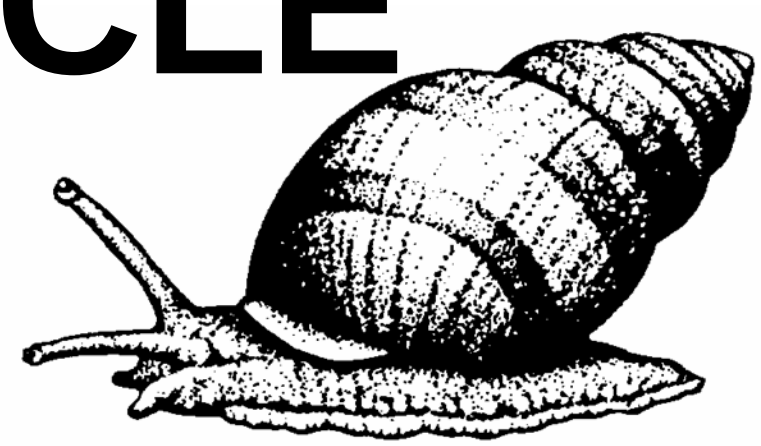
The Newsletter of the IUCN/SSC Mollusc Specialist Group
Species Survival Commission ● IUCN - The World Conservation Union

TENTACLE

UNITAS MALACOLOGICA



Editorial

This issue marks additional changes in *Tentacle*. Although the printed version of *Tentacle* is still distributed to those people with no web access, the great majority of the *Tentacle* readership now accesses the newsletter on the web: www.hawaii.edu/cowielab/Tentacle.htm. I have decided, therefore, that it is no longer necessary to impose the constraints on illustrations demanded by the need to produce *Tentacle* as a black and white photocopy. This, then, is the first issue of *Tentacle* to include color illustrations. While the printed version will still be produced as a black and white photocopy, the web accessible color version will, I feel, dramatically enhance the appeal of the newsletter. By promoting the visual splendor of many of the animals discussed within its pages, I hope that *Tentacle* will attract greater interest in and concern for these animals that we are all working to conserve – which of course is one the major purposes of this newsletter. And I hope you enjoy it. Also, all web and e-mail addresses in the text are now hot links.

All issues of *Tentacle* are available on the web at the above web site. Hard copies are sent only to those people on the distribution list for whom I do not have e-mail addresses – but you will receive only the black and white photocopy. If you receive a hard copy but can access *Tentacle* on the web and do not need the hard copy, please let me know – it helps to save costs. Also, since I announce the publication of each new issue to all who are on the e-mail distribution list, so please keep me updated with your current e-mail addresses so that you do not drop off the list. I also announce the availability of each issue on the MOLLUSCA listserver (for details, see page 42).

As always, I reiterate that the content of *Tentacle* depends largely on what is submitted to me. *Tentacle* is one means to publicise the threats molluscs face—and the conservation successes. But it is also a free, easy way to advertise your own projects! Sometimes you may notice that I have included articles not directly dealing with threatened molluscs (alien species, for instance). But many issues are linked to the threats faced by molluscs and there is no good reason to exclude them from a newsletter such as this. So I encourage anyone with anything relevant to mollusc conservation, even in a broad

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sense, to send me an article, however short. Don't wait until I put out a request for new material (usually via the MOLLUSCA listserver). Send me something now, and it will be included in the next issue (published once a year, in January). I would especially like to have more from members of the Mollusc Specialist Group—I have not heard from many of you for a long time!

I generally make only editorial changes to submitted articles and I accept almost everything submitted to me, so the balance of each issue reflects more or less whatever I receive. However, before I accept an article I will make a judgement about whether it really has anything to say that is relevant to mollusc conservation, and whether any conclusions drawn are adequately supported by the information presented. However, *Tentacle* is not a peer-reviewed publication, and statements made in *Tentacle* remain the authors' responsibilities.

Printing and mailing of *Tentacle* is supported 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, fill out the application form at the end of this issue of *Tentacle*.

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NEWS

Three snails thought extinct discovered

Forwarded on 9 May 2005 by Kendra Womack, U.S. Fish and Wildlife Service, 1387 S. Vinnell Way, Room 368, Boise, Idaho 83709, USA. Tel. +1 208 685 6955.

Associated Press, Birmingham, Alabama.

Three snails listed as extinct have been rediscovered in the Coosa and Cahaba rivers, the Nature Conservancy announced Tuesday.

Jeff Garner, the Alabama Department of Conservation and Natural Resources' mollusk biologist, rediscovered the cobble elimia and the nodulose Coosa River snail on a dive in the Coosa River.

Stephanie Clark, a University of Alabama postdoctoral student from Australia, stumbled onto a Cahaba pebblesnail on a trip to the Cahaba River in Bibb County.

The findings, being announced by the Nature Conservancy, were reported Tuesday by The Birmingham News.

Alabama is known to be the nation's top spot for extinct and imperiled mollusks, the snails and mussels in river beds. Many were lost as dams were built along the Coosa River from 1917 to 1967, when it became a series of reservoirs.

In recent years, scientists have discovered some species hiding in the streams between reservoirs where the Coosa retains some of its original habitat.

Garner went diving below Lake Logan Martin and found two species that had not been spotted since the dams changed the river. Clark was accompanying a graduate student to the Cahaba River National Wildlife Refuge when she found the Cahaba pebblesnail that had not been spotted since 1965.

Garner, who has found several other species believed to be extinct, knew what he had immediately.

"One of these I found is pretty distinctive," Garner told the News. "I've always said it was my favorite snail—I hated it was extinct. It sort of has teardrops around the periphery."

Clark, who began postdoctoral research at the University of Alabama last year, didn't know what she had found at first.

"Behold, there was this oddball snail under a rock," Clark said. "I didn't know that I'd found an extinct one straightaway, but I knew I'd found something that I hadn't seen before."

The Cahaba pebblesnail—round, yellow, only about a quarter of an inch [~ 6 mm] long—had not been spotted since 1965.

NEW RECORDS OF *HENDERSONIA OCCULTA* (GASTROPODA: HELICINIDAE) IN LIMESTONE AREAS OF PENNSYLVANIA, USA

By Timothy A. Pearce

A project studying land snails of limestone areas in Pennsylvania, USA, found three previously unknown populations of the operculate land snail *Hendersonia occulta* (Say, 1831) (cherrystone drop snail), increasing the known records for this scarce calciphile snail in Pennsylvania from two to five of the 67 counties.

The Snails of Limestone Areas Project, funded by Pennsylvania's Wild Resources Conservation Program, is updating distribution maps of Pennsylvania's 120 land snail species. In 2005, the project surveyed 11 high quality limestone areas in western Pennsylvania. Studying the diverse and abundant snail faunas on limestone areas gives us the most dots on the map for the least effort.

During surveys in 2005 that found populations in Bedford and Huntingdon Counties and found a new population of the snail in Greene County, I noticed a correlation of the presence of *Hendersonia occulta* with that of a rare larkspur plant, *Delphinium exaltatum* Ait., which is also a calciphile. I predicted that the snail might occur in a fifth county (Fayette County) where a large population of *D. exaltatum* grows, and indeed, botanist Steve Grund of Western Pennsylvania Conservancy found *H. occulta* there. The snail and the plant probably do not depend on each other; instead both taxa probably require extensive limestone outcrops that are relatively free from human disturbance. Locating additional populations of the snail might be possible by visiting the few additional known sites for the larkspur.

H. occulta is now known from five counties in Pennsylvania (Bedford, Fayette, and Huntingdon Counties join the previously known Allegheny and Greene Counties). I have been unable to locate voucher specimens for the literature

records reporting *H. occulta* in Washington and Westmoreland Counties (Brooks, 1929: 23; MacMillan, 1950; Hubricht, 1985; Hotopp *et al*., 2003), so I consider those county records to be unconfirmed at this time. An examination of museum specimens and literature records suggests that populations in Allegheny County have not been seen for more than 50 years, so the species might be locally extinct there.

Hendersonia occulta (cherrystone drop snail). Shell is 6 mm diameter. (Photo: T.A. Pearce)

Hendersonia occulta is unusual among temperate climate land snails for having an operculum, one of only two such land snails in Pennsylvania, the other being the amphibious *Pomatiopsis lapidaria* (Say, 1817). Most operculate land snails are tropical and there are hundreds of species of Helicinidae throughout the tropics. While other temperate helicinids are known, e.g., *Hemipoma hakodadiense* (Hartman, 1890) in Japan and the southern Kuril Islands (Kuwahara & Katakura, 1992; Pearce *et al*., 2002), *H. occulta* is notable as the only helicinid in temperate parts of North America (Pilsbry, 1948).

According to Hubricht (1985), *H. occulta* has become extinct in five states since the Pleistocene, and although modern populations are known from 11 states in the eastern USA, its continued decrease has it listed as threatened or of special concern in some states. These new distribution records of *H. occulta* will be useful as the Mollusk Technical Committee of the Pennsylvania Biological Survey works to assess conservation priorities for the mollusks of the state.

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REARING TROPICAL ARBOREAL SNAILS IN THE LABORATORY

By Pete Krull

More articles may have been written about tree snails in the genus *Liguus* than any other group of snails. We know much about their life history (e.g., Close, 2000). However, we do not know for sure if they came to Florida from Cuba or vice versa. We also know almost nothing about how they inherit all those wonderful color patterns. And the biggest thing we have not known until recently is how to maintain and propagate them in captivity. This article outlines a method for doing that.

Pilsbry (1912) stated that "there remain many points which can be elucidated only by breeding the snails". Later authors also indicated the need for captive breeding studies especially to determine the genetics of color inheritance (Roth & Bogan, 1984; Emmel & Cotter, 1995). At least a couple of attempts were made to perform these experiments but none has been successful.

During the 1960s and 1970s I became obsessed with the idea of raising *Liguus* tree snails in captivity. I had read several

articles by people who had collected a couple, taken them home and put them in a 'terrarium' to keep as pets. I did the same. However, much to my dismay, the snails always died. I persevered, yet time after time the snails perished.

Collecting *Liguus* was legal in Florida until some time in the 1980s when they were listed as 'Species of Concern'. Prior to this, collectors would wait until the growing season was over, around mid August, and collect until October when the snails would begin aestivation and become more difficult to find. Mating season is between July and August and eggs are laid in mid September.

If you collected snails in August or early September they would often readily lay eggs in captivity. They would then proceed to aestivate, as in the wild, and would emerge from aestivation in the spring, ready to begin growing. That is when they would die. Young hatched in captivity would also begin growing and then they too would die.

Liguus in the wild are often seen on tree trunks in the middle of a hot July day, resting in full sunlight. However, upon closer study it turns out that they spend much of their daylight hours on the underside of a leaf, perhaps hiding from predators, yet still exposing part of their shell and soft body to the rays of the sun.

Liguus fasciatus alternatus (left) and *L. fasciatus fuscoflammellus* (right), two of the first shell color forms of *Liguus* raised in captivity.

It finally occurred to me that perhaps *Liguus* actually required sunlight to survive and produce new shell growth. When I realized this, I had three snails that had recently come out of aestivation. One died and another was showing signs that it would not live long. It could no longer hold on to a branch, did not eat and was clearly just days from dying, as all the previous snails had done. I took it outside and set it in direct sunlight, sure that it would quickly cook. But it did not cook, so the next day I did the same thing and left it out even longer. After just a few days the snail climbed onto a branch and began to eat. I put the other surviving snail through the same process then put both on a tree in my yard. Both snails lived two more years in captivity, grew new shell both years, mated, laid eggs, and were then returned to the wild.

I continued my study of *Liguus* off and on until collecting them became illegal. I discovered that artificial ultraviolet light worked as well as sunlight in maintaining *Liguus*, so the captive snails were able to complete their entire life cycle in a laboratory setting. I kept the snails in 10 gallon [~ 38 liter] aquariums and tried as many different ultra-violet bulbs (sold in pet stores for lizards) as were on the market. All seemed to work equally well. The small size of the tank kept the snails close to the light source. I stood the tanks up with the top facing out, covered the opening with mesh screen and attached the light to the outside of the screen. Except during egg-laying season I used one inch [2.54 cm] thick foam on the bottom of the tank to cushion the snails if they fell. For egg laying this was replaced by sterilized peat moss about 2 inches [5.08 cm] deep.

I developed an artificial food that was blended to the consistency of a thick milk shake. This was painted onto the sides of the tank and left to dry. The tanks were misted two to four times a day with water and food was added every couple of days as it was eaten.

Pleurodonte marginella, possibly *P. marginella semiaperta*, introduced to Florida, crawling on the special snail food formula.

The basic ingredients of the food included broccoli (high in calcium), beer (because snails like it), buttermilk, a chewable multi-vitamin and calcium carbonate, with oat flour used to thicken the mixture to a paintable consistency. Other ingredients often added were baby food vegetables, honey, bananas, carrots, tropical fish food (especially algae-derived formulas), papaya, yogurt, dry non-fat milk. Almost any nutritious food that was not too acid was used. The fresh vegetables were boiled in beer and all ingredients blended until smooth.

The final ingredient used when setting up a new tank was black sooty mold spores from a citrus or gardenia bush. This mold is often seen on tree branches in the hardwood hammocks where *Liguus* is found in the wild. It is also eaten off citrus plants by species of *Drymaeus* and off coffee plants by species of *Polymita* in Cuba (Fernandez Milera, 1999). A similar mold is eaten by achatinelline tree snails in Hawaii (Kobayashi & Hadfield, 1996). Blended into the food the mold quickly grew and consumed the rest of the food. Mold made it unnecessary to clean the inside glass as it did not go sour like the food itself might. Whenever new food was added the mold would spread. If the tank was used for several months algae would often grow as well. By having a screen cover on the tank, the inside would dry out completely between mistings. This created an almost perfect environment for the *Liguus*.

Do other arboreal snails require sunlight? I don't know. I would guess that species of *Orthalicus* do, and maybe species of *Drymaeus*, *Polymita*, *Achatinella* and *Amphidromus*. Indonesian *Asperitas* species do not, nor do tropical American species of *Pleurodonte*, which can both be successfully raised in the same tank without the UV light.

I hope that this article will spark the interest of researchers by providing information about the special requirements of *Liguus* and possibly other tropical arboreal snails.

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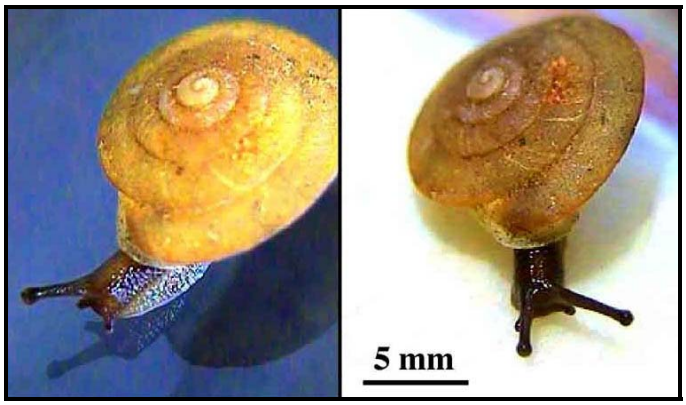
THE BIOLOGY AND POPULATION GENETICS OF *EUCHEMOTREMA HUBRICHTI*, A HIGHLY RESTRICTED ENDEMIC POLYGYRID LAND SNAIL IN ILLINOIS

By Frank E. Anderson

Euchemotrema hubrichti, the carinate pillsnail, is a polygyrid land snail that was described by Pilsbry (1940) from shells collected from talus at the base of a limestone bluff in the Larue–Pine Hills region of Union County, southwestern Illinois, USA. Pilsbry regarded the species to be a "spectacular find", as he considered it to be the first known carinate member of the *Stenotrema monodon* group. The shells of *E. hubrichti* are rather robust and can be abundant, but live individuals are more elusive—initially, the species was believed to be extinct (Pilsbry, 1940; Hubricht, 1943).

Hubricht (1943) described his first encounter with live *E. hubrichti*—finding them on the walls of a moist ravine—and he noted that searches of the talus slopes failed to produce a single recent shell. He also noted that the species showed "a decided preference for such situations as would require the collector to risk his neck to collect them". Later, Hubricht (1985) described the habitat of *S. hubrichti* as "crevices of shaded cliffs, often more than 20 ft [~ 6 m] above the ground".



A live specimen of *Euchemotrema hubrichti* (the carinate pillsnail) from Anderson & Smith (2005).

Until recently, very little was known about the species, and the soft-part anatomy had never been described. This dearth of information was unfortunate, as the restricted distribution of this species (total length of known range ~5 km) may qualify it for federal threatened or endangered status—it is considered a Regional Forester Sensitive species by the United States Department of Agriculture Forest Service. It has a NatureServe (www.natureserve.org) Global Status of G1 (critically imperiled across its entire range) and an IUCN *Red List* designation of Data Deficient. Fortunately, the known range of *E. hubrichti* lies within the LaRue–Pine Hills/Otter Pond Research Natural Area, and the region is also a National Natural Landmark. This area is a part of the Shawnee National Forest where collections are prohibited, but management practices such as controlled burns could still adversely impact the species.

In an effort to enhance knowledge of this poorly known species, we have 1) surveyed the Larue–Pine Hills region to find populations of live *E. hubrichti*, 2) performed mark-recapture experiments at two sites to estimate population sizes (Anderson, 2005, submitted), 3) redescribed the soft-part anatomy, jaws and radula of *E. hubrichti* (Anderson & Smith, 2005), and 4) investigated the population genetics of the species (Anderson, submitted). This work was supported by grants to FEA from the Illinois Department of Natural Resources, the United States Department of Agriculture Forest Service and the National Science Foundation.

Surveys of the Larue–Pine Hills region revealed that Hubricht's observations tell only part of the story. *Euchemotrema hubrichti* is fairly common on moist ravine walls in precarious locations, as Hubricht noted, but he does not seem to have found the areas where *E. hubrichti* is truly

abundant—the shaded tops of certain outcrops. In these areas, *E. hubrichti* is by far the most common land snail. The species is found at several sites throughout the Pine Hills region, and has been found on limestone outcrops in Jackson County, immediately to the north of the main Larue–Pine Hills bluff line (J. Slapcinsky, pers. comm.). However, during a summer 2003 exploration of two of these outcrops by FEA, no live *E. hubrichti* specimens or shells were found. To our knowledge, no other traces of *E. hubrichti* have been found outside of this region, suggesting that the species is restricted to the Larue–Pine Hills bluff system.

Mark-recapture experiments at two of the higher abundance sites suggest that population sizes of *E. hubrichti* are in the low to high hundreds—201 individuals (95 % confidence interval = 178-230) at one site and 723 (95 % CI = 594-923) at the other (Anderson, 2005, submitted). No migration was detected between these two sites over three years, despite the close proximity of the sites (they are <100 m apart). These findings suggest that the species is not especially rare, but individuals do appear to be concentrated at a few sites and the dispersal ability of the species seems limited.

Despite the highly restricted range of the species, the fragmentary nature of preferred *E. hubrichti* habitat coupled with low dispersal ability suggested that patterns of genetic variation within *E. hubrichti* might show geographic structure. To test this possibility, a region of the mitochondrial cytochrome c oxidase subunit I gene was amplified by PCR and sequenced from 53 snails collected from seven sites spanning the known range of the species. Levels of sequence variation in this gene were low, but an analysis of molecular variance (AMOVA) and nested clade analysis (NCA) revealed significant genetic structure among collection sites. Two sites in particular (sites E and F, known collectively as population 2) appeared to be isolated from the other five sites (sites A-D and G; population 1) based on nested clade analysis, but partitioning the data by population in AMOVA did not explain a significant amount of the observed genetic variation. Coalescent analyses were used to estimate effective population sizes and migration rates for populations 1 and 2. These analyses suggested that migration rates between the populations are unequal; the migration rate from population 1 into population 2 is low, but the migration rate from population 2 into population 1 has been zero.

These results are probably related to a combination of factors. The patterns do not appear to reflect an ancient vicariant event that cut off gene flow between populations 1 and 2. In patchily distributed species with low dispersal potential and low population sizes, patterns of geographically based genetic structure can arise even in the absence of historic breaks in gene flow (Irwin, 2002). Therefore, it is more likely that the genetic patterns seen in *E. hubrichti* reflect the extremely low dispersal ability of the species, which, in conjuction with the patchy nature of preferred *E. hubrichti* habitat, severely limits gene flow. These results suggest that the two populations should be treated as separate management units.

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THEBA SUBDENTATA HELICELLA (WOOD, 1828) FROM SOUTHERN SPAIN

By Alex Menez

Theba subdentata (Férussac, 1821) is a polytypic species found in western Morrocco. The subspecies *T. s. helicella* (Wood, 1828) is found from the mouth of the Oued Tensift (~30 km south of Safi) southward to Cap Rhir (~35 km north west of Agadir) (Gittenberger & Ripken, 1987). The adult shell is up to 22 mm in length and depressed with 4¼ to 5 flattened whorls that are all sharply keeled at the periphery. This adult state instantly differentiates this subspecies from adult *Theba pisana*, which is only keeled as a juvenile. Genital anatomy and dart morphology also differentiate the species. According to Gittenberger & Ripken (1987), a sample in the former Altimira collection (Leiden, Nationaal Natuurhistorische Museum ('Naturalis') [formerly Rijksmuseum van Natuurlijke Historie]) indicates that the subspecies had once been found in southern Spain, at El Alquián in the province of Almería. The second author tried in vain to confirm this record and concluded that *T. s. helicella* had most probably been introduced to Spain and eventually became extinct again.

I found the subspecies at Retamar, Almería, in southern Spain in December 2001. There were only a few individuals attached to *Thymelaea hirsuta* (L.) shrubs. In July 2002 I searched for the subspecies in El Alquián (about 5 km from Retamar, and the locality cited by Gittenberger & Ripken, 1987). Many sites were searched along the coastline and I found the subspecies at one, where it was present in densities up to about 50/m^2, mostly on *Stauracanthus* sp. shrubs. These were established populations with juvenile, sub-adult and adult snails. Surrounding and nearby areas were populated with *Theba pisana* (Müller, 1774). At the site where I found *T. s. helicella* there was also *Theba pisana*, though at densities less than 50 % of those for *T. s. helicella*. As far as I know, this is the only recorded instance of the existence of two *Theba* species at the same locality in southern Spain, and raises interesting

questions about the co-existence of these species and their use of resources. My records confirm the presence of the subspecies in southern Spain and add to those of Puente *et al*. (1994) and Moreno & Ramos (2000).

Theba subdentata helicella (Wood, 1828) from El Alquián, Spain. Top: on *Stauracanthus* sp. in the wild. Bottom: in captivity.

I am currently doing work on the south Iberian *Theba* that may help to answer questions such as whether *T. s. helicella* is a native south Iberian species or an introduction from north Africa (Gittenberger & Ripken, 1987; Gómez Moliner *et al*., 2001). I have also kept individuals in captivity where they have fed on lettuce, carrot and apple.

Detailed fieldwork along the entire south Iberian coastline (about 1500 km of coastline), which has yielded the subspecies at only two localities, suggests that this subspecies may have very localized distributions with foci of high abundance, and some areas of low abundance. Gómez Moliner *et al.* (2001) proposed vulnerable status for this subspecies. The coastline in the Province of Almería is one that is undergoing extensive building development, as are many coastlines in Spain, and the rest of the Mediterrranean. It is easy to imagine how just one more tourist complex could wipe out what is probably one of the few established populations of this subspecies in Spain.

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PREVALENCE OF INVASIVE SLUGS IN THE LEAF LITTER OF WISCONSIN STATE NATURAL AREAS

By Joan P. Jass

Slugs were part of a 2003-4 survey of 21 counties in southeastern Wisconsin for the presence of nonindigenous leaf litter invertebrates in State Natural Areas (SNAs). At each SNA, a 1 m x 1 m quadrat of the habitat's floor was arbitrarily selected for sampling, which entailed transfer of all litter plus the top 1-2 cm of loose soil by trowel to a white sheet placed next to the quadrat, where it was searched by hand. Specimens of the nonindigenous invertebrates targeted were collected and identified in the laboratory, and an Excel file was created with the following information for each site: county, category (woodland, wetland, grassland), habitat (a descriptive phrase), and total area of the SNA.

The slug species collected, ranked from most to least abundant, were *Arion fasciatus* (Nilsson, 1823), *Deroceras laeve* (Müller, 1774) and *D. reticulatum* (Müller, 1774). Native slugs in the family Philomycidae, which have been documented in the state previously, were not encountered in these SNAs. Nor was the pest species *Limax maximus* Linnaeus, 1758 found, although it frequently occurs in urbanized and cultivated habitats of southeastern Wisconsin. Wetlands and woodlands yielded similar total numbers of slugs, with grasslands yielding fewer individuals.

SNAs have been considered islands of relatively pristine natural habitat, existing within the ocean of an otherwise significantly altered landscape. Therefore, one expectation might be that smaller SNAs, which have a higher proportion of boundary to enclosed surface area, would exhibit a greater vulnerability to invasion by nonindigenous species from the more disturbed habitats surrounding them than would larger SNAs. Two subsets from the initial 2003 May-September season in which 37 SNAs were surveyed were used in a simple test to look for evidence of a relationship between the number of target species found and SNA size. The mean area of those SNAs where no target species of nonindigenous invertebrates were collected (six SNAs) was 38.5 ha [95 acres], while that of SNAs where more than one target species occurred in the sample (five SNAs) was 26.3 ha [65 acres], providing some

preliminary indication of the importance of 'island' size as an insulating factor for these areas.

Invasive slugs have been the focus of recent studies that analyze especially those traits that may indicate their potential negative effects on native species. For example, the research of Pinceel *et al*. (2004, 2005) suggests that certain arionids may actually be species complexes, with some populations having a propensity for developing into pests, while others do not. Grimm (1996) found arionids in Canada to be thoroughly naturalized in relatively undisturbed forests, noting that they are fairly omnivorous, while native slugs as a rule are mycophagous. Wisconsin SNAs are presumed to be habitats subject to less disturbance than their surroundings. While this preliminary survey documented a widespread presence of invasive slug species at these sites, the dynamics of their interactions with the native flora and fauna there remain to be documented.

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FIRST GENERAL INVENTORY OF THE MALACOLOGICAL FAUNA OF SANTA CATARINA STATE, SOUTHERN BRASIL

By A. Ignacio Agudo & Mário Saraiva Bleicker

The State of Santa Catarina (SC) is part of Brasil's southernmost region, situated between the states of Paraná (PR) to the north and Rio Grande do Sul (RS) to the south, with Argentina to the west. The Atlantic Ocean forms its entire eastern border, with 580 km of sinuous and diversified continental coast and islands, located in a wide zone of transition resulting from the convergence of two important marine currents, a warm current from Brasil in the north and a cold current from the Malvinas (Falkland Islands) in the South, a condition that results in a heterogeneous local environment.

Santa Catarina lies between latitudes 25° and 30° S and longitudes 48° and 54° W, extends 377 km from north to south and 547 km from east to west at its most distant points, and has an area of 95,985 km^2, which include 502 km^2 of rivers and lakes. The state constitutes only 1.13 % of the total area of Brasil and is divided geographically into three large parts: the Atlantic Coastal Plains, with several rivers that discharge into the Atlantic Ocean; and two independent great river basin systems that irrigate the land in the central and western highlands—the Iguazu (= Iguaçu) to the north and the Uruguay (= Uruguai) to the south. As yet, of this entire area, we have only covered some hydrographical portions of the Atlantic coastal plains (the best studied up to now) and of the Rio Uruguay (Agudo, 2004a, b). The dominant climate is damp sub-tropical, with average temperatures of 17-21 °C, and the vegetation is of the coastal damp forest type (mainly tropical Atlantic woodland), which covers 29,622 km^2.

A. Ignacio Agudo in the field in Santa Catarina.

The non-marine molluscs of Santa Catarina State are especially poorly known, as traditionally in the State the marine malacofauna has attracted greater study (Agudo, 2004a). Information on the known species of the region, their geographical range, history and conservation status is largely unpublished or widely scattered in the literature (Agudo, 2004c, e, 2005a).

Mário Saraiva Bleicker in the authors' malacological collection in the "Guarda do Embaú Village", Santa Catarina.

An integrated malacological inventory conducted in the region by us since 1982 for marine and 1996 for non-marine molluscs (Agudo, 2004a, e, 2005a, b; Agudo-Padrón, in preparation; Agudo & Bleicker, 2005a-c, in press a, b, submitted a, b), based on our own field work and studies of reference material and the literature has recorded a total of 722 living mollusc species, as of November 2005.

Continental forms

In total, 124 terrestrial and freshwater mollusc species and subspecies have been recorded: 102 Gastropoda, including 11 Prosobranchia (10 are freshwater forms) and 91 Pulmonata (20 are freshwater forms), in 25 families and 53 genera; and 22 Bivalvia, including 17 Unionoida and 5 Veneroida, in 4 families and genera (Agudo, 2004b, 2005a). Among these there are 18 introduced species (7 freshwater—3 Bivalvia and 4 Gastropoda; 11 terrestrial) (Agudo & Bleicker, submitted b). An additional invasive species, the freshwater Asiatic bivalve *Limnoperna fortunei* (Dunker, 1857), has the potentail to invade the State in the near future (Agudo, 2004c, d).

In 2003 and 2004, the Brasilian Ministry of the Environment listed ten of the non-marine species recorded in Santa Catarina State in its "Official Lists of Fauna Threatened with Extinction": one terrestrial pulmonate, with IUCN status listed as Endangered, and nine freshwater mussels/naiads, three listed as Endangered and six as Vulnerable.

Thirteen of the gastropod species recorded (five introduced forms—four terrestrial, one freshwater; eight natives—five freshwater, three terrestrial) have been confirmed as intermediate vectors of two parasitic diseases of humans (Agudo-Padrón, in preparation).

Left: *Megalobulimus* (= *Psiloicus*) *oblongus*. Right: *Drymaeus papyraceus*.

Anodontites trapesialis.

Marine forms

In total, 598 marine mollusc species and subspecies were recorded: 10 Polyplacophora, 349 Gastropoda, 220 Bivalvia, 10 Scaphopoda and 9 Cephalopoda, in 135 families and 303 genera (Agudo & Bleicker, 2005a-c, in press a, b, submitted a). Among these there are just five Bivalvia that are counted as introduced species (Agudo & Bleicker, submitted b), including the confirmed recent record of the alien oyster *Crassostrea virginica* (Gmelin, 1791).

Among these marine species, nine (six bivalves—oysters, scallops, mussels, small clams, and three cephalopods, two pelagic squids and one octopus) sustain industrial fishing activities, cultivation in marine farms and local artisanal fishing for human consumption (Agudo & Bleicker, 2005b, in press a, b, submitted b).

Up to now surveys of the malacofauna of a region or state have focused on species of importance to agriculture, medicine, veterinary issues, human disease, food and specific aspects of ecology features. Given the lack of a general listing, and with the intention of contributing to the future production of a catalogue for the region, our work is the first step towards a general malacological inventory of the fauna of the state of Santa Catarina.

Left: *Lyropecten* (= *Nodipecten*) *nodosus*. Right: *Olivancillaria vesica auricularia*.

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LAND SNAILS OF SABAH PROJECT

By Menno Schilthuizen

The Malaysian state of Sabah covers the northernmost one-tenth of the island of Borneo. Well known for the 4,095 m high Mount Kinabalu, the tallest peak between the Himalaya and New Guinea, the area also has high land snail diversity (photo).

Terrestrial molluscs have been the subject of study at Universiti Malaysia Sabah (UMS) for the past six years. The ultimate goals of the ongoing research projects are, among other things, understanding land snail endemism, speciation and conservation in isolated limestone outcrops (e.g., Schilthuizen *et al*., 2005a, b) and levels of diversity (e.g., Schilthuizen *et al.*, 2001, 2002, 2003). However, to do so, we needed a much better taxonomic basis. Six years ago, only the Cyclophoridae, Diplommatinidae and Streptaxidae had been revised, by Jaap Vermeulen in his series of papers in the Dutch journal *Basteria* on the 'non-marine molluscs of the island of Borneo'. All other groups were in a sorry state of taxonomy. Today, thanks mostly to the efforts of Jaap and students of UMS, and with considerable help from the Mollusc Department of the National Museum of Natural History ('Naturalis') in Leiden, the Netherlands, we have a detailed knowledge of the morphology, distribution, and nomenclature of all of the more than 300 land snail species that occur in Sabah (about 30 % of which are new). Expeditions to remote or geologically unusual areas (such as volcanic or ultramafic soils) continue to bring in a small trickle of new species but we are confident that we have documented the majority of the more widespread taxa. Most samples are stored permanently in the UMS collection (photo), with voucher specimens deposited in the collections of Sabah Parks, Naturalis and Jaap's private collection.

The end product will be a *Field Guide to the Land Snails of Sabah*, which is currently in preparation. Another spin-off was the 2005 course in Tropical Malacology at UMS (taught by Satoshi Chiba and myself), which was attended not only by students but also by officials and staff of local conservation agencies (photo). It was especially rewarding to notice that Sabah Parks (which manages the largest conservation areas in Sabah, such as Kinabalu Park and Crocker Range Park) now takes a keen interest in monitoring and protecting land snails.

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DRAMATIC DECLINE AND LOSS OF MOLLUSC DIVERSITY IN LONG-LIVED LAKES IN GREECE

By Christian Albrecht, Dirk Lohfink & Roland Schultheiß

The global decline of nonmarine molluscs has recently been pointed out; freshwater faunas like North American unionid mussels and Australian spring snails are known to be in severe danger of extinction (Lydeard *et al*., 2004). Other regions and faunas are much less known in terms of their conservation status. Though a dozen or so of the world's ancient or long-lived lakes are famous as evolutionary theatres displaying an extraordinarily high degree of mollusc endemism (e.g. Wilson *et al*., 2004), it appears to have been overlooked that these faunas are often under extreme anthropogenic pressure.

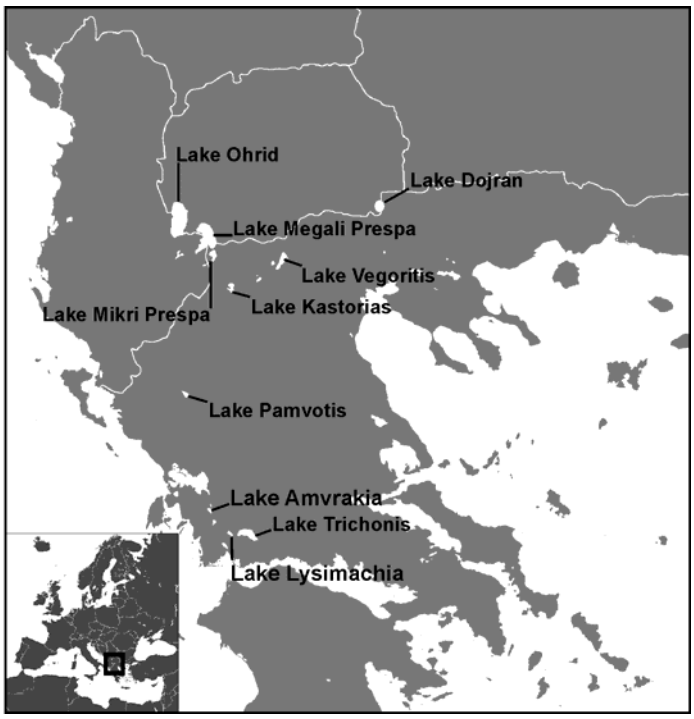
During ongoing studies on the evolution and diversity of recognized and putative European long-lived lakes, we had the opportunity to survey major natural lakes in continental Greece in spring and autumn 2005. Most of these lakes are thought to be of Pliocene (tectonic) origin (Zacharias *et al*., 2002). Although not as well-known as the famous lakes Ohrid (Macedonia-Albania) and Prespa (Macedonia-Greece-Albania) regarding their malacofauna, several endemic mollusc species were described from other Greek lakes a few decades ago (e.g. Radoman, 1983, Schütt, 1962, 1980).

We here report on the decline and potential loss of endemic mollusc diversity in six Greek lakes (see map) and raise a cautionary note for urgently needed conservation measures in order to preserve the remaining faunal elements. All lakes investigated in continental Greece show a decline of population density and eventual loss of endemic species.

Lake Doirani (Dojran) on the border of Greece and the Republic of Macedonia (Macedonia-Thessaly region) has experienced considerable human impact since the 1950s (Griffith *et al*., 2002). The only Recent endemic gastropod of that lake, *Graecoanatolica macedonica* Radoman & Stankovic, 1978, is believed to be extinct (Ryan & Griffith, 2001). The population decline of molluscs is not only evident among the endemic but also among the most common species, e.g. *Dreissena* sp., of which we could find one single live individual only after intensive sampling. The lake's littoral zone has been damaged because of repeated massive recent water extractions. In 2005, there were almost no live molluscs from the lake proper, while common opportunistic species could be found only at the margins.

Lake Vegoritis (Macedonia-Thessaly region) was known for its endemic hydrobiid, *Graecoanatolica vegorriticola* (Schütt, 1962), which used to occur in the stony littoral in very high abundances. We did not find this species, while colleagues report only empty shells (A. Falniowski, pers. comm., 2005). Of the 16 species cited by Schütt (1985) only five could be collected in 2005. We found two additional cosmopolitan taxa, *Lymnaea stagnalis* and *Physa* sp.

The precarious ecological situation of Lake Amvrakia (South Adriatic-Ionian region), with two known endemics (*Dianella schlickumi* Schütt, 1962; *Islamia graeca* Radoman, 1973), has already been pointed out by Reischütz & Reischütz (2002). Szarowska *et al*. (2005) were unable to find *D. schlickumi*. Its habitat (sublittoral rocks) is almost completely terrestrial nowadays. By September 2005, only *Dreissena* sp. seemed to live in the lake's (new) littoral.



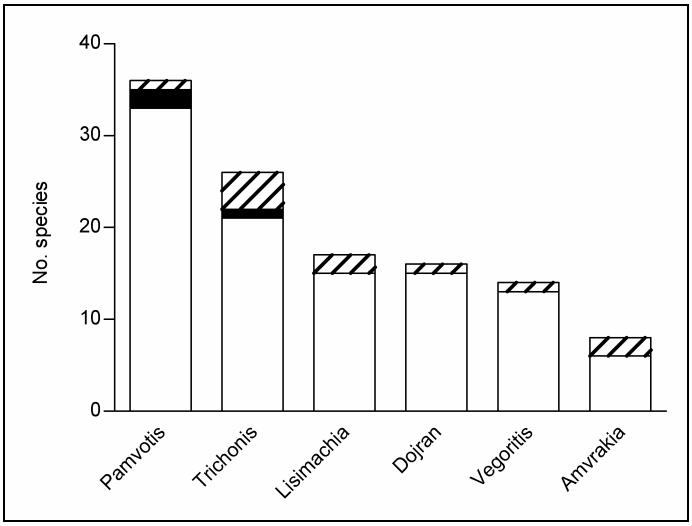
Location of the European (putative) ancient lakes mentioned in this article.

A similar situation is present in the lakes Lysimachia and Trichonis (South Adriatic-Ionian region). While Szarowska *et al*. (2005) could collect very few specimens of *Dianella thiesseana* (Kobelt, 1878), our new collecting did not yield live specimens. The current status of this species is unclear, Reischütz & Reischütz (2003) found shells only. Since rather fresh shells were found, we assume that *D. thiesseana* still lives in some places in the sublittoral of the lake. However, *Trichonia trichonica* Radoman, 1973 and *Islamia trichoniana*

Radoman, 1978, as well as *Pseudoislamia balkanica* Radoman 1978, all described from rocky or stony bank parts of the lake, seem to be gone, since neither we nor other recent collectors (A. Falniowski pers. comm., 2005) found these species alive. There is one possible exception, Reischütz & Reischütz (2003) reported *Islamia trichoniana* from one locality of Lake Trichonis. No live specimens of *Valvata klemmi* Schütt, 1962 could be found in 2005 nor in collections made in 2002 by Reischütz & Reischütz (2003). This species was described from Lakes Lysimachia and Trichonis.

In the shallow urban Lake Pamvotis, also called Ioannina (South Adriatic-Ionian region), *Paladilhiopsis janinensis* (Schütt, 1962) was described from springs at the northern edge of the lake. While Reischütz & Sattmann (1990) reported it from a nearby spring, Frogley & Preece (2004) where not able to relocate this species. The spring at Perama (north-west bank of the lake) had already dried out in the 1980s (A. Falniowski pers. comm., 2005). It is uncertain whether *P. janinensis* has ever lived in the actual lake. Two other species that have their type locality at the Perama spring, *Horatia epirana* Schütt, 1962 and *Semisalsa steindachneri* (Westerlund, 1902), could also not be found during the 2005 survey.

Inability to locate a certain species is certainly no conclusive evidence for its extinction. However, the intense collecting effort during different seasons, together with published and unpublished results of colleagues who have been working in the region recently, strengthen the concerns raised so far from anecdotal evidence. There can be no doubt that the mollusc faunas of the major Greek lakes are extremely vulnerable and most of the endemics are in extreme danger of becoming extinct, if that is not already the case. Very often, only cosmopolitan species are left in the lakes.



Potential loss of endemics. The number of non-endemic molluscs are in white bars while the number of endemics are either black or hatched. Species that could not be relocated during the field surveys in 2005 are hatched. The total species number is extracted from the literature (see text) and our own survey data.

Additionally, new introduced species can be recognized, as for example *Sinanodonta woodiana* (Lea, 1834) in a fish pond connected to Lake Pamvotis, which potentially threatens the native mussel fauna there. Recently, an invasive planorbid snail, *Planorbella anceps* (Menke, 1830), has been reported from Lake Prespa (Erőss *et al*., 2005).

Szarowska & Falniowski (2004) reported the eradication of several type localities at spring sites in continental Greece. Lakes in circum-Mediterranean countries are under ever increasing anthropogenic pressure. Major causes are dramatic changes in water levels resulting from massive extraction for agribusiness. At the same time the eutrophication level of most lakes has increased during recent decades (Zacharias *et al*., 2002) as a result of a combination of water use, fisheries, pollution, toxification and climatic extremes, especially during summer. Both factors lead to habitat destruction by exposing former underwater areas and by increasing macrophytic and algal cover on both the lake bottom and especially the rocky or stony parts of the shorelines of these lakes. The content of dissolved organic matter and mud changes. Benthic communities are altered and eventually entire food webs become interrupted. Specialized species cannot cope with these environmental changes, which happen very quickly in some cases, e.g. during a single season.

A critical point in all conservation efforts related to the lakes described here is public awareness of the uniqueness of these ecosystems. This is unfortunately not the case at present. Water management plans must assure controlled water extraction. These regulations must be supervised and enforced. Sewage treatment systems should be installed along the actual lakes and all tributary systems. Agricultural practices should be more sustainable with reduction of fertilizer and pesticide use as ultimate goals. All these practices can only be effective if a concerted action plan can be implemented very soon in order to preserve this limnic fauna that is of continental importance.

Along with witnessing the decline and potential loss of mollusc diversity, it appears that the degree of endemism in the long-lived lakes of Greece is probably underestimated at present. For example, yet undescribed bithyniid species were found during our surveys of Lake Kastorias and Lake Trichonis (P. Glöer, pers. comm., 2005). As of 2004, none of the species mentioned above is listed in the IUCN *Red List of Threatened Species*. These examples from the Greek lakes raise serious concerns about threats to the unique and world famous Lakes Ohrid and Prespa, where similar human pressures are also acting at an increasing rate.

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FIRST RECORD OF *ANISUS VORTICULUS* ON THE ISLE OF TERSCHELLING, THE NETHERLANDS

By Henk K. Mienis

During my recent, annual visit to Terschelling, one of the Frisian islands in the north of the Netherlands, I had the opportunity to sample once again a relatively new temporary storage reservoir for run off rainwater near the village of Midsland for the presence of freshwater molluscs. A check in the previous three years revealed an annual increase of the number of species living in the reservoir: from two species of gastropods in 2002 to eight species in 2004 (Mienis, 2005).

In the autumn of 2005 I was again noted an increase in the mollusc faunal biodiversity in the reservoir: 10 species of gastropods and the first bivalve species were observed (Mienis, in press). Among the newcomers I found to my surprise *Anisus vorticulus* (Troschel, 1834) (family Planorbidae). This species had not been encountered so far on Terschelling.

Moreover, *Anisus vorticulus* is a species included in the Red List of Dutch molluscs (De Bruyne *et al*., 2003). Its range in the Netherlands is decreasing rapidly because of habit changes and pollution. The artificial storage reservoir, laid out in a nature-friendly way, is characterized by the presence of a high diversity of aquatic vegetation. This is probably also the reason that the water is clear and of good quality. In fact it forms just the exact habitat where you might expect to find a species like *Anisus vorticulus*.

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MOLLUSC CONSERVATION IN HUNGARY: RARITY, REGIONALITY AND RESPONSIBILITY

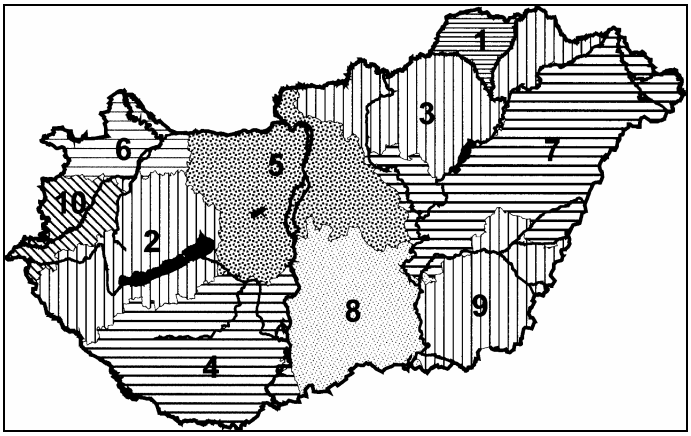
By Péter Sólymos, Zoltán Fehér & András Varga

The distributions of Hungarian mollusc species are fairly well known (Pintér & Suara, 2004) compared to other invertebrate taxa. Based on these data we assessed the rarity of the species according to global range size and local frequency of occurrence. We used correction terms if necessary in cases of biased local frequency estimates for some species (Sólymos, 2004; Fehér *et al*., in press). We used distribution data and rarity scores to identify hotspots and evaluate the congruence between hotspots and protected areas (Sólymos & Fehér, 2005).

These were, however, only the first steps to enhance the protection of the mollusc fauna in Hungary. Because the National Park Directorates (NPDs) are responsible for protecting natural heritage in well defined regions (see map) by using well defined (often scarce) resources, here we propose a simple scoring method to scale up the responsibility of each NPD in the protection of mollusc species individually and collectively.

We used data for the rare species (those falling in the rarest quartile of all species—Sólymos, 2004; Fehér *et al*., in press), putting special emphasis on species that are involved in the 2nd and 4th Annexes of the EU Habitats and Species Directive

(92/43/EEC). We scored the species in each NPDs' region (see map) on a 0–3 scale: 0—absent, 1—marginal occurrence, 2—central occurrence, 3—exclusive occurrence of a given species in a given region. We summed the scores of the species within each region to calculate responsibility score for NPDs. The priority species identified for each NPD are listed at: www.univet.hu/users/psolymos/responsibility. Evidently, Hungarian responsibility for species is highest in case of narrow range endemics restricted to the Carpathian Basin, i.e. *Bythiospeum hungaricum* (=*Paladilhia hungarica*), *Bythiospeum oshanovae* (=*Paladilhia oshanovae*), *Sadleriana pannonica*, *Theodoxus prevostianus*, *Kovacsia kovacsi* (=*Hygromia kovacsi*). Among these, *B. oshanovae* is unprotected and threatened by water level changes in the Szigetköz area (Fertő-Hanság NPD). The unique Romanian population of the periglacial relict *T. prevostianus* is declining (Sîrbu & Benedek, 2005), and the last Hungarian population is on private land; thus this species is globally threatened. Another taxon, *Bythinella austriaca hungarica*, is also worth mentioning. Although its subspecific distinction from *B. austriaca* is questioned by several taxonomists, CLECOM (Falkner *et al.*, 2001) lists this taxon as a distinct species, *B. hungarica*. Its entire distribution, some small springs around Budapest, is threatened by habitat destruction.



Map of Hungary showing the areas of responsibility of the National Park Directorates (NPDs): 1—Aggteleki, 2—Balatoni, 3—Bükki, 4—Duna-Dráva, 5—Duna-Ipoly, 6—Fertő-Hanság, 7—Hortobágyi, 8—Kiskunsági, 9—Körös-Maros and 10—Őrségi.

Although half of the rare species are not currently protected in Hungary (Fehér *et al*., in press; Sólymos & Fehér, 2005; Sólymos, in press), most of the occurrences of these rare species are in protected areas. Consequently, these species are relatively safe. There are, however, exceptions, i.e. *Gyraulus riparius* (Szigetköz area, Fertő-Hanság NPD; only 50 % of its occurrences are in protected areas) and *Gyraulus rossmaessleri* (River Bódva area, Aggteleki NPD), both of which are threatened by habitat degradation. More than 75 % of the known occurrences of *Faustina illyrica* (=*Helicigona planospira* in Hungarian literature) (SW Transdanubia, Duna-Dráva NPD) and two thirds of the occurrences of *K. kovacsi* are outside of protected areas. These species need more attention and monitoring to detect possible changing trends in their populations.

Concerning each NPD's regional responsibility for species in the EUHSD Annexes, regional difference were not pronounced. Concerning all the species analyzed, the summed responsibility score of the Bükki NPD was the highest (73 points) followed by the Duna-Ipoly and the Fertő-Hanság NPDs (41 and 38 points respectively).

The protection of habitats of those species for which NPDs are most responsible is an important task. The simple method we have used can ease the transfer of evidence-based scientific results to conservation professionals and policy makers in order to improve conservation of the Mollusca.

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SEASONALITY AND SURVEYS OF THE GATINEAU TADPOLE SNAIL, *PHYSA GYRINA LATCHFORDI* (PHYSIDAE), IN GATINEAU PARK, QUÉBEC, CANADA

By André L. Martel & Jaqueline B. Madill

In Canada the gastropod *Physa gyrina latchfordi* (Baker, 1928), called the Gatineau tadpole snail (Clarke, 1981), is believed to occur in only one region: the Gatineau Park region, with its type location being Lac Meech, in the southern part of Gatineau Park, Québec (Heron, 1880). This physid is morphologically distinct and was initially named *Physa lordi* (Heron, 1880). The taxonomical status of this physid subspecies remains unclear: it could be a genetically or morphologically unique *Physa gyrina* population, a subspecies or a unique species.

Surveys of the Gatineau tadpole snail conducted during the late summer months in the 1980s in selected Gatineau Park lakes, including Meech Lake and Philippe Lake, have led to the belief among biologists and conservation staff that the snail was rare in the park. During these summer surveys in the 1980s, typically a few tens of live individuals of the Gatineau tadpole snail were observed following the systematic examination of numerous field sites around the entire perimeter of the lakes (Meech, Philippe) (wading along the littoral zone, using a viewbox). In contrast, much higher population estimates were obtained at Meech Lake when surveys of this snail were conducted in late fall instead of during the summer (Martel *et al*., 2004; Martel & Madill, 2004). During late fall surveys (November to early December, i.e. just before the winter ice forms along the lakeshore) we had observed about ten times more live snails per survey. Field observations at Meech Lake (2001-2003) had indeed indicated that late fall was the period when individuals have reached maturity (adult shell length, 15-25 mm). Only then would the snails be large enough for the human observer to notice their presence while looking through a viewbox (Martel *et al*., 2004; Martel & Madill, 2004). At Meech Lake, using the time-search method (40 person minutes per site) and covering ~ 75 m^2 (a corridor roughly 3 m wide x 25 m long) of littoral habitat along the shore, an average of 20.5 Gatineau tadpole snails were counted per site. A population estimate for the whole of Meech Lake ranged between 5,000 and 10,000 individuals (Martel *et al*., 2004).

Live Gatineau tadpole snail (*Physa gyrina latchfordi*) (Physidae), 22 mm shell length, crawling in a glass dish.

During November 2005, we conducted a similar population survey of the Gatineau tadpole snail at Philippe Lake, Gatineau Park. Philippe Lake (approximately 4.1 km long and 0.6 km wide) is one of the most heavily used lakes in the park. The snail was surveyed at 13 sites along the lake perimeter, using the same time-search methodology as that used at Meech Lake (40 person minutes per site, ~ 75 m^2, using a viewbox), with observations restricted to nearshore habitats (water depth 0.1-1.3 m) (Martel *et al*., 2004). Live Gatineau tadpole snails were found at 12 of the 13 study sites, with a total of 422 live snails counted and an average of 32.5 individuals per site (3 sites yielding over 60 live individuals). Based on these counts, a conservative estimate of the total population of the Gatineau tadpole snail at Philippe Lake is in the range of at least 5,000 to >10,000 individuals, which is comparable to the estimate obtained for Meech Lake.

Our results emphasize the importance of conducting field surveys and inventories of this physid snail during late fall, just before the ice forms, since it is at that time of year that juveniles reach adult size and are easy to locate, identify and count along the littoral zone.

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FAILED ATTEMPTS TO SMUGGLE LIVE *FILOPALUDINA MARTENSI* INTO ISRAEL, BUT…

By Henk K. Mienis

Inspectors of the Plant Protection and Inspection Services (PPIS) of the Ministry of Agriculture of Israel carefully check every incoming shipment of agricultural and horticultural merchandise at the Ben-Gurion airport or in the harbors of Haifa and Ashdod for the presence of unwanted hitchhikers. At the airport they also carry out spot checks of the luggage of people arriving from the Far East and from African countries.

If molluscs are intercepted, they are sent to me for identification. Usually they belong to a number of species that are typical of the so-called hothouse and nursery fauna. Typical species among the terrestrial snails and slugs found in commercial shipments are *Vallonia excentrica* Sterki, 1893, *Hawaiia minuscula* (Binney, 1841), *Zonitoides arboreus* (Say, 1816), *Deroceras laeve* (Müller, 1774), *Deroceras reticulatum* (Müller, 1774) and *Lehmannia valentiana* (Férussac, 1821); and among the aquatic snails *Galba truncatula* (Müller, 1774), *Pseudosuccinea columella* (Say, 1817), *Planorbella duryi* (Wetherby, 1879), *Haitia acuta* (Draparnaud, 1805) and *Melanoides tuberculatus* (Müller, 1774).

Specimens found among the personal items of travelers belong usually to more exotic species. Snails discovered in the luggage of passengers arriving from Ghana and Nigeria have so far solely been the so-called giant African snails, *Achatina fulica* Bowdich, 1822, and the much larger *Achatina achatina*

(Linnaeus, 1758), usually intended for sale to pet shops.

During 2005, PPIS inspectors discovered on two occasions (17 March, 16 November) something quite different among the personal belongings of temporary workers arriving from Thailand: live specimens of the freshwater prosobranch snail *Filopaludina* (*Siamopaludina*) *martensi* (von Frauenfeld, 1865) (family Viviparidae). This species' natural range is central and southern Thailand and Malaysia. It is a highly appreciated local food in Thailand. They tried to smuggle it into Israel most probably in order to grow it locally and to use the offspring as an additional food source.

Fortunately the PPIS inspectors succeeded this time in averting a potential disaster. Not only is the autochthonous freshwater mollusc fauna of Israel already suffering more and more from competition with alien species, but also the quality of various freshwater bodies is increasingly deteriorating from pollution, or the springs, streams and even lakes are slowly but steadily disappearing because of an increasing decline in annual rainfall or over-pumping from the aquifer.

Moreover *Filopaludina martensi* is known in Thailand as an important intermediate host of intestinal flukes in the genus *Echinostoma*, which can cause serious illness in humans (see Brandt, 1974).

Although the inspectors succeeded in preventing the illegal introduction of *Filopaludina martensi* twice this year, I do not rule out the possibility that in other cases Thai laborers have succeeded in smuggling this species into Israel.

Those carrying out fieldwork in aquatic habitats in Israel should take into account the possible presence of this alien species. If it is indeed discovered, the relevant authorities should be informed immediately.

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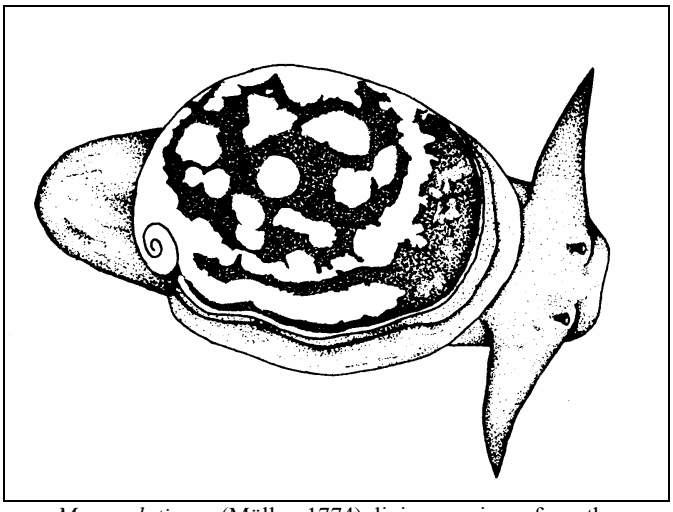
DISAPPEARANCE OF FRESHWATER GASTROPODS IN NIEPOŁOMICE FOREST (SOUTH POLAND)

By Magdalena Szarowska & Andrzej Falniowski

The northern part of Niepołomice Forest is a riparian deciduous forest complex situated on the south bank of the Vistula River, about 20 km to the ESE of Kraków, South Poland. Strongly affected by the steel works at Nowa Huta (eastern Kraków), it still harbours a rather rich malacofauna. In 1976-1977, land snails of this area, the three nature reserves in particular, were studied (Dyduch, 1980). Two of the reserves, Koło and Wiślisko-Kobyle, were established to protect the old river beds of those names, part of the Vistula River. The reserves comprise the old river beds and rather narrow land borders. Outside the protected areas, at Ispina, there once was a moderately big, shallow pond. Between the Vistula River and its floodbank, adjacent to the Wiślisko-Kobyle reserve, there is another old river bed, in which a hybrid of *Viviparus viviparus* (Linnaeus, 1758) and *V. contectus* (Millet, 1813) has been found (Falniowski *et al*., 1993).

In 1976, in the pond at Ispina, two noteworthy gastropod species were found. For one of them, *Marstoniopsis insubrica* (Küster, 1853), this was its southernmost locality in Poland (Falniowski, 1987). At that time, the *Marstoniopsis* snails of the locality were regarded as *M. scholtzi* (Schmidt, 1856), so that was the southernmost European locality for this species. Subsequently, Falniowski & Wilke (2001), based on morphological and molecular data, demonstrated that *M. scholtzi* is the same species as the north Italian *M. insubrica*, which occurs in a few lakes, far from the main part of the range of '*M. scholtzi*'. Thus, the locality at Ispina was at most the southernmost locality of the continuous, northern part of the range of *M. insubrica*.

The other, perhaps more interesting gastropod inhabitant of the pond at Ispina was *Myxas glutinosa* (Müller, 1774). Somewhat ephemeral in occurrence, it was once (before World War II) not too rare in Poland, especially in the northern part of the country (Feliksiak, 1938). Later the species became more and more rare all over Europe, Poland included. Some freshwater malacologists, including lymnaeid specialists, from Poland had never found living specimens (e.g. M. Jackiewicz, pers. comm., 1978; A. Piechocki, pers. comm., 1989). In 1975, *M. glutinosa* was found in Modła Lake, West Pomerania, North Poland (Dyduch & Falniowski, 1979).



Myxas glutinosa (Müller, 1774), living specimen from the pond at Ispina, shell height 16 mm.

During the last 29 years, the habitats of the northern part of the Niepołomice Forest have been extensively changed. On the one hand, since 1989 the level of pollution caused by the steel works has decreased, as a result of both the more advanced technology implemented and a decrease in steel production. On the other hand, the area has become drier than it used to be. This, in part, is a natural phenomenon: a result of normal succession, through which an old river bed shrinks and becomes more and more shallow and muddy. In Niepołomice Forest, however, the process is sharply accelerated by human activity. The bed of the Drwinka River that flows across the area was dredged and made deeper in the late 1970s. Because

of this, and the drainage of the adjacent meadows and fields, the water level decreased so that water either vanished from some old river beds, like Koło, or at least was reduced drastically, as in the Wiślisko-Kobyle. In the latter, there is now a lot of mud and no molluscs are left other than a few planorbid species. The pond at Ispina had been completely drained and a forest was planted there. The habitat of the two interesting gastropod species disappeared. Only the old river bed situated between the Vistula River and its floodbank still exists, its malacofauna as rich as before. This, probably, is because, through occassional floods, the habitat still remains in contact with the river.

Marstoniopsis insubrica was possibly brought to the pond at Ispina by birds, but this seems unlikely for *Myxas glutinosa*. Thus, the latter species must have had to occur somewhere close to the pond. We tried, with no successt, to find it during several visits to the Niepołomice Forest. There may yet be some ponds, river beds, etc. that may be suitable for *M. glutinosa* remaining in the area despite the disappearance of many other water bodies. It is therefore necessary to look for the species in all such habitats. *M. glutinosa*, now so rare in Europe, deserves protection at any locality at which it occurs.

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MAJOR DECLINES IN POPULATIONS OF THE WETLAND SNAIL *VERTIGO MOULINSIANA* IN A UK PROTECTED WETLAND SITE

By Peter Tattersfield & Ian Killeen

In 2003 one of us reported (*Tentacle*, issue 11, p. 12-13) the start of a major new four-year study in the UK on the hydrological requirements of the wetland snail *Vertigo moulinsiana*. This snail is listed on Annex II of the European Union's Habitats and Species Directive, which requires member states to designate and protect Special Areas of Conservation (SAC) for the species. The study, which is now nearing completion, was undertaken in the Kennet and Lambourn Floodplain SAC, which contains some of the best chalk streams in England and supports large populations of *Vertigo moulinsiana.* The main objective of the project was to determine whether licensed abstraction could influence water levels in the rivers and associated wetlands, and thus detrimentally affect the snail's populations. As the competent authority with statutory responsibility for issuing abstraction licences, the work was part of an investigation by the Environment Agency into the impacts of existing permissions (review of consents) on the SAC.

The SAC consists of eight separate component wetland sites, extending for about 20 km and 7 km along the Rivers Kennet and Lambourn respectively. During the project, detailed information has been collected about the distribution and ecology of the snail at two geographical scales within each of the SAC component sites. Extensive surveys covering all areas of potentially suitable wetland habitat have provided a broad overview of the species' range within each site and across the whole SAC, whereas the establishment of a series of small scale intensive sampling grids and transects on some of the sites has generated detailed information enabling very localised distribution patterns to be mapped and then related to local conditions and vegetation, and monitored over the course of the project. A series of hydrological studies examining water levels in both superficial deposits and deeper strata have also been undertaken. Most of the surveys and monitoring have been repeated at least once over the course of the project and earlier surveys were undertaken in the late 1990s and early 2000s. The available data therefore provide detailed information on the snail's distribution and abundance on the SAC over about the past decade.

Over the course of the project we have recorded a major decline in the status of the snail on several of the component sites. Since the selection of the SAC's component sites in 1996/1997, the snail has been completely lost from two sites (Hunts Green and Bagnor Island) and local populations within sites have become extinct or major declines occurred at three further sites (Chilton Foliat, Boxford and Rack Marsh). The situation is apparently continuing to deteriorate at Boxford, and we have recorded no or very little evidence of recovery at Hunts Green, Bagnor Island, Rack Marsh, or on the affected part of Chilton Foliat in 2004 or 2005. Thus, at present, *Vertigo moulinsiana*'s status is declining on over half of the eight component sites that make up the SAC and it is not present at all in two of them. Populations appear to be stable and healthy on some of the other sites, including Thatcham, which supports the largest populations of the species within the SAC.

The reasons for the declines are not fully clear, although hydrological changes appear to be significant at some sites, especially at Boxford and Bagnor Island. At Boxford, the prevailing dry weather conditions over the last couple of years seem to have been a major factor, whereas at Bagnor Island there have been management issues associated with a sluice downstream limiting the flow of water across site; this situation has now been rectified although no evidence of recolonisation has been recorded in 2005. Elsewhere, we do not understand the cause of the local losses and declines, although hydrological factors do not seem to be obviously implicated. However, what our observations do show in

general is that *V. moulinsiana* populations are very dynamic, strongly influenced by hydrological regimes and other forms of land/water management, and therefore that they are vulnerable and potentially highly dependent on conservation management. Clearly, the very dynamic nature of the snail's populations recorded on the SAC over the past four years raises questions about what magnitude of population change should be regarded as significant. However, whilst large fluctuations in population numbers may be a natural part of the species' population dynamics, the complete loss of the species from component sites in the SAC would appear to be more fundamental. A longer time series of data is required to understand these issues, and further monitoring is needed. The appropriate assessment of any impact from water abstraction licences (on their own and in combination with other potential influences) on the Kennet and Lambourn Floodplain SAC is due to be completed by 31 March 2006.

These observations also have implications for the conservation strategy for *V. moulinsiana* on other SACs designated for the species, and in the UK more generally. They strengthen the view that the species is vulnerable, and dependent on active conservation measures, especially habitat and water management. We feel these are strong arguments why the species should be retained on the UK's Biodiversity Action Plan list of priority species.

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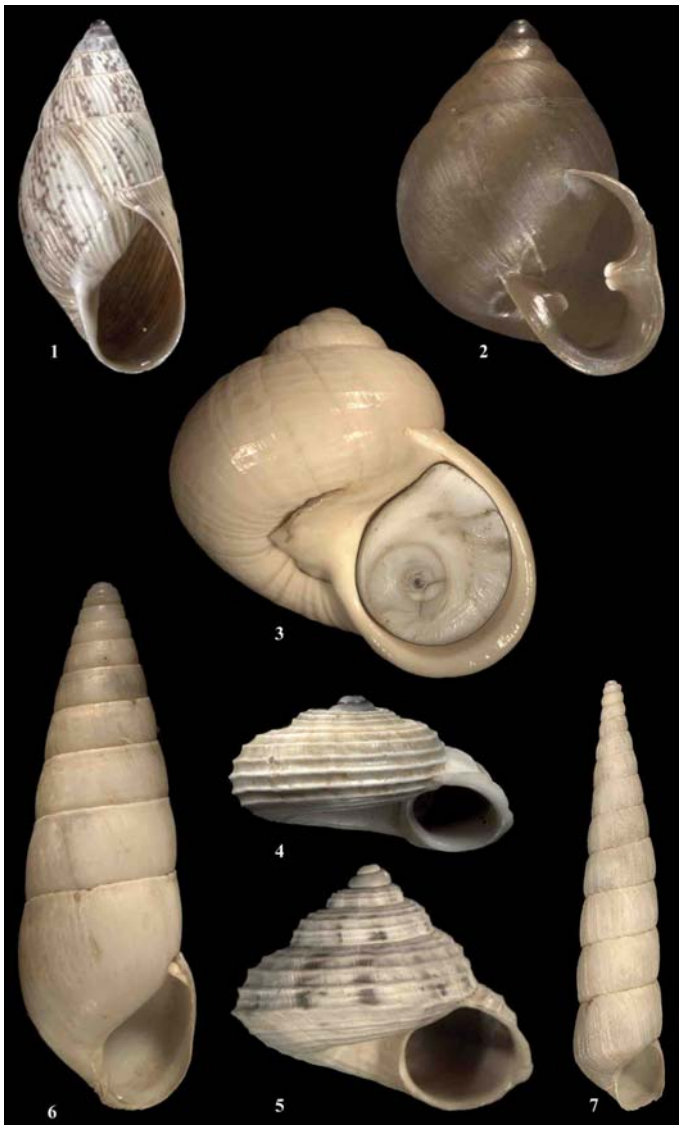
DIVERSITY OF TERRESTRIAL MOLLUSCAN SPECIES IN THE SOQOTRAN ARCHIPELAGO—RECOVERING A HOTSPOT OF MOLLUSCAN EVOLUTION

By Eike Neubert

The Soqotran Archipelago is composed of a group of four islands situated in the southern part of the Gulf of Aden off the Horn of Africa. It was split from the Afro-Arabian plate during the early formation of the Gulf of Aden ~32 million years ago. Since this time, the islands have been isolated from the surrounding terrestrial areas, providing an opportunity for an endemic radiation of the organisms trapped on the microplates.

In 1999, I was part of an international group of visitors who had the goal of producing an inventory of the biota of the Soqotran Archipelago. In terms of terrestrial molluscs, the area had been largely ignored for 100 years and a more modern assessment of the snail community living on the islands was lacking. During my stay, I collected a considerable amount of shells. Unfortunately, only a few species could be collected alive because of the dry weather conditions in January and February 1999. The terrestrial malacofauna is mainly composed of members of the eupulmonate families Cerastidae, Subulinidae, Pupillidae and Ferrusaciidae and the caenogastropod family Pomatiidae.



1: *Achatinelloides hadibuensis* (Godwin-Austen, 1881), shell height 22.0 mm. 2: *Passamaella mirabilis* (E.A. Smith, 1897), shell height 23.2 mm. 3: *Socotora naticoides* (Récluz, 1843), shell diameter 39.5 mm. 4: *Lithidion lithidion* (Sowerby, 1847), syntype, The Natural History Museum, London (1843.10.2.122), shell diameter 9.6 mm. 5: "*Tropidophora*" *socotrana* Godwin-Austen, 1881, shell diameter 10.2 mm. 6: *Riebeckia sokotorana* (Martens, 1881), shell height 64.0 mm. 7: *Balfouria* sp., shell height 22.4 mm.

The current project aims at a complete taxonomic revision of the malacofauna to lay the foundation for projects focusing on phylogeography, autecology and synecology, conservation, area management, etc. The commencing development of the islands puts increasing constraints on the social as well as natural resources, and so the project also aims at a contribution towards our knowledge of 'what is there' and 'what are we about to loose'.

The revisions (Neubert, 2002, 2003, 2004, 2005a, b) are being published in a series of papers with the running title "The continental malacofauna of Arabia and adjacent areas". With the publication of the fifth contribution (Neubert, 2005b), the family Cerastidae has been completed and parts of the Subulinidae and Pomatiidae have been covered. A final treatment of the latter two families is in preparation. So far, 25 new species and 3 new genera have been described. The

Hagghier Mountains and the Wadi Qualaansiyah were identified as two centres of evolutionary radiation on the main island Soqotra.

The dense collection grid and accurate locality data indicate that most species live in small restricted areas and thus are particularly vulnerable to uncontrolled human activities.

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ENDEMIC HYDROBIOIDS IN DOBRUJA, ROMANIA

By Magdalena Szarowska, Ioan Sirbu & Andrzej Falniowski

Dobruja, the easternmost part of Romania, is mostly a lowland area, situated along the coast of the Black Sea. It comprises several lagoons and lakes, some of them brackish or truly saline, others freshwater, with some of them belonging to the Danube Delta in the north.

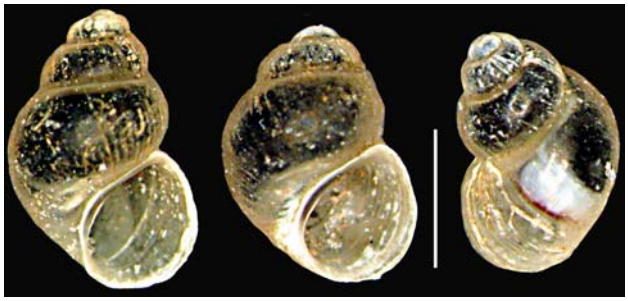
Apart from the brackish-water Hydrobiidae, five species assigned to the genus *Pseudamnicola* have been recorded from the area, four of them new to science and endemic (Grossu, 1986). All of the species, however, were described based on empty shells only, and their distinctness remains unclear. Similarly, the exact distributions of these species are uncertain, since empty shells may be transported by various mechanisms from quite distant places.

Another interesting hydrobioid snail known from Dobruja is *Grossuana serbica codreanui* (Grossu, 1946). First collected in 1938 by Radu Codreanu near Balcic in Bulgaria (Grossu, 1986), it was described by Grossu as *Pseudamnicola codreanui* (Grossu, 1946). Its type locality is "a vaulted spring by the south-west bank of Techirghiol, near the place Technir-Ghiol [sic], not far from the Agigea Lake, 15-20 km south of Constanca [sic]" (Radoman, 1983).

Last but not least, about six species of Micromelaniinae, some of them subfossil, have been recorded from the area (Grossu, 1986). The Micromelaniinae are elements of the relict Ponto-Caspian fauna, including such characteristic bivalves as *Adacna fragilis* (Milachewich, 1908), *Monodacna colorata* (Eichwald, 1829) and *M. pontica* (Eichwald, 1838).

In September 2005 we undertook a field trip to Dobruja, to look for the hydrobioid gastropods. Despite extensive searching, we did not find a trace of any *Pseudamnicola* species listed by Grossu. The spring fauna in Dobruja is subject to the same threats as in Greece (Szarowska & Falniowski, 2004) and other Balkan countries like Montenegro and Croatia. Several small springs are destroyed, some of them changed into small muddy basins used by cattle. It seems that most if not all of the bigger springs are changed to water intakes, all the water pumped away, the spring inhabitants, if still living, inaccessible. After a thorough search we found the type locality of *Grossuana serbica codreanui* at Techirghiol Lake. This was a very small spring, about 0.5 m in diameter, but still inhabited by the snails. The spring, as the type locality of the subspecies (Radoman, 1983) and the only known locality of the species in Romania, deserves conservation efforts.

In Romania, as in other countries of the region, human impact is mainly related to agriculture, waste deposits, household discharges, destruction of habitats, deforestation, industry (compared with agricultural pollution and household wastes, this is of lesser importance in the last decade) and the overexploitation of water resources.



Grossuana serbica codreanui (Grossu, 1946) from the type locality; scale bar, 1 mm.

Yet, there are some other, specific factors that affect the fauna in the area. There is a huge system of lagoons, estuaries and lakes along the Romanian coast of the Black Sea. More or less brackish, or their salinity higher than that of the neighbouring sea, they harbour the interesting, relict, Ponto-Caspian fauna. This system has been strongly affected by artificial blocking of water exchange between these water bodies and the sea, to which canals between these lagoons and the Danube Delta branches have been dug. This has resulted in a significant drop of salinity, with the lagoons and lakes becoming freshwater. These lagoons are yet subject to occasional seawater floodings caused by storms. As a result, only the most euryhaline freshwater species can survive in the area. This must have affected the relict, Ponto-Caspian fauna.

All the pyrgulid snails, micromelaniids included, are known to occur rather ephemerally, one year in abundance at a particualar location and another year not occurring there at all. We did not find any micromelaniids, either in Razelm or in Sinoie Lagoon. This, in part may have been because of the

time of year and the fact that we were not searching deeper in the lagoons. Yet it seems that the micromelaniids, if still present, are scarce and their survival depends absolutely on re-establishing the direct connection between the lagoons and the sea, the Razelm Lagoon being the most deserving of conservation efforts.

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COULD DEER OVERABUNDANCE IMPACT TERRESTRIAL MOLLUSKS?

By Aydin Örstan

Terrestrial mollusk surveys of the U.S. forests, especially in the east and mideast, have consistently recorded a rich diversity of native species (e.g., Coney *et al*., 1982; Strayer *et al*., 1986; Örstan, 1999; Nekola, 2004). Comparisons with records from the 1800s suggest that the terrestrial mollusk species compositions of the present second-growth forests may not be too different from those of the old-growth forests. The same second-growth forests are also inhabited by growing populations of the native white-tailed deer, *Odocoileus virginianus*. From these two lines of information, one may conclude that the deer have not had a negative impact on forest snails and slugs. Two recent studies, however, have raised the possibility that overabundance of deer may reduce the numbers of at least some species of terrestrial mollusks.

Suominen (1999) looked at the effects of reindeer and moose grazing on land mollusks in 23 paired plots in Finland and Sweden. In each pair, one plot was fenced to keep large animals out. Suominen used pitfall traps to collect gastropods and concluded that "there were generally more snails and slugs active in those plots where cervid access was prevented than in reference plots where cervids had grazed or browsed."

One confounding factor in this study was that the fences had been placed at different dates, one dated from the 1940s, while others dated from the 1960s through the 1980s. Rooney & Waller (2003) noted another potential interpretational problem with the use of exclosures to keep out all grazing animals: "While exclosures clearly and graphically demonstrate how ungulates can affect vegetation structure and composition, they can also be misleading when the relationship between ungulate density and the dependent variable is non-linear." As they explain (their Fig. 4), some species of plants, and indirectly, animals may actually benefit from intermediate deer densities (see also Côté *et al*., 2004).

Moreover, as Suominen (1999) also noted, pitfall trapping is not effective for sampling terrestrial gastropods and is not even considered in studies testing the effectiveness of different survey methods (e.g., see Oggier *et al*., 1998). Pitfall traps do not adequately sample land mollusks, presumably because, unlike arthropods that do fall into the traps and die, snails and slugs, being always attached to a substrate, do not commonly fall into the traps and if they enter one, they may be able to crawl back out before they are killed.

More recently, Allombert *et al*., (2005) carried out invertebrate surveys on the Haida Gwaii archipelago (Queen Charlotte Islands), 80 km off British Columbia, Canada, where Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) were introduced in 1878. They determined the abundances of various arthropods and land mollusks on six islands, two of which did not have deer, and concluded that "gastropod species density (significantly) and abundance (markedly but not significantly) decreased with increasing [deer] browsing history".

This study also has methodological and interpretational problems. First, Allombert *et al*., (2005) also used pitfall traps and identified only nine snail species. Unfortunately, they did not give a list of species names. I would like to know if any of the mollusk species were introduced to any of the islands as a result of human activities, because if they were, then this would be a factor in determining their presence or absence on a particular island.

Second, the Sitka deer is not native to the study area. Consequently, the results may not be relevant to the North American forests where the white-tailed deer is native and is expected to have coevolved with all other forest taxa. Any impact the white-tailed deer, present at normal or near normal population densities, might have on the other native inhabitants would be a natural process. In this context, it is worth keeping in mind that, although deer populations in North America have been growing, Côté *et al*., (2004) noted that it is not known if the present deer populations are higher than those before European colonization.

Another problem common to both the studies of Suominen (1999) and Allombert *et al*. (2005) is that the recorded mollusk species diversities and abundances were low in comparison with those of lower latitude forests. Suominen (1999) found 13 species of gastropods, but six of them were represented by 13 or fewer specimens. The abundances of two of the remaining seven did not differ significantly between grazed and ungrazed plots, four species were more abundant on ungrazed plots and one species, *Zoogenetes harpa*, was significantly more abundant on grazed plots. Likewise, Allombert *et al*. (2005) collected 26,818 invertebrates, of which only 0.4 % were gastropods, including nine species and giving an average of less than 12 specimens per species distributed over six islands. At such low species and specimen numbers, I would suspect that in either study chance events are highly likely to have influenced distribution patterns and survey results.

The impact of deer density on diversity and abundance of other

forest taxa can be complex and in the presence of deer some species may decline in abundance, while others may increase (Rooney & Waller, 2003; Côté *et al*., 2004). Therefore, it may be difficult to come up with generalizations that would be applicable in all or most instances. What Suominen (1999) and Allombert *et al*., (2005) found may indeed be highly relevant as far as the interactions of large grazing mammals and the somewhat scanty snail faunas of high latitude forests are concerned. But, for all the above reasons, I am hesitant to extrapolate their conclusions to the interactions of terrestrial mollusks and deer in lower latitude forests.

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COULD DEER OVERABUNDANCE IMPACT TERRESTRIAL MOLLUSKS?—A RESPONSE TO ÖRSTAN

By Jean-Louis Martin

Aydin Örstan, in this issue of *Tentacle*, questions the conclusions of two recently published papers that suggested possible negative effects of current deer populations on mollusks. One of theses papers is by Allombert *et al*. (2005a). Before addressing the specific points raised by Aydin Örstan I should mention that mollusks were only marginally touched upon in our paper. The study only suggested that some mollusks that depended on live understory vegetation might have been affected. What our study showed was that a dramatic reduction in the understory vegetation, the result of a long history of deer browsing, had led to a dramatic reduction of the overall abundance and species *density* (see Gotelli & Colwell, 2001) of the invertebrate fauna that relies directly or undirectly on that vegetation. It also showed that the effects on the litter fauna were more complex. Our conclusion was not one of plain extrapolation to continental forests but suggested closer attention to potential effects of current deer populations on other components of the forest ecosystems.

Örstan, on the basis of records from the 1800s, states that species composition in east and mid east U.S. forests has not changed. This may be true. But the question we address is: have species abundances and species *densities* remained the same? If there are no data available to judge variation in abundance or species *density*, past records are of little help. If we take our data on plants (Stockton *et al*., 2005), invertebrates (Allombert *et al*., 2005a) or songbirds (Allombert *et al*., 2005b) and look at variation in species lists from island to island, there is at best a weak effect of browsing history. If we take variation in abundance into account, than the effect becomes overwhelming and many species have to be considered ecologically and locally extinct.

Although many people still resist the idea, there is an increasing amount of evidence in the literature that shows that deer populations are currently changing forest ecology, particularly in eastern north America and western Europe. Two of the authors mentioned by Örstan, Don Waller and Steeve Côté, are, with their teams, among the scientists that take the potential for negative effects on many plant and animal populations very seriously. We also increasingly realize that density does not tell it all. It has to be matched with current carrying capacity, browsing history, landscape structure and the presence or not of fear from predators. We are currently only learning the complexities of these interactions and their link to land use changes by human activities. The studies on Haida Gwaii by our research group, the studies of Steeve Côté and colleagues on Anticosti Island, and the work of Don Waller's team in eastern forests, just to mention the authors listed by Örstan, are part of that effort to quantify the potential of dramatic ecosystem simplification by forest ungulates. This of course does not imply that there are necessarily dramatic effects on mollusks. It only means that the question deserves careful consideration.

Örstan also raised a number of specific points. Indeed, as recognized in the studies he comments on, there are methodological problems both with exclosure experiments and with pitfall traps. These have to be taken into account when analyzing the data and interpreting the results. This is especially true for pitfall traps and mollusks.

In the Haida Gwaii study all mollusk species recorded were native. The study was conducted on remote small islands in an uninhabited and road-less part of the archipelago. No introduced mollusk species were recorded. The only human visitations were those by the research team. The rate of drop offs was similar for all islands. The sampling by pitfall traps was done within one single field season. This should further reduce the likelihood of unwanted biases caused by species getting a ride from the scientists. The concern is a valid one though.

Örstan wonders if mainland mollusks could have "coevolved" and be better adapted to deer presence than island populations. The point made by Allombert *et al*. (2005a) is that deer eat

most of the resources on which the insects and mollusks depend. We found no evidence that, all other things being equal, invertebrate species may adjust better to starvation on the mainland.

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CERVIDS AND GASTROPODS—A RESPONSE TO ÖRSTAN

By Otso Suominen

Aydin Örstan, in this issue of *Tentacle*, criticizes extrapolation of the results of the negative impacts of cervids on terrestrial gastropods in the studies of Suominen (1999) and Allombert *et al*. (2005). There is at least one more similar study by Wardle *et al*. (2001) from New Zealand.

Örstan seems to confuse the impacts on local abundance (density), local species density (α-diversity) and regional species richness (γ-diversity). Results of these three studies showed that the local abundance of several species and, in some cases, α-diversity were negatively affected by cervid presence. In my study (Suominen, 1999), all species were found in both grazed and ungrazed plots in the pooled data, except for one species found only in grazed plots. Thus, regional species richness was not affected. These ecological studies considered diversity as an ecological parameter of local communities. That is a very different concept than the regional species pool, which, I presume, is the focus of the surveys Örstan is referring to.

The critique of pitfall traps as a method relates to the above issue of ecological diversity as a theoretical concept versus biodiversity surveys for conservation. In the latter case it is essential to try to record all species of the target taxon, and pitfall traps would be absolutely inadequate for gastropods. If the focus is the impact of some ecological variable on species diversity as such there is no need to collect all species as long as we can assume that the method collects individuals equally effectively in all 'treatments'. For example, we have studied the relationship between the size of aspen stands and gastropod diversity using data from masonite boards (Suominen *et al*., 2003), pitfall traps, and litter samples (Suominen, Edenius, Ericsson & Zakrisson, unpublished data). While the relative abundance, species composition and exact diversity values vary among the methods the relationship between aspen stand area and gastropod diversity remains similar.

I am aware of several confounding factors related to exclosure experiments (e.g. Suominen & Danell, in press) but I feel that the consistent results from exclosures representing variable ages and habitat types reported by Suominen (1999) and Wardle *et al*. (2001) rather makes the results more generalisible than if all the exclosures had been similar.

Just as Örstan suggests, diversity of the gastropod fauna seems to be especially readily affected in the northern sites where several species live close to their distributional limits and have narrower habitat requirements (Suominen 1999; Suominen *et al*., unpublished data). It has been suggested that large herbivores are more likely to have negative impacts on communities when they are not native (e.g. Wardle *et al*., 2001; Suominen & Danell, in press), which is in accordance with Örstans considerations. However, Wardle *et al*. (2001) found that "… reduction of gastropod species richness by browsers [in New Zealand] was comparable to that observed by Suominen (1999) … in Scandinavia."

If cervid browsing has an impact on terrestrial gastropod faunas by lowering density of some of the species or by lowering overall species density, that is an impact on gastropods, even though it is quite different from saying that this constitutes a threat to a regional gastropod species pool. There is a forthcoming review (Suominen & Danell, in press) in which we point out that, among the invertebrates, terrestrial gastropods seem to respond exceptionally consistently and negatively to browsing in different studies, while for most other invertebrates there is no consistent direction of the impact. Thus, gastropods seem to be especially vulnerable to browsing impacts. Even though the low number of studies does not allow for generalized predictions, I would be surprised if the ungulates would not have some kind of impact on litter dwelling gastropods if they have a substantial impact on quality and quantity of litter fall.

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PROPAGATION AND JUVENILE CULTURE OF THE ROUND MUSSEL (*ANODONTA WOODIANA PACIFICA*) (BIVALVIA: UNIONIDAE)

By Dan Hua, Ruobo Gu, Gangchun Xu & Haibo Wen

The round mussel, *Anodonta woodiana pacifica* (Heude), is a large species with a maximum length of 180 mm. It is found in the mud substrate of lakes, ponds, rice fields and rivers, and was formerly widespread throughout most drainages in China. However, recently the population has declined dramatically as a result of pollution caused by agriculture, urbanization and industry, and because of siltation. We therefore attempted to propagate *A. w. pacifica* for the purpose of restoration.

The spawning season of *A. w. pacifica* lasts from April to mid-August. Gravid mussels were collected from Taihu Lake in April 2004. Glochidia have a triangular shape with a slightly curved hang line. The ventral margin constricts to a sharp point; anterior and posterior margins are equivalent. Each glochidium has one lanciform hook at the lateral margin of the ventral flange of each valve which facilitates parasitizing the host fish. Glochidia from Taihu Lake (length 301.3 ± 8.7 µm, height 245.7 ± 10.6 µm) were larger than those from NanHu Lake, Hubei (length 173 µm, height 157 µm).

Twenty tilapia (*Oreochromis nilotica*), 20 yellow headed catfish (*Pseudobagrus fulvidraco*) and 20 bighead carp (*Aristichthys nobilis*) were infected with glochidia of *A. w. pacifica* via 20 min exposure. Metamorphosis of juveniles took 11-19 days at around 20 °C. Tilapia sustained more juveniles than the other two fish species (see table) and had highest survival rate during the parasitized period ($P < 0.01$).

The round mussel, *Anodonta woodiana pacifica*. Left: adult; top right: glochidia; bottom right: juvenile.

Juveniles were cultured in the hatchery until they attained a length of 1 cm. They were maintained in pond water that contained suitable algae and organic detritus as a food source. The density was approximately 20,000 individuals/m^2; water velocity was 3-5 cm/min. Juveniles grew fast and reached 1 cm in length after two months. Thereafter, they were transferred into net cages (50 cm × 50 cm × 10 cm) at a density of 200 individuals/m^2 and cultured in fish ponds. The bottoms of the cages were wrapped in plastic film and filled with thick hard mud to a depth of 2 cm. The cages were then placed on the bottom of the pond bank. Most juveniles reached 5-6 cm after 5 months.

Numbers of juveniles per host and host survival rate for the three species of fish hosts

Host	Average number of juveniles/host	Host survival rate (%)
O. nilotica	2045	100
A. nobilis	220	30
P. fulvidraco	287	60

Extensive propagation was conducted in the Jiangyin hatchery, Freshwater Fisheries Research Center, in April 2004. Fifteen hundred gravid mussels and 250 kg tilapia (around 15 cm in length) were used for infestation. Over three million juveniles with an average length of 1.2 cm were collected in July. They were then assigned to 15,000 cages and reared in 5 ponds (2 ha each). In November 2004, most juveniles had reached about 5 cm. One million juveniles were released in tributaries of the Yangtze River.

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TWO ENDEMIC GENERA OF BIVALVES IN THE TUNGA RIVER OF THE WESTERN GHATS, KARNATAKA, INDIA

By N.A. Madhyastha & Kamalesh D. Mumbrekar

Arcidopsis (family Unionidae) and *Pseudomulleria* (family Etheridae) are two endemic genera of freshwater mussels found in the river systems of the Western Ghats. Both are monotypic genera with *Arcidopsis footei* and *Pseudomulleria dalyi* as the only described species. The description of *Arcidopsis footei* by Theobald (1876) was based on incomplete specimens and no complete adult specimens were available to permit Prashad (1920) to discuss the true position *Arcidopsis* and its relation to other Indian genera. *Pseudomulleria dalyi* was described by Smith (1898), and its anatomy was studied by Woodward (1898). *Pseudomulleria dalyi* is of importance as it is the only cemented bivalve of the Western Ghats and a Gondwana relict (Madhyastha, 2001).

The Tunga River originates in the Kudremukh region of the Western Ghats (Karnataka, India). It is one of the major tributaries of the Tungabhadra River. There is a dam across the Tunga River at Gajanur (13° 85’ N, 75° 70’ E) and another project, the Upper Tunga Project, is to increase the height of the existing dam. The Tunga River is one of the major habitats for both the endemic species of bivalves and hence the Upper Tunga Project is sure to affect the population of these two

endemic genera adversely (Madhyastha, 2005).

Our attempts to collect *Arcidopsis footei* from the type locality at Ghataprabha and at Koyna valley, and *Pseudomulleria dalyi* from Koyna valley have proved to be futile. In Ghataprabha, the Idkal dam in the upper Ghataprabha River has resulted in the drying up of the river during summer months and hardly any water is available for the bivalves to survive. To evaluate the status of these bivalves elsewhere, we undertook a survey of the Tunga River during the summer months (April, May), after confirming that the Tunga River has rich bivalve populations (Madhyastha, 2005). Two trained people searched for *Arcidopsis footei* and *Pseudomulleria dalyi* along the rocky habitats of the river at intervals of 30 km up to 125 km downstream from the Western Ghats covering sites at Kasarvalli, Melige, Mandagadde and Thirthalli (all in Shimoga District, Karnataka).

In Madagadde, there is an island in the Tunga River that is known as a bird sanctuary. It is the only place in the Western Ghats river systems where both the endemic bibalves are found in hundreds, in addition to *Lamellidens corrianus* and *Parreysia rugosa*. The congregation of bivalves at Mandagadde may be a consequence of the large amounts of guano from hundreds of birds in the sanctuary, which facilitates the growth of plankton and fish populations in the water. Since the larvae of unionid bivalves are parasites on the fin or gills of the fish, the fish population may thereby enhance unionid survival. Also, the mussels are food for the fish as well as for the birds of the sanctuary. Thus, there is an interesting interaction among fish, birds, mussel and plankton in Tunga River at Mandagadde.

Bivalve populations in the Tunga River.

Locality	Bivalve species	Abundance
Kasarvalli	*Arcidopsis footei*	Rare
	Pseudomulleria dalyi	Rare
	Parreysia rugosa	Common
Thirthalli	*Arcidopsis footei*	Rare
	Pseudomulleria dalyi	Rare
Melige	*Arcidopsis footei*	Rare
	Pseudomulleria dalyi	Rare
	Parreysia rugosa	Common
Mandagadde	*Arcidopsis footei*	Very common
	Pseudomulleria dalyi	Very common
	Lamellidens corrianus	Very common
	Parreysia rugosa	Very common

Rare: <10 in a 500 m transect. Common: 10-100 in a 500 m transect. Very common: >100 in a 500 m transect.

Although the extinction rate of molluscs in India has not yet been evaluated, it is probably not less than the global rate. Excessive withdrawal of water for irrigation using pump sets (there are 50-80 pump sets per km in the Tunga River) during summer months causes the river to dry up. We have noticed hundreds of *Arcidopsis footei*, *Pseudomulleria dalyi* and *Lamellidens corrianus* dead near the bird sanctuary at Mandagadde. Siltation of rivers resulting from deforestation and mining are other major threats to the bivalves. Siltation blocks the source of food or interferes in feeding. We plan to study the biology and niche requirements of the bivalves, which will help us to structure conservation plans and prioritise conservation efforts.

Shells of *Arcidopsis footei* exposed by lowering of the water level in the Tunga Rriver.

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PACIFIC ISLAND LAND SNAILS

Report on the joint American Malacological Society and Western Society of Malacologists 2005 symposium: Pacific island land snail diversity - origins and conservation

By Diarmaid Ó Foighil

The terrestrial snail faunas of the Pacific islands have attracted considerable scientific interest for two very different reasons. Classically, they have been viewed as influential examples of evolutionarily rapid endemic species radiations. Unfortunately, many of these faunas are now best known as the victims of mass extinction events. This poignant blend of exceptionally high biological interest and extraordinary vulnerability represented the two primary themes of a symposium held on 29 June 2005 as part of the conference co-

hosted by the American Malacological Society (AMS) and the Western Society of Malacologists (WSM), at the Asilomar Conference Grounds in Monterey, California.

The meeting was supported, in large part, by the U.S. National Science Foundation and also by the AMS and the University of Michigan Museum of Zoology. It featured an international line-up of speakers that included both established and up-and-coming researchers. I am pleased to report that the quality of the talks was uniformly impressive and that we were treated to a comprehensive series of presentations on endangered wild populations, captive populations and archived museum material. The common themes of the presentations focused on new insights into how these faunas evolved and how some of them might be saved. The meeting also significantly facilitated the establishment of valuable collaborative ventures among the participants.

Carole Hickman was the first speaker and she delivered an excellent introduction into the geologic and evolutionary context of Pacific island land snail diversification. Brenden Holland discussed his ongoing research (with Robert Cowie) on the relative roles of vicariance and dispersal in Pacific Succineidae and Michael Hadfield gave an update on his long-term comprehensive research program on Hawaiian achatinelline snails. There was a nested set of four presentations concerning aspects of the endangered partulid fauna of the Society Islands. Bryan Clarke summarized his four decades of work (with Jim Murray) on this malacofauna; Diarmaid Ó Foighil presented preliminary data from ongoing research (with T. Lee and J.B. Burch) on historical museum samples; Trevor Coote reported on relictual Tahitian wild populations; and Paul Pearce-Kelly gave an informative overview of the International Partulid Conservation Programme. Finally, there were impressive presentations on land snail diversity and conservation of specific archipelagos by Benoît Fontaine (Australs), Rebecca Rundell (Belau) and John Slapcinsky (Louisiade, Papua New Guinea). The symposium ended with an open discussion centered on sampling issues for molecular phylogenetic studies, the differential survival of some Tahitian *Partula* lineages, the possible role of anthropogenic introductions involving presumed endemics, the research utility of museum collections and the future of captive populations.

Symposium abstracts are available at:
www.malacological.org/meetings/archives/2005/abstract_volume_html-01/node29.html

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Galápagos bulimulids: status report on a devastated fauna

By Christine E. Parent & Robert P. Smith

With over 80 species and subspecies described, the endemic bulimulid land snails of Galápagos represent the most species rich lineage on these islands. The different species vary remarkably in shell size, shape, color, and color pattern; and this morphological diversity is presumably a reflection of the variety of habitats these land snails have adapted to. Indeed, Galápagos bulimulid land snails are found in all of the seven vegetation zones described for Galápagos except the littoral (or coastal) zone, which comprises the shoreline and is composed mainly of lava boulders and sandy beaches.

Bulimulus reibischi from Santa Cruz Island.

Less than two decades ago, much if not most of this diversity was thought to have vanished. This conclusion was mostly drawn from surveys conducted on Santa Cruz Island. In an effort to re-evaluate the status of the Galápagos bulimulid species, over the past five years we surveyed and collected bulimulids across the archipelago, taking extensive notes on the distribution, density, micro-habitat, and ecology of the different species and populations. The initial results led to the re-assessment of 49 bulimulid species on the IUCN 2004 *Red List*, which now includes 57 species. The table shows the geographical distribution by island of the bulimulid species assessed, according to the IUCN *Red List* categories.

The loss of bulimulid species began over a century ago during early colonization of the islands, but has accelerated in the past few decades. In 1970, one of us (RPS) recorded snail species on six of the major islands and on several smaller islets. During trips in 2004-5, the exact routes taken in 1970 were retraced to record changes in snail distribution. While intact populations were present at many sites, the fauna was entirely absent from some areas and restricted to remnant patches of habitat in other sites. The rich bulimulid fauna on Santa Cruz Island, where the human population has rapidly multiplied as the hub of tourism, has largely disappeared in the past 20 years. In highland areas where five or more endemic species were abundant in 1970, no live snails were found. Dr. Guy Coppois, who studied the 27 taxa of Santa Cruz bulimulids in the early 1970s, reported that a decade later he could not find live populations of all but a few of these species. Much of the highland area that supported forests of endemic *Scalesia peduncula* and stands of the endemic *Miconia robinsoniana* is now covered by an invasive species of quinine tree.

One striking observation from the table is that Santa Cruz, San Cristobal, and Floreana islands all have more than five species categorized as critically endangered (CR) or endangered (EN),

and have already lost previously recorded species. Not surprisingly, these three islands happen to be three of the four islands with permanent human settlements. Not only have humans destroyed habitat to build their houses and roads, they have also introduced (intentionally or not) species of plants and animals alien to these islands. Land snail populations can be directly affected by these invaders, for example by fire ants that are potential predators of land snails, or indirectly affected as a result of habitat transformation by introduced plants. We used regression analysis to evaluate the role of plant introductions on the risk of extinction of bulimulid land snails. The graph below shows the significant positive effect that the number of introduced plant species has on the proportion of endangered (CR and EN) bulimulid species found on each island. As an island hosts an increasing number of introduced plant species, the proportion of endangered bulimulid species increases.

Geographical distribution of the threatened bulimulid species of Galápagos. Categories follow the IUCN *Red List* classification: CR–Critically Endangered; EN–Endangered; VU–Vulnerable; DD–Data Deficient. Some species are found on more than one island; therefore the sum of all categories on all islands does not correspond to the total number of bulimulid species that have been assessed for Galápagos.

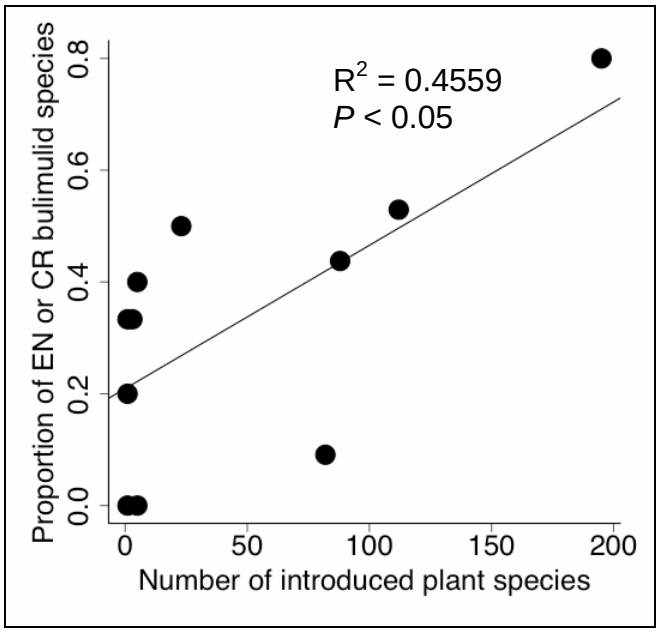
	IUCN *Red List* Categories			
Island	CR	EN	VU	DD
San Cristobal	5	4	1	2
Española	1	1	1	0
Floreana	1	6	1	1
Santa Cruz	16	0	5	1
Santiago	3	2	2	1
Pinzon	1	0	0	0
Rabida	0	0	2	0
Santa Fe	0	1	0	0
Pinta	0	1	0	1
Isabela	0	1	1	7
Fernandina	0	0	1	1

However, there is considerable scatter of the points on this graph, suggesting that the number of introduced plant species is not telling us the whole story. Indeed, snails are also absent from a large intact "sedge-fern" zone near the island summit of Santa Cruz Island that once supported thriving snail populations, and live snails are almost extirpated from the remnant patches of *Scalesia peduncula* forest that appear to be otherwise intact.

Together, these observations suggest that factors other than habitat loss have affected these snails. Invasive species (especially the ant *Wasmania auropunctata* and perhaps other invertebrates) may have taken a toll. However, there is little direct evidence at this point to implicate a specific cause for the remarkable disappearance of this fauna.

Habitat loss is clearly a continuing threat on settled islands, as well as on some remote islands. On Floreana and San Cristobal islands, small communities have been present for over a century, and limited farming of highland areas has restricted endemic vegetation substantially. Since 1970, sites that harbored abundant snail populations are now devoid of live bulimulids, but the remnant patches of forest still host populations of a number of species endemic to these islands, and there remains the opportunity to protect these sites and some snail populations. On the isolated volcano Alcedo (Isabela Island), there are no human settlements, but extensive defoliation by goats has limited populations of four or more species to small patches of forest that are unreachable by goats. The ground beneath denuded shrubs where there had once been an abundant arboreal species is littered with bleached shells. Presumably, if the goat eradication program is successful, remnant populations may thrive again on Alcedo, but the threat of invasive species brought in from other islands remains a major concern. The snail species composition on Santiago Island appears to be relatively intact, despite the extensive destruction of vegetation by introduced goats and pigs, and with a control program of these mammals underway, there has been a remarkable recovery of native vegetation in the past decade.

The absence of a once abundant snail population of *Bulimulus planospira* from two remote islets that are rarely visited by humans is more difficult to explain. While invasive species may have been introduced to these sites, no direct evidence to support this possibility exists. While researchers and other authorized visitors to protected sites undergo a careful inspection of their gear and clothing before embarking, unauthorized visits to most islands occur commonly, and could be the source for the introduction of invasive species such as fire ants.



Linear regression of the proportion of EN and CR bulimulid species on islands against the number of introduced plant species.

Together, these observations suggest that habitat loss is an important threat to the survival of Galápagos bulimulids, but other factors such as introduced predators and/or competitors, and island size might also be very important. Bulimulids like many other land snails probably do not need a large patch of habitat to survive. However, species with greater density and wider distribution have greater chances of long time survival. We are using a combination of population genetics and biogeographical analyses to understand better the potential

impact of reduction and partition of suitable habitat for bulimulid land snails on the genetic diversity and structure of different populations. Ultimately, we hope to be able to define better what are the habitat needs of the different species in this remarkable group, so that more informed decisions can be made towards their protection.

On a few islands, there is still a chance that this fascinating mollusk fauna may be preserved, but continued efforts to understand the causes of the demise of snails on islands such as Santa Cruz is necessary. Until those causes are better understood, habitat protection is all that can be accomplished, and it may not be enough.

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Conservation of the land snails of Belau and the Federated States of Micronesia

By Rebecca J. Rundell

In August through November 2005 intensive field work was conducted in the Republic of Belau (Palau) and the Federated States of Micronesia (FSM) as part of the Belau Land Snail Project and broader land snail survey work in Micronesia. One of the main goals of this work was to contribute to the conservation of these land snail faunas through broad sampling, educational outreach and training local personnel in land snail survey techniques.

Left: An undescribed species of *Hungerfordia* from Airai State, Island of Babeldaob, Belau. Right: *Palaina albata*, Peleliu State, Island of Peleliu, Belau. (Photos: R.J. Rundell)

The 2005 survey builds on the results of the 2003 project, which are summarized here. Eighty (80) species from 17 families were recorded in the 2003 Belau land snail survey. Of these species, 69 were endemic, five were indigenous but not endemic, and six were introduced species. Of the 80 species, 43 were undescribed, most of these being diplommatinids. This survey substantially increases the number of species recorded from Belau. Smith (1993) listed 69 described species (including both native and introduced species), 37 of which were recorded in 2003. The species that were not found may be located on islands not included in this survey, or may be exceedingly rare or extinct. Cowie *et al.* (1996) suggested that there may be 40-50 indigenous/endemic species in Belau, based on a survey of the literature and a scan of the Bishop Museum (Honolulu, Hawaii) collections. The present total of 74 indigenous/endemic species exceeds this number.

Given that the 2005 survey for the Belau Land Snail Project covered many more islands than the 2003 survey, it is likely that the number of endemic and indigenous species known from Belau will continue to increase, as the results of this 2005 field season are tabulated. Distribution data will also be useful for assessing the conservation status of individual land snail species. Currently 46 land snail species from Belau are listed as Data Deficient by the IUCN (2004). Among these are several endodontid and diplommatinid species that were collected at many localities in 2005. There are indications that data may now be sufficient for the conservation status of many of these species to be assessed. This is vitally important since the ranges of many of these ground-dwelling taxa are relatively restricted. Comparisons of 2003 and 2005 data with historical museum records (e.g. from the Bishop Museum) may be useful in understanding potential changes in distributions.

Results of the 2005 survey are also being used to write regulations for the protection of land snails in the Rock Islands-Southern Lagoon Area of Koror State (Belau). This is part of the overall effort initiated by the Rock Islands-Southern Lagoon Area Management Plan (2004-2008) and is a collaboration of the Belau Land Snail Project with the Koror State Department of Conservation and Law Enforcement and Koror State Legal Counsel. Although no cutting of rainforest is currently allowed in the management area, the increasing development of tourism and other uses of the Rock Islands make such regulations important to the future of the land snail fauna in Belau. This will also ensure the protection of the Critically Endangered (CR) partulid land snails, some of which occur in the Rock Islands.

Education and local capacity-building are important parts of land snail conservation in Belau and the Federated States of Micronesia (FSM). Efforts in 2005 included presentations on local radio programs and in schools, as well as snail survey workshops with personnel from Belau and FSM government agencies and NGOs. An important part of these educational programs is teaching people to identify invasive species and understand the role of indigenous species in healthy forest ecosystems. One such program took place at the Ngardok Lake Reserve (Melekeok State, Belau), which will be part of the Protected Area Network established by The Nature Conservancy. The Ngardok Lake forest land snail fauna is unique and harbors several species endemic to the island of Babeldaob. Ngardok Lake's location near the new capital building, where development is increasing, also makes the conservation of this fauna important. In addition to these field efforts, an exhibit on the evolution and conservation of Belau land snails was produced for the opening of the Belau National Museum's new building in September 2005.

The Belau Land Snail Project benefited from collaboration with local and state agencies, including the Belau Conservation Society, Belau Cares, Inc., the Belau Office of the President's Office of Environmental Response and Coordination, the Koror State Department of Conservation and Law Enforcement and the Coral Reef Research Foundation. Surveys in FSM benefited from many individuals, including those from the Yap Community Action Program and Yap Department of Forestry, the Conservation Society of Pohnpei, the Secretariat of the Pacific Community and the Kosrae Island

Resource Management Authority. Field assistants on the project were Jesse Czekanski-Moir, Ric Brewer, Rachael Orben and Samantha Wilkinson. This work is part of my Ph.D. dissertation research at the Field Museum and the University of Chicago.

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Molecular phylogenetics reveals biogeographic surprises and the presence of multiple distinct invasive succineid lineages in the Pacific

By Brenden S. Holland & Robert H. Cowie

Biologically, the Hawaiian Islands are well-known for their spectacular radiations of endemic terrestrial lineages. Many groups of animals (e.g. damselflies, leaf hoppers, spiders, honeycreepers, fruitflies), including land snails (Holland & Hadfield, 2004; Rundell *et al*., 2004) have been subject to recent molecular scrutiny, and each reveals a unique history.

One of the most complex and interesting biogeographic patterns thus far documented is that of the Pacific succineid land snails. In collaboration with Gary Barker of Landcare Research, New Zealand, and Marta deMaintenon of the University of Hawaii at Hilo, we are focusing on colonization pathways, systematics and historical biogeography of Pacific succineid land snails. The emerging pattern is overturning some long-held biogeographic precepts. For example, we have discovered evidence of multiple colonizations of the Hawaiian, Samoan, Society and Galapagos Islands, and of Japan and Melanesia. Thus, the idea that passive colonization of geographically isolated oceanic island groups is so rare that lineage monophyly can be assumed, does not hold for these succineids. In addition, the idea that snails are poor dispersers is also being challenged, since not only have succineids reached every major Pacific island group, but in many cases they have arrived on more than occasion, from more than one geographic source. Finally, the notion that the Hawaiian Islands represent an evolutionary 'dead end' has also been contradicted by the discovery of lineages in Tahiti and Samoa that may have originated in the Hawaiian Islands.

In addition, we have discovered two morphologically similar but genetically distinct recently introduced species in Hawaii. They include one as yet unidentified species that probably originated in the western Pacific and *Succinea costaricana* from Central America. Both species are being spread throughout the Hawaiian Islands by the horticulture industry. Invasive succineids, genetically identical to the unidentified western Pacific species, have been collected from nurseries in Washington State, Florida and California, and specimens collected in Saipn are genetically identical to another Costa Rican species, again probably an anthropogenic introduction.

Unidentified invasive succineid species collected on Oahu, Hawaiian Islands, in a horticultural nursery. (Photo Brenden S. Holland)

We have also discovered an extremely widespread Polynesian lineage (*Succinea manuana*), ranging from Samoa (from where it was described by A.A. Gould in 1846) to Fatu Hiva, Nuku Hiva, and Ua Huka in the Marquesas, and south to Rimatara in the Austral Islands, a maximum distance of more than 1,200 km, perhaps suggesting a human role, modern or prehistoric, in its dispersal.

Succinea manuana, Ua Huka, Marquesas Islands. Also, far left, *Gastrocopta servilis*, introduced widely in the Pacific by prehistoric Pacific island people. (Photo Brenden S. Holland)

We have recently expanded our sampling strategy to encompass all continents and as many island groups as possible. If any readers of *Tentacle* find succineids during the course of their field work, or have or know of ethanol preserved succineid material, we would very much appreciate receiving a sample. We typically do not destroy whole specimens but take small tissue samples of 10-20 mg for DNA analysis and can then return specimens to senders if necessary.

This work is supported by the U.S. National Science Foundation, grant DEB-0316308.

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Helicinids and endodontids alive in Hawaii! A comment on the conservation of family level land snail diversity in Hawaii

By Wallace M. Meyer III

Many land snail faunas world-wide are under extreme threat and land snails have the highest number of documented extinctions of any major taxonomic group (Nash, 2004; Cowie, 2004; Lydeard *et al*., 2004; Whitten, 2004). This is especially true in Hawaii, where the native Hawaiian land snail fauna used to be extremely diverse (over 750 species) and exhibited extremely high endemism (over 99 %); however, most of these unique species are now extinct (Cowie, 1998, 2005). Habitat destruction and invasive species (especially the introduced predatory snails *Euglandina rosea* and *Oxychilus alliarius*, as well as a predatory flatworm *Platydemus manokwari*) are the two main reasons for the decline of the Hawaiian land snail species (Hadfield, 1986; Cowie, 2005; Meyer, 2005).

Despite the depressing numbers associated with land snail diversity in Hawaii, in one day I found two extremely rare snail species in one gulch in the Waianae Mountains in the western part of the island of Oahu. The first species was an endodontid in the genus *Cookeconcha*, species unknown but possibly undescribed. The family Endodontidae is probably the most diverse Pacific land snail family (Solem, 1976). Although once widespread throughout the Pacific, the Endodontidae appear to be reduced to sparse, highly localized populations on those islands they formerly inhabited, with most species now extinct (Lydeard *et al*., 2004). The population in the Waianae Mountains seems to be around a few hundred individuals according to The Nature Conservancy, who have begun monitoring (D. Sailer, personal communication, 2005). I know of no other populations of endodontids in the Hawaiian Islands.

The second snail was a helicinid in the genus *Orobophana*, species also unknown (cf. Neal, 1934). Previously, all helicinids were considered extinct since many of the Hawaiian land snail experts had never seen a live helicinid snail (R.H. Cowie, personal communication, 2005).

So what do these findings mean for land snail conservation? First, these two species belong to two families that were considered either extinct or extremely threatened not only in the Hawaiian Islands but throughout the Pacific. Thus in a small portion of Oahu, already protected for the conservation of Hawaiian tree snails (*Achatinella* spp.), we have an opportunity to protect two additional distinct evolutionary lineages. Since a greater amount of evolutionary history and biological distinctiveness is lost when the last species of an entire genus or family is lost, some scientists suggest that conservation efforts should focus on protecting higher taxonomic groups under threat (Kareiva & Marvier, 2003). Second, these findings suggest that biotic surveys remain critical even in presumed well inventoried areas such as Oahu. Unfortunately, relatively little effort has been focused on surveying the ground dwelling/litter land snail fauna of Hawaii, compared to the achatinelline tree snail fauna, in part perhaps because most ground dwelling species have been considered extinct. Hopefully, this will change and appropriate survey work will be conducted before we forget to look for these species again. I suggest that comprehensive surveys be done to not only find and protect these rare species but begin to understand the physical, chemical, and biological properties of the habitats where these species still occur.

At this time in Hawaii we have the opportunity to preserve two distinct evolutionary lineages that seem to be threatened throughout the Pacific. It is my sincere hope that these unique species will be monitored, managed, and ultimately protected. The Nature Conservancy, the land managers in charge of this particular gulch, are currently working on management plans for these snails.

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FRESHWATER BIVALVES IN NORTH AMERICA

Hatcheries strengthen mussel species on Appalachian river

By Kim A. O'Connell

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http://news.nationalgeographic.com/news/2005/12/1206_051206_mussels.html

Dr. Seuss could not have come up with better names for five endangered mussel species that inhabit the Big South Fork National River.

The Cumberland elktoe, Cumberlandian combshell, tan riffleshell, and two pearlymussels, the little-wing and the Cumberland bean, all cling to life in the silt of this waterway, which straddles Tennessee and Kentucky.

Although the five species are the rarest, all the waterway's mussels are in danger. Where 50 to 70 species once thrived, today only 26 species remain.

Well-known environmental pressures—mining, logging, and pollution—occur here, as does a more obscure threat: the crush of horses' hooves as recreational riders cross the river.

A vast mussel "baby-making" operation, however, may now be giving the species their last, best hope for survival. Since 2002 the U.S. National Park Service has worked with the U.S. Fish and Wildlife Service, other federal and state agencies, and two mussel hatcheries—the Virginia Tech Aquaculture Facility and the Kentucky Center for Mollusk Conservation.

The consortium aims to breed freshwater mussels and reintroduce them to the Big South Fork. Through an intricate and exacting process, about 80,000 juveniles have already been reintroduced to the river. Many more mussel births are planned.

"Big South Fork is a real biological treasure," said Steve Ahlstedt, a retired U.S. Geological Survey biologist who has worked on the recovery effort. "It has the best mussel fauna that's left among many hundreds, if not thousands, of miles of streams."

"This is the last stronghold," he added. "This is the seed stock for mussel recovery, and if we lose that seed stock, then we're out of business."

Juvenile Detention

A century ago, the luminescent shells of freshwater mussels were nearly as valuable to the button industry as their pearls were to jewelers. The mussel industry was lucrative for decades. But eventually the bottom fell out as mussel beds were depleted.

It took years for mussel populations to recover. But they did, thanks in large measure to federally protected riverbank areas, such as the Big South Fork National Recreation Area popular with boaters, hikers, and equestrians, the riverway contains 90 free-flowing miles (145 kilometers) of the Big South Fork of the Cumberland River. The river system harbors more federally listed aquatic species, including mussels, than any other U.S. national park.

In recent decades, however, mussels there have fallen prone to numerous upstream threats. Mining, logging, oil and gas drilling, among other activities, have sent pollutants into the waterway and the reserve's sensitive mussel breeding sites. The mussel baby-making project is designed to tip the scales in favor of the fragile species.

Mussels depend on certain fish that host the mollusks for part of their reproductive cycle. The delicate process is complicated to replicate in a laboratory.

Hatchery staff first take egg-bearing female mussels from the river and place them in holding tanks. The biologists then take fertilized mussel eggs and place them on the gills of fish hosts, where they develop into juvenile mussels.

Once the juveniles drop off their hosts and reach a viable size, they are returned to the river system. The goal is to spread mussel populations throughout the park so that individual species are not so vulnerable.

"A lot of what we're doing is very new," said Jess Jones, a U.S. Fish and Wildlife Service biologist who works with the Virginia Tech hatchery. "We're just scratching the surface of this process. We don't really know yet how many individuals we have to reintroduce to bump up an endangered species. The more we learn, the more we realize we need to do."

Continuing Threats

Controlled mussel breeding poses many uncertainties. Last year both hatcheries in the project produced fewer viable juveniles than in previous years. Biologists are still examining water quality and other factors for possible explanations.

To boost the breeding effort, the Park Service is working with state wildlife agencies to transplant mussels to the park. The relocated mollusks come from other locations where they are under pressure, either from sedimentation or altered water temperatures caused by new dams.

"We're not putting all our eggs in one basket," said Steve Bakaletz, a National Park Service biologist. "We're taking adults that are stranded on the island of ecology. We've got the free-flowing territory here, and when they get back to normal temperatures, they can pick up where they left off and complete a normal lifecycle."

Next year [2006] the team will begin measuring the effectiveness of the four-year breeding program and the viability of reintroduced mussels. This summer, the park also released a plan that outlines future alternatives to protect mussel species and other aquatic resources.

Meanwhile, the Cumberland elktoe, combshell, bean, tan riffleshell, and the little-wing continue to face a threat that seems as old as the hills—coal mining.

After years of decline in the Tennessee Valley, coal mining has resurged in recent years thanks to newly available earth-moving equipment. Some conservationists express concern that current mining practices are drastically altering natural landscapes and sending acidic drainage into streams essential to aquatic life.

"With the increase in coal mining, there seems to be a total disregard for water quality," Ahlstedt, the retired USGS biologist, said. "People who raise concerns about water quality get branded as environmentalists or wackos."

"But that isn't the way it should be," he added. "This is water that everybody should use, not just fish and mollusks. I'm concerned that any recovery that has happened naturally could turn around in a heartbeat."

The rare olive hickorynut mussel, *Obovaria olivaria*, in the Ottawa River, eastern Canada

By André L. Martel, Isabelle Picard, Nancy Binnie, Beverly Sawchuk, Jacqueline Madill & Frederick Schueler

The Ottawa River has a rich fauna of freshwater mussels (family Unionidae), with a minimum of 14 recognized species, including the rare olive hickorynut, *Obovaria olivaria* (Rafinesque, 1820), of which the conservation status in Canada is currently being examined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, see Martel & Picard, 2005). Populations of olive hickorynut mussels in the province of Ontario have nearly all vanished, because of water pollution, the near extirpation of stocks of its probable fish host (lake sturgeon) and the introduction and spread of the zebra mussel (*Dreissena polymorpha*) across the Laurentian Great Lakes and the St. Lawrence River in the late 1980s. Surveys conducted in recent years indicate that the province of Quebec currently remains the major territory where this species still occurs in Canada. The lake sturgeon, *Acipenser fulvescens*, is its most likely fish host, and in Canada, live olive hickorynuts have only been found in rivers where the lake sturgeon is known to occur. In the Ottawa River, populations of the lake sturgeon, although not abundant, are believed to be reasonably healthy (Haxton 2002). The Ottawa River is impounded by many hydroelectric dams, which both impede the movement of sturgeons (and other potential fish hosts) and render long reaches of the river less suitable for unionid mussels. The olive hickorynut is regarded as a deep water species, which may mean that the heavy compact shells will rarely be washed up on shore, where they can be found by relatively casual searches.

Since 2000, we have found the olive hickorynut in three free-flowing reaches of the Ottawa River. The northernmost and farthest upstream sites are represented by empty shells from the tributary Blanche River at Judges and Belle Vallée (Ontario side of the Ottawa River), the main river at Notre-Dame-du-Nord (Québec), as well as in mid-river sites at Chenal-de-la-Culbute, near Waltham (Québec). Several live juveniles were collected in the Rivière Coulonge, near its junction with the Ottawa River, as well as empty shells at Petite-Île-Limerick and Rapides-de-Sable (Québec).

During September and October 2005, we undertook an intensive search for the olive hickorynut mussel in a mid-section of the Ottawa River called Lac Deschesnes. This reach, which begins at the Chat Falls Dam and ends 53 km downstream at the city of Ottawa, is heavily used for sport fishing, power boating and sailing. Historically, only two empty shells of the rare olive hickorynut mussel had been found in this portion of the Ottawa River; near the historical town of MacLaren's Landing, Ontario, during July and September 1962, about 9 km below the Chat Falls dam (Canadian Museum of Nature Mollusks Collection catalogue numbers 14162, 14163).

Live Olive Hickorynut mussels (*Obovaria olivaria*) collected during SCUBA diving in sandy shoals near Mohr Island, Ottawa River, Canada, November 2005.

During September 2005 numerous SCUBA dives conducted nearshore at the historical MacLaren's Landing site yielded not a single empty shell or live specimen. Following our initial failure to locate specimens along the shore, we focused underwater searches on the habitat preferred by the species in other river systems, such as the Mississippi River, USA: mid-river relatively deep habitats, moderate to fast current, and sandy substrates (Parmelee & Bogan, 1998). Using these criteria, we focused on the Mohr Island area, located just off of MacLaren's Landing. The Mohr Island area consists of an extensive underwater plateau of pure sand covering nearly 3 km^2 of river bottom at a water depth of 1.5 to 6 m, in the middle of the river, where water current is moderate. Specimens of olive hickorynut were found during the first and subsequent SCUBA dives conducted within the sandy shoal near Mohr Island (30-45 min of diving time at each site). Living or empty shells of olive hickorynut were found partly buried in the sand. Single shells of olive hickorynut were found amongst hundreds of other live freshwater mussels belonging to diverse unionid species, including the plain pocketbook (*Lampsilis cardium*), eastern elliptio (*Elliptio complanata*), eastern lampmussel (*Lampsilis radiata*), black sandshell (*Ligumia recta*) and triangle floater (*Alasmidonta undulata*). Density of all unionid mussel species combined in the area of Mohr Island is high, commonly ranging between 30 and 130+ mussels per m^2. However, the density of the olive hickorynut is very low, estimated to range between 0.01 and 0.05 individual per m^2 of sandy bottom. An estimate of the population of olive hickorynuts for sandy shoals around Mohr Island would be in the range of 10,000-30,000 individuals.

Although the density of the olive hickorynut mussel is very low, it may be widely distributed within the Lac Deschesnes reach of the Ottawa River, inhabiting large mid-river sandy

shoals with fair or moderate water current. Such habitats occur in many areas of Lac Deschesnes that have yet to be explored for *Obovaria olivaria*, as well as in upstream reaches between Chats Falls and the Des Joachims Dam, and in free-flowing reaches downstream of Ottawa. Additionnal SCUBA searches of these habitats will enable us to outline the distribution and abundance of the species in the lower Ottawa River. Further research is needed to better understand the life history and conservation biology of this freshwater mussel in Canadian waters.

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Apparent refugia of native freshwater mussels in the upper Rideau River threatened by increased *Dreissena polymorpha* 15 years after its introduction

By André L. Martel, Jacqueline Madill & Frederick Schueler

The spread of the non-indigenous zebra mussel, *Dreissena polymorpha*, across much of the central and eastern United States and Canada, continues to adversely affect and extirpate native communities of freshwater mussels (Unionidae). The disastrous result of this introduction has been well documented in large lake and large river systems. As humans continue to disperse this pest mollusk widely, largely through introductions on pleasure boats and trailers, the zebra mussel quickly spread to small water bodies, including small river systems that were also rich in native unionid mussels. In Canada one such small river is the Rideau River and Rideau Canal system (100 km long) of Eastern Ontario, which is subject to very heavy pleasure boat traffic originating in the Great Lakes and St. Lawrence River. We have reported on the spread of *D. polymorpha* and its impact on native mussels along a 30 km downstream impounded section of the river, documenting the situation of native molluscs before, during and after rapid population growth of *D. polymorpha* in the area (Martel *et al*., 2001). In the eight years from 1993 to 2000, the introduction of *D. polymorpha* had resulted in an almost complete elimination of all unionids from this downstream section of the Rideau River, between the city of Ottawa and the town of Kars, Ontario. Thus, ten years after its initial discovery in the river (1990), *D. polymorpha* had affected almost the entire downstream half of the river.

In contrast to downstream localities, native communities of unionid mussels, especially in the rapids and riffles that bypass the locks of the Rideau Canal, such as Burritts Rapids, Andrewsville and Smith Falls, had remained basically free of biological fouling, even though *D. polymorpha* was already present (Martel, 1995). We surmised that favorable hydrological conditions (riffles, strong water current) and less intensive manipulation of water levels of the Canal allowed the persistence of these upstream “hot spots” of unionid diversity and abundance, containing nine different unionid taxa (Pathy *et al*., 2000), some of which are probably now extirpated from the Laurentian Great Lakes and the St. Lawrence River because of the zebra mussel, e.g. the black sandshell (*Ligumia recta*) (Metcalfe-Smith & Cudmore-Vokey, 2004), many of them of exceptional size and apparent age. In the course of an intensive three year (1998-2000) population inventory, no significant fouling by *D. polymorpha* was observed in the entire Burritts Rapids-Smiths Falls corridor (Pathy *et al*., 2000), but the presence of occasional zebra mussels attached to navigation buoys and locks at upstream locations (Burritts Rapids-Smiths Falls), in the vicinity of the unionid hot spots, suggested that *D. polymorpha* might eventually increase in numbers and threaten the remaining mussel beds.

A *Dreissena polymorpha* individual attached to the shell of a native unionid bivalve.

We have been surveying changes in the macroinvertebrate fauna at the Andrewsville ‘hot spot’, upstream of the town of Burritts Rapids, Ontario, by wading and turning rocks, in roughly annual summer visits since 1981. From 1991 to 1998 no *D. polymorpha* were found. From 1999 to 2002 they were found at a rate of about 1.25 individuals per hour of searching. During 2003-2005 they have been common, in increasing numbers each year. The *D. polymorpha* fouling unionids at Andrewsville are large, ranging between 15 and 40 mm. The first year when a greatly increased number of empty unionid shells was found was 2005, suggesting that *D. polymorpha* fouling has begun to cause significant mortality. During November 2005 we surveyed the riffle at the bridge of Andrewsville with snorkeling and an underwater camera, in a water depth of 0.3-1.0 m. Observations and underwater photographs show that *D. polymorpha* is now found throughout the riffle habitat, with 25-50 % of native mussels with 1-2 *D. polymorpha* on their shell.

In their study on the impact of the zebra mussel in the St. Lawrence River, Ricciardi *et al*. (1996) had shown that a few large *D. polymorpha* may impair unionids by interfering with valve closure. They also demonstrated that mean infestations as low as ten *D. polymorpha* per native mussel can result in a sharp decline in unionid abundance after only a few years. This suggests that although the number of *D. polymorpha* per unionid at Andrewsville is currently low (1 to 2 fouling zebra mussels per native mussel), such an infestation may nonetheless result in the decline and possible extirpation of this community of unionids. The decline will also occur sooner than expected if numbers of *D. polymorpha* keep increasing annually, as they have in the past few years. The case of the native mussel community of the Rideau River, with its ongoing decline following the introduction of *D. polymorpha* by humans over 15 years ago, points to the importance of public awareness and education as an absolute necessity if we want to conserve regional biodiversity as well as ecosystem functions in our river systems.

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Hemolymph as a nonlethal and minimally invasive source of DNA for molecular systematic studies of freshwater mussels

By Morgan E. Raley, Jay F. Levine & Arthur E. Bogan

North America is home to more than 300 species of freshwater mussels in the family Unionidae (Williams *et al*., 1993). These freshwater invertebrates play an essential role in maintaining water quality in aquatic ecosystems. However, more than 70 % of North American freshwater mussels are imperiled. This imperiled status functionally limits the number of individuals that can be used for genetic analysis as individuals are often sacrificed in the normal course of research on the group. Research groups have begun to propagate mussels with the goal being to augment many of these critically threatened species (O'Beirn *et al*., 1998). As such, the emphasis has been to develop culturing systems for these species, a daunting task itself. However, without requisite extensive genetic sampling of these groups, only minimal *a priori* genetic knowledge exists for these species and in some instances, augmentation efforts could fail in a manner similar to those witnessed in the salmon fisheries (Waples, 1991). Nonlethal procedures for acquiring DNA for genetic analysis are needed to facilitate phylogenetic and population level genetic studies so that previous kinds of augmentation failure can be avoided. These new techniques will facilitate appropriate sampling and aid researchers and wildlife managers to develop accurate estimates of genetic diversity without adversely impacting the population in question.

Previous efforts by our lab have led to the development of nonlethal protocols used to monitor the health of freshwater mussels via biochemical standards routinely employed in veterinary medicine (Gustafson *et al*., 2005a, b). Blood chemistry panels can now be conducted using hemolymph, the circulatory fluid of invertebrates, instead of whole organisms or tissues to monitor the impacts of environmental contaminants on freshwater mussels. These techniques have proven no more lethal than a typical veterinary blood draw so long as individuals are sampled only once a month. Hemolymph contains several classes of hemocytes, all potential DNA sources for genetic studies. To investigate the utility of hemolymph as a reliable non-lethal source of DNA for molecular investigations, we collected 30 *Elliptio complanata* Lightfoot, 1786 from a site in Wake County, North Carolina (Richland Creek, Neuse River drainage), and drew hemolymph before sacrificing them for phylogenetic examination as part of our ongoing research examining relationships among southeastern *Elliptio* species. Sterile tuberculin syringes (1.0 ml, 25 guage x 5/8 inch [[16 mm]) were inserted into the sinus in the anterior adductor muscle following the protocol outlined by Gustafson, *et al*. (2005a). Depending on the size of the individual, between 0.1 and 0.5 ml of hemolymph was drawn, placed in sterile microcentrifuge tubes and held at -20 °C until the samples could be processed. After sacrificing the specimens, mantle tissue was clipped and held in 95 % ethanol, which is one current standard practice of obtaining tissue samples in freshwater mussels. All voucher specimens were deposited with the North Carolina State Museum of Natural Sciences (NCSM 28211).

DNA was extracted from all samples (hemolymph and mantle tissue) using the DNeasy® tissue kit (Qiagen, Inc.) following the manufacturer's recommended protocols. Samples (5.0 µl) were loaded on 1-2 % agarose check gels to visually inspect the integrity of all genomic preparations. All mantle tissue preparations showed a visible band while all hemolymph preparations lacked such a band. PCR amplifications of three mitochondrial gene regions (COI, ND1, cytochrome-*b*) were run for all samples, following published protocols and using standard primers (Folmer *et al*., 1994; Merritt *et al*., 1998; Serb *et al*., 2003). Successful reactions were cleaned using QIAquick® spin columns (Qiagen, Inc.), sequenced (in both orientations) with BigDye® ver. 3.1 (Applied Biosystems, Inc), cleaned with DyeEx® spin columns (Qiagen, Inc.) and

electrophoresed on an ABI PRISM® 377 XL automated sequencer (Applied Biosystems, Inc). Sequences were edited and compiled independently using Sequencher™ ver. 4.2 (Gene Codes Corp.). Resultant sequences from hemolymph and mantle tissue from the same individual were compared for sequence identity in each of the three mitochondrial genes to determine the concordance between tissue types (hemolymph and mantle). In all instances, hemolymph-derived sequences were determined to be identical to mantle-derived sequences and proved to be a reliable source of DNA for genetic analysis. In general, differences between tissue types were minimal and assumed to be a result of the lower concentration of DNA in the hemolymph samples. These minor differences, which only affected the intensity of the sequencing signal occasionally, could probably be compensated for by using a polymerase specifically designed for low copy number samples or by simply increasing the concentration of template used in the initial PCR reactions.

Our previous studies have shown that sampling hemolymph from freshwater mussels is non-lethal if contact is limited to sampling once a month. The present study demonstrates that this same technique can be used to sample DNA for a variety of genetic studies. We have also shown that hemolymph genetically matches somatic tissues, thus avoiding the issue of doubly uniparental inheritance exhibited in gonadal tissues of many mussel taxa (Hoeh *et al*., 2002). Widespread use of this method with appropriate photodocumentation of potentially confusing species could prove invaluable for conducting genetic studies involving threatened or endangered species of this critically pressured invertebrate group. This method will also facilitate large scale genetic sampling schemes necessary to ensure that augmentation programs minimize the effects of unintentional genetic biasing of their propagated stocks.

We acknowledge LeRoy Humphries for collecting *E. complanata* and drawing hemolymph samples for this study. This work would not have been possible without Lori Gustafson's dissertation research. This work was funded, in part, by a grant from the North Carolina Department of Transportation and North Carolina State University.

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MARINE MATTERS

New marine species recorded for the Mediterranean fauna of Israel

By Henk K. Mienis

During 2005, six species have been recorded for the first time from the Mediterranean waters off the coast of Israel.

Gastropoda

Two rock snails of the family Muricidae were recorded from the northern part of the Mediterranean coast: *Thais sacellum* (Gmelin, 1791) from the Akhziv-Rosh Haniqra area and Qiriyat Yam, and *Ergalatax obscura* (Houart, 1996) from the islands of Rosh Haniqra and in shallow water near Akhziv (Singer, 2005).

Bivalvia

The diminutive oyster *Nanostrea exigua* Harry, 1985 (family Ostreidae) was recorded from Al Manara Island (= Isle of the Flies), off Akko (Lubinevsky & Mienis, 2005). Another exotic oyster *Alectryonella crenulifera* (Sowerby, 1871) (Ostreidae) was found living on the pillars of the coal conveyor belt of the power plant at Hadera (Sharon *et al*., 2005); this first record has since been confirmed by two additional finds.

Cephalopoda

The bobtail squid *Rossia macrosoma* (Delle Chiaje, 1830) (family Sepiolidae) was recorded from a depth of 375 m off Ashqelon (Mienis, 2005a). A small octopus species, *Octopus aegina* Gray, 1849 (Octopodidae), was recognized among unidentified material in the National Mollusc Collections of the Hebrew University of Jerusalem and the Tel Aviv University from the following Mediterranean localities off Israel: Atlit (collected in 1934) and at a depth of 20 m off Tel Aviv (Mienis, 2005b).

All of these species, except the bobtail squid, *Rossia macrosoma*, belong to the group of so-called Lessepsian or

other Indo-Pacific migrants now occurring in the Eastern Mediterranean Sea. The bobtail squid is a well-known species from the Mediterranean and eastern Atlantic Ocean. They may all be added to the checklist of marine molluscs found along the coast of Israel.

In the near future we may expect the publication of several additional new species for the fauna of Israel. Advanced work is currently being carried out on a tiny species of spiny oyster characterized by the presence of numerous rows of barbed spines, most probably of Red Sea or Indo-Pacific origin, a puzzling small bivalve apparently belonging to the genus *Scintilla* of unknown origin, and two Mediterranean cephalopods not previously recorded from Israel.

Because of the continuous arrival of new migrants among the molluscs, several students are currently involved in studies concerning the impact of all these exotic species on the autochthonous marine mollusc fauna.

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Henk K. Mienis, Mollusc Collection, National Collections of Natural History, Department of Zoology, Tel Aviv University, IL-69978 Tel Aviv, Israel, and National Mollusc Collection, Department of Evolution, Systematics & Ecology, Hebrew University of Jerusalem, IL-91904 Jerusalem, Israel. mienis@netzer.org.il

Results of the giant Pacific octopus census in Puget Sound, 2000-2005

By Roland C. Anderson

In my job as the octopus caretaker at the Seattle Aquarium I am frequently asked how many octopuses there are in Puget Sound and how the population has been doing over the years. To answer these questions, on 19 February 2000, the Saturday of President's Day weekend in the U.S., we organized the first divers' census of giant Pacific octopuses in Puget Sound. We hoped to establish a baseline of how many octopuses are in the area and conduct this survey annually, to see if the population is healthy and if there are fluctuations from year to year.

In addition to the large cadre of volunteer divers at the Aquarium, we enlisted the help of sport divers in the area to look for octopuses. In support of this effort, I spoke to scuba diving clubs, sent information out by mail and email to dive shops and dive charters and made numerous phone calls alerting divers of the upcoming octopus census. In addition, our marketing department arranged for media coverage of the event, resulting in publicity in newspapers, radio and television.

We chose a late winter date because more octopuses are seen in winter. There is some evidence that octopuses migrate down to deeper, colder, darker waters in the summer, and because of this, more octopuses are seen by divers in the winter, although this may be because less kelp is covering the dens. President's Day weekend is a holiday weekend and although in the winter, usually has decent diving weather in the Pacific Northwest. The underwater visibility also tends to be better in the winter because of the lack of plankton. Reports from these surveys indicated that the visibility averaged 20-25 feet [6-7.5 m] during the survey, quite reasonable for Puget Sound.

I asked all divers to report any octopus sightings to me at the Aquarium. The information requested was the location of the dive site, where the octopus was in relation to shore landmarks, the depth of the water, time of day (so we could correlate the depth to the level of the tide), a description of the octopus's den, and an estimate of the size of the octopus, including the size of some feature of the octopus such as width of the largest sucker seen. This size estimate was used to distinguish between sighting of the giant Pacific octopus and another species present in Puget Sound, the little red octopus. I also asked how many divers participated, whether they saw any octopuses or not, to get an idea of diver effort in seeing the octopuses.

The first two years the survey was held on only one day, and on the basis of the results of the second year, when there was snow on the ground that day, we thereafter increased the reporting time to the whole three days of the holiday weekend. The octopus sightings then had to be carefully correlated to day, time, dive site and location of each octopus so as to not count each animal more than once.

I received reports from sport divers and shore observers who questioned emerging divers. In 2000 (one day only) 114 divers participated in the survey, plus four Aquarium divers diving in Elliott Bay at the Aquarium, a spot where octopuses are frequently seen. Other dive sites surveyed were scattered around the Sound, mostly in well-known dive sites but a few in unexpected areas. In total, 18 octopuses were spotted and reported back to the Aquarium, of which 13 were seen in southern Hood Canal, including four females guarding eggs.

Nearly all the octopuses seen had made dens under large rocks, in hollow sunken logs or shipwrecks. One was out in the open, sitting unprotected on the bottom, a large octopus, probably

senescent, that eventually crawled away from the observing divers down to deeper water. Some were in dens that had been used sporadically with wolf eels for many years. It is interesting to note that an octopus was seen being eaten by a wolf eel during the survey of 2005.

Since then, five more annual surveys have been conducted and some interesting results are becoming apparent. The average depth of octopus sightings was 59 feet [~18 m], with a range of 30-104 feet [~9-31 m]. In 2001 and 2005, no octopuses were seen in southern Hood Canal.

Puget Sound octopus survey data 2000-2005.

Year	Number of divers	Average number of divers/day	Octopuses seen	Average number of octopuses seen/day
2000[1]	118	118	18	18
2001[1]	67	67	15	15
2002[2]	197	66	70	23
2003[2]	136	45	73	24
2004[2]	169	56	72	24
2005[2]	210	70	61	20

[1] Census was one day only. [2] Census was three days.

We know there are periodic low oxygen events in Hood Canal that either force deep water fish (and presumably octopuses) into shallow water where there is more oxygen, or it kills them. Octopuses are intelligent and they will move out of an area that is harmful to them and it is very likely that these survey results reflect the effects of the low oxygen there. In one year during such an event, Washington State Department of Fish and Wildlife diver surveys at a popular dive site in southern Hood Canal found no live octopuses and two dead females in dens with dead eggs; the females are great mothers and do not leave their eggs and so were killed. As such then, these areas and their usual octopus inhabitants are probably good indicators of the health of Hood Canal and perhaps of the onset of such low oxygen events.

In addition to learning information about our octopuses, in the first year we learned a lot about how to conduct such a survey and have conducted it a bit differently in succeeding years. More and better advertising before the event helps. Becoming an annual event has encouraged more divers to participate, which is important, and getting them to dive at more locations is also important. We need to be sure that all divers in the area report back, whether they saw octopuses or not, so that we can get a better idea of the diver effort involved per octopus sighting. Local dive clubs and dive boat charters have been extremely helpful in conducting the census, making it an annual event in their schedules.

I had originally hoped to make an estimate of the total number of octopuses in Puget Sound based on these findings, but as it is, I do not feel comfortable doing that with these meager data. There seem to be three or four "hotspots" for seeing octopuses: the Admiralty Inlet area, Hood Canal, Elliott Bay, and the Tacoma Narrows area. In 2005 octopuses were still being seen in the northern Hood Canal area in good numbers and in spite of no diving under the Narrows Bridge during construction, there were still good numbers seen in that general area. In a previous year, eight were seen on one dive under the bridge, indicative of the area's favorable conditions for octopuses.

I want to thank all divers and shore observers for participating in the annual octopus census over the last six years and I hope that you all will participate in future years!

Roland C. Anderson, The Seattle Aquarium, 1483 Alaskan Way, Seattle, Washington 98101, USA. Tel +1 206 386 4359, Roland.anderson@seattle.gov

RECENT PUBLICATIONS RELEVANT TO MOLLUSC CONSERVATION

The proceedings of a symposium entitled "Non-marine alien molluscs: the future is a foreign ecosystem", held at the American Malacological Society's 2003 meeting in Ann Arbor, and edited by Robert H. Cowie were published in 2005 in the *American Malacological Bulletin* 20: 87-159. The following papers were included:

Robinson, D.G. & Slapcinsky, J. Recent introductions of alien land snails into North America. p. 89-93.

Cowie, R.H. Alien non-marine molluscs in the islands of the tropical and subtropical Pacific: a review. p. 95-103.

Darrigran, G. & Damborenea, C. A South American bioinvasion case history: *Limnoperna fortunei* (Dunker, 1857), the golden mussel. p. 105-112.

Lee, T., Siripattrawan, S., Ituarte, C.F. & Ó Foighil. Invasion of the clonal clams: Corbicula lineages in the New World. p. 113-122.

Padilla, D.K. The potential of zebra mussels as a model for invasion ecology. p. 123-131

Smith, J.W. Recently recognized risk of importing the giant African snail, *Achatina fulica* Bowdich, 1822, and its relatives into the United States and the efforts of the U.S. Department of Agriculture to mitigate the risk. p. 133-141.

Vermeij, G.J. Invasion and evolution: why do herbivorous and carnivorous land snails invade but not originate on islands. p. 143-146.

Britton, D.K. & McMahon, R.F. Analysis of trailered boat traffic and the potential westward spread of zebra mussels across the 100th meridian. p. 147-159.

Other literature brought to the attention of *Tentacle* include:

Clements, R., Koh, L.P., Lee, T.M., Meier, R. & Li, D. 2006. Importance of reservoirs for the conservation of freshwater molluscs in a tropical urban landscape. *Biological Conservation* 128: 136-146.

Fehér, Z., Majoros, G. & Varga, A. in press. A scoring method for the assessment of rarity and conservation value of the aquatic molluscs in Hungary. *Heldia* 6: 127-140.

Gasparini, J.L., Floeter, S.R., Ferreira, C.E.L. & Sazima, I. 2005. Marine ornamental trade in Brazil. *Biodiversity and Conservation* 14: 2883-2899.

Gössling, S., Kunkel, T., Schumacher, K. & Zilger, M. 2004. Use of molluscs, fish, and other marine taxa by tourism in Zanzibar, Tanzania. *Biodiversity and Conservation* 13: 2623-2639.

Herbert, D.G. 2002. *Gulella salpinx* sp. n., a new critically endangered holoendemic species from limestone deposits of the Marble Delta, KwaZulu-Natal, South Africa (Mollusca: Gastropoda: Streptaxidae). *African Invertebrates* 43: 125-138.

Herbert, D.G., Hamer, M.L., Mander, M., Mkhize, N. & Prins, F. 2003. Invertebrate animals as a component of the traditional medicine trade in KwaZulu-Natal, South Africa. *African Invertebrates* 44(2): 327-344.

Herbert, D.G. & Kilburn, R. 2004. *Field guide to the land snails and slugs of eastern South Africa.* Natal Museum, Pietermaritzburg. 336 p.

Hoke, E. 2005. The freshwater mussels (Mollusca: Bivalvia: Unionidea) of northern Nebraska: the Missouri, Niobrara, and White River basins. *American Malacological Bulletin* 20: 27-35.

Juřičková, L. & Kučera, T. 2005. Ruins of medieval castles as refuges for endangered species of molluscs. *Journal of Molluscan Studies* 71: 233-246.

Killeen, I. & Moorkens, E. 2004. Freshwater mollusc rearing in Georgia. *Mollusc World – Magazine of the Conchological Society of Great Britain and Ireland* 6: 11.

Örstan, A., Pearce, T.A. & Welter–Schultes, F. 2005. Land snail diversity in a threatened limestone district near Istanbul, Turkey. *Animal Biodiversity and Conservation* 28: 181-188.

Ponder, W.F. 2004. Narrow range endemism in the sea and its implications for conservation. In: *Conserving marine environments: out of sight out of mind* (Hutchings, P. & Lunney, D., eds.), p. 89-102. Royal Zoological Society of New South Wales, Mosman.

Ponder, W.F. 2004. Springs of the Australian Great Artesian Basin—progress, lessons and mistakes. In*: Conference proceedings. Spring-fed wetlands: important scientific and cultural resources of the intermountain region, 2002* (Sada, D.W. & Sharpe, S.E., eds.), p. 1-13. Desert Research Institute, Nevada. http://www.wetlands.dri.edu

Ponder, W.F. & Walker, K.F. 2003. From mound springs to mighty rivers: the conservation status of freshwater molluscs in Australia. *Aquatic Ecosystem Health & Management* 6: 19-28.

Sólymos, P. in press. Are current protections of land snails in Hungary relevant to conservation? *Biodiversity and Conservation*.

Sólymos, P. & Fehér, Z. 2005. Conservation prioritization using land snail distribution data in Hungary. *Conservation Biology* 19: 1084-1094.

Stanisic, J. & Ponder, W.F. 2004. Forest snails in eastern Australia - one aspect of the other 99%. In: *Conservation of Australia's Forest Fauna: Second Edition* (Lunney, D., ed.), p. 127-149. Royal Zoological Society of New South Wales, Mosman.

Warren, M.V., Jr. & Haag, W.R. 2005. Spatio-temporal patterns of the decline of freshwater mussels in the Little South Fork Cumberland River, USA. *Biodiversity and Conservation* 14: 1383-1400.

Watson, A.M. & Ormerod, S.J. 2005. The distribution and conservation of threatened Sphaeriidae on British grazing marshland. *Biodiversity and Conservation* 14: 2207-2220.

IUCN AND SSC NEWS

All the following communicated by Mary Seddon, Mollusc Specialist Group Chair, unless otherwise indicated (Mary.Seddon@nmgw.ac.uk; additional contact details in the list of Mollusc Specialist Group members at the end of this issue of *Tentacle*).

Changes at the Species Programme

This year has seen many changes in the Species Survival Commission (SSC). The new Chair of the Commission, Holly Dublin, has now been in post a year, and has reviewed the entire structure of the SSC. Holly has made several changes to the specialist groups, and has created a new series of subcommittees and a new steering committee to work on delivering the IUCN programme over the next three years. The Mollusc Specialist Group is one of few invertebrate specialist groups that are still extant. This reflects the work you are all doing on mollusc conservation, and the engagement with work programmes such as the IUCN's Freshwater Biodiversity Assessment.

The new subcommittees are:

- Biodiversity Assessment Subcommittee (chaired by Simon Stuart)
- Biodiversity Indicators Subcommittee (chaired by Georgina Mace)
- Plant Conservation Subcommittee (chaired by Mike Maunder)
- Marine Conservation Subcommittee (chaired by Kent Carpenter)
- Invertebrate Conservation Subcommittee (chaired by Michael Samways)

These subcommittees have been charged to undertake various tasks by the Chair of the Commission, as part of the delivery of the IUCN programme. The formal recognition of both the Marine Conservation Subcommittee and the Invertebrate Conservation Subcommittee is a great step forward, as these now have an established place within the IUCN species programme. The challenge for both subcommittees and the specialist groups will be to use this new structure to promote the work already ongoing more widely through the IUCN membership. The specialist groups also contribute to the work of the Biodiversity Assessment Subcommittee, which manages the Red List programme, the Global Assessment programmes (Global Amphibian Assessment, Global Mammal Assessment) and the Regional Freshwater Assessment programmes (Africa, Mekong). The other new programme, Biodiversity Indicators, is seeking to develop a series of tools for external users, such as the Convention on Biological Diversity, that use Biodiversity Assessment data to monitor changes in trade use, and to evaluate the impacts of invasive species, effectiveness of protected areas for species cosnervation and valuation of ecosystem services provided by species.

A new Head of the Species Programme, Dr. Jane Smart (formerly of Plantlife), has been appointed and started work in April 2005. Jane is now reviewing the work of the Species Programme. Mariano Giminez-Dixon has moved on from Gland; he was the contact officer for the Mollusc Specialist Group for many years, and we wish him well in the future. Alison Rosser has also moved from the SSC Wildlife Trade Programme; she is now at the Durrell Institute of Conservation and Ecology at the University of Kent at Canterbury (UK), where she is developing a new programme on conservation and international wildlife trade. Alison worked with the Mollusc Specialist Group on various trade issues, most recently *Lithophaga lithophaga*.

Jane Smart reports:

> "The Species Programme has traditionally provided support to the SSC network, including contact information, financial support, information on the species assessment process and the IUCN Red List, support for the action planning process, communications and press support as well as interaction through project work, and co-ordination of work in relation to input into the international conventions.
>
> "Much has changed in the world of both IUCN as a whole and SSC, and it is for this reason that I am reviewing the

Programme. The challenge to raise funds has become greater (from June last year we no longer receive core support from WWF), your needs as specialist groups have changed somewhat, and thus the network perhaps needs a different kind of support than previously has been the case. Other changes include the fact that IUCN and WWF have re-defined their role in relation to TRAFFIC which has repercussions for the IUCN Wildlife Trade Programme….); network members are engaging in a variety of ways and much of the assessment work is being tackled through large global projects."

Below are contact points on the SSC staff for the network and its operations. Full details are posted at www.iucn.org/themes/ssc/aboutssc/staff.htm

- Red List issues: Craig Hilton-Taylor and Caroline Pollock craig.hilton-taylor@ssc-uk.org caroline.pollock@ssc-uk.org
- Trade, CITES and sustainable use issues: Thomasina Oldfield Thomasina.Oldfield@ssc-uk.org
- Freshwater issues: Will Darwall Will.Darwall@ssc-uk.org
- Plants: Craig Hilton-Taylor craig.hilton-taylor@ssc-uk.org
- Marine: Kent Carpenter kcarpent@odu.edu
- Invertebrates: Jean-Christophe Vié j.c.vie@iucn.org
- Species Information Service and the Data Entry Module (used for Red List Assessments) Jim Ragle james.ragle@iucn.org
- Network membership/online registration issues/contact details: Nathalie Velasco nav@iucn.org
- Press and communication issues: Anna Knee and Andrew McMullin alk@iucn.org andrew.mcmullin@iucn.org

IUCN Red List website

The next major upgrade will take place in May 2006. However, the Red List web site (www.redlist.org) has recently undergone a minor upgrade to incorporate some new functions, including:

- Addition of a "What's New" page, where important notices, news releases, bulletins, etc. will be displayed. This will be updated regularly and the Red List office welcomes comments or contributions.
- A Feedback form for users to report any errors or submit additional information directly to the Red List Programme office. As relevant, this information will be forwarded to the appropriate specialist groups and Red List authorities.
- An Export function enabling users to download extended summary search results in a format that can easily be imported into a spreadsheet or database.

Caroline Pollock, Research Assistant, IUCN SSC Red List Programme, 219c Huntingdon Road, Cambridge, CB3 0DL, UK. caroline.pollock@ssc-uk.org

IUCN Red List 2007

The next deadline for submission of fully documented species for the 2007 Red List will be 31 August 2006. All species now need to be assessed using IUCN Categories and Criteria (version 3.1), which is available on the website. This includes taxonomic information, a distribution map, details of threats to the species, and indication of habitats and life-cycle if known. If in doubt about the use of the categories and criteria, send a few assessments to Caroline Pollock (caroline.pollock@ssc-uk.org) at the Red List Office or to Mary Seddon, who will advise as to whether the criteria have been properly applied.

There is now a revised pdf document on the Red List website containing comprehensive guidelines on use of the IUCN Red List Categories and Criteria.

IUCN global marine assessments

The SSC has established a new programme to undertake marine species threat assessments over the next four years. They have appointed Kent Carpenter as the overall programme coordinator. At present the programme is concentrating on fund raising and on marine mammal assessments; however, some groups of molluscs are under discussion. Please contact Mary Seddon in the first instance if you are interested in participating in a global species threat assessment and have the relevant skills and knowledge to contribute either taxonomically or geographically. The groups under discussion include giant clams, *Nautilus*, Conidae, Littorinidae and Cephalopoda.

IUCN freshwater assessments

Given the rapid decline in the status of many freshwater molluscs, we were very pleased that, after discussion with Will Darwall, the IUCN SSC Freshwater Biodiversity Officer, molluscs were selected as one of five taxonomic groups for full species assessments in their work programme. Will has been seeking funding for regional assessments undertaken together with capacity building projects for local scientists. There are now two members of staff to assist Will in these projects: Kevin Smith and Anna McIvor (who may be familiar to some of you, as she did her Ph.D. on freshwater mussels with David Aldridge in Cambridge, UK).

African freshwater biodiversity assessment

The pilot project in East Africa is now completed, with many lessons learned. Will Darwall and Jean-Christophe Vié have been successful in obtaining a five year grant from the EU to extend the programme to all of Africa. This programme maps the distributions of all species of freshwater fish, molluscs, dragonflies/damselflies, crabs and plants; and assesses the threats to the species and makes regional Red List Assessments for all the species. The next areas to be reviewed are West Africa and South Africa. If you have any data to contribute on species distributions in these areas, please contact Thomas Kristiansen ttkristensen@dblnet.dk or Barbara Curtis (South Africa only) treeatla@mweb.com.na.

Freshwater assessment of North American species

Natureserve has just obtained a grant to make an assessment (for many species, this will be a reassessment) of the status of freshwater taxa in North America. If you have data that are not in the public domain on distributions, habitats and life-cycles please contact Larry Master (larry_master@natureserve.org), as this programme will be ongoing over the next year (2006).

The Mollusc Specialist Group will be involved in reviewing the threat assessments forthcoming from this project.

Freshwater assessment of the Mekong River system

The SSC is investigating sources of funding to review the use of the freshwater fauna of the Mekong River system. Part of the programme is to undertake threat assessments for the fauna. Contact Will Darwall (Will.Darwall@ssc-uk.org) if you have data that are not in the public domain on species distributions, habitats and life-cycles, as this programme will be ongoing over the next year (2006). The Mollusc Specialist Group will be involved in reviewing the threat assessments forthcoming from this project.

Challenges for the future of the Mollusc Specialist Group

The Plant Conservation Subcommittee has set itself a target of achieving a "preliminary assessment" of the threat status of ALL plants by 2010. This is a major step forward in understanding the level of threatened species worldwide. Clearly this will not be a full species assessment, as the Global Amphibian Assessment was, with every species mapped and a full Red List assessment made using full documentation.

The plants preliminary assessment, will take the form of:

1. Recognising whether the species has information from which a threat assessment can be made.
2. Reviewing the data and deciding which species are of "least concern"; flagging these species; and leaving the documentation for a later stage.
3. Attempting to assign preliminary categories and criteria for all threatened species.
4. As soon as possible, proceed to full documentation of the Red List species, inlcuding documentation of range, population, habitats and threats.

There is a lot of similarity between areas with high plant endemism and high mollusc endemism. It may be possible for the Mollusc Specialist Group to proceed down a similar path. After all, in many regions we have distributional data, some idea of which regions contain endemic species, their habitats and the threats to the species. If you are interested in trying to compile a provisional list of threatened species in your region or area of specialism, then please contact Mary Seddon for further details on documentation requirements.

Impact of climate change on invertebrates

There have been recent discussions about the impact of climate change on inverterate species, especially Arctic Alpine species, which are currently doing well and live in habitats that are not threatened. The Standards Working Group of the Biodiversity Assessment Subcommittee is looking for examples of species with good research data that may become extinct should climate change continue. The group wishes to sample a number of species with different life styles to evaluate whether the criteria adequately reflect the threats to species from long term climatic change. Contact Mary Seddon to request contact details for the committee review panel.

Impact of bycatch on invertebrate conservation

Following publication of the "Shattering the Myth" report by The Ocean Conservancy, highlighting the fact that marine species are vulnerable to extinction, the Invertebrate Conservation Subcommittee wishes to gather information and bring together case studies on the impact of bycatch on invertebrates. If you have published on this topic or have unpublished research and would like to be involved in discussion of this topic, please contact Mary Seddon who will put you in contact with the coordinator of the programme.

Island invertebrate initiative

The newly formed Invertebrate Conservation Subcommittee has proposed some new initiatives to reinvigorate invertebrate conservation efforts following the restructuring of many of the invertebrate specialist groups. The subcommittee recognises that island invertebrates are frequently more threatened than continental faunas. At present the initiative is a concept awaiting development, but I know that there are many mollusc specialists who are interested in island conservation issues. We will be setting up a discussion forum for this topic. If you wish to participate actively or contribute information and contacts for your region, please contact Mary Seddon or Justin Gerlach (jstgerlach@aol.com).

Cave invertebrate initiative

Another proposal made by the Invertebrate Conservation Subcommittee is a review of the conservation of cave dwelling invertebrate groups. These provide challenges for the interpretation of the IUCN Red List criteria, as their ranges are difficult to measure. Again at present the initiative is a concept awaiting development, but I know that there are some mollusc specialists who are interested in mollusc conservation issues and who work in cave systems. We will be setting up a discussion forum for this topic. If you wish to participate actively or contribute information and contacts for your region, please contact Mary Seddon or Justin Gerlach (jstgerlach@aol.com).

Building Capacity for Ecology Fund

The British Ecological Society (BES) was the first national ecological society and has been an invaluable resource for ecologists in Britain and worldwide since 1913. In anticipation of its centenary, the BES will be supporting ecologists to establish organisations that can promote the science of ecology in their geographic area. The BES will do this through a new initiative called the Building Capacity for Ecology Fund (BCEF), which has the backing of the International Association of Ecology (Intecol). The Building Capacity for Ecology Fund will assist in the establishment or development of networks of ecologists that will allow ecologists in countries that currently lack a well-developed society or ecology institute to interact and gain from the experience and activities of colleagues. Ultimately, we expect the interactions promoted by the Fund to lead to the creation of new national or regional

societies that will affiliate to Intecol. Ecological societies provide the network within which ecologists can interact, exchange ideas and influence each other. Ecological societies are also important in promoting the science and its application with policymakers, natural resource managers and the public. The lack of activities that a society can provide is a major obstacle for the development and practice of ecology in many regions.

The BES has committed UK£500,000 over a five-year period to provide resources to build capacity for ecological networks. Support will focus on building effective ecological networks in Eastern Europe and Africa.

First round deadline: 21 April 2006.

More information:
www.britishecologicalsociety.org/articles/grants/bcef/

Small Grants from Endangered Species Fund

The Chicago Zoological Society makes annual grants to SSC Specialist Groups from its Chicago Board of Trade Endangered Species Fund for small projects identified in Action Plans or other group priority setting exercises. The first grant cycle for 2006 will be in April. The committee is looking for projects that will be conducted between April and September 2006. Mary Seddon (Mary.Seddon@nmgw.ac.uk) has copies of the application form and will be required to endorse any project proposal. **Proposals are due by e-mail by end of day of 8 February 2006.**

MEETINGS 2006-2008

UNITAS Malacologica 2007

The next World Congress of Malacology will take place in the summer of 2007 in Antwerp, Belgium. Check the UM website for details:
www.ucd.ie/zoology/unitas/index.html

Freshwater Mollusk Conservation Society

The Freshwater Mollusk Conservation Society will have its 2006 workshop at the Columbus [Ohio] Zoo and Aquarium on 5-7 March on the theme of the Propagation and Captive Care of Freshwater Molluscs.

There is a slate of distinguished speakers for this workshop. The talks will be published later as a Proceedings, which will constitute a primer on raising freshwater molluscs, some of the most imperiled animals in the world.

Topics include:

- Making baby mussels and snails, a primer
- Caring for captive freshwater molluscs, including assessing overall health
- What to feed your charges
- Water chemistry
- Genetic issues
- Mussel parasites and diseases
- Case studies of reintroduction

The final half day will be devoted to the legal, red-tape problems of what to do with your babies once you've made them, with speakers from the U.S. Fish and Wildlife Service and the Ohio Department of Natural Resources.

The workshop's website is:
www.biosci.ohio-state.edu/~molluscs/OSUM2

Bivalvia 2006

International Congress on Bivalvia

Organised by

July 22 - 27, 2006

Universitat Autònoma de Barcelona, Bellaterra, Catalunya, Spain

The Departament de Geologia of the Universitat Autònoma de Barcelona (UAB), the Sociedad Española de Malacología (SEM), and CosmoCaixa Barcelona, Museu de la Ciència de l'Obra Social "la Caixa", invite professionals and students with an interest in bivalves to participate in **Bivalvia 2006**, an international congress with venue on the campus of the UAB in Bellaterra and at the Museu de la Ciència in Barcelona.

After nearly eight years of abstinence we think it is time for a new specific congress on this second largest group of Mollusca and to venture a new synthesis. Neontologists and paleontologists are invited to present their most recent research results on bivalve ontogeny, evolution, palaeontology, systematics, freshwater mussels, conservational biology, and stratigraphy. Contributions on other molluscan taxa are acceptable as long as they shed light on the origin and phylogeny of the Bivalvia. **Syntheses are especially welcome**. Detailed works on single organisms or containing extensive taxonomic lists should be presented as a poster.

Accommodation will be on campus, in the Hotel Serhs or the students' residence "Vila Universitaria" next to the hotel.

Informal registrations can be sent to Niko Malchus, by either fax +34 93 581 12 63 "Bivalvia 2006-register" or e-mail nikolaus.malchus@uab.es subject line "Bivalvia2006-register". Please specify name, institution, whether you wish to present a talk or poster, and preliminary title. Do not send abstracts.

Formal registrations require the use of the registration forms provided on the congress webpage: http://bivalvia2006.uab.es. Only in case of technical problems contact Niko Malchus, as above.

Early registration: until March 1, 2006
On-site registration: after July 14, 2006 only on-site registration is possible
Cancellation with refund: until June 1, 2006
Abstract submission deadline: April 30, 2006

For additional details, check the meeting website http://bivalvia2006.uab.es

American Malacological Society and Western Society of Malacologists

The 72nd annual meeting of the American Malacological Society and the 39th annual meeting of the Western Society of Malacologists will be held jointly in Seattle from 29 July to 3 August 2006 under the coordination of co-president Dr. Roland C. Anderson. The main venue for the meeting will be the University of Washington with reasonably-priced housing available at the University dormitories and the University Inn Motel. The opening night reception will be in the Burke Museum, located on campus, and the ending banquet will be at the University Club, also on campus. Thursday 3 August will be devoted to field trips.

There will be three symposia: on cephalopod behavior organized by Jennifer Mather of the University of Lethbridge, on chitons organized by Douglas Eernisse of California State University, Fullerton, and on opisthobranchs organized by Sandra Millen of the University of British Columbia.

There will be a sale of molluscan reprints to benefit the student fund of the WSM and the traditional spirited auction of books and molluscan memorabilia (no shells) that will benefit the student funds of both organizations. Several notable items of cephalopod art have already been donated as well as a copy of the 2nd edition of Abbott's *American Seashells*. Bring some of your unused reprints, books and molluscan art to benefit this very worthy cause! Reprints and auction items can be sent to Roland Anderson at the address below.

For further information please contact AMS and WSM president, Roland C. Anderson, 1483 Alaskan Way, Seattle, Washington 98101 USA. Tel +1 206 386 4346, Roland.anderson@seattle.gov, or check the website of the American Malacological Society www.malacological.org/

Society for Conservation Biology

2006 meeting

The 20th annual meeting of the Society for Conservation Biology, *Conservation Without Borders*, will be held at the San Jose McEnery Convention Center in San Jose, California, USA, 24-28 June 2006. The chair of the meeting will be Dr. Erica Fleishman, from the Center for Conservation Biology at Stanford University. More information is available at http://conbio.net/2006/

2007 meeting

The 21st annual meeting of the Society for Conservation Biology will be held at the Nelson Mandela Metropolitan University, Port Elizabeth, South Africa, tentatively, 3-7 July 2007. The chair of the meeting will be Dr. Graham Kerley, Graham.Kerley@nmmu.ac.za, from the Terrestrial Ecology Research Unit, Department of Zoology at the Nelson Mandela Metropolitan University. More information available soon.

2008 meeting

The 22nd annual meeting of the Society for Conservation Biology will be held at the Chatanooga Convention Center, Chattanooga, Tennessee, USA, 13-18 July 2008. The chair of the meeting will be Dr. David A. Aboprn, David-Aborn@utc.edu, from the Deptartment of Biological and Environmental Sciences, University of Tennessee at Chattanooga. More information available soon.

INTERNET RESOURCES: LISTS, WEBSITES, ETC.

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

UNITAS MALACOLOGICA

Unitas Malacologica is the society for worldwide malacologists and malacology. Its aim is to further the study of Mollusca by individuals, societies and institutions worldwide. UM provides financial support for the production of *Tentacle* and I urge all readers to become members. The upgraded 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 inforamation in *Tentacle*.
www.ucd.ie/zoology/unitas/index.html

Red List

The entire Red List of Threatened Animals can be searched at any of the following addresses
www.redlist.org www.redlist.net www.iucnredlist.org

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>

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 D.R. Lindberg of the University of California Museum of Paleontology, Berkeley, USA.

Mollia

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

CITES

CITES-L is a Bulletin board restricted to trade issues for endangered species, which is managed from 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

Unionids

UNIO is a listserver focusing on the biology, ecology and evolution of freshwater unionid mussels. Details, including how to subscribe, are given at the UNIO website:
http://my.fit.edu/~rtankers/unio.htm
The primary objectives of the list are (1) to foster communication and collaboration among scientists, researchers, and students engaged in mussel-related activities and (2) to facilitate the informal discussion of regional and federal research priorities. Postings related to mussel conservation issues, including the artificial propagation and captive rearing of threatened and endangered species, are especially welcomed. Subscribers are also encouraged to use the list for posting information on mussel-related meetings, symposia, workshops, and funding opportunities. The list is sponsored by the Florida Institute of Technology and administered and managed by Rick Tankersley (rtank@fit.edu) to whom any questions regarding the list, including problems while attempting to subscribe or post messages, should be addressed. There are currently about 400 members.

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.
http://ellipse.inhs.uiuc.edu/FMCS/
The FMCS now publishes the journal *Walkerana*
www.ummz.lsa.umich.edu/mollusks/publications/walkerana/

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, is available in HTML at
www.amonline.net.au/invertebrates/marine_overview/
and PDF at
www.amonline.net.au/invertebrates/pdf/marineoverview.pdf

Invasive Species Specialist Group

Includes details of the Aliens-L listserver and the ISSG newsletter, *Aliens*.
www.issg.org/index.html

MUSSEL database project

http://clade.acnatsci.org/mussel/

American Malacological Society

The homepage of the AMS carries a link to the Society's conservation policy.
http://www.malacological.org/

Illinois Natural History Survey

This site has much information on the mussels of North America, with links to other mussel sites.
www.inhs.uiuc.edu/cbd/collections/mollusk/molluskintro.html

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.
http://www2.bishopmuseum.org/PBS/samoasnail/
It is part of the Bishop Museum's Pacific Biological survey.
www.bishopmuseum.org/research/pbs/pbs.html

Jamaican Land Snail Project

A key to Jamaican land snails is now online, on the DiscoverLife website at
http://pick4.pick.uga.edu/mp/20q?guide=Molluscs
The key is part of Gary Rosenberg's ongoing work on the Jamaican fauna: http://data.acnatsci.org/jamaica/
The key is still being developed and 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, http://clade.acnatsci.org/rosenberg/

Conchologists of America

The homepage of the COA carries a link to a number of pages dealing with its conservation policy and conservation issues.
www.conchologistsofamerica.org/home/

Field Museum land snails

Information for over 142,000 lots (a lot is a collection of a single species taken from a single locality on a single occasion), including over 2,500 type lots, of land snails in the Field Museum (Chicago) collections is accessible at
fm1.fieldmuseum.org/collections/search.cgi?dest=inverts

The Malacological Society of London

http://www.malacsoc.org.uk/

Malacological Society of Australasia

www.amonline.net.au/malsoc/

Haus der Natur—Cismar

The homepage carries a link to a page on mollusc conservation in Germany, as well as other links.
www.hausdernatur.de/

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.
http://hbs.bishopmuseum.org/hbs1.html

Hilton Pond Center for Piedmont Natural History

From time to time photo essays about some mollusks encountered at the Center are posted on-line, for example:
www.hiltonpond.org/ThisWeek011022.html
www.hiltonpond.org/ThisWeek030401.html
www.hiltonpond.org/ThisWeek000608.html

Links

Useful sites with links to many of the major malacological websites:
www.manandmollusc.net/
www.staffs.ac.uk/schools/sciences/biology/dhome/dhome.htm
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. The group is currently being reformed, and new members will be added to this list. We anticipate expansion to reflect the needs of new regional freshwater assessment programmes and to respond to requests for assistance related to other activities such as the global marine assessment, island invertebrarte initiative, cave invertebrate intiative and assessment of the impact of bycatch on molluscan faunas (see IUCN and SSC news in this issue of *Tentacle*).

Chair

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Application for Unitas Malacologica membership

Herewith I apply for membership in UNITAS MALACOLOGICA and accept the current rules.

Title and full name (family name in CAPITALS)……
Full address for correspondence (private or business). If business, please give full details (Department, etc.).

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Telephone …… Fax …….
E-mail …….

I intend to pay my subscription in the following way:

- remittance in EURO to **Belgian Postcheque Bank, Koloniën Street 56, B-1100 Brussels,** in favour of **IBAN code: BE07 0001 5390 6866 (for the account number of Unitas Malacologica, Vautier Street 29, B-1000 Brussels), and BIC or SWIFT code: BPOTBEB 1 (to characterize the Belgian Postcheque Bank)**,
- International Postal Money Order in EURO (you can obtain forms from your Post Office),
- credit card: VISA, MASTERCARD or EUROCARD (please fill in carefully),
- remittance to a Belgian Bank in EURO,
- cash (in this case only you will receive a receipt),
- through the intermediary of my colleague ...……
  address: ……..
  ……

Signature ……..…….. Date ……...

Current membership fee is 48 EURO for a three years period.

Please send the application form to the Treasurer:
Dr J. Van Goethem
Royal Belgian Institute of Natural Sciences
Vautier Street 29 B–1000 BRUSSELS (Belgium)

IF PAYMENT BY CREDIT CARD, PLEASE COMPLETE THIS AUTHORISATION
(Visa, MasterCard or EuroCard ONLY)

Name .....…….

Address .....…….

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VISA O MASTERCARD O EUROCARD O (Please tick the appropriate card)

Card number | | | | | | | | | | | | | | | | |

Name on card:.....…….. **Expiry date:** ..…...../....….....

Amount for annual dues ..... EURO
Donation to Trust Fund ..... EURO

TOTAL AMOUNT | | EURO

Signature .....