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

TENTACLE

UNITAS MALACOLOGICA

EDITORIAL

The United Nations declared 2010 the International Year of Biodiversity – a celebration of life on earth and of the value of biodiversity for our lives. So, biodiversity for its own sake – a philosophical concept – and biodiversity as useful to humanity because it provides food, tourist revenue, ecosystem services and so on, or simply aesthetic pleasure. In the words of the great American conservationist Aldo Leopold, who wrote 'Is my share in Alaska worthless to me because I shall never go there?' (*A Sand County Almanac*, 1949), just knowing it exists is of value to us. I may never see an endangered endemic New Zealand *Powelliphanta augusta*, a large land snail that preys on earthworms and that is currently threatened by coal mining, but I am glad to know that it exists and do not want it to go extinct. I do believe in the philosophical concept of biodiversity for its own sake, but I also get great satisfaction from knowing that spectacular plants and animals and their more mundane (to us perhaps) relatives are out there living their lives, whether I will ever see them or not. Elizabeth Tova Bailey's book *The Sound of a Wild Snail Eating* (reviewed on p. 48), I think implicitly, and beautifully, embodies this ethos.

But back to *Tentacle*. Once again the largest issue ever. The main articles begin with a major contribution from Alvar Carranza and colleagues. Longer than the three page limit I have set for most articles in *Tentacle*, it deserves publishing here because it potentially represents a watershed for marine mollusc conservation in South America. South America has arguably lagged behind other regions of the world in the assessment and conservation of mollusc biodiversity, but this continent-wide effort to bring together malacologists who are committed to conservation to develop a concerted conservation agenda is a huge step forward. The article, with authors from seven countries, is a timely summary of both the threats the marine molluscs of South America face and the efforts being made to surmount them. It is a landmark effort. We now need a similar collaborative effort to begin to address the South American non-marine molluscs, which are relatively poorly known but which face huge threats, especially from habitat destruction. Who will stand up and lead this?

Robert H. Cowie, Editor

In this issue:

TENTACLE – PUBLICATION GUIDELINES AND INFORMATION

If you plan to submit an article to Tentacle
PLEASE READ THESE GUIDELINES
AND FOLLOW THEM!

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. 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 journal. 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.

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

Also, 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. It takes me many many hours simply inserting commas or semi-colons or italicizing '*et al*.' – please do it for me! Especially, please pay very careful attention to the format of references in the reference lists.

Printing and mailing of *Tentacle* has been supported in the past by Unitas Malacologica, 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. 57 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

Carol Belle Stein

Carol Belle Stein (1937-2010) passed away in Johnstown, Ohio, on 6 December 2010. Carol, along with her advisor Dr. David Stansbery, nearly single-handedly created the Division of Molluscs at the Ohio State University. Carol's specialty was freshwater snails and she collected them with a passion at a time when few researchers paid any attention to them. Carol received her MS and PhD from Ohio State University and was a curator there for 31 years. She was among the first to realize the potential of electronic databases for museum data. She also pioneered the conservation of rivers and streams, lending her professional voice in protest against projects that would jeopardize these ecosystems. Her efforts paved the way for the successful Scenic Rivers Program both in Ohio and throughout the USA. After retirement Carol devoted herself to rescuing dogs and placing them in homes, including training dogs as companions to the elderly.

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Freshwater Gastropods of North America

The Freshwater Gastropods of North America project is pleased to announce one of the biggest steps forward in our 12 year history. Come visit us again, for the first time!

Returning users will immediately appreciate the fresh look and feel of our new web site, brought to us by talented designer Steve Bleezarde. Like previous versions of our site, fwgna.org may be entered geographically, through any of the four states currently covered. Users now also have the option of accessing our web resources taxonomically, through either an alphabetical index or a systematic index. The former index

includes an extensive list of synonyms, both generic and specific. The latter is sortable by state. Try both of these new portals to see what we mean!

Perhaps a less striking improvement, but certainly no less important, is the significant upgrade to our coverage of Virginia. Over 500 new records and six species have been added, bringing the total species indexed on the site to 65. For each of the species confirmed (or reported) for Virginia Atlantic drainages, we have developed one-page species accounts and made them available as pdf downloads. The present renovation of our site was made possible by funding from the Virginia Department of Game and Inland Fisheries, to whom we offer our sincere thanks.

Users entering through the old front door at cofc.edu will be routed directly to the new fwgna.org index page for the foreseeable future. But direct links to older versions of any of the (several hundred!) internal pages will eventually expire, and I'm not sure we'll be able to redirect users very efficiently. So update your bookmarks!

And keep in touch.

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TOWARDS A SOUTH AMERICAN NETWORK FOR SHELLFISH CONSERVATION AND RESTORATION

By Alvar Carranza, Omar Defeo, Adriana Gracia, Alex Gamarra, Marcela Pascual, Marcelo Henriques, Luis Prado, Luis León & César Lodeiros

Mussel and oyster beds or aggregations provide a wide variety of ecosystem goods and services, and are also of utmost importance in maintaining α-diversity (Borthagaray & Carranza, 2007, Thiel & Ullrich, 2002). However, these habitats may be among the most imperiled on Earth (Beck *et al*., 2008; Carranza *et al*., 2008a, 2009; Coen *et al*., 2007; Kirby, 2004; Ogburn *et al*., 2007). Apart from ecological considerations, conservation of shellfish habitats is critical since socio-economic regional development associated with aquaculture and artisanal fisheries practices is tightly linked to the condition of natural banks (Lovatelli *et al*., 2008). Thus, there is an urgent need in South America to raise awareness of these issues and to focus the scientific community on some of the most pressing data gaps concerning these species and habitats (Carranza *et al*., 2008a, 2009).

To this end, a workshop was convened during the VII Latin-American Malacological Congress (Valdivia, Chile, 8-9 November 2008) and experts from Colombia, Venezuela, Brasil, Uruguay, Argentina, Chile and Peru were invited. Here we present the main outcomes of this workshop, reporting updates on the current situation of oyster and mussel conservation in South America in the form of short country summaries. Further, we provide a comprehensive review of the condition of South American shellfish beds, review ongoing conservation actions, including shellfish restoration projects, and suggest priorities for future initiatives.

The condition of oyster and mussel beds or aggregations can be directly assessed because usually just one or occasionally a few species are responsible for the creation of the underlying structure for entire ecosystems. In this study, condition of oyster and mussel beds or aggregations was established based on the percent of shellfish remaining compared to historical baselines. This was done mainly based on estimates of abundance from the primary and 'grey' literature, supported when necessary by expert surveys when direct data were lacking. Condition categories were defined on the basis of percentages of current to historical indicators of abundance of oyster and mussel beds or aggregations remaining of > 50 % (fair), 11-50 % (degraded), 1-10 % (depleted) and < 1 % (functionally extinct). Where possible we gathered evidence that directly estimated the distribution of oyster and mussel beds or aggregations from past to present either from the same publication or from multiple publications. When using fisheries indicators, fully exploited populations or those close to or being exploited at their maximum sustainable yield were classified as in degraded condition (11-50 % remaining). In cases with fishery collapse and no evidence of renewal, the population was classified as depleted (≤ 10 % remaining). When references and surveys indicated that it was difficult and sometimes impossible to find any beds or aggregations or structures remaining in places where beds or aggregations had been extensive, we estimated that < 1 % of the habitat was remaining and the condition was identified as functionally extinct.

Argentina

The Puelche oyster, O*strea puelchana*, is distributed from southern Brasil (22º 56'S) to the San José Gulf, Argentina (42º 21'S), and is both economically and ecologically important (Castanos *et al*., 2001; Cremonte *et al*., 2005; Narvarte *et al*., 2007; Pascual & Zampatti, 1999; Pascual *et al*., 2002; Shilts *et al*., 2007). In addition, the Pacific oyster, *Crassostrea gigas*, was introduced in 1981 to the south of Buenos Aires province (Orensanz *et al*., 2002; Pascual & Castaños, 2000). Among mussels, the blue mussel, *Mytilus platensis*, extends along the coast reaching the north of Chubut, while the southern mussel, *Mytilus chilensis*, extends from the south of Chubut to Tierra del Fuego. The taxonomy of Argentinean *Mytilus* has yet to be clarified since different forms overlap along the coast. The ribbed mussel, *Aulacomya atra*, occurs on rocky intertidal and shallow water shores from Río Negro to Tierra del Fuego. The scallop *Aequipecten tehuelchus* inhabits shallow shelf bottoms of north Patagonia, sustaining fisheries mainly in the San Matías and San José gulfs (Orensanz *et al*., 1991).

The San Matías Gulf (41ºS; north Patagonia) offered the rare opportunity for studying the structure of one of the few natural and untouched flat oyster populations in the world, the Puelche oyster. The information gathered from extensive surveys performed from 1985 to 1991 helped support permanent closure of the *O. puelchana* fishery in 1980. Heavy

mortality occurred in aquaculture stocks in 1996, associated with a native strain of the parasite *Bonamia* (Kroeck & Montes, 2005). This, combined with clandestine small scale fishing and anthropogenic disturbances, has caused a significant depletion of natural populations during the last decade. This species is particularly vulnerable to exploitation because of its slow growth, common clustering habit and its peculiar reproductive strategy (small, dwarf males attached to larger females), a feature that makes it unique among bivalves (Pascual, 2000; Pascual *et al*., 1989).

Crassostrea gigas is well established in the field and now covers nearly 50 % of rocky substrata in Anegada Bay (Buenos Aires) (Pascual, unpublished data). This population is expanding south of the bay, invading the coast of the neighbouring province of Río Negro (C. Castaños & M.S. Pascual, pers. comm.). The scallop *A. tehuelchus* sustained an industrial dredge fishery during two periods in the 1970s and 1980s, and was completely depleted by several short pulses of fishing by small dredges and intensive diving. At present there are only scattered individuals in the San Matías gulf. The San José diving fishery resulted from a permanent ban of dredges since 1970. The fishery has been managed by the closure of some areas, legal sizes, quotas and restricted boat entry, which, combined with recruitment heterogeneity and diver behaviour, lead to comparative stability (Orensanz *et al*., 1991). In the north Patagonian San Matías gulf, *M. platensis* has been exploited by industrial dredging (1983-1992) and artisanal dredging and diving (2002-2008) (Morsan & Zaidman, 2009). Mussel populations have gradually declined in all grounds, and now occur at low densities and with poor recruitment. Dredging and absence of fishing regulations are possible causes of population decline (Morsan & Zaidman, 2009).

Restoration and/or conservation efforts are now focused on two species: the mussel *Mytilus platensis* and the oyster *Ostrea puelchana*, both in the San Matías Gulf (northern Patagonia). In the case of the Puelche oyster, these efforts aim to: 1) carry out extensive surveys to evaluate the state of the three main grounds and compare them with prior surveys; 2) determine the age of the oysters; and 3) initiate seeding experiments using hatchery seed to evaluate an alternative for restoring the most severely depleted beds or aggregations.

A more ambitious restoration project is focused on mussels, intended to recover the *M. platensis* population of El Sótano, a traditional mussel fishing ground located in an area historically characterized by strong recruitment. Almost a decade of intensive diving and dredging drove this population almost to extinction. The project will combine aquaculture practices and adaptive fishing, in a controlled closed and dredge-free experimental area, with the goal of restoring the population.

Brazil

Several oyster and mussel species can be found in estuaries, mangroves and rocky outcrops along the Brasilian coast. Currently, the brown mussel, *Perna perna*, is the most important species in southern Brasil, both in terms of landings and economic value. The estuarine mussels *M. charruana* and

Fig. 1. A local market in Valdivia, Chile. Shellfish are an important component of Chilean fisheries.

M. guyanensis and mangrove oysters, *Crassostrea* spp., are also exploited, mainly for local consumption. This activity is of high socio-economic importance for local people. In subtropical areas of Brasil, the uncontrolled exploitation of natural beds or aggregations of mud mussels, *Mytella* spp., has raised concerns about the sustainability of these fisheries (Oliveira *et al*., 2005; Pereira *et al*., 2003). Up to a 50 % decrease of stocks in Mundaú Lagoon (Alagoas, Brasil) can be linked with climate shifts, since an extended rainy season is increasing freshwater inflow into the system. A 60 % reduction in stocks of this species has also been reported for Espirito Santo State (M. Henriques, pers. comm.). Decreases in stocks of *P. perna* in São Paulo are attributed to effects of global climate change and over-exploitation (Henriques *et al*., 2004). Some mangrove oyster populations are being exploited close to their maximum sustainable yields, and are also threatened by the reduction of mangrove habitat (Pereira *et al*., 2001).

Ongoing initiatives linking poverty alleviation with sustainable extractive activities are being developed in Pernambuco, Rio Grande do Norte, Paraíba, Bahia, São Paulo and Santa Catarina States. To this end, US$3,127,000 are being invested in Pernambuco, Rio Grande do Norte and Paraíba. The Brasilian model of co-management of natural resources, known as ‘reservas extrativistas’ (RESEX), developed with fishers, government agencies and partners in São Paulo and Santa Catarina, are considered a promising tool to conserve native shellfish populations in the country.

Chile

Along the Chilean coast, several bivalves are important habitat-forming species, but four species are key because of their ecological roles and socio-economic importance (Fig. 1). The small non-exploited mussel *Perumytilus purpuratus* is a dominant competitor in rocky intertidal environments. *Mytilus chilensis* is the main cultured mussel in the country. Up to 1982, 10,000 tonnes per year were landed by the fisheries. However, in 1983, mussel aquaculture started in Chile, focused on this species, and in 1985, 20,000 tonnes were landed, 50 % of this from aquaculture. Since then, aquaculture

grew exponentially, and in 2007, 153,500 tonnes were landed, aquaculture representing 98 % of this production. *Choromytilus chorus* is distributed from Peru to Cape Horn, and is an important species in fisheries and aquaculture in Chile. *Aulacomya atra* is also distributed from Peru to Cape Horn but also extends along the Atlantic coast up to Argentina. It is also subject to fisheries and aquaculture activities. *Ostrea chilensis* occurs from Ecuador to Cape Horn.

All the exploited mussel species (*Mytilus chilensis*, *Aulacomya atra*, *Choromytilus chorus*) present several conservation problems, but aquaculture is now replacing extraction from natural beds or aggregations. The recent introduction of *Mytilus galloprovincialis* has yet to be fully evaluated as a threat to native mussels on the Chilean coast, but in the future this species could represent a serious threat as a dominant competitor, displacing native species of mussels (Castilla & Neill, 2009). The Chilean oyster, *Ostrea chilensis*, was rapidly over-exploited from the beginning of the fishery in 1978. There is scarce information concerning fisheries, but landings are comparatively low when compared to aquaculture activities, suggesting a replacement of wild stock harvesting with aquaculture.

In Chile, several management policies have been adopted. All exploited species have minimum legal size limits for extraction. In addition, the Fishery Subsecretary created two genetic reserves aiming to protect the stocks of *O. chilensis*. The implementation of Coastal Marine Protected Areas (CMPA) opened new avenues for conservation of bivalves in Chile, and the recovery of natural banks of *Choromytilus chorus* in Lafken CMPA has been reported (L. Prado, pers. comm.). Some restocking attempts have been performed with *A. atra* and *C. chorus* but no results have been reported. For *Choromytilus chorus* it has been shown that the area must be large enough to ensure the presence of several patches with asynchronic recruitment and the presence of certain species of algae to promote successful recruitment. This recommendation could be considered for the conservation of reef-building mussel bivalves.

Colombia

Colombia is the only South American country with coastlines on the Pacific Ocean and the Caribbean Sea. Two osyter species, *Saccostrea prismatica* [= *Ostrea iridecens*] and *Crassostrea columbiensis* [= *C. corteziensis*], and the mud mussel *Mytella guyanensis* occur on the Pacific coast but are not of great socio-economic importance. On the Caribbean coast, the mangrove oyster *Crassostrea rhizophorae* is both ecologically and economically important.

On the Caribbean coast, the *Crassostrea rhizophorae* population in the largest coastal Caribbean lagoon (Cienaga Grande de Santa Marta – CGSM) has been affected by human-induced alterations in the exchange of riverine and marine waters in this system. Thus, fishery landings fell from 42 % of the total landings in 1994 to 37 % in 1995, and represented only 4 % in 1996 (INVEMAR, 2003). *Crassostrea rhizophorae* vanished from CGSM by 1996 but data from a monitoring programme indicates that a relictual or newly established bank was depleted by uncontrolled extraction in 2007 (INVEMAR, 2007). Alterations in river flow and loss of mangrove habitat are the primary drivers of this loss, and recovery is hindered by unauthorized harvest from remnant populations. Although the mangrove oyster is not protected, there are initiatives to include this species in the Colombian Red List, listed as vulnerable. However, there are no current management plans that explicitly take into account this species. In this vein, integrated plans should include the restoration of oyster beds or aggregations combined with the development of culture systems, providing an alternative to extraction and helping to conserve wild populations.

Peru

Peruvian marine ecosystems are strongly affected by the Humboldt Current System, which extends from central Chile (~40°S) to northern Peru (~4-5°S), where the transition zone between the Peruvian and Panamic biogeographic provinces is located. The Humboldt Current System is highly variable on an interannual basis, as a consequence of large scale oceanographic processes (ENSO) that affect biological communities on the Peruvian coast (Arntz & Fahrbach, 1996; Tarazona *et al*., 2003). Warm ENSO events can affect shallow subtidal bivalve populations positively (e.g. the scallop *Argopecten purpuratus*) or negatively (e.g. the mussel *Aulacomya atra*) (Gamarra & Cornejo, 2002; Mendo & Wolff, 2003; Soenens, 1984). These species are heavily exploited, particularly *A. atra* (IMARPE, 2008). In the transition zone between 3°24'S and 6°S, the oyster *Ostrea iridescens* sustains small scale, unregulated fisheries (Ordinola *et al*., 2008). The *Ostrea* fishery has been growing since 2006 but is still poorly managed due to limited biological knowledge. In addition, the mussels *Choromytilus chorus* and *Mytella guayanensis* are targeted by small scale artisanal fisheries (Estrella *et al*., 2000, 2001; IMARPE, 2008a, b).

Recent conservation efforts directed at commercially important bivalves have been mainly focused on *A. purpuratus* (Mendo *et al*., 2002). There are some ongoing restoration and aquaculture efforts in the north of the country. Similarly, there are artisanal fisher communities (in Arequipa, Moquegua and Tacna) involved in restoration of the yellow clam, *Mesodesma donacium* (A. Gamarra, pers. comm.). In addition, experimental suspended cultures of *A. atra* have been developed by IMARPE and the Spanish Cooperation Agency. There are 4500 ha of protected mangroves (National Mangrove Sanctuary) where there are community-based efforts targeting the sustainable exploitation of *Anadara* spp., based on traditional ecological knowledge.

Priority actions for the conservation of Peruvian shellfish are: (1) improvement of stakeholder involvement in the use of sustainable populations of shellfish; (2) strengthening fisher associations to establish participatory management policies; and (3) implementation of an ecosystem approach for commercially exploited bivalves.

Uruguay

Uruguay is located in a South Atlantic transition zone between temperate and subantarctic biotas (Carranza *et al*., 2008b). The Uruguayan shelf lies within the Uruguay-Buenos Aires shelf

ecoregion, which has been recognized as one of the highest ranked ecoregions of conservation importance in Latin America and the Caribbean (Sullivan Sealey & Bustamante, 1999). The western region is characterized by the invasive mussel *Limnoperna fortunei*. *Brachidontes darwinianus* and *Mytella charruana* overlap with *Brachidontes rodriguezii* from the eastern half of the central region and are replaced by this species in the eastern region (Scarabino *et al*., 2006). *Mytilus edulis*, in turn, is distributed from the eastern half of the central region, being the dominant mussel species in this zone (Scarabino *et al*., 2006). The commercially exploited mussel beds or aggregations at Isla Gorriti and Isla de Lobos are structured by *M. edulis platensis*, *B. rodriguezi* and *B. darwinianus* in decreasing order of abundance (Hernández & Defeo, 2005). Recent populations of the brown mussel, *Perna perna*, are distributed along the Atlantic coast of South America from Rio de la Plata, to Recife, Brasil, with a large gap until they occur further north on the Caribbean shores of Venezuela (Wood *et al*., 2007). In contrast to other temperate systems, the ecological role of oysters in the shallower shelf is not well known.

The condition of native mussel beds, overall, is thought to be fair. Despite the lack of quantitative information, and with the exception of the commercially exploited beds or aggregations of *M. edulis*, which are categorized as fully exploited (Defeo, 1991; Defeo & Riestra, 2000), there is no evidence of significant declines of mussel beds or aggregations in Uruguay (Carranza *et al*., 2009). However, there are severe gaps in the biological knowledge needed for the sustainable management of wild fisheries, and critical deficiencies in monitoring and management capabilities.

The main recommendations for sustainable use and long-term conservation of Uruguayan mussel beds or aggregations are (Defeo *et al*., 2009): 1) adoption of an ecosystem level approach for fisheries management; 2) implementation of conservation measures directed to preserve 'pristine' beds or aggregations; and 3) development of experimental co-management practices, in particular for small-scale benthic shellfisheries, to link economic issues for artisanal fishermen with conservation.

Venezuela

The coast of Venezuela supports a high diversity of coastal ecosystems including rocky shores, sandy beaches, mangroves, coral reefs and mussel and seagrass beds, leading to a diversity of mollusc populations. This diversity is coupled with high primary production, particularly on the eastern coasts, supporting important bivalve beds or aggregations, including oysters, mussels, pearly oysters, clams and arks (Lodeiros *et al*., 1999). In Venezuela there are four native oyster species, two of which form beds or aggregations and are of commercial importance: *Crassostrea rhizophorae* and *C. virginica*. The main beds or aggregations of *C. rhizophorae* are in mangrove lagoons, and *C. virginica* occurs in Guariquén faucets (Sucre State) and in swamps of Lake Maracaibo (Zulia State). Extraction of both species has declined since 1998 and currently only the La Restinga population in La Restinga

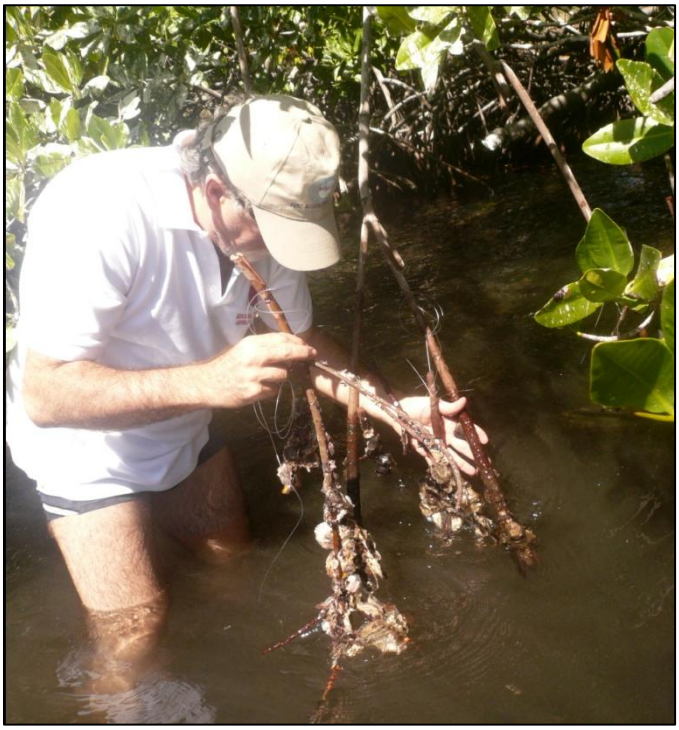

Fig. 2. Restoration of the mangrove oyster in Mochima National Park, Venezuela. Oysters were transplanted from La Restinga National Park.

National Park (Nueva Esparta State) can be considered healthy, the rest being degraded or depleted due to over-exploitation (Fig. 2).

The brown mussel, *Perna perna*, and the recently introduced exotic green mussel, *Perna viridis*, are commercially exploited (Acosta *et al*., 2006; Fernández & Jiménez, 2006; Lodeiros Seijo & Freites Valbuena, 2008) and there is evidence that *P. viridis* is displacing *P. perna* (L. León, pers. obs.). Mussel extraction has also declined, from 360 to 200-250 tonnes per year since 2000. There are some government initiatives promoting aquaculture, and some coastal communities are involved in small scale production.

In order to improve the conservation status of oyster beds or aggregations in Venezuela, there are proposals to restore beds or aggregations in the Mochima National Park, and other places such as Cariaco Gulf, using a community-based approach. Additionally, it will be necessary to improve control measures for beds or aggregations that are in good shape (e.g. La Restinga lagoon, Margarita Island). The native brown mussel, *P. perna*, is in urgent need of conservation actions that can be linked to improved fishery management in order to restore the depleted beds or aggregations. Aquacultural activities could also be useful for conservation.

Discussion

This is the first continental scale assessment of the condition of natural South American shellfish beds. There is remarkable diversity in the habitat forming species of Ostreidae in South America: in all, 13 species of native Ostreidae (plus three introduced species) inhabit the coastal waters (Carranza *et al*., 2008a). Although not all of these oyster species can be considered habitat-forming, this is in stark contrast with the

Table 1. Summary of assessed species/populations, conservation status (see text for details), country and geographic scale of the assessments.

Species	Conservation status	Country	Scale
Aulacomya atra	Degraded	Chile	National
Aulacomya atra	Depleted	Peru	Southern Peru
Aulacomya atra	Degraded	Peru	Northern Peru
Brachidontes rodriguezii	Healthy	Uruguay	Cerro verde
Choromytilus chorus	Depleted	Chile	National
Crassostrea columbiensis	Healthy	Colombia	Colombian Pacific
Crassostrea rhizophorae	Healthy	Venezuela	La Restinga
Crassostrea rhizophorae	Depleted	Venezuela	Las Marites
Crassostrea rhizophorae	Degraded	Venezuela	Laguna del Obispo
Crassostrea rhizophorae	Depleted	Venezuela	Mochima
Crassostrea rhizophorae	Degraded	Venezuela	Cuare - Morrocoy
Crassostrea rhizophorae	Locally extinct	Colombia	Cienaga Grande de Santa Marta
Crassostrea rhizophorae	Healthy	Colombia	Tayrona National Park
Crassostrea rhizophorae	Degraded	Colombia	Cispatá Bay
Crassostrea spp.	Healthy	Brasil	São Paulo State
Crassostrea virginica	Degraded	Venezuela	Guariquén
Crassostrea virginica	Degraded	Venezuela	Lago Maracaibo
Mytella charruana	Healthy	Brasil	São Paulo State
Mytella guyanensis	Healthy	Colombia	Colombian Pacific
Mytilus chilensis	Healthy	Chile	National
Mytilus chilensis	Healthy	Argentina	National
Mytilus edulis platensis	Degraded	Uruguay	Punta del Este
Mytilus edulis platensis	Healthy	Uruguay	Inner shelf beds
Mytilus edulis platensis	Degraded	Argentina	San Matias Gulf
Mytilus edulis platensis	Depleted	Argentina	Inner shelf beds
Mytilus edulis platensis	Degraded	Argentina	Southern Argentina
Ostrea chilensis	Degraded	Chile	National
Ostrea puelchana	Degraded	Argentina	San Matias Gulf
Perna perna	Healthy	Venezuela	Sucre State
Perna perna	Degraded	Venezuela	Lobos island and Caribbean coast
Perna perna	Depleted	Venezuela	Los Frailes island
Perna perna	Degraded	Venezuela	La Guardia, Tacuantar, Guayacan
Perna perna	Healthy	Uruguay	Cerro verde
Perna perna	Degraded	Brasil	São Paulo State
Perumytilus purpuratus	Healthy	Chile	National
Saccostrea prismatica	Healthy	Colombia	Colombian Pacific

relatively few native habitat-forming species that exist, for example, in North America. Concerning mussels, at least 14 species exhibit large ecosystem level effects at local scales, because of their ability to form beds or aggregations (Carranza *et al*., 2009). The most troubling finding was that nearly half of the assessed shellfish populations were either moderately or highly threatened by overfishing and environmental degradation. Overall, 1 % of the populations assessed were locally extinct, 15 % were depleted, 31 % were degraded, while the remaining 53 % ranked fair (Table 1, Fig. 3).

Although the status of native oysters and mussels in South America may not yet be as dire as that in many other regions of the world, shellfish on these coasts are following the same declining trends as populations elsewhere. Apart from ecological considerations, this is critical since socio-economic regional development associated with aquaculture practices is closely tied to the conservation of natural banks, in a context of increasing shellfish production in South America. Several species are in particular jeopardized by the extensive loss of mangroves, their primary settlement habitat. Fishing, including illegal harvest, is a pervasive threat that, particularly when coupled with other factors such as mangrove loss and alterations in river flow, poses real challenges to conservation (A. Gracia, pers. comm.). This trend is not exclusive to South American mangrove oysters, because the Chilean flat oyster, *Ostrea chilensis*, has been rapidly over-exploited since the

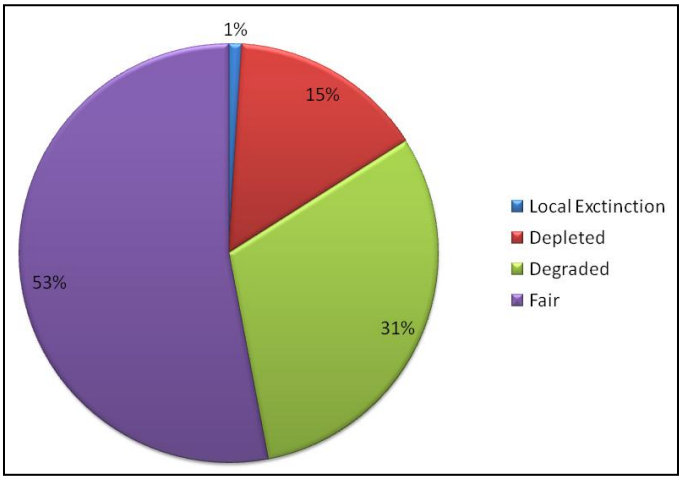

Fig. 3. Overview of the condition of South American oyster and mussel beds or aggregations based on analysis of primary data and expert opinion.

fishery started in 1978. Similarly, there is also evidence of declines in one of the most important populations of *O. puelchana* in the North Patagonian Gulf ecoregion (M. Pascual, pers. comm.). *Crassostrea gasar* in the Eastern Brasil ecoregion and *Crassostrea rhizophorae* in the Central Caribbean ecoregion are in need of urgent conservation actions (Carranza *et al*., 2008a).

Several species sustain important artisanal fisheries or aquaculture systems. In this vein, for the period 1985-2005, exploitation of natural beds in Latin America and the Caribbean ranged between 150,000 and 250,000 tonnes, with Chile, Peru, Mexico, Venezuela and Argentina reporting bivalve catches exceeding 25,000 tonnes (Lovatelli *et al*., 2008). This represents a significant fraction of overall production, with nine mussel and oyster species in the top ten. Therefore, conservation of biogenic structures provided by mussel and oysters should be a key target of long term policies in South American countries (Lovatelli *et al*., 2008). Such policies will be critical because increasing coastal development pressure threatens most nearshore habitats throughout the continent, including mangroves and other ecosystems on which bivalves depend.

However, as in other parts of the world, lack of data has hindered assessment of the actual condition of populations, even in cases where populations are, apparently, in good condition, representing an important opportunity for conservation. Activities enhancing coordination among conservation and/or restoration initiatives at a continental scale *are* needed, and development of a standardized methodology and metrics for assessing the condition of oyster and mussel populations is critical. To this end, creation of collaborative networks directed to increase transfer of technical knowledge focused on enhancing and sustaining aquaculture and management of bivalve molluscs has recently been identified as a continental scale priority (Lovatelli *et al*., 2008).

Given the outstanding diversity in species ecology and socio-economic systems, there is no universal protocol to address the most pressing needs for shellfish conservation in South

America. However, the implementation of co-management initiatives, with local communities directly involved in resource management (Fig. 4), is especially well-suited for South America (Castilla & Defeo, 2001; Castilla & Fernández, 1998; da Silva, 2004; Defeo & Castilla, 2005; Nursey-Bray & Rist, 2009). For example, community-based management and co-management in Chile and Brasil is providing opportunities to enhance conservation and enable sustainable fishing. Such approaches could be employed more broadly within South America, as in other regions, to help ensure the sustainability of shellfish exploitation and biodiversity conservation.

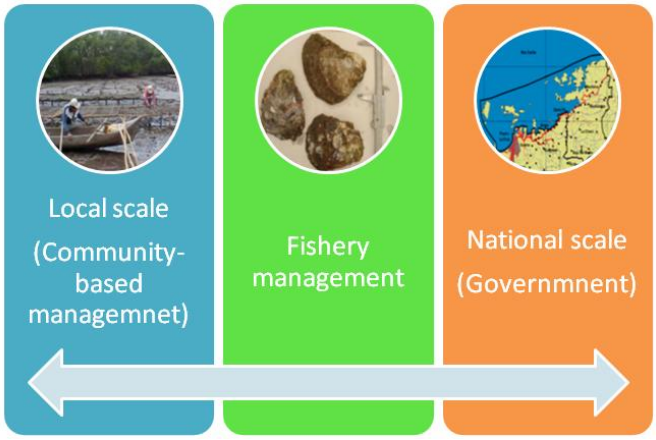

Fig. 4. The involvement of local communities in a collaborative framework with national governments is seen as a promissory tool for ensuring the long term sustainability of South American shellfish populations.

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LAND MOLLUSCS AND THEIR CONSERVATION IN MONTE DE PALMARITO WILDLIFE REFUGE, EASTERN CUBA

By David Maceira Filgueira, Yosvanis Batista, Andrés Arévalo Torres, Pedro López del Castillo, Pedro Hernández Rodríguez, Luis Pompa Núñez, Manuel Torres Gómez & Juan Torres Gómez

The Monte de Palmarito Wildlife Refuge is located in Yara municipality in Granma province. It is the only primary forest in the Cauto River savanna, with an extent of 104 ha and elevation of 80 m above sea level (Lastre *et al*., 2009) (Fig. 1).

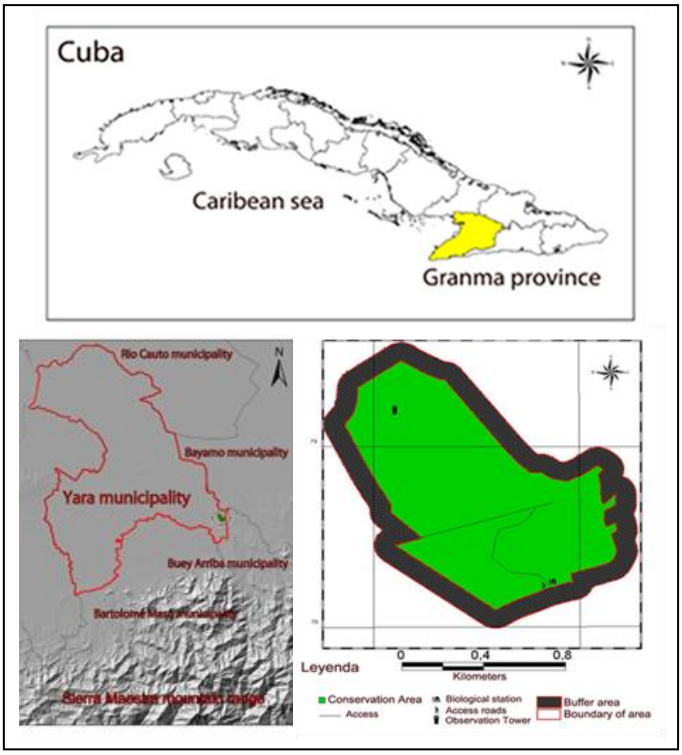

Fig. 1. Monte de Palmarito Wildlife Refuge.

The land snail fauna of the refuge has not previously been studied, except for a few collections. This is because the mollusc fauna living in many protected areas in the eastern Cuba mountains is largely unknown, as are the threats they face and the use that local residents make of them (Maceira Filgueira, 2010). This study contributes to the knowledge of the terrestrial molluscs of Monte de Palmarito Wildlife Refuge and the threats they face.

On 26 June 2010 we surveyed the arboreal and ground dwelling molluscs that inhabit the semideciduous microphyll forest of the refuge (Fig. 2). Abundant rain the day before, related to the hurricane season, meant that many snails were active during the day, allowing us to ascertain more easily the composition of the fauna, endemism and threats. All samples are deposited in the Malacological Collection of the Centro Oriental de Ecositemas y Biodiversidad – BIOECO (BSC-M).

Fig. 2 Some members of the field team. Left to right: Juan Torres Gómez, Pedro López, David Maceira, Yosvanis Batista.

Twelve species of land snails were recorded, of which ten are endemic to Cuba and two are introduced. Of this total, ten are pulmonates and two are prosobranchs, while nine live on trees and three on the ground. The recorded mollusc fauna included widespread species of eastern Cuba, with the exception of *Parachondria canescens* (Pfeiffer), which is known from only a few localities. The threatened endemic *Polymita venusta* (Gmelin) was the most abundant snail and was found on 21 plant species of which *Brya ebenus* (L.) DC. (Granadillo) and *Swietenia mahagoni* (L.) Jacq. (Caoba) were the most used (Figs. 3-5, and see faunal and floral lists below). Another endemic snail, *Caracolus sagemon* (Beck), was the second most abundant, found on the branches and trunks of many trees and bushes (Fig. 6) but occurring in particularly numerous aggregations of more than 50 individuals (Fig. 7) on *Cecropia peltata* Lin. (Yagruma). *Parachondria canescens* was the third most abundant mollusc, with 31.8 % of this species being observed in copulation up to 1.45 meters up on *Brya ebenus* plants (Fig. 8). All individuals of the endemic *Liguus fasciatus achatinus* Clench were observed on a single tall *Sterculia apetala* (Jacq.) Karst (Anacagüita, Anacahuita) with trunk circumference of over 7 m at the side of the road (Figs. 9, 10). The introduced species were only found in relatively low abundance.

Fig. 3. *Polymita venusta* (Gmelin), yellow shell

Fig. 4. *Polymita venusta* (Gmelin), red shell.

Fig. 5. *Polymita venusta* (Gmelin), one green shell, one yellow shell.

Fig. 6. *Caracolus segemon* (Beck)

Fig. 7. Aggregation of *Caracolus sagemon* (Beck) high on *Cecropia peltata* Lin. (Yagruma).

Fig. 8. Copulation of *Parachondria canescens* (Pfeiffer) on *Brya ebenus* (L.) DC. (Granadillo).

Fig. 9. Aggregation of *Liguus fasciatus achatinus* Clench on *Sterculia apetala* (Jacq.) Karst (Anacagita, Anacahuita).

Fig. 10. *Liguus fasciatus achatinus* Clench.

Threats to the conservation of land molluscs inhabiting the semideciduous microphyll forest in the Monte de Palmarito Wildlife Refuge include intense human activity that has resulted in destruction and fragmentation of the original plant formation and the introduction of two species of terrestrial molluscs not characteristic of this ecosystem (*Hawaiia minuscula* and *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*, *Felis catus*, *Canis familiaris*, *Sus scrofa*), droughts, natural and human caused fires and forest clearings becoming dominated by *Panicum maximum* Jacq. (Hierba de Guinea). The *Liguus fasciatus achatinus* population is at risk of extinction as a result of tree felling or fire. There are difficulties in obtaining the necessary resources to develop an adequate technical and administrative infrastructure to support an ecological station for the development and maintenance of research. In addition, lack of personnel for patrolling and protecting the area, the nonexistence of means of communication among personnel and the absence of vehicles suitable for the conditions add to the problems. Communities of people resident in the reserve ignore the value of the natural resources in their surroundings and environmental education programs remain inadequate.

The research and monitoring program includes:

- Accomplishing other malacological inventories in the area to complete the mollusc list, since slugs were not observed but their presence in the area is suspected.
- Carrying out a captive breeding program for *Liguus fasciatus achatinus* with the goal of future re-introduction to other sites of the semideciduous microphyll forest to prevent its extinction and to re-establish its ecological role in the ecosystem, as it is the largest mollusc species in the area.
- Monitoring population density of the endemic and threatened *Polymita venusta* because it requires particular conditions of humidity and leaf litter for oviposition in the ground, which suggests its potential as an indicator of ecosystem condition.
- Reforesting clearings with the natural plant species of the semideciduous microphyll forest.
- Eliminating the grass *Panicum maximum* in forest clearings and along roads.
- Getting adequate support to enlarge the Ecological Station and retain the researcher and other personnel.
- Establishing a program of environmental education for the local human communities and a program to prevent the spread of rats, cats, dogs and pigs in the area.

Land mollusc species list

The number of snails of each species that were found per hour is given in parentheses.

Class GASTROPODA

Subclass PROSOBRANCHIA

Family HELICINIDAE

Emoda pulcherrima pulcherrima (Lea, 1834). Arboreal species endemic to eastern Cuba. (2.5)

Family ANNULARIIDAE

Parachondria (*Parachondria*) *canescens* (Pfeiffer, 1852). Arboreal

species endemic to eastern Cuba. (28.5)

Subclass PULMONATA

Family ORTHALICIDAE
Liguus fasciatus achatinus Clench, 1934. Arboreal species endemic to eastern Cuba. (19.5)

Family SUBULINIDAE
Subulina octona (Bruguière, 1792). Introduced species, found in leaf litter around the Estación Eclógica in relative low abundance. (1).

Family OLEACINIDAE
Oleacina solidula (Pfeiffer, 1840). Widespread Cuban endemic found in leaf litter in relatively low abundance. (1)

Family VITRINIDAE
Hawaiia minuscula (Binney, 1840). Introduced species, found in leaf litter around the Estación Eclógica in relative low abundance. (1)

Family CAMAENIDAE
Zachrysia (*Chrysias*) *bayamensis* (Pfeiffer, 1854). Cuban endemic, generally arboreal although sometimes found on the ground. (6)
Caracolus sagemon (Beck, 1837). Eastern Cuban endemic, generally arboreal although sometimes found on the ground. (58)

Family XANTHONICHIDAE
Cysticopsis pemphigodes (Pfeiffer, 1846). Eastern Cuban endemic, found in leaf litter in relatively low abundance. (1)
Coryda alauda (Férussac, 1821). Arboreal species endemic to eastern Cuba. (6)
Polymita venusta (Gmelin, 1791). Threatened arboreal species endemic to eastern Cuba. (65.5)
Hemitrochus lucipeta (Poey, 1854). Arboreal species endemic to eastern Cuba. (13)

List of plants used by *Polymita venusta*

The percentage of snails found on each plant is given in parentheses.

Family BORAGINACEAE
Gerascanthus collococcus (L.) Borhidi (Ateje común) (0.01 %)

Family BURSERACEAE
Bursera simaruba (L.) Sargent (Almácigo) (0.01 %)

Family RHAMNACEAE
Colubrina arborescens (Mill.) Sarg. (Bijáguara) (0.01 %)

Family ARECACEAE
Sabal palmetto (Walt.) Loddiges (Palma cana) (0.01 %)

Family ERYTHROXYLACEAE
Erythroxylon havanense Jacq. (Jibá) (0.01 %)

Family MIMOSACEAE
Samanea saman (Jacq.) Merrill (Algarrobo) (0.01 %)

Family RUBIACEAE
Guettarda calyptrata A. Rich. (Contraguao) (0.01 %)

Family ANACARDIACEAE
Comocladia dentata Jacq. (Guao) (1.52 %)

Family SAPINDACEAE
Cupania americana L. (Guárano) (1.52 %)

Family FLACOURTIACEAE
Zuelania guidonia (Sw.) Britt. & Mill. (Guaguasí) (1.52 %)

Family ANNONACEAE
Oxandra lanceolata (Sw.) Baill. (Yaya) (1.52 %)

Family SAPINDACEAE
Melicoccus bijugatus Jacq. (Mamoncillo) (1.52 %)

Family CLUSIACEAE
Clusia rosea Jacq. (Cupey) (2.29 %)
Calophyllum antillanum Britt. (Ocuje blanco) (3.81 %)

Family OLACACEAE
Ximenia americana L. (Ciruelillo) (3.05 %)

Family MYRTACEAE
Eugenia pinetorum Urb. (Guairaje) (4.58 %)

Family LAURACEAE
Ocotea coriacea (Sw.) Britt. (Sigua) (4.58 %)

Family SMILACACEAE
Smilax havanensis Jacq. (Alambrillo, Raíz de China) (5.34 %)

Family SAPOTACEAE
Sideroxylon salicifolium (L.) Lam. (Cuyá) (8.39 %)

Family MELIACEAE
Swietenia mahagoni (L.) Jacq. (Caoba) (14.5 %)

Family FABACEAE
Brya ebenus (L.) DC. (Granadillo) (40.45 %)

We thank Sibylle Maurer-Wohlatz of the German non-governmental organization BUND (Bund für Umwelt und Naturschutz Deutschland) for support of studies of *Polymita* in Cuba, Turquino National Park, the Monte de Palmarito Wildlife Refuge and Centro Oriental de Ecositemas y Biodiversidad (BIOECO) for support of the fieldwork. We also thank the drivers Luís Pérez Vázquez and Rafael Socorras Martínez and Hilda Magaña González who made our meals. Plants were identified by MSc. María Caridad del Carmen Fagilde Espinosa of BIOECO. And we thank Dr. Bernardo Reyes Tur (Universidad de Oriente), who gently collected samples during 16-17 October 2005 and donated them to BIOECO.

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FIRST RECORD OF THE EUROPEAN LAND SNAIL *CARYCHIUM MINIMUM* IN PENNSYLVANIA, USA

By Timothy A. Pearce & Stephanie L. Payne

In the course of studying snails in goose droppings at a park in Pittsburgh, we discovered the minute land snail *Carychium minimum* O.F. Müller, 1774, the first record of the species in Pennsylvania. This European wetland species, known also from greenhouses in Europe, was first found in North America in 1912 in a greenhouse in Quincy, Massachusetts (Clapp, 1912), the specimens cataloged at Carnegie Museum as

CM82877. Subsequently, it has been reported from North America in San Francisco (Roth, 1982), Ontario (Forsyth, 2004) and New York (Weigand & Jochum, 2010).

On 20 October 2010 we found empty shells of *Carychium minimum* in a grassy area beside Panther Hollow Lake, Schenley Park, in Pittsburgh, Pennsylvania (40.4367°N 79.9480°W; specimens cataloged as CM108617; Fig. 1) along with other native and non-native snail species including *Cecilioides acicula*, *Cochlicopa lubrica*, *C. lubricella*, cf *Lucilla singleyana*, *Oxychilus draparnaudi*, *Vallonia costata*, *V. excentrica*, *Ventridens ligera*, *Vertigo cristata* and *Zonitoides nitidus*. Following days with freezing weather, we found live individuals on 21 and 30 November 2010, both days with cool weather (9-10°C). The extent of the colony has not been determined, but empty shells occurred along at least 205 m of the south shore of the lake. We have found living individuals only in a small area about 4 m diameter at the southeast end of the lake.

Fig. 1. *Carychium minimum* found beside Panther Hollow Lake in Schenley Park. Note the internal lamella visible through the translucent shell. Scale bar = 1 mm.

We do not know how long *C. minimum* has been in Pittsburgh. The size of the colony implies it must have been present at least several years. The recent finds of this species in other places in North America imply recent spread, but it is hard to separate this possibility from a longer residency but its having been overlooked. Further study is necessary to determine if this introduced species is having any negative effects on the native biota.

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OGASAWARA ECOSYSTEM WILL SURVIVE ON ANIJIMA

By Kiyonori Tomiyama

The Tokyo Metropolitan Government (TMG) is likely to abandon the notorious plan to constcuct an airport on Anijima in the Ogasawara archipelago (Fig. 1) (*Tentacle* 1997, 1998). As far as we know, in the 1990s and 2000s TMG received more than 200 letters of protest from organizations and individuals, including *Tentacle* readers, from around the world. We believe these intemational voices made major contributions to this victory and thank all of you who protested to TMG.

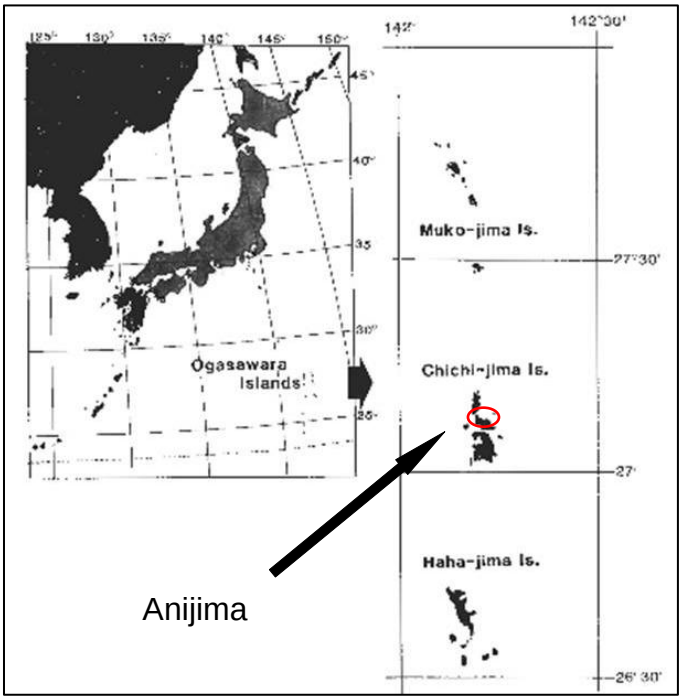

Fig. 1 Japan, showing the location of the Ogasawara Islands and of Anijima within the Chich-jima group.

The unique ecosystem of the Ogasawara archipelago could be called the Asian Galapagos because of its many equivalent features. Fortunately it survives, but only on the little island of Anijima (Fig. 2). The biota surviving on this uninhabited island, including the unusually diverse fauna of terrestrial molluscs (Fig. 3), was threatened with extinction by the airport construction. The planned 1800 m runway was unreasonably big for the 2000 Ogasawaran residents, even for extravagant tourism.

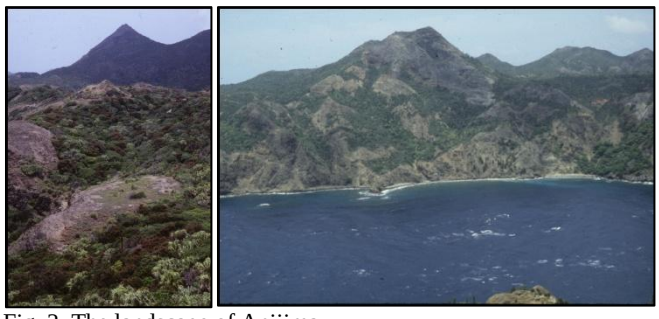

Fig. 2. The landscape of Anijima.

For a decade, TMG had insisted that the Anijima airport was environmentally appropriate based on subjective assessments made by private consulting companies. In 1997, TMG entrusted professional researchers with the environmental assessment and re-evaluation of the airport construction. The committee of environmental scientists in charge reported the results of a seven month investigation. Their report clearly demonstrated that the Ogasawara biota remained in a relatively pristine state only on Anijima, stressing the importance of special protection for the island. Finally, the report strongly recommended nine possible alternative locations for the airport. Thus, it is unlikely that Anijima will again be chosen for destruction.

Fig. 3. Endemic Ogasawara land snails: *Hirasea diplomphalus* (left) and *Mandarina anijimana* (right).

In 1998, TMG announced plans for a new airport on an inland area of the island Chichijima. However, TMG abandoned this plan in 2003. Now TMG has another plan to build a new airport in a coastal area on Chihijima, but the plan has been postponed because of the severe financial situation. Thus, we should not yet be complacent with this news of success, but should remain aware. However, this successful change of airport construction was perhaps not possible without the worldwide protest from *Tentacle* readers.

During the 2000s, the Japanese government proposed Ogasawara as a candidate World Heritage site. Now a number of projects to remove certain alien species are in progress in Ogasawara. Anijima is now free of goats, for example. Protection efforts for terrestrial molluscs are also being promoted.

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MOLLUSCS INTERCEPTED AT THE BORDERS OF ISRAEL IN 2009 AND 2010

By Svetlana Vaisman and Henk K. Mienis

The intentional or unintentional import of land and freshwater gastropods can lead not only to the establishment of new pest species, but under certain conditions may also have a negative impact on the local mollusc fauna. This can be best illustrated by a few examples from Israel.

The most common freshwater snail encountered in almost any aquatic environment (spring, ditch, stream, river, marsh, pond or lake) is without doubt the North-American *Haitia acuta* (Draparnaud, 1805) [= *heterostropha* (Say, 1817)]. It may occur in such large numbers that it out-competes any autochthonous basommatophoran species (Roll *et al*., 2009).

Thiara scabra (Müller, 1774), a tropical freshwater snail, which has been imported for the aquarium trade in Israel, has become recently the most prolific species in the Sea of Galilee, occurring here-and-there at densities of over 6000 specimens per square metre. Its presence may not only have a disastrous effect on the endemic *Falsipyrgula barroisi* (Dautzenberg, 1894) sharing the same habitat, but it may also change the whole biological equilibrium in the lake: Israel's number one source of potable water (Mienis & Mienis, 2008).

In 1971 the North American *Gastrocopta procera* (Gould, 1840) was encountered so abundantly in a soil sample taken in the date palm plantations of En Gedi – more than 10,000 specimens in less than 4 kg of soil (Mienis, 1977) – that it has replaced there the only autochthonous African element in the land snail fauna of Israel, *Pupoides coenopictus* (Hutton, 1834). This *Gastrocopta* species reached En Gedi as a hitchhiker among the roots of palm trees imported from the Salton Sea area in California.

The mollusc fauna of hothouses and nurseries is dominated by a number of allochthonous species like *Zonitoides arboreus* (Say, 1816), *Hawaiia minuscula* (Binney, 1840), *Lehmannia valantiana* (Férussac, 1822), *Prietocella barbara* (Linnaeus, 1758) and *Xerotricha conspurcata* (Draparnaud, 1801). They occur sometimes in such large numbers on the commercial plants that the latter are unsuitable for export and are sold locally in garden centres. In other words, hothouses and nurseries in fact constitute major foci for the distribution of exotic snails to private gardens and public parks (Roll *et al*., 2009). In this way the dominant species occurring in gardens and parks are *Prietocella barbara* (Linnaeus, 1758), *Eobania vermiculata* (Müller, 1774) and especially the huge *Cornu aspersum megalostomum* (Bourguignat, 1864). Some of these species are also from time to time encountered in more natural environments and have therefore been considered as invasive species.

At present about 20 % of all the terrestrial and aquatic gastropods occurring in Israel are of foreign origin (Roll *et al*., 2009). The number of such allochthonous snail and slug species is rising constantly in spite of the efforts by the Plant Protection and Inspection Services (PPIS) of the Ministry of Agriculture in Israel. The PPIS maintains permanent control posts at the places of entry into Israel including international airports, harbours along the Mediterranean and Red Sea coasts and land border crossings with Jordan and Egypt. These posts are manned almost everywhere 24 hours a day and merchandise arriving from abroad is spot checked for the presence of potential pest species including snails.

In order to get an idea what is arriving in Israel in the form of stowaways or by means of intentional illegal imports, and that may turn into serious competitors of native species, we provide a brief overview of the interceptions of alien molluscs by inspectors of the PPIS in 2009 and 2010.

On 26 February 2009 *Zonitoides arboreus* was found on

Nertera pot plants arriving at Ben-Gurion Airport from the Netherlands (PPIS Mol. 258). Since this North American species is already well established in Israel the merchandise was allowed to enter Israel.

On 27 February 2009 a temporary labourer arriving from Thailand at Ben-Gurion Airport tried to smuggle into Israel almost 2 kg of living freshwater snails. Four taxa were involved: *Pila ampullacea* (Linnaeus, 1758), *Filopaludina martensi martensi* (Frauenfeld, 1865), *Filopaludina sumatrensis polygramma* (Martens, 1860) and *Filopaludina sumatrensis speciosa* (Deshayes, 1876) (PPIS Mol. 259). All these species are known intermediate hosts of echinostomiasis, a parasite of human importance not known to occur in Israel. All the snails were confiscated.

On 18 October 2009 several specimens of *Eobania vermiculata* (Müller, 1774) were discovered in a shipment of fresh olives arriving at the Hussein Bridge border crossing with Jordan (PPIS Mol. 262). The whole shipment was returned to Jordan because of the invasive character of this species in areas with a Mediterranean climate.

On 20 October 2009 *Zonitoides nitidus* (Müller, 1774) was found on pot plants (plant species not recorded) arriving at Ben-Gurion Airport from the Netherlands (PPIS Mol. 261). Since this holarctic species is already established in hothouses and nurseries in Israel these pot plants were allowed to enter Israel.

On 21 December 2009 *Deroceras reticulatum* (Müller, 1774) was found in a shipment of *Tropaeolum major* arriving at Ben-Gurion Airport from the United Kingdom (PPIS Mol. 264). After identification the merchandise was allowed to enter Israel because the species is already known from hothouses and nurseries in Israel.

On 26 December 2009 23 live specimens of *Hemiplecta distincta* (Pfeiffer, 1850) were found in the luggage of a temporary labourer arriving from Thailand at Ben-Gurion Airport (PPIS Mol. 265) (Fig. 1). The snails were brought to Israel with the intention of establishing local populations and exploiting them as food. This land snail is a well known host of the rat lungworm, *Angiostrongylus cantonensis*, a parasite of human importance not known to occur in Israel. All the snails were confiscated (Mienis *et al*., 2010).

On 24 February 2010 23 tons of 'Pink Lady' apples imported from France arrived in Ashdod harbour. A standard check of the merchandise revealed the presence of several living specimens of *Cernuella virgata* (Da Costa, 1778) and *Monacha cartusiana* (Müller, 1774) (PPIS Mol. 268). Because at least *Cernuella virgata* is considered a potential pest in countries with a Mediterranean climate, the entire shipment was returned to France (Mienis & Vaisman, 2010).

On 26 March 2010 another shipment of 20 tons of 'Pink Lady' apples imported from France arrived in Ashdod harbour. During a spot check of the apples a single juvenile *Cornu aspersum aspersum* (Müller, 1774) was discovered (PPIS Mol. 271). Since the snail turned out to be fresh dead and no living specimens were seen, the merchandise was allowed to enter Israel, in spite of the fact that the European Brown Snail is considered a serious pest species in agriculture and horticulture.

Fig. 1. A batch of *Hemiplecta distincta* intercepted from the personal luggage of a temporary labourer arriving from Thailand.

On 1 June 2010 a shipment of 70 olive saplings (*Olea europaea*) and 50 pomegranate saplings (*Punica granata*) arrived at the Allenby Bridge Check Point with Jordan. The merchandise arrived from Tunisia. An inspection of the young trees revealed the presence of four adult specimens of *Otala constantina* (Forbes, 1838) (PPIS Mol. 272) (Fig. 2). Hardly anything is known about the biology and ecology of *Otala constantina*, a species restricted to the eastern part of Algeria and Tunisia. Since the closely related *Otala lactea* (Müller, 1774) and *Otala punctata* (Müller, 1774) from Spain and southern France are considered species of quarantine importance the shipment of these young trees was not allowed to enter Israel (Mienis *et al*., 2010).

On 4 July 2010 15 marine snails were found in a shipment of other marine animals that arrived at the Ben-Gurion Airport on a flight arriving from the Far East (PPIS Mol. 274). The

Fig. 2. *Otala constantina* intercepted on a shipment of young trees arriving from Tunisia. (Photo: Oz Rittner)

material consisted of 5 specimens of *Turbo bruneus* (Röding,1798) and 10 specimens of *Nassarius luridus* (Gould, 1850). Since the shipping invoice did not mention the gastropods and lacked the proper import licenses, the material was confiscated.

On 11 July 2010 a female tourist arrived at Ben-Gurion Airport on a flight from Greece with 7.5 kg of living snails in her luggage (PPIS Mol. 275). She refused to tell why she brought the snails to Israel. Since it is forbidden to import living terrestrial snails without a proper license and certainly not those species that have a reputation of being plant pests, the whole batch was confiscated. It consisted of more than 1000 specimens of *Cornu aspersum aspersum* (Müller, 1774) and seven specimens of *Eobania vermiculata* (Müller, 1774).

On 17 October 2010 a shipment of potted coralberries, *Ardisia* sp., arrived at Ben-Gurion Airport on a plane arriving from the Netherlands. A check of some of the plants revealed the presence of three specimens of *Deroceras reticulatum* (Müller, 1774) and one specimen of *Lehmannia valentiana* (de Férussac, 1822). Since both species of slugs commonly occur already in hothouses and nurseries throughout Israel, the merchandise was allowed to enter the country.

On 20 October 2010 a single specimen of *Candidula intersecta* (Poiret, 1801) was found adhered to an old railway sleeper in a shipment with a total weight of 40 tons arriving in the harbour of Ashdod from Belgium. Since the shell contained the dead dried animal of the snail and no other specimens had been found, the merchandise was allowed to enter Israel.

On 2 November 2010 a shipment of 105 potted spindle trees (*Euonymus* sp.) arrived at Ben-Gurion Airport on a flight from the Netherlands. During an inspection of some of the plants, two slugs belonging to *Deroceras laeve* (Müller, 1774) and one belonging to *Lehmannia valentiana* (Férussac, 1822) were discovered. Since both species commonly occur already in hothouses and nurseries throughout Israel the merchandise was allowed to enter the country.

Although alien snails or slugs were discovered in merchandise or luggage of passengers arriving in Israel only 14 times in 2009-2010, among the intercepted material were five species that had never been encountered before: the land snails *Candidula intersecta*, *Monacha cartusiana* and *Otala constantina* and marine gastropods *Turbo bruneus* and *Nassarius luridus.*

All three land snails may be considered potential invaders able to establish populations in one way or another in Israel. *Otala constantina* is without doubt most adapted to the natural conditions prevailing in Israel, while *Candidula intersecta* and *Monacha cartusiana* have to be looked upon as potential colonizers of gardens, parks and similar man-made regularly irrigated habitats. The latter two species are therefore less likely to become competitors of autochthonous terrestrial snails under natural conditions. Although the merchandise on which the three terrestrial species had been found was not allowed to enter Israel, based on strict agricultural precautions as they are potential agricultural pest species, the prevention of these species from entering Israel has to be considered as a positive aid in the conservation of the natural terrestrial gastropod fauna of Israel.

Attempts to establish the tropical freshwater snails belonging to *Pila* and *Filopaludina* in Israel have to be considered highly undesirable from both a medical and zoological point of view. This is also the case with *Hemiplecta distincta*. Like the giant African snail, *Achatina fulica* Bowdich, 1822, of which viable populations were discovered in private gardens in Tel Aviv in the autumn of 2009, *Hemiplecta* is active during the hot summer months and is able to establish populations in Israel in irrigated gardens.

Fig. 3. *Hemiplecta distincta.*

Although *Eobania vermiculata* was already known from gardens in various towns in Israel, the import of fresh olives from Jordan contaminated with *Eobania vermiculata* was prevented because of its status as a pest species in horticulture and agriculture in the Mediterranean region or in other regions elsewhere characterized by a Mediterranean climate.

Of the other species, numerous viable populations of *Zonitoides arboreus*, *Z. nitidus* and *Deroceras reticulatum* were already known to exist in Israel in hothouses and nurseries and therefore the authorities of the Ministry of Agriculture allowed the infected merchandise to enter Israel. From a conservation point of view this has to be considered an unfortunate decision.

We thank the inspectors of the Plant Protection and Inspection Services of the Ministry of Agriculture (Bet Dagan, Israel) for supplying us with the material discussed. We also thank Oz Rittner (National Collections of Natural History, Tel Aviv University) for the photographs of *Hemiplecta distincta* and *Otala constantina.*

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NON-MARINE MOLLUSCS IN THE EMILIA-ROMAGNA REGION OF NORTHERN ITALY: STILL MUCH TO KNOW ABOUT THEIR DIVERSITY AND CONSERVATION

By Paolo G. Albano & Bruno Sabelli

The Emilia-Romagna region is in northern Italy (Fig. 1). Its northern border is the Po river while its southern border is the northern Appenines ridge. It therefore hosts a variety of habitats from mountains up to 2000 m high to fluvial plains and coastal areas and lies climatically in the European continental biogeographic region.

Fig. 1. The Emilia-Romagna region of Italy (red rectangle)

The region experiences heavy anthropogenic pressures, being one of the most industrialized regions in Italy and with extensive areas of intensive agriculture. This is especially true on the plain, while the mountains are progressively depopulating and therefore reverting to their natural conditions.

The region includes an extensive Natura 2000 network with almost 150 Sites of Community Importance (Directive 92/43/EEC 'Habitat') and Special Protection Areas (Directive 79/409/EEC 'Birds') for an overall extent of 325,000 ha (14.5 % of the region). Moreover, the areas of greatest conservation interest are within a network of national and regional parks that further enhances their protection.
A project carried out in 2010 tried to develop a first assessment of the entire fauna, to include compilation of a check list of non-marine animal species and collection of biodiversity records for a subset of target species of conservation interest. Our group was part of the team dealing with small vertebrates and invertebrates and focused its attention on non-marine molluscs.

The check list listed 4144 species of which 682 were vertebrates and 3462 invertebrates (Fig. 2). It is important to highlight that the invertebrate fauna list was not at all complete. It was compiled for the groups for which there was enough taxonomic and faunistic knowledge and the estimated real overall number of species is up to 16,000 (R. Fabbri, pers. comm.). Thus invertebrates constituted 96 % of the fauna. The mollusc list has a much lower degree of uncertainty and accounts for 166 species (4% of the check list and 1% of the estimated fauna).

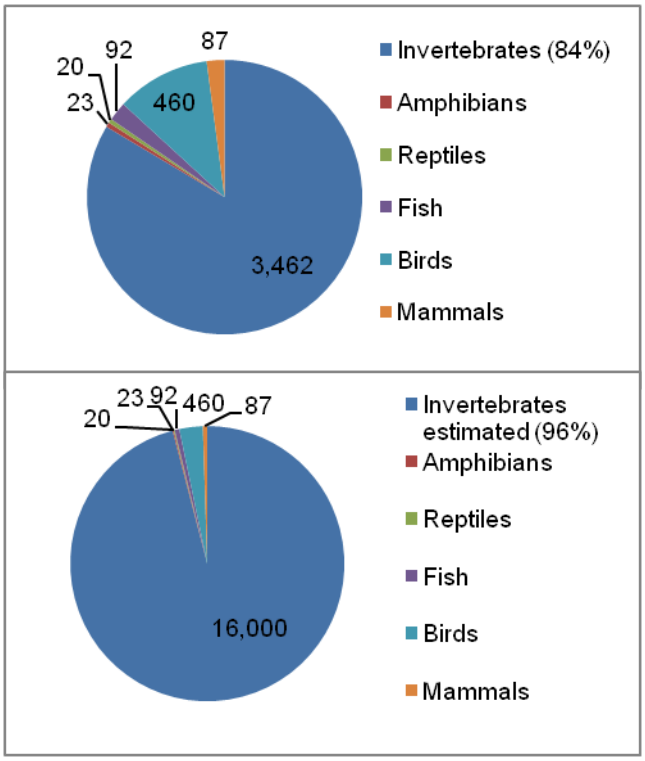

Fig. 2. Proportions of species in major taxonomic groups in the Emilia-Romagna faunal check list (top) and considering the estimated number of species (bottom).

The list of target species was compiled considering several conservation issues, including whether a species was listed in laws and international conventions, endemicity, biogeographic interest, level of pressures, population trends, etc. A few invasive species were also considered, considering them a threat to species of conservation concern. This list of target species included 375 taxa (Fig. 3): 22 amphibians (96 % of the fauna), 17 reptiles (85 %), 56 fishes (61 %), 122 birds (27 %), 48 mammals (55 %) and 110 invertebrates (just 3 % of the total number of species in the check list and 0.7% of the estimated fauna!) . Sixteen mollusc species were considered of

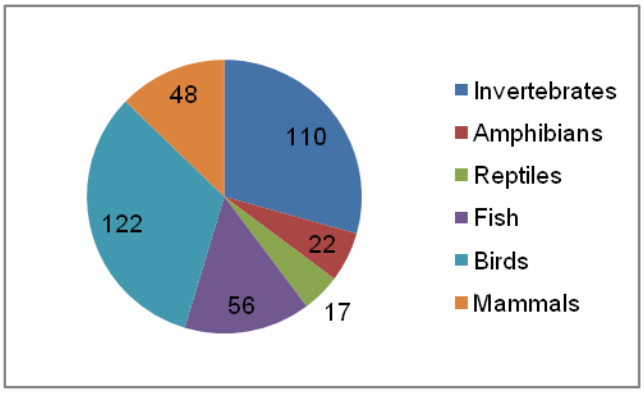

Fig. 3. Proportions of target species in Emilia-Romagna.

conservation interest, although it is important to highlight the total lack of information on their ranges and population trends, which severely influenced their listing (as for most invertebrates).

The project then tried to collect all records of presence of the target species from the literature (including grey literature), museum and private collections, databases etc. Despite being far from complete, this work allowed us to compile almost 160,000 records in a relational database. However, this number is strongly biased towards birds (130,000!) with high numbers of records for mammals (9,987), reptiles (6,451) and amphibians (4,739) but just 8,826 records for all invertebrates (Fig. 4). If a ratio between records and number of target species is computed, then the mean for vertebrates is 375 records/species (!) while invertebrates have only 80 records/species and molluscs 14 records/species.

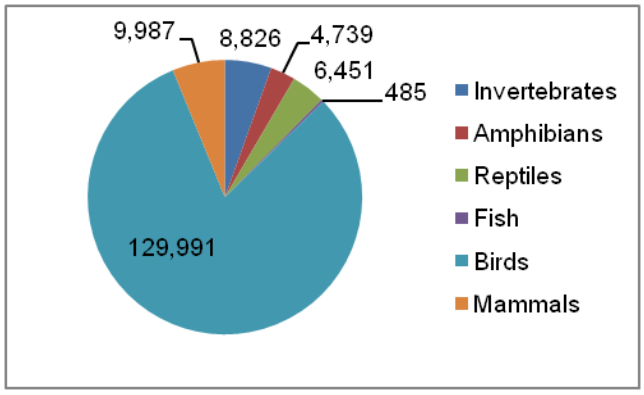

Fig. 4. Proportions of records of target species.

So, invertebrates account for most of the fauna in the Emilia-Romagna region but have clearly received a much lower share of investment in monitoring effort than vertebrates. Although they include species of commercial interest, pests, aliens and the greatest share of biodiversity they are relegated to relative neglect when research and conservation are considered.

This is also true for molluscs, which have one of the lowest records/target species ratio (after anellids) despite including edible species (Helicidae), invasive species (e.g. *Arion lusitanicus*, *Anodontia woodiana woodiana*) or species listed in the 'Habitats' Directive (e.g. *Vertigo angustior*, *Vertigo moulinsiana*). We strongly believe that 'scientists and managers can conserve biodiversity only if they know what it is they are conserving' (Lydeard *et al*., 2004) and hope that the future will shed more light on this cryptic but important biodiversity.

The project was coordinated by Dr. Francesco Besio (Regione Emilia-Romagna, Servizio Parchi e Risorse Forestali, which is under the responsibility of Dr. Enzo Valbonesi). Extensive support was given by Dr. Marco Pattuelli and Dr. Stefano Bassi. Funding was provided by the European Union Program for Rural Development 2007-2013. Data on birds were assembled by Ecosistema scrl, while those on fish by Università di Parma, Dipartimento di Scienze Ambientali.

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LAND SNAILS AS FLAGSHIP AND UMBRELLA SPECIES FOR BRASILIAN ATLANTIC FOREST CONSERVATION

By Sonia Barbosa dos Santos

As stated by the WWF (2010), flagship species are 'iconic animals that provide a focus for raising awareness and stimulating action and funding for broader conservation efforts'. A good example is the giant panda that has been the WWF symbol since 1961 when the organization was formed. Also related to conservation is the umbrella species concept that, despite a large number of definitions (Roberge & Angelstam, 2004), can be defined as a species 'whose conservation confers a protective umbrella to numerous co-occurring species'.

In general, flagship species are popular, charismatic and beautiful, explaining why large and attractive vertebrates are on the top of flagship species lists. On the other hand, when talking about invertebrates, feelings such as antipathy and phobia are very common, especially concerning slugs, worms and spiders (Kellert, 1993; Costa-Neto & Magalhães, 2007). As for flagship species, umbrella species are usually vertebrates, mostly mammals and birds, with rare exceptions. This is the case in Brasil. Considering the Atlantic Forest, one of the most endangered environments in the world (Myers *et al*., 2000), we have vertebrates as flagship species, for example, the golden lion tamarin, *Leonthopithecus rosalia* (Linnaeus, 1766), the southerrn muriqui monkey, *Brachyteles arachnoids* (Geoffroy, 1806), the northern muriqui monkey, *Brachyteles hypoxanthus* (Kuhl, 1820) or the lobo-guará (maned wolf), *Chrysocyon brachyurus* (Illiger, 1815).

Invertebrates are rarely used in nature conservation projects, beautiful and attractive butterflies being an exception (Schlegel & Rupf, 2010). Breaking the rule, in Brasil we have the onycophoran *Peripatus acacioi* Marcus & Marcus, 1955, the unique invertebrate flagship species supporting the

creation of a nature reserve (Tripuí Reserve) (Lewinsohn *et al*., 2005).

In May 2009, the workshop 'Strategies and actions to Atlantic Forest Conservation in the State of Rio de Janeiro' was organized by the 'Instituto Biomas' (Bergallo *et al*., 2009). For a week more than 50 researchers, governmental entities, NGOs and conservationists discussed questions related to the Atlantic Forest biome, aiming to identify priority areas and actions to improve conservation. The status of land invertebrates such as ants, butterflies, dragonflies, bees, spiders, oligochaetes and land snails were analyzed (Santos *et al*., 2009).

Although Brasil is considered a megadiverse country, its biodiversity is underestimated (Lewinhson & Prado, 2005). So, aiming to focus attention on conservation of the poorly known land snails of the Atlantic Forest, especially the almost completely unknown microsnails, the specialists in the workshop proposed the big *Megalobulimus* snails, the brilliant orange-yellow streptaxid *Streptaxis contusus* (Férrusac, 1821) (Fig. 1) and the emerald green bulimulid *Leiostracus perlucidus* (Spix, 1827) (Fig. 2) as umbrella and flagship species (Santos *et al*., 2009).

Megalobulimus ovatus (Müller, 1774) and *M. oblongus* (Müller, 1774) (Megalobulimidae) (Fig. 3) are the biggest land snails endemic to South America. They are listed as threatened in the Rio de Janeiro Red List (Bergallo *et al*., 2000).

Fig. 1. *Streptaxis contusus*. (Photo: S.B. dos Santos)

Fig. 2. *Leiostracus perlucidus*, live snail and empty shell. (Photo: Antônio Carlos de Freitas)

Fig. 3. *Megalobulimus ovatus*. (Photo: S.B. dos Santos)

This is the first time in Brasil that land snails are being considered to be flagship or umbrella species. We hope this action can stimulate the recognition of other land snails or even freshwater snails as flagship or umbrella species in other threatened ecosystems such as the Cerrado and the Pantanal.

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A NEWLY RECORDED LOCALITY OF EXTINCT *MARGARYA* (VIVIPARIDAE) SPECIES IN CHINA: A CASE OF EXTINCTION CAUSED BY EARTHQUAKE?

By Ya Li, Qin Xu, Cheng Tang, Chuze Shen & Min Wu

Margarya Nevill, 1877, is a group of charismatic freshwater gastropods distributed in the lakes of Yunnan, China. The genus comprises 11 species, of which *Margarya elongata* Tchang & Tsi, 1949, *M. francheti* (Mabille, 1886), *M. tchangsii* Xia, 1982, *M. yini* Tchang & Tsi, 1949 have been assessed as Extinct, *M. bicostata* Tchang & Tsi, 1949, *M. carinata* Nuemayr, 1898, *M. monodi* Dautzenberg & Fischer, 1905 and *M. tropidophora* (Mabille, 1886) assessed as Endangered, *M. yaungtsunghaiensis* Tchang & Tsi, 1949 assessed as Critically Endangered and *M. mansuyi* Dautzenberg & Fischer, 1905 and *M. melanioides* Nevill, 1877 assessed as Vulnerable (Liu & Wu, 2005). The latest assessment (IUCN, 2010) increased the threat level for the last two species to Endangered and of *M. monodi* to Critically Endangered. Unfortunately, the taxonomy of *Margarya* has been established based on fewer than ten published papers and is far from perfect. However, in the face of rapidly declining environmental quality, it is of urgent necessity to make conservation a priority, in spite of other problems, that is, in *Margarya*, the confused taxonomy.

Fig. 1. Embedded small map: lake chain on Yungui Plateau with known locations of *Margarya* spp. indicated. Main map: enlarged map showing lakes with *Margarya* spp.; concentric circles—known distributions of *Margarya* before this survey, star—Jialize Peatland.

Jialize Peatland (Figs. 1, 2), ca. 46 km northeast of Kunming, the capital of Yunnan, is a disappearing peatland situated in a basin, encircled by hills 200-300 m higher than the peatland. The peatland region, with an area of about 10 km^2, has been completely artificially changed. During field work in December 2010 we found numerous old empty shells of *Margarya melanioides* deposited in the peat layer, which is

Fig. 2. Jialize Peatland, a fast disappearing peatland. Very few natural ponds, as shown in this picture, now remain.

Fig. 3. Jialize Peatland, a pile of *Margarya* shells in peat after being dug out by a mechanical digger from a depth of about 3 m. Beyond is the red soil transported from elsewhere for filling the bog.

Fig. 4. In Jialize Peatland, mechanical diggers are seen everywhere. The white spots (inset) are shells of *Margarya*. None of the shells is new but they have not obviously been fossilized.

covered by a thin red soil layer of about 5-10 cm. The distribution of shells in this profile is quite different from that of the western shore of Dianchi lake (Xia, 1982), where all shells were found in the red soil layer.

The extinction of *Margarya* in Jialize is now hypothesized by us to have been caused by the great earthquake (magnitude >8) of 6 September 1833 (the most serious one in Yunnan). The center of this earthquake was Jialize Peatland. In the official record in the Qing Dynasty History, it is recorded that 'bottom of rivers and swamps in this region moved to higher places and dried as a result of the earthquake'. And now this peatland is seriously threatened by a variety of human activities (Figs. 3, 4). However, it seems that these threats are

Fig. 5. *Margarya melanioides* for sale in the market of Dali, 26 June 2002. (Photo: Min Wu)

not the direct cause of the extinction of *Margarya* in this region (in Dali, see Fig. 5, the situation is similar but *Margarya* is in less danger). The encouraging news is that a program has been initiated to avoid excessive exploitation of Jialize Peatland. If the plan, in which we have been invited to participate, is carried out, the region will be closed and the natural landscape will recover naturally, although re-introduction of indigenous biota will be seriously considered, based on scientific information.

Funding for this project was provided by the National Natural Science Foundation of China (NSFC 31071882) and a project from the Science and Technology Ministry (2006FY111000).

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MOLLUSC FAUNA OF SANTA CATARINA STATE, CENTRAL SOUTHERN BRASIL: CURRENT STATE OF KNOWLEDGE

By A. Ignacio Agudo-Padrón

After completing 14 years (1996-2010) of systematic work in Santa Catarina State, the small central geographical component of Brasil's southern region (Fig. 1), finally we have at least a basic listing of the species of continental (land and freshwater) and marine molluscs that have been fully confirmed by our field work, review of the available technical literature and/or through specimens deposited in collections, reinforced by consultation and interaction with numerous specialists in both national and international institutions. The listing contains a confirmed total of 878 species and

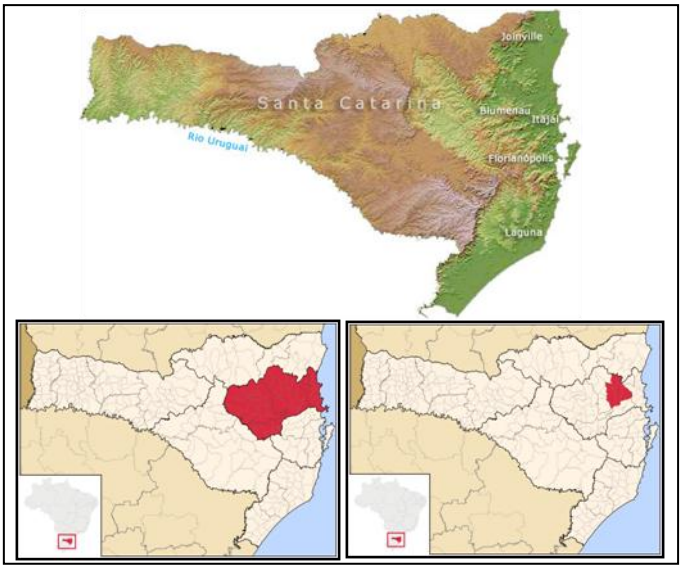

Fig. 1. Location of the Itajaí River Basin (left) and the metropolitan region of Blumenau city (right) in Santa Catarina State.

subspecieses (695 marine and 183 continental forms).

A number of recent regional activities including revisions, discussions and opportune field studies, contributed significantly to the development of this fundamental knowledge, as follows.

1. Official state program for listing and control of invasive exotic species

Starting from November 2009, and for the first time in the environmental history of Santa Catarina, integrated study was undertaken to confirmed the presence of introduced and invading alien molluscs (Agudo & Bleicker, 2006a; Agudo-Padrón, 2007; Agudo-Padrón *et al*., 2009). This arose from official seminars (State Program for Listing and Control of Invasive Exotic Species), organized and driven by the Santa Catarina State Environment Foundation (Fundação do Meio Ambiente – FATMA) jointly with the Hórus Institute of Development and Environmental Conservation (Instituto Hórus de Desenvolvimento e Conservação Ambiental), seeking as the main goal the construction of an 'Official State List of Species'.

At present there 21 fully verified alien mollusc species (48 % of the total confirmed in Brasil), based on the contributions of Agudo & Bleicker (2006b), Agudo-Padrón (2008b) and Agudo-Padrón & Lenhard (2010).

2. Construction of the official species list of fauna threatened with extinction

For the first time in the environmental history of the state the confirmed presence and conservation status of the native mollusc fauna in the state has been assessed.

Sponsored, organized and driven by FATMA, jointly with the IGNIS – Planejamento e In-formação Ambiental (IGNIS – Planning and Environmental Information), the work on these regional invertebrates was officially initiated in October 2009 (IGNIS online published information), with the results presented at the 'IV IGNIS Discussion Forum' in March 2010, extending until April of the same year.

Of seven participant researchers in the mollusc group, only two work with special emphasis in continental species, and just one on a permanent basis with the state in this regard, extending his work on the marine forms in the state (Agudo, 2002, 2004; Agudo & Bleicker, 2005a, b, 2006a; Agudo-Padrón, 2008a-c, 2010; Agudo-Padrón *et al*., 2009).

As these activities came to a close, a total of 675 marine and 82 continental mollusc forms was officially listed for the state in the IGNIS databases, incorporating an additional 17 new records of marine species, that is, the additional records of Agudo-Padrón & Bleicker (2011).

An additional four bivalve species were included based on the zoogeographical likelihood of their presence but whose presence in the state is not yet confirmed by a literature reference, specimen collected in field or material in collections: *Anodontites trapezeus* (Spix, 1827), *Anodontites trigonus* (Spix, 1827), *Fossula fossiculifera* (d'Orbigny, 1835) (family Mycetopodidae) and *Castalia undosa* Martens, 1885 (family Hyriidae).

3. Malacological field research in the Itajaí-Açu river basin valley

In March 2010, an Environmental Impact Study was undertaken by a private company in negotiation with the municipal city hall of Blumenau in the area of the valley and the mid basin of the Itajaí-Açu river, the largest Atlantic drainage-basin of the state (Fig. 1).

Eight species of continental molluscs – six liminic/freshwater (2 gastropods, 6 bivalves) and 2 terrestrial – were recorded, including two that constitute new species records for the state (Figs. 2, 3). In some riverine places, they form large accumulations of shells (Figs. 4, 5).

Fig. 2. Native arboreal micro-snail *Helicina angulata* Sowerby, 1873 (Helicinidae) of the Itajaí-Açu river mid valley. (Photos: Agudo-Padrón)

The entire malacological material discussed here will be deposited at the Museu Zoobotânico Augusto Ruschi (MUZAR), Passo Fundo University, Rio Grande do Sul State, Brasil.

The study was the first extensive effort to survey these animals in the mid basin of the Itajaí-Açu river. Previous literature on molluscs of the area were scarce (Agudo-Padrón, 2008c, 2009a). Some information was available for the Itajaí river valley in general and specifically the Blumenau municipal district in various other publications, among them Morretes (1949, 1953), Prando & Bachia (1995), Silva & Veitenheimer-Mendes (2004), Arroz Irrigado (2005), Simone (2006), Molozzi *et al*. (2007) and Agudo-Padrón (2008c).

In this way, we have finally overcome the initial ignorance of molluscs in Santa Catarina State, but a lot of work remains to be done. For more complete and detailed information

Fig. 3. Limnic/freshwater *Aylacostoma* sp. (Thiaridae) of the Itajaí-Açu river basin. (Photo: I. Agudo-Padrón)

Fig. 4. Accumulation of limnic/freshwater shells found (top) in riverside of the Itajaí-Açu river basin, including several bivalves and *Pomacea* cf. *sordida* Swainson, 1823 (Ampullariidae) (bottom). (Photos: I. Agudo-Padrón)

Fig. 5. Native freshwater mussels, *Diplodon aethiops* (= *Rhipidodonta charruana*), of the Itajaí-Açu river basin. (Photo: I. Agudo-Padrón)

concerning the species recognized to date in Santa Catarina State, please contact the author of this contribution.

Special thanks to Dra. Sílvia R. Sziller, executive director and researcher of the Instituto Hórus de Desenvolvimento e Conservação Ambiental (Florianópolis, SC) and Dra. Roberta Aguiar dos Santos, researcher at CEPSUL – ICMBio (Itajaí, SC), for information, final critical observations/discussion, timely suggestions and opportune help with other regional marine and freshwater mollusc information.

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THE CONTINENTAL MOLLUSCS OF SANTA CATARINA STATE, CENTRAL SOUTHERN BRASIL: NEED FOR MORE POPULATION STUDIES

By A. Ignacio Agudo-Padrón

As previously noted by specialists (Moraes, 2006), all native Brasilian continental mollusc species are under serious threat of extinction, including forms as yet undiscovered, and there is an urgent need to inventory and study them, as the first step in their conservation. Considering the rapid anthropogenic environmental degradation, surely several species have became extinct before they have even been discovered (Simone, 2006).

Besides the environmental degradation (including deforestation for agriculture and/or forest exploration, mining, pollution of the river basins, indiscriminate application of agricultural pesticides and chemical fertilizers, proliferation of the construction of hydroelectric plants, and urban expansion into natural spaces), native Brasilian species also face competition from invading forms that are also responsible for serious sanitary and agronomic problems, among others (Agudo & Bleicker, 2006a; Agudo-Padrón, 2008; Agudo-Padrón & Lenhard, 2010). Introduced deliberately or accidentally, those exotic species are alien to the local ecosystem and because they do not possess natural predators, population growth may be uncontrolled, leading to the extirpation of the native species.

The freshwater bivalve molluscs are particularly sensitive to

trampling, to organic and chemical pollution and other types of environmental degradation. They exhibit relatively slow growth and they do not usually occupy disturbed environments. Endemic species may be restricted to particular basins, many of which have been subject to countless environmental alterations as a result of recent human occupation.

This picture is worsened by the lack of a conscience for preservation of these animals, as can be seen by their representation on lists of threatened animals: rarely is a natural area preserved because of a snail – molluscs have little appeal to the public compared to flashy vertebrate species, in spite of being fundamental for the ecological balance (Moraes, 2006).

Current knowledge of populations of the native continental molluscs of Santa Catarina State in southern Brasil is extremely poor. Of the 56 native continental species considered by us in terms of the IUCN threat categories – 48 Gastropoda (33 terrestrial, 15 freshwater) and eight limnic Bivalvia (Agudo-Padrón, 2010: 32-33), including the recent new records in the extreme west of the State of the land gastropod species *Macrodontes thielei* Pilsbry, 1930 (Odontostomidae) and *Streptaxis pfeifferi* (Pilsbry, 1930) (Streptaxidae) (Agudo-Padrón & Bleicker, 2011) – only 5 have been the subject of any kind of population study in the state: the freshwater snails *Pomacea* '*lineata*' (Spix, 1827) (Ampullariidae) and *Potamolithus kusteri* (Ihering, 1893) (Hydrobiidae), and the bivalves *Diplodon parallelipipedon* (Lea, 1834) (Hyriidae), *Pisidium pipoense* (Ituarte, 2000) and *P. taratuyense* (Ituarte, 2000) (Sphaeriidae) (Perizzolo, 2003; Santos *et al*., 2005; Agudo-Padrón, 2010).

In spite of galloping scientific and technological progress, and as is also the case in other parts of the Neotropics and the planet in general, we still today have a lot of difficulty in evaluating the threats faced by continental – land and freshwater – molluscs in Santa Catarina State, the smallest part of the southern Brasil mosaic (Agudo & Bleicker, 2006b, Agudo, 2007). Among the reasons for this are the lack of solid population data and the small number of resident specialists in the state, essentially us alone, working systematically for 14 years at the regional level (Agudo-Padrón, 2008, 2009a, b, 2010).

We have special concern for certain species that have declined and disappeared in particular areas of the State, for instance the native giant snail *Megalobulimus gummatus* (Hidalgo, 1870), magnificent representative of the Megalobulimidae in the valley of the Uruguay River basin in Santa Catarina. Previously abundant in this area, today it is difficult to find, evidently a consequence of the increase in regional agricultural activities (application of pesticides, mainly), while invading exotic species proliferate and take its place.

Endemic regional species, such as the small aquatic snail *Potamolithus catharinae* Pilsbry, 1911 (Fig. 1), representative of the family Hydrobiidae, and the tiny freshwater limpets *Burnupia ingae* Lanzer, 1991 and *Ferrissia gentilis* Lanzer, 1991, of the family Ancylidae (Agudo-Padrón, 2008), are particularly vulnerable to alteration of their fragile natural habitats by any type of human action.

Fig. 1. Native freshwater snails *Potamolithus catharinae* Pilsbry, 1911 from Itajaí River Basin Valley, Santa Catarina. (Photo: I. Agudo-Padrón)

In general, today there is a regrettable lack of basic information at several levels, particularly in the spatio-temporal dynamics of populations and communities, as well as the impact of several human activities. There is an urgent need for greater attention to the conservation situation of the continental molluscs of Santa Catarina State, and especially to the ecological factors that may influence their populations, in order to assess which species and groups require special attention (Agudo-Padrón, 2010).

For more complete and detailed information concerning the species recognized to date in Santa Catarina State, please contact the author.

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ARE FRESHWATER GASTROPODS NOT IMPORTANT ENOUGH? COMPARISON OF PUBLICATIONS ON FRESHWATER GASTROPODS AND FRESHWATER BIVALVES IN CHINA

By Chuze Shen, Cheng Tang & Min Wu

Scientific papers written in Chinese are usually unfamiliar to other scientists around the world. This is the case regarding malacological publications. We searched for papers on freshwater molluscs in Chinese, using the Google Scholar search engine. Due to the possible unavailability of internet accessible papers published before 1980, a list of papers published from 1949 to 1980 was obtained from Ma & Xie (1991), which covers almost all the papers on malacology during these three decades. A total of 434 papers on freshwater bivalves and 165 on freshwater gastropods, distributed in the categories of toxicology, physiology and anatomy, application, diversity, methodology, biology, paleontology and introduced species, were found. Some papers that were ambiguous in their classification were assigned to a category according to their main purpose and interest. Very few papers had to be counted twice because of their equal contribution to each category. Numerous papers dealing with aquaculture were excluded because of the likelihood that they are mostly technical and not interesting scientifically. Among these papers, those of interest to malacologists working on mollusc conservation and malacodiversity are those on diversity, biology (with ecology and so on included) and introduced species.

Generally, the papers increase steadily in numbers decade by decade from 1949 to 2010 (Fig. 1), with the exception that the number of palaeontological papers decreased a little in the two decades after 1980. Papers on introduced species of freshwater gastropods were dominated by *Pomacea canaliculata*, which was introduced deliberately in the early 1980s from Taiwan, and by *Physa acuta*, which was first reported in 2006 from Taihu lake and has successfully colonized northern China, as indicated by a few recent reports. The papers from 1949 to 1979 are mostly on fossil molluscs and in the categories of

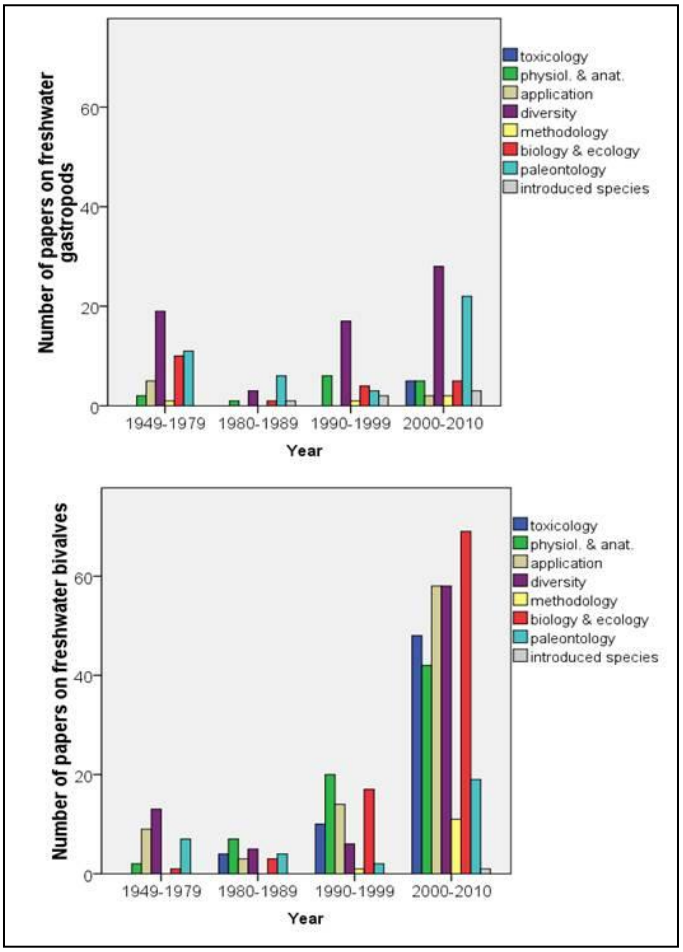

Fig. 1. Numbers of papers on freshwater molluscs published in Chinese from 1949 to 2010. A vast difference in number between freshwater gastropods (upper) and freshwater bivalves (lower).

diversity and biology/ecology, with a number of studies focused on *Oncomelania* Grelder (Pomatiopsidae). The majority of bivalve papers are those related to aquaculture, which focused on their use as food or for pearl production.

Compared to freshwater bivalves, in general since 1949 the freshwater gastropods have been paid significantly less attention (chi-square test, $df = 1$, $p < 0.0001$), and the number of the papers on gastropod diversity is more than that on bivalve diversity only in the 1990s. However, the difference should be noted between the level of coverage of literature available via the internet and from traditional publication sources.

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FEDERALLY ENDANGERED LAND SNAIL *POLYGYRISCUS VIRGINIANUS* (BURCH, 1947) STILL ALIVE IN PULASKI COUNTY, VIRGINIA, USA (GASTROPODA: HELICODISCIDAE)

By Timothy A. Pearce & Kenneth P. Hotopp

In fall 2010 we were fortunate to encounter a live example of one of the most unusual snails in North America, *Polygyriscus virginianus* (Burch, 1947). The find was the product of four weeks of land snail inventory by a team along the New River in western Virginia in 2009 and 2010. Work was conducted mainly by the second author's consulting company, Appalachian Conservation Biology (ACB), for the US Fish and Wildlife Service, with help from the Virginia Department of Game and Inland Fisheries and the Carnegie Museum of Natural History's Section of Mollusks. None of the inventory work would have been possible without the generous cooperation of several private landowners.

Polygyriscus virginianus has one of the strangest shells in North America (Solem, 1975; Batie, 1987a, b; Fig. 1). Adults of this small (~4 mm diameter) snail are unmistakable thanks to a bizarre twist at the end of the final whorl – the last fifth of a whorl (of its 4.5 tightly coiled whorls) is slightly detached from the rest of the shell and deflected ventrally. The shell has 8-10 spiral ridges, and in fresh shells four of the ridges bear striking periostracal fringes (Solem, 1975). It was listed as endangered in 1978 (Greenwalt, 1978) and its conservation status remains G1, S1, meaning that it is critically imperiled both globally and in the State of Virginia (NatureServe, 2010).

For more than 30 years, *P. virginianus* was known from only a few square meters at its type locality on a slope above the New River in Pulaski County near Radford, where it had been discovered by Burch. Then in the 1980s, new finds by Robert Batie, then teaching at Radford University, expanded its range to about 10 km along the river (USFWS, 1983; Batie, 1987a). Subsequent fieldwork by ACB, initially in 2008 and then in 2009-2010, expanded the known range to approximately 16 km. Live animals are known from a much smaller area - our find of a live juvenile expands the range of living individuals from < 100 m to approximately 5 km along the river.

Shells of this rare snail have been found mainly on and near dolomitic limestone bluffs facing the New River, within stable (relatively) talus, either at the foot of slopes, below rock outcrops, or at the base of trees (USFWS, 1983; Hotopp, unpublished data). In our land snail inventory we surveyed by visual search and excavated pits, often to 0.5 m deep. We encountered shells of *P. virginianus* in few places, but did eventually find hundreds of specimens and some new sites. We found that dead tree root masses on slopes can have shells in areas that are otherwise unproductive. Sites are usually shaded by a hardwood forest overstory, including vines. The talus substrate is typically a matrix dominated by small to medium stones, with some decaying leaves and soil, but can also include large rocks too big for a person to move (Batie, 1987b; Hotopp, unpublished data).

Fig. 1. *Polygyriscus virginianus*, relatively fresh shell with fringes. 4 mm diameter. (Photo: K.P. Hotopp)

Most *P. virginianus* shells are encountered 10-30 cm below the surface, with some as deep as 60 cm (Batie, 1987b; Hotopp, unpublished data). On several occasions we found old shells on the surface, and they have previously been collected within 1 cm of the surface (Batie, 1987a). It is unclear whether the depth of old shells is mainly due to their location at death or subsequent sedimentation and erosion. The live juvenile that we found was on the damp soil surface beneath a small flat rock at 1 cm deep, which is shallower than previous reports of live animals. Batie (1987b) found a live individual at 10 cm deep, and prior living individuals had been found deep in talus at 25-40 cm beneath the surface (USFWS, 1983).

Our find of a live juvenile *Polygyriscus virginianus* indicates this federally endangered snail is still extant, so conservation and research efforts should continue. As noted by Drummond (2007), we have little information on the snail's biology or life history, and we still do not know its specific habitat requirements or threats that currently limit its distribution. Further analysis of data may allow us to infer population trends at specific sites. We did also encounter a handful of fresh-looking shells, having an intact periostracum with spiral fringes, at sites where live animals have yet to be found.

Thanks to Mike Drummond, US Fish and Wildlife Service; to Brian Watson, Virginia Department of Game and Inland Fisheries; and to Jeff Schwartz, Kenneth R. Hotopp, Sr., and Alice W. Doolittle for their invaluable help in the field.

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NARROW-MOUTHED WHORL SNAIL SHELL ABNORMALITIES

By Zofia Książkiewicz

Vertigo (*Vertilla*) *angustior* (Jeffreys, 1830) is a small snail in the family Vertiginidae (Gastropoda, Pulmonata) that occurs in Europe and Asia. The species is listed in the IUCN Red List (Hilton-Taylor, 2000) and in Annex II of the European Union's Habitat Directive.

The range of *Vertigo angustior* is declining (Pokryszko, 2003, 2004). Fortunately, however, recent research has revealed new locations of the species. Extensive field surveys in Poland lead to numerous sites harbouring *Vertigo angustior* being identified (Ksiazkiewicz, 2008, 2010; Golab *et al*., 2008; Kaszuba, 2009; Grochowska *et al*., 2010).

More detailed research was conduced in northwestern Poland in 2008 and 2009. The study area was in a small lowland river valley, Ilanka near Torzym city (Fig. 1). The area was semi-open, eutrophic and moderately humid. *Carex acutiformis* was the dominant plant and the moss layer was poor.

Fig. 1. Location (red dot) of the study site in Poland.

During two years of study 4077 adult shells were viewed. The shell was considered as normal if it was sinistral, had 4.5-5 whorls, shell height was 1.5-1.9 mm and the aperture had 5-6 teeth (Wiktor, 2004).

We found that four of the 4077 shells diverged from these normal characteristics in size, number of whorls and presence of apertural teeth and apertural lip. Two types of abnormalities were found.

A regular shell and an abnormal shell are illustrated in Fig. 2. The abnormal shell has 5.5 whorls, no apertural teeth and no thickened apertual lip. The lack of palatal teeth influences the aperture shape, which has a triangular outline. The shell is 1.9 mm high. Only one shell with this abnormality was founded.

Fig 2. Apertural (left) and abapertural (right) views of normal and abnormal (arrowed) shells of *Vertigo angustior*.

Fig. 3. Dwarf examples of *Vertigo angustior*.

Dwarfing was the second type of abnormality (Fig. 3). Three dwarf shells with only four whorls were found. The apertural teeth and lip were formed but shell height was only 1.3 mm.

In conclusion, the variation in shell size in a population of *Vertigo angustior* was recorded during the course of two years of study in the area near Ilanka river. Four of the 4077 shells showed abnormalities. One shell had an extra half whorl but neither the teeth nor lip were formed. Three shells had a half whorl less and were smaller than the normal shells.

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IS *ACICULA PALAESTINENSIS* IN NEED OF SPECIAL PROTECTION?

By Henk K. Mienis

Only a single species of Aciculidae occurs in Israel. It was originally described as *Acicula* (*Acicula*) *parcelineata palaestinensis* by Forcart (1981) from nine specimens collected in a cave between Khirbet Zemach and Hanita, western Upper Galilee. Several additional specimens had been recorded previously as a possible new subspecies of *Acicula parcelineata* (Clessin, 1911) from a soil sample taken on Mount Karmel opposite Oranim by Mienis (1976). It has not been recorded since. However, in their revision of the Aciculidae Boeters & Gittenberger (1989) raised its status to a full species: *Acicula palaestinensis.*

Since this endemic species was known from only two localities, it was awarded the status of 'rare' by Heller (1993) and Mienis & Ortal (1994), which indication remained unaltered in the recently published enlarged English edition of Heller's book (Heller, 2009).

Recently the status of *Acicula palaestinensis* has been changed to 'vulnerable' on several websites without stating why its status has been changed.

In fact there are new indications that the species is more common than previously thought. In the wake of the Evolution Canyon II-project, initiated by Prof. E. Nevo of Haifa University, recent collecting activities have been carried out on both steep slopes of Nahal Keziv by one of his Ph.D. students, Mr. Shmulik Raz. At my request small soil samples were taken at three stations on both the north and south facing slopes. At all the localities on the north facing, so-called 'European' slope, *Acicula palaestinensis* was found in small numbers, doubling the number of specimens collected so far.

The steep slopes of the dry beds of the east-west running ephemeral streams in Western Galilee, from the Lebanese border southwards to the north facing slopes of the Karmel Mountains, have hardly been studied for the presence of minute land snails with the help of soil and litter samples. The recent effort in Nahal Keziv has shown that this *Acicula* species is far from rare if the right collecting method is applied.

Since the slopes of most of the river beds are so steep that building activities may be ruled out in the near future I do not think that any special conservation measures are necessary to protect this species. In fact this species and all other terrestrial, fluviatile and marine molluscs are already protected by law in Israel.

I thank Mr. Shmulik Raz (Haifa University) for collecting the samples in Nahal Keziv and Mrs. Svetlana Vaisman (Plant Protection and Inspection Services, Ministry of Agriculture) for her excellent help in screening the soil and litter samples for the presence of land snails.

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LOPHAUCHEN CRISTATELLUS, A THREATENED BRADYBAENID INCORRECTLY PLACED IN THE FAMILY ENIDAE

By Jingjing Guo, Qin Xu & Min Wu

Möllendorff (1901: 377, pl. 17, figs. 23-25) designated the subgenus *Lophauchen* to accommodate *Buliminus cristatellus*, which was known from Gansu and Sichuan (China). The definition of the genus was modified by Schileyko (1998) as 'Shell subcylindrical, slender, rather solid, slightly translucent, of 9-10.5 moderately convex whorls; last straight or slightly and gradually descending toward aperture. Color uniformly light corneous. Embryonic whorls practically smooth, postapical bear strong rounded ribs with irregular fine radial wrinklets interspaces. Aperture somewhat oblique, small, rounded, continuous because of strong development of parietal callus. Margins of aperture weakly reflexed, thickened, white. Neck thickening whitish. Umbilicus, a short and narrow slit. Height 9.0-11.5, diam. 3.5-3.7 mm'.

We now know that the only species of *Lophauchen* is very rare and narrowly distributed, as indicated by our recent field work (2000-2006 in southern Gansu and northwestern Sichuan). In studying the few specimens at hand, we find that it is in fact a typical species of the bradybaenid genus *Pseudobuliminus*. Here we give a redescription of both the shell and the genital anatomy of this species, based on the following material in the Mollusc Collection in the Museum of Hebei University (MHM) and the Senckenberg Museum, Frankfurt (SMF): MHM00489, Dangchang, Gansu, 27 March 2004; MHM00502, Nanping (type locality), Sichuan, 7 May 2004; MHM04459, Wenxian, Gansu, May 2004; SMF42084, holotype (with damaged protoconch), Nan-ping, Kansu, China; collector Potanin (collection numbers 540, 717); O. v. Möllendorff collection. The new material from Dangchang (one fully mature shell, height 7.5 mm, width 2.6 mm) and Nanping (one juvenile) are distinctly smaller than both the holotype and specimens in MHM04459 (2 fully mature shells, height 10.0-10.4 mm, width 3.9-4.1 mm).

Fig. 1. *Lophauchen cristatellus* (Möllendorff, 1901). A. Holotype, SMF42084, protoconch damaged. Height 10.3 mm, diameter 4.1 mm, aperture height 3.1 mm, aperture breadth 2.4 mm; B. MHM04459 smaller specimen (number 1).

Fig. 2 *Lophauchen cristatellus* (Möllendorff, 1901). Proximal part of genitalia, showing dart apparatus, MHM04459 specimen number 1.

The shell is dextral, cylindrical-conic, with apex blunt, solid, opaque, glossy. Whorls are convex, not speckled, with sparse and indistinct spiral grooves especially on the body whorl. Embryonic shell is granulate. Postnuclear whorls are equally spaced ribbed. Last whorl is nearly straight in front, rounded at periphery. Aperture is subcircular, rather oblique, not armed. Peristome is thickened, slightly expanded. Parietal callus is distinct and thick. Columellar margin only very slightly reflexed. Umbilicus is a narrow slit. Shell is uniformly corneous (Fig. 1).

Limited by the material at hand, the genitalia of only one specimen was examined (Fig. 2). The dart apparatus is well developed. Penial sheath is present. The species apparently belongs to *Pseudobuliminus* (Bradybaenidae), as supported by the characters of the dart apparatus, granulate embryonic whorl and elongate shell (Wu, 2004).

This species represents the most western distribution of the genus *Pseudobuliminus* and as a species living in bushes on hill slopes, it is now seriously threatened by the pasturing of goats, which greatly accelerates the degeneration of the habitat of this species.

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PREDATION ON THE THREATENED ENID SPECIES *SUBZEBRINUS ERRATICUS* (PILSBRY, 1934) BY A SARCOPHAGID FLY

By Linhui Gao, Qin Xu & Min Wu

A ten-year study (2001-2010) confirmed that a sarcophagid fly, *Miltogrammoides* sp. (Miltogrammatinae, Miltogrammatini), is a specialist predator consuming the threatened land snail *Subzebrinus erraticus* (Pilsbry, 1934), which is narrowly distributed in Maoxian, Sichuan, in a limited range of less than ~100 km^2 (Fig. 1). The snail lives sympatrically with other bradybaenids. Two other dipteran species, *Carcelia xanthohirta* Chao & Liang (Tachinidae), 1986 and *Delia platura* (Meigen, 1926) (Anthomyiidae), also use the corpse of *S. erraticus*, after the snails have been preyed upon by a walking beetle.

Fig. 1 Habitat of *Subzebrinus erraticus* (Pilsbry, 1934). The snails are mostly observed on grass and bushes.

The latest field survey was conducted from 5 May to 13 May 2010 by Linhui Gao at Hongqishan Hill (1660 m asl., 31.658981°N, 103.814387°E) to compare un-predated *S. erraticus* with material from the previous surveys. The top of the hill is truncated and flat. *Subzebrinus erraticus* was found on the north, east and west facing slopes. The north facing slope is rocky and we did not sample there. In 2009 Min Wu and Linhui Gao investigated 600 m^2 on the east facing slope and found seven predated snails, significantly fewer than found on the west facing slope, where they found 555 predated snails in 672 m^2. Therefore our work focusing on the relationship between snails and their dipteran predators was mainly done on the west facing slope. During the 2009 field

work, the sample site was once covered by snow. The samples with or without snow coverage, which was assumed to be a factor affecting survival rate of the predatory flies, were studied separately. During the 2010 field work, 392 m^2 was searched and 36 live adults and three fly-predated subadults were found on bushes (Figs. 2, 3), where numerous empty shells were found following the flies' eclosion. Also, numerous young juveniles were active during the 2010 field work. Another 31 adult *S. erraticus* were collected outside the sampling area.

Fig. 2 Upper: a living *S. erraticus*; lower: a *S. erraticus* predated by *Miltogrammoides* sp. Successful predation is characterized by the sponge-like plug on the aperture, which also attaches the shell to the plant.

For comparison, we studied the material (127 fully mature, living and unpredated individuals) collected on 11 October 2001(Min Wu) at a nearby site (1574 m asl., 31.659833°N, 103.813528°E, this site is separated from Hongqishan Hill by the Minjiang River) where none of the *S. erraticus* was found to have been predated by the fly. This suggests that the distribution of the predatory sarcophagid does not cover the entire range of *S. erraticus*.

Fig. 3 Left: exposed shell of *S. erraticus*; right: *Miltogrammoides* sp.

Special thanks go to Prof. Wanqi Xue for identification of the dipterans and to Dr. Binhong Liang for identification of the walking beetle. Funding for this project was provided by the National Natural Science Foundation of China (NSFC, 31071882) and a project from the Science and Technology Ministry (2006FY111000).

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MOLLUSCS ASSESSED BY COSEWIC IN 2010: A NEW SPECIES ADDED TO THE LIST, ONE UPLISTED, ONE DOWNLISTED AND TWO REMAINED THE SAME

By Robert Forsyth & Dwayne Lepitzki

In 2010 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed or re-assessed five species of molluscs. While two of the four reassessed species remained at Endangered, a previously assessed Endangered species was downlisted to Special Concern and a previously assessed Special Concern species was uplisted to Endangered.

Threaded Vertigo—*Nearctula* sp.

Threaded Vertigo, *Nearctula* sp. (Fig. 1), a terrestrial snail that is at the northern extent of its range in Canada, was newly assessed in 2010. This minute snail, the smallest mollusc and among the smallest species yet assessed by COSEWIC, occurs in lowland areas around the Strait of Georgia and on southern Vancouver Island, British Columbia, where most individuals live on the bark of Bigleaf Maple (*Acer macrophyllum*) trees. The species appears to have poor capacity for dispersal between trees and sites. Removal of trees and habitat degradation due to urban expansion, roads and associated infrastructure, forestry, and agriculture were identified as the main threats and the species was assessed as Special Concern.

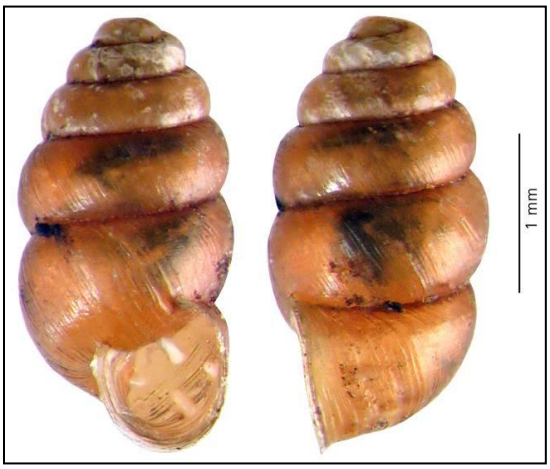

Fig. 1. A Vancouver Island example of *Nearctula* sp. (Threaded Vertigo). This species was assessed in 2010 by COSEWIC as Special Concern. (Photo: Robert Forsyth)

Under Canada's Species at Risk Act (SARA), COSEWIC is required to review its assessments of species every ten years. Four species, all unionids, were re-assessed this year.

Northern Riffleshell—*Epioblasma torulosa rangiana*

Northern Riffleshell, *Epioblasma torulosa rangiana*, is a small freshwater mussel restricted to two rivers in southern Ontario. Since the original COSEWIC assessment in 2000, a small, possibly reproducing population was discovered in the Ausable River although only 16 live individuals, including one juvenile, have been found over the last 10 years. Recruitment is occurring at several sites along the Sydenham River and the population appears to be stable, but the perceived recovery could be due to increased sampling effort over the past 12 years. The main limiting factor is the availability of shallow, silt-free riffle habitat. Both riverine populations are in areas of intense agriculture and urban and industrial development, subject to siltation and pollution. Only four populations in the world, including the two in Canada, show signs of recruitment; the other two reproducing populations are in Pennsylvania (USA). The status of the Northern Riffleshell was re-examined and confirmed as Endangered in April 2010.

Rayed Bean—*Villosa fabalis*

Rayed Bean, *Villosa fabalis*, is one of the smallest freshwater mussels in Canada. It is found in two rivers in southern Ontario. More than 99 % of the estimated total Canadian population is found in the Sydenham River. The original COSEWIC assessment in 2000 concluded that it had been extirpated from most of its Canadian range and was confined to one river but a new, albeit small, population was discovered in 2004 in the North Thames River. Thirteen live individuals were found between 2004 and 2008 in this river. The main limiting factor is the availability of shallow, silt-free riffle habitat. Both riverine populations are in areas of intense agriculture and urban development, subject to siltation and pollution. Invasive zebra (*Dreissena polymorpha*) and quagga (*D. rostiformis*) mussels have rendered much of the historic habitat unsuitable and pose a continuing threat to one of the last remaining populations. The status of the Rayed Bean was re-examined and confirmed as Endangered in April 2010.

Wavy-rayed Lampmussel—*Lampsilis fasciola*

Wavy-rayed Lampmussel, *Lampsilis fasciola*, is a medium-sized freshwater mussel confined to four river systems and the Lake St. Clair delta in southern Ontario. Since the original COSEWIC assessment of Endangered in 1999, surveys have identified a large, previously unknown reproducing population in the Maitland River. The mussels in the Thames River are also now reproducing. The largest population is in the Grand River. Smaller but apparently reproducing populations are in the Ausable River and Lake St. Clair delta. Although water and habitat quality have declined throughout most of the species' former range in Canada, there are signs of improvement in some populations but habitats in Great Lakes waters are now heavily infested with invasive mussels and are uninhabitable for native mussels. The main limiting factor is the availability of shallow, silt-free riffle/run habitat. All riverine populations are in areas of intense agriculture and urban and industrial development, subject to degradation, siltation, and pollution. Invasive mussels continue to threaten the Lake St. Clair delta population and could be a threat to populations in the Grand and Thames Rivers if they invade upstream reservoirs. The species was reassessed as Special Concern in April 2010.

Rocky Mountain Ridged Mussel—*Gonidea angulata*

Rocky Mountain Ridged Mussel, *Gonidea angulata* (also known as the Western Ridged Mussel; Fig. 2), is one of only a few species of freshwater mussels in British Columbia and is restricted in Canada to the Okanagan basin. Increased field surveys have found additional sites since the original COSEWIC assessment in 2003. Historically, channelization and water regulation in the Okanagan River have affected mussel beds and caused population reduction, and ongoing foreshore and riparian development, and some methods of control of invasive Eurasian watermilfoil reduces habitat and affects water quality. However, zebra and quagga mussels were deemed the most serious potential threat to the native mussel. Dreissenid mussels have had devastating effects on native unionid communities elsewhere, such as in the Great Lakes region. A recent assessment of the sensitivity of the Okanagan basin to dreissenid mussels demonstrated that the latter could spread quickly and establish intense infestation on native mussels once introduced. Within the foreseeable future the introduction of dreissenids into the Okanagan basin is likely because they can survive for days out of water and are known to be transported between water bodies on trailered watercrafts; dreissenid mussels have been intercepted on

Fig. 2. Three Rocky Mountain Ridged Mussels, *Gonidea angulata*, from Okanagan Lake, among several animals observed by the Molluscs Species Specialist Subcommittee (SSC) of COSEWIC during their annual meeting in 2010. The SSC was shown the species and its habitat under the guidance of British Columbia government officials. (Photo: Dwayne Lepitzki)

trailered boats heading to British Columbia from neighbouring US states in recent years. Originally assessed as Special Concern in 2003, COSEWIC reassessed this species as Endangered in November 2010.

COSEWIC was established in 1977 and made its first assessment in 1978. In 2003, the Species at Risk Act (SARA) established COSEWIC as an advisory body for government decisions to list species under the Act. Twice each year, the Committee meets to assess the status of wild species, subspecies, varieties or other important units of biological diversity considered to be at risk in Canada. COSEWIC uses the best available scientific, aboriginal traditional and community knowledge provided by experts from governments, academia and others. For more information on COSEWIC and links to status reports see www.cosewic.gc.ca.

For their expertise on these species, the Molluscs Species Specialist Subcommittee thanks the report writers, Kristiina Ovaska, Lennart Sopuck, David T. Zanatta, Shawn K. Staton, Daelyn A. Woolnough, Todd J. Morris, Lea Gelling, Leah Ramsay and Sue Pollard.

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LONGEVITIES OF COLONIES OF *POMATIOPSIS LAPIDARIA*

By Aydın Örstan & Timothy A. Pearce

The superfamily Rissooidea comprises several families of small aquatic and semi-terrestrial snails. Some rissooids, for example *Assiminea infima* (Hydrobiidae) (NatureServe, 2010a), have restricted ranges and are threatened, while others, for example *Pomatiopsis lapidaria* (Pomatiopsidae) (NatureServe, 2010b), are widespread and secure. Understanding the dispersal abilities and the resilience of the colonies of such species as *P. lapidaria* should offer clues to the processes that make some species abundant and others rare and may help conserve the latter. Therefore, we are studying the distribution, ecology and the longevities of the colonies of *P. lapidaria* along the Potomac River in the vicinity of Washington, D.C. In this note, we present preliminary results of our ongoing research.

DeWitt (1952) reported finding *P. lapidaria* at three locations near Washington, D.C. During the last year or so, we revisited DeWitt's locations and found live *P. lapidaria* at all of them. DeWitt's locations are now on US Government park property. Because we did not have collection permits, we did not take specimens, but recorded the presence of live snails by photographing them. DeWitt's (1952) description of his locations is as follows:

'[*Pomatiopsis lapidaria*] occurs in large numbers on the west side of the river about one-quarter of a mile [~400 m] downstream from Key Bridge. It occurs also, but in smaller numbers, on the east side of the river near Fletcher's Boat House about two and one-half miles [4 km] upstream from Key Bridge, and at Fox's Ferry approximately 7 miles [~11 km] downstream from Key Bridge.'

We visited the west side of the river downstream from Key Bridge on 11 December 2009 and on 27 November 2010. We searched for snails along the river's west shore starting at a point about 170 m downstream from Key Bridge and ending at a point about 800 m from the bridge. We found no *P. lapidaria*. But on 27 November 2010, we found live *P. lapidaria* on the west shore of Theodore Roosevelt Island at a spot about 650 m downstream from Key Bridge and 100 m from the west side of the river (38.89693°N, 77.06580°W). We believe our location is close enough to that of DeWitt for our record to be considered a duplication of his.

The location DeWitt called Fletcher's Boat House is Fletcher's Cove on the Potomac River next to the C&O Canal (38.91914°N, 77.10336°W). A boathouse still exists at the location. We found live *P. lapidaria* there on 4 December 2009 and on 15 January 2010. The snails were on wet soil under dry tree leaves about 5 m from the edge of the water.

DeWitt's third location, Fox's Ferry, referred to the ferry that once operated between Oxon Cove on the east side of the Potomac and Alexandria, Virginia, across the river (Woodward, 1907). Oxon Cove is now protected within Oxon Cove Park. We visited the park on 27 November 2010 and found live *P. lapidaria* (Fig. 1) next to the Potomac River on the southern shore of the cove (38.80414°N, 77.01689°W).

Fig. 1. Live *Pomatiopsis lapidaria* photographed at Oxon Cove. Scale is in mm.

The presence of colonies of *P. lapidaria* at more or less the same locations almost 60 years later is intriguing, because the banks of the Potomac River are flooded annually. We cannot demonstrate that the snails we found were the actual descendants of those that made up the colonies DeWitt sampled in or before 1952. It is possible that the present day colonies were established recently by migrants from elsewhere after earlier colonies had gone extinct. The species is probably present at many additional locations along the river, which provide reservoirs that could contribute to its recolonization. Nevertheless, our findings show that if suitable habitats are protected and retained in their natural state, *P. lapidaria* either persists at a given location even when it faces drastic, but natural, changes in its environment, such as floods, or recolonizes the same places once the habitat conditions return

to normal. The semi-terrestrial lifestyle of this species that makes its home both under the water and above it in the leaf litter (Dundee, 1957) undoubtedly contributes to its resilience.

We thank Beysun Örstan for companionship during the November 2010 field trip.

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TYPES OF *VALVATA MERGELLA* WESTERLUND, 1883 LOCATED AT THE SWEDISH MUSEUM OF NATURAL HISTORY, STOCKHOLM

By Edward J. Johannes

Valvata, thought to be *Valvata mergella* Westerlund, 1883, the rams-horn valvata, and *Amnicola* n. sp. 1, the lake amnicola, formerly referred to as the Washington duskysnail (Frest & Johannes, 1995; WNHP, 2010; MNHP, 2010) were discovered in Pattison Lake, Thurston County, Washington during a survey for *Potamopyrgus antipodarum* (Gray, 1843), the New Zealand mudsnail, within a 5 mile (8 km) radius of Capitol Lake conducted for the Washington Invasive Species Council (Olympia, Washington) (Johannes, 2010a, b) (Fig. 1). These rare species have been reported previously from two Washington State sites: *Valvata mergella* from Paradise Lake in north King County (western Washington) and *Amnicola* n. sp. 1 from Curlew Lake, near Republic, Ferry County (eastern Washington) (Frest & Johannes, 1993, 1995). In addition, *Amnicola* n. sp. 1 has been collected from Spectacle Lake, near Enterprise, Okanogan County, eastern Washington and McWenneger Slough (oxbox lake), Flathead County, Montana (Frest & Johannes, 1995). The specimens are preserved in the collections of Deixis Consultants.

Valvata mergella is a somewhat obscure species for North American malacologists because of its isolated type locality, lack of specimens in North American museums and the unknown location of type material in European museums. Despite this the species has been reported from Alaska to Washington (Dall, 1905; Burch, 1989) and in the Russian Far East across the Bering Strait from the reported Alaska occurrence on the Chukchi Peninsula (Starobogatov *et al.*, 2004). The types were collected near Port Clarence, Seward Peninsula, Alaska by the Swedish Vega Expedition (Westerlund, 1883, 1887). Westerlund (1883) gave a brief

Fig. 1. Location of *Valvata* sp. and *Amnicola* n. sp. 1 (red dot) at Pattison Lake, Thurston County, Washington. Yellow star (upper left) indicates the location of *Potamopyrgus antipodarum* introduction in Capitol Lake.

description of the species in both Swedish and Latin but did not illustrate it until his later publication on the molluscs collected during the Vega Expedition (Westerlund, 1887). He referred to *Valvata mergella* as a new species in two places in the 1887 publication (p. 163, 209). No institution was indicated for the types nor was a holotype selected (Westerlund, 1883). The location of the type specimens was reported as "not traced" as recently as 2009 (Kantor *et al.*, 2009). A literature and internet search was conducted in an attempt to locate the types but without success.

Westerlund's material has ended up in various institutions including the Swedish Museum of Natural History (Naturhistoriska Riksmuseet), Stockholm, Sweden; the Lund Museum, Sweden; the Dublin Museum, Eire; and Kelvingrove Art Gallery and Museum, Glasgow, UK. Some material is also in the Melvill-Tomlin collection at the National Museum of Wales, Cardiff, UK. A large part of his collection is now deposited in the Natural History Museum in Gothenburg (Naturhistoriska Museum, Göteborg), Sweden (Dance, 1986).

As it has the largest part of the Westerlund collection, I contacted Ted von Proschwitz (Senior Curator, Section of Invertebrate Zoology) at the Natural History Museum in Gothenburg. A search of the collection yielded no types of *Valvata mergella*. At the suggestion of Ted von Proschwitz, I contacted Anders Warén (Senior Curator, Department of Invertebrate Zoology) at the Swedish Museum of Natural History, Stockholm. A search of this collection resulted in finding the types (SMNH type no. 1640) (pers. comm. Karin Sindemark Kronestedt, Curatorial Assistant, Department of Invertebrate Zoology) (Figs. 2A, 3). The type lot contains 16 specimens (Fig. 3).

A comparison of the *Valvata* collected from Pattison and

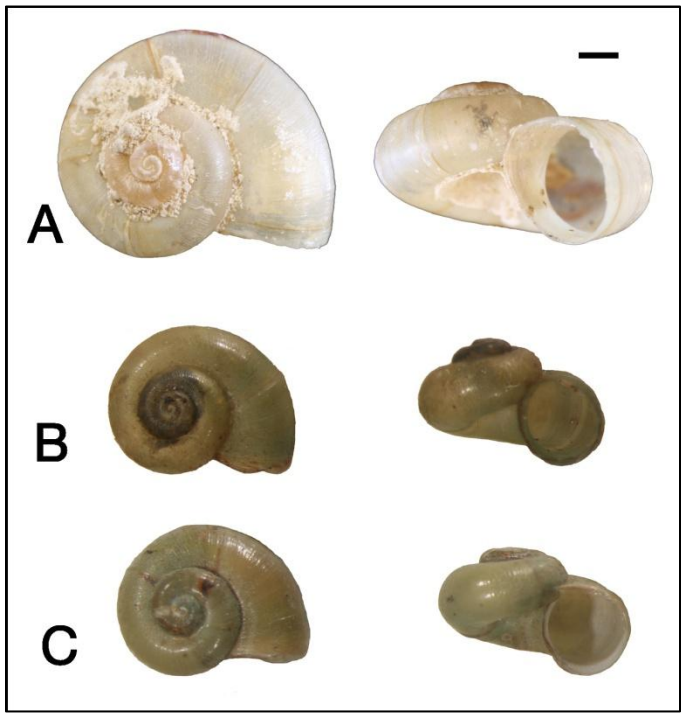

Fig. 2. A: One of the type specimens of *Valvata mergella* Westerlund, 1883 (SMNH type no. 1640; 6.8 mm diameter); B: *Valvata* sp. from Pattison Lake, Thurston County, Washington (Deixis collection, 4.56 mm diameter); C: *Valvata* sp. from Paradise Lake, King County, Washington (Deixis collection, 4.69 mm diameter). Bar = 1 mm. (Photos: top two, A. Warén)

Fig. 3. Type lot of *Valvata mergella* Westerlund, 1883 (SMNH type no. 1640). Bar = 1 mm. (Photo: A. Warén)

Paradise lakes with the types of *Valvata mergella* revealed morphological differences. The relatively larger size and the color of *Valvata mergella* does not fit the light green, smaller shell and expanded aperture of the Paradise and Pattison lakes specimens (Figs. 2, 3). It is possible that this *Valvata* is a new species as it does not match any other described species of *Valvata* found in western North America (e.g. lower spire and not blue-green or emerald green as in *Valvata virens*). Whether *Valvata mergella* occurs outside of Alaska in western Canada, the Russian Far East or in Washington State needs to be confirmed. The status of Alaskan populations is not known (McClory & Gotthardt, 2005); there have been no reports in recent years despite some searching.

Despite the rarity of *Valvata mergella*, this species is currently not officially listed as Endangered or Threatened by the US Government or by the States of Alaska or Washington (ADFG, 2006; ANHP, 2010; WNHP, 2010). It is, however, tracked by the Natural Heritage Programs in both Alaska and Washington, which have given it a State Rank of S1 (critically imperiled or at high risk) in both states (ANHP, 2010; WNHP, 2010).

I thank the landowners for allowing access on or through their properties during the survey. Thanks also to Bert Bartleson (Olympia) for accompanying me into the field and for urging me to collect in Pattison Lake despite being outside the official survey area. I especially acknowledge the efforts of Wendy Brown (Washington Invasive Species Council Coordinator) for pushing this project through despite the current tight State budget. I thank Ted von Proschwitz at the Natural History Museum in Gothenburg and Karin Sindemark Kronestedt at the Swedish Museum of Natural History for searching for the types of *Valvata mergella* at their respective institutions. Thanks go to Anders Warén (Swedish Museum of Natural History, Stockholm) for photographing the type lot of *Valvata mergella*. And finally, I thank Stephanie Clark (EKOsystems Services LLP, Chicago, Illinois) for comments on this article. The survey was conducted for the Washington Invasive Species Council, Olympia, Washington, under Contract 10-1908 and executed under the provisions of Washington Department of Fish and Wildlife Scientific Collection Permit No. 10-262, issued to Edward J. Johannes, SeaTac, Washington.

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PROPOSED RE-INTRODUCTION OF THE ENDANGERED BLACK NERITE, *THEODOXUS PREVOSTIANUS* (MOLLUSCA, NERITIDAE) IN HUNGARY

By Zoltán Fehér, Gábor Majoros, Sándor Ötvös & Péter Sólymos

Theodoxus prevostianus (C. Pfeiffer, 1828) is a rare and endangered neritid species (Fig. 1.) occurring in hypothermal springs in the Pannonian biogeographical region (Fehér *et al*., 2009). Once, 15-20 populations were known (Fig. 2), but the majority have become extinct in the past 50 years (Gagiu, 2004; Jurcsák, 1969; Kormos, 1905, 1906; Piringer, 2001; Schréter, 1915; Sîrbu & Benedek, 2009; Soós, 1943; Vásárhelyi, 1957; Wagner, 1927, 1937). Now, only four remaining populations are known: two in Austria (Bad Vöslau and Bad Fischau), one in Slovenia (Bušeča vas) and one in

Fig. 1. A black nerite (*Theodoxus prevostianus*) specimen in Kács, Hungary.

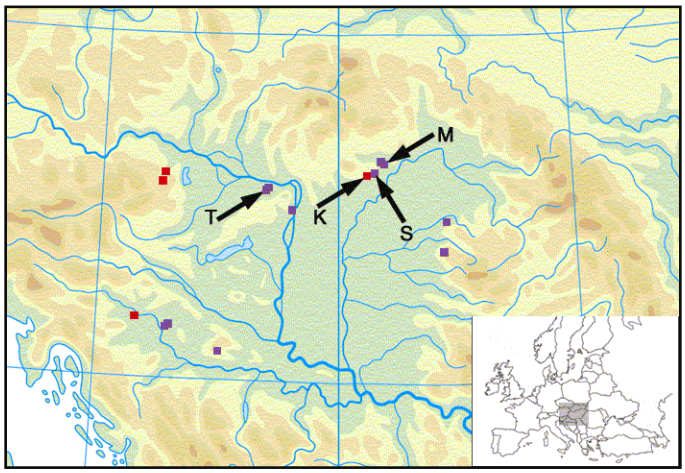

Fig.2. Location of existing (red) and extinct (purple) *Theodoxus prevostianus* populations in the Pannonian biogeographical region. K: Kács, T: Tata, S: Sály, M: Miskolctapolca.

Hungary (Kács). Therefore, the species is of high conservation concern; it is legally protected in Hungary, listed in Annex IV of the European Habitats Directive and categorized as endangered (EN), according to IUCN categories (IUCN, 2010).

In Kács, two groups of springs can be found; one of them has cool water (~15.4 °C) and is controlled by North Hungarian Regional Waterworks Ltd., with only a part of the capacity allowed to run freely. A group of hypothermal springs (22 °C) emerges nearby. A Benedictine monastery was built 700 years ago over the main spring (mean flow rate 44 liters s^{-1} (Savanyú *et al*., 1986)), with the stream emerging from beneath the monastery building (Figs. 3, 4). The hypothermal branch is bordered by five to six additional seepage springs (also hypothermal). Both the cool and the hypothermal branches are ~100 m long before their confluence. The *T. prevostianus* population occurs in the hypothermal section and in the combined section, ~800 m down from the confluence. The total population size is estimated ato be 3-3.2 million specimens, 800,000 in the hypothermal branch and 2.2-2.4 million in the joint section (Varga *et al*., 2007). Despite the legal protection, the species' conservation status in Kács seemed unsatisfactory, most of all because the population is located within private property, outside of the territory of the Bükk National Park. The vulnerability of this remnant black nerite population in Hungary is well illustrated by the events that occurred in April 2010.

In the middle of April 2010, an unusually large amount of rainfall fell in the vicinity of Kács village. Due to the nature of the land relief, the poor rainfall retention ability of the local

Fig. 3. The outflow of the main hypothermal spring in Kács, Hungary, with the Benedictine monastery in the background.

Fig. 4. The upper section of the hypothermal branch of the stream in Kács. The picture was taken before the flood in April 2010. The stream bed is covered by pebbles and gravel.

vegetation and the lack of protecting structures around the spring, a large quantity of water carrying a large sediment load got into the stream. Water volume in the upper stream section increased 10-15 times the usual amount. After this flood, the streambed was covered by a 30-50 cm thick silt layer (Fig. 5), which made almost the whole biotope unsuitable for this species, as it needs solid surfaces. According to our estimation, in the the upper stream section, 99 % of the animals died and only a few thousand speciemens survived in the seepage springs bordering the hypothernal branch, whereas in the joint section ~50 % were extirpated. In order to eliminate the consequences of such floods in the future, the stream has been dredged out and a concrete streambed has been built by North Hungarian Regional Waterworks Ltd. (Figs. 6-7). Though conservation considerations did not play any role in this construction, the concrete streambed seems suitable for *T. prevostianus*; the population seems to have recovered and populated the newly built structures.

The vulnerability of the Kács population was so obvious that the idea of creating insurance populations had long been considered prior to these alarming events. It was first proposed by one of us (GM) in 1999. The plan took the form of a proposal during the Annual Meeting of Hungarian Malacologists in 2009. We proposed to re-introduce black nerites to certain places in Hungary, from which it had become extinct in the past decades. Preliminarily, three sites were

Fig. 5. The confluence of the hypothermal (on the left) and the cold (on the right) branches of the stream in Kács. The picture was taken after the flood in April, 2010, the streambed of the hypothermal branch is covered by thick silt layer.

Fig. 6. The stream in Kács was dredged out after the flood in April 2010 and a concrete streambed has been built. The picture was taken on 21 August 2010.

Fig. 7. The newly built concrete streambed of the stream in Kács. The picture was taken on 14 November 2010.

considered: Fényes Springs in Tata, Csónakázó-tó in Miskolctapolca and Vízfő Spring in Sály. In Tata, the springs had dried out in the 1960s due to groundwater extraction in connection with coal mining. In Miskolctapolca, the extinction of the population was connected to the reconstruction of the Cave Bath, which is fed by the same springs as the Csónakázó-tó. Vízfő Spring in Sály was captured in the 1970s and there were periods when the outflow completely dried up, causing the extinction of that population. Now, all three locations seem to be suitable to host black nerites again.

Fig. 8. The outflow of the Vízfő Spring and concrete covered uppermost section of the stream in Sály.

Fig. 9. The stream of the Vízfő Spring in Sály with natural streambed.

There was a reported case of a benign introduction of this species that gave us hope. In 1909, Lajos Soós introduced some speciemens from Tata to Budapest (Római-fürdő). That population successfully established there and existed for decades (Soós, 1943).

In March 2010, we analyzed the water quality in the three proposed sites. Regarding Ca and Mg content, Vízfő Spring is closest to the hypothermal spring of Kács. Fényes Springs have the same Ca content but three times higher Mg content. In the outflow of Csónakázó-tó in Miskolctapolca, we measured hardly any Mg but high Ca content. The concentration of organic matters seemed to be sufficiently low in each site, except in Miskolctapolca, where it was slightly higher than optimal. Sulphide, an indicator of anaerobic processes like rotting, could not be detected in any of the analyzed locations. We proposed to introduce 200 *T. prevostianus* specimens per year for a period of 3 years to each locations (1800 specimens altogether). We applied for permission to the National Inspectorate for Environment, Nature and Water in March 2010. After a long procedure, we got permission to re-introduce black nerites to Miskolctapolca and Sály but not to Tata, and we are allowed to collect only 200 specimens per year between 2010 and 2012 (600 specimens altogether).

Because of the low number of specimens we are allowed to collect, we decided to start with one location only in the first year. We chose Vízfő Spring, which seemed to be the most promising on the basis of water quality data. Similarly to the cold spring in Kács, this spring has been captured by North

Fig. 10. To avoid immediate drifting away of the re-introduced specimens caused by the strong water current, they were placed out in small flowerpots in the stream of the Vízfő Spring in Sály.

Hungarian Regional Waterworks Ltd. and only a part of the capacity is allowed to run naturally. In the uppermost 10 m section, the stream flows in a concrete basin (Fig. 8.), while downstream it looks more natural with pebbles and gravel in the streambed (Fig. 9). During our first attempt, 200 specimens were transferred from Kács to Sály on 4 November 2010. The duration of the transport was less then 30 minutes. Animals were carried between wet tissue paper and were released in two spots ~15 m apart: one in the concrete section and one in the natural section of the stream. To avoid immediate drifting away of the withdrawn specimens caused by the strong water current, they were placed out in small flowerpots (Fig. 10).

We propose to monitor the re-introduced population three-four times per year in the coming years. Depending on the success of this first re-introduction attempt, we will consider how to use the permitted quota in the next two years (shall we try the re-introduction to Miskolctapolca or supplement the population in Sály?) and we might apply for further permits (either re-inroductions or benign introductions to other hypothermal springs in Hungary).

We thank Erika Bagladi and Szabolcs Mosonyi for making available their picture (Fig. 6). ZF received support from the Hungarian Scientific Research Fund (OTKA-NNF 78185) and the János Bolyai Research Scholarship of the Hungarian Academy of Sciences. PS was supported by a postdoctoral fellowship from the NSERC and the Alberta Biodiversity Monitoring Institute.

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FRESHWATER BIVALVES IN NORTH AMERICA

In addition to the following articles, see the article by Robert Forsyth and Dwayne Lepitzki about conservation assessments of molluscs in Canada in 2010 (p. 31-33), which includes both a terrestrial species and freshwater bivalves.

A new threat to conservation of North American freshwater mussels: Chinese Pond Mussel (*Sinanodonta woodiana*) in the United States

By Arthur E. Bogan, Jeanette Bowers-Altman & Morgan E. Raley

North America is home to a very diverse unionid fauna (Bogan & Roe, 2008). This fauna is being threatened by pollution and habitat modification as well as the continued introduction of freshwater bivalves including the Asian clam (*Corbicula fluminea*), zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*) (Ricciardi *et al*., 1996, 1998). Each of these species exhibit a different threat to the health and conservation of native unionoid species: competing for space, food and/or encrusting shells of native species.

Fig. 1. The shell of one of the specimens collected from fish ponds, Hunterdon County, New Jersey. NCSM 46965-3.

The Chinese pond mussel, *Sinanodonta woodiana* (Lea, 1834), is probably the most widely introduced unionid around the world. Watters (1997), and see numerous publications by H.K. Mienis in *Ellipsaria* (1987-2010), surveyed the countries in which this invasive species had been documented as established, reporting them from 15 countries in Europe, as well as Indonesia, Costa Rica and the Dominican Republic, but reported no records from the United States. The native range of this species was considered to be eastern Russia and China.

Watters (1997) observed that 'it is likely that *A. woodiana* eventually will invade North America and other countries.' This species apparently has been introduced as a byproduct of the import of its commercially sold host fish.

Three live specimens of an anodontine bivalve subsequently identified as *Sinanodonta woodiana* were collected from the New Jersey Conservation Foundation's fish ponds, Franklin Township, Hunterdon County, New Jersey by the New Jersey Endangered and Nongame Species Program staff on 7 June 2010 (Fig. 1). These specimens were sent to the North Carolina State Museum of Natural Sciences, Raleigh, and cataloged (number NCSM 46965) into the Mollusc Collection. These specimens were identified as *Sinanodonta woodiana* based on shell characters. Identification was confirmed based on a comparison of cytochrome oxidase subunit 1 (CO1) DNA sequences (Bogan *et al*., 2011).

New Jersey Conservation Foundation staff lowered the ponds, fish were killed with Rotenone and all fish have been removed from the ponds. Shells of the Chinese Pond Mussel have also been found in Wickecheoke Creek downstream of the ponds. This creek is a tributary of the Delaware River. The extent of the invasion is unclear at this time.

Future conservation impacts of this species on native freshwater mussels are unclear. *Sinanodonta woodiana* grows to large size and will be a competitor for food and may compete for space at least in lakes and ponds.

The molecular work presented here is a contribution from the North Carolina State Museum's Molecular Genetics Laboratory.

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Persistence of unionids in a region of significantly increased urbanization: a comparative analysis of two historic collections

By Joan P. Jass

Separated by a span of seven decades, researchers Chadwick (1905, 1906) and Mathiak (1979) reported the results of their surveys of Wisconsin freshwater mussels (Unionidae). In this region of the Midwestern United States, the unionid fauna has been known for its rich diversity, but now many of the species are classified as endangered, threatened, or species of special concern. However, a comparison of the results of these two surveys from Wisconsin's southeastern corner shows a surprising persistence of these unionids. This is especially notable because the region is the most intensively urbanized section of the state and includes the city of Milwaukee, the population of which doubled to exceed 600,000 during that time period.

Data for this comparison come from two sources: the Chadwick and Mathiak publications and the voucher specimens documenting their findings, which they both deposited in the Mollusk Collection of the Milwaukee Public Museum. Chadwick (1906) described a total of 93 collecting stations, listing those relevant under each species he recorded, and Mathiak (1979) included detailed spot maps for each species he collected throughout the state. The geographic focus for this current comparison was narrowed down to waterways in the Lake Michigan drainage of five counties in southeastern Wisconsin, enabling the total area compared to be the same (though sampling points were not identical). In this focus region, Mathiak recorded 13 unionids in 1976-7 from 24 localities along Cedar Creek and the Des Plaines, Milwaukee, Pike, and Root rivers, reporting from one to nine species at these sites.

Table 1. Comparison of Chadwick (1900s) and Mathiak (1970s) surveys of unionids in the Lake Michigan drainage of a five county area of southeastern Wisconsin. Presence indicated by 'X'.

Species	1900s	1970s
Actinonaias ligamentina mucket	X	-
Alasmidonta marginata elktoe	X	X
Alasmidonta viridis slippershell mussel*	X	-
Anodontoides ferussacianus cylindrical papershell	X	X
Elliptio dilatata spike	X	X
Fusconaia flava Wabash pigtoe	X	X
Lampsilis cardium plain pocketbook	X	X
Lampsilis siliquoidea fatmucket	X	X
Lasmigona complanata white heelsplitter	X	X
Lasmigona compressa creek heelsplitter	X	X
Lasmigona costata flutedshell	X	X
Pyganodon grandis giant floater	X	X
Strophitus undulatus creeper	X	X
Toxolasma parvus lilliput	-	X
Truncilla donaciformis fawnsfoot	X	-
Venustaconcha ellipsifomis ellipse	X	X
Villosa iris rainbow	X	-

The mussels recorded are listed alphabetically (Table 1), with nomenclature following Turgeon *et al*. (1998). With regard to the failure of Chadwick to report *Toxolasma parvus*, Mathiak (1979) hypothesized that, due to the ease of overlooking specimens because of their small size, this mussel would prove to be much more common than earlier records had indicated. Of those missing from the Mathiak listing, only *Actinonaias ligamentina* has an 'apparently secure' conservation status in the state, while *Alasmidonta viridis* is imperiled and both *Truncilla donaciformis* and *Villosa iris* (Fig. 1) are critically imperiled, as designated by NatureServe. While the apparent loss of these four species from the area is significant, the good news for conservation is that 76 % of the fauna survived the considerable changes to the environment that took place in this region during the first seven decades of the last century.

Fig. 1. *Villosa iris*, a critically imperiled Wisconsin species (Milwaukee Public Museum Mollusk 4715, collected Milwaukee River, opposite Lindwerm, Milwaukee County, Wisconsin, Chadwick Survey prior to 1905).

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Northern Riffleshell reintroduction in Illinois: summary of activities in 2010

By Jeremy S. Tiemann, Robert E. Szafoni, Joseph Kath & Kevin S. Cummings

The recovery plan for the federally endangered northern riffleshell (*Epioblasma rangiana*), approved by the US Fish and Wildlife Service (USFWS) in 1994, listed an objective of establishing viable populations of the species in ten river drainages throughout its range. The recovery plan stated that population augmentations and reintroductions would be needed to achieve this objective, and listed the Vermilion River (Wabash River drainage) in Illinois as a potential location for reintroduction. Beginning in 2005, Illinois partnered with the USFWS and state agencies in Ohio and Pennsylvania and began planning the release of *E. rangiana* into the Vermilion River. After 5 years of planning, individuals were translocated into the Vermilion River watershed. On 7 September 2010, staff from the Illinois Natural History Survey and USFWS transferred 146 *E. rangiana* to Illinois. Within a week, staff from the Illinois Department of Natural Resources and the University of Illinois PIT (passive integrated transponder) tagged these animals and released them at two sites within the Vermilion River basin (Fig. 1). Plans include regular monitoring of both sites several times over the summer for the next 2-5 years.

Fig. 1. PIT tags (left) and plastic numbered tags (right) used to mark all northern riffleshell individuals released in Illinois. Both tag types were secured with a 'super glue' product and the PIT tags were later covered with marine grade epoxy. All released mussels carry a PIT tag on one valve and a plastic numbered tag on the opposite valve.

Animals will be documented via PIT tag readers and a small percentage will be excavated to assess survival. For more information on this project, please contact Jeremy Tiemann.

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PACIFIC ISLAND LAND SNAILS

Hawaiian tree snail conservation lab

By Brenden Holland & Ryan Hoan

The Hawaiian Tree Snail Conservation Lab, located on the University of Hawaii's main campus, is the only laboratory in the world working with captive populations of rare Hawaiian tree snails. The main aim of the lab, funded by the US Fish and Wildlife Service (USFWS) and the Oahu Army Natural Resources Program (OANRP), is to care for, maintain, propagate and study the endangered Hawaiian tree-dwelling gastropods. These stunningly colored, ornately banded snails (Figs. 1, 2) were once abundant throughout the islands of Hawaii, but their populations have dwindled in recent decades due to predation by alien species and habitat loss. Although all species in the Oahu genus *Achatinella* have been protected by the US Endangered Species Act since 1981, all species continue to face threats from invasive plants encroaching into native habitat and direct predation by introduced species such as rats and the carnivorous snail *Euglandina rosea*, as well as other species (Holland *et al*., 2010). Unlike most snails, members of the four genera in the endemic Hawaiian subfamily Achatinellinae grow and reproduce at an extremely slow pace, reaching reproductive maturity at around 5 years of

Fig. 1. Representative species of rare Hawaiian tree snails, *Achatinella* spp. and *Partulina* spp.

Figure 2. *Achatinella* sp. (left) and *Achatinella livida* (right) from the Koolau Mountains, Oahu.

age and giving birth to a single offspring only a few times a year. The combination of disturbed and degraded habitat, decreasing numbers due to predation, lack of dispersal ability and slow birth and reproductive rates has rendered natural population recovery all but impossible in the wild.

Prior to the onset of the ecological problems due to habitat loss and invasive species, there were about 100 species of tree snails, and 41 on the island of Oahu alone, yet today only about 24 remain across all islands, including only nine on Oahu. The Hawaiian Tree Snail Conservation Lab maintains 13 species, nine of which are endangered. In the lab, populations are maintained in environmental chambers, which simulate natural daily temperature fluctuation, rainfall, and photoperiods found in the mid-elevation montane cloud forest habitats where the snails naturally occur (Figs. 3,4).

The lab, supervised by Dr. Brenden Holland and staffed by a dedicated team of technicians, interns, undergraduate and graduate students and postdoctoral researchers, is continually working to improve our understanding of physiological and nutritional requirements of these sensitive snails in an effort to optimize captive conditions, indicated by reproduction, growth and survival. Currently, a priority is to stimulate reproduction and enhance survival of captive populations of tree snails by improving their diet. Hawaiian tree snails feed on fungi that grow on the surface of leaves and bark of native trees and shrubs, so leaves and branches are collected on a weekly basis, and a strain of fungus is cultured in the lab as a supplement (Fig. 5).

Fig. 3. Hawaiian tree snail habitat, mid-elevation cloud forest, Oahu.

Fig. 4. Koolau summit, Oahu.

We are interested in optimizing the diet of the different species of tree snails in captivity by diversifying the cultured fungi, since in the wild it is likely that snails feed on more than a single type of fungus, as mycologists have shown that dozens and dozens of species typically occupy a particular plant surface in the forest. We are interested in isolating and culturing several fungal species from native trees, and have begun doing so, and hope to begin feeding some of these cultured native fungi to the tree snails. In addition, feeding trials with a dietary supplement have been initiated. We are feeding a commercially available tree snail supplement to the captive Hawaiian snails, developed by Harlan Laboratories™, specifically for captive Tahitian tree snails (Partulidae) and fortified with nutrients and minerals that the snails require. In the long-term, our goal is to release healthy, reproductive aged snails back into areas of their native habitat that have been deemed predator free. We are also involved in efforts and experiments to gain understanding of the feeding and tracking behavior of key predators of the Hawaiian tree snails (Holland *et al*., 2010, in press, Sugiura *et al*., 2011), so that we can ultimately use this information to capture, kill, control and eradicate these invasive pests.

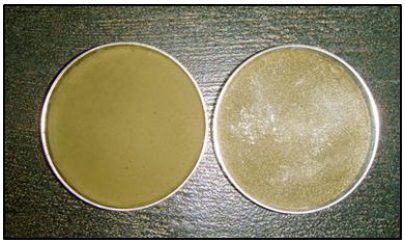

Fig. 5. Cultured fungus on potato dextrose agarose growth medium, used to feed captive populations of Hawaiian tree snails. Petri dish on the right has 0.10 g of snail supplement added.

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MARINE MATTERS

Can horse mussel reefs be restored in Strangford Lough?

By Elisabeth Strain, Jose Maria Fariñas Franco, Emma Gorman, Anne Marie Mahon, David Roberts & David Symth

Horse mussel (*Modiolus modiolus*) reefs are one of the most productive and diverse habitats in the UK (Fig. 1). These reefs provide habitat and refuge for hundreds of species, including commercially important species, and the mussels themselves can improve water quality through filtering (Roberts *et al*., 2004). Horse mussel reefs are one of the key features that have resulted in Strangford Lough being designated as a special area of conservation interest (SAC). Although horse mussel reefs were once very rich in Strangford Lough, recent research has demonstrated that they have been declining at an alarming rate (Roberts *et al*., 2004).

Fig 1. Horse mussel reefs in Strangford Lough.

The horse mussel restoration group was created by Queen's University, Belfast, UK, with the aim of restoring the reefs within Strangford Lough. Artificial reefs are one approach that the team is currently trialling to help increase the numbers of horse mussels in the Lough. This experiment is designed to test whether the mussels will form healthy and productive reefs when they are supplied with a raised artificial habitat. The new reef is designed to benefit the mussels by increasing the water flow and availability of food. It will also remove the mussels from the sediment, which can clog their filtering and feeding mechanisms, and eventually kill the animals.

Fig 2. Cranes and barge used to lift and transport the 1 tonne scallop shell mesh bags.

In November 2009, the group started to rebuild a site that once contained an abundance of horse mussels. This operation required seven HSE Level IV scientific divers, 30 1 tonne polypropylene bags filled with scallop shells, a transport barge, and a crane to lift the bags into the water (Fig. 2). This experiment is the most ambitious project undertaken by the group. The experiment has three treatments: raised scallop shells, flattened scallop shells and no scallops shells.

Fig 3. The scallop shell artificial reef used to restore the horse mussel reefs. Left, March 2010; right, September 2010.

Artificial reefs have been used successfully in other parts of Europe and the United States to restore shellfish populations (Schulte *et al*., 2009). These reefs can be used to assess whether there are any environmental conditions that will benefit the horse mussels and their associated fauna. The horse mussel restoration group is currently monitoring the artificial scallop reef in Strangford Lough to determine whether the mussels will successfully establish onto their new habitat. The preliminary results show that the horse mussels have attached to the new reef and appear to be healthy and filtering well (Fig. 3) and the densities of invertebrates and fish tripled in 6 months (Fig. 4). However, there were no detectable

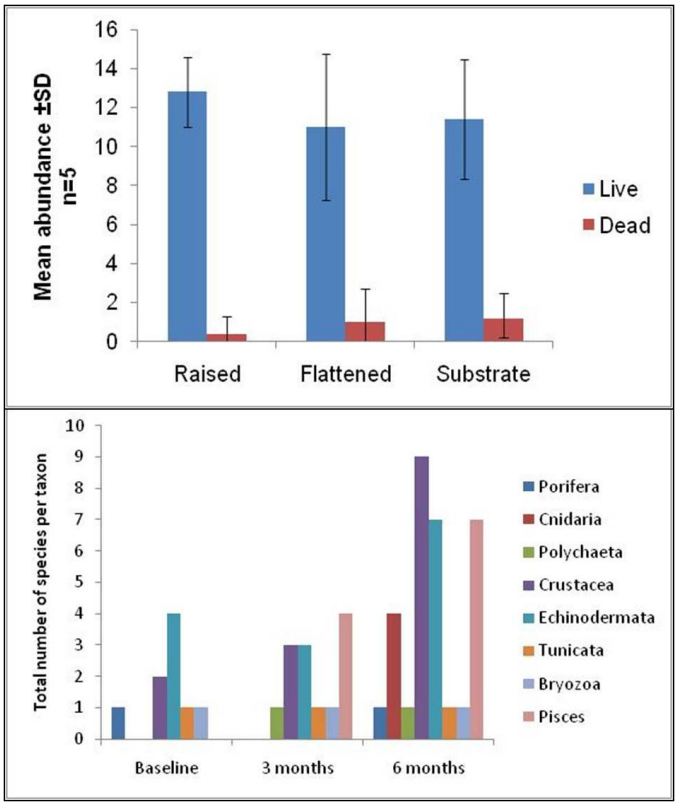

Fig 4. Effect of treatments on horse mussel survival (top) and epifauna community (bottom) after 6 months.

differences in horse mussel densities among treatments (Fig. 4). The group are continuing to monitor the experiment and the long term results should be interesting both for science and for divers in Strangford Lough.

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Schulte D.M., Burke R.P. & Lipcius, R.N. 2009. Unprecedented restoration of a native oyster metapopulation. *Science* 325: 1124-1128.

Elisabeth Strain, Jose Maria Fariñas Franco, Emma Gorman, Anne Marie Mahon, David Roberts & David Symth, Queen's University Marine Laboratory, Portaferry, Northern Ireland BT22 1PF, UK. e.strain@qub.ac.uk, j.farinas@qub.ac.uk, e.gorman@qub.ac.uk, a.mahon@qub.ac.uk, d.roberts@qub.ac.uk, d.smyth@qub.ac.uk

Biology and conservation status of the endemic Maltese top-shell *Gibbula nivosa* (A. Adams, 1851) (Trochidae)

By Julian Evans, Joseph A. Borg & Patrick J. Schembri

The Maltese top-shell, *Gibbula nivosa*, was first described by A. Adams in 1851, who, however, did not state from where the specimens he described had originated. Comparisons of Adams' type material with shells collected from around the central Mediterranean island of Malta established that *G. nivosa* occurs at this locality (Ghisotti, 1976), while it has never been recorded from anywhere else in the Mediterranean, despite extensive searches by shell collectors (Schembri, 1985). Such a situation is practically unique amongst marine molluscs within the whole Mediterranean region (Palazzi, 1978) and *G. nivosa* is now firmly established as a Maltese endemic (Ghisotti, 1976) and is protected under local and European Union legislation as well as by international conventions (the Bern Convention and Barcelona Convention).

However, *G. nivosa* appears to be rare even within the Maltese Islands themselves. For instance, Palazzi (1978) searched 13 sites for this species but found live individuals only in St. Thomas Bay, although three years later Cachia (1981) recorded live specimens from Santa Marija Bay and Delimara as well. Since shells of *G. nivosa* had become sought after by shell collectors and were appearing in the catalogues of professional shell dealers, Palazzi invited malacologists and shell collectors to refrain from collecting this species because it risked becoming extinct as a result of over-collection. Despite this and the legal protection it was subsequently afforded, there were no records of live individuals for over 25 years (between 1981 and 2006), in spite of intensive searches carried out at St. Thomas Bay and Santa Marija Bay (Schembri *et al.*, 2007). Given its disappearance from localities where it used to occur, *G. nivosa* was considered to be critically endangered (Schembri *et al.*, 2007).

Fig 1. Individuals of *Gibbula nivosa* on a cobble substratum, collected from Marsamxett Harbour. (Photo: Julian Evans)

In 2006, we discovered a population of *G. nivosa* in Marsamxett Harbour (Fig. 1), while two live individuals were also encountered off western Comino in 2008, which proved that the Maltese top-shell is not extinct. Interestingly, at both sites the snails were recorded from a cobble/pebble substratum and not seagrass (*Posidonia oceanica*) meadows, which was their reported habitat at St. Thomas Bay (see Evans *et al.*, 2010). We subsequently carried out studies on the population in Marsamxett Harbour in order to obtain basic information on the ecology and behaviour of *G. nivosa* – biological data which, despite being essential for conservation management of the species, was previously unavailable. Our results indicated that the snails have a circadian activity pattern with nocturnal foraging, which may have evolved in response to diurnal

predation. Recruitment was observed around September suggesting that *G. nivosa* spawns in early summer as the sea temperature rises. Although the snails did not show gregarious behaviour, their distribution in the field was slightly aggregated giving rise to spatial variation in population density. The overall population size in Marsamxett Harbour was estimated at around 100,000 individuals in January 2008; however, large temporal fluctuations in abundance were also recorded, implying that population size is very variable and may be much lower than the estimated value at certain times of the year.

Given these new data, we re-evaluated the conservation status of *G. nivosa*. The estimated extent of occurrence of this species is less than 100 km^2, while its actual area of occupancy is less than 10 km^2 (Fig. 2). The species is known only from a single location (Malta) and the entire population is fragmented (the only confirmed populations are found at Marsamxett Harbour and Comino). Finally, a decline in its extent of occurrence has been observed since the populations at St. Thomas Bay and Santa Marija Bay appear to have become extinct. Thus, *G. nivosa* should still be considered as critically endangered under the 2001 IUCN Red List criteria (CR B1ab(i)+2ab(i); IUCN, 2001). More details of our study on *G. nivosa* are given by Evans *et al.* (in press).

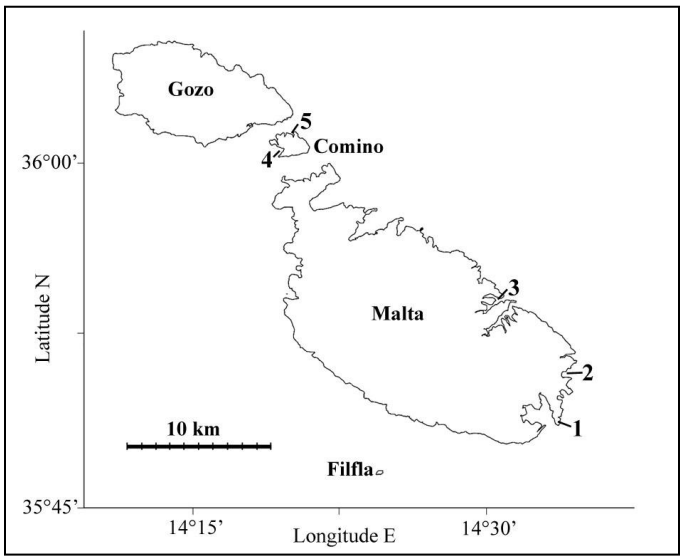

Fig 2. Map of the Maltese Islands showing the locations from where live individuals of *Gibbula nivosa* have been recorded: 1– Delimara, 1981; 2 – St. Thomas Bay, 1981; 3 – Marsamxett, 2006; 4 – SW Comino, 2008; 5 – Santa Marija Bay, 1981.

This work was partly funded through a Malta Government Scholarship Scheme grant (ME 367/07/35) awarded to JE. The study conforms fully to the laws of Malta, and we thank the Malta Environment and Planning Authority for granting the necessary permits that enabled us to study the protected Maltese top-shell.

Cachia, C. 1981. Notes on some uncommon species of molluscs from the Maltese Islands. *Bollettino Malacologico* 17: 291-294.

Evans, J., Borg, J.A. & Schembri, P.J. 2010. Rediscovery of live *Gibbula nivosa* (Gastropoda: Trochidae). *Rapport de la Commission internationale de la Mer Méditerranée* 39: 507.

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Cone snails in the spotlight

By Howard Peters

Throughout the tropics, burgeoning human populations in coastal areas are increasing stress on marine life through over-extraction and destructive fishing practices (Pandolfi *et al.*, 2003). On land, coastal development, shoreline structures, agriculture and forest clearance disrupt marine ecosystems, while discharge of nutrients and other pollutants into the seas result in the death of many species (Rogers, 1990). Coral reefs and associated ecosystems of mangrove forests and seagrass beds are in long term decline exacerbated by elevated sea-surface temperatures and acidification from the burning of fossil fuels (Kleypas *et al.*, 1999). The results can be seen in a global diminution of coral cover, increased abundance of algae and a sharp decline in structural complexity of reefs and the impoverishment of reef biodiversity (Alvarez-Philip *et al.*, 2009).

Tropical seas are of critical importance in supplying goods and services to the nations whose shores they bound (Moberg & Folke, 1999). However, the impact of habitat degradation on populations of marine molluscs seldom receives the same levels of exposure as that of finfish, primarily because of their relatively minor contribution to human protein requirements and to the general belief that invertebrates are reasonably resistant to extirpation or extinction owing to their wide distribution and the likelihood of hidden pockets of survivors (Jamieson, 1993). The paucity of statistical data on mollusc abundance and species richness when compared to fish is a reflection of their lesser importance in fisheries management despite many artisanal communities being dependent upon them and even though such taxa are comparatively easy to assess.

Researchers at the Environment Department of the University of York, UK, are looking into the threats facing all 600-plus

species of cone snail (*Conus* spp.) with emphasis on habitat loss. *Conus* has been chosen because of its global biogeography, its importance to marine biodiversity and its potential in biopharmacology.

Cone snails are predatory gastropod molluscs that capture their prey of fish, worms or molluscs (according to species – Fig. 1) through the deployment of venom apparatus consisting of radular teeth that have evolved into detached hollow harpoons for the delivery of a complex of neurotoxins. Each snail synthesises its own species-specific venom from a combination of toxins that number in total some 50,000 across the genus with little replication (Craig *et al*., 1999). It is these toxins, or conopeptides that offer great promise in the development of drugs for a range of pernicious diseases and ailments. However, less than two percent of conopeptides have so far been characterized (Kaas *et al*., 2010).

Fig. 1. Diet and toxicity. Left: *Conus geographus* Linnaeus, 1758; piscivorous, shell length to165 mm; significant fatality risk to humans. Centre: *C. textile* Linnaeus, 1758; molluscivorous, shell length to 150 mm; handle with extreme caution. Right: *C. betulinus* Linnaeus, 1758; vermivorous, shell length to177 mm; handle with care; note operculum. All species shown are Indo-Pacific (Röckel *et al*., 1995). (Image: H. Peters)

Research at York is being managed through a series of interconnected projects, the first of which is to undertake a global assessment of all cone snail species against IUCN Red List criteria. This will culminate in a workshop that will bring together experts in *Conus* from both scientific and commercial backgrounds to validate the findings and to classify each species where possible according to its perceived level of risk. At present there are just five *Conus* species listed: four from Angola reviewed in 1996 and assessed as vulnerable D2 and one from the Galapagos, also from1996, assessed as Data Deficient. All five species are now in need of update and will be reviewed in line with the revised criteria on vulnerability.

The findings from the Red List assessment will be used to focus fieldwork on those species in the highest risk category or where data deficiency combined with other indicators, in particular restricted geographical range, would suggest field research is demanded.

In-water censuses will be undertaken to determine population statistics of those surviving in differing habitats under varying levels of degradation. Orthogonal survey designs are to be employed to contrast differing combinations of environmental and anthropogenic pressures controlled by species-dependent variables such as habitat type and bathymetry. Further research into fecundity, life expectancy and mortality will determine the recovery prospects and level of protection required for those species under greatest threat.

This project is being funded by a National Environmental Research Council joint award with the Economic and Social Research Council. The IUCN Red List workshop is being funded by the Encyclopedia of Life.

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Röckel, D., Korn, W. & Kohn, A.J. 1995. *Manual of the living Conidae*, Vol 1. Verlag Christa Hemmen, Wiesbaden. 517 p.

Rogers, S.R. 1990. Responses of coral reefs and reef organisms to sedimentation. *Marine Ecology Progress Series* 62: 185-202.

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Describing the molluscan biodiversity of 'Secche di Tor Paterno', a peculiar Marine Protected Area in Italy

By Paolo G. Albano & Bruno Sabelli

The molluscan fauna of the Mediterranean Sea consists of 1500-2000 species and is one of the most studied in the world. This does not necessarily mean it is one of the best known. Two centuries of malacologists and paleontologists have described most of the diversity but also produced a very large number of names and it is often difficult to study the fauna without getting lost in unclear synonymies, missing types, obscure publications and inaccessible museums. Many species rich families like Turridae, Pyramidellidae and Cerithiopsidae still wait for a sound revision. Geographically, knowledge is patchy, with greater information in the western Mediterranean but serious lack of information in some sectors of the eastern and southern Mediterranean. Last, but not least, although marine protected area (MPA) networks exist, the diversity

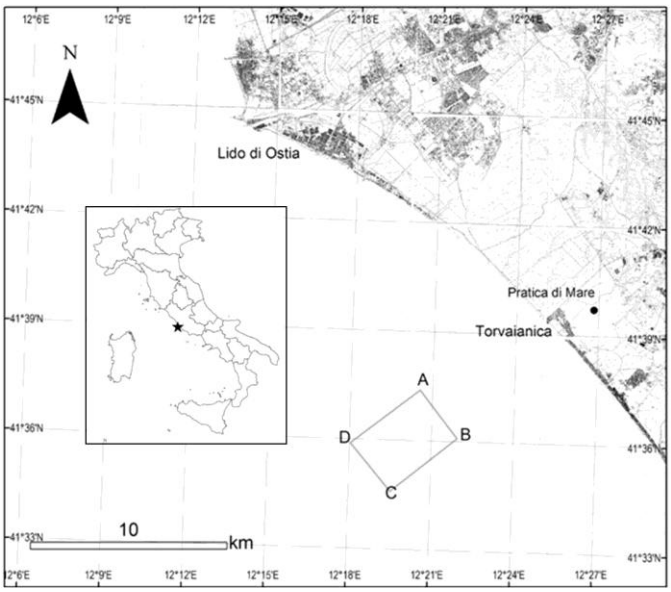

Fig. 1. Geographical location of the Marine Protected Area 'Secche di Tor Paterno'.

they represent is rarely assessed, especially for invertebrates. This is particularly true in Italy where marine protected areas were rarely established based on a biodiversity and conservation assessment but more often on the presence of charismatic species or outstanding coastal landscapes.

The Marine Protected Area 'Secche di Tor Paterno' is a peculiar site in the Italian MPA network (Fig. 1). The area encompasses an off-shore reef, an outcrop of recent (Pleistocene) sedimentary rock emerging from soft substrates between 18 and 60-80 m depth. It is heavily covered with coralligenous assemblages with several different facies, with patches of *Posidonia oceanica* and detritic pools. This is the only Italian MPA without any coastal area and is frequented only by divers and fishermen. Both activities are now severely regulated and the effects on the fauna are clearly visible by the increasing sightings of *Epinephelus marginatus* (dusk grouper) and *Myliobatis aquila* (common eagle ray). The site is not only a MPA but is also a proposed site of importance in the European Union Natura 2000 network because of the presence of *Posidonia oceanica* (a habitat of priority interest for conservation according to the Council Directive 92/43/EEC Habitats Directive).

The 'Secche di Tor Paterno' MPA supports iconic species of molluscs (Fig. 2) but the molluscan fauna of the area was previously studied only once (Università La Sapienza, 1993) in a wider survey of the area and data on molluscs were gathered by limited live sampling of communities, organogenous sediment analysis and study of fishing residuals from an area wider than the actual MPA both geographically and bathymetrically. From May to July 2007 intense sampling was carried out by our team in the area with the objective of reassessing the molluscan biodiversity specifically within the borders of the protected area and in the most exploited depth interval: from the top to almost 30 m depth where most divers go (130 ha). This is the depth that hosts the greatest habitat diversity, since *Posidonia oceanica* is limited to the shallower sectors of the reefs.

Four biocoenoses were sampled: the extensive coralligenous, the *Posidonia oceanica* rhizomes and leaves, and the detritic pools. Sampling was carried out by air-lift suction sampling in all biocoenoses except on *P. oceanica* leaves, which were sampled with a net. The use of the air-lift suction sampler on the coralligenous was selected to reduce damage to the encrustations, the standard method being brushing, which is much more destructive.

In total, 12 stations were sampled with three replicates at each for a grand total of 36 samples. This sampling effort and other occasional sightings resulted in records of 162 live species of shelled molluscs. Of these, four species are of conservation interest: *Erosaria spurca* and *Luria lurida* (Gastropoda: Cypraeidae), *Lithophaga lithophaga* (Bivalvia: Mytilidae) and *Pinna nobilis* (Bivalvia: Pinnidae).

This number of species is very high (roughly 10 % of the Mediterranean fauna) considering the geographically restricted area, the narrow depth interval that implies that several biocoenoses are not present (e.g. photophilous algae, deep water corals), the lack of true soft substrates, the single season and single year of sampling and that a 1 mm sieve was used (so missing some tiny species like Pyramidellidae). Moreover, the use of non destructive sampling devices means that some endobenthos species may have been missed (e.g. Vanikoridae, boring bivalves). To overcome the season, size and sampling bias, organogenous sediments were collected and are at present under study in order to develop a more comprehensive understanding of the diversity of the area.

Further good news is the total lack of any alien molluscan species. We also preserved some specimens in ethanol for addressing at least some of the taxonomic problems of the Mediterranean fauna with modern molecular techniques (work in progress on Muricidae with Marco Oliverio, Università La Sapienza in Roma, Fig. 3). A booklet for the wider public (Albano & Sabelli, 2009) was promptly published to advertise the richness of the area and to increase awareness of the molluscs as animals, not just their shells, as a way of making people understand that shells are not just objects but living creatures that are better kept alive underwater than dead on the

Fig. 2. *Alvania settepassii* Amati & Nofroni, 1985 is an iconic species in the Secche di Tor Paterno, which is its type locality.

Fig. 3. Despite currently being considered the same species, *Muricopsis cristata* (Brocchi, 1814), these two forms (top and bottom) are likely to be two distinct species, as supported both by morphological and molecular evidence, adding to the biodiversity of the area.

living room table. A thousand copies were printed and are all already gone!

The survey also produced a wealth of specimens of other phyla and some results are now being published (e.g. Brachiopoda; Evangelisti *et al*., in press) in order to exploit fully the sampling effort and describe and disseminate as much as possible the richness of this peculiar marine protected area. Results on molluscs are expected to be published in 2011.

Sampling was supported by the Ministero dell'Ambiente e Tutela del Territorio e del Mare. Luca Marini, director of the MPA and manager of the managing body RomaNatura, greatly helped in obtaining these funds.

Albano P.G. & Sabelli B. 2009. *I molluschi delle Secche di Tor Paterno*. RomaNatura, Roma. 96 p.

Evangelisti F., Albano P.G. & Sabelli B. in press. Recent Brachiopoda of the Marine Protected Area 'Secche di Tor Paterno', Central Tyrrhenian Sea. *Cahiers de Biologie Marine*.

Università La Sapienza. 1993. *Caratteristiche ambientali e risorse da pesca della secca di Tor Paterno*. Ministero della Marina Mercantile, Roma. 159 p.

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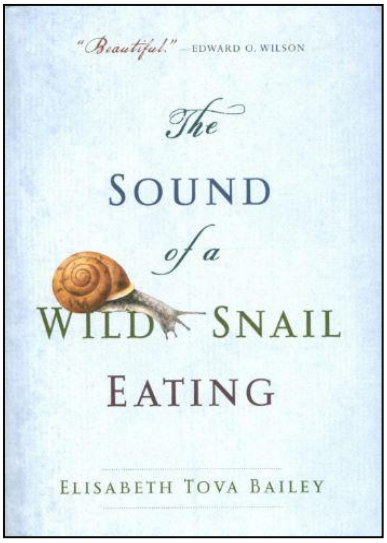
RECENT PUBLICATIONS RELEVANT TO MOLLUSC CONSERVATION

Book review



Elisabeth Tova Bailey, 2010. *The Sound of a Wild Snail Eating*. Algonquin Books of Chapel Hill, Chapel Hill, North Carolina, USA. ISBN 978-1-56512-606-0. US$18.95.

By the Editor

Endorsed by renowned biologist and conservationist Edward O. Wilson as 'beautiful', this was one of my most enjoyable reads for a long time. Filled with humour, pathos and a gentle wonder, this delightful and exquisitely written book is the reflections of a young woman, ill and bedridden, who draws strength from observing the life of a snail picked up by a friend in the nearby woodland and given to her with a pot of violets. The snail was identified for her by Tim Pearce (a regular contributor to *Tentacle*) as *Neohelix albolabris*, a woodland snail of eastern North America.

As the year goes by, the author becomes increasingly fascinated by her snail, watching its behaviour, reproduction and so on. Soon she wants to know more about snails, so she delves far and wide into the literature, ranging from Darwin's *Origin* and *Descent of Man* to Wilson's *Biophilia*, via Barker's *The Biology of Terrestrial Mollusca*, Wilbur's *The Mollusca* and Solem's *The Shell Makers*, literature that no doubt is familiar to many readers of *Tentacle*. She cites papers by Tim Pearce, Eddie Gittenberger and even by me. And she even quotes my own Ph.D. supervisor, Arthur Cain, and his botanist friend Tony Bradshaw.

The book is not about snail conservation, but as an expression of sheer wonder at the beauty and complexity of a small brown snail the book is a reflection of what I suspect drives most of us to work to preserve malacological diversity. If more people were as inquisitive and open to thinking about molluscs, and biodiversity in general, as Bailey is, our work in conservation would be much much easier.

I gave this book to everyone in my lab at the University of

Hawaii and I encourage all readers of *Tentacle* to go out and get a copy. You can read more about it at the author's website.

Robert H. Cowie, *Tentacle* Editor.

Leslie Hubricht Memorial Symposium on Terrestrial Gastropods

Derived from the Leslie Hubricht Memorial Symposium on Terrestrial Gastropods held at the 2008 meeting of the American Malacological Society in Carbondale, Illinois, USA, the following papers were published in the *American Malacological Bulletin*, volume 28.

Perez, K.E. Current research on land snails and land snail conservation: Leslie Hubricht Memorial Symposium on Terrestrial Gastropods. 13-14.

Gerber, J. Leslie Hubricht (1908–2005), his publications and new taxa. 15-27.

Nekola, J.C. & Coles, B.F. Pupillid land snails of eastern North America. 29-57.

Naranjo-García, E. & Fahy, N.E. The lesser families of Mexican terrestrial molluscs. 59-80.

Rundell, R.J. Diversity and conservation of the land snail fauna of the western Pacific islands of Belau (Republic of Palau, Oceania). 81-90.

Minton, R.L. & Perez, K.E. Analysis of museum records highlights unprotected land snail diversity in Alabama. 91-95.

Coppolino, M.L. Strategies for collecting land snails and their impact on conservation planning. 97-103.

Sinclair, C.S. Surfing snails: population genetics of the land snail *Ventridens ligera* (Stylommatophora: Zonitidae) in the Potomac Gorge. 105-112.

Örstan, A. reproductive biology and annual population cycle of *Oxyloma retusum* (Pulmonata: Succineidae). 113-120.

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, the editor of *Tentacle*, Robert Cowie.

Anderson, R. & McCormack, S. 2010. Re-discovery of *Omphiscola glabra* (O.F. Müller) (Lymnaeidae) in Ireland. *Journal of Conchology* 40(2): 243.

Dallimer, M. & Melo, M. 2010. Rapid decline of the endemic giant land snail *Archachatina bicarinata* on the island of Príncipe, Gulf of Guinea. *Oryx* 44: 213-218.

DeBoer, T.S. & Barber, P.H. 2010. Isolation and characterization of 9 polymorphic microsatellite markers for the endangered boring giant clam (*Tridacna crocea*) and cross-priming testing in three other tridacnid species. *Conservation Genetics Resources* 2: 353-356.

Douda, K. 2010. Effects of nitrate nitrogen pollution on Central European unionid bivalves revealed by distributional data and acute toxicity testing. *Aquatic Conservation* 20(2): 189-197.

Eads, C.B., Bringolf, R.B., Greiner, R.D., Bogan, A.E. & Levine, J.F. 2010. Fish hosts of the Carolina Heelsplitter (*Lasmigona decorata*), a federally endangered freshwater mussel (Bivalvia: Unionidae). *American Malacological Bulletin* 28: 151-158.

Evans, R.R. & Ray, S.J. 2010. Distribution and environmental influences on freshwater gastropods from lotic systems and springs in Pennsylvania, USA, with conservation recommendations. *American Malacological Bulletin* 28: 135-150.

Galbraith, H.S., Spooner, D.E. & Vaughn, C.C. 2010. Synergistic effects of regional climate patterns and local water management on freshwater mussel communities. *Biological Conservation* 143(5): 1175-1183.

Garner, J.T. & Haggerty, T.M. 2010. Distribution, density, and population dynamics of the Anthony Riversnail (*Athearnia anthonyi*) in Limestone Creek, Limestone County, Alabama. *American Malacological Bulletin* 28: 121-126.

Geist, J. 2010. Strategies for the conservation of endangered freshwater pearl mussels (*Margaritifera margaritifera* L.): a synthesis of conservation genetics and ecology. *Hydrobiologia* 644: 69-88.

Geist, J., Geismar, J. & Kuehn, R. 2010. Isolation and characterization of the first microsatellite markers for the endangered swan mussel *Anodonta cygnea* L. (Bivalvia: Unionoidea). *Conservation Genetics* 11(3): 1103-1106.

Haag, W.R. & Warren, M.L., Jr. 2010. Diversity, abundance, and size structure of bivalve assemblages in the Sipsey River, Alabama. *Aquatic Conservation* 20(6): 656-667.

Hall, K.T., Baker, M.B. & Hadfield, M.G. 2010. Using dispersal rates to guide translocation across impermeable wildlife reserve boundaries: Hawaiian tree snails as a practical example. *Malacologia* 52(1): 67-80.

Haskell, D.G. & Pan, J.W. 2010. The short-term effects of foot clipping as a nonlethal method of obtaining tissue samples from terrestrial gastropods. *Journal of Molluscan Studies* 76: 301-302.

Hornbach, D.J., Hove, M.C., Dickinson, B.D., MacGregor, K.R. & Medland, J.R. 2010. Estimating population size and habitat associations of two federally endangered mussels in the St. Croix River, Minnesota and Wisconsin, USA. *Aquatic Conservation* 20(3): 250-260.

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IUCN, SSC AND MOLLUSC SPECIALIST GROUP NEWS

www.iucn.org/

News items provided by Mary Seddon, chair of the Mollusc Specialist Group of the IUCN Species Survival Commission, unless otherwise indicated.

Online IUCN and related resources

Red List training materials online

IUCN receives frequent requests from around the world for formal training in the use of the IUCN Red List Categories and Criteria. The Red List unit is developing new and revitalised training materials to facilitate understanding and application of the IUCN Red List methodology. There is a wealth of resource materials on the Red List training pages including: Red List Documents, Training Presentations, Case Studies and the Species Information Service (SIS).

UNEP digitise old publications

Since its creation in 1979 the World Conservation Monitoring Centre (WCMC) has produced well over 1500 books and major reports. UNEP-WCMC has selected 380 of the most important books and reports from this collection and has worked with the Biodiversity Heritage Library to make these freely available online. These include the classic publication by Sue Wells and June Chatfield (1990) on the Status of Non-Marine Molluscs in Europe and the 1984 Red Data Book of Invertebrates by Sue Wells, Robert Pyle and Mark Collins.

A Sampled approach to Red Listing: Freshwater Mollusc Assessment

Over the last two years the Sampled Red List team at the Zoological Society of London has coordinated the assessment of the conservation status of 960 species of freshwater molluscs, which, once combined with the other assessments from African, Asian and European projects, will give a total of 1500 freshwater species representative of the estimated 5900 species of freshwater molluscs. This will provide a vital overview of the overall status of freshwater molluscs, pending the completion of all of the regional assessments.

In February 2010 an evaluation workshop was held at the Zoological Society of London with 20 freshwater mollusc specialists from all parts of the world convened for a week to evaluate these species assessments. We thank all of the specialists who kindly donated their time at this workshop. During the week over 700 species were reviewed, including those that were provisionally assessed as threatened as well as those species that were considered Data Deficient. The team worked with the experts to update the species information and confirm the threatened status of the species.

An initial discussion on the first day of the workshop examined the basis for assessment with the outcome required to establish a consistent approach to the adequacy of data and the issue of taxonomic uncertainties in species limits. Taking a precautionary attitude in the interests of conservation of biodiversity requires assessment of the threat status of species that are currently in need of taxonomic review. An evidence-based approach to establishing declines of species would result in a high percentage of species classified as Data Deficient. While striving to always use the best quality data, the group decided that a precautionary attitude was in the interests of conservation of biodiversity, which included viewing all species as currently valid, pending future review and using 'proxy data' and all information suggesting possible declines of the species rather than being strictly 'evidence-based', i.e. requiring irrefutable evidence of decline.

Among other outputs form the workshop, David Aldridge (University of Cambridge) led a session to review the major threats to freshwater molluscs. The resulting conservation assessments have been imported into the IUCN SIS online

database by Caroline Pollock and the final stages of consistency checking are ongoing, as well as evaluation of the 'Least Concern' species, which there was not time to accomplish in the main workshop.

This project has been run in cooperation with the Zoological Society of London and thanks are due to Nadia Dewhurst for leading this part of the project very ably, along with the teams of interns who worked hard on the evaluation phase. Ben Collen and Monika Bohn are managing the completion of the project, as Nadia has now moved on to a Ph.D. project.

Save Our Species (SOS)

Save Our Species (SOS) is a global coalition initiated with three founding partners (IUCN, GEF and the World Bank) to build the biggest species conservation fund, supporting on-the-ground field conservation projects all over the world. SOS will combine resources and funding experience from the World Bank and GEF (Global Environment Facility), the authoritative science of IUCN and the resources and ingenuity of the private sector to create a mechanism that ensures sufficient funding goes to species conservation projects where and when it will have the most impact. Save Our Species will be managed through a secretariat housed within the IUCN for the allocation of funds. Grants will be allocated according to strategic directions identified in consultation with IUCN's Species Program and Species Survival Commission.

Save our Species is unique in that it facilitates co-funding from the corporate sector. The first company to sign on to the SOS initiative has been Nokia.

There are sizeable and sound investments for species conservation already under way, but even so the number of species currently receiving sufficient conservation attention and funding to bring them back from the brink of extinction is minimal. SOS grants will fill a vital gap for medium-sized to large grants that can be applied specifically to saving threatened species and their habitats.

SOS has two types of grants:

- Species conservation grants (US$25,000-800,000), which will respond to a call for proposals and specific priorities
- Rapid action grants supporting conservation actions in emergency situations

Given that more than 18,000 species are currently known to be threatened, it will be impossible to meet all the needs. SOS will set funding priorities, which will be established based on SSC expertise and will be maintained for 2 years. Every year new priorities will be added. Calls for proposals will be regularly issued. The first priorities for species conservation grants will be: (i) threatened mammals in Asia, (ii) threatened amphibians, (iii) Critically Endangered birds.

During project preparation the SOS Donor Council approved the funding of a limited number of pilot projects. The decision was made to support existing grant making mechanisms:

- Preventing Extinctions Programme (BirdLife International)
- Conservation Leadership Programme (Fauna & Flora International, BirdLife International, Conservation International, Wildlife Conservation Society)
- EDGE (Evolutionarily Distinct and Globally Endangered) of Existence Programme (Zoological Society of London)
- Amphibian Conservation Programme (Conservation International)

In addition, there is currently one SOS emergency response grant: Critically Endangered Saiga antelope (Saiga Conservation Alliance), following the death of nearly 12,000 Saiga in western Kazakhstan last May.

The first call for proposal will be issued at the beginning of 2011, reflecting the species priorities listed above. However, the Red List assessment programme and the inclusion of molluscs in the freshwater priorities does mean that if a major crisis appears in a region, then funding can be applied for to carry out emergency field surveys.

Red List of globally threatened species: cephalopods

By Louise Allcock

Over the past couple of years a small group within the cephalopod community has been working to assess all cephalopods for the IUCN Red List. Given the small number of extant cephalopod species, this initially appeared a not too daunting task. However, the process has simply served to show how little we know about many species. Nomenclatural and taxonomic problem abound, making even the compilation of a complete list of valid species a difficult and contentious issue. Nonetheless we have made progress: the cuttlefish are pretty much complete and have been reviewed by the community, the oegopsid squids are complete but not yet reviewed, and the octopuses are about 50 % complete.

The cephalopods are a particularly interesting group to look at because of their very wide range of life history strategies. On the one hand there is *Nautilus*, with its slow growth, limited distribution, long development time and low fecundity, while on the other is *Octopus vulgaris* with an almost worldwide distribution, 1-2 year life cycle and high fecundity with planktonic larvae. There are many intermediate strategies that certainly render some groups potentially susceptible to anthropogenic impacts. And of course, a limited number of species are of very great commercial interest.

Yet so little is known about so many other species. Numerous species are known only from the type material, and while these specimens may be of sufficient quality to assess the species' validity, they rarely tell us anything about distribution (beyond type locality) or life history, characteristics that are fundamental in making Red List assessments.

Overall, the process is really showing us how little we know about this fascinating group and I hope it serves to highlight the need to focus research on some of the more obscure taxa.

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Assessment of freshwater molluscs of the Eastern Himalaya hotspot

By N.A. Aravind, B.A. Daniel, Prem B. Budha & David Allen

The diversity of habitats in the Eastern Himalayan region ranges from coastal deltas to alluvial grasslands at lower elevations, subtropical broadleaf forests in the foothills, temperate broadleaf forests in the mid-hills, mixed conifer and conifer forests at higher altitudes, and alpine meadows above the tree line. This, together with rich species diversity, makes the region a global biodiversity hotspot. The region, which is a component of the Indo-Malayan ecoregion, contains one of the most diverse alpine botanic zones on earth, and some of the most ecologically diverse assemblages of vertebrates and flowering plants. The Eastern Himalayan region is highly disturbed by anthropogenic impacts including habitat loss and fragmentation, *jhum* cultivation (shifting agriculture) and aquatic pollution from a wide range of sources, making the region a priority for conservation. But much less is known about the conservation status of the biodiversity in this region. The current socio-political situation makes the problem of conservation and research much more challenging. In order to understand the status of freshwater biodiversity, IUCN (Freshwater Biodiversity Unit), with the Zoo Outreach Organisation, undertook a project to assess the conservation status of all freshwater molluscs, Odonata and fishes within the region (Fig. 1). Here we summarize the important findings of the freshwater mollusc assessment.

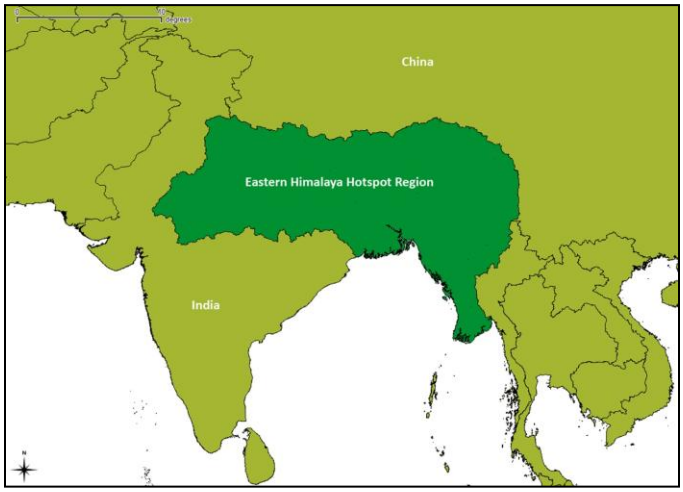

Fig. 1. The Eastern Himalaya freshwater biodiversity assessment region.

We assessed 186 species of freshwater molluscs reported from this region according to the IUCN Red List Categories and Criteria (IUCN, 2001) and mapped their global distributions. The assessment included 112 (60 %) species of gastropods and 74 (40 %) species of bivalves. The gastropods belong to 13 families and 33 genera and freshwater bivalves to 5 families and 16 genera. Of the 186 species, only 2 gastropod species (*Lymnaea ovalior* and *Tricula mahadevensis*) were assessed as Vulnerable (VU) and the bivalve *Sphaerium austeni* was assessed as Near Threatened (NT), with a very high proportion of the species assessed as either Least Concern (66.1%) or Data Deficient (32.3%) (Figs. 2, 3). Given the meagre

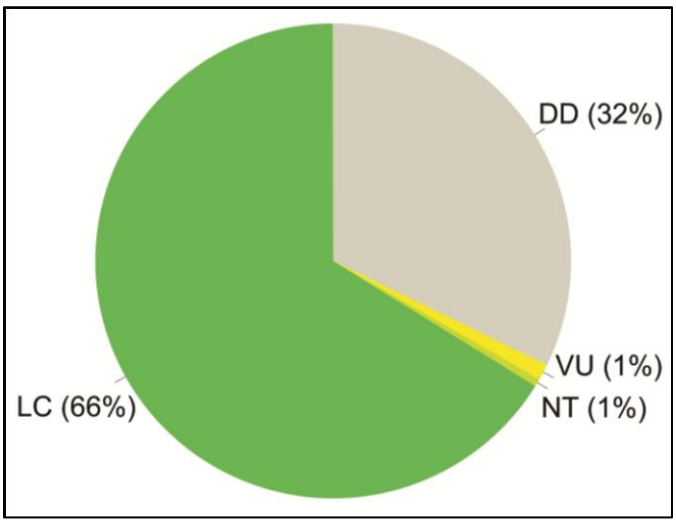

Fig. 2. Percent freshwater mollusc species in each global Red List category. NT, Near Threatened; V, Vulnerable; LC, Least Concern; DD, Data Deficient.

knowledge of the distribution, population trends and threats to freshwater molluscs in this region, we made a precautionary assessment based on the level of knowledge about the sites and projected ranges. This explains why there are so many species in the DD and LC category.

Within the hotspot region the areas of highest species richness are in the Ganga delta and basins of the Ayeyarwaddy River in Myanmar. The species richness of freshwater molluscs in the Eastern Himalayan hotspot region decreases from east to west. The farthest western region of the hotspot has fewer than 40 species, compared to the eastern region, where nearly 130 species occur. Within the Eastern Himalaya region, the number of endemic species is highest in northeastern India and western Myanmar. Some of the unique and endemic freshwater molluscs of this region are *Solenaia soleniformis* and several species of *Parreysia* and *Pseudodon* that are known only from the Myanmar drainages.

The area with the highest levels of species richness also has highest levels of Data Deficient species. This shows that for an

Fig. 3. The Kathmandu valley, showing habitat similar to the type locality of *Tricula mahadevensis* (VU). (Photo: David Allen)

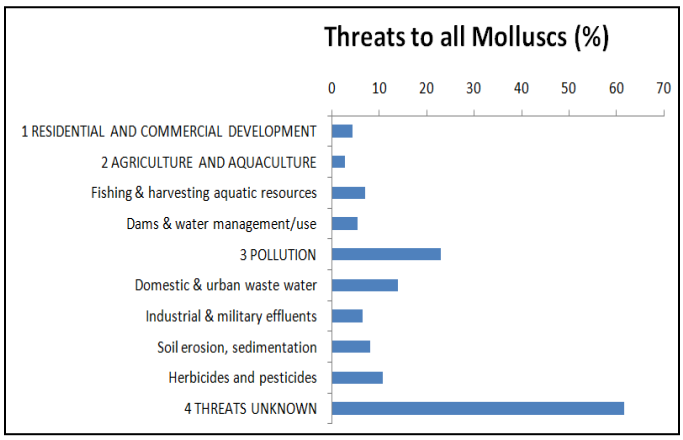

Fig. 4. Threats to molluscs within the Eastern Himalaya assessment region.

exceedingly high proportion of species detailed information is lacking. The high number of Data Deficient species indicates that information on population status, habitat, distribution and threats at the species level is absent or deficient for these species. Our knowledge of freshwater molluscs from some parts of the region is especially limited, mainly due to the lack of scientists working in these areas as a result of political instability (e.g. in Myanmar and parts of India and Nepal). Many DD species are known only from their 19th or 20th century descriptions, and they have often not been collected since. There is a need for further expert survey across the region to determine the conservation status and current distributions of these species.

Many taxonomic issues remain to be resolved within the regional molluscan fauna. Inconsistencies in the available data clearly indicate that the taxonomic situation is still a major problem in establishing a database for species conservation planning in the region. However, we emphasise that the assessment was based on the best available data for this region in the published literature.

The major threats to aquatic molluscs in the Eastern Himalayan hotspot include construction of dams, pollution, agricultural intensification, impacts resulting from the use of poisons and other damaging fishing practices, urban runoff and water abstraction for industry and irrigation (Fig. 4). Among these, pollution (from industry, agriculture and urban runoff), dams and over-harvesting (for food, ornaments, and other purposes; Fig. 5) are the major factors. However, it is clear that a great deal more information is required on the scope, scale and impact of threats across the region, as shown by the large number of species for which threats are unknown.

Fig. 5. Children in the Nepalese *terai*, harvesting snails (*Bellamya bengalensis* and *Parreysia* spp.) for consumption. (Photo: Prem B. Budha)

The best available information was used for the current assessment. The very high level of Data Deficient species shows that there is a great need for further research in this region. Future research should concentrate on (i) the taxonomy of the regions' mollusc fauna; (ii) the ecology, distribution and population trends of freshwater molluscs in the hotspot region; and (iii) the key threats to the freshwater mollusc fauna. It is likely that the level of threatened freshwater mollusc species will increase when better information on the scale and impact of threats to species and their habitats is available.

The full report is available on line: The status and distribution of freshwater biodiversity in the Eastern Himalaya.

IUCN, 2001. *IUCN Red List categories and criteria*. Version 3.1. IUCN Species Survival Commission, Gland, Switzerland and Cambridge, UK.

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The IUCN Red List evaluation workshop on European terrestrial molluscs

By Eike Neubert

IUCN is conducting a Red List evaluation of selected European terrestrial mollusc species, through a project funded by the European Commission. The aim of this project is to assess about 1200 species from previously selected families, following the standard IUCN Red List methodology for regional assessments.

This assessment covers all accepted species of the Aciculidae, Lauriidae, Orculidae, Argnidae, Valloniidae, Pupillidae, Chondrinidae, Vertiginidae, Enidae, Vitrinidae, Bradybaenidae, Helicodontidae, Trissexodontidae, Cochlicellidae, Hygromiidae and Helicidae. As systematic and distributional background, we use the most recent version of the checklist of European Continental molluscs provided by the Fauna Europea project. This guarantees a high level of comparability and reliability of our data. Distributional records and all other relevant information for each species are

Fig. 1. The workshop participants. Front, left to right: K. Triantis, R. Roberts (IUCN), A. Cuttelod (IUCN), J. R. Arrebola Burgos, B. Páll-Gergely, A. Martinez-Orti. Central row, left to right: O. Gargominy, B. Gómez-Moliner, M. Lutz (IUCN), M. Bilz (IUCN), M. Seddon. Third row, left to right: K. Groh, J. Rüetschi, E. Neubert, Z. Fehér, A. Reischütz, T. von Proschwitz, R. Slapnik, M. Falkner.

critically collected from the literature and amended by unpublished data from private or institutional collections accessible to the data contributors. Regional specialists then evaluate these species according to the standard IUCN Red List methodology, and thus deliver a first estimate of particular threats to species in their European range (which in most cases represents the complete distribution area of a species). This first assessment is then critically cross-checked by IUCN to guarantee the correct application of the rules and the coherence of data for all species.

In order to remove any inconsistency of data, an invited evaluation workshop was organized from 28 September to 2 October 2010 in the Natural History Museum of Bern (Switzerland), which gathered 19 participants (including IUCN staff) (Fig. 1). The workshop was attended by the following colleagues (in alphabetical order): J.R. Arrebola Burgos, Jose Ramon (Spain); Margrit Falkner (Germany); Zoltan Fehér (Hungary); Olivier Gargominy (France); Benjamion Gómez-Moliner (Spain); Klaus Groh (Germany); Alberto Martinez-Orti (Spain); Eike Neubert (Switzerland); Barna Páll-Gergely (Hungary); Ted von Proschwitz (Sweden); Alexander Reischütz (Austria); Jörg Rüetschi (Switzerland); Mary Seddon (United Kingdom); Rajko Slapnik (Slovenia); Konstantinos Triantis (Greece).

The workshop mainly focused on the most threatened species. After splitting into four regional working groups (Macaronesian Islands, Iberian Peninsula, Central Europe, Eastern Europe), the classification of the respective species into IUCN categories was discussed. During this process several problems in European malacology were addressed, for example, differing concepts regarding taxonomic levels of species and subspecies, or inconsistent interpretation of national categories of threats and their consequences for conservation at national and European levels. For many (particularly continental) species, distribution patterns became visible for the first time. The final assessments should be published in 2011, leading to a report on the conservation situation of the assessed families.

This workshop offered a platform for productive discussions in a friendly and open atmosphere, and the opportunity for all participants to get deeper into the subject. Thanks to the enormous engagement of all participants, who unselfishly shared their knowledge, and the tremendous support by the IUCN staff members, this workshop became a key milestone in the project. Its results will be presented to the responsible European politicians and hopefully lead to differentiated and adequate conservation actions for the terrestrial molluscs of Europe.

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ARKive extends its tentacles in the hunt for imagery

ARKive, the world's centralised digital library of films and photographs of threatened animals, plants and fungi, is calling on all *Tentacle* readers to help in the search for imagery of endangered molluscs. See *Tentacle* 18 (p. 51) for more details.

MEETINGS 2011

Freshwater Mollusk Conservation Society 2011

Managing Your Mollusks: Reflecting on the Past, Preparing for the Future

The 7th biennial symposium of the Freshwater Mollusk Conservation Society will be held at Seelbach Hilton Louisville in Louisville, Kentucky, USA, 11-15 April 2011. A plenary session will open the meeting and provide updates on freshwater mollusk conservation and habitat restoration. The focus will be on state and regional management of molluscs. Platform and poster session topics are welcome.

For more information, contact:
Monte McGregor: monte.mcgregor@ky.gov, +1 502 573 0330 ext 221
Leroy Koch, leroy_koch@fws.gov, +1 502 695 0468 ext. 106
Or go to the FMCS website.

American Malacological Society 2011

The 77th annual meeting of the American Malacological Society will take place 23-28 July 2011 at Duquesne University in Pittsburgh, Pennsylvania, USA. Check the AMS meetings webpage for more details as they become available.

Western Society of Malacologists 2011
Sociedad Mexicana de Malacología 2011

The 44th annual meeting of the Western Society of Malacologists will be held jointly with the 12th biannual meeting of the Sociedad Mexicana de Malacología, 27-30 June 2011 at the Instituto Politécnico Nacional, La Paz, Baja California Sur, Mexico.
First Flyer for Meeting
Multi-page Promotional Presentation for 2011 Meeting
Tentative abstract deadline: 12 March 2011
Early registration deadline: 30 April 2011
Regular registration: 1 May - 1 June 2011
Late registration: after 1 June 2011, register on site
For more information please contact WSM President, Dr. Esteban Fernando Felix Pico: efelix@ipn.mx

XXII Brasilian Malacological Meeting 2011 – XXII EBRAM

The Brasilian Society of Malacology (SBMa – Sociedade Brasileira de Malacologia) will hold its XXII Brasilian Malacological Congress at Fortaleza city, Ceará State, northeast Brasil, 4-8 September 2011. The congress will be hosted by the Federal University of Ceará (UFC). The congress will be organized as our last highly successful XXI EBRAM Congress in Rio de Janeiro (July 2009). Special sessions of contributed papers, oral presentations and poster sessions will be open to all aspects of Malacology, including taxonomy, ecology, biology, evolution, distribution and conservation of terrestrial, marine and freshwater molluscs, fisheries and other topics. Some symposia are also being planned. It will be a great opportunity for all people who study or are interested in molluscs, as the major goal of the XXII Brasilian Malacological Congress is to provide conditions for students and researchers to discuss and exchange their results. Registration will begin on 1 February 2011 at http://xxiiebram.webnode.com.br/
Contact details:
Dra. Sonia Barbosa dos Santos - President of the Brasilian Society of Malacology (sbmalacologia@yahoo.com.br)
Dra. Helena Matthews-Cascon – Chair of the XXII Brasilian Malacological Meeting (ebram2011@gmail.com)

XI International Congress of Medical and Applied Malacology—XI ICMAM 2012

After two consecutive congresses in Asia (Qingdao, China, 2006; Busan, Korea, 2009), the XI ICMAM will be held in Rio de Janeiro, Brasil in 2012, on a date to be determined soon. The purpose of this congress is to bring together scientists working on various aspects of molluscan biology, including basic biology, systematics, molluscs as intermediate hosts of parasitic diseases of humans and domestic and wild animals, as well as pests of agriculture, bioindicators, food, etc. The congress is being organized jointly by the International Society for Medical and Applied Malacology (ISMAM) and the Brasilian Society of Malacology (SBMa), hosted by:
Dra. Sonia Barbosa dos Santos – President of the Brasilian Society of Malacology
Dra. Silvana Thiengo – Chair of the Brasilian Committee for the XI ICMAM
Dr. John Burch – Chair of the International Committee for the ICMAMs.

Society for Conservation Biology 2011

Society for Conservation Biology

The 25th International Congress for Conservation Biology, hosted by the Society for Conservation Biology (SCB) and the University of Canterbury in Christchurch, New Zealand, will take place 28 November - 2 December 2011. SCB's International Congress is recognized as the most important global meeting for conservation professionals and students. For more information go to the Society's website.

UPCOMING FUNDING OPPORTUNITIES FOR 2011

From Mary Seddon, chair of the Mollusc Specialist Group of the IUCN Species Survival Commission. Please direct any questions to her.

Leverhulme / Royal Society Africa Awards – 9 February. The Leverhulme Trust and the UK's Royal Society collaborate to provide grants for research in biodiversity, agriculture, water and sanitation, energy and basic human health in Tanzania and Ghana. Applicants from these countries partner with institutions in the UK. Awards are a maximum of £50,000 per year for 3 years. For more information see: http://www.terravivagrants.org/Home/funding-news/application-deadlines-2/february-2011

Fondation Ensemble - Programs Fund 2011 – 11 February. Fondation Ensemble supports projects in sustainable development and animal biodiversity (protection of endangered and threatened animal species). Grants are €50,000 per year for at least 2 years. Priority countries for 2011 are Benin, Burkina Faso, Malawi, Mali, Senegal, Cambodia, India and Peru. Grants are to international NGOs. For more information see: http://www.fondationensemble.org/projeta.php Fondation Ensemble also has a Small Grants Fund (see same website) for which the deadline for applications will be 11 March.

Chicago Board of Trade (CBOT) Endangered Species Fund – 14 February. The Society funds projects that will assist directly in the protection of populations of threatened and endangered species or a specific habitat that is of high biological value or that is substantially threatened (IUCN Red List Status). Grants are open to SSC Specialist Group Chairs and Officers, AZA/WAZA Chairs and Officers, and all interested researchers. Each group should select and submit only one proposal that has been ranked as the highest funding priority and endorsed by the group. The Fund will support small projects usually up to $5,000. For more information see: http://www.brookfieldzoo.org/czs/CBOTGrant

Critical Ecosystem Partnership Fund (CEPF) – 15 February. Civil Society Organisations are invited to propose projects for funding in the Maputaland-Pondoland-Albany Hotspot. This area spans 275,000 km², stretching from Xai-Xai in Mozambique in the north to Port Elizabeth in South Africa in the south. The call is for applications for both large and small grants (grants of over US$20,000 and small grants of US$20,000 or less). The primary objective of the investment is strengthening the involvement and effectiveness of civil society in conservation and the management of globally important biodiversity. For more information see: http://www.cepf.net/grants/Pages/default.aspx

Fondation Nature & Decouvertes – 15 February. Fondation Nature & Decouvertes funds projects for nature protection in France and Francophone Africa. Applications for small grants ('coup de main') can be submitted throughout the year. The application deadline for major projects (€3000 to €30,000) is 15 February. For more information, see: http://www.natureetdecouvertes.com/pages/Corporate/FONDATION/4_candidature.asp

ERA-NET - Biodiversity Research in Tropical and Subtropical Europe (Net-Biome) – 28 February. Net-Biome is a consortium of 11 partners from five European Union member states to fund research for the sustainable management of biodiversity in the outermost regions and territories of Europe. Net-Biome's first call for proposals is to fund research projects on biodiversity management in support of sustainable development in the Tropical and Subtropical Outermost Regions and Overseas Countries and Territories of Europe. Proposals should involve at least three partners. For more information see: http://www.netbiome.org/

US Fish and Wildlife Service, Grants for Latin America and the Caribbean – 1 March. USFWS regional programs ('Wildlife Without Borders') support capacity-building with a priority of protected areas and buffer zones in ecosystems of global significance in the Latin America and Caribbean region. For more information see: http://www.fws.gov/international/dic/regionalprograms/lac/lachow.html

Zoological Society of London - Conservation Expeditions 2011. The Zoological Society of london invites grant applications for field expeditions that address threatened or poorly-known species or habitats currently receiving little or no conservation attention. Preference will be given to teams of three or more persons rather than individuals, especially to support undergraduate/postgraduate expeditions. Applicants should be resident in the UK and/or registered at a UK university or college. For more information see: http://www.zsl.org/conservation/expeditions/zsl-conservation-expeditions,565,AR.html

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 listserver and the ISSG newsletter, *Aliens*.

CITES

CITES-L is a bulletin board restricted to trade issues for endangered species, coverd by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It is managed by the World Conservation Monitoring Centre in Cambridge. The majority of information relates to mammal and bird trade, but updates to the CITES lists are posted there. To subscribe send a one line message to:

majordomo@wcmc.org.uk

with the command line (in message body):

subscribe cites-l

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

The MOLLUSCA listserver is intended as an informal forum for discussions of molluscan evolution, palaeontology, taxonomy and natural history. There are over 700 subscribers. From time to time it has something of interest related to conservation. To subscribe to the list send e-mail to

listproc@ucmp1.berkeley.edu

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.

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 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

Mollia

The MOLLIA web site includes instructions to authors, subscription information and links to malacological journals. It also allows you to subscribe to the MOLLUSCA listserver (above) and to access the MOLLUSCA archives. MOLLIA, like MOLLUSCA, is maintained at the University of California Museum of Paleontology, Berkeley, USA.

Unio listserver

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

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*.

American Malacological Society

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

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.

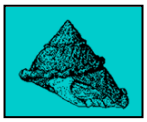
The Malacological Society of London

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.

Field Museum land snails

The on-line databse 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.

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.

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.

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 Samoan Snail Project has as its goals assessing the diversity and historical decline of the native Samoan non-marine snail fauna, as a first step in its conservation. It is part of the Bishop Museum's Pacific Biological Survey.

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.

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.

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.

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.

Oregon/Washington, USA – Interagency Special Status/Sensitive Species Program

The Pacific Northwest Regional Office of the US Forest Service and Oregon/Washington State Office of the US Bureau of Land Management have an interagency program for the conservation and management of rare species including more than 100 molluscs. Species Fact Sheets, Conservation Assessments and survey reports are available online and constantly being updated.

Other useful links

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

SSC MOLLUSC SPECIALIST GROUP

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

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