to the conservation of *Partula* species and we will miss his humour, as well as his commitment and enthusiasm for the *Partula* snails.

## From Mike Bruford, Cardiff University and former colleague

Trevor gained his B.Sc. from Nottingham University as a mature student in 1991 and his Ph.D. from the University of London in 1999. He first volunteered at the Institute of Zoology in 1992, subsequently being employed as a technician, and was instrumental in developing and applying human microsatellite DNA markers in apes and Old-World monkeys. This work resulted in a number of well cited publications, including the first detailed study of relatedness structure using high-resolution DNA markers in a highly social primate (Altmann *et al*., 1996). In 1994 he embarked on his Ph.D. examining genetic diversity in *Partula* snails, from French Polynesia, to which he had been introduced by Professor Bryan Clarke during his undergraduate degree, based at the Institute but in collaboration with Professor Richard Nichols at Queen Mary University (formerly Queen Mary College) in London. His scientific ethos included a granite hard commitment to his personal codes and to openness. This integrity was central to his Ph.D., for which he eschewed many intriguing and plausible results, because he insisted on checking and rechecking them, and finding they did not meet his standards. He is fondly remembered by his colleagues as a smart, hard-working, humble and extremely funny individual. A north Londoner born and bred, Trevor had a varied and interesting life outside of science and was a published author of several novels.

Former colleagues Richard Nichols, Dada Gottelli, Chris Faulkes, Dave Cheeseman, Kath Jeffery and Michelle Bayes also contributed to this remembrance.

Altmann, J., Alberts, S.C., Haines, S.A, Dubach, J., Muruthi, P., **Coote, T.**, Geffen, E., Cheesman, D.J., Mututua, R.S., Saiyalel, S.N., Wayne, R.K., Lacy, R.C. & Bruford, M.W. 1996. Behavior predicts genetic structure in a wild primate group. *Proceedings of the National Academy of Sciences of the United States of America* 93: 5797-5801.

# NEWS

## Príncipe's Obô snail population declines by more than 75% in the last 20 years

*From the Fauna & Flora International website, 14 January 2020. Complete article by Sarah Pocock.*

Príncipe lies in the Gulf of Guinea off the west coast of Africa and is the smaller of the two main islands that make up the nation of São Tomé and Príncipe. The Obô snail (*Archachatina bicarinata*) is larger than its cousin, the West African giant land snail (*Archachatina marginata*), which was introduced to Príncipe in the 1980s and quickly spread across much of the inhabited north of the island. At the same time, the Obô snail declined in this area, retreating south. Competition with the West African snail for resources and the introduction of disease are among the potential reasons for this shift. Historical collection by people is another likely reason for the sharp drop in Príncipe's Obô snail population.

The Obô snail is no longer regularly harvested because of the longer distances required to travel in order to find it and the low numbers available. The West African snail has now become an important source of food and income for rural communities and is also in demand from international exporters.

Information from recent surveys will be used to update the Obô snail's status on the IUCN Red List, which was last assessed 20 years ago and is in urgent need of an update as the species' current classification as Vulnerable no longer reflects the situation on the ground. Plans to develop a formal conservation action plan for the Obô snail commenced in October 2019 with workshops held in both Príncipe and São Tomé – where the species also occurs and is experiencing similar, but less severe, declines.

Ed. — See also:
Panisi, M., Sinclair, F. & Santos, Y. 2020. Single species action plan for the conservation of the Obô Giant Snail *Archachatina bicarinata*, 2021-2025. IUCN SSC Mid-Atlantic Island Invertebrate Specialist Group. (English Version) (Portuguese version).


Obo snails - going out with a crunch. Originally from the Fauna & Flora International e-newsletter, for which you can sign up here.

## Neglected species – the symbolic significance of saving snails

*From the Fauna & Flora International website, 3 March 2021. Complete article by Tim Knight.*

In the run-up to the Convention on Biological Diversity conference in China later in 2021, Fauna & Flora International will be showcasing some of the neglected plants and animals

Karst-dependent snail from Malaysia discovered by Junn Kitt Foon, a 2019 winner of the Tony Whitten Conservation Award (see *Tentacle* 28) and new member of the Mollusc Specialist Group. (Photo: Junn Kitt Foon)

that it is helping to protect. In this first instalment of the series, the focus is on snails.

These snails (e.g. partulids, karst habitat snails, the Ôbo snail) have a symbolic significance that transcends their own intrinsic right to survival. They represent neglected species everywhere and fly the flag for neglected nature as a whole.

## Spiralling out of existence, the snails we have forgotten

*From the Fauna & Flora International e-newsletter 11 March 2021.* (Sign up for the newsletter here).

There is an amazing secret about the Earth's humble molluscs: their shells follow the same Golden Ratio as the galaxies that whirl around us.

Put simply, there is a quiet reflection of the cosmos travelling at your feet, found crossing your garden patio and sneaking into your vegetable patch.

These unobtrusive gardeners have managed our ecosystems in ways we haven't ever had to think about. On land, in wetlands and at sea, they are a crucial segment for a myriad of ecosystems and are the bedrock of survival for hundreds of other species.

They are also extremely sensitive individuals, noticing alterations in the environment long before other species do.

Photo: Jeremy Holden/FFI

And this is something humans haven't noticed.

Humanity has left them behind.

They may reflect the galaxy but they don't enjoy the superstar status of many other species. They don't possess a majestic mane or stupendous stripes or tremendous trunks and because of this they have been left to fight for survival on their own.

Close to the bottom of the food chain, they have suffered immeasurably from being at the bottom of our thoughts.

The swirling shells on their backs grown for protection act in vain against the countless threats. They are swallowed up by invasive species, their homes destroyed by deforestation, and their shells crushed during the constructions of dams, roads and buildings.

They have silently slipped into a critical situation and they cannot call for help. Snails are now facing alarming rates of extinction.

But we can do something to change this.

A symbol of the overlooked and undervalued, we know that our snails are seen by our supporters to need just as much protection as our more glamorous species.

We stand up for the little guys.

It's not just the snails that need help. All manner of incredible creatures are considered insignificant by humans, and are suffering the same fate, even as you read this.

As little as they are, their numbers are falling on a colossal scale.

[Fauna & Flora International welcomes donations]

## The Tony Whitten Conservation Award 2020

Guoyi Zhang

Tony Whitten (1953-2017) was an inspirational conservationist who championed biodiversity across Asia and beyond. As a tribute to him, the Cambridge Conservation Initiative (CCI) has been delighted to invite applications for this award for early career conservationists and biodiversity researchers from East and Southeast Asia. Winners of the 2019 awards included three working on molluscs (see *Tentacle* 28).

The five 2020 winners were announced in the February 2021 issue of *Oryx* (*Oryx* 55(2): 169), and included one working on molluscs: Guoyi Zhang, for work on the taxonomy of snails of karst mountains in northern China. Zhang's project uses DNA and morphological characters to resolve the relationships of snails in the family Camaenidae and shed light on the biogeography of these and related molluscs. Zhang has also exposed illegal collection and trading, and will use this award both to expand survey areas and to visit museums to check specimens.

## *DRYMAEUS CURRAIS* SIMONE, BELZ & GERNET, 2020, A NEWLY DISCOVERED SPECIES THAT IS BORN THREATENED

*By Marcos de Vasconcellos Gernet, Luiz Ricardo L. Simone & Carlos Eduardo Belz*

Found for the first time in 2015 and formally described in December 2020, *Drymaeus currais* (Fig. 1) was collected in a small marine archipelago located off the coast of the State of Paraná, southern Brasil (Simone *et al*., 2020). Formed by three small islands, the Currais Archipelago is the third Brasilian National Marine Park. It was created by federal law 12,829 of 20 June 2013 and received the name of Marine National Park of the Currais Islands (*Parque Nacional Marinho das Ilhas dos Currais*).

**Fig. 1.** *Drymaeus currais* Simone, Belz & Gernet, 2020. Shell of holotype MZUSP 150548.

The archipelago is located off the central region of the Paraná coast (25°44′07,74″S, 48° 21′58,12″W) (Fig. 2) approximately 11 km from the municipality of Pontal do Paraná, and is composed of three small islets. Grapirá Island constitutes 81% of the total area of the archipelago, estimated at 73,534 m². The rest of the area, 19%, includes two small rock outcrops: the first (Três Picos) is 7,748 m² and the second (Filhote), the westernmost, is 6,249 m² (Borzone *et al*., 1999).

The archipelago originated as a precambrian crystalline rocky outcrop of the so-called Coastal Granitoid Strip, presenting a lithology formed by intrusive and migmatitic granites (Bigarella *et al*., 1965). Its vegetation is of the Dense Ombrophylous Forest of Lowlands type, with pioneer rupicolous formations of marine influence along the rocky shores. This phytogeographic category is characterised by an indisputable environmental importance, with high biological diversity and high endemicity. It exhibits a typical floristic and structural composition composed of different communities along an altitudinal gradient and pioneer formations, ranging from herbaceous vegetation to remains of trees rich in epiphytes (Roderjan *et al.*, 2002).

Despite being a national park, the archipelago still suffers a lot from the pressures of tourism and professional fishing, as the region has always been an important fishing spot on the coast

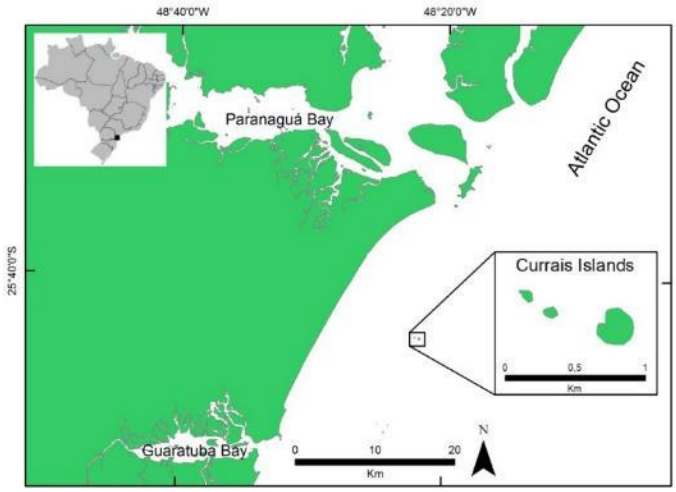


**Fig. 2.** Paraná State coast, with the location of the Currais Archipelago and and the configuration of the islands. *Drymaeus currais* occurs on the largest island.

of Paraná. The difficulty of overseeing the protected area by the responsible agency, the Chico Mendes Institute for Biodiversity Conservation (ICMBio), aggravates the situation in the area.

There is also a lack of knowledge of the biodiversity of this island environment, and research in the region is related only to its avifauna (Krul, 2004), so the discovery of this new species of mollusc endemic to the locality reinforces the need for environmental protection of the Currais Archipelago.

The small area of the archipelago, its vulnerability and the extreme local endemicity of the new species means that any environmental imbalance (pollution, fires and introduction of non-native species) may cause its extinction, which makes quick decisions for efficient management of the park especially urgent.

The authors thank Carlos J. Birckolz for making the map.

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# IMMEDIATE CONSERVATION CONCERNS FOR TERRESTRIAL JAMAICAN MOLLUSCS – WHY SML-173 WILL BE A PROBLEM FOR COCKPIT COUNTRY

*By Heather L. Kostick and Susan Koenig*

Recently, an Environmental Impact Assessment (EIA) was submitted for consideration to the National Environmental and Planning Agency (NEPA) of Jamaica by Noranda Jamaica Bauxite Partners II (NJBP II) in regards to a permit application to mine an area called SML-173 (Conrad Douglas & Associates Limited, 2020) (Fig. 1). SML-173 (SML standing for Special Mining Lease) is a part of Cockpit Country, which is the largest contiguous mesic limestone forest on the island and home to many endemic molluscan and other invertebrate species that cannot be found elsewhere on Jamaica. Cockpit Country has large reserves of aluminium-bearing soils (bauxite) and is constantly under threat of disturbance and mining despite protection measures. We provided critique and commentary to NEPA on the EIA, rejecting it for its inadequacies, including unclear reporting, lack of research and citations, unclear field methodologies and inaccurate results. We share a summary of some of these comments here to report on ongoing conservation issues and concerns for Jamaican terrestrial molluscs.

Although much of the EIA report can be critiqued for data collection methodologies of various taxa alone, it was the molluscan survey section that particularly stood out in its inadequacy. The EIA gastropod methodology simply stated (page 5-198 of the EIA):

> "Gastropod observations were initially made along walking traverses at the periphery of the depression or orebody locations and within the hillocks during the plotless surveys. In the plot-based surveys, the transects were assessed for snail populations."

The "hillocks" here refer to the gumdrop-like geomorphology of the cockpit karst limestone of Jamaica. The two-sentence


**Fig. 1.** A polygon delineating SML-173 located in Trelawny and St. Ann Parishes, Jamaica as reported by the EIA (Google LLC 2020). SML-173 is directly adjacent to a proposed Cockpit Country Protected Area, which takes up most of Trelawny Parish.

methodology does not state what collection methods were used (e.g. hand-collected, leaf litter samples etc.) nor how the plot-based surveys were completed in regards to molluscs nor whether they submitted any voucher specimens to the Natural History Museum of Jamaica, which houses the country's natural history collection. A later section notes that "Gastropods were observed either on the ground for ground gastropods and on tree trunks for arboreal gastropods" (page 5-259 of the EIA). Even with these paltry descriptions of field methodologies, one would think that the field surveyors would have found an abundance of species. Jamaica has over 500 endemic land snails and slugs (Rosenberg & Muratov, 2006), and as such it is very easy to find molluscs pretty much anywhere on Jamaica. Within the boundaries of the proposed SML-173, 103 terrestrial mollusc species can be found, and up to 131 species if one includes the border of SML-173 and an additional one kilometer of the surrounding area (Jamaican Biotic Survey Dataset, 2019). However, the EIA results were reported, very briefly, as follows:

> "Two (2) types of terrestrial snails were observed during inspections conducted within the study area. These were the arboreal *Thelidomus cognate* [sic] (see Figure 5-176), and a ground snail *Pleurodonte peracutissima*. One live *Pleurodonte peracutissima* specimen was observed on a traverse between survey transects (see Figure 5-177), but numerous shells were observed on the ground, in particular, in the forested areas of SML 173. Slugs, possibly the Pancake Slug (*Veronicella sloanii* - see Figure 5-178) were observed under rocks surveyed during traverses and under leaf litter within transect areas. A number of *Thelidomus cognate* [sic] individuals were observed on tree trunks within the transect deployed."

This section of the report (pages 5-234 to 5-237) also provides locations of where they found the individual snails, and some poor-quality photos of the observed snails and slug. The first land snail species mentioned is *Thelidomus cognate* [sic], which is misspelled, and probably not correctly identified given the known range of the species. The majority of the known range of *Thelidomus cognata* (Férussac, 1821) is in Westmoreland and Hanover Parishes of Jamaica, which are on the western portion of the island (Fig. 2) (Jamaican Biotic Survey Dataset, 2019). There is an eastern locality for the species in the St. Mary Parish; however it is only a single observation and there is not currently enough data to confirm the establishment of the species in that region. That individual could have traveled there via transport with soil, by a bird, on lumber, or by some other method of external dispersal. Regardless, *Thelidomus cognata* has not yet been documented in Cockpit Country, including where SML-173 is located. The species that was probably observed was the closely related *Thelidomus aspera* (Férussac, 1821), which has been widely documented in Cockpit Country and the adjacent areas (Fig. 3). Although the ranges of these species do overlap, the majority of that overlap is in western Jamaica and not in Cockpit Country. The confirmation of this identification could have been done through using publicly available data from iDigBio (2020).

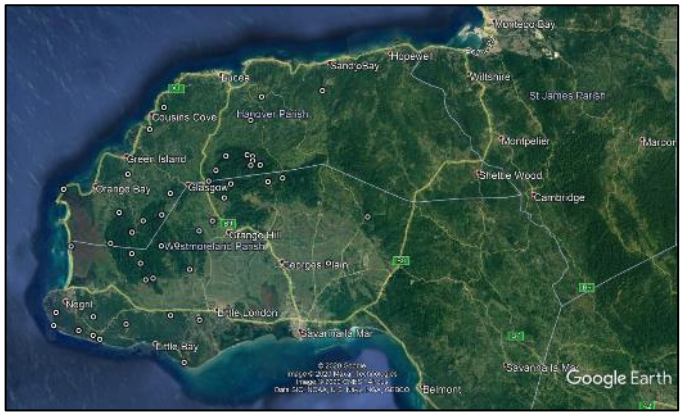


**Fig. 2.** A map of western Jamaica with the species range data of *Thelidomus cognata* (Jamaican Biotic Survey Dataset 2019; Google LLC 2020).


**Fig. 3.** A map of Jamaica with the species range data of *Thelidomus aspera* (Jamaican Biotic Survey Dataset 2019; Google LLC 2020).

The second species that the EIA reports is *Pleurodonte peracutissima* (Adams, 1845). Aside from the outdated genus name used in the report, the species now being placed in *Dentellaria* (see Sei *et al*., 2017), this identification cannot be confirmed. The photos used in the report were taken from far away, only a single view of the shell is provided, and it is unusable in confirming the identification of the shell (EIA pages 5-234 to 5-237). Also, at least ten documented species of pleurodontids are known from within and around the SML-173 area, and without proper documentation or identification techniques, this identification is useless (Jamaican Biotic Survey Dataset, 2019).

There are other troubling claims and statements in the EIA. One such claim is that by only mining the low-lying areas, the elevated hills would be unaffected by mining activities and they claim that the elevated portions are where most of the biodiversity is located. The methodologies and species identification techniques used for the EIA field surveys for all taxa were poorly explained and vague. The results shared were of a similar ilk. This EIA was submitted by Noranda Jamaica Bauxite Partners II (NJBP II) as part of an effort to obtain a permit to mine bauxite in SML-173. While the NJBP II EIA report claims that environmental mitigation efforts will be made if their environmental permit is granted, they fail to discuss exactly what these efforts would be and how effective

they would be. The theme of vague claims, explanations and research leads one to speculate on the validity of the process: was the EIA undertaken merely to check off a requirement; and not done in good faith for the Jamaican people or ecosystems?

There has been an abundance of outcry not just from Jamaican farmers and rural residents who would be displaced by the mining operation, but also from Jamaican scientists and researchers who work in Jamaica or on Jamaican fauna or flora. Our more-detailed critiques of the EIA were submitted to Jamaica's NEPA for consideration of rejecting the permit. Ours are merely two of many voices in the effort to halt the mining in SML-173. Mining operations have long been known to cause negative environmental impacts (Hogsden & Harding, 2011; Stretesky & Lynch, 2011). However, purported short-term financial gains seem to sometimes outweigh the long-term detrimental effects on ecosystems, on the sustainable services they provide and on human health. Hopefully, comments and critiques that are being submitted to NEPA will aid in rejecting this EIA, withdrawal of SML-173, and prevention of new SMLs from being issued for Cockpit Country.

The two volume EIA report submitted by NJBP II, and other related documents, are publicly available at the following link: https://www.nepa.gov.jm/environmental-impact-assessments.

This article is dedicated to Tony Whitten who contributed immeasurable behind-the-scenes conservation support for Cockpit Country and to the Windsor Research Centre.

Conrad Douglas & Associates Limited. 2020. *Environmental Impact Assessment for proposed Mining Operations in the Special Mining Lease 173 (SML 173) Area located in the Parishes of St. Ann and Trelawny, Jamaica by Noranda Jamaica Bauxite Partners II (NJBP II). Volume I. Draft Final*. Conrad Douglas & Associates Limited, Kingston.

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## RELICT POPULATION OF OREGON FORESTSNAIL (*ALLOGONA TOWNSENDIANA*) ON VANCOUVER ISLAND, BRITISH COLUMBIA

*By Kristiina Ovaska & Lennart Sopuck*

The Oregon forestsnail (*Allogona townsendiana*) is listed as endangered in Canada under the federal Species At Risk Act. Most populations are embedded within urban and rural areas in the Lower Fraser Valley in mainland British Columbia, where they suffer from habitat fragmentation and degradation from intensive human land uses. One relict population, first reported in 1903 (Whiteaves, 1906), is known from Vancouver Island, and the site has been designated as Critical Habitat for the species (Environment Canada, 2016). It is presumed to have been isolated from its mainland counterparts since the retreat of the glaciation ~15,000 years ago, and it is therefore of evolutionary, scientific and conservation significance. In spring 2019 we initiated a study to investigate habitat use and abundance of the Vancouver Island population.

Surveys along meandering transects revealed that the snails were patchily distributed across the ~109 ha study area. The species was most often found in large stinging nettle (*Urtica dioica*) patches in gaps and edges of mixed-wood forest stands with bigleaf maples (*Acer macrophyllum*) (Fig. 1). Occupied sites contained an understory of various shrubs and often abundant herbaceous vegetation. Similar association of the species with stinging nettles has been documented in the Lower Fraser Valley (COSEWIC, 2002, 2013; Steensma *et al.*, 2009).

To obtain information on the abundance and movements of the snails, we established five 7.5 m radius capture-mark-recapture (CMR) plots at occupied habitat patches. Two plots overlapped an old railway embankment; three were in adjacent mixed-wood second growth forest. We marked snails individually with small fluorescent, numbered tags glued to the shell and/or with PIT tags (passive integrated transformer; Oregon RFID; full-duplex; 8.0 mm long, 1.4 mm wide) inserted into the umbilicus and glued in place (a manuscript on

**Fig. 1.** Oregon forestsnail (*Allogona townsendiana*) habitat in forest gap with stinging nettles and sword ferns.

**Fig. 2.** Tagged juvenile (top) and adult (left) Oregon forestsnail (*Allogona townsendiana*). The tip of a PIT tag can be seen protruding from the umbilicus of the adult.

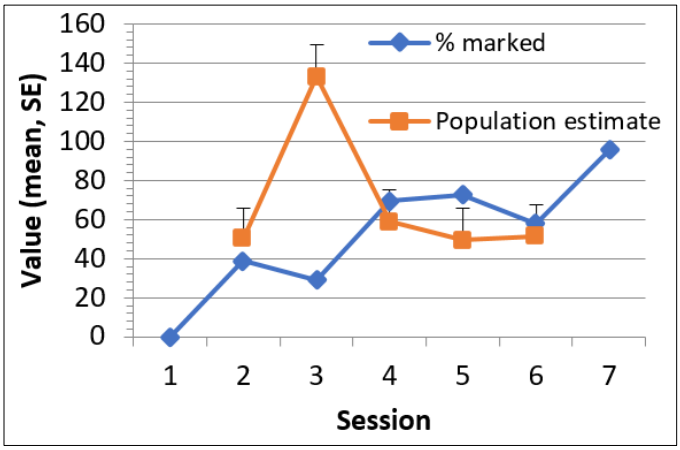


**Fig. 3.** Recapture success and population estimate during seven sampling sessions at five 7.5 m radius CMR study plots combined (sampling 883.6 $m^2$), April–October 2019.

PIT-tagging methodology is in preparation) (Fig. 2). We surveyed the plots and a buffer zone around them both visually and with a PIT tag reader (Biomark HPR Plus; detection distance ~25 cm) for recaptures. There were seven surveys from 18 April to 8 October 2019 during the active season of the snails, and one survey on 6 March 2020, when the snails were inactive in their over-wintering sites; further site visits in 2020 were curtailed by COVID-19 restrictions.

In total, we tagged 121 snails, of which 58% were recaptured at least once. Adults, distinguished from juveniles by their thickened apertural lip (Fig. 2), constituted 78% of the snails. The population estimate for all plots combined peaked at 133


**Fig. 4.** Examples of an overwintering site (star) of two snails in relation to their activity season capture sites.

snails on 28 May 2019 but was similar (49-59) in other sampling periods in 2019 (Jolly-Seber method; Krebs, 2011) (Fig. 3). Calculated from these estimates, the mean density ranged from 0.06 to 0.15 snails/$m^2$ in the plots. These estimates apply to adults and large juveniles; small juveniles < 10 mm in shell width were not sampled. These densities are roughly an order of magnitude lower than reported previously for a mainland population in Langley, British Columbia (mean 1.0 snails/$m^2$; Steensma *et al*., 2009). Survivorship was relatively high throughout the snails' activity period and ranged from 0.72 to 0.95 between sampling sessions in 2019.

Multiple captures of individual snails allowed a preliminary examination of movements. During the active season in 2019, most snails confined their movements within areas of < 5 $m^2$ (median 3.2 $m^2$, range 0.01-25.6 $m^2$, n = 38; minimum convex polygon method); the longest displacement by most individuals was < 10 m (median 4.12 m, range 0.4-17.5 m, n = 70). These values are lower than recorded at Langley for 21 snails followed for varying periods over a three year period (maximum displacement 32.3 m; "home range" size 18.4-404.4 $m^2$; Edworthy *et al*., 2012), possibly reflecting the shorter period of our study.

In early February 2020, there was a major flooding event during which vast areas of the landscape were under water. Subsequently, on 6 March, we noted scouring of the litter layer in depressions and low-lying areas of the study plots. With the PIT tag scanner, we detected 27 snails (24.1% of the snails tagged in 2019, excluding nine found dead in summer). The over-wintering sites were within or immediately adjacent to the summer activity areas of individual snails (longest displacement: median 3.6 m, range 0.9-14.0 m, n = 27; Fig. 4). The snails were buried under duff in sword fern (*Polystichum*

*munitum*) hummocks or at fern bases on embankments, and these slightly elevated sites probably allowed them to survive the flooding.

Multiyear studies are required to document habitat requirements and population biology of the snails more accurately. However, the preliminary results are expected to help direct management and stewardship activities at the site, including protecting occupied habitat patches from disturbance. The presence of sword ferns and elevated micro-sites appears to be an important habitat feature facilitating the persistence of the population during storms and extreme weather events, which are expected to increase in frequency and severity as climate change proceeds. The results also provide baseline data to assess the feasibility of translocation of the snails to additional Vancouver Island localities as part of conservation efforts.

We thank Eric Gross (Canadian Wildlife Service) for his advice, help with logistics, and securement of funding. PIT-tag readers to locate tagged snails in the field were courtesy of Eric Gross, and Purnima Govindarajulu and Melissa Todd (British Columbia Ministry of Environment). Sam Norris of Halalt First Nation provided able assistance in the field. We very much appreciate support from the Halalt First Nation, who allowed us access to their lands.

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## RECOVERY EFFORTS FOR ENDEMIC BERMUDA LAND SNAILS CONTINUE

*By Mark E. Outerbridge, Kristiina Ovaska & Gerardo Garcia*

Bermuda's land snail fauna includes two endemic species of the genus *Poecilozonites*, remnants of a group with a long evolutionary history on the island (Hearty & Olson, 2019). Widespread and abundant until about the 1960s (Gould, 1969), both species are now on the verge of extinction. The Greater Bermuda Land Snail, *P. bermudensis* (shell width up to ~28 mm), and the Lesser Bermuda Land Snail, *P. circumfirmatus* (shell width up to ~9 mm) are both designated as Critically Endangered in Bermuda and recently (December 2019) as such by the IUCN (Ovaska & Outerbridge, 2019a, b).

Previously (*Tentacle* 27), we reported on reintroductions of *P. bermudensis* to offshore islands in the Bermuda archipelago (Outerbridge *et al*., 2019). Here we provide an update on follow-up monitoring at these sites and further introductions to additional islands. We also describe the initial phase of the reintroduction of *P. circumfirmatus* to one of the islands from captive colonies. Since 2004 *P. circumfirmatus* has been reared in captivity by the Zoological Society of London (ZSL); no wild populations are known. *Poecilozonites bermudensis* from a remnant wild population (Outerbridge, 2014) was sent to ZSL in 2014 and to Chester Zoo, UK, in 2016. Since then, Chester Zoo specifically developed new snail facilities (modified shipping container) to effectively breed both species in captivity, providing a source of snails for the reintroduction programme (Fig. 1).


**Fig. 1.** Shipment of snails arriving in Bermuda from the captive-breeding programme at Chester Zoo, UK.

A disease risk assessment, evaluating the risk of pathogen introduction to the *P. bermudensis* wild population on Nonsuch Island, from the reintroduction of Chester Zoo captive-bred *P. bermudensis*, was completed. Information about known snail pathogens and bacteriology, histopathology and parasitology screening of captive bred and wild caught snails was used to assess qualitatively the likelihood of potential pathogen dissemination and severe consequences to the wild population following the reintroduction. No organisms identified in captive bred individuals were found to pose a high risk to the wild

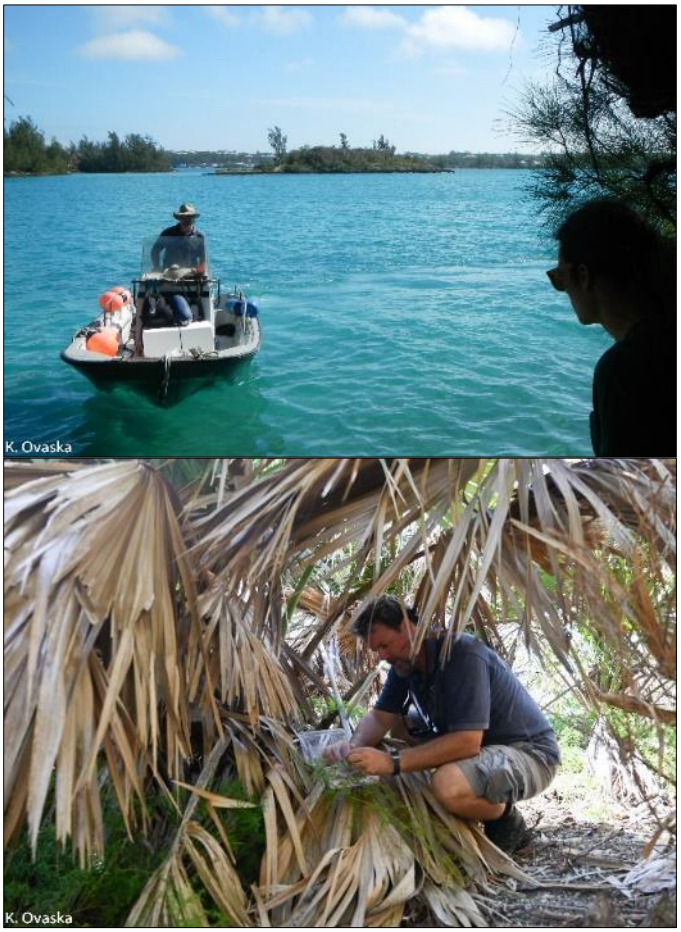


**Fig. 2.** Introducing *P. bermudensis* from captive colonies to small offshore islands, showing transport in coolers by boat (top) and releasing snails under native palmettos (bottom) in February 2020.

wild. Body condition was compared between the captive and wild caught snails, the latter having more limited fat stores (although somewhat variable among sites) than the captive snails, most of which were relatively fat. In addition, captive snails presented fewer signs of natural processes of "wear and tear", signs of localised inflammation, and infection than their wild counterparts. Both these features are representative of life in captivity, with easy access to food and a protected environment, and suggested the animals were fit for release.

In February 2020, we monitored *P. bermudensis* at three sites on Nonsuch Island (with releases from 2016 to 2019; Ovaska, 2020) and visited Hall's and Trunk Islands, two of four small islands where the species was introduced in 2019. On Hall's Island, the snails had established an apparently thriving population, and we detected numerous snails ranging from hatchlings to adults within ~ 6 m of the release sites. In contrast, on Trunk Island, we detected only a few adult snails and no evidence of reproduction. We augmented this island's population with new releases. Additionally, we released captive-reared *P. bermudensis* on two small islands, Nelly's and Saltus, and two sites on the Main Island (Fig. 2). As part of this programme, *P. bermudensis* has now been released on seven offshore islands as well as on the Main Island. The introductions have been successful at least on


**Fig. 3.** Wild *P. bermudensis* feeding on greenery at a successful introduction site on Nonsuch Island. The snails also fed on palmetto nuts, grazed on plant debris, and opportunistically scavenged on dead frogs and invertebrates.


**Fig. 4.** Mark-recapture was conducted at release sites on Nonsuch Island to obtain detailed information on movements and survivorship. Snails were marked with fluorescent numbered tags and/or PIT (passive integrated transponder) tags inserted into the umbilicus and glued in place.

Hall's and Nonsuch Islands. At this time it is too early to confirm the fate of the other releases.

On Nonsuch Island, the snails at the first (2016) introduction site began breeding within the first year after release and have continued to thrive and expand their range since (Fig. 3). The area of occupancy has increased each year since the release and encompassed ~ 1,900 $m^2$ in February 2020; this represents an expansion of 495% from the previous year. The maximum straight-line distance from the original release point four years earlier was ~ 40 m. At the other two release sites on this island, the snails continued to persist but had not yet established self-sustaining populations. At these sites, snails were located within 6 m and 10 m of their release sites, respectively. Monitoring snails through mark-recapture methods is continuing (Fig. 4).

In February 2020, we carried out an experimental release of captive-bred *P. circumfirmatus* on Nonsuch Island. This species is smaller, more delicate, and more difficult to monitor than *P. bermudensis* (Fig. 5). Consequently, we used a staged "soft release" method unlike that for *P. bermudensis*, which were released directly into the environment. The first stage consisted of release of snails into 1 m x 1 m paired enclosures (100 snails/enclosure) at three sites on the island (Fig. 6). One of the paired enclosures received only juveniles and the other only adult snails. The enclosures were provided with ample cover and, periodically over the following months, a variety of food items. For comparisons, we also released larger juveniles directly into the environment in a different part of the island.


**Fig. 5.** Captive-bred *P. circumfirmatus* ready for release into enclosures on Nonsuch Island.

The intention is to sample the enclosures and "hard-release" sites in 2021 to compare the age structure and survivorship among sites and between treatments (adult versus juvenile snails). The snails will then be allowed to exit the enclosures into the surrounding habitat. The hope is that the lessons learned will facilitate further releases of *P. circumfirmatus* on the other islands where *P. bermudensis* survived release.

The snail reintroductions described here support the recovery objectives for the two species of *Poecilozonites* (Outerbridge & Sarkis, 2018). In addition, they contribute to a larger goal of restoration of native ecosystems at sites where this is still a possibility, such as nature reserves on small offshore islands managed by Bermuda National Trust.

The Department of Environment and Natural Resources is extremely grateful to the invertebrate teams at Chester Zoo and the ZSL who continue to take great care of Bermuda's land snails. In addition to breeding for reintroduction, Chester Zoo covered health screening, shipment, and staff support in the field. Particular thanks are due to Heather Prince, Tamas Papp and Amber Flewitt from Chester Zoo. and to Paul Pearce-Kelly, Dave Clarke, Craig Walker and Ben Tapley from ZSL. Javier Lopez and Lisa Lewis provided the disease risk assessment and health screening for the reintroduction. We also thank Robbie Struan Smith for his continuing support of the project, and the Bermuda Zoological Society, which

**Fig. 6.** Soft release of *P. circumfirmatus* on Nonsuch Island in February 2020. Sewing snail-proof tops for 1 m x 1 m enclosures (top); releasing snails into the enclosures at night (bottom).

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## *MIRINABA CURYTIBANA*: A SPECIES AT HIGH EXTINCTION RISK, OR IS IT ALREADY GONE?

*By Marcos de Vasconcellos Gernet, Giovanna Yumi Scorsim Omura, Carlos João Birckolz & Fabricius Maia Chaves Bicalho Domingos*

*Mirinaba curytibana* (Lange-de-Morretes, 1952) (Fig. 1) is a land snail (family Strophocheilidae) discovered at Pilarzinho, a locality now extremely urbanised in the large city of Curitiba, Paraná State, southern Brasil. Only four shells were collected by malacologist Frederico Lange de Morretes in 1937, which were used in its formal description (Lange-de-Morretes, 1952; Gernet *et al*., 2018). Its main distinguishing characteristics are a thin, oval acuminated shell with a pronounced dorso-ventral flattening, reddish-brown periostracum, and no operculum. Its shell is approximately 48 mm in length (Lange-de-Morretes, 1952, Indrusiak & Leme, 1985).

In 1977 and 1978, the malacologist Leocádia Indrusiak undertook an expedition in the Pilarzinho region, but she did not collect any specimen in this area. She highlighted the

**Fig. 1.** *Mirinaba curytibana* holotype (MZUSP 16660).

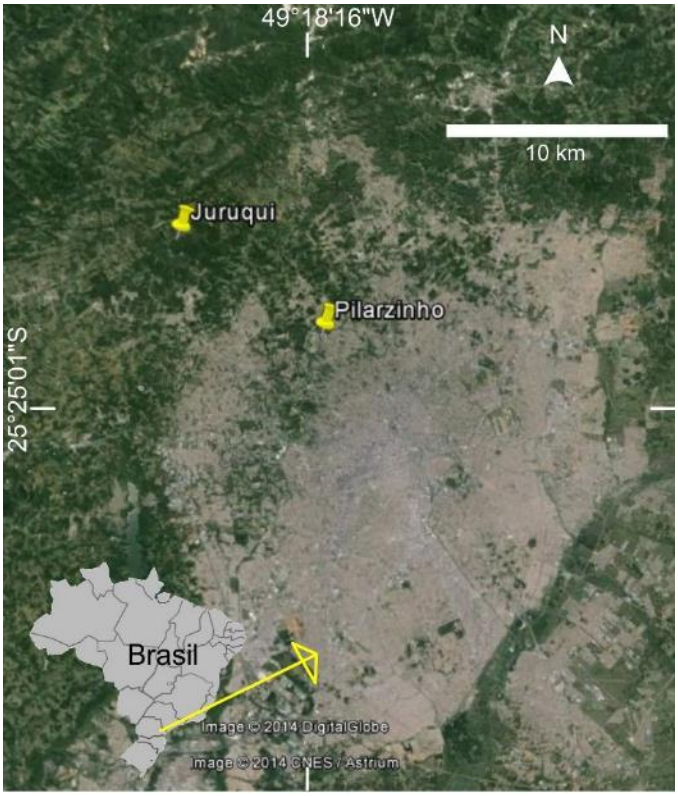


**Fig 2.** Known distribution of *Mirinaba curytibana* in Paraná State, southern Brasil. Adapted from Google Earth.

intense urbanisation that probably made the area unsustainable for the survival of these snails (Indrusiak & Leme, 1985). Nonetheless, three shells and a live specimen were found in Juruqui, Campo Magro municipality. This locality is ~ 8 km from the type locality of the species (Fig. 2) (Indrusiak & Leme, 1985; Simone, 2006; Gernet *et al*., 2018). Currently, Juruqui is inside the Passaúna Environmental Protection Area (Category V of the IUCN Protected Areas System; Dudley, 2008). However, the native vegetation in this area is very disturbed and fragmented, threated by agriculture, livestock and *Pinus* and *Eucalyptus* plantations.

Paraná State was originally covered by a large area of Atlantic Forest (83%) in its east-west extension, interspersed with non-forested formations (17%). Mainly four phyto-physiognomy units are found in the Atlantic Forest biome in the state: Dense Ombrophilous Forest, Mixed Ombrophilous Forest, Seasonal Semideciduous Forest, and Grassland (Maack, 1981; Roderjan *et al.*, 2002).

*Mirinaba curytibana* is confined to the Mixed Ombrophilous Forest, or Araucaria moist forest formation, which is characterized by numerous epiphytes, vines, palms and abundance of the pine tree *Araucaria angustifolia*. These forests can exhibit sharp small-scale variation in plant species composition and vegetation structure, because of differences in altitude, drainage, temperature and soil fertility (Veloso *et al*., 1991; Roderjan *et al*., 2002), but only about 1% of this formation remains in Paraná (FUPEF, 2001). This variation may influence the patterns of terrestrial gastropod distribution and endemism in the region (Indrusiak & Leme, 1985), and it is possible that the *M. curytibana* specimens collected by

Lange de Morretes were associated with very particular local landscape and vegetation structure characteristics.

The species is considered Critically Endangered by the IUCN (Mansur, 1996). The Brasilian Red List, compiled by the Instituto Chico Mendes de Conservação da Biodiversidade, the Brasilian federal environmental agency (ICMBio, 2018), included the species in the Endangered category (Ohlweiler, 2008; Santos *et al*., 2013), but it was excluded from the list in its most recent review, because of the lack of more accurate bibliographic information on the species (Santos *et al*., 2015; ICMBio, 2018).

During 2015 and 2016 we did an extensive inspection throughout Pilarzinho and the surrounding area, searching in small fragments of native vegetation, but we were unable to find evidence of the species' existence. Because *M. curytibana* is a highly endemic species, its absence in the field is definitely not a good sign. Is the species already extinct? If not, evidence suggests that it is at a very high risk of extinction. Further expeditions to search for this species throughout all natural vegetation remnants around the cities of Curitiba and Campo Magro are needed to clarify this situation. If living specimens are found, management measures should be quickly implemented to ensure the species' conservation.

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## ATEWA RANGE, GHANA: SPECIES-RICH AND ENDEMIC-RICH UPLAND EVERGREEN FORESTS THREATENED BY ALUMINIUM ORE EXTRACTION

*By Peter Tattersfield, Anton J. de Winter & Mac Elikem Nutsuakor*

The Atewa range (Fig. 1), Ghana, is situated about 80 km northwest of Accra and contains the largest remaining area (~ 174 km$^2$) of upland evergreen forest in Ghana. It is one of only two reserves in Ghana that support this uncommon forest type (the other reserve, Tano Offin, is already severely degraded). There are few elevated areas in West Africa so

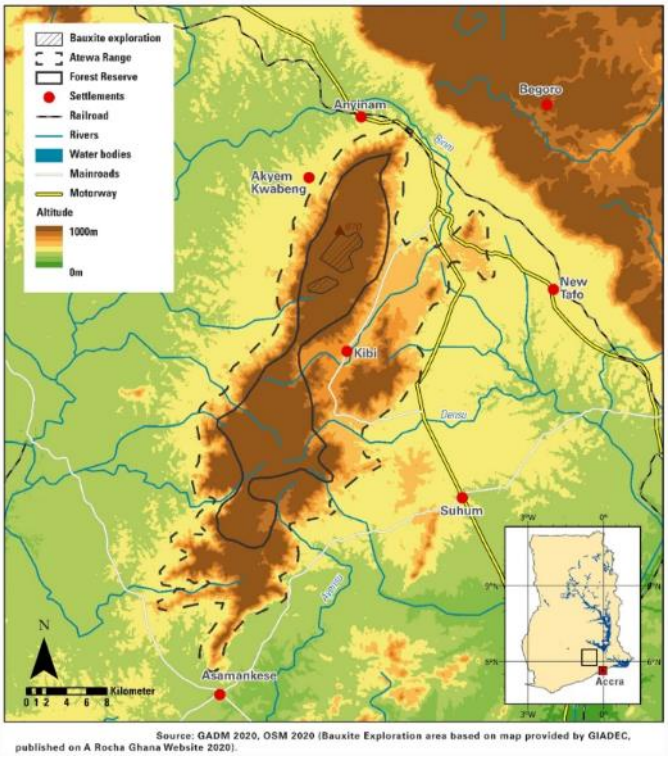


**Fig. 1.** The Atewa Range, identifying the Forest Reserve boundary and area of bauxite exploration.

**Fig. 2.** Some species from Atewa Forest Reserve. Clockwise from top left: *Saphtia* sp. (Urocyclidae), *Pseudopeas* cf. *guineensis* (Subulinidae), "*Gonaxis*" sp. (Streptaxidae), an undescribed urocyclid slug species, *Pseudavakubia majus* (an endangered endemic streptaxid) and *Paucidentella* sp. (Streptaxidae).

the Atewa range (842 m) also represents a biodiversity resource of regional importance. The biological importance of the Atewa Range has been long recognised. It was gazetted as a National Forest Reserve in 1926, then subsequently a Special Biological Protection Area in 1994, a Hill Sanctuary in 1995 and as one of Ghana's 30 Globally Significant Biodiversity Areas in 1999. It is also recognised as an Important Bird Area. Conservation International's Rapid Biological Assessment report (McCullough *et al*., 2007) summarises Atewa's importance for a range of animal and plant groups.

Like most tropical areas, Atewa's malacofauna (Fig. 2) is poorly explored and much of the range has not been surveyed at all. However, recent, currently unpublished surveys suggest that it supports one of the richest land snail faunas in West Africa, including a number of range restricted species. Conservatively, and on the basis of sampling a few very restricted areas, we estimate that the area supports at least 90 terrestrial gastropod species, with particularly high diversity in the Streptaxidae (estimated at least 32 species) and Subulinidae (estimated at least 26 species). Range restricted species currently known include the Red List Endangered streptaxids *Pseudavakubia majus* de Winter & Vastenhout and *Pseudavakubia atewaensis* de Winter & Vastenhout, and *Gulella atewana* de Winter and the subulinid *Ischnoglessula*

**Fig. 3.** Areas of forest cleared in 2019, to create access routes and geological survey stations.

*echinophora* Verdcourt. About 20 shelled species, the majority undescribed, are only known from the Atewa Range and are thus potentially restricted range endemics. Urocyclid slug diversity appears to be substantial, but remains largely unstudied. Alpha taxonomic work is ongoing so estimates of total and range restricted species diversity are likely to increase, possibly substantially.

Unfortunately, the Atewa Range and its upland evergreen forest habitats are imminently threatened by bauxite (aluminium ore) mining. In 2018 the Government of Ghana signed a $2 billion loan agreement with Chinese company Sinohydro, to be repaid with the proceeds from the bauxite. The proposals, which are well advanced, would, if implemented, destroy upland forest snail habitats and cause further potentially significant indirect effects on snail faunas in remaining areas. Wider consequences could include microclimate deterioration, edge effects and dust deposition, and any increase in access to the remaining forest could lead to higher levels of disturbance, fragmentation, exploitation etc. These impacts would be likely to be significant for much of the forest biota, but perhaps especially for specialised forest molluscs for which microclimate changes can be particularly detrimental.

Substantial areas of intact forest have already been cleared (in 2019) to establish access routes for geological surveys (Fig. 3). These resulted in the direct destruction of an estimated 0.66 km$^2$ of forest and have also clearly caused further indirect impacts on adjacent land-snail habitats.

There is local and international opposition to the mining proposals. In 2020, associated with the postponed World Conservation Congress in Marseille, France, the IUCN passed Motion 103 (see also p. 48 of this issue of *Tentacle*) urging the Ghanaian Government to immediately and permanently halt all mining-related operations and other destructive activities in Atewa Forest, and to establish a national park over the entirety of Atewa Forest to ensure its conservation in perpetuity.

In the light of the immediate threats, further studies are urgently needed on Atewa's mollusc fauna, to confirm the area's importance and to understand the full implications of the proposed bauxite mining.

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## LAND SNAILS REDISCOVERED AFTER MORE THAN 70 YEARS: *WEBBHELIX MULTILINEATA* IN PENNSYLVANIA; *HENDERSONIA OCCULTA* IN ALLEGHENY COUNTY, PENNSYLVANIA

*By Timothy A. Pearce*

After decades of collecting snails in the field, I am still excited to find species that were presumed extinct. Until 2019, the polygyrid land snail *Webbhelix multilineata* had not been documented anywhere in Pennsylvania since 18 May 1947 and the helicinid land snail *Hendersonia occulta* had not been seen in one specific county (Allegheny) in Pennsylvania since 27 Aug 1948; therefore, they had both been presumed locally extinct. Finding living members of those species in those areas in 2019 was cause for excitement.

*Webbhelix multilineata* has never been an abundant snail in Pennsylvania. I searched for records of it in Pennsylvania on iDigBio and InvertEBase and obtained ten records from three major museums. Of those ten lots, only seven distinct localities are known, mostly in western Pennsylvania. Five localities are in southwestern Pennsylvania along the lower Allegheny and upper Ohio Rivers. One is from northwestern Pennsylvania in Pymatuning Swamp. Only one record is from eastern Pennsylvania, at Mohnton in Berks County, collected by W.S. Cramer on an undocumented date. Given that three lots of other molluscan species at the Carnegie Museum were collected by W.S. Cramer in June 1938 and one lot at the Field Museum of Natural History was collected by W.S. Cramer in July 1938 (and no other Cramer collections were dated), it is likely that the undated *Webbhelix multilineata* was also collected in 1938. Until 2019, the most recent lot of *Webbhelix multilineata* collected anywhere in Pennsylvania was dated 18 May 1947.

**Fig. 1.** *Webbhelix multilineata* juvenile found in York County in 2019. (Photo: Kerry Givens).

Photographs of an immature *Webbhelix multilineata* in Hellam Hills Natural Area in York County, Pennsylvania, were forwarded to me by two hikers on 2 June 2019 (Fig. 1). I recognised the species by the reddish spiral lines on the shell and by the relatively large, reddish body tubercles. This sighting is the first record in 72 years of *Webbhelix multilineata* anywhere in Pennsylvania, and it represents a new county record as well.

The relatively dry habitat where this snail was seen is unexpected. The hikers reported the snail in a dry area of a mature deciduous forest, at least 150 m from the nearest stream. Such a relatively dry area contrasts with what is generally known about the habitat of *W. multilineata*. Previous reports of its habitat indicate it occurs in low, moist areas including floodplains, marshes and swamps (Pilsbry, 1940; Burch & Jung, 1988; Hubricht, 1985; Dourson, 2010, 2015). This apparently novel habitat is surprising; future research could explore such habitat for this species.

*Hendersonia occulta* is an uncommonly encountered, operculate land snail (the operculum closes the shell's aperture) and is unusual in occurring farther north than most operculate land snails in North America and farther north than all other members of the family Helicinidae. *Hendersonia occulta* has become extinct in five USA states since the Pleistocene (Hubricht, 1985), and although modern populations are known from 13 states in the eastern USA, it is of conservation concern (S1-S3) in all 11 of those states for which it has been assessed (NatureServe, 2019) because of its continued decrease.

In Pennsylvania, *H. occulta* was first recorded in Allegheny County in 1832 (Green, 1832) and it was found in that county from time to time until 1948. Allegheny and Green Counties were the only counties where it had been reported before 2006, then Pearce (2006) reported finding it in Bedford, Fayette, and Huntingdon Counties. It was later found in Westmoreland County by Pearce (in 2006), thus confirming one of the two questionable literature records of a

Pennsylvania county for which no specimen seemed to exist. Washington County is the other county mentioned in the literature, but that occurrence is unsupported by a specimen. An occurrence in Washington County seems plausible, especially given that a population exists on the Green County side of Ten Mile Creek, which coincides with the county line separating those two counties. *Hendersonia occulta* is currently known from six counties in Pennsylvania. Despite searches at 370 locations in Allegheny County since 2002, it had not been seen in Allegheny County since 1948. However, in 2019, a living population was discovered in Allegheny County.

On 4 May 2019, I found four living *Hendersonia occulta* in Allegheny County in a wooded area beside the Great Allegheny Passage (a railroad converted to a trail) near the town of Sutersville (40.2404°, -79.8069° [decimal degrees]). *Hendersonia occulta* is a calciphile (Hubricht, 1985) requiring limestone. Although I did not notice limestone or limestone indicator vegetation at the site, a geological map (Pennsylvania Geologic Survey, 1974) indicates that the area is underlain by limestone. Interestingly, I had searched this location in 2008 and not seen this species there.

The discovery of living populations of these snails in these areas of Pennsylvania is relevant to conservation, because they can no longer be considered locally extinct. Although there is no evidence that the populations have recovered (as opposed to just being overlooked), I like to think that conservation efforts have played a role in improving conditions for these populations.

I am grateful to Kerry Givens and Kevin Faccenda for noticing and photographing the snail, and for alerting me to its existence.

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## LISTING AND DOCUMENTING INTRODUCED MOLLUSCS OF INDIA

*By N.A. Aravind*

Ever-increasing trade and movement of people has resulted in the introduction of species from one region to another. The species introductions are either accidental or deliberate through agricultural trade, as pets, for research etc. (Essl *et al*., 2011). Some of these introduced species often establish and become invasive outside their native range. Once they become invasive, they cause havoc to local biodiversity, ecosystem services and human and environmental health (Pimentel, 2011; Nghiem *et al*., 2013; Jackson 2015).

Invasive species are among the leading threats to native biodiversity. According to the Convention on Biological Diversity (CBD), since 1700 AD, invasive alien species (IAS) have contributed to more than 40% of all animal extinctions. The economic loss caused by introduced species in many developed and developing countries is estimated to be over US$ 137 billion (Pimenel *et al*., 2000). Hence there is an urgent need to address the problem of IAS as economic and environmental impacts are severe.

Documenting, cataloguing and mapping of non-indigenous species is important given their impacts. Early detection and prevention is a key for further spread of introduced species. Globally, there are efforts for listing invasive species from different parts of the world. (Cowie *et al*., 2009; Budha, 2014; Naranjo-García & Castillo-Rodríguez, 2017; Nurinsiyah & Hausdorf, 2019). India is a signatory to the CBD and harbours four internationally recognised biodiversity hotspots with rich biodiversity. India thus has to identify, prevent and develop strategies for controlling and managing the impact of introduced species.

A comprehensive list of introduced and invasive plants exists, but there has been no such attempt made to document introduced molluscs of India. In this short note, a list of introduced molluscs reported to date from the Indian region has been compiled. India is home to 1,132 land mollusc species, 210 freshwater species and over 3,400 marine species (Ramakrishna *et al*., 2010; Aravind & Páll-Gergely, 2018). The compilation of introduced molluscs was done using published literature on India's land, freshwater and marine species. The impact of these species, if available, is also compiled.

To date, 21 species belonging to 16 families and 20 genera are reported from India (Table 1). Of these 21 species, eight are terrestrial, five are freshwater and eight are marine (Table 1). Among land snails, three species, namely *Lissachatina fulica*, *Allopeas gracile* and *Laevicaulis alte*, are widely distributed, occurring almost throughout India except in high altitude cold regions of the Himalayas and dry and arid desert regions in northwestern India. From freshwater, *Physella acuta* and from marine *Mytilopsis sallei* have been reported.

There are also unconfirmed reports of the presence of *Euglandina rosea* in mainland India and the Andaman Islands. According to the literature, this species was introduced in

**Table 1.** Introduced molluscs of India, with biogeographic region of origin. Asterisk indcates the exact range could not be determined.

| Family | Species | Origin |
|---|---|---|
| Land | | |
| Achatinidae | *Lisschatina fulica* | Afrotropical |
| Agriolimacidae | *Deroceras leave* | Palaearctic |
| Agriolimacidae | *Deroceras reticulatum* | Palaearctic |
| Veronicellidae | *Eleutherocaulis haroldi* | Afrotropical |
| Veronicellidae | *Laevicaulis alte* | Afrotropical |
| Limacidae | *Limax maximus* | Palaearctic |
| Subulinidae | *Allopeas gracile* | ? Neotropical |
| Camaenidae | *Bradybenia similaris* | Indomalayan |
| Freshwater | | |
| Ampullariidae | *Pomacea diffusa* | Neotropical |
| Physidae | *Physella acuta* | Nearctic |
| Planorbidae | *Planorbarius corneus* | Palaearctic |
| Planorbidae | *Planorbella duryi* | Nearctic |
| Planorbidae | *Amerianna carinata* | Australian |
| Marine | | |
| Mytilidae | *Perna perna* | Atlantic* |
| Mytilidae | *Mytella strigata* | Neotropical |
| Dreissenidae | *Mytilopsis sallei* | Neotropical |
| Umbraculidae | *Umbraculum umbraculum* | Neotropical |
| Thracidae | *Thracia adenensis* | Afrotropical |
| Polyceridae | *Thecacera pennigera* | Palaearctic |
| Trinchesiidae | *Tenellia adspersa* | Palaearctic |
| Vermetidae | *Eualetes tulipa* | Neotropical |

1968 (Mead, 1979). However, according to Rao *et al*. (1971) and Sankaran (1974), it has been unsuccessful in establishing a population in India. Apart from the above-listed species, there are eight species of freshwater molluscs that are in the aquarium trade (*Clithon corona*, *Vittina semiconica*, *Neritina zebra*, *Neritina turrita*, *Neritina natalensis*, *Clea helena*, *Brotia pagodula* and *Faunus ater*). These species are not yet reported from natural habitats and care should be taken to avoid their accidental introduction.

Biogeographic patterns in introduced molluscs indicate that the species are mainly from the Palaearctic (6 species), Neotropical (6 species, tentatively including *Allopeas gracile*, the true origin of which is not very clear) and Afrotropical (4 species) regions (Fig. 1). Analysis of species occurrence in different ecoregions of India indicates that the marine ecoregion has eight species. The Trans-Himalayan region and Desert have no reported introduced species to date. The Andaman and Nicobar Islands have only *L. fulica* reported to date.

Impact on biodiversity and natural ecosystems has not been documented for any of the species, except *Mytilopsis sallei* (Dreissenidae), which is a bio-fouling species. However, the impact on agriculture has been widely studied for *Lissachatina fulica* and *Laevicaulis alte*. A significant number of studies have assessed the impact on agricultural productivity and a few have addressed control. There are no studies on the impact on native biodiversity and ecosystem health. Hence, there is an urgent need to assess the impact as India has high numbers of endemic species in both land and freshwater environments.

The role of citizen scientists is immense in cataloguing biodiversity (Gallo & Waitt, 2011; Aravind, 2013; Johnson *et al*., 2020). Open-access platforms such as the India Biodiversity Portal and iNaturalist have provided a space for documenting introduced molluscs, especially in terrestrial habitats. For example, the recently introduced slug *Eleutherocaulis haroldi* (Veronicellidae) has 53 records in the citizen science portal as opposed to 16 in the published literature. Citizen science initiatives such as Mapping Snails and Slugs (MISS) and Spotting Alien Invasive Species (SPIAS) in the India Biodiversity Portal have been initiated for mapping Indian introduced molluscs (and other species).

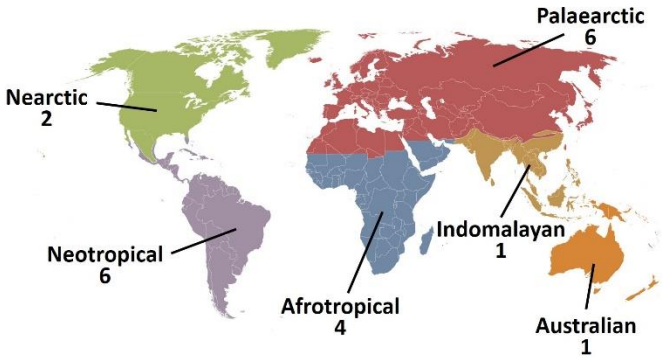


**Fig. 1.** Proportion of introduced species in India from different biogeographic realms (excluding *Perna perna*).

The compilation will help natural habitat and ecosystem managers and policymakers to take proactive steps in managing the introduced species. This compilation also prompts researchers to undertake studies on the impact of these species on local biodiversity, ecosystems and human health.

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## DIVERSITY OF TERRESTRIAL MOLLUSCS IN THE VALLE DE VIÑALES, VIÑALES NATIONAL PARK, CUBA

*By Maike Hernández, Manuel A. Bauzá, Gustavo Blanco & Luis Alvarez-Lajonchere*

The Cuban archipelago is considered an important biodiversity hotspot. Among the most diverse groups are molluscs, with ~ 3,000 marine and non-marine species (Espinosa *et al*., 2009; Hernández *et al*., 2017). Among the non-marine species, 1,406 gastropods have been recorded: 473 species of Neritimorpha and Caenogastropoda, of which 99.6% are endemic, and 933 species of Heterobranchia, of which 94.2% are endemic (Hernández *et al*., 2017; Hernández & Bauzá, unpublished).

The Guaniguanico mountain range is one of the regions of the Cuban archipelago with the greatest diversity of land molluscs, ~ 342 species (Bauzá & Hernández, 2020). The only previous studies of the group in this region are those of Jaume (1945, 1972), Berovides *et al*. (1994), Oliva-Olivera & Real (2009) and Bauzá & Hernández (2020). Within this mountain range, one of the emblematic protected areas is the Viñales National Park, where the Viñales Valley is located; made up of a matrix of small isolated mountains and mogotes (steep-sided limestone mounts), agricultural areas and urban settlements. Knowledge of molluscs in the Viñales Valley is nil. For this reason, the main interests of this study were to document the diversity of terrestrial molluscs in the Viñales Valley and to recognise the main threats faced by this group.


**Fig. 1.** Study locations in Valle de Viñales, Viñales National Park. 1, mogote El Valle; 2, mogote Dos Hermanas; 3, mogote north of mogote El Valle; 4, mogote Palmarito; 5, mogote Coco Solo; 6, mogote north of mogote Dos Hermanas.

Surveys were carried out in May, July, August and September 2014. Plots with a surface area of 10 $m^2$ and karstic wall of 22 $m^2$ were randomly chosen in six elevation locations of the Viñales Valley (Fig. 1). In the mogote El Valle, seven plots and seven karstic walls were chosen, in Dos Hermanas two plots and two karstic walls, in the mogote to the north of mogote El Valle one plot and three karstic walls, in mogote Palmarito one plot and three karstic walls, in mogote Coco Solo two karstic walls and in a mogote to the north of mogote Dos Hermanas, one karstic wall. Only living individuals were counted.

In total, 38 species were recorded (Table 1). The greatest diversity was recorded in mogote El Valle with 33 species, followed by mogote Dos Hermanas with 22, the mogote to the north of mogote El Valle with 14, mogote Palmarito with 15, the mogote north of mogote Dos Hermanas with seven and mogote Coco Solo with six.

Of the total recorded species, 12 belong to the subclass Neritimorpha with two families, eight to the subclass Caenogastropoda with two families; 18 species belong to the subclass Heterobranchia with 10 families. The best represented families at the species level were Helicinidae and Annulariidae. Of the total species, 34 (89.5%) are Cuban endemics, of which 26 are regional endemics (i.e. restricted to a particular region in Cuba) and one is a disjunct endemic, occurring in the west and in the extreme east of Cuba (Table 1). *Viana regina*, *Nodulia vignalensis*, *Proserpina globulosa* and *Chondrothyra reticulata* were observed in high abundance (Fig. 2). Oliva-Olivera & Real (2009) did not list *Guppya gundlachi* and *Veronicella* cf. *cubensis* in their study, so they are considered new records for the karst elevations of Viñales.

During the study we identified potential threats to the diversity of land snails (Fig. 3): patches inside the mogotes created by the residents for cultivation of root crops, coffee and bananas, loss of the native vegetation at the bases of the mogotes, animal husbandry (domestic pigs, cows, goats), invasive species like ants and rats and intensive tourism for practice of extreme sports like climbing. According to Espinosa (2011), the main threats to terrestrial molluscs are the extreme

**Table 1.** Taxonomic composition, endemism and abundance of terrestrial molluscs in six elevations of the Viñales Valley, Pinar del Río, Cuba. *Cuban endemic species. **Regional endemic species. ***Disjunct endemic species.

| Taxon | Abundance plot / karstic wall | | | | | |
|---|---|---|---|---|---|---|
| | El Valle | Dos Hermanas | North of El Valle | Palmarito | Coco Solo | North of Dos Hermanas |
| **Neritimorpha** | | | | | | |
| **Helicinidae** | | | | | | |
| *Alcadia dissimulans*** | 2/1 | 1/10 | -/14 | - | - | - |
| *Alcadia minima** | - | - | - | -/2 | 3 | 1 |
| *Alcadia rotunda*** | 19/3 | 13/- | - | /1 | - | - |
| *Emoda sagraiana*** | 22/10 | - | 2/- | 5/3 | 1 | 1 |
| *Helicina adspersa** | 7/2 | 2/1 | - | - | - | - |
| *Semitrochatella fuscula*** | - | -/13 | 2/- | - | - | - |
| *Troschelviana chrysochasma*** | -/17 | -/1 | - | /26 | 4 | - |
| *Troschelviana rubromarginata*** | 9/- | - | 1/- | - | - | - |
| *Ustronia acuminata*** | 3/20 | - | 6/28 | - | - | - |
| *Viana regina*** | 100/98 | /16 | 29/60 | 47/154 | - | 24 |
| **Proserpinidae** | | | | | | |
| *Proserpina depressa**** | -/1 | - | - | - | - | - |
| *Proserpina globulosa** | -/189 | 1/56 | 7/15 | /39 | - | - |
| **Caenogastropoda** | | | | | | |
| **Annulariidae** | | | | | | |
| *Anularops coronadoi*** | 1/3 | - | - | - | - | - |
| *Anularops semicana organicola*** | 30/22 | -/2 | - | -/1 | - | 3 |
| *Chondropometes vignalense*** | -/6 | - | - | - | - | - |
| *Chondrothyra affinis*** | -/1 | - | - | - | - | - |
| *Chondrothyra reticulata*** | 17/49 | -/11 | 7/15 | -/9 | - | 7 |
| *Rhytidotyra bilabiata*** | 39/7 | - | 3/- | 1/- | - | - |
| **Megalomastomatidae** | | | | | | |
| *Farcimen superbum*** | 9/- | - | - | - | - | - |
| *Farcimen vignalense*** | 8/1 | -/3 | - | 6/- | - | - |
| **Heterobranchia** | | | | | | |
| **Urocoptidae** | | | | | | |
| *Nodulia* sp. ** | -/7 | - | - | - | - | - |
| *Nodulia vignalensis*** | 69/35 | -/2 | 13/5 | 3/44 | 30 | 6 |
| *Tomelasmus irroratus*** | 13/3 | - | - | - | - | - |
| **Agriolimacidae** | | | | | | |
| *Deroceras laeve* | - | -/3 | - | - | - | - |
| **Cepolidae** | | | | | | |
| *Guladentia subtussulcata*** | 1/5 | - | - | - | - | - |
| *Jeanneretia parraiana*** | 7/9 | 3/7 | 7/11 | 2/3 | - | - |
| *Setipellis* cf. *stigmatica*** | -/7 | - | - | - | - | - |
| **Euconulidae** | | | | | | |
| *Guppya gundlachi* | - | -/10 | - | - | - | - |
| **Sagdidae** | | | | | | |
| *Lacteoluna selenina* | -/6 | - | - | - | | - |
| **Orthalicinae** | | | | | | |
| *Liguus flammellus*** | 1/- | -/1 | - | - | 1 | - |
| **Achatinidae** | | | | | | |
| *Subulina octona* | -/2 | -/1 | - | - | - | - |
| **Oleacinidae** | | | | | | |
| *Melaniella acuticostata** | 2/1 | - | - | - | - | - |
| *Oleacina solidula** | - | -/1 | - | - | - | - |
| *Oleacina straminea** | 3/5 | 4/1 | -/1 | 3/1 | - | - |
| *Rectoleacina cubensis*** | -/1 | 1/- | - | - | - | - |
| **Zachrysiidae** | | | | | | |
| *Zachrysia guanensis castanea*** | 9/9 | 1/1 | 1/- | -/6 | 4 | 1 |
| **Veronicelidae** | | | | | | |
| *Veronicella* cf *cubensis** | 2/- | 3/2 | - | - | - | - |
| *Veronicella tenax*** | 3/4 | -/2 | 3/2 | -/1 | - | - |

anthropisation of their habitats and their surroundings, in addition to illegal commerce. This brief study shows the need to monitor terrestrial mollusc populations in the Viñales Valley because of human interaction with their habitats.

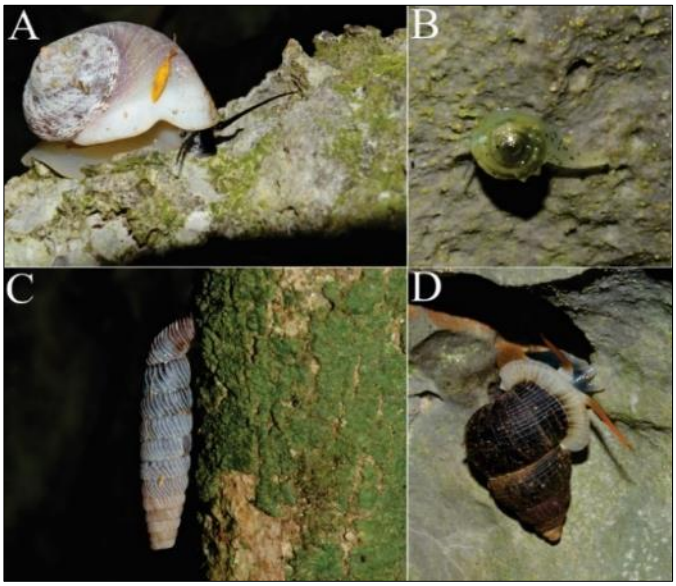


**Fig. 2.** Some of the most abundant species: *Viana regina* (A), *Nodulia vignalensis* (B), *Proserpina globulosa* (C), *Chondrothyra reticulata* (D).

**Fig. 3.** Some of the main threats to the diversity of terrestrial molluscs in the Viñales Valley, Viñales National Park.

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## PRELIMINARY REPORT ON A MOLLUSC SURVEY OF HANNAN WUHU WETLAND NATURE RESERVE

*By Zhe-Yu Chen*

During 2020, the Wuhan Municipal Bureau of Gardening and Forestry entrusted Hubei Broad Nature Technology Service Co., Ltd. to carry out a baseline survey of species diversity of Wetland Nature Reserves in Wuhan. As part of this effort, the author participated in the survey of the mollusc component of the benthic fauna in the Hannan Wuhu Wetland Nature Reserve in late 2020. This article reports the results of this survey. All the voucher specimens were deposited in the Broad Nature Biodiversity Museum. Wuhu Wetland is located in the southwest of Wuhan City, about 60 km from the city centre, and covers a wetland area of 3,293 km$^2$ (Fig. 1). Wuhu wetland is close to the Yangtze River and connects with it in flood seasons. Winter is the dry season for the wetland, and large areas of dried mud banks are exposed, on which many empty mollusc shells are found (Fig. 2), and on which this survey was based.

The survey recorded 35 species representing13 families of molluscs in the Wuhu Wetland (Table 1). Among them, there were 19 species of Bivalvia, representing four families and 15 genera, and 16 species of Gastropoda representing nine families and 13 genera. The survey demonstrated that mussel diversity in Wuhu Wetland is high. Compared with the number of mussel species in China, estimated by Bogatov & Prozorova (2017) as about 170, the mussel fauna of Wuhu Wetland includes representatives of almost 10% of the total. Therefore, establishment of this wetland reserve is significant for the survival of mussel diversity in China. Also worth noting is that a large number of *Oncomelania hupensis* were


**Fig. 1.** Wuhu Lake showing its proximity to the outskirts of the city of Wuhan and to the Yangtse River.


**Fig. 2.** Wuhu Lake during the dry season. A, exposed mud banks; B, empty bivalve shells on the exposed mud banks.

observed. This suggests that the reserve needs to regularly monitor whether *Schistosoma japonicum*, the cause of

**Table 1.** Check-list of molluscs of Wuhu Lake.

**Bithyniidae**
*Parafossarulus eximius* (Frauenfeld, 1864)
*Parafossarulus manchouricus* (Bourguignat, 1860)
*Parafossarulus sinensis* (Möllendorff (1888)
*Gabbia longicornis* (Benson, 1842)
**Lymnaeidae**
*Radix auricularia* (Linnaeus, 1758)
**Planorbidae**
*Helicorbis cantori* (Benson, 1850)
*Choanomphalus* [as "Chanomphalus] *heudiana* Yen, 1937
**Pomatiopsidae**
*Oncomelania hupensis* Gredler, 1881
**Semisulcospiridae**
*Semisulcospira ningpoensis* (Lea, 1857)
**Viviparidae**
*Cipangopaludina catayensis* (Heude, 1890)
*Cipangopaludina chinensis* (Gray In Griffith & Pidgeon, 1833)
*Sinotaia quadrata* (Benson in Cantor, 1842)
**Ampullariidae**
*Pomacea canaliculata* (Lamarck, 1822)
**Succineidae**
*Succinea arundinetorum* Heude, 1882
**Camaenidae**
*Acusta ravida* (Benson in Cantor, 1842)
*Bradybaena similaris* (Férussac, 1821)
**Corbiculidae**
*Corbicula fluminea* (Müller, 1774)
**Mytilidae**
*Limnoperna fortunei* (Dunker, 1857)
**Pharidae**
*Novaculina chinensis* Liu & Zhang, 1979
**Unionidae**
*Aculamprotula scripta* (Heude, 1875)
*Aculamprotula tientsinensis* (Crosse & Debeaux, 1863)
*Aculamprotula zonata* (Heude, 1883)
*Acuticosta chinensis* (Lea, 1868)
*Anemina arcaeformis* (Heude, 1877)
*Arconaia lanceolata* (Lea, 1856)
*Cristaria plicata* (Leach, 1814)
*Cuneopsis heudei* (Heude, 1874)
*Lamprotula caveata* (Heude, 1877)
*Lamprotula elongata* Liu, Zhang & Wang, 1980
*Lanceolaria grayii* (Gray, 1833)
*Lanceolaria gladiola* (Heude, 1877)
*Nodularia douglasiae* (Gray in Griffith & Pidgeon, 1833)
*Sinanodonta woodiana* (Lea, 1834)
*Sinohyriopsis cumingii* (Lea, 1852)
*Sinosolenaia oleivora* (Heude, 1877)

schistosomiasis, is present or absent. Monitoring after floods is particularly important, as this could affect the livelihood of people in the large cities downstream.

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# CONSERVATION STATUS OF TWO *HEMICYCLA* SPECIES (HELICIDAE) FROM WESTERN TENERIFE (CANARY ISLANDS)

*By Marco T. Neiber*

The genus *Hemicycla* Swainson, 1840 (Helicidae) is probably the most conspicuous group of land snails in the Canary Islands (eastern Atlantic) and represents, with over 40 extant (sub)species, the second largest radiation of terrestrial molluscs in the archipelago (Bank *et al*., 2002; Alonso &

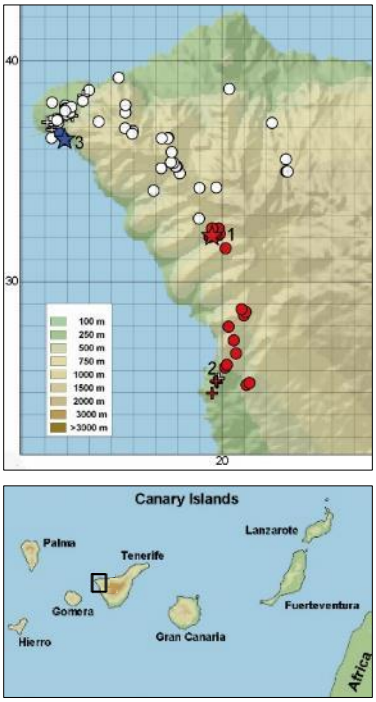


**Fig. 2.** Top: distribution of *Hemicycla mascaensis* (red symbols), *H. diegoi* (blue symbols) and other *Hemicycla* species (white symbols) known from the Teno Massif in western Tenerife (Canary Islands). The map is based on my own records and published records from Ibáñez *et al*. (1988), Hutterer (1994) and Neiber *et al*. (2011). Stars: type localities; dots: extant populations; crosses: (sub-) fossil populations. 1: Lomo de Masca, 2: eastern slope of Guamasa Mountain, 3: Los Roques, south-western slope (type locality of *H. diegoi*). 1 km × 1 km UTM grid (WGS 84, Zone 28R). Bottom: map of the Canary Islands and location of the study area.

Ibáñez, 2007; Núñez Brito & Núñez Fraga, 2010). From the Teno Massif in the western part of Tenerife, one fossil and five extant taxa belonging to *Hemicycla* are currently known (Ibáñez *et al*., 1987, 1988; Vega-Luz & Vega-Luz, 2008; Neiber, 2010; Neiber *et al*., 2011), among these the closely related *H. mascaensis* Alonso & Ibáñez, 1988 and *H. diegoi* Neiber, Vega-Luz, Vega-Luz & Koenemann, 2011 (Fig. 1).

Both taxa appear to have very narrow ranges in the Teno Massif and are usually found aestivating under large rocks in areas with Canarian xerophytic scrub communities that are formed by stem and leaf succulents and woody sclerophyllous shrubs in arid locations. *Hemicycla diegoi* is only known from mountain slopes with this type of vegetation at the westernmost tip of the Teno Massif (Fig. 2), while *H. mascaensis* has almost exclusively been reported from the surroundings of the village of Masca (Fig. 2, close to locality 1) in the south-eastern part of the Teno Massif (Ibáñez *et al*., 1988; Neiber *et al*., 2011; Groh & Alonso, 2013; Groh, 2017). Only Alonso *et al*. (1990) mentioned *H. mascaensis* also from the surroundings of Los Gigantes further to the south, but without detailed locality data. The ranges of the two taxa are separated by several deep ravines and the Cumbres de Baracán ridge that is covered by more humid tree heath and laurel forests, which seems to be unsuitable habitat for either *H. mascaensis* or *H. diegoi*, but where other *Hemicycla* species occur (Neiber, 2010).

*Hemicycla diegoi* has been assessed as Near Threatened (NT) in the current version (2020-3) of the IUCN Red List of Threatened species because of its small range, while *H. mascaensis* is assessed as Critically Endangered (CR) because aside from its small range, the species is thought to be negatively impacted by ongoing urbanisation and tourist activities in its range (Cuttelod *et al*., 2011; Groh & Alonso, 2013; Groh, 2017; Neubert *et al*., 2019).

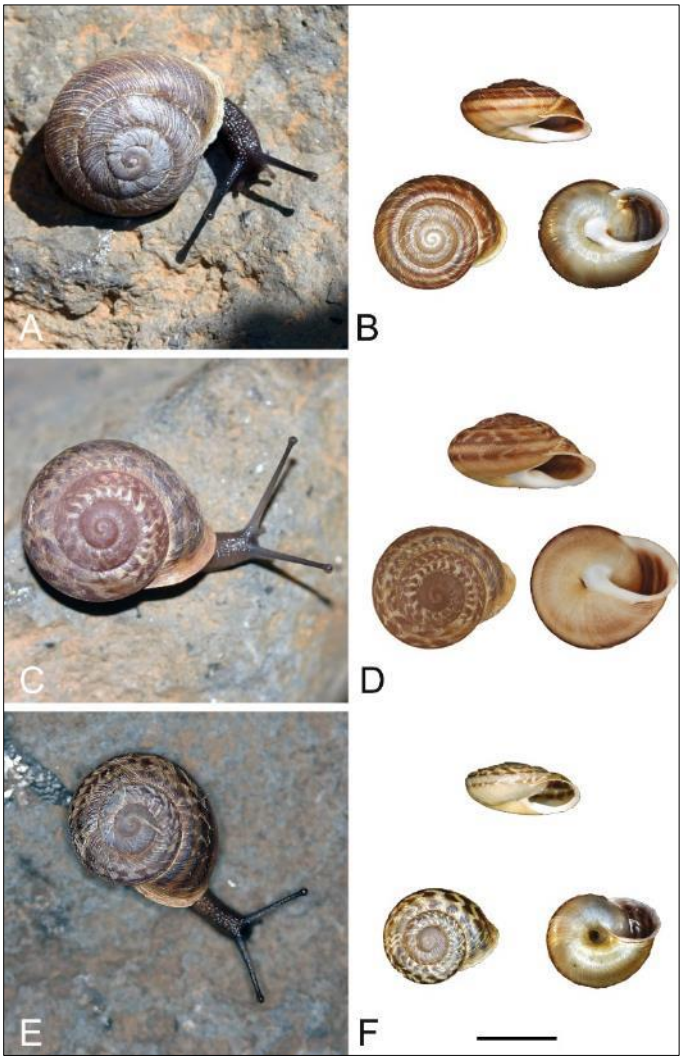


**Fig. 1.** Photographs of living specimens and shells of *Hemicycla mascaensis* (A–D) and *H. diegoi* (E–F). A, B, Lomo de Masca, 28°18'10" N, 16°50'14" W. C, Guamasa, eastern slope, 28°14'56" N 16°50'00" W. D, Guama, eastern slope, 28°16'22" N, 016°49'34" W. E, F, Los Roques, south-western slopes, 28°20'27" N, 16°54'32" W. Scale bar (B, D, F): 10 mm. A, C, E, F, modified from Neiber *et al*. (2011).

*Hemicycla mascaensis* is also known in a subfossil state from slope deposits in Los Gigantes and Puerto Santiago in the southernmost part of the Teno Massif (Hutterer, 1994; see also Fig. 2), which suggests, together with the record of Alonso *et al*. (1990) (Fig. 2, close to locality 2), that the taxon may have a wider distribution in the southern part of the Teno Massif in areas with suitable habitat between Masca and Los Gigantes. Field work in this area from 2000 to 2018 resulted in the discovery of several new populations in the southern part of the Teno Massif and adjacent Valle de Santiago (Fig. 1) that can be assigned to *H. mascaensis* based on shell morphology.

The relationships among the different *H. mascaensis* populations and the relationship of *H. mascaensis* and *H. diegoi* are currently being investigated using morphometric and phylogenomic techniques (Bober *et al*., in press). Based on the outcome of these investigations the conservation status of both species will be re-assessed. *Hemicycla mascaensis* in particular may not be as threatened as previously thought, especially since most of the newly discovered populations lie within the boundaries of protected landscapes.

I thank Jennifer Lauschke (CeNak, Hamburg, Germany) for taking the shell images.

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# THE USA PACIFIC NORTHWEST LAND SNAIL *CRYPTOMASTIX DEVIA* (GOULD, 1846) REJECTED FOR LISTING UNDER THE ENDANGERED SPECIES ACT

*By Edward J. Johannes*

The land snail *Cryptomastix devia* (Gould, 1846) (Puget Oregonian) convulsed conservation history in the USA starting under President Clinton's Northwest Forest Plan (NWFP) (FEMAT, 1993; USDA & USDI, 1994), and subsequent litigation and petitions for listing under the Endangered Species Act (ESA) have been covered previously in *Tentacle* (Johannes, 2012, 2013, 2020a, b).

As the result of litigation and petitions the US Fish and Wildlife Service (USFWS) determined that *Cryptomastix devia*, found in the states of Washington and Oregon, USA (Fig. 1), might be eligible for endangered species protection under the ESA (USFWS, 2011).

After much delay a Species Status Assessment was undertaken in 2019 to assess the species' overall viability and identify its ecological requirements for survival and reproduction at the individual, population and species levels (Le & Waterstrat, 2019). This report also described risk factors influencing the species' current and future condition.

Despite identifying ongoing threats to its habitat from logging, agricultural conversion, the increase in high intensity fires and climate change induced die-off of *Acer macrophyllum* (bigleaf maple; a tree *Cryptomastix devia* is closely associated with), USFWS determined that this species does not warrant listing under the ESA (USFWS, 2020).

Unlike the USA, Canada has listed *Cryptomastix devia* as a Species at Risk in British Columbia, but as possibly extirpated there. Recent surveys have not found this species at the locations of the two reported occurrences in the 1800s (Pfeiffer, 1850; Taylor, 1889) and one in the early 1900s (Dall, 1905) or elsewhere in British Columbia (COSEWIC, 2002, 2013) (Fig. 2).

I would like to thank Jonathan Ablett (Curator of Non-Marine Mollusca and Cephalopoda, Natural History Museum, London), for providing the photo of *C. devia* and specimen label.


**Fig. 1.** *Cryptomastix devia* sites (red dots) in Oregon and Washington, USA, and one site (blue dot at top of map) in Victoria, Vancouver Island, Canada.

**Fig. 2.** *Cryptomastix devia* (type specimen for *Helix baskervillei* Pfeiffer, 1850) formerly in the Hugh Cumming collection reported to have been collected from Vancouver Island, British Columbia. (Photos: Natural History Museum, London)

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## PANDEMIC AND CONSERVATION OF FRESHWATER MOLLUSCS IN ARGENTINA

*By Diego E. Gutiérrez Gregoric, Micaela de Lucía, Santiago Torres & Gustavo Darrigran*

To date, the impact of the Coronavirus COVID-19 pandemic in Argentina has been quite significant in terms of social activity, but more specifically in terms of scientific field research (because of the absence of collection permits, the restrictions on circulation, the closure of laboratories, border controls and social distancing, among other issues). Completion of research by the present authors on issues related to the conservation and distribution of gastropods and freshwater bivalves from Argentina, for example by Torres & Darrigran (2019) and de Lucía & Gutiérrez Gregoric (2020), has been delayed because of laboratories being closed or field work not being possible. Even though the quality of the thesis work of these doctoral students (de Lucía, Torres), and of other students and researchers, has not diminished, its completion has been held back.

Regarding conservation of the freshwater mollusc fauna of Argentina, there is a relatively high species richness of around 168 species (Rumi *et al*., 2006, 2008; Núñez *et al*., 2010) but there are also considerable information and resources gaps when it comes to the study of freshwater molluscs, both native and non-native, the latter also being a threat to native biodiversity (Darrigran *et al*., 2020). For conservation management, it is necessary to generate an update of the current diversity of freshwater molluscs in Argentina in particular and in South America in general. For this purpose, we have taken up the challenge of generating an update of the distributions of the freshwater mollusc taxa of Argentina, as well as their conservation status according to criterion B of regional distribution according to the IUCN (2012).

The latest overall study of freshwater gastropods of Argentina (Núñez *et al*., 2010) counted 103 available species, of which 40 were considered vulnerable. However, in this study, the IUCN criteria were not used to determine their status. The IUCN, for Argentina, published evaluations in 2010/2011 (in which G. D. participated) using the official IUCN categories: Critically Endangered-CR, Endangered-EN, Vulnerable-VU, Near Threatened-NT and Least Concern-LC.

Due to the closure of laboratories and the necessity of working from a home office, as a result of the COVID-19 pandemic, the databases of freshwater molluscs have been updated, based on records in malacological collections, that is, analysis of new pre-pandemic collections, as well as publications since 2008 and 2010, when the latest updates had been made for bivalves and gastropods, by Rumi *et al*. (2008) and Núñez *et al*. (2010), respectively.

To date, we have finished updating both the list of species, as well as the records for bivalves. For gastropods, the list of species has been fully updated, but the list of records has only been partially updated. For the completed databases, the GEOCat software applied by IUCN has been used to estimate the Extent of Occurrence (EOO) and Area of Occupation (AOO) of each of the species, and thus to determine the level of vulnerability (Bachman *et al*., 2011).

As a result of this update, we estimate that in Argentina there are 68 species of bivalves (63 natives, three non-natives, two possible synonyms of other species) and 117 gastropods (106 natives, six non-natives, three possible synonyms of other species). Thus the numbers of recorded freshwater mollusc species in Argentina appears to have increased in recent years, rising from 168 to 185.

For bivalves, the database used by Rumi *et al*. (2008), included 2,100 geo-referenced records, and as a result of the present update, 3,200 geo-referenced records have been obtained (Fig. 1). Of the 63 native species, 56 of them have been evaluated (species with just one or two records have been omitted). Considering the AOO, all species in Argentina are, at least, Endangered (EN), whereas some are Critically Endangered (CR). Regarding the EOO, some species are considered threatened, for now, potentially CR (8 species), EN (7), VU (4) species; others are assessed as NT (5) and LC (32).

Regarding gastropods, the database used by Núñez *et al*. (2010) included ~ 4,000 geo-referenced records, and so far we have been able to increase this to 5,000 records. Within this group, the database of the Chilinidae (Fig. 2) is fully updated, with 670 records and 24 species (seven species with one or two records). As for bivalves, all Chilinidae species may be EN, according to the AOO. Regarding the EOO, some species are considered threatened, for now, potentially CR (2 species), EN (1), VU (3); others are assessed as NT (2) and LC (9).

Once all the databases have been updated, our next step is to analyse the threats to each species to evaluate their final

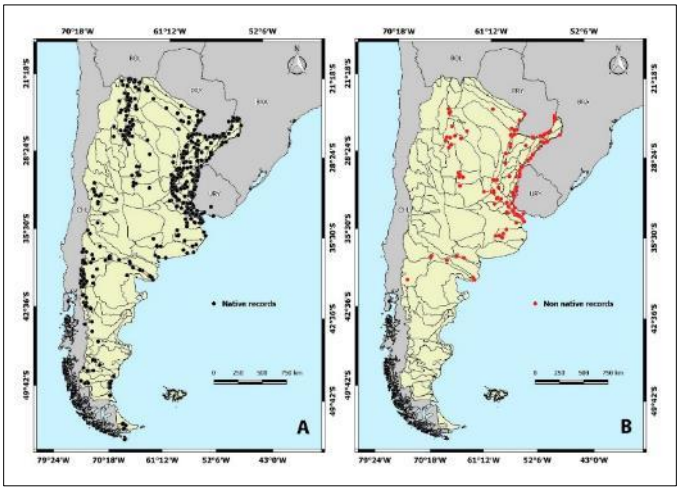


**Fig. 1.** Geo-referenced bivalve records for Argentina. A, native species; B, non-native species.

**Fig. 2.** *Chilina fluminea* (Gastropoda, Chilinidae, length ~ 1.5 cm) in the Río de la Plata (Buenos Aires province), on a branch with settled *Limnoperna fortunei* (Bivalvia), an invasive species and one of the main threats to the epifauna in this river basin.

conservation status. In addition, we aim to analyse how the distribution of freshwater molluscs is related to protected areas. In this sense, the work of Torres *et al*. (2018), which showed that fewer than 14% of the Argentinean protected areas have records of Unionida and only 9% have records of four or more species, may serve as a useful precedent.

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## NOT SILVER, NOT GOLD BUT A PRECIOUS MUSSEL FAUNA: PAST AND FUTURE OF UNIONIDA OF RÍO DE LA PLATA

*By Cristhian Clavijo & Igor Christo Miyahira*

The Río de la Plata basin covers an area of 3.25 million km$^2$ making it the 6th largest river basin in the world. It includes territory of five South American countries (Argentina, Bolivia, Brasil, Paraguay and Uruguay) and large rivers as tributaries, notably the Paraná, Paraguay and Uruguay Rivers. The name ‘Plata’ (which means ‘silver’ in Spanish) was given by the conquerors because of their belief that they would find this precious metal by following the river. The silver was not found in great quantities, but another precious thing was found later, a rich mussel fauna (Fig. 1). Freshwater mussels (Unionida) are represented in the Río de la Plata basin by two families: Mycetopodidae and Hyriidae. There has been more than 200 years of research on this basin but this effort did not take place continuously or homogeneously through time, and thus knowledge of these molluscs is still poor. These gaps in knowledge hinder the evaluation of conservation status and

the development of conservation programmes and sustainable use of unionids. As an initial effort to change this situation, we submitted a project proposal to the Mohamed bin Zayed Foundation entitled "Conservation of freshwater bivalves of Río de la Plata basin" and it was funded. The main goal of this project is to evaluate the conservation status of the mussels of the Río de la Plata basin. The project will include field surveys, several analyses and finally a workshop for species evaluation, following the IUCN criteria.

Because of the COVID-19 pandemic, our schedule is delayed. The field and museum surveys are now indefinitely postponed. However, we are working on a robust database as a baseline for future studies. We are trying to stand on giants' shoulders to look forward. Thus, the aim of this note is to present the first data resulting from the literature survey. The literature survey was done based mainly on our experience. We decided not to use a standard search protocol on Google Scholar or Web of Science, as done for example by Miyahira *et al*. (2020), because of the type of data. Several old studies do not appear in those databases and important information could be lost. The bibliographic review returned more than 350 publications and included papers, books, book chapters and technical reports. From each publication some information was gathered: species, type (morphology, ecology, etc) and area studied (river, basin, etc). Information obtained from online databases like the Mussel Project and SpeciesLink will also be used. The information is still being processed but some conclusions can be drawn.

**Fig. 1.** A sample of mussel diversity of the Río de la Plata basin. Specimens collected from the lower Uruguay River, Uruguay.

There are 55 species of Unionida currently recognised in the Río de la Plata, 23 in Mycetopodidae and 32 in Hyriidae, based mainly on Pereira *et al*. (2014) and Cuezzo *et al*. (2020), with some modifications. Several species in the basin are in need of revision (Pereira *et al*., 2012; Miyahira *et al*., 2017), so these numbers of species are not definitive. The most diverse genus in the basin is *Diplodon* (20 species), followed by *Anodontites* (9), *Castalia* (6), *Rhipidodonta* (6) and *Monocodylaea* (5). Some species are widespread throughout the basin, such as *Anodontites trapesialis* and *Mycetopoda siliquosa*; others are restricted to smaller areas, such as *Diplodon variabilis* (lower Uruguay River) and *Diplodon caipira* (upper Paraná River).

Despite the large number of published articles, basic studies are sparse for most species. Some details of shell morphology or internal anatomy are known for some species, but others are still today known only from the original descriptions, such as *Monocondylaea guarayana* and *Diplodon funebralis*. Detailed distributional information is lacking for most species. The distributional information that is available represnts two extremes: occurrence records for a very restricted area (e.g. *Anodontites ferrarisii* (see Mansur & Olzarri, 1995) or general distributional information for large basins (e.g. Simone, 2006; Pereira *et al*., 2014; Cuezzo *et al*., 2020). Recently we have presented detailed distributional accounts for other freshwater bivalve groups (e.g. Clavijo & Carranza, 2018) or Unionida of other basins (e.g. Miyahira *et al*. 2019). The methodology of some of those studies must be replicated in the Río de la Plata basin. Detailed distributional information is essential for a proper conservation evaluation. The goal is not only to detail the distribution of species, but also evaluate the possibility of population reductions.

Information on ecology and reproduction was even more obscure. As in the USA, commercial exploitation of mussels had stimulated ecological studies (especially population dynamics). Bonetto *et al*. (1950) were the first to undertake one of the few population studies of freshwater mussels in South America (see also Clavijo, 2017). The effects of habitat modification and invasive species were also poorly understood. In several cases, the decline of species was observed, but the processes involved were not known.

In the Río de la Plata basin several threats have been reported. There are habitat modifications, such as reservoirs and industrial plants (Fig. 2). The second largest reservoir in the world, held back by the Itaipu dam, is in the Río de la Plata basin on the border between Brasil and Paraguay. Invasive species are also found in the basin. *Limnoperna fortunei*, one of the most harmful invasive species, is widespread and *Corbicula* spp., introduced since the 1970s are also present. These modifications and introductions are problably causing reductions in the mussel populations.

**Fig. 2.** The rich fauna of the Río de la Plata basin is threatened. In this picture a dam on the upper Paraguay River.

The Río de La Plata was one of the most diverse basins in South America (Pereira *et al*., 2014), and therefore essential for conservation. Currently there is a regional research network involving several countries in South America (BIVAAS: Bivalves of South America, in Portguese or Spanish; see the guest editorial in *Tentacle* 26) that seeks to add information and implement research projects, to overcome information gaps as a first step towards the implementation of broader research programmes. The exchange of information with other members of the network will certainly help to improve the results obtained by the present project.

As can be seen, the road is long. This initial literature survey gave us the first directions to initiate our walk. In the following years we hope to have a more detailed picture of the conservation situation of the freshwater mussels, the real treasure of the Río de la Plata basin (Fig. 3).

**Fig. 3.** Hope can not be lost: the Paraná River running between Argentina and Paraguay near a protected area.

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## RECOVERY OF RIVERS IN ROMANIA: HOPE FOR SOME MOLLUSCS DESPITE NEW EMERGENT THREATS

*By Ioan Sîrbu, Ana-Maria Benedek & Monica Sîrbu*

Between the very early 1990s and the end of the 2000s, the tone of malacological conservation literature in Romania was rather pessimistic. Before the fall of the Iron Curtain in 1989 there were no threats to environment or species: everything ran perfectly under the totalitarian government! Except for – almost everything! Then, the curtain was torn, and an increasing number of publications has been drawing attention to the disappearance of freshwater species along extended sections of rivers or entire rivers, the effects of pollution and habitat degradation. Degraded quality of rivers, decreases in abundance, range contractions, local extinction of the large mussels (Unionidae) and most operculate gastropods, and wide distributions and high abundances of a few eurybiotic pulmonate gastropods were the topics of the published stories. Things became worse when we learned that the newly established free economy and socially impaired, chaotic development, assisted by the lack of or disrespect for laws, caused the extinction of at least two species (*Melanopsis parreyssii* and *Theodoxus prevostianus*). Some other critical issues have also been highlighted, creating the image that some species or habitats managed to survive the old, centralised and autocratic society, only to take their last breath under the newly established free market economy. After three decades, the transition is not complete, by far, resulting in a puzzling social,

**Fig. 1.** Witness of the past: disabled works in Copșa Mică, which poisoned the region and its waters (inset: Târnava Mare River).

**Fig. 2.** Lower Târnava River in 2018 with *Unio crassus* and other recolonising species.

behavioural, moral, cultural, political and economic landscape characterised by a mixture of archaic atavisms and newly developed, adaptive features, with repercussions for all aspects of life, including nature conservation. During this ongoing transition some things have happened, such as the decline and decay of heavy industry and other sources of pollution that were inherited from the centralised economy, and the lack of funding for further destruction of rivers and their water quality. Such events and forces resulted in certain resurrections of the fresh waters, followed by some remarkable recovery of aquatic mollusc species and communities.

### Târnava Mare River

Our first example is the Copșa Mică locality and its industry, located on the Târnava Mare River, a tributary of the Mureș River. The two factories (one producing non-ferrous metal, especially zinc and lead, and the other specialised in carbon black) had had a huge impact on the environment and a correlated bad international reputation as (maybe) the most polluted town (and area) in Europe (Fig. 1). Heavy metals and other toxic compounds were discharged into waters throughout the region, leading to, among other impacts, the disappearance of many species, including most molluscs, not only from the Târnava, but also along its receptor, the Mureș River. Emblematic species like *Unio crassus* (thick shelled river mussel) and *Theodoxus transversalis* (striped nerite freshwater snail), repeatedly sampled and reported from Transylvanian rivers in the 19th century, had been declared extinct from the Târnava (Sárkány-Kiss & Sîrbu, 1998) and from the Mureș, downstream from this tributary for a distance of about 350 km to the point where it flows into the Tisa/Tisza River, in Hungary (Sárkány-Kiss, 1995). Other sources, factories and mining works had added their impacts, defining one of the most heavily polluted regions and river basins in Europe. Then, between 1993 and 2009, these works, among many others, closed and the environment began a natural process of recovery. Although the ghosts of the renowned works are still present (Fig. 1) and the rivers still have traces of heavy metals in their sediments, molluscs have returned. Starting from different sources, e.g. tributaries, where some species survived by chance, and also from the lower Mureș River in Hungary, driven by fish carrying glochidia, at least some species recolonized the Mureș and then its tributary. In the lower Mureș, in 2015 we found rich and abundant unionid communities, including *U. crassus* as well as the elusive *Pseudanodonta complanata*, the rarest mussel in this group and area, but also the newly arrived alien *Corbicula fluminea*. In 2018, we found the formerly lost *U. crassus* in the lower Târnava River (Fig. 2) in densities in some microhabitats exceeding tens to hundreds of individuals per square meter, along with lower abundances of *Unio pictorum* and *Anodonta anatina*, but also the newly colonised alien *Sinanodonta woodiana*. Following its first record, this last species needed two decades to invade almost all of Europe, but it took almost 40 years for it to invade Transylvania (the central region of Romania). One reason is the higher altitude of the region, which is enclosed by the Carpathian mountains, which act as an efficient but still not impenetrable barrier against invaders. Now, the formerly destroyed rivers are once again inhabited by naiads (Unionidae), both along the Târnava and the rest of the Mureș river courses, downstream of their confluence. But one species is still missing: *T. transversalis*, which had become extinct in Transylvania by the second half of the 20th century (Sîrbu & Benedek, 2005). Seemingly, it was unable to survive in any of the possible refuges.

*Theodoxus transversalis* and *U. crassus* are repeatedly mentioned here, because they are sensitive bioindicators that may act as witnesses of environmental changes, but also because they are species of great conservation interest, listed in Annex II and IV of the EUHSD (92/43/EEC 1992), also known as the European Habitats and Species Directive, for which the European Union requires the designation of Special Areas of Conservation where species in need of strict conservation are present.

### Olt River

A similar course of events unfolded in the Olt River: pollution and a sequence of reservoirs built along its middle course, in Transylvania, have drastically changed and impoverished the freshwater mollusc communities. Several species had been


**Fig. 3.** Reservoir on the middle Olt River: Insets: a, *Theodoxus transversalis* (shells from the E.A. Bielz 19th century collection); b, *Anodonta anatina*; c, *Dreissena polymorpha* and *Sinanodonta woodiana*; d, *Corbicula fluminea* and other invasive species.

sampled by naturalists since the 19th century, but had been reported as extinct in the region during the late 1990s (Sîrbu *et al*., 1999), among them *T. transversalis* (Fig. 3a). The artificial lakes were colonised by other, lentiphilic species such as the swan mussels (*Anodonta* spp.) (Fig. 3b) and *Musculium lacustre*, followed around 2007-2009 by *Dreissena polymorpha*, a native invader formerely confined to Danubian waters, these being joined and largely replaced by *S. woodiana* some time around 2015 (Fig. 3c). A few years later we also found *S. woodiana* along some tributaries, both in stagnant and flowing waters, and in February 2020 we also found, in a reservoir, *Corbicula fluminea* (Fig. 3d), another alien invader, this being probably the first finding in Transylvania and central Romania (Sîrbu, 2020). In the lotic sections, upstream and downstream of the reservoirs, *U. crassus* (Fig. 4 right, with *D. polymorpha*) had also reappeared, after an absence of probably more then 40-50 years, along with other species, remnants of the former communities, but also new inhabitants, alien or autochthonous invaders, among them *S. woodiana* (Fig. 4 left) being the dominant species in some habitats. *Corbicula fluminea* inhabits only the lower section of the sequence of reservoirs, namely those lakes used by fishermen who use boats. These boats are probably the cause of introduction and the main carrier of both *C. fluminea* and *D. polymorpha*.

In spring 2020, at the beginning of the lockdown measures related to the COVID-19 pandemic, we organised short sampling trips and set up a small home laboratory, sampled along the middle Olt River section from all types of freshwater habitats, from running to stagnant (reservoirs), and asked questions about the effects of invasive aquatic mollusc species (six at this time in the area of reference) on autochthonous community structures. We learned that besides time-related changes and environmental parameters, alien species were significantly responsible for structural and functional changes in the native communities. We presented some of these results in December 2020, at the online Festival of Ecology organised by the British Ecological Society, with more then 1,500 participants from diverse countries.

**Fig. 4.** Faunistic changes in the lotic sectors (not reservoirs) of the middle Olt River. The native *Unio crassus* has returned (inset: right), sometimes covered by the native invader *Dreissena polymorpha*, while the alien *Sinanodonta woodiana* (inset: left) colonises both lotic and lentic habitats.

Regarding invasive species, unfortunately there are no regulations or governmental institutions that might effectively control their spread, and the national system of invasive species monitoring and/or management is either absent or useless. Newly implemented expensive projects to produce monitoring and publishing guides on invasive invertebrates, including molluscs, have been far from adequate. The recently published guide is sketchy, uninformative, with mistakes and of no use, at least regarding molluscs. Quoting this guide is futile and seems a waste of both government and EU money, an ongoing hopeless effort.

But returning to the Olt River, we address again the problem of regional extinction of *T. transversalis*. This species went extinct in the upper and middle courses of the river, as in the whole of Transylvania, as well as in many, if not most, parts of its range. But there is also another episode of this story. After 25 years of searching, we finally found *T. transversalis* in the Danube, alive, downstream from where the Olt River joins it.

## The Danube

The recent story of freshwater molluscs in the lower Danube is hard to link to real evidence. We do have good information about their status prior to the acceleration of human pressure during the first decades of the 20th century. Then, two dams were built across the Danube, downstream from the gorges known as the Iron Gates. In addition, other hydro-technical works have altered its flow and shape, and pollution from a significant part of Europe increased the effect of human impact on the river. As noted above, some published syntheses of the mollusc fauna have reported species without clear details of when and where they have been found, often based on data from out of date literature with no critical update. To this, the Habitats Directive (EUHSD 92/43/EEC 1992) prompted an urge to search for, and find, species of community interest (i.e. of community conservation interest as defined above). Thus many lay people and non-professionals have striven to access funds for conservation purposes

**Fig. 5.** The Danube River in Romania. In sections with hard, artificial riverbanks, rare individuals of *Theodoxus transversalis* have been found.

(usually for monitoring and writing management projects, which required the finding of species of conservation interest). If such projects reported a species absent or extinct, funds could have been cut, because of the lack of protection goals. Driven by ignorance and interest, a mixture of genuine and false data have emerged and some were published; thus it became impossible to discriminate between fictitious and real species distribution information.

Reporting of *T. transversalis* along the Danube is such an example. All data from the last five decades, at least, have to be taken with great scepticism (Sîrbu, 2019). We have searched for the species, along the Danube's lower section in Romania, during the 1990s to early 2010, but without success. We have asked repeatedly for proof (specimens) from some of those who claimed to have found the species alive along the Danube, but received none. Sometimes we got excuses. At least in the Bulgarian section of the Danube, some more recent records were published, namely of two individuals found on the shores of two islands (Pavlova *et al.* 2013), but we raise questions about their status and significance: were they simply washed down from a tributary, occurring there only by chance, or had they actually colonized those two island shores? So we had serious doubts about the survival of this nerite in the Romanian Danube section of reference, until 2018, when we finally found it alive, downstream from where the Olt River flows into the Danube. It was not everywhere, as sometimes is claimed in the literature, but only on hard substrates (something seldom found along the lower course), in short sections with boulders and concrete placed by humans, for various purposes, for instance around water captures for agricultural reasons. In two such sections, on artificial hard substrate near the banks, from a boat we dredged several living individuals during our autumn 2018 field survey (Fig. 5). These riverside works, no longer functional, built decades ago and now derelict because of lack of management, may be stepping stones for the recolonisation of the lower Danube. On soft substrates, which are characteristic of the riverscape in this area, we found no *T. transversalis* during our surveys.

**Fig. 6.** Rare species along the soft banks of the lower Danube: *Pseudanodonta complanata* (inset: top), joined sometimes by *Unio crassus* (inset: bottom), both of great conservation interest.

The fate of *T. transversalis* and its story is impossible to state unequivocally, but to the best of our knowledge we assume this: due to human pressure, it had vanished (or at least become drastically reduced) during the second half of the 20th century, but is probably beginning to recolonise the lower Danube, from sources probably along some small tributaries in Bulgaria. We know that some Bulgarian rivers support populations, while Romania probably does not, and the snail is unlikely to originate from upstream in the Danube itself, because of the Iron Gates dams and reservoirs, where it is unlikely to survive (we surveyed these sections between 2001 and 2016 with no success). Besides those short sections with artificial hard materials along their riversides, most parts of the lower Danube are slow flowing on soft substrates, this habitat being inhabited by a rich and abundant mollusc community. In 2018 we also found, rare and scattered, living individuals of *U. crassus*, which is usually confined to higher altitudes and more rapid flows, as well as *Pseudanodonta complanata* (Fig. 6), among other species.

Locations of Figs. 1-6 are shown in Fig. 7.

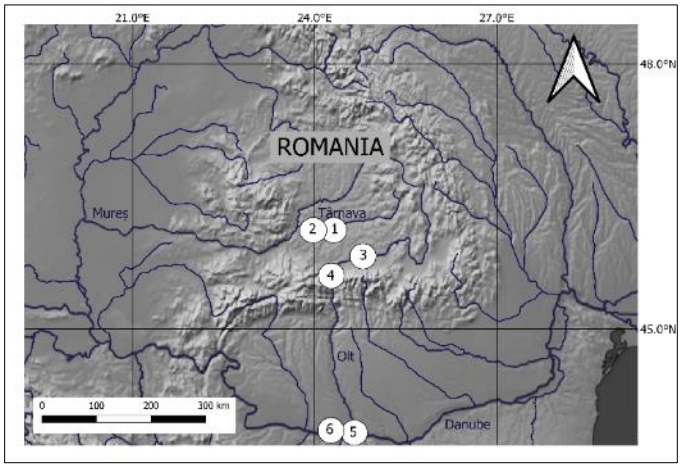


**Fig. 7.** Map of the area of reference; the location numbers correspond to those of Figs. 1-6.

### Take home messages

There are several. First, some emblematic species of conservation interest, like *U. crassus* and *T. transversalis*, that were once extinct in many habitats and parts of their ranges, show a definite recovery trend. This trend is possible only if and where sources of recovery are still present, something we assume is responsible for the fact that *T. transversalis* is unlikely to reappear in Transylvania, where all the sources have vanished. Second, is that blaming the past (e.g. pollution history related to the centralised economy) has been very useful and a psychological relief, but it cannot protect the species and their environment from further and new threats, like those posed by invasive species. We are just beginning to understand how these invasions are reflected in structural and functional features of native freshwater mollusc communities. Our country has legislative and organisational flaws that hinder the monitoring and control of invaders. Money is wasted, projects are conducted by non-professionals and the laws if not absent, are useless. The EU legislation is also sketchy about this issue, to say the least. We are starting to understand, that in time, and in relation to the rise in temperature and modified hydrological regime, invasive species are becoming more diverse and abundant, while native freshwater mollusc communities are responding in a contrasting way. A new diffuse network of diverse pollution sources and other threats is emerging (Sîrbu & Benedek, 2018). Disentangling the effects of environmental changes and alien introductions on native molluscs, still needs to be done and methodologically developed. Mapping the possible sources of survival and recolonisation of threatened species in the rivers of the hydrographical basins (and especially along their tributaries) and if necessary managing their conservation for future purposes, is another target that is not covered by projects in our region. Blaming the past is of no use anymore, because new threats emerge and new developments are ongoing, which require new laws, multidisciplinary research and multivariate data analyses.

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## CONSERVATION OF MOLLUSCS IN CENTRAL SOUTHERN BRASIL: UPDATES TO THE INVENTORY OF SPECIES OF SANTA CATARINA STATE

*By A. Ignacio Agudo-Padrón*

A product of 24 years of systematic research, the inventory of molluscs of Santa Catarina State, central southern Brasil, is here further updated. The fauna comprises 1,042 verified species, of which 788 are marine (12 Polyplacophora, 475 Gastropoda, 15 Scaphopoda, 262 Bivalvia, 24 Cephalopoda) and 254 non-marine (85 freshwater – 45 Gastropoda (~3 endemic) and 40 Bivalvia (~36 native and 4 non-native); 3 amphibious/limnophile Gastropoda; and 166 land Gastropoda (~21 endemic)) (Agudo-Padrón, 2020a; Agudo-Padrón & Carneiro, 2020), representing 199 genera and 98 families. Santa Catarina State is now one of the few geopolitical territories in Brasil to have this type of basic knowledge organised.

The 40 species of freshwater bivalves represent five families. They include 1 non-native mussel (Mytilidae), 23 native mussels (11 Mycetopodidae, 12 Hyriidae), 3 non-native clams (Cyrenidae), 13 native clams (2 Cyrenidae, 11 Sphaeriidae) and deserve special mention (Agudo-Padrón, 2020b). Following the global trend, they constitute the most endangered molluscs in the state, principally because of various anthropogenic impacts that damage their vulnerable and restricted (lotic and lentic) aquatic habitats.

In the course of 2020, and based on the latest systematic listings (Agudo-Padrón, 2017, 2020a), an additional six new species, including four native gastropods (two marine, two freshwater) and two bivalves (one native freshwater mussel, one non-native marine mussel) were added to the current

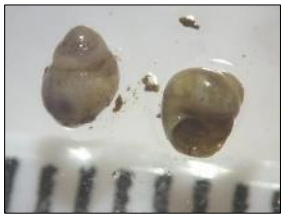

**Fig. 1.** *Amphithalamus* aff. *glabrus* Simone, 1996, found in São Francisco do Sul Municipal District, in local sector of the Brazilian transverse highway BR-280 near the "São Chico" Port (approximately 2.5 km from the sea), Northern region of Santa Catarina State. Voucher in the malacological collection of the Regional University Foundation of Blumenau, Blumenau, Santa Catarina State, FURB-MO(-C) 641. (Photo: Francisco Carneiro, collaborator of the Project AM)

**Fig. 2.** *Solariorbis* cf. *schumoi* (Vanatta, 1913), found in Monte de Trigo River, São Francisco Island, São Francisco do Sul Municipal District near "Babitonga Bay", Northern region of Santa Catarina State. Voucher in the malacological collection of the Regional University Foundation of Blumenau, Blumenau, Santa Catarina State FURB-MO (registration number pending. (Photos: Francisco Carneiro, collaborator of the Project AM).

inventory of non-marine and marine/estuarine molluscs occurring in the State.

These recently incorporated species occur in malacological regions 1, 2 and 6 of the State (see previous articles in *Tentacle* for descriptions and maps of these regions), as follows: native limnic apple snail (Ampullariidae) *Pomacea maculata* Perry, 1810 (region 1) (Agudo-Padrón, 2020c); native freshwater mussel (Hyriidae) *Rhipidodonta hylaea* (d'Orbigny, 1835) (region 6) (Agudo-Padrón & Carneiro, 2020); freshwater snail (Rissoidae) *Cingula* aff. *peteningensis* (Gould, 1852) (region 6) (Agudo-Padrón & Carneiro, 2020); native marine microsnail (Anabathridae) *Amphithalamus* aff. *glabrus* Simone, 1996 (region 2) (Fig. 1); native marine microsnail (Tornidae) *Solariorbis* cf. *schumoi* (Vanatta, 1913) (region 2) (Fig. 2); and non-native marine mussel (Mytilidae) *Mytilus galloprovincialis* Lamarck, 1819 (region 1) (Belz *et al*., 2020).

However, despite being a big step forward, this inventory is nowhere near complete. No doubt, additional regional malacological surprises await us. Reiterating once again, research on the conservation status of mollusc biodiversity in the State of Santa Catarina is urgent in view of the rapid changes taking place to the natural environment as a result of human activities and the parallel very rapid process of invasion by alien species. In depth studies of the basic population biology and reproductive cycles of the region's molluscs are urgently needed, in addition to middle- and long-term ecological research.

For more complete and detailed information, please contact the author of this report.

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## BRASILIAN TROGLOBITIC SNAILS BEGIN TO EMERGE – AND ARE ALREADY IN DANGER

*By Daniel C. Cavallari, Fernanda S. Silva, Carlo M. Cunha, Maria E. Bichuette, Rodrigo B. Salvador*

The Brasilian territory is very extensive and harbors ~ 20,000 caves, over half of which are calcareous (Fig. 1; CECAV, 2020). A reduced number of the ~ 700 terrestrial and nearly 260 freshwater gastropod species reported from Brasil (Simone, 2006; Birckolz *et al*., 2016; Salvador, 2019) inhabit cave environments exclusively.

Since the description of the first exclusively subterranean gastropod in the 1990s (*Potamolithus troglobius* Simone & Moracchioli, 1994), 17 land and three freshwater troglobitic snails have been described from Brasil (Table 1). Most of the descriptions stem from recent studies carried out over the past decade and several additional new species are in the process of being described (Table 1; Fig. 1).

Nevertheless, considering the country's vast territory and numerous caves, such a small number of cave endemics seems to be much underestimated. As Salvador (2019) pointed out, caves are among the least explored habitats in malacological studies in Brasil, a bias that is also common in other countries (e.g. Gladstone *et al*., 2018; Czaja *et al*., 2020).

Caves are potential hotspots for molluscan diversity, especially freshwater snails (Culver & Sket, 2000; Grego *et*

**Fig. 1.** Entrance to Domingão Cave, Carinhanha municipality, Bahia state, Braszil, where a new freshwater snail (*Spiripockia* sp.) has just been discovered.

**Table 1.** Troglobitic gastropod species in Brasil. Although most land snails typically also occur in surface areas, the species listed below have so far been found only in caves or their immediate vicinities.

| |
|---|
| **Caenogastropoda** |
| *Habeas corpus* Simone, 2013 |
| *Habeas data* Simone, 2013 |
| *Habeas priscus* Simone, 2013 |
| *Habeastrum parafusum* Simone, 2019 |
| *Habeastrum omphalium* Simone, 2019 |
| *Habeastrum strangei* Simone, Cavallari & Salvador, 2020 |
| *Potamolithus karsticus* Simone & Moracchioli, 1994 |
| *Potamolithus troglobius* Simone & Moracchioli, 1994 |
| *Potamolithus* spp. [5 new species *sensu* Bichuette & Trajano, 2018] |
| *Spiripockia punctata* Simone, 2012 |
| *Spiripockia* sp. |
| **Stylommatophora** |
| *Anctus prolatus* Simone & Casati, 2013 |
| *Bahiensis ribeirensis* Salvador, Cavallari & Simone, 2016 |
| *Clinispira insolita* Simone & Casati, 2013 |
| *Cyclodontina capivara* Simone & Casati, 2013 |
| *Gastrocopta sharae* Salvador, Cavallari & Simone, 2017 |
| *Gonyostomus elinae* Simone, 2016 |
| *Kora nigra* Simone, 2015 |
| *Lavajatus moroi* Simone, 2018 |
| *Rhinus gilbertus* Simone & Casati, 2013 |
| *Streptartemon molaris* Simone & Casati, 2013 |
| *Zilchogyra paulistana* (Hylton Scott, 1973) |

*al*., 2000; Sket, 2016; Bichuette & Trajano, 2018). Some studies point towards cryptic species in single caves or even cave systems: a local example may be the caves in the Ribeira Valley in southeastern Brasil. Bichuette & Trajano (2003, 2018) have identified several morphotypes of *Potamolithus* sp. in those caves, though species limits need to be investigated further, preferably using molecular data and more detailed morphological analysis (e.g. micro-CT).

Moreover, as cave environments are progressively explored in Brasil, partially because of large programmes to explore mining resources and developmet of the energy sector (hydrolectric plants), the rate of description of troglobitic species is expected to increase, as seen by the description dates of most species in Table 1. Furthermore, there has been renewed interest in terrestrial and freshwater gastropod systematics in Brasil (Salvador, 2019), which also contributes to this trend. Hopefully, this trend will continue to improve.

These important discoveries require protection: only three troglobitic gastropod species are currently listed on the Brasilian Red List (ICMBio, 2018). According to the IUCN

**Fig. 2.** Serra do Ramalho, Bahia state, Brasil, is known for its numerous limestone caves. Many areas, like the one above, show signs of deforestation.

(2012) guidelines, one of these species is considered endangered (EN) (*Spiripockia punctata*) and the other two (*Potamolithus karsticus* and *P. troglobius*) critically endangered (CR). The Brasilian List of Threatened Fauna was recently revised (not yet officially published) but there remains no legal protection for this fragile fauna and the surrounding areas (Fig. 2).

As we reveal these fascinating cave species (Fig. 3), understanding their spatial distribution and endemism, and based on that, assessing their conservation status, should become a priority. Exploring these environments in search of more discoveries is also needed. Perhaps even more critically endangered than the already battered terrestrial gastropods in general, these troglobitic snails are in danger of disappearing before we get to know them.

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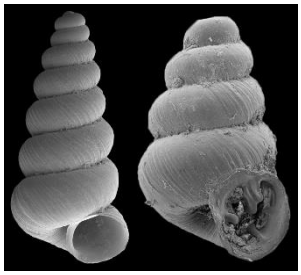

**Fig. 3.** Two recently-described troglobitic snails from Brazil: *Habeastrum strangei* (left, shell height = 1.6 mm), from caves in Minas Gerais state, and *Gastrocopta sharae* (right, 1.9 mm), from Domingão Cave (Fig. 1), Bahia state.

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# PACIFIC ISLAND LAND SNAILS

## Evidence of parasitism in the semi-slug *Omalonyx gayana* d'Orbigny, 1835 with *Leucochloridium paradoxum* (Carus, 1835) sporocysts on Robinson Crusoe Island, Chile

*By Viviana M. Castillo and Hernán González*

The Succineidae have representatives grouped into three subfamilies and 23 genera (MolluscaBase, 2021), and are found in many tropical, subtropical and temperate regions worldwide. Specifically for Chile there are descriptions of 16 species in the family, of which 15 belong to the genus *Succinea* Draparnaud, 1801 and one to the genus *Omalonyx* d'Orbigny, 1838 (Valdovinos, 1999). In terms of the representatives of *Succinea* in Chile, ten of these species are endemic to the Juan Fernández Archipelago (JFA) and five are distributed throughout mainland Chile, and of the latter, only two species have shared distributions with Argentina, Peru and Brasil (Valdovinos, 1999). In the case of *Omalonyx*, Chile is represented only by *Omalonyx gayana* d'Orbigny, 1835, a semi-slug endemic to Robinson Crusoe Island or Más a tierra (Odhner, 1921), categorised as a highly vulnerable species with a reduced population density (Category S), according to the Chilean Hunting Law (Servicio Agrícola y Ganadero, 2018).

Gastropods are intermediate hosts of parasites, mainly trematodes, some of which are important for public health and/or animal production (Lockyer *et al*., 2004). The genus *Leucochloridium* Carus, 1835 parasitises the cloaca and the bursa of Fabricius of its avian final hosts, and is distributed throughout the Holarctic region (Ohari *et al*., 2019). Representatives of this genus use Succineidae as intermediate hosts and produce vividly coloured sporocyst broodsacs that occur in the eye tentacles of these snails, which are colloquially referred to as "zombie snails".

Specimens of *Omalonyx gayana* were collected on Robinson Crusoe Island in the Valparaíso Region of Chile (Fig. 1). The specimens were pre-treated with 3% ethanol for 1 hour, and subsequently preserved in 80% ethanol. In the laboratory, they were dissected and identified through analysis of their reproductive systems and radulas. Parasites from infected snails were isolated and examined. Published keys to the species of *Leucochloridium* (Kagan, 1952; Pojmańska, 1969) were used for morphological identification.

We collected specimens of *O. gayana* in four locations on Robinson Crusoe Island (Fig. 1; Table 1), and in just one found specimens parasitised with green-banded broodsac *Leucochloridium* sporocysts. The species was identified as *L. paradoxum* based on previous molecular analyses that indicated that the colour pattern of the mature sporocyst stage is valid for their identification at the species level (Nakao *et al*., 2019). Five of the specimens of *O. gayana* were infected with green-banded *Leucochloridum* (Fig. 2). No adult stages of the parasite were found, nor were *Leucochloridium* eggs found in bird faeces in the sampling areas.

The finding of *L. paradoxum* is evidence that the populations of Succineidae in the JFA are at a greater risk than already

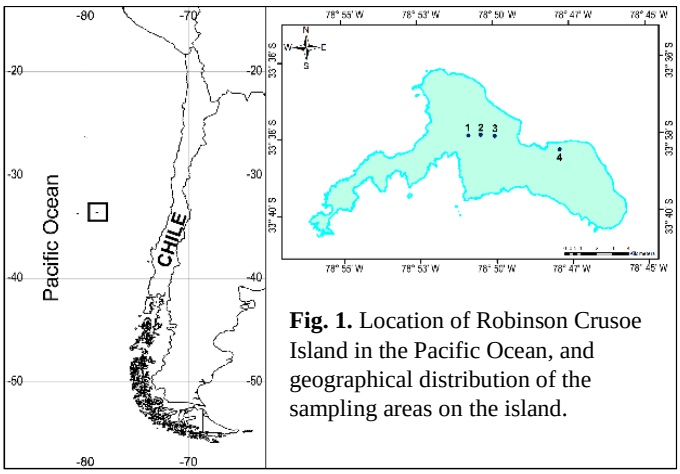


**Fig. 1.** Location of Robinson Crusoe Island in the Pacific Ocean, and geographical distribution of the sampling areas on the island.

**Table 1.** Sampling locations of *Omalonyx gayana* (N/P: non-parasitised specimens; P: parasitised specimens).

| Site | Location | Latitude | Longitude | Condition |
|---|---|---|---|---|
| 1 | Salto blanco | 78° 51.5109' S | 33° 38.2119' W | P |
| 2 | Plazoleta El Yunque | 78° 50.6205' S | 33° 38.1935' W | N/P |
| 3 | Mirador de Selkirk | 78° 51.0988' S | 33° 38.1615' W | N/P |
| 4 | Cerro Centinela | 78° 48.4163' S | 33° 38.5762' W | N/P |

known. That being said, strategies have been developed to preserve endemic species of JFA terrestrial gastropods in Chile, such as their incorporation into the Hunting Law, a legal recourse of the Chilean government that has allowed restriction of the collection of terrestrial snails that are endemic to these islands, along with the development of inspection strategies on the islands to prevent the entry of alien species from the mainland and/or their movement between the islands (Castillo *et al*., 2020).

Although the Succineidae have achieved global radiation, the species that inhabit Chile are particularly characterised as needing microhabitats that are associated with very humid forest areas. It has previously been inferred that the reduction of Succineidae populations in the JFA is due to habitat loss associated with degradation of the native forest by anthropogenic activities and by the presence of alien species (Valdovinos, 1999). These alien species include the predatory snails *Oxychilus alliarius* and *O. cellarius*, which share biotopes with endemic species and have been found associated with native plant species such as *Amomyrtus luma* and *Boehmeria excelsa*, together with various sucineid taxa, amongst which are *O. gayana* (Castillo *et al*., 2020).

However, the presence of *L. paradoxum* in this vulnerable environment adds another species that adversely affects the succineids. The parasitism of *O. gayana* facilitates predation on these animals by birds. Previously, it had been documented that parasitism by representatives of *Leucochloridium* generates changes in the behaviour of the host snail, making it more exposed in the vegetation so that birds can prey on the host snail more easily, thereby enhancing the parasite's ability to continue its life cycle in its final host (Wasolowska & Wesolowski, 2014). Furthermore, in addition to its colour pattern, the presence of a pulsating sac in the sporocyst is a strategy of the parasite to attract the avian final host because it simulates larval stages of insects, thereby attracting insectivorous birds (Wesołowska & Wesołowski, 2014). This type of mimicry has been called reproductive mimicry, since it constitutes a strategy to optimise the reproduction of the parasite by imitating signals whereby the receptor (bird) is attracted to the potential prey, thus improving the chance of the parasite completing its life cycle, developing to the adult form in the birds. We were unable to determine which birds are being affected on the island by this parasite (Zabka & Tembrock, 1986). However, on Robinson Crusoe Island the both endemic and alien insectivorous birds are common (Hahn *et al*., 2009), and it is very likely that migratory birds infected with *L. paradoxum* arrived on the island, with other bird species becoming infected and the parasite completing its life cycle on the island. In the literature there are no records of the presence of *L. paradoxum* in the Neotropical Region. This finding is the first report of *L. paradoxum* in the Southern


**Fig. 2.** Non-parasitised specimen (A) and parasitised specimen (B) of *Omalonyx gayana*.

Hemisphere, and therefore further studies are needed to identify final hosts and to verify whether there are other populations of Succineidae infected.

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## Translocation of endangered *Mandarina* in the Ogasawara Islands

*By Hideaki Mori, Mayu Inada & Satoshi Chiba*

The Ogasawara Islands are approximately 30 small oceanic islands on which at least 120 land snail species have been recorded. Several genera (e.g. *Mandarina*, *Ogasawarana* and *Hirasea*) show significant adaptive radiation (Chiba, 1999; Chiba & Cowie, 2016). Because of these unique examples of evolution, the Ogasawara Islands were registered as a UNESCO World Natural Heritage Site in 2011. However, these land snails have recently become threatened by non-native predators (Okochi *et al*., 2004; Chiba, 2010; Uchida *et al*., 2016). As a result, several conservation programmes have been initiated in collaboration with the government, residents and scientists (Mori *et al*., 2020). Using ex situ breeding, endangered species evacuated from several islands can be translocated back to the wild in the Ogasawara Islands.

Land snails on Chichijima (24 km$^2$) are on the verge of extinction under the serious impact of the malacophagous flatworm *Platydemus manokwari* (Ohbayashi *et al*., 2007; Chiba & Cowie, 2016). They have not yet invaded Tatsumijima, a small island (0.04 km$^2$) fringed by cliffs, only

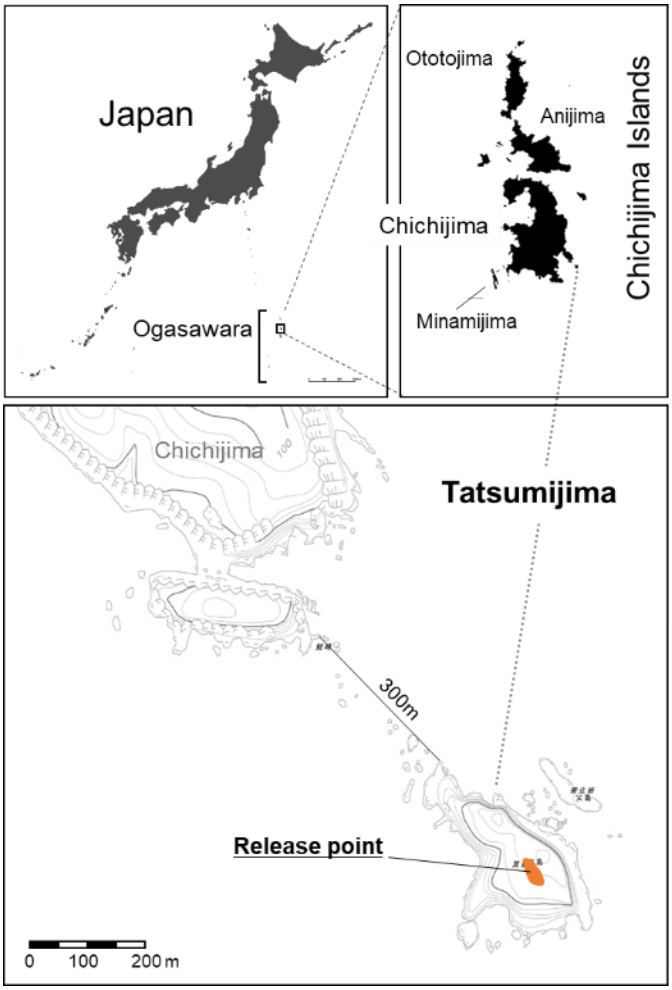


**Fig. 1.** Map showing Tatsumijima in Ogasawara with the location of the *Mandarina* release point.

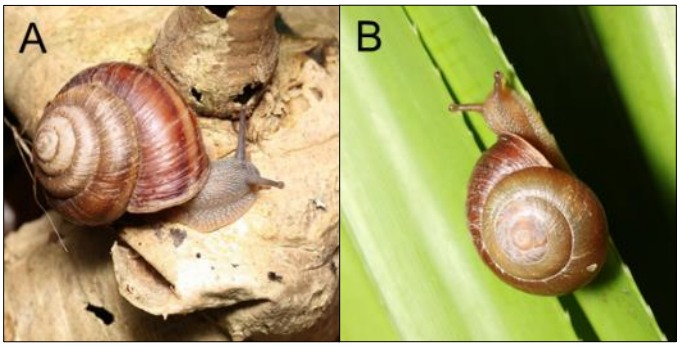


**Fig. 2.** The *Mandarina* species evacuated and subsequently translocated back to Tatsumijima. A, *Mandarina chichijimana*; B, *Mandarina hirasei*.

300 m from Chichijima (Fig. 1). The two islands share common species; therefore, Tatsumijima was seen as a potential refuge for the snails. However, the black rat (*Rattus rattus*) had damaged the land snail populations on Tatsumijima. Consequently, *Mandarina chichijimana* and *Mandarina hirasei* of Tatsumijima were evacuated as part of an emergency breeding programme started in 2014 (Fig. 2). Rodenticides were also used to eradicate rats and thereby improve the snail habitat.

The habitat's forests were also damaged by typhoons and moth outbreaks, threatening the survival of the wild populations. Our response was to undertake a reinforcement project using individuals bred in captivity.
The Ministry of the Environment developed a translocation plan for *Mandarina* under the official Working Group's supervision in 2019. The plan followed IUCN guidelines for reintroduction (IUCN/SSC, 2013), and Dr. Robert Cowie provided an international evaluation of our conservation activities in Ogasawara. Our plan was to implement two approaches to translocating the breeding populations to areas where wild snails remained, taking special care to prevent introducing parasites.

Since possible parasites (nematodes) are not vertically transmitted, one approach was to translocate eggs. Eggs to be released in the wild before hatching were placed in artificial soil after washing with distilled water and stored in an incubator in a separate room. The other approach was to release hatched individuals, as has been described previously (see *Tentacle* 28). These individuals were handled separately from the rest of the breeding populations; soil and fallen leaves were not used and the hatchlings were fed only artificial food to prevent the risk of parasite infection. Because the equipment, room and staff were separate from the regular breeding population, parasites were considered to be absent from the system. To be certain, approximately 30% of those expected to be translocated were dissected. Nematode infection was confirmed to be absent.

Translocation applying these methods was implemented with the final approval of the Working Group. In total, 179 eggs were released in November 2020 and 160 hatched individuals in Februaty 2021 (Table 1). The hatching rate of the translocated eggs was examined by placing eggs in a basket covered with netting until they hatched and marking the

**Table 1.** Numbers of *Mandarina* individuals translocated to Tatsumijima.

| Species | Release stage | | | Total |
|---|---|---|---|---|
| | Eggs | 3-4 months | 11-12 months | |
| *Mandarina hirasei* | 152 | 118 | 23 | 293 |
| *Mandarina chichijimana* | 27 | 19 | - | 46 |
| Total | 179 | 160 | | 339 |

hatchlings before release (Fig. 3). Individuals at least 3 months old were selected for translocation; this was a rough guide for the age at which snails can survive well in the wild. An identification tag was attached to each individual before release (Fig. 3). Over the ensuing year, monitoring establishment and evaluating the outcomes will be continued to improve the plan for more effective translocation.

This initiative was the first clear attempt in Japan to return land snails to the wild. It will be a major step in preventing the extinction of land snails in the Ogasawara Islands as well as an opportunity to promote the conservation of land snails in Japan. While learning from international precedents, accumulating domestic achievements is essential in the future.

We are grateful to Tsukasa Waki and Rintaro Shigeno of Toho University for parasite checks, and Robert Cowie for advice and support. We also thank our collaborators and the Ministry of the Environment for running the conservation programmes and providing funding.

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**Fig. 3.** Implementation status of translocation. A, the translocation area in the native forest of Tatsumijima;. B, translocation of *Mandarina* eggs; C, released *Mandarina hirasei* with tag on its shell.

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## Further *Partula* reintroductions postponed in 2020 but poised to continue in 2021

*By Trevor Coote & 26 others*

### Reintroduction of species from the breeding programme

The plan for 2020 was for four shipments of snails to be sent to Tahiti for release onto four islands. However, due to the severe restrictions imposed in the battle against the dispersal of SARS-CoV-2 no shipments occurred and consequently there were no releases in 2020. Although an unavoidable setback for the programme, reintroductions are set to resume in 2021.

Reintroductions of species onto Tahiti and Moorea have become routine since 2015 but those onto the Leeward Islands have proved to be more problematic. The original objective for 2020 was to concentrate on releases onto Raiatea and Huahine but that was not to happen. In 2016 the release of three species into Faaroa Valley on Raiatea was badly impacted by predation by the carnivorous flatworm *Platydemus manokwari*, not previously considered a threat, and at least one third of the snails released were recovered as dead shells. Soon after, the site was cleared by the agriculture department for plantation and all the *Partula* were lost. On nearby Huahine, the release of two species in two sites in 2019 again resulted in considerable mortality, some of which was caused by *P. manokwari*, but subsequent monitoring suggested that the poor habitat contributed more to the losses, especially to the more

**Fig. 1.** *Partula tohiveana* released in 2019 and photographed in early 2020.

**Table 1.** *Partula* post-release mortality 2019 to 2020.

| Species | Number released 2019 | Number of adults found | Number of adults dead | Adults % dead |
|---|---|---|---|---|
| **Moorea** | | | | |
| *Partula tohiveana* | 710 | 257 | 77 | 30.0 |
| *P. suturalis vexillum* | 210 | 151 | 9 | 6.0 |
| *P. taeniata simulans* | 360 | 116 | 3 | 2.6 |
| *P. taeniata nucleola* | 219 | 130 | 10 | 7.7 |
| *P. mirabilis* | 60 | 35 | 6 | 17.1 |
| **Tahiti** | | | | |
| *P. affinis* | 182 | 39 | 14 | 35.9 |
| *P. hyalina* | 12 | 12 | 2 | 16.7 |
| *P. nodosa* | 2,528 | 1,300 | 158 | 12.2 |
| **Huahine** | | | | |
| *P. varia* | 1,896 | 853 | 196 | 23.0 |
| *P. rosea* | 522 | 233 | 85 | 36.5 |
| **Total** | **6,699** | **3,126** | **560** | **17.9** |

sluggish *Partula rosea*. For a summary tabulation of numbers of *Partula* individuals released on their native islands in French Polynesia in 2015-2019 (a total of 15,835 released), please see the report in *Tentacle* 28.

Only two live *Partula* from the 2019 releases were recorded early in 2020, an adult *P. tohiveana* on Moorea (Fig. 1) and one *P. nodosa* on Tahiti, the first time that a live individual of the latter species has been recorded a year after release.In general, the estimated mortality of released snails remains low, though there is considerable variation among species (Table 1).

In March 2020, shipments of *Partula* for reintroduction later in the year still seemed possible and an expedition was made to Raiatea to confirm Hamoa Valley in the north of the island as the best location for future releases on that island (Fig. 2). In 2017 the valley had been badly infested by *Playdemus* but in 2019 the density of flatworms had diminished and a potential site for release had been identified. In 2020 another site deeper in the valley and higher up the slopes was considered preferable as it was away from the marshy river area where flatworms persisted in numbers.

The release of two species onto Huahine that took place in 2019 resulted in considerable losses, which were largely attributable to sub-optimal habitat. As expected, a monitoring session nine months after the previous one did not reveal any live individuals but additional dead shells were found. However, there was an offer of another potential release location in a private garden above the main village of Fare. The site was very small and only realistic for a small release, but as on Raiatea it was a site higher up the slopes and away from river areas more amenable to flatworm infestation.

Individuals of all the species of *Partula* that are held in the international breeding programme have now been released with the exception of one subspecies (*strigosa*) of *Partula suturalis*. A summary of the reestablishment possibilities of each taxon was given in *Tentacle* 27 and has not changed.

### Relict populations of *Partula*

Wide ranging surveys across the Society Islands throughout the 2000s revealed two classes of relict *Partula* populations:

- Those surviving in the valleys (*Partula hyalina*, *P. clara*, *P. incrassa* on Tahiti, and *P. taeniata* (two subspecies) on Moorea. These have often been found in the presence of the predatory snail *Euglandina rosea*. *Partula hyalina* and *P. clara* are widespread but not common. *Partula incrassa*

**Fig 2.** Hamoa Valley, proposed release site on Raiatea.

**Fig. 3.** *Partula incrassa*.

(Fig. 3) is endemic to Tiapa Valley. *Partula taeniata* has been found in a few locations but has become rare.

- Those surviving at high altitude (*P. otaheitana* on Tahiti, and *P. meyeri* on Raiatea). Access is very difficult in many places on Tahiti but *P. otaheitana* has survived well on Mt. Marau above 1,000 m. The status of the very rare *P. meyeri* on the highest peak of Raiatea (Mt. Toomaru) is unknown.

A number of sites containing relict populations on Tahiti and Moorea were monitored between 2005 and 2016. In 2020 exploration continued in various parts of Tahiti and Moorea to 1) confirm the presence of small relict populations and assess any new threats, 2) explore areas previously considered promising and 3) search in previously unexplored places.

### Tahiti

#### Mt. Marau

Despite the inexorable spread of invasive plant species, the spread of habitat degradation and the occasional presence of individuals of *Euglandina rosea*, the populations of the Mt. Marau ravines between 1,000 m and 1,400 m remain the most beautiful. and the most genetically diverse in Tahiti. The main species present is *Partula otaheitana*, which accounted for about 90% of all *Partula* species found in the Tahiti valleys in

the 1980s before their extinction and survival in relict populations above 1,000 m elevation. It is also possible that the cryptic species *P. compressa* still exists. It had previously been confused with *P. affinis* because of a labelling and identification error, and a number of shells were identified at high elevation locations. No visit was possible in 2020.

**Tiapa Valley**

A good population of what was then considered an unusual variety of *Partula clara* was first discovered at a single location in 2004. By 2013, widespread clearances had taken place to make way for crops, but despite the habitat destruction the *Partula* persisted. In 2018, this species was reclassified as the valley endemic, *Partula incrassa incrassa* (Fig. 3). That year, *Euglandina rosea* appeared for the first time, though a good distance from the *Partula*. In 2020, not only were no *E. rosea* recorded but a small, new population of *P. incrassa* was found seven river crossings beyond the monitored population. As this species is particularly robust it does not appear to be in immediate danger.

**Tipaerui-Iti and Matatia Valleys**

These two dry valleys harbour excellent populations of *Partula hyalina* (Fig. 4), which has declined elsewhere. In Tipaerui, they are in great numbers, especially at a site in the smaller twin valley. The presence of the elusive *Samoana attenuata* has also been confirmed among the population of *P. hyalina*. In Matatia, many *P. hyalina* are found in the brush along a stretch between the river and the cliff. That said, the situation in the ravine itself remains unknown as access is blocked. Robust populations were confirmed in both valleys in 2020.

**Fig 4.** *Partula hyalina.*

**Fautaua Valley**

Fautaua Valley (Fig. 5) seemed to be the last place in Tahiti where *Euglandina rosea* was still common, and several visits in 2020 confirmed that this was still the case. However, in August a population of *Partula hyalina* was rediscovered in a gully along the upper trail before the view over the waterfall. It had first been discovered in 2007 but had not been seen since 2013 and the grove of *opuhi* where they lived had been cut back. This is good information for the reintroduction programme as it gives hope to the possibility of finding individuals sometime after their dispersal on release. A unique population of *P. clara* (Fig. 6) discovered in 2008 along the upper trail, far past Fachoda and near the pass was quickly lost to *E. rosea* and has not been seen in many expeditions over the years. In 2020 none was seen, though a baby *Samoana attenuata* was seen in the *opuhi*, the first time in this valley. There was a baby *E. rosea* nearby, but as noted, they are common in Fautaua. The predator may still persist elsewhere, but there has been a considerable decline over the past five years and *E. rosea* may even be extinct on the Leeward Islands.


**Fig. 5.** History of *Partula* discoveries in Fautaua Valley since 2004.

**Fig. 6.** *Partula clara.*

**Fig. 7.** *Partula teaniata* cf. *elongata.*

**Atehi Valley**

Although this small ravine had been explored up to the waterfall on previous occasions, no *Partula* had been recorded. However, information had been received from botanists that two small populations of *Partula* had been seen deep in the valley above the waterfall and beyond. An expedition was undertaken to this location in 2020 and the first population was confirmed in an area of red ginger or *opuhi*. It was *Partula clara*, thin-shelled and resembling the forms found in neighbouring Papehue and Maruapo Valleys. The trail is steep, but a visit is recommended once a year to check on its status. No *E. rosea* or *P. manokwari* were seen, though it is likely that the latter is present.

**Moorea**

*Partula taeniata* is the only non-reintroduced species of *Partula* surviving on Moorea. There are also some rare, scattered populations of *Samoana attenuata* and maybe *S. diaphana*. The populations of *P. t. elongata* (Fig. 7) discovered in the Maatea and Haumi Valleys are on the verge of extinction because of predation, that of Haumi has probably already disappeared, but they may persist in a few other places in very small and discreet populations. One population of *P. t. nucleola* survives in Moruu Valley in the occasional presence of *E. rosea*.

An exceptional population of *Partula taeniata elongata* discovered a few years back along the Trois cocotiers trail in Maramu Valley has declined over the past two years. In 2020 no individuals were found. However, there were no dead shells to suggest predation and it seems likely that the population has moved elsewhere. A mixed population of *P. taeniata* and *Samoana attenuata* was discovered at the end of

2014 just below the ridge separating Vaianae and Maramu Valleys, but has not been seen since 2016, and indeed none was seen in 2020. An enigmatic population of *P. taeniata* survives in a small patch of mangrove ferns at the edge of the main road in Opunohu Bay (Fig. 8). Their survival is probably due to occasional flooding of brackish water, which excludes both *Euglandina rosea* and *Platydemus manokwari*. The *Partula* remain there despite the rubbish dumped on the site and the dust and disturbance created by the renewal of the bridge that borders the site. The snails are officially protected.

## Conclusion

As the fieldwork passes from the programme fieldworker and main author of this report, who retired (and tragically died – see p. 1, 2 of this issue of *Tentacle*), to a local scientist and assistants from French Polynesia, the main post-release field monitoring objectives and actions for 2021 have been agreed with the local environment department (Diren). Covid-19 permitting, reintroductions are set to resume with a tentative aim of three shipments, one of two species destined for release on Raiatea and one of two species destined for Huahine. Both would contain some surplus stock of Moorean species. If possible, additional *Partula nodosa* will also be released in Papehue Valley on Tahiti. The year 2021 will undoubtedly be a challenge for everyone involved in the *Partula* conservation and reintroduction programme but progress to date and the agreed collaborative conservation plan and ongoing collaborative commitment makes it well placed to succeed.

This conservation progress has only been possible because of the long-term collaboration between the French Polynesian environmental agencies and the international zoo community together with IUCN's SSC Conservation Planning, Mollusc and Reintroduction Specialist Groups, with additional funding support from the Mohamed Bin Zayed Species Conservation Fund.

**Some key partulid conservation publications**

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Coote, T, *et al*. 2018. Evolving strategy for release of *Partula* species back onto their islands of origin. *Tentacle* 26: 16-19.

**Fig. 8.** Opunohu site; mangrove ferns containing *Partula taeniata*.

Coote, T. *et al*. 2017. Ten endemic species of *Partula* reintroduced onto three of the Society Islands. *Tentacle* 25: 36-38.
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Trevor Coote, Conservation field biologist, Partulid Global Species Management Programme (deceased; see p. 1-2 of this issue of *Tentacle*)
Sam Aberdeen, EEP *Partula* Studbook Keeper, Zoological Society of London
Christophe Brocherieux, Direction de l'environnement, Government of French Polynesia
Ross Brown, Collection Manager, Marwell Wildlife
Mark Bushell, Curator of Invertebrates, Bristol Zoological Society
Paul Buzzard, Director of Conservation, Detroit Zoological Society

# MARINE MATTERS

## The collapse of native molluscan diversity in the eastern Mediterranean Sea

*By Paolo G. Albano*

The eastern Mediterranean Sea is mostly known because of the Lessepsian invasion. This massive biological invasion was caused by the opening of the Suez Canal and has triggered the establishment of hundreds of Indo-Pacific species in the basin. Much less known is that the basin is experiencing the largest eradication of native species quantified in the oceans so far.

We used death assemblages, the accumulations of skeletal material on the sea bottom after the death of living individuals (Fig. 1), to reconstruct historical species richness and we deployed an intense sampling effort in 2016-2018 to capture current species richness along the 200 km long coastline of Israel in the Mediterranean Sea. We focused on molluscs because of their taxonomic and functional diversity and because their shells are preserved for a long time in the sediments.

We recorded only 12% and 5% of historically present native species on shallow (5-40 m) subtidal soft and hard substrates, respectively (Fig. 2). The intertidal and

**Fig. 1**. Shell death assemblages enable reconstructing species composition even of profoundly modified ecosystems.

mesophotic assemblages did not show such a marked biodiversity loss. Additionally, ~ 60% of the recorded shallow subtidal native species do not reach reproductive size, casting a dark shadow on the future of Mediterranean molluscs in this part of the basin. In contrast, non-indigenous species thrive.

The easternmost Mediterranean has historically been the warmest part of the basin. Additionally, most Mediterranean native species are of temperate to boreal in origin. The warming that has occurred over the last few decades has pushed most native species beyond their thermal tolerance limits whereas the thermophilic non-indigenous ones are finding fully suitable conditions for their further establishment. This interpretation is supported by the lack of such a dramatic decline in the intertidal, which hosts species more adapted to temperature extremes, and in the mesophotic

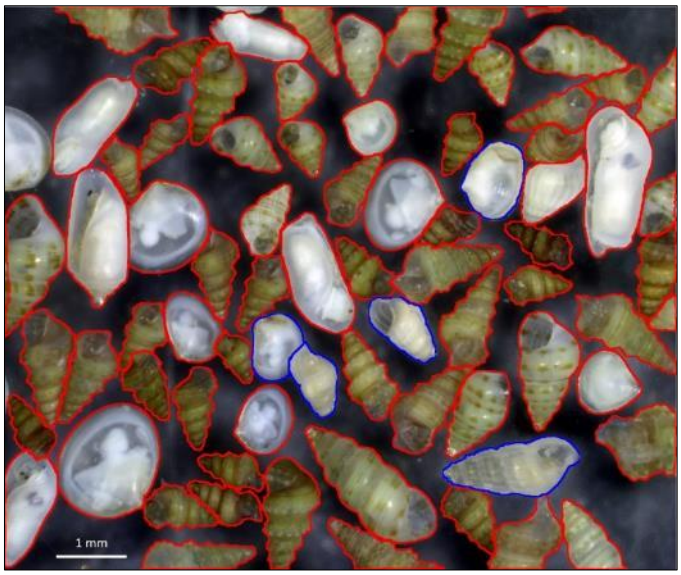


**Fig. 2**. Molluscs of a sample from southern Israel: in red those belonging to species of Red Sea origin, in blue those of Mediterranean origin. Native species are very few whereas tropical ones are dominant, marking the transformation of the ecosystem.

zone, the temperature of which is much lower than in the shallow subtidal.

The phenomenon that we have described probably occurs elsewhere in the eastern Mediterranean and may extend westward as temperatures continue to rise. The eastern Mediterranean hosts endemic species and clades that may thus face global extinction in the near future.

The full article has been published open access (Albano *et al*., 2020).

Albano, P.G., Steger, J., Bošnjak, M., Dunne, B., Guifarro, Z., Turapova, E., Hua, Q., Kaufman, D.S., Rilov, G. & Zuschin, M. 2020. Native biodiversity collapse in the eastern Mediterranean. *Proceedings of the Royal Society B* 288(1942): 20202469.

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## Update on the trade in chambered nautilus in, from and into Indonesia

*By Vincent Nijman*

The chambered nautilus (*Nautilus pompilius*) has been protected in Indonesia since 1987 and the species remains included on the new 2018 protected species list (Nijman & Shepherd, 2020). Trade in chambered nautilus, in whole or in parts, from Indonesia is not allowed. Penalties that can be imposed when this law is broken can total fines of up to US$ 6,700 and imprisonment for up to five years. Enforcement and successful prosecution of illegal traders in marine molluscs is a very rare occurrence (Nijman, 2019), and for decades Indonesia was one of the major exporters of chambered nautilus (DeAngelis, 2012; Freitas & Krishnasamy, 2016). The trade within Indonesia was also common and open (Nijman & Lee, 2016). In September 2016 all six species of *Nautilus* were added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), regulating all international trade; this agreement came into force in January 2017. With the renewed attention for chambered nautilus and stricter international regulations, the hope was to see a decline in the trade in the species in and from Indonesia.

I here give an overview of the conservation of chambered nautilus in Indonesia largely based on reports of the trade in the species, and enforcement of domestic legislation and CITES regulations, from January 2017 to May 2020.

Over this period, I kept track of newspaper articles and press releases with information on seizures of chambered nautilus shells in Indonesia. In May 2020 I searched the CITES trade database for official import and export figures related to Indonesia (i.e. import of chambered nautilus into Indonesia from other countries, their import into other countries from Indonesia, their export from Indonesia to other countries and their import into Indonesia). This was restricted to the years 2017 and 2018 as data from 2019 and 2020 were not yet available. In May 2020 I also searched for whole chambered nautilus shells for sale online in Indonesia. Five e-commerce platforms offered the species: Alibaba Indonesia, Lazada, Tokopedia, Shopee and Bukalapak. All reports and adverts were in Bahasa Indonesia; translations are mine and all prices are converted to US$.

I first present data on the international trade in the species. Data from the CITES trade database show that Indonesia does not report the export nor the import of any chambered nautilus (whole or products) for 2017 and 2018. For 2017 the USA reports the import of 31 pieces of chambered nautilus jewellery sourced from wild-caught individuals, from Indonesia for commercial purposes (again, Indonesia does not report their export as that would be in violation of its protected species legislation). In May 2018 on two occasions four shells were intercepted in Baubau, Southeast Sulawesi, that were to be exported to an unknown country via Bekasi in West Java. In June 2018 19 shells were confiscated at Denpasar Gusti Ngurah Rai International Airport on Bali; the shipment was to be sent to the Maldives. While it is unclear if any arrests were made, I was not able to find any information to suggest that any of the traders were successfully prosecuted.

On two Indonesian e-commerce platforms (Alibaba Indonesia and Lazada) I found a minimum of 13 (mostly wholesale) traders that offered chambered nautilus for sale to Indonesian customers. Five were based in the Philippines (Talisay, Leyte, San Rafael, and two in Cebu), three in Vietnam (Ho Chi Min City, Khánh Hòa, and Bà Rịa), one in Thailand (Nakhon Pathom), and five in unknown locations in China. Five wholesale traders indicated minimum order sizes (Thailand: 500; Philippines 100 and 12; Vietnam: 5 and 1) and one seller in Vietnam indicated that they were able to deliver 200 shells within five days and another Vietnamese seller was able to deliver up to 1,000 shells per month. None of the traders, nor the two platforms that they used, indicated the need for CITES permits. Prices in the international trade are typically in the order of US$85 to US$100 per shell, although this depends on the size and especially the quantity one orders. One trader from Vietnam charges US$100 for a shell when fewer than 20 shells are bought, but this goes down to US$70 when more than 50 shells are ordered. Fig. 1 (next page) shows examples of sites selling chambered nautilus shells.

In terms of domestic trade, I found four reports of chambered nautilus being seized by the Indonesian authorities. In February 2017 chambered nautilus shells were seized twice at Kupang El Tari International Airport, in West Timor. The first seizure was one shell and the second was two shells, alongside a number of shells from other protected molluscs. In November 2018, 19 shells were confiscated at Denpasar Gusti Ngurah Rai International Airport on Bali. At some time in 2018 50 kg of shells were confiscated in Ambon, Maluku. I found no evidence that any arrests were made, or that any of the traders was successfully prosecuted.

I found three e-commerce platforms where Indonesian traders offered chambered nautilus for sale. Eight traders, four based in Bali and four in Jakarta, were active on Tokopedia. Two traders, one in Bali and one in Semarang, offered chambered nautilus at Shopee and one trader from Bali offered them on Bukalapak. It is unclear what quantities of shells they each had available. None of the traders, nor the three platforms they used, indicated that trade in chambered nautilus was illegal in

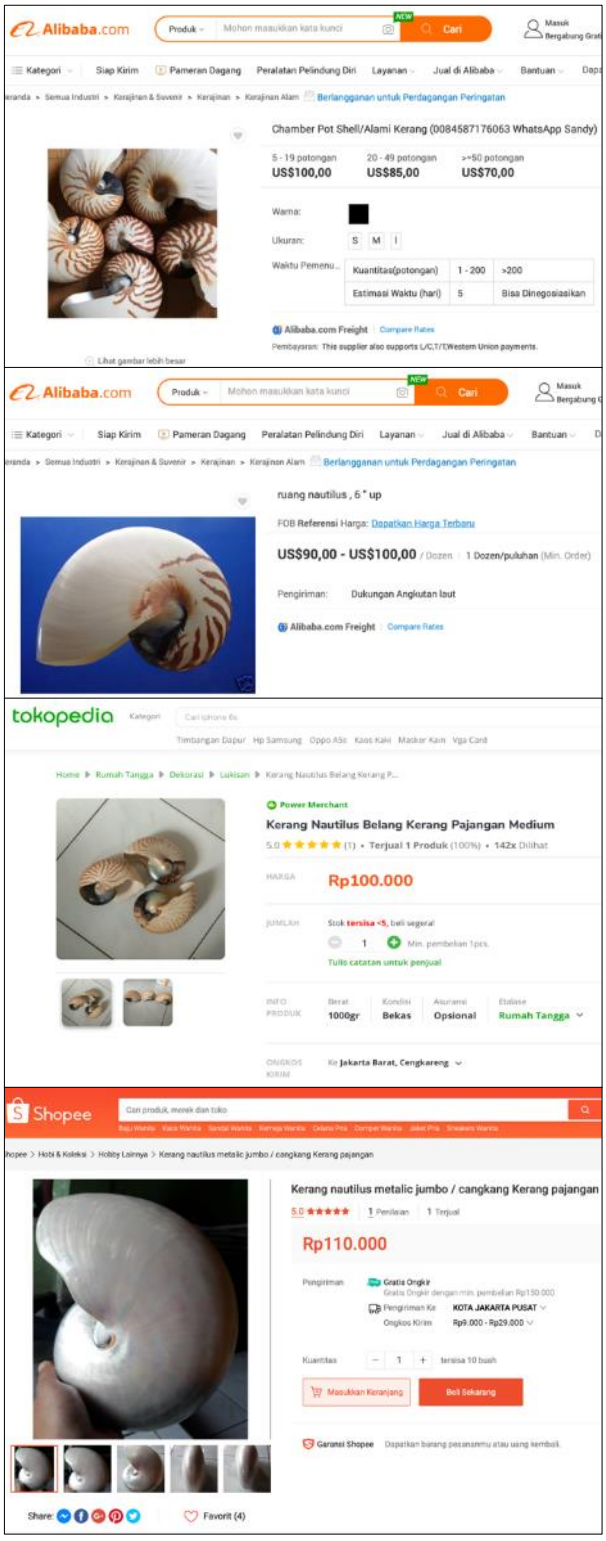



**Fig. 1.** Examples of the online trade in chambered nautilus (*Nautilus pompilius*) in and to Indonesia. From the top: seller based in Ho Chi Min City, Vietnam (200 shells can be delivered in five days); seller based in Leyte, Philippines (minimum order 12 shells); seller based in Jakarta, Indonesia; seller based in Banjar, Bali, Indonesia.

Indonesia. Prices are considerably lower, typically between US$7 and US$12 for a shell, although one trader in Jakarta offered one shell with an asking price of US$100.

In conclusion, it appears that while some enforcement efforts have been made to curb the domestic and international trade of chambered nautilus in Indonesia, this has been mostly confiscating the shells without prosecution of the traders. The (online) trade continues. The offers of import of chambered nautilus from countries like the Philippines, Vietnam and Thailand suggest that there is indeed still a market for the shells in Indonesia, and that in the absence of strong enforcement this demand will be met. Given that, as of yet, no country has reported the legal export of chambered nautilus to Indonesia with appropriate CITES permits, all international trade and the import of shells into Indonesia is illegal. All domestic trade is, and has been for decades, illegal as well. I urge the Indonesian authorities to better enforce their own legislation, to properly prosecute those that are found trading in chambered nautilus, and for the CITES management authorities in at least the Philippines, Vietnam and Thailand, to ensure that none of their chambered nautilus shells are exported without having acquired the appropriate permits.

DeAngelis, P. 2012. Assessing the impact of international trade on chambered nautilus. *Geobios* 45: 5-11.

Freitas, B. & Krishnasamy, K. 2016. *An Investigation into the Trade of Nautilus*. TRAFFIC and World Wildlife Fund, Washington DC.

Nijman, V. 2019. Wildlife trade, CITES and the protection of marine molluscs in Indonesia. *Molluscan Research* 39(3): 1-10.

Nijman, V. & Lee, P.B. 2016. Trade in nautilus and other large marine molluscs as ornaments and decorations in Bali, Indonesia. *Raffles Bulletin of Zoology* 64: 368-373.

Nijman, V. & Shepherd, C.R. 2020. Indonesia's new protected species list a step back for marine mollusc conservation. *Tentacle* 28: 40-41.

Vincent Nijman, Oxford Wildlife Trade Research Group, Oxford Brookes University, Oxford OX0 3BP, UK. vnijman@brookes.ac.uk

## RECENT PUBLICATIONS RELEVANT TO MOLLUSC CONSERVATION

### Freshwater Mollusk Biology and Conservation


*Freshwater Mollusk Biology and Conservation*, formerly *Walkerana* is the on-line journal of the Freshwater Mollusk Conservation Society, based in North America. In 2020, it published two issues: volume 23, number 1, with five papers, and number 2, with eight papers. All issues are available on-line at the journal's website, with open access.

**Volume 23, number 1**

Alvear, D., Diaz, P.H., Gibson, J.R., Hutchins, B.T., Schwartz, B.& Perez, K.E. 2020. Expanding the known ranges of the phreatic snails (Mollusca, Gastropoda, Cochliopidae) of Texas, USA. Freshwater Mollusk Biology and Conservation 23: 1-17.

Diaz, P.H., Alvear, D. & Perez, K.E. 2020. Mesohabitat associations of the Devil Tryonia, *Tryonia diaboli* (Gastropoda:

Truncatelloidea: Cochliopidae). *Freshwater Mollusk Biology and Conservation* 23: 18-24.

Dinkins, G.R. 2020. Provenance and disposition of specimens appearing in color plates of the Freshwater Mussels of Tennessee. *Freshwater Mollusk Biology and Conservation* 23: 25-35.

Sullivan, K.T. & Littrell, B.M. 2020. Freshwater mussel assemblage structure in a small Edwards Plateau impoundment with comments on conservation implications for Texas fatmucket, *Lampsilis bracteata* (Gould 1855). *Freshwater Mollusk Biology and Conservation* 23: 36-41.

Osborne, R.K., Gillis, P.L. & Prosser, R.S. 2020. Transgenerational effects of copper on a freshwater gastropod, *Planorbella pilsbryi*. *Freshwater Mollusk Biology and Conservation* 23: 42-54.

**Volume 23, number 2**

Burak, G. & Hopper, D. 2020. Translocation and reproductive benefits to a highly endemic and endangered species, the Banbury Springs limpet, *Idaholanx fresti* (Mollusca: Gastropoda). *Freshwater Mollusk Biology and Conservation* 23: 55-60.

Dinkins, G.R., Womble, K.I. & Ahlstedt, S.A. 2020. A survey of the freshwater mussels (Mollusca: Bivalvia: Unionida) of the upper Barren River system, Tennessee. *Freshwater Mollusk Biology and Conservation* 23: 61-68.

Kemble, N.E., Besser, J.M., Steevens, J. & Hughes, J.P. 2020. Assessment of burrowing behavior of freshwater juvenile mussels in sediment. *Freshwater Mollusk Biology and Conservation* 23: 69-81.

Pinkney, A.E., Kline, K.M. & Morgan, R.P., II. 2020. Comparison of surface- and pore-water quality between two Maryland streams with the endangered Dwarf Wedgemussel (*Alasmidonta heterodon*). *Freshwater Mollusk Biology and Conservation* 23: 82-91.

van Ee, B.C., Nickerson, Z.L. & Atkinson, C.L. 2020. Picky pigs prefer pigtoes: evidence for species selective feral pig predation on freshwater mussel. *Freshwater Mollusk Biology and Conservation* 23: 92-98.

Beyett, T.W., McNichols-O'Rourke, K., Morris, T.J. & Zannata, D.T. 2020. Use of morphometric analyses and DNA barcoding to distinguish *Truncilla donaciformis* and *Truncilla truncata* (Bivalvia: Unionidae). *Freshwater Mollusk Biology and Conservation* 23: 99-108.

Dunn, H.L., Zigler, S. & Newton, T. 2020. Mussel community assessment tool for the upper Mississippi river system. *Freshwater Mollusk Biology and Conservation* 23: 109-123.

Olson P.J. & Vaughn, C.C. 2020. Population genetics of a common freshwater mussel, in a southern U.S. river. *Freshwater Mollusk Biology and Conservation* 23: 124-133.

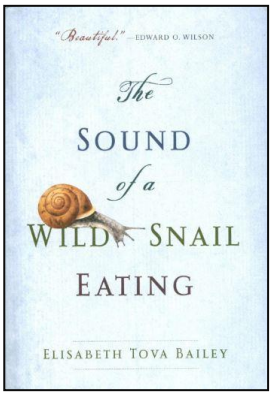
## Journal of Threatened Taxa

All issues for 2020 (volume 12), and the first two for 2021 (Volume 13), of the *Journal of Threatened Taxa* are available on-line now.

## The Sound of a Wild Snail Eating

Elisabeth Tova Bailey, original edition 2010. Algonquin Books of Chapel Hill, Chapel Hill, North Carolina, USA.

Here is my usual notice of this delightful book, which I continue to thoroughly recommend. It was originally reviewed in *Tentacle* 19 (2011). The memoir recounts the author's year-long observation of a forest snail, *Neohelix albolabris*. The original book was published in the USA in 2010, but it has

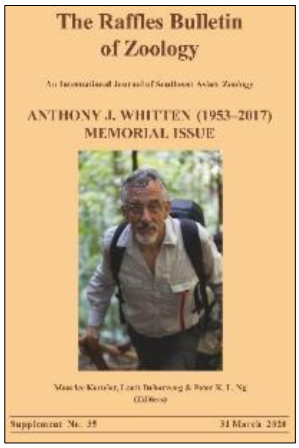



been translated into various languages For links to the publishers of these editions please see the author's website. An audiobook edition is available as a Kindle or hard CD. And there is an award winning short film adapted from it (see wildsnailfilm.org for upcoming screenings).

**Film of the book available**

The author informs me that the film of the book (around 15 minutes) is available for screenings to malacology and other groups and departments. Anyone interested in such a group screening for their lab or department should send an e-mail to info@wildsnailfilm.org. I recently saw the film for the first time and can recommend it highly – it is as delightful and thought provoking as the book.

## Anthony Whitten memorial issue of the Raffles Bulletin of Zoology




Tony Whitten died in 2017 as the result of a cycling accident – see *Tentacle* 26. See also *Tentacle* 28 for details of the Tony Whitten Conservation Prize, and p. 3 of this issue of *Tentacle* for an annoucement of a malacological winner of the 2020 prize. His conservation interests were many, as reflected in this memorial issue of the *Raffles Bulletin of Zoology* (2020, Supplement 35), edited by Maurice Kottelat, Louis Deharveng and Peter Ng, and with a biobibliography of Tony by Jane Whitten, his wife.

Whitten, J. 2020. Anthony J. Whitten (1953-2017). *Raffles Bulletin of Zoology* Supplement 35: 1-10.

He was particularly interested in land snails, notably those of Southeast Asia. Three papers on Southeast Asian land snails are included in this compilation.

Foon, J.K & Marzuki, M.E. 2020. Two new species of land snails of the genus *Rahula* from Peninsular Malaysia (Gastropoda: Euconulidae). *Raffles Bulletin of Zoology* Supplement 35: 137-142.

Liew, T.-S. & Clements, G.R. 2020. *Whittenia*, a new genus of land snails from Perak, Peninsular Malaysia (Gastropoda: Diplommatinidae). *Raffles Bulletin of Zoology* Supplement 35: 143-148.

Sutcharit, C., Lin, A. & Panha, S. 2020. Two new species of the carnivorous snail genus *Discartemon* from Thailand and Myanmar (Eupulmonata: Streptaxidae). *Raffles Bulletin of Zoology* Supplement 35: 149-155.

Note that Junn Kitt Foon was awarded an inaugural 2019 Tony Whitten Conservation Prize (see *Tentacle* 28).

## Other publications of interest

This is by no means a comprehensive list but simply a list of publications that I have happened to come across, additional to those mentioned elsewhere in this section. If you want to have your publications listed in the next issue of *Tentacle*, please send details to me, Robert Cowie, the editor of *Tentacle*.


Balashov, I.A., Neiber, M.T. & Hausdorf, B. 2020. Phylogeny, species delimitation and population structure of the steppe-inhabiting land snail genus *Helicopsis* in Eastern Europe. *Zoological Journal of the Linnean Society* On-line early.

Böhm, M., Dewhurst-Richman, N.I., Seddon, M., Ledger, S.E.H., Albrecht, C., Allen, D., Bogan, A.E., Cordeiro, J., Cummings, K.S., Cuttelod, A., Darrigran, G., Darwall, W., Fehér, Z., Gibson, C., Graf, D.L., Köhler, F., Lopes-Lima, M., Pastorino, G., Perez, K.E., Smith, K., van Damme, D., Vinarski, M.V., von Proschwitz, T., von Rintelen., T., Aldridge, D.C., Aravind, N.A., Budha., P.B., Clavijo, C., Tu, D.V., Gargominy, O., Ghamizi, M., Haase, M., Hilton-Taylor, C., Johnson, P.D., Kebapçı, Ü., Lajtner, J., Lange, C.N., Lepitzki, D.A.W., Martínez-Ortí, A., Moorkens, E.A., Neubert, E., Pollock, C.M., Prié, V., Radea, C., Ramirez, R., Ramos, M.A., Santos, S.B., Slapnik, R., Son, M.O., Stensgaard, A.-S. & Collen, B. 2020. The conservation status of the world's freshwater molluscs. *Hydrobiologia* On line ahead of print.

Cumplido, M. & Bigatti, G. 2020. Maturity assessment for the implementation of the first fishery regulation in Patagonian marine gastropods. *Malacologia* 63(1): 139-147.

Curry, P.A., Yeung, N.W., Hayes, K.A. & Cowie, R.H. 2020. The potential tropical island distribution of a temperate invasive snail, *Oxychilus alliarius*, modeled on its distribution in Hawaii. *Biological Invasions* 22(2): 307-327.

de Oliveira, J.L., Miyahira, I.C., Gonçalves, I.C.B., Ximenes, R.F., de Lacerda, L.E.M., da Silva, P.S.C., Fonseca, F.C., Barbosa, A.B., Nunes, G.K.M. & dos Santos, S.B. 2020. Non-marine invasive gastropods on Ilha Grande (Angra dos Reis, Rio de Janeiro, Brazil): distribution and implications for conservation. *Biota Neotropica* 20(3): e20201060.

Fabres, A., Valladares, M.A., Sáez, P.A., Colladao, G.A., Pastenes, L. & Méndez, M.A. 2020. Novel microsatellite markers for an endangered freshwater snail, *Heleobia atacamensis* (Caenogastropoda: Cochliopidae), from the Atacama Saltpan. *Molluscan Research* 40(3): 231-235.

Gargominy, O., Butaud, J-F., Fontaine, B. Prié, V., Zuccon, D., Tercerie, S. Hauata, J. & Hauata, M. 2020. Discovery of the only living population of *Pupoidopsis hawaiensis* (Gastropoda: Pupillidae) in the last 50 years. *American Malacological Bulletin* 38(1): 50-54.

Grego, J., Mumladze, L., Falniowski, A., Osikowski, A., Rysiewska, A., Palatov, D.M. & Hofman, S. 2020. Revealing the stygobiotic and crenobiotic molluscan biodiversity hotspot in Caucasus: part I. The phylogeny of stygobiotic Sadlerianinae Szarowska, 2006 (Mollusca, Gastropoda, Hydrobiidae) fromGeorgia with descriptions of five new genera and twenty-one new species. *ZooKeys* 955: 1-27.

Ng, T.H., Annate, S., Jeratthitikul, E., Sutcharit, C., Limpanont, Y. & Panha, S. 2020. Disappearing apple snails (Caenogastropoda: Ampullariidae) of Thailand: a comprehensive update of their taxonomic status and distribution. *Journal of Molluscan Studies* 86(4): 290-305.

O'Hanlon, A., Fahy, R. & Gormally, M.J. 2020. Indication of interference competition between the EU-protected Kerry slug *Geomalacus maculosus* and the native tree slug *Lehmannia marginata* in Ireland. *Journal of Molluscan Studies* 86(4): 389-400.

Paschoal, L.R.P., Andrade, D.P., Pimpão, D.M., Torres, S. & Darrigran, G. 2020. Massive mortality of the giant freshwater mussel *Anodontites trapesialis* (Lamarck, 1819) (Bivalvia: Mycetopodidae) during a severe drought in a Neotropical reservoir. *Anais da Academia Brasileira de Ciências* 92(Suppl. 2): e20180811.

Raabe, J.M. & Gilg, M.R. 2020. Native and nonnative bivalve settlement: potential competition for spatial resources in a northeast Florida estuary. *Journal of Molluscan Studies* 86(4): 372-381.

Richard, J.C., Leis, E., Dunn, C.D., Agbalog, R., Waller, D., Knowles, S., Putnam, J. & Goldberg, T.L. 2020. Mass mortality in freshwater mussels (*Actinonaias pectorosa*) in the Clinch River, USA, linked to a novel densovirus. *Scientific Reports* 10: 14498.

Savić, A., Dmitrović, D., Glöer, P. & Pešić, V. 2020. Assessing environmental response of gastropod species in karst springs: what species response curves say us about niche characteristic and extinction risk? *Biodiversity and Conservation* 29(3): 695-708.

Siddique, M.A., Khatun, M.A., Rahman, M.M., Ahmed, G.U., Moniruzzaman, M. & Uddin, M.J. 2020. Annual gametogenic cycle of the freshwater pearl mussel, *Lamellidens marginalis* (Lamarck, 1819) collected from a perennial lentic habitat of Bangladesh. *Molluscan Research* 40(1): 36-43.

Sonowal, J. & Kardong, D. 2020. Assessment on diversity, distribution and conservation status of Indian freshwater pond mussel *Lamellidens* spp. from upper Brahmaputra basin of Assam. *Asian Journal of Conservation Biology* 9(1): 123-129.

Sullivan, K.T. & Littrell, B.M. 2020. Spatiotemporal variation in *Elimia comalensis* (Gastropoda: Pleuroceridae) density and interspecific associations with exotic thiarid snails in the upper San Marcos River, Texas. *Malacologia* 63(1): 1-9.

Sun, W., Liu, X., Wu, R., Wang, W., Wu, Y., Ouyang, S. & Wu, X. 2019. Declining freshwater mussel diversity in the middle and lower reaches of the Xin River Basin: threat and conservation. *Ecology and Evolution* 9(24): 14142-14153.

von Proschwitz, T. & Wengström, N. 2020. Zoogeography, ecology, and conservation status of the large freshwater mussels in Sweden. *Hydrobiologia* On-line early.


## IUCN/SSC AND MOLLUSC SPECIALIST GROUP NEWS AND ANNOUNCEMENTS


www.iucn.org/

News and information provided by Mary Seddon, chair of the Mollusc Specialist Group (MSG) of the IUCN Species Survival Commission (SSC).

### Message from Mary Seddon, chair of the Mollusc Specialist Group

I hope that everyone is managing to continue to work throughout this unusual time and that your families remain healthy. This last year has been challenging for everyone, with changes worldwide in the way that we work and communicate. All conservation organisations have faced issues with fund-raising, with loss of donors, inability to undertake fieldwork and species monitoring, reprioritisation of funders to supporting COVID-19 related research and organisations facing losses from COVID-19. However, we have also found new ways to

work together, with increased funding placed into creating webinar resources for learning about conservation tools, methodologies and sharing good practices.

As we move into 2021, there are various new IUCN initiatives ongoing to promote opportunities to share experiences and work together towards better conservation outcomes, not just for the furry and feathery species on the planet. The post-2020 framework, like the Aichi Targets for 2020, will have shared aims and objectives of the signatory parties that are still being formulated by the Convention on Biological Diversity (CBD). At present, the targets for 2030 and 2050 on species, continue to be revised, but it is clear that measuring success for meeting these targets will still be very dependent on using the IUCN Red List outputs on changing status of species, hence it is increasingly important to both assess species for the Red List and revise old assessments on a regular basis.

Within SSC the creation of a new partnership with Indianapolis Zoo to create a global species centre, demonstrates an SSC commitment to better communicating conservation stories. A new #reversethered campaign will focus on achieving long-term actions across a wide range of habitats and species, as well as reflecting the balance between conserving biodiversity and sustainable use of resources. There is also a major push to increase the national level actions, from supporting Red List assessments of national endemics; for example IUCN/SSC are assisting IUCN national offices to streamline endemic assessments from the Red List of Korea into the IUCN Global Red List. There are also ongoing discussions about creation of national level SSC specialist groups.

The IUCN Congress, postponed a year, includes various motions that could benefit many threatened mollusc species. A list of some of the more relevant motions with proposed actions is included here, but full details including the proposing organisations are included on the IUCN Congress website. For example, Motion 019, provides a case for better management of springs in the Mediterranean region, noting the inevitable number of extinctions without sustainable management of water resources in the near future; Motion 027 calls for better data on the impacts of bycatch on marine fauna including invertebrate species; and Motion 103 calls for a ban on mining in the Atewa forests (Ghana), which has several endemic land snails and the threats are described more fully in the article by Peter Tattersfield *et al*. (p. 13 of this issue of *Tentacle*). Other motions, for example a moratorium on mining in the deep oceans (Motion 069) remains to be debated at the Congress in September 2021.

Working with the IUCN programme staff has yielded more benefits, in terms of fund-raising, as in Europe we look forward to commencing another major project funded by the EU. This will see the reassessment of freshwater molluscs and selected groups of land snails (~ 2,000 species) that were last assessed in 2008-2011. This project will provide a substantive regional reassessment that will allow the creation of a regional Red List Index for non-marine molluscs. There is an IUCN funded project in development to combine invertebrate groups for a unified multi-taxon workshop approach to Assess-Plan-Act in the Western Ghats of India, which is a new approach for terrestrial ecosystems. Other projects that are now formally within the SSC strategic goals include completion of the global freshwater bivalve assessments, reassessment of the family Conidae and regional assessments of Antarctic marine molluscs Grant applications are in place for several of these projects.

Finally, I look forward to another year, during which we continue to work together towards our communal goal of conserving molluscs worldwide.

Mary Seddon, Chair, Mollusc Specialist Group

## IUCN World Conservation Congress 2020

The International Union for Conservation of Nature (IUCN) and the French government have agreed to hold the IUCN World Conservation Congress 2020 from 3 to 11 September 2021 in Marseille. The event, originally scheduled for June 2020, was postponed due to the COVID-19 pandemic.

The world is increasingly recognising the inextricable link between biodiversity conservation and human and economic wellbeing, a connection made all the more visible by the COVID-19 pandemic. The IUCN Congress will be a key milestone for nature conservation and the development of a new global framework for biodiversity. The French government and IUCN remain steadfast in their commitment to these goals.

For more information visit the Congress website.

## IUCN publications

IUCN has one of the world's most comprehensive ranges of authoritative publications, reports, guidelines and databases for conservation and sustainable development. It publishes or co-authors more than 100 books and major assessments every year, along with hundreds of other reports, documents and guidelines.

You can access the complete collection of digitized IUCN publications and grey literature here, including the following:

- IUCN annual reports
- All annual reports (including regional and thematic annual reports)
- 2018 publications and grey lit - 2017 publications and grey lit - 2016 publications and grey lit
- Red List / Red data publications
- Publications on protected areas (EN / FR / ES)

You can visit the IUCN HQ Library to consult publications that have not yet been digitized.

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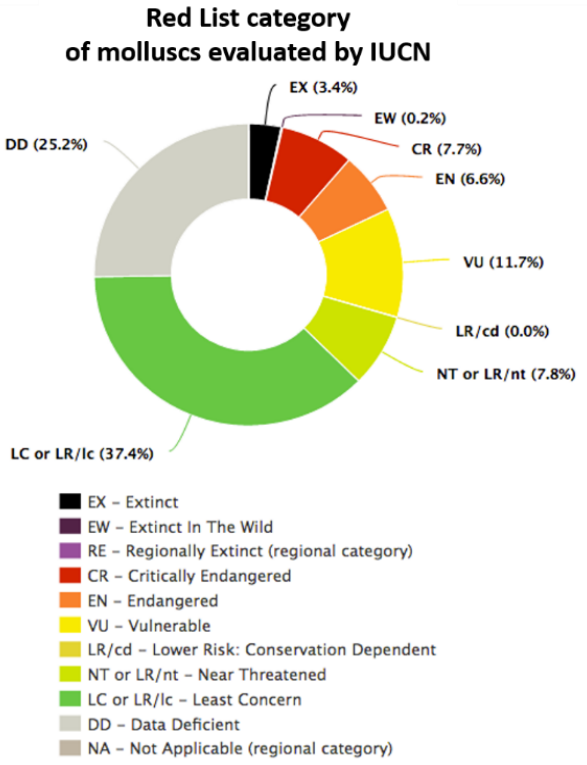
To learn about the latest IUCN publications, sign up for the bimonthly Off the Shelf newsletter here! You can also sign up for other IUCN newsletters.

## IUCN Red List of Threatened Species 2020

There were three updates in 2020, with the latest update on Thursday 10 December. There are now 128,918 species on the IUCN Red List, of which 35,765 are threatened with extinction (Critically endangered, Endangered, Vulnerable, i.e. CR, EN, VU). For molluscs, 8,846 species have been assessed, including nearly all the Cephalopoda (750 species). Overall 26% of molluscs are considered threatened with a further 25% having insufficient data to classify them (especially within the Cephalopoda). There were 43 molluscs that were reassessed and changed category in 2019-2020, but only seven species showed a genuine change, all declining, with species like *Pseudocleopatra togoensis* going from Least Concern to Critically Endangered, illustrating the extreme pressures on freshwater resources worldwide.




## New initiative: Global Center for Species Survival at Indianapolis

In January 2021, a groundbreaking partnership between the Indianapolis Zoo and IUCN SSC has moved forwards with the appointment of seven coordinators who will be focused on supporting, connecting and communicating the work and efforts of the SSC Network.

These seven coordinators are:

- Angela Yang, Mammal Coordinator
- Nicolette Roach, Reptile and Amphibian Coordinator
- Mimi Kessler, Bird Coordinator
- Riley Pollom, Marine Coordinator
- Catia Canteiro, Plant and Fungi Coordinator
- Monika Böhm, Freshwater Coordinator
- Sergio Henriques, Invertebrate Coordinator

Within the MSG, we will be working with three of the coordinators, Riley, Monika (Monni) and Sergio. Monni should already be well known to many freshwater mollusc specialists, as she has been coordinating Sampled Red List Index (SRLI) assessment projects for the Zoological Society of London and for the last six years has been working closely with MSG members to finalise outputs for the Global Freshwater Molluscs SRLI. However, Monni has also worked on the global cephalopoda assessment with Louise Alcock and the hydrothermal vents projects with Julia Sigwart and Elin Thomas. We know that Monni will ensure that molluscs will be well represented in projects that are ongoing at the new Global Centre for Species Survival. Riley has worked with various SSC specialist groups, such as Sharks and Rays, and Seahorses, as well as working more broadly on marine resource management in Canada. She will be focussed on cross-cutting issues for marine conservation, including by-catch, using marine protected areas as a conservation tool for species and conflicts with fisheries management. Sergio also worked for the Zoological Society of London, but with a specialism in spiders and scorpions, and now has a wider remit to support invertebrate conservation within the SSC. In the past he has worked on CITES/wildlife trade issues as well as reviewing use of sampled data to support the assessment of specious groups. More information including brief biographical information for the new staff can be found in the announcement of the coordinator team. At present, their work programmes have yet to be agreed, but we look forward to the opportunity to have this centre and their staff promoting the work that the specialist groups have been doing worldwide.

## #Reverse the Red: communication campaign to improve conservation 2021

The IUCN Red Lists of Threatened Species and of Ecosystems are the world's most comprehensive information source on the global conservation status of animal, fungi and plant species and of ecosystems. The goal of The Red Lists is to catalyse action to reduce or prevent species extinctions and ecosystem collapse by providing information and analysis, including threats, ecological requirements, habitats and required conservation action. When used together the Red List of Threatened Species and the Red List of Ecosystems provide the most informative indicator of the status of biological and abiotic diversity at the national, regional and global levels.

- #ReverseTheRed will be an umbrella movement to bring together a diverse coalition of partners to collaborate, scale up targets and impact and engage people from all walks of life to take action for species and ecosystems.
- #ReverseTheRed catalyses collaboration and energises decentralised networks and communities around the world to Assess – Plan – Act for species and ecosystems.
- #ReverseTheRed works in complement to goals of protecting 10% of the world's oceans, and landscape based conservation efforts such as Global Campaign for Nature's goal of conserving 30% of the planet in its natural state by 2030. These initiatives seek to protect

space for nature, but do not necessarily ensure the survival of the species and ecosystems within these spaces.
- #ReverseTheRed calls on countries around the world to commit to demonstrating positive progress in their National Red List Index for both species and ecosystems, as the primary measure of species survival trajectory.
- #ReverseTheRed partners will support this vision through strategic leadership, development of models and tools, support the establishment of national and regional implementation centers, and facilitate integration into international policy mechanisms.
- #ReverseTheRed is also a promise that we will all work together to make this a reality. The current trajectory for species survival and ecosystem health is negative; but through clear, intelligent target setting, ambitious capacity building and increased collaborative action we can turn this trend around, we can ***Reverse The Red***.

There is a series of webinars bringing together people from a variety of conservation organisations worldwide, to discuss how to create actions that will ***Reverse The Red***.
https://www.reversethered.org/news

## IUCN Standard to support global action on invasive alien species

The Environmental Impact Classification for Alien Taxa (EICAT) will alert scientists, conservation practitioners and policy makers to the potential consequences of invasive alien species, guiding the development of prevention and mitigation measures. As the result, there are now additional new members of the MSG, who have specific expertise in terms of identifying invasive alien species and taking action.

## Post 2020 biodiversity targets

IUCN is currently engaged with other NGOs in generating proposals for goals and targets to be considered during the Conference of the Parties on the Convention of Biodiversity, postponed from 2020 and now to be held later in 2021. These discussions have been taking place in virtual workshops rather than at physical meetings. The changing status of species on the IUCN Red List, the percentage of areas that are protected and the introduction of IUCN Green Lists and IUCN Key Biodiversity Areas (KBAs) are tools that could be used for monitoring the extinctions of species, making progess in conserving species and protecting areas considered to be of high biodiversity value. The current working document can be seen here.

## SSC plan 2020-2024: Assess-Plan-Act

As advised in the last issue of *Tentacle* (issue 28), the Species Survival Commission (SSC), the umbrella organisation within IUCN of which the Mollusc Specialist Group is a part, is moving to a model that focuses away from undertaking assessments towards planning and acting to obtain conservation benefits for all species, not just threatened species. More emphasis on conservation successes is being proposed for the post-2020 targets. Currently SSC is reviewing sources of small funding to enable conservation activities for pilot projects that create multi-species/habitat conservation plans. The first of the projects is anticipated to be undertaken in the Western Ghats, India. As a result, we have recruited more new members to the MSG, who have specific expertise in terms of conservation planning and actions.

## IUCN Motions

At the World Conservation Congresses, IUCN members agree to various motions that will form the programme of works for the coming four years. The congress in June was postponed for six months, and now again till September 2021. However, there was an electronic discussion system, with members voting on proposed motions in October 2020. Some have been deferred for discussion at the congress in 2021, but others have been agreed, and therefore will be put into the programme for the next four years. Various motions, listed and summarised below, will impact conservation of molluscs in the coming four years. Full details of the motions are on the IUCN Congress site.

The following motions have been agreed, and a summary of some of the proposed actions are given.

### 009 Protecting rivers and their associated ecosystems as corridors in a changing climate

This motion relates to the Aichi Biodiversity Target 11 for terrestrial, freshwater and marine conservation through a well-connected system of protected areas as well as Strategy 1.7 of the Ramsar Convention on Wetlands on catchment/river basin management. It notes that the level of extinction in freshwater systems is much higher than in marine and terrestrial systems and calls upon IUCN to undertake more work on river protection and connectivity in 2020-2024. It calls on government members to work with other organisations (eg NGO's, Private Companies) to identify, restore and protect free-flowing rivers or stretches and their associated ecosystems, that provide essential services, or resilience in a changing climate, including providing funding for the work

### 015 Supporting the Lower Mekong Basin countries with the transboundary management of water resources, ecosystems and biodiversity

This motion asks IUCN and its' members to actively look for alternatives to new dams that will reduce the impact on the Mekong River's ecosystems, including changes to river flows, increased salinisation, and reduced sediment and fisheries resources. Also to raise awareness concerning unsustainable socio-economic development and the overuse of groundwater in the Mekong Delta.

### 018 Conservation of spring ecosystems in the Mediterranean region

This motion, whilst focussed on the Mediterranean region, is much more widely applicable, as data on Molluscs show. The motion notes that springs are one of the least explored

and most neglected habitats, and that de facto – or reasons of scale – they were not protected throughout the region by the European Union's Habitats Directive or Water Framework Directive. The Congress urges IUCN Commissions to raise greater awareness regarding the importance of conserving spring ecosystems, promoting projects that allow for progress to be made in their conservation. The congress calls upon State Members in the Mediterranean region as well as their regional governments, to adopt effective conservation measures for spring biodiversity, its geodiversity and geological heritage. The Congress notes that there is inadequate prioritisation of habitat conservation for spring habitats as a key biotope for preserving European aquatic biodiversity and calls upon state members to recognise these priority habitats of community interest in the Mediterranean region as well as being a "ecosystem dependent" on groundwater bodies, and encourage their monitoring and management; and requests the inclusion of the conservation of spring ecosystems as a priority objective in their national strategies for biodiversity and adaptation to climate change.

**019 Protection of natural flows of water for the conservation of wetlands**

The IUCN 2020 congress requests that IUCN draws from the Global Wetlands Outlook to highlight the present situation of the loss and deterioration of wetlands in river basins and coastal regions, as well as the construction of artificial structures that prevent the natural flow of water and to update the protected area management guidelines in order to guarantee effective protection of wetland habitats.

**022 Stopping the global plastic pollution crisis in marine environments by 2030**

The IUCN 2020 congress notes that the production of plastic in the world is due to increase by 40% over the next 15 years but plastic waste is present, notably in the form of micro-plastics, in the remotest and deepest parts of the ocean, as well as in the entire food chain. The IUCN World Conservation Congress 2020 asks IUCN Commissions to collaborate with Members on raising public awareness and promoting innovative solutions to preventing marine plastic pollution, to promote responsible management of single-use plastic waste and scrap that prevents its leakage into the environment and to mobilise technical and financial support to facilitate implementation of these actions.

**025 Halting biodiversity loss in the insular Caribbean**

The IUCN World Conservation Congress 2020 requests state members, as well as regional and international organisations responsible for environmental and economic sustainability issues, to strengthen actions to halt biodiversity loss in the insular Caribbean. It suggests mainstreaming biodiversity conservation in planning mechanisms at local, regional and national levels and increasing national commitments and budgets for biodiversity management. It calls upon countries to ratify the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region and its Protocol, in particular the Specially Protected Areas and Wildlife (SPAW) Protocol.

**027 Reducing impacts of incidental capture on threatened marine species**

The IUCN World Conservation Congress 2020 requests the IUCN Director General and the Species Survival Commission (SSC) produce a comprehensive analysis of the impacts of non-selective fisheries on ETP species, involving all Commissions and addressing small-scale artisanal to industrial fleets, as well as a full range of marine taxa (e.g. invertebrates, fishes, reptiles, mammals, seabirds) by 2022**.** The motion calls on State and Government Agency Members to enhance deployment of selective gear and practices that reduce or eliminate bycatch, as well as to continue scientific studies and analyses of new mitigation measures for ETP species.

**033 For the urgent global management of marine and coastal sand resources**

The IUCN World Conservation Congress 2020 recommends that state members and other relevant authorities should support the implementation of strategic plans for the management of terrestrial and marine sand at a regional or island level. This should be based on the study of sediment flows upstream to downstream, take the effects of climate change into account, so as to ensure sustainable use of sand and ensure that the management and regulation of sand extraction activities is carried out in a sustainable way.

**049 Australia's extinction crisis and national environmental law reform**

The IUCN World Conservation Congress 2020 calls on the Australian Government to demonstrate national leadership in environmental protection and ensure that reform of its national environmental law: to prevent the destruction of primary, remnant, old-growth or high-conservation value forests; prevents the avoidable extinction of native fauna and flora; and protect and recover key biodiversity areas, threatened ecological communities and threatened species, including strict protection for their critical habitats.

**094 Linking in situ and ex situ efforts to save threatened species**

The IUCN World Conservation Congress 2020 urges the IUCN Secretariat and professional societies to promote integration of in situ and ex situ conservation interventions by applying the One Plan Approach, to ensure effective use of all available conservation tools. It also all Members make proactive and timely application of planning methods, such as the One Plan Approach, and informed by the Guidelines on the Use of Ex situ Management for Species Conservation. It calls on CITES Parties and governments to support and take measures, as appropriate and consistent with applicable laws, to enable efficient transfer of samples from/to biobanks for effective species conservation purposes.

**100 Rewilding**

The IUCN World Conservation Congress 2020 calls on IUCN Director General, in consultation with CEM and SSC, to establish with urgency an inter-disciplinary and cross-Commission working group to agree a clear definition and

understanding of rewilding, including rewilding principles and to develop parameters and guidelines for applying rewilding approaches that reflect the need for careful assessment of the relative risks and rewards to ecosystems and local communities affected by land-use changes.

**103 Urgent measures to safeguard the globally important Atewa Forest, Ghana**

The IUCN World Conservation Congress 2020 urges the Government of Ghana to immediately and permanently halt all mining-related operations and other destructive activities in Atewa Forest; and to establish a national park over the entirety of Atewa Forest to ensure its conservation in perpetuity and requests the IUCN Director General, in view of the extreme urgency of the situation in the Atewa Forest, to provide a special report to the next session of the World Conservation Congress on the implementation of this Resolution. (See also the article by Tattersfield *et al*. on p. 13 of this issue of *Tentacle*.)

**124 Reducing the impact of fisheries on marine biodiversity**

This motion requests that the IUCN Director General and Commission Chairs to establish a Task Force to reconcile fisheries and conservation that will producea scientific and technical Situational Analysis on the effects of fisheries on biodiversity by 2022, including diverse fisheries (e.g. small-scale, artisanal, women's, indigenous, non-selective, invertebrate, distant-water); and diverse issues (e.g. spatial management, efficacy of legal instruments, perverse incentives, economic dependencies, human well-being and rights, climate change impacts). It also asks all IUCN State and Government Agency Members and other competent authorities tob. ensure that national Red List assessments and national, regional, or global biodiversity reports include marine fishes and invertebrates and remove perverse incentives for fisheries, including harmful subsidies.

The following motions will go to the Congress for further debate.

013 Protection of Andes-Amazon rivers of Peru: the Marañón, Ucayali, Huallaga and Amazonas, from large-scale infrastructure projects
021 Planning of maritime areas and biodiversity conservation
024 Restoring a peaceful and quiet ocean
034 Climate Change and Biodiversity Crisis
039 Protecting environmental human and peoples' rights defenders and whistleblowers
040 Develop and implement a transformational and effective post-2020 global biodiversity framework
044 Actions to strengthen food sovereignty and security of indigenous peoples and peasant communities
045 Recognising and supporting indigenous peoples' and local communities' rights and roles in conservation
048 Rediscovering the care of Mother Earth from the vision of indigenous peoples
062 Towards a Policy on Natural Capital
067 Reducing the impacts of the mining industry on biodiversity
069 Protection of deep-ocean ecosystems and biodiversity through a moratorium on seabed mining
075 IUCN Principles on Synthetic Biology and Biodiversity Conservation
125 Strengthening the protection of old-growth forests in Europe and facilitating their restoration where possible
126 Advancing conservation and sustainable use of marine biological diversity in the ocean beyond national jurisdiction

## MEETINGS 2021-2022

This is not a comprehensive list of mollusc and conservation related meetings but includes those for which people have sent me details and the major ones that I am generally aware of without doing a thorough search. Robert Cowie, *Tentacle* editor.

### Euromal 2020, now 2021, convention

The 9th European Congress of Malacological Societies (EUROMAL 2@2@) will now take place during 5-9 September 2021 in Prague, Czech Republic, hosted by the Czech University of Life Sciences. Details on thematic sessions, symposia and registration are available on the conference website or via e-mail: info@euromal.cz.

### Annual meeting of the American Malacological Society

Originally planned for Cape Breton, Nova Scotia, our annual meeting will be going virtual this year. Nevertheless, we look forward to presenting a stimulating meeting filled with interesting talks and posters and to providing you with a framework for sharing information and ideas, strengthening ongoing collaborations, and making new connections. Please see the conference website for additional information.


### XXVII Brasilian Malacological Meeting (XXVII EBRAM)

The Brasilian Society of Malacology (SBMa – Sociedade Brasileira de Malacologia) will hold its XXVII Brasilian Malacological Meeting (XXVII EBRAM), in the city of Porto Alegre, state of Rio Grande do Sul, southern Brasil, during 6-8 October 2021. The congress will be hosted by the Federal University of Health Sciences of Porto Alegre (UFCSPA). Unfortunately, due to the current health situation and the

uncertainty generated by COVID-19, the organizing committee decided to make this meeting an online meeting.

The theme of the event is inspired by the huge, challenging and urgent United Nations initiative entitled "Decade of Ocean Science for Sustainable Development". The meeting will encourage presentations that are concerned with: (i) One Planet, One Ocean and (ii) our conduct as citizens, considering the impacts of civic engagement on societies. The Fifth Symposium of Young Latin-American Taxonomists is being planned. It will be a great opportunity for all young researchers to discuss and exchange their results. In addition, special sessions of contributed papers, oral presentations and posters sessions will be open to all aspects of malacology, including taxonomy, ecology, biology, evolution, distribution and conservation of terrestrial, marine and freshwater molluscs, fisheries and other topics. There will also be roundtable discussions on gender, racial and ethnic equality in science (especially in malacology).

Furthermore, there will be a STEAM (Science, Technology, Engineering, Arts and Mathematics) festival with an emphasis on Manufacturing 4.0.

Students can apply for the "Prof. Maury Pinto de Oliveira Award to Incentivise Malacological Studies" (for work in general malacology) and the "Dr. Wladimir Lobato Paraense Award" (for work in medical malacology). More information will be available as soon as possible at www.sbmalacologia.com.br.

### Conchologists of America 2021 convention

The 2021 CoA Convention is planned to take place in Melbourne, Florida, 14-20 June 2021. Additional information is available at the Convention website.

### International Congress for Conservation Biology 2021

The Society for Conservation Biology (SCB) 30th International Congress for Conservation Biology (ICBB 2021) will take place during 12-16 December 2021 in Kigali Rwanda. For additional information visit the congress website.

### World Congress of Malacology 2022

The next Unitas Malacologica World Congress of Malacology will be hosted in Munich, Germany, during 1-5 August 2022. Additional information can be found at the congress website.

## INTERNET RESOURCES

These are just a few of the many websites dealing with mollusc conservation, and with molluscs and conservation in general. If you would like me to include any new ones or to update any of the current ones, please send details to me, Robert Cowie, editor of *Tentacle*.

### IUCN Red List

The entire *IUCN Red List of Threatened Animals* can be searched at the following address: www.iucnredlist.org

### IUCN Invasive Species Specialist Group

The ISSG website includes details of the Aliens-L listserver and the ISSG newsletter, *Aliens*.

### Unitas Malacologica

Unitas Malacologica (UM) is the worldwide society for malacologists and malacology. Its aim is to further the study of Mollusca by individuals, societies and institutions worldwide. UM has provided financial support for the production of *Tentacle* in the past and I urge all readers to become members. The UM website has links to many interesting and useful sources of malacological information, including all the UM newsletters, which have a lot of information complementing information in *Tentacle*. UM also makes small grants available to students for both research and travel to the triennial UM World Congress of Malacology. To become a member of UNITAS, go to its website and follow the links to the application.

### Mollusca list

The MOLLUSCA listserver is an informal forum for discussions of molluscan biology. There are over 700 subscribers. You can subscribe to the list here. Once your subscription is approved, you will receive anything that is posted to the list, and be able to post to the list. To post to the list, send email to molluscalist@listserv.dfn.de. The list is now managed by Julia Sigwart of the Senckenberg Museum, Frankfurt, with David Lindberg and Gerhard Haszprunar.

### MolluscaBase

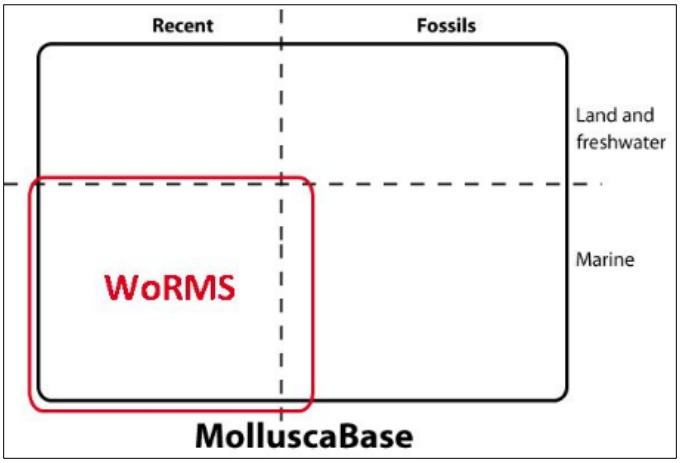
MolluscaBase is a taxonomically oriented database that aims to provide an authoritative, permanently updated account of all molluscan species.

Subject to availability, the following information is provided for taxa included in MolluscaBase:

- Accepted (valid) name
- Classification (presented with a parent/child hierarchy)
- Synonyms
- Reference of original description and other relevant literature sources
- Type locality and distribution
- Stratigraphic range
- Traits (environment, feeding type, host/parasite relationship) and notes

- Images

The recent, marine component coincides with the Mollusca entries in the World Register of Marine Species (WoRMS), whereas the non-marine and fossil components are not displayed in the WoRMS interface, although the former are increasingly being added.




## American Malacological Society

The homepage of the American Malacological Society carries a link to its conservation policy. Student research grants are available.

## MUSSEL database project

The MUSSEL Project is an on-going study aimed at the global revision of the classification of the Unionoida, otherwise known as freshwater mussels. The two principle investigators, Daniel L. Graf and Kevin S. Cummings, combine their efforts to maintain an efficient malacological strike force equally capable of working in remote collection localities or urban mollusc collections. Toward this end, they are compiling an exhaustive database of all Recent described unionoid species and genera. This database will eventually serve as the basis for a universal synthesis and revision of freshwater mussel taxonomy.

## Freshwater Mollusk Conservation Society


The Freshwater Mollusk Conservation Society (FMCS) is devoted to the advocacy for, public education about and conservation science of freshwater molluscs, North America's most imperiled fauna. Its website has an excellent page of links. The FMCS now publishes the journal *Freshwater Mollusk Biology and Conservation* (formerly *Walkerana*) and has all issues on-line and available, including volume 1, which includes Jack Burch's *Identification of Eastern North American Land Snails* and two-part *North American Freshwater Snails*.

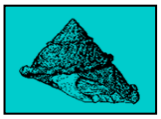
## Malacological Society of Australasia

The Malacological Society of Australasia is networked with the leading conservation organisations and is working with the IUCN Mollusc Specialist Group to list Australia's threatened and endangered species of molluscs. The society publishes the journal *Molluscan Research*.

## Brasilian Society of Malacology


The Sociedade Brasileira de Malacologia (SBMa) welcomes malacological researchers, professionals and students, Brasilian and foreign, as well as aficionados of molluscs, having as its main objective to encourage the study of malacology, promoting knowledge of molluscs and its dissemination at all cultural levels, and taking reasonable measures to preserve the Brasilian mollusc fauna.

## Western Society of Malacologists



The WSM home page carries links to membership, conferences, grants, and other news.

## Conchologists of America

The homepage of the COA carries a link to a number of pages dealing with its conservation policy and conservation issues. Research grants are available.

## Haus der Natur – Cismar

The Haus der Natur homepage carries a link to a page on mollusc conservation and responsible collecting, as well as other links.

## The National Museum of Wales – Mollusca

The Mollusca page of the National Museum of Wales provides information on the global projects on molluscs underway based in Cardiff. The museum's Mollusca collection database is searchable.

## Illinois Natural History Survey

The Illinois Natural History Survey's mollusc page has much information on the mussels of North America, with links to other mussel sites.

## Unio listserver

Unio is an unmoderated internet listserver focusing on the biology, ecology and evolution of freshwater unionid mussels.

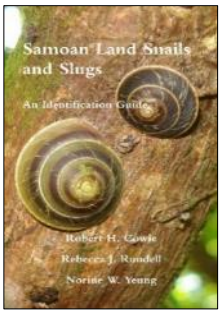
The list is sponsored by the Florida Institute of Technology and administered and managed by Rick Tankersley (rtank@fit.edu).

## Caucasian Snail Project

The Caucasian Land Snails Project is a major collaborative effort. The website is maintained by Bernhard Hausdorf, mollusc curator at the Zoological Museum, Hamburg University.

## Samoan Snail Project

The Samoan Snail Project had as its goals assessing the diversity and historical decline of the native Samoan non-marine snail fauna, as a first step in its conservation. It is part of the Bishop Museum's Pacific Biological Survey. In 2017 an inexpensive illustrated paperback guide to the Samoan Islands land snail fauna was published (see *Tentacle* 26).




## Tropical land snail project at the Natural History Museum, London

The Tropical Land Snail Diversity site provides access to the Sri Lankan and South and South-east Asian snail projects of Fred Naggs, Dinarzarde Raheem and colleagues. There are some marvellous photos of brightly coloured snails.

## CLEMAM: Check List of European Marine Mollusca

The Check List of European Marine Mollusca database provides a list of taxonomic references concerning all molluscan taxa living in marine waters of Europe.

## Hawaii Biological Survey

The Hawaii Biological Survey (based at the Bishop Museum, Honolulu) web site has searchable databases and much additional information on most Hawaiian organisms, including both indigenous (99 % endemic) and non-indigenous land and freshwater snails, endangered species, and so on.

## Field Museum land snails

The on-line database of Chicago's Field Museum mollusc collections contains information for over 158,000 lots (a lot is a collection of a single species taken from a single locality on a single occasion), including over 2,500 type lots, of land snails.

## Australian marine invertebrates

*Overview of the Conservation of Australian Marine Invertebrates* by W. F. Ponder, P. Hutchings & R. Chapman (588 p.), published in July 2002.

## CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The majority of information relates to mammal and bird trade, but a number of molluscs are listed in the Appendices.

## Other useful links

www.manandmollusc.net/
www.staff.uni-mainz.de/lieb/Moll.html

# *TENTACLE* – PUBLICATION GUIDELINES AND INFORMATION

**Disclaimer 1: *Tentacle* is not issued for purposes of zoological nomenclature. All or any names or nomenclatural acts in it are disclaimed for nomenclatural purposes. See the *International Code of Zoological Nomenclature*, Fourth Edition, Article 8.**

**Disclaimer 2: Views expressed in *Tentacle* are those of the authors of individual articles. They do not necessarily reflect the views of the Editor, nor of the Mollusc Specialist Group, the Species Survival Commission or of IUCN.**

*Tentacle* is a web-based newsletter, accessed at www.hawaii.edu/cowielab/Tentacle.htm, where all issues are available. Guidelines for submission of articles to *Tentacle*, and other related IUCN links are also on this website.

If you plan to submit something to *Tentacle*, please read the following guidelines. Carefully following the guidelines will make the life of the editor a lot easier!

Your submission **must** be **explicitly** relevant to **mollusc conservation**.

I usually make only editorial changes to submitted articles and in the past have accepted almost everything sent to me. However, before I accept an article I will assess whether it really includes anything **explicitly relevant to mollusc conservation** and whether any conclusions drawn are supported by the information presented. For example, **new records of non-native species and lists of non-native species will not be accepted unless there is a clear and significant relevance to mollusc conservation**. So, fully explain the conservation relevance in your article and be sure not to speculate too wildly. Unjustified statements (even if probably true) do a disservice to conservation as they permit our critics to undermine our overall arguments. *Tentacle*, however, is not a peer-reviewed publication and statements made in *Tentacle* remain the authors' responsibilities.

I stress that *Tentacle* is not a peer-reviewed publication. Please do not see *Tentacle* as an easy way to get your original data published without going through the rigours of peer review. ***Tentacle* is a newsletter** and so it is primarily **news items** that I want, including summaries of your ongoing studies, rather than full, data-rich reports of your research. Those reports should be submitted to peer reviewed journals. I will increasingly decline to publish articles that I feel should be in the peer-reviewed literature, especially if they are long.

There is, therefore, a **limit of three published pages**, including all text, illustrations, references, etc., for all articles that I accept for publication in *Tentacle* (though I reserve the right to make rare exceptions if I consider it appropriate).

**Please make every effort to format your article, including fonts (Times New Roman), paragraphing styles, heading styles, and especially citations, in a way that makes it easy for me simply to paste your article into *Tentacle*, which is created in Microsoft Word. Please pay special attention to the format (paragraphing, fonts, font sizes, etc.) in past issues. TEMPLATES FOR ARTICLES ARE AVAILABLE. Conformance to the guidelines has improved – perhaps because of my many many reminders! But it still takes many many hours to format your submissions – please do it for me! Especially, please pay very careful attention to the format of references in the reference lists, especially punctuation – it still takes inordinate amounts of time deleting commas, inserting colons, changing journal titles to italics, putting initials after not before names, deleting parentheses around dates and so on. Here are examples of how it should be done – please follow them very carefully:**

Cowie, R.H., Régnier, C., Fontaine, B. & Bouchet, P. 2017. Measuring the sixth extinction: what do mollusks tell us? *The Nautilus* 131(1): 3-41.

Cowie, R.H., Evenhuis, N.L. & Christensen, C.C. 1995. *Catalog of the Native Land and Freshwater Molluscs of the Hawaiian Islands*. Backhuys Publishers, Leiden. vi + 248 pp.

Cowie, R.H. 2011. Snails and slugs. In: *Encyclopedia of Invasive Introduced Species* (ed. Simberloff, D. & Rejmánek, M.), p. 634-643. University of California Press, Berkeley.

Also note that **illustrations and tables must fit in a single column**, so make sure your maps, diagrams and tables are readable and show what you intend when they are reduced to this size. **Any text on a figure must be large enough to read**.

**Metric Système International** units are used throughout *Tentacle*. Please do not use miles, inches, gallons, etc.

*Tentacle* is published using **British English** not American English, e.g. "mollusc" not "mollusk"!

Membership of the Mollusc Specialist Group is by invitation. However, everyone is welcome to submit articles to *Tentacle* and to promote its distribution as widely as possible. Since I announce the publication of each new issue to all who are on my *Tentacle* e-mail distribution list, please keep me updated with your current e-mail address so that you do not drop off the list. I also announce the availability of each issue on the MOLLUSCA listserver (for details, see p. 50 of this issue of *Tentacle*) and the Unitas Malacologica members e-mail list.

As always, I reiterate that the content of *Tentacle* depends on what you send me. So I encourage anyone with anything relevant to mollusc conservation to send me something now, and it will be included in the next issue (published once a year, usually in January-March).

# SSC MOLLUSC SPECIALIST GROUP

This is a new look membership list that aims to comply with legal issues regarding privacy in certain jurisdictions. It now lists taxonomic and conservation expertises, to the extent they are known. In order to keep your details up to date, please inform the chair of the Mollusc Specialist Group, Mary Seddon, and the editor of *Tentacle*, Robert Cowie, of any changes or corrections, especially regarding expertises. If there is any information you do not want to be public, please also inform us.

The list is in two parts: Official Members and Honorary Members. The former are currently listed on the IUCN official register of members of the IUCN SSC Mollusc Specialist Group. The latter are people who may have served on the Mollusc Specialist Group in the past and whom we acknowledge for their continued support of the work of the Group, although they are not currently listed on the IUCN official register of members.

**Chair**
*Mary B. Seddon*, Okehampton, UK. mary.molluscsg@gmail.com

**Editor (*Tentacle*)**
*Robert H. Cowie*, University of Hawaii, Honolulu, USA. cowie@hawaii.edu www.hawaii.edu/cowielab/

| Name | Country | Taxonomic Expertise | | | Conservation Expertise | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Official Members** | | | | | | | | | | | | | |
| Christian Albrecht<br>Justus Liebig University, Giessen | Germany | | X | | X | X | | | | X | | | |
| David Aldridge<br>University of Cambridge, Cambridge | UK | | X | | | X | | | | X | | X | |
| Louise Allcock<br>National University of Ireland, Galway | Ireland | X | | | X | | | | | | | | |
| Maria Rosario Alonso<br>Universidad de la Laguna, Tenerife | Spain | | | X | X | | | | | | | | |
| Rafael Araujo<br>Museo Nacional de Ciencias Naturales, Madrid | Spain | | X | | X | X | | | X | | | | |
| Jose Arrebola Burgos<br>Universidad de Sevilla, Sevilla | Spain | | | X | X | | | | X | | | | X |
| Thierry Backeljau<br>Royal Belgian Institute of Natural Sciences, Brussels | Belgium | X | | X | X | | | | | X | | X | |
| Igor Balashov<br>Schmalhausen Institute of Zoology, Kiev | Ukraine | | | X | X | X | | | | | | | |
| Gary Barker<br>Landcare Research, Hamilton | Australia / New Zealand | | | X | X | | | | | | | | |
| Gregory Barord<br>Des Moines, Iowa | USA | X | | | X | | | | | | | | |
| Arthur Bogan<br>North Carolina State Museum of Natural History, Raleigh | USA | | X | | X | X | | | X | | | | |
| Monika Böhm<br>Institute of Zoology, London | UK/USA | X | X | | X | | X | | | | | | |
| Ivan Bolotov<br>Northern Arctic Federal University, Arkhangelsk | Russian Federation | | X | | X | | | | | | | | |

| Name | Country | Taxonomic Expertise | | | Conservation Expertise | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Official Members (continued)** | | | | | | | | | | | | | |
| Prem Budha<br>Tribhuvan University, Kathmandu | Nepal | | X | X | X | X | | | | | | | |
| Viviana Castillo<br>Servicio Agrícola y Ganadero, Santiago | Chile | | | X | | X | | | | | | X | |
| Chong Chen<br>Japan Agency for Marine-Earth Science and Technology, Yokosuka | Japan | X | | | X | X | | | | | | | |
| Satoshi Chiba<br>Tohoku University, Sendai | Japan | | | X | | X | | | X | | | | |
| Simone Cianfanelli<br>Museo di Storia Naturale dell'Università degli Studi di Firenze | Italy | | X | X | X | X | | | X | | | X | |
| Stephanie Clark<br>Invertebrate Identification Australasia, Chicago, Illinois | USA | | X | | X | X | | | | | | | |
| Cristhian Clavijo<br>Museo Nacional de Historia Natural, Montevideo | Uruguay | | X | | X | X | | | | | | | |
| Mary Cole<br>East London Museum | South Africa | | | X | X | X | | | | | | | |
| Robert H. Cowie<br>University of Hawaii, Honolulu, Hawaii | USA | | X | X | X | X | | | | | | X | |
| Kevin Cummings<br>Illinois Natural History Survey, Champaign, Illinois | USA | | X | | X | X | | | | | | | |
| Gustavo Darrigran<br>Museo de La Plata | Argentina | X | X | | X | | | | | | | X | |
| Ivaylo Dedov<br>Institute of Biodiversity and Ecosystem Research, Sofia | Bulgaria | | X | X | X | X | | | | | | | |
| Zoltán Fehér<br>Hungarian Natural History Museum, Budapest | Hungary | | X | X | X | X | | X | | | | | |
| Junn Kitt Foon<br>Australian Museum, Sydney | Australia / Malaysia | | | X | X | X | | | | | | | |
| António Frias Martins<br>Universidade dos Açores, Ponta Delgada | Portugal (Azores) | X | | X | X | X | | | | | | | |
| Gerardo Garcia<br>Chester Zoo | UK | | | X | | | | | X | | | | |
| Olivier Gargimony<br>Muséum national d'Histoire naturelle, Paris | France | | | X | X | X | | | | | | | |
| Daniel Geiger<br>Santa Barbara Museum of Natural History, California | USA | X | | | X | X | | | | | | | |
| Jürgen Geist<br>Technische Universität München, Freising | Germany | | X | | X | X | | | X | | | | |
| Dilian Georgiev<br>University of Plovdiv | Bulgaria | | X | X | X | X | | | | | | | |
| Justin Gerlach<br>University of Cambridge | UK/Seychelles | | | X | X | X | | | | | | | |

| Name | Country | Taxonomic Expertise | | | Conservation Expertise | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Official Members (continued)** | | | | | | | | | | | | | |
| Mohammed Ghamizi<br>Muséum d'Histoire Naturelle de Marrakech, Marrakech | Morocco | | X | X | X | X | | X | X | | | | |
| Ronaldo Gomes de Sousa<br>University of Minho, Braga | Portugal | | X | | X | X | | X | X | X | | X | |
| Benjamin Gomez-Moliner<br>Universidad de Pais Vasco, Vitoria | Spain | | | X | X | X | | | | | | | |
| Daniel Graf<br>University of Wisconsin, Stevens Point, Wisconsin | USA | | X | | X | X | | | X | | | | |
| Klaus Groh<br>Büro Groh, Bad Dürkheim | Germany | X | X | X | X | X | | | | | | | |
| Diego Gutierrez Gregoric<br>Museo de La Plata | Argentina | | X | | X | X | | | X | | | | |
| Michael G. Hadfield<br>University of Hawaii, Honolulu, Hawaii | USA | | | X | | | | | | | | | |
| Kenneth A. Hayes<br>Bishop Museum, Honolulu, Hawaii | USA | | X | X | X | X | | | | | | | |
| Dai Herbert<br>National Museum of Wales, Cardiff | UK / South Africa | X | | X | X | X | | | | | | | |
| Auke-Florian Hiemstra<br>Naturalis Biodiversity Center, Leiden | Netherlands | X | | | | X | | | | | | | X |
| Isabel Hyman<br>Australian Museum, Sydney | Australia | | | X | X | X | | | X | | | | |
| Mayu Inada<br>Ministry of the Environment, Chichijima | Japan | | | X | | X | | | X | | | | |
| Paul Johnson<br>Alabama Aquatic Biodiversity Center, Marion, Alabama | USA | | X | | X | | | | X | | | | |
| Michael Klutzinger<br>North Lakes, Queensland | Australia | | X | | X | | | | | | | | |
| Frank Köhler<br>Australian Museum, Sydney | Australia | | X | X | X | X | | | | | | | |
| Andrew Kough<br>John G. Shedd Aquarium, Chicago | USA | X | | | | X | | | X | | | | X |
| Charles Lange<br>National Museums of Kenya, Nairobi | Kenya | | X | X | X | | | | | | | | |
| Dwayne Lepitzki<br>Wildlife Systems Research, Banff | Canada | | X | | X | X | | X | | | | | |
| Manuel Lopes-Lima<br>University of Porto | Portugal (Azores) | | X | | X | X | | X | X | X | | | |
| Aravind Madhyastha<br>Ashoka Trust for Research in Ecology and the Environment, Bangalore | India | | | X | X | X | | | | | | | |
| Alberto Martinez-Orti<br>Museu Valencià d'Història Natural, Valencia | Spain | | X | X | X | X | | | | | | X | |
| Iris Meza-Sanchez<br>Universidad Ciudadana, Monterrey | Mexico | | X | | X | X | | | | | | | |
| Igor Miyahira<br>Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro | Brasil | | | | | | | | | | | | |

| Name | Country | Taxonomic Expertise | | | Conservation Expertise | | | | | | | | |
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| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Official members (continued)** | | | | | | | | | | | | | |
| Evelyn Moorkens<br>County Wicklow | Ireland | | X | X | X | X | | X | X | | X | | |
| Hideaki Mori<br>Japan Wildlife Research Center, Tokyo | Japan | | | X | | X | | | X | | | X | |
| Marco Neiber<br>Universität Hamburg | Germany | | X | X | X | X | | | | | | | |
| Jeff Nekola<br>Masaryk University, Brno | Czech Republic / USA | | | X | | X | | | | | | | |
| Eike Neubert<br>Naturhistorisches Museum, Bern | Switzerland | | | X | X | X | | | | | | | |
| Christine Ngereza<br>National Museums of Tanzania, Dar es Salaam | Tanzania | | | X | X | X | | | | | | | |
| Vincent Nijman<br>Oxford Brookes University, Oxford | UK | X | | | | | | | | | | | X |
| Ayu Nurinsiyah<br>Museum Zoologicum Bogoriense, Bogor | Indonesia | | | X | X | X | | | | | | | |
| Mac Elikem Nutsaokor<br>Kwame Nkrumah University of Science and Technology, Kumasi | Ghana | | | X | X | X | | | | | | | |
| Kristiina Ovaska<br>Royal British Columbia Museum and Biolinx Environmental Research Ltd., Victoria | Canada | | | X | X | X | | X | X | | | | |
| Barna Páll-Gergely<br>Centre for Agricultural Research, Budapest | Hungary | | | X | X | X | | | | | | | |
| Somsak Panha<br>Chulalongkorn University, Bangkok | Thailand | | | X | X | X | | | | | | | |
| Christine Parent<br>University of Idaho, Moscow, Idaho | USA/Galapagos | | | X | X | X | | | | | | | |
| Paul Pearce-Kelly<br>Zoological Society of London | UK | | | X | | X | | | X | | | | X |
| Kathryn Perez<br>University of Texas Rio Grande Valley, Edinburgh, Texas | USA | | X | X | X | X | | X | | | | | |
| Howard Peters<br>University of York | UK | X | | | X | | | | | | | | X |
| John Pfeiffer<br>Smithsonian National Museum of Natural History, Washington, DC | USA | | X | | X | X | | | | X | | | |
| Winston F. Ponder<br>Australian Museum, Sydney | Australia | | | | | | | | | | | | |
| Vincent Prié<br>Muséum national d'Histoire naturelle, Paris | France | | X | | X | X | | X | | X | X | | |
| Canella Radea<br>National and Kapodistrian University of Athens | Greece | | X | | X | X | | | | | | | |
| Nicoletta Riccardi<br>Institute of Ecosystem Study, Verbania Pallanza | Italy | | X | | X | X | | X | X | | X | | |
| Ira Richling<br>Staatliches Museum für Naturkunde Stuttgart | Germany | | X | X | X | X | | | | X | | | |

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| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Official members (continued)** | | | | | | | | | | | | | |
| Rodrigo Salvador<br>Museum of New Zealand Te Papa Tongarewa, Wellington | New Zealand / Brasil | | X | X | X | X | | | X | | | | |
| Sonia B. dos Santos<br>Universidade do Estado do Rio de Janeiro, Rio de Janeiro | Brasil | | X | | | X | | | | | | | |
| Menno Schuilthuizen<br>Naturalis Biodiversity Center, Leiden | Netherlands | | | X | | X | | | | X | | | |
| Mary B. Seddon<br>Oakhampton | UK | X | X | X | X | X | X | | | | X | | |
| Julia Sigwart<br>Senckenberg Research Institute and Natural History Museum, Frankfurt am Main | Germany | X | | | X | X | | | | | X | | |
| Ioan Sîrbu<br>Lucian Blaga University of Sibiu | Romania | | | X | X | | | | | | | | |
| David Sischo<br>Department of Land and Natural Resources, State of Hawaii, Honolulu, Hawaii | USA | | | X | | | | X | X | | | | |
| Rajko Slapnik<br>Agencija Republike Slovenije Okolje, Ljubljana | Slovenia | | X | X | X | | | | | | | | |
| Peter Tattersfield<br>Bakewell | UK | | | X | X | X | | X | | | X | | |
| Dinarte Teixeria<br>Instituto das Florestas e Conservação da Natureza, Madeira | Portugal (Madeira) | | | X | X | X | X | | | | | | |
| Elin Thomas<br>Queen's University Belfast, Portaferry | UK | X | | | X | X | | | | | X | | |
| Kostas Triantis<br>National and Kapodistrian University of Athens | Greece | | | X | X | X | | | | | | | |
| Do Van Tu<br>Institute of Ecology and Biological Resources, Hanoi | Viet Nam | | X | | X | X | | | | | | | |
| Dirk Van Damme<br>Destelbergen | Belgium | | X | | X | X | | | | | | | |
| Jackie Van Goethem<br>Royal Belgian Institute of Natural Sciences, Brussels | Belgium | X | | X | | X | | | | | | | |
| Ilya Vikhrev<br>N. Laverov Federal Center for Integrated Arctic Research, Arkhangelsk | Russian Federation | | X | | X | X | | | | X | | | |
| Maxim Vinarksi<br>Saint Petersburg State University | Russian Federation | | X | | X | X | | | | X | | | |
| Ted von Proschwitz<br>Göteborg Natural History Museum | Sweden | | X | X | X | X | | | | | | | |
| Thomas von Rintelen<br>Museum für Naturkunde, Berlin | Germany | | X | | X | X | | | | | | | |
| Norine Yeung<br>Bishop Museum, Honolulu, Hawaii | USA | | | X | X | X | | X | X | | | | |
| Tadeusz Zajac<br>Institute of Nature Conservation, Krakow | Poland | | X | | X | X | | | X | | | | |
| Alexandra Zieritz<br>University of Nottingham | UK/Malaysia | | X | | X | X | | | X | | | | |

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| **Honorary Members** | | | | | | | | | | | | | |
| Takahiro Asami<br>Shinshu University, Matsumoto | Japan | | | | | | | | | | | | |
| Philippe Bouchet<br>Muséum national d'Histoire naturelle | France | | | | | | | | | | | | |
| John B. Burch<br>University of Michigan, Ann Arbor, Michigan | USA | | | | | | | | | | | | |
| David Clarke<br>Zoological Society of London | UK | | | | | | | | | | | | |
| Jay Cordeiro<br>Boston | USA | | | | | | | | | | | | |
| Gerhard Falkner<br>Bayerische Staatssammlung für Paläontologie und historische Geologie, München | Germany | | | | | | | | | | | | |
| Hiroshi Fukuda<br>Okayama University | Japan | | | | | | | | | | | | |
| Terrence Gosliner<br>California Academy of Sciences, San Francisco, California | USA | | | | | | | | | | | | |
| Owen Griffiths<br>Mauritius | Mauritus | | | | | | | | | | | | |
| Jason Hall-Spencer<br>University of Plymouth | UK | | | | | | | | | | | | |
| Joseph Heller<br>Hebrew University, Jerusalem | Israel | | | | | | | | | | | | |
| Neo Mei Lin<br>National University of Singapore | Singapore | | | | | | | | | | | | |
| Charles (Chuck) Lydeard<br>Morehead State University, Morehead | USA | | | | | | | | | | | | |
| Maria Cristina Dreher Mansur<br>Museu de Ciências e Tecnolo, Porto Alegre | Brasil | | | | | | | | | | | | |
| Ristiyanti M. Marwoto<br>Research and Development Centre for Biology, Bogor | Indonesia | | | | | | | | | | | | |
| Paula M. Mikkelsen<br>Paleontological Research Institution, Ithaca | USA | | | | | | | | | | | | |
| Richard Neves<br>Virginia Tech, Blacksburg, Virginia | USA | | | | | | | | | | | | |
| Timothy A. Pearce<br>Carnegie Museum, Pittsburg | USA | | | | | | | | | | | | |
| Beata M. Pokryszko<br>Wroclaw University | Poland | | | | | | | | | | | | |
| Barry Roth<br>San Francisco, California | USA | | | | | | | | | | | | |
| David Robinson<br>USDA/APHIS/PPQ, Academy of Natural Sciences, Philadelphia | USA | | | | | | | | | | | | |
| Rebecca J. Rundell<br>State University of New York, Syracuse | USA | | | | | | | | | | | | |
| John Stanisic<br>Queensland Museum, South Brisbane | Australia | | | | | | | | | | | | |

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| | | Marine molluscs | Freshwater molluscs | Land snails | Assessment | Survey & monitoring | Red List trainer | Habitat status & restoration | Conservation breeding | Conservation genetics | Environmental legislation | Invasive species | Wildlife trade |
| **Honorary members (continued)** | | | | | | | | | | | | | |
| Jaap J. Vermeulen<br>National Botanic Garden, Singapore | Singapore | | | | | | | | | | | | |
| Peter Ward<br>University of Washington, Seattle | USA | | | | | | | | | | | | |
| Anton (Ton) J. de Winter<br>Nationaal Natuurhistorisch Museum, Leiden | Netherlands | | | | | | | | | | | | |
| Min Wu<br>Nanjing University | China | | | | | | | | | | | | |
| Xiaoping Wu<br>Nanchang University | China | | | | | | | | | | | | |