

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

TENTACLE



UNITAS MALACOLOGICA



EDITORIAL

I have edited *Tentacle* since issue 5 of May 1995. That's 17 issues and almost 18 years. Issues 1 and 2 were prepared on a typewriter and copied somehow (I don't know how). I am not sure how issue 3 was created, but issues 4-5 were published with assistance from the Shell oil company. This became quite complicated, and I was somewhat ambivalent about it anyway, given the environmental reputation of many oil companies. Because of the problems with Shell, which happened just at the time when it became possible to produce quite good looking documents using word processing software, every issue from issue 7 onwards, including this one, has been produced entirely using word processing software. As the software has become more sophisticated and my ability to use it to its full potential has increased, *Tentacle* has become a much more attractive, and bigger, newsletter. The structure has been re-organized from time to time to give prominence to the more important and interesting issues. And colour was introduced in issue 14 in 2006 because the constraints of photocopying in black and white and mailing hard copies were no longer limiting. Additional format changes have been made since then to make *Tentacle* more attractive visually. In addition, distribution of *Tentacle* has changed. Originally it was sent by snail mail to a small group of people, the members of the Mollusc Specialist Group. The mailing list rapidly increased, but by 2000 was still fewer than 200 people. Since at least 2002, the costs of mailing were supported by Unitas Malacologica, and that is why the UM logo has appeared on all issues of *Tentacle* since then and why all readers of *Tentacle* are encouraged to join UM. Of course, it was sent to all members of UM also by this time. Gradually, it has changed into an on line only publication, as a pdf, with all issues available on [my lab website](#) and announced via my personal list of *Tentacle* contacts, the UM list of members and the Mollusca listserv, thereby reaching probably around 1000 people directly.

I have done my best for *Tentacle* over almost two decades, but I think the time may have come for me to pass the baton. I have enjoyed editing *Tentacle* and electronically meeting so many wonderful people who are committed to mollusc conservation. I think *Tentacle* is a marvellous publication.

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However, I think that if our mollusc conservation message is to reach a wider audience than just us who are already committed, then we need to have a better internet presence. It has been suggested that *Tentacle* should become a blog. Perhaps it would be appropriate for a younger, more technically sophisticated person to take over.

I am open to suggestions about how to take *Tentacle* forward and if someone would like to take over as editor, I am very receptive to that! I think I have done my duty. Please e-mail me your ideas and suggestions.

Robert H. Cowie, Editor

TENTACLE – PUBLICATION GUIDELINES AND INFORMATION

I am hoping that by this time next year someone else will be editing *Tentacle*. However, if it is still me, then please take note of the following guidelines. **IT IS PARTICULARLY IMPORTANT THAT YOU FOLLOW THE GUIDELINES REGARDING REFERENCES. DESPITE MY PLEAS, PEOPLE STILL DO NOT PAY ATTENTION TO THE CORRECT FORMAT, WHICH MEANS I SPEND MANY EVENINGS FORMATTING AUTHORS' REFERENCE LISTS. PLEASE FOCUS ON COMMAS, INITIALS AFTER NAMES, ITALICIZATION, ETC. SO...HERE IS WHAT I HAVE SAID BEFORE 😊:**

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

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

I usually make only editorial changes to submitted articles and I accept 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, 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. Because I accept most articles that are submitted, *Tentacle* might be seen 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. Despite many reminders, it still takes me many many hours formatting your submissions – please do it for me! Especially, please pay very careful attention to the format of references in the reference lists - I still spend 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:

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.
 Barker, G.M. & Efford, M.G. 2004. Predatory gastropods as natural enemies of terrestrial gastropods and other invertebrates. In: *Natural Enemies of Terrestrial Molluscs* (ed. Barker, G.M.), p. 279-403. CABI Publishing, Wallingford.

Also note that all 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. 54 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).

NEWS

Rather than bury the following news item in the ‘IUCN, SSC and Mollusc Specialist Group news and announcements’ section, I thought it was sufficiently important to be given more prominence here. This is the official news release from IUCN.

New species from the Pacific added to IUCN Red List

Suva, Fiji, 17 October 2012 (IUCN) - New information for Pacific Island freshwater fishes, land snails and reptiles is part of the latest update of the [IUCN Red List of Threatened Species™](#) released today by the [International Union for Conservation of Nature](#) (IUCN). These data indicate that 32% of these species are threatened with extinction.

This is an important milestone for understanding the challenges of managing plant and animal life in the Pacific Islands. [IUCN Oceania](#), in partnership with the IUCN Red List Unit and other regional partners, is currently expanding the assessment of Pacific Island species for the IUCN Red List.

‘The Pacific Islands of Melanesia, Micronesia and Polynesia are home to an astonishingly diverse range of terrestrial species, many of which are found nowhere else on earth’, says Helen Pippard, Species Programme Officer for IUCN’s Oceania Regional Office in Suva Fiji. ‘But in order to conserve the species that are so vital for the health, culture and livelihoods of Pacific Islanders, we must improve our knowledge of these species’.

In the most comprehensive assessment of its kind in the Pacific, an expert team evaluated 167 freshwater fishes, 166 species of land snail and 157 reptiles for inclusion in the IUCN Red List of Threatened Species™ (IUCN Red List). This two-year project is the first step in a process that aims to systematically address different Pacific Island species groups over the next 10 years.

Although these species may not be seen as ‘charismatic’, they are extremely important in maintaining general ecosystem health: land snails play a vital role in nutrient-cycling, especially of calcium; reptiles can take on the role of predator or prey and often act as seed dispersers; and in the freshwater realm, fishes recycle nutrients, purify water and provide an important food source for many Pacific Islanders.

Land snails are found to be the most highly threatened group, with 70% of the assessed species threatened: half of all threatened species are listed as Critically Endangered, and many, including *Aaadonta angaurana* from Angaur island in Palau and *Lauopa mbalavuana* from Vanua Balavu in Fiji, also qualify for Possibly Extinct, as no live or dead shells have been found in recent times. Land snails also have the highest number of species found nowhere else, with 86% of species recorded from a single country. In Fiji, three quarters of all assessed species are endemic, and in Palau, over 90% of species are unique to the archipelago. These restricted range species are especially vulnerable to the presence of invasive species such as the giant African snail, Rosy wolf snail and predatory mammals like rats and mongooses, which are decimating these snail populations. Habitat destruction for

logging, agriculture and development has also been identified as a major threat.

The threatened freshwater fishes are confined to single or few river systems and are severely impacted by the existence of dams (e.g. Futuna’s emperor, *Akihito futuna* (CR) from the island of Futuna) and by pollution from deforestation, agriculture and mining effluents - for example, *Stiphodon discotorquatus* (CR) from the Tubuai Islands in French Polynesia is affected by land clearance, pesticides and the construction of dams, and *Sicyopterus eudentatus* (EN) from the Federated States of Micronesia is threatened by agricultural run-off devastating its habitat. Whilst many fish species are not listed as threatened (due to their larger range and ability to occupy a variety of freshwater, estuarine and marine habitats), a large number (40%) are listed as Data Deficient. We urgently need information on these species in order to evaluate their conservation status, protect them and ensure that people’s livelihoods are safeguarded.

Almost one fifth of reptiles have been assessed as threatened, and are impacted by invasive mammals and plants, and by habitat degradation (e.g. the Pohnpei forest skink, *Emoia ponapea* (EN), and the Fijian banded iguana, *Brachylophus bulabula* (EN)). Some species are affected by hunting and trade (e.g. the widespread Pacific boa, *Candoia bibroni* (LC) and the endemic Fijian crested iguana, *Brachylophus vitiensis* (CR)). Future impacts from climate change may affect the thermo-regulation of some reptiles such as the Polynesian slender treeskink, *Emoia tongana* (LC). *Tachygyia microlepis*, previously recorded from Tonga, has been driven to extinction as a result of habitat loss, human colonization and invasive predators such as dogs, pigs and rats. Conservation efforts are therefore needed to protect the identified threatened species and prevent further extinctions.

This study highlights the enormous strain on our natural environments. The results are particularly important for guiding decision-making and conservation activities of Pacific Island governments, NGOs and the private sector and enabling direct action on the ground.

‘Until now we have not had the information we need about species and the threats they face’, says Bernard O’Callaghan, IUCN Oceania’s Regional Programme Coordinator. ‘But these IUCN Red List assessments can now help decision-makers develop suitable policies and plans, to manage these threatened species and protect and value Pacific Island biodiversity.’

The findings of this assessment are being published in a regional report, and summary documents are now available from the IUCN Oceania website.

The Red Listing Project to carry out assessments on land snails, freshwater fishes and reptiles in the Pacific region is supported by funding from the Critical Ecosystem Partnership Fund and the Fonds Pacifique.

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The IUCN report on the land snail component of this project, compiled by Helen Pippard, is available on line: [The current status and distribution of land snails in the Pacific Islands of Oceania.](#)

LAND MOLLUSCS AND PROBLEMS FOR THEIR CONSERVATION IN THE MONTE BARRANCA MANAGED FLORISTIC REFUGE, EASTERN CUBA

By David Maceira Figueira, Jorge Reyes Brea, Armando Tizón Pérez, Senén González Fajardo, Beatriz Lauranzón Meléndez & María del Carmen Fagilde Espinosa

Monte Barranca Managed Floristic Refuge is located in Palma Soriano municipality, Santiago de Cuba province. It constitutes the only primary forest in the Palma Soriano savanna with an area of 311 ha and hills between 149 to 203 m above sea level, surrounded by sugar cane plantations (Salmeron López *et al.*, 2011). The land snail fauna of this protected area has not previously been studied, except for a few collections. This study contributes to the knowledge of the terrestrial molluscs of Monte Barranca Managed Floristic Refuge and the threats they face.

On 14 February 2012 we recorded all tree snail species and individuals from 8 to 10 am and ground dwelling snails from 10.30 am to 12.30 pm in the semideciduous mesophyll forest. All collections are deposited in the Malacological Collection of the Centro Oriental de Ecosistemas y Biodiversidad (BIOECO - BSC-M).

Eleven species of land snails were recorded, of which eight are endemic to Cuba, one is widely distributed on many Caribbean islands and two are introduced. Nine are pulmonates and two are operculate snails (formerly 'Prosobranchia'). Eight live in trees and three on the ground. The molluscs recorded are widespread in eastern Cuba, with the exception of *Parachondria dilatatus toroensis*, for which this is only the second known locality.

The threatened endemic *Polymita venusta* was the most abundant land snail and was observed on 12 plant species (see list below). In the forest *Oxandra lanceolata* was the plant most used by adults and juveniles, although juveniles were seen on three other plants. In forest clearings and along the roads juveniles were mostly on the grass *Panicum maximum*. Green shells are the most frequent in both adult and juvenile *Polymita venusta*, followed by red and banded shells (Fig. 1).

Adult *Polymita venusta* are found highest above the ground on *Cupania americana*, followed by *Bursera simaruba* and *Coccoloba* sp., while juveniles occur highest on *Xanthoxylum martinicensis* (Fig. 2).

In contrast, all individuals of the endemic *Liguus fasciatus achatinus*, the biggest tree snail in the area, were observed on two tall trees of *Lysiloma latisilicum* (L.) Denth. (Soplillo) at

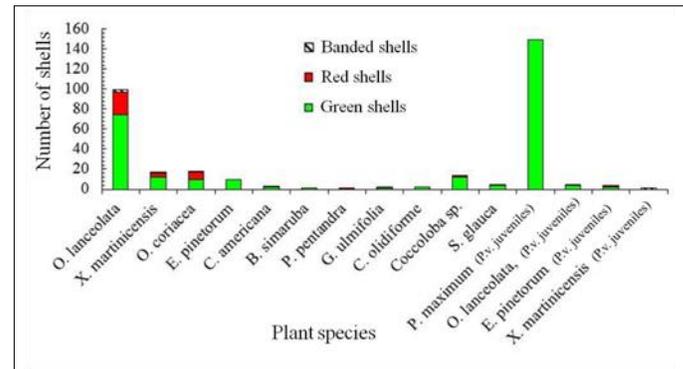


Fig. 1. The numbers of *Polymita venusta* with green, red and banded shells on different plant species.

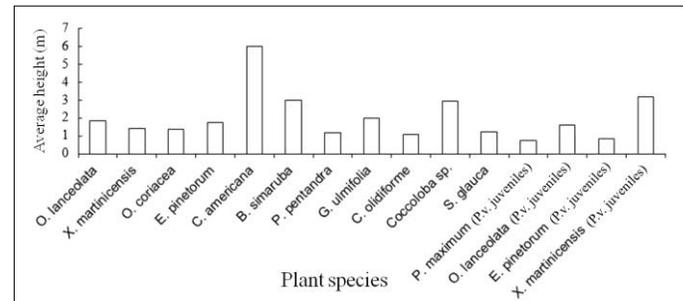


Fig. 2. Average height of *Polymita venusta* on trunks and stems of different plant species.

the side of the road, with trunk circumferences of 7.2 m and 1.2 m. The average height from the ground was 5.4 m.

In general, mollusc abundance was low, with the exception of *Polymita venusta* and *Caracolus sagemon*.

Threats to the land molluscs inhabiting the semideciduous mesophyll forest at the Monte Barrancas Managed Floristic Refuge include intense human activity that has resulted in destruction and fragmentation of the original plant formation and the introduction of one species of terrestrial mollusc not characteristic of this ecosystem (*Subulina octona*). In addition to this habitat loss and deforestation, other threats include illegal extraction of wood for craft, firewood and building houses, introduction of alien animals (*Rattus rattus*), droughts and natural and human caused fires. The *Liguus fasciatus achatinus* population is at risk of extinction from tree felling or fire. There are difficulties obtaining the necessary resources to develop an adequate technical infrastructure to support an ecological station for the development and maintenance of research. Communities of people resident in the reserve ignore the value of the natural resources in their surroundings and a program of environmental education is still insufficient.

The research and monitoring program includes

- Carrying out a *Liguus fasciatus achatinus* captive breeding program and subsequent re-introduction in other sites of the semideciduous mesophyll forest to prevent its extinction and to re-establish its ecological role in the ecosystem as the biggest species of mollusc.
- Monitoring population density of the endemic and threatened *Polymita venusta*, which requires specific conditions of humidity and litter for laying its eggs in the ground, making it an indicator of ecosystem condition.

- Reforesting forest clearings with the original plant species belonging to the semideciduous mesophyll forest.
- Replacing *Panicum maximum* in the clearings with *Oxandra lanceolata*, *Eugenia pinetorum* and *Xanthoxylum martinicensis*, plants that are important for adult *Polymita venusta*.
- Establishing a program of environmental education for the local human communities.
- Establishing a program to control *Rattus rattus* in the area.

Land mollusc species list

The number of snails of each species that were found per hour living in the semideciduous mesophyll forest is given in parentheses.

Class GASTROPODA

Subclass 'PROSOBRANCHIA'

Family HELICINIDAE

Emoda pulcherrima (Lea, 1834). Tree snail endemic to eastern Cuba (1).

Family ANNULLARIDAE

Parachondria (Parachondria) dilatatus toroensis (Torre & Bartsch, 1938). Tree snail endemic to eastern Cuba (3).

Subclass PULMONATA

Family VERONICELLIDAE

Veronicella cubensis (Pfeiffer, 1840). Widely distributed in many Caribbean islands (2).

Family ORTHALICIDAE

Liguus fasciatus achatinus Clench, 1934. Tree snail endemic to eastern Cuba (5.5).

Family UROCOPTIDAE

Macroceramus canimarensis (Pfeiffer, 1839). Tree snail endemic to eastern Cuba (2).

Family SUBULINIDAE

Subulina octona (Bruguière, 1792). Ground dwelling snail introduced to Cuba (3).

Family OLEACINIDAE

Oleacina solidula (Pfeiffer, 1840). Ground dwelling snail endemic to Cuba (1).

Family CAMAENIDAE

Caracolis sagemon (Beck, 1837). Tree snail endemic to Cuba, sometimes seen on the ground (23).

Family XANTHONICHIDAE

Polymita venusta (Gmelin, 1791). Tree snail endemic to eastern Cuba (167).

Coryda alauda (Férussac, 1821). Tree snail endemic to eastern Cuba (1).

Hemitrochus lucipeta (Poey, 1854). Tree snail endemic to eastern Cuba (3).

List of plant species used by *Polymita venusta*, with common names used in Cuba

Family ANNONACEAE

Oxandra lanceolata (Sw.) Baill. (Yaya)

Family ASTERACEAE

Panicum maximum Jacq. (Hierba de Guinea)

Family BURSERACEAE

Bursera simaruba (L.) Sargent. (Almácigo)

Family LAURACEAE

Ocotea coriacea (Sw.) Britt. (Sigua)

Family MYRTACEAE

Eugenia pinetorum Urb. (Guairaje)

Family MALVACEAE

Guasuma ulmifolia (Lam.). (Guásima)

Family PICRAMNIACEAE

Picramnia pentandra Sw. (Aguedita)

Family POLYGONACEAE

Cocoloba sp. (Uvero)

Family RUTACEAE

Xanthoxylum martinicensis (Lam.) DC. (Ayúa)

Family SAPINDACEAE

Cupania americana L. (Guáranó)

Family SIMARUBACEAE

Simaruba glauca DC. (Palo Blanco)

Family ZAPOTACEAE

Crisophylum olidiforme L. (Caimitillo)

We thank Empresa de Flora y Fauna, Refugio Florístico Manejado 'Monte Barranca' and Centro Oriental de Ecosistemas y Biodiversidad (BIOECO) for support of the fieldwork, and the driver, Ramón Cueto.

Salmeron López, A., González Rodríguez, A., Álvarez Quintana, L.O. & Silot Leyva, M. 2011. *Plan Operativo Especial 2012 Reserva Florística Manejada 'Monte Barranca'*. Fondos de BIOECO, Santiago de Cuba. 67 p.

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CERION COUTINI (PULMONATA, CERIONIDAE) AT TAKO BAY KEY, BARACOA, GUANTÁNAMO, CUBA

By Alexis Suárez Torres & Norvis Hernández Hernández

The eastern Cuba region includes Las Tunas, Holguín, Granma, Guantánamo and Santiago de Cuba provinces. Among the Cerionidae of Cuba, 40% of the species are found in the region, with each one found in a particular area. They occur in all provinces except Santiago de Cuba (south coast) (Espinosa & Ortea, 2009).

There is little knowledge of the ecology of Cerionidae in Cuba. Some limited information has been provided by Espinosa & Ortea (2009), Maceira Filgueira (2000), and Rodríguez, *et al.* (2006), with more detail on Cuban species by Suárez Torres *et al.* (2012a, b), Suárez Torres & Fernández Velázquez (2012) and on other species by Woodruff (1978) and Baldini *et al.* (2007).

During 1-19 April 2010, the Bariguá, Barigüita, Yara, Nibujón, Bahía de Taco, Nava and Yamanigüey localities of Baracoa, Guantánamo were surveyed with the goal of locating *Cerion* populations.

Tako Bay Key, in Tako Bay (20°31'N, 74°40'W), which is within the Alejandro de Humboldt National Park, is the type locality and supports the only known population of *Cerion coutini* Sánchez Roig, 1951. The dominant vegetation is coconut plantations (Fig. 1).



Fig. 1. Tako Bay, habitat of *Cerion coutini*.

In an area of 4000 m² all individuals were counted and the substrate on which the snails were found was recorded: coconut plants, earth, fallen coconut leaves, coconut shells and fallen coconut trunks. The height of the snails above the ground was measured with a 5 m stick marked every meter and categorized in 1 m classes. Density was calculated by the direct technique suggested by Berovides *et al.* (2005).

This place had been lashed directly by two hurricanes and a violent penetration of the sea during the previous two years, which resulted in several changes to the shore ecosystem. In particular the Sea Grape (*Coccoloba uvifera*) was badly damaged at the time of the survey, with the plants reaching no more than 1.5 m in height.

In total, 126 individuals were counted, for a density of 0.03 ind/m². Of these, 62 were on living coconut trunks (Fig. 2), 23 were on coconut shells on the ground, 21 were on fallen leaves, 19 were on fallen trunks and only one was found on the ground. This relationship between *C. coutini* and coconut in this locality is notable, as the plant was introduced about 500 years ago, at the beginning of 16th century. *Cerion coutini* was associated neither with *Coccoloba uvifera* nor with the secondary vegetation that grows in this location. It could be that this resource is used because of the shortage of natural resource resulting from the effects of the recent storms in the area but notes made previously to these events refute this idea.

Cerion species exhibit marked variation in substrate preferences. *Cerion alberti* Clench & Aguayo, 1949 at Península de Antillas prefers a rocky substratum (Suárez Torres *et al.*, 2012a). *Cerion politum maisianum* Pilsbry, 1902 at Paso de los Azules, Punta de Maisí, prefers dead vegetal substrates (Suárez Torres & Fernández Velázquez, 2012). *Cerion peracutum* Clench & Aguayo, 1951 at Loma de Bellomonte, Guanabo, was associated with dry grass and bushes (70%), live plants (29%) and the ground (1%), and at Boca de Jaruco this species prefers a sandy-stony substrate (Suárez Torres *et al.* 2012b). *Cerion monaensis* was associated with limestone at Mona Island (Thompson, 1987), and *Cerion nanus* Maynard, 1889 preferred crab bush (*Evolvulus arbuscula*) on Little Cayman (Hounscome & Askew, 1980).

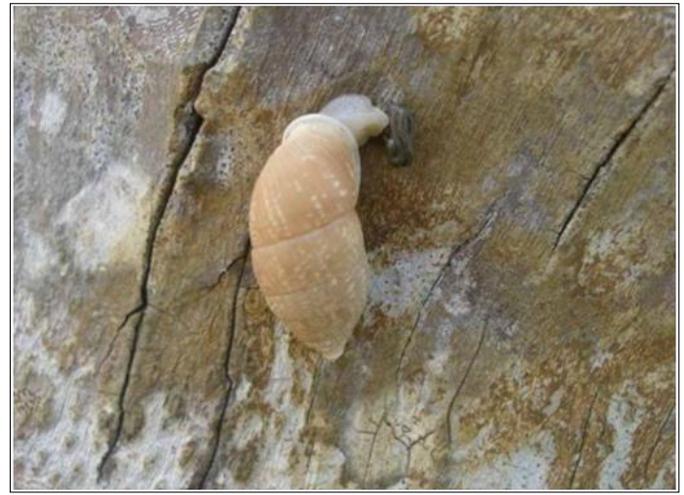


Fig.2. *Cerion coutini* on coconut.

The 62 individuals on coconut plants were found at heights above ground as follows: 0-1 m, 35% (22 snails); 1-2 m, 39% (24); 2-3 m, 11% (7); 3-4 m, 11% (7); and above 4 m, 3% (2). The other snails found on other substrates were at least 1 m above ground, and only one was found on the ground.

Cerion politum maisianum was found at low heights < 0.50 m above ground (Suárez Torres & Fernández Velázquez, 2012).

The reason for 99% of the *C. coutini* being found above the ground could be to avoid predators. The crab *Gecarcinus lateralis*, a common inhabitant of our shores is known to prey on *Cerion* (Quensen & Woodruff, 1997).

Human activities in the area include the use of coconut plants for many purposes. Their fruits are valued as food, the leaves for building huts and the trunks for construction of corrals. The level of use of the coconut plants means that there is concern regarding the health of this *Cerion* population, such that constant environmental education is a basic necessity for the protection of this species.

We thank the Alejandro de Humboldt National Park for facilitating this work, Guillermo Ponce de León for company during this work, Alejandro Fernández, José Espinosa, José Antonio Ruiz, Gladys Gil, Iriel Hernández and Nayla García for their help and Teresita de Jesús Ruíz for help with translation.

Baldini, L.M., Walker, S.E., Railsback, L.B., Baldini, J.U.L. & Crowe, D.E. 2007. Isotopic ecology of the modern land snail *Cerion*, San Salvador, Bahamas: preliminary advances toward establishing a low-latitude island paleoenvironmental proxy. *Palaios* 22: 174-187.

Berovides, V., Cañizares, M. & González, A. 2005. *Métodos de Conteo de Animales y Plantas Terrestres. Manual para la capacitación del personal técnico de las Áreas Protegidas de Cuba*. Centro Nacional de Áreas Protegidas, Publicaciones del Ministerio de Ciencias, Tecnología y Medio Ambiente, La Habana. 47 p.

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FIVE LAND SNAIL SPECIES PREDICTED TO DECLINE WITH CLIMATE WARMING IN PENNSYLVANIA, USA

By Timothy A. Pearce & Megan E. Paustian

For taxa that have an altitudinal range determined by temperature, climate warming is expected to shift altitudinal ranges upward, as has been shown for plants (Gottfried *et al.*, 2012). Where higher elevations occupy less surface area than lower elevations, an upward shift in altitudinal range will mean a geographical reduction in range. Climate warming could have a particularly large effect on high-altitude endemic taxa (Dirnböck *et al.*, 2011).

Land in Pennsylvania, USA, spans only a moderate elevational range, from sea level to 978 m. Of the US states traversed by the Appalachian Mountains, Pennsylvania has the lowest high point. However, elevations are not equally represented, with only 2% of the surface area being above 700 m. Consequently, snail populations currently in cooler habitats at higher elevations would be expected to suffer population declines with climate warming.

In a study of potential effects of climate warming in Pennsylvania (Pearce & Paustian, in review), we sampled 108 localities (12 localities for each of nine elevations from 100 to 900 m) and we supplemented those samples with data from museum specimens having precise enough location data to

assign reliable elevations. Fieldwork yielded 1137 species occurrences of 69 species and examination of museum specimens yielded 7036 species occurrences of those 69 species.

We found that overall numbers of species and abundances of land gastropods decreased at higher elevations. Regressing numbers of occurrences in 100 m elevation increments showed that five species, *Helicodiscus shimiki*, *Mesomphix perlaevis*, *Neohelix dentifera*, *Striatura ferrea* and *Striatura milium*, occurred significantly more at higher elevations. Four additional species, *Mesomphix inornatus*, *Pallifera dorsalis*, *Philomycus flexuolaris* and *Philomycus togatus*, had non-significant trends to occur more at higher elevations, and all but the first of those are native slugs. While none of these species is currently scarce in Pennsylvania, we predict they will probably suffer marked population declines as the climate warms. Assisted migration (Örstan, 2009) might help these populations.

We did not examine other aspects of climate change, e.g. precipitation changes and indirect effects such as habitat shifts and new species moving into an area (predators, parasites, diseases or competitors). These other aspects of climate change can be expected to affect snails. For example, the Aldabra banded snail (*Rhachistia aldabrae*) gained the distinction of being the first documented species extinction due to climate change (Gerlach, 2007), evidently because reduced rainfall increased mortality of juveniles.

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FIRST RECORD OF *COCHLODINELLA MANZANILLENSIS* (UROCOPTIDAE) IN HOLGUÍN, CUBA

By Alejandro Fernández Velazquez & Steffen Franke

The land mollusc fauna of Cuba includes 476 species of operculate snails (formerly Prosobranchiata) in 52 genera and 6 families, and 922 pulmonate species in 103 genera and 27 families (Maceira *et al.*, 2011). Among these groups, the Urocoptidae are the most diverse (Espinosa & Ortea, 2009).

The genus *Cochlodinella* includes 39 species in four subgenera: *Orientocoptis*, *Ventricoptis*, *Cochlodinella* and *Blainia*. Twenty species of subgenus *Cochlodinella* have been recognized; they are widely distributed but most abundant in central Cuba, with only one species, *Cochlodinella* (*Cochlodinella*) *manzanillensis*, exclusively confined to Granma province (Torre & Bartsch, 2008).

In November 2003, *Cochlodinella manzanillensis* (Fig. 1) was discovered in Holguín province for the first time. Its known distribution had thus been extended more than 130 km north-east of the type locality, Manzanillo, Granma province (Fig. 2).

Previously, *C. manzanillensis* was known from a few localities between Cabo Cruz and Manzanillo in Granma province: Ojo de Agua, Ceiba Hueca, Central Niquero, Las Coloradas, Mota and La Vigia, Ensenada de Mora (Torre, 1930; Espinosa & Ortea, 1999; Torre & Bartsch, 2008).

This species has been found in two tourist areas, at the Hotel Villa Islazul Mirador de Mayabe and the Motel Villa Azúcar, which are separated from each other by a road, and where the original vegetation was semideciduous forest; both sites are at the top of a hilly region (215 m asl), less than 200 m apart, and about 8 km south-east of Holguín (Fig. 2).

These populations could be considered as a relict nucleus of this species, which in the past was more widespread, and many populations have probably been extirpated by human activities, mainly during expansion of agriculture. Today, no



Fig. 1. *Cochlodinella manzanillensis* from the Hotel-Villa Mirador de Mayabe. (Scale in mm).



Fig. 2. Geographic location of *Cochlodinella manzanillensis* on Loma El Mirador de Mayabe (HMM).

other populations of *C. manzanillensis* are known in the Cauto river basin between Granma and Holguín.

The microhabitats where *C. manzanillensis* is found are exclusively composed of limestone outcrops in shady vegetated areas around the buildings of the two tourist villas. The area occupied is small: at the Hotel Villa Islazul El Mirador de Mayabe there are two patches of about 50 m² behind and near the restaurant; in the Villa Azúcar, the population is in an even smaller area in front of the manager's offices.

Living specimens were found under and on top of calcareous rocks and in crevices, usually covered by dead leaves or fallen twigs, in the upper leaf litter among large fissured rocks, specifically restricted to limestone outcrops.

There is probably no gene flow among these populations because *C. manzanillensis* have low vagility and only occur on isolated limestone outcrops. Grassland, roadways, paths, bare ground and so on, where there is no connection via limestone outcrops or calcareous rocky areas, are barriers to dispersal.

Since 1980, after building the two tourist villas, these populations have not been directly affected by human activities, because the snails are naturally protected on the limestone outcrops, which are covered by large trees, bushes and lianas, making these places a safe microhabitat for *C. manzanillensis*. Of course, some demes were probably extirpated during the constructive of the tourist villas, but in reality the magnitude of impacts on these calcareous rock dwellers is unknown.

Also, people have limited access to these sites, and the staff of these tourist villas pay careful attention and do not disturb them. Many times, at least once per year (2005, 2007, 2008, 2010, 2011) the sites have been visited, confirming the continued existence of these populations.



Fig. 3. *Torrecopsis holguinensis* (Aguayo, 1934). Threatened species: Vulnerable; endemic at Holguín, only known at a few localities: El Yayal, Lomerio de San Germán, Rejondones de Báguanos, Mirador de Mayabe and Camazán, and the last two are new records of occurrence. Scale in mm.

Other species of land snails have been listed at El Mirador de Mayabe Hill, for a total of 18 species belonging to 11 families: *Alcudia minima* (d'Orbigny, 1842), *Troschelviana holguinensis* (Aguayo, 1932) (Helicinidae); *Annularisca holguinensis* Torre & Bartsch, 1941 (Potamiidae); *Liguus fasciatus* (Müller, 1774) (Orthalicidae); *Brachypodella angulifera* (Gundlach in Pfeiffer, 1858), *Torrecopsis holguinensis* (Aguayo, 1934) (Fig. 3), *Cochlodinella manzanillensis* (Torre, 1930) (Urocoptidae); *Subulina octona* (Bruguère, 1792), *Obeliscus bacillus* (Pfeiffer, 1861) (Subulinidae); *Oleacina solidula* (Pfeiffer, 1840) (Oleacinidae); *Caracolis sagemon* (Beck, 1837), *Zachrysis auricoma* (Férussac, 1822), *Zachrysis gundlachiana* Pilsbry, 1928 (Camaenidae); *Euclastaria euclasta* (Shuttleworth, 1852) (Sagdidae); *Hemitrochus lucipeta* (Poey, 1854), *Coryda alauda* (Férussac, 1821) (Cepolidae); *Praticolella griseola* (Pfeiffer, 1841) (Polygyridae) and *Polymita muscarum* (Lea, 1834) (Xanthonychidae).

Most of these species are Cuban endemics, with the exception of two alien species: *P. griseola* and *S. octona*. Three species are threatened, categorized as Vulnerable according to the IUCN criteria (Bidart *et al.*, 1995): *P. muscarum*, *L. fasciatus* and *T. holguinensis*.

At El Mirador de Mayabe Hill more species could probably be recorded if the same amount of field work were to be carried out as in El Yayal, which is located toward the western part of El Mirador de Mayabe, about 2 km away, where 31 species have been recorded (Bidart *et al.*, 1996; Fernández *et al.*, 1999; Franke & Fernández, 2005). The entire hilly zone must be considered as a faunal refuge near Holguín, and we think further that it should be set aside as a protected area.

The specimens of *C. manzanillensis* from Mirador de Mayabe conform very closely regarding conchological features to the original description of this taxon (Torre, 1930; Torre & Bartsch, 2008), with only one exception: the marmorated appearance of the shell in all the specimens from Holguín is lost. In the light of this, a taxonomic study might distinguish a new subspecies, which would be important from a conservation perspective.

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THE IMPORTANCE OF EDUCATING PEOPLE ABOUT THE DIFFERENCES BETWEEN ALIEN *ACHATINA FULICA* AND NATIVE *MEGALOBULIMUS PARANAGUENSIS* ON THE COAST OF PARANÁ STATE, BRASIL

By Carlos João Birckolz & Marcos de Vasconcellos Gernet

The first intentional species translocations from one region of the planet to another were intended, primarily, to meet agricultural and forestry needs, among other kinds of use. Biological contamination is worrisome because it is a threat to natural populations, being the second biggest cause of extinctions throughout the planet. The use of these species has jeopardized the integrity of ecosystems, compromising their ecological function and causing the extinction of native species (Keane & Crawley, 2002).

The invasive alien snail *Achatina fulica* Bowdich, 1822 in Brasil (Fig. 1) is native to East Africa, its original distribution having a southern limit in Natal (South Africa) and a northern limit in Somalia (Raut & Barker, 2002). Currently, due to its success as an invader, its distribution extends to almost all continents (Africa, the Americas, east and south Asia) and to islands of the Indian and Pacific Oceans, including temperate regions (Raut & Barker, 2002). It can act as an intermediate host of the nematode *Angiostrongylus cantonensis*, which causes disease in humans and other mammals. It can also cause environmental damage, including ecological pressure on native populations of molluscs that share the same environment (Fischer & Colley, 2005), and economic losses in

agriculture (Zenni & Ziller, 2010).

The first records of *A. fulica* in Brasil are from 1988 (Teles *et al.*, 1997). On the coast of Paraná state, the first records of the species in the municipalities of Antonina and Morretes were in 1994, and in 2002 it had already spread to all coastal municipalities of the state (Kosloski & Fischer, 2002).

The native Brazilian species *Megalobulimus paranaguensis* (Pilsbry & Ihering, 1900) (Fig. 1) has as type locality the municipality of Paranaguá on the coast of Paraná state. Its range extends to the south as far as the municipality of Garuva, in the state of Santa Catarina, and to the north as far as Peruíbe, in the state of São Paulo (Morretes, 1954). Recently it was also recorded further north, in the municipality of São Vicente, São Paulo (Pecora *et al.*, 2011). This species is common on the coastal plain areas, where it was once widely used in the everyday lives of traditional people for food, medicinal purposes, crafts, decorations and tools, and even as a symbol of power (Birckolz & Gernet, 2012).



Fig. 1. Left: *Achatina fulica* shell. Right: *Megalobulimus paranaguensis* shell.

Previously most easily found on the coast of Paraná state, this species is currently suffering from anthropogenic pressure resulting from the housing boom and vegetation removal. The use of the shells of these animals in craft activities also causes their rapid disappearance. Currently, one of the major threats to this species is the presence of the alien snail *Achatina fulica*, which is an intermediate host of *Angiostrongylus* and is often eliminated by local people. However, the people confuse them with native snails, causing indiscriminate extermination of the native species as well (Fischer & Colley, 2004, 2005).

Thus it became important to conduct educational activities in the municipalities of Guaratuba, Matinhos, Morretes, Paranaguá and Pontal do Paraná, all on the coast of the state of Paraná (25°06'-25°58'S, 48°06'-48°53'W), explaining the main morphological differences between the two species, and discussing observations on their behaviour, feeding and reproductive habits. The problems caused by *A. fulica* to health and agriculture and the ways to control it, were also explained, seeking ways to decrease their populations. As well as the cultural and environmental importance of *M. paranaguensis*, the decrease of their populations caused by the expansion of urban areas and the possible trophic competition



Fig. 2. An educational activity in progress at a school in the municipality of Pontal do Paraná.

with alien species were discussed in the workshops (Birckolz, 2011; Paz *et al.*, 2012).

These activities began in November 2009. In schools, two terrariums were used, placed one beside the other, with living specimens of each species (Fig. 2). In the activities with local residents shells and eggs of the two species were used. Most of the people who knew the native species were elderly, young people knew mostly *A. fulica* (Birckolz, 2011; Paz *et al.*, 2012).

Similar efforts to educate people about Megalobulimidae have also been conducted in other states of Brasil, including Goiás, Rio de Janeiro and São Paulo (Coelho, 2005; Pecora & Silva, 2011; Silva *et al.*, 2008, 2009). They also could potentially contribute to the conservation of other families of terrestrial gastropods, such as Strophocheilidae and Bulimulidae.

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INSIGHTS INTO THE NATURAL HISTORY OF AMPULLARIIDS FROM THE LOWER RÍO DE LA PLATA BASIN, ARGENTINA

By Pablo R. Martín, Silvana Burela & María José Tiecher

Apple snails (Ampullariidae) are renowned globally as successful invaders, as voracious pests of aquatic crops and as promoters of ecosystem changes in natural wetlands. However, a recent review highlighted that only 14 species of apple snails have been translocated beyond their native areas and less than half of them have caused ecological or economical impacts (Horgan *et al.*, 2012). Most of their reputation is attributable to a few New World species of the genus *Pomacea* (in particular *P. canaliculata*) and to the ramshorn apple snail, *Marisa cornuarietis*. This prompted the IUCN Invasive Species Specialist Group to include *Pomacea canaliculata* in the list of 100 of the World's Worst Invasive Alien Species (Lowe *et al.*, 2000), although at least one other species of the genus, *Pomacea maculata* (see Hayes *et al.*, 2012), could probably be included in the list.

The apple snails that have received most attention from the scientific community and the public during the last few decades are mainly the invasive ones such as *M. cornuarietis*, *P. canaliculata* and *P. maculata*. The Florida apple snail, *Pomacea paludosa*, a non-invasive species with a limited Caribbean distribution, is a remarkable exception although in

this case most of the interest comes from it being the staple food of the specialized apple snail predator, the snail kite *Rostrhamus sociabilis*, an endangered raptor in Florida. Other *Pomacea* species such as *P. patula* and *P. urceus* have also raised some conservation concern because they are overexploited for human consumption in Central and South America (Ramnarine, 2003; Espinosa-Chávez, *et al.*, 2005).

The aforementioned apple snail species are just the emerging tip of the apple snail diversity 'iceberg' the underwater part of which is the large number of species still living beyond the reach of scientific inquiry in tropical and subtropical areas around the world. Many of them inhabit inland waters of the Neotropics (Central and South America), where four genera are recognised (*Pomella* has recently been synonymised with *Pomacea*; Hayes *et al.*, 2012) and dozens of species have been described (Cowie & Thiengo, 2003), although only a few of them have received more than a name, a brief description of the shell and an imprecise type locality.

The Lower Río de la Plata basin hosts representatives of all the genera of Neotropical apple snails, including some endemic genera and species (Rumi *et al.*, 2004; Gutiérrez Gregoric *et al.*, 2006), but it is also the source of the three *Pomacea* species introduced into Asia, North America, Pacific islands and, recently, Europe (Hayes *et al.*, 2008; López *et al.*, 2010). The fame of their invasive relatives probably leads to the conservation of these non-invasive apple snails being of least concern but in fact little is known about their natural history, distribution, demography and conservation status. The large number of genera and species in the area almost certainly reflects a high diversity of life history strategies and degrees of habitat specialization. Probably many of these species are not as flexible and adaptable as the invasive representatives.

The apple snails inhabiting the Río de la Plata basin, the main hydrographic drainage in southern South America, face the impacts of habitat modifications resulting from the construction and operation of several very large dams as well as the impacts of invasive species (Scarabino, 2004; Gutiérrez Gregoric *et al.*, 2006). Beyond changing the nature of the habitat from lotic to lentic over large distances, these dams have disrupted the naturally variable hydrological regime of these rivers and hence affected the cycle of high and low waters in their flood plains. Deforestation, reforestation and land use intensification may provoke changes in detrital inputs, water quality and aquatic communities. Furthermore, the Paraná river has become a major 'hydroway' and is one of the main routes for transporting cargo among the various countries of the region (Argentina, Brasil, Paraguay and Uruguay). The Uruguay river, which supports the highest diversity of apple snail genera in the world, serves as the border between Argentina, Uruguay and Brasil and has been the focus of recent environmental concerns related to the installation of paper mill industries.

Only five out of twelve species of apple snails inhabiting Argentinean waterbodies have been included in the IUCN Red list of Threatened Species (IUCN, 2012), and none of them was considered as endangered. *Pomacea canaliculata* was

categorized as of Least Concern because of its wide distribution and positive population trend. *Pomacea megastoma*, *Felipponea neritiformis* and *Asolene pulchella* were also considered as of Least Concern because of their wide distributions, although their population trends were unknown. *Felipponea iheringi* was categorized as Data Deficient because of the lack of reliable information on its distribution. The status of the only species of *Marisa*, *M. planogyra*, which is restricted to the middle Paraná river (Castellanos *et al.*, 1976), has not been evaluated.

Some of these species were considered as widely distributed and hence of Least Concern because of their presence in three countries (Argentina, Brasil and Uruguay), although in fact they inhabit only a single drainage basin or part of it (i.e. the Uruguay or Paraná river basin). However, Rumi *et al.* (2006) considered that *Asolene platae*, *Felipponea elongata* and *F. iheringi* were endangered on the basis of their ‘continuous restricted distribution’. Some species, such as *P. megastoma* and *Felipponea neritiformis*, apparently restricted to places with bedrock and running water, seem to be especially prone to reductions in habitat extent by the impoundment of sections of the rivers. Moreover, *P. megastoma* seems to be mostly restricted to the left bank of the Uruguay river and Río de la Plata because of this habitat requirement (Hylton Scott, 1943; Clavijo *et al.*, 2008). The fouling of apple snail shells and hard substrates by the invasive golden mussel, *Limnoperna fortunei*, has raised some concern especially regarding these apples snails associated with rocky bottoms (Scarabino, 2004; Clavijo *et al.*, 2008).

During the last decade there have been important advances in knowledge of the distribution of Argentinean apple snails (Rumi *et al.*, 2006). However, there were almost no studies concerning the natural history of apple snails other than *Pomacea* spp. (but see Martín, 2002). Even information about the basic aspects of the anatomy and biology of very conspicuous species such as *P. megastoma* has emerged only in the last few years. For instance, the left nuchal lobe of *P. megastoma*, used for aerial respiration in apple snails, was described as rudimentary and almost absent (Hylton Scott, 1943) but our observations showed that it can be used as a snorkel to reach the surface in the same way as in *Pomacea*. Only recently the egg masses of this species have been reported (Hayes *et al.*, 2009) and they are aerial and calcareous, as in *Pomacea*, and not gelatinous and subaquatic like those of the genus *Asolene* in which it was placed until recently (Hylton Scott, 1943; Castellanos *et al.*, 1976).

Presently there are two ongoing projects funded by the Universidad Nacional del Sur (UNS, PGI24/B185) and the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET, PIP11220090100473) on the biology and ecology of Argentinean apple snails. Our aims in the short term are to study the natural history of at least one of the non-invasive species of each genus of apple snails with the goal of achieving a better comprehension of the evolution of their behavioral and physiological adaptations.

The apple snails are collected with the required legal permissions, and then taken to the laboratory to establish



Fig. 1. Left: *Asolene pulchella* ovipositing in the lab. Right: *Asolene pulchella* crawling in the lab. (Photos: María José Tiecher)



Fig. 2. Left: *Pomacea megastoma* pair in copulation in the lab. *Pomacea americanista* crawling in Bonito stream (Misiones province, Argentina). (Photos: Silvana Burela)



Fig. 3. Left: *Felipponea iheringi*, shell collected in Bonito stream, Acaraguá Basin (Misiones province, Argentina). Right: Bonito stream, a site of collection of *Felipponea iheringi* and *Pomacea americanista*. (Photos: Silvana Burela)

populations that are maintained under controlled water temperature, light and food. All possible aspects of the life history of the snails are studied, including life span, egg-laying behaviour, fecundity, thermal limits and other habitat requirements. Our experience indicates that *P. canaliculata*, *P. maculata* and *Asolene pulchella* (Fig. 1) readily grow and reproduce under laboratory conditions, but some species of *Pomacea* (*P. megastoma* and *P. americanista*; Fig. 2) and *Felipponea* (Fig. 3) at first proved to be difficult to maintain in laboratory cultures even under carefully controlled conditions. Most species do not thrive in tap water, unlike *P. canaliculata*. *Asolene pulchella* preys readily on its own egg masses and hence requires special care; in individual aquaria females frequently deposits an egg mass and eat it in the course of a single night, even with lettuce provided *ad libitum*. Some species are slow growing and long lived, apparently maturing in their second year of life at 25 °C, which makes demographic studies difficult.

It is common sense that we cannot conserve what we do not know. We hope that the information that we are gathering in our projects will help to categorize the different species of apple snails from the Lower Río de la Plata Basin and hence to preserve as much as possible of the Neotropical ampullariid diversity.

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MARK-RECAPTURE METHODOLOGY: A SIMPLE AND INEXPENSIVE TECHNIQUE FOR THE STUDY OF BIVALVES AND GASTROPODS IN BRASIL

By Vanessa Fontoura-da-Silva, Jéssica Beck Carneiro, Igor Christo Miyahira, Sonia Barbosa dos Santos & Carlos Henrique Soares Caetano

The mark-recapture technique typically involves repeated sampling of a target population, allowing recognition of uniquely marked individuals previously sampled and can be used to analyze the specific capture history and movements of each individual animal (Seber, 1992). It was first used in ecology in 1896 to analyze fish movements (Ricker, 1975).

The method is as follows. The first time that you capture an individual, you have to mark the animal with a tag (or something else). The second time that you sample this same population, some individuals (the marked ones) can be identified as recaptured. Mark-recapture models are widely used in ecology, providing information on individual mobile organisms (Krebs, 1999), and the method has proven to be a great tool for quantifying various demographic parameters such as survival rate, recruitment and migration (Schwars & Seber, 1999; Senar *et al.*, 2004; Amstrup *et al.*, 2005; Kurth *et al.*, 2007; Wilson *et al.*, 2011) as well as information on absolute abundance (Krebs, 1999). It is considered one of the most reliable methods for these analyses (Villemela *et al.*, 2004), but to be accurate some restrictive assumptions must be made. The study should be well-designed so that it takes into account the importance of various factors that affect these parameters, including characteristics of individuals (e.g. sex), changes over time (e.g. seasonal effects) and impacts of management (e.g. predator control) (Lettink & Armstrong, 2003).

It is also important that the animals have the same probability of being caught and tags are not lost or become illegible. Recaptures must be recorded accurately, tagging and handling must not affect the survival or recapture of animals and tagged animals must be representative of the target population (Villemela *et al.*, 2004).

Most studies of population biology using the direct method of marking and recapture have focused on vertebrates and have relatively rarely been performed on invertebrates (Strayer & Smith, 2003; Henry & Jarne, 2007). Henry & Jarne (2007) reviewed studies on gastropods and concluded that mark-recapture had been used 10 times more in terrestrial vertebrates than in gastropods. In freshwater mussels this

situation is not so different (Villella *et al.*, 2004).

Most studies of gastropods have been short-term and marked each individual with paint (Giokas & Mylonas, 2003; Foltan & Konvicka, 2007; Takada, 2008; Michel-Morfin *et al.*, 2009). However, long-term research requires a more resistant label (Henry & Jarne, 2007). Usually, such long-term studies of gastropods employ colored plastic marks, which have also been used for queen honeybees (Henry & Jarne, 2007), fluorescent markers (Chatzinikolaou & Richardson, 2008), numbered Floy laminated disk tags (Catchpole *et al.*, 2001), a code written on the shell and covered with cyanoacrylate adhesive (Riascos & Guzman, 2010), drilled holes on the shell (Chatzinikolaou & Richardson, 2008; Kleewein, 1999), photographs of the mantle surface to identify each individual by color patterns (Luüttmann *et al.*, 2006; Kawai, 2008), elastomers injected beneath transparent tissue (Wallin & Latty, 2008) or plastic circles affixed to the shell (Chlyeh *et al.*, 2003; Bloch & Willig, 2008; Peel & Aranda, 2012). There are some long term studies of bivalves and the most common marking method, though expensive, is the use of passive integrated transponder (PIT) tags (Villella *et al.*, 2004; Kurth *et al.*, 2007; Wilson *et al.*, 2011), although other methods have also been used, including numbered tags (Hart *et al.*, 2001; Haag & Commens-Carson, 2008; Haag, 2009) and colour-coded ink dots placed on each valve (Peterson *et al.*, 1994). In Brasil few mark-recapture studies have been undertaken and all were short-term. For gastropods, individuals have been marked with drilled holes on the shell (Coelho *et al.*, 1986) and bee tags attached to the shell (Miglioli, 2000). Only one mark-recapture study of bivalves appears to have been done in Brasil, on the mussel *Diplodon* sp. (Oliveira *et al.*, 2009).

We initiated a research project in 2009 with the objective of evaluating some biological aspects of the marine snail *Tegula viridula* (Gmelin, 1791) from Fleixeiras beach, Itacuracá island, Sepetiba Bay, state of Rio de Janeiro, Brasil (22°56' S, 43°53' W). At first, only the indirect method (modal progression analysis based on monthly length-frequency data) was used to analyse population biology. Subsequently, we decided to mark the individuals in order to obtain direct data for comparison with the indirect data.

The first method used to mark the snails was numbering the shell with aeromodelling paint. However, this method did not work as expected and no marked individuals were recaptured. According to Henry & Jarne (2007), the painting method is not suitable for long-term studies but is very useful in short-term studies.

We then tried to mark the shells with vinyl numbering made with a labelling device (Fig. 1A). Before marking, shells were dried and gently brushed using towels. These numbers were attached with a 5-minute epoxy glue to the outer surface of the last whorl, opposite to the aperture (Fig. 1B).

In total, 765 individuals were tagged and 407 were recaptured, some of them more than once. The individual that was caught over the longest period was marked in July 2010 and recaptured six times, the last time in December 2011. The highest number of recaptures of an individual snail was eight times, although in a shorter period. The population size did not

change from one year to another. The results indicate that the method did not affect the snails' life history or population dynamics.

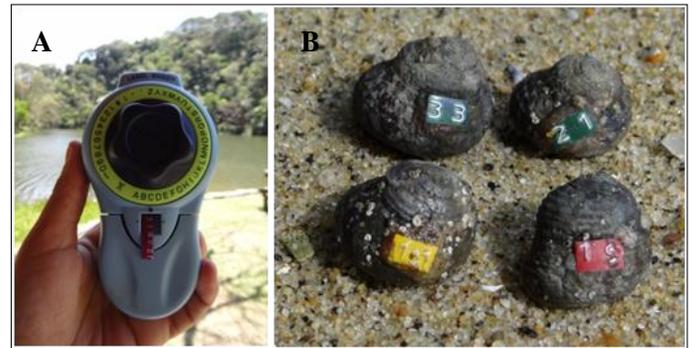


Fig. 1. A - labeler used to create vinyl tags. B - individuals of the marine snail *Tegula viridula* collected at Fleixeiras beach and marked with the tags.

With the success achieved in marking and recapturing this marine gastropod, we decided to test the methodology on freshwater Unionoida mussels. We initiated a study with a population of *Diplodon* sp. in a small lake in the municipality of Piraí, state of Rio de Janeiro, Brasil (22°39' S, 43°50' W). The study started in October 2012 and is planned to continue until June 2014. The only difference from the methodology used for *T. viridula* is that the tag is attached on the posterior region of the left valve (Fig. 2). In the first three months of the study we marked 979 individuals and recaptured 202, some of them more than once. This *Diplodon* population is an exception in terms of its large size; other population in the state of Rio de Janeiro are smaller (Miyahira *et al.*, 2012). This large population is good news for the conservation of the genus and could be used as a model for the study of mussel population biology.



Fig. 2. A tagged individual of the freshwater mussel *Diplodon* sp. collected in Piraí, Rio de Janeiro, Brasil.

The study of population dynamics of freshwater bivalves can be an important tool for monitoring endangered species. Unionoid mussels are some of the most imperiled animals in the world (Ricciardi & Rasmussen, 1999), with 26 species listed in the Brazilian Red Book of Endangered Fauna (Machado *et al.*, 2008). Several mussel populations have not been found again because of modification of the habitat and the introduction of alien species (Miyahira *et al.*, 2012; Mansur *et al.*, 2012). Attempts to address the cause of these

declines are often limited by insufficient knowledge of the biology and ecology of mussel populations (Villemela *et al.*, 2004). For example, it is necessary to have information about life expectancy, population dynamics, mortality, etc., which for most of our species is lacking.

Using this mark recapture methodology we achieved success and were able to monitor the population of *Tegula viridula* for two years (May 2010 to May 2012) and begin monitoring a population of *Diplodon* sp.

Long-term studies of marked animals can be important for answering many fundamental questions related to population dynamics and for conservation of these species.

The choice of tagging method will depend on shell thickness, habit characteristics and ease of implementation in the field (Kurth *et al.*, 2007). In some studies, funding is limited. Here we have described a cheap, easy and reliable method for marking snails and mussels from marine and freshwater environments for long term studies as an alternative to other expensive or non-persistent methods.

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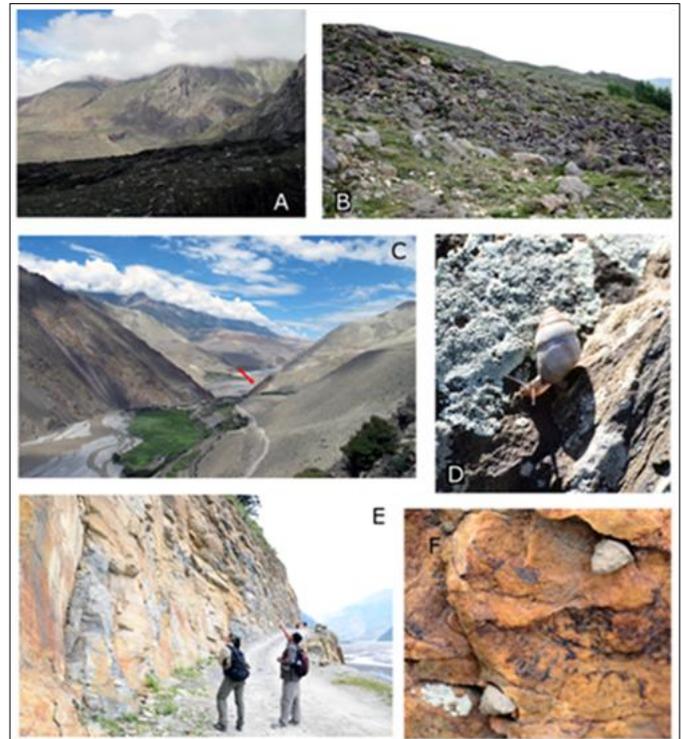


Fig. 1. A, B, D: Muktinath. A, meadow with scattered limestone rocks, 3800 m asl, where no *Pupinidius* were found; B, piles of fragmented rocks, one of the best habitats for *Pupinidius siniayevi*; C, midway from Muktinath to Jomson - the arrowed darker patch indicates the sandy stone outcrop where we found the only *Pupinidius* population in this area; D, habitat of *P. siniayevi*; E, midway from Kalapani to Tukuche, the rocky wall with numerous *P. siniayevi* individuals; F, two juveniles of *P. siniayevi* with shells coated with smooth earth crust.

PUPINIDIUS ON THE SOUTH SLOPE OF THE HIMALAYAS, NEPAL

By Qin Xu, Prem B. Budha & Min Wu

The enid genus *Pupinidius* Moellendorff, 1901 has a wide distribution across the Himalayas (southwest Himalayas: Kuznetsov & Schileyko, 1997, 1999; northeast Himalayas: reviewed by Wu & Zheng, 2009). The three *Pupinidius* species of the region constitute a geographically discrete group distinct from the rest of the genus. Their distribution pattern prompts the question of how they are differentiated both morphologically and genetically, and this motivated our field work in Annapurna National Park, Mustang district, Mid-Himalayas of western Nepal. We trekked from Beni, 880 m elevation and warm and humid, partly along the classical ABC trekking route, via Tatopani, Ghasa, Tukuche, Jomsom and Kagbeni, mostly cold and dry, to our final destination, Muktinath, 3800 m elevation and chilly and wet (Fig. 1). The landscape from Beni to Tatopani is characterized by slates and dense vegetation, with much rain in late August, and in this area we found land snails in the families Ariophantidae (all arboreal), Corillidae (in grass and shrubs, rock crevices) and Cyclophoridae (in grass and shrubs). In the area to the north, from Tatopani to Kalapani, only one ariophantid species was found.

Near Tukuche, the environment changed completely, becoming much more arid and dominated by reddish yellow sandy stone/slate. What most excited us here was finding typical specimens of *Pupinidius siniayevi* Kuznetsov and Schileyko, 1999 and a very few specimens of *Laevozebrinus cf. nepalensis* Schileyko & Frank, 1994. In this region, the animals lived on the rocky wall, usually up to 30 m above the road aggregating in high density. Interestingly, we observed two forms of the earth crust stuck to their shells by juvenile *P. siniayevi*, one smooth, the other with regularly arranged granules; such coatings were absent in the adults. In this season the animals, as observed on the west bank of Kali-Gandaki river, were aestivating attached to the rocky walls. The environment became even more arid, perhaps because of the constant wind throughout the valley of Kali-Gandaki from Tukuche to Jomsom. The bare rocks of reddish sandy stone and the connected darker slate, in some cases dead trees, constituted another appropriate habitat for *P. siniayevi* as evidenced by their relative abundance. In contrast to the habitat high above the road that we saw in Tukuche, in this region the *Pupinidius* snails lived quite low on the cliff.

Near the Muktinath Hindu temple (3267 m, 28°49'41"N 83°48'28"E), large fragments of slate and limestone are mixed, piled up in heaps making numerous variously dimensioned crevices, and the vegetation is composed of high mountain herbaceous and woody plants, including dwarf *Rhododendron*

spp., the final blooming of which indicated the end of summer. This particular structure provided a good environment for *P. siniayevi* and other landsnail species, i.e. *Pyramidula* sp. The environment changed little as the altitude increased. The limestone outcrops are well exposed on the upper grassland (3854 m, 28°49'02"N 83°52'28"E) on which small pieces of limestone rocks are scattered. The snail species here are not surprisingly minute, and included *Macrochlamys* sp. and *Vallonia* sp. found in the upper surface of the thin humus layer, and pupillids and pyramidulids that were always found on the undersides of the rocks scattered in the meadow.

With the exception of several tributaries of the Kali-Gandaki river, this trek covered most of the localities indicated in the map that summarizes the three collecting trips conducted by A. G. Kuznetsov and V. V. Siniayev (Kuznetsov & Schileyko, 1999: Fig. 3). As a result of this field work, we found that the Nepalese *Pupinidius* species have a more northern distribution and the northernmost known population, i.e. the *P. siniayevi* in Muktinath, prefers the lower habitat of fragmented rocks to higher limestone outcrops.

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LAND AND FRESHWATER MOLLUSCS IN TWO WET ZONE FOREST RESERVES, SRI LANKA

By *Santhushya Hewapathirana*

Udawattha Kele Sanctuary and Gannoruwa Forest Reserve are located in Kandy, Sri Lanka (Figs. 1, 2). Gannoruwa forest is a remnant primary forest patch of about 267 ha with an elevation of 500-580 m above sea level. Udawattha Kele forest is the only man made urban forest in Sri Lanka, (Illangasinghe *et al.*, 1999) with an extent of 257 ha and elevation of 500 m above sea level. Both forests possess semi-evergreen type vegetation (Illangasinghe *et al.*, 1999). The mollusc fauna of these two forests has not previously been studied. The present study was carried out to inventory the species and to strengthen conservation strategies. From August to November 2012, I surveyed the arboreal, litter dwelling and freshwater molluscs that inhabit both forests. Surveys were done during the day from 8 am to 10 am. In Gannoruwa forest only the natural forest was surveyed. Adjacent mahogany plantation was neglected.

Molluscs were categorized in each of the forests as commonly

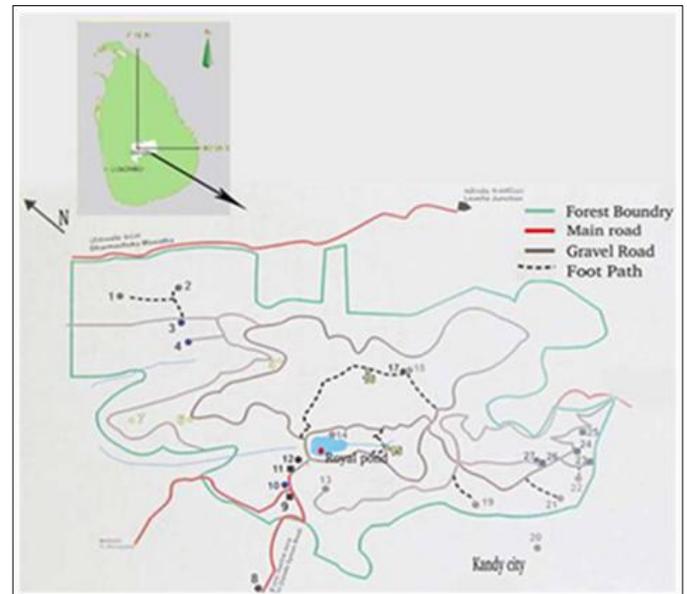


Fig. 1. Map of Udawattha Kele forest.

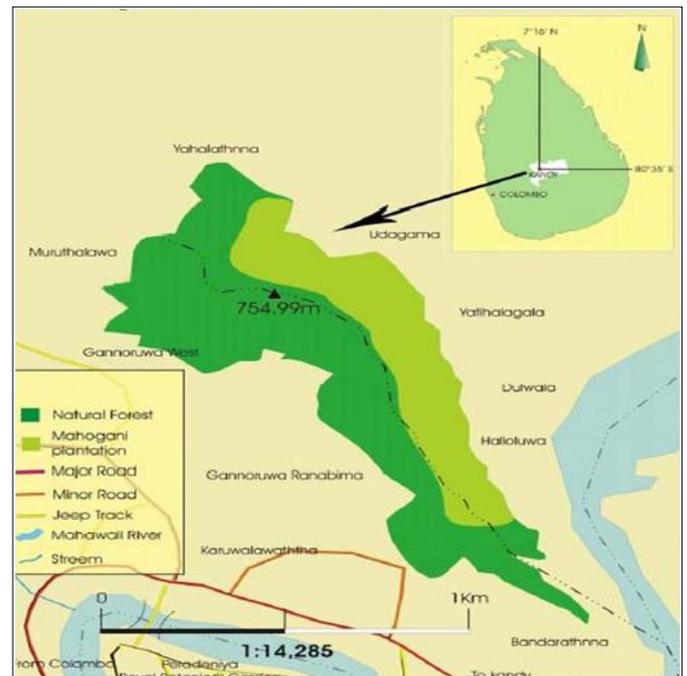


Fig.2. Map of Gannoruwa forest (Samarawickrama *et al.*, 2006).

encountered (C) - individuals encountered in >75% of the surveys, infrequently encountered (I) - individuals encountered in 10-74% of the surveys, and rarely encountered (R) - individuals encountered in <10% of the surveys.

A checklist of molluscs was prepared for each forest at the end of the survey along with their habitat type, endemism, IUCN status, national Red List status and their status in the forest according to the categories above (Tables 1, 2). Twelve species (including subspecies) of land snails and two freshwater species were recorded in Udawattha Kele forest reserve, 71% of them endemic to Sri Lanka. Of these species four are operculates, nine are pulmonates and one is a freshwater mussel. The two freshwater species were in the 'Royal pond', a natural pool in the middle of the forest. Ten

Table 1. Checklist of molluscs reported from Udawattha Kele forest. *Endemic to Sri Lanka. ^{IN}Introduced

Species	Habitat	IUCN Sri Lanka Red List (2007) status	National Red List (2012) status	Status in Udawatthakele
Acavidae				
<i>Acavus phoenix phoenix</i> *	arboreal	-	NT	I
<i>Acavus phoenix castaneus</i> *	arboreal	-	NT	C
<i>Acavus superbus grevillei</i> *	arboreal	DD	VU	I
Ariophantidae				
<i>Cryptozonia bistrialis</i>	litter	-	LC	C
<i>Ratnadvipia irradians</i> *	arboreal	-	VU	I
<i>Macrochlamys kandensis</i> *	litter	DD	CR	R
Corillidae				
<i>Corilla colletti</i> *	litter	VU	VU	R
Streptaxidae				
<i>Indoartemon layardianus</i> *	litter	NT	VU	R
Cyclophoridae				
<i>Cyclophorus menkeanus</i> *	litter	NT	VU	C
<i>Aulopoma grande</i> *	litter	DD	VU	C
<i>Theobaldius cratera</i> *	litter	DD	DD	I
Achatinidae				
<i>Lissachatina fulica</i> ^{IN}	arboreal + ground	NE	NE	I
Viviparidae				
<i>Bellamya dissimilis</i>	aquatic	-	-	C
Unionidae				
<i>Lamellidens consobrinus</i>	aquatic	-	-	I

Table 2. Checklist of molluscs reported from Gannoruwa forest. *Endemic to Sri Lanka

Species	Habitat	IUCN Sri Lanka Red List (2007) status	National Red List (2012) status	Status in Gannoruwa
Ariophantidae				
<i>Cryptozonia bistrialis</i>	litter	-	LC	C
<i>Ratnadvipia irradians</i> *	arboreal	-	VU	I
Camaenidae				
<i>Beddomea albizonatus</i> *	arboreal	-	VU	I
Corillidae				
<i>Corilla colletti</i> *	litter	VU	VU	R
Cyclophoridae				
<i>Cyclophorus menkeanus</i> *	litter	NT	VU	C
<i>Aulopoma grande</i> *	litter	DD	VU	C
<i>Theobaldius cratera</i> *	litter	DD	DD	I
Endodontidae				
<i>Philalanka liratula</i> *	arboreal	DD	CR	I
Helicarionidae				
<i>Sivella galerus</i> *	litter	DD	CR	C
Pupinidae				
<i>Tortulosa haemastoma</i> *	litter	EN	EN	C

species of land snails were recorded in Gannoruwa forest, 90% of them endemic to Sri Lanka. Of these species four are operculates and six are pulmonates.

Threats to the conservation of land molluscs of Gannoruwa forest include intense human activities that have led to destruction and fragmentation of the forest ecosystem. People from the local communities illegally extract wood for fuel and house building. So, a better monitoring system is needed for conserving this forest ecosystem and its land snail fauna. And in Udawattha Kele, due to the gravel roads that have been

Fig. 3. Left, *Acavus phoenix castaneus*; right, *Cyclophorus menkeanus*.Fig. 4. Left, *Aulopoma grande*; right, *Ratnadvipia irradians*.Fig. 5. Left, *Corilla colletti*; right, *Sivella galerus*.Fig. 6. Left, *Beddomea albizonatus*; right, *Tortulosa haemastoma*.Fig. 7. Left, *Bellamya dissimilis*; right, *Lamellidens consobrinus*.

built within the forest for the use of people who visits the sanctuary, most of the land snail populations are isolated and fragmented and population size has been reduced. Also the non-native snail *Lissachatina fulica* has invaded the forest ecosystem, in an area where there are some anthropogenic habitats within the forest (Senanayake Hermitage and German Temple, numbers 3 and 4 on the map, Fig. 1). More surveys of the molluscs are needed in the mahogany plantation area of Gannoruwa forest, since this survey was done only within the natural forest. Furthermore, increasing the awareness of local

communities, including school children, about the importance of these two forest ecosystems and their faunas is needed in order to promote their conservation.

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CONSERVATION ASSESSMENT OF FRESHWATER BIVALVES IN NORTHERN VIETNAM, 2012

By A.E. Bogan & V.T. Do

Recently, the International Union for the Conservation of Nature (IUCN) has assessed the conservation status of aquatic organisms in the Indo-Burma (eastern Myanmar, Cambodia, Laos, Thailand and Vietnam) area including freshwater molluscs (Allen *et al.*, 2012). We participated with six colleagues in developing an up-to-date faunal list and evaluating the conservation status of known freshwater molluscs of the Indo-Burma area (Köhler *et al.*, 2012). This project listed 325 species in 20 families of gastropods and 116 species in 10 families of freshwater bivalves. Köhler *et al.* (2012) listed a total of 430 freshwater molluscan taxa and assessed 8 as Critically Endangered, 12 as Endangered and 28 as Vulnerable.

A two-week field trip in 12 northern provinces of Vietnam was conducted to assess the status and distribution of the freshwater bivalve species. Freshwater shrimp, crabs and molluscs were sampled at 60 stations. Numerous local markets were visited to check freshwater molluscs and crustaceans being sold. Local farmers, fishermen and market vendors were all interviewed regarding the local occurrence of freshwater bivalves, where animals for sale in the market were collected, how abundant they are and the last time they had seen any live bivalves in the local area. Local people were interviewed and shown examples of different shaped freshwater bivalve shells, including specimens of *Corbicula* spp.

We were particularly concerned about the status and continued survival of six species of *Lamprotula* in the Bang River Basin and tributaries of Li Chiang in northeastern Vietnam and China. Six species of *Lamprotula* (*L. crassa* (Wood, 1815), *L. blaisei* (Dautzenberg & Fischer, 1905), *L. contritus* (Heude, 1881), *L. liedtkei* (Rolle, 1904), *L. nodulosa* (Wood, 1815), *L. ponderosa* (Dautzenberg & Fischer, 1905)) and *Cuneopsis demangei* Haas, 1929 have not been seen in the past several decades. No shells or live specimens of these taxa were collected during our fieldwork, strongly suggesting that these taxa are extirpated from their former range in Vietnam. *Lamprotula leai* (Gray, 1834) was collected from three sites and a few markets. Dry shells of *Lamprotula quadrangulosa*

(Heude, 1881) (taxonomic status uncertain) were collected from two sites. Dead shells of *Protunio messengeri* (Bavay & Dautzenberg, 1901) were collected from two rivers, but no live specimens were seen. *Protunio messengeri* has not been reported in many years.

Recently, *Margaritifera laosensis* (Lea, 1863) has been collected alive from five sites in northern Laos in the Mekong River basin (M. Kottelat, pers. comm; Lorraine Scotson, IUCN, pers. comm.; Artamonova *et al.*, 2012). Historically it was collected from the area around Dien Bien Phu, Dien Bien Province (University of Michigan Museum of Zoology Mollusc Collection) and northern Vietnam (Muséum d'Histoire Naturelle, Geneva). No shells or live specimens were seen or collected during this field trip. Several rivers in Dien Bien and Son La provinces were visited as well as local markets, but no one had seen this species.

The Biochemistry Department of Tay Bac University in Son La, Son La Province, was visited and all of the freshwater molluscs and crustaceans in their limited collection were examined. The biology professor and two instructors agreed to ask their biology students from western and northern Vietnam to look for shells around their homes when they go home for the New Year break. Any shells collected would be identified by Do Van Tu.

We were told by vendors in the local markets that freshwater clam species were selected for market depending on their taste. *Sinanodonta* spp. and *Nodularia* spp. can be regularly sold, but *Lanceolaria* spp., *Scabies* spp., *Lamprotula* spp. and *Hyriopsis cumingii* (Lea, 1852) are considered bitter and not good to eat. This affects the species that may show up in markets. Another factor influencing the use of market surveys to assess the local molluscan fauna is that mussels and gastropods found in northern provinces were shipped in from southern provinces (Yen Bai, Vinh Phuc, Phu Tho, Nam Dinh) as far south as Ha Noi (over 100 km). Just because it shows up in the local market does not necessarily mean it was locally collected. The vendors need to be asked where their animals were collected and if they are of local origin.

Many impacts on the freshwater environment were visible during this trip including deforestation, road construction, in-stream sand and gravel mining, harvesting for food, domestic pollution and construction of various dams and hydroelectric projects (Figs. 1-3). Streams have been locally modified by restriction of channels, diversion of water for rice fields and flood plains that have been terraced for rice production. Most of the large trees have been cut from the mountains, having an effect on the rain runoff patterns. All of these modifications are impacting freshwater mussels and gastropods. A few species are doing well in disturbed habitats and show up in the markets, including *Sinanodonta* spp., *Cristaria plicata* (Leach, 1815) and *Nodularia* spp.

In addition to established national parks and conservation areas, beginning in 2008 and extending to 2020, Vietnam will establish 45 areas for protection of inland water bodies. Some parts of the Hong and Da rivers (in the north of Vietnam) will be included in protected areas. However, conservation activities for freshwater bivalves have never been mentioned.



Fig. 1. Open pit mining, Cao Bang Province, Vietnam. (Photo: Arthur Bogan)



Fig. 2. Road construction and disposal of debris over the edge of the road and the impact on the local river; the river is the same color as the earth being dumped. Lang Son Province, Vietnam. (Photo: Arthur Bogan)



Fig. 3. In stream gravel mining, Dien Bien Province, Vietnam. (Photo: Arthur Bogan)

Some of freshwater bivalve species already seem to have disappeared from northern Vietnam and the future for endangered freshwater bivalve species is pessimistic. New outreach materials are being developed for distribution to local people, aquaculture agencies and universities to describe the unique life cycle of freshwater mussels in the family Unionidae and to illustrate the native freshwater bivalve fauna

of northern Vietnam.

J.M. Smith, H. Fredricks and C.M. Bogan are thanked for kindly reviewing drafts of this article.

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ONE UP, ONE DOWN, ALL CHANGE: THE STATUS AND IDENTITY OF TWO CRITICALLY ENDANGERED MADEIRAN LAND SNAILS

By Robert Cameron & Dinarte Teixeira

Even the most cursory inspection of Mary Seddon's (2008) *The Landsnails of Madeira* shows the large number of Critically Endangered species in the archipelago. Some of these have not been found for over a century, and have the grim addendum 'possibly extinct'. Among these Critically Endangered species is one currently named *Discus guerinianus* (Lowe, 1852) with two described subspecies, *D. g. guerinianus* from Madeira itself, and *D. g. calathoides* from Deserta Grande and Bugio. Both were recorded alive in the 19th century, although Wollaston (1878) had not seen anything other than subfossil shells of the latter, and Seddon listed it as possibly extinct, as various later visits to the Desertas had failed to find it.

Until recently neither form had been found alive for many years. Cameron & Cook (1999) claimed to have rediscovered *D. g. guerinianus* at two sites at the west end of Madeira. A closer inspection, prompted by new surveys of endangered species, has shown that this was a misidentification (the identity of these juvenile shells remains unknown). A search of all recent records has failed to turn up any of living *D. g. guerinianus* and efforts to find it at recorded locations have failed. It must be regarded as possibly extinct.

By contrast there is good news about *D. g. calathoides*. As a part of the Natural Park of Madeira, the Deserta Islands are



Fig. 1. Live *Discus guerinianus calathoides* from Deserta Grande. The shell is c. 6 mm in diameter. (Photo: R. Cameron)

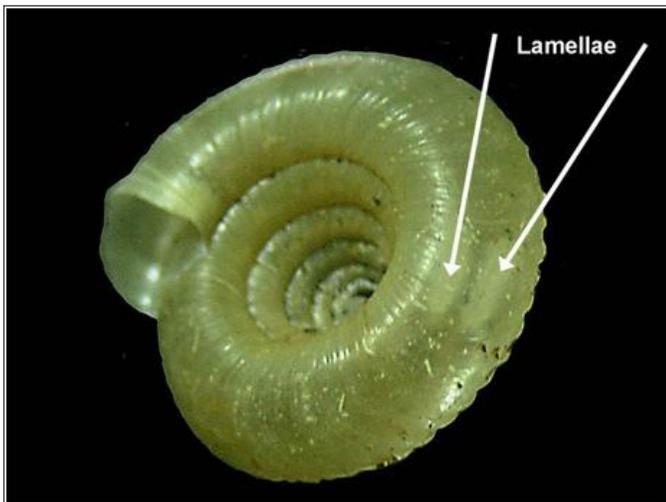


Fig. 2. The internal lamellae of *Discus guerinianus calathoides*, visible from outside the shell. (Photo: R. Cameron)

patrolled regularly by reserve wardens, and one of them, Isamberto Silva, has become a very good field malacologist. In addition to discovering new deposits containing subfossil shells, he has discovered living populations of *D. g. calathoides* living among the rocks of near-inaccessible cliffs on Deserta Grande. He obtained living specimens for us during a visit to the Desertas in April 2012 (Fig. 1). Unlike *D. g. guerinianus*, which has the darker radial stripes found in the common European *Discus rotundatus*, the shell is colourless. It is easy to see why Wollaston was doubtful about the status of the shells he had seen.

Subfossil faunas from the Desertas, including *D. g. calathoides*, are much richer than the currently known living fauna, though more discoveries of living species are being made. Habitat destruction (by goats, rabbits and mice) has undoubtedly contributed to this impoverishment, but now that rabbits are eliminated and goats severely reduced in numbers, species surviving in small, undiscovered patches are beginning to spread. Restricted access to the islands and the elimination of these mammalian pests should safeguard the species.

The story does not end there. Until now, there has been no anatomical material available for study. Work in progress shows that this species is not *Discus* at all (family Discidae),

but a gastrodontid related to another Macaronesian genus, *Janulus*. A taxonomic revision is in progress, but the key conchological feature is the presence of internal palatal lamellae (Fig. 2), present in both the Desertan and Madeiran forms. *Janulus* is a relict genus now confined to Madeira and the Canary Islands, but more widespread in the Tertiary. *D. guerinianus* is part of this ancient radiation, and not a recent development from European *Discus*.

Thanks are due especially to Isamberto Silva, whose discoveries on the Desertas have prompted a major revision of their snail fauna, with more good news to come, and to Miguel Ibáñez for the first dissection of the species.

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IMPORTANCE OF BIOLOGICAL COLLECTIONS IN THE STUDY OF NAIAD POPULATIONS (MOLLUSCA: BIVALVIA: HYRIIDAE) IN ARGENTINA

By Santiago Torres & Gustavo Darrigran

Freshwater mussels (naiads) in the families Hyriidae and Etheriidae are infaunal species occurring in the Neotropical region. Habitat alteration and competition with the invasive species *Corbicula fluminea* and *Limnoperna fortunei* (Darrigran *et al.*, 1998; Clavijo, 2009) impact their natural populations (Fig. 1).

Globally the rate of extinction of freshwater bivalves is very high, and greater than in other groups, notably vertebrates. The IUCN Red List (Baillie *et al.*, 2004) shows that of the 306 bivalve species assessed, 41% are seriously threatened. Given that they are considered one of the most endangered groups at risk of extinction, distributional and systematics studies are important in their conservation as they allow recognition of potential priority areas for protection (Bogan & Roe, 2008). This communication presents the start of a research project on the geographical distribution of *Diplodon* spp. that uses information in the malacological database of the Museo de La Plata (Argentina).

The genus *Diplodon* (Fig. 2) belongs to the family Hyriidae and is endemic to the Neotropical region. It is found in the Guayano-Brasilian sub-region, extending in Argentina to the



Fig. 1. Impact of *L. fortunei* on native species (fouling).



Fig. 2. *Diplodon*. Top: internal view; bottom: external view. Scale bars: 1 cm.



Fig. 3 Distribution of the Hyriidae in Argentina (modified from Rumi *et al.*, 2008)

subtropical domain through the Parana-Plata system, as well as in the northwest of the country and towards the Pampas domain (Castellanos & Landoni, 1990) (Fig. 3).

This genus is represented in Argentina by 17 species, of which 10 are located in the Plata basin (Rumi *et al.*, 2008). These species are an important component of the infauna of lotic and lentic water bodies, living in muddy bottoms, sandy loam and, unusually, on hard substrates. They are filter feeders, with an important role as recyclers of organic matter. Knowledge of

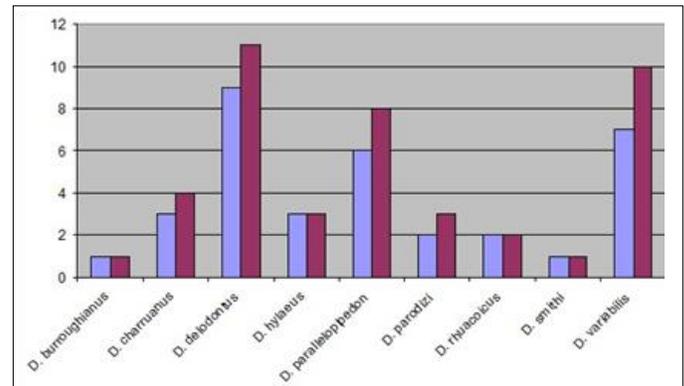


Fig. 4. Number of locations (left hand bars) and sites (right hand bars) at which species of *Diplodon* are recorded in the Museo de La Plata database (modified from Torres *et al.*, 2012).

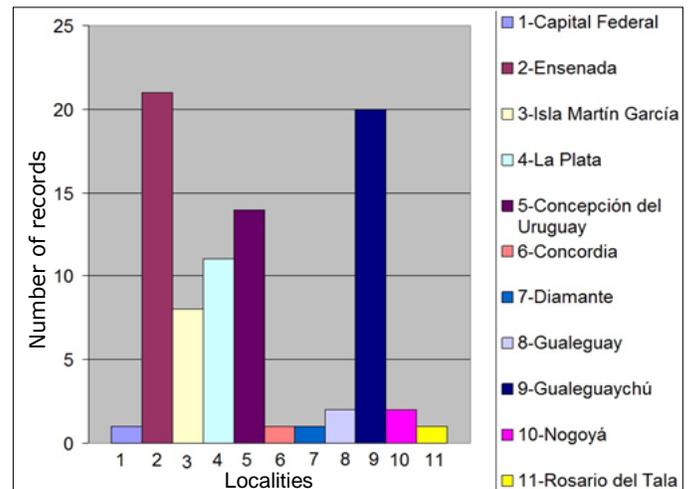


Fig. 5. Total number of records from each locality represented in the Museo de La Plata database (modified from Torres *et al.*, 2012).

the distribution of *Diplodon* spp. in Argentina enables the recognition of potential priority areas for conservation (Torres *et al.*, 2012). Based on the available literature and on specimens of *Diplodon* in the Malacological Collection of the Museo de La Plata (FCNyM-UNLP), a data matrix was built that includes the specimen identification, the collection where it is deposited, catalog number, locality and date of collection. Each locality was identified by using maps of Argentina and literature reviews, mapping the coordinates for each point using Google Earth satellite imagery. The results permitted the distribution of the native species and the degree of overlap with the two species of bivalve invaders to be determined (Figs. 4, 5, Table 1).

The analysis of malacological database collections deposited in museums, as here in the Museum of La Plata, and the use of new technological tools (Google Earth, GPS, GIS) is an important step in the investigation of the geographical and temporal distribution of native freshwater bivalve species, allowing work with historical records so we can assist in defining priority areas for conservation.

This note is the start of a taxonomic study of the naiads in southern South America, taking as the subject of study in the first instance, the species *Diplodon chilensis*, endemic to the mountainous region of west and central Patagonia.

Table 1. Records of *Corbicula fluminea* from the MLP collection (from Torres *et al.*, 2012).

Number of records	Localities
1	Alvear, Arroyo Brazo Chico, Arroyo Tabai, Bella Vista, Centenario, Chajarí, Chimpay, Colón, Concepción del Uruguay, Confluencia, Dto. Candelaria, Dta. San Ignacio, Federación, Guaaleguaychú, Iberá, La Cruz, La Cumbre, La Plata, Mocoretá, Paraje Absente, Pichimaida, Rio Colorado, San Isidro, San Nicolas, Selva del Rí Oro, Tapes, Viedma
2	Concordia, Ituzaingo, Monte Caseros, Paso de los Libres, San Ignacio, Yapeyú
3	Paso de la Patria
4	Ensendada
5	Isla Martín García
6	Olivos
7	Magdalena

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EXTRAORDINARY ENDEMIC SPRINGSNAIL RADIATION: JUSTIFICATION FOR EXPANDING THE CASCADE-SISKIYOU NATIONAL MONUMENT, SOUTHWEST OREGON

By Edward J. Johannes

On 9 June 2000, President Clinton (Clinton, 2000) designated the 221 km² (additional 130 km² in state and private land inholdings) Cascade-Siskiyou National Monument (CSNM). This was the first U.S. National Monument set aside solely for biodiversity preservation, finally realizing a much broader scope of protection under the 1906 Antiquities Act. The CSNM is southeast of Ashland on the south end of the Cascade Range abutting the Siskiyou Mountains (Fig. 1). The

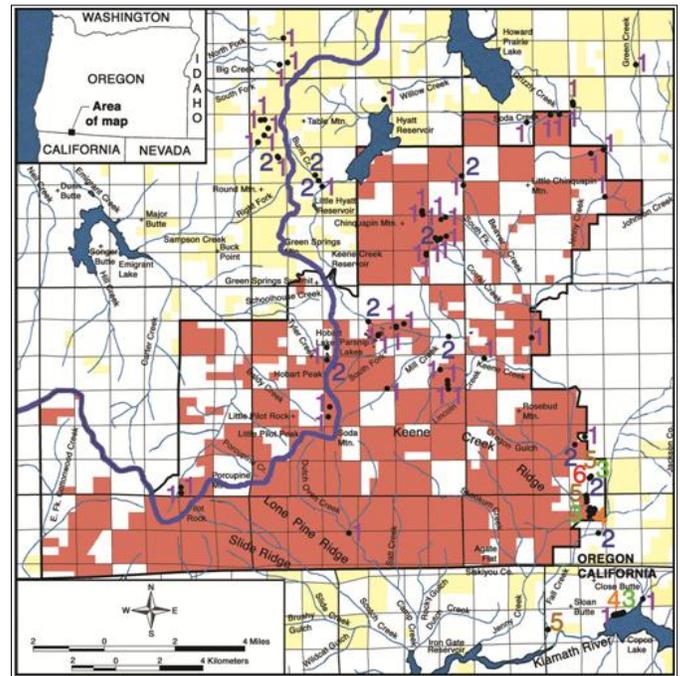


Fig. 1. Current CSNM configuration with a checkerboard pattern of federal (red) and private (white) ownership. Medford District BLM land outside the Monument is in yellow. Black dots are *Fluminicola* sites in CSNM and the number of species present in the vicinity is indicated by a colored number. The thick blue line is the divide between the Klamath and Rogue river drainages.

area has one of the highest diversities of butterflies in the U.S., high diversity of springsnails and a significant diversity of plants, native fish, small mammals, reptiles and amphibians. The CSNM straddles the Rogue and Klamath river basins; most of the Monument is in the latter. It is in the Klamath Molluscan Province (Frest & Johannes, 2005) where three ecoregions coalesce (Cascade, Siskiyou, Klamath). The CSNM contains the Soda Mountain Wilderness (erected in 2009) and most of the Cascade Siskiyou Ecological Emphasis Area (established under the Northwest Forest Plan in 1994). The Medford District of the Bureau of Land Management (BLM) manages the patchwork of federal land within the CSNM.

In total, 129 sites on federal land and 24 on state and private land in the CSNM were surveyed for molluscs between 1991 and 2004 (Frest & Johannes, 2005; Fig. 1). Of the sites on federal land 81 lacked molluscs or only had molluscs other than *Fluminicola*; 48 (springs and creeks) had *Fluminicola*; 101 are cold springs, and 41 of these (41%) had *Fluminicola*. This proportion of springs with springsnails is high compared to adjacent basins such as the Upper Klamath Lake (26%), Interior Oregon (10%) and similar to the Upper Sacramento River drainage (40%). In the western U.S. springs are important reservoirs of mollusc diversity (Frest & Johannes, 1995, 1998, 2005; Hershler, 1999; Hershler *et al.*, 2003, 2007) and the Monument has a large number and higher density of springs than the surrounding region. Five bivalve and 25 gastropod species have been found in the CSNM (Table 1). Three *Juga* spp. (1 endemic to CSNM) and at least 14 *Fluminicola* springsnail species (3 endemic to CSNM) are

Table 1. Cascade-Siskiyou National Monument mollusc fauna.

Scientific Name	Common Name
Gastropods	
<i>Fluminicola</i> n. sp. 10 ^{1, 4, 5, 6, 7}	nerite pebblesnail
<i>Fluminicola</i> n. sp. 11 ^{5, 6, 7}	toothed pebblesnail
<i>Fluminicola</i> n. sp. 12 ^{1, 5, 6, 7}	diminutive pebblesnail
<i>Fluminicola</i> n. sp. 13 ^{4, 5, 7}	topaz pebblesnail
<i>Fluminicola</i> n. sp. 14 ^{4, 5, 6}	Fall Creek pebblesnail
<i>Fluminicola</i> n. sp. 15 ^{4, 5}	contrary pebblesnail
<i>Fluminicola</i> n. sp. 16	Keene Creek pebblesnail
<i>Fluminicola</i> n. sp. 17 ²	Fredenburg pebblesnail
<i>Fluminicola</i> n. sp. 17?	-
<i>Fluminicola</i> n. sp. 39 ³	Chinquapin pebblesnail
<i>Fluminicola</i> n. sp. 40 ³	Pilot Knob pebblesnail
<i>Fluminicola</i> n. sp. 43 ^{4, 5, 7}	Shoat Spring pebblesnail
<i>Fluminicola</i> n. sp. 44 ^{3, 5}	subglobose pebblesnail
<i>Fluminicola</i> n. sp. 45 ^{4, 5}	picayune pebblesnail
<i>Fossaria</i> (<i>B.</i>) <i>bulimoides</i>	prairie fossaria
<i>Fossaria</i> (<i>F.</i>) <i>parva</i>	pygmy fossaria
<i>Gyraulus</i> (<i>T.</i>) <i>parvus</i>	ash gyro
<i>Juga</i> (<i>C.</i>) n. sp. 5 ^{5, 6, 7, 8}	Fall Creek juga
<i>Juga</i> (<i>J.</i>) <i>silicula shastaensis</i> ⁵	Shasta juga
<i>Juga</i> (<i>O.</i>) n. sp. 3 ^{3, 5, 9}	Spring Creek juga
<i>Juga</i> (<i>O.</i>) n. sp. 1 ⁴	Close Butte juga
<i>Juga</i> (<i>O.</i>) n. sp. 2 ³	Rattlesnake Spring juga
<i>Physella</i> (<i>P.</i>) <i>gyrina</i>	tadpole snail
<i>Planorbella</i> (<i>P.</i>) <i>subcrenata</i>	western rams-horn
<i>Radix auricularia</i> *	big-eared radix
Bivalves	
<i>Margaritifera falcata</i>	western pearlshell
<i>Pisidium casertanum</i>	ubiquitous peaclam
<i>Pisidium pauperculum</i>	-
<i>Pisidium insigne</i>	shiny peaclam
<i>Sphaerium patella</i>	Rocky Mountain fingernailclam
¹ listing proposed under ESA (Curry <i>et al.</i> , 2008; Johannes, 2012; USFWS, 2011, 2012) ² survey and manage species (USDA & USDI, 1994; Johannes, 2012) ³ endemic to CSNM ⁴ found in Close Butte springs ⁵ found in Spring Creek ⁶ found in Schoolhouse Meadow springs and spring runs ⁷ found in lower Fall Creek ⁸ formerly <i>Juga</i> (<i>C.</i>) <i>acutifilosa</i> (Campbell <i>et al.</i> , in prep.) ⁹ formerly <i>Juga</i> (<i>O.</i>) <i>'nigrina'</i> (Campbell <i>et al.</i> , in prep.) *introduced species	

endemic to portions of drainages both in and just outside the Monument, with most occurring at 10 or fewer sites (Frest & Johannes, 2005). The CSNM covers only 1-2% of the areas of the nearby Upper Sacramento River drainage and adjacent Upper Klamath Lake basin, but has a mollusc diversity that is 38% and 43% of those areas, respectively (Table 2).

Significantly, 9 of the 14 species of CSNM *Fluminicola* (64%) are found only in a 2 km² area in the southeast corner of the Monument, in Spring Creek (including Shoat Spring) and Schoolhouse Meadow springs and runs (Tables 1, 2; Figs. 1, 2). Endemism and sympatry (up to 6 species in a single site) are high here, and there are several species with atypical shell morphologies for the genus (e.g. collumellar node; Fig. 3). Since the CSNM formation, additional surveys revealed that this *Fluminicola* radiation extends outside the southeast corner of the Monument into lower Fall Creek and springs on the south side of Close Butte (Frest & Johannes, 2005; Figs. 1-3).

Fluminicola species fall into two groups, one generally with shells 2-6 mm high (smaller group) and the other with shells often 6-12 mm high (larger group). The CSNM springsnails belong to the former group. There are 10 described (Hershler & Frest, 1996; Hershler & Lui, 2012) and probably around 5 undescribed species in the larger group and 19 described

Table 2. Comparison of Cascade-Siskiyou National Monument with significant springsnail diversity areas.

Land unit or basin (area)	Total diversity (highest sympatry)	Number of endemic gastropods	Number of springsnail species (area / springsnail diversity)
CSNM, Oregon (221 km ²)	24 snails ^{1, 4} 5 clams ⁴ 29 total (6) ⁴	3 <i>Fluminicola</i> ⁴ 1 <i>Juga</i> ⁴ 4 total	14 <i>Fluminicola</i> ⁴ (16 km ² /sp.)
Fall/Spring creeks & Close Butte springs, California & Oregon (39 km ²)	16 snails ^{1, 4} 3 clams ⁴ 19 total (6) ⁴	7 <i>Fluminicola</i> ⁴ 1 <i>Juga</i> ⁴ 8 total	9 <i>Fluminicola</i> ⁴ (4 km ² /sp.)
Upper Sacramento Basin, California & Oregon (19,830 km ²)	57 snails ^{1, 2, 6, 7} 20 clams ² 77 total (1) ^{2, 6, 7}	13 <i>Fluminicola</i> ⁷ 1 <i>Colligyrus</i> ⁶ 4 <i>Pyrgulopsis</i> ⁶ 9 <i>Juga</i> ¹ 27 total	13 <i>Fluminicola</i> ⁷ (1525 km ² /sp.) 1 <i>Colligyrus</i> ⁶ 6 <i>Pyrgulopsis</i> ⁶ (all 992 km ² /sp.)
Upper Klamath Lake Basin, Oregon (14,763 km ²)	49 snails ³ 19 clams ³ 68 total (2) ³	11 <i>Fluminicola</i> ³ 3 <i>Colligyrus</i> ³ 2 <i>Pyrgulopsis</i> ³ 16 total	11 <i>Fluminicola</i> ³ (1342 km ² /sp.) 3 <i>Colligyrus</i> ³ 3 <i>Pyrgulopsis</i> ³ (all 868 km ² /sp.)
Cuatro Cienegas Basin, Mexico (12,000 km ²)	13 snails ⁵ (5) ⁵	9 (5 endemic genera) ⁵	13 hydrobioid ⁵ (923 km ² /sp.)
Great Artesian Basin, Australia (1.7 million km ²)	26 snails ^{9, 10, 11} (6) ^{10, 11}	26 (3 endemic genera) ^{9, 10, 11}	26 hydrobioid ^{9, 10, 11} (74,391 km ² /sp.)
Edwards (Balcones) Fault Zone) Aquifer, Texas (11,266 km ²)	10 snails ⁸ (5) ⁸	6 (2 endemic genera) ⁸	10 hydrobioid ⁸ (1127 km ² /sp.)
¹ Campbell <i>et al.</i> (in prep.) ² Frest & Johannes (1995) ³ Frest & Johannes (1998) ⁴ Frest & Johannes (2000, 2005) ⁵ Hershler (1984) ⁶ Hershler <i>et al.</i> (2003)		⁷ Hershler <i>et al.</i> (2007) ⁸ Hershler & Longley (1986) ⁹ Perez <i>et al.</i> (2005) ¹⁰ Ponder <i>et al.</i> (1989, 1995, 1996, 2008) ¹¹ Ponder & Clark (1999)	

(Hershler & Frest, 1996; Hershler, 1999; Hershler *et al.*, 2007) and at least 50 undescribed species in the smaller group. It has been proposed that a new genus be erected for the smaller group (Hershler & Frest, 1996; Hershler & Lui, 2012). *Fluminicola* are found in streams of all sizes (usually the larger group) or in cold springs (often but not always the smaller group) and are among the most commonly encountered northwestern U.S. freshwater snails. The CSNM *Fluminicola* are commonly spring dwellers or inhabit particularly pristine creek stretches, especially if these are spring-fed or have obvious spring influence. The CSNM is on the western edge of the distribution of the smaller group of *Fluminicola* (Frest & Johannes, 2005).

The degree of local springsnail diversity, endemism and sympatry found adjacent to and in the southeast corner of the CSNM is exceptional for North America, quite unusual on a worldwide basis and may be an extreme example of sympatric speciation of springsnails (Table 2; Figs. 1, 3). Perhaps the closest similar example is Steptoe Valley, a very small internal drainage basin in Nevada, which has 5 endemic *Pyrgulopsis* species within a few km² (Hershler, 1994; Hershler & Sada, 2002), although none are sympatric. Occurrence of more than



Fig. 2. Map of the southeast corner of CSNM including Fall Creek, Spring Creek, Shoat Spring, Schoolhouse Meadow and Close Butte springs. Red shaded area is BLM land in the CSNM, gray shaded area is BLM land outside CSNM. A is Spring Creek just below Shoat Spring; B is the west spring run in Schoolhouse Meadow; C is the westernmost spring run on the south side of Close Butte. (Photos: A & B - T. Frest © Deixis Consultants; C - S. Clark © Invertebrate Identification Australasia)

one species of a springsnail genus at a site in the western U.S. is unusual, although 2-3 taxa may co-occur at a few Amargosa Valley (Nevada) springs (Hershler & Sada, 2002). A single taxon per site is the usual pattern for *Fluminicola* but 2 per site is not unusual in springs in the Upper Klamath Lake drainage and in a portion of and just west of the CSNM (Frest & Johannes, 1998, 2005; Fig. 1).

Threats to spring and creek habitats in the CSNM include cattle grazing, pump chance development (artificially created ponds fed by diverted spring flow) and road construction. Timber harvesting, expansion of current or granting of new water rights, mining and geothermal activity are restricted on federal land in the CSNM, but not in private inholdings. Shoat Spring and the Schoolhouse Meadow springs are protected from cattle grazing by enclosures or fencing but most springs in the area are not. Spring Creek is partially diverted to Schoolhouse Meadow by a concrete canal. Outside the CSNM a portion of lower Fall Creek is diverted for the city of Yreka water supply and above this by one of the oldest, continuously operated hydroelectric facilities in the Pacific Northwest. This project includes a diversion dam, canal and penstock to a powerhouse, where a 2.7 km stretch of Fall Creek is partially diverted. In addition, lower Fall Creek is impacted by water withdrawal for and effluent from the Fall Creek Fish Hatchery.

Under Presidential Proclamation 7318 (Clinton, 2000), the Secretary of the Interior through the BLM is required to

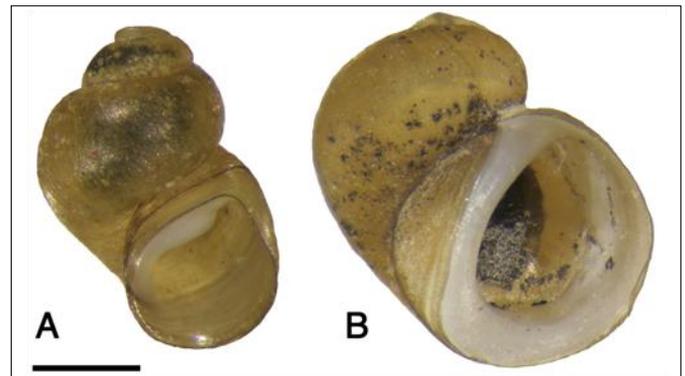


Fig. 3. Unusual shell morphology in *Fluminicola* in the southeast corner of the CSNM. A: nodose *Fluminicola* n. sp. 11 (toothed pebblesnail) from Shoat Spring, Jackson County, Oregon; B: neritiform *Fluminicola* n. sp. 10 (nerite pebblesnail) from Fall Creek, Siskiyou County, California. Scale bar = 1 mm. (Photos: E. Johannes © Deixis Consultants)

protect 'objects of biological interest', one being the 'significant center of fresh water snail diversity'. The proclamation withdrew public lands in the CSNM from a number of uses and limited commercial harvest of timber within the Monument 'except when part of an authorized science-based ecological restoration project'. Also, the proclamation directs the Secretary of the Interior to undertake a study of livestock grazing within the CSNM and to retire grazing allotments 'should grazing be found incompatible with protecting the objects of biological interest'. Of the CSNM *Fluminicola*, only the Fredenburg pebblesnail has additional protection as a Survey and Manage species under the Pacific Northwest Forest Plan (Table 1). A petition to list 32 Pacific Northwest terrestrial and freshwater gastropods (Curry *et al.*, 2008) under the Endangered Species Act (ESA) was modified by the USFWS (2011) to include only 26 but did include 2 CSNM *Fluminicola* species. Listing of 14 (all freshwater gastropods) of the 26 was recently rejected (USFWS, 2012; Johannes, 2013). Even within the CSNM, federal ownership is not complete, but this is especially the case south and southeast of the Monument (Figs. 1, 3). Despite most springs in the CSNM being on federal land, areas with the highest *Fluminicola* diversity (usually in the largest springs and most pristine creeks) in the southeast corner of the Monument and adjacent areas are in private hands (Fig. 3). As a result, the current CSNM configuration fails to uphold one of the mandates of the 1906 Antiquities Act, that the President reserve 'the smallest area compatible with the proper care and management of the objects to be protected'. The proclamation forming the CSNM states 'Lands and interests in lands within the proposed monument not owned by the United States shall be reserved as a part of the monument upon acquisition of title thereto by the United States'. Both the BLM and private organizations should consider these high diversity springsnail areas within and outside the CSNM to be a priority for purchase and President Obama should consider expanding the CSNM to include those areas outside the Monument for protection. In doing this, Obama would finally join the ranks of Presidents who have used the Antiquities Act for the good of the nation.

Thanks to Stephanie Clark (Invertebrate Identification Australasia, Chicago) for providing information and references on the Great Artesian Basin molluscs and for the photo of a Close Butte spring. I also acknowledge the efforts of Karen Bolda, Jayne LeFors, Steve Miles, Jay Doino and David Hering, former members of the Medford District BLM springsnail survey crews.

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MOLLUSCS ASSESSED BY COSEWIC IN 2012

By Dwayne A.W. Lepitzki & Gerald L. Mackie

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established in 1977. In 1994 its mandate was expanded to include some groups of invertebrates and in 1996 the first mollusc was assessed. When the federal Species at Risk Act (SARA) became law in 2003, COSEWIC was confirmed as the body that advises the Canadian government on which species to list and be legally protected under the Act. The best available scientific, aboriginal traditional and community knowledge are compiled into a COSEWIC status report that goes through various levels

of review and scrutiny. COSEWIC then meets twice each year to review the status report and assess the status of the wild species, subspecies, varieties or other important units of biological diversity considered to be at risk in Canada. Results of these assessments are communicated to the federal government and the public at the same time and within days of each meeting. As of November 2012, there were 668 wildlife species in various COSEWIC risk categories and another 15 that are extinct. So far, 31 molluscs have been assessed in Canada: 1 Extinct, 2 Extirpated, 18 Endangered, 3 Threatened, and 7 Special Concern. An additional 2 molluscs have been assessed as Not at Risk and 5 others as Data Deficient. In 2012, two molluscs were assessed, one for the first time and the other a reassessment. COSEWIC is required to review its assessments of species every ten years.

***Magnipelta mycophaga* — Magnum Mantleslug:** This large slug, up to 80 mm in length (Fig. 1), is endemic to the northern Columbia Basin in western North America. About half of the species' global range extends into southeastern British Columbia, Canada. It occurs in a number of widely separated habitat patches and is confined to cool, moist microhabitats in coniferous forests at mid to high elevations. While hundreds of sites have been searched for slugs and land snails within the range of this slug, mostly within the past decade, there were only 13 records for it in Canada as of November 2010. Since the 1960s its habitat has become increasingly fragmented. The number and variety of threats, including logging, recreational developments and activities, wildfire and changes in moisture regimes caused by climate change, increase the level of risk. Given these reasons, COSEWIC assessed this slug as Special Concern in April 2012.



Fig. 1. *Magnipelta mycophaga*, the Magnum Mantleslug observed in the Kootenay region of British Columbia. (Photo: K. Ovaska, used with permission)

***Physella winnipegensis* — Lake Winnipeg Physa:** This freshwater snail was described as being endemic to Lake Winnipeg, Manitoba, Canada and originally assessed as Endangered in 2002 by COSEWIC. Despite annual searches, the last observation of the taxon was in 2006. The taxonomic uncertainty and the lack of genetic material for further study resulted in a designation of Data Deficient in November 2012. Data Deficient is a status category that applies when the

available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.

More information on [COSEWIC](#) can be found online. Finalized status reports of COSEWIC assessed species are available on the [SARA Public Registry](#); the two most recent mollusc reports should be available after September 2013.

The Molluscs SSC of COSEWIC thanks the 2012 status report writers, Kristiina Ovaska, Lennart Sopuck and Dwayne Lepitzki, for their expertise on these species. Because Dwayne wrote the report on the Lake Winnipeg *Physa*, Gerry was the responsible co-chair for editing and steering the report through the COSEWIC process. COSEWIC was asked if Dwayne could remain in the room when the species was discussed. While Dwayne was allowed to be present and could answer questions about the species and the report at the species assessment meeting, he did not vote on the species' status.

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TERRESTRIAL GASTROPODS OF THE HORBAT QARTA NATURE RESERVE AND THEIR ROLE IN DIFFERENTIATING BETWEEN TWO TYPES OF KURKAR OUTCROPS IN ISRAEL

By Henk K. Mienis, Oz Rittner & Svetlana Vaisman

On 4 December 2012 the two senior authors undertook fieldwork to collect terrestrial gastropods on a kurkar outcrop near Atlit, Israel. Kurkar is the Hebrew name for a local aeolian calcareous sandstone. The work was restricted to a relatively small nature reserve, Horbat Qarta (= Khirbat Karta), overlooking the former salt-ponds of Atlit. On the top of this outcrop are the remains of a Crusader stronghold 'Casel Destreiz' (Fig. 1) [also spelled Dustrey and le Destroit (Nir, 1959)].

This kurkar ridge consists of two layers: the upper one a hard fine-grained sandstone, 'Kurkar-Dor', and the lower one a rather soft, coarse-grained sandstone, 'Kurkar Ramat-Gan'. The upper layer, formed 40-60k years ago, is separated from the lower layer, formed 60-100k years ago, by a layer of 'hamra', a reddish-brown soil, which is the result of erosion of the lower kurkar layer (Galili & Tirosh, 2009). Westwards near the sea and especially southwards along the coast of Israel and north of Akko only the older kind of kurkar outcrops are present.

Many of the snails encountered in the reserve were still actively crawling after the rains of the previous night, others



Fig. 1. Ruins of the Crusader stronghold 'Casel Destreiz' near Atlit. (Photo: Oz Rittner)



Fig. 2. Normal specimen of *Sphincterochila cariosa*. (Photo: Oz Rittner)

were found under large stones scattered on the slopes or near the ruins. A litter sample was also collected and screened for the presence of shells by the third author. The following 12 species were found:

- Granopupa granum* (Draparnaud, 1801)
- Truncatellina haasi* Venmans, 1957*
- Euchondrus saulcyi* (Bourguignat, 1852)*
- Euchondrus septemdentatus* (Roth, 1839)
- Paramastus episomus* (Bourguignat, 1857)*
- Eopolita protensa jebusitica* (Roth, 1855)
- Deroceras berytensis* (Bourguignat, 1852)
- Sphincterochila cariosa* (Olivier, 1804)* (including a subscalarid specimen, Figs. 2, 3)
- Monacha syriaca* (Ehrenberg, 1831)
- Xeropicta vestalis joppensis* (Schmidt, 1855)
- Helix engaddensis* Bourguignat, 1852
- Levantina spiriplana caesareana* (Mousson, 1854)* (Fig. 4)

Asterisks indicate the five species that are typical of the fine grained Kurkar-Dor sandstone and are found under similar conditions between Ma'agan Mikhael and Jisr ez Zarqa, among other locations (unpublished previous observations by HKM, and by HKM and OR on 4 December 2012). They are typical mountain species. The nearest place where they



Fig. 3. Subscalarid specimen of *Sphincterochila cariosa*. (Photo: Oz Rittner)



Fig. 4. *Levantina spiriplana caesareana*. (Photo: Oz Rittner)

normally live near Atlit or Ma'agan Mikhael – Jisr ez Zarqa is formed by the Carmel Mountains some 3 km east of the Kurkar-Dor ridge. The Carmel Mountains have several valleys orientated east-west and during pluvial periods large amounts of sediments were deposited in the form of saddles east of the Kurkar-Dor ridges (Nir, 1959). It is possible that snails were transported with this erosion material from the Carmel Mountains and reached the sandstone ridge, finding a suitable habitat on the fine grained substrate of these rocks.

The slug *Deroceras berytensis* was commonly encountered on the Kurkar-Dor sandstone, but in areas with Kurkar-Ramat Gan sandstone it occurs only in hamra patches among the kurkar rocks.

The above five snail species never occur naturally on kurkar-outcrops of the Ramat Gan type. Instead, we find several species that are more-or-less confined to coarse-grained sandstone outcrops. Noteworthy among them are:

- Truncatellina cylindrica* (Férussac, 1807) (although more typical of sandy patches within the kurkar outcrops)
- Euchondrus* species (until recently referred to as *E. ovularis*)

Euchondrus sulcidens (Mousson, 1861) (although more typical of sandy patches within the kurkar outcrops)
Sphincterochila aharonii (Kobelt, 1913)
Xerocrassa davidiana davidiana (Bourguignat, 1863)
Xerocrassa davidiana picardi (Haas, 1933)
Xerocrassa simulata lothari Mienis, 2011
 None of these seven species has ever been encountered on the fine-grained Kurkar-Dor outcrops.

Since each type of Kurkar sandstone is inhabited by a number of highly characteristic terrestrial gastropods these snails can be used to differentiate between the two types of local sandstone. This can be important from a conservation point of view, because some of the characteristic species occurring on the Kurkar-Ramat Gan sandstone are threatened or endangered and one, *Xerocrassa davidiana picardi*, is probably already extinct. In fact all sandstone habitats in Israel are in constant danger of disappearing. From early historic times this type of material has been exploited intensively as building material and the number of undisturbed outcrops is rapidly dwindling. Moreover some of the most important sandstone hills were located in the now densely built up areas of the greater Tel Aviv region and most of them have completely disappeared.

Since both types of sandstone outcrops are unique to the Levant and in need of protection, from the malacological point of view the establishment of Nature Reserves on Kurkar-Ramat Gan outcrops should be an urgent priority.

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NATIVE SPECIES AND URBAN HEAT ISLANDS

By Heike Kappes

This is an extended summary of work that was published by Kappes *et al.* (2012).

While human populations in cities and metropolitan areas continue to grow globally, urban areas create a novel type of ecosystem that sprawls into the countryside. Based on the sheer size of urban areas, these also need to contribute to biodiversity conservation. Overall gastropod species richness readily exceeds 100 species in German cities (Böbneck, 2005, and references therein). High urban species richness, however, is often achieved through beta diversity, that is, a high spatial

turnover with patchy occurrences in different habitat types of non-native species (Böbneck, 2005; Horsák *et al.*, 2009; Lososová *et al.*, 2011).

Habitat has a stronger effect on snail assemblages than macroclimate for European cities across a large macroclimatic gradient (Lososová *et al.* 2011). However, sealed areas (roads, car parks, etc.) can decouple the meso- and microclimates from the macroclimate, causing warmer winters and overheating effects during summer. This phenomenon is called 'urban heat islands' and recently thermal maps have become available for several larger cities. The aim of the pilot study in Frankfurt am Main, Germany, was to assess whether meteorological data provide a meaningful proxy for urban biodiversity assessment.

To this end, 34 sites were sampled along a transect from the city center through an unsealed low heat stress area to some recently sealed northern suburbs, in which a total of 31 species were found. This represents less than 30% of the overall species richness to be expected from the data of Böbneck (2005), but the area covers only a portion of the metropolis. The study underlines that gastropod species richness is substantially impaired in sealed areas with high thermal stress classes (Fig. 1). Native species experienced a higher proportional loss in species richness than introduced species, but introduced species richness was not increased in the highly sealed areas (Fig. 1). Only four introduced species were observed in the course of the study, which certainly only represent a fraction of the total non-native gastropods of the city: *Arion lusitanicus* auct non Mabille (synonym *A. vulgaris*), *Deroceras panormitanum* (synonym *D. invadens*), *Oxychilus draparnaudi* and *Monacha cartusiana*. All four species originate from a warmer, less continental climatic zone, supporting the assumption of warmer conditions during winter. Urban cover as such explained less variability in gastropod richness than thermal stress class. The data suggest that thermal stress (on native species) contributes to the depletion of metropolitan alpha diversity.

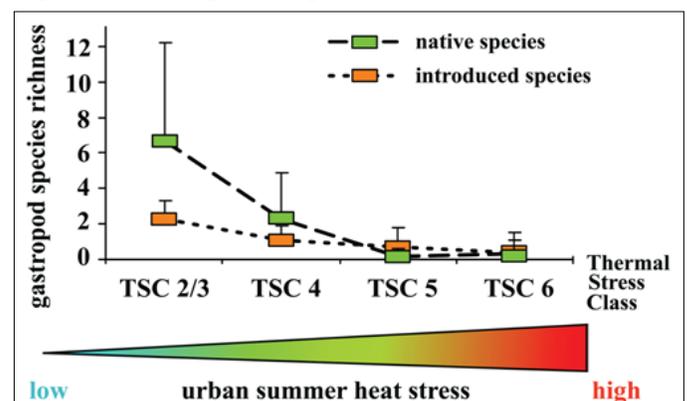


Fig. 1. Gastropod alpha diversity along the gradient of thermal stress classes from 34 sites in Frankfurt am Main, Germany.

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U.S. FISH AND WILDLIFE SERVICE REJECTS 14 OF 26 PACIFIC NORTHWEST SNAILS AND SLUGS PROPOSED FOR LISTING AND SETS A DANGEROUS PRECEDENT

By Edward J. Johannes

The 2007 decision to discontinue the Survey and Manage Program (SMP) under the Northwest Forest Plan (NWFP) (USDA & USDI, 1994) prompted five conservation organizations, led by the Center for Biological Diversity (CBD), to petition the U.S. Fish and Wildlife Service (USFWS) in 2008 to list 32 terrestrial and freshwater gastropod species as threatened or endangered under the Endangered Species Act (ESA) (Curry *et al.*, 2008; USFWS, 2011; Johannes, 2012). These species are found in California, Washington and Oregon. All but 2 of the petitioned species are SMP species. Of the 44 SMP mollusc species, 15 were not included in the petition. Since 1993, 8 of the 19 undescribed SMP mollusc species have been described (Hershler *et al.*, 2003, 2007). To reflect the taxonomic changes, the petition was amended by CBD in 2009 to include 29 species of molluscs. USFWS found that the CBD petition presented substantial scientific or commercial information to indicate that listing 26 of the 29 petitioned molluscs as threatened or endangered might be warranted under the ESA (USFWS, 2011; Johannes, 2012). USFWS felt 3 petitioned SMP molluscs did not warrant listing. USFWS initiated a status review of the 26 species. Public comment was requested on scientific and commercial data and other information on the 26 molluscs during a 60 day comment period, which ended on 5 December 2011 (USFWS, 2011).

USFWS has submitted a 12-month finding on 14 (freshwater molluscs only; terrestrial species to be handled at a later date) of the 26 species (USFWS, 2012; Table 1). Listing of the 8 undescribed species was not considered warranted because these snails do not constitute listable entities under the ESA (Table 1). However, USFWS (2012) admits ‘It is rare for us to list entities that have not been formally described, but we have occasionally done so in the past’. Since the inception of the ESA, 5 undescribed species or subspecies have been listed. Three are fish: Hutton tui chub (*Gila bicolor* spp.), Foskett speckled dace (*Rhinichthys osculus* spp.) and Bluemask Darter

Table 1. Fourteen mollusc species rejected for listing by USFWS.

Scientific Name	Common Name
<i>Colligyrus convexus</i>	canary duskysnail
<i>Colligyrus</i> n. sp. 1	Columbia duskysnail
<i>Colligyrus</i> n. sp. 2	masked duskysnail
<i>Fluminicola anserinus</i>	Goose Valley pebblesnail
<i>Fluminicola multifarius</i>	Shasta pebblesnail
<i>Fluminicola</i> n. sp. 2	tall pebblesnail
<i>Fluminicola</i> n. sp. 3 ¹	Klamath Rim pebblesnail
<i>Fluminicola</i> n. sp. 11 ²	Fredenburg pebblesnail
<i>Fluminicola potemicus</i>	Potem Creek pebblesnail
<i>Fluminicola seminalis</i>	nugget pebblesnail
<i>Fluminicola umbilicatus</i>	Hat Creek pebblesnail
<i>Juga</i> n. sp. 2	basalt juga
<i>Juga</i> n. sp. 3 ³	cinnamon juga
<i>Vorticifex</i> n. sp. 1	knobby rams-horn
¹ <i>Fluminicola</i> n. sp. 3 (diminutive pebblesnail) replaced in USFWS (2012)	
² <i>Fluminicola</i> n. sp. 11 (nerite pebblesnail) replaced in USFWS (2012)	
³ Fig. 1.	



Fig. 1. *Juga* n. sp. 3, the cinnamon juga. One of 14 snails rejected for listing. (© Deixis Consultants). Scale bar = 2 mm.

(formerly *Etheostoma* sp., now *Etheostoma akatulo* Layman & Mayden, 2009); and 2 are molluscs: Banbury Springs lanx or limpet (*Lanx* sp.) and Bliss Rapids snail (now *Taylorconcha serpenticola* Hershler, Frest, Johannes, Bowler & Thompson, 1994). It is curious that only 2 undescribed fish are mentioned in the 12-month finding despite the listing of 2 undescribed middle Snake River molluscs (USFWS, 1992). Listing of an additional 6 described snails was not considered warranted under section 4(a)(1) of the ESA (USFWS, 2012; Table 1).

The CBD petition included both *Fluminicola* n. sp. 3 (diminutive pebblesnail) and *Fluminicola* n. sp. 11 (nerite pebblesnail) (Curry *et al.*, 2008). However USFWS (2012) believed that these were ‘incorrect rather than simply alternate common names because Frest and Johannes (the original discoverers of these snails) referred to all four named molluscs as separate species’ and ‘in this document we will refer to the petitioned mollusc *Fluminicola* n. sp. 3 as the Klamath Rim pebblesnail and to the petitioned mollusc *Fluminicola* n. sp. 11 as the Fredenburg pebblesnail, rather than as the diminutive and nerite pebblesnails, respectively’. It is obvious that the

species information supplied for the diminutive pebblesnail and the nerite pebblesnail in the CBD petition is a mix of these two species and the Klamath Rim and Fredenburg pebblesnails, respectively (the latter two being SMP species). However, the replacement of the diminutive and nerite pebblesnails by two other species not on the amended CBD petition raises the question of the legality of such an action by USFWS and sets a bad precedent for future petitions.

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SNAILS ON THE ROCK: KARST CONSERVATION

By Heike Kappes & Menno Schilthuizen

The exploitation of karst terrains by quarrying for cement manufacture is one of the 15 hot global conservation issues identified by Sutherland *et al.* (2012). Karst destruction is accompanied by disturbances of karst forests by fire, logging and tourism. This is particularly worrying for taxa such as terrestrial snails that have high population densities on calcareous substrates (Schilthuizen *et al.*, 2005; Clements *et al.*, 2006). For these taxa, conservation of entire communities may be linked to the protection of limestone hills. However, a much debated issue is the dilemma of choosing between establishing a single large or several small reserves (SLOSS)

(e.g. Diamond, 1975; Higgs & Usher, 1980; Ovaskainen, 2002; Johst *et al.*, 2011), and conservation planning for karst systems urgently needs information on the relevant spatial scales.

Calcareous outcrops are heterogeneously structured macrohabitats. In addition, they fulfill one of the basic needs of snails, namely a high calcium availability. Calcareous outcrops are amazingly rich in snail species (Nekola, 1999). They are key structures for snail diversity and their species richness readily surpasses that of otherwise favourable microhabitats provided by coarse woody debris or historical mining pits (Kappes *et al.*, 2012).

We have begun a project that aims to lay the foundations for building a model that incorporates ecological theory on species richness and community assembly (e.g. Rosenzweig, 1995; Weiher *et al.*, 2011, and references therein), such as the relative effects of niche differentiation, competition, dispersal, extinction and speciation. It aims to identify the relevant spatial scales for each of the processes. Such a model will not only help us to understand biodiversity patterns in this study system, but may also provide a point of reference for similar studies in other systems, and can be applied in conservation.



Fig. 1. Outcrops in the Kinabatangan area (Sabah, Borneo) harbour, among other species, the rock-dwelling microsnail *Opisthostoma concinna* (insert: a subadult and a juvenile).

For the nine smallest spatial scales (from 1 km² down to 10 x 10 cm), we will select two mostly undisturbed limestone hills of approximately 1 km² in Malaysian Borneo. This project will be undertaken together with local cooperating partners at Universiti Malaysia Sabah (UMS) and the Danau Girang Field Center. The latter organization kindly helped to gather the first data set from an outcrop in the Kinabatangan area (Fig. 1). However, limestone or karst areas are found in different climatic conditions around the world. It thus appears promising to compare different climatic and evolutionary backgrounds and areas that differ in primary plant productivity. We are therefore also undertaking field work in limestone areas in Central Europe, for example in the area around the Kakushöhle in the Eifel Hills, Federal State of North Rhine-Westphalia, Germany (WGS84: approximately 50.545°N, 6.66°E). Collecting in 2012 revealed that several of

the snail species occurring at that outcrop are listed as vulnerable or endangered in this Federal State (Kobialka *et al.*, 2009), e.g. *Azeca goodalli*, *Sphyradium doliolum*, *Pupilla muscorum*, *Truncatellina cylindrica* and *Balea perversa*. Further analyses will consider potential management issues in that area, among other issues.

The project is funded by the Netherlands Organisation for Scientific Research (NWO - ALW 821.01.002).

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FLAGSHIPS AND UMBRELLAS: UNBALANCED CONSERVATION EFFORT TOWARDS CHARISMATIC SPECIES AS POTENTIAL THREAT TO THE UNKNOWN

By Vincent Prié

It is a basic tenet of conservation that charismatic vertebrate species draw most of the conservation effort (Régnier *et al.*, 2009). The other 99% (Ponder *et al.*, 1999), although representing the bulk of biodiversity, are poorly considered or not considered at all. Molluscs, and particularly unionoids, were in fashion in Europe during the 19th century. Shells attracted collectors and naming species new to science stroked their egos. Since then, they have been buried in the other 99% graveyard, missing the advent of conservation policies in the mid 20th century, which focused mostly on bird species: the European Bird Directive dates to 1979, while the Habitats and Species Directive came into force only in 1992.

The Habitat and Species Directive listed two bivalve species in Annex II: the Freshwater Pearl Mussel, *Margaritifera margaritifera*, and the Thick-shelled Mussel, *Unio crassus*. This conservation status has probably contributed to drawing the attention of European naturalists back to freshwater bivalves (Fig. 1), as evidenced by the success of the International Meeting on Biology and Conservation of Freshwater Bivalves held in September 2012 in Portugal, and coordinated by Amílcar Teixeira and Manuel Lopes Lima. For four days, this meeting gathered about 250 people in the small town of Bragança; there were 46 oral and 58 poster presentations. However beyond the warm welcome, the quality of the presentations and the pleasure of the discussions, this meeting left a bitter taste in my mouth, as I expected a more balanced program.

As might be imagined due to the geographical location of the congress, European species received the lion's share, with 69% of the talks dedicated to European species (invited speakers excluded). Among the 18 European unionoid species (including the introduced *Sinanodonta woodiana*), a single

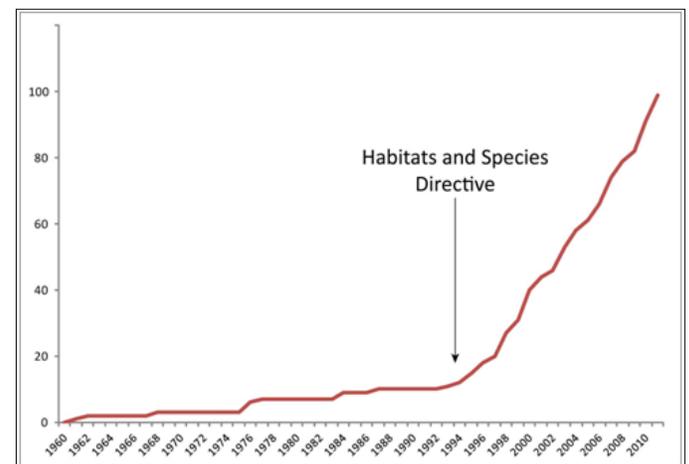


Fig. 1. Cumulative number of papers dealing specifically with *M. margaritifera* and the date of the Habitat and Species Directive.

species, the Freshwater Pearl Mussel, *Margaritifera margaritifera*, accounted for an astonishing 60% of European speakers' communications (Fig. 2). And indeed, the European commission supports as many as 21 conservation programmes targetting *M. margaritifera* through the [LIFE programme](#), for a global amount of over €51 million. Six of them (in Belgium, Spain, Sweden, Luxembourg, France and Finland) are dedicated specifically to this species for a total amount of €4.678 million (LIFE Programme, 2013). There is funding for hatching farms in the Czech Republic, U.K., Austria, Sweden, Germany, Luxembourg, Ireland, Belgium, Spain and France.

Why did the Freshwater Pearl Mussel become such a flagship species for freshwater bivalve conservation?

The key to success probably relies on a few social and cultural issues. The Freshwater Pearl Mussel is widely distributed across Europe (Fig. 3), and is therefore a species of concern for many countries and environmental stakeholders, thus *bringing people together*, for example at conferences, congresses and other meetings. It is *accessible to the general public*, living in small, shallow and clear streams and is easy to identify, as it is generally the only bivalve species found in the habitats where it live. It is associated with *attractive stories* about pearls, charismatic fish hosts (salmon and trout) and water quality. The Freshwater Pearl Mussel has become the *tiger* of mollusc conservation.

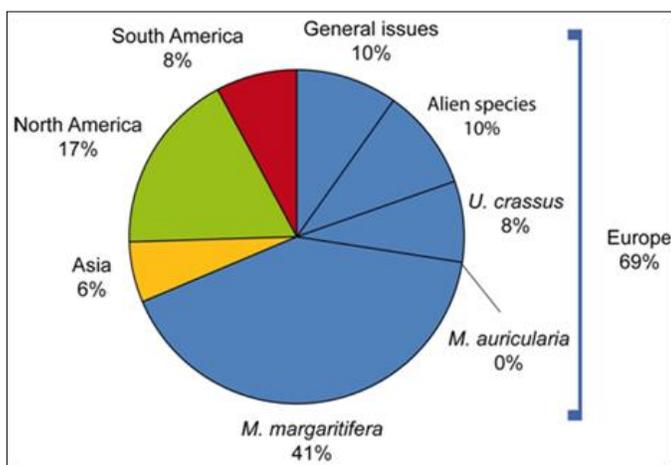


Fig. 2. The distribution of European speakers' talks at the International Meeting on Biology and Conservation of Freshwater Bivalves in 2012 illustrates the imbalance among species listed in the Habitat and Species Directive.

Whether conservation strategies and efforts should focus on *M. margaritifera* (Geist, 2010) is however questionable. This species is admittedly locally threatened, and has been locally extirpated, but it is not globally threatened by extinction: it remains widespread in Europe and large populations are still found in Finland and Russia, with an estimated 140 million specimens in the environmentally preserved Varsuga River alone (Henrikson & Söderberg, 2010). If it can arguably be considered a flagship species, it is questionable as an umbrella species. Umbrella species are generally defined as 'a species with large area requirements for which protection of the species offers protection to other species that share the same habitat' (Noss, 1990; Simberloff, 1998; Ozaki *et al.*, 2006).

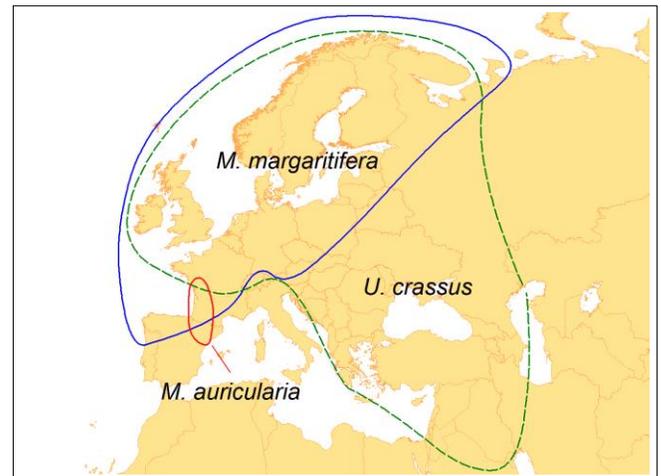


Fig. 3. Approximate distributions of *M. margaritifera* (blue line), *M. auricularia* (red line) and *U. crassus* (green dashed line) in Europe. Although less vulnerable, widespread species are more likely to attract conservation efforts.

The Freshwater Pearl Mussel has a narrow ecological niche, being the only large freshwater clam living in upstream acidic waters. They do not appear to be indicators of fish species richness in headwater regions (Geist *et al.*, 2006) and their habitat supports only a small fraction of freshwater biodiversity. Moreover, in a hydrological context, upstream habitats do not depend on what happens downstream, while species living downstream could be affected by a degradation of upstream habitats.

In contrast, its 'sister' species (sister is not used here in a phylogenetic sense) the Giant Pearl Mussel, *M. auricularia* (Fig. 4), is critically endangered (Altaba, 1990, 1997; Araujo & Ramos, 2000, 2001; Cochet, 2001; Nienhuis, 2003; Prié *et al.*, 2008; Prié & Cochet, 2010; Cuttelod *et al.*, 2011) and could become extinct within a few decades (it was even believed extinct for a while). As usual, large species disappear first and *M. auricularia*, which is one of the largest freshwater invertebrates, relies on the largest west European fish ever found in rivers, the critically endangered European Sturgeon, *Acipenser sturio*, the only known natural host fish for Atlantic populations. It lives in habitats suitable for most unionoid species. As a downstream specialist species, it depends on the quality of the whole river network. It is therefore indisputably a good candidate umbrella species.

But having been extirpated from most of its original range (western European countries), its conservation now relies only on Spain and France, and is a matter of concern for very few people. It is not easily accessible to the general public, living in deep and turbid waters, and it is not identified with pristine and healthy stream ecosystems (Geist, 2010). For all these social and cultural reasons, and in spite of its alarming conservation status and its valuable umbrella species status, it has not become a charismatic species and receives little attention.

Nowadays, in European countries, most conservation efforts follow the European Habitats and Species Directive, which lists in Annex II the species for which Europe requires the designation of Special Areas of Conservation, and in Annex

IV the species in need of strict protection. Inexplicably, the Giant Pearl Mussel was not listed in Annex II, which questions the relevance of these lists for conservation (Bouchet et al. 1999). As a consequence, very few conservation efforts are focussed on the Giant Pearl Mussel and fund raising is difficult.



Fig. 4. The Giant Pearl Mussel, *Margaritifera auricularia*, is one of the largest continental invertebrate species in Europe.

The Thick-shelled Mussel, *Unio crassus*, is in between: *M. margaritifera* yields about 80,000 results when Googled, *U. crassus* about 40,000, *M. auricularia* about 15,000. The difference between *M. auricularia* and *U. crassus* probably lies in their distribution (Fig. 3): although it is not as accessible as *M. margaritifera*, being harder to identify and living in less clear streams, 30 European countries are concerned (Fauna Europaea, 2013). It is thus more likely to bring people together. Paradoxically, the more widespread a species is, the more it attracts conservation efforts!

Funds for conservation are limited. Drawing most of the European financial support for freshwater molluscs, *M. margaritifera* unavoidably focuses conservation efforts on its peculiar environment and limits the resources allocated to other species. Nature conservation is strongly linked to social issues. While freshwater bivalves seem to have become visible from a conservation perspective, the other 99% syndrome remains ambushed. European (and other) malacologists should be aware of this pitfall when ranking conservation priorities.

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ON THE BRINK OF EXTINCTION: FATE OF THE PEȚEA THERMAL LAKE (ROMANIA) AND ITS ENDEMIC SPECIES

By Ioan Sîrbu, Adrian Gagiu & Ana Maria Benedek

The Pețea Lake (also known as the Ochiul Mare Lake on the Pețea rivulet) lies in the north-western part of Romania, close to the town of Oradea, in Bihor county. The lake is situated above a rich geothermal aquifer, which has been known and

valued since ancient times. The accessibility of thermal waters in the area favored the establishment of two resorts situated close to one another: Băile 1 Mai (Băi meaning Baths) and Băile Felix. At the first site (in the past also known as Băile Episcopiei, Püspökfürdő in Hungarian or Bischofsbad in German) thermal springs supplied the Pețea Lake (Fig. 1), formed in the second half of the Holocene (Sümegei *et al.*, 2012a, b). Pețea Lake became world-famous especially because it is the only location in Europe where the Egyptian white water-lily (*Nymphaea lotus thermalis*) grows naturally, here represented by an endemic thermal variety. Along with this plant, which was the main reason for declaring the lake a nature reserve in 1932, another two local endemic species occur, namely the fish *Scardinius racovitzai* Müller, 1958 and the snail *Melanopsis parreyssii* (Philippi, 1847). Later, custody of the area was taken over by the Țării Crișurilor Museum in Oradea, and in early 2007 it became part of a Natura 2000 Site of Community Importance.



Fig. 1. The thermal Pețea Lake in August 1999, highlighting two of its marvels: a, *Nymphaea lotus thermalis*; b, the local endemic snail *Melanopsis parreyssii*. (Photos: I. Sîrbu, 1999, O. Pascu, 2013, respectively)

This snail probably diverged from its closest living relative *Fagotia acicularis* or *Esperiana (Microcolpia) daubertii acicularis* (Férussac, 1823). Why and when it happened, and what the current status of the local endemic species is, remains debatable. According to Smoleń & Falniowski (2009), who analyzed partial sequences of ribosomal 18S and mitochondrial COI, *Fagotia* should be synonymized with *Melanopsis*. The application of a molecular clock, with one point calibration for COI for the Hydrobiidae, estimated the times of divergence as 2.53 ± 0.56 Mya for *M. parreyssii* and *F. acicularis*. This age of 2.5 Mya coincides with the beginning of the glacial period in Europe. Recently Sümegei *et al.* (2012a, b) undertook palaeontological research in this area; malacological examinations were completed in conjunction with sedimentological, geochemical, radiocarbon, anthracological and palynological examinations. There is continuity in the changing variation, which can be traced through the Holocene, and according to Sümegei *et al.* (2012a, b), this morphological variation along the lineage suggests that *Melanopsis parreyssii* is (or was) an eco-form of *Fagotia acicularis*, adapted to thermal conditions of 28-32 °C. However, there are two possibilities: *M. parreyssii* may be an

eco-morphological form of *F. acicularis* adapted to 32-34 °C thermal water conditions, or it may be a separate species that became adapted to thermal water. If they really are distinct taxa, then *M. parreyssii* is the youngest endemic to have evolved in the Carpathian Basin (Sümegei *et al.*, 2012a, b). Whatever its true status, the shell morphology and ecology of present-day representatives of the two taxa are seemingly different. Fig. 2 shows the shells of *Melanopsis parreyssii* and its closest relative, *Fagotia acicularis*, sampled from an isolated, relict, meso-thermal spring and rivulet in Răbăgani about 30 km east of Pețea Lake.

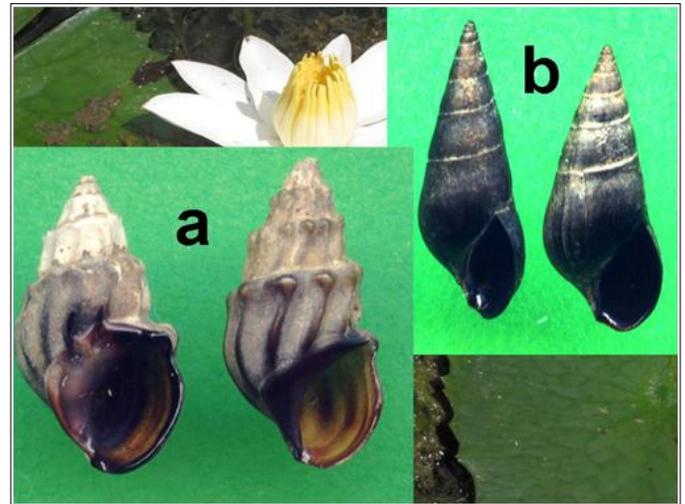


Fig. 2. a, shells of *Melanopsis parreyssii* from Pețea Lake; b, its possible closest living relative, *Fagotia acicularis*, from Răbăgani (Bihor county, Romania).

In the malacological and conservation biology literature there have been many mistakes or overstatements concerning the present day distribution of *Melanopsis parreyssii*. The citing of this species from Hungary has two causes. The first is because before World War I Transylvania (including the area of reference) was part of Hungary or the Austro-Hungarian Empire. The second is because some *M. parreyssii* individuals were introduced to Malom-tó, in Budapest, as well as Körösladány, but after several years of persistence it seems that the colonizers have disappeared (Fehér, 2012, and pers. comm., 2012). It was also reported in 2000 from a spring at Pyasachnik Dam in the Upper Thracian lowland (Bulgaria), but the destruction of the habitat made it impossible for Georgiev (2010) to find any live individuals or shells in order to draw any conclusions about its former presence. Thus, the species is either extinct in Bulgaria (the possibility that it was introduced should also be considered) or it never existed there, having been reported erroneously.

It thus remains obvious that *Melanopsis parreyssii* is still to be considered as a thermophilous, endemic taxon that requires strict protection. The problem is that the thermal waters that supplied and sustained the unique Pețea Lake were also the reason for its decline. Especially after the political changes in the early 1990s, the villages and resorts began to expand, more and more tourist facilities were built: villas, pensions, hotels, spas and recently a waterworld, all of them drilling and exploiting the main resource of the area: the geothermal



Fig. 3. Changes in the Pețea Lake water level, vegetation and general view of the habitat: a, August 2007; b, December 2011; c, July 2012; d, November 2012. (Photos b-d: O. Pascu)

waters. Much of the drilling is done officially, but other unknown and illegal drilling also takes place. Thus, a reduction of the flow of the thermal springs and of the water level and surface area of the lake were witnessed in the last few years. Along with the habitat's deterioration, a constant decline in the size of the *M. parreyssii* population occurred. The poor condition of the lake and its surroundings worsened because of the increased tourism, siltation, collection of specimens for different reasons by people from all over the world (Sîrbu, 2006), introduction or expansion of populations of allochthonous species, e.g. *Sinanodonta woodiana* (Lea 1834) in the first decade of the 21st century, etc. Changes in the Pețea Lake water level, vegetation and general view of the habitat, between 2007 and 2012, can be seen in Fig. 3. Considering all these, as well as the threats caused by pollution and habitat disturbance, which are ongoing, *M. parreyssii* was assessed by Z. Fehér in the *IUCN Red List of Threatened Species* (2012, v. 2012.2) as Critically Endangered (CR B1ab(iii,v)+2ab(iii,v), v. 3.1).

The decline in population size became exponential in the last months of 2011. On 13 December 2011, the thermal underwater spring that supplied Pețea Lake ceased activity, resulting in an abrupt reduction of both water level and surface area. Divers, called especially to investigate this event, recorded the lack of flow and clogging of the spring. The Țării Crișurilor Museum, legal custodian of this nature reserve as well as of the related Natura 2000 site alerted the local and national environmental authorities. Consequently, beginning in spring 2012, several meetings and discussions, with all possible authorities, scientists, naturalists, mass-media, etc., resulted in the establishment of two commissions: one (with the Regional Environmental Agency, the Environmental Guard, etc.) aiming to find solutions for the problems, and a second to control the first. As a favour and at the request of the Museum, SC Turism Felix SA, which owns the rights to water of the thermal aquifer, pumps water into the dying lake, usually intermittently, from one of its drilling sites in the vicinity. The Pețea Lake is now like an intubated person in a coma, living only with the help of artificial respiration and



Fig. 4. Beginning of December 2012. The lake is reduced to a small pond, in which snails, fish and other animals are overcrowded. The hose comes from a drill in the aquifer and pumps water into the lake to keep it alive. (Photo: O. Pascu)

other medical devices. Thus, for now, the lake is artificially kept in a form of existence by the same process that destroyed it: thermal aquifer exploitation. Nothing comic: the tragedy prevails!

Since February 2012 the Țării Crișurilor Museum has established two aquariums, one with *Scardinius racovitzai* and another with *Melanopsis parreyssii*, in order to have a last and desperate source of potential repopulation. The representatives of this custodian institution asked for permission to plant *Nymphaea lotus* in an artificial thermal ornamental basin from the neighboring Băile Felix, but so far they were refused, and anyway the procedure for obtaining the required legal permits is very slow.

In the spring of 2012, the state of the lake seemed to improve partially, probably because, due to the rising temperatures, the urge to exploit the thermal waters to heat guest houses in the area has diminished. A limited flow of the thermal underwater spring was noticed. During the summer of 2012 the first established commission carried out an inspection of the whole area to identify illegal consumers of the thermal waters. Only some could be traced, because many 'were not at home', others were not willing to open their doors, some had already established drills, but did not use them, while others have contested the inspection. During the autumn of 2012, the water level dropped once again, and the spring has again become less active. This acute event was surely also linked to the establishment of an aquapark in Băile Felix on 29 October. The situation during December 2012 - January 2013 can be seen in Figs. 4 and 5; the custodians and their supporters are visiting and monitoring the state of the lake weekly. They also ask for water to be pumped from the drilling site mentioned above, to keep the patient alive. In the small remaining pond, there are still many overcrowded snails and fish facing a food shortage and being at the mercy of many predators (birds, turtles, tourists, etc.). The viability of these remnant populations is between extremely low and non-existent.

A helping hand was recently raised by a NGO and a University from Hungary, in order to establish at least one project to send specimens of the endemic taxa to be maintained and bred ex-situ. Legal requests have already been made and the search for grants and funds has begun. However,



Fig. 5. Still striving to rescue the remnants of Pețea Lake and its inhabitants. The curators and custodians from the Țării Crișurilor Museum doing Sisyphean work, not letting the patient die. Inset, one of the last reserves: aquarium held specimens. (Main photo: O. Pascu, 8 January 2013, inset: www.ebihoreanul.ro)

all possible assistance, at the entire range of scales and from all fields of knowledge will be crucial to save these taxa, including the endemic snail *Melanopsis parreyssii* and its habitat, the thermal Pețea or Ochiul Mare Lake, and to save this heritage for further generations. There is Sisyphean work to be done in order to try, *in extremis*, to keep as much as possible of the former habitat and its unique species.

The authors thank Prof. Peter Glöer (Hetlingen, Germany) and Dr. Zoltan Fehér (Budapest, Hungary) for all the help, literature and advice they offered, and Mr. Ovidiu Pascu (Oradea, Romania) for the photos he provided.

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HAVE INVASIVE FRESHWATER GASTROPODS CONQUERED THE LOWER PART OF THE TANNINIM RIVER IN ISRAEL?

By Henk K. Mienis and Oz Rittner

Until recently the Tanninim River (Nahal HaTanninim or Crocodile River), between Ma'agan Mikha'el and Jisr ez Zarqa (Fig. 1), was considered the only unspoiled Mediterranean coastal river in Israel. All other coastal rivers have suffered intensively since 1948 from urban, industrial and agricultural pollution. Most of the lower part of the Tanninim River and its surroundings has been declared a nature reserve.



Fig. 1. South bank of the Lower Tanninim River with the village Jisr ez Zerqa in the background. (Photo: Oz Rittner)

The status of being a reserve is important from the conservation point of view. The lower part of the river is the only tidal river in the Mediterranean coastal belt of Israel in which a brackish water fauna still thrives.

The biodiversity of aquatic molluscs of the Tanninim River was still relatively high in 1986 (Mienis & Ortal, 1996, 1997). Yet the first changes in the composition of its fauna were already evident during an intensive survey of its waters in that year. Not only had some species disappeared, for example most of the large mussel species, but also the first introduced species, including the North American *Haitia acuta* (Daraparnaud, 1805) and the Nilotic *Ferrissia clessiniana*

(Jickeli, 1882), had arrived in the river.

The fauna of the lower part of the Tanninim River, i.e. from the Roman Dam westwards to the mouth of the river in the Mediterranean just beyond the ruins of the Turkish bridge, consisted of the following 13 species (asterisks indicate those that were extremely common on or near the south bank of the river):

**Theodoxus karasuna* (Mousson, 1874)
Islamia gaillardoti (Germain, 1911)
 **Heleobia phaeniciaca* (Pallary, 1939)
 **Bithynia phialensis* (Conrad, 1852)
 **Melanoides tuberculata* (Müller, 1774)
 **Melanopsis buccinoidea* (Olivier, 1801)
 **Melanopsis lampra* Bourguignat, 1884
 **Haitia acuta* (Draparnaud, 1805)
Gyraulus ehrenbergi (Beck, 1837)
Gyraulus piscinarum (Bourguignat, 1852)
 **Phytia myosotis* (Draparnaud, 1801)
Unio terminalis delicatus Lea, 1863
Corbicula consobrina (Cailliaud, 1823)

On 4 December 2012 we briefly surveyed the south bank of the river for the presence of the amphibious gastropod *Phytia myosotis*, which we found still present here and there under *Halimione portulacoides* growing on the banks just above the water. At the same time we sampled aquatic weeds growing in the water and those terrestrial plants hanging into the water. To our surprise only four species of aquatic snails were encountered alive:

Pseudoplotia scabra (Müller 1774) (better known as *Thiara scabra*) (Fig. 2)

Pyrgophorus species (Fig. 3)

Haitia acuta (Draparnaud, 1805)

Pseudosuccinea columella (Say, 1817)

All four are invasive alien species. In particular, we found hundreds of specimens of an extremely variable New World *Pyrgophorus* species. Sometimes it was the only species present in our sieve.

Of the native species only old empty shells of *Theodoxus karasuna*, *Heleobia phaeniciaca*, *Bithynia phialensis*, *Melanoides tuberculata*, *Melanopsis buccinoidea* and *Melanopsis lampra* were found in fair numbers.

The question is have these four invasive species conquered the Lower Tanninim River and outcompeted the local species? We hope sincerely that in the future the local species may regain their place among the aquatic mollusc fauna inhabiting the southern banks of the Lower Tanninim River.

It will not be an easy task because they not only have to compete with the invasive species but also to cope with deterioration of the water quality. The south bank of the lower part of the river is suffering here and there from a continuous stream of raw sewage, which has its origin in one or more overflowing sewer pits collecting the sewage of the nearby village Jisr ez Zarqa. We think it will be a fine job for a dedicated group of conservationists to clear up this mess.

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Fig. 2. *Pseudoplotia scabra*. (Photo: Oz Rittner)



Fig. 3. *Pyrgophorus* species, coronated form. (Photo: Oz Rittner)

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THE PULMONATE SNAILS OF TRINDADE ISLAND, BRASIL

By Rodrigo B. Salvador, Carlo M. Cunha & Luiz R.L. Simone

Trindade Island (*Ilha da Trindade* in Portuguese) lies about 1140 km off the Brazilian coast (Figs. 1, 2). It is the top of a volcanic cone rising 5500 m from the ocean floor, part of the Vitória-Trindade Seamount Chain left by a magma plume. Trindade has just a handful of known pulmonate snails (Fig. 3), all endemic: *Bulimulus bruno*i and *Naesiotus arnaldo*i

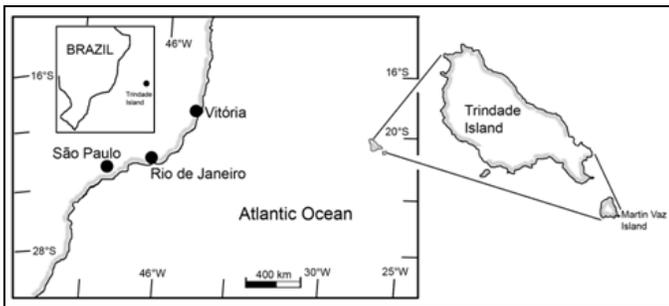


Fig. 1. Location of Trindade Island off the coast of Brasil.

(Orthalicidae), *Oxyloma beckeri* and *Succinea lopesi* (Succineidae) and *Vegrandinia trinidadensis* (Subulinidae). And this fauna seems to have gone through hard times during the last few decades.

Recently, five non-native pulmonate species were found on the island: *Bradybaena similaris* (Bradybaenidae), *Discus rotundatus* (Discidae), *Pupisoma dioscoricola* (Valloniidae), *Gastrocopta pellucida* and *Vertigo substriata* (Vertiginidae). When they were introduced and their precise place of origin are unknown. The island was discovered in 1501 by Portugal, later claimed by England, and finally became part of Brasil in 1822. Many military and scientific expeditions from Europe, North America and of course Brasil visited the island. As such, there were many opportunities for introducing such diminutive snails, as they are easily carried around and rarely noticed. Land snails have been unintentionally introduced in many regions around the globe, impacting native vegetation and preying upon or outcompeting native species. However, whether these non-native snails had any effect on the native ones is also unknown. Still, one astonishing fact remains: no living animal, native or non-native alike, has been found on the island since the end of the 1980s. So the real problem for the native snails might lie somewhere else.

The military expeditions sent to claim and occupy the island brought goats and house mice with them. Introduced mammals are extremely destructive to the native fauna and flora of oceanic islands. The house mouse population on Trindade is estimated at tens of thousands and they might have played a part in the snails' disappearance: it is well known that mice can voraciously prey upon land snails, especially if other food sources are scarce. However, they will only eat medium-sized to large snails and, on Trindade Island, this means the native orthalicids. Goats are the main cause of extinctions on many islands. On Trindade, goats were responsible for drastic deforestation, leading to the extinction or almost extinction of many endemic plant species. This resulted in a loss of habitat and food resources, which might have been the major cause of the disappearance of the native snails.

Even so, it is still too early to embrace an extinction scenario for Trindade's land snails: after a great campaign to eradicate the goats, concluded in 2005, the flora seems to be recovering with the help of some researchers. With this, snail populations should be able to re-establish themselves, provided that some managed to survive somewhere on the island. However, this is valid for both native and non-native species alike.

Unfortunately, Trindade is still open to future invasions and



Fig. 2. Trindade Island.

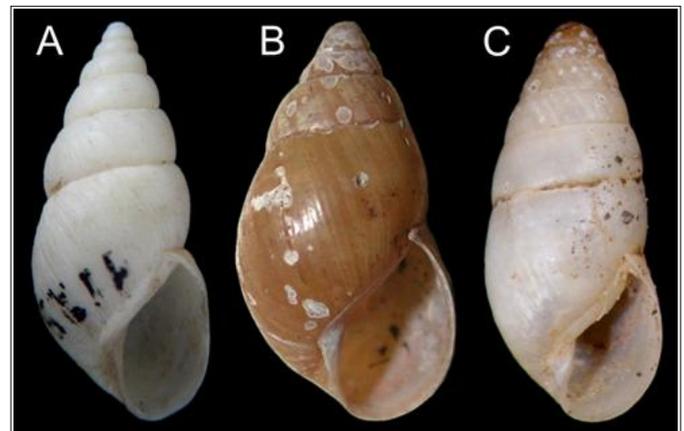


Fig. 3. A, *Bulimulus brunoi* (shell length 21 mm); B, *Naesiotus arnaldoi* (10 mm); C, *Vegrandinia trinidadensis* (7 mm).

some measures should be taken to prevent them. Previous experience with invasive snails make it painfully clear that preventing an invasion is much easier than trying to control or eradicate an invasive species. Since the island does not have a large permanent settlement and thus the flow of people is very restricted, it would not be too difficult to implement and maintain an inspection and quarantine program.

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FRESHWATER AND TERRESTRIAL MOLLUSCS IN BRASIL: CURRENT STATUS OF KNOWLEDGE AND CONSERVATION

By Sonia Barbosa dos Santos, Igor Christo Miyahira & Maria Cristina Dreher Mansur

Brasil, a country of continental dimensions, is recognized as one of the most megadiverse countries, harbouring high diversity of biomes and fantastic species richness. However, current knowledge about our biota is still scarce and heterogeneous, focused on just a few groups, especially when talking about invertebrates, including hidden invertebrates, i.e. parasites (Lewinsohn & Prado, 2002; Lewinsohn *et al.*, 2004). This ignorance is an impediment to conservation action.

The publication of the *Red Book of Brazilian Fauna Threatened with Extinction* (Machado *et al.*, 2008) aimed to consolidate the national effort for animal conservation and indicated a significant advance concerning invertebrates. Although the role of Red Lists in conservation is questioned by some (Bouchet *et al.*, 1999), there is no doubt about the importance of so-called 'Red Books' for decision makers, politicians, environmental professionals, researchers and the general public.

Considering the continental dimensions of Brasil, it is clear that an overall list of Brazilian endangered species does not provide information about regional differences (Bergallo *et al.*, 2000; Machado, 2008). These differences are related not only to the peculiar characteristics of each ecosystem but also to local levels of habitat degradation, scientific knowledge of the biology and distribution of species and extinction risk for local populations (Bergallo *et al.*, 2000). So the elaboration of regional lists is important because each list reflects different pressures and threats in each region, which will help build more consistent national lists (Bergallo *et al.*, 2000; Gardenfors *et al.*, 2001; Machado, 2008).

The Brazilian fauna has been the target of severe threats, especially environment modifications (Amaral *et al.*, 2008). In terrestrial environments the destruction of native vegetation to establish crop plantations and grassland is a major problem. In freshwater environments the construction of hydroelectric dams is a serious problem because the transformation of lotic into lentic environments can reduce (Pereira *et al.*, 2012) or even eliminate species typical of rapids and well oxygenated water, such as gastropods of the genus *Aylacostoma* (Thiengo *et al.*, 2005).

Talking about invaders, *Achatina fulica* Bowdich, 1822 stands out in the terrestrial environments, whereas in the freshwater habitats Asian clams, *Corbicula* spp., and the golden mussel, *Limnoperna fortunei* (Dunker, 1857), are the stars (Santos *et al.*, 2012). In addition to this, we have the introduction of an unknown number of small sized alien species (Santos *et al.*, 2008).

It was clear from the preparation of the official national list that molluscs as a group had received little attention. The first list of Brazilian Endangered Fauna (Carvalho, 1968), approved

Table 1. Numbers of molluscs in the official state lists and in the Brazilian Red List in comparison to the total number of threatened invertebrates. PA - Pará (SEMA-PA, 2007), RJ - Rio de Janeiro (Bergallo *et al.*, 2000), SP - São Paulo (SP, 1998), RS - Rio Grande do Sul (Marques *et al.*, 2002), BRL - Brazilian Red List (Machado *et al.*, 2008).

State	Gastropoda	Freshwater Bivalvia	Total invertebrates	%
PA	3	6	37	24
RJ	4	1	99	5
SP	1	0	46	22
RS	3	11	45	31
BRL	12	26	208	18

by the Brazilian government (Portaria IBDF nº 303, 29/5/68), featured 44 species but no molluscs. The first list published by IBAMA (Portaria nº 1.522), in 1989, included 206 animal species under threat of extinction, 174 vertebrates and 32 invertebrates, but no molluscs.

The current official '[List of Endangered Species](#)', published through the Normative Statements of the Ministry of the Environment (MMA nº 3/2003 and nº 5/2004) and consolidated in the *Red Book of Brazilian Fauna Threatened with Extinction* (Machado *et al.*, 2008), includes 627 species: 130 terrestrial invertebrates, 78 aquatic invertebrates, 16 amphibians, 20 reptiles, 160 birds, 69 mammals and 154 fish. Among the invertebrates, 12 are gastropods (11 terrestrial and one limnic) and 26 are limnic bivalves, comprising 18% of the invertebrates listed as endangered (Table 1). Thus, it took 40 years until the molluscs, the second largest phylum in terms of described biodiversity, garnered the attention of Brazilian researchers involved in conservation.

Despite the importance of the regional lists (Bergallo *et al.*, 2000), up to 2010, out of the 26 Brazilian States and the Federal District (Brasília), only seven states (Pará, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Rio Grande do Sul) had official lists of threatened fauna, but only four states (Pará, Rio de Janeiro, São Paulo, Rio Grande do Sul) included limnic and terrestrial molluscs in their lists (Table 1). Table 2 shows the number of species according to threat category for each state in comparison to the federal list (BRL). Looking at the current list for Rio de Janeiro state it seems that a number of terrestrial gastropods could act as flagship and umbrella species for the Atlantic Forest: *Streptaxis contusus* (Férussac, 1822) (Streptaxidae),

Table 2. Numbers of molluscs listed as threatened in the Brazilian State Lists and in the Brazilian Red List, with the IUCN threat category. Sources as for Table 1. DD - Data Deficient, NT - Near Threatened, EN - Endangered, VU - Vulnerable, CR - Critically Endangered.

State	Gastropoda						Bivalvia				TOTAL
	Terrestrial			Limnic			NT	EN	VU	CR	
	NT	EN	VU	DD	EN	VU					
PA	0	2	1	0	0	0	0	0	6	0	9
RJ	3	0	0	0	1	0	1	0	0	0	5
SP	0	0	0	0	0	1	0	0	0	0	1
RS	0	2	1	0	0	0	0	3	8	0	14
BRL	0	7	4	1	0	1	0	13	12	1	39

Table 3. Threatened non-marine molluscs in Brasil. Some species need careful taxonomic revision as noted by Pereira *et al.* (2012) for freshwater mussels. NT- near threatened, VU- vulnerable, EN- endangered, CR- critically endangered, EX - extinct.

Species	Common names	Threat
Freshwater snails		
Hydrobiidae		
<i>Potamolithus troglolobus</i> Simone & Miracchiolli, 1994	Unknown	VU ^{1,6}
Ampullariidae		
<i>Pomacea sordida</i> (Swainson, 1823)	aruá-do-brejo	EN ²
Land snails		
Orthalicidae		
<i>Eudolichotis lacerta</i> (Pfeiffer, 1855)	Unknown	EN ⁵
<i>Orthalicus pulchellus</i> (Spix, 1827)	caramujo do café	VU ⁵
Bulimulidae		
<i>Drymaeus</i> spp.	Unknown	NT ²
<i>Tomigerus (Biotocus) turbinatus</i> (Pfeiffer, 1845)	Unknown	VU ^{4,6} , EX ⁷
<i>Tomigerus (Digerus) gibberulus</i> (Burrow, 1815)	Caracol	VU ^{4,6} , EX ⁷
Megalobulimidae		
<i>Megalobulimus cardosoi</i> Morretes, 1952	aruá-do-mato	EN ^{4,6} , CR ⁷
<i>Megalobulimus grandis</i> (Martens, 1885)	aruá-do-mato, aruá-gigante, caracol-gigante	EN ^{4,6} , EX ⁷
<i>Megalobulimus lopesi</i> Leme, 1989	caracol-gigante-da-Boracéia	EN ^{4,6,7}
<i>Megalobulimus parafragilior</i> Leme & Indrusiak, 1990	caracol-gigante	EN ^{4,6,7}
<i>Megalobulimus oblongus</i> (Müller, 1774)	Caramujo	EN ⁵
<i>Megalobulimus proclivis</i> (Martens, 1888)	aruá-longado	EN ^{4,6} , CR ⁷
<i>Megalobulimus</i> spp.	aruá-do-mato	NT ²
Streptaxidae		
<i>Reclartemon depressus</i> (Heynemann, 1868)	caracol	VU ^{3,4,6}
Strophocheilidae		
<i>Gonyostomus gonyostomus</i> (Férussac, 1821)	caracol	NT ²
<i>Gonyostomus henseli</i> (Martens, 1868)	caracol	VU ^{4,6,7} , EN ³
<i>Gonyostomus insularis</i> Leme, 1974	caracol-da-ilha	VU ⁷ , EN ^{4,6}
<i>Mirinaba curytibana</i> (Morretes, 1952)	Caracol	EN ^{4,6} , CR ⁷
Bivalvia (freshwater mussels)		
Hyriidae		
<i>Castalia undosa</i> Martens, 1827	concha-borboleta	EN ^{4,6}
<i>Diplodon besckeanus</i> (Dunker, 1848)		NT ²
<i>Diplodon caipira</i> (Ihering, 1893)	marisco-de-água-doce	EN ^{4,6}
<i>Diplodon dunkerianus</i> (Lea, 1856)	marisco-de-água-doce	EN ^{4,6,7}
<i>Diplodon expansus</i> (Küster, 1856)	marisco-de-água-doce	VU ^{4,6,7} , EN ^{4,6}
<i>Diplodon fontainianus</i> (d'Orbigny, 1835)		EN ^{4,6}
<i>Diplodon greffeanus</i> (Ihering, 1893)	marisco-de-água-doce	EN ^{3,4,6}
<i>Diplodon iheringi</i> (Simpson, 1900)	marisco-barrigudinho	EN ^{3,4,6}
<i>Diplodon koseritzii</i> (Clessin, 1888)	marisco-do-junco	EN ³ , CR ^{4,6}
<i>Diplodon martensi</i> (Ihering, 1893)	marisco-de-água-doce	VU ^{4,6}
<i>Diplodon pfeifferi</i> (Dunker, 1848)	marisco-de-água-doce	VU ⁷ , EN ^{4,6}
<i>Diplodon rotundus</i> (Spix, 1827)	concha disco	VU ^{4,6}
Mycetopodidae		
<i>Anodontites elongatus</i> (Swainson, 1823)	Marisco-pantaneiro	VU ^{4,6}
<i>Anodontites ensiformis</i> (Spix, 1827)	Estilete	VU ^{3,6}
<i>Anodontites ferrarisi</i> (d'Orbigny, 1835)	Redondo-rajado	VU ³ , EN ^{4,6}
<i>Anodontites iheringi</i> (Clessin, 1882)	Alongado-rajado	VU ³ , EN ^{4,6}
<i>Anodontites soleniformes</i> (d'Orbigny, 1835)	Marisco-de-água-doce	VU ^{4,6}
<i>Anodontites tenebricosus</i> (Lea, 1834)	Marisco-rim	VU ^{4,6}
<i>Anodontites trapesialis</i> (Lamarck, 1819)	Prato, saboneteira	VU ^{4,6}
<i>Anodontites trapezeus</i> (Spix, 1827)	Marisco-de-água-doce	EN ^{4,6}
<i>Bartlettia stefanensis</i> (Moricand, 1856)	Ostra-de-rio	VU ^{4,6}
<i>Fossula fossiculifera</i> (d'Orbigny, 1835)	Fóssula	VU ³ , EN ^{4,6}
<i>Leila blainvilliana</i> (Lea, 1834)	Leila	EN ^{3,6}
<i>Leila esula</i> (d'Orbigny, 1846)	Leila	VU ^{4,6}
<i>Monocondylaea paraguayana</i> (d'Orbigny, 1835)	Cofrinho	VU ^{3,4,6}
<i>Mycetopoda legumen</i> (Martens, 1888)	Faquinha-arredondada	VU ^{3,4,6}
<i>Mycetopoda siliquosa</i> (Spix, 1827)	Faquinha-truncada	VU ^{3,6}

¹São Paulo List (SP, 1998); ²Rio de Janeiro List (Bergallo *et al.*, 2000); ³Rio Grande do Sul List (Marques *et al.*, 2002); ⁴Brasil List (Machado *et al.*, 2005); ⁵Pará List (SEMA-PA 2007); ⁶Brasilian Red List (Machado *et al.*, 2008); ⁷IUCN Red List (2010).

Leiostracus perlucidus (Spix, 1827) (Bulimulidae) and species of *Megalobulimus* (Santos *et al.*, 2009; Santos, 2009).

Considering all the state and federal lists combined, there are 47 threatened non-marine species (27 freshwater bivalves, 2 freshwater and 17 terrestrial gastropods) (Table 3). This is almost 20% more species than actually listed in the federal Brazilian Red List (Machado *et al.*, 2008), which does not include all the species in the four state lists, for example *Pomacea sordida*, listed in the Rio de Janeiro list but not in the federal list. The real number of threatened species is probably even higher, particularly as in some poorly studied genera, for example *Drymaeus* Albers, 1850 and *Megalobulimus* Miller, 1878 in the Rio de Janeiro list (Bergallo *et al.*, 2000), there is more than one species, not identified, but under threat.

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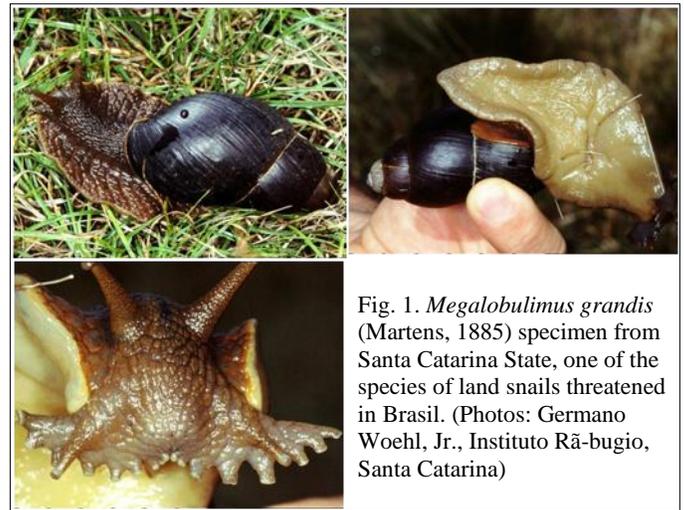


Fig. 1. *Megalobulimus grandis* (Martens, 1885) specimen from Santa Catarina State, one of the species of land snails threatened in Brasil. (Photos: Germano Woehl, Jr., Instituto Rã-bugio, Santa Catarina)

species are already listed is because they are very well recognised by everyone. However, the destruction and alteration of natural environments, mainly caused by deforestation and the spread of agricultural plantations, often involving indiscriminate use of agro-chemicals, in conjunction with lack of adequate studies mean that the sizes of their remaining populations are unknown.

Introduction of alien species, such as the giant African snail, *Achatina (Lissachatina) fulica* Bowdich, 1822, is one of the most serious threats that our malacofauna faces. *Achatina fulica* has spread rapidly to all states in Brasil (Thiengo *et al.*, 2007). Hasty public attempts aimed at eradication and control of *A. fulica* in particular, with increasing efforts since at least 2003, have led to a further unexpected and serious threat to our already suffering and vulnerable fauna of native and endemic molluscs. Prompted by the threats posed by *A. fulica*, campaigns conducted through the news media have alarmed the public, who now indiscriminately consider any snail to be a dangerous enemy to be quickly banished or destroyed, an attitude that prevails in the face of what should be effective defense and conservation of our scientifically little known species of South American snails (Agudo-Padrón, 2012).

This situation needs immediate urgent attention from the relevant authorities to provide the necessary clarification for the public and to seek collaborative solutions that are truly effective, viable and considered that can solve the catastrophic environmental conflict now underway.

On a continental scale of priorities regarding mollusc conservation, freshwater molluscs are the most in need of immediate attention, as many human actions are recklessly detrimental to their restricted and fragile habitats. Terrestrial species are the next priority, with marine species lowest priority. However, this is in contrast to general practice, as whenever the issue of the conservation status of molluscs in Brasil is addressed, almost invariably the immediate center of attention is directed in the first instance to marine species, followed soon after by freshwater species, leaving terrestrial species last in the ranking, a situation that is invariably explained/justified immediately by the lack of researchers focussed on terrestrial snails, and the consequent lack of required minimum ecological and population data.

THREATS TO CONTINENTAL MOLLUSCS IN BRASIL, WITH SPECIAL EMPHASIS ON LAND GASTROPODS

By A. Ignacio Agudo-Padrón

Currently, around 700 species of terrestrial gastropods are known from South America. Of these, only 11 are listed in the Brazilian Red Book (Machado *et al.*, 2008). All are stylommatophorans: two species of Bulimulidae, five Megalobulimidae (Fig. 1), one Streptaxidae and three Strophocheilidae. The status categories listed in the Brazilian Red Book differ in some cases from those in the IUCN Red List (IUCN, 2012). In practice, many more species than just these 11 are threatened.

It is the general consensus among those who work with terrestrial gastropods in Brasil that many native mollusc species are under serious threat of extinction, including species that are as yet unknown. The reason why these 11

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THE MONSOON FOREST REFUGE OF THE ONLY CHINESE AMPHIDROMUS

By Li Du, Qin Xu & Min Wu

Amphidromus Albers, 1850 is a camaenid genus comprising more than 70 splendid tropical species widely distributed in South Asia including Peninsular Malaysia, Thailand, Cambodia, Laos, China (Hainan and Taiwan), Singapore, Indonesia and some nearby islands. In 2005, we found an empty shell of *Amphidromus rhodostylus* Moellendorff, 1901 (Fig. 1) on the ground of the partially burned monsoon forest of Exianling, Dongfang county of Hainan, accompanied by many shells of *Achatina fulica* Bowdich, 1822. Before and after that find, no empty shells or living specimens were found by us again, even in the well preserved part of Exianling forest, which is not far from the Jianfengling National Park. In June 2008, Mr. Gang Lu, a biodiversity conservation volunteer took a photograph of *A. rhodostylus* near Weidong Forest Conservation Station, 230 m asl in Jianfengling National Park (established in 1976, ca. 447 km²) (Fig. 2). One juvenile specimen was observed active on a broad leaf of *Castanopsis fissa* (family Fagaceae) (Fig. 3).

To date only one species, *A. cognatus*, of the genus *Amphidromus* has been listed by IUCN, assessed as Lower



Fig. 1 *Amphidromus rhodostylus* Moellendorff, 1901. BUMM04829, Exianling, stone forest, Dongfang county, Hainan, 27 March 2005, 316 m asl, 19°00'33.5"N, 109°05'15.8"E, collected by Min Wu & Gang Qi. The apex was broken when the animal was alive.



Fig. 2. A river passes through 'the best lowland forest of Hainan', Jianfengling, where *Amphidromus rhodostylus* were found. (Photo: Gang Lu, 2008)



Fig. 3. A juvenile (the same specimen) of *Amphidromus rhodostylus* illustrating the arboreal habitat. Jianfengling National Park, Hainan. (Photo: Gang Lu, 2008)

Risk/Near Threatened (IUCN, 2012). More information on nearly all *Amphidromus* species is needed so that they can be assessed, although in recent years many malacologists have been working on various aspects of this genus. Our several years' field investigation in Hainan Island suggests Jianfengling is the only known locality of *Amphidromus rhodostylus*, a highly endangered land snail species deserving

to be focused upon right now.

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NON-MARINE MOLLUSC CONSERVATION IN SOUTHERN BRASIL: CURRENT SITUATION IN NORTHWESTERN RIO GRANDE DO SUL STATE, UPPER URUGUAY RIVER BASIN

By A. Ignacio Agudo-Padrón

The municipalities of Derrubadas (27°15'54"S, 53°51'39"W; elevation up to 485 m asl; with river borders with Argentina in the north-west and the Brazilian state of Santa Catarina in the north-east) and Iraí (27°11'38"S, 53° 15'03"W; elevation up to 235 m asl; with a river border with Santa Catarina state to the north) are located in the upper Uruguay River basin region of Rio Grande do Sul state, southern Brasil (Fig. 1).

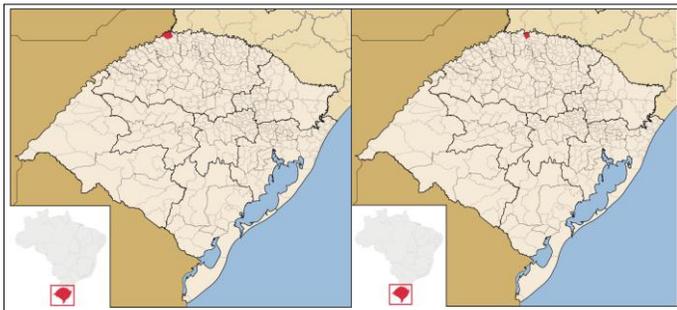


Fig. 1. Locations of Derrubadas (left - downstream) and Iraí (right - upstream) municipal districts of Rio Grande do Sul state, southern Brasil. Insets: location of Rio Grande do Sul State in Brasil.

The general area, a region of seasonal deciduous forest, has a mesothermal humid climate, with high temperatures in summer and relatively low temperatures during the winter, and an average annual temperature of 24.5 °C (from June to October the temperature can drop to 0 °C).

The Parque Florestal Estadual de Turvo (Turvo State Forest Park) is in Derrubadas municipality. The famous Salto do Yucumã (Yucumã falls) (Figs. 2, 3), one of the longest waterfalls in the world at 1800 m (Gonçalves, 1999), is located within the park. The park lies within the so-called Paraná River Basin Basaltic Plateau, and has altitudes ranging between 100 and 400 m with steep slopes and valleys that open to the west and north, resulting in natural drainage into the Uruguay River system.

The park covers an area of 17,491 ha and supports some of the tallest forests in the state, with trees up to 30-40 m tall, the last remnants of the dense forest of the upper Uruguay, a



Fig. 2. The Yucumã falls and their environment between Argentina and Brasil.

formation with similar characteristics to the Iguazú Waterfalls National Park in southern Paraná State (Agudo-Padrón, 2008).

Upstream is Iraí municipality, well known as a hidromineral resort, its thermal mineral waters recommended as a treatment by doctors and specialists and attracting visitors from all over Brasil and neighboring countries. The Rio do Mel (Honey River) (Fig. 4), an important tributary of the Uruguay River, and flows through the Oswaldo Cruz Thermal Spa, 2 km distant from its entry into the Uruguay. At 200 m outside the Spa, its average depth is 2 m and average width is 20 m.

On 15-18 November 2011, in the course of travelling for environmental survey work in the upper Uruguay River basin region, we visited these two localities. Only the Turvo State Forest Park remains relatively intact, resisting the relentless advance of the agricultural fields that surround it and the threats that they pose.

This region has suffered severe deforestation as a result of logging, intensive monoculture of crops (specifically wheat, soy and corn), clearing for pastures (Fig. 5), livestock farming (pigs and poultry) and constant and indiscriminate application of pesticides, leaving only sparse small areas of preserved forest known as 'legal reserve' that are mandated by the Brazilian Forest Code and that unfortunately are unrepresentative of the great forests of former times.



Fig. 3. Aspects of the field visit to the Yucumã Waterfalls.

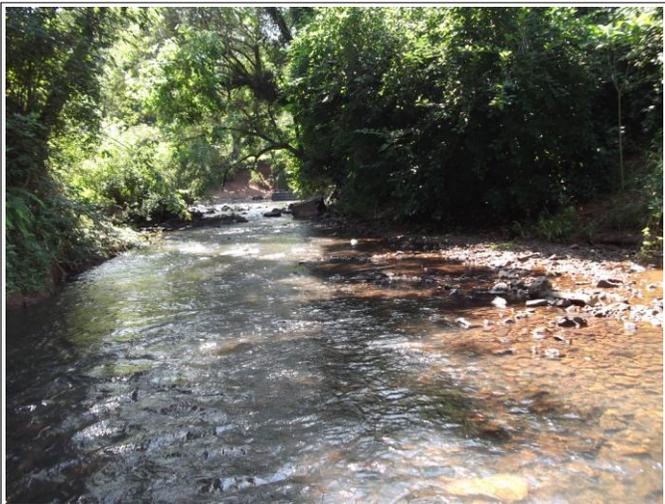


Fig. 4. The Rio do Mel (Honey River) in Iraí municipality.

Another big regional problem is the proliferation of both large and small hydroelectric power plants throughout the watershed of the upper Uruguay River basin.

This continuing environmental degradation is clearly reflected in the impacts sustained by the local faunal biodiversity, particularly the terrestrial molluscs, with native endemic forest megasnails such as *Megalobulimus gummatius* (Hidalgo, 1870) (Megalobulimidae) and others that were formerly abundant and widespread in the region now fast disappearing, becoming increasingly rare and difficult to encounter in nature (Agudo-



Fig. 5. Agricultural fields around the Turvo State Forest Park.



Fig. 5. Shells of *Corbicula* spp. (right) and fragments of the native freshwater gastropod *Pomella americanista* (left).

Padrón, 2010, 2011b).

In addition there has been a parallel and alarming introduction and spread of invading alien molluscs (Agudo-Padrón & Lenhard, 2010; Agudo-Padrón 2011a, 2012a, b).

The only land snail we found was the alien Asian garden snail, *Bradybaena similaris* (Rang, 1831). In the two freshwater localities visited, alien Asian clams, *Corbicula fluminea* (Müller, 1774) and *Corbicula largillierti* (Philippi, 1844), were predominant (Fig. 5), with very few native species and these only rarely observed, suggesting that they are under some degree of threat.

The Uruguay river basin is important from a mollusc biodiversity perspective. For instance, it supports 42 species (18%) of Brasil's freshwater bivalves, making it the third most diverse hydrogeographic basin in Brasil after the Paraná/Paraguai and the Atlântico Sul/Sudeste basins (Pereira *et al.*, 2012).

This short article is the first report of non-marine molluscs occurring in the northwestern region of the state of Rio Grande do Sul and the corresponding section of the upper Uruguay river basin.

Native mollusc species found

Class GASTROPODA

Family AMPULLARIIDAE

Pomella americanista (Ihering, 1919) (Fig. 6). Known from the vicinity of Iguacú and Encarnación in the Rio Paraná system (Ihering, 1919). Previously recorded in Rio Grande do Sul by Agudo-Padrón (2009).



Fig. 6. Fresh shells of *Pomella americanista* (left) and eggs in the Rio do Mel (right).

Felipponea neritiniiformis Dall, 1919. The genus is endemic to the Uruguay River basin (Clavijo *et al.*, 2010). Previously recorded in Rio Grande do Sul by Agudo-Padrón (2009).

Family HYDROBIIDAE

Potamolithus cf. catharinae Pilsbry, 1911. Previously recorded in Rio Grande do Sul by Agudo-Padrón (2009).

Class BIVALVIA

Family MYCETOPODIDAE

Anodontites tenebricosus (Lea, 1834) (Fig. 7). Assessed as IUCN threat category Vulnerable (Agudo-Padrón, 2011b). Previously recorded in Rio Grande do Sul by Agudo-Padrón (2009).



Fig. 7. Fresh shell of *Anodontites tenebricosus*.

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PACIFIC ISLAND LAND SNAILS

Hawaiian land snail project

By Norine W. Yeung, Kenneth A. Hayes & Robert H. Cowie

Taxonomy is crucial to credible, reproducible and comparable biological studies and the rapid loss of biodiversity underlines the urgency for training taxonomic experts. Gastropoda is the largest class of Mollusca, the second largest animal phylum, yet lags behind other major groups in taxonomic effort. Island faunas, especially land snails, have been key in the development of ideas of evolution, ecology and biogeography.

The Hawaiian land snail fauna is arguably the most diverse in the world in relation to land area: >750 currently valid species. Yet reflecting the isolation of the Hawaiian Islands only 10 families are represented, making the fauna eminently tractable taxonomically. Although certain groups were revised during the early 20th century none has been comprehensively analyzed in a contemporary systematic-phylogenetic context using modern morphological and molecular techniques and the real species diversity is poorly known.

The fauna is under severe threat, but levels of extinction have been based solely on conjecture (Solem, 1990; Lydeard *et al.*, 2004) and never adequately assessed. Our project, which is funded by the U.S. National Science Foundation, is using a comprehensive approach to understanding the diversity,



Fig. 1. Adult specimens of *Cookeconcha hystericella* (left) and *Pleuropoma oahuensis* (right) from the island of Oahu. Scale bars = 1 mm. (Photos: K.A. Hayes)



Fig. 2. Two species of *Auriculella* from the island of Oahu. Top: *A. tenella*; bottom: undescribed species. (Photos: N.W. Yeung)

phylogenetic relationships and taxonomy of the Hawaiian land snail fauna. The primary goals of the project are:

- Complete a comprehensive and systematic survey of the Hawaiian land snail fauna
- Develop comprehensive phylogenetic hypotheses for all Hawaiian land snail species using material from the above survey and the extensive museum material available
- Update the taxonomic framework of Hawaiian land snails using an integrated phylogenetic and morphological approach, and describe/redescribe taxa as necessary

So far we have collected >60 species, several of which have not been seen in decades, and a few not seen since their original descriptions and that were thought to be extinct. In particular, we discovered species of Endodontidae and Helicinidae that are extremely rare and have only been



Fig. 3. SEM images (left to right: apertural, aperture, umbilical) of genetically distinct Tornatellidinae individuals from the island of Maui. Scale bars = 1 mm. (Photos: N.W. Yeung)

recorded a few times since their original description, but were found in our early surveys (Fig. 1). We have obtained genetic data (mtDNA and nDNA) for 95% of the species collected recently and >250 specimens from the Bishop Museum (Honolulu) collections. Preliminary phylogenetic analyses of these data indicated a large amount of cryptic diversity, which translates into a much higher biodiversity of land snails in Hawaii than previously thought. For example, there are only three species of the genus *Elasmias* described from Hawaii. However, our data recovered five discrete genetic lineages that correspond to distinct morphologies. Similarly, we have already found 29 species of Helicarionidae while only 66 have been described from Hawaii (Cowie *et al.*, 1995). Additional sampling is sure to recover numerous others. We have also found an undescribed *Auriculella* sp. (Fig. 2) on Oahu and an undescribed succineid on the island of Kauai. Thus, despite the grim reports of the demise of much of the land snail fauna, many species (described and undescribed) still remain and there is hope that they can be preserved for future generations.

We have obtained scanning electron micrographs of shells (Fig. 3) and radulae from numerous species representing the five subfamilies of the Achatinellidae, and these data corroborate the patterns of species diversity and monophyly recovered in our molecular analyses.

In addition to phylogenetic, anatomical and biogeographic data, we have also begun collecting ecological and life history

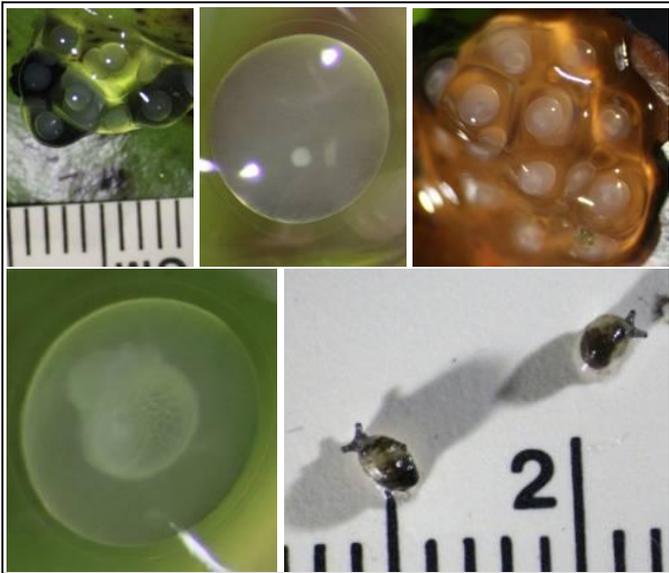


Fig. 4. Reproduction of *Catinella lumbalis*. Top row left to right: 1 day old eggs, close up of 1 day old egg, 7 day old eggs with embryos visible; bottom row left to right: close up of 7 day old egg, 6 day old hatchlings. (Photos: K.A. Hayes)

data from a number of species. In particular we have targeted species that are extremely rare (e.g. heliciniids, amastrids, endodontids) with little to no data on their reproductive habits. We have already documented previously unknown details of the life history of *Catinella lumbalis*, a Kauai endemic succineid (Fig. 4), and recorded the eggs of *Pleuropoma* sp. and *Auriculella* sp. from Kauai and Oahu respectively.

Addressing our ambitious goals will provide major contributions to malacology and to evolutionary biology and offers the opportunity to address fundamental issues related to the conservation of a vanishing fauna.

We thank all the students in our lab, the large and extensive group of collaborators from the National Tropical Botanical Gardens, Oahu Army Natural Resources Protection Program, Hawaii Department of Land and Natural Resources and the Nature Conservancy, and Brenden Holland, Gary Barker and Marta deMaintenon.

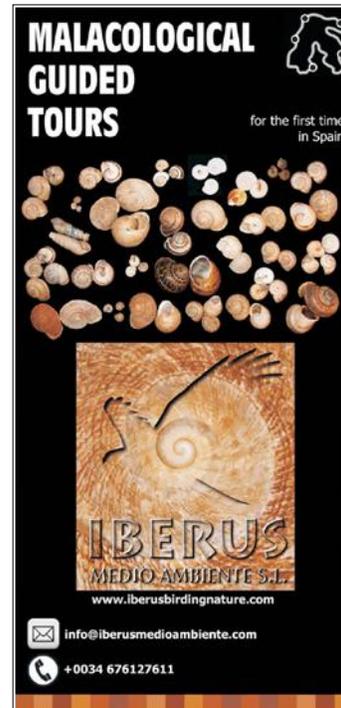
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MALACOLOGICAL TOURISM IN SPAIN



[Iberus Birding & Nature](http://www.iberusbirdingnature.com) is a Spanish company that has worked during the last few years on education and environmental conservation. They have recently developed tours carefully designed for lovers of terrestrial molluscs. You can find more information by going to their home page, clicking on 'Tours' then click on 'Nature' from the drop-down list, then 'Andalusian molluscs' from the next list.

RECENT PUBLICATIONS RELEVANT TO MOLLUSC CONSERVATION

All reviews and comments are by the Editor of *Tentacle*, Robert Cowie.

The Sound of a Wild Snail Eating

Elisabeth Tova Bailey, 2010. Algonquin Books of Chapel Hill, Chapel Hill, North Carolina, USA. ISBN 978-1-56512-606-0. US\$18.95.



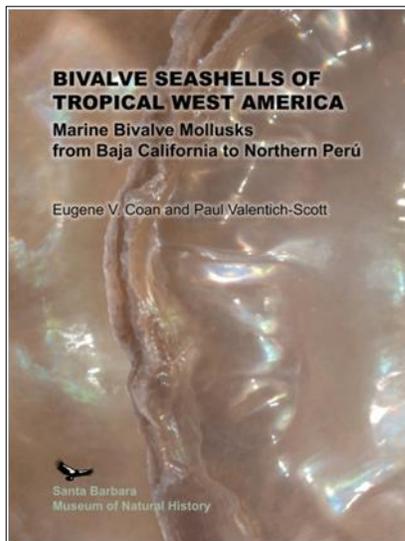
This delightful book was reviewed in *Tentacle* 19 (2011). In *Tentacle* 20 (2012) I announced publication of the Korean edition and the forthcoming publication of the German edition.

The book is now available in Taiwan (left hand cover, above) and mainland China (right hand cover). Later in 2013 French and Japanese editions will come out.

The author tells me that she is ‘working with a group of 9th grade biology students this winter [2012/13] on a project we are calling the Wild Snail Migratory Book Project. The students will ‘release’ about 40 books to public locations and then track where the books go via a website. It should be fun and interesting!’

Check out the [author’s website](#).

Bivalve Seashells of Tropical West America



- The most extensive book ever written on tropical marine bivalves
- 890 species, with detailed descriptions and distributions
- Over 5000 full color photographs, and 150 drawings
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‘A magnificent, full-color revision of a rich tropical fauna. A book of lasting value not just for the region, but for anyone interested in marine bivalves. Sure to become a modern classic.’ - Dr. David Jablonski, University of Chicago.

‘The color illustrations are superb and clearly depict morphological characters with taxonomic value. It will immediately become a crucial reference for biodiversity and ecological studies.’ - Dr. Martha Reguero, Universidad Nacional Autónoma de México.

‘It is clearly written and exhaustive definitively an essential reference book for every amateur and professional malacologist.’ - Dr. Eduardo Rios, Universidad de Guadalajara, México.

‘This is an indispensable work for professional and amateur malacologists interested in the identification, systematics and biogeography of marine bivalves..... destined to be an enduring classic.’ - Dr. George M. Davis, George Washington University Medical Center, Editor of *Malacologia*.

‘...destined to become instant classics that needs a prime spot on the malacological bookshelf...’ - Dr. Rüdiger Bieler, Field Museum of Natural History, Chicago.

[Download PDF to order.](#)

MalaCo – an online journal



MalaCo (ISSN 1778-3941), a peer reviewed journal referenced by the *Zoological Record*, is an electronic open access publication. Articles, in French or English, focus on the ecology, biology, systematics and conservation of continental [European] molluscs. *MalaCo* publishes original work as well as news, short notes and practical tools for species identification.

Since the last issue of *Tentacle*, two issues of *MalaCo* have appeared, issues 8 and 9.

Since November 2007, articles have become available on the *MalaCo* website as soon as they are accepted. To submit papers, please see author recommendations and contact the editorial team: J.-M. Bichain, X. Cucherat, B. Fontaine, O. Gargominy and V. Prié.

For more information contact Mollusc Specialist Group member jean-michel.bichain@educagri.fr

Journal of Threatened Taxa

The latest issue (Vol. 5, No. 5) of the *Journal of Threatened Taxa* is available on line now.

Other publications of interest

This is by no means 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*.

Braby, M.F., Willan, R.C., Woinarski, J.C.Z. & Kessner, V. 2011.

Land snails associated with limestone outcrops in northern Australia - a potential bioindicator group. *Northern Territory Naturalist* 23: 2-17.

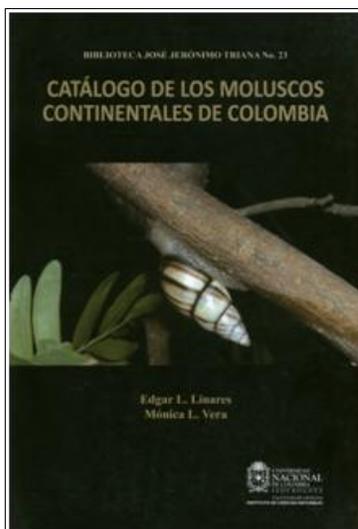
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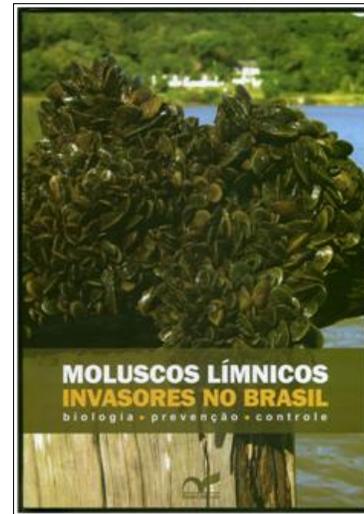
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IUCN, SSC AND MOLLUSC SPECIALIST GROUP NEWS AND ANNOUNCEMENTS



www.iucn.org/

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

Freshwater species in Indo-Burma region under threat

An assessment of 2515 described freshwater species in the Indo-Burma region by the International Union for Conservation of Nature (IUCN) and partners has revealed that 13% of these species are threatened with extinction. The report comes at a time when large scale hydrological development is underway, or is proposed, throughout this region, which is known for its exceptionally high diversity of freshwater species. This [IUCN Red List of Threatened Species](#) assessment details the location and status of all described species of freshwater fish, molluscs, odonates, crabs and selected families of aquatic plants within each of the 1082 individual river or lake sub-catchments across the region. As the most comprehensive assessment yet of freshwater species in this global biodiversity hotspot, it provides valuable information that can help mitigate and minimize the impact of ongoing and future hydrological developments throughout the region.

The report is available on line: [The Status and Distribution of Freshwater Biodiversity in Indo-Burma](#).

New IUCN SSC Policy Subcommittee underway

The new Policy Subcommittee (PSC) aims to increase the visibility of species issues in policy fora with a view to achieving the best possible conservation outcomes for species. The committee will coordinate SSC activities related to policy in multilateral and intergovernmental fora and provide advice to SSC and IUCN, based on the best available science. SSC Steering Committee members and Chairs of Specialist Groups have been asked to nominate members of the PSC. Stay tuned for more information as the committee members are selected and activities get underway. Please contact the Chair, Susan Lieberman slieberman@pewtrusts.org with any questions.

2012 IUCN Congress Resolutions

Resolutions and recommendations from the 2012 IUCN World Conservation Congress are now available online in English,

French and Spanish, along with the related voting records. The Resolutions process remains a central element of IUCN's governance system and an important means by which members can influence future directions in the conservation community and seek international support in various conservation issues. These [Resolutions and Recommendations](#), together with the IUCN Programme 2013-2016, constitute the foundation for the work of the Union and assist IUCN in achieving its mission.

IUCN's Red List of Ecosystems is now starting assessment work

From Australia to Patagonia, from coral reefs to rainforests and deserts, the new [IUCN Red List of Ecosystems](#) will assess the status of ecosystems worldwide, to identify their risks and the potential impact on both ecosystems and human wellbeing.

Modelled on the influential IUCN Red List of Threatened Species, the Red List of Ecosystems will identify if an ecosystem is Vulnerable, Endangered or Critically Endangered, based on an agreed and internationally accepted set of criteria for risk assessment. In addition to providing a global standard for assessing the status of ecosystems, the outputs of the Ecosystem Red List could also be used to inform on the current and future threats to the services that such ecosystems provide, such as clean water, climate regulation and natural products.

'Natural environments are under increasing pressure from unsustainable use and other threats', says Jon Paul Rodriguez, Leader of the IUCN Commission on Ecosystem Management's Ecosystems Red List Thematic Group. 'Functional ecosystems are essential to our livelihoods and wellbeing. We will assess the status of marine, terrestrial, freshwater and subterranean ecosystems at local, regional and global levels. This, in turn, will help inform on the link between such systems and the livelihoods of those who depend on them. The assessment can then form the basis for concerted implementation action, so that we can manage them sustainably if their risk of collapse is low, or restore them if they are threatened and then monitor their recovery'.

The [Red List of Ecosystems](#) can help guide conservation action on the ground, including land use planning and investment priorities, by evaluating the risks of ecosystem collapse and the subsequent loss of ecosystem services. This can be a basis for landscape and economic analysis, which then forms the basis for action, leading, for example, to ecosystem restoration and improved governance.

WCPA-SSC Joint Task Force on Biodiversity and Protected Areas seeks population abundance data for global study

The WCPA-SSC Joint Task Force on Biodiversity and Protected Areas is continuing its work to understand the best predictors of success in conserving protected areas. The Task Force has been successful in assembling and analysing a

global data set, but still needs to broaden the analysis and reduce data biases. In a new collaboration with the [Zoological Society of London](#) and [WWF](#), we are seeking additional population abundance time series data to support the global study and refine regional analyses for both terrestrial and marine realms. This project aims to gather data on changes in population abundance for vertebrates and invertebrates, both inside and outside protected areas, to address this issue. To find out more about the project and how to contribute, please contact Sarah Whitmee: sarah.whitmee@ioz.ac.uk.

IUCN/TRAFFIC Analyses of Proposals to amend CITES Appendices for CITES CoP16

In preparation for the CITES CoP16 meeting that took place 3-14 March 2013 in Bangkok, Thailand, IUCN and TRAFFIC released the [Analyses of the Proposals](#) to Amend the CITES Appendices on 24 December 2012. More information and the Analyses are available.

Changes to the IUCN Red List assessment process

Some significant changes to the IUCN Red List assessment process have been made that are intended to help expedite the time taken to complete a Red List assessment in order for it to be included on the global IUCN Red List. These new rules are in immediate effect and it is hoped they will help dramatically improve the time taken to complete any single assessment while still maintaining the necessary rigour of the Red List. The new supporting information requirements for IUCN Red List assessments can be found as Annex 1 to the document [Rules of Procedure for the IUCN Red List Assessment process 2013-2016](#).

IUCN workshop on freshwater Key Biodiversity Areas in Bosnia

The Freshwater Biodiversity Unit of the IUCN Global Species Programme organised a workshop bringing together a range of stakeholders to validate freshwater Key Biodiversity Areas (KBAs) in the southern European part (Balkan region) of the Mediterranean Biodiversity Hotspot.

In this [workshop](#), held in Jahorina (Bosnia and Herzegovina) during 11-13 December 2012, experts evaluated, completed and validated the river or lake catchments previously identified and proposed as freshwater KBAs for this part of the Mediterranean. They also identified priority actions for each catchment. This work aims to provide the foundation for the creation of a representative protected areas network for freshwater species, as well as the resources that are essential for guiding decisions on the conservation and sustainable management of freshwater biodiversity in the Mediterranean Basin Biodiversity Hotspot. This includes all the species of freshwater molluscs (gastropods and bivalves) that were assessed as part of the European project that was completed in November 2011.

KBAs are sites that contribute significantly to the global persistence of biodiversity.

The importance and urgency of this work is evident from the concentration of species found in the fresh waters of the Mediterranean Basin, the ecosystem services that are supplied to human communities by these fresh waters and their biodiversity, and the increasing threats to these ecosystems. This was the first stakeholder KBA workshop, organised in collaboration with the IUCN Centre for Mediterranean Cooperation. This project is part of the initiative 'Mediterranean Biodiversity Assessment II', identification of important freshwater areas funded by various partners including EU project [Biofresh](#), [MAVA Foundation](#) and [CEPF](#).

Access the Freshwater BioBrowser on your iPhone

The Freshwater BioBrowser, a simple interactive map that allows you to explore the biodiversity of Africa's freshwaters, can now be accessed on your smartphone! It works best on iPhones but is also available on android phones. To access it, download the [ArcGIS app](#) and search for 'Freshwater BioBrowser'.

Conservation Leadership MS Program - Colorado State University

CSU's Conservation Leadership Program, also called, Conservation Leadership Through Learning (CLTL), is a 21-month Master of Science degree that will prepare students to be a part of the next generation of conservation leaders who will tackle these dynamic challenges. CLTL merges trans-disciplinary university education with real-world action to train leaders who can deliver on-the-ground benefits for conservation and communities. By reaching far beyond the classroom walls, students will develop the knowledge and real-world skills to become effective conservation leaders making a difference for the environment and people's lives. CLTL is a partnership between Colorado State University's Warner College of Natural Resources, Universities, NGOs, government agencies and local communities around the world. For more information see the [CLTL website](#) or contact leadership@warnercnr.colostate.edu. It is too late to apply for admission in 2013 but there may be an opportunity in 2014.

Masters in Conservation Leadership at the University of Cambridge

The course is a full-time, one year Masters degree, aimed at graduates of leadership potential with at least three to five years of experience relevant to biodiversity conservation. The unique feature of the course is its delivery by a collaboration between six University of Cambridge departments and nine leading conservation organizations based around Cambridge, and its focus on issues of management and leadership. A key aim of the course is to build the capacity of conservation leaders from tropical countries. Further details of the course and scholarships can be found at its [website](#).

IUCN Commission Newsletters

World Commission on Protected Areas: [WCPA News update](#)
 Commission on Education and Communication: [CEC Newsletter](#)

Commission on Environmental Law: [CEL Newsletter](#)
 Commission on Ecosystem Management: [CEM News Ecosystem](#)

Commission on Commission on Environmental, Economic and Social Policy: [CEESP Newsletter](#)

MEETINGS 2013-14

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.

World Congress of Malacology



The World Congress of Malacology is the emblematic event of UNITAS MALACOLOGICA (UM). The 2013 congress will be held on the main campus of the University of the Azores, at Ponta Delgada, São Miguel, 21-28 July 2013. It is the 18th International Congress of UM, the 6th after UM has become a worldwide association. The congress will be run in conjunction with a number of its affiliated societies, including the Malacological Society of London and the American Malacological Society (which will not have a separate annual meeting in 2013) and others. Details at the [congress website](#).

Western Society of Malacologists 2013



The [2013 WSM meeting](#) will be held in San Diego, California, USA, 23-26 June 2013.

American Malacological Society 2013 meeting



The American Malacological Society will hold its 2013 meeting in conjunction with the World Congress of Malacology in the Azores. Check the [AMS meetings website](#) and the [WCM website](#) for details.

Conchologists of America 2013 Convention



The COA will hold its 2013 convention in Sarasota, Florida, USA, 17-21 July 2013. See the [COA conventions page](#) for more details.

Brasilian Society of Malacology: 23rd EBRAM



The Brazilian Society of Malacology (SBMa – Sociedade Brasileira de Malacologia) will hold its XXIII Brazilian Malacological Meeting in Rio de Janeiro, 22-25 October 2013. The congress will be hosted by the University of the State of Rio de Janeiro (UERJ), Maracanã Campus. A Symposium of Young Latin-American Taxonomists is planned. It will be a great opportunity for all young researchers to discuss and exchange their results. As 2013 is the International Year of Water Cooperation, there will be an emphasis on aquatic molluscs and environments. In addition, special sessions of contributed papers, oral presentations and posters will be open to all aspects of malacology. Registration will begin on 1 March 2013. More information will become available as soon as possible at <http://www.sbmalaecologia.com.br>, or contact Dra. Sonia Barbosa dos Santos, President of the SBMa: sbmalaecologia@yahoo.com.br.

First Argentinean Congress of Malacology



The first Congreso Argentino de Malacología will take place 18-20 September 2013, organised by the Asociación Argentina de Malacología (ASAM) and the la Facultad de Ciencias Naturales y Museo of the Universidad Nacional de La Plata.

For more information, visit the [congress website](#) or contact Dr. Gustavo Darrigran at darrigran@gmail.com.

Society for Conservation Biology 2013



The [SCB](#)'s 26th International Congress for Conservation Biology, previously annual, is now biennial. The 2013 Congress will be held in Baltimore, Maryland, USA, 21-25 July. Details are available at the [ICCB 2013 website](#).

Mollusca 2014: The Meeting of the Americas

Mollusca 2014: The Meeting of the Americas, the first All-America malacological conference, will be held at Universidad Nacional Autonoma de Mexico, Mexico City, 23-27 June 2014. This first All-America meeting is jointly organized by Sociedad de Malacología de Mexico, Western Society of Malacologists, American Malacological Society and Asociacion Latinoamericana de Malacologia. The President is Dr. Edna Naranjo from UNAM.

Follow Mollusca 2014 on Facebook, Google Plus, Orkut (Brazil) and Twitter, join our email list writing to mollusca-2014-info%2Bsubscribe@googlegroups.com, or write to mollusca2014@gmail.com for more information.

American Malacological Society 2014 meeting



The American Malacological Society will hold its 2014 meeting in conjunction with the Mollusca 2014 meeting in Mexico City. Check the [AMS meetings website](#) and the Mollusca 2014 website when it

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 www.redlist.net www.iucnredlist.org

IUCN Invasive Species Specialist Group

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

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* 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*.

Mollusca list

The MOLLUSCA listserv 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

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

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 listserv (above) and to access the MOLLUSCA archives.

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

Unio listserv

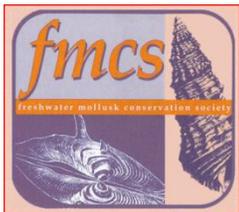
[Unio](#) is an unmoderated internet listserv focusing on the biology, ecology and evolution of freshwater unionid mussels. The list is sponsored by the Florida Institute of Technology and administered and managed by Rick Tankersley (rtank@fit.edu).

American Malacological Society



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

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 [Walkerana](#) 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*.

Malacological Society of Australasia



The [Malacological Society of Australasia](#) is networked with the leading conservation organizations, and is working with the IUCN Mollusc Specialist Group to list

Australia's threatened and endangered species of molluscs.

The Malacological Society of London



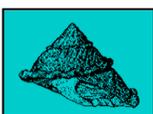
One of my favourite logos, *Pomacea canaliculata* by David Reid, modified from the original [Malacological Society of London](#) logo. Research and travel grants and awards are made each year.

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.

Western Society of Malacologists



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

The National Museum Wales – Mollusca

The [Mollusca page](#) of the National Museum of Wales provides information on the global projects on molluscs underway based in Cardiff.

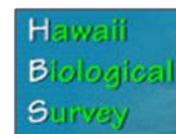
Field Museum land snails

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 2500 type lots, of land snails.

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.

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.

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.

Samoan 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](#).

Jamaican land snail project

A [key to Jamaican land snails](#) is now online, on the DiscoverLife website. The key, with many excellent photographs, is part of [Gary Rosenberg](#)'s work on the Jamaican fauna. Comments can be sent to Gary Rosenberg, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195, USA. Tel +1 215 299 1033, fax +1 215 299 1170, rosenberg@ansp.org.

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.

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.

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.

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.

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.

Other useful links

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

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

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