Molluscan Forum 2012

Flett Theatre
Natural History Museum, London
28th November 2012

NATURAL HISTORY MUSEUM

ORGANISED BY:
THE MALACOLOGICAL SOCIETY OF LONDON
NATURAL HISTORY MUSEUM, LONDON

Welcome!

As representatives of THE MALACOLOGICAL SOCIETY OF LONDON and the NATURAL HISTORY MUSEUM, we welcome you to the annual Molluscan Forum. This informal meeting is designed to showcase the work of those who are just starting their research on molluscs.

During this meeting, we hope that presenters will not only be able to discuss their research with each other, but that the more established researchers in attendance will be generous with their comments and advice. This meeting should be a casual, enjoyable experience for all.

We would like to take this opportunity to thank everyone who has helped us to make this meeting a reality.

We hope you enjoy the meeting.

JONATHAN ABLETT, Organiser
Curator of non-marine Mollusca & Cephalopoda, Natural History Museum
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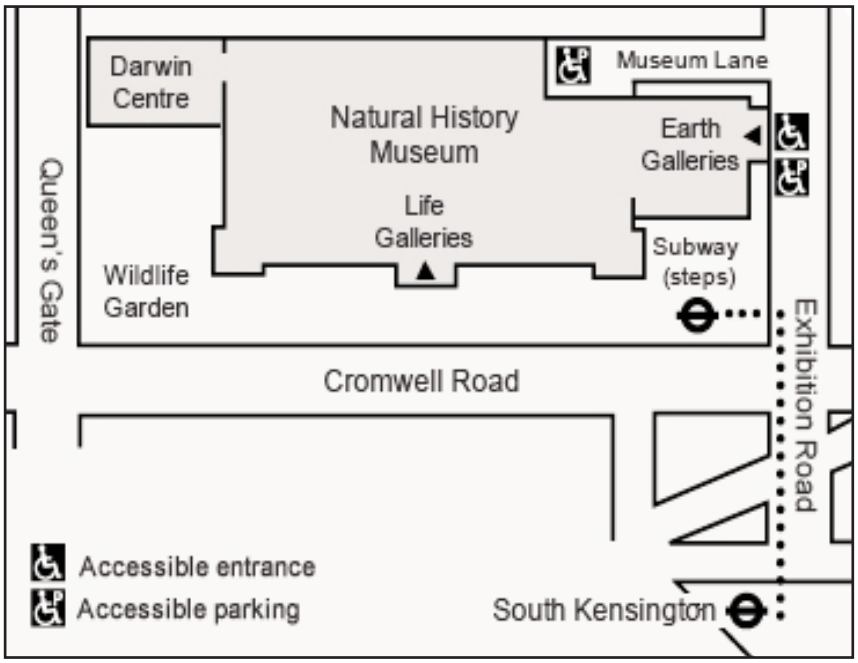
cover photo of *Opisthostoma mirabile* Smith, 1893 by Harry Taylor, Natural History Museum

Arrival

Getting to the Natural History Museum
The NATURAL HISTORY MUSEUM is located in South Kensington, London. It is easily accessible by bus, underground or taxi. For detailed instructions, please see the museum website at www.nhm.ac.uk.

Finding the Forum and meeting procedures
The Molluscan Forum will take place in the Flett Theatre, on the first floor of the earth galleries building. Non-NHM attendees should enter the museum through the staff entrance on exhibition road just before the public entrance to the earth galleries (see map below). All attendees must sign in at the staff entrance reception desk. Registration begins at 9.15 but all speakers and those presenting posters should arrive at 9.00 to allow time to prepare.

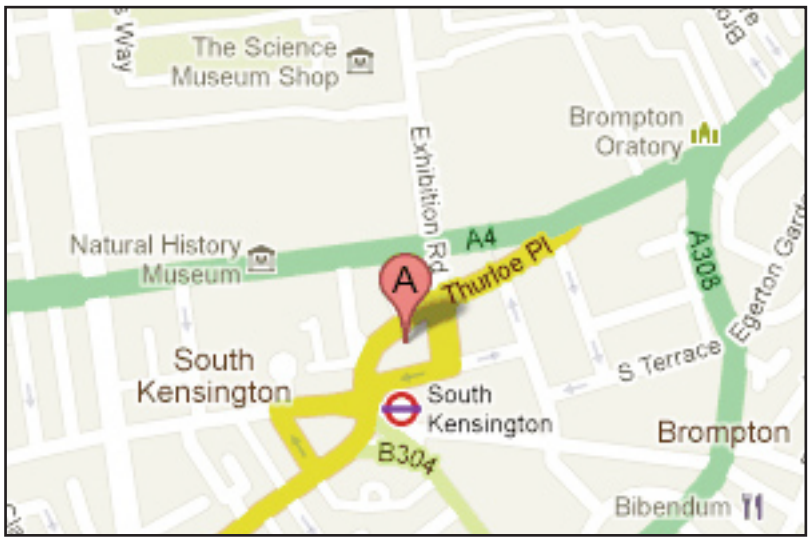
Once through the staff entrance, follow signs for the Molluscan Forum and the Flett Theatre. The door to the Flett Theatre reception room is not locked and so late comers will be able to enter the talks at any time. Out of consideration for the speakers, we kindly ask that late-arriving attendees only enter the Flett Theatre between talks.



Eating and drinking

Conference lunch and refreshments
Lunch will be provided for all attendees who have registered. Lunch will be served in the Flett Theatre reception area and will consist of sandwiches (meat, fish and vegetarian fillings), crisps, fruit and cakes. Tea, coffee and mineral water will be provided on arrival and for the duration of the conference.

Wine reception
At 17.35 when the conference ends there will be a final poster session and a chance to socialise over a glass of wine. Afterwards, the attendees may wish to gather in the pub to further discuss the day's events. The Hoop & Toy (A on the map below) is located near South Kensington underground station at 34 Thurloe Place and is popular with NHM staff.



Abstracts
Alphabetical by presenter

Bivalves in the mud: a comparative approach to temporal variation in shallow subtidal bottoms

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Thanks to their wide variety of adaptations, life habits and feeding strategies, bivalves are usually one of the most important faunal groups in subtidal muddy bottoms. The diversity of the group in this kind of habitats is commonly high, and species like *Thyasira flexuosa* (Montagu, 1803) or *Kurtiella bidentata* (Montagu, 1803) are frequently among the most abundant ones in these communities. Because of this, the study of the temporal variation of the bivalve assemblages in muddy bottoms is essential to understand the functioning of these ecosystems, what remains intriguing due to their peculiar environmental conditions. With this aim, two muddy bottoms located in two different embayments in the NW of the Iberian Peninsula (Ensenada de Baiona and Ría de Aldán) were sampled monthly from May 1996 to May 1997 and from May 1998 to May 1999, respectively. Five replicate samples for the study of the bivalve assemblage and an additional one for the characterization of the sediment were taken by means of a Van-Veen grab, the former being then sieved through a 0.5mm mesh. In the case of the Ría de Aldán, physicochemical features of the water column and the sediment were also measured using a portable microprocessor. A total of 38 bivalve species were found, being 13 of them shared by both sites. In general terms, the site located in the Ría de Aldán, which is deeper and muddier, showed a higher diversity; whereas the one in the Ensenada de Baiona, less exposed but more affected by human impact, presented higher values of total density. In both sites, the features of the bivalve assemblage correlate mainly with the grain size of the sediment, especially with gravel and mud contents. In neither of the studied bottoms the assemblages show a clear seasonal structure, except for marked shifts happening by the beginning of the summer and characterized by lower densities of the most abundant species.

Parasitic influences on the host genome using the molluscan model organism *Biomphalaria Glabrata*

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Biomphalaria glabrata (Say, 1818) is the intermediate snail host for schistosoma parasites, causing Schistosomiasis (Bilharzia) in humans. Due to its importance in the spread of this disease *B. glabrata* has been selected for whole genome sequencing and thus becomes a molluscan model organism. In this study we are investigating the response of *B. glabrata* genes after a parasitic infection or stress caused by heat shock. A proportion of genes that are up-regulated soon after an exposure to parasite or heat shock non-randomly alter their nuclear location. We are investigating how these genes get to their new locations and what nuclear architecture they are interacting with in their new positions.

Predative pressure of Drilus (Coleoptera: Elateridae: Drilini) beetles against land snails in Greece and the Netherlands

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Drilus beetles occur in various habitats together with populations of terrestrial molluscs, upon which their larvae feed. *Drilus* larvae are specialised predators of land snails; they bite and paralyse a snail, after which they eat the snail from inside out. The larvae shed their skin inside the shell of their prey and use the shell for protection. During fieldwork in Greece (2011) and the Netherlands (2012), a number of larvae have been collected and observed while attacking various species of land snails. In addition to living larvae, a large number of empty shells have been collected. Because *Drilus* larvae leave their skin inside their host, species specificity could be measured by using morphological and DNA analysis of the excuviae. A number of different patterns have been observed. In Greece, the main host of some small Greek *Drilus* species are aestivating *Albinaria* snails (Clausilidae). These snails have a clausilium, a door-like-structure in the aperture, which might hinder a *Drilus* larva to enter the shell. In order to predate *Albinaria* snails, a hole is made in some

occasions, but *Drilus* larvae are also able to open the clausilium without damaging the shell or clausilium. In addition to these small *Drilus* species, which might be specialized in predating clausilids, there are larger *Drilus* species which might be adapted to larger snails such as helicids. The larvae of these *Drilus* species have a body widened towards the end which fits better into helicid snails. These, and other patterns, show a possible arms-race between *Drilus* larvae and their hosts. During this presentation a number of video´s and photo´s will be shown to illustrate the interaction between *Drilus* beetles and their prey.

Determining the origin of Antarctic calliostomatids: a molecular phylogeny of carnivorous deep-sea gastropods

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The trochoid family Calliostomatidae was traditionally comprised of two subfamilies: Calliostomatinae and Thysanodontinae. A third subfamily, Margarellinae, was recently described based on molecular studies that show *Margarella spp*. from Antarctica, traditionally assigned to the trochid subfamily Cantharidinae, also form a clade within the Calliostomatidae. The understanding of systematic relationships among these subfamilies is still in flux. In this study we use Bayesian inference based on sequence data from four genes to 1) examine the systematic relationships of subfamilies within the Calliostomatidae, 2) use DNA sequence data to delimit species within the most speciose genus, *Calliostoma*, and 3) investigate the historical biogeography of Antarctic species from *Margarella*, *Calliostoma* and *Falsimargarita* and assess the role of Antarctica as a source of diversity. This study represents the most comprehensive molecular phylogeny of the gastropod family Calliostomatidae to date, in terms of numbers of taxa and of gene sequences. A total of 470 sequences were obtained from representatives of the subfamilies Calliostomatinae, Margarellinae, and Thysanodontinae, together with nine species belonging to the Trochidae as outgroup taxa. One fossil record of *Calliostoma* was used to calibrate a molecular clock to examine patterns of divergence in calliostomatids. The phylogeny demonstrates that all three recognised subfamilies are highly supported. Furthermore it was found that within the family Calliostomatidae there is strong support for three new subfamilies, including species of the genera *Venustatrochus*, *Falsimargarita* and an unnamed calliostomatid genus. Within the Calliostomatinae, a total of 55 *Calliostoma* species were identified using statistical methods to analyse DNA sequences. Analyses also showed that both Antarctica and tropical deep water are origins of species diversity in Calliostomatidae. The Antarctic species *Calliostoma nudum* clustered within the *Calliostoma* clade, but was sister to a clade from the East and West Pacific, with a divergence about 23 Ma. This coincides with the establishment of the northward movement of Antarctica bottom water that is thought to have aided dispersal in many marine taxa (20 – 5 Ma).

Displacement patterns of intertidal consumers of a subtropical rocky shore.

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The present study assesses the influence of tide, photoperiod and extreme subtropical temperatures on the linear displacement of two intertidal gastropods and it characterizes the maximal activity period regarding to the tides and photoperiod and the spatial scale of locomotion of three intertidal consumers from different trophic level. Displacements of the predator dogwhelks drop according with variances of air temperature while orientation of displacements of limpets was associated to the tidal cycle, which has shown diurnal activity in contrast with previous literature. A logarithmic scale of displacement and the relative locomotion rate of the three consumers are here described, which are a key quantitative data to interpret the causality of the interspecific relationships and the ecosystem functioning. This study contributes to the better understanding of the relevance of the environmental factors on the locomotive performance of the subtropical intertidal consumers, less known when compared with organisms from temperate rocky shore.

An association of mitochondrial haplotype with shell shape in an intertidal gastropod

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The high rates of substitution and assumed neutrality of mitochondrial polymorphisms encourage the use of mtDNA in phylogenetic and evolutionary studies. However the true nature of the mitochondrial genome and its influence upon processes of adaptation and speciation are not fully understood, particularly where associations appear to exist between 'neutral' mitochondrial haplotypes and characteristics under direct selection. In snails, one such characteristic is shell shape and in this study we investigate the relationship between mitochondrial haplotypes and shell shape in the rough periwinkle *Littorina saxatilis* (Olivi). *L. saxatilis* forms two distinct ecotypes, a high shore (H) morph which has a thin shell and wide aperture allowing for a larger foot and greater adhesion to the substrate in the face of increased wave action, and a mid-shore (M) morph with a larger, more robust shell and smaller aperture offering increased protection against crab predation. On a UK shore, these ecotypes are found to associate with mitochondrial lineages forming a distinct cline in mtDNA, suggesting a significant intraspecific reproductive barrier. This relationship appears not to be universal and is not observed on any other shores studied. Possible processes involved in the formation of the cline are discussed. Additionally, a mitochondrial haplogroup is found to be confined at one end of the spectrum of shell variation in the H ecotype. We put this forward as evidence for hitherto unexpected selection and perhaps even some reproductive isolation between this group and the rest of the population, proposing intergenomic coadaptation as a possible mechanism through which this occurs.

Do barnacles act as a potential reservoir for pathogenic bacteria on commercial shellfish beds?

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The monitoring of bacterial levels in commercial bivalve shellfish destined for human consumption is a common global practice designed to preserve both public health and the future economic prosperity of the shellfish industry. Recent research has focused primarily on identifying the sources of bacterial contamination affecting shellfish beds globally, aided by the development of new molecular tools. This study adopts a different perspective, by attempting to identify potential bacterial reservoirs among shellfish symbionts. Previous studies have shown that on intertidal mussel (*Mytilus edulis*) beds sediments can act as a significant reservoir for bacteria with up to 1.5 billion *Escherichia coli* per kilogram of sediment. Anthropogenic activities as well as natural events such as storms, re-suspend the bacteria allowing the subsequent uptake by bivalve shellfish. This study examined the importance of encrusting barnacle species on three intertidal M. edulis beds in North Wales, UK. Results demonstrated that across all sites, encrusting barnacles had significantly higher coliform levels respective to their associated symbionts. Coliform levels ranged from 2 to 5 times higher in the barnacles suggesting that barnacles represent a significant bacterial reservoir on commercial mussel beds. This has important implications for the shellfish industry, particularly where commercial shellfish are marketed as "natural" and sold complete with their associated organisms. This study illustrates the need for an extensive in situ analysis of global shellfish beds to identify and quantify bacterial fluxes on a localized scale to improve commercial shellfish quality and preserve public health.

Are there any similar patterns in species composition and richness between grassland snail and plant assemblages?

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We studied plant and snail assemblages at 62 plots in dry grasslands and mesic meadows of three nearby regions: Southern Moravia (SM), southern (SWC) and northern (NWC) part of the White Carpathians (Czech Republic). As generally known, the SWC region supports grasslands of the highest plant alpha-diversity in Europe, contrary to the grasslands in SM and NWC regions being of lower species richness. In this study we explore whether also snail assemblages reflect the same patterns of species richness and composition as vegetation. Detrended correspondence analysis detected one strong gradient of snail species composition changes; mainly associated with altitude, temperature, annual precipitation and longitude. This main gradient in snail species composition was also strongly associated with that of vegetation. Canonical correspondence analysis revealed significant differences both in plant and snail species composition between SM and the White Carpathians (SWC and NWC); a significant difference between SWC and NWC regions was found only for vegetation. We documented also several differences in species

richness of plant and snail assemblages among the regions. While the highest gamma diversity of plants was recorded in SWC region, the highest gamma diversity of snails was found in SM region. Alpha diversity of plants was also the highest in SWC region, but there was a contradiction in snail alpha diversity, related on considering of live snail species only or all snail species (both live individuals and empty shells together). Based on live snail species only, SWC region harbored the highest number of species, contrary to SM region that hold a higher number if also empty shells were counted.

Microsatellite markers for analysis of parentage and sexual behavior of banana slugs (Pulmonata: Arionidae: *Ariolimax*)

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Terrestrial pulmonate slugs are hermaphroditic and often are capable of both outcrossing and self-fertilization. This mixed breeding system may severely affect population genetic structuring and taxonomic differentiation. Currently little is known about the breeding system(s) of Banana slugs (*Ariolimax*), a group of taxonomically ill-defined slugs living along the West Coast of North America, from California to southern Alaska. Based on genital morphology and mtDNA sequence data (COI, 16S and CytB), the genus *Ariolimax* is nowadays interpreted as a group of eight species level taxa, viz *Ariolimax columbianus*, *A. buttoni*, *A. stramineus*, *A. californicus*, *A. dolichophallus*, *A. brachyphallus* and two undescribed species. These species appear to be closely related as 19 microsatellite DNA loci identified from *A. californicus* consistently amplify in all of the described taxa and share many alleles. Hence, these microsatellites can help to clarify *Ariolimax* taxonomy. To this end, four microsatellite loci were used to study potential interspecific crosses of *A. californicus* x *A. dolichophallus*. This showed that none of these crosses produced hybrid offspring and that *A. californicus* reveals multiple paternity under natural conditions. Conversely, a panel of 28 microsatellites applied to cross-breeding experiment between two populations of *A. buttoni*, showed that all the parental specimens involved only three homozygous multilocus genotypes (MLG) and that offspring of pairs in which both parents had a different genotype, always were monomorphic for the same homozygous MLG of one of the parents. This confirms that *A. buttoni* is able to self-fertilize. Yet, to what extent self-fertilization is common in natural conditions remains to be investigated.

Contemporary population genetic differentiation in *Melarhaphe neritoides* (Gastropoda: Littorinidae), a long-lived planktonic-dispersing mollusc

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Marine invertebrates with planktonic-dispersing larvae are assumed to be good dispersers over long distances. This high dispersal capacity implies a high gene flow between populations and a homogeneous population genetic structuring over wide geographic scales.The marine gastropod *Melarhaphe neritoides* has a long-lived planktonic larval dispersal stage and allozyme data suggest that it is genetically homogeneous over its whole European distribution area. In contrast, preliminary mtDNA sequence data uncovered a remarkable degree of genetic diversity and genetic structuring on smaller geographic scales.In order to explore this mtDNA diversity and structuring in *M. neritoides* we started to survey sequence variation at COI and 16S rDNA all over the Azores archipelago. These data reveal that the Azorean populations share very few haplotypes.Hence, it seems that *M. neritoides* with its long-lived planktonic larval stage nevertheless shows a strong local population genetic structuring and thus challenges the current paradigm that correlates modes of larval development with levels of genetic structuring. It also stresses the importance of the sampling intensity (both in terms of numbers of specimens and genetic markers) to avoid experimental biases when assessing genetic diversity.

The lost snail of Captain Spratt: mapping *Albinaria eburnea* in the high summits of the Mediterranean island of Crete (Gastropoda: Pulmonata: Clausiliidae)

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Albinaria eburnea is a clausiliid snail of Crete scarcely represented in museum collections: the knowledge we have to date is similar to what we had for other Cretan species in the 1870's mainly due to the inaccessibility of its distribution range in the White Mountains. Two subspecies were collected in 1851 by Captain T. A. B. Spratt of the Royal Navy at 5000 and 6500 ft. altitude with no concrete locality data. Since then nobody has

been able to locate the animals again. One of these two, the nominate subspecies lot that was used by Pfeiffer in 1854 to describe the species, is formed by only four shells in the world: the syntypes held at the Natural History Museum of London. Over the last decades a few other distant, patchy and non-connected localities have been recorded but none above the 4000 ft. altitude line. Being *A. eburnea* an eminently montane animal, doubts have been expressed about its current taxonomical subdivision with four subspecies. It is suspected that gradual and continuous morphological changes can happen within this species over the distribution range, questioning its taxonomical arrangement as it has been shown to be the case with many other Cretan *Albinaria*. In order to find this "lost snail of Captain Spratt" of taxonomical interest, two collecting trips were done in Crete in 2011 and 2012. From his own accounts, we reconstructed the routes most likely used by Spratt when he visited the heart of the White Mountains and we designed several high altitude transects partially using 19th century mule tracks. Over 100 continuous stations were covered for morphometrical and molecular study, being half of them at 3300-7000 ft. altitude. Some populations from the summits, when compared to the original type material sent on loan to the Natural History Museum of Dublin from London, allowed us to determine with a low error margin the locality where the snails of Captain Spratt were collected 160 years ago. Preliminary observations from the work in progress and its taxonomical implications for the species are discussed in a poster with maps and photographs.

How will climate change affect the potential distribution of Madeira's land snail species?

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The studies regarding the impacts of climate change on global biodiversity have increased over the last years. However, several evidences have suggested that the biological and ecological responses of a wide range of life forms require progressively more advanced tools in the creation of action plans and other conservation strategies (IPCC , 2007). In order to properly understand this issue and provide preliminary data for future studies concerning the archipelago's malacofauna, we aim to evaluate the performance of various native and exotic species of terrestrial molluscs, facing a futuristic climate scenario created for Madeira Island, and considering how the distribution of these populations can be affected. To perform this study, seven species of land snails were selected based in their ecological characteristics. *Actinella armitageana*, *Plutonia marcida*, *Disculella maderensis taeniana* and *Leiostyla vincta vincta* represented alpine, laurel forest and two costal distribution species. To evaluate the impact of invasive species on native fauna, the potential distribution of *Actinella nitidiuscula* was modeled and compared with *Theba pisana*. We also included *Leiostyla colvillei*, a vulnerable specie according to IUCN Red List, to represent a specie with a particular geographical distribution and improve the significance of the use of predictive models in the conservation of land snails. The use of predictive models demonstrates a high efficiency in the identification of the variables that limit the distribution of the target species, also providing important evidences about the assessment of the conservation status of their populations over the next 80 years. The results should provide an integrative platform for the development of action plans and establishment of mitigation procedures preventing the fragmentation of populations and habitats, and subsequently the loss of biodiversity in one of the world's most remarkable hotspot, minimizing the impact of climate change on Madeira's land snail species.

Predation on greek *Albinaria* (Pulmonata: Clausiliidae) by *Poiretia* (Pulmonata: Oleacinidae) and by an unknown organism making circular holes

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Albinaria is an extremely speciose genus of land snails, with about a hundred species occurring in limestone habitats in Greece. These snails, being present in rather high densities on exposed rock faces, are predated by many organisms. Among these predators are other terrestrial snails, of the genus *Poiretia*. This genus is represented by *P. dilatata peloponnesica* on the Peloponnese and by *P. compressa* on the Ionian islands. Their mode of predation is rather interesting; they are said to sit on the shell of their prey for two days and create a large, elongated hole in it by excreting an acid. These predation marks were investigated in samples of empty *Albinaria* shells, in order to compare predation rates in different *Albinaria* populations. Additionally, *Poiretia* specimens were dissected and studied histologically to investigate how the excreted acid is produced.

Another type of predation mark frequently found on *Albinaria* shells, is a small, circular or nearly circular hole. These holes are assumed to be predation marks, or marks made by a parasite, because of their occurrence in "fresh" non-eroded shells and their consistency in size and circularity. The rate of occurrence in *Albinaria* shell samples and previous reports of these holes were examined to gain insight in the distribution of this phenomenon. Unfortunately, no observations of organisms making such a hole have been reported and no remains of possible predators have been found inside shells with circular holes, so the identity of the so-called Circular Hole Organism remains a subject of speculation.

Vetigastopoda (Mollusca: Gastropoda) from the Plio-Pleistocene of the Philippines

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An extremely well-preserved Plio-Pleistocene mollusc fauna was found in the north-western Philippines. The heteropod and pteropod species in this fauna were previously studied and their species number was found to be higher than in any other fauna found to date. Subsequently, several vetigastropod families were studied and systematically described. The paleoenvironmental and paleobiogeographical character of the fauna is explored; the fauna indicates relatively deep water (c. 200–300 m paleodepth) depositional settings. Twenty six species of gastropods were studied, three of which are described as new; *Halystina conoidea, Calliotropis arenosa* and *Ethminolia wareni*. An additional number of four new combinations are proposed; *Pseudotalopia taiwanensis* (Chen, 2006), *Solariella segersi* (Poppe, Tagaro & Dekker, 2006), *Zetela tabakotanii* (Poppe, Tagaro & Dekker, 2006) and *Ilanga konos* (Vilvens, 2009). Thirteen species are known living and another five are possibly ancestors of modern species, giving the fauna an overall modern resemblance. Most modern species still occur around the Philippines. In addition, two of the species are shared with Neogene deposits from southwestern Pacific islands. The new fauna offers insights into the character of deep water Indo-West Pacific mollusc faunas prior to the onset of the Quaternary ice ages. The fauna also contains many other mollusc species still waiting to be studied.

Cost of autotomy drives ontogenetic switching of anti-predator mechanisms under developmental constraints in a land snail.

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Autotomy of body parts offers various prey animals immediate benefits of survival in compensation for considerable costs. I found that a land snail *Satsuma caliginosa* of populations coexisting with a snail-eating snake *Pareas iwasakii* survived the snake predation by autotomising its foot, whereas those out of the snake range rarely survived. Regeneration of a lost foot completed in a few weeks but imposed a delay of shell growth. Imprints of autotomy were found in greater than 10 per cent of *S. caliginosa* in the snake range but in only less than 1 per cent out of it, simultaneously demonstrating intense predation by the snakes and high efficiency of autotomy for surviving snake predation in the wild. However, in experiments, mature *S. caliginosa* performed autotomy less frequently. Instead of the costly autotomy, they can use defensive denticles on the inside of their shell apertures. Owing to the constraints from the additive growth of shells, most pulmonate snails can produce these denticles only when they have fully grown up. Thus, this developmental constraint limits the availability of the modified aperture, resulting in ontogenetic switching of the alternative defenses. This study illustrates how costs of adaptation operate in the evolution of life-history strategies under developmental constraints

Succession of mollusc assemblages in quarries of Bohemian Karst, Czech Republic

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Molluscan succession was studied in 18 abandoned limestone quarries of different age in Bohemian Karst, Czech Republic. The number of species in studied quarries increases in the time. The less species were found in the oldest quarries. This trend was probably caused by habitat diversity decline although it is not conclusive. The best predictors of mollusk species composition are type of surrounding vegetation, light and age. It is important to take into account correlations of the other environmental variables with light and the cover of tree layer. Compositions of mollusk assemblages of north and south-facing slopes differ, but these differences diminish with ongoing succession. Quarries represent suitable model sites for the study of succession.

Restoration of a long forgotten name *Helix straminea* (Pulmonata: Helicidae) for a new recognised species widely distributed in Italy and Balkans

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The familiar genus *Helix* Linnaeus, 1758 comprises the largest European pulmonate snails. In Italy, five species are currently recognised. One of them is *H. lucorum* Linnaeus, 1758, a species with large range extending from Iran in east to Italy in west. In collections from Italy, two conchologically distinct forms can be encountered under the name *H. lucorum*. Whereas in the north of the country lives a typical *H. lucorum*, the form from central and southern Italy can be conchologically distinguished as different and was described as *Helix straminea* Briganti, 1825. However, it has been then considered as conspecific with *H. lucorum* to this day. The putative *H. straminea* shells resemble Balkanian species *H. vladica* (Kobelt 1898) instead of *H. lucorum*. The main conchological differences to *H. lucorum* are larger protoconch in *H. straminea* and shell coloration. Based on shell morphology, we propose that *H. straminea* is a valid species, different from *H. lucorum* and close to *H. vladica*. We test this hypothesis by means of 16S and COI phylogeny. Two distinct lineages were found within Italian *H. lucorum*, one of them representing true *H. lucorum* and the second corresponding to *H. straminea*. *Helix vladica* is a junior synonym of *H. straminea*, which this has a disjunct trans-adriatic distribution. The haplotype distribution suggests that the colonisation of Apennine peninsula may have taken place from south. *Helix straminea* is not closely related to any other Italian species, the closest relative among them is *H. pomatia* Linnaeus, 1758. Two problematic Balkan taxa, *H. volensis* Kobelt, 1906 and *H. vardarica* Knipper, 1939, are placed in synonymy with *H. straminea* solely on the basis of shell characters. The range of *H. straminea* in Balkans extends from Montenegro to eastern Central Serbia and to Albania and Greece.

Conservation status of freshwater Bivalves in Europe: state of the art, perspectives and future challenges

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Freshwater ecosystems are at risk and invertebrates are particularly vulnerable. However, this situation is not recognized since major conservation efforts are directed to vertebrate species (particularly birds and mammals). Given this situation mollusks and freshwater bivalves in particular, deserve conservation attention. Although some attention is been given to the situation in North America (particularly on unionid species) Europe still does not give too much attention to this faunistic group. Therefore in Europe there is an urgent need for a more integrated and holistic conservation approach on these taxa. Specific areas of research are required from taxonomy and systematics, through biological research (with emphasis on ecological aspects and life history traits) to more effective applied conservation and propagation strategies. In the present work several European experts on freshwater bivalves was gathered to bring input on the distribution and conservation status of freshwater bivalves in their countries. The integration of all these data is here presented as well as directives and opportunities for cooperative European conservation with regard to freshwater bivalves. These challenges will require the participation of as many affected and interested groups, from local communities to governmental and European agencies for successful implementation and management.

Methods to explore the immune-effects of pollution on parasite-host interactions.

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The trematode *Schistosoma mansoni* is a significant human parasite with a global impact considered second only to malaria. It is transmitted to humans via tropical freshwater snails of the genus *Biomphalaria* which can often be found in areas highly polluted by a range of anthropogenic contaminants. Various chemical pollutants have previously been shown to influence the immune systems of molluscs, which in turn may alter the dynamics of disease transmission. We report here the development and adaptation of in vitro techniques for use in assessing the effects of selected contaminants on cellular immune functions in *B.glabrata* including

processes related to infection with *S.mansoni*. Phagocytosis is a key function of the immune system in molluscs, as in many species, and represents a well-established biomarker for immunotoxicity. To assess effects of chemicals on phagocytosis we have developed a novel method for *Biomphalaria* haemocytes using imaging flow cytometry. Brightfield and fluorescent channel images were obtained from haemocytes exposed to latex beads. An automated method for quantifying the phagocytosed beads and excluding non-internalized (free) beads was developed using the analysis software. Differences within haemolymph pools (intra assay) and differences between pools (inter assay) for the phagocytosis assay showed coefficients of variation of 3 and 9.6% respectively. The automated data analysis showed 99.8% agreement with visual observations regarding classification of phagocytosisng and non-phagocytosisng cells as well as the number of beads within each cell. Another important feature of immunity in *B.glabrata*, directly related to *S.mansoni* infection, is the ability of haemocytes to encapsulate sporocysts for subsequent killing. To investigate the effects of chosen chemicals on the encapsulation process we have used a sporocyst encapsulation assay as well as assays designed to measure cell motility. To date preliminary results from these and a range of other assays suggest that certain pollutants can have immunomodulatory effects on *B.glabrata* haemocytes in vitro at environmentally relevant ranges. Given the role of *Biomphalaria* as intermediate host to a major human parasite any factors modulating immune functioning could potentially lead to a disruption in the parasite-host balance altering transmission rates and resulting in possible human health implications.

Morphologic variation as a potential driver of taxonomic richness: Venerid Bivalves of the Indo-Pacific

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Studies of modern taxonomic richness look increasingly to the fossil record for information about the formation and development of biodiversity. As a hotspot of modern diversity in marine habitats, the Indo-Pacific has been recognized as a persistent center of origination for the majority of the Cenozoic. In this context, I am investigating the evolution of venerid-bivalve biodiversity throughout the Indo-Pacific with the goal of understanding causal mechanisms for the development of the tremendous molluscan diversity observed in terms of both species richness (i.e. biodiversity) and morphologic variation (i.e. disparity). I hypothesize that closely constrained biotic interactions, such as the agonistic relationship between venerid bivalves and their predators, shell-drilling naticid gastropods, may cause directional changes in shell shape and form as a heritable phenotypic response. Further, this evolutionary response may contribute to genetic differentiation and promote speciation within preexisting clades. As an initial step, I report here on a preliminary assessment of morphological variation among several Cenozoic venerid genera from the Indo-Pacific in a stratigraphic and geographic context, taking into account frequency of naticid drilling as a potential function of morphological variation. Digital photographs of fossil material from the Natural History Museum (London), the Muséum National d'Histoire Naturelle (Paris), Naturalis Biodiversity Research Center (Leiden), and the National Museum of Natural History (Washington D.C.) were obtained for Neogene specimens from Indonesia, Japan, Malaysia, Australia, New Zealand, and the Philippines. Shape analyses of these bivalve specimens were conducted using biologically significant and homologous landmarks preserved on the shell and also gross shell shape, by means of the overall shell outline. Shell outlines were captured using an automated image recognition process and decomposed into Fourier ellipses and compared across regional geographic scales and through time using Principal Components Analysis. In an initial examination of morphologic attributes of several common venerid genera, taxa are randomly distributed throughout shape space with respect to geographic and temporal distributions. However, when predation instances (i.e. drilled specimens) are superimposed on the ordination in shape space, a potential bias in prey selectivity is observed.

Characterization of the Colonizing Decollate Snail, *Rumina decollata* (Mollusca: Pulmonata: Stylommatophora)

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The hermaphroditic, facultatively selfing, land snail *Rumina decollata* is a common, widespread species indigenous in the western Mediterranean region, that has been introduced in many other parts of the world. Recent DNA sequence analyses have shown that *R. decollata* is a complex of several (phylogenetic) species, two of them corresponding to previously distinguished allozyme strains with different body colours (light

vs. dark). Therefore, considering this new taxonomic interpretation, we here attempt to identify which, and how many, species of the *R. decollata* complex have been introduced outside their native area. Comparative DNA sequence analysis of introduced populations from South America, North America, Japan and the North Atlantic Islands vs. native populations from the Mediterranean area, revealed that all introduced populations belong to one single phylogenetic species, previously recognized as the dark strain. Therefore, the colonizing and invasive character of *R. decollata* is mainly, if not entirely, due to this dark strain. Furthermore, the Iberian Peninsula seems to be an important source for introduced *R. decollata* populations outside Europe. Within this work, we will discuss about the invasive character of the dark strain and the possible source areas of the introduced populations.

Fossil pulmonate snails from Brazil and their potential for biogeographical studies

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The Brazilian fossil record of pulmonate snails is not very diverse, counting only with about 30 species. Nevertheless, such record is extremely important on biogeographical grounds, for it encompasses some of the most ancient records known for some families, subfamilies and many genera. Itaboraí Basin (Middle Paleocene), Rio de Janeiro, have the most diverse and abundant pulmonate record in the country (especially for the stylommatophorans), with about 2/3 of the Brazilian diversity. This basin harbors the oldest record for the families Strophocheilidae (together with the Uruguayan Santa Lucía Basin; the fossil genus *Eoborus*) and Ferussaciidae. Moreover, its records of Charopidae, Clausiliidae, Cerionidae, Orthalicidae, Urocoptidae and Vertiginidae are among the most ancient in the world and include the oldest records of the subfamilies Neniinae (Clausiliidae), Odontostominae (Orthalicidae, together with the Uruguayan Queguay Formation or, more likely, earlier than it). Among these records, the occurrence of fossils of Cerionidae, Clausiliidae e Urocoptidae has an additional importance: they mark a place far removed from these families' recent distribution. Regarding the genera, Itaboraí basin has the oldest records of *Austrodiscus*, *Brachypodella*, *Cecilioides*, *Cyclodontina*, *Gastrocopta*, *Leiostracus* and *Temesa*. The remaining fossil pulmonates are very sparse, but are also very interesting, especially regarding the basommatophorans: the Lower Cretaceous (Aptian-Albian) Ilhas Formation, Bahia, houses the oldest record of *Biomphalaria*; the Upper Cretaceous (Senonian) Bauru Group, São Paulo, houses the oldest record of *Physa* and also of the family Physidae. The gathering of such distributional and time span data is just the first step of a broader project that aims to study the paleobiogeography of the South American pulmonate snail fauna. These fossils have great potential to help solving many biogeographical questions about the recent fauna.

Adaptive conchology in *Albinaria* (Pulmonata: Clausiliidae): the effects of shell shape on defense against *Drilus* (Coleoptera: Elateridae: Drilini) and *Poiretia* (Pulmonata: Oleacinidae) predation

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Albinaria snails are extremely common inhabitants of limestone habitats in Greece. Different species vary from one another in distinctive shell characters, including the thickness and pigmentation of the shell, the radial ribbing, the shape and angle of the aperture, the ornamentation of the cervix, and the position of the lamellae and folds in the aperture. It is likely that many of these conchological features are under natural selection by the environment. *Albinaria* snails have three main predators: the larvae of *Drilus* beetles, other terrestrial snails of the genus *Poiretia* and an unknown Circular Hole Organism (discussed in more detail by Renate Helwerda). The larvae of *Drilus* beetles bore holes in the shell and bite and paralyze the snail, after which they eat the snail from the inside out. Consequently, they use the shell for protection while they shed their skin, and emerge by boring a new hole in the now empty shell. The presence of these bore holes on the empty shells has been used as a measure for *Drilus* predation. *Poiretia* snails have a different mode of predation: they sit on the shell of their prey and most likely excrete an acid to dissolve the shell and gain excess to the snail, leaving a distinctive, shallow, elongated hole in the shell. During fieldwork in Greece in 2011, large samples of empty *Albinaria* shells have been collected from five different localities in the Peloponnese. Five widespread *Albinaria* species were selected, differing in clausilial apparatus and shell characteristics. For each collected adult shell, the presence of *Poiretia* predation marks and the number and positions of *Drilus* bore holes have been determined. In addition, several relevant shell characters have been measured. Statistical analysis of these measurements can be used

to show correlations between *Drilus*/*Poiretia* predation and *Albinaria* shell shape, and help to understand shell evolution in *Albinaria*, which may involve an 'arms-race' with *Drilus* and/or *Poiretia* predation.

Systematics of terrestrial Snails of the family Streptaxidae Gray, 1860 in Thailand

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Carnivorous terrestrial snails of the family Streptaxidae though poorly known are among the most remarkable of living pulmonates, they are highly specialized predators hunting various kinds of prey but principally land snails from other families, slugs, earthworms and some insect larvae. They are distributed across tropical areas of South America, Africa and Asia. Streptaxids can be distinguished from other land snail groups by a combination of their shell characters, lanceolate radula teeth and yellow to bright orange body. Shells may be flattened, heliciform to high spired, often with whorls following an oblique axis, thin to solid, generally glossy, sometimes transparent and often with apertural barriers. The majority of species are known only from their shells and internal anatomy has rarely been used for discriminating different taxa. Live specimens were collected from 91 localities in 28 provinces throughout Thailand. Reproductive organs, especially penis, penial sheath, vas deferens, vagina, gametolytic sac and duct, free oviduct and talon were examined under a stereo-microscope. On streptaxids the penis possesses cat-like claws that are supposed to differ in size and shape and pattern of distribution between taxa but these have not been studied systematically. One difficulty is that they have a minute and of a similar pale colour to surrounding tissue and thus difficult to see under a light microscope. On the basis of shell and reproductive organ characters 29 species in 5 genera were recognized. The examples of each species were prepared by critical point drying. After critically investigation on penial and vaginal walls of streptaxids under SEM, we found the penial hooks that differ in size and shape. Vaginal walls possess complementary structures such as surface pits and vaginal hooks were firstly discovered. In addition, the Thai streptaxid genera will be added to an existing molecular phylogenetic tree of the Streptaxoidea.

Ontogeny, morphology and taxonomy of the soft-bodied Cambrian 'mollusc' *Wiwaxia*

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The soft-bodied Cambrian organism *Wiwaxia* is a long-standing taxonomic conundrum. A molluscan affinity has recently been reasserted based on the identification of an unusual radula, but its position within Mollusca and its implications for molluscan evolution remain unclear. Indeed, its imbricated dorsal scleritome is difficult to compare with any mollusc, and has somewhat resembles that of certain annelid worms. This study of 476 new and existing fossil specimens from the 505 million year old Burgess Shale casts fresh light on *Wiwaxia*'s sclerites and scleritome. My observations clarify that the scleritome was not moulted, as previously thought, but developed gradually by the piecewise addition of individually-secreted sclerites. Mineral-filled chambers within the sclerites are described for the first time; these may reflect microvillar secretion, but also resemble the aesthete-like canals found in other Cambrian sclerite-bearers. *Wiwaxia* (along with similar Cambrian molluscs) can be accommodated within the Aculifera (Polyplacophora + Aplacophora) without too much difficulty. However, a morphology-based phylogenetic analysis supports the traditional account of molluscan evolution. In this alternative framework, *Wiwaxia*'s bizarre morphology could represent the ancestral Molluscan body plan – and perhaps even the ground plan of Conchiferan molluscs and of other Lophotrochozoan phyla.

Movement and behavior of Humboldt squid (*Dosidicus gigas*)in relation to oxygen minimum zones

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Humboldt squid (*Dosidicus gigas*) are large (> 1 m), short-lived (1-2 years), fast-growing (1 mm/d in adults), highly fecund (30 million eggs/female), generalist predators in the eastern Pacific Ocean that support the world's largest invertebrate fishery. Daily vertical migrations from 250 m or more during the day to the surface at night expose these squid to a great range of pressure, temperature, and dissolved oxygen

concentration. The Humboldt squid's life history and behavioral characteristics have likely facilitated its range expansion into the northern California Current System. Habitat utilization, behavior and food habits of *D. gigas* were compared between an area recently inhabited in the northern California Current System (CCS) and a historically established area of residence in the Gulf of California (GOC), Mexico. Low dissolved oxygen concentrations at midwater depths define the oxygen minimum zone (OMZ), an important environmental feature in both areas. We analyzed vertical diving behavior and diet of *D. gigas* and hydrographic properties of the water column to ascertain the extent to which squid utilized the OMZ in the two areas. The upper boundary of the OMZ has been shoaling in recent decades in the CCS, and this phenomenon has been proposed to vertically compress the pelagic environment inhabited by aerobic predators. A shoaling OMZ will also bring mesopelagic communities into a depth range with more illumination during daytime, making these organisms more vulnerable to predation by visual predators (i.e. jumbo squid). Because the OMZ in the GOC is considerably shallower than in the CCS, our study provides insight into the behavioral plasticity of jumbo squid and how they may respond to a shoaling OMZ in the CCS. We propose that shoaling OMZs are likely to be favorable to jumbo squid and could be a key indirect factor behind the recent range expansion of this highly migratory predator.

The effect of artificial diets on the growth and development of the tropical marine gastropod *Turbo argyrostoma*

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Turbo argyrostoma is a marine gastropod found on tropical reefs across the Indo-Pacific and Indian Ocean. In the past they have been widely harvested for their shells and their meat however, they are becoming increasingly important within the marine aquarium trade. Traded animals are being taken directly from reefs which are already being heavily impacted by overharvesting, so the establishment of culture methods for this species could help reduce pressure on their natural habitat. The main aim of this project was to investigate the effect of prepared diets on the growth rate and gonad development of *T. argyrostoma*. One-hundred and fifty *T. argyrostoma* were purchased from the Tropical Marine Centre in Manchester. Three isoenergetic diets were created; Diet A was protein based, Diet B was macroalgal based and Diet C was microalgal based. Twelve to thirteen individuals were fed on each of these diets over an elven week period and their growth and weight were measured every two weeks. At the end of the experiment, survival rates were recorded and some individuals sacrificed to measure gonad development. Results showed that *T. argyrostoma* had a significantly higher growth rate on the protein based diet compared to the microalgal based diet. There is also evidence that *T. argyrostoma* fed a protein based diet gained weight at a faster rate than either of the algal based diets. Despite this, the significantly poor survival rate on the protein diet indicates that this diet would be unsuitable in its current form for use in the mass culture of this species. Also, the diets used did not encourage substantial gonad growth, with female gonads appearing degraded by the end of the experimental period. Further research is needed into the effect of mixed diets on growth and gonad development in *T. argyrostoma* over a longer time period.

Spatial predictive distribution modelling of Madeira's endemic land snail species

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The potential distribution of 68 terrestrial endemic land snails species from the Madeira Island - Portugal were modeled throughout MAXENT software. Species distribution data from BIOBASE database and from field surveys made on 2007 and 2008 was crossed with twenty-two variables (climate, geology, land use, hydrology, disturbance, geographic location and altitude) in order to identify the species distribution patterns of endemic land snail species. We recognize a marked geographical differentiation among faunas from coastal, forest and alpine regions in Madeira Island. The coastal zone comprises three sub-areas of distribution, South coast, North coast and S. Lourenço's Eastern Cape, contradicting the early assumptions of Cameron & Cook. Compared to the coastline area, the forest and alpine regions are more homogeneous. Furthermore, the model allowed identifying the endemic species with an anthropogenic distribution such as *Disculella maderensis taeniana* and *Disculella maderensis maderensis*. In addition to that, the model also validated the importance of the altitude and slope in the distribution of species with fusiform shell as postulated by Cameron & Cook.

New potential distribution areas for vulnerable taxa such as *Discus guerinianus guerinianus*, *Craspedaria moniziana* and *Leiostyla cassidula* were identified, enhancing the value of predictive models as a tool for management and conservation of land snail species. Future work should include predictive modeling with historical data, ecological and species life histories, as well as future climate scenarios in order to fulfill information gaps related to environmental variables.

Land snail species of Porto Santan islets – The LIFE project experience

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The Porto Santan Island is one of the world's biodiversity hotspot as the land snails conservation is concerned. Dispersed on a total area of 232 ha, the Porto Santan Islets (PSI) enclose 33 taxa, where 30 (90.8%) are endemic to the archipelago and eight (24.24%) are exclusive. Some of these species, like *Discula turricula* (Cima Islet) and *Idiomela subplicata* (Baixo Islet), have a very restricted distribution, with a range less than 500m2. Several of those exclusive species have an unfavorable conservation status as they are listed as endangered both on International and Regional Red Lists. The LIFE Project "Halt the loss of European Biodiversity through the recovery of habitats and species of the PSI and surrounding marine area (LIFE09 NAT/PT/000041 - LPSI)" has the purpose of guarantee that the ecosystems on the Nature 2000 Network site of PSI (PTPOR0001 – Habitat 1250) reach a stable, favorable and self-sustainable conservation status. Taking place between 2010 – 2014, one of main aims of the LPSI is to create conditions to enable the recovery of the European priority land snail species such as *Caseolus calculus*, *Caseolus commixtus*, *Helix subplicata* and *Discula turricula*. The main ecological and conservation actions for land snails includes (1) the establishment of monitoring schemes to assess the taxa response to the concrete conservation actions implemented on the PSI, (2) improve the current knowledge about the taxonomy of the terrestrial malacological fauna of the PSI, (3) elaborate Action Plans for each of the species listed in the Habitats Directives; (4) improve the expansion of the populations of severely endangered endemic land snails (*C. calculus, C. commixtus, D. turricula, H. subplicata*) (5) Set up a network of "shelters" and exclusion areas in order to reduce and/or prevent the predation of land snails by seagulls and mice, (6) Build up of a strong support of the general public and awareness regarding the land snail species and ecosystems in question.

The effect of urban heat islands on the composition of snail communities in a large urban area.

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The concrete of cities has a high heat storage capacity. Cities are usually warmer than their rural surroundings, forming urban heat islands (UHI). For city residents, this can lead to an increase of heat-related health problems in summer (heat stress), but ecological effects and evolutionary pressure of UHI formation were hardly studied. There has not been known much about the UHI in Dutch cities until recently. Weather stations were traditionally placed outside the cities; therefore few observations were available in urban areas. In 2009, heat islands were mapped in Rotterdam (NL), showing that on a hot summer day parts of the city could be up to 7°C hotter than other parts of the city. We expect that the number of native species will be depleted in the urban areas; whereas some introduced Mediterranean species may be favored. Selection may further be on other traits including average shell size of communities (overall water content, or refuge use). Several other Dutch cities (such as Arnhem) have also been mapped for UHI formation, allowing a replication of the results is possible. In this project, the aim is to detect the signature of adaptation to so-called "heat islands' in urban areas. The question we are trying to answer is: What is the impact of UHI conditions (heat stress) on snail populations in urban areas? Sub questions will be: Will the number of species decrease? What traits (phenotypes, biological strategies) are influenced by UHI conditions and how do the traits change along the temperature gradient?

The effect of macrofauna on the success of cockle (*Cerastoderma edule*) post-larval colonisation

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Cockle populations often have highly patchy distributions as seen in many other intertidal soft sediment invertebrates. High densities of filter

feeders and/or bioturbators has been thought to reduce the success of larval settlement. However, current studies on the common cockle (*Cerastoderma edule*) indicate that the post-settlement stage maybe more important for post-larvae interactions with macrofauna than larval settlement. Manipulative field experiments in combination with two laboratory studies were conducted to investigate the effect of adult cockles and lugworms (*Arenicola marina*) on cockle colonisation success, and seek to identify the mechanisms responsible. Two field manipulation experiments which excluded the presence of adult cockles and lugworms separately, in two locations (Dee estuary and Traeth Melynog respectively), were established from the time of initial larval settlement to late summer in 2012. Each experiment consisted of six control, procedural control and exclusion plots, each 1 m^2 in area. From May to August an increasing trend of higher colonisation in plots where lugworms were excluded was observed. By August post-larvae density in the exclusion plots were significantly higher than in the control treatments, over double at 544 post-larvae per m^2. The field experiment excluding adult cockles produced the opposite trend. Colonisation of post-larvae were lower in the adult cockle exclusion plots. An aquarium study was conducted to test if any effect on colonisation could be attributed to mortality due to the presence of macrofauna. Unfortunately due to methodological problems the results of the laboratory based experiments were inconclusive. However the flume experiment, to investigate if the presence of macrofauna increased byssus drifting rates in post-larvae, indicated the possible relationship hypothesised. The mechanisms controlling the trends seen in the field experiments are still unclear from the laboratory experiments and warrant further investigation. We conclude that the presence of adult cockles and lugworms influences the colonisation success of *C. edule* post-larvae. The relationships observed increased in their strength over time. However the causal processes remain unclear. From the current results we suggest the density, distribution and population dynamics of macrofauna, such as those tested, may have significant implications on the success and spatial distribution of cockle recruitment.

PKC and *Lymnaea stagnalis* embryogenesis

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Embryonic development and morphogenesis rely on the co-ordination of complex cell signalling mechanisms. In this study, embryos of the freshwater pond snail *Lymnaea stagnalis* were used as a model to study Protein kinase C (PKC) signalling during molluscan embryogenesis. Using anti-phospho-specific antibodies against conventional PKC isoforms and confocal immunofluorescence microscopy, phosphorylated (activated) PKC was found in early 1-24 cell and late 24-36 cell embryos. In early embryos, PKC activation appeared transient and cyclical; in addition, PKC activation was observed in the nuclear region during cell division. The PKC inhibitor GF109203X blocked PKC activation in developing embryos providing a tool to explore the role of PKC during embryogenesis. Early-cleaving embryos were exposed to different concentrations of either GF109203X or the PKC activator phorbol-myristate acetate (PMA). Results revealed that early cleaving embryos which were exposed to 1 μM and 10 μM PMA did not develop further and appeared abnormal after 24 hours; however when exposed to 1 μM and 10 μM GF109203X embryo development proceeded. Chronic PMA treatment (0.01 μM and 0.1 μM) of early cleavage stage embryos during development resulted in 20% death prior to hatching whilst exposure of later embryonic stages produced 60% embryolethality. Chronic GF109203X treatment showed no lethal effects on later stage embryos, although 20% death was observed with 10 μM GF109203X treatment during development of cleavage stage embryos. Cleavage stage embryos exposed to GF109203X displayed delayed hatching whereas PMA did not affect duration to hatching; GF109203X had the opposite effect when used with later stage embryos. During these experiments rotation, heart beat and gliding were observed. Results revealed that early cleavage stage embryos exposed to PMA throughout development had significantly increased rotation, gliding, heartbeat, whereas GF109203X treated embryos showed significantly lower rotation and gliding, as well as slower heartbeat. GF109203X and PMA had considerably less effect on these parameters when short term incubations (0 – 60 min) were performed, demonstrating that the effects seen following exposure of early cleavage stage embryos are likely due to developmental defects. From these findings it can be concluded that PKC plays an important role during early embryogenesis of *L. stagnalis.*

Schedule

9.15 - 9.45 Registration & coffee

9.45 - 11.10 **Session I: Phylogeny & Morphology** *abstract*

9.45 TONY WALKER: Welcome and introduction to the day
9.50 LISA-MARIE BRAUN: Determining the origin of Antarctic calliostomatids: a molecular phylogeny of carnivorous deep-sea gastropods page 6
10.10 THANIT SIRIBOON: Systematics of terrestrial snails of the family Streptaxidae Gray, 1860 in Thailand page 14
10.30 MARTIN R. SMITH: Ontogeny, morphology and taxonomy of the soft-bodied Cambrian 'mollusc' *Wiwaxia* page 14
10.50 GARY MOTZ: Morphologic variation as a potential driver of taxonomic richness: Venerid Bivalves of the Indo-Pacific page 12

11.10 - 11.30 Coffee & poster viewing

11.30 - 13.10 **Session II: Population & Distribution**

11.30 SÉVERINE FOURDRILIS: Contemporary population genetic differentiation in *Melarhaphe neritoides* (Gastropoda: Littorinidae), a long-lived planktonic-dispersing mollusc page 8
11.50 NATHAN A. M. CHRISMAS: An association of mitochondrial haplotype with shell shape in an intertidal gastropod page 6
12.10 VANYA PRÉVOT: Characterization of the Colonizing Decollate Snail, *Rumina decollata* (Mollusca: Pulmonata: Stylommatophora) page 12
12.30 ONDŘEJ KORÁBEK: Restoration of a long forgotten name *Helix straminea* (Pulmonata: Helicidae) for a new recognised species widely distributed in Italy and Balkans page 11
12.50 HALIME D. ARICAN: Parasitic influences on the host genome using the Molluscan model organism *Biomphalaria Glabrata* page 5

13.10 - 14.00 Lunch break & poster viewing

14.00 - 15.40 **Session III: Ecology & Environment**

14.00 TIMOTHY WHITTON: The effect of macrofauna on the success of cockle (*Cerastoderma edule*) post-larval colonisation page 16
14.20 FERNANDO ANEIROS: Bivalves in the mud: a comparative approach to temporal variation in shallow subtidal bottoms page 5
14.40 ISABEL CASILLAS BARRAGÁN: Displacement patterns of intertidal consumers of a subtropical rocky shore. page 6
15.00 DINARTE TEIXEIRA: Spatial predictive distribution modelling of Madeira's endemic land snail species page 15
15.20 MANUEL LOPES-LIMA: Conservation status of freshwater Bivalves in Europe: state of the art, perspectives and future challenges page 11

15.40 - 16.00 Tea break & poster viewing

16.00 - 17.30 **Session IV: Life History & Behaviour**

16.00 VAINORA ZUKAITE: PKC and *Lymnaea stagnalis* embryogenesis page 17
16.20 RENATE A. HELWERDA: Predation on greek *Albinaria* (Pulmonata: Clausiliidae) by *Poiretia* (Pulmonata: Oleacinidae) and by an unknown organism making circular holes page 10
16.40 ELS BAALBERGEN: Predative pressure of *Drilus* (Coleoptera: Elateridae: Drilini) beetles against land snails in Greece and the Netherlands page 5
17.00 JULIA S. STEWART: Movement and behavior of Humboldt squid (*Dosidicus gigas*) in relation to oxygen minimum zones page 14

17.15 - 18.30 Wine social & final poster viewing

Poster Presentations