

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  
Associate Editor – Kathryn E. Perez



## EDITORIAL

Please note that I have placed the guidelines for submissions to [Tentacle](#) towards the end of this issue in order not to distract readers from the real content of the newsletter. But please follow those guidelines as carefully as possible – it helps me enormously in putting *Tentacle* together.

A major landmark publication appeared in 2016: Justin Gerlach's monograph on the Partulidae, entitled *Icons of evolution: Pacific island tree snails, family Partulidae*. This is an important contribution that has been needed for many years. The last comprehensive revision of the Partulidae was that of Yoshio Kondo, his 1955 PhD dissertation, which, alas, was never published. I trust that Yoshi would be happy that Justin took up the challenge and would be pleased with the result. You can obtain a copy via Justin's [Partulid research website](#).

Partulids are certainly in the news. For the second year running *Tentacle* reports on the reintroduction of partulids to the Society Islands of French Polynesia. Let's hope that the new releases fare well and multiply. Achatinellids have also been released in Hawaii and we hope they do well, too.

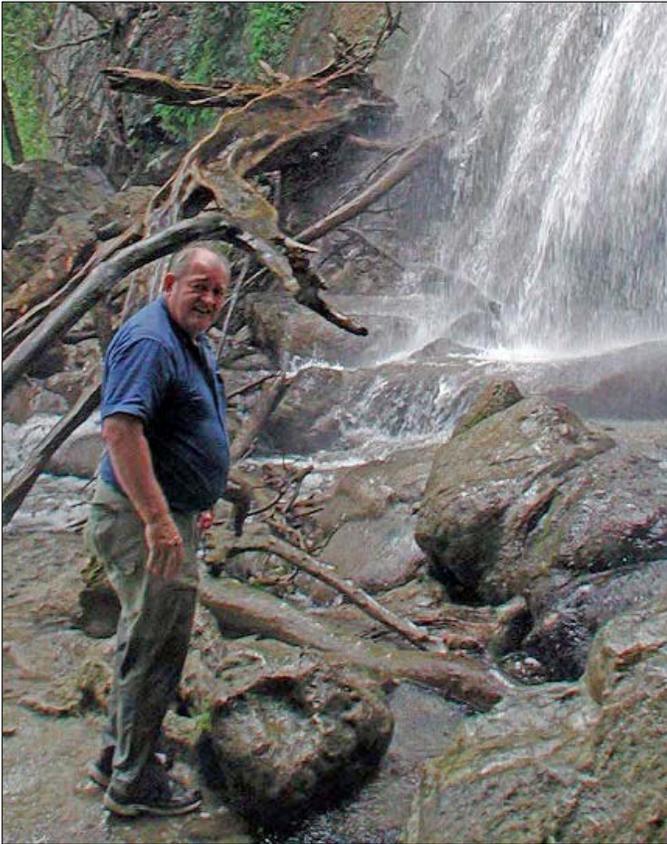
But although partulids gain a lot of publicity, many more species throughout the world are the subjects of articles in every issue of *Tentacle* because they are threatened to various degrees. While the majority of articles in *Tentacle* are about land snails, this issue includes an article by Julia Sigwart about a spectacularly unusual newly discovered and described marine snail of Indian Ocean hydrothermal vents, known as the scaly-foot gastropod because of the unique armour of plates covering the dorsal surface of its foot. Its potential global habitat is only around 0.27 km<sup>2</sup>. It is clearly in need of conservation action, especially as it is severely threatened by mining concessions that, in fact, threaten the entire faunas of all hydrothermal vents in international waters.

Robert H. Cowie

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## IN MEMORIAM — FRED G. THOMPSON

By John Slapcinsky



**Fig. 1.** Fred G. Thompson conducting fieldwork at Cascadas de Micos, in the state of San Luis Potosi, Mexico.

Leading non-marine malacologist Fred G. Thompson (Fig. 1) died Tuesday, 27 December 2016 at the age of 82. Born in 1934 in Cleveland, Ohio, Fred was fascinated by the natural world from an early age. Herpetology was his initial interest, but during his travels he was struck by the diversity of non-marine molluscs and became intrigued by the lack of published research on the group. This realisation propelled him on a 65 year long odyssey to nearly every corner of the planet to discover, study and publish on these diverse, poorly known and often endangered animals.

Fred's first papers on the systematics of land snails in Mexico and Central America were published while he was an undergraduate at the University of Michigan, from where he graduated in 1958. He received his Master of Science degree at Wayne State University in 1961. After graduating, Fred moved to Florida where he received his PhD at the University of Miami in 1964. His dissertation led to his seminal work on the hydrobiid snails of Florida's springs (Thompson, 1968). These taxonomically difficult, minute and diverse snails are often restricted to single spring runs and include numerous species that are highly endangered by hydrological changes and other habitat modifications resulting from Florida's rapid Anthropocene development. The existence of many of these species would not be known if not for Fred's extensive surveys throughout the state.



**Fig. 2.** Type locality of *Hendersoniella miquihuanae* (Thompson & Correa-Sandoval, 2011) east of Sierra Los Soldados in the state of Tamaulipas, Mexico.

In 1965 Fred moved to the University of Florida to work as a Research Associate and in September 1966 he was hired as the Florida Museum of Natural History's first mollusc curator. Through his tireless fieldwork and careful acquisition of private and orphaned collections, he took a small collection of a few hundred local molluscs and grew it into the largest mollusc collection in the southeast USA and one of the largest in the country with over half a million specimen lots comprising approximately three million specimens. The collection has the largest non-marine snail collections in the world from Hispaniola, Mexico-Central America, Madagascar, Pakistan and Thailand, and has especially large holdings from the southeastern USA, West Indies, Andean South America, Southeast Asia and Oceania. Fred was also an early proponent of collection digitisation. Because of his foresight, the entire collection is accessible online, serving data on more molluscs than any other collection in the world.

Throughout his career, he continued his fieldwork on non-marine snails of Mexico and Central America (Fig. 2) leading to the discovery of many species (Fig. 3) and resulting in the only modern compilation of the non-marine molluscan fauna of the area (Thompson, 2011). His work on freshwater snails in the southeastern United States and especially Florida led to



**Fig. 3.** *Hendersoniella miquihuanae* (Thompson & Correa-Sandoval, 2011), an aberrant urocoptid, and one of many species discovered and described by Fred G. Thompson.



**Fig. 4.** Fred G. Thompson speaking at his retirement party at the Florida Museum of Natural History in October 2012.

the publication of the only key to Florida's freshwater snails (Thompson, 1999) and helps form the basis for most other research on these highly endangered animals.

Fred was honored with an Appreciation Award for his "Dedication and support in preserving the Wekiva River Basin" by the Friends of the Wekiva River in 2001 and he received a Lifetime Achievement award from the Florida Association of Benthologists in May 2011. Fred retired, becoming Curator Emeritus, in October 2012 (Fig. 4) and continued to work on his beloved molluscs until his death. His contributions continue to be felt through his students, many of whom work at museums, universities and government agencies in the USA, Mexico and Central America.

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## NEWS

### Mollusks in Peril Forum

From Robert H. Cowie (Editor of *Tentacle*)

A forum entitled "[Mollusks in Peril](#)" took place in May 2016 at the Bailey-Matthews National Shell Museum on Sanibel Island, Florida, USA, at the instigation and with the support of Smoky and Stephanie Payson, and organised by the Museum's Executive Director Dorrie Hipschman and Science Director and Curator José Leal. The forum brought together a group of biologists closely involved with current large-scale threats to molluscan diversity to discuss, through presentations and

panels, the challenges facing arguably the second most species-rich (numbers of described species) group of animals on earth, after Arthropoda. Over 50 people participated in the forum.

A six minute professionally produced video outlining some of the major issues discussed at the forum is available on [YouTube](#), featuring Dorrie Hipschman, Smoky Payson and a number of the presenters. Videos of most of the full presentations can also be seen on YouTube by following the links from this short video, or by clicking on the links provided in the following list of speakers and presentation titles.

[Robert Cowie](#) - What do we know about mollusk extinctions?

[Kenneth Hayes](#) - Pacific island land snail conservation: case studies from the Hawaiian Islands

[Norine Yeung](#) - To know is to care: stemming the decline of mollusks and malacologists

[Arthur Bogan](#) - Freshwater mollusks in peril

[Chuck Lydeard](#) - Hidden diversity in plain sight: delimiting species boundaries in freshwater mollusks

[Brad Seibel](#) - Human-induced threats to pelagic mollusks

Julia Sigwart - Is mining the seabed bad for mollusks?

[Emily Carrington](#) - Hanging on by a thread? Mussel attachment in a warmer, higher-CO<sub>2</sub> world

[Mark Eakin](#) - Hot sour soup: how climate change and ocean acidification endanger coral reefs and mollusks

[Meredith White](#) - The impacts of coastal acidification on early larval growth and development of bay scallops (*Argopecten irradians*)

[George Waldbusser](#) - Ocean acidification threats to seashells at the beginning and end of life for marine bivalves

Two of these contributions (Cowie, Sigwart) are scheduled to be published in the March 2017 issue of [The Nautilus](#).

## THE UNEXPLORED POTENTIAL OF VIDEO GAMES FOR ANIMAL CONSERVATION

By Rodrigo B. Salvador

There is no doubt that the media and works of fiction, like novels and films, can contribute greatly to environmental and ecological education. One particular type of medium has grown considerably in the last decade: video games. It is widely known today that games out-perform Hollywood, generating much more revenue than the movie industry (e.g. Chatfield, 2009; McGurk, 2014). As such, it is not a big stretch to think that games can and should have a much more prominent role in eco-environmental education. However, this area still constitutes a tremendous untapped potential as virtually no video game company has dared to explore it.

The game *Never Alone* explored this opportunity a little and, despite being more focused on culture than ecology, it is a reasonably successful story that serves as an example of my point. Developed by the company Upper One Games and published by E-Line Media, *Never Alone* launched for multiple platforms in November 2014. The game was made in partnership with Inuit storytellers and is based on Alaskan indigenous stories. The player controls an Iñupiaq girl named

Nuna and her arctic fox friend (Fig. 1) and certain in-game actions unlock special “extras”, which are short documentaries about the Arctic, its fauna and its people, focussing mainly on Inuit culture and myths. The critics acclaimed the game’s cultural context and the effort put into the educational aspects. The important message from *Never Alone* is that one can have an actual game with actual informative content, contrary to educational games used for teaching, which are usually off-putting for students (and gamers) and may actually do more harm than good.



**Fig. 1.** Scene from *Never Alone*, showing Nuna and her fox companion. Screenshot of the game taken from [Riot Pixels](#). Copyright Upper One Games and E-Line Media.

Another success story can be found in the world-famous *Angry Birds* franchise, from Rovio Entertainment Ltd. Rovio took a more direct environmentalist approach and, in a handful of different instances, joined forces with several organisations in actual conservation efforts (e.g. [BirdLife International](#), [United for Wildlife](#), [WWF](#)). These efforts were mainly related to birds, of course, but some mammal species also received attention.

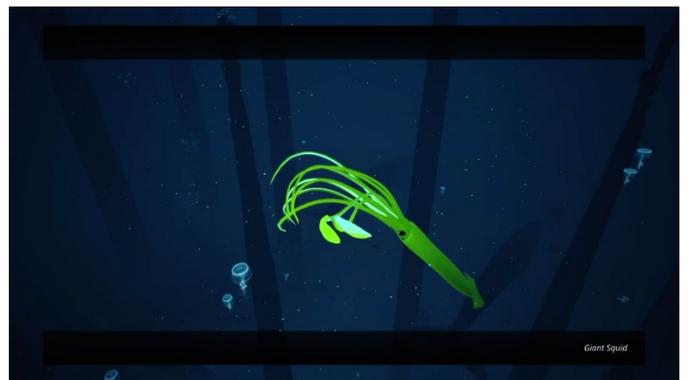
The last two years saw the release of two video games that prominently feature animals that usually never get the public’s attention, namely molluscs. These games are *Splatoon* and *Abzû* and they will be explored here in turn.

*Splatoon* was published by Nintendo Co., Ltd. and launched in May 2015 for the *Nintendo Wii U* console, becoming an instant hit. The game belongs to a genre called “third-person shooter”, but the characters shoot ink instead of bullets. And that is for a very simple reason: they are squids. Named inklings, the creatures from the game can alternate between a cartoonish squid form and a humanoid form, with tentacles springing from their hair (Fig. 2). As argued by Salvador & Cunha (2016), the developing team behind *Splatoon* took great care to be as biologically accurate as possible with their cartoonish squids, only compromising biology when gameplay features should take precedence. Despite this care in depicting the animals, and the certain awareness about squids *Splatoon* raised among the gaming community, Nintendo did not take the game one step further. Unfortunately, the company did not invest in the game’s potential for educating players and raising environmental awareness, nor move towards some kind of cephalopod conservation effort.



**Fig. 2.** Scene from *Splatoon*, showing blue and orange inklings (in both humanoid and squid form) battling. Screenshot of the game taken from [Riot Pixels](#). Copyright Nintendo Co., Ltd.

*Abzû* was developed by the company Giant Squid, published by 505 Games Ltd. and released in August 2016 for the *PlayStation 4* console and *Microsoft Windows*. This game is an underwater adventure focusing on exploration of the sea and peaceful interactions with its fauna. *Abzû* features artistic, but still reasonably accurate, renditions of several animal species (identified by their common names or, eventually for the more obscure ones, by the genus name) and includes faithful depictions of behaviour, such as predation and shoaling. A remarkable section of the game consists of the player exploring the depths where *Architeuthis* lives (Fig. 3). Other molluscs include other squid species, octopuses, nautilus and even a “forgotten animals trove” with living ammonoids.



**Fig. 3.** Scene from *Abzû* showing the giant squid *Architeuthis*. Screenshot of the game. Copyright Giant Squid and 505 Games Ltd.

It is a shame that games such as *Splatoon* and *Abzû* failed to invest in ecological education, because the potential is certainly there. Not only have such games reached lots of people (especially children in the case of *Splatoon*), they also prominently feature invertebrates, which are typically not a priority in conservation efforts (Wilson, 1987; Salvador & Tomotani, 2014). Raising awareness of these animals, either through the cute cartoonish squids of *Splatoon* or the awe-inspiring “krakens” of *Abzû*, could go a long way to bringing people to their defense. Moreover, molluscs have been featured in games for a very long time, but usually as

monstrous enemies (e.g. Cavallari, 2015). Thus, games that depict these animals as positive protagonists or allies are definitely a change in the right direction.

Naturally, people have already realised that there is this potential of games for education. For instance, [Games for Change](#) is a nonprofit corporation, founded in 2004, dedicated to using games as a tool for social change. Although successful, for now few of the games they curate are high-profile enough to attract much attention (some exceptions include *Never Alone* and *Life Is Strange*). Moreover, besides a couple of games exploring topics such as recycling and global warming, their focus is clearly on society and not on nature, so none of the games has a strong conservation edge. Fortunately, I am not alone in realising that there is this potential, as other academics (who may also be gamers) are also beginning to see this (Dorward *et al.*, 2017). It falls to us to make sure that video game companies also realise this and that this immense untapped force for conservation starts to be explored.

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## CROWDSOURCING AND CONSERVATION OF INDIAN NON-MARINE MOLLUSCS

By Aravind N.A.

In a resource crunched world, conservation of biodiversity becomes more challenging. Unless we know which species are distributed where, it is difficult to plan for their conservation and management (Groves *et al.*, 2002). The lack of trained scientists and resources is a major limitation for any conservation programme and hinders the collection of data at a large spatial scale. One way to overcome these limitations, to a certain extent, is to use citizens or volunteers to collect data, i.e. crowdsourcing by citizen scientists. Citizen science is engaging the public in scientific research and a citizen scientist is one who collects and/or processes data as part of a scientific project purely on a voluntary basis (Silvertown, 2009). A large amount of

data can be procured through these kinds of crowdsourcing efforts in a small time-window and over a large spatial scale. Apart from generating big data, citizen science initiatives can have increased outreach and networking advantages.

Despite the critiques of citizen science initiatives for scientific research because of questions regarding data quality, there are many studies that have shown its potential in ecological and conservation research (Aravind, 2013; Pimm *et al.*, 2015). These crowdsourcing efforts are not new in the biodiversity and conservation fields. Several attempts in the past have used citizens to map the distribution of various taxa with varying levels of success (Dickinson *et al.*, 2010; Ingwell & Preisser, 2011). However, many of these efforts are biased towards charismatic animals such as birds.

Global initiatives on crowdsourcing mollusc data are very limited. The [Evolution Megalab](#) citizen science project to study mollusc evolution in the backyard is one of the earliest efforts in Europe. The Snails and Slugs Living in Metropolitan Environments ([SLIME](#)) is a citizen science project by the Natural History Museum of Los Angeles County that aims to catalogue terrestrial gastropods in southern California.

Indian efforts in using citizen science in data collection for scientific and conservation purposes is limited and biased towards birds and plants. There are two citizen science portals that have data on Indian molluscs: [India Biodiversity Portal](#) (IBP) and [iNaturalist](#). The IBP is an open access citizen science platform dedicated to Indian flora and fauna. In this portal amateurs and experts can interact easily (Vattakaven *et al.*, 2016), share data and identify organisms. On the other hand, iNaturalist is a global initiative. Apart from these structured initiatives, there are other platforms where citizen scientists contribute data enormously, especially in the form of photos, i.e. Facebook, [indianaturewatch](#), Flickr, etc. These are rather ad hoc in nature with only the location and date information provided. At our centre, we collate data from both structured and ad hoc sources by assigning geo-coordinates where these data are not available. This database is used for addressing various ecological and conservation questions.

As of 17 November 2016, a total of 1,287,957 observations had been posted in the India Biodiversity Portal. Of these, around 557 are mollusc observations, only 0.05 % of the total number of observations. On the same date, iNaturalist had 170 observations on molluscs, of which 65 were identified to species level and 90 to genus level. Among these, 22 land snail observations were identified to species level, with seven of these being of the Western Ghats endemic *Indrella ampulla* (Ariophantidae) and 10 of the invasive *Achatina fulica* (Achatinidae). In addition, 45 marine species were identified to species level.

India harbours 1,340 mollusc species (210 freshwater and 1,130 terrestrial) with endemism ranging from 40 % in freshwater to 80 % for terrestrial snails. The amount of observational data available in these portals is rather disappointing. This poor representation is due to lack of popular field guides, taxonomic difficulties, limited number of experts and because many molluscs are not easily visible to the untrained eye, especially small ones. Recently the Natural

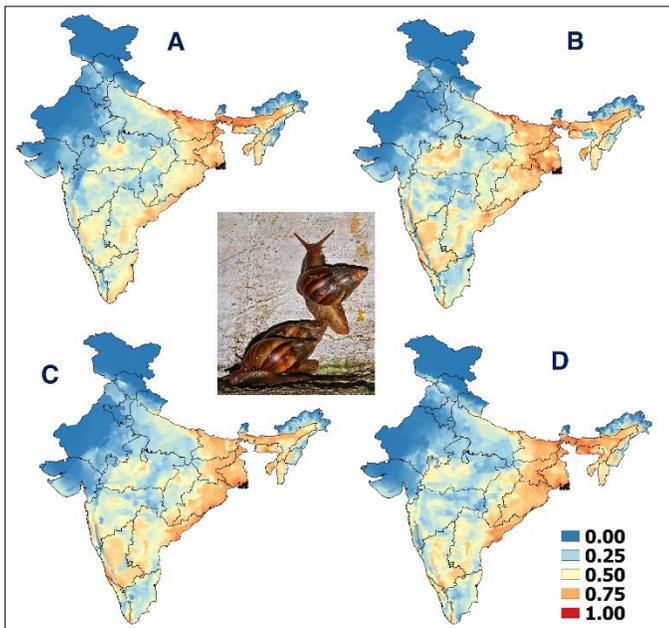
History Museum (NHMUK), London, along with the Ashoka Trust for Research in Ecology and the Environment (ATREE), India, and Cambridge University, brought out a book entitled *Systematic revision of land snails of the Western Ghats* (Raheem *et al.*, 2014). This will help at least in identification of terrestrial molluscs from the Western Ghats region. More such guides are required to encourage citizen scientists to get actively involved in documentation of molluscs of India.

Here I report two case studies in which we used the data from these various sources to assess the impact of climate change on the distribution of the invasive *Achatina fulica* and the endemic *Indrella ampulla*.

The SPIAS (Spotting Invasive Alien Species) initiative on invasive species in the IBP, had 26 observations on *A. fulica*, one of the worst invaders in the world; iNaturalist had 10 records of *A. fulica* in India; and we also collated information from social media sites (Facebook, Flickr and Indianaturewatch.net). We compiled the data from all these sources into a database.

These crowdsourced data along with the records from the literature were used to assess the invasion pattern of *A. fulica* in India using ecological niche modeling tools under current and future climate change scenarios. The model predicts that there will be a 2-4 % increase in the invasion in India under different climate change scenarios (Fig. 1) by the year 2080 (Sarma *et al.*, 2015).

In the second study we attempted to assess the impact of climate change on the endemic terrestrial species *Indrella ampulla*. The results show that there will be a decrease in suitable areas, especially in the southern Western Ghats under climate change up to the year 2070 (Sarma & Aravind, in prep.).



**Fig. 1.** Potential distribution of *Achatina fulica*. A, under current climate condition; B, under RCP 4.5; C, under RCP 6.0; and D, under RCP 8.5. The colours indicate habitat suitability increasing from blue to red.

The data from the crowdsourcing portals for both the studies was around 30 % of the total data used for the modeling exercise, and all these crowdsourced data came from places where the species has not been recorded formally in the literature. This demonstrates that information on species distributions in India, derived from the crowdsourcing resources could be used and significantly augment the data available in the literature. Continuous and long-term data collection will help in understanding changes in the species populations or distributions. Crowdsourcing allows for the collection of a large amount of data in a short time, which would not have been possible by individual scientists. However, it must be acknowledged that in this kind of crowdsourcing initiative, species may be wrongly identified, erroneous place names may be associated with the data and locality records may be broad (e.g. Western Ghats, south India). Despite these negatives, a lot of good data can still be used for scientific studies (Aravind, 2013).

Sustained campaigns using different media, including print, electronic and social network media, will have an impact on the number of observations posted. This has been shown for other initiatives hosted by the IBP such as the Neighborhood Tree Campaign and the Spotting Invasive Alien Species (SPIAS) programme. We intend to have a campaign called “Map Snails” in the coming monsoon season (June to October 2017) to populate IBP with mollusc observations. The campaign will have workshops, identification manuals and press releases. A sustained and long-term campaign is essential to get both spatial and temporal data that can be used for scientific studies and conservation action. Crowdsourcing will help to document lesser known taxonomic groups such as molluscs in species rich countries like India. This will also help in creating awareness and appreciation of unknown or lesser known biodiversity.

I thank the Department of Science and Technology, Government of India, for funding (ref no: SR/SO/AS/89-2012).

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## FRESHWATER MOLLUSC CONSERVATION RESEARCH IN THE CONGO BASIN

By Oscar Wembo Ndeo, Marie Claire Dusabe & Christian Albrecht

Although the Congo River is known as a global hotspot of freshwater biodiversity, this recognition is mostly based on fish biodiversity and endemism. Less attention has been paid to invertebrates, including molluscs. The few existing data refer to original taxonomic descriptions or deal with the Congo basin molluscs in general. The most recent account of freshwater molluscs of Central Africa states that many species in the region are known from only a relatively small number of specimens, and most of those have not been corroborated by recent sampling. In general, new material of selected molluscan groups has been studied only occasionally and has often originated from very restricted regions, and most of the literature focusses exclusively on intermediate gastropod hosts of medically relevant parasites. Considering both the role as aquatic resources for riparian people and the expected threats posed by various factors, knowledge of actual populations and their distributions in this region becomes an urgent necessity. Attempts to initiate research into biodiversity, evolution and conservation of freshwater molluscs of the Congo basin (Albrecht *et al.*, 2014) have recently resulted in the funding of two research projects that deal with mollusc conservation.

The project “Endemic gastropods of the Central Congo River: a conservation assessment” (Fig. 1) is based at the University of Kisangani, Democratic Republic of Congo (Principal Investigator Wembo) and will target species of the gastropod genus *Potadoma* that are ranked as Vulnerable and Endangered by the IUCN. The conservation status of most freshwater molluscs from the Congo River cannot be assessed adequately because of the lack of sufficient data. The new project primarily focusses on *Potadoma ponthiervillensis* (Dupuis & Putzeys, 1900), a species endemic to the eastern Democratic Republic of Congo.

The habitat of the lower part of the species’ range is degrading because of urbanisation, with pollution and sedimentation being the main drivers. Until now, there has been no information available regarding population sizes, no conservation measures in place specific for this species, and no data on population trends. Moreover, the target species is currently consumed in large quantities by riparian people. No quantification of this threat exists. The target species, as for



**Fig. 1.** Local children assisting the assessment of freshwater molluscs along the Congo River. Photo: Oscar Wembo Ndeo

many of the associated species, lives in specific habitats, e.g. zones with rocky substrate, rapids and falls. These habitats are recognised for endemic and rare vertebrate species such as fish and amphibians, some with unique adaptations found nowhere else. The project seeks to assess 1) the mollusc biodiversity in the central Congo River and its tributaries around the town of Kisangani, with particular focus on the type locality and remaining populations of the target species; 2) the habitat status and the pollution and human pressure trends to which it is subject, and 3) the conservation status of the target species, and develop a conservation plan for them.

The second project addresses the vital gaps in knowledge concerning the impacts of river pollution on macro-invertebrates, including molluscs, particularly along the heavily populated western African rift, where some of the tributaries of the River Congo originate. A recent study reported that most of the rivers draining into Lake Kivu are moderately polluted to critically charged (Wronski *et al.*, 2015). However, the impacts of anthropogenic activities on water bodies in the Ruzizi basin (connected to Lake Kivu) have not been studied. The Ruzizi River is critically important because it charges the world famous ancient Lake Tanganyika, which is linked to the River Congo system via the Lukuga River. The project, which is based at the Mbarara University of Science and Technology, Uganda (PI Dusabe; Fig. 2), aims at an assessment of water quality and invertebrate, especially mollusc, diversity of the Ruzizi



**Fig. 2.** The second author conducting field work sampling molluscs. (Photo: Mercy Grolia Alchept)

tributaries on the Rwandan side. It also aims to determine the extent of the variability of land use in the watershed and its ecological impact. Ecological alteration due to human activity will be quantified and recommendations for the effective protection and management of these riverine ecosystems will be provided for the first time.

Freshwater molluscs are basically not recognised by people in local African communities. Generally, interest in freshwater conservation is very limited despite the fact that freshwater systems are often under severe anthropogenic pressure, which is especially the case in Africa. Promotion of the under-recognised molluscs is one expected outcome of the current projects. Raising local awareness of freshwater conservation in general will also be fostered with the completion of the projects. The projects, funded by the Congo Basin Grant Program (CBGP) of the [Conservation Action Research Network](#) (CARN), a US based non-profit research organisation during 2017 will provide basic population and threat data for the target species and a concrete conservation strategy based on them. It is hoped that these initiatives are just the beginning of more dedicated research and conservation activities for the remaining freshwater molluscs in the freshwater diversity hotspot of the Congo River basin.

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## MOLLUSCS ASSESSED BY COSEWIC IN 2016

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

The Molluscs Species Specialist Committee of [COSEWIC](#) (Committee on the Status of Endangered Wildlife in Canada) was especially busy in 2016, assessing or reassessing six molluscs: three slug species, one snail species and two designatable units of a mussel species. COSEWIC is the independent body of species and conservation experts that assesses the conservation status of species using IUCN criteria and recommends listing and legal protection under the Canadian Species at Risk Act (see [Tentacle 21](#) for details).



**Fig. 1.** A live shortface lanx (*Fisherola nuttallii*) on a rock in the Columbia River, downstream of Trail, British Columbia, 10 October 2014. Photo: D. Lepitzki

The Act requires at-risk species to be reassessed every 10 years.

In April 2016, one slug was reassessed while two other slugs and a freshwater snail were assessed for the first time. The blue-grey tailedropper (*Prophysaon coeruleum*), pygmy slug (*Kootenaia burkei*), and sheathed slug (*Zacoleus idahoensis*) are all small slugs that, in Canada, are found only in British Columbia. The blue-grey tailedropper, confined to the southeastern tip of Vancouver Island, was reassessed as Threatened, a downlisting from the previous Endangered. More subpopulations have been found since the previous assessment in 2006 although a continued decline in habitat quality is anticipated from natural ecosystem modifications, competition with invasive species and climate change.

The other two slugs are confined, in Canada, to riparian habitats within the Columbia River basin in south-central British Columbia. Both were assessed as Special Concern. Logging and the projected consequences of climate change were included among the many threats.

The shortface lanx (*Fisherola nuttallii*) (Fig. 1) is also confined to the Columbia River basin in both Canada and the United States. The first recent evidence that the snail still lived in Canada was the discovery of live individuals near Trail in 2009 and 2010. Field verification in 2014 confirmed it still existed in this short stretch of the Columbia River. Because of its small distribution area and exposure to a variety of threats caused by dams, pollution from urban and industrial sources, invasive species and climate change, it was assessed as Endangered.

In November 2016, two designatable units of the mapleleaf (*Quadrula quadrula*) were reassessed. Designatable units (DU) are taxonomic entities below the species level that are both discrete and evolutionarily significant. The Saskatchewan-Nelson Rivers designatable unit of this freshwater mussel is confined, in Canada, to the Assiniboine and Red rivers and their tributaries. Additional subpopulations were recently discovered in a few tributaries to Lake

Winnipeg. Discovery of these additional subpopulations resulted in this DU being downlisted to Threatened from its 2006 status of Endangered. Recent invasion of the Red River and Lake Winnipeg by zebra mussels (*Dreissena polymorpha*) is a new threat, while threats from agricultural, urban and industrial pollution continue.

The other DU of the mapleleaf, the Great Lakes-Upper St. Lawrence population, is confined to southern Ontario. Additional subpopulations and the apparent stability of other large subpopulations in Lake St. Clair, Lake Erie and western Lake Ontario watersheds warranted a downlisting from its previous Threatened (2006 status) to Special Concern. Dreissenid mussel infestation and pollution are continuing threats.

Status reports for the species assessed in April 2016 are currently available on the [SARA Public Registry](#); the report on the mapleleaf will be available in the fall of 2017.

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## NATIVE AND ALIEN TERRESTRIAL SNAILS IN URBAN AREAS OF SERGIPE, NORTHEAST BRASIL

By Jucicleide Ramos-de-Souza, Silvana C. Thiengo, Suzete R. Gomes, Monica A. Fernandez, Marianna C. Clímaco, Sona Jain, Luciene Barbosa & Silvio S. Dolabella

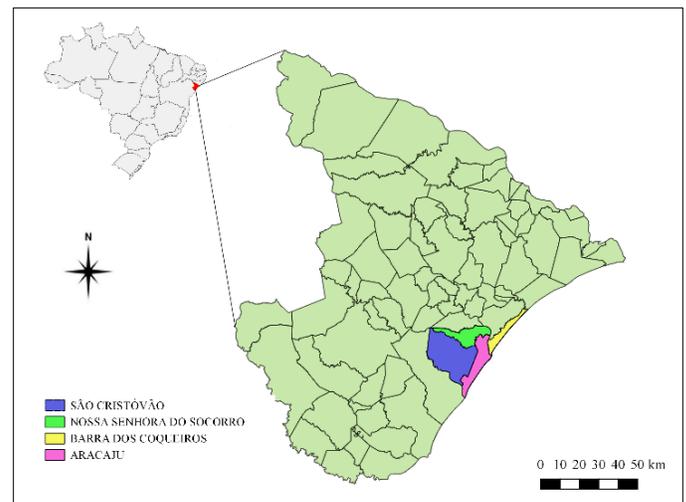
Despite the great diversity of the Brazilian malacofauna, knowledge of it is far from satisfactory, which may be linked to a number of factors. Among these stands out the huge extent of the territory, with different ecosystems and little or no taxonomic research having been undertaken in some of them, as well as the small number of taxonomists. In addition to its importance as a component of biodiversity, the malacofauna is also important in relation to human and animal health, as many species act as hosts of parasitic helminths, including *Schistosoma mansoni*, *Fasciola hepatica* and *Angiostrongylus* spp.

In view of the rising numbers of cases of cerebral angiostrongyliasis in Brasil (Morassutti *et al.*, 2014), due in part to the infestation of the invasive snail *Achatina fulica* Bowdich, 1822, research is being carried out to investigate possible transmission foci of this zoonosis in the Metropolitan Region of Aracaju, in the state of Sergipe, northeast Brasil. The nematode *Angiostrongylus cantonensis* (Chen, 1935) is the etiological agent of cerebral angiostrongyliasis, which is manifested as eosinophilic meningitis. As it can undergo its biological cycle in many mollusc species (Thiengo *et al.*, 2013; Kim *et al.*, 2014; Morassutti *et al.*, 2014), we collected and analysed the entire malacofauna found in association with *A. fulica*. In this context, the present study aimed to identify

and describe the terrestrial molluscs found in Sergipe, highlighting new occurrences for the state. The parasitological analyses will be published elsewhere.

The municipalities investigated included Barra dos Coqueiros, Nossa Senhora do Socorro, São Cristóvão, and Aracaju, the state capital (Fig. 1). In each municipality, three sites favourable to the occurrence of *A. fulica* were georeferenced and terrestrial molluscs were collected between April and October 2016, covering three seasons of the year (autumn, winter and spring).

We obtained 978 specimens: 264 in Aracaju, 326 in Barra dos Coqueiros, 211 in Nossa Senhora do Socorro and 177 in São Cristóvão. The highest number of specimens was obtained in autumn. All collected material (Table 1) was identified at the Laboratório de Referência Nacional em Esquistossomose – Malacologia (LRNEM), Instituto Oswaldo Cruz / Fundação Oswaldo Cruz (IOC / FIOCRUZ). Voucher specimens of each species from each locality were fixed in 70 % ethanol and deposited in the mollusc collection of the Instituto Oswaldo Cruz (CMIOC).



**Fig. 1.** Map of Brasil and Sergipe State, highlighting the Metropolitan Region of Aracaju, the state capital, and the municipalities of Barra dos Coqueiros, Nossa Senhora do Socorro and São Cristóvão.

**Table 1.** Numbers of each species of terrestrial mollusc collected from the Metropolitan Region of Aracaju, Sergipe, from April to October 2016. Alien species in Brasil are asterisked.

Species	Number collected
<i>Achatina fulica</i> Bowdich, 1822*	399
<i>Cyclodontina fasciata</i> (Potiez & Michaud, 1838)	225
<i>Subulina octona</i> (Bruguière, 1792)*	135
<i>Bulimulus tenuissimus</i> (d'Orbigny, 1835)	104
<i>Leptinaria unilamellata</i> (d'Orbigny, 1835)*	56
<i>Sarasinula linguaeiformis</i> (Semper, 1885)	30
<i>Streptartemon cookeanus</i> (Baker, 1914)	7
<i>Omalonyx</i> sp.	7
<i>Allopeas gracille</i> (Hutton, 1834)*	6
<i>Tamayoa banghaasi</i> (Thiele, 1927)	3
<i>Streptartemon quixadensis</i> (Baker, 1924)	2
<i>Latipes erinaceus</i> (Colosi, 1921)	2
<i>Helicina</i> sp.	2



**Fig. 2.** *Achatina fulica*, main intermediate host of the nematode *Angiostrongylus cantonensis*. Scale 2 cm. Photo: Raquel Leal



**Fig. 3.** *Leptinaria unilamellata*, invasive alien species from Nossa Senhora do Socorro. Scale 5 mm. Photo: LABMAL/IOC (Laboratory of Malacology/Oswaldo Cruz Institute)

Of these 13 species, *Helicina* sp., *Omalonyx* sp. and seven other species (*B. tenuissimus*, *C. fasciata*, *L. erinaceus*, *S. linguaeformis*, *S. cookeanus*, *S. quixadensis* and *T. banghaasi*) are considered native in Brasil. Most, however, have a wide distribution, without a known place of origin, and exhibit synanthropic behaviour. Although only four of the 13 species were recognised as alien in Brasil, in numbers of specimens collected they represented the great majority (60.9 %, 596/978 specimens), which is of concern in relation to future consequences because of the reproductive and ecological characteristics of invaders. Of the alien species, *A. fulica* was predominant (66.9 %, 399/596 specimens), followed by *S. octona* (22.7 %, 135/596), *L. unilamellata* (9.4 %, 56/596) and *A. gracille* (1.0 %, 6/596).

The only native species already recorded from Sergipe is in the genus *Omalonyx*, from the village of Igreja Velha, municipality of Itabaiana, identified as *O. convexus* (Jesus & Manso, 2010). According to Simone (2006), this species occurs in Porto Alegre, Rio Grande do Sul State, Brasil, and in Uruguay. *Omalonyx* species have amphibian habits, occur in flooded areas and are considered semi-slugs because of their much reduced shell, which is flattened and fingernail-shaped (Thomé *et al.*, 2006).

Among the alien species, the giant Avrican snail, *A. fulica* (Fig. 2), occurs in all studied municipalities and was found in all seasons. It is already present in all Brazilian states, including the Federal District (Thiengo *et al.*, 2013; Agudo-Padrón, 2016) and is considered among the worse invasive alien species in the



**Fig. 4.** *Allopeas gracille*, alien species recorded in Aracaju. Scale 5 mm. Photo: Suzete Gomes



**Fig. 5.** *Subulina octona*, invasive alien species, recorded in the four municipalities. Scale 5 mm. Photo: LABMAL/IOC (Laboratory of Malacology/Oswaldo Cruz Institute)

world (Lowe *et al.*, 2000). Besides its rapid proliferation and damage caused to small-scale farming, there is also concern about the possibility of spreading *Angiostrongylus cantonensis*, the etiological agent causing cerebral angiostrongyliasis, as well as *Angiostrongylus costaricensis*, the etiological agent of abdominal angiostrongyliasis (Laitano *et al.*, 2001), especially in urban areas.

The other alien species all belong to the family Subulinidae. *Leptinaria unilamellata* (Fig. 3) had previously been recorded in Santa Cruz de La Sierra, Bolivia and, in Brasil in the states of Mato Grosso, Amazonas, Roraima, Minas Gerais, Bahia, Rio de Janeiro, São Paulo, Paraná, Pernambuco, Espírito Santo and Santa Catarina (Brandolini & Gomes, 2002; Simone, 2006; Almeida & Mota, 2011). Its known area of occurrence was increased by our finding it in the municipality of Nossa Senhora do Socorro. *Allopeas gracille* (Fig. 4) and *Subulina octona* (Fig. 5), recorded in Aracaju and in all four municipalities, respectively, had already been reported from Central and South America (Simone, 2006). In the spring, lower abundance of molluscs was observed compared to other seasons, probably because it is a dry season with high temperatures in northeast Brasil, making it difficult to find terrestrial molluscs. The high incidence of sunlight and high temperatures are environmental variables that contribute to the loss of moisture from the soil surface, plants and the body of animals, leading to desiccation (Colley, 2013).

The presence of well established *A. fulica* populations in the studied areas is worrying from the point of view of public

health in these urban environments because being in an urban setting increases the chances of human contact with infected molluscs and the consequent transmission of helminth parasites.

Although this survey was carried out in only four municipalities, finding nine native species demonstrates the need for continued monitoring aimed at mitigating the knowledge gap regarding terrestrial molluscs of northeast Brazil. The generated knowledge is undeniably essential for the preservation of local faunal diversity, as well as conservation of environments modified by the introduction of invasive alien species.

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## MAJOR WATER PROJECTS AND THE DISPERSAL OF ALIEN MOLLUSCS: THE SÃO FRANCISCO RIVER LARGE-SCALE WATER TRANSPOSITION PROJECT IN THE SEMI-ARID NORTHEAST REGION OF BRASIL

By Silvana Carvalho Thiengo, Elizangela Feitosa da Silva, Raquel de Souza Leal, Rafael Alves Esteves & Monica Ammon Fernandez

The São Francisco river large-scale water transposition project aims to increase the water potential in the semi-arid region of the states of Pernambuco, Ceará, Rio Grande do Norte and Paraíba by supplying water and benefiting 12 million people. The São Francisco River is 2,700 km long and covers four states (Minas Gerais, Sergipe, Alagoas and Pernambuco). The ongoing water-transposition project captures 1.4 % of the river's flow and divides it into two axes, the East Axis and the North Axis. It is consolidated as a national integration project, a priority for the economic development of the semi-arid region of northeast Brazil. Despite the social and economic importance of this impoundment, the environmental impact report (RIMA, 2004) pointed out 44 impacts, among them the risk of spread of water-borne diseases as well as changes in the biological communities of the watersheds integrated with the São Francisco River channels. In fact, the connections among water basins can create social, ecological, biological and health changes that may alter the original fauna and water flow and encourage introduction and spread of disease vectors, including those of schistosomiasis (Madsen & Frandsen, 1989; Marques *et al.*, 2004; Thiengo & Fernandez, 2008).

The present work integrates a broad project supported by the National Health Fund and performed by a team of six laboratories of the Instituto Oswaldo Cruz/FIOCRUZ that aimed to study schistosomiasis along the North Axis of the project, from an epidemiological and ecological point of view. Data on autochthonous human cases of schistosomiasis and the snail vectors have been published (Favre *et al.*, 2016) and those on native species will be published elsewhere. We present here the results of a survey of alien freshwater



**Fig. 1.** Collecting freshwater molluscs: (A) Jucurutu river, state of Rio Grande do Norte, (B) detail of the collecting site in the Jucurutu river, (C) São Francisco river, state of Pernambuco, (D) detail of the collecting site in São Francisco river, (E) water accumulated in a dinosaur footprint near a stream in the municipality of Sousa, state of Paraíba, (F) detail of the collecting site.

molluscs in the municipalities affected by the environmental changes caused by this water-transposition, in addition to data from the Sobradinho dam and the municipality of Juazeiro, both in the state of Bahia, because they are near the point of diversion and withdrawal of the water to the channels of transposition.

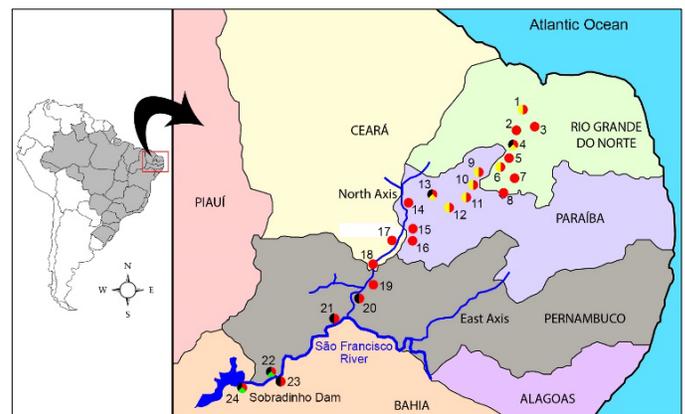
Molluscs were collected in different breeding sites (streams, ditches, lakes and so on) (Fig. 1) in the 24 municipalities of the five states from 2008 to 2012. Specimens were relaxed in 1 % Hypnol® (Cristália, Brasil) prior to dissection, and after 4–6 h removed from their shells, with the aid of forceps in order to tear off the columellar muscle. The soft bodies were then preserved in Railliet-Henry's fixative (2 % acetic acid, 5 % formol, 0.6 % NaCl) or 95 % ethanol, for morphological and molecular studies, respectively.

The specimens collected belonged to eight major taxa, seven families (Ampullariidae, Corbiculidae, Mycetopodidae, Physidae, Planorbidae, Sphaeriidae and Thiaridae) and one superfamily (Rissooidea). They were represented by 19 species, among them four alien species: *Physa acuta* Draparnaud, 1805, *Melanooides tuberculata* (Müller, 1774), *Corbicula fluminea* (Müller, 1774) and *Corbicula largillierti* (Philippi, 1844) (Fig. 2).

*Melanooides tuberculata* was the most widely distributed species in the study area (Fig. 3), which is worrying because



**Fig. 2.** Freshwater molluscs: *Corbicula fluminea* (A), *Corbicula largillierti* (B), *Melanooides tuberculata* (C) and *Physa acuta* (D). Scale bars: 5 mm.



**Fig. 3.** Distribution of alien freshwater molluscs in the area of transposition of the São Francisco River: *C. fluminea* (black), *C. largillierti* (yellow), *M. tuberculata* (red) and *P. acuta* (green). Municipalities: Açú (1), São Rafael (2), Itajá (3), Jucurutu (4), São Fernando (5), Jardim de Piranhas (6), Caicó (7), Ipeira (8), São Bento (9), Paulista (10), Pombal (11), Aparecida (12), Sousa (13), Cajazeiras (14), Monte Horebe (15), Bonito de Santa Fé (16), Mauriti (17), Pena Forte (18), Salgueiro (19), Terra Nova (20), Orocó (21), Petrolina (22), Juazeiro (23), Sobradinho (24).

this species can cause changes in the local communities of molluscs, besides participating in the biological cycles of helminth parasites of humans and animals. Changes in local mollusc communities caused by this species had already been reported in the upper Tocantins Tiver in the lake created by the Serra da Mesa dam, in central Brasil, where populations of the native thiarid *Aylacostoma tenuilabris* (Reeve, 1860) decreased and even disappeared in some localities in contrast to the increase of *M. tuberculata* populations (Thiengo *et al.*, 2005). Similarly, in two other stretches of the Tocantins River, Fernandez (2011) documented the dispersal and colonisation of *M. tuberculata* associated the decline of the population of *A. tenuilabris*. However, she correlated this decline with the difficulty of *A. tenuilabris* to adapt to the environmental changes caused by the construction of the dam for the hydroelectric plant and not necessarily due to the presence of this alien mollusc. From the parasitological point of view *M. tuberculata* can act as carrier of paragonimiasis, centrocestiasis and clonorquiasis, human helminthiasis endemic to Asia but with foci in South America (Paz *et al.*,

1995; Pinto, 2009). In Brasil, *M. tuberculata* was first reported infected with *Centrocestus formosanus* (Nishigori, 1924) in the state of Minas Gerais (Pinto & Mello, 2010), and then in the states of Bahia, Goiás, Rio de Janeiro, Rio Grande do Norte and Tocantins (Fernandez *et al.*, 2015).

*Physa acuta*, native to North America, had previously been reported from Brasil, in the states of Bahia (municipality of Salvador), Goiás (Campinaçu, Campinorte, Colinas, Formosa, Minaçu, Niquelândia, Santa Rita do Novo Destino and Uruaçu), Mato Grosso do Sul (Campo Grande), Paraná (Curitiba), Rio de Janeiro (Angra dos Reis, Duas Barras, Duque de Caxias, Macuco, Niterói, Nova Friburgo, Petrópolis, Rio de Janeiro, São Fidélis, São José do Vale do Rio Preto and Teresópolis) and São Paulo (Santos and São Paulo) (Fernandez, 2011; Paraense, 2011; Santos *et al.*, 2016; Thiengo *et al.*, 1998, 2001, 2004). In the study area its occurrence was restricted to Sobradinho and Petrolina (Fig. 3) in the states of Bahia and Pernambuco, respectively, and this is the first record of the species from these municipalities. In the reservoir of the Serra da Mesa dam, a decrease was reported in the native species *Physa marmorata* Guilding, 1828 after the introduction and spread of *P. acuta* (Fernandez & Thiengo, 2016).

*Corbicula fluminea* and *C. largillierti* are native to Asia but both have spread in recent years to other continents, including South America, in association with human activities such as in ballast water from ships. The first report of *C. fluminea* in Brasil was from the Guaíba River basin, state of Rio Grande do Sul, in the 1970s (Veitenheimer-Mendes, 1981; Mansur *et al.*, 2004). Since then it has been reported in central Brasil from the Pantanal in the state of Mato Grosso (Callil & Mansur, 2002) and Lake Paranoá in Brasília (Rodrigues *et al.*, 2007); in southeast Brasil from São Paulo (Sapucaí/Grande River basin and reservoirs of the middle Tietê River) and Minas Gerais (drainage basin of Araguari River) (Suriani *et al.*, 2007; Viana & Avelar, 2010; Maroneze *et al.*, 2011); in the northeast from the state of Paraíba (Paraíba River basin) (Almeida *et al.*, 2015) and in the north (Amazon basin) (Beasley *et al.*, 2003; Pimpão & Martins, 2008). The first report of *C. largillierti* in Brasil was from the Uruguay River and coastal lagoons of Rio Grande do Sul (Mansur *et al.*, 2004). Other records are from the middle São Francisco River and the hydrographic basin of the Paraíba do Sul, Doce and Tocantins Rivers (Mansur *et al.*, 2016; Fernandez, 2011).

Both species of *Corbicula* may be associated with decline of native bivalve populations, since they live in colonies of large numbers of individuals and compete with native species (Mansur *et al.*, 2011). In addition to the direct impact on the diversity of the malacofauna, they may also cause significant economic losses resulting from the clogging of pipelines in water infrastructure projects, such as hydroelectric plants, as happened at the Porto Colombia Hydroelectric Power Plant, in the state of Minas Gerais (Mansur *et al.*, 2004). According to Graney *et al.* (1980) and McMahan (1982), the adaptive success of this species is due to resistance to environmental stress, tolerance of various substrates, high reproductive capacity, rapid growth and the ability to filter large volumes of water. There are no records of reversal of invasions by *C.*

*fluminea* or *C. largillierti*, which implies an increasing density of established populations and the possibility of dispersal to rivers bordering the basins, such as the São Francisco River and the small basins of the semi-arid region with which this river will be connected later.

The presence of well-established populations of alien *C. fluminea*, *C. largillierti*, *M. tuberculata* and *P. acuta* reinforces the need to adopt multidisciplinary approaches aiming at the construction of public policies for the management and conservation of native mollusc species. The invasive potential and success in establishing populations of those alien molluscs make it imperative to carry out studies on the biology and ecology of those species in order to provide technological support for effective control of them and prevention of their deleterious environmental effects and effects on human health and local economies.

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## THE PEARL INDUSTRY AND PIONEERING RESEARCH IN BIOLOGY AND CONSERVATION OF PEARL MUSSELS (UNIONOIDA) IN THE RÍO DE LA PLATA BASIN

By Cristhian Clavijo

Freshwater pearl mussels can be used to make ornaments, buttons, nuclei for pearls, cosmetics, cattle and chicken feed, fertiliser and lime. In the middle 19th century the abundance of freshwater pearl mussels in the central United States and the high prices of pearl generated a pearl rush, with a maximum annual production of over 5.75 billion buttons in 1916 (Anthony & Downing, 2001).

In the Rio de la Plata basin before the development of the local industry and until 1945, pearl use was basically for



**Fig. 1.** Different kinds of buttons produced from South American freshwater mussels.

handcrafted articles, for example to decorate gourds (used for *mate*), guitars, snuff boxes and combs. In the context of World War II the local need for buttons drove development of the local industry, even reaching a level supporting export.

In both Argentina and Uruguay the industry focused on the production of buttons (Fig. 1). In Uruguay the industry was centralised in the capital, Montevideo, but extraction of mussels occurred throughout the country. According to Olazarri (1975) it was common in train stations to find advertisements requesting mussels. Even in the most widely circulating newspaper of the time announcements appeared offering to buy any amount of shells. In Argentina the industry had two centres (Santa Fe and Buenos Aires) with the main extraction in the Paraná River and the inner Río de la Plata. By 1960 the price was 4,000 % higher than at the beginning of the rush, with an annual production of 3,600 tons, which means 72 million mussels extracted per year. At the height of the rush each person manually collected 80-200 kg per day. In just five years specimens suitable for industrialisation were reduced to 25 % and mussels were recorded as extinct in many water bodies (Bonetto *et al.*, 1950). By the start of the 1950s the mussel banks had suffered such a decline that extraction was forced to expand northward through the Paraná River and its floodplain. Associated with this industry, several institutions (National Institute of Limnology, Hydrological Station of Rosario and La Plata Museum) began research on the biology and ecology of the mussels and developed conservation and management measures. During 1952, repopulation experiments were conducted in lakes near the city of Rosario (Santa Fe, Argentina). Eight species of fish were experimentally infected but only in two, *tararia* (*Hoplias malabaricus*) and *sábalo* (*Prochilodus lineatus*), was the infection successful. During this time more than 300,000 larvae of *Diplodon parallelipedon* and *D. charruanus* were reintroduced to the environment (Canzio, 1960). In 1959 an Argentinean interprovincial congress on conservation of natural resources suggested the following measures:

- Rotation of extraction localities
- Returning of small individuals (<6 cm)
- Forbidding extraction with the trampling method and promotion of the use of a dredge rake
- Throwing the gills of gravid mussels back into the water
- Forbidding fishing in the lagoons during times of drought
- Promotion of repopulation (translocations of adults, fish infection with larvae)

Despite this effort, the industry collapsed in the mid 1960s. In 1965 new attempts to revitalise the industry in both Argentina

and Uruguay were not successful, and buttons made from mussel shell disappeared completely and were replaced by plastic (Castellanos, 1965; Olazarri, 1975).

Concern for the survival of populations of pearl mussels resulted in the first local research on the biology of these species and the first conservation measures and actions in South America. Much of the knowledge generated during the development of the pearl industry is essential to the conservation of freshwater mussel species today. Unfortunately all this research was published in the grey literature and is virtually unknown outside the region and by decision makers in Argentina and Uruguay. More than 50 years later, knowledge of the biology and ecology of pearl mussels is still insufficient for the proper management of these species with serious conservation problems (Clavijo & Scarabino, 2013). As an example, of the 22 species of Mycetopodidae living in the Plata basin only four have been studied genetically, the larvae of only eight have been described and only 15 have been described anatomically.

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## MOLLUSCS INTERCEPTED AT THE BORDERS OF ISRAEL IN 2016

By Svetlana Vaisman & Henk K. Mienis

Inspectors of the Plant Protection and Inspection Services (PPIS) of the Ministry of Agriculture stationed at the borders of Israel are the only agents who can prevent the entrance of allochthonous molluscs into Israel. Although their main

function is to prevent the import of agricultural pests they also prevent the introduction of possible alien faunal and floral elements that may endanger or alter the biodiversity of Israel. In this way it is an important tool in the conservation of the native mollusc fauna of Israel.

Inspectors of the PPIS stationed at Ben Gurion airport near Lod, the Mediterranean harbours of Haifa and Ashdod and the border crossing with Gaza, Palestine, near Kerem Shalom intercepted 24 samples of gastropods in 2016. All the intercepted snails and slugs turned out to be terrestrial species.

The material was handed over to Mrs. Svetlana Vaisman of the mollusc identification unit of the PPIS in Bet Dagan. She brought the samples for final verification and permanent storage to Mr. Henk K. Mienis at the Mollusc Collection of the Steinhardt Museum of Natural History – Israel National Center for Biodiversity Studies, Tel Aviv University.

The 24 samples treated in this report arrived from five countries: Palestine (14), the Netherlands (7), Austria (1), France (1) and the United Kingdom (1). These samples contained ten different taxa of terrestrial snails (8) and slugs (2). All the molluscs (Table 1) were intercepted in agricultural or horticultural shipments. In addition to date of collection, species name, number of specimens, country of origin and type of merchandise from which the snails or slugs were intercepted, we have also listed the PPIS numbers of the mollusc samples. Missing numbers in the sequence represent samples that were collected within Israel.

**Table 1.** Molluscs intercepted at the borders of Israel in 2016.

Date	PPIS no.	Species intercepted (number of specimens)	Origin	Shipment
3 Jan	359	<i>Theba pisana</i> (12)	Palestine	red cabbage
10 Jan	360	<i>Theba pisana</i> (9)	Palestine	green cabbage
10 Jan	361	<i>Theba pisana</i> (4)	Palestine	red cabbage
21 Jan	362	<i>Theba pisana</i> (4)	Palestine	cauliflower
21 Jan	363	<i>Theba pisana</i> (9) <i>Monacha syriaca</i> (2)	Palestine	cauliflower
21 Jan	364	<i>Theba pisana</i> (2) <i>Prietocella barbara</i> (1)	Palestine	red cabbage
28 Jan	365	<i>Theba pisana</i> (6)	Palestine	red cabbage
28 Jan	366	<i>Theba pisana</i> (8) <i>Monacha syriaca</i> (2)	Palestine	green cabbage
28 Jan	367	<i>Theba pisana</i> (2) <i>Monacha syriaca</i> (3)	Palestine	cauliflower
10 Mar	369	<i>Novisuccinea ovalis</i> (1)	Palestine	red cabbage
24 Mar	370	<i>Vallonia excentrica</i> (1)	Austria	horseradish
22 Mar	371	<i>Theba pisana</i> (1)	Palestine	tomatoes
10 Apr	373	<i>Zonitoides arboreus</i> (2) <i>Deroceras reticulatum</i> (1) <i>Arion intermedius</i> (1)	Netherlands	potted azaleas
3 Apr	374	<i>Theba pisana</i> (9)	Palestine	tomatoes
17 Apr	375	<i>Oxyloma elegans</i> (1)	France	hand apples
3 May	376	<i>Theba pisana</i> (7)	Palestine	tomatoes
11 May	378	<i>Monacha syriaca</i> (1)	Palestine	tomatoes
13 Jun	379	<i>Succinea putris</i> (1) <i>Deroceras reticulatum</i> (1)	UK	<i>Vinca</i> cuttings
19 Jun	380	<i>Zonitoides arboreus</i> (6)	Netherlands	potted azaleas
14 Aug	381	<i>Deroceras reticulatum</i> (1)	Netherlands	potted <i>Hydrangea</i>
25 Aug	382	<i>Deroceras reticulatum</i> (1)	Netherlands	green cabbage
10 Nov	383	<i>Deroceras reticulatum</i> (1)	Netherlands	green cabbage
17 Nov	384	<i>Deroceras reticulatum</i> (1)	Netherlands	peace lilies
17 Nov	384	<i>Zonitoides arboreus</i> (9)	Netherlands	potted azaleas

Snails were found 14 times on shipments of cabbage and tomatoes from the Gaza Strip, Palestine, at the border checkpoint near Kerem Shalom. The destination of the merchandise was not Israel but the so-called West Bank, which is also governed by the Palestinian National Authority.

The discovery of *Prietocella barbara* on a shipment of red cabbage (*Brassica oleracea* var. *capitata* forma *rubra*) means that this invasive species occurs in the Gaza Strip, where it had so far remained unknown (Vaisman & Mienis, 2016a). Another invasive species found on red cabbage from the Gaza Strip, *Novisuccinea ovalis*, had already been recorded there during the period when the Gaza Strip was occupied by Israel (1967-2005).

Three times specimens of the orchid snail, *Zonitoides arboreus*, a North-American species but now almost cosmopolitan in hothouses and nurseries, were discovered in shipments of azalea (*Rhododendron* species) from the Netherlands. *Zonitoides arboreus* is already well established in Israel, not only in hothouses and nurseries but also in private gardens, public parks and even orchards. The same can be said of *Vallonia excentrica*, an invasive species in Israel that is regularly encountered in urban environments.

*Succinea putris* is rarely encountered in/on merchandise arriving in Israel and so far it has never been encountered in Israel. Another amber snail, *Oxyloma elegans*, regularly encountered on shipments of hand apples (*Malus pumila*) from France (Vaisman & Mienis, 2016b), has to be considered an autochthonous species in Israel.

*Deroceras reticulatum* was intercepted five times on imports from the Netherlands. Twice it was found on red cabbage and once each on azalea, hortensia (*Hydrangea* species) and peace lily (*Spathiphyllum* species). This slug of palaearctic origin is probably already established in hothouses and nurseries in Israel. It is not only a well known agricultural pest but it may endanger the native *Deroceras berytensis*.

*Arion intermedius* is here recorded for the first time on merchandise entering Israel. No species of *Arion* had ever before been intercepted at the borders or found alive in Israel.

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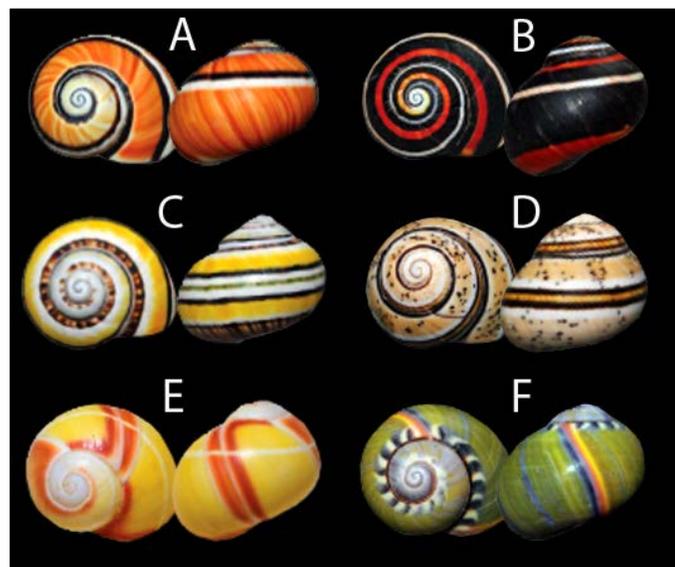
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## AN ASSESSMENT OF THE POTENTIAL EFFECTS OF CLIMATE CHANGE ON THE DISTRIBUTION OF PAINTED LAND SNAIL SPECIES, GENUS *POLYMITA* (GASTROPODA: CEPOLIDAE)

By Carlos A. Mancina, Maike Hernández, Daily Martínez & Reinaldo Estrada

There is evidence that climate change will become one of the major drivers of extinction in the 21st century. The Caribbean region is among the global areas with the highest concentration of species vulnerable to climate change (Pacifi, 2015). However, there are few assessments of the possible effects of climate change on biodiversity in Cuba, in spite of the fact that many species are currently at risk of extinction (González Alonso *et al.*, 2011). In particular, many Cuban terrestrial gastropods may be highly susceptible to climate change impacts because of their restricted ranges, limited ability to disperse to new geographic areas and because it would increase loss and degradation of their natural habitats.

Species of the genus *Polymita* are land snails endemic to the eastern region of the Cuban archipelago (Espinosa, 2013). The genus contains six species and because their shells exhibit impressive colour patterns (Fig. 1) they are considered among the most beautiful snails in the world. All species are threatened because of reduction in extent of their occurrence. Like many other Cuban land snails (Alfonso & Berovides, 1993), *Polymita* species are negatively impacted by the loss, fragmentation and degradation of their natural habitats, in this case aggravated by the intensive illegal trade of their shells. These species are currently protected by Cuban regulations, and very recently by the Convention on International Trade in Endangered Species (CITES Appendix II).



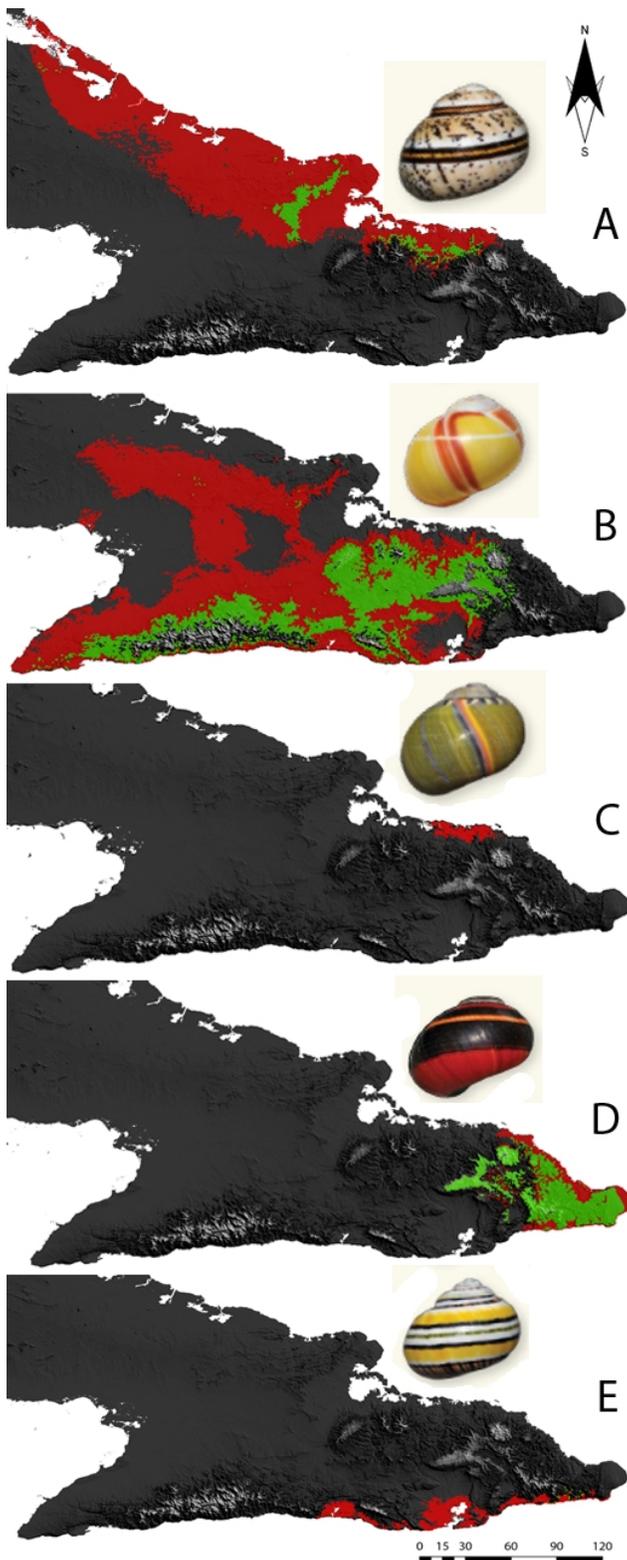
**Fig. 1.** Five species of *Polymita*; A—*P. pictanigrolimbata*, B—*P. pictaiolimbata*, C—*P. versicolor*, D—*P. muscarum*, E—*P. venusta*, F—*P. sulphurosa*.

Ecological niche modeling is a tool that has been increasingly used to assess the impacts of climate change on biodiversity (Anderson, 2013). These models characterise conditions suitable for the species in the current climate, projecting onto geography to identify the areas that fulfill those conditions; the resulting models are then applied to climate projections to infer potential climatically suitable areas in the future (Peterson *et al.*, 2011). Studies of the effects of different climate change scenarios on land snail populations provide a means of refining predictions of their responses to global climate change. Here, we summarise a first assessment of the potential impact of climate change on the distribution of climatically suitable areas of five species of *Polymita* under an assumption of no dispersal. Our main aim was, based on global climate models, to identify those species with the highest risk of extinction due to climate change, and to identify the most susceptible areas. These results are part of the national project “Current and future potential distribution of Cuban fauna and flora species: exploring the effects of climate change on the terrestrial biota” of the Cuban Programme on Climate Change.

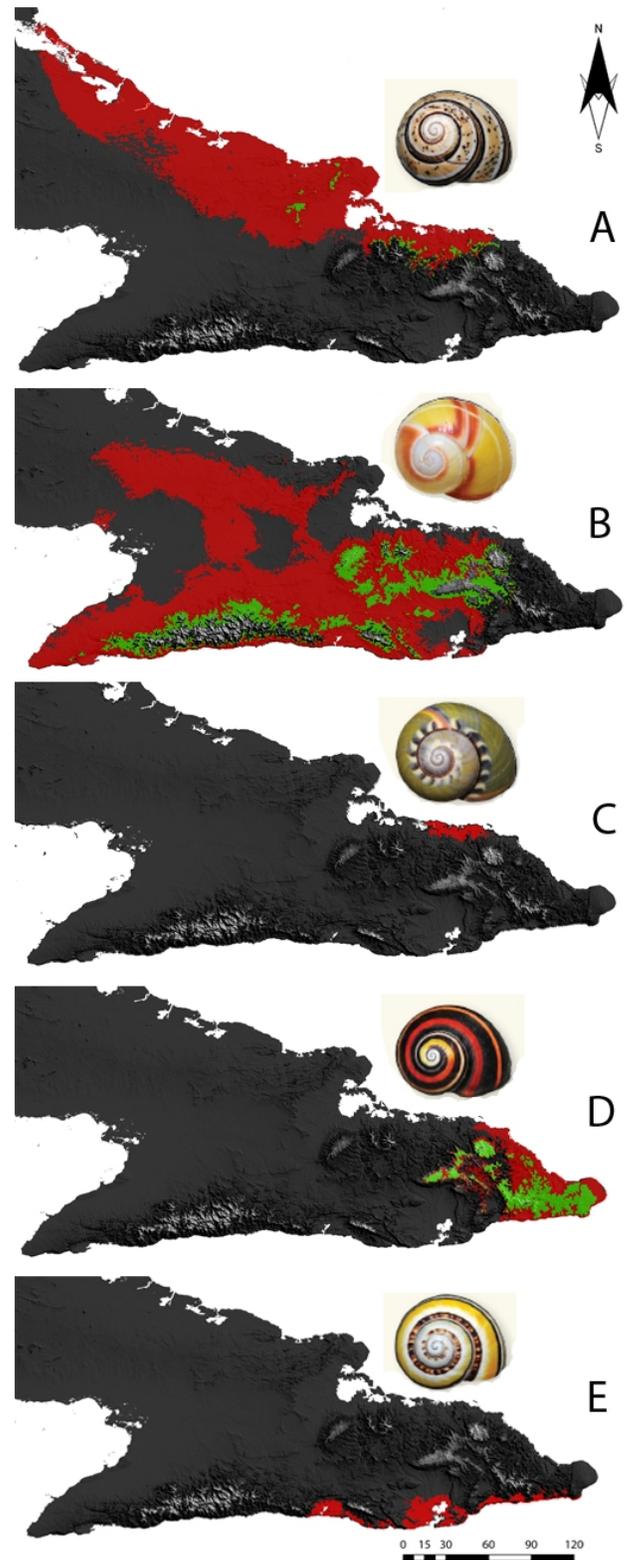
We made correlative niche models relating environmental conditions to species occurrence data using MAXENT software (Phillips *et al.*, 2006). In order to improve the accuracy of predictions we analysed the five species with the widest distributions and with the most geo-referenced presence records. All data come from published papers, museum databases and personal communications. As predictor variables we used 19 bioclimatic variables with a resolution of ~ 1 km<sup>2</sup> obtained from the [WorldClim](#) database. To estimate the influence of climate change on the distribution of climatically suitable areas, the ecological niche models generated were then projected onto climatic data for the year 2050 from three global climate models (BCC-CSM1, MIROC-ESM and Hadgem2). In addition, we used two Representative Concentration Pathways (RCPs) (RCP2.6 and 8.5 W/m<sup>2</sup>) adopted by the IPCC’s fifth assessment report, which simulate two possible radiative values. Both RCPs are based on plausible ranges of greenhouse gas concentration pathways, with RCP8.5 being the worst scenario (Moss *et al.*, 2010). We defined future suitable areas from consensus projection of at least two global climate models.

We found that ecological niche models could accurately predict the geographic distributions of the five *Polymita* species; the average training AUC was 0.91 and only the *P. venusta* model had an AUC < 0.9. The current climatically suitable areas ranged from 270 km<sup>2</sup> for *P. sulphurosa* to 23,369 km<sup>2</sup> for *P. venusta*. Based on current climatically suitable areas and the Extent of Occurrence criterion (criterion B1) of the IUCN, four species could be considered threatened: *P. picta*, *P. versicolor* and *P. sulphurosa* as Endangered and *P. muscarum* as Vulnerable.

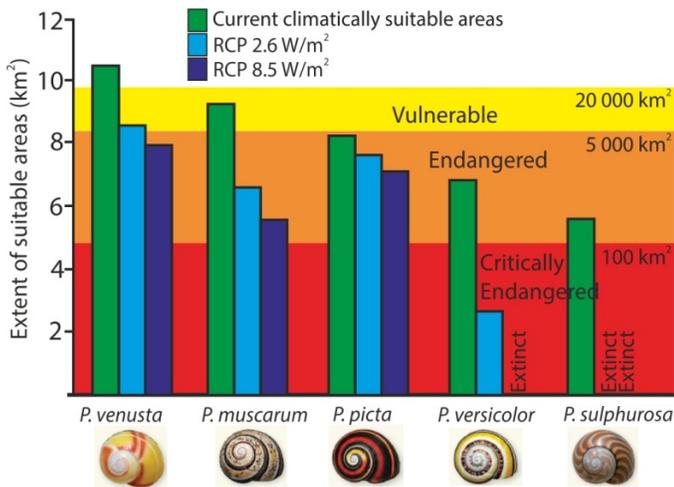
The models suggest that all species are vulnerable to future climate change, with those species (i.e. *P. muscarum*, *P. sulphurosa* and *P. versicolor*) restricted to coastal or low altitude habitats apparently being more vulnerable (Figs. 2 & 3). Within the ranges of *Polymita* species at least two global climate models predict that by the year 2050 there will be an



**Fig. 2.** Current and changes in the distribution of climatically suitable areas in five species of *Polymita* under climate change scenarios; the maps representing the consensus of at least two global climate models under the representative concentration pathways to 2.6 W/m<sup>2</sup>. The red shading represents retraction areas (suitable areas at present but not in 2050), green shading represents climatically stable regions. A—*P. muscarum*, B—*P. venusta*, C—*P. sulphurosa*, D—*P. picta*, E—*P. versicolor*.



**Fig. 3.** Current and changes in the distribution of climatically suitable areas in five species of *Polymita* under climate change scenarios; the maps representing the consensus of at least two global climate models under the representative concentration pathways to 8.5 W/m<sup>2</sup>. The red shading represents retraction areas (suitable areas at present but not at 2050), green shading represents climatically stable regions. A—*P. muscarum*, B—*P. venusta*, C—*P. sulphurosa*, D—*P. picta*, E—*P. versicolor*.



**Fig. 4.** Extent of climatically suitable areas for five species of *Polymita* projected to the year 2050 on the basis of three global circulation models and two representative concentration pathways (2.6 and 8.5 W/m<sup>2</sup>). The data were logarithmically (natural log) transformed to improve visualisation. The IUCN threat status was estimated according to the Extent of Occurrence criterion (criterion B1). We assume that the reduction of suitable areas under climate change indicates the continuing decline of the extent of occurrence.

increase in the mean annual temperatures of 1.4–2.4 °C and a decrease in mean annual precipitation. This study shows a reduction of suitable areas of 44–100 % of the current areas in the next 35 years (Fig. 4), aggravating the threatened status of the species, with two species (*P. sulphurosa* and *P. versicolor*) likely to go extinct because of an overall loss of potential climatically suitable areas. These results suggest the need for management actions (e.g. assisted colonisation) to ensure the survival of the most affected species.

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## ON THE VERGE OF EXTINCTION BUT NOT YET GONE: REDISCOVERY OF *HEMICYCLA MODESTA* (FÉRUSSAC, 1822) ON TENERIFE (CANARY ISLANDS)

By Marco T. Neiber, Jesús Santana & Miguel Artilles

The Canary Islands, like the other Macaronesian archipelagos, harbour a rich fauna of terrestrial molluscs including species-rich radiations, for example, in the families Enidae, Vitrinidae and Helicidae. With nearly 150 names, of which 58 are currently accepted to represent valid recent and fossil species or subspecies, the endemic genus *Hemicycla* Swainson, 1840 (Helicidae) ranks second among these radiations and its members are represented on all seven major islands and most of the smaller islets of the archipelago. Intensive systematic research on *Hemicycla* since the mid-1980s has greatly increased our knowledge of the diversity of the genus and the distribution of many of its constituent taxa, and has also yielded a number of rediscoveries of poorly known taxa as well as several new discoveries (e.g. Groh, 1985; Ibáñez *et al.*, 1987, 1988a, b; Alonso *et al.*, 1990, 1991; Groh *et al.*, 1992, 1996; Beck & Rähle, 2006; Alonso & Ibáñez, 2007; Ibáñez & Alonso, 2007; Vega-Luz & Vega-Luz, 2008; Yanes *et al.*, 2009; Neiber *et al.*, 2011; Castro *et al.*, 2012; Verbinnen & Swinnen, 2014).

Comparatively little is known about the relationships of the species in the genus (Neiber, 2010; Neiber *et al.*, 2011), though recent molecular genetic investigations (Chueca *et al.*, 2015; Neiber & Hausdorf, 2015; Razkin *et al.*, 2015) point towards a close relationship of *Hemicycla* to a group of genera inhabiting the Iberian Peninsula and adjacent parts of France as well as the northernmost part of Morocco opposite Gibraltar (*Iberus* Montfort, 1810 and *Pseudotachea* Boettger, 1909) and especially to *Allognathus* Pilsbry, 1888 (including *Iberellus* Hesse, 1908), which is native to the Balearic Islands. Chueca *et al.* (2015) suggested two scenarios that could explain the colonisation of the Canary Islands by *Allognathus* or its ancestors: 1) from the Iberian Peninsula, after the colonisation of the Balearic Islands by ancestors of *Allognathus*, or 2) from the Balearic Islands, once they had been colonised by proto *Allognathus* + *Hemicycla*. However, this latter view has recently been challenged by Quintana Cardona *et al.* (2015), who present an alternative biogeographic scenario based on the progressive fragmentation of the Hercynian shield as the main event that determined the divergence between *Allognathus* and *Hemicycla*. These authors also considered the possibility of a closer relationship of the endemic North African helcid fauna with *Hemicycla* and/or *Allognathus*, a



**Fig. 1.** Living specimen of *Hemicycla modesta* (Férussac, 1822) from the southern population (see Fig. 3).

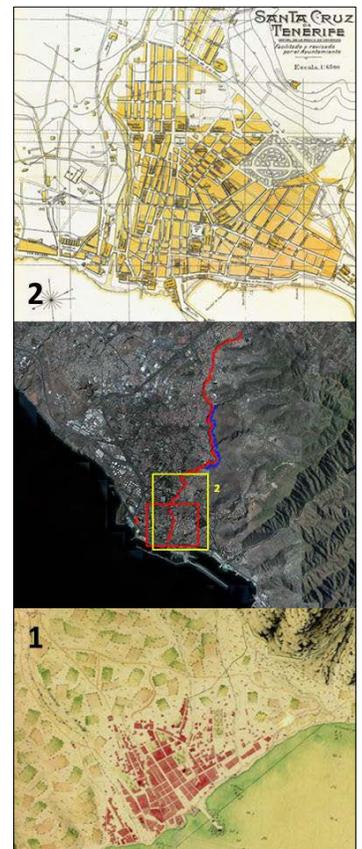
hypothesis that merits further investigation given the rather fragmentary knowledge of this diverse helicid fauna.

There are also several insufficiently known species assigned to *Hemicycla*. One of these, *Hemicycla modesta* (Férussac, 1822) (= *Helix paivana* Lowe, 1861) (Fig. 1), is among the first species to have been scientifically named from the Canary Islands. It is endemic to Tenerife and 19th century malacologists reported it as a common species near Santa Cruz de Tenerife, particularly in the “Barranco Santo” (= Barranco de Santos) (Lowe, 1861; Mousson, 1872; Wollaston, 1878; Mabille, 1885). Since then only a single, somewhat doubtful record from the coastal area to the southeast of Santa Cruz (Alonso *et al.*, 1990; the record of Neiber (2010) refers to *H. bethencourtiana* Shuttleworth, 1852) has been published, indicating a severe decline in extent and occurrence of the species during the 20th century. Accordingly, *H. modesta* was listed as Critically Endangered (Possibly Extinct) (CR D) in the most recent version (2016-3) of the [IUCN Red List](#) (Groh & Neubert, 2011; Cuttelod *et al.*, 2011).

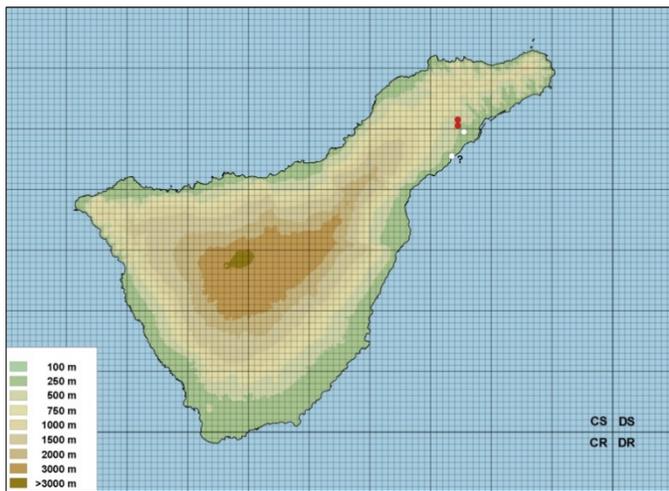
During a research trip in 2015 to an area near the uppermost part of the Barranco de Santos, trying to find a trace of *H. modesta*, some subfossil shells and a single live specimen of some *Hemicycla* species were found, hidden in volcanic crevices in a steep ravine quite close to the urban area of La Cuesta, which is a district of Santa Cruz de Tenerife. Some of these shells were identified as *H. pouchadan* Ibáñez & Alonso, 2007, which is also known from the surroundings of Santa Cruz de Tenerife. Some of the other shells, however, matched the original description and illustrations of *H. modesta* and its synonym *H. paivana* Lowe, 1861 (see Férussac, 1821-1822; Férussac & Deshayes, 1819-1851; Lowe, 1861). To ascertain the identity of the newly discovered specimens, they were compared with one of the six syntypes of *Helix (Helicigona) modesta* Férussac, 1822 in the collection of the Muséum nationale d’Histoire naturelle (Paris) (Férussac collection, MNHN 22942), two possible syntypes of *Helix (Mycena) paivana* Lowe, 1861 in the collection of the National Museum of Wales (Cardiff) (Melvill-Tomlin collection, ex coll. Wollaston, NMW.1955.158.24957) and specimens determined

as *H. modesta* in the collection of the Museum für Naturkunde (Berlin) (ZMB). After additional intensive surveys in the area, two small colonies of *H. modesta* were discovered on opposite slopes of the uppermost part of the Barranco de Santos, one quite difficult to reach because of the steep volcanic walls that are inhabited by the snails, but fortunately not yet much affected by human settlements; and the other in an open euphorbia shrubland area of less than 200 m<sup>2</sup>, where a few specimens were found aestivating under stones syntopically with specimens of *Hemicycla pouchadan* (the easternmost known colony of this species). The population density was quite low, with many shells showing evidence of predation by introduced rodents but also by native Canarian lizards. The area of the Barranco de Santos currently inhabited by the species is less than 5 % of the total length of the ravine. The species was referred to in the 19th century literature as a common species in the surroundings of Santa Cruz de Tenerife, so it can be supposed that the dramatic changes in the urban development of the city (Fig. 2) have played a major role in the decline of the habitat of *H. modesta*.

The major threat to *H. modesta* is habitat destruction through the growing urbanisation of Santa Cruz de Tenerife. Other threats probably include grazing by goats and a possible increase in stochastic events such as fires. Moreover, predation by introduced rodents may also negatively affect the species, especially as the only two known extant populations (Fig. 3) are close to human settlements where the abundance of mice and rats is usually higher than in near-natural habitats. Finally, preliminary genetic analyses suggest that there might also be introgression from species belonging to the *H.*



**Fig. 2.** Urban development in the area of the Barranco de Santos, Santa Cruz de Tenerife (Canary Islands) in the last c. 250 years. The red square corresponds to the area shown in a map of 1771 (map 1); the yellow square corresponds to the area shown in a map of 1920 (map 2); the red line indicates the urban area in 2014 (100 % of the western slope of the ravine); the blue line indicates the area currently not urbanised (c. 30 % of the eastern slope of the ravine).



**Fig. 3.** Distribution of *Hemicycla modesta* (Férussac, 1822). Red dots: newly discovered populations; white dots: literature records; UTM (MGRS) 1 km × 1 km grid (WGS 84).

*consobrina* (Férussac, 1822) complex, to which *H. modesta* is closely related (Neiber, unpublished). Nonetheless, *H. modesta* is a so-called Lazarus taxon, i.e. a species that was thought to be extinct but could be rediscovered through intensive surveys in its historic distribution range. Although not gone yet, *H. modesta* remains a species on the verge of extinction and the assessment of the species as Critically Endangered (CR) by Groh & Neubert (2011) in the IUCN Red List is still valid because of the very small range (< 2 km<sup>2</sup>) of the species and the multiple threats that the populations of the species are facing.

We thank Ben Rowson and Harriet Wood (NMW), Thomas von Rintelen and Christine Zorn (ZMB) and Virginie Héros (MNHN) for the loan of material, access to the museum collection and/or photographs of shells.

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## ON THE CRIMEAN ENDEMIC TERRESTRIAL MOLLUSCS IN THE IUCN RED LIST

By Igor Balashov

The Crimea is a large peninsula (27,000 km<sup>2</sup>) in southern Ukraine, it is surrounded by the Black and Azov seas, connected with mainland Ukraine by a narrow neck of land. The northern, larger part of the peninsula is a dry plain (altitude up to 189 m) that was covered primarily by steppe (dry grassland), currently almost completely replaced by agricultural landscapes and settlements; its biodiversity is very low. The Crimean Mountains are in the southern, smaller part of the peninsula (about a quarter of its area), with their highest elevation being 1,545 m. This is an “island” of high biodiversity, consisting of numerous invertebrate and plant endemics, and Mediterranean species and habitats, including various mountain forests. Being legally a part of Ukraine the Crimea was occupied by the Russian Federation in 2014 and currently is under de facto control by its government.

Among the terrestrial molluscs of the Crimea, 17-21 species are considered endemic or almost endemic (i.e. with a few scattered naturally occurring populations just to the north of the Crimea), with the species status of four of them not generally accepted (Balashov & Gural-Sverlova, 2012; Balashov, 2014, 2016a, b). Of these 21 species, 12 are listed in the [IUCN Red List](#) and correspondingly in the European

IUCN Red List of non-marine molluscs of Europe (Cuttelod *et al.*, 2011), eight as Least Concern (LC), two as Not Threatened (NT), one as Data Deficient (DD) and one as Extinct (EX). However, this does not conform to current knowledge of the terrestrial molluscs of the Crimea (Balashov, 2016a, b) and requires reconsidering.

According to my estimate, using the IUCN criteria (IUCN, 2012), of the 21 endemic species, 13 are LC, one is NT, three are Endangered (EN), two are almost certainly intraspecific forms of the LC species and two more are of unclear systematic status and should be referred to as DD (Balashov, 2016a, b).

The 13 LC Crimean endemic and almost endemic molluscs are: *Brephulopsis cylindrica* (Menke, 1828), *Brephulopsis bidens* (Krynicky, 1833), *Peristoma rupestre* (Krynicky, 1833), *Peristoma ferrarii* (Hausdorf, 1994) (traditionally placed in *Thoanteus*, but it is most certainly a species of *Peristoma* (Balashov, 2016b)), *Thoanteus gibber* (Krynicky, 1833) (Enidae), *Mentissa canalifera* (Rossmässler, 1836), *Mentissa gracilicosta* (Rossmässler, 1836), *Mentissa velutina* Baidashnikov, 1990 (Clausiliidae), *Oxychilus diaphanellus* (Krynicky, 1836) (Oxychilidae), *Bilania boettgeri* (Clessin, 1883) (Daudebardiidae), *Deroceras tauricum* (Simroth, 1901) (Agriolimacidae), *Helicopsis retowskii* (Clessin, 1883) (Geomitridae) and *Monacha fruticola* (Krynicky, 1833) (Hygromiidae) (Balashov, 2016a). All except *Brephulopsis cylindrica* and *Monacha fruticola* are endemic to the Crimea, with these two species also occurring naturally in a few adjacent areas to the north. Six of these 13 species are correctly listed as LC in the IUCN Red List and six more are not listed. One species, *P. rupestre*, is listed as NT in the IUCN Red List. This species lives in the Crimean Mountains only, but is widely distributed across the entire mountain system. It lives most commonly in beech and oak forests, but often also in any other types of forests and in high montane open habitats, with a few records in urban environments on the southern coast (Balashov, 2016a, b). Therefore there is no reason to expect significant decline of this species in the foreseeable future and it should be considered LC.

The recently described *Brephulopsis konovalovae* Gural-Sverlova & Gural, 2010 is probably an intraspecific form of *B. bidens* that sometimes occurs in populations of the latter species in the central and eastern Crimean Mountains (Balashov, 2016b), and therefore there is no reason to assess its conservation status.

However, the taxonomy of the Crimean *Helicopsis* species is in flux. Four species are reported from the Crimea in the recent literature: *H. retowskii*, *H. filimargo* (Krynicky, 1833), *H. arenosa* (Krynicky, 1836) and *H. paulhessei* (Lindholm, 1936). The first two of these species are listed as LC in the IUCN Red List, the third as DD and the last as extinct. However, these species are extremely variable geographically, there are no distinct boundaries between their morphological variability and there are no localities where any two of these species are sympatric. It is possible that all these forms represent just one complex and variable species (Balashov, 2016b) (Fig. 1). It is especially unlikely that *H. paulhessei* is a



**Fig. 1.** *Helicopsis* cf. *retowskii* on the rock near the Great Canyon of Crimea. Photo: I. Balashov



**Fig. 2.** *Taurinellushka babugana* (from Balashov, 2014).

separate species, as most specialists consider it to be an intraspecific form of the common *H. retowskii* (Gural-Sverlova, 2012; Balashov, 2016b). Moreover, it is not obvious that this form is extinct in its type locality. During an expedition in May 2015 I found a *Helicopsis* population near the type locality of *H. paulhessei* in the town of Gaspra. These snails do not correspond perfectly to the original description of *H. paulhessei*, but are quite close to it (Fig. 1).

For another *Helicopsis* species the situation is more difficult. At least one species is common and widespread in the Crimea (and even spreads into some other regions north of the Black Sea); it is traditionally referred to as *H. retowskii*. Another two forms, *H. filimargo* and *H. arenosa*, have much more limited distributions, mainly inhabiting natural grasslands. They may be threatened or near threatened, especially *H. arenosa*. Therefore, these species should be evaluated as DD prior to revision using molecular genetic methods.

The recently described *Taurinellushka babugana* Balashov, 2014 (Prisilomatidae) (Fig. 2) lives in undisturbed habitats at altitudes above 1,000 m in the central Crimean Mountains; it is considered to be NT (Balashov, 2014, 2016a). This is the only known species of the genus with its closest relatives in the Balkans (Balashov, 2014), which may suggest additional conservation importance.

The rare *Peristoma merduenianum* Krynicki, 1833 (Fig. 3) is listed as NT in the IUCN Red List. There are only around nine known extant populations of this species, almost all of which

are exclusively associated with sparse forests of Greek juniper (*Juniperus excelsa*). This habitat is a relic and most threatened in the Crimea not only because of its destruction and transformation (which often takes place), but also because of genetic degradation of the Crimean populations of this tree. The Greek juniper is listed in the Red Book of Ukraine as “vulnerable” and sparse forests of it are listed in the Green Book of Ukraine (list of protected habitats) in the highest most threatened first category (MENR, 2009; Balashov & Baidashnikov, 2013). These habitats occur mainly in the southern foothills of the Crimean Mountains along the southern coast, with their overall area of occupancy here being about 40 km<sup>2</sup>. *Peristoma merduenianum* was found in six of nine plots with sparse forests of Greek juniper (Balashov & Baidashnikov, 2013), so its area of occupancy must be less than 40 km<sup>2</sup>. The overall extent of its occurrence is about 2,000 km<sup>2</sup> but it is very much fragmented. Therefore this species should be considered EN B1ab(iii)+2ab(iii).

Another rare endemic species is *Ramusculus subulatus* (Rossmässler, 1837) (Enidae) (Fig. 4). This species is listed as LC in the IUCN Red List, but in fact it is one of the most threatened molluscs in the Crimea (Balashov & Baidashnikov, 2013; Balashov, 2016a). This species is known only from seven recent locations, six being montane steppe and one sparse Greek juniper forest. A single fossil record of this species is from the early Holocene of the Kerch Peninsula (eastern Crimea). This fossil finding is on the Crimean plain quite far from the current range of *R. subulatus*, which suggests that the species was much more widely distributed in prehistoric times and has declined because of destruction of the natural steppe habitat. Most of these seven populations are not protected or are insufficiently protected. The largest and most numerous population of this species, on the northern slope of Chatyr-Dag Plateau (Fig. 4) is near but outside the boundary of the Crimean Nature Reserve. The steppes are threatened habitats in the Crimea, facing afforestation (which is especially concerning for mountain populations of *R. subulatus*), excessive grazing and mowing, premeditated fires, off-road driving, etc. (Parnikoza & Vasiluk, 2011; Balashov, 2016a). The area of *R. subulatus* occupancy is about 20 km<sup>2</sup> and its extent of occurrence is about 2,000 km<sup>2</sup>. Therefore, as for the previous species, it should be considered EN B1ab(iii)+2ab(iii). It also should be stated that *R. subulatus* is sometimes placed in the other endemic Crimean genus, *Brephulopsis*, without explanation (Gümüş & Neubert, 2012; Welter-Schultes, 2012). However, this is clearly incorrect, as these snails are very different from *Brephulopsis* both in shell structure and in significant anatomical characters (Balashov, 2016b). It is most likely that *Brephulopsis* is not the closest relative of *Ramusculus*. Perhaps a reason of this placement is



**Fig. 3.** *Peristoma merduenianum*. Photo: A. Baidashnikov



**Fig. 4.** *Ramusculus subulatus* on the northern slope of the Chatyr-Dag plateau. Photo: I. Balashov

confusion of *R. subulatus* and *B. bidens*, which are of similar size and shape (Fig. 5), the photo of the latter species labelled as *B. subulatus* by Welter-Schultes (2012). Thus *R. subulatus* is the only species of this endemic Crimean genus.

Another concern regarding conservation of *P. merduenianum* and *R. subulatus* is that both these species were excluded from



**Fig. 5.** *Brephulopsis bidens* (left) and *Ramusculus subulatus*. Photo: I. Balashov

the Red Book of the Crimea in 2015, despite the first species being listed in the Red Book of Ukraine since 1994 and the decision to include *R. subulatus* in the next edition having been accepted in 2014 by the Commission on the Red Book of Ukraine (Balashov, 2016a).

One more species among the most threatened in the Crimea is *Vitrea nadejdae* Lindholm, 1926 (Pristilomatidae), which is not covered by the IUCN Red List. This species occurs exclusively in a few forested massifs on the subtropical coast near Yalta, specifically inhabiting forests of oriental hornbeam and Greek juniper on the mountain foothills. All known records are within the southern part of the Yalta Forest-Mountain Nature Reserve or its former lands. This is one of the most troublesome protected areas in the Crimea. It is located in the most attractive resort area where often semi-legal building of personal residences and other infrastructure takes place (both before and after 2014), exactly where *V. nadejdae* occurs. In 2012, part of the protected lands on the southern coast were excluded from the reserve and instead some much less valuable forests in the other part of the mountains were added to it. Currently, the boundaries of the reserve are not officially designated. Therefore, it cannot be said that this species is protected and it is threatened by habitat destruction and transformation. The extent of *V. nadejdae* occurrence is no more than 100 km<sup>2</sup> and its area of occupancy is less than 30 km<sup>2</sup>. Therefore according to the IUCN criteria it should be evaluated as EN B1ab(iii)+2ab(iii) or perhaps even CR B1ab(iii) (Balashov, 2016a). Most recently, I found this rare species in May 2015 near the town of Gaspra in sparse Greek juniper forest (just a few fresh empty shells).

Consequently, I suggest making the following changes in the IUCN Red List: 1) exclude *Helicopsis paulhessei* or at least switch its status to DD; 2) change the status of *Peristoma rupestre* from NT to LC; 3) change the status of *Peristoma merduenianum* and *Ramusculus subulatus* to EN; 4) include *Vitrea nadejdae* and *Taurinellushka babugana* in the IUCN Red List as EN and NT, respectively.

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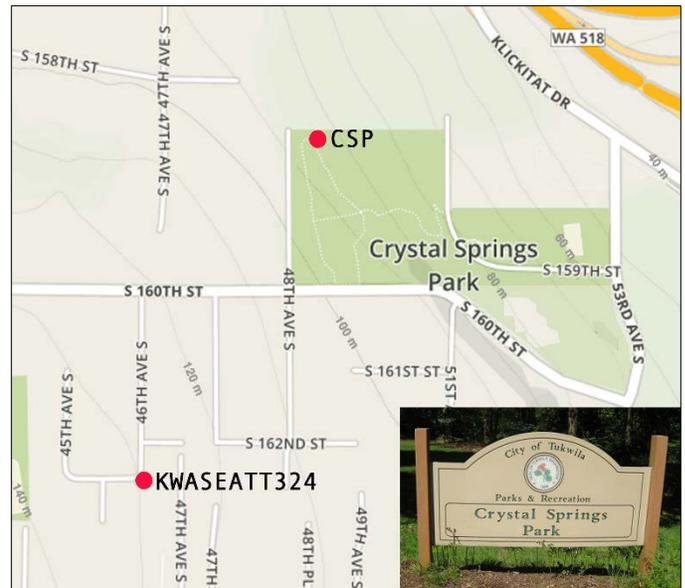
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## CORRELATING PERSONAL WEATHER STATION DATA WITH OBSERVATIONS OF THE ACTIVITY OF *ALLOGONA TOWNSENDIANA* AT CRYSTAL SPRINGS PARK, TUKWILA, WASHINGTON STATE, USA

By Edward J. Johannes

Over the years I have taken my dogs on walks nearly every day to Crystal Springs Park, Tukwila (Fig. 1). I casually observed in this 4.5 ha (11 acre) city park the seasonal activity of a colony of *Allogona townsendiana* (Oregon forestsnail) and appearances of other native land molluscs such as *Ariolimax columbianus* (Pacific banana slug) with occasional appearances of *Monadenia fidelis* (Pacific sideband), *Ancotrema sportella* (beaded lancetooth), *Haplotrema vancouverense* (robust lancetooth), *Prophysaon andersoni* (reticulate tailedropper), much more rarely *Cryptomastix devia* (Puget Oregonian) and, so far, long dead shells only of *Vespericola columbiana* (northwest hesperian). They are found on the top of a seepy well-vegetated, forested slope above Crystal Springs. In addition to the land molluscs, Crystal Springs is the northernmost site for the springsnail *Pristinicola hemphilli* (pristine pyrg) in the Puget Sound basin. Occurrence of this springsnail is an anomaly in a once heavily glaciated region. It was during surveys for *P. hemphilli* that I found additional sites for *Allogona townsendiana* in the Puget Sound region including Crystal Springs (Johannes, 2016).

Recently, I decided that *Allogona townsendiana* (Fig. 2) would be a good candidate to study the relationship between seasonal weather conditions and the activity of land snails. This snail is usually found in isolated, relatively densely populated colonies that are associated with *Urtica* sp. (stinging nettles), typically near springs and seeps (Waldock, 2002; Steensma *et al.*, 2009; Edworthy *et al.*, 2012; Johannes, personal observations). This makes locating them and performing censuses of them much easier than for other native





**Fig. 3.** Transect site CSP along a paved path in Crystal Springs Park under a Bigleaf maple (*Acer macrophyllum*) dominated forest with sword fern (*Polystichum munitum*) and stinging nettles (*Urtica*; dead stalks) understory. Max with front paws next to the right corner stake of a 1 m X 10 m transect area bordered by a yellow shock cord.

To survey the daily absence or presence and numbers of *Allogona townsendiana* methodically I set up a 1 m x 10 m transect through the centre of the snail colony, designated site CSP (Fig. 1; 47.461° N, 122.273° W; elevation 90 m). The corners of the transect are marked by wooden stakes used to stretch a 15.24 m (50 ft), 0.625 cm (0.25 inch) diameter shock cord (bungee) around them to define the boundaries (Fig. 3). This shock cord does not remain at the site but is only set up during observations when snails are found to be present and active. The *A. townsendiana* colony has a paved path cutting through part of it (Fig 3). It is also being encroached on by invasive *Hedera helix* (English ivy) that has taken over parts of the ground cover of the park, excluding native plants including *Urtica* sp. This could possibly threaten the continued existence of this *A. townsendiana* colony.

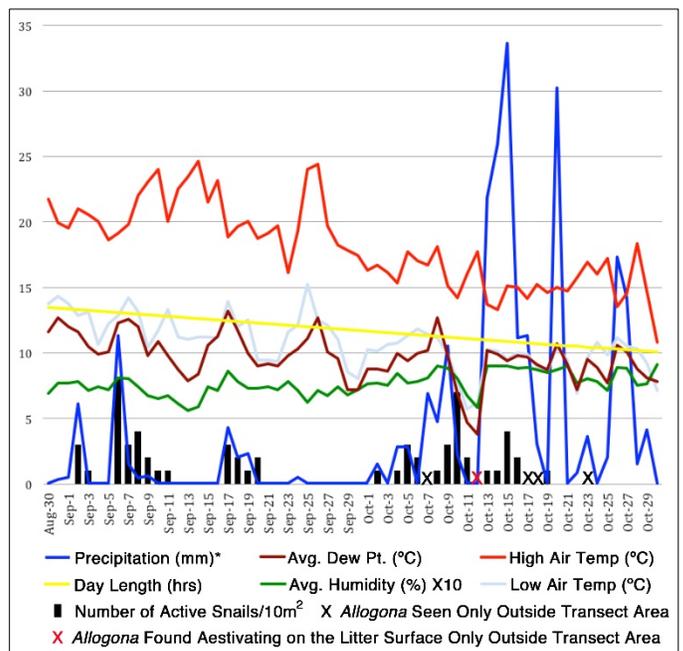
Biological studies in the past requiring continuous weather data used either the closest National Weather Service (NWS) station or a weather station placed on site. Setting up a weather station on site entails the possible risk of expensive equipment being vandalised or stolen, which could potentially cut short a project. Constraints on placement of a weather station at a site may also be due to accessibility or that it is not permissible, as in Crystal Springs Park. The dependence on NWS stations restricted where such studies could be conducted because the further the site is from the station the less likely the data are to reflect local conditions at the site. The nearest NWS station to site CSP is 3.6 km away at Seattle-Tacoma International Airport (Sea-Tac Airport) ([KSEA](#) at 47.445° N, 122.314° W; elevation 132 m). As shown in Table 1, this weather station and a personal weather station (PWS) closer to site CSP differ in the rainfall amounts measured. The advent of PWS streaming to the web has made it possible to use a nearby station that more closely reflects the

**Table 1.** Comparison of some daily precipitation records between two weather stations, KSEA at Sea-Tac Airport and PWS KWASEATT324 near CSP.

Date	Precipitation (mm)	
	KSEA	PWS KWASEATT324
1 Sep 2016	4.3	4.1
2 Sep 2016	1.3	2.5
6 Sep 2016	10.7	10.7
7 Sep 2016	1.0	1.5
8 Sep 2016	0.8	1.0
17 Sep 2016	4.1	6.3
23 Sep 2016	0.3	0.5
1 Oct 2016	1.3	1.5
4 Oct 2016	3.3	4.3
6 Oct 2016	7.9	4.6
7 Oct 2016	2.8	4.1
8 Oct 2016	15.5	14.0
9 Oct 2016	1.5	2.5

weather conditions found at a biological study site at little or no cost. The proliferation of PWS has resulted in widespread coverage of local weather conditions that are stored on web sites like [Weather Underground](#) and [MesoWest](#), making real-time and historical information very accessible to the public. Real-time and historical data from NWS stations are posted at both web sites as well. The nearest PWS to site CSP is just 0.4 km away (Fig. 1; [KWASEATT324](#) at 47.457° N, 122.275° W; elevation 131 m). This station started operating on 15 January 2015 and is streaming weather data to the Weather Underground site.

Initial results of this study at site CSP show unsurprisingly a close correlation between precipitation and the appearance of active *Allogona townsendiana*, at least initially (Fig. 4). During the 62 days of observations from 30 August (the start of seasonal rainfall) to 30 October 2016, the snails were active



**Fig. 4.** Snail observations and weather data from PWS KWASEATT324 recorded from 30 August to 30 October 2016.  
\* Total rainfall amounts calculated between observations

for a total of only 26 days. Snails were seen during five active periods with lengths of one to 16 days. At the onsets of dry periods between rains the snails completely disappear, usually within a couple of days or fewer. On two days with 0.5 mm of rainfall no snails appeared, but it does seem that at least 1.5 mm of precipitation is enough to rouse the snails from their slumbers.

A sudden cold snap (5.7 °C) resulted in a few *A. townsendiana* being found aestivating on the surface of the leaf litter (Fig. 4). I also observed this behaviour at a second *A. townsendiana* site nearby on the same day. It was as if they had been caught out by the rapid air temperature change and were unable to crawl back to their usual hiding spots. All revived with warmer temperatures the following days, but despite regional record-breaking rainfall for October all land molluscs essentially disappeared and will not reemerge until the spring.

PWS are another useful tool now available for the conservation management of sensitive or endangered species, especially projects with limited budgets. I hope to continue this project for several years to assess the response of *Allogona townsendiana* to daylight length, seasonal weather conditions and more importantly climate change.

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## EXCAVATA ELEGANTULA (GASTROPODA: HELICINIDAE) IN URBAN PARKS IN THE DOMINICAN REPUBLIC

By *Altigracia Espinosa J.*

Most studies of molluscs from Hispaniola focus on taxonomy, and rarely on species biology and conservation status. As a consequence, the impact on their populations from natural or human driven environmental changes are unknown. Lately, urban development of the city of Santo Domingo has increased. For the most part, the increase is not based on urban planning studies, resulting in the loss of large green areas with native vegetation. A solution to this situation is to create protected areas or urban parks like Mirador Sur Park, the Wildlife Refuge Los Tres Ojos and the Iberoamerican Park. Mirador Sur Park is a 6 km long green area, parallel to the south coast of Santo Domingo (ADN, 2016). This area was a paddock when it was protected in 1970 with the intention of protecting its long rocky cliff with caves (Fig. 1) and underground rivers. In 1993, Manigua's Cave or the Lake Cave, a limestone area with lentic and lotic waters, was opened to the public.

Despite the environmental impact, populations of *Excavata elegantula* (Pfeiffer, 1850) remain in Mirador Sur Park, dwelling on native and introduced plants and on the rocky cliffs. On my first sampling occasion, on a rainy day in 2016, I counted 120 individuals of this species: 81 along a 600 m long cliff, eight on the trunk of *Delonix regia* (*flamboyán*), 30 on a 3 m long concrete bench (Fig. 2) and one on the trunk of a royal palm tree (*Roystonea hispaniolana*). I also observed vertical movement of individuals on the trunk of this palm tree (Fig. 3). On other occasions, on sunny days, I counted 58 individuals alive: 27 on a 32 m transect on limestone rocks (Fig. 4), 11 in Taina Cave 1, four in a 25 x 25 cm parcel on rock, one in the vegetation, one on a neem (*Azadirachta indica*) trunk and three on a laurel (*Ficus* sp.). In an area with lots of trash and domestic animals, there were 12 individuals.

Parallel to the coast of Eastern Santo Domingo County is the wildlife refuge Los Tres Ojos (Fig. 5) with a limestone cave system with a lagoon fed by water from Brujuelas River. This system resembles three eyes, the source of the name. It was discovered in 1916 and has been protected since 1972. It is a 3.5 km<sup>2</sup> area with low urban impact and has many native plant species. We found 54 individuals of *E. elegantula*: eight on *Guettarda* sp., four on *Cecropia schreberiana* (*yagrumo*), one on *Kalanchoe daigremontiana*, one on *Zamia pumila* (*guáyiga*), 10 on the trunk of a palm tree (*R. hispaniolana*),



**Fig. 1.** A limestone cave in the Mirador Sur Park.



**Fig. 2.** Concrete benches used by *E. excavata* during the rainy season.



**Fig. 3.** *Excavata elegantula* on a trunk of *Roystonea hispaniolana*.

and three on the base of *magueyito* (*Tradescantia spathacea*), system with a resembles three eyes, the reason for the name. It was lagoon fed by water from Brujuelas River. This system almost at ground level. Except for the last case, all of these molluscs were found between 1 and 2 m above ground. We also found 23 individuals on a metal railing used for protection and four on rocks.

The Iberoamerican Park (Fig. 6) was another urban park where we counted *E. elegantula*. The National Dominican Zoo



**Fig. 4.** An individual of *Excavata elegantula* on rocks.



**Fig. 5.** Los Tres Ojos Wildlife Refuge.



**Fig. 6.** Iberoamerican Park.

was located in this area until 1974. Like the other two areas, its substrate base is limestone with some cliffs and it has only small patches of vegetation. Santa Ana cave is in this park, and we found *E. elegantula* on the rocky walls of this cave and on the trunks of some trees.

In this park we counted 98 snails: 44 on 10 m<sup>2</sup> of the cave walls, two on a *lino criollo* (*Leucaena leucocephala*) trunk 1.4 m above ground, 10 on a laurel (*Ficus* sp.) trunk 2.7 m above ground, and 42 on a 5 m long concrete stairway.

*Excavata elegantula* has survived the impact of urban development in Santo Domingo. Nowadays, this species uses substrates such as endemic and native plants, extended limestone areas and areas that have been opened as a result of the urban impact. These populations are isolated, and even though they are in protected areas, in the case of those in the Mirador Sur and Iberoamerican Park, these areas are occasionally subject to modifications that have an impact on the *E. elegantula* populations. As is well known, urban biodiversity is highly threatened by human activities (e.g. de Juana Aranzana, 2015). Among the three areas studied, Los Tres Ojos wildlife refuge offers the best protection for this species because of its stricter protection status as a wildlife refuge.

I thank Ruth Bastardo, who took all the photos and reviewed and made suggestions to improve the text, Dr. David Hernández M. for reviewing for improvement and translating the text, and Samy Castro, América Sánchez, J. Martínez and J. Aybar for their collaboration in the field. Dr. Ira Richling, Curator of Malacology at the Stuttgart State Museum of Natural Sciences, confirmed the species identity.

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## ATLANTIC FOREST TERRESTRIAL MOLLUSCS OF THE TAQUARA MUNICIPAL NATURE PARK, STATE OF RIO DE JANEIRO, BRASIL

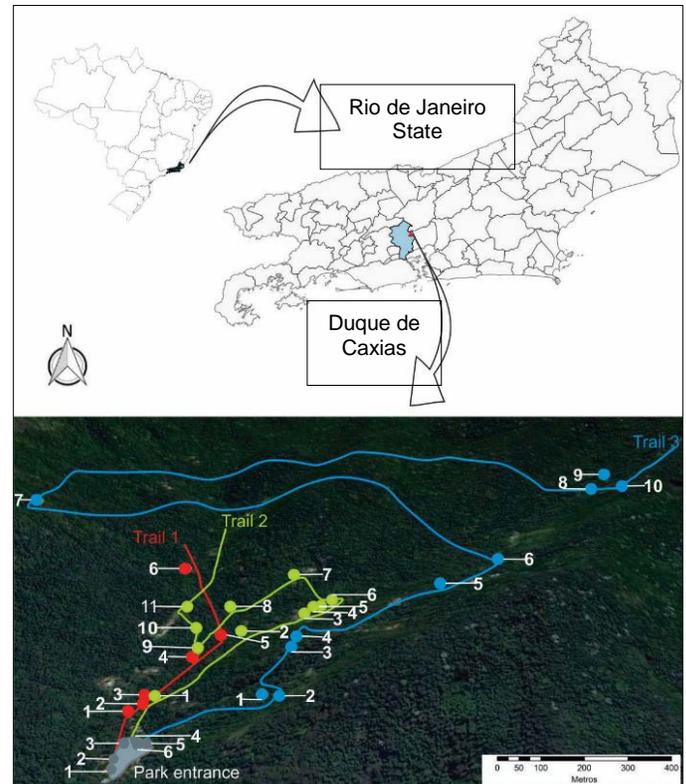
By Alessandra da Costa Lima, Suzete Rodrigues Gomes, Norma Campos Salgado & Monica Ammon Fernandez

The Atlantic Forest is one of the major Brazilian biomes, as well as one of the most extensive on the planet, but it has suffered widespread devastation caused by human development throughout the last century. The Taquara Municipal Nature Park (PNMT), located in the Duque de Caxias municipality, Rio de Janeiro State (Fig.1), is characterised by this biome. This 20 ha area of environmental protection, approximately 48 km from the Rio de Janeiro metropolis, was created in 1992. It is important to emphasise that PNMT also contains residential ranches established before its foundation, as well as waterfalls that are open to the public. This makes some areas heavily degraded by the presence of domestic animals and littering by residents or visitors, especially on trails and access routes to the waterfalls.

The few studies concerning the fauna and flora of the PNMT (S. Fadel, personal communication) emphasise the importance of this place as a green corridor for several Atlantic Forest

species, linking various national environmental protection areas. Since no study has attempted to evaluate the malacofauna in PNMT, the present research was intended to determine the taxonomic identity of the terrestrial mollusc species found in the area.

The surveys for molluscs were conducted in October, November and December 2015 and February 2016. Thirty-three randomly chosen stations were sampled and georeferenced on the three main trails (subareas 1-3) and in the area near the park entrance (subarea 4) (Fig. 1). Trail 1 leads to major waterfalls and is used primarily by visitors, while the others are mainly used by residents.



**Fig. 1.** Area of study indicating the 33 sampling stations in the four subareas: trails 1 (red), 2 (green) and 3 (blue) and the area near the park entrance (grey).

The species were searched for on leaves and stems, under fallen trunks, rocks and fallen dead leaves. The specimens were sorted at the Malacology Laboratory of the Instituto Oswaldo Cruz, and identified based on observation of shells and anatomy under a stereomicroscope. All shells were analysed with respect to their general shape, colour, texture, protoconch features, number of whorls, spire height, aperture shape and umbilicus diameter and depth, in order to identify them to the lowest taxonomic level. Data were compared to the available literature, which included general works for Brazil and specific works for certain groups or geographic regions (Lanzieri & Almeida, 1964; Monteiro & Santos, 2001; Pena *et al.*, 2005; Simone, 2006; Thomé *et al.*, 2006; Colley, 2008; Ohlweiler *et al.*, 2010; Lopes *et al.*, 2012; Rodrigues *et al.*, 2016). Samples of all species were deposited in the Instituto Oswaldo Cruz Mollusc Collection (CMIOC), FIOCRUZ.



**Fig. 2.** Synanthropic species widespread in the tropical Americas and present in the Taquara Municipal Park. A—*Leptinaria unilamellata*, B—*Subulina octona*, C—*Beckianum beckianum*, D—*Achatina fulica*, E—*Deroceras laeve*, F—*Sarasinula linguaeformis*.

We recorded 21 species, representing 12 families (Tables 1, 2). Of these families, three include species considered alien in Brasil (Achatinidae, Agriolimacidae and Subulinidae) (Fig. 2), which occur mainly in disturbed areas and on the edges of native areas. The other nine families include native Brazilian species (Fig. 3)

Considering the type of substrate on which they were found, species in four families were associated with the branches of trees and bushes: Eucolunidae, Helicinidae, Simpulopsidae, each represented by a single species, and Bulimulidae. *Habroconus semenlini* were collected from the lower leaves of trees and fallen dry leaves. *Helicina inaequistriata*, *Simpulopsis* sp. and *Rhinus ciliatus* were found above ground in the trees, resting on the upper surfaces of the leaves.

The most diverse family was the Subulinidae, with five species, followed by Bulimulidae, Systrophidae and Streptaxidae. The other families were represented by only one species. Trail 3 had the greatest abundance, with 16 species (Tables 1, 2), including six alien and ten native species. Of the 433 specimens collected, alien species predominated and constituted 75 % of the specimens. Although found in all subareas, few specimens of the alien *Deroceras laeve* were collected, in contrast to *Beckianum beckianum*, with 173 specimens (Table 1).

Among the native molluscs (25 % of the specimens), the Bulimulidae predominated, being represented by four species: *Bulimulus tenuissimus*, *Colchlorina aurisleporis*, *Rhinus*



**Fig. 3.** Native Brazilian terrestrial snails found in the Taquara Municipal Nature Park. A—*Bulimulus tenuissimus*, B—*Thaumastus taunaisii*, C—*Megalobulimus ovatus*, D—*Habroconus semenlini*, E—*Helicina inaequistriata*, F—*Colchlorina aurisleporis*, G—*Simpulopsis* sp., H—*Happia vitrina*, I—*Streptartemon cookeanus*, J—*Solaropsis brasiliana*, K—*Streptaxis contusus*, L—*Tamayoa banghaasi*. *Bulimulus tenuissimus* and *Streptartemon cookeanus* are often collected in urban and surrounding landscapes in Rio de Janeiro State (Lopes *et al.*, 2012; Rodrigues *et al.*, 2016).

*ciliatus* and *Thaumastus taunaisii*. Few specimens of each of these species were obtained, with the exception of *T. taunaisii*, which was represented by 42 shells collected on trail 3, all but one from a single station (Table 2) near a possible lizard burrow.

The information presented here is considered preliminary, being part of a major study that intends to analyse the distribution of terrestrial molluscs throughout the Atlantic Forest areas of Rio de Janeiro State, as well as the morphological variability of the populations based on the Mollusc Collection of the Instituto Oswaldo Cruz and the National Museum of Rio de Janeiro. Even so, these records are a starting point for future studies in this area (recently placed under environmental protection) that will help to develop conservation efforts and temporal evaluation of the effects of invasive alien species on native species in PNMT.

The presence of a high number of native species in the PNMT area demonstrates its potential as an environmental protection location, and the need for actions to preserve these species and

**Table 1.** Alien species with synanthropic behaviour in Rio de Janeiro State and wide distribution in South America, including Brasil, and their occurrence in the four subareas of the Taquara Municipal Nature Park, with sampling station and number of specimens collected.

Family	Species	Sampling station (number of specimens)
<b>Subarea 1</b>		
Agriolimacidae	<i>Deroceras laeve</i>	1(2)
Subulinidae	<i>Leptinaria unilamellata</i>	1(3), 2(3), 3(1), 4(2)
<b>Subarea 2</b>		
Achatinidae	<i>Achatina fulica</i>	3(1), 5(2), 7(2), 9(15)
Agriolimacidae	<i>Deroceras laeve</i>	1(1)
Subulinidae	<i>Allopeas micra</i>	9(1)
	<i>Beckianum beckianum</i>	1(22), 2(2), 7(7), 9(3), 10(4)
	<i>Lamellaxis gracile</i>	11(1)
	<i>Subulina octona</i>	2(1), 7(3), 9(1), 10(1), 11(4)
<b>Subarea 3</b>		
Agriolimacidae	<i>Deroceras laeve</i>	7(1),
Subulinidae	<i>Allopeas gracile</i>	5(3)
	<i>Allopeas micra</i>	3(1), 5 (1)
	<i>Beckianum beckianum</i>	1(33), 2(4), 3(14), 4(55), 5(7)
	<i>Leptinaria unilamellata</i>	3(5), 4(1), 5(1)
	<i>Subulina octona</i>	6(1), 3(22), 4(19)
<b>Subarea 4</b>		
Achatinidae	<i>Achatina fulica</i>	1(1), 6(7), 5(2)
Agriolimacidae	<i>Deroceras laeve</i>	1(1)
Subulinidae	<i>Allopeas micra</i>	4(2)
	<i>Beckianum beckianum</i>	1(6), 3(4), 3(12)
	<i>Leptinaria unilamellata</i>	1(5), 5(14)
	<i>Subulina octona</i>	1(11), 4(1), 5(7)
Veronicellidae	<i>Sarasinula linguaeformis</i>	5(2)

control the alien mollusc populations, especially *Achatina fulica*, which was recorded in two of the four subareas.

Gaining knowledge of poorly known species and preservation of the diversity of species are growing concerns among the scientific community, especially as there are still countless areas with unknown biodiversity (Barbosa, 1995). Although it is a preliminary study, this characterisation of the PNMT terrestrial malacofauna reinforces the need to address the existing issue of biodiversity loss, since the area with greatest impacts caused by anthropogenic activities (subarea 4) was dominated by alien species, which can quickly expand and interfere with the native fauna, competing for space and food.

This study allowed a quick diagnosis of the preservation quality of the Atlantic Forest in this region, which is certainly diverse in terrestrial mollusc species, especially if we take into account the extent of the area and the floristic and environmental diversity, and that it was mainly the areas impacted anthropogenically that were sampled.

We are grateful to Alberto Pereira Leite, Director of the Taquara Municipal Nature Park, and his team, who facilitated our work, mainly regarding access to trails.

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**Table 2.** Native Brazilian species found in the four subareas of Taquara Municipal Nature Park, with sampling station and number of specimens collected.

Family	Species	Sampling station (number of specimens)
<b>Subarea 1</b>		
Bulimulidae	<i>Rhinus ciliatus</i>	1(2), 3(1)
Helicinidae	<i>Helicina inaequistriata</i>	5(2)
Simpulopsidae	<i>Simpulopsis</i> sp.	2(1), 3(1)
Streptaxidae	<i>Streptaxis contusus</i>	1(1)
Systrophiidae	<i>Happia vitrina</i>	3(1)
<b>Subarea 2</b>		
Bulimulidae	<i>Bulimulus tenuissimus</i>	5(2)
	<i>Cochlorina aurisleporis</i>	9(1), 11(1)
Euconulidae	<i>Habroconus semenlini</i>	7(4)
Helicinidae	<i>Helicina inaequistriata</i>	8(2)
Solaropsidae	<i>Solaropsis brasiliiana</i>	9(1)
Streptaxidae	<i>Streptaxis contusus</i>	9(1)
Systrophiidae	<i>Tamayoa banghaasi</i>	6(4), 7(1)
<b>Subarea 3</b>		
Bulimulidae	<i>Bulimulus tenuissimus</i>	7(1)
	<i>Thaumastus taunaisii</i>	9(41), 8(1),
Euconulidae	<i>Habroconus semenlini</i>	1(1), 7(1),
Helicinidae	<i>Helicina inaequistriata</i>	6 (1)
Megalobulimidae	<i>Megalobulimus ovatus</i>	2(2)
Solaropsidae	<i>Solaropsis brasiliiana</i>	2(1)
Streptaxidae	<i>Streptaxis contusus</i>	10(2), 9(1), 4(4)
	<i>Streptartemon cookeanus</i>	3(1), 4(6), 5(1)
Systrophiidae	<i>Tamayoa banghaasi</i>	7(1), 6(3), 3(1), 4 (7)
	<i>Happia vitrina</i>	1(1)
<b>Subarea 4</b>		
Bulimulidae	<i>Bulimulus tenuissimus</i>	6(1)
Systrophiidae	<i>Tamayoa banghaasi</i>	1(1), 5(3)

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## NATURAL PREDATION ON *LISSACHATINA FULICA* IN CUBA

By Michel Matamoros Torres, Luis Álvarez-Lajonchere, Nivia Cueto Zaldívar & Darel Mompeller Rodríguez

There is little experience of biological control of terrestrial molluscs and much remains to be learned in relation to the knowledge of pathology, parasitism and predation in insects (Wilson, 2012). However, some authors, such as Barker (2004) and Auffenberg & Stange (2014) have commented on the predation of molluscs. They agree that we still understand little about the role of natural enemies of molluscs in ecosystems, so it is very premature to speak of augmentative biological control for these organisms.

The giant African snail, *Lissachatina fulica* (Bowdich), is an achatinid gastropod originating in East Africa that has agricultural, medical-veterinary and environmental importance. Due to its prolific reproduction, omnivorous habit, adaptability and endurance, it is among 100 of the most harmful invasive alien species on the planet (Lowe *et al.*, 2004). *Lissachatina fulica* is considered a threat to agriculture because of the large number of plant species (234) it has been reported to damage (Mead, 1961). The most widely used and effective method of control is by physically collecting and destroying both eggs and snails in the infested area (Mead, 1961). Use of biological control to regulate populations of this pest is not recommended, because, for example in the Hawaiian Islands, where alien predatory snails were introduced in attempts to control it, the predators did not control it but preyed on more vulnerable endemic arboreal snails (Cowie, 2001; USDA-APHIS, 2007).

Among the natural predators of molluscs are birds, mammals, insects (Coleoptera and Diptera), planarians, other molluscs, reptiles, spiders, mites, nematodes and bacteria (Barker, 2004). In Cuba natural enemies that act in the regulation of populations of *L. fulica* are not known, which is why we consider it necessary to report, from a conservation perspective, natural predation on the giant African snail in a natural ecosystem (protected area) affected by this pest in Cuba.

On 30 June 2014, five achatinid snails from the Poey neighborhood of Arroyo Naranjo were identified as *L. fulica*, at the Institute of Plant Health Research (INISAV), the first record of the species in Cuba. Identification of this species followed Mead (1950, 1979, 1995), based on external

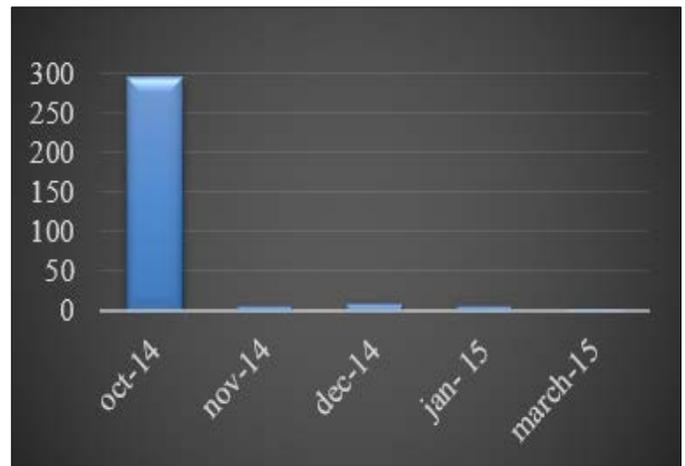


Fig. 1. Numbers of snails detected and destroyed in GPMH.

conchological characters as well as the anatomy of the reproductive apparatus. The specimens were deposited in the malacological collections of the Museum of Natural History “Felipe Poey”, University of Havana and Institute of Ecology and Systematics.

This species has spread rapidly in the province of Havana, where all the municipalities of the city now have some locality affected with its presence and there is the risk of introduction to other, natural areas. The area where the focus was detected within the Gran Metropolitan Park of Havana (GPMH) is a protected area, Isla Josefina, which is 10.6 ha of natural landscape, located in the municipality Plaza de la Revolución (82°40'63" N 23°11'11" W). Populations of *L. fulica* in this area have been subject to eradication efforts by provincial quarantine authorities since October 2014 (Fig. 1).

The evidence of predation was found at 23°06'57.4 "N 82°24'24.3" W in the strip of vegetation that lies between the

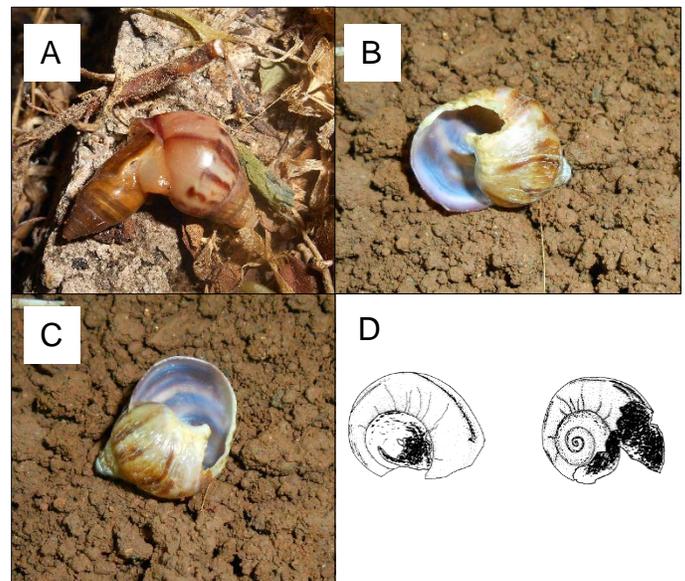


Fig. 2. GPMH predation. A—*Oleacina straminia*, B & C—shell with indication of rodent predation (frontal and lateral views), D—predation of shells observed by Faus (1988) (note similar pattern).

street and the river at 200 m from the cabaret “El Chévere”. The microhabitat was stones and leaves on a mound of soil only 3 m from the street, where an adult *Oleacina straminia* was found consuming the soft parts of *L. fulica* (Fig. 2A).

Evidence of rodent predation (Figs. 2B, 2C) was found only 20 m from the predation by *Oleacina straminia*. We identified this as rat predation following the description and criteria of Faus (1988) (Fig. 2D).

The site where *L. fulica* predation by *O. straminia* was found is a protected area. The vegetation provides the humidity necessary for the presence of this and other species of molluscs adapted to the environment, but not the invasive species. Cars and other vehicles pass just a few metres from this area and their emissions pollute the environment. Circumstances seem to indicate that eradication efforts and natural control have resulted in populations of *L. fulica* at levels well below those seen in 2014 (Fig. 1). At present INISAV leads the national project “Diagnosis, characterization and control of the giant African snail in Cuba”, to provide all the scientific and technical elements necessary to address this phytosanitary problem.

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## CONSERVATION OF MOLLUSCS IN SOUTHERN BRASIL: FIRST CONFIRMED RECORD OF THE GENUS *ORTHALICUS* IN SANTA CATARINA STATE

By A. Ignacio Agudo-Padrón

The genus *Orthalicus* Beck, 1837, of the family Orthalicidae, includes some of the most beautiful native forest snails in South America. It is one of the most endangered groups of terrestrial molluscs in Brasil because of rampant human modification of habitat, and more recently, for its disastrous and mistaken destruction due to phenotypic similarities of the shells with those of the alien invasive giant African snail, *Achatina fulica* Bowdich, 1822 (Agudo-Padrón, 2012).

Species in the genus *Orthalicus* have never before been reported in any of the three states that comprise the southern region of Brasil: Paraná, Santa Catarina and Rio Grande do Sul, with the limit of their geographic distribution in Brasil believed to be the neighbouring state of São Paulo to the north. On 5 August 2016, the occurrence of a representative of this genus was confirmed for the first time in the Arvoredo Municipal District (27°6'32.44"S, 52°24'14.67"W) in the west of Santa Catarina State, part of the great Uruguay River basin (Fig. 1). The watershed of the Uruguay River stands out regionally as it has the greatest biodiversity of molluscs in Latin America.

The local naturalist Emanueli Marin Albino found this specimen in a riparian strip of Atlantic Forest surrounding the Ariranha River basin. The individual, identified as *Orthalicus* aff. *prototypus* (Pilsbry, 1899), has a shell approximately 67 mm in length (Fig. 2), and constitutes the first record of this species for Santa Catarina State, increasing to 155 the number of species, and to 69 the number of genera of terrestrial gastropods known in the state (Agudo-Padrón, 2014).

This brief report represents the first record of this genus of endangered native forest snails in southern Brasil. It is of concern that it was found in an area heavily subject to anthropogenic agricultural activity.



**Fig. 1.** Location of Santa Catarina State in Brasil (inset) and of the Arvoredo Municipal District in the west of the state, part of the Uruguay River basin.



**Fig. 2.** The native forest snail *Orthalicus* aff. *prototypus* (Pilsbry, 1899) found in a riparian strip of Atlantic Forest in the Arvoredo Municipal District, western Santa Catarina State. Photo: Emanuelli Marin Albino

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

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## PROTECTED AREAS AND LAND SNAIL HABITAT LOSS IN ISLA DE LA JUVENTUD, CUBA

By Jane Herrera Uria

In all the world there is no place of equivalent area that has a greater number of species and races of land snails than the island of Cuba (Torre & Bartsch, 1938). The Cuban terrestrial malacofauna is important from a biodiversity conservation point of view because of its high number of species (1,390) and percentage of endemism (95 %) (Espinosa, 2013).

Isla de la Juventud (Island of Youth) is the biggest island (2,204 km<sup>2</sup>) of the Canarreos archipelago and the second largest of the Cuban archipelago, separated from the main island by about 94 km of water. In the northern part of Isla de la Juventud, there is a complex limestone karst ecosystem and in the south there is a broad plain of carbonate rock. Also in the south is the third most important Ramsar wetland site in Cuba, Ciénaga de Lanier (CNAP, 2013).

In Cuba, 211 protected areas of either national (77) or local (134) significance have been established in the National System of Protected Areas (SNAP). Every year, efforts to protect marine and terrestrial species increase but currently



**Fig 1.** Protected areas of Isla de la Juventud, Cuba. Each area is listed in Table 1, with management categories according to CNAP (2013), which are homologous to those of the IUCN.

only 20 % of Cuba is protected. With the exception of some highly charismatic species of land snails, such as species of *Polymita* and *Liguus*, no other land snails are taken into consideration when selecting protected areas or delimiting their borders (CNAP, 2013). Isla de la Juventud contains eight protected areas of national (5) and local (3) significance, which represent 19.8 % of the area of the island (Fig. 1).

**Table 1.** Protected areas of Isla de la Juventud, Cuba, with their CNAP and IUCN categories in decreasing order of protection: PN—National Park, RE—Ecological Reserve, END—Outstanding Natural Element, RF—Faunal Refuge, PNP—Protected Natural Landscape, APRM—Protected Area of Managed Resources. IJ—Isla de la Juventud.

Locality	Area (ha)	CNAP protection category	IUCN protection categories
Punta Francés	1,562	PN	II
Los Indios	5,189	RE	II
Punta del Este	8,209	RE	II
Pinar Calizo	515	END	III
Ciénaga de Lanier	16,714	RF	IV
Sierra de las Casas	300	PNP	V
La Cañada	765	APRM	VI
Sur de la IJ	100,944	APRM	VI

The most complete checklist of land snails from Isla de la Juventud was that of Milera & Correoso (2003). They reported 75 taxa of terrestrial molluscs of which 58.7 % were endemic. Research since Milera & Correoso (2003) has updated the number of species in the following localities (Table 2): Punta del Este, Carapachibey, Sierra de las Casas and Sierra Bibijagua (Herrera-Uria 2015, 2016; Herrera-Uria *et al.*, 2016). Valdés *et al.* (1998) considered that the majority of

Cuban terrestrial molluscs are threatened. At least 21 species of endemic molluscs from Isla de la Juventud are not included within the limits of any protected area. The largest protected territory is in the south, while most land snail species inhabit the region with marble mining in the north of Isla de la Juventud. The number of terrestrial gastropod species in La Cañada (APRM) is very low because the substrate is slate. There are many threats to the conservation of these invertebrates, including human caused fires, but one of the principal threats is habitat loss. This threat is perennial because one of the most important economic activities in Isla

**Table 2.** Population distribution of land snails of Isla de la Juventud according to Milera & Correoso (2003) and recent research.

Locality	Number of species (endemic species)	CNAP protection category
Sierra de Caballos	15(13)	-
Sierra Colombo	12(8)	-
Morrillo del Diablo	3(3)	-
Sierra Bibijagua	16(8)	-
Sierra de las Casas	25(14)	PNP
La Cañada	3(-)	APRM
Punta del Este	8(7)	RE
Cerro Caudal, Sur de la IJ	7(2)	APRM
Carapachibey, Sur de la IJ	6(6)	APRM



**Fig. 2.** Fragmentation of habitat of land snails in Sierra de las Casas in Isla de la Juventud as a result of marble quarrying. Photo: Rafael Aguilera Torres



**Fig. 3.** Habitat loss in Sierra de Colombo in Isla de la Juventud as a result of marble quarrying. Photo: Rafael Aguilera Torres

de la Juventud for the past two centuries is marble exploitation (Figs. 2, 3).

The marble from Isla de la Juventud is desired for its quality and variety of colors: black, red, grey, pink and white. This mineral is associated with carbonate rock at all elevations in the northern part of the island. Marble is extracted from three quarries located in the mountains of Sierra de Colombo, Sierra de Caballos and Sierra de las Casas (Fig. 4) for various uses: construction materials, decorative rocks, traditional



**Fig. 4.** Marble quarrying across the north of Isla de la Juventud.

handicrafts and sculpture supplies. These mountains are the habitat of at least 35 endemic gastropod species of Isla de la Juventud.

In view of these circumstances, the endemic terrestrial molluscs of Isla de la Juventud are at risk. More detailed studies are urgently required to address the limited knowledge of the distributional patterns and ecological interactions of the species in order to estimate their vulnerability to habitat loss.

We are thankful to the Rufford Foundation, UK, for a Small Grant for Nature Conservation (19062-2) in support of the Project.

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## PACIFIC ISLAND LAND SNAILS

### Ten endemic species of *Partula* reintroduced onto three of the Society Islands

By Trevor Coote and 27 others

July 2015 had marked a major milestone in the long running *Partula* snail conservation initiative with two experimental releases of three species of *Partula* from the international conservation breeding programme – *Partula nodosa*, *P. affinis* and *P. hyalina* – at two locations on Tahiti. The first release was into a prepared predator-proof reserve and the second involved releasing snails directly into unsecured trees. The failure of the reserve and the more promising results from the tree releases meant that the second strategy was adopted for all future releases. Between mid-September and early November 2016 ten species of *Partula* and one subspecies from the international breeding programme were shipped to Tahiti and released into a dozen sites at five locations on three islands of the Society group.

In view of the more complicated nature of this year's shipments of *Partula* for release a new decree needed to be sanctioned by the local government which took into account: 1) The maximum number snails of each species available for shipment and importation; 2) the potential arrival of shipments from multiple institutions (Edinburgh Zoo and London Zoo (UK) and Artis Zoo (Netherlands)); 3) the release of animals onto three islands (Tahiti, Moorea and Raiatea). A new decree was issued on 31 May 2016 that gave approval for the importation of stipulated maximum numbers of each species. All had to rigorously satisfy the animal health regulations of French Polynesia and to have separate approval from the local government vet before shipping.

The strategy of releasing *Partula* directly into trees had evolved from field observations of relict populations of *Partula clara* persisting in the branches of *mape* trees in the presence of severe invasions of *Euglandina rosea*. Nevertheless, at least two of the species due for release were specific to shrubs. As sightings of *Euglandina* had been extremely rare in recent years, it was decided to also consider spots where much of the low-level habitat consisted of the climbing pandanus or 'ie'ie and other shrubs, some of which climbed individual trees. The original ranges of species and the collection locations were taken into account as closely as



Fig. 1. *Partula* in quarantine, Environment Department, Tahiti.

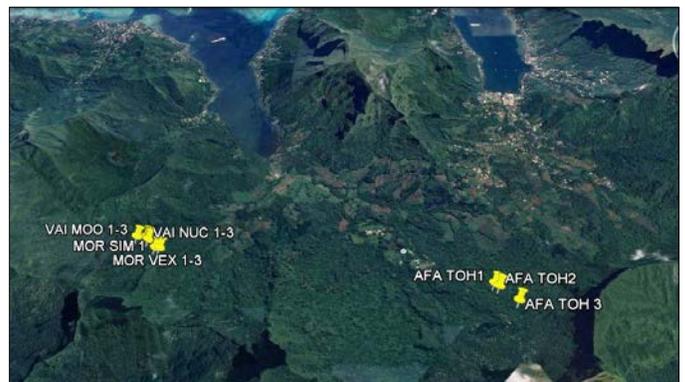


Fig. 2. Release sites selected on Moorea (see Table 1 for details).

possible, and the species were separated, especially those between which hybridisation was a possibility.

The following species of *Partula*, with their IUCN Red List conservation status indicated, were involved in the releases (Table 1):

#### Tahiti

- *Partula affinis* (CR). One known surviving population on the peninsula of Tahiti. Failed in the reserve but released in 2016 in a small ravine in the same region.
- *Partula hyalina* (VU). Widely distributed on Tahiti but nowhere common.
- *Partula nodosa* (EW). Most successful species in the breeding programme. Promising results from 2015 tree releases and released again in Papehue Valley, and in nearby Maruapo Valley.

#### Moorea

- *Partula mooreana* (EW). Small species, 'ie'ie specialist.
- *Partula suturalis vexillum* (EW). Generalist.
- *Partula taeniata* (EW). Red List assessed at species level.
  - *P. t. elongata*, a generalist, persists in the wild but not in the breeding programme.
  - *P. t. nucleola*. One known surviving population in western Moorea
  - *P. t. simulans*. May be extinct in the wild.

**Table 1.** Numbers of each species released.

Species	Location	Release date	Number
<b>Moorea</b>			
<i>Partula mooreana</i>	Vairahi Valley	20 Sep. 2016	592
<i>P. suturalis vexillum</i>	Morioahu Valley	20 Sep. 2016	374
<i>P. taeniata simulans</i>	Morioahu Valley	20 Sep. 2016	67
<i>P. tohiviana</i>	Afareaito Valley	20 Sep. 2016	193
		24 Oct. 2016	446
<i>P. taeniata nucleola</i>	Vairahi Valley	14 Oct. 2016	100
<b>Tahiti</b>			
<i>P. affinis</i>	Faarapa Valley	21 Sep. 2016	201
<i>P. hyalina</i>	Papehue Valley	25 Oct. 2016	8
<i>P. nodosa</i>	Papehue Valley	7 Nov. 2016	842
	Maruapo Valley	10 Nov. 2016	35
<b>Raiatea</b>			
<i>P. dentifera</i>	Faaroa Valley	26 Oct. 2016	96
<i>P. tristis</i>	Faaroa Valley	26 Oct. 2016	38
<i>P. hebe</i>	Faaroa Valley	26 Oct. 2016	81

- *Partula tohiviana* (EW). Large, sinistral ‘ie ‘ie specialist, endemic to Afareaito Valley, where it has now been released in two locations, one being the site of the abandoned 1994 reserve.

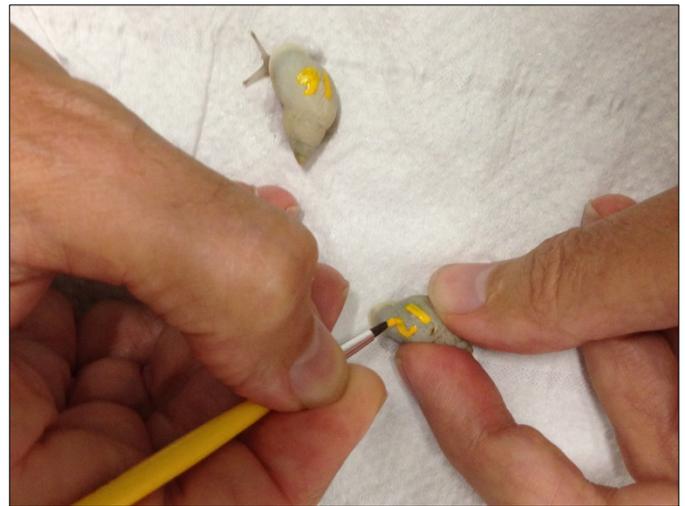
#### Raiatea

- *Partula dentifera* (EW). Ground-dwelling species.
- *Partula tristis* (EW). Species from western Raiatea.
- *Partula hebe* (EW). Small species with pink apex, from the south-east of Raiatea.

Four shipments of 11 taxa of *Partula* arrived at Tahiti’s Faa’a Airport during six weeks. Deaths en route were negligible and more than compensated for by newborns in transit and in quarantine. The snails were taken to quarantine in the offices of the Environment Department for 2-3 days to allow them to awake from aestivation and to assess what was available for release. The loss of documentation by the airlines meant that the second shipment had to be maintained in quarantine for a week before release. The shells of all the adult *Partula* were marked with enamel paint for individual identification and to facilitate recording of dispersal information. They were then packed into pots and placed in a cooler box ready for transport to the release sites. The newborns – almost 200 – were left in tanks in the quarantine room for department personnel to maintain until they were mature enough to release.

The release protocol followed that of the previous year. The snails were placed into pots containing sphagnum moss, which were secured at varying heights in selected trees to allow the animals to recover and disperse in their own time. If enough adults were available, three pots each containing 15 animals were prepared for monitoring purposes. All the other pots contained individuals marked with a spot (yellow denoting 2016 releases) on top of the shell or the apex according to their development stage.

The pots were taken in cooler bags to the various release sites by bus on Tahiti, by ferry to Moorea, and by plane to Raiatea. After 2-3 months of intensive monitoring it is clear that the response to novel conditions has varied more between species than between locations. In general, long-term captive bred populations of *Partula* have adapted well in natural habitat



**Fig. 3.** Marking *Partula tohiviana* in quarantine.



**Fig. 4.** Release of *Partula affinis* into Faarapa Valley, covered by [TNTV news](#).



**Fig. 5.** *Partula tohiviana* emerge from their pots.

and have reverted to ancestral behaviour when released.

However, the threat of the New Guinea flatworm, *Platydemus manokwari*, has unexpectedly become a bigger potential threat to the *Partula* than *Euglandina rosea*. Fortunately, most species have opted for vertical dispersal, which is a far better survival strategy against the threats faced. The most vulnerable appear to be the specialists that prefer lower shrubs (*Partula tohiviana* and *P. mooreana*), or that naturally live in the leaf litter (*P. dentifera*). The known generalists such as *P. taeniata*, *P. suturalis* and *P. nodosa* look pretty secure.

Although most of the released *Partula* had dispersed out of sight by the beginning of January, with very few deaths recorded, the results should again be highly informative for the new shipments due in 2017.

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 Breeding and Mollusc Specialist Groups.



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- Gerardo García, Scott Wilson, Scott Wilson, North of England Zoological Society
- Justin Gerlach, Terrestrial and Freshwater Invertebrate Red List Authority (IUCN/SSC)
- Don McFarlane, Auckland Zoo
- Bobbi Miller, Woodland Park Zoo
- Claude Serra, Government of French Polynesia
- Jamie Sincage, Disney's Animal Kingdom

## Reintroduction of the endangered Hawaiian tree snail *Achatinella lila* from captive propagation

By David R. Sischo

The Hawai'i Snail Extinction Prevention Program (SEPP), in partnership with the U.S. Fish and Wildlife Service and the University of Hawai'i recently reintroduced a population of *Achatinella lila*, a nearly extinct tree snail, back into the wild from captive propagation. This is the first Hawaiian snail species to be reintroduced from captive stock, representing a milestone for the island's conservation programmes. Tree snails in the subfamily Achatinellinae have long lifespans (>10 years), mature slowly (approximately five years), and have low reproductive rates (1-7 offspring per year depending on the species). Unfortunately, the entire subfamily is near extinction, a result of historical over-collection, habitat alteration and introduced predators (Hadfield, 1986; Hadfield & Miller 1989; Hadfield *et al.*, 1993).



**Fig. 1.** *Achatinella lila* released into the wild from captive propagation.

*Achatinella lila*, an achatinelline tree snail endemic to the island of O‘ahu, is listed as Endangered by the US Fish and Wildlife Service, and Critically Endangered on the IUCN Red List. Prior to this reintroduction, only one small wild population was known to persist in a remote summit region of O‘ahu’s northern Ko‘olau Mountains.

The captive population of *A. lila* was started in 1997 with six snails collected from a rapidly disappearing population. These founders and their progeny were reared for 20 years in the University of Hawai‘i’s tree snail captive rearing laboratory, founded by Dr. Michael Hadfield. The reintroduction became a reality after habitat was secured by a predator-proof fence.

The first cohort of 50 snails was released in August 2016, with a second cohort of 50 snails released in October (Fig. 1). Prior to release each snail was photographed and given a unique identifier. Photographs are used to identify individual snails during routine monitoring with the photo identification software Hotspotter (Crall *et al.*, 2013). Using photographs to identify individuals precludes the need to physically mark snails. SEPP staff conduct monthly monitoring at the site, during which all snails seen are photographed and a search of the ground for shells is conducted to identify dead snails.

After six months, released snails are surviving and newborn *A. lila* have been observed. Over the next five years SEPP will continue to augment this new population with small batches of 50-100 individuals from captive propagation.

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## MARINE MATTERS

### Deep-sea conservation and the ‘scaly-foot gastropod’

By Julia D. Sigwart

The scaly-foot gastropod (*Chrysomallon squamiferum*) is remarkable for the eponymous dermal scales that cover the whole outside surface of its foot (Fig. 1). These animals were first discovered in 2000 and are iconic members of the hydrothermal vent fauna in the Indian Ocean, but have been reported from only three sites worldwide. Like most vent endemic species, it depends on chemoautotrophic symbiotic bacteria for nutrition. In addition to its distinctive exterior scales, the scaly-foot has several other remarkable adaptations that are changing the way we think about evolution in vent ecosystems (Chen *et al.*, 2015a). There are no conservation measures for this (or any) hydrothermal vent species; but is conservation needed?



**Fig. 1.** *Chrysomallon squamiferum*, the scaly-foot gastropod; overlapping scales cover the whole dorsal surface of the foot. Photo: © JAMSTEC

Mining exploration licenses have been granted by the International Seabed Authority since 2001, and cover all known hydrothermal vent areas in the ‘high seas’ or international waters, over 200 nautical miles (370.4 km) from the coast (ISA, 2015). The key targets of commercial seabed exploitation include sulfides and rare earth minerals such as cobalt, which are found in high densities at sites of geological spreading activity, such as hydrothermal vents (Van Dover, 2014).

Geothermal anomalies are small. Like geysers or volcanoes on land, deep sea hydrothermal vent fields occupy relatively small spatial areas. And, like terrestrial features, hydrothermal vents in some areas are very dynamic and fast growing (such as the earliest discoveries on the East Pacific Rise) and others are extremely stable and slow-spreading (such as the Central Indian Ridge, home of the scaly-foot). Vent endemic species

are not globally distributed; they occur in at least 11 distinct biogeographic provinces corresponding to tectonic geology. Indian Ocean vents lack the iconic *Riftia* worms of the East Pacific Rise, but they have several lineages of large endemic gastropods.

The size of the five well-mapped hydrothermal vent fields in the Indian Ocean ranges from 225 m<sup>2</sup> to 15,000 m<sup>2</sup>. Excluding the smallest field, the average area is 7,225 m<sup>2</sup> per vent field. (Most of these fields are separated by distances on the order of 100 or 1,000 km.) Combining records of all known fields and additional anomalies (temperature or chemical signatures recorded from oceanographic instruments that indicate probable sites), suggests records for up to 39 vent sites in the Indian Ocean (Beaulieu, 2016). Simple multiplication and an assumption that the scaly-foot could potentially live anywhere within any vent site in this ocean basin, provides a generous estimate of total global potential habitat for the scaly-foot gastropod of around 0.27 km<sup>2</sup>.

*Chrysomallon squamiferum* is an extraordinary snail, its habitat occupies an area significantly less than 500 km<sup>2</sup>, at fewer than five specific locations, with limited migration between sites (Chen *et al.*, 2015b). Its two high seas localities are under license for mining exploration, which could reasonably be projected to lead to further reduction in habitat. Conservation of the deep sea, including hydrothermal vents, must account for the modern understanding of geographical variation in ecosystems and these unique regional endemics.

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## Seizure data suggest on-going large-scale horned helmet trade in and from Indonesia

By Vincent Nijman & K.A.I. Nekaris

The horned helmet (*Cassis cornuta*) is a marine gastropod mollusc, and the largest, and arguably most collectable, of all helmet shells and allies (Cassidae). The shell itself is robust, round with large solid protrusions dorsally. The base is flat. Dorsally the shell is whitish or pale orange in colour whereas ventrally it is brightly orange. Maximum lengths are around

35 cm. Specimens in trade are normally caught alive and cleaned to prepare them for the trade as washed up shells often have lost most of their coloration and shine.

The horned helmet is widespread in the Indo-West Pacific, from East Africa, Madagascar and the Red Sea to eastern Polynesia, north to Japan and Hawaii, and south to Queensland and New Caledonia (Poutiers, 1998). More so than other large marine molluscs, the species is vulnerable to over-exploitation. While they are difficult to spot when partly buried on sand, their large size and, more importantly, their tendency to congregate in larger colonies (Poutiers, 1998) makes it possible to collect large quantities of them in a single diving trip. To prevent over-exploitation, horned helmets are protected from commercial exploitation in at least part of their range, including Indonesia (see below), Australia (Queensland Fisheries Act 1994 and the Fisheries Regulation 1995), the Philippines (Fisheries Administrative Order 158 of 1986), India (Wildlife Protection Act of 1972, Schedule I), among other countries. Despite this, they are still traded in large quantities. For instance, one exporter on Cebu in the Philippines reported a turnover of 5,000 to 7,000 horned helmet shells a month, mainly to other parts of Asia and Europe, with the shells sourced from the seas surrounding Cebu, Masbate and the northern tip of Mindanao (Floren, 2003). Indonesia is a significant exporter of wildlife, including marine wildlife (Lunn & Moreau, 2004; Nijman, 2010) but little quantitative information is available on the trade in marine molluscs in general or horned helmets in particular (Nijman *et al.*, 2015).

Indonesia added the horned helmet to its list of protected species by ministerial decree in January 1987. In 1990, this decree was consolidated into Act No. 5 on the Conservation of Living Resources and their Ecosystems. Horned helmets are furthermore covered under Government Regulation 7 concerning the Preservation of Plants and Animals (Noerjito & Maryanti, 2001). Combined, the decree, act and regulation prevent all possession, transport or trade in the species. Penalties that can be imposed when these laws are broken can total fines of up to IDR 100,000,000 (~USD 8,500 at 2016 exchange rates) and imprisonment for up to five years. The Fisheries Act 31 of 2004 as amended in 2009 has stipulations and restrictions pertaining to the trade in fish, with a wide range of penalties, the lightest for offences committed by an artisan (small) fisherman (*nelayan kecil*) (i.e. up to one year imprisonment and fines of up to IDR 250,000,000 or ~USD 21,250) and more severe ones for commercial traders with large vessels (i.e. up to seven years imprisonment and fines of up to IDR 3,000,000,000 or ~US\$ 255,000). While horned helmets are not fish, in Act 31 'fish' includes not only fish but also crustaceans, amphibians, algae, marine mammals and molluscs. Exports without the appropriate permits can result in fines imposed by Customs of between US\$85 and US\$850 per shipment (Anonymous, 2009).

Despite this legal protection, the species is openly traded domestically, especially in tourist resorts in Java (Fig. 1) (Nijman *et al.*, 2015) and Bali (Nijman & Lee, 2016). International trade of horned helmets from Indonesia has been more difficult to assess. Nijman *et al.* (2015) obtained data on

wholesalers trading in large protected marine mollusc shells (including horned helmets) and compiled seizure data of horned helmets up to 2012. Both the information from wholesales and seizure data suggest an on-going trade in the species.



**Fig. 1.** Horned helmet (*Cassis cornuta*) shells openly for sale at a shop in the Pangandaran beach resort in West Java, Indonesia. Photo: K.A.I. Nekaris

We here summarise three recent (2015 and 2016), and one not so recent (2012), large-scale seizures of horned helmet shells in Indonesia, as reported by the Indonesian customs agencies, the natural resources conservation agency (BKSDA), and the Indonesian media. The aim is to explore commonalities and differences in these seizures, to get an insight in the trade patterns, and to comment on the conservation management of the horned helmet in Indonesia.

As part of a larger research project on the trade in marine mollusc shells in Indonesia (e.g. Nijman *et al.*, 2015, in press; Nijman & Lee, 2016) we compiled seizure data of horned helmets as reported in the Indonesian media. Search terms were the Indonesian / Latin name of horned helmet (*kerang kepala kambing / cassis cornuta*) in combination with the words for seizure or confiscation (root: *serah, sita*) or the acronyms of agencies that do most of the confiscations (*phka, bksda*) or customs (*bea cukai*). Additional data were obtained checking websites of the various Natural Resources Conservation Agencies, Customs and the Ministry of Forestry (responsible for protected species management) and the Ministry of Fisheries. Once a seizure was found, key facts (date, location, volume) were used to find corroborating reports with the aim of filling in blanks or to check if prosecution and sentencing were pursued. Most reporting was done in Bahasa Indonesia; all translations are ours.

**2012 Surabaya seizure.** On 19 June 2012 two 40 feet (~ 12 m) containers with, among others, 20,515 horned helmet shells was confiscated by the Indonesian Customs office in the Tanjung Perak International Container Terminal in Surabaya. The shipment was bound for China. It was seized after a tip-off because of non-compliance with a decree from the Ministry of Industry and Trade concerning the export of commercial goods (No. 385/MPP/Kep/6/2004). The goods were labelled with HS code 0508.00.90.00 indicating 'coral/shells – other'. The

exporting company, CV Sindong Karsa Manunggal, based in Surabaya, is an import-export company trading mostly in carving stones. According to the customs officer involved, it was not certain where the shells were obtained (speculating that they may have come from the Aru Sea, the coast of Sumatra, the east coast of Borneo or the north coast of East Java), and the case was to be passed to the East Javan Natural Resources Conservation Agency (Anonymous, 2012). We could not find any information in the media on whether or not prosecution was indeed pursued and if so if it was successful.

**2015 Jakarta seizure.** On 12 August 2015 a container with 15,725 horned helmet shells, among others, was confiscated at Jakarta International Container Terminal, Tanjung Priok. The shipment was bound for China. It was seized after having received a tip-off, apparently by a team comprising customs and the Directorate General of Forest Protection and Nature Conservation (PHKA). The exporter allegedly used the name of another company (PT BNP), and, as in the Surabaya case the tariff heading codes they used indicated merely shells or molluscs (i.e. HS code 0508.0020.00 or 0508.00.90.00) (Anonymous, 2015). Reference was made to Government Regulation No. 7 of 1999. No information was provided as to where the shells may have originated. The evidence was to be submitted to the Natural Resources Conservation Agency of Jakarta. We could not find any information in the media on whether or not prosecution was pursued and if so if it was successful.

**2016 Makassar seizure.** On 9 January 2016 the Indonesian harbour police (*Polsek Kawasan Pelabuhan Nusantara*) intercepted a shipment of 262 bags of horned helmet shells in Makassar, South Sulawesi. With apparently 30 shells per bag this amounts to 7,860 shells. The goods were onboard a motor vessel *Thalia*, owned by a Mr. Ancu from the Bulukumba regency in South Sulawesi. The vessel was on its way to the city of Nunukan in Indonesian Borneo, close to the border with Malaysian Borneo. The case was to be passed on to the police in Nunukan (Hakim, 2016). We could not find any information in the media on whether or not prosecution was pursued and if so if it was successful. Given the timing of the seizure there is a chance that it is still too early to reach conclusions about this.

**The 2016 Jakarta seizure.** On 18 February 2016 a sea container with 388 bags containing 4,268 horned helmet shells were confiscated at Tanjung Priok harbour by the harbour's Customs Agency (Anonymous, 2016; Fig. 2). They were heading for China. The exporter used documents with false company details, using the name of another company (PT YBS), and while the paperwork did mention mollusc shells, species details were lacking. Disclosing details on the seizure, the authorities referred to Government Regulation No. 7 of 1999 as well as CITES Appendix II, but no information was provided as to where the shells may have originated. We could not find any information in the media on whether or not prosecution was pursued and if so if it was successful.

We were able to document some aspects of the topology and the magnitude of the illegal trade in horned helmets in Indonesia through an analysis of seizure data reported in the



Fig. 2. Indonesian customs officer holding two horned helmet shells at a press conference announcing the seizure of 4,268 of these shells in Jakarta harbour in February 2016. Photo: Bea Cukai Jakarta

Indonesian media. The four seizures demonstrate that there is an ongoing, large-scale, commercial and illegal trade in horned helmets in Indonesia, probably largely to supply the international demand. The volumes are considerable, almost 50,000 shells, which is a considerable weight (if we assume a mass of ~1 kg per shell, the shipments are between 4 and 21 metric tonnes) and not easily concealed. Three of the shipments were in containers, using fake or generalised HS codes, and paperwork was false or incomplete. This shows that the trade in horned helmets is run in a business-like fashion, requiring planning, financing, a logistics network and possibly bribing and collusion.

The origin of the shells is unclear. The 2016 Makassar seizure probably comprised shells collected in the seas surrounding South Sulawesi, but the seizures in Jakarta and Surabaya could have been mixed collections from various parts of Indonesia. While Surabaya has been identified as a major hub in the illegal trade in marine molluscs it is significant to note that neither Makassar nor Jakarta were recognised as major trade hubs in this respect (Nijman *et al.*, 2015). Three of the four shipments were bound for China, and the third, probably, to Malaysia (given its small size and limited trade links to the rest of Indonesia, it is unlikely that Nunukan would have been the end destination). We have no data whatsoever regarding the impact of the trade on populations of wild horned helmets but given the number of shells seized we do not expect it to be negligible.

Different agencies are involved in regulating the trade (and export) of protected wildlife. In the four seizures summarised above, at least five agencies were involved, i.e. customs, the harbour police, the police, the Natural Resources Conservation Agency and the Directorate General of Forest Protection and Nature Conservation. Customs can halt the export of horned helmets when the export permits are deficient and they have the power to seize and impose fines. Twice the case was said to have been passed on to the local natural resources conservation agency and once to the police. Enforcement of species protection laws in Indonesia is weak and rarely do violators get prosecuted; indeed we were not able to find any data to suggest that the exporters or owners of the seized horned helmets were indeed prosecuted, let alone convicted.

Legal protection of horned helmet in Indonesia is certainly sufficient, with both the Government Regulation 7 concerning the Preservation of Plants and Animals and the Fisheries Act 31 of 2004 offering legal instruments to prosecute exporters of illegal shipments. Fines and prison sentences can be substantial. Yet we found no evidence of any of those involved in the four seizures being prosecuted. The four seizures we report on are large, and all were accompanied by press conferences organised by the Indonesian authorities. We expect that if prosecution had been pursued, and especially if a conviction had been accomplished, this would have been reported in the Indonesian media. Therefore we are confident that the seizures were just that, the goods were seized and offenders were able to walk away without standing trial. We urge the Indonesian authorities to follow through with prosecution of offenders, and the Indonesian media to continue to cover the cases they so widely report, as mere seizure of goods will not be enough of a deterrent to persuade unscrupulous traders to continue to export Indonesia's protected wildlife.

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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 2016, it published two issues (volume 19, numbers 1 and 2) with ten papers. All issues are available on-line with open access.

Freshwater Mollusk Conservation Society. 2016. A national strategy for the conservation of native freshwater mollusks. *Freshwater Mollusk Biology and Conservation* 19(1): 1-21.

Fritts, A.K., Stodola, A.P., Douglass, S.A. & Vinsel, R.M. 2016. Investigation of freshwater mussel glochidia presence on Asian carp and native fishes of the Illinois River. *Freshwater Mollusk Biology and Conservation* 19(1): 22-28.

Gibson, K.J., Miller, J.M., Johnson, P.D. & Stewart, P.M. 2016. Toxicity of sodium dodecyl sulfate to federally threatened and petitioned freshwater mollusk species. *Freshwater Mollusk Biology and Conservation* 19(1): 29-35.

Ahlstedt, S.A., Fagg, M.T., Butler, R.S., Connell, J.F. & Jones, J.W. 2016. Quantitative monitoring of freshwater mussel populations from 1979-2004 in the Clinch and Powell Rivers of Tennessee and Virginia, with miscellaneous notes on the fauna. *Freshwater Mollusk Biology and Conservation* 19(2): 1-18.

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Pandolfo, T.J., Kwak, T.J. & Cope, W.G. 2016. Microhabitat suitability and niche breadth of common and imperiled Atlantic slope freshwater mussels. *Freshwater Mollusk Biology and Conservation* 19(2): 27-50.

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### Journal of Threatened Taxa

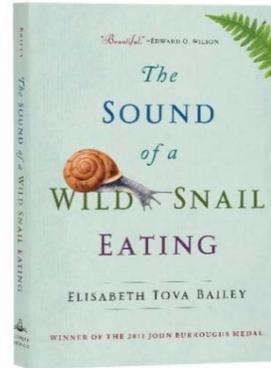
The latest issue (Vol. 8, No. 14, December 2016) of the [Journal of Threatened Taxa](#) is available on-line now.

### 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.

### The Sound of a Wild Snail Eating

Elisabeth Tova Bailey, 2016. Algonquin Books of Chapel Hill, Chapel Hill, North Carolina, USA. Paperback edition. ISBN 978-1-6162056512-642-0.



Here is my usual notice of this delightful book, which is now available in the USA in paperback. It was reviewed in [Tentacle 19](#) (2011). The original hard cover version was published in the USA in 2010, but hard cover editions and translations are now available in Australia and New Zealand, Austria, Germany and Switzerland, the United Kingdom, France, China, South

Korea, Taiwan and Japan. It has received accolades globally. Seriously, if you have not obtained a copy, go and get one. An [audiobook](#) edition is available as a Kindle or hard CD. Check out the [author's website](#).

### Other publications of interest

This is not a comprehensive list but simply a list of publications I have happened to come across. 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*.

Aravind, N.A., Sarma, R.R. & N.A. Madhysatha. 2016. Conservation of *Cremnoconchus* Blanford 1869, an iconic freshwater gastropod genus from the Western Ghats, India. [Current Science](#) 111(6): 1097-1103.

Balashov, I. 2016. [Conservation of terrestrial molluscs in Ukraine](#).

Institute of Zoology, National Academy of Sciences of Ukraine, Kiev. 272 p. [in Russian with English summary and preface]

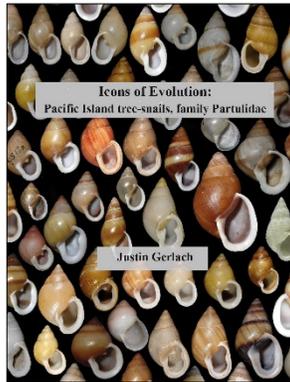
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## IUCN AND MOLLUSC SPECIALIST GROUP NEWS AND ANNOUNCEMENTS



[www.iucn.org/](http://www.iucn.org/)

### IUCN review workshop on terrestrial molluscs of Europe successfully held in Uppsala

By Eike Neubert, Mary Seddon & David Allen

IUCN and the IUCN/SSC Mollusc Specialist Group held a very successful five-day workshop in Uppsala at the end of 2016 (28 November - 2 December) to review draft assessments of the extinction risk of the more than 1,200 European terrestrial molluscs (snails and slugs) included in the current round of the European Red List of terrestrial molluscs project. There are nearly 2,500 terrestrial mollusc species in Europe, of which approximately 1,200 were assessed through the first stage of the project in 2009-2011. This is the first complete assessment of the conservation status of all non-marine molluscs for a region, hence it provides a comprehensive guide to the proportion of species threatened, which can be compared with the threat status for the other species that have been comprehensively assessed such as birds, mammals, amphibians, reptiles, dragonflies, butterflies and grasshoppers.



**Fig. 1.** Workshop participants. Upper row (from left): Marco T. Neiber, Michael Duda, Alexander Reischütz, Benjamín Juan Gómez-Moliner, Aristeidis Parmakelis, Rajko Slapnik, David Allen, Mary Seddon, Dinarte Teixeira, Ben Rowson. Central upper row: Zoltan Feher, Kostas Triantis, Ted von Proschwitz. Central lower row: Thierry Backeljau, Marta Calix, Robert Cameron. Front row: Eike Neubert, Alberto Martínez-Ortí, Klaus Groh, Ruud Bank, Ivailo Dedov, Dilian Georgiev.

The Uppsala workshop was hosted by ArtDatabanken (the Swedish Species Information Centre of the Swedish

University of Agricultural Sciences) and brought together 21 mollusc experts (Fig. 1) from 13 European countries. In this workshop we prioritised the species that had been provisionally assigned to the threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) Red List categories, and we reviewed at least 550 species assessments and distribution maps - a fantastic result that could not have been achieved without the hard work and dedication of the expert participants, who worked long hours. The workshop was supported by Naturvårdsverket (the Swedish Environmental Protection Agency) and the LIFE Programme of the European Union.

We aim to hold a second workshop in Cambridge, UK, in early 2017 to finalise the remaining assessments, the majority of which are Least Concern (LC). The assessments and accompanying digital distribution maps will be published in the IUCN Red List of Threatened Species by early 2018.



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### MEETINGS 2017

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

### International Congress for Conservation Biology



The Society for Conservation Biology (SCB) 28th International Congress for Conservation Biology (ICCB 2017) will focus on “Insights for Sustaining Life on Earth”, responding to the need for conservation science to help create a better tomorrow for both biodiversity and people who depend upon it.

Conservation science must inform local, national and international efforts for effective, just and enduring conservation of biodiversity. Accordingly, ICCB is more than just a forum for showcasing the latest in conservation science. It's also a place to address the greatest conservation challenges

of our time, for training early-career professionals, and for catalysing conservation action.

ICCB welcomes participants interested in conservation science and its application to policy and practice. It invites researchers, students, agency personnel, environmental educators, practitioners, and other conservation stakeholders to join us for lively discussions on the nexus between biodiversity conservation and genetics, ecology, biogeography, anthropology, history, psychology, economics, conservation marketing, religion, and more.

For more information visit the [SCB ICCB 2017 website](#).

### 10th Latin-American Congress of Malacology



The Latin-American Congress of Malacology (CLAMA) is the triennial event of Asociación Latinoamericana de Malacología (ALM). Uruguay is proud to be hosting the congress for the very first time. The X CLAMA will be an opportunity for the Latin-american malacological community to present their work, exchange ideas and develop collaborations and networking with other scientists. The congress will seek to build bridges between different disciplines and contribute to the exploitation of scientific information generated by the malacological community of Latin America, in order to increase the visibility of malacological research at the continental level and contribute to the sustainable development of the region. The X CLAMA will be held in the beautiful resort of Piriapolis, Uruguay. Thus, the ALM and Sociedad Malacológica del Uruguay, jointly with the Centro Universitario Regional del Este (CURE) of Universidad de la República, the National Museum of Natural History and the NGO InvBiota welcomes you to be part of it.

Dates: 1-6 October 2016. For more information see the congress [website](#) or e-mail [xclama@cure.edu.uy](mailto:xclama@cure.edu.uy)

### American Malacological Society 2017 meeting



The 83rd meeting of the American Malacological Society, organised by the Delaware Museum of Natural History (DMNH), will be held 16-21 July 2017 at the Clayton Hall Conference Center on the Laird Campus of the University of Delaware in Newark, with the concluding banquet at DMNH.

The scientific program will kick off with the workshop 'Digitizing the 2nd largest Invertebrate Phylum: Mollusks'.

The President's Symposium 'Mollusk research in a digital world: creating, integrating and mining large datasets' expands on the workshop to discuss and provide examples of

how large, interconnected datasets are changing how research is done across disciplines.

Delaware's location on the I-95 corridor and along the main AMTRAK railway route means it is easy to get to, and a great jumping off point for all types of travel. In addition to the extensive DMNH collection, the research collections of the Smithsonian, Academy of Natural Sciences, American Museum of Natural History, Yale Peabody Museum, and Harvard's Museum of Comparative Zoology are all a quick AMTRAK trip away. Travel grants sponsored by the Museum's Society of the Natural History of Delaware Fund are available on a competitive basis for graduate students who wish to conduct research in the mollusc collection at the DMNH.

For more details see the meeting [website](#) or contact one of the conference organisers:

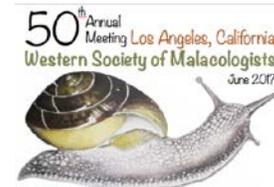
Liz Shea – AMS President 2017 and Curator of Mollusks, Delaware Museum of Natural History

Halsey Spruance, Executive Director, Delaware Museum of Natural History

Jean Woods, Director of Collections, Delaware Museum of Natural History

Alex Kittle, Collections Manager of Mollusks, Delaware Museum of Natural History

### Western Society of Malacologists 2017 meeting



The 50th annual meeting of the Western Society of Malacologists will take place 19-23 June 2017 at the University of Southern California and Natural History Museum of Los Angeles County.

Symposia and special sessions will include 'Molluscs and Climate Change', 'Molluscan Paleontology', '50 years of WSM: a Retrospective' and 'Terrestrial Gastropods'. As always, talks and/or posters about almost any aspect of molluscan biology, paleontology and archeology/anthropology are welcome. Please contact WSM President Jann Vendetti at [jannvendetti@yahoo.com](mailto:jannvendetti@yahoo.com) with questions or comments. To register and submit abstracts go to the [meeting website](#) for more details.

### 8th Congress of the European Malacological Societies



Seven very successful congresses of the European malacological societies have been held, each hosted by a national society. Now it is our turn, and on behalf of the Association of Polish Malacologists, it is our great pleasure to invite you to the historic city of Kraków, Poland, for the eighth Congress (8th EUROMAL) to be held 10-14 September 2017.

The Congress acts to bring together both young and experienced malacologists from across Europe and the world.

The latest advances in all aspects of malacology will be presented, including the use of malacological research in practical issues of pest control and medicine.

Plenary lectures will be given by Robert Cameron (University of Sheffield, UK), Jan Kozłowski (Jagiellonian University, Poland) and Caryn Vaughan (University of Oklahoma, USA).

The Congress offers the chance to meet potential collaborators from many countries, and to present work in progress for constructive comment. There will be sessions covering all aspects of malacology, determined by the number and relatedness of contributions as talks or posters. Here is the opportunity to showcase your work and find new contacts. Please join us in always sunny gold Polish autumn in Kraków, for both work and pleasure in September 2017!

We look forward to seeing you!

Tadeusz Zajac on behalf of the Association of Polish Malacologists

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web: [www.euomal.pl](http://www.euomal.pl)

<https://www.facebook.com/euomal2017/>

### Brasilian Society of Malacology 2017 meeting

The Brazilian Society of Malacology (SBMa – Sociedade Brasileira de Malacologia) will hold its XXV Brazilian Malacological Meeting (XXV EBRAM) in the city of Mossoró, state of Ceará, northeastern Brazil 19-23 June 2017. The congress will be hosted by the Universidade Federal Rural do Semi-Árido (UFERSA). The Third Symposium of Young Latin-American Taxonomists is planned. It will be a great opportunity for all young researchers to discuss and exchange their results. In addition, special sessions of contributed papers, oral presentations and posters will be open to all aspects of malacology. Registration will begin in January 2017. More information can be found on the [meeting website](#) or send e-mail enquireis to [secretaria.ebram2017@ufersa.edu.br](mailto:secretaria.ebram2017@ufersa.edu.br)

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

Profa. Dra. Inês Xavier Martins – Head of the XV EBRAM

### Conchologists of America 2017 convention



The 2017 COA convention will take place in Key West, Florida, 15-19 August. Information can be found at the [COA conventions website](#).

### INTERNET RESOURCES

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

#### Red List

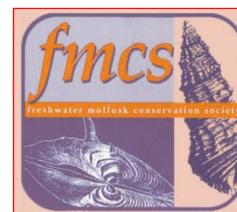
The entire *IUCN Red List of Threatened Animals* can be searched at any of the following addresses, which all take you to the same website:

[www.redlist.org](http://www.redlist.org) [www.redlist.net](http://www.redlist.net) [www.iucnredlist.org](http://www.iucnredlist.org)

#### Unitas Malacologica

[Unitas Malacologica](#) (UM) is the society for worldwide 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 mollusks, 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* and has all issues of volume 1 on-line and

available, 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 evolution, palaeontology, taxonomy and natural history. 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 [listproc@ucmp1.berkeley.edu](mailto:listproc@ucmp1.berkeley.edu)

Then on the first line of the body of the message:  
sub mollusca <your\_name without the brackets>  
Alternatively, send e-mail to

[Majordomo@listlink.Berkeley.Edu](mailto:Majordomo@listlink.Berkeley.Edu)

And on the first line of the message:  
subscribe molluscalist <your\_name without the brackets>  
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. 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) and to access the MOLLUSCA archives.

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

### Unio listserver

[Unio](#) is an unmoderated internet listserver focusing on the biology, ecology and evolution of freshwater unionid mussels. The list is sponsored by the Florida Institute of Technology and administered and managed by Rick Tankersley ([rtank@fit.edu](mailto:rtank@fit.edu)).

### 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.

### Brasilian Society of Malacology



The [Soceidade 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

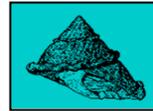
molluscs and its dissemination at all cultural levels, and taking reasonable measures to preserve the Brazilian mollusc fauna.

### 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 News](#). Student research grants are available.

### Western Society of Malacologists



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

### Conchologists of America



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

### 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.

### IUCN Invasive Species Specialist Group

The [ISSG website](#) includes details of the Aliens-L listserver 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.

### 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.

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

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

### CLEMAM: Check List of European Marine Mollusca

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

### Hawaii Biological Survey



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

### Samoa Snail Project

The [Samoa 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](#).

### 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/](http://www.manandmollusc.net/)  
[www.staff.uni-mainz.de/lieb/](http://www.staff.uni-mainz.de/lieb/)

# Specialisation Course on Medical and Applied Malacology

## Instituto Oswaldo Cruz / Fiocruz

### Rio de Janeiro, Brasil



Since 1994 the Specialisation Course on Medical and Applied Malacology of Instituto Oswaldo Cruz/Fiocruz has been offered addressing, in addition to biosafety norms concerning medical and applied malacology, theoretical and practical aspects of mollusc taxonomy, host-parasite interactions, ecology, health education, and control of parasitic diseases transmitted by molluscs. Emphasis is given to the study of mollusc vectors of schistosomiasis and other helminthiases of medical and veterinary interest as well as molluscs that are agricultural pests.

The course aims to contribute to training of human resources in medical malacology, with emphasis on the in-service training of professionals from government health agencies, as well as biologists and other related professionals working in health, education and the environment and who wish to enter into a career in research and teaching. It is offered every two years in the second semester and lasts for five months. The first two months are dedicated full-time to theoretical and practical classes, and the following three months to development of a monograph, which can be undertaken in the student's home institution.

#### Disciplines:

Biosafety

Malacology

Host-parasite interactions

Ecology

Health and Education

Control of Mollusc vectors and agricultural pests

#### Registration:

May to August 14

#### Selection:

August 15 to 31

#### Course Period:

11 September 2017 to February 2018

#### CONTACT:

Dr. Silvana Carvalho Thiengo and Dr. Monica Ammon Fernandez at Laboratory of Malacology Instituto Oswaldo Cruz/Fundação Oswaldo Cruz, Avenida Brasil, 4365 - Manguinhos 21040-900, Rio de Janeiro, R.J, Brasil. Tel 55 21 2562-1305  
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## TENTACLE – PUBLICATION GUIDELINES AND INFORMATION

*Tentacle* is a web-based newsletter, accessed at [www.hawaii.edu/cowielab/Tentacle.htm](http://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 lives of the editorial team a lot easier!

Your submission **must** be 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 us! Especially, please pay very careful attention to the format of references in the reference lists – 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:**

- Selander, R.K., Kaufman, D.W. & Ralin, R.S. 1974. Self-fertilization in the terrestrial snail *Rumina decollata*. *The Veliger* 16: 265-270.
- South, A. 1992. *Terrestrial slugs: biology, ecology, and control*. Chapman and Hall, London. x + 428 p.
- Cowie, R.H. & Robinson, D.G. 2003. Pathways of introduction of nonindigenous land and freshwater snails and slugs. In: *Invasive species. Vectors and management strategies* (ed. Ruiz, G.M. & Carlton, J.T.), p. 93-122. Island Press, Washington.

Also note that **illustrations must fit in a single column**, so make sure your maps and diagrams are readable and show what you intend when they are reduced to this size.

Printing and mailing of *Tentacle* has been supported in the past by [Unitas Malacologica](http://www.units-malacologica.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 listserver (for details, see [p. 48](#) 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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