

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

After a rather small issue of *Tentacle* in 2018, this issue is back to its usual length of 50-60 pages, and there is a lot to read about from all over the world. Thank you to everyone for your submissions.

Most of you will have heard about the devastating impacts the predatory snail *Euglandina rosea* has had on endemic island land snail faunas, especially in the Pacific, following its introduction as a putative biological control agent. As it turns out, “*E. rosea*”, at least in Hawaii, is in fact two distinct species, as shown in 2017 by Meyer *et al.* (*Biological Invasions* 19: 1399-1405). Perhaps less well known is the predatory flatworm *Platydemus manokwari*, the New Guinea flatworm, which has also been widely introduced, generally illegally, as a biocontrol agent, again notably in islands of the Indian and Pacific Oceans. Of particular note has been its impacts on the endemic land snails of the Ogasawara Islands of Japan, as reviewed by Satoshi Chiba & myself in 2016 (*Annual Review of Ecology, Evolution, and Systematics* 47: 123-141).

But it is not these well known predators that I want to highlight here, but another potential biocontrol agent that we as mollusc conservationists should be aware of – the nematode *Phasmarhabditis hermaphrodita*. This species is being promoted for control of pest snails and slugs – it is already available commercially in Europe, its native range. The first main article in this issue of *Tentacle*, by Carl Christensen, points out that although this pathogenic worm is seen by some as having wide application with minimal impact on human health, the environment and non-target organisms, we know very little about its host range, and what we do know suggests it is probably broad. More research is needed before this potentially harmful species is released in other parts of the world, especially in areas where there are vulnerable native land snail faunas.

Robert H. Cowie

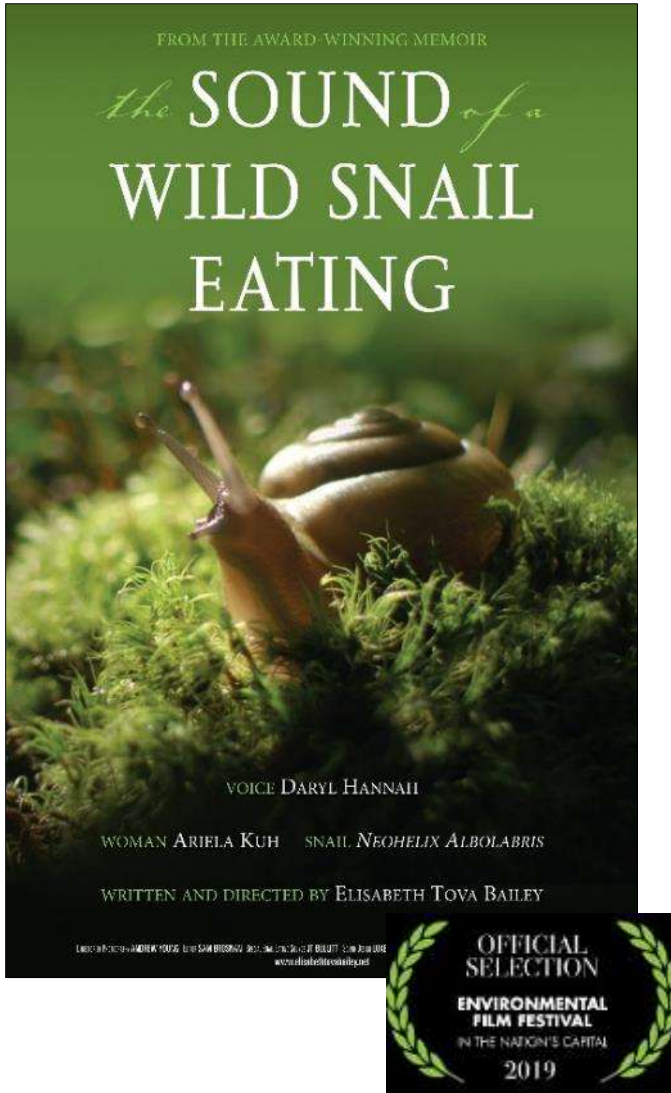
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NEWS

Sound of a Wild Snail Eating – The Movie!



From Elisabeth Tova Bailey

The short film of *The Sound of a Wild Snail Eating* will launch on 16 March 2019 at 2 pm (14.00 h) at the Carnegie Institution of Science as part of the [Environmental Film Festival in the Nation's Capital](#). This is the biggest environmental film festival in the world with attendance of about 20,000 and venues throughout Washington DC.

I am hoping to make the film available to some of the annual malacology conferences as well and will soon figure out if I can do that during the festival year or if I have to wait until after the festival year. But at the moment the film is submitted to film festivals around the world; Washington is hopefully just the start of its long glide.

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SHOULD WE OPEN THIS CAN OF WORMS? A CALL FOR CAUTION REGARDING USE OF THE NEMATODE *PHASMARHABDITIS HERMAPHRODITA* FOR CONTROL OF PEST SLUGS AND SNAILS IN THE UNITED STATES

By Carl C. Christensen

Malacologists have reason to be concerned about the safety of biological control measures targeting pest species of non-marine molluscs because of the impacts past such efforts have had on non-target land snails. Not all biocontrol agents are environmentally benign (Simberloff & Stiling 1996). Predatory snails of the genus *Euglandina* have been introduced to numerous islands in the Pacific in an effort to control the giant African snail, *Lissachatina fulica* (Bowdich, 1822). The environmental cost of this programme has been the extinction of numerous partulids and other native land snails (Clarke *et al.*, 1984; Civeyrel & Simberloff, 1996; Coote & Loève, 2003; USFWS, 2016). Similarly, the predatory flatworm *Platydemus manokwari* de Beauchamp, 1963 has been used in the control of *L. fulica* (Winsor *et al.*, 2004) even though it poses a similar threat to native land snails (Ohbayashi *et al.*, 2007; Sugiura & Yamaura, 2009; USFWS, 2016). Accordingly, malacologists may rightly question new biocontrol proposals targeting non-marine molluscan pests unless the proposed agent has been thoroughly tested and proven safe for non-target organisms, especially if that agent is not narrowly host-specific. One such proposal is the use of the nematode *Phasmarhabditis hermaphrodita* (Schneider, 1859) (Fig. 1).

Phasmarhabditis hermaphrodita (Nematoda: Rhabditidae), a parasitic nematode lethal to many slugs and snails, is widely distributed in Europe and elsewhere but has only recently been found in the United States (Tandingan De Lay *et al.*, 2017). It is available for sale as a biocontrol agent in Europe under the trade name Nemaslug® (Wilson & Grewal, 2005; Rae *et al.*, 2007). It is not yet available in the United States, though proposals for its use here are likely (Stevens & Lewis, 2017). Its life history is complex, as is the manner in which it and its associated bacterium *Moraxella osloensis* Bøvre & Henrikson, 1967 infect and kill host molluscs (Morand *et al.*, 2004; Rae *et al.*, 2007).

It is claimed that the use of *Phasmarhabditis hermaphrodita* as a biocontrol agent poses risks to non-target molluscs that are at most minimal (e.g. Bathon, 1996; Wilson *et al.*, 2000; Morand *et al.*, 2004). Although it is said that *P. hermaphrodita* and entomopathogenic nematodes [EPNs] have a “wide host range” (Askary, 2010: 347), they are nevertheless claimed to be “safe for humans, other non-target organisms and virtually posing no hazardous effect on the environment” (Askary, 2010: 348). Although “its effect on non-target organisms has not been extensively studied” we are assured that “the information available makes the evidence clear that [*P. hermaphrodita*] is safe for non-target snails” (Askary,



Fig. 1. Third stage dauer parasitic rhabditic nematode *Phasmarhabditis hermaphrodita*. (Photo: Peter Andrus, Creative Commons Attribution-Share Alike 4.0 International license)

2010: 368). Given the limited information available on this topic, scepticism seems warranted. Notwithstanding the paucity of studies of its effects on non-target species, we do know that in addition to slugs of the families Limacidae, Arionidae, Milacidae and Veronicellidae several species of helicid snails are susceptible to *P. hermaphrodita* (Rae *et al.*, 2007; Tandingan De Ley *et al.*, 2017), as is the achatinid *Lissachatina fulica* (McDonnell *et al.*, 2018) and a freshwater snail, *Lymnaea stagnalis* (Linnaeus, 1758) (Tandingan De Ley *et al.*, 2017; but see Whitaker & Rae, 2015). The absence of information on other non-target taxa leaves open the likelihood that some could be adversely impacted if they should encounter *P. hermaphrodita*.

Not all land and freshwater snails are susceptible to *Phasmarhabditis*, but the broad taxonomic and ecological range of species known to be vulnerable to it shows that *P. hermaphrodita* is not narrowly host-specific, thus raising legitimate doubts as to its supposed benign nature. Furthermore, at least one of the arguments for its lack of impact on non-target snails is based on a faulty assumption: although Wilson & Grewal (2005: 427) admit that “[l]ittle work has been done on the effects of *P. hermaphrodita* on non-target organisms” they nevertheless conclude that “[i]t is unlikely that many snail species would come into contact with *P. hermaphrodita* as they tend to live in plants above the ground, unlike the shell-less slugs that live in the soil (Mengert, 1953). Thus the threat to non-target snails is unlikely to be high”. See also Wilson *et al.* (2000: 716), who assert that “non-target snails, unlike slugs, tend to live on sites above the soil eg [sic] on plant foliage, stems and stones, and thus out of contact with soil dwelling nematodes”. The erroneous assumption that ground-dwelling snails are few (which is clearly false: Pearce & Örstan, 2006; Durkan *et al.*, 2013) indicates a troubling lack of knowledge of land snail biology. Freshwater species may also be at risk. As “[t]he complete host range of *P. hermaphrodita* is poorly understood and many slug and snail species have never been tested for their susceptibility toward this nematode” (Whitaker & Rae,

2015: 679), it would be unreasonable to assume the absence of adverse impacts on non-target species. Furthermore, as *P. hermaphrodita* has only recently been reported from the United States (Tandingan De Ley *et al.*, 2017), it cannot be presumed to be indigenous here as in the U.K. (Wilson *et al.*, 2000) and thus its ecological impact may be greater here than in regions where it has long been established.

Formerly, legislation prohibited the sale of *P. hermaphrodita* in the United States as it was not known to occur here (Rae *et al.*, 2007). The recent discovery of this species in California (Tandingan De Ley *et al.*, 2017) changes the regulatory framework, but certain federal and state approvals would nevertheless be required. Certain EPNs pose little threat to non-target organisms or the environment and thus are not subject to federal pesticide registration requirements (Stevens & Lewis, 2017); and some EPNs and their associated bacteria have been exempted by the Environmental Protection Agency from regulation under the federal Insecticide, Fungicide, and Rodenticide Act (Nickle *et al.*, 1988). While this may be appropriate for EPNs targeting insects, the paucity of information on its effect on non-target molluscs should preclude such treatment for *P. hermaphrodita* at this time; the same condition should apply to other species of *Phasmarhabditis* if their similar use is proposed in the future. The decision whether to approve the use of *Phasmarhabditis* in the United States, or parts thereof, when and if made, should be based on a clear understanding of the threat its use may pose to the nation’s native non-marine molluscs. In the opinion of this writer, the information necessary to make such an informed decision is not yet available and any approval of its use should be deferred until that deficiency is remedied.

Contribution No. 2019-001 of the Hawaii Biological Survey.

- Askary, T.H. 2010. Nematodes as biocontrol agents. In: [Sociology, Organic Farming, Climate Change and Soil Science](#) (ed. Lichtfouse, E.), p. 347-378. Springer, Heidelberg.
- Bathon, H. 1996. Impact of entomopathogenic nematodes on non-target hosts. [Biocontrol Science and Technology](#) 6: 421-434.
- Civeyrel, L. & Simberloff, D. 1996. A tale of two snails: is the cure worse than the disease? [Biodiversity and Conservation](#) 5: 1231–1252.
- Clarke, B., Murray, J. & Johnson, M.S. 1984. The extinction of endemic species by a program of biological control. [Pacifica Science](#) 38: 97-104.
- Coote, T. & Loève, É. 2003. From 61 species to five: endemic tree snails of the Society Islands fall prey to an ill-judged biological control programme. [Oryx](#) 37(1): 91-96.
- Durkan, T.H., Yeung, N.W., Meyer, W.M., III, Hayes, K.A. & Cowie, R.H. 2013. Evaluating the efficacy of land snail survey techniques in Hawaii: implications for conservation throughout the Pacific. [Biodiversity and Conservation](#) 22: 3223-3232.
- McDonnell, R., Tandingan De Ley, I. & Paine, T.D. 2018. Susceptibility of neonate *Lissachatina fulica* (Achatinidae: Mollusca) to a US strain of the nematode *Phasmarhabditis hermaphrodita* (Rhabditidae: Nematoda). [Biocontrol Science and Technology](#) 28: 1091-1095.
- Mengert, H. 1953. Nematoden und Schnecken. [Zeitschrift für Morphologie und Ökologie der Tiere](#) 41(4): 311-349.
- Morand, S., Wilson, M.J. & Glen, D.M. 2004. Nematode parasites. In: [Natural Enemies of Terrestrial Molluscs](#) (ed. Barker, G.M.), p. 525-557. CAB International, Wallingford.

- Nickle, W.R., Drea, J.J. & Coulson, J.R. 1988. [Guidelines for introducing beneficial insect-parasitic nematodes into the United States](#). *Annals of Applied Nematology* 2: 50-56.
- Ohbayashi, T., Okochi, I., Sato, H., Ono, T. & Chiba, S. 2007. Rapid decline of endemic snails in the Ogasawara Islands, western Pacific. *Applied Entomology and Zoology* 42: 479-485.
- Pearce, T.A. & Örstan, A. 2006. Terrestrial Gastropoda. In: *The Mollusks. A Guide to their Study, Collection, and Preservation* (ed. Sturm, C.F., Pearce, T.A. & Valdés, A.), p. 261-285. Universal Publishers, Boca Raton.
- Rae, R., Verdun, C., Grewal, P.S., Robertson, J.F. & Wilson, M.J. 2007. Biological control of terrestrial molluscs using *Phasmarhabdits hermaphrodita* – progress and prospects. *Pest Management Science* 63: 1153-1164.
- Simberloff, D. & Stiling, P. 1996. Risks of species introduced for biological control. *Biological Conservation* 78: 185-192.
- Stevens, G. & Lewis, E. 2017. Status of entomopathogenic nematodes in integrated pest management strategies in the USA. In: *Biocontrol Agents. Entomopathogenic and Slug Parasitic Nematodes* (ed. Abd-Elgawan, M.M.M. & Coupland, J.), p. 289-311. CAB International, Wallingford.
- Sugiura, S. & Yamaura, Y. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions* 11: 737-742.
- Tandingan De Ley, I., McDonnell, R., Paine, T.D. & De Ley, P. 2017. *Phasmarhabdits*: the slug and snail parasitic nematodes in North America. In: *Biocontrol Agents. Entomopathogenic and Slug Parasitic Nematodes* (ed. Abd-Elgawad, M.M.M. & Coupland, J.), p. 560-578. CAB International, Wallingford.
- USFWS [United States Department of the Interior, Fish and Wildlife Service]. 2016. [Endangered and threatened wildlife and plants: endangered status for five species from American Samoa](#). *Federal Register* 81: 65466–65508.
- Whittaker, G. & Rae, R. 2015. The gastropod parasitic nematode *Phasmarhabdits hermaphrodita* does not affect non-target freshwater snails *Lymnaea stagnalis*, *Bithynia tentaculata* and *Planorbartus corneus*. *Nematology* 17: 679-683.
- Wilson, M.J. & Grewal, P.S. 2005. Biology, production and formulation of slug-parasitic nematodes. In: *Nematodes as Biocontrol Agents* (ed. Grewal, P.S., Ehlers, R.-U. & Shapiro-Ilan, D.I.), p. 421-429. CAB International, Wallingford.
- Wilson, M.J., Hughes, L.A., Hamacher, G.M. & Glen, D.M. 2000. Effects of *Phasmarhabdits hermaphrodita* on non-target molluscs. *Pest Management Science* 56: 711-716.
- Winsor, L., Johns, P.M. & Barker, G.M. 2004. Terrestrial planarians (Platyhelminthes: Tricladida: Terricola) predaceous on terrestrial gastropods. In: *Natural Enemies of Terrestrial Molluscs* (ed. Barker, G.M.), p. 227-279. CABI Publishing, Wallingford.
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Fig. 1. Two undescribed species of *Cremnoconchus* from the Western Ghats.

perennial rivers. Spread across 160,000 km², it is home to an amazing diversity of globally threatened flora and fauna. This region, regarded as a biodiversity hotspot, supports a unique assemblage of terrestrial biota (Myers *et al.*, 2000). It has also been recognised as a globally significant centre of diversity and endemism for freshwater species (Thomsen, 1999; Aravind *et al.*, 2011; Reid *et al.*, 2013).

The Ghats is home to a large number of endemic freshwater taxa. One such example is the genus *Cremnoconchus*. It is the lone freshwater representative of the largely marine family Littorinidae, belonging to the Caenogastropoda. It has been classified in this family since its first anatomical description by W.T. Blanford. The present report is part of a larger study on the systematics and ecology of freshwater molluscs of the Western Ghats funded by the Department of Science and Technology, Government of India, and the National Geographic Society. We have sampled over 150 waterfalls covering the entire range of the Western Ghats from south to north. During the course of the study we uncovered highly endemic radiations in the genus *Cremnoconchus*. The genus is found exclusively below 21° N as far as 13° N, south of which it is replaced by the genus *Neritina* (Neritidae). Restricted only to the spray zones of waterfalls and montane streams of the western escarpment of the Western Ghats, *Cremnoconchus* comprises nine described species (Reid *et al.*, 2013) and another 12 hitherto unknown species (N.A. Aravind *et al.*, in preparation) (e.g. Fig. 1). Its range is extremely narrow such that both the described and the undescribed species have been reported only from the central (CWG) and northern Western Ghats (NWG). Broadly, the NWG species are larger with shells more conspicuously ribbed than those from the CWG, though these cannot be used as diagnostic traits. Its distribution is restricted within an altitudinal range of 500-1,400 m above mean sea level. Phylogenetic analysis, using both mitochondrial and nuclear markers, strongly supports its monophyly within the family and distinct CWG and NWG clades. It appears to have separated from its marine counterparts about 120-110 mya (A. Saha *et al.*, in preparation).

Freshwater habitats, comprising lakes, rivers and swamps, cover only 0.01 % of the Earth's surface but harbour about 10 % of its biodiversity. In terms of human activities and dependence, freshwater ecosystems are some of the most affected and important. In addition, biodiversity decline is

CREMNOCONCHUS: AN ENDEMIC FRESHWATER RADIATION OF THE MARINE FAMILY LITTORINIDAE IN THE WESTERN GHATS

By Sudeshna Chakraborty & N.A. Aravind

The Western Ghats is a mountain range that runs parallel to the west coast of India. It stretches from the southern part of Gujarat to parts of Tamil Nadu and traverses the states of Maharashtra, Goa, Karnataka and Kerala. It forms one of the four important watersheds in the country that feed several



Fig. 2. Habitat and threats to *Cremanoconchus* spp.

higher in freshwater ecosystems than terrestrial ecosystems (Sala *et al.*, 2000; Dudgeon *et al.*, 2006). This might be attributable to the relatively small extent of freshwater systems compared to marine systems. Thus, although pollution affects all habitats adversely, the limited extent of freshwater systems makes them more vulnerable than marine systems and renders their capacities to efficaciously mitigate the effects of contaminants insufficient. While accounting for these losses and devising conservation plans, gastropods are, more often than not, overlooked since they are not among the “charismatic” taxa. This is very evident from the fact that freshwater gastropods comprise about 20 % of all recorded extinctions (Strong *et al.*, 2007).

The highly restricted ranges and local endemism of *Cremanoconchus* spp. make them extremely vulnerable to extinction as a result of anthropogenic activities (Fig. 2). Each of the threats, namely upstream pollution, habitat fragmentation, mining, construction of dams, etc., are detrimental to these taxa. But the biggest effect is due to extreme tourism-related activities and the unimaginable quantities of solid-waste that come with it. All newly described and undescribed species are from waterfalls that suffer from high tourist pressure. Some of these waterfalls see an influx of more than 100,000 people annually (e.g. Hanumangundi waterfalls in Karnataka, southern India, type

locality of *C. hanumani*), a number that significantly increases post-monsoon when the waterfalls are flowing strongly. Our study shows that the threats are greater in the NWG than in the CWG. Additionally, dumping of sewage also severely pollutes their habitat. An example of this scenario is the absence of *Cremanoconchus conicus* in a stream flowing through Mahabaleshwar in Maharashtra, which was its type locality (Aravind *et al.*, 2016). In view of the above, immediate steps should be taken towards conservation of these so-called “non-charismatic” but iconic species of freshwater habitats of the Western Ghats. Not only are they important sources of calcium for calcium-deficient habitats but they are critical indicators of the health of the environment. In summary, given their narrow range, niche specificity, threats due to anthropogenic activities especially tourism, and their unusual evolutionary history, prompt action is needed towards devising catchment-based conservation plans, stricter pollution laws, effluent treatment before release into water bodies to prevent downstream pollution, restoration of the unique habitats in which they occur and minimising human-related activities around them.

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- Aravind, N.A., Madhyastha, N.A., Rajendra, G.M. & Dey, A. 2011. The status and distribution of freshwater molluscs of the Western Ghats. In: *The status and distribution of freshwater biodiversity in the Western Ghats, India* (compilers Molur, S., Smith, K.G., Daniel, B.A. & Darwall, W.R.T.), p. 49-62. Cambridge, UK and Gland, Switzerland: IUCN, and Coimbatore, India: Zoo Outreach Organisation.
- Aravind, N.A., Sarma, R.R. & Madhyastha, N.A. 2016. Conservation of *Cremanoconchus* Blanford 1869, an iconic freshwater gastropod genus from the Western Ghats, India. *Current Science* 111(6): 1097-1103.
- Dudgeon, D., Arthington, A.H., Gessner, M.O., Kawabata, Z.-I., Knowler, D.J., Lévêque, C., Naiman, R.J., Prieur-Richard, A.-H., Soto, D., Stiassny, M.L. & Sullivan, C.A. 2006. Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews* 81(2): 163-182.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853-858.
- Reid, D.G., Aravind, N.A. & Madhyastha, N.A. 2013. A unique radiation of marine littorinid snails in the freshwater streams of the Western Ghats of India: the genus *Cremanoconchus* W.T. Blanford, 1869 (Gastropoda: Littorinidae). *Zoological Journal of the Linnean Society* 167(1): 93-135.
- Sala, O.E., Chapin, F.S., Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A. & Leemans, R. 2000. Global biodiversity scenarios for the year 2100. *Science* 287(5459): 1770-1774.
- Strong, E.E., Gargominy, O., Ponder, W.F. & Bouchet, P. 2008. Global diversity of gastropods (Gastropoda; Mollusca) in freshwater. *Hydrobiologia* 595(1): 149-166. [on line 18 December 2007]
- Thomsen, J.B. 1999. Looking for the hotspots. *World Conservation* 2(99): 6-7.
- Sudeshna Chakraborty and N.A. Aravind, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Srirampura, Jakkur PO, Bangalore 560064, India. sudeshna@atree.org aravind@atree.org

FIRST RECORD OF AN IMPORTANT NATURA 2000 INDICATOR SPECIES, *VERTIGO MOULINSIANA* (GASTROPODA: VERTIGINIDAE), IN KOSOVO

By Zoltán Fehér, Zoltán Péter Erőss, Tamás Deli & Halil Ibrahim

As a part of the Mediterranean basin, the Balkan peninsula is among the most important global biodiversity hotspots. Molluscs contribute significantly to the species diversity of this region (Cuttelod *et al.*, 2011). Within the Balkans, Kosovo is among the least explored and lesser known areas.

The bachelor's thesis of Hoti (2018) is a rare exception for specifically Kosovo related records. Neither the [IUCN Red List](#) nor the [Fauna Europaea](#) checklist contain specifically Kosovo related data and what we know about species occurring in Kosovo is scattered in taxonomic papers dealing with certain groups (Sturany & Wagner, 1915; Jaeckel, 1954; Schütt, 1960, 1975; Nordsieck, 1971, 1972, 1974; Pintér, 1972; Radoman, 1983; De Winter & Maassen, 1992; Glöer & Pešić, 2014; Fehér & Szekeres, 2016; Grego *et al.*, 2017) or faunal works of wider geographical scope (Tomić, 1959).

Currently, there are two national parks, 11 nature reserves, 99 natural monuments and three protected landscapes in Kosovo (Veselaj & Mustafa, 2015), but Kosovo has not yet joined the European Natura 2000 Network.

In order to contribute to improving environmental conditions in Kosovo, the Kosovo Environmental Programme (KEP) was launched in 2016. One of the KEP's specific objectives is to enhance knowledge and protection of biodiversity and develop capacity for improved management of protected areas, and one of KEP's technical components, among others, is to compile the Red Book of animal species in Kosovo.

With the aim of better exploring the distributions of mollusc species of conservation importance and to discover species new to science, we have made five collecting trips in the recent past in Kosovo. During the last of these trips we discovered a viable population of *Vertigo moulinsiana* (Dupuy, 1849), a Natura 2000 indicator species, which, according to the best of our knowledge, had not yet been recorded from Kosovo.

Vertigo moulinsiana was found in the floodplain of the Lepenac/Lepenica River within Drekoc/Drajkovce village in the Ferizaj/Uroševac district, 735 m above sea level (N42.2579 E21.0801) (Figs. 1, 2). The population lives in a wet meadow of 60 m × 12 m, surrounded by a local road, a poplar forest, and arable lands. Due to the presence of pill clams (*Pisidium* sp.), we assume that the meadow is an intermittent wetland, but at the time of the sampling (19 October 2018) it was not covered by water. The vegetation comprises patches dominated by reed, sedge and butterbur. At the time of the visit, the majority of the area was trampled and we have found only a ca. 5 m × 5 m spot where sedge vegetation remained intact. At a rough estimate, within this spot there were 50,000–100,000 *Vertigo moulinsiana*



Fig. 1. Tamás Deli and Zoltán Péter Erőss collecting *Vertigo moulinsiana* in a small wet meadow in Drekoc/Drajkovce village in Kosovo. The majority of this small meadow is heavily trampled. Behind the collectors, there is a ca. 5 m × 5 m spot with intact sedge vegetation where the majority of living individuals were found.

individuals but the fact that in the trampled area their density was much lower (only empty shells were found in soil samples), indicates the extreme vulnerability of this population. Within the poplar forest, there are intermittently water covered parts with sedge patches, but there we found only *Columella edentula*.

This species has a wide range but is associated with habitat types that are severely imperiled all over the range. Habitat quality and number of subpopulations is decreasing in at least part of the range (Seddon & Holyoak, 1993). At a European scale it is assessed as Vulnerable (A2ac) according to the IUCN categories (Killeen *et al.*, 2012). Kosovo is on the periphery of the range and so far only this subpopulation is known, but we might suppose that systematic survey of various wetland habitats in Kosovo will discover further populations.

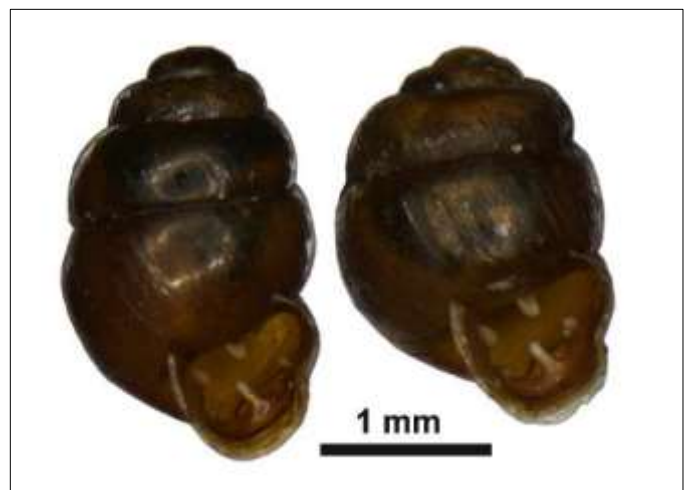


Fig. 2. A typical and an extremely tumid *Vertigo moulinsiana* found in Drekoc/Drajkovce village in Kosovo.

Kosovo is planning to join the European Natura 2000 Network and the first finding of *Vertigo moulinsiana* broadens the taxonomic scope of indicator species during a future site designation process.

Field work in 2018 was supported by the Kosovo Environmental Programme, and in 2014 and 2016 by the Austrian Science Fund (FWF P 26581-B25).

- Cuttelod, A., Seddon, M. & Neubert, E. 2011. [European Red List of Non-marine Molluscs](#). Publications Office of the European Union, Luxembourg. x + 97 p.
- De Winter, A.J. & Maassen, W.J.M. 1992. Two new Hygromiidae from Crna Gora and Kosovo (Gastropoda Pulmonata), with a checklist of the hygromiid species described from western Balkan. [Basteria 56: 173-192](#).
- Fehér, Z. & Szekeres, M. 2016. Taxonomic revision of the rock-dwelling door snail genus *Montenegrina* Boettger, 1877 (Mollusca: Gastropoda: Clausiliidae). [ZooKeys 599: 1-137](#).
- Glöer, P. & Pešić, V. 2014. Two new species of the genus *Bythinella* Moquin-Tandon, 1856 (Mollusca: Gastropoda: Hydrobiidae) from the western Balkan peninsula. [Ecologica Montenegrina 1\(4\): 249-255](#).
- Grego, J., Glöer, P., Eröss, Z.P. & Fehér, Z. 2017. Six new subterranean freshwater gastropod species from northern Albania and some new records from Albania and Kosovo (Mollusca, Gastropoda, Moitessieriidae and Hydrobiidae). [Subterranean Biology 23: 85-107](#).
- Hoti, D. 2018. *Distribution and Habitat Specificity of Terrestrial Snails (Gastropoda) in Kosovo*. BSc Thesis, University of Konstanz, Konstanz. 72 p.
- Jaeckel, S. 1954. Zur Systematik und Faunistik der Mollusken der nördlichen Balkanhalbinsel. [Mitteilungen aus dem Zoologischen Museum in Berlin 30\(1\): 54-95](#).
- Killeen, I., Moorkens, E. & Seddon, M. 2012. [Vertigo moulinsiana](#). The IUCN Red List of Threatened Species 2012: e.T22939A128409258. Accessed 9 December 2018.
- Nordsieck, H. 1971. Zur Anatomie und Systematik der Clausilien, IX. Dinarische Clausiliidae, III: das Genus *Herilla*. [Archiv für Molluskenkunde 101\(1/4\): 39-88](#).
- Nordsieck, H. 1972. Zur Anatomie und Systematik der Clausilien, XI. Neue Formen und taxonomische Revision einiger Gruppen der Aloiinae. [Archiv für Molluskenkunde 102\(1/3\): 1-51](#).
- Nordsieck, H. 1974. Zur Anatomie und Systematik der Clausilien, XV. Neue Clausilien der Balkan-Halbinsel (mit taxonomischer Revision einiger Gruppen der Aloiinae und Baleinae). [Archiv für Molluskenkunde 104\(4/6\): 123-170](#).
- Pintér, L. 1972. Die Gattung *Vitrea* Fitzinger, 1833 in den Balkanländern (Gastropoda: Zonitidae). [Annales Zoologici 29\(8\): 209-315](#).
- Radoman, P. 1983. Hydrobioidea a superfamily of Prosobranchia (Gastropoda) I. Systematics. [Pozebna Izdanja, Prirodnjatshku Muzej u Beogradu 57: 1-256](#).
- Schütt, H. 1960. Neue Höhlenschnecken aus Montenegro. [Archiv für Molluskenkunde 89\(4/6\): 145-152](#).
- Schütt, H. 1975. Die Formen der Gattung *Iglica* A.J. Wagner. [Archiv für Molluskenkunde 106\(1/3\): 1-14](#).
- Seddon, M.B. & Holyoak, D.T. 1993. Land Gastropoda of NW Africa: new distributional and nomenclatural data. [Journal of Conchology 34\(5\): 321-332](#).
- Sturany, R. & Wagner, A.J. 1915. Über schalenträgende Landmollusken aus Albanien und Nachbargebieten. [Denkschriften der kaiserlichen Akademie der](#)

[Wissenschaften, mathematisch-naturwissenschaftliche Klasse 91: 19-138](#).

Tomić, V. 1959. Sbirka retsentikh puzheva P.S. Pavlovića, u Prirodnjatshkom Muzeju u Beogradu [P.S. Pavlovic's collection of the recent gastropods in the National History Museum in Belgrade]. [Pozebna Izdanja, Prirodnjatshku Muzej u Beogradu 27: 1-74](#).

Veselaj, Z. & Mustafa, B. 2015. Overview of nature protection progress in Kosovo. [Landscape Online 45: 1-10](#).

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PROGRESS TOWARDS RESEARCH AND CONSERVATION OF GEORGIAN FRESHWATER MOLLUSCS

By Levan Mumladze, Ani Bikashvili, Nino Kachlishvili, Jozef Grego, Bella Japoshvili, Katrin Schniebs, Maxim Vinarski, Andrzej Falniowski & Dmitry Palatov

According to [WWF](#) estimates, worldwide populations of freshwater species have declined by 76 % since 1970 and the rate of decline is two times faster than in land or marine ecosystems (McLellan *et al.*, 2014). On the other hand, while freshwater ecosystems constitute less than 1 % of the world's surface area, they support around 10 % of its biodiversity, which makes them a top conservation priority (Strayer & Dudgeon, 2010). Some of the reasons for the high vulnerability of freshwater ecosystems are increasing demand for their services, pollution, habitat degradation, flow modification and biological invasions (Dudgeon *et al.*, 2006). Among freshwater faunas, probably one of the most affected animal groups is the molluscs, which include many rapidly declining species as well as some of the most important invasive alien species. Saving vulnerable mollusc species on the one hand and mitigating the spread of aliens on the other requires a substantial knowledge of their biology, taxonomy and ecology. Unfortunately, there is yet much left to understand about freshwater molluscs.

The Republic of Georgia (Fig. 1) is rich with all kinds of freshwater habitats. It is a central part of the Caucasus biodiversity hotspot, though freshwater biodiversity was not considered when attributing this status to the region (Myers *et al.*, 2000). The reason is clear since the freshwater fauna was and still is largely understudied in the Caucasus. Molluscs are no exception. In the 20th century, only a handful of papers on them were published (e.g. Lindholm, 1913; Zhadin, 1932, 1952; Starobogatov, 1962). Since the 1989 collapse of the Soviet Union no research paper on Georgian freshwater molluscs was published until Vinarski *et al.* (2014). Taking



Fig. 1. Location of Georgia between the Black and Caspian Seas, and showing the location of the Caucasus mountain ranges. www.freeworldmaps.net

into account that Georgian freshwater molluscs were scarcely studied during the Soviet time, knowledge of species diversity and distributions is miserable. Not surprisingly, there is no Red-listed or protected mollusc species in Georgia and they have never been taken into account during human alteration of freshwater habitats.

To fill this gap, in 2017 we launched a project aimed at studying freshwater molluscs of Georgia and promoting their conservation. There are for main directions of our work, as follows.

Freshwater mollusc inventory

Apart from four recent articles (Vinarski *et al.*, 2014; Grego *et al.*, 2017; Mumladze *et al.*, in review; Vinarski & Palatov, in review), there have been no other publications clarifying or updating the systematics or distributions of freshwater molluscs of Georgia during the last 40 years. The only check-list of Georgian freshwater molluscs was that of Javelidze (1973) in which the taxonomy was outdated and information on species distributions unreliable and unusable (for example western Georgia was indicated as an occurrence but without reference to more precise localities or to voucher specimens). A recent compendium of freshwater molluscs of Russia and adjacent countries by Vinarski & Kantor (2016) lists 91 species and subspecies of 14 families for Georgia (Lymnaeidae (12 (sub)species), Planorbidae (25 (sub)species), Physidae (4 (sub)species), Acroloxidae (1 species), Valvatidae (2 species), Neritidae (2 species), Hydrobiidae (8 species), Viviparidae (2 species), Bythinellidae (1 species), Bithyniidae (2 species), Melanopsidae (6 (sub)species), Sphaeridae (14 (sub)species), Cyrenidae (1 species), Unionidae (11 (sub)species)) and underlines some taxonomic uncertainties needing to be addressed. For instance, according to this list, some eight species of the superdiverse family Hydrobiidae are recognised in Georgia, which, based on our yet unpublished data, seems significantly underestimated (see also Grego *et al.*, 2017). It should be noted that this compendium was based chiefly on already published sources and thus reflects the state of the art rather than providing a new taxonomy. We plan to update the freshwater mollusc species check-list



Fig. 2. Map of Georgia with sampling localities (circles) from which freshwater molluscs were collected in 2016-2018.

for Georgia with modern taxonomy and develop a thorough distributional database for each species, accessible freely on the internet. This will be based mainly on an extensive countrywide inventory of molluscs from all kinds of freshwater systems, landscapes and climatic zones. Unfortunately, two regions of Georgia (Abkhazia and South Ossetia) are currently inaccessible for regular field work (at least for non-Russian citizens) because of military conflict and much less information is expected to be obtained from these areas. During the last two years, we were able to sample a large part of Georgia (more than 400 localities) and collected many freshwater molluscs (Figs. 2, 3). These samples are under intensive study and we are preparing for additional sampling in the upcoming field seasons.

Environmental ecology of all freshwater mollusc species

Since knowledge of a species' environmental requirements is key information for its conservation, we are going to undertake thorough descriptions of species habitats in each locality. This will include geographic data, habitat structure, physico-chemical characteristics of the water and co-occurring communities. With basic ecological studies, we will develop a national red list of freshwater molluscs based on species distributions and habitat preferences.

Develop multilocus DNA barcodes

DNA barcoding is a powerful tool for resolving taxonomic problems, as a component of integrative taxonomy (Will *et al.*, 2005) and for inferring evolutionary history (Hjibabaei *et al.*, 2007). Since Georgia represents a Plio-Pleistocene refugium for freshwater fauna it is supposed to harbour a vast diversity of endemic or local lineages of species difficult to detect based only on morphology. For these reasons we will use at least two mitochondrial DNA markers (CO1, 16S) to develop barcodes for as many species as possible, especially range restricted or uncertain taxa, to aid in species identification and phylogenetic inference. Up to now, we were able to sequence different genetic markers for several species including *Ancylus* spp., several lymnaeids and hydrobiids, as well as *Theodoxus* spp. and *Viviparus* spp. The work is ongoing and we expect to generate much more data in the near future.



Fig. 3. A sample of recently collected freshwater mollusks from various localities in Georgia. A-B – *Radix* spp., C – *Agrafia* sp., D – *Melanopsis* sp., E – *Planorbis* sp., F – *Theodoxus* sp., G – *Unio* sp.

Develop internal expertise and an international collaborative network

One of the main obstacles to progress in molluscan research in Georgia is the lack of local malacologists in the country. Until recently there was no single local authority interested in freshwater mollusks. One of the primary goals is to support the younger generation in this respect. Currently one PhD and one MSc student are actively studying and working on freshwater mollusks at the Ilia State University and more are planned. By gaining experience of field and laboratory work locally, we are also trying to increase their skills via short term scholarships with external collaborators. To this end, we hope to build an international team to develop the research programme. Our group (the co-authors of this article) is not final and we are happily open to collaboration with as many interested experts worldwide as possible.

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- Dudgeon, D., Arthington, A.H., Gessner, M.O., Kawabata, Z.I., Knowler, D.J., Lévêque, C., Naiman, R.J., Prieur-Richard, A.-H., Soto, D., Stiassny, M.L.J. & Sullivan, C.A. 2006. Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews* 81(2): 163-182.
- Grego, J., Hofman, S., Mumladze, L. & Falniowski, A. 2017. *Agrafia* Szarowska et Falniowski, 2011 (Caenogastropoda: Hydrobiidae) in the Caucasus. *Folia Malacologica* 25(4): 237-247.
- Hajibabaei, M., Singer, G.A., Hebert, P.D. & Hickey, D.A. 2007. DNA barcoding: how it complements taxonomy, molecular phylogenetics and population genetics. *Trends in Genetics* 23(4): 167-172.
- Javelidze, G. 1973. Freshwater mollusks. In: *Animal Worlds of Georgia, Vol. IV.* (ed. Kurashvili, B.E.), p. 6-19. Tbilisi, Georgia.
- Lindholm, W.A. 1913. Beschreibung neuer Arten und Formen aus dem Kaukasus-Gebiete. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft* 45: 17-23, 62-69.
- McLellan, R., Iyengar, L., Jeffries, B. & Oerlemans, N., Grooten, N., Guerraoui, M. & Sunters, P. 2014. *Living Planet Report 2014. Species and Spaces, People and Places.* WWF International, Gland.
- Mumladze, L., Bikashvili, A. & Japoshvili, B. In review. *Mytilopsis leucophaeata* in Georgia – a first dreissenid record for south Caucasus and notes for other invasive non-marine molluscan species. *Vestnik Zoologii*.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853-858.
- Starobogatov, Y.I. 1962. Contribution to knowledge of mollusks from subterranean waters of the Caucasus. *Byulleten' Moskovskogo Obshchestva Ispytateley Pripody, otdel biologicheskij* 67(6): 42-54. [In Russian]
- Strayer, D.L. & Dudgeon, D. 2010. Freshwater biodiversity conservation: recent progress and future challenges. *Journal of the North American Benthological Society* 29(1): 344-358.
- Vinarski, M.V., Palatov, D.M. & Glöer, P. 2014. Revision of 'Horatia' snails (Mollusca: Gastropoda: Hydrobiidae sensu lato) from South Caucasus with description of two new genera. *Journal of Natural History* 48(37-38): 2237-2253.
- Vinarski, M.V. & Kantor, Y.I. 2016. *Analytical Catalogue of Fresh and Brackish Water Molluscs of Russia and Adjacent Countries.* KMK Scientific Press, Moscow.
- Vinarski, M.V. & Palatov, D.M. In review. A survey of the *Belgrandiella*-like gastropods of the northern Black Sea region (Mollusca: Gastropoda: Hydrobiidae s. lato): morphological variation and morphospecies. *Zoologicheskij Zhurnal*.
- Will, K.W., Mishler, B.D. & Wheeler, Q.D. 2005. The perils of DNA barcoding and the need for integrative taxonomy. *Systematic Biology* 54(5): 844-851.
- Zhadin, V.I. 1932. Die Süßwassermollusken aus der Rion-Höhle bei Kutais. *Archiv für Molluskenkunde* 64: 12-14.
- Zhadin, V.I. 1952. Mollusca of fresh and brackish waters of the USSR. *Opredeliteli po faune SSSR, izdavaemye Zoologicheskim institutom AN SSSR. Sovetskaya Nauka, Moscow-Leningrad* 43: 1-346.
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MOLLUSCS ASSESSED BY COSEWIC IN 2018

By Dwayne A.W. Lepitzki & Joseph P. Carney

Two molluscs were assessed by the Committee on the Status of Endangered Wildlife in Canada ([COSEWIC](#)) in 2018: a species not previously assessed, and a species that was reassessed. COSEWIC is an independent body of experts that assigns conservation status of species using IUCN criteria and recommends listing and legal protection under the Canadian Species at Risk Act (SARA; see [Tentacle 21](#) for details). The *Act* requires at-risk species to be reassessed every ten years. *Webbhelix multilineata* (striped whitelip) is a large terrestrial snail (Fig. 1) present on Pelee Island in Lake Erie and at three sites on the mainland in Ontario, including Point Pelee National Park. It appears to have been extirpated from four other historically known mainland sites and from at least one additional site on Pelee Island. Human-driven habitat loss and alteration led to population isolation and decline. Extreme weather events such as droughts, prescribed burns to restore more natural vegetation regimes, human disturbance and introduced wild turkeys are all threats. COSEWIC assessed this species as Endangered in April 2018.

Physella johnsoni (Banff Springs snail), an endemic confined to thermal springs in Banff National Park, Alberta, Canada



Fig. 1. *Webbhelix multilineata* (striped whitelip), Pelee Island, Lake Erie, Canada, August 2016. (Photo: R. Forsyth)



Fig. 2. A cluster of *Physella johnsoni* (Banff Springs snail), Upper Middle Springs, Banff National Park, Alberta, Canada, June 2017. This subpopulation was re-established in November 2002 after being extirpated. Note the size of snails in contrast to the spruce needles. (Photo: D. Lepitzki)

(Fig. 2), was assessed for the fourth time. In 1997 it made history by being the first extant mollusc to be assessed by COSEWIC. When COSEWIC adopted IUCN criteria in 2000 it was uplisted from Threatened to Endangered, a status reassigned again in 2008 and April 2018. Reasons for this status include an extremely small range, fewer than five locations, continuing decline in habitat quality and annual subpopulation fluctuations of one or two orders of magnitude. While major strides have been made in protecting its habitat from human disturbance, including prohibiting human use of the thermal springs, climate change and drying of thermal springs continue to be major threats.

Status reports for these two wildlife species should be posted soon; follow the links at the [COSEWIC website](#).

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PYRGULOPSIS ROBUSTA (WALKER, 1908) IN THE COLUMBIA RIVER: AN INTRODUCTION

By Edward J. Johannes

There has been much concern about the introductions of *Potamopyrgus antipodarum* (New Zealand mudsnail, NZMS) in the Columbia River and elsewhere, as there should be for this extremely invasive species. Another snail thought to have been introduced in the Columbia River drainage before the NZMS is *Radix auricularia* (big-ear radix). Of course, we cannot forget *Corbicula fluminea* (Asian clam), the first introduced mollusc in the Columbia River, which was the

earliest recorded introduction of this bivalve in North America (Burch, 1944). But one would be mistaken to think that the list of introduced molluscs ends with these species. One other snail, a native North American species, was also introduced in the Columbia River and thought initially to be a natural occurrence overlooked by previous surveys and a new species of *Pyrgulopsis* (Frest & Johannes, 1995; Fig. 1). Hershler & Liu (2004a) later placed this snail, along with the formerly federally listed endangered *Pyrgulopsis idahoensis* (Idaho springsnail) (USFWS, 2006, 2007) and *Pyrgulopsis hendersoni* (Harney Lake springsnail) as synonyms of *Pyrgulopsis robusta* (Jackson Lake springsnail). In the Columbia River *P. robusta* (*Pyrgulopsis* sp. A in Fig. 1) has often been misidentified as the NZMS, confounding documentation of the spread of that species in the river (Fig. 2).

Despite earlier surveys of the Columbia having been undertaken from the late 1800s to the 1970s by several malacologists including Henry Hemphill, Junius Henderson, and Dwight Taylor, *P. robusta* had not been found in the river. Some of their surveys did include the Columbia Gorge area where this snail was eventually first discovered. However, no *P. robusta* specimens have been found in museum collections from the Columbia River collected before the 1980s.

Unlike in the extinct Lake Idaho (middle Snake River) or sediments in the adjacent Great Basin, *Pyrgulopsis* has not been found in Miocene, Pliocene or Quaternary fossil freshwater deposits in the Columbia River basin either in Washington or Oregon (Taylor, 1985).

Specimens of *P. robusta* were first found in 1988 by U.S. Fish & Wildlife Service (USFWS) personnel in dredge samples collected from the deep pools of Bonneville Dam on the Columbia River (Fig. 1) and sent for identification to Terry Frest at Deixis Consultants. Subsequently, in adjacent areas of the Columbia Gorge, this species was found in nearshore shallow habitats.

Surveys in the lower Columbia by Deixis Consultants (unpublished) and Neitzel & Frest (1993) found no evidence of this snail before 2002 (Frest & Johannes, 2004; Fig. 1). It was also not noted during surveys conducted for molluscs or for invertebrates in general in the most intensively studied stretch of the Columbia River, the Hanford Reach, until 2005 (Frest *et al.*, 2008a, b; B. Tiller, personal communication, 2005; Fig. 1). Following establishment of the Department of Energy Hanford site, invertebrate surveys have been conducted since the 1950s in this reach (for references see Neitzel & Frest, 1993; Frest *et al.*, 2008a, b). Battelle's Pacific Northwest Laboratory has deposited some mollusc samples collected prior to 2005 in the Hanford Reach in the Deixis collections; none includes *P. robusta*. Surveys upstream of the Hanford Reach have not found this species or NZMS as yet, nor have they been found in the only mollusc survey conducted on Wanapum Lake after an emergency draw down was necessitated by cracks discovered in Wanapum Dam (Tiller *et al.*, 2015 and references therein).

Surveys conducted in Hells Canyon (lower Snake River) by Idaho Power (Richards *et al.*, 2005) and Owyhee River (lower Snake River tributary) by Deixis Consultants (Frest, 2003) did

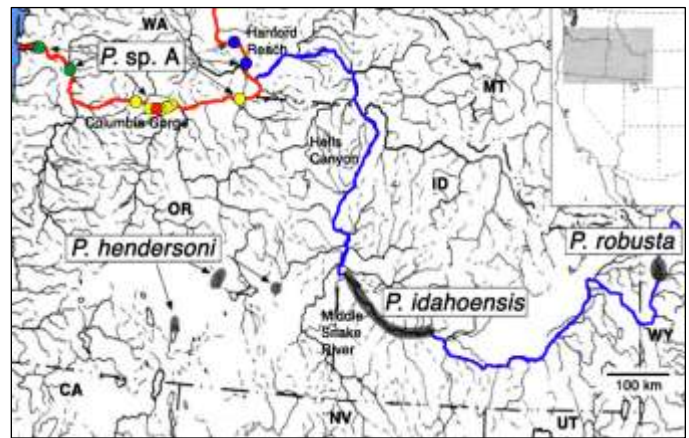


Fig. 1. *Pyrgulopsis robusta* (referred to as its junior synonyms) sites in the Snake River (blue), Columbia River (red) and adjacent internal basins. Red dot – 1988, orange dots – 1994-95, green dots – 2002-03, blue dots – 2005. Note large gaps in distributions, especially in the lower Snake River. Map modified from Hershler & Liu (2004a). States: CA – California, ID – Idaho, MT – Montana, NV – Nevada, OR – Oregon, UT – Utah, WA – Washington, WY – Wyoming.

not find *P. robusta*. However, a new species of *Taylorconcha*, now named *T. insperata* (Hells Canyon snail) was found in both areas (Hershler *et al.*, 2006), while its federally listed threatened sister species, *T. serpentincola* (Bliss Rapids snail), co-occurs with *P. robusta* upstream in the middle Snake. Thus the occurrence of *T. insperata* in Hells Canyon indicates that suitable habitat for *P. robusta* may exist there. Nevertheless, surveys conducted by Deixis Consultants in other lower Snake tributaries such as the Salmon, Imnaha and Grande Ronde rivers have not found *P. robusta*. All the above evidence suggests that *P. robusta* has been recently introduced in the Columbia River.

DNA evidence (Hershler & Liu, 2004a, b) further strengthens this conclusion. It indicates that the closest congeners of Columbia River populations are from Polecat Creek, Wyoming, in the upper Snake River drainage (Fig. 1), not the geographically closer middle Snake River populations. This further supports introduction in the Columbia as the most likely possibility (Fig. 3).

Why *P. robusta* does not occur in the Hells Canyon portion of the Snake, despite a high chance of being swept into this area from upstream populations is a mystery. The Snake formerly flowed west through Oregon, hence explaining *P. robusta* occurrences in the Great Basin of eastern Oregon (*P.*

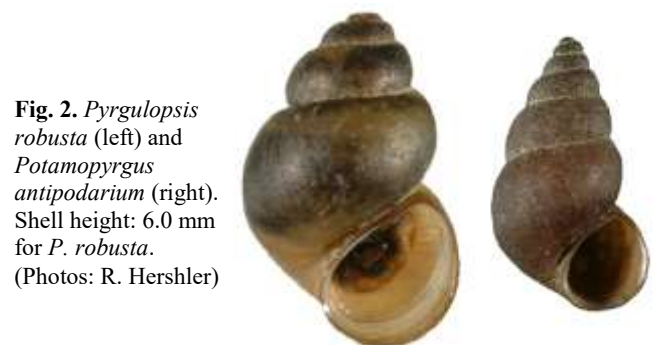


Fig. 2. *Pyrgulopsis robusta* (left) and *Potamopyrgus antipodarum* (right). Shell height: 6.0 mm for *P. robusta*. (Photos: R. Hershler)

hendersoni sites in Fig. 1), but was later captured by headwater erosion in Hells Canyon before the early Pleistocene, becoming a Columbia River tributary (Wheeler & Cook, 1954; Taylor, 1985). This is not the only snail with a distribution reflecting this former drainage divide. *Valvata utahensis* (desert valvata), *Stagnicola hinkleyi* (rustic pondsnail), and *Vorticifex effusa* (Artemesian rams-horn) are among those also absent in Hells Canyon despite their presence just upstream in the Snake (Taylor, 1985; Frest & Johannes, 1995; Richards *et al.*, 2005). *Vorticifex effusa* also occurs in the Columbia but probably arrived via a short-lived connection between the Klamath and Deschutes drainages (Taylor, 1985). *Pristinicola hemphilli* (pristine pyrg), a Columbia basin snail, also has its furthest upstream site on the Snake in Hells Canyon. However, Hells Canyon is not a total barrier to freshwater snail migration. Species of *Fluminicola* were present in the Columbia in the Miocene (Taylor, 1985) and probably arrived there by a different route, but the distribution of *F. fuscus* (ashy pebblesnail) and an unidentified species of *Fluminicola* in the Columbia and Snake indicates that these snails went through Hells Canyon (Liu *et al.*, 2013). Only *Fisherola nuttalli* (shortface lanx) is known to have crossed this former divide by moving upstream from the Columbia (Taylor, 1985). Despite all this activity, *P. robusta* remains stubbornly in place in the middle Snake River, even though it has shown the ability to expand elsewhere in the Columbia and in the past in the Snake.

Pyrgulopsis robusta was introduced into the Columbia River nine years before the NZMS. In 2015 both essentially covered the same stretch of the Columbia River, from the mouth to the Hanford Reach. *Pyrgulopsis robusta* took at least 27 years while NZMS took 18 years to cover the same stretch of river, about 612 km (380 miles). How *P. robusta* was introduced into the Columbia River from Polecat Creek or nearby populations is unknown. One possibility is human-mediated transfer with fish. A possible introduction source, the Jackson National Fish Hatchery, is several kilometres downstream from Polecat Creek in the upper Snake River basin and has been in operation since the 1950s. A US National Museum of Natural History online collection record identified specimens occurring in a spring creek feeding hatchery as *P. robusta* but this was found to be a misidentified *Colligyrus* species (R. Hershler, pers. comm., 2014). Making this source even more unlikely, the hatchery distributes trout only in western Wyoming and eastern Idaho; supposedly none has ever been sent to the Columbia River.

Pyrgulopsis idahoensis was originally listed with four other middle Snake River snails: *Valvata utahensis* (desert or Utah valvata), *Physa natricina* (Snake River physa), *T. serpenticola* and *Idaholanx fresti* (Banbury Springs lanx) (*T. serpenticola* and *I. fresti* are the only molluscs among handful of animals listed under the Endangered Species Act before being scientifically described) (USFWS, 1990). It is unfortunate that *P. idahoensis* was removed from the federal endangered species list as a result of being synonymised with *P. robusta* (Hershler & Liu, 2004a). Morrison *et al.* (2009) cited this as one of few examples of a decrease in the conservation status of a species as a result of taxonomic change. The range

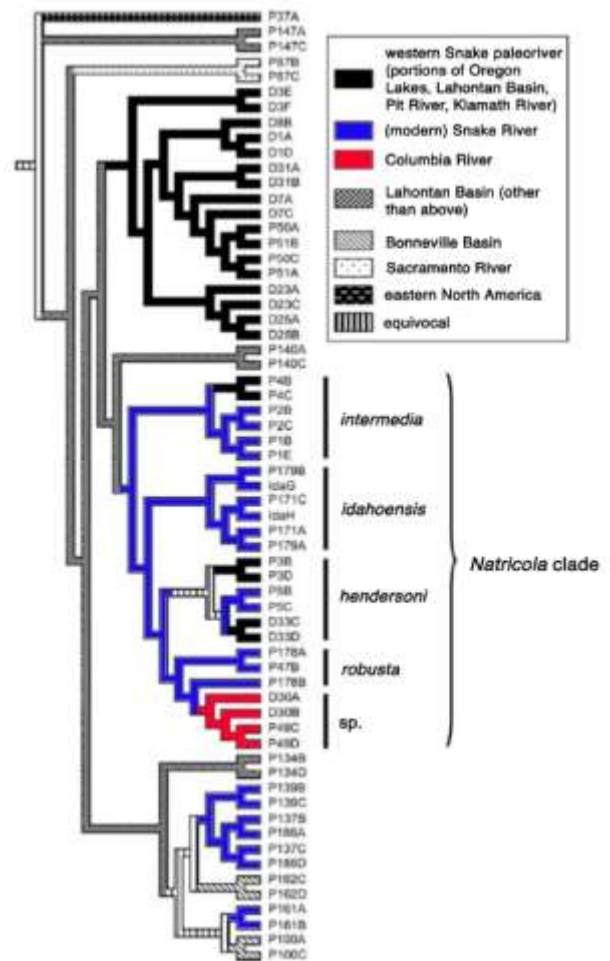


Fig. 3. Phylogenetic reconstruction of drainage occurrences showing that *Pyrgulopsis robusta* (from Polecat Creek) is the closest congener to the Columbia River populations. Figure modified from Hershler & Liu (2004b), based on fig. 2 therein).

increase that resulted from lumping several *Pyrgulopsis* species into *P. robusta* (Fig. 1) was the major justification given by USFWS (2006, 2007) for delisting *P. idahoensis* (this reason was also given for the delisting of the co-listed snail *V. utahensis*) (USFWS, 2010). Supposedly the range extension has secured its future survival. But the knowledge that the Columbia River populations are introductions could possibly have resulted in a different outcome, the listing of *P. robusta* in place of *P. idahoensis*.

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Burch, J.Q. 1944. Corbiculidae. *Minutes of the Conchological Club of Southern California* 38: 18.

- Frest, T.J. 2003. *Progress Report. Owyhee River Mollusk Inventory. July, 2003*. Report to the Vale District, Bureau of Land Management, Vale, Oregon. Deixis Consultants, Seattle. 7 p.
- Frest, T.J. & Johannes, E.J. 1995. [Interior Columbia Basin Mollusk Species of Special Concern](#). Final Report prepared for Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington. Deixis Consultants, Seattle. xi + 274 p.
- Frest, T.J. & Johannes, E.[J.] 2004. Some freshwater mollusks of the Lower Columbia River, Oregon and Washington. In: [Lower Columbia River Aquatic Nonindigenous Species Survey 2001-2004. Final Technical Report: Appendices](#) (Sytsma M.D., Cordell, J.R., Chapman, J.W. & Draheim, R.C.), p. 69-88. Prepared for the U.S. Coast Guard and the U.S. Fish & Wildlife Service. Center for Lakes and Reservoirs, Portland State University, Portland, Oregon.
- Frest, T.J., Johannes, E.J., & Tiller, B.L. 2008a. Mollusk observations along the Hanford Reach of the Columbia River: 100 and 300 areas river corridor baseline risk assessment. Appendix F. Mollusk observations for the 100/300 area. In: [Inter-Areas Component of the River Corridor Baseline Risk Assessment Sampling Summary](#) (Queen, J.M.), p. Fi-ii, F1-40. Washington Closure Hanford, LLC, Richland, Washington.
- Frest, T.J., Johannes, E.J., & Tiller, B.L. 2008b. Mollusk observations along the Hanford Reach of the Columbia River: inter-areas river corridor baseline risk assessment. Habitat assessment and likelihood of species presence. Appendix G. Mollusk observations for the inter-areas. In: [Inter-Areas Component of the River Corridor Baseline Risk Assessment Sampling Summary](#) (Queen, J.M.), p. Gi-ii, G1-6. Washington Closure Hanford, LLC, Richland, Washington.
- Hershler, R. & Liu, H-P. 2004a. Taxonomic reappraisal of species assigned to the North American freshwater gastropod subgenus *Natricola* (Rissooidea: Hydrobiidae). [The Veliger 47: 66-81](#).
- Hershler, R. & Liu, H-P. 2004b. A molecular phylogeny of aquatic gastropods provides a new perspective on biogeographic history of the Snake River Region. [Molecular Phylogenetics and Evolution 32: 927-937](#).
- Hershler, R., Liu, H.-P., Frest, T.J., Johannes, E.J. & Clark, W.H. 2006. Genetic structure of the western North American aquatic gastropod genus *Taylorconcha* and description of a second species. [Journal of Molluscan Studies 72: 167-177](#).
- Liu, H.-P., Walsh, J. & Hershler, R. 2013. Taxonomic clarification and phylogeography of *Fluminicola coloradensis* Morrison, a widely ranging western North American pebblesnail. [Monographs of the Western North American Naturalist 6\(1\): 87-110](#).
- Morrison, W.R. III, Lohr, J.L., Duchon, P., Wilches, R., Trujillo, D., Mair, M. & Renner, S.S. 2009. The impact of taxonomic change on conservation: does it kill, can it save, or is it just irrelevant? [Biological Conservation 142: 3201-3206](#).
- Neitzel, D.R. & Frest, T.J. 1993. [Survey of Columbia River Basin streams for Columbia Pebblesnail *Fluminicola columbiana* and Shortface Lanx *Fisherola nuttalli*](#). Pacific Northwest Laboratory, Richland, Washington. ix + 29 p., appendices.
- Richards, D.C., Falter, C.M., Lester, G.T. & Myers, R. 2005. Responses to FERC Additional Information Request AR-2. Listed Mollusks. Hells Canyon Project FERC No. P-1971-079. In: *Snake River Aquatic Macroinvertebrate and ESA Snail Sampling: 2004* (Clark, W.M. et al.), Appendix 14. Report to U.S. Fish & Wildlife Service, Boise, Idaho. Idaho Power Company, Boise, Idaho.
- Taylor D.W. 1985. Evolution of freshwater drainages and molluscs in western North America. In: *Late Cenozoic History of the Pacific Northwest* (ed. Smiley, C.J.), p. 265-321. Pacific Division AAAS and California Academy of Sciences, San Francisco.
- Tiller, B., Timko, M. & Johannes, E.J. 2015. *Assessment of the Emergency Drawdown Impact on the Mollusks and Other Organisms in Wanapum Lake, Columbia River, Grant County, Washington*. Report submitted to Public Utility District No. 2 of Grant County. Environmental Assessment Services, LLC, Richland, Washington.
- USFWS. 1990. Endangered and threatened wildlife and plants; proposed endangered status for five Idaho aquatic snails. [Federal Register 55: 51931-51936](#).
- USFWS. 2006. Endangered and threatened wildlife and plants; 12-month finding on a petition to delist the Idaho Springsnail; 12-month finding on a petition to list the Jackson Lake Springsnail, Harney Lake Springsnail, and Columbia Springsnail; and proposed rule to remove the Idaho Springsnail from the List of Threatened and Endangered Wildlife. [Federal Register 71: 56938-56948](#).
- USFWS. 2007. Endangered and threatened wildlife and plants; final rule to remove the Idaho Springsnail (*Pyrgulopsis (=Fontelicella) idahoensis*) from the List of Endangered and Threatened Wildlife. [Federal Register 72: 43560-43563](#).
- USFWS. 2010. Endangered and threatened wildlife and plants; removal of the Utah (desert) valvata snail from the Federal List of Endangered and Threatened Wildlife. [Federal Register 75: 52272-52282](#).
- Wheeler H.E. & Cook, E.F. 1954. Structural and stratigraphic significance of the Snake River capture, Idaho-Oregon. [Journal of Geology 62: 525-536](#).

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ON SOME FRESHWATER MOLLUSCS FROM BUDHABALANGA RIVER IN ODISHA, INDIA

By Basudev Tripathy, Sheikh Sajjan & Kailash Chandra

Freshwater molluscs are an integral part of aquatic ecosystems and play important roles in freshwater, including water purification, maintenance of the bio-chemical cycle, recycling of nutrients and being major components of food webs. Many species have highly specialised ecological niches, making them vulnerable to modification of their environments (Lydeard *et al.*, 2004). Also, they are the most biologically used indicator species for assessing water quality, toxicity and pollution (Elder & Collins, 1991; Choubisa & Sheikh, 2013). The presence or absence of certain species can indicate the health of an aquatic habitat.

Globally, more than 5,000 described freshwater mollusc species are known. In India, 217 freshwater mollusc species have been recorded, of which 27 species (as well as an additional 13 forms and varieties), belonging to 16 genera (11 gastropod and 5 bivalve) and 11 families (8 gastropod and 3 bivalve) have been reported from the state of Odisha (Subba Rao *et al.*, 1989). Recently, Ghosh *et al.* (2015) added *Pila virens* to the list of species in Odisha. Nevertheless, the number is far from complete. This note is based on preliminary findings of a study to map critical freshwater habitats in Odisha for conservation and sustainable use of resources.

The Budhabalanga River is one of the major rivers of northern Odisha (Fig. 1). It originates in the Similipal Biosphere Reserve, flows through Mayurbhanj and Balasore districts and

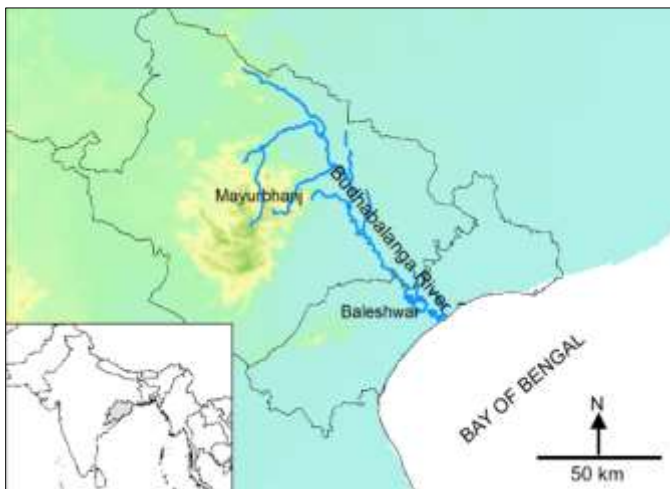


Fig. 1. Location and origin of the Budhabalanga River, northern Odisha, India. Inset, location of the state of Odisha.



Fig. 2. The Budhabalanga River, northern Odisha, India.

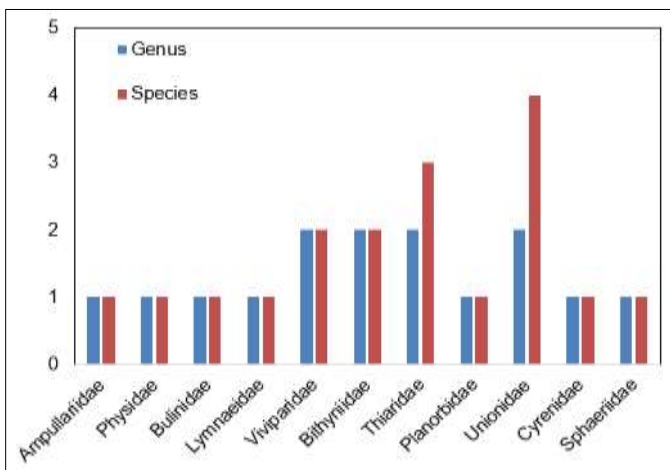


Fig. 3. Numbers of genera and species recorded in each family during the surveys.

discharges into the Bay of Bengal at Balaramgadi after covering a distance of 175 km. This river is considered one of the most important water sources for agriculture as well as fisheries and thereby provides a livelihood for the northern Odisha farmers and fishermen (Fig. 2). A survey of the

Table 1. The malacofauna collected from six study sites in the River Budhabalanga during the survey (details of sites in text).

Scientific Name	S-1	S-2	S-3	S-4	S-5	S-6
<i>Pila globosa</i>	+				+	
<i>Physella acuta</i>	+					
<i>Indoplanorbis exustus</i>	+	+	+	+	+	+
<i>Radix rufescens</i>	+	+	+	+	+	+
<i>Filopaludina bengalensis</i>	+	+	+	+	+	+
<i>Idiopoma dissimilis</i>	+	+	+	+		
<i>Gabbia orcula</i>	+					+
<i>Bithynia pulchella</i>	+	+			+	+
<i>Melanoides tuberculata</i>	+	+	+	+	+	+
<i>Tarebia granifera</i>	+	+	+		+	+
<i>Tarebia lineata</i>	+	+	+	+	+	+
<i>Gyraulus convexiusculus</i>	+	+	+	+	+	+
<i>Parreysia corrugata</i>	+	+				+
<i>Parreysia favidens</i>	+	+				+
<i>Lamellidens corrianus</i>	+	+	+			+
<i>Lamellidens marginalis</i>	+	+			+	+
<i>Corbicula striatella</i>	+	+	+	+	+	+
<i>Musculium indicum</i>	+	+	+	+		+
Total	18	15	11	09	11	16

freshwater molluscs in the Budhabalanga River was undertaken and for the first time documented species diversity and distributions in the river. Molluscs were collected by hand picking at six sites in Mayurbhanj district at an interval of 10 km (S-1, S-2 and S-3 near Baripada town, S-4 in Kuchei, S-5 in Karanjipal and S-6 near Bangripisi).

In total, 257 specimens representing 18 species (12 Gastropoda, 6 Bivalvia) belonging to 11 families and 15 genera were recorded in the field survey (Table 1, Fig. 3). Among the gastropods, Thiaridae were dominant with three species, while among bivalves, Unionidae were dominant with four species. *Physella acuta*, a species native to North America and globally invasive, was also recorded for the first time from the river, which is also the first record for the state. In addition to *P. acuta*, the following species were commonly abundant in the sampling sites: *Radix rufescens*, *Indoplanorbis exustus*, *Filopaludina bengalensis*, *Melanoides tuberculata*, *Tarebia lineata*, *Gyraulus convexiusculus* and *Corbicula striatella*.

The maximum number of species (18) was recorded from Site 1 (near Baripada town), whereas very few species (9) were recorded from Site 4. During the surveys, the authors recorded anthropogenic activities, including road-over-bridge construction cutting through the river (Fig. 4), illegal sand mining and urban sewage draining into the river. These activities presumably affect the biota of the river, including the freshwater molluscs.

Freshwater molluscs in riverine ecosystems of Odisha are poorly studied. There are more than ten major rivers in Odisha, most of them originating from mountains, and these rivers potentially harbour many freshwater molluscs. Unfortunately, anthropogenic pressures from illegal sand mining, diverting of river water for industrial purposes, dam construction for hydropower projects and untreated sewage disposal from urban drainage will all in the long run impact the biodiversity of the riverine fauna including that of the molluscs, certain species of which are potential indicators of



Fig. 4. Road-over-bridge construction cutting through the Budhabalanga River near Kuche (Site 4).

the health of the aquatic environments. Therefore, suitable conservation and management interventions are required for saving the rivers and their aquatic biodiversity. Regular monitoring and inventory surveys are an important component of such efforts.

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Choubisa, S.L. & Sheikh, Z. 2013. Freshwater snails (Mollusca: Gastropoda) as bio-indicators for diverse ecological aquatic habitats. *Cibtech Journal of Zoology* 2(3): 22-26.

Elder, J.F. & Collins, J.J. 1991. Freshwater molluscs as indicators of bioavailability and toxicity of metals in surface-water systems. *Reviews of Environmental Contamination and Toxicology* 122: 37-79.

Ghosh, A.K., Sahu, H.K., Sethi, S. & Sajan, S.K. 2015. A new record of *Pila virens* (Lamarck, 1822) (Molluscs: Gastropoda: Ampullariidae) from Odisha with note on description. *Life Sciences Leaflets* 67: 46-50.

Lydeard, C., Cowie, R.H., Ponder, W.F., Bogan, A.E., Bouchet, P., Clark, S.A., Cummings, K.S., Frest, T.J., Gargominy, O., Herbert, D.G. & Hershler, R. 2004. The global decline of nonmarine mollusks. *BioScience* 54(4): 321-330.

Subba Rao, N.V., Mitra, S.C. & Manna, R.N. 1989. Mollusca (freshwater). In: *Fauna of Orissa. Part 2* (ed. Jairajpuri, M.S.), p. 277-318. Zoological Survey of India, Kolkata.

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MARYLAND BIOBLITZ CONTRIBUTES NEW GASTROPOD RECORDS

By Aydin Örstan, Megan Paustian, Makiri Sei & Timothy A. Pearce

Maryland Biodiversity Project ([MBP](#)) is a non-profit organisation aimed at cataloging all the living things of Maryland. MBP was started in June 2012 and so far, more than 1,000 contributors have helped MBP catalogue over

18,000 species found in Maryland. In addition to frequent field trips, MBP organizes one bioblitz each year attended by dozens of naturalists. MBP's 2018 bioblitz was on 8 September at the University of Maryland's Center for Environmental Science [Horn Point Laboratory](#). The first three authors participated in the bioblitz (Fig. 1), while Tim Pearce helped with the identifications of the collected specimens and contributed to the writing of the manuscript.

The Horn Point Laboratory is on the banks of the Choptank River on the eastern shore of the Chesapeake Bay, a few kilometres west of the city of Cambridge, Maryland. The laboratory property covers more than 300 hectares of assorted habitats, including secondary growth forests, meadows and river banks facing tidal brackish waters. A rain storm in the morning delayed our survey until after lunch. The benefit of the rain was that by the time we started our survey, snails and slugs had started to crawl about. We searched for gastropods in the forests, along the banks of the Choptank River and at locations close to buildings on meadows and at the edges of groves of trees. We found the following 16 species.

Land snails: *Anguispira alternata*, *Anguispira fergusonii*, *Triodopsis juxtidentis*, *Triodopsis hopetonensis*, *Helicodiscus parallelus*, *Zonitoides arboreus*, *Glyphyalinia indentata*, *Striatura meridionalis*, *Xolotrema fosteri*, *Mesodon thyroidus*, *Ventridens ligera*

Amphibious snails: *Littoraria irrorata*, *Melampus bidentatus*

Slugs: *Philomycus carolinianus*, *Pallifera* sp., *Ambigolimax* cf. *valentianus*

All of these species other than *Xolotrema fosteri* and *Ambigolimax* cf. *valentianus* are native to Maryland. We



Fig. 1. Malacologists in the field. The background shows some of the habitat types that were sampled during the bioblitz.



Fig. 2. Live *Anguispira fergusonii* found in the forest. This species has a grey foot and colourless slime, in contrast to *A. alternata*, which has a reddish foot and yellow slime.

found seven of the native land snails and the two philomycid slugs in or at the edges of forests. Our findings underline the importance of forests in the survival of the native gastropod species. It was especially heartening to find live *A. fergusonii* (Fig. 2) as well as a shell of its close relative *A. alternata*. According to a recent study, the latter species may have been declining in abundance (Pearce & Arnold, 2016).

Xolotrema fosteri, *M. thyroidus* and *A. alternata* were in a pile of tree branches at the edge of a grove of trees near the laboratory buildings, while the tentatively identified *Ambigolimax* cf. *valentianus* was found on the inside of the peeling bark of a plant growing near one of the ponds close to the Choptank River. The two amphibious species, *L. irrorata* and *M. bidentatus*, were on stems of the plants growing in water at the bank of the Choptank River where we also found two shells of *T. hopetonensis* (Fig. 3) near each other. We could not determine if the latter had been brought by the tides or actually lived there. We collected the shells of nine land snails and photographed the live specimens before releasing them. The shells have been deposited in the mollusc collection of the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA.

Ambigolimax cf. *valentianus* is a European species that was introduced long ago to the USA. It is often present near human dwellings. The native range of *X. fosteri* is in Illinois and Missouri (Hubricht, 1985). William G. Binney introduced this species into the garden of his home in Burlington, New Jersey in the 1860s (Pilsbry, 1940: 832). By 1909, the snails had dispersed at least 13 km (8 miles) down the Delaware River from Burlington (Pilsbry, 1940 [in 1939-1940]: 832). Since the early 1960s, *X. fosteri* has continued to be found not only in Burlington, but also as far south as Somerset County, Maryland, which is almost 250 km from Burlington (Örstan & Pearce, 2016). Our bioblitz record from near Cambridge in



Fig. 3. Shells of the *Triodopsis* species collected. Left, *T. juxtidentis*, right, *T. hopetonensis*. The scale is in mm.

Dorchester County, Maryland is about 220 km from Burlington. It is hard to believe that the descendants of Binney's colony have managed to travel so far and wide from a garden in Burlington. An alternative explanation for the sporadic yet widespread distribution of *X. fosteri* is that over the years there have been additional, but undocumented introductions of the species into the area either intentionally or as a result of some unknown human activity.

A recent review pointed out that on several occasions in the UK and the USA, the species inventories produced by bioblitz events have contributed to the development of habitat management and conservation policies (Ballard *et al.*, 2017). Our group intends to participate in future MBP bioblitzes with the hope that our efforts may contribute further to the preservation of the biodiversity of Maryland.

Ballard, H.L., Robinson, L.D., Young, A.N., Pauly, G.B., Higgins, L.M., Johnson, R.F. & Tweddle, J.C. 2017. Contributions to conservation outcomes by natural history museum-led citizen science: examining evidence and next steps. *Biological Conservation* 208: 87-97.

Hubricht, L. 1985. The distributions of the native land mollusks of the eastern United States. *Fieldiana: Zoology New series* 24: i-viii, 1-191.

Örstan, A. & Pearce, T.A. 2016. What determines long-term success in the assisted colonization of land snails? Insights from a 19th century experiment. *Tentacle* 24: 44-45.

Pearce, T.A. & Arnold, C.D. 2016. Decline of the land snail *Anguispira alternata* (Pulmonata: Discidae) in Pennsylvania, U.S.A. *Annals of Carnegie Museum* 84: 9-21.

Pilsbry, H.A. 1939-1940. *Land Mollusca of North America (North of Mexico)*, Vol. 1, Parts 1-2. Academy of Natural Sciences of Philadelphia, Philadelphia, Monograph 3: 1-994.

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BACK FROM THE BRINK - RECOVERY EFFORTS FOR ENDEMIC LAND SNAILS OF BERMUDA

By Mark E. Outerbridge, Kristiina Ovaska & Gerardo Garcia

Bermuda is a small island archipelago situated in the Atlantic Ocean 1,000 km east of the Carolinas (USA) and around 1,500 km north of the Bahamas. It is only around 50 km² in area, but over 70 % of the land mass is considered developed. Only 3 % of Bermuda's biodiversity is endemic (Sterrer, 1998) but included in that unique group is an entire genus of land snails, *Poecilozonites*. At least 12 species are known from the fossil record, which dates back one million years before present (Hearty & Olson, 2010). The late evolutionary palaeontologist Stephen J. Gould (who did his doctorate studying *Poecilozonites* on Bermuda during the 1960s) described adaptive radiations of these snails similar in scope to those of Darwin's finches on the Galapagos Islands (Gould, 1993).



Fig. 1. Greater Bermuda Snail, *Poecilozonites bermudensis*. Left: with a fluorescent Alpha tag glued to its shell. Right: a tagged snail under UV-light, which was used to help locate marked snails at night.

Sadly, only two species are deemed extant today: *P. bermudensis* (greater Bermuda land snail; adult shell width up to 28 mm; Fig. 1) and *P. circumfirmatus* (lesser Bermuda land snail; adult shell width up to 9 mm). Historically described as very common (Gould, 1969), both species experienced drastic declines in abundance and distribution during the latter half of the 20th century and are now on the verge of extinction. The accidental and deliberate introduction of predatory snails (*Euglandina rosea*, *Gonaxis kibweziensis*, *G. quadrilateralis*) during the 20th century (Bieler & Slapcinsky, 2000) and the discovery of predatory terrestrial flatworms and ribbon worms (*Bipalium vagum*, *Gigantea governoni*, *Geonemertes pelaensis*) in the early 21st century (Jones & Sterrer, 2005) proved disastrous for Bermuda's endemic land snails. *Poecilozonites bermudensis*, thought to be extinct until recently, was serendipitously discovered in an alleyway in the city of Hamilton in 2014 (Outerbridge, 2014). Rescue of the population became necessary because of impending development of the site shortly after its discovery, and allowed the initial establishment of a captive breeding programme. An additional remnant population of the snail was discovered on an offshore island in 2017. Live specimens of *P. circumfirmatus* have not been found in the wild since 2004, despite repeated searches.

As a safeguard against extinction, both species are reared in captivity for eventual release in the wild. *Poecilozonites circumfirmatus* has been reared in captivity by the Zoological Society of London (ZSL) since 2004. *Poecilozonites bermudensis* was sent to the ZSL in 2014 and to the Chester Zoo in 2016. These British organisations have been very effective at breeding both species in captivity, raising thousands of snails in a very short period of time. In addition to their primary function, the captive colonies provide opportunities for research on life history, physiology and other aspects of the species' biology, as well as on conservation techniques. For example, a student project investigating the efficacy of different marking methods is currently in progress. The captive colonies have also provided Chester Zoo an opportunity to undertake a thorough comparative health screening with snails from the wild in order to minimise the risk of pathogen transmission prior to conservation translocations.

Translocations into the wild have mainly focused on *P. bermudensis*. It is hoped that experience gained with this



Fig. 2. Habitat at the translocation site on Nonsuch Island in native palm-dominated forest. The colored flags indicate locations of tagged snails.

species can be extended to *P. circumfirmatus* and its eventual release into the wild from the captive breeding colonies. In March 2016, 204 individuals of *P. bermudensis* from the rescued Hamilton population were released on Nonsuch Island. This island is a 5.2 ha nature reserve owned and maintained by the Bermuda Government. It serves as a living museum of pre-colonial Bermuda and functions as a wildlife sanctuary for native and endemic species. The majority of the island is currently covered in dense, mature woodland of mixed deciduous trees and endemic palms, and habitat restoration is ongoing (Fig. 2).

The 2016 translocation attempt proved successful; range expansion and recruitment were observed during the two years that followed (Ovaska, 2017, 2018). Based on mark-recapture, the population was estimated to consist of 162-171 adults and subadults in February 2017, close to one year after the translocation, and 281-285 adults and subadults in February 2018. These estimates represent an increase of 107-113 % from 2017 to 2018, mainly reflecting an increase in the number of subadult snails nearing maturity. Juveniles with

shell width <15 mm were not marked and are excluded from the estimates, but numerous small individuals, particularly hatchlings, were observed in both 2017 and 2018. By February 2017, the snails had spread from their initial release site to occupy an area of ~114 m². By February 2018, concomitant with an increase in the population size, the area of occupancy had almost doubled. An old free-stack stone wall provided refuges and appeared to facilitate the dispersal of the snails from the initial release point.

It is worth noting that the new colony of released snails survived a direct hit from a category 3 hurricane in October 2016 during which Nonsuch Island (and the rest of Bermuda) experienced hours of 200 km/h storm winds that were saturated with salt water.

Since March 2016, three additional release events have occurred on Nonsuch Island involving 450 individuals, some of which were individually marked with fluorescent Alpha tags (Northwest Marine Technology, Seattle, Washington; Fig. 1). It is unlikely that there are many locations on the main islands of Bermuda that are free of terrestrial snail predators; however, there are a few smaller, uninhabited nearshore islands that appear to be free of them, and they are currently under assessment for their ability to support translocated populations of endemic Bermuda land snails.

Legal protection for Bermuda's endemic land snails is provided by the Protected Species Act (2003), and a recovery plan was created for both species in May 2018, which outlines the threats and describes the conservation actions required for their recovery.

The Department of Environment and Natural Resources is extremely grateful to the invertebrate teams at the ZSL and Chester Zoo who have been taking such great care of Bermuda's land snails. Particular thanks are given to Paul Pearce-Kelly, Dave Clarke, Craig Walker, Ben Tapley at the ZSL and to Heather Prince, Tamas Papp, Javier Lopez and Amber Flewitt at Chester Zoo.

Bieler, R. & Slapcinsky, J. 2000. A case study for the development of an island fauna: recent terrestrial mollusks of Bermuda. *Nemouria* 44: 1-100.

Gould, S.J. 1969. An evolutionary microcosm: Pleistocene and recent history of the land snail P. (*Poecilozonites*) in Bermuda. *Bulletin of the Museum of Comparative Zoology* 138(7): 407-532.

Gould, S.J. 1993. *Eight little piggies: reflections in natural history*. W.W. Norton & Co., New York, London. 479 p.

Hearty, P.J. & Olson, S.L. 2010. Geochronology, biostratigraphy, and changing shell morphology in the land snail subgenus *Poecilozonites* during the Quaternary of Bermuda. *Palaeogeography, Palaeoclimatology, Palaeoecology* 293: 9-29.

Jones, H. & Sterrer, W.E. 2005. Terrestrial planarians (Platyhelminthes, with three new species) and nemertines of Bermuda. *Zootaxa* 1001: 31-58.

Outerbridge, M. 2014. Report on the rediscovery of Bermuda's endemic land snail *Poecilozonites bermudensis*. Unpublished report. Department of Environment & Natural Resources, Bermuda.

Ovaska, K. 2017. Introduction and monitoring of *Poecilozonites bermudensis* on Nonsuch Island, Bermuda. Unpublished report. Department of Environment & Natural Resources, Bermuda.

Ovaska, K. 2018. Reintroduction of the endemic Bermuda snail *Poecilozonites bermudensis* to Nonsuch Island. Unpublished report. Department of Environment & Natural Resources, Bermuda.

Sterrer, W.E. 1998. How many species are there in Bermuda? *Bulletin of Marine Science* 62(3): 809-840.

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NATURE RESERVES SHELTERING NON-MOLLUSC SPECIES PROMOTE MALACODIVERSITY CONSERVATION IN CHINA

By Yifan Zou & Min Wu

As of 2018, China has established 2,740 natural reserves (Fig. 1), of which 1,574 are terrestrial and more than 420 are aquatic, covering a total area of 1.47 million km², about 15.3 % of China's land mass ([Ministry of Ecology and Environment](#) of the People's Republic of China). On average every county has more than one natural reserve, given that China is administratively divided into 1,636 counties. Up to now, no reserve specifically targets preservation of terrestrial or aquatic molluscs. However, natural reserves with the objective of conserving certain key species not only protect the key species but also protect the whole ecosystem that comprises a complex of organisms including molluscs.

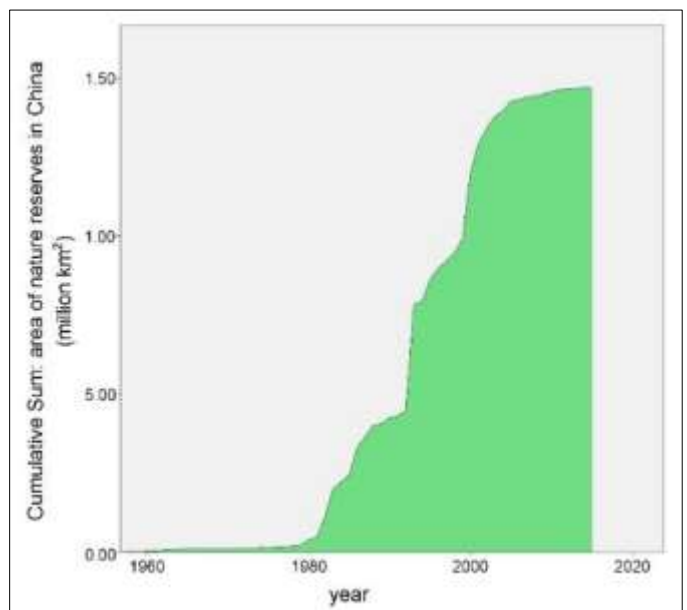


Fig. 1. The increment of China's nature reserves from 1956 (the first reserve, Dinghushan National Natural Reserve, 11.33 km²) to 2015 (2,740 natural reserves, total area 1.47 million km²).

Table 1. Some land snail hotspots in several of China's provinces.

Province	Hotspot	Indigenous species	Total species	Years reserves established
Sichuan	Jiuzhaigou	26	29	1963, 1978, 1993, 2009
Sichuan	Wenchuan	18	22	1963, 2001
Sichuan	Baoxing	20	20	1975, 1999
Gansu	Wenxian	44	47	1963, 1992, 2004, 2006
Chongqing	Chengkou	111	114	1979
Hubei	Badong	82	113	2002
Hubei	Yichang	19	31	2001
Hunan	Hengshan	27	35	1984
Anhui	Ningguo	21	23	1995
Jiangxi	Lushan	24	31	1981, 2000
Yunnan	Dali	44	46	1981, 1988
Guangdong	Luofushan	22	29	1985
Hainan	Haikou	17	22	1988

Some nature reserves play a critical role in the protection of land molluscs. There are in China approximately 1,626 land snail species in the orders Archaeogastropoda, Mesogastropoda and Stylommatophora, excluding species without accurate locality information. The eight provinces that possess the highest malacodiversity are in the subtropics and include Sichuan, Hubei, Gansu, Hunan, Chongqing, Yunnan, Guangdong and Guangxi, where 1,379 land snail species (including overlapping species) are known and make up about 84.8 % of the Chinese malacofauna. However, in area, 1,111 natural reserves in the above eight provinces represent just 18.2 % of all the reserves of the country, and the total area of these eight provinces is merely 23 % of the country's land mass. This suggests that the value of the above nature reserves in malacodiversity conservation is hardly replaceable. Furthermore, in the past in China, land snails were usually described originally from the localities with relatively easier access, rather than from the primary forests and the other intact ecosystems that are remote but usually or unexceptionally included in today's natural reserves. Therefore the nature reserves may contain more undescribed snail species that undoubtedly make these reserves more valuable and fascinating in terms of both discovery and conservation of the local malacodiversity.

The existing nature reserves mostly cover the well-known regions/hotspots of mollusc species discovery in China. For example, Jiuzhaigou (previously known as "Nanping"), where 29 land snail species including 26 indigenous species have been recorded, now includes four reserves established in 1963, 1978, 1993 and 2009. Information of some other hotspots for landsnails is shown in Table 1. In Sichuan and Gansu, there are 248 natural reserves of which 47 were set up especially for conserving a flagship species, the Giant Panda (*Ailuropoda melanoleuca*). These 47 reserves constitute about 78 % in number and 91 % in area of all the country's 60 Giant Panda reserves, in Sichuan, Gansu and Shaanxi. Considering the highest terrestrial mollusc diversity (i.e. nearly 500 species of indigenous land snails) are contributed by Sichuan and Gansu, the occupancy of the land molluscs strongly overlaps with the Giant Panda's occupancy that is now protected by many reserves. Understanding that the Giant Panda has served as an umbrella species, as the preservation of their habitat also helps other endemic species in China, including 70 % of the

country's forest birds, 70 % of mammals and 31 % of amphibians (Pimm & Li, 2015), we should conclude that what has also been protected might include the land molluscs.

Pimm, S.L. & Li, B.V. 2015. China's endemic vertebrates sheltering under the protective umbrella of the giant panda. *Conservation Biology* 30(2): 329-339.

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DISTRIBUTION AND CONSERVATION STATUS OF FRESHWATER BIVALVIA (UNIONIDA, MYTILIDA, VENERIDA) IN ARGENTINA

By Santiago Torres & Gustavo Darrigran

There are about 60 species of freshwater bivalves recorded in Argentina. Of these, 32 are in the order Unionida (naiads) and 28 in the orders Venerida and Mytilida. As a group they range from northern Argentina (23°9' S, 64°19' W) in the malacological province of Middle Paraná to Tierra del Fuego (54°50' S, 68°16' W) in the malacological province of Southern Patagonia (Núñez *et al.*, 2010; Pereira *et al.*, 2013; Torres *et al.*, 2018).

The study of freshwater mussels in Argentina started in the mid 20th century with the works of various Argentinean malacologists (e.g. A. Bonetto and Z. Ageitos de Castellanos). However, most of the publications by Argentinean researchers on Unionida were produced in the 1970s and 1980s.

With the aim of assessing unionidan distributions and evaluating the conservation status of the species of the order in Argentina, we started gathering and updating the information available. Analysis of databases of malacological collections deposited in museums is a particularly important step in the investigation of the geographical and temporal distributions of native freshwater bivalve species (Torres & Darrigran, 2013).

For this research, malacologists from the Centro de Investigaciones y Transferencia Santa Cruz (CIT Santa Cruz) in Patagonia, Argentina, and the División Zoología Invertebrados, Museo de La Plata (FCNyM-UNLP) in La Plata, Argentina, analysed three sources of data: (1) The databases of Argentina's main malacological collections containing unionidan specimens (Museo de La Plata (MLP) and Museo de Ciencias Naturales "Bernardino Rivadavia" (MACN), Buenos Aires province; Fundación Miguel Lillo (FML), Tucumán province and Museo de Santa Fe (MSF), Santa Fe province), (2) available literature on Unionida in Argentina and (3) new collections from freshwater systems in various regions of Argentina (Fig. 1).

The results of this investigation, which is the most recent update of available information on the distribution and conservation status of the unionidan species of Argentina, have been published (Torres *et al.*, 2018). In that work, the potential causes of impacts on the naiad populations and the



Fig. 1. Survey of a naiad population in a tributary of the Parana River in Entre Ríos province.

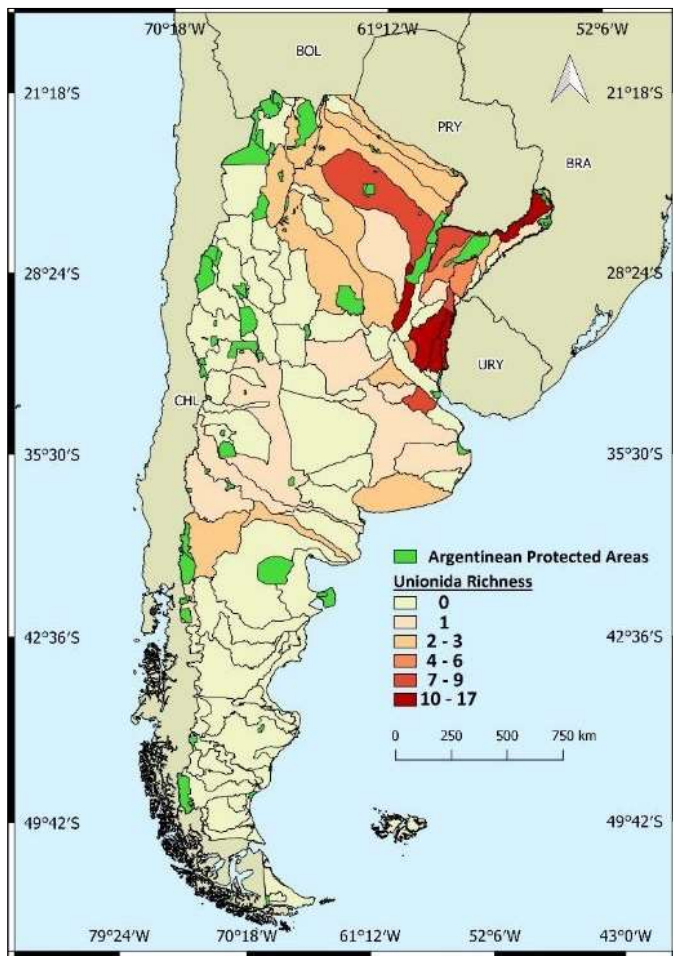


Fig. 2. Argentinean protected areas (APA) and naiad richness in Argentina (modified from Torres *et al.*, 2018).

freshwater environment in general (habitat loss, pollution, invasive species, climatic change) were noted. The spatial analysis of the Unionida showed that less than 14 % of the Argentinean Protected Areas (APA) contains unionidan records and only 9 % contains records of four or more species

Table 1. Numbers of species of Unionida from Argentina and neighboring countries in each IUCN Red List category (modified from Torres *et al.*, 2018).

	CR	EN	VU	NT	LC	DD	NE	Total
Argentina	0	0	0	0	2	4	26	32
Brasil	0	0	3	0	5	4	70	82
Uruguay	0	0	1	0	3	2	28	34
Bolivia	0	0	0	0	5	3	12	20
Paraguay	0	0	1	0	4	1	21	27
Chile	0	0	0	0	1	0	0	1

CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, LC - Least Concern, DD - Data Deficient, NE - Not Evaluated

Table 2. Venerida and Mytilida species with records in Argentina, after Pereira *et al.* (2014). Species in red are not native to Argentina.

Venerida	
Cyrenidae	<i>Cyanocyclus limosa</i> (Maton, 1811) <i>C. paranaensis</i> (Orbigny, 1835) <i>Corbicula fluminea</i> (Müller, 1774) <i>C. largillierti</i> (Philippi, 1844)
Sphaeriidae	<i>Byssanodonta paranensis</i> d'Orbigny, 1846 <i>Eupera doellojuradoi</i> Klappenbach, 1962 <i>E. elliptica</i> Ituarte & Dreher-Mansur, 1993 <i>E. guaraniana</i> Ituarte, 1994 <i>E. iguazuensis</i> Ituarte, 1989 <i>E. platensis</i> Doello-Jurado, 1921 <i>Musculium argentinum</i> (d'Orbigny, 1835) <i>M. patagonicum</i> Pilsbry, 1911 <i>Pisidium chicha</i> Ituarte, 2005 <i>P. chilense</i> (d'Orbigny, 1846) <i>P. chiquitanum</i> Ituarte, 2001 <i>P. huillichum</i> Ituarte, 1999 <i>P. inacayali</i> Ituarte, 1996 <i>P. lebruni</i> Mabile, 1884 <i>P. magellanicum</i> (Dall, 1908) <i>P. observationis</i> Pilsbry, 1911 <i>P. ocluya</i> Ituarte, 2005 <i>P. omaguaca</i> Ituarte, 2005 <i>P. patagonicum</i> Pilsbry, 1911 <i>P. pipoense</i> Ituarte, 2000 <i>P. plenilunium</i> (Melvill & Standen, 1907) <i>P. sterkianum</i> Pilsbry, 1897 <i>P. taraguyense</i> Ituarte, 2000 <i>P. vile</i> Pilsbry, 1897
Mytilida	
Mytilidae	<i>Limnoperna fortunei</i> (Dunker, 1857)

(Fig. 2). This percentage clearly establishes how urgent it is to create new protected habitats for freshwater environments where the naiad populations can grow and stabilise.

In all of South America, out of the 112 species listed by Pereira *et al.* (2014), only 20 have been evaluated by the IUCN and are included in the IUCN Red List (IUCN, 2018). Of these, one species is Critically Endangered (CR), three are Vulnerable (VU), 11 are of Least Concern (LC) and six are Data Deficient (DD) (Torres *et al.* 2018). Table 1 summarises the IUCN categorisation of the Unionida species specifically of Argentina and the immediately adjacent countries only. In all of these countries most species have not been evaluated by the IUCN, which reflects the lack of knowledge regarding the conservation of the group.



Fig. 3. Survey of *Pisidium* sp. population in the Chico River (Santa Cruz Province, Patagonia, Argentina).

With the same goals as for the analysis of the Unionida, in November 2018, we started a new study on the rest of the freshwater Bivalvia in Argentina (Table 2) (Pereira *et al.* 2013). We started analysing the main malacological databases, obtaining available bibliographic information and undertaking new surveys in a range of freshwater environments in Argentina (Fig. 3).

For the bibliographic analysis, we plan to construct a database of all publications on non-Unionida freshwater bivalves produced by Argentinean malacologists, from the 20th century to the present, noting the following information: (1) Author, (2) year of publication, (3) taxonomic level of the study, (4) geographic region and (5) research topic (e.g. ecology, taxonomy, distribution, physiology, life history).

For the analysis of distributions, we work with the main malacological collection databases following the methodology of Torres *et al.* (2018), to develop a data matrix that includes: (1) taxonomic identification, (2) collection and catalogue numbers, (3) collection locality, (4) geographical information (latitude and longitude) and (5) collection date. Records that do not include geographical information will be georeferenced following Wieczorek *et al.* (2004). We intend to finish the data collection and analysis by early 2019.

These kinds of studies, gathering data from different sources (databases, malacological collections and the literature)

constitute the starting point for the optimisation of conservation strategies and evaluation of the status of species according to the IUCN (2012) categories and criteria. However, this is only the start, which must then be built on via new surveys and studies in order to provide up to date evaluations of the status of the populations and species.

- IUCN. 2012. *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0*. IUCN, Gland, Switzerland and Cambridge, UK. iii + 43 p.
- IUCN. 2018. *The IUCN Red List of Threatened Species*. Version 2018–2. Accessed 25 February 2019.
- Núñez, V., Gutierrez Gregoric, D.E. & Rumi, A. 2010. Freshwater gastropod provinces from Argentina. *Malacologia* 53: 47-60.
- Pereira, D., Dreher Mansur, M.C., Duarte, L.D.S., Schramm de Oliveira, A., Mansur Pimpão, D., Tasso Callil, C., Ituarte, C., Parada, E., Peredo, S., Darrigran, G., Scarabino, F., Clavijo, C., Lara, G., Miyahira, I.C., Rodriguez, M.T.R. & Lasso, C. 2014. Bivalve distribution in hydrographic regions in South America: historical overview and conservation. *Hydrobiologia* 735(1):15-44.
- Torres, S. & Darrigran, G. 2013. Importance of biological collections in the study of naiad populations (Mollusca: Bivalvia: Hyriidae) in Argentina. *Tentacle* (21): 21-23.
- Torres, S., Cao, L., Gutiérrez Gregoric, D.E., de Lucía, M., Brea, F. & Darrigran, G. 2018. Distribution of the Unionida (Bivalvia, Paleoheterodonta) from Argentina and its conservation in the southern Neotropical Region. *PLOS ONE* 13(9): e0203616.
- Wieczorek, J., Guo, Q. & Hijmans, R. 2004. The point radius method for georeferencing locality descriptions and calculating associated uncertainty. *International Journal of Geographical Information Science* 18(8): 745-767.

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A REPORT ON THE TERRESTRIAL MOLLUSCS OF HAIKOU (HAINAN ISLAND, CHINA)

By Zhe-Yu Chen

Hainan Island, a tropical island on the continental shelf and separated by the Qiongzhou Strait from the mainland, is a southern province of China. The north part of the island is covered by basalt, which is thought to be disadvantageous for terrestrial malacodiversity. The molluscan research concerning this area was mainly carried out by H. Adams and Otto F. von Möllendorff in the 19th century (Yen, 1939). Subsequently, only very few studies were undertaken (Chen & Gao, 1984; Wu *et al.*, 2007). From 2017 to 2018, we conducted two surveys in Haikou focusing on the local terrestrial molluscs and recorded 21 land snail species representing 10 families (Table 1). The specimens were temporarily deposited in the author's private collection. The surveys were done mainly at two sites in the downtown area (Jinniuling Park, 20.00° N, 110.31° E; Wanlvuyuan Park, 20.02° N, 110.31° E) and two in the suburbs (Shishan Volcanic Group National Geopark,

Table 1. The land snail species of Hainan Island, from the two recent surveys. Asterisks indicate indigenous species.

Species	Habitat	Population
Helicinidae		
<i>Aphanoconia hungerfordiana hainanensis</i> (Möllendorff, 1882)*	arboreal	common
Cyclophoridae		
<i>Cyclophorus clouthianus</i> (Möllendorff, 1881)	ground	uncommon
<i>Cyclophorus pyrostoma</i> Möllendorff, 1882	ground	uncommon
<i>Cyclotus hainanensis</i> (H. Adams, 1870)*	ground	uncommon
<i>Leptopoma polyzonata</i> Möllendorff, 1882*	arboreal	uncommon
<i>Scabrina hirsuta</i> (Möllendorff, 1884)	ground	rare
<i>Japonia longipilus</i> (Möllendorff, 1884)	ground	uncommon
Succineidae		
<i>Succinea</i> sp.	litter	uncommon
Streptaxidae		
<i>Indoartemon bidens</i> (Möllendorff, 1883)*	ground	uncommon
Veronicellidae		
<i>Laevicaulis alte</i> (Férussac, 1822)	ground	common
Dyakiidae		
<i>Quantula striata</i> (Gray, 1834)	litter	common
Ariophantidae		
<i>Macrochlamys cincta</i> Möllendorff, 1883*	litter	uncommon
Clausiliidae		
<i>Phaedusa hainanensis</i> (Möllendorff, 1884)*	—	extinct?
Camaenidae		
<i>Camaenella platyodon</i> (Pfeiffer, 1845)	arboreal	common
<i>Ganesella schomburgiana</i> (Möllendorff, 1884)*	litter	uncommon
<i>Acusta tourannensis rhodostoma</i> (Möllendorff, 1884)	litter	common
<i>Acusta ravida</i> (Benson, 1842)	litter	common
<i>Bradybaena similaris</i> (Rang, 1831)	litter	common
Achatinidae		
<i>Lissachatina fulica</i> (Bowdich, 1822)	litter	common
<i>Allopeas gracile</i> (Hutton, 1834)	ground	common
Chronidae		
<i>Kaliella</i> sp. 1	ground	common
<i>Kaliella</i> sp. 2	ground	common

19.93° N, 110.22° E; Haikou Yangshan Wetland, 19.93° N, 110.33° E).

The dominant species in the downtown area were *Lissachatina fulica*, *Acusta tourannensis rhodostoma*, *Bradybaena similaris*, *Camaenella platyodon* and *Quantula striata*, while in the suburbs the dominant species were usually *Aphanoconia hungerfordiana hainanensis*, *Leptopoma polyzonata*, *Cyclotus hainanensis* and *Ganesella schomburgiana*.

Chinese Rhytididae, represented by only the two species *Macrocyloides crenulata* and *Macrocyloides hainanensis*, are known from Hainan and Hongkong, respectively. The type specimens of the latter species was from Haikou (Yen, 1939). However, the validity of *M. hainanensis* is highly questionable. As we observed, *M. hainanensis* always lives together with the streptaxid *Indoartemon bidens*. Both by comparing the animal and shell morphology of *M. hainanensis* and *Indoartemon bidens* and by performing laboratory rearing experiments, we are convinced that the rhytidid *M. hainanensis* is simply *I. bidens* that has not reached maturity as would be indicated by the distorted shell columella. The same situation, at a guess, also happens in the Hongkongese *M. crenulata*, which might be the juvenile of *Haploptychius sinensis*. This finding hints that there are no Rhytididae species in China.

Another species arousing our interest is *Phaedusa hainanensis* which was established by Möllendorff in 1884 based on the

specimens collected by Herz in Hoihow (Haikou). Previous reports (Chen & Gao, 1984; Wu *et al.*, 2007), information from local collectors' recent collections and our recent surveys suggest that this species *P. hainanensis* has not been found on the entire island for many years. Considering the environmental damage caused by local agriculture and the drastically developed tourism in recent years, we are quite depressed by the situation of this species, which is now restricted to a very limited unexplored place or is likely to have become extinct, at least in the type locality.

I thank Dr. Huang Sheng-Zhuo (Chinese Academy of Tropical Agricultural Sciences), Mr. Pan Yun-Hao (Zhejiang) and Mr. Meng Fei (Hainan) for support of the field work. I also thank Prof. Wu Min (Nanjing University) for improving the readability of the text.

Chen, D.N. & Gao, J.X. 1984. Preliminary study of Guangdong (Hainan island) terrestrial mollusks and new domestic records.

Sichuan Journal of Zoology 3: 10-17. [in Chinese]

Wu, M., Liu, J.-M., Qi, G., Wu, Q. & Zheng, W. 2007.

Malacodiversity in Hainan's limestone areas: status and conservation strategy. *Tropical Forestry* 35: 14-18. [in Chinese]

Yen, T.C. 1939. Die chinesischen Land-und Süßwasser-Gastropoden des Natur-Museums Senckenberg. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 444: 1-234, pls. 1-16.

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WHY MONITORING AND CONSERVATION ASSESSMENT PROJECTS FAIL – A TALE OF MOLLUSC SPECIES OF COMMUNITY INTEREST IN ROMANIA

By Ioan Sîrbu

A decade ago Romania became a member of the European Union (EU) and has since developed and invested in nature conservation projects, especially those related to EUHSD (92/43/EEC 1992), the Habitats Directive. Consequently, in 2007 and 2011 new laws were adopted aimed at conservation of natural habitats of the wild fauna and flora. Some mollusc species were listed in their annexes as requiring special attention and protection. Monitoring and conservation projects have been developed and implemented, guidelines and other materials have been published and it was expected that within ten years of joint efforts at least the status and problems related to protected species would be revealed. But this expectation was only partially met, and in some regards the entire effort turned out to be a major failure. Incomplete or erroneous information has been produced and propagated because of a wide, complex array of causes.

I joined this effort in 2007 as a “local non-key expert on biomonitoring and biological parameters inventory – specialist in malacology”, under the framework of a PHARE/Europe Aid Project aimed at the “Implementation of Natura 2000 Network in Romania” (Goriup, 2008). Having as my primary

task to write the fact sheets for the eight mollusc species of community interest from Romania (listed in Annexes II and IV of the Habitats Directive, as requiring special conservation efforts), I had to highlight the main problems recognised by both Romanian laws and the Habitats Directive for these species. Among them *Theodoxus prevostianus* was already reported as extinct in Romania (making its monitoring difficult); *T. transversalis* had not been found by reliable sources in recent decades; *Vertigo genesii*, listed in Romania, was probably misidentified *Vertigo geyerii* with an unverified distribution and lacking evidence of its present status, and similarly for other species. On the other hand *Kovacsia kovacsi* (originally described as *Hygromia kovacsi*) (Fig. 1) is endemic to the western Carpathians of Romania that extends into the Pannonian region, yet still awaits listing and recognition as a monitoring priority under Romanian legislation (Fehér *et al.*, 2009a, b; Farkas & Fehér, 2013).



Fig. 1. *Kovacsia kovacsi*. (Main photo: T. Deli; inset Z. Fehér)

Despite the fact that I have sent the evidence of these investigations to the project managers as well as to the authorities responsible for implementation of the Habitats Directive and the Natura 2000 network in Romania, the species is still (after more than ten years) not listed among the species of community interest in Romania, nor is it a subject of monitoring and conservation. A trend became obvious: not considering or intentionally ignoring species that are known to occur in Romania versus overemphasizing species that either do not live here, have no reliable record of their presence, or that were obviously misidentified. This was the picture that emerged, at least at the time we set out a basis for further development and hoped for a programme to overcome these problems; but the expectations were not met. During recent years the Habitats Directive and the Natura 2000 network have become major thematic umbrellas for most environmental and nature conservation projects and facilitated competition for funds to generate data by many organisations and institutions. Experts (few) and lay people (mostly) took advantage of this trend with interesting outcomes, even from unexpected sources. In disregard of the above projects and without collaborating with them or considering their results, the Grigore Antipa National Natural History Museum in Bucharest (in collaboration with other organisations, relying on an expected sound expert basis and under the framework of another project), published a handbook of Natura 2000 animal species from Romania with the aim of serving as an identifier and a reliable source of information for a wide group of users and purposes (Tatole *et al.*, 2009). Molluscs were an undervalued and poorly treated group, despite the fact that some experts could have been involved and asked for advice.

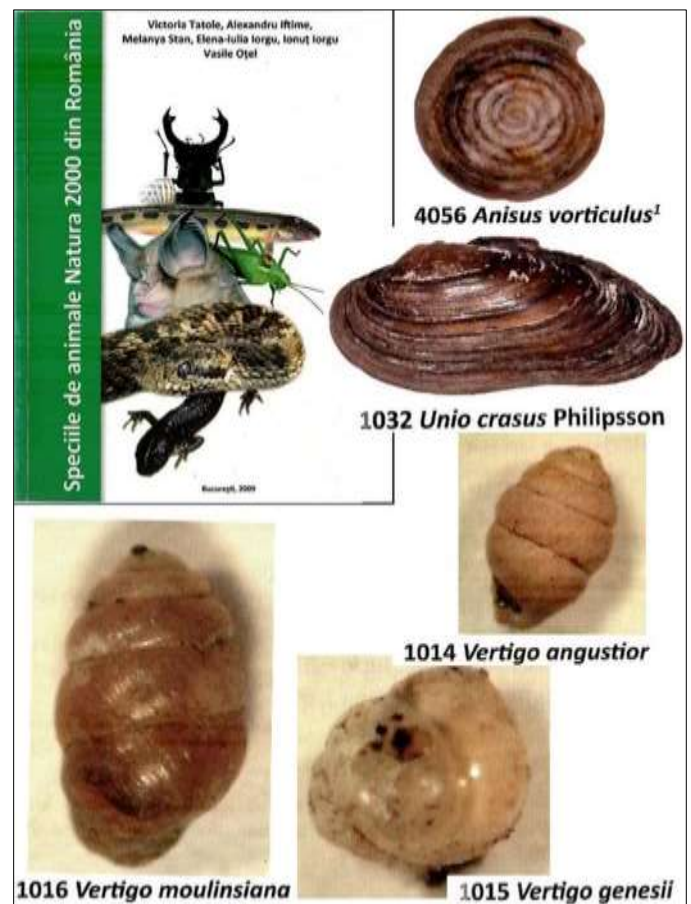


Fig. 2. Extracts from the handbook published by the Grigore Antipa National Natural History Museum in Bucharest showing misidentifications and non-informative illustrations.

As seen in Fig. 2, among the seven mollusc species of community interest treated in this booklet, there are severe problems with the treatments of at least five: the shells of *Anisus vorticulus* and *Unio crassus* are almost certainly misidentified; the illustrations of the three *Vertigo* species depict their taxonomically non-informative dorsal sides, and the information on their distribution was also out of date. I therefore wondered what could be expected from other sources if something like this was published by one of the most emblematic scientific institutions in my country?

Still, there was hope for the future. The Romanian Academy Institute of Biology in Bucharest, in partnership with the Ministry of Environment and Forestry, won a 52 million RON (about 13 million US\$) grant, co-funded by the European Regional Development Fund, aimed at "[Monitoring the conservation status of species and habitats of Romania, based on article 17 of the Habitats Directive](#)" (i.e., species of community interest, listed in the Habitats Directive Annexes). Among several other tasks it also includes planning and documenting the monitoring of invertebrates of community interest. What happens next can only be understood in the context of the existing framework. When a beneficiary (institute, governmental agency etc.) obtains an EU grant it has to open a bid for carrying it out. It cannot hire experts and manage the project directly, and this acting by intermediaries

is a plague for both the environment and society, one of the greatest errors in the present legislation. As a result, none of the known or desired experts can be hired by the project managers. Any firm that manages to fulfill some of the requirements (which can be done in different ways) can participate. The firms have to provide documentation and a list of “experts”, who also have to fulfill minimum requirements. Sometimes these people have to possess BSc degrees, not necessarily in biology or related disciplines (but also in environmental studies, geography, geology etc.) and prove their ability to undertake the project by the number of previous projects in which they were involved. Sometimes the experts also have to prove their expertise based on their publications on a specific taxonomic group, but alternatives are always readily available. But there is a problem: there are usually more firms than experts, thus the firms bid with the same or partially overlapping lists of specialists. A few years ago there was a law requiring that an expert be included in only one list and on behalf of just one bidding firm, but this restriction was abolished since it was impossible to find enough working specialists to have the job done. The next step was that the same experts were asked to participate in different lists belonging to as many firms for the same bid, and the firm asking for the least money (and often having the best political relations) won the contest. Less money also provided an excuse for paying those involved in the projects less, mainly the biologists and environmental experts, because the rest of the personnel involved had to earn the same money (or more) while doing nothing of importance. Each year huge amounts of funds are lost or wasted, enriching people who have nothing constructive to contribute to environmental and conservation projects. The number of experts is usually almost constant but the bidding firms are growing dramatically. When a firm is selected, any of the losers can legally challenge the decision, so that the process has to be restarted and time is lost, and this can happen repeatedly. Sometimes funds are lost and projects not undertaken because no winner can be declared in good time, and so the money is either returned or vanishes into a black hole. Finally, the above project, supposed to last from 2011 to 2015, was taken over by a team of managers and experts were designated, but there was still another problem. Those entitled to establish the monitoring plans and field expertise for the mollusc species, also from the Grigore Antipa National Natural History Museum, identify themselves not as malacologists but molecular biologists and, at least the leading character, has an apparent contempt for field work and related specialities. Thus some other working hands were needed, and so I was also selected, among others, to play a defined role. But, during the bidding and the repeated contests, valuable time was lost, and the project, intended to last for about five years, was restricted to about one year, and the field work to only a few months. The team in part did, and in part did not, work properly and the results compared poorly to the expected and promised objectives. A few of these are shown in Fig. 3, which depicts some information from the “Synthetic report on the conservation status of species and habitats of community interest” published by the beneficiaries (Mihăilescu *et al.*, 2015). In the upper half of the figure you can see, among other

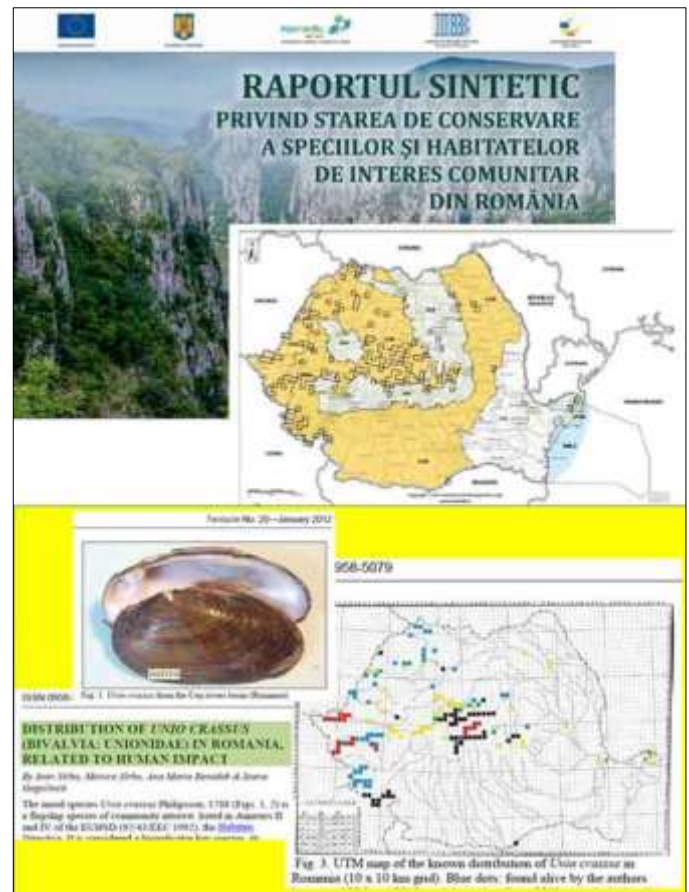


Fig. 3. Synthetic report on the conservation status of species and habitats of community interest, published in 2015, contains, among other mistakes related to the mollusc species, useless information, and an inaccurate map and conservation assessment of *Unio crassus*. Compare that map, obtained under the framework of this resource-consuming national monitoring project, with that (yellow panel) based on our 2012 inventory.

information, an image and distribution map of *Unio crassus* in Romania (the small, unfilled, quadrats of 10 km x 10 km in the ESRI mapping system should show a main result of the project). By contrast, in the lower part of Fig. 3 an excerpt from Sirbu *et al.* (2012) shows a UTM distribution map of the same species, also using a 10 km x 10 km square grid but also using different symbols and colours on the distribution map to highlight the areas where it is known to occur, areas where it is extinct, and areas checked recently with various outcomes, etc. The number of plots in the two figures do not differ significantly, but compared to our map, based on personal work and financed from our own pockets, the results of the multi-million RON project are poor and inadequate, as is the text related to it. And similar problems are also seen for other mollusc species. The same publication states that *Theodoxus transversalis* (Fig. 4) had not been assessed, which is false. During the last 20 years of field research I have personally visited many of the places from which it had been reported but failed to find it. I have also asked repeatedly for material from some of those who claimed to have collected it during recent years, but never received material proving these claims. Knowing that a successful expert is the one who can find



Fig. 4. *Theodoxus transversalis*.
(Photos: I. Sirbu).

species of importance, I have to question these findings until evidence is provided. During the project, material from the Museum of Natural History in Sibiu and the Grigore Antipa National Natural History Museum in Bucharest was used and photos were included to show the species and its habitats. But the depicted individuals were collected a long time ago; the individual shown in Fig. 4 is from a 19th century collection and the label is handwritten by E.A. Bielz, a naturalist of the Transylvanian Society of Natural Sciences in Sibiu. The species has disappeared from Transylvania and most parts of Romania. It is questionable if it managed to survive or repopulate the lower Danube, as sometimes claimed but not yet proved. In addition to all these problems, during the course of the project our partners avoided a major part of the field work to which they were committed. Seemingly the molecular biologists abhorred field work but not the undeserved money, and when I took on the responsibility of doing the surveys that were allocated to them and also expressed my feelings in a critical way, I became an outcast, gained a bad reputation and was banned from various other roles. One of the problems with people from this region (i.e. some parts of the former Eastern European block) is that they used to live for a long time under a dictatorial, centralised political system, and in order to survive were compelled to obedience and submissiveness. This behaviour persists today and is directed toward temporarily elevated figures like directors and acting leaders. Many of those involved in the project recognise privately the insufficiency of the outcomes and the inefficient use of resources, but none would raise their voice or try to repair what went wrong, simply because they are afraid and because the acting heads of the project and/or institution are beyond the reach of critics, as constructive as this may be. In this respect, and in contrast, maybe my voice is weak, but still, it is a voice.

In 2019 the same institutions are once again supposed to report the results of the conservation and monitoring project. But I wonder how this can be accomplished, since nothing was really done during this time, at least not in an organised way. According to the lead institutions the results of this and the ongoing monitoring and conservation assessment project can be found on the platform accessible at this link: www.simshab.ro. Do not bother if it does not work; it also hardly and only partially worked in 2015 when we were supposed to upload the results of the field surveys. Another problem was the structure of the data and the database: it had hardly anything to do with the real data that could be acquired during a brief timespan in the field, and (much) more than

50 % of the structure was meaningless and an invitation to use poor data disguised as (non-)educated guesses. The IT sector dedicated to the project also swallowed enormous funds and resources, and the results are at least inconsistent and untraceable.

Another outcome, the monitoring guide for invertebrates of community interest (Iorgu *et al.*, 2015), was a better and more reliable product, but also with some problems. The conservation status assessment that was proposed by us, the authors, was rejected and replaced with a new assessment by the senior project managers. The reasons are not clear, maybe because they had reported something previously and did not want to change the outcome, or perhaps they knew better the status of the species from their offices in Bucharest than we could assess by means of field work.

To conclude, the Habitats Directive and its applications also face other issues. The species list in the legislation can be criticised and in my opinion should be subject to future amendments. However, the positive effect has been that attention and resources were attracted, among other issues, towards mollusc conservation and research on a larger scale. Negative effects were the exaggerated attention given to a few taxa and the related neglect of others, the opportunistic rise of pseudo-specialists, writing and reporting data erroneously, wasting of resources, etc. Finding the subject species in certain areas is rewarding for scientists, managers and local inhabitants, but especially for politicians, and therefore the subject became of political and social interest, surpassing the evidence of data and common sense. Political ambiguity, ignorance, opportunism and other issues are also linked to what has become a fashion. One can imagine how faulty legislation and attitudes in Romania are responsible for these problems. Nevertheless, I have several inconvenient questions. Are those who provide EU money and evaluate the results of such projects fully unaware of what is happening and, if so, why? Is incompetence endemic or is it affecting societies at a larger scale? When in 2017 I raised these issues at the European Congress of Malacological Societies in Kraków, Poland, one of the most prevailing world experts in molluscs conservation gave me a brief answer, something like: “politics is everywhere the same; what do you expect? There is nothing to be done”. In this I see further problems: if this is not only a local issue but a general trend, then are conservation malacologists really involved in what they do, or is conservation only a subterfuge for having failed to do something better than that in another field of expertise? I cannot help wondering why there is such a small lobby for and representation concerning molluscs in international laws and conventions. How is it possible that in many countries the impact of some non-native mollusc species is almost unanimously recognised (for instance *Corbicula* spp. and *Dreissena* spp., which have the honour of being called “pest clam”, etc.) but not a single mollusc species is considered within the EU legislation as an Invasive Alien Species of Union concern. But in that EU legislation we can find the raccoon, the raccoon dog, the grey and the fox squirrel, the Siberian chipmunk, the sacred ibis and other dangerous creatures. Is this because malacologists are unseen, have no

lobby power, or something else? Maybe if we would consider caring more for the molluscs and collaboration but less about our status and importance, issues like those presented here could be turned in a better direction. If it is only a local or my personal problem please ignore this letter; if something rings familiar from your surroundings then maybe we should change our attitudes.

I express my gratitude to those who have assisted me and improved this contribution, namely Miklós Szekeres (who almost rewrote it), Zoltán Fehér and Tamás Deli.

Farkas R. & Fehér Z. 2013. A dobozi pikkelyescsiga (*Kovacsia kovacsi* [Varga & Pintér, 1972]) elterjedésének vizsgálata a Zempléni-hegységben (Study on the distribution of *Kovacsia kovacsi* (Varga & Pintér, 1972) in the Zemplén mountains (Northern Hungary)). *Állattani Közlemények* 98: 57-64.

Fehér, Z., Szabó, K., Bozsó, M. & Péntes, Z. 2009a. Phylogeny and phylogeography of the *Lozekia*–*Kovacsia* species group (Gastropoda: Hygromiidae). *Journal of Zoological Systematics and Evolutionary Research* 47: 306-314.

Fehér, Z., Varga, A., Deli, T. & Domokos, T. 2009b. Geographic distribution and genital morphology of the genera *Lozekia* Hudec, 1970 and *Kovacsia* Nordsieck, 1993 (Mollusca, Gastropoda, Hygromiidae). *Zoosystematics and Evolution* 85: 151-160.

Goriup, P. (compiler) 2008. *Natura 2000 in Romania: Species Fact Sheets*. Ministry of Environment and Sustainable Development, Romania.

Iorgu, I.Ș., Surugiu, V., Gheoca, V., Popa, O.P., Popa, L.O., Sirbu, I., Părvulescu, L., Iorgu, E.I., Mancu, C.O., Fusu, L., Stan, M., Dascălu, M.M., Székely, L., Stănescu, M. & Tibor-Csaba Vizauer, T.C. 2015. *Ghid sintetic pentru monitorizarea speciilor de nevertebrate de interes comunitar din România*. București, 162 p.

Sirbu, I., Sirbu, M., Benedek, A.M. & Gogolincă, I. 2012. Distribution of *Unio crassus* (Bivalvia, Unionidae) in Romania, related to human impact. *Tentacle* 20: 22-23.

Mihăilescu, S., Strat, D., Cristea, I. & Honciuc, V. (eds.). 2015. *Raportul sintetic privind starea de conservare a speciilor și habitatelor de interes comunitar din România*. Editura Dobrogea, Constanța. 282 p.

Tatole, V., Iftimie, A., Stan, M., Iorgu, E.I., Iorgu, I. & Oțel, O. 2009. *Speciile de animale Natura 2000 din România*. Imperium Print, București. 174 p.

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INTERESTING FINDS IN JAMAICA – REPORT FROM THE FIELD 2018

By Heather L. Kostick

I travelled to Jamaica with Makiri Sei and Gary Rosenberg in July 2018 to collect species of under-surveyed terrestrial molluscs for future molecular and morphological analyses. Jamaica is home to over 500 endemic terrestrial mollusc species (Rosenberg & Muratov, 2006). The two major highlights of this trip were documentation of range extensions for *Megannularia rosenbergi* (Wood, 1828) and *Chittypoma jarvisi* (Henderson, 1901) (Fig. 1). *Megannularia rosenbergi* was previously known from an area between eastern Manchester Parish east towards Ewarton in St. Catherine Parish and then north to just south of Alderton in St. Ann



Fig. 1. Live individuals of *Chittypoma jarvisi*. (Photo: Heather L. Kostick)

Parish. During our trip we found it farther east in the foothills of the Thetford Mountains. *Chittypoma jarvisi* was found and collected live for the first time in 20 years. It is known only from a small area in the Thetford Mountains. Individuals were collected live at a site known from previous taxonomic surveys, and from two new sites in the Thetford Mountains. The periodic documentation of live specimens is important as *Chittypoma jarvisi* has such a restricted range and therefore is vulnerable to environmental changes and/or other impacts. Exact locations of these two species are withheld at the request of the Jamaican National Environmental and Planning Agency (NEPA).

An important observation to note is the possible identification of the predatory New Guinea flatworm, *Platydemus manokwari*, in the shell of a freshly dead *Lucerna* (Pleurodontidae) species. *Platydemus manokwari* is native to New Guinea and was introduced to a number of Pacific islands to control the invasive giant African snail, *Lissachatina fulica*, but was found to also prey on endemic snail species (Raut & Barker, 2002). In the Caribbean, the first record of *P. manokwari* was in Puerto Rico (Justine *et al.*, 2015). Aside from its natural dispersal abilities, the New Guinea flatworm can be spread in association with plants, plant parts, and soil. Although generally ground-dwelling, this flatworm will climb trees to follow its snail prey. It reaches 50 mm in length and 5 mm in width and has a black-olive body with a central longitudinal pale stripe and a pale white belly. *Platydemus manokwari* has been listed among 100 of the world's worst invasive species, a list put together by the Global Invasive Species Programme (GISP) (Lowe *et al.*, 2000). Given that Jamaica is home to over 500 endemic terrestrial molluscan species, this threat to this fauna should be taken seriously and additional field surveys should be done to ascertain the range of *P. manokwari* in Jamaica. There are native flatworms in Jamaica, but little is known about them. Unfortunately, the specimen pictured in Fig. 2 could not be preserved well enough for molecular analysis, but the visual



Fig. 2. A suspected *Platydemus manokwari* found live inside the shell of a recently dead individual of a species of *Lucerna*. (Photo: Makiri Sei)

identification by Makiri Sei indicated that it was likely that this flatworm was *Platydemus manokwari*.

- Justine, J.-L., Winsor, L., Barrière, P., Fanai, C., Gey, D., Han, A.W.K., La Quay-Velazquez, G., Lee, B.P.Y.-H., Lefevre, J.-M., Meyer, J.-Y., Philippart, D., Robinson, D.G., Thévenot, J. & Tsatsia, F. 2015. The invasive land planarian *Platydemus manokwari* (Platyhelminthes, Geoplanidae): records from six new localities, including the first in the USA. [PeerJ 3: e1037](#).
- Lowe, S., Browne, M., Boudjelas, S. & De Poorter, M. 2004. [100 of the World's Worst Invasive Alien Species](#). Updated and reprinted version. Invasive Species Specialist Group, Auckland. 12 p.
- Raut, S.K. & Barker, G.M. 2002. *Molluscs as Crop Pests*. CABI Publishing, Wallingford, UK.
- Rosenberg, G. & Muratov, I.V. 2006. Status report on the terrestrial Mollusca of Jamaica. [Proceedings of the Academy of Natural Sciences of Philadelphia](#) 155: 117-161.

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NOTES ON VULNERABILITY OF THE MICROENDEMIC CLAUSILIID SPECIES *ACROTOMA ENGURIENSIS* FROM THE SOUTHWESTERN CAUCASUS

By Jozef Grego & Levan Mumladze

The pulmonate gastropod family Clausiliidae Gray, 1855 with its almost 1,300 recorded extant species is one of the most diverse land snail families worldwide. The extraordinarily high diversity results from a long history of evolution (since the late Cretaceous) and the environmentally driven fragmentation of populations in many genera. Such fragmentation resulted in a remarkable number of microendemic species, many of them representing relict taxa. Most of the small range and relict clausiliids occur almost exclusively in mountain habitats, where complex geomorphology and orogenesis contributed to the fragmentation of habitats and populations, leading to isolation over time. Within the European mountains several such radiation events took place. Genera with microendemic species include *Siciliaria* Vest, 1867 (Nordsieck, 2002) of

southern Italy, *Alopiia* H. & A. Adams 1855 (Fehér *et al.*, 2013) of Romania, *Agathylla* H. & A. Adams, 1855 (Fehér *et al.*, 2014) and *Montenegrina* Boettger, 1877 (Fehér & Szekeres, 2016) of the western Balkans, *Albinaria* Vest, 1867 (Hirschsfielder & Kittel, 2018) of Greece, *Armenica* Boettger 1877 and *Inobseratella* Lindholm, 1924 of Turkey, and *Christatria* Vest, 1867 (Uit de Weerd & Gittenberger, 2005) of the Levant and Israel. The western Caucasus hosts the clausiliid genera *Acrotoma* Boettger, 1881 and *Micropontica* Boettger, 1881 (Likharev, 1962; Sysoev & Shileyko, 2009) with many species occurring in fragmented, isolated populations (Likharev & Schileyko, 2007; Suvorov, 2002; Solodovnikov & Szekeres, 2017; Hausdorf *et al.*, 2018). One of the most recently described species of the genus *Acrotoma*, the rock dwelling *A. (Iliamneme) enguriensis* Hausdorf, Walther & Neiber, 2018 (Fig. 1) is one such microendemic relict species with a supposedly high level of isolation, known to inhabit only two relatively small roadside cliffs along the road from Zugdidi to Mestia, close to the village of Jvari in Georgia. The two known localities of the species, both limestone cliffs about 40-50 m long and 5-20 m high, are very close to each other, at a distance of around 400 m. The limestone is covered by a dark green-greyish layer of microalgae, which serves as the main food for the rock-dwelling snail species (Fig. 2). Searches in the vicinity and in the broader neighbourhoods of both localities, along the road and below or above its level, did not find the species. Both localities had already been affected by anthropogenic activities during the construction of the road in the 1930s, but since then the surface area of cliffs increased and its microalgal layer recovered, and *A. eguriensis* managed to survive and even established relatively stable populations. The road, which



Fig. 1. live specimen of *Acrotoma eguriensis* Hausdorf, Walther & Neiber, 2018.



Fig. 2. Top: type locality of *Acrotoma eguriensis* Hausdorf, Walther & Neiber, 2018. Bottom: second northern locality of *A. eguriensis*.

supports moderately dense traffic (peaking in summer) seems to have minimum or no influence on the current populations and the current status is not faced with significant threat. As the species was apparently reintroduced to the cliffs after the road construction, it is very likely that it spread back from micropopulations in the close neighbourhood, though our effort to find such adjacent populations was unsuccessful.

Almost nothing is known about the biology, habitat preference and survival strategy of this species. In 2018 we visited the locality in May, during the most humid period of the vegetative season, and here we share our observations. Having survived the winter season, the snails are hidden in tiny crevices, cracks and flat spaces between the limestone beds aestivating during hot and dry days. At least some of the hiding places may be relatively deeper, as some of the snails appeared on the surface only after three days of continuous rain, with their shell surfaces still covered by mud and limestone incrust. Similar behaviour was observed in the rock dwelling *Montenegrina hiltrudae fusca* Fehér & Szekeres, 2006 from Albania, where after a few rainy days the snails appeared all at once from their hiding places in crevices shortly after the rain had stopped, first juveniles, then adult specimens stained by mud. Many of the *A. eguriensis* individuals (about 20-25 %) freshly emerging from their crevices were covered by a strong, secondarily precipitated carbonate layer over their entire shells, while others had no trace of any precipitate and some even had eroded shell

surfaces. Even in wet underground crevices the formation of such a relatively thick inorganic sinter layer would take some time, and probably only if each snail regularly returns to the same precise hiding place exposed to the carbonate saturated water supply. This would explain why the sinter overlay is observed only in part of the population in each locality (higher frequency at the more northern site) and why the species is restricted with its mobility to such a relatively small microhabitat. Probably the snails spend their entire lives within a few square metres of the limestone cliff. *Acrotoma eguriensis* and its closest relative *A. baryshnikovi* are rock dwelling and not true MSS (mesovoid shallow substratum) species, but both prefer subterranean habitats for their survival strategy during the winter and during dry summer days. The latter species was found only inside a cave entrance with accumulation of empty shells in the aestivation site. It is very likely that the presence of small caves associated with spaces and gaps between the limestone beds is one of the factors also determining the habitat preference of *A. eguriensis*. Very similar hidden microhabitats, but for their entire life cycle, are preferred by true MSS genera of Clausiliidae, such as *Sciocochlea* and *Tsoukatosia* from western Greece and the Peloponnese, which also have fragmented patchy distributions with isolated populations. It was also remarkable that both localities of *A. eguriensis* had only subvertical orientation of the limestone beds perpendicularly oriented to the slope of the cliff, while the neighbouring cliff sites that lacked the presence of this species had different orientations of the limestone beds, sometimes subvertical but oriented parallel to the slope and cliff, forming much less accessible interbed cavities, that would be suitable as shelters. The localities are situated at the southern edge of a NE-SW oriented limestone ridge between the valleys of the Enguri and Magana rivers. As the localities were visited during heavy rain with a strong northerly wind coming from the entrance of the Enguri Valley, it was obvious that both localities are sheltered from the dominant northerly wind. The other localities in the neighbourhood where the species was not detected were exposed to strong cold winds from the deep valley of the Enguri, resulting in a different quality of the microclimate, with alternating humidity. Probably the microhabitat preference of *A. eguriensis* consists of several factors, including the presence of suitable survival crevices and optimal climatic conditions of the locality, maybe associated with preferred types of algae and moss as food and other so far unknown factors.

The microhabitat character of the *A. eguriensis* locality also predisposes it to being vulnerable, as it is situated on the left side of the main highway connecting the regions of Zugdidi and Mestia. As tourism in Georgia is one of the fastest developing segments of the local economy, the local government would like to support it by massive road reconstruction, especially along the main highways. The region of Mestia, with characteristic Svan fortress-like settlements, with wonderful panoramas of the Greater Caucasus and Mount Ushba, is one of the most attractive tourist destinations in Georgia, not only for hiking but most recently also for winter sports in newly built ski resorts. It is just a matter of time before the road from Javari to Mestia is

reconstructed and broadened to serve the increasing numbers of visitors and provide more comfortable travelling between the two locations. If broadening of the main highway were to be done in the usual way by massive cliff removal (excavating large parts of the cliff, throwing the debris down the slope to the bottom of the valley and casting a concrete support wall instead of the cliff), the populations of *A. enguriensis* would be eliminated almost immediately after the start of construction. As it is not very likely that other populations would be found on undisturbed areas along the ridge, or that some small surviving population could re-populate the disturbed cliffs without their natural algal layer, *A. enguriensis* is definitely under threat of extinction by these activities. Unfortunately, none of the mollusc species (except Data Deficient *Helix buchii* Dubois de Montpereux, 1839) is protected or even red-listed, in Georgia. Accordingly, there is no legal basis for the protection of such small-range animals, which further aggravates potential threats to this and other species. An environmental appeal has to be made to the local government and construction companies to reconstruct the highway in an environmentally friendly way without demolishing the entire cliff and hillside, especially around the only known localities of *A. enguriensis* and, if necessary, to allocate suitable resources for such an environmentally friendly solution. Unfortunately, in several countries this does not work and saving a single endemic mollusc counts for little in comparison with the increased construction costs and is usually ignored. We already have negative examples of road construction related destruction of habitat and microendemic clausiliid localities in Albania, where highway construction destroyed one of the two known localities of microendemic *Montenegrina perstriata plenostoma* Fehér and Szekeres, 2006 along the Pogradec to Lin road on the bank of Lake Ohrid. Similarly, the type localities of two MSS species, *Tsoukatosia evauemgei* N. Reischütz, A. Reischütz & P.L. Reischütz, 2012 (Reischütz *et al.*, 2018) in the Peloponnese and *Sciocochlea llogarenis* A. & P.L. Reischütz, 2009 (Reischütz *et al.*, 2016) in Albania were destroyed. We strongly hope that the Georgian microlocalities will not follow the negative examples from other parts of Europe and that an appropriate solution for the locality conservation will be found. In this way the list of human-driven extinctions would not need to be extended by a remarkable gastropod species from the western Caucasus.

- Fehér, Z., Németh, I., Nicoară, A. & Szekeres, M. 2013. Molecular phylogeny of the land snail genus *Alopiia* (Gastropoda: Clausiliidae) reveals multiple inversions of chirality. *Zoological Journal of the Linnean Society* 167(2): 259-272.
- Fehér, Z., Parmakelis, A., Koutalianou, M., Mourikis, T., Eröss, Z.P. & Krizsik, V. 2014. A contribution to the phylogeny of Albanian *Agathylla* (Gastropoda, Clausiliidae): insights using morphological data and three mitochondrial markers. *Journal of Molluscan Studies* 80(1): 24-34.
- Fehér, Z. & Szekeres, M. 2016. Taxonomic revision of the rock-dwelling door snail genus *Montenegrina* (2016) Boettger, 1877 (Mollusca, Gastropoda, Clausiliidae). *ZooKeys* 599: 1-137.
- Egorov, R.E. 2001. *Clausiliidae (Serrulininae, Alopiinae, Mentissoideinae)*. *Treasure of Russian shells*, 5(1). Colus Publishing Co, Moskva, 61 p.
- Egorov, R.E. 2002. Clausiliidae (Clausiliinae, Baleinae). *Treasure of*

- Russian shells*, 5(2). Colus Publishing Co, Moskva, 78 p.
- Likharev, I.M. 1962. *Clausiliidae. Fauna SSSR, Molluski*. 3(4). USSR Academy of Sciences, Moskva, Leningrad. 317 p. [in Russian].
- Likharev, I.M., Schileyko, A.A. 2007. A new species and a new subgenus of *Acrotoma* O. Boettger, 1881 New Clausiliidae from Abkhazia 165 (Pulmonata, Clausiliidae). *Ruthenica* 17: 65-67.
- Nordsieck, H. 2002. Contributions to the knowledge of the Delimini (Gastropoda: Stylommatophora: Clausiliidae). *Mitteilungen der Deutschen Malakozoologischen Gesellschaft* 67: 27-39
- Nordsieck, H. 2005. Systematics of the Mentissoideinae (Gastropoda: Stylommatophora: Clausiliidae). *Archiv für Molluskenkunde* 134: 53-64.
- Pokryszko, B.M., Cameron, R.A.D., Mumladze, L. & Tarkhinashvili, D. 2011. Forest snail faunas from Georgian Transcaucasia: patterns of diversity in a Pleistocene refugium. *Biological Journal of the Linnean Society* 102: 239-250.
- Solodovnikov, I.A. & Szekeres M. 2017. Three new species of Clausiliidae (Gastropoda, Pulmonata) from Abkhazia. *Ruthenica* 27(4): 159-165.
- Suvorov, A.N. 2002. A new subgenus and three new species of the genus *Acrotoma* O. Boettger, 1881 (Pulmonata Clausiliidae) from western Transcaucasia. *Ruthenica* 12: 161-166.
- Sysoev, A.V. & Schileyko, A.A. 2009. *Land snails and slugs of Russia and adjacent countries*. Pensoft Publishers, Sofia, Moskva, 312 p.
- Uit de Weerd, D.R. & Gittenberger, E. 2005. Towards a monophyletic genus *Albinaria* (Gastropoda, Pulmonata): the first molecular study into the phylogenetic position of eastern *Albinaria* species. *Zoological Journal of the Linnean Society* 143(4): 531-542.
- Uit de Weerd, D.R. & Gittenberger, E. 2013. Phylogeny of the land snail family Clausiliidae (Gastropoda, Pulmonata). *Molecular Phylogenetics and Evolution* 67: 201-216.
- Reischütz, A., Reischütz, P.L. & Szekeres, M. 2016. The Clausiliidae subfamily Phaedusinae (Gastropoda, Pulmonata) in the Balkans. *Nachrichtenblatt der Ersten Voralberger Malakologischen Gesellschaft* 23: 93-117.
- Reischütz, A., Reischütz, P.L. & Szekeres, M. 2018. The genus *Tsoukatosia* Gittenberger 2000 (Gastropoda, Clausiliidae, Phaedusinae) in the Parnon Mountains (Greece, Peloponnesos). *Nachrichtenblatt der Ersten Voralberger Malakologischen Gesellschaft* 25: 51-58.

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CONSERVATION OF NON-MARINE MOLLUSCS IN CENTRAL SOUTHERN BRASIL: RECENT ADDITIONS TO THE INVENTORY OF SANTA CATARINA STATE

By A. Ignacio Agudo-Padrón

During 2018, based on the latest systematic list (Agudo-Padrón, 2018), ten new species (eight gastropods, six native, two non-native invasives) and two native bivalves were added to the current inventory of non-marine molluscs occurring in the state of Santa Catarina, the small geographically central



Fig. 1. Location of Santa Catarina state in Brasil. Map by Raphael Lorenzeto de Abreu, source Wikimedia Commons (GNU Free Documentation License).

portion of southern Brasil, part of the Atlantic slope of South America (Fig. 1). This addition means that there are now 242 species and subspecies confirmed in Santa Catarina state (including 28 non-native species: 24 gastropods, four bivalves). In total, there are 206 gastropods (160 terrestrial, 3 amphibian, 43 freshwater) and 36 freshwater bivalves (21 mussels, 14 clams, and the invasive golden mussel, *Limnoperna fortunei*). This inventory is the product of 23 years of systematic field research, examination of specimens in museum collections and parallel study of the literature.

For all taxa, information concerning their known regional geographic distribution have been incorporated/updated, according to the geographical division of Santa Catarina state into six major malacological regions, numbered as in Fig. 2.

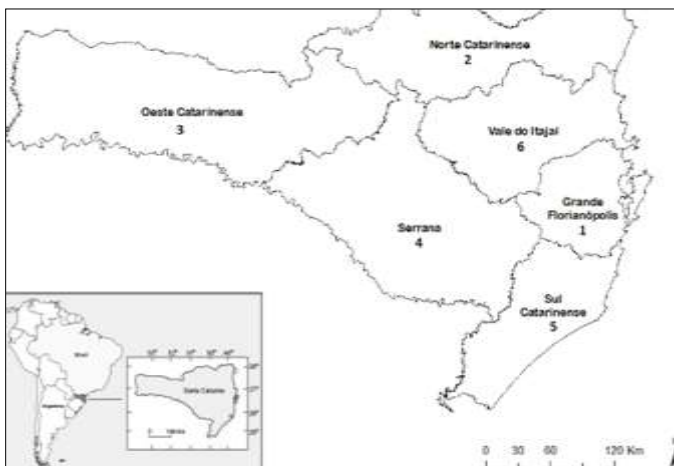


Fig. 2. Malacological regions of Santa Catarina State: 1, Greater Florianópolis, coastal and mountain region; 2, Northern region; 3, Western region; 4, Highlands region; 5, Southern region; 6, Itajaí River Valley region.

The recently incorporated species occur in malacological regions (r.) 1, 2 and 6 of the state. They include eight native species, as follows: the rare forest semi-slug *Peltella palliolium* (Férussac, 1821) (Amphibulimidae) (r. 2) (Fig. 3A), the pupiform snail *Gastrocopta servilis* (Gould, 1843) (Vertiginidae) (r. 1) (Fig. 3B), the amphibian semi-slug *Omalonyx matheroni* (Potiez & Michaud, 1838) (Succineidae) (r. 1, 6) (see Coscarelli *et al.*, 2018), the terrestrial planispiral snail *Streptaxis tumescens* Suter, 1900 (r. 1) (Streptaxidae) (Fig. 3C), the little clam *Cyanocyclus paranacensis* (d'Orbigny, 1835) (Cyrenidae) (r. 2) (Fig. 3D), the freshwater planispiral *Drepanotrema kermatoides* (d'Orbigny, 1835) (Planorbidae) (r. 2), the little limnic limpet *Anisancyclus*

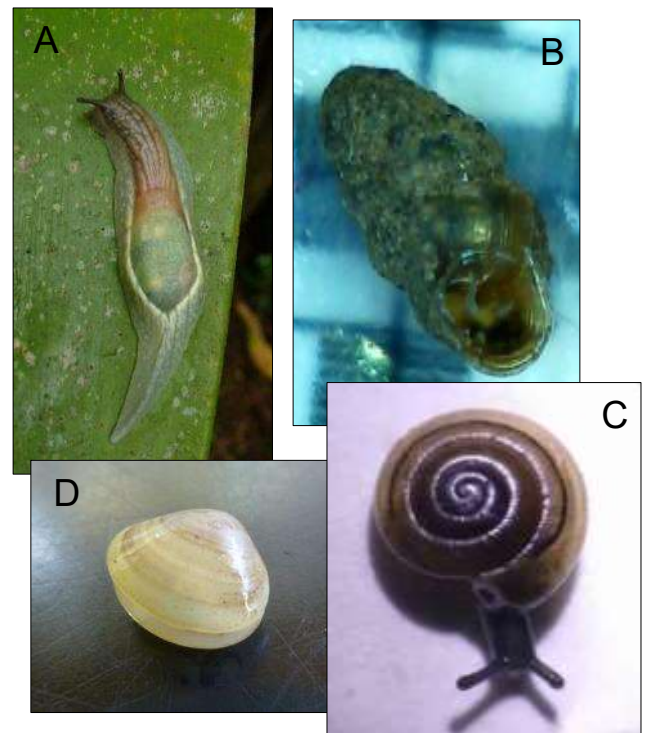


Fig. 3. A, *Peltella palliolium*. B, *Gastrocopta servilis*. C, *Streptaxis tumescens*. D, *Cyanocyclus paranacensis*.

obliquus (Broderip & Sowerby, 1832) (Planorbidae, previously Ancyliidae) (r. 2), the native freshwater mussel *Diplodon charruana* (d'Orbigny, 1835) (Hyriidae) (r. 6) and two alien invasive gastropods, the Asiatic (Japanese) terrestrial jumping snail *Ovachlamys fulgens* (Gude, 1900) (Helicarionidae) (r. 6) and the European freshwater snail *Galba truncatula* (Müller, 1774) (Lymnaeidae) (r. 6).

Reiterating once again that research into 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 regional 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.

Agudo-Padrón, A.I. 2018. Revised and updated systematic inventory of non-marine molluscs occurring in the state of Santa Catarina/SC, central southern Brazil region. *Advances in Environmental Studies* 2(1): 54-60.

Coscarelli, D., Montresor, L.C., Russo, P., Melo, A.L. de & Vidigal, T.H.D.A. 2018. Predicting the distribution of *Omalonyx* (Mollusca: Pulmonata: Succineidae) species from literature review, museum databases and new sampling efforts in Brazil. *Biota Neotropica* 18(1): 1-20.

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PERSPECTIVES ON SCIENCE COMMUNICATION AND PUBLIC OUTREACH FOR MALACOLOGISTS

By Katrin L. O'Donnell, Rodrigo B. Salvador, Julia Kasper, Barbara M. Tomotani, Daniel C. Cavallari, João V. Tomotani & Rhian A. Salmon

Science communication and public outreach are of utmost concern for malacologists working in conservation. However, malacology – and invertebrates in general – is often a difficult topic for science communicators to approach. Molluscs may be less interesting or less appealing to non-expert audiences than larger, more attractive vertebrates, but many invertebrate scientists have strategies and creative techniques for public engagement and outreach that are worth exploring. Our study is a preliminary research project assessing scientists' approaches and attitudes towards the infinitely broad topic of invertebrate science communication and outreach, as well as the public's understanding and engagement with it. Thus far, we have surveyed scientists from around the world, and we are currently in the process of distributing a complementary survey for non-scientists to the New Zealand publics. In this article, we hone in on some of our findings from the first survey as they pertain to mollusc conservation.

In 1993, Timothy New described a “crisis in invertebrate conservation” rooted in public prejudices towards invertebrate animals (New, 1993). Given the weight that public opinion can have in conservation efforts (e.g. Brockington *et al.*, 2006) and other policy issues, this lack of awareness of invertebrates has a significant effect on the allocation of funding to conservation projects that are focused on invertebrate animals such as molluscs (New, 1993). The need for effective science communication surrounding mollusc conservation is therefore clear, but the best media and methods for public outreach and engagement are contested. Much of the conversation is centered on overcoming people's disgust for invertebrate animals by correcting misinformation about specific species and filling in the knowledge gap in the public's perception of invertebrate science. This deficit model of science communication has been repeatedly challenged in recent years, with many scholars advocating for methodologies that focus on building trust between scientists and non-scientists.

Our first survey aimed to assess what strategies invertebrate scientists commonly employ when they engage with non-scientists. We had over 200 respondents, of which the largest proportion were malacologists (~33 %).

Among other things, we asked the respondents to nominate groups of organisms that, in their experience, tend to fascinate the public. Cephalopods ranked the highest (12.5 %), alongside lepidopterans. This may be surprising at first, but cephalopods have been receiving increased (social) media attention because of their intelligence and their communication and camouflage abilities. Moreover, when asked about specific species that are particularly good at capturing people's attention, Octopuses of the genus *Octopus* (especially *O. vulgaris*), the giant squid *Architeuthis dux*, and

the nautilus (genus *Nautilus*) were the most common responses alongside the monarch butterfly and the honeybee. Given the astounding diversity of invertebrates and the myriad of possible answers, the prevalence of these molluscs in response to this question is both impressive and encouraging. However, it is actually relatively straightforward to understand the appeal of these species. The giant squid is notable for being the largest invertebrate on the planet; it also has an air of mystery, since it was this species that gave rise to the legend of the Kraken (Salvador & Tomotani, 2014). The interest in nautilus is probably aesthetic, related to their beautiful and large shells, often used as ornaments; furthermore, their shells are usually presented to the public as mathematically perfect golden spirals, which is fallacious (Peterson, 2005).

Of course, cephalopods are just one branch of this diverse phylum, and the question of how to make the public interested in the less charismatic mollusc species is less straightforward. In response to this, a number of respondents told us about creative activities, techniques, and “tricks” that they have used to make people interested in bivalves, gastropods and other small invertebrates that hold a similar place in public imagination, but are in need of more attention and funding for conservation. For example, two respondents reported that a good way to entice the public and make them understand the importance of invertebrates is to link these animals to more “relatable” fauna. For instance, one malacologist said that placing land snails in a food web and linking the decline of snails to the decrease in songbird populations was an effective means of making people interested in mollusc conservation. This seems to be a common strategy, as we found that the most common overarching topic usually addressed by respondents was biodiversity, closely followed by conservation and evolution.

Hands-on activities are a great tool to engage the public, and can pave the way to deeper learning (van Dijck, 2003). A number of respondents strongly advocated for the use of live specimens in outreach activities, especially in the context of field trips. Even though this does not happen often, when scientists do have the opportunity to use live specimens the outreach is generally well-received and effective. A number of respondents said that showcasing local biodiversity (including fossils) was an effective engagement strategy, and helping people understand the importance of their region to scientific research seems to be a meaningful starting point for science communication. For example, one respondent recalled a leaf litter sorting activity in which the public identified various crustaceans, molluscs and insect larvae. Sorting leaf litter is a logistically simple task and thus a good introduction to food webs and life cycles of invertebrate animals. Another respondent recounted taking people on field trips during which they were able to find fossil animals themselves. The respondent described this as an incredibly effective engagement strategy, stating that “people like discovery, even if it's of less charismatic groups like bivalves”.

One respondent reported that outdoor field activities can be a very powerful tool to bring together groups with conflicting interests in the region, such as local farmers, environmental NGOs, government officials and attorneys. Another talked

about using field excursions to showcase habitats in need of protection and to raise money for conservation. Given the current popularity of online crowdfunding initiatives, this is a good path for NGOs and academic societies to explore. Some initiatives, including citizen science projects, are already starting to tap this potential (Jones *et al.*, 2017; Gallo-Cajiao *et al.*, 2018).

Overall, results from our survey present an optimistic view of the ways that public outreach initiatives can and do engage the public with issues relating to invertebrate science, including mollusc conservation. Our results have provided us with some great insights into the nuances of science communication and engagement strategies employed by invertebrate scientists around the world. Though it was not the focus of the survey, conservation was a major point, and many of the strategies employed in outreach initiatives were tied to making the public more aware of issues in invertebrate conservation.

We are now embarking on the second part of this research project, which takes a comparative approach by surveying the public about their engagement with invertebrate science communication. As we analyse and compare the results of these two surveys, we will address any dissonance between the perspectives of scientists and the general public on this topic. In other words, we hope to uncover what invertebrate scientists get right, and what they tend to get wrong about public engagement with their field. We expect that our research will offer some guidance to malacologists who are interested in public outreach and communication for the purposes of raising awareness of mollusc conservation. The results of our research will be published in an academic journal.

Brockington, D., Igoe, J. & Schmidt-Soltau, K. 2006. Conservation, human rights, and poverty reduction. *Conservation Biology* 20: 250-252.

Gallo-Cajiao, E., Archibald, C., Friedman, R., Steven, R., Fuller, R.A., Game, E.T., Morrison, T.H. & Ritchie, E.G. 2018. Crowdfunding biodiversity conservation. *Conservation Biology* 32(6): 1426-1435.

Jones, B.L., Unsworth, R.K.F., McKenzie, L.J., Yoshida, R.L. & Cullen-Unsworth, L.C. 2017. Crowdsourcing conservation: the role of citizen science in securing a future for seagrass. *Marine Pollution Bulletin* 134: 210-215.

New, T.R. 1993. Angels on a pin: dimensions of the crisis in invertebrate conservation. *American Zoologist* 33: 623-630.

Peterson, I. 2005. [Sea shell spirals](#). *Science News* 1 April 2005.

Salvador, R.B. & Tomotani, B.M. 2014. The Kraken: when myth encounters science. *História, Ciências, Saúde – Manguinhos* 21: 971-994.

van Dijck, J. 2003. After the “Two Cultures”: toward a “(multi)cultural” practice of science communication. *Science Communication* 25(2): 177-190.

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MOLLUSCS INCLUDED IN THE NEW VERSION OF THE RED BOOK OF BRASILIAN FAUNA THREATENED WITH EXTINCTION

By A. Ignacio Agudo-Padrón

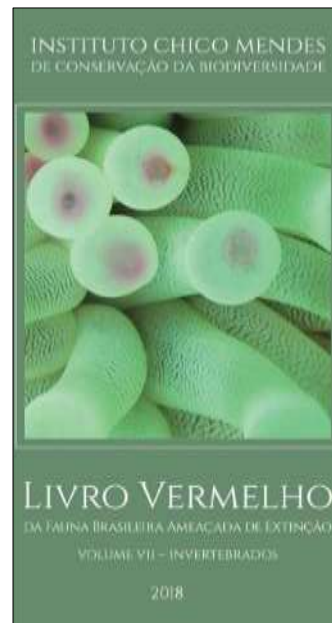


Fig. 1. The 2018 *Red Book of Brazilian Fauna Threatened with Extinction*

A product of the collective effort of approximately 1,700 faunal specialists from Brasil who participated in at least one of the stages of the evaluation process, the new version of the *Red Book of Brazilian Fauna Threatened with Extinction* (ICMBio, 2018) comprises seven volumes, and in *Volume 7 – Invertebrates* 23 species of molluscs are included and allocated to IUCN Red List categories: eight Critically Endangered, nine Endangered and six Vulnerable. Among these, six are marine (one bivalve, five gastropods), eight are terrestrial and nine are freshwater (two bivalves, seven gastropods) (Table 1).

A highlight is recognition that the forest snail *Megalobulimus cardosoi* (Morretes, 1952) (Strophocheilidae), which was formerly considered Extinct is now listed as Critically Endangered (Salvador *et al.*, 2018), a dramatic example of what little we actually know about our diverse malacofauna. Four freshwater species (two bivalves, two gastropods), as well as one coastal marine gastropod (Fig. 2) need to be re-evaluated (Agudo-Padrón, 2018).

Agudo-Padrón, A.I. 2018. The freshwater mollusks “officially endangered” in the state of Santa Catarina / SC, central southern



Fig. 2. *Olivancillaria contortuplicata*.

Brazil: a brief critical review of their current situation. *Ellipsaria* 20(2): 35-37.

Salvador, R.B., Charles, L., Simone, L.R.L. & Maestrati, P. 2018. Presumed extinct land snail *Megalobulimus cardosoi* found again in Pedra Talhada Biological Reserve, north-east Brasil. *Tentacle* 26: 13-14.

ICMBio [Instituto Chico Mendes de Conservação da Biodiversidade]. 2018. *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção. Volume VII – Invertebrados*. ICMBio, Brasília. 727 p.

Table 1. Mollusc species considered in the new 2018 *Red Book of Brazilian Fauna Threatened with Extinction*, with their IUCN threat categories. VU - Vulnerable, EN - Endangered, CR - Critically Endangered.

<i>Euvoila ziczac</i>	EN
<i>Diplodon koseritzi</i>	EN
<i>Mycetopoda legumen</i>	EN
<i>Pomacea sordida</i>	EN
<i>Spiripockia punctata</i>	EN
<i>Potamolithus karsticus</i>	CR
<i>Potamolithus troglolobius</i>	CR
<i>Macrodonates dautzenbergianus</i>	VU
<i>Thaumastus lundii</i>	CR
<i>Tomigerus gibberulus</i>	EN
<i>Lymnaea rupestris</i>	VU
<i>Megalobulimus cardosoi</i>	CR
<i>Physa marmorata</i>	VU
<i>Plesiophysa dolichomastix</i>	CR
<i>Hypselartemon alveus</i>	VU
<i>Gonyostomus insularis</i>	EN
<i>Succinea lopesi</i>	EN
<i>Phyllocaulis renschi</i>	EN
<i>Aliger costatus</i>	VU
<i>Eustrombus goliath</i>	VU
<i>Petalococonchus myrakeenae</i>	CR
<i>Olivancillaria contortuplicata</i>	CR
<i>Olivancillaria teaguei</i>	CR

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THE NON-MARINE ENDEMIC GASTROPOD MOLLUSCS OF SANTA CATARINA STATE, CENTRAL SOUTHERN BRASIL: A BRIEF UPDATE

By A. Ignacio Agudo-Padrón

Since 2012, 24 endemic non-marine gastropod species (3 freshwater, 21 terrestrial) have been recorded in Santa Catarina state on the Atlantic Slope of southern Brasil (Agudo-Padrón, 2012, 2018), representing 17 genera and 10 families (Table 1).

From a biogeographical point of view, 12 species were found in the upper Uruguay River basin in inland riparian areas of the Deciduous Seasonal Forest in the west of the state, including the very rare arboreal forest odontostomid *Macrodonates thielei* Pilsbry, 1930 (Fig. 1) and the rocky stream lymnaeid *Galba rupestris* (Paraense, 1982). Five species were found in the Itajaí Valley, the largest river basin

of the central Atlantic Slope in Santa Catarina, one in the highlands, three in the northern sector and one in the southern sector (Agudo-Padrón, 2018). Seven additional species have been recorded in the literature but with no locality information other than Santa Catarina state (Agudo-Padrón, 2018).

Table 1. Endemic non-marine gastropods of Santa Catarina state, central southern Brasil, recorded since 2012. Source: Project AM archives/database.

Helicinidae	<i>Alcaldia iheringi</i> Wagner, 1910
Hydrobiidae	<i>Potamolithus kusteri</i> (Ihering, 1893)
Thiaridae	<i>Aylacostoma</i> sp.
Lymnaeidae	<i>Lymnaea rupestris</i> Paraense, 1982
Bulimulidae	<i>Leiostracus</i> sp. <i>Protoglyptus dejectus</i> (Fulton, 1907) <i>Rhinus obeliscus</i> Haas, 1936 <i>Thaumastus sellovii</i> (King, 1831)
Amphibulimidae	<i>Simpulopsis (Eudiotops) araujo</i> Breure, 1975 <i>Simulopsis (Simulopsis) pseudosulculosa</i> Breure, 1975 <i>Simulopsis (Simulopsis) wiebesi</i> Breure, 1975
Odontostomidae	<i>Bahiensis occultus</i> (Reeve, 1849) <i>Bahiensis reevei</i> (Deshayes, 1851) <i>Macrodonates fasciatus</i> (Pfeiffer, 1869) <i>Macrodonates thielei</i> Pilsbry, 1930 <i>Moricandia parallela</i> (Pfeiffer, 1857)
Streptaxidae	<i>Rectartemon muelleri</i> (Thiele, 1927) <i>Streptaxis cypsele</i> (Pfeiffer, 1849) <i>Streptaxis iheringi</i> Thiele, 1927 <i>Streptaxis pfeifferi</i> (Pilsbry, 1930)
Systrophiidae	<i>Happia vitrina muelleri</i> Thiele, 1927
Charopidae	<i>Radioconus amoenus</i> (Thiele, 1927) <i>Radioconus goeldii</i> (Thiele, 1927) <i>Zilchogyra clara</i> (Thiele, 1927)

In the course of the last seven years the validity of the following genera within their respective families (Agudo-Padrón, 2012) was confirmed by reference to WoRMS (World Register of Marine Species, which also includes many non-marine taxa), resulting in the following changes: *Potamolithus* removed from Hydrobiidae and transferred to Tateidae, *Leiostracus* and *Rhinus*, removed from Bulimulidae and transferred to Simpulopsidae, *Simpulopsis* removed from Amphibulimidae and transferred to Simpulopsidae, and *Thaumastus* removed from Megaspiridae and kept in Bulimulidae.

Four major threats faced by the non-marine molluscs of Santa Catarina state have been identified during field work over the course of 23 years (1996-2018), according to the decreasing order of their impact as follows: 1) environmental modification with emphasis on deforestation of natural vegetation and alteration of river basins; 2) agricultural



Fig. 1. *Macrodonates thielei* Pilsbry, 1930 (Odontostomidae).

activities, 3) uncontrolled urbanisation, and 4) presence of non-native, invasive species introduced passively or actively.

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

Agudo-Padrón, A.I. 2012. New contributions to the systematic list of continental mollusks occurring in the state of Santa Catarina, Brazil. *Amici Molluscarum* 20(1): 35-42.

Agudo-Padrón, A.I. 2018. Revised and updated systematic inventory of non-marine molluscs occurring in the state of Santa Catarina/ SC, central southern Brazil region. *Advances in Environmental Studies* 2(1): 54-60.

Paraense, W.L. 1982. *Lymnaea rupestris* sp. n. from southern Brazil (Pulmonata: Lymnaeidae). *Memórias do Instituto Oswaldo Cruz* 77(4): 437-443.

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MARVELLOUS MUD SNAILS – CONSERVATION OF *OMPHISCOLA GLABRA* IN SCOTLAND

By Joanna Lindsay

The [Marvellous Mud Snails](#) project, funded by the Heritage Lottery Fund and local councils, is a two-year mission started by [Buglife](#) in April 2017 aiming to tackle the rapid decline of the pond mud snail (*Omphiscola glabra*) and bring it back to its former glory in Scotland.

Once widespread throughout lowland England, Wales and as far north as Perth in Scotland, the pond mud snail has declined by almost 50 % across its UK range in the last 25 years, with surveys in 2005-2006 highlighting a 64 % decline in Scotland alone. Habitat loss is the culprit in this crime, as the pools this snail calls home are frequently filled in and altered for human purposes. As a consequence, the pond mud snail has been categorised as Near Threatened on the [IUCN Red List](#) (Prié *et al.*, 2011), is “vulnerable” in the Red Data Books (Bratton, 1991) and is on the [Scottish Biodiversity List](#).

This tiny freshwater mollusc – rarely growing larger than 15 mm in length – inhabits nutrient-poor temporary pools, ditches and marshes, which often dry out or diminish during the summer season. During this time, the snails burrow into the mud where they remain inactive until the water returns, hence their common name. Unfortunately, these inconspicuous habitats generally go unnoticed and this ignorance has played a key part in the mud snail’s demise.

The three major goals of the Marvellous Mud Snails project are: to reassess the current population of the pond mud snail in Scotland, to double this population through captive breeding and habitat creation and to promote the importance of freshwater habitats through public engagement and education.

When the project began, the pond mud snail was known from just five sites across the whole of Scotland. Within the first year, two new populations were discovered bringing the total number of sites up to seven. The populations are spread



Fig. 1. Pond mud snails (*Omphiscola glabra*). (Photo: Scott Shanks)

widely across the Central Belt of Scotland, each in a different local authority area: Falkirk, Clackmannanshire, East Dunbartonshire, West Lothian, North Lanarkshire, Edinburgh and the Scottish Borders.

During the initial stages, individuals from each population were collected for captive breeding both in the Buglife Scotland offices and in local schools. Over the course of the two years, four of the seven populations bred successfully and juveniles from these populations have now been released into new habitats within their respective authority areas, increasing the total number of sites in Scotland to eleven. The four release sites will continue to be surveyed on an annual basis for the next four years to monitor the success of these new populations.

With very little research on this species having been done previously, it has been difficult to determine optimum conditions for rearing the snails in captivity and it is currently unclear why some populations had better survival and reproduction rates than others. However, Edinburgh Napier University is currently undertaking research on factors triggering breeding in this species and partners on the project

Fig. 2. One of the original sites for the pond mud snail (*Omphiscola glabra*) in Falkirk. (Photo: Joanna Lindsay)



from the Royal Zoological Society of Scotland are conducting genetic tests to determine the relative health of each population, so these studies may shed some light on the issue.

Supplementary to the conservation programme, the mud snail project has worked with nine schools and has engaged with over 2,000 members of the public to promote the importance of freshwater habitats for molluscs and other invertebrates. The Marvellous Mud Snails project in Scotland is due to end on 31 March 2019, but has been voted into the finals of the [Aviva Community Fund](#) to receive funding to go ahead in Cornwall, where the pond mud snail has also declined.

To find out more about the Marvellous Mud Snails project and Buglife's other work go to www.buglife.org.uk or follow @BuglifeScotland on twitter.

Bratton, J.H. 1991. *British Red Data Books. Part 3. Invertebrates Other than Insects*. Joint Nature Conservation Committee, Peterborough, UK.

Buglife. 2013. [Species management sheet. Pond mud snail \(*Omphiscola glabra*\)](#). Buglife, Peterborough, UK.

Prić, V., Seddon, M.B. & Vavrova, L. 2011. *Omphiscola glabra*. *The IUCN Red List of Threatened Species 2011*: [e.T156100A4894924](#). Accessed 20 February 2019.

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PACIFIC ISLAND LAND SNAILS

Fourth year of *Partula* species reintroductions into natural habitat on Tahiti and Moorea

By Trevor Coote & 27 others

September 2018 marked the fourth consecutive year of releases of *Partula* species – the majority extinct in the wild – from the international conservation breeding programme back onto their islands of origin (Table 1).

Species	Location	2015	2016	2017	2018	Total
Moorea						
<i>Partula mooreana</i>	Vairahi Valley	-	592	-	-	
	Afareaito Valley	-	-	344	-	936
<i>P. suturalis vexillum</i>	Morioahu Valley	-	374	-	-	
	Afareaito Valley	-	-	290	171	835
<i>P. taeniata simulans</i>	Morioahu Valley	-	67	-	-	
	Afareaito Valley	-	-	-	549	616
<i>P. tohiviana</i>	Afareaito Valley	-	193	204	-	
	Afareaito Valley	-	446	746	766	2,354
<i>P. taeniata nucleola</i>	Vairahi Valley	-	100	-	-	
	Afareaito Valley	-	-	206	201	507
<i>P. mirabilis</i>	Afareaito Valley	-	-	-	10	10
Tahiti						
<i>P. affinis</i>	Tefaaiti Valley	48	-	-	-	
	Faarapa Valley	-	201	129	240	480
<i>P. hyalina</i>	Papehuet Valley	-	8	90	71	
	Tefaaiti Valley	1	-	-	-	170
<i>P. nodosa</i>	Papehuet Valley	150	842	1777	-	
	Tefaaiti Valley	70	-	-	-	
	Maruapo Valley	-	35	-	-	2,804
Raiatea						
<i>P. dentifera</i>	Faarapa Valley	-	96	-	-	96
<i>P. tristis</i>	Faarapa Valley	-	38	-	-	38
<i>P. hebe</i>	Faarapa Valley	-	81	-	-	81
Total		269	3,073	3,786	2,008	8,927

Following the poor results, expense and impracticability of the reserve strategy in 2015, all subsequent releases of *Partula* have been directly into native trees (Figs. 1-3). At first these were all Tahitian chestnut or *mape* (*Inocarpus fagifer*) as this was the tree species in which surviving populations of *Partula clara* had been recently recorded persisting in the presence of the carnivorous rosy wolf snail (*Euglandina rosea*). However, that field release strategy has been refined over the years such that species with known shrub preferences, notably climbing pandanus or 'ie 'ie (*Freycinetia impavida*), were released into their preferred habitat. Regular monitoring has shown that the mortality rate of the released species, based on dead shells recovered, has remained low (Table 2).

Table 2. Post-release mortality of *Partula* released in 2018.

Species	Total released	Newborn and juveniles excluded	Adults found, live and dead	Adults dead	Adults % dead
Moorea					
<i>Partula tohiviana</i>	766	106	343	49	14.3
<i>P. suturalis vexillum</i>	171	58	85	3	3.5
<i>P. taeniata simulans</i>	549	416	153	5	3.3
<i>P. taeniata nucleola</i>	201	0	108	7	6.5
<i>P. mirabilis</i>	10	0	10	0	0
Tahiti					
<i>P. affinis</i>	240	174	60	8	13.3
<i>P. hyalina</i>	71	16	49	6	12.2
Total	2008	770	808	78	9.7

Partula releases 2018

There was one shipment (two crates) from UK zoo collections in 2018 with negligible mortality en route. The procedure for quarantine, marking and release followed that of previous years (see [Tentacle](#) 24, 25, 26). Two species – *Partula affinis* and *P. hyalina* – were released at two locations, the valleys of Faarapa and Papehuet on Tahiti (Table 3, Figs. 1, 2). On Moorea, three taxa – *P. tohiviana*, *P. suturalis vexillum*, *P. mirabilis* (first release of this species) and two subspecies of *P. taeniata* (*simulans* and *nucleola*) – were again released into Afareaito Valley at selected locations (Table 3, Fig. 3).

Table 3. *Partula* release details for 2018.

Species	Location	Arrival date	Release date	Number released
Moorea				
<i>Partula tohiviana</i>	Afareaito Valley	1 Sep 2018	3 Sep 2018	766
<i>P. suturalis vexillum</i>	Afareaito Valley	1 Sep 2018	4 Sep 2018	171
<i>P. taeniata simulans</i>	Afareaito Valley	1 Sep 2018	4 Sep 2018	549
<i>P. taeniata nucleola</i>	Afareaito Valley	1 Sep 2018	4 Sep 2018	201
<i>P. mirabilis</i>	Afareaito Valley	1 Sep 2018	4 Sep 2018	10
Tahiti				
<i>P. affinis</i>	Faarapa Valley	1 Sep 2018	5 Sep 2018	240
<i>P. hyalina</i>	Papehuet Valley	1 Sep 2018	7 Sep 2018	71
Total				2,008

Overview of the release programme

Individuals of all the species of *Partula* that are held in the international breeding programme have now either been released or earmarked for release. The following species of *Partula*, with their IUCN Red List conservation status indicated, have been involved in the releases.

Tahiti

- *Partula affinis* (CR). One known surviving population on the peninsula of Tahiti. Failed in the reserve but released



Fig. 1. *Partula affinis* in Faarapa Valley, Tahiti.



Fig. 2. Polynésie 1ère news records the release into Papehue Valley, Tahiti.



Fig. 3. *Partula suturalis vexillum* in Afareaito Valley, Moorea.

in 2016, 2017 and 2018 in a small ravine in the same region, Faarapa Valley. Estimated mortality rate for the three years is >10 %.

- *Partula hyalina* (VU). Widely distributed on Tahiti but not especially common. Released into Papehue Valley in

2016, 2017 and 2018. Estimated mortality rate for the three years is >10 %.

- *Partula nodosa* (EW). Most successful species in the breeding programme. Promising results from 2015 tree releases and released again in Papehue Valley (with a few in nearby Maruapo Valley) in 2016 and 2017. Estimated mortality rate for the three years is ~6 % but this may be an underestimate because of the complexity of the monitoring environment.

Moorea

- *Partula mooreana* (EW). Small sinistral species, specialist on 'ie'ie. A few initial deaths but some recruitment, too. Estimated mortality rate for the two years (2016, 2017 releases) is >8 %.
- *Partula suturalis vexillum* (EW, Fig. 3). Generalist. Rapid disperser. Estimated mortality rate for the three years (2016, 2017, 2018 releases) is ~3 %, though this may be an underestimate.
- *Partula taeniata* (EW, assessed at species level). *Partula taeniata elongata*, a generalist, persists in the wild but not in the breeding programme.
 - *Partula taeniata nucleola*. One known surviving population in western Moorea. May be the most promising species released, with individuals surviving from earlier years and a number of young produced. Estimated mortality rate for the three years (2016, 2017, 2018 releases) is ~8 %.
 - *Partula taeniata simulans*. May be extinct in the wild. Releases in 2016 and 2018. Seems fine in *mape* habitat. Difficult to estimate mortality rate but probably very low, ~3 %.
- *Partula tohiviana* (EW). Large, sinistral, 'ie'ie specialist, endemic to Afareaito Valley, where it has now been released in two locations, the main one being the site of the abandoned 1994 trial reserve. A number of deaths, some due to *Platydemus manokwari* predation, but survivors from previous years (released 2016, 2017, 2018) and a number of unmarked juveniles. Mortality >14 %.
- *Partula mirabilis* (EW). First release in 2018. Just ten adults but no observed deaths.

After regular monitoring of all releases on Tahiti and Moorea it is clear that although there are differences among species, the snails have in general successfully adapted to the novel conditions. However, the New Guinea flatworm (*Platydemus manokwari*) is currently a bigger potential threat to the *Partula* than is *Euglandina rosea*, and there have been a few victims in certain locations, notably *Partula tohiviana*, which when released often remains in lower shrubs making it more vulnerable to predation. Fortunately, most species have quickly dispersed higher into the trees out of reach of the flatworm. The known generalists such as *P. taeniata*, *P. suturalis* and *P. nodosa* look pretty secure.

With the process of reintroductions onto Tahiti and Moorea now well established this leaves Raiatea and Huahine as the final destination for Society Island *Partula* releases, planned for 2019. In 2016 the first releases of the three species from

Raiatea maintained in the breeding programme were severely compromised by predation from high densities of *Platydemus manokwari* (Fig. 4).

Raiatea

- *Partula navigatoria* (formerly *dentifera*) (EW). Ground-dwelling species. Half lost from 2016 release because of *Platydemus* predation.
- *Partula garretti* (formerly *tristis*) (EW). Species from western Raiatea. A third lost from 2016 release, probably mostly because of *Platydemus manokwari* predation.
- *Partula hebe* (EW). Small species, variety *bella*, with pink apex, from the south-east of Raiatea. A third lost from 2016 release, though it is unclear how many were *Platydemus manokwari* victims.

As a result of these relatively high losses no *Partula* have been released on Raiatea since but surveys are now being undertaken to establish the status and level of threat posed by the flatworm on Raiatea, as well as on Huahine.

Huahine

Huahine is different from the other reintroduction islands in that it was the centre of the shell jewellery tradition and also because a lack of government land means that reintroductions are dependent on the goodwill of local landowners. An initial limited visit in 2018 highlighted the problem of widespread insecticide spraying but a follow-up visit confirmed great local interest and keenness to participate, as well as locations that, though the habitat is not great, are free of crop spraying.

- *Partula varia* (EW). Formerly very widespread and traditionally harvested at sustainable rates for the making of shell jewellery.
- *Partula rosea* (EW). Also, formerly widespread and used by local artisans.



Fig. 4. Surveying for *Platydemus manokwari* on Huahine.

The overall current situation is thus as follows.

Tahiti and Moorea

Platydemus flatworms have been recorded at all release locations. Some *Partula tohiveana* have been victims of predation, in part because the released snails have tended to remain in lower 'ie'ie shrubs. However, the low estimated

mortality, the observation of individuals from the previous years' releases and dead adult shells that had been marked as younger developmental stages, suggest either *P. manokwari* is less efficient as a predator where snails move higher into the trees or that there had been an invasion that is now in decline.

Raiatea and Huahine

Surveys of both islands by Justin Gerlach in 2017 revealed high levels of infestation by *P. manokwari* on both islands. The priority is now to obtain sufficient field status updates before any releases planned for both islands in 2019 can be considered. In 2018 surveys at three potential release sites on Raiatea and two on Huahine suggested that the status of *P. manokwari* was not notably different from its status on Tahiti and Moorea. However, these surveys occurred during a very dry period when the flatworms tend to hide and more surveys are planned for the height of the rainy season early in 2019.

Conclusion

The *Partula* tree snail reintroduction programme is almost unprecedented in the world of conservation in terms of the number of species extinct in the wild being repatriated to their ancestral home. After four years of reintroductions onto three of the four Society Islands where all 12 of the released taxa originated, the rapid dispersal and very low mortality rate on Tahiti and Moorea has transcended expectations. However, the failure on Raiatea due to predation by the New Guinea flatworm *Platydemus manokwari* highlights the need for constant vigilance. The first in a series of surveys on Raiatea and Huahine into the status of *P. manokwari* on those islands took place in 2018 and will continue early in 2019 in preparation for releases later in the year. Reintroduction in itself does not guarantee reestablishment but early results certainly give hope.

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

- Coote, T. *et al.* 2018. Evolving strategy for release of *Partula* species back onto their islands of origin. [Tentacle 26](#): 16-19.
- Coote, T. *et al.* 2017. Ten endemic species of *Partula* reintroduced onto three of the Society Islands. [Tentacle 25](#): 36-38.
- Coote, T. *et al.* 2016. *Partula* return to Tahiti after 30 years of conservation efforts. [Tentacle 24](#): 45-48.
- Coote, T. 2012. Tahiti becomes the focus of *Partula* conservation. [Tentacle 20](#): 28-30.

- Coote, T. 2008. Revised Red List categories for Partulidae. In *2008 IUCN Red List of Threatened Species*. IUCN, Gland.
- Coote, T., Merz, R. & Pearce-Kelly, P. 2005 (revised 2006, 2009, 2010, 2012, 2013, 2014, 2015). *Action Plan for the conservation of French Polynesia's endemic tree snails of the genera Partula, Samoana, & Trochomorpha*. Partulid Global Species Management Programme in association with La Service Direction de l'Environnement de la Polynésie française.
- Coote, T., Clarke, D., Hickman, C.S., Murray, J. & Pearce-Kelly, P. 2004. Experimental release of endemic *Partula* species, extinct in the wild, into a protected area of natural habitat on Moorea. *Pacific Science* 58(3): 429-434.
- Coote, T. & Loève, E. 2003. From 61 species to five: endemic tree snails of the Society Islands fall prey to an ill-judged biological control programme. *Oryx* 37: 91-96.
- Gerlach, J. 2016. *Icons of Evolution: Pacific Island Tree Snails, Family Partulidae*. Phelsuma Press, Cambridge.
- Mace, G., Pearce-Kelly, P. & Clarke, D. 1998 An integrated conservation programme for the tree snails of Polynesia (Partulidae): a review of captive and wild elements. *Journal of Conchology Special Publications* 2: 89-96.
- Ó Foighil, D. 2009. Conservation status update on Society Island Partulidae. *Tentacle* 17: 30-35.
- Pearce-Kelly, P., Brewer, R., Coote, T., McFarlane, D. & Noelle, M. 2010. Conservation in a snail shell: working together to save some of Polynesia's most remarkable species. In: *Building a future for wildlife: zoos and aquariums committed to biodiversity conservation* (ed. Dick, G. & Gusset, M.), p. 167-172. World Association of Zoos and Aquariums Executive Office, Gland.
- Pearce-Kelly, P., Clarke, D., Walker, C. & Atkin, P. 1997. A conservation programme for the partulid tree snails of the Pacific region. *Memoirs of the Museum of Victoria* 56(2): 431-433.
- Pearce-Kelly, P., Mace, G. & Clarke, D. 1995. The release of captive bred snails (*Partula taeniata*) into a semi-natural environment. *Biodiversity and Conservation* 4: 645-663.
- Pearce-Kelly, P., Clarke, D. & Mace, G. 1994. *Partula '94: an action plan for the conservation of the family Partulidae*. Pacific Island Land Snail Group, Zoological Society of London, London.

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 Sam Aberdeen, *Partula* 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
 Dave Clarke, Team Leader, Zoological Society of London
 Maartje de Vries, Lead *Partula* keeper, Royal Artis Zoo
 Matai Depierre, Direction de l'environnement, Government of French Polynesia
 Jo Elliott, Animal Collection Manager, Royal Zoological Society of Scotland
 Glenn Frei, *Partula* SSP Studbook Keeper, St Louis Zoo
 Gerardo García, Curator of Lower Vertebrates & Invertebrates, North of England Zoological Society
 Justin Gerlach, Chair - Terrestrial and Freshwater Invertebrate Red List Authority (IUCN/SSC)
 Sandra Honigs, Curator, Landeshauptstadt Düsseldorf, Der Oberbürgermeister, Aquazoo - Löbbecke Museum
 Don McFarlane, International *Partula* Studbook Keeper, Auckland Zoo
 Bob Merz, *Partula* Species Survival Plan Coordinator, St Louis Zoo
 Bobbi Miller, Field Conservation Coordinator, Woodland Park Zoo
 Pete Mohan, Director of Animal Operations, Detroit Zoological Society

- Sarah Robinson, Conservation, Royal Zoological Society of Scotland
 Claude Serra, Direction de l'environnement, Government of French Polynesia
 Jamie Sincage, Zoological Manager Disney's Animal Kingdom,
 Ed Spevak, Curator Invertebrates, St Louis, Zoo
 Christoph Schwitzer, Director of Conservation, Bristol Zoological Society
 Janos Szánthó, Conservation projects, Artis Royal Zoo
 Miri Tatarata, Chief, Direction de l'environnement, Government of French Polynesia
 Scott Wilson, Head of Field Programmes, North of England Zoological Society
 Tim Woodfine, Director of Conservation, Marwell Wildlife
 Paul Pearce-Kelly, International *Partula* programme coordinator, Zoological Society of London

MARINE MATTERS

Where is the limpet that was here? The case of *Lottia noronhensis* from Brasil

By Luiz Ricardo L. Simone, Daniel Abbate, Patricia Oristanio V. Lima & Carlos Eduardo Belz

Since the 1990s a long-term project has been developed on western Atlantic insular malacofauna, mainly on Brazilian oceanic islands. Recently the seventh expedition by malacology researchers of Museu de Zoologia da Universidade de São Paulo to Fernando de Noronha, ~500 km from the northeastern Brazilian coast, was undertaken, in October 2018. The intention of the expeditions has been to observe the local malacofauna, collect samples and survey the malacofauna. One of the main goals is to determinate gene flow in supposedly the same or similar species among islands and with the mainland, mainly by DNA sequencing.

One of the species surveyed is *Lottia noronhensis* (E.A. Smith, 1890) (Fig. 1), family Lottiidae, an endemic species from Fernando de Noronha but clearly similar to the mainland species *L. sobrugosa* (d'Orbigny, 1846). It is expected that the anatomical and molecular differences between these species



Fig. 1. *Lottia noronhensis*, two living specimens just collected during the 2005 expedition, ventral view, larger specimen ~25 mm.

could clarify the interrelationships among lottiids of the region, and fresh samples are important for this.

Lottia noronhensis used to be very abundant on Fernando de Noronha (Fig. 2), occurring on the profuse local rocky shores, in the lower supratidal to high intertidal zones, as observed during the previous expeditions that took place over a period of almost 20 years.

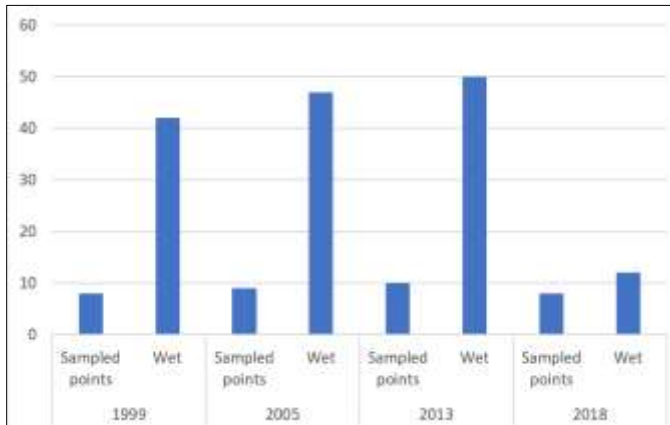


Fig. 2. *Lottia noronhensis*, histogram of specimens sampled in four of the seven expeditions (in the other three the specimens were checked but not collected). In 1999, 2005 and 2013 the collect was far from exhaustive, while in 2018 the histogram includes all specimens found, though most were not collected.

Looking for samples of this species during the 2018 expedition, it was shocking to record its almost total disappearance. In a week of concentrated effort, only 12 living specimens were found (not all collected), while in previous years we found, on average, 45 living specimens in non-exhaustive surveys. This intense decline of this endemic population is alarming and further studies must be undertaken to clarify the situation, as no ecological assessments have been made.

Interestingly, other mollusc species that occur in the same habitat, such as siphonariids, fissurellids and mytilids, were apparently not affected and maintain their previous density. This is the first alert to warn people of what has happened, with the hope of stimulating studies to determine the causes of this decline of *L. noronhensis*. Possibly the species is heading towards extinction. Recent development in Fernando de Noronha has been implemented to improve tourist access to the beaches and the numbers of people on the beaches. There have been no studies regarding the impact of these alterations and increased activities on the intertidal malacofauna. Possibly *L. noronhensis* has suffered from them.

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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 2018, it published two issues (volume 21, numbers 1 and 2) with five papers. All issues are available on-line at the journal's website, with open access.

- Do, V.T., Tuan, L.Q. & Bogan, A.E. 2018. Freshwater mussels (Bivalvia: Unionida) of Vietnam: diversity, distribution, and conservation status. *Freshwater Mollusk Biology and Conservation* 21(1): 1-18.
- McMurray, S.E., Hundlay, J.T. & Faiman, J.S. 2018. A survey of the freshwater mussels (Mollusca: Bivalvia: Unionida) of the Niangua River basin, Missouri. *Freshwater Mollusk Biology and Conservation* 21(1): 19-27.
- Lafrancois, T., Fritts, A., Knights, B. & Garner, J.T. & Karns, B. 2018. Stable isotope comparison between mantle and foot tissues of two freshwater unionids: implications for food web studies. *Freshwater Mollusk Biology and Conservation* 21(2): 28-35.
- Jones, J., Lane, T., Ostby, B., Beaty, B., Ahlstedt, S., Butler, R., Hubbs, D. & Walker, C. 2018. Collapse of the Pendleton Island mussel fauna in the Clinch River, Virginia: setting baseline conditions to guide recovery and restoration. *Freshwater Mollusk Biology and Conservation* 21(2): 36-56.
- Roznere, I., Sinn, B.T. & Watters, G.T. 2018. The *Amblyma plicata* transcriptome as a resource to assess environmental impacts on freshwater mussels. *Freshwater Mollusk Biology and Conservation* 21(2): 57-64.

Malacological Review

I am informed by Dr. Tom Duda of the University of Michigan that *Malacological Review* is no longer to be published, despite my positive announcement in last year's *Tentacle* that it was still alive. The last volume to be published was 45/46 (2017), which is available on-line at the link above. Although there were plans to make previous issues also available on-line, I do not know whether this will happen. If it does, I will announce it in a future issue of *Tentacle*.

Journal of Medical and Applied Malacology

I am also informed by Dr. Duda that the *Journal of Medical and Applied Malacology* is also unlikely to continue publication. If I hear more news about this journal I will also include a note about it in a future *Tentacle*.

Journal of Threatened Taxa

All issues for 2018, and the first three for 2019, of the *Journal of Threatened Taxa* are available on-line now.

AMS Imperiled Species Newsletter

Keep up to date on threatened and endangered molluscs with the American Malacological Society's Imperiled Species Newsletter from Jay Cordeiro, Chair of the AMS Conservation Committee. It is available on the [AMS conservation webpage](#). The most recent issue is for [January 2016](#), reporting on events in 2015. Maybe a new one will be forthcoming.

The Sound of a Wild Snail Eating

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



Here is my usual notice of this delightful book. It was originally reviewed in [Tentacle 19](#) (2011). The original hard cover version was published in the USA in 2010, but hard cover editions in English and translations in French, German, Chinese, Japanese and Korean are also available. In 2018 it became available in Italian (left), published by [Marsilio Editori](#). It is available in paperback in some countries. It has received global

accolades. I still thoroughly recommend it. An [audiobook](#) edition is available as a Kindle or hard CD. And there will soon be a movie (see [p. 2](#) of this issue of *Tentacle*)! Check out the [author's website](#).

Other publications of interest

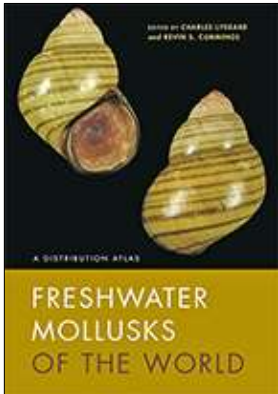
This is not a comprehensive list but simply a list of publications that I have happened to come across, additional to those mentioned elsewhere in this section. If you want to have your publications listed in the next issue of *Tentacle*, please send details to me, Robert Cowie, the editor of *Tentacle*.

- Archambault, J.M., Prochazka, S.T., Cope, W.G., Shea, D. & Lazaro, P.R. 2018. Polycyclic aromatic hydrocarbons in surface waters, sediments, and unionid mussels: relation to road crossings and implications for chronic mussel exposure. *Hydrobiologia* 810(1): 465-476.
- Balashov, I., Kramarenko, S., Shyriaieva, D. & Vasyliuk, O. 2018. Invasion of a Crimean land snail *Brephulopsis cylindrica* into protected relict steppe hilltops (tovtrs) in western Ukraine: a threat to native biodiversity? *Journal of Conchology* 43(1): 59-69.
- Balashov, I., Vasyliuk, O., Shyriaieva, D., Shvydka, Z., Oskyrko, O., Marushchak, O., Stetsun, H., Bezsmertna, O., Babytskij, A. & Kostushyn, V. 2018. Terrestrial molluscs in the dry grasslands of the Dnipro upland (central Ukraine): new records, rare species and conservation potential. *Vestnik Zoologii* 52(1): 3-12.
- Bick, C.S., Pearce-Kelly, P., Coote, T. & Ó Foighil, D. 2018. Survival among critically endangered partulid tree snails is correlated with higher clutch sizes in the wild and higher reproductive rates in captivity. *Biological Journal of the Linnean Society* 125(3): 508-520.
- Blakeslee, C.J., Silldorff, E.L. & Galbraith, H.S. 2018. Changes in freshwater mussel communities linked to legacy pollution in the lower Delaware River. *Northeastern Naturalist* 25(1): 101-116.
- Bossenbroek, J.M., Burlakova, L.E., Crail, T.C., Karatayev, A.Y., Krebs, R.A. & Zanatta, D.T. 2018. Modeling habitat of freshwater

- mussels (Bivalvia: Unionidae) in the lower Great Lakes 25 years after the *Dreissena* invasion. *Freshwater Science* 37(2): 330-342.
- Bouska, K.L., Rosenberger, A., McMurray, S.E., Lindner, G.A. & Key, K.N. 2018. State-level freshwater mussel programs: current status and a research framework to aid in mussel management and conservation. *Fisheries* 43(8): 345-360.
- Cao, Y.-L., Liu, X.-J., Wu, R.-W., Xue, T.-T., Li, L., Zhou, C.-H., Ouyang, S. & Wu, X.-P. 2018. Conservation of the endangered freshwater mussel *Solenia carinata* (Bivalvia, Unionidae) in China. *Nature Conservation* 26: 33-53.
- Geist, J., Moorkens, E., Killeen, I., Feind, S., Stoeckle, B.C., Connor, Á.O. & Kuehn, R. 2018. Genetic structure of Irish freshwater pearl mussels (*Margaritifera margaritifera* and *Margaritifera durrovensis*): validity of subspecies, roles of host fish, and conservation implications *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(4): 923-933.
- Gladstone, N.S., Carter, E.T., McKinney, M.L. & Niemiller, M.L. 2018. Status and distribution of the cave-obligate land snails in the Appalachians and interior low plateau of the eastern United States. *American Malacological Bulletin* 36(1): 62-78.
- Grego, J. 2018. First record of subterranean rissoidean gastropod assemblages in Southeast Asia (Mollusca, Gastropoda, Pomatiopsidae). *Subterranean Biology* 25: 9-34.
- Hausdorf, B., Walther, F. & Neiber, M.T. 2018. Molecular phylogeny and systematics of *Acrotoma* (Gastropoda: Clausiliidae) from the Caucasus. *Systematics and Biodiversity* 16(7): 692-713.
- Kappes, H. 2018. Mollusken- und Asselbeobachtungen aus dem Rheinbogen bei Köln-Porz-Langel. *Schriften zur Malakozoologie* 30: 29-38.
- Krebs, R.A., Prescott, T.J., Clapham, W.B., Jr. & Klarer, D.M. 2018. Freshwater mussel assemblages at the lotic-lentic interface along Lake Erie. *American Malacological Bulletin* 36(1): 31-41.
- Marshall, N.T., Banta, J.A., Williams, L.R., Williams, M.G. & Placyk, J.S., Jr. 2018. DNA barcoding permits identification of potential fish hosts of unionid freshwater mussels. *American Malacological Bulletin* 36(1): 42-56.
- Richart, C.H., Chichester, L.F., Boyer, B. & Pearce, T.A. 2018. Rediscovery of the southern California endemic American keeled slug *Anadomulus cockerelli* (Hemphill, 1890) after a 68-year hiatus. *Journal of Natural History* on-line early.
- Rudzīte, M., Boikova, E., Dreijers, E., Jakubāne, I., Jermakovs, V., Parele, E., Pilāte, D. & Rudzītis, M. 2018. Distribution and protection of the molluscs of Latvia. *Schriften zur Malakozoologie* 30: 19-28.
- Torres, S., Cao, L., Gutiérrez Gregoric, D.E., de Lucía, M., Brea, F. & Darrigran, G. 2018. Distribution of the Unionida (Bivalvia, Paleoheterodonta) from Argentina and its conservation in the southern Neotropical Region. *PLoS ONE* 13(9): e0203616.
- Wiese, V. 2018. *Vertigo angustior* Jeffreys 1830 auf der Insel Fehmarn (Gastropoda: Vertiginidae). *Schriften zur Malakozoologie* 30: 47-48.
- Zieritz, A. & Lopes-Lima, M. 2018. *Handbook and National Red-List of the Freshwater Mussels of Malaysia*. Zieritz & Lopes-Lima, Kuala Lumpur, 29 p.
- Zieritz, A., Bogan, A.E., Froufe, E., Klishko, O., Kondo, T., Kovitvadi, U., Kovitvadi, S., Lee, J.H., Lopes-Lima, M., Pfeiffer, J.M., Sousa, S., Do, T.V., Vikhrev, I. & Zanatta, D.T. 2018. Diversity, biogeography and conservation of freshwater mussels (Bivalvia: Unionida) in East and Southeast Asia. *Hydrobiologia* 810(1): 29-44.



Forthcoming publication



Freshwater Mollusks of the World. A Distribution Atlas. Edited by Charles Lydeard & Kevin S. Cummings. Johns Hopkins University Press, Baltimore, USA. 256 p.

To be published in 2019. Can be ordered now on the [publisher's website](#); will ship in March. Price: \$125.00.

From the publisher's website:

"There are more species of freshwater mollusks – well over 5,000 – than all the mammal

species of the world. Freshwater mollusks are also arguably the most endangered fauna on the planet. Yet few references exist for researchers, shell enthusiasts, and general readers who are interested in learning more about these fascinating creatures. In *Freshwater Mollusks of the World*, Charles Lydeard and Kevin S. Cummings fill that void with contributions from dozens of renowned mollusk experts.

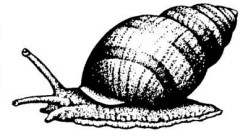
"Touching on 34 families of freshwater gastropods (snails) and nine families of freshwater bivalves (mussels and clams), each chapter provides a synthesis of the latest research on the diversity and evolutionary relationships of the family. The book also includes

- a look at how evolving DNA sequencing data techniques help shed light on mollusk taxonomy
- distribution maps of each family's biogeographic locales
- a representative photo and distribution map for each of the freshwater mollusk families
- the latest information on each family's conservation status – and how to reverse the habitat destruction, modification, and pollution that threatens it
- a discussion of the ecological and economic damages caused by invasive mollusk species, as well as their role as disease vectors

"Mollusks provide us with amazing biogeographical insights: their ancient fossil record goes back over 500 million years, and their distribution patterns are a reflection of past continental and climate changes. The only comprehensive summary of systematic and biodiversity information on freshwater mollusk families throughout the world, this reference is a must for malacologists, limnologists, ichthyologists, stream ecologists, biogeographers and conservation biologists."

Contributors: Christian Albrecht, Rüdiger Bieler, Bert Van Bocxlaer, David C. Campbell, Stephanie A. Clark, Catharina Clewing, Robert H. Cowie, Kevin S. Cummings, Diana Delicado, Hiroshi Fukuda, Hiroaki Fukumori, Matthias Glaubrecht, Daniel L. Graf, Diego E. Gutiérrez Gregoric, Kenneth A. Hayes, Yasunori Kano, Taehwan Lee, Charles Lydeard, Nathaniel T. Marshall, Paula M. Mikkelsen, Marco T. Neiber, Tímea P. Neusser, Winston Ponder, Michael Schrödl, Alena A. Shirokaya, Björn Stelbrink, Carol A. Stepien, Ellen E. Strong, Maxim V. Vinarski, Amy R. Wethington, Thomas Wilke.

IUCN AND MOLLUSC SPECIALIST GROUP NEWS AND ANNOUNCEMENTS



www.iucn.org/

All news and announcements provided by Mary Seddon, chair of the Mollusc Specialist Group (MSG) of the IUCN [Species Survival Commission](#) (SSC).

Change of Leadership

On 15 February 2019, the IUCN Director General Ingar Andersson announced that she had been nominated to take the position of the Executive Director of the United Nations Environment Programme. UNEP and IUCN already have a close working relationship since a previous IUCN DG, Achim Steiner, held the position from 2006 to 2016. If accepted by the UN General Council, then IUCN will appoint an interim director pending a new appointment. This was announced on the [IUCN website](#) on 21 February 2019.

IUCN World Conservation Congress 2020

The [next IUCN congress](#) will be held from 11 to 19 June 2020 at Parc Chanot in Marseille, France. It is backed at all levels of French government, from the municipal level to the national government, and has full engagement from French IUCN members. There are 49 IUCN Member organisations in France and the IUCN French National Committee, aims to facilitate cooperation between them and other parts of the Union. This meeting will discuss the new global targets to curb the escalating biodiversity crisis under the UN Convention on Biological Diversity, which are due to be set later in 2020. This is also the year when the Paris Agreement on climate change will formally come into effect and start being implemented, with countries submitting new or updated pledges. SSC members may attend as observers, but cannot vote, unless part of an IUCN member delegation.

Both IUCN and SSC are currently working to develop their work plans for 2020-2025. These will be presented to congress for approval. IUCN's current work plan can be seen on the website, but includes development of new tools such as the [IUCN Green List](#) and the [IUCN Red List of Ecosystems](#), as well as increased use of National Red Lists and increased involvement of indigenous peoples in conservation actions. SSC also has a work plan, aimed to include, when possible, those priority activities undertaken by specialist groups that move towards a common goal. For example, many of the Mollusc Specialist Group (MSG) activities contribute to "Assessing the Barometer of Life" as well as monitoring progress towards determining the likelihood of achieving the Aichi target for "no net loss" of biodiversity by 2020.

Developing motions to put to IUCN congress

The period to submit new motions to go before the congress will open later in 2019. These could include requests for IUCN to consider implementing new conservation actions, undertaking reviews of the impact of climate change or making representations about conservation issues on which governments and NGOs could work in partnership towards solutions. Only member organisations (NGO or governmental) can submit a motion, but specialist group members can work with organisations to help prepare motions, as we did in 2016 when we helped with the motion led by Tony Whitten ([Fauna and Flora International](#)) on limestone quarrying.

How does the MSG work with SSC and IUCN?

At present most of IUCN SSC Mollusc Specialist Group (MSG) activities revolve around Red Listing, measuring the impact of species loss on ecosystems and promoting conservation actions for Red Listed species.

Over the last five years, MSG members have been consulted on various cross-cutting issues for SSC. These have included review of new CITES monitoring protocols for several mollusc taxa, development of the criteria for the [Green List of Species](#), review of the criteria for [Key Biodiversity Areas](#) (KBAs), setting of thresholds for KBAs and the IUCN Green List of Species, review of classification schemes for threats and conservation actions and developing monitoring schemes for freshwater KBAs. As Chair, I thank all the members involved in these reviews, whose time and energy is very welcome and who add a unique perspective to these ongoing processes, as invertebrate specialists who deal with animals that have very different life histories from those of the many bird, mammal and amphibian specialist groups whose scientists are also contributing to the process of compilation and evaluation of new schemes.

IUCN Freshwater Biodiversity Unit projects

The IUCN SSC Mollusc Specialist Group continued to work with the Freshwater Biodiversity Unit on several projects over the last year.

Christian Albrecht has been working on a reassessment of the Lake Malawi molluscs, which were last assessed in 2005-2007. There have been various taxonomic changes in the intervening period and the new information will be published in 2019 with a full report available online.

Thomas von Rintelen has been working on an assessment of the molluscs of the Malili Lakes in Sulawesi, a region on which he has been working with other malacologists for over a decade. In this time there have been considerable changes in the habitats as well as the introduction of new species of fish in the lakes. These assessments will be published in 2019 and a full report will be available online. There are serious concerns about the status of these species and urgent conservation actions are now required to prevent further extinctions.

The next stage of reassessments for the West African freshwater molluscs will be commencing in 2019. In 2009 it was recognised that many of the species of conservation concern

occurred in river rapids that had highly oxygenated water and where damming and other activities could affect water quality.

For further information contact Catherine.sayer@iucn.org

IUCN European Unit projects

The report for the European Terrestrial Mollusc project is currently being finalised and will be available in 2019.

Although a proposal has been submitted for 2020 to undertake reassessments for the freshwater molluscs, as yet full funding has not been secured. In 2011 it was recognised that many of the species of conservation concern occurred in the springs used for domestic water supplies and were threatened by water abstraction, damming, increased frequency of droughts and other disturbances that could affect water quality or loss of habitat. Other threats came from pollution and conversion of land because of urbanisation and agricultural development. If the status of a species has changed because of changing threats, members are invited to continue to update assessments until a comprehensive reassessment is financed.

For further information contact davidallen@iucn.org or eike.neubert@nmbe.ch

IUCN Western Mediterranean projects

Work is ongoing in the Sebou and Doura River systems to define KBAs for the molluscs. A report will be available in 2019. The next stage involves creation of a monitoring protocol and Manuel Lopes-Lima is leading this for the SSC Mollusc Specialist Group.

For further information contact lopeslima.ciimar@gmail.com or Catherine.numa@iucn.org

IUCN SSC Sampled Red List Index freshwater mollusc project

Although a proposal is being developed for 2020 to undertake reassessments for all 1,200 global freshwater molluscs, as yet full funding has not been secured. In 2009-12 it was recognised that many of the species of conservation concern occurred in the springs used for domestic water supplies and were threatened by water abstraction, damming, increased frequency of droughts and other disturbance that could affect water quality or loss of habitat. Other threats to the bivalves came from pollution, damming and invasive species. If the status of a species has changed because of changing threats, members are invited to continue to update assessments via Monika Böhm, until a comprehensive reassessment is financed.

For further information contact Monika.Bohm@ioz.ac.uk

Grant Opportunities

Mohamed bin Zayed Species Conservation Fund

[Grants](#) in support of endangered and critically endangered species. Grants (up to US\$25,000) are awarded to individuals, communities and organisations for conservation of threatened or poorly known animal, plant and fungi species worldwide. Deadlines are 28 February, 30 June and 31 October 2019.

JRS Biodiversity Foundation

The current call for proposals to the [JRS Biodiversity Foundation](#) focusses on biodiversity informatics for African freshwater and pollinator biodiversity. The call requests proposals for multi-year projects focussed on biodiversity data, knowledge and information services related to freshwater biodiversity and pollinator biodiversity in eastern and southern Africa. Each multi-year grant will range from about US\$50,000 to about US\$250,000. Deadline for applications is 28 February 2019. [No doubt too late for readers of this issue of *Tentacle*, but something to be aware of in the future (Robert Cowie – editor)].

National Geographic Society Species Grants

IUCN Species Survival Commission (SSC) in partnership with the [National Geographic Society](#) (NGS), provide species grants with the aim of halting further biodiversity decline.

The quarterly request for proposals (RFP) will allow applicants to implement IUCN SSC Species Conservation Plans for species and groups of species. Typical proposal requests should be less than \$30,000; however, applicants may request up to \$50,000. Successful applicants may use awarded funds over one or two years. For species with no published Species Action Plans, please ensure that the proposed actions reflect the published Red List species account. Contact one of the Red List coordinators to update a species listing prior to making an application.

Proposals that focus on the following themes are encouraged:

- Specific and defensible priority actions to avert decline of a species or group of species
- Projects that include the active involvement of early career conservationists
- Projects that support conservation leaders from the countries where the species or group of species occur

Applications for NGS grants will require a letter of endorsement from the specialist group chair and should be made through the website.

For further information please visit the [NGS RFP website](#) or write to speciesrecovery@ssc.iucn.org

Learning Opportunities

Graduate / Professional Training at Smithsonian-Mason School of Conservation

The Smithsonian-Mason School of Conservation ([SCBI](#)) is excited to announce its upcoming course schedule for 2019. All courses are currently either one or two week intensive residential courses hosted in the school's sustainably built Academic Center on the grounds of SCBI in Front Royal, Virginia, USA. All courses offer continuing education credits (CEUs) and some can be taken for graduate credit as well. Limited scholarships are available for eligible applicants to some programmes. Visit their [website](#) for more details about each course, course costs and credits earned. The school expects more courses to be confirmed in the near future for

late 2019, so check the website regularly. Spring programmes include: Statistics for Ecology and Conservation Biology (11-22 March 2019), Communication and Facilitation Skills for Conservation Managers (8-12 April 2019) and Practical Zoo Nutrition Management (6-10 May 2019).

Durrell Conservation Academy

The [DCA](#) based at Jersey Zoo is running a number of [courses](#) in 2019, as follows.

- Endangered Species Recovery, 9-21 September. Introduction to the practical skills involved in saving threatened species.
- Integrated Species Conservation and Management, 28 October - 1 November. Theoretical and practical skills required for effective management of threatened species.

Opportunities to work with the SSC Mollusc Specialist Group

Most of these opportunities are voluntary positions and do not come with any funding. SSC is a volunteer network devoted to trying to prevent species extinction and promote and exchange information ensuring best conservation practice. For more information contact the MSG Chair, Mary Seddon: mary.molluscsg@gmail.com

Assistance needed documenting Limestone Extinctions

At the last IUCN Congress in Hawaii in 2016, Tony Whitten (FFI; [Fauna and Flora International](#)) put forward a motion to congress asking IUCN to promote actions towards preventing species extinctions caused by uncontrolled quarrying of limestone. This motion was passed by the general congress but before certain actions could be finalised, such as the code of conduct for quarrying, Tony died in a road accident (see In Memoriam, [Tentacle 26](#)). At the IUCN congress in 2020, all motions passed in 2016 will have various progress reports presented. In order to monitor future impacts of quarrying, FFI and the MSG are keen to maintain the momentum in continuing to document declines and extinctions caused by quarrying. If anyone is interested in volunteering to act as a coordinator to work with the chair over the next 12 months to prepare a report on impacts of limestone quarrying on molluscs on a worldwide basis, but especially in Asia, please contact the MSG Chair, Mary Seddon: mary.molluscsg@gmail.com

Assistance needed documenting impact of microplastics on molluscs

A recent quick survey of malacologists suggests that we consider that an under-valued threat to molluscs, especially filter feeders, is the increased volume of microplastics in the oceans and inland waters. However, at present the Red List does not recognise this specific threat, hence we cannot use this as a data source to support a motion at the next IUCN congress in Marseille in 2020. If anyone is interested in volunteering to act as a coordinator to work with the chair of Red List assessments for freshwater molluscs and other specialists over the next 12 months to prepare a report on

impacts of microplastics on molluscs on a worldwide basis, please contact the MSG Chair, Mary Seddon: mary.molluscsg@gmail.com

Assistance needed documenting decline of Freshwater Bivalves

There are still over 300 species of freshwater bivalves in need of Red List assessments to complete the goal of assessing all freshwater bivalves. If anyone is interested in helping to document these species, which includes creating a map as well as compiling a general account of life history, distribution, fish hosts, threats to the species and current or potential conservation actions, then we would be interested in hearing from you. You would need to successfully complete the online training course for Red List assessments prior to starting to compile species assessments. Please contact Manuel Lopes-Lima, the chair of Red List assessments for freshwater molluscs: lopeslima.ciimar@gmail.com

Testers for new extinction methodologies

IUCN is developing a new set of extinction methodologies, to provide a better guide to the likelihood that a species has become extinct, based on the limited sighting data over the last century. At present, the current guidelines are rather qualitative and whilst some papers have been published on various groups, including molluscs, there are some issues that still arise in terms of the testing. IUCN wishes to develop a standardised methodology and hence is interested in testing different data sets against a range of different methods. A group of SSC scientists and others have developed a new approach for EX and CR(PE) listings, published in a series of three papers last year (see references below). An initial testing of this approach is being carried out by [BirdLife International](#) on a set of bird species.

If you have a dataset and the inclination to assess species with the proposed methods, even a few species you know well, in fact even a single species, this would be useful. The ideal dataset would be a set of species including some that are likely to be extinct, some likely to be extant (but not recently recorded) and some in between. The expertise necessary for these assessments is knowledge of the history of records and surveys of the species and the threats they face. Additional technical support will be provided by the Red List Standards and Petitions Subcommittee and the Red List Technical Working Group.

The main goals of this testing would be to determine the applicability of the methods and to develop practical guidelines. If the methods are demonstrated to be generally applicable, they will be fully incorporated into the Red List Guidelines as possible approaches to listing species in these categories.

The three methodologies for testing are described in the following publications:

Keith, D.A., Butchart, S.H.M., Regan, H.M., Harrison, I., Akçakaya, H.R., Solow, A.R. & Burgman, M.A. 2017. Inferring extinctions I: a structured method using information on threats. *Biological Conservation* 214: 320-327.

Thompson, C.J., Koshkina, V., Burgman, M.A., Butchart, S.H.M. & Stone, L. 2017. Inferring extinctions II: a practical, iterative model based on records and surveys. *Biological Conservation* 214: 328-335.

Akçakaya, H.R., Keith, D.A., Burgman, M., Butchart, S.H.M., Hoffmann, M., Regan, H.M., Harrison, I. & Boakes, E. 2017. Inferring extinctions III: a cost-benefit framework for listing extinct species. *Biological Conservation* 214: 336-342.

If you would like to contribute to this effort please contact MSG Chair, Mary Seddon for further information: mary.molluscsg@gmail.com

Recent IUCN Publications

Oil palm and biodiversity: a situation analysis by the IUCN Oil Palm Task Force

Meijaard, E., Garcia-Ulloa, J., Sheil, D., Wich, S.A., Carlson, K.M., Juffe-Bignoli, D. & Brooks, T.M. (eds.) 2018. *Oil Palm and Biodiversity. A Situation Analysis by the IUCN Oil Palm Task Force*. IUCN Oil Palm Task Force, IUCN, Gland, Switzerland. xiii + 116 p. doi.org/10.2305/IUCN.CH.2018.11.en ([pdf](#))

The situation analysis focusses primarily on oil palm in the context of biodiversity conservation based on literature published before 31 January 2018 and aims to provide a constructive pathway to addressing sustainability challenges in the oil palm industry. This report does not assess the social and economic implications of oil palm production and expansion but refers to these when they are likely to have an impact on biodiversity conservation. Through identification of key knowledge gaps, the situation analysis will also provide direction to the Oil Palm Task Force in terms of seeking to address these knowledge gaps in the remainder of the 2017-2020 quadrennium.



Guidelines for invasive species planning and management on islands

IUCN. 2018. *Guidelines for Invasive Species Planning and Management on Islands*. IUCN, Cambridge, UK, and Gland, Switzerland. viii + 40 p. doi.org/10.2305/IUCN.CH.2018.15.en ([pdf](#))

Invasive species are plants, animals, disease agents and other organisms taken beyond their natural range by people, deliberately or unintentionally, and that become destructive to the environment or human livelihoods (often known as pests, weeds and diseases). Islands are particularly vulnerable to invasive species because of the evolution of their native animals and plants in isolation from predators and diseases, and the dependence of island people on imports, travel and tourism, which lead to high rates of arrival of new pests. These guidelines are designed to assist anyone planning and programming the management of invasive species on islands, with the aim of reducing the negative impacts of invasives on



the islands' rich and fragile natural heritage, communities and livelihoods. The document provides guidance for anyone who has to find, plan and prioritise funds and resources for invasive species management and research, on islands anywhere, including for the design of national invasive species strategies and action plans. It provides support for islanders and island agencies working on invasives, as well as

guidance for international and regional agencies in providing assistance to them. A major aim is to help and guide the development of more objective, realistic and achievable invasive species plans and programmes.

Tools for measuring, modelling, and valuing ecosystem services. Guidance for Key Biodiversity Areas, natural World Heritage sites, and protected areas

Neugarten, R.A., Langhammer, P.F., Osipova, E., Bagstad, K.J., Bhagabati, N., Butchart, S.H.M., Dudley, N., Elliott, V., Gerber, L.R., Gutierrez Arrellano, C., Ivanić, K.-Z., Kettunen, M., Mandle, L., Merriman, J.C., Mulligan, M., Peh, K.S.-H., Raudsepp-Hearne, C., Semmens, D.J., Stolton, S. & Willcock, S. 2018. *Tools for Measuring, Modelling, and Valuing Ecosystem Services. Guidance for Key Biodiversity Areas, Natural World Heritage Sites, and Protected Areas*. IUCN, Gland, Switzerland. x + 70 p. <https://doi.org/10.2305/IUCN.CH.2018.PAG.28.en> ([pdf](#))



Increasing interest in measuring, modelling and valuing ecosystem services (ES), the benefits that ecosystems provide to people, has resulted in the development of an array of ES assessment tools in recent years. Selecting an appropriate tool for measuring and modelling ES can be challenging. This document provides guidance for practitioners on existing tools that can be applied to measure or model ES provided by important

sites for biodiversity and nature conservation, including Key Biodiversity Areas (KBAs), natural World Heritage sites (WHS), and protected areas (PAs). Selecting an appropriate tool requires identifying the specific question being addressed, what sorts of results or outputs are required, and consideration of practical factors such as the level of expertise, time and data required for applying any given tool. This guide builds on existing reviews of ES assessment tools, but has an explicit focus on assessing ES for sites of importance for biodiversity and nature conservation.

MEETINGS 2018-2019

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, editor.

World Congress of Malacology in conjunction with the annual meetings of the American Malacological Society and the Western Society of Malacologists



The 2019 World Congress of Malacology will take place 11-16 August 2019 at the Asilomar Conference Grounds, Pacific Grove, California, USA, hosted by the California Academy of Sciences. Details of registration, accommodation, abstract submission (deadline 30 April 2019), keynote speakers, symposia and thematic sessions, and field trips are available on the [Congress website](#) or for additional information send e-mail to wcm2019@calacademy.org.

Brasilian Society of Malacology 2019 meeting

The Brazilian Society of Malacology (SBMa – Sociedade Brasileira de Malacologia) will hold its XXVI Brazilian Malacological Meeting (XXVI EBRAM) in the city of Juiz de Fora, state of Minas Gerais, southeastern Brasil, 7-11 October 2019. The congress will be hosted by the Universidade Federal de Juiz de Fora (UFJF) in Juiz de Fora, where the SBMA was founded.

In 2019 we are celebrating the 50th anniversary of the founding of the Brazilian Society of Malacology! The program will cover three main areas:

- Memory and history of malacology in Brasil
- Malacological collections in Brasil

- Current challenges for conservation and knowledge about the diversity of molluscs in Brasil

A fourth 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 poster 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.

Students will be able to compete for the “Prof. Maury Pinto de Oliveira Award to Incentivise Malacological Studies” (for work in general Malacology) and for 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

Profa. Dra. Sonia Barbosa dos Santos – President of the Brazilian Society of Malacology

Profa. Dra. Sthefane D’ávila – Head of the XXVI EBRAM

Conchologists of America 2018 convention



The 2019 COA convention will take place 17-18 June (field trips) and 19-23 June (meeting) on beautiful Captiva Island in Florida, USA. For information, visit the [COA Conventions website](http://www.coaconventions.com).

Island Biology 2019



Connecting the three major oceans in the Malagasy region hotspot: emphasizing large biodiversity rich islands and conservation studies of islands

The University of La Réunion is delighted to be the venue for the next international Island Biology conference. After Hawaii and the Azores, the third Island Biology conference will be held 8-13 July 2019 on La Réunion in the heart of the Malagasy region biodiversity hotspot, and its neighboring islands in the southern hemisphere.

At the crossroads of three major biogeographical regions of the World (Afrotropical, Indomalayan, Australasian), the Indian Ocean hosts islands of highly contrasting climate, from

tropical to Antarctic conditions, and of highly contrasting size, from immense islands facing environmental challenges of continental scale to small islands paving the way for restoration and rewilding projects. The conference will gather scientists from all over the world and practitioners working together on islands with particular emphasis on ecology, evolution, conservation and biogeography of terrestrial and marine biotas.

For more information please contact
Dr. Claudine Ah-Peng
Université de La Réunion
UMR PVBMT
7 chemin de l'IRAT
97410 Saint-Pierre
La Réunion, France
claudine.ahpeng@gmail.com

International Congress for Conservation Biology 2019



The [Society for Conservation Biology](http://www.scb.org) (SCB) 29th International Congress for Conservation Biology ([ICCB 2019](http://www.iccb2019.org)) will be held in Kuala Lumpur, Malaysia, 22-26 July 2019.

Researchers, students, agency personnel, environmental educators, practitioners, and other conservation stakeholders will join us for lively discussions on the nexus between biodiversity conservation and genetics, ecology, biogeography, anthropology, history, psychology, economics, conservation marketing, religion and more.

Find a schedule at a glance [here](http://www.iccb2019.org) for more information.

INTERNET RESOURCES

These are just a few of the many websites dealing with molluscan conservation, and with molluscs and conservation in general.

Red List

The entire *IUCN Red List of Threatened Animals*, now redesigned, can be searched at any of the following addresses, which all take you to the same website:

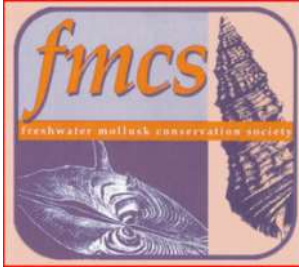
www.redlist.org www.redlist.net www.iucnredlist.org

Unitas Malacologica

[Unitas Malacologica](http://www.umalacologica.org) (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*.

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*.

Mollusca list

The MOLLUSCA listserver is intended as an informal forum for discussions of molluscan biology. There are over 700 subscribers. From time to time it has something of interest related to conservation. To subscribe to the list send e-mail to molluscalist@lists.berkeley.edu with the word Subscribe in the subject line. You will get a reply soon after saying that your name has been added. You will then receive anything that is posted to the list. To post to the list, send email to molluscalist@lists.berkeley.edu. MOLLUSCA is maintained and managed by David R. Lindberg of the University of California Museum of Paleontology, Berkeley, USA.

Mollia



The [MOLLIA](#) web site includes instructions to authors, subscription information and links to malacological journals. It also allows you to subscribe to the MOLLUSCA listserver (above).

MOLLIA, like MOLLUSCA, is maintained by David Lindberg at the University of California Museum of Paleontology, Berkeley, USA.

MolluscaBase

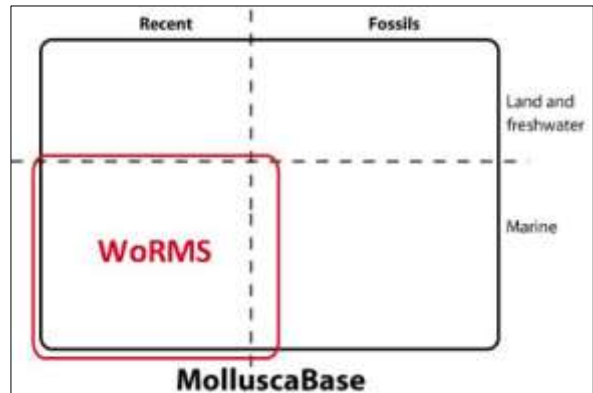
[MolluscaBase](#) is a taxonomically oriented database that aims to provide an authoritative, permanently updated account of all molluscan species.

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.



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*.

American Malacological Society



The homepage of the [American Malacological Society](#) carries a link to its [conservation policy](#) and to the [AMS Conservation Committee Imperiled Species Newsletter](#). Student research grants are available.

Western Society of Malacologists



The [WSM](#) home page carries links to membership, conferences, grants, and other news.

Brasilian Society of Malacology



The [Sociedade Brasileira de Malacologia](#) (SBMa) welcomes malacological researchers, professionals and students, Brazilian 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 Brazilian mollusc fauna.

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.

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.

Unio listserv

[Unio](#) is an unmoderated internet listserv 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).

IUCN Invasive Species Specialist Group

The [ISSG website](#) includes details of the Aliens-L listserv and the ISSG newsletter, [Aliens](#).

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.

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.

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.

Hawaii Biological Survey

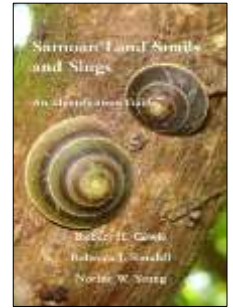


The [Hawaii Biological Survey](#) (based at the Bishop Museum, Honolulu) web site has searchable databases and much additional information on most Hawaiian organisms, including both indigenous (99 % endemic)

and non-indigenous land and freshwater snails, endangered species, and so on.

Samoan Snail Project

The [Samoan Snail Project](#) has 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 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, Dinarzade 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.

Haus der Natur – Cismar

The [Haus der Natur](#) homepage carries a link to a page on mollusc conservation in Germany, as well as other links.

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/

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 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, etc.) in past issues. 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.

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”!

Printing and mailing of *Tentacle* has been supported in the past by [Unitas Malacologica](http://www.molluscology.org/), the international society for the study of molluscs, for which the Mollusc Specialist Group is most grateful. To become a member of UNITAS, go to its website and follow the links to the application.

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 listserv (for details, see [p. 47](#) 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, or at least soon thereafter).

SSC MOLLUSC SPECIALIST GROUP

In order to keep these details up to date, please inform the editor, Robert Cowie, of any changes or corrections.

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