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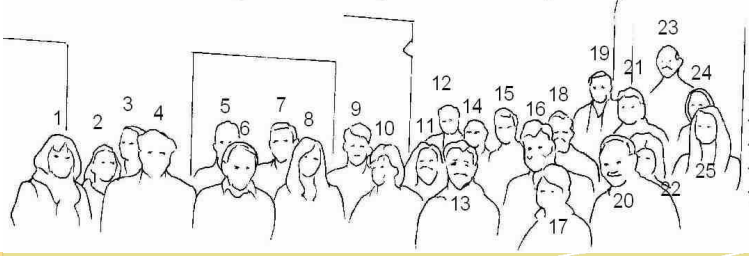
Molluscs as environmental indicators

Meeting of The Malacological Society of London,
St Catharine's College, Cambridge, Wednesday 14 April 2010



1 Emily Glover, NHM
2 Holly Barclay, Cambridge
3 David Akele, Benin
4 John Taylor, NHM
5 George Speller, Cambridge
6 Alistair Crame BAS
7 Tom White, Cambridge
8 Rowan Whittle, BAS
9 David Reynolds, Bangor
10 Elizabeth Platts
11 Olivier Moine, CNRS Meudon
12 James Scourse, Bangor
13 Dan Gianolla, Rome
14 Paul Butler, Bangor
15 David Aldridge, Cambridge
16 Richard Preece, Cambridge
17 Nicole Limondin-Lozouet, CNRS Meudon
18 Robert Cameron, Sheffield
19 Mark Davies, Sunderland
20 Charles Turner, Open & Cambridge
21 Martin Willing
22 Katrin Linse, BAS
23 David Reid, NHM
24 Jill Saffrey, Open
25 Alexandra Zieritz, Cambridge

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The Malacological Society of London was founded in 1893 and registered as a charity in 1978
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EDITORIAL

Demise of snail mail

This is the first issue of *The Malacologist* designed to be mailed electronically to most members. Very few requests for paper copy have been received, but a few spares have been prepared and will be available for anyone who neglected to request these earlier. I would appreciate feedback on quality, timing, type of material included etc. There are no 'flyers', so please enter details of forthcoming meetings into your diary now.

I apologize for tardiness in producing this issue; August has proved a difficult month in which to contact contributors and others involved in its production because of holidays, conferences and field work. I do sincerely thank those who have contributed material to this issue.

Please send me contributions for the next (February 2011) issue by mid-July. Short original articles, reviews and news items are welcome, as well as reports of recent or forthcoming meetings. Please remember to keep articles and abstracts "as short as possible but as long as necessary" and avoid or explain specialist terms. Where appropriate, please include a reference to a more detailed account, and illustrations. Copyright on all illustrations remains with the originator.

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TAXONOMIC/NOMENCLATURAL DISCLAIMER

This publication is not deemed to be valid for taxonomic/nomenclatural purposes [see Article 8b in the International Code of Zoological Nomenclature 3rd Edition (1985), edited by W.D. Ride *et al.*].

NEWS

Antarctic octopus venoms faster when cold

Venom from the posterior salivary glands is used to kill prey by many octopods, being injected by toothed salivary papillae through punctures made by the beak or the radula, and causing immobilization of the prey – usually crustaceans or molluscs. Venom from four species of eledonines (the dominant octopods in Antarctica) were assayed for alkaline phosphatase (ALP), acetylcholinesterase, and proteolytic, PLA_2 and haemolytic activities. Three showed activities in all assays, a fourth showed no haemolytic activity. Three showed higher ALP and proteolytic activity at 0°C than at 37°C , suggesting extreme cold adaptation In contrast, most proteases of psrychophilic animals have thermal optima well above that of their natural surroundings – often around 40°C.

E A B Undheim *et al.* (2010) *Toxicon* doi 10.1016/j.toxicon.2010.06.013

Intraspecific Diversity of *Conus* venoms

Improved sensitivity of mass spectroscopy allows analysis of venoms from individual venomous animals. Each of the 700 species of cone shells produces venoms based on hundreds of peptides, with dramatic differences between closely related species, such that characteristic chemical 'fingerprints' have suggested a possible 'chemotaxonomy'. This work analysing venoms of individuals of the Indo-Pacific fish-eating *Conus consors* showed not only differences between individuals, but one individual produced two completely non-overlapping sets of peptides, and surprisingly there was no correlation between the peptides extracted from the venom duct and those extracted by 'milking' the snail.

Dutertre S A *et al*. (2010) *Toxicon* **55**(8), 1453-62.

Review of conotoxins

60 years of research into peptides in cone shell venoms has delivered new analgesics, and other highly selective ion channel inhibitors and modulators are likely to be discovered

J-P Bingham, E Mitsunaga & Z L Bergeron. (2010) *Chemico-Biological Interactions* **183**, 1-18

Sperm competition in hermaphrodite land snail

Sperm competition, a component of sexual selection, is thought to exert a considerable influence on the evolution of behavioural, physiological and anatomical adaptations. *Cornu aspersum* snails (previously *Helix aspersa* and *Cantareus aspersus*) were mated with three partners, and in 19 resulting ovipositions, only 1 was sired by one partner, 7 by two partners, and the remaining 11 by three partners. Mating order is important– third partners achieved greater paternity than first and second mating partners, and second partners least. Paternity precedence was also influenced by epiphallus length (the epiphallus produces the spermatophore), and the time between mating and egg-laying.

M-E Garefalaki *et al.* (2010) *J. Evol. Biol.* **23**(5), 966-976.

Multiple paternity and sperm use in *Arianta*

Multiple paternity was detected in all of 26 wild-caught mother snails examined. Snails from a high density population showed highest level of multiple paternity, and paternity patterns were often highly skewed. A low level of selfing was found in one population.

Kupfernagel S *et al.* (2010) *Biol J Linn Soc.* 99(2), 350-361.

Effects of body size on courtship in *Succinea putris*

S. putris is a hermaphroditic land snail in which the 'active' partner mounts the shell of the 'passive' partner before reciprocal penis intromission. The smaller partner is more likely to adopt the active role. Larger individuals donate more sperm, but adjust the amount to the size of the partner. The number of sperm donated decreased in later copulations, indicating that previous matings affect resource allocation.

Dillen L *et al.* (2010) *Anim. Behav.* 79(5) 1125-1133.

Continued on page 7

Molluscs as Environmental Indicators

A meeting of The Malacological Society of London, organised by Richard Preece and David Aldridge and held at St Catharine's College, University of Cambridge, on Wednesday 14th April 2010.

The meeting covered the reconstruction from bivalve shells of ancient marine environments, including polar seas, the environmental factors influencing shell morphology in freshwater bivalves, and reconstructions of climate and human activities based on terrestrial mollusc assemblages. Abstracts of the talks were given in the February 2010 issue of *The Malacologist*, and a short overview follows.

The reconstruction of ocean chronologies from the annual growth rings of long lived mussels is similar to the use of tree growth rings or coral growth. **James Course and Paul Butler** of Bangor described the use of *Arctica islandica* – a species which includes the oldest known individual 'Ming the Mollusc' - to construct an absolute and high resolution chronology of the seas of north west Europe. The hinge region of the shell provides the most useful region for measuring increments in growth (fig. 1). Individuals of different ages respond similarly to the

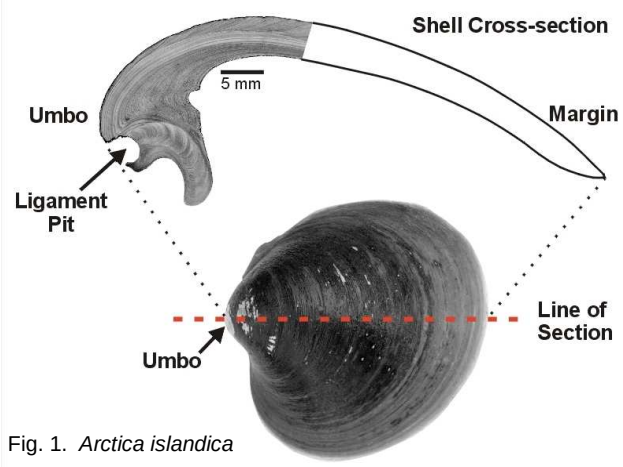

Fig. 1. *Arctica islandica*

same set of external stimuli (e.g. shells grow better in years following warm sea temperatures), so an overlapping set of individuals can be cross matched. Growth slows with age, but this decline can be compensated for mathematically. The chronologies can be constructed back through several thousand years, although very ancient shells are scarce. By recording radiocarbon ratios in growth rings, the movement of fossil fuel carbon dioxide through the environment has been illustrated, showing the role of oceans as source or sink, while changes in carbon ratios in sediment cores and in *Arctica* shells around the time of the mediaeval warm period map the shifting position of the polar front between Arctic and Atlantic water masses. A wider set of marine environments can be reconstructed by using shorter lived bivalves, as **David Reynolds** of Bangor showed, although more individuals must be found to complete a chronology. They often have a different habitat and latitudinal distribution, for example *Glycimeris glycimeris* - a mere youngster at 100-200 yrs longevity – is common in course sand and gravel and *Glossus humanus* in fine muds (fig. 2).

Fig. 2. Left *Glycimeris glycimeris*,; right: *Glossus humanus*.

Freshwater environments can be reconstructed using the shells of unionoideans. **Alexandra Zieritz**, Cambridge, is studying this, together with the ways in which environments influence shell morphology. For example, river mussels, *Unio pictorum*, grow more slowly than those in marinas, perhaps related to the cooler waters, but the shape of the dorso-posterior margin also differed, perhaps due to different water velocities. Periostracal spikes, abundant in juveniles shells, are also common in species from fast flowing rivers with coarse sediments.

Rowan Whittle (British Antarctic Survey) reviewed the use of molluscan fossils to reveal the palaeogeography of the polar regions. Seymour Island and King George Island in particular have yielded many fossils, and the former provides the best-preserved K-T boundary (fig. 3). The opening of the Drake passage, the onset of glaciation and expanded ice sheets in the Oligocene formed a barrier to animals: there was, however, a wealth of molluscs. *Limopsis*, a diverse genus of Recent Antarctic bivalve, originated in Europe, radiated in the Cretaceous, and then contracted in south polar seas where it underwent a re-radiation in the Cenozoic. **Alistair Crame** (BAS) presented evidence for a late Mesozoic origin of the antarctic fauna although faunal interchange between the polar regions occurred repeatedly. Two families of neogastropods, the buccinids and turrids, dominate both polar regions, while the tropics have more variety. In bivalves, higher level clades are similar in the tropics and both poles, but several euheterodont families commonly found in Antarctica are scarce or absent in the tropics. Additionally, polar regions became net importers of species in the Cenozoic.

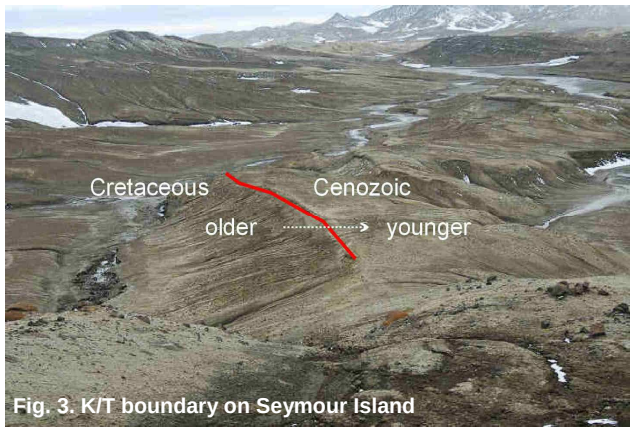

Fig. 3. K/T boundary on Seymour Island

In the first talk on terrestrial assemblages, **Olivier Moine** (CNRS, Meudon) described the transfer functions which have been developed to relate fossil mollusc faunas to climatic features such as temperature and rainfall. These include the $\delta^{13}C$ (the ratio of ^{13}C to ^{12}C), and $\delta^{18}O$. Tufas (soft porous rocks deposited from springs rich in lime) are good archives of Quaternary malacofaunal successions (fig. 4), and **Nicole Limondin-Lozouet** (CNRS, Moudon) presented a picture of the most completely known Pleistocene interglacial assemblages in Britain, Germany, Luxembourg and Northern France. Each interglacial episode is characterised by specific land snails some of which are now extinct or which then occurred well outside their modern range. Cold marshy ground, characterised by *Columella columella*, became forested, represented by *Retinella* (*Lyrodiscus) elephanticum* assemblages representing humid forest, and pine forest with *Discus rotundatus* changed to deciduous forest with *Discus ruderalis*. From 400 ka to the Holocene, Europe can be split into an 'Oriental ' and 'Atlantic' province, but there was a decrease in species richness in successive interglacials, resulting a lack of immigration in the Holocene climatic optimum, and unrelated to anthropogenic influence. In contrast, studies of Holocene tufa formations in Ireland (fig. 5), related by **George Speller** (Cambridge), show deforestations between 5000 BC and 1600 AD, with an early Neolithic phase, followed by regrowth, and an iron age lull, and then almost complete tree removal in the early Christian period. These changes are indicated by the pollen records, and mirrored by the mollusc record - *Trochea hispida* replacing *Discus rotundatus* and *Aeginopinella pura*. However, the scarcity of some critical taxa from Ireland, such as *Vallonia costata*, give different faunal signatures to events compared to those from southern England.

Bill Bailey

Fig. 4. Mollusc shells deposited in tufa.

Fig. 5. Richard Preece against tufa horizons

TRAVEL GRANT REPORT

2010 International Cephalopod Fishery Symposium, Zhoushan, China

Jennifer M Smith, University of Aberdeen

I recently had the opportunity to attend and present at the 2010 International Cephalopod Fishery Symposium held 14-16 May in Zhoushan, China. This conference provided a unique opportunity for knowledge-exchange between researchers from around the world and those based at Zhejiang Ocean University in Zhejiang Province. The island city of Zhoushan is located on the East China Sea near Shanghai and is an important base for shipbuilding, fishing, aquaculture and the processing of seafood products. Zhoushan is responsible for 10% of China's annual marine catch and more than half of that of the province, and local seafood is exported to over 50 countries and regions around the world.

More than 120 attendees from fifteen countries and five continents gathered at the Sheraton Zhoushan Hotel to hear over 25 presentations on current cephalopod-based research, including delegates from Australia, Brazil, France, Germany, India, Italy, Japan, Russia, South Korea, Spain, Taiwan and the UK. Dominant themes included environmental interactions with fisheries, cultivation technology, development throughout the life cycle, growth and maturation relationships, genetic variation and behavioural studies of octopus, squid and cuttlefish. Cephalopods possess numerous unique life cycle characteristics which contribute to their sensitivity as a fished species. Many species have only a one-year life cycle, with rapid somatic growth rates which have been shown to be temperature-dependent. There is typically little overlap between generations of a population, and therefore a lack of buffering from environmental and fishing stressors that are generally found with other commercially-viable marine species. In addition, many cephalopod fisheries around the world operate in the complete absence of regulation or management. Therefore, there is a present need to understand both the mechanisms driving the life history of cephalopods and the resulting effects on these often unpredictable fisheries, particularly for species for which there is a commercial market, so that important biological and management reference points can be identified.

Fig. 1. Welcome sign for World Cephalopod Fisheries Symposium

Keynote presentations which addressed these themes included:

- Age and maturation of *Uroteuthis (Photololigo) edulis* in the East China Sea - Lee Kuo-tien, National Taiwan Ocean University, Taiwan
- Reproductive and spawning habits of *Sepiella maindroni* off Zhejiang, China - Wu Changwen, President of Zhejiang Ocean University, China
- Ecology of cephalopod pelagic wild paralarvae: the effect of climate on the common octopus resource - Ángel F. González, Instituto de Investigaciones Marinas, Spain
- Pelagic cephalopods: biodiversity and adaptations - Ángel Guerra, Instituto de Investigaciones Marinas, Spain
- Cephalopod stocks in the north-eastern Atlantic: population assessments by ICES partners - Jean-Paul Robin, Université de Caen Basse-Normandie, France
- Fishery, management and biology: 15 years of research on southern calamari - Natalie Moltschaniwskyj, University of Tasmania, Australia
- Parasites of cephalopoda - V.N. Kazachenko, Far Eastern State Technical Fisheries University, Russia

The event was part of the 2010 Zhejiang International Forum on Marine Science and Technology, sponsored by the local government and Zhejiang Ocean University. This forum has been organized to create a platform for international cooperation on marine development. The cephalopod symposium was held with the purpose of bringing together international researchers to further shared knowledge of cephalopod biology, fisheries and aquaculture techniques with researchers from the host institution, Zhejiang Ocean University. This institution, which was founded in 1958, offers degrees and advanced training in subjects including marine biology and fisheries science and technology.

The symposium coincided with the 3rd Zhoushan China International Fisheries & Seafood Expo, which attendees visited to learn about some of the more than 700 aquatic product processing companies that operate in Zhoushan. Featured items included dried squid, frozen fish and shellfish, algae food products and fish oil supplements. Samples were generously offered, and visitors seemed to enjoy tasting the sea cucumber in particular, which according to the vendors, is purported to boost one's immune system. Delegates were invited to the opening banquet of the Expo, at which Chinese delicacies were served while traditional music from the region was performed live on stage. More than 20 different dishes of food were offered, from fresh fruit and nuts, steamed vegetables, and something which translated into English as "edible tree fungus;" shellfish such as lobster, clams, shrimp and muscles; finfish including local small yellow croaker, pomfret and sea bream; and meat dishes made with chicken and pork. We tasted Chinese tea, which we were told had medicinal properties, and fresh goji berries, which are normally found in the West in dried form only. When ordering water to accompany a meal, it was always served hot (sometimes seemingly just below the boiling point), and upon asking, I was told that it is believed to be better for digestive health at a warm temperature as opposed to cold or room temperature. Unfortunately, it was quite difficult to take a drink, as the glasses were burning the tips of our fingers!

A group excursion was also taken to Mt. Putuo, a neighboring rocky island known for its Buddhist temples dedicated to the goddess Guanyin, and included hiking, a lunch of locally caught seafood and visits to religious sites of interest. Unfortunately, during the trip, as well as throughout the entirety of the symposium, the weather in Zhoushan was cloudy and overcast with sporadic rain showers, which did not make for good scenic views or colorful photographs, but the friendliness, eager desire to impress, and the enthusiasm of the local organizers made for a very welcoming introduction to East Chinese culture and hospitality!

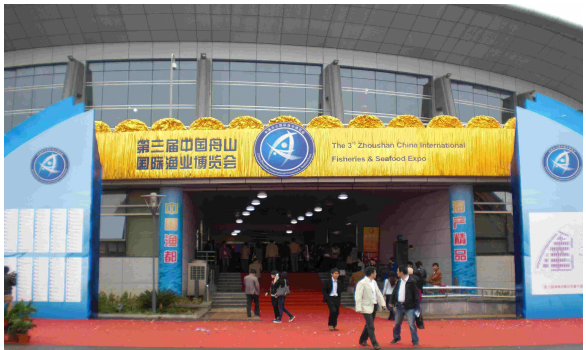

Fig. 2. Entrance to 3rd Zhoushan International Fisheries and Seafood Exposition


Fig. 3. Sea cucumbers for sampling at the Seafood Expo.


Fig 4. Delegates examine fish landed at a local market on Mt Putuo Island


Fig. 5. Buddhist temple on Mt Putuo Island

Comparative morphology and phylogeny of anomalodesmatan bivalves

The Annual Award Winner, **André F. Sartori**, describes his work

As I spent hours drafting my very first e-mail to Dr Harper, making sure my English was both clear and polite, I had no idea I was taking the initial step towards radically changing my life, professionally and on a personal level. In a little less than a couple of years, I would have finished my MSc in Brazil, left my family and friends, and moved to a remarkable but then daunting University to begin the work that culminated in my PhD dissertation.

Simply put, the aim of my doctoral research was to learn as much as possible about the evolution of anomalodesmatan bivalves, a puzzling group of marine bivalves which are ancient and ecologically diverse, but nevertheless inconspicuous in most shallow water communities. Although the original plan was to integrate palaeontological, morphological and molecular data in the pursuit of that aim, after some scaling down and sensible pruning, work consolidated around the former two datasets. The resulting dissertation is divided into three major parts:

1 Structure and development of the ligament

The hinge ligament has figured prominently in systematic treatments of virtually all bivalves. Since most anomalodesmatan lineages are currently defined on the basis of morphological variations in this organ, a fresh look into the structure and development of the ligament seemed an appropriate starting point for a study of the clade.

Fig. 1. The author digging for *Thracia phaseolina* at Mill Bay, U.K. Analysis of a growth series of the species was fundamental for understanding the anomalodesmatan ligament.

Detailed analyses of the ligament of selected representatives were undertaken using a range of zoological and palaeontological techniques, including traditional and confocal light microscopy, SEM and the preparation of etched sections through the organ. Observations revealed that the adult ligament of anomalodesmatans is not always a continuation of the larval one. In several representatives, larval and adult ligaments occur in conjunction through at least part of the animal's ontogeny, whereas in others only the former ligament is deposited.

Hence, homology hypotheses used in previous systematic treatments of the clade do not hold. An alternative scheme of ligament grades and their transitions was proposed, which better reflects the novel observations.

Related publication:

Sartori, A.F. & Ball, A.D. 2009. Morphology and postlarval development of the ligament of *Thracia phaseolina* (Bivalvia: Thraciidae), with a discussion of model choice in allometric studies. *Journal of Molluscan Studies 75*, 295–304.

2 Form, function and evolution of the arenophilic glandular system

The arenophilic system, comprising multicellular pallial glands which agglutinate sediment and other extraneous particles, is one of the only anatomical characters that is exclusively anomalodesmatan. However, the use of this system as a taxobasis had been hampered by reliance on the detection of the glands themselves along the animal's mantle margins, a method which can only be applied to material with the soft parts preserved, and may be both expensive and time-consuming.

Fig. 2. *Pholadomya margaritacea*, one of the fossil species from which arenophilic lines were recorded.

By focusing on the characteristic lines deposited by the glands on the shell surface, I was able to reveal the presence of an arenophilic system in extant members of the Laternulidae and Pholadomyidae, as well as to recognise the first known instances of fossilised arenophilic lines.

[1]University of Cambridge, U.K. Present address:

Department of Zoology (Invertebrates), Field Museum of Natural History, Chicago, IL 60605, U.S.A.

Related publications:

Sartori, A.F. & Harper, E.M. 2009. Sticky bivalves from the Mesozoic: Clues to the origin of the anomalodesmatan arenophilic system. *Lethaia 42*(4), 486–494.

Sartori, A.F., Passos, F.D. & Domaneschi, O. 2006. Arenophilic mantle glands in the Laternulidae (Bivalvia: Anomalodesmata) and their evolutionary significance. *Acta Zoologica 87*, 265–272.

3 Reappraisal of morphological characters and cladistic analysis

In face of the marked contrast between previous morphological and molecular cladistic analyses of anomalodesmatan bivalves, a comprehensive comparative analysis was undertaken to reassess hypotheses of primary homology established by previous investigators, as well as to identify novel morphological characters for phylogenetic inference. Discrete characters were coded both from original observations and literature accounts and the matrix thus compiled subjected to parsimony analysis. Among traditionally recognised superfamilies, Pholadomyoidea, Clavagelloidea and Septibranchia were found to be monophyletic. Taxa commonly referred to Pandoroidea and Thracioidea were recovered as part of two new clades, which are also supported by recent molecular studies.

Interpreted in the light of the fossil record, reconstructed phylogenetic relationships favoured the iterative evolution of shallow infaunal and epifaunal anomalodesmatans from deep-burrowing ancestors over previously advanced patterns for the history of the clade, namely ventral migration of the ligament and irreversible radiations into a deep infaunal life habit. Dissemination of these results is ongoing, with papers focusing on this cladistic analysis in preparation.

Acknowledgements

During the course of my PhD, Dr Harper, whom I had so formally addressed in our first contact, quickly became Liz Harper and then simply Liz. Without her support and encouragement my dissertation would never have been completed, never mind won the Annual Award. Without the generous gift of a Gates Cambridge Scholarship, the work briefly summarised above would not have been possible. Last but not least I sincerely thank the Malacological Society of London not only for the present award, but also for continuing support during the duration of my PhD.

Present appointment

Following the completion of his PhD, André was hired as a Postdoctoral Researcher at the Field Museum of Natural History, Chicago, U.S.A., where he has continued studying the evolution of bivalves. For details of his current project, please visit http://www.bivatol.org/BiTS.

News continued from page 2

Limiting similarity theory tested in land snails

One way species may co-exist is by being more different from each other than would occur by chance, thereby reducing competition. This limiting similarity theory was tested in the sizes and diets of treeless fen communities of snails in the Western Carpathian mountains. Contrary to expectations, co-existing snail species were MORE similar in size than expected. However, communities were less evenly distributed in their breadth of diet than expected by chance, with detritivores more common at the expense of predators.

B Schamp *et al.* (2010) *J. Anim. Ecol.* 79(4), 803-810.

Tooth wear in chitons and limpets

The teeth of chitons and limpets are among the most complex wear resistant structures in the animal kingdom, and of biomimetics interest. Whereas polychaete and termite mandibles incorporate zinc or copper, chitons and limpets iron-mineralize some or most of their teeth. Patterns of wear, and grazing marks made in a wax substrate indicate the teeth are designed to last as long as possible

J A Shaw *et al.* (2010) *Biol. Bull. Mar. Biol Lab. Woods Hole* **218**(2), 132-144.

Maternal inheritance of racemism in *Bradybaena*

Mutations of visceral asymmetry established early in development, reverse development in half or fewer homozygotes, but in pulmonates, dextral and sinistral alleles have been thought to determine polarity with complete dominance. However, a mutant is described that produces both left and right-handed forms in one clutch. The authors show that consistent production of both forms is due to the maternal effect of a recessive gene. A left-right reversed strain cannot usually be established because it has great difficulty mating with the wild type.

Utsuno H & Asami T (2010) *J. Hered.* 101(1), 11-19.

Reproductive isolation in *Littorina saxatilis*

L. saxatilis is widely distributed with high densities along wave-impacted rocky shores of the N. Atlantic. Several distinct ecotypes exist, the best investigated being S and E in Sweden and H and M in UK from cliff and boulder habitats, and RB and SU from upper and lower intertidal in Spain, where the inferred selection is between crabs and waves. Gene flow between adjacent ecotypes is restricted due to the lack of a planktonic stage. The data from these regions support a non-allopatric model of ecotype formation rather than an allopatric one, although several types of non-allopatric mechanism can explain the repeated evolution of the ecotypes.

K Johannesson *et al.* (2010) *Philos. Trans. R. Soc. Lond. Ser. B: Biol. Sci.* **365** (1547), 1735-1747.

Inbreeding depresses plasticity of defence to predator

The genetic effects of inbreeding are well known, but inbreeding may also affect the ability to respond to the environment. In nature, environmental conditions are variable, favouring the evolution of plasticity. Selfed and outcrossed hermaphroditic *Physa acuta* were reared in presence or absence of chemical cues from predatory crayfish and measured the expression of an inducible defence. Inbred snails had reduced defences but while

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RESEARCH GRANT REPORT

Corbicula fluminea as ecosystem engineer: functional importance

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Introduction and sampling strategy

Non-indigenous invasive species (NIS) are altering ecosystems at unprecedented rates representing a serious threat to biodiversity. Currently the Asian clam *Corbicula fluminea* is one of the most widespread species in aquatic ecosystems being listed as one of the 100 worst invasive species in Europe. Given its ability to attain high densities over large areas, this species can significantly alter the structure and functioning of the benthic community. In this study, our aims were to examine if the engineering effects of *C. fluminea* are responsible for significant changes in associated macrozoobenthic assemblages subjected to different abiotic conditions (brackish and freshwater); to check for possible temporal changes in the main patterns identified and to recognize the faunal groups most affected by *C. fluminea*.

Taken in account the above mentioned aims the engineering influence of *C. fluminea* was evaluated across five sites in the Minho estuary (NW of the Iberian Peninsula) during three distinct periods (winter, spring and summer) of 2009. This estuary has a high density and biomass of *C. fluminea* (e.g. some sites with a density and biomass of more than 4000 ind. m^{-2} and 550g AFDW m^{-2}, respectively; Sousa et al. 2007, 2008a, c, d and e). The surveyed sites were chosen based on the following criteria: (i) three sites were located in the lower estuarine area to evaluate the influence of *C. fluminea* on the brackish macrozoobenthic assemblage; (ii) two sites were located in the upper estuarine area to evaluate the possible effect of *C. fluminea* on the freshwater macrozoobenthic assemblage; (iii) sites within each estuarine salinity regime (i.e. brackish or freshwater) were chosen based on their similar abiotic conditions (e.g. depth, salinity, sediment characteristics) and their variation in the density of *C. fluminea*. Abiotic variables (e.g. temperature, conductivity, total dissolved solids, redox potential, salinity, dissolved oxygen, pH, nitrites, nitrates, ammonia, phosphates, hardness, granulometry of the sediment and organic matter content of the sediment) were measured at each site. Biological samples to study the macrozoobenthic assemblages associated with *C. fluminea* were obtained using a Van Veen grab.

Results

A total of 4406 specimens belonging to 32 species were collected at the brackish sites. The five most abundant species were *Corophium multisetosum* (63.2% of the total individuals present in the lower estuarine area), *Cyathura carinata* (12.4%), Chironomidae (6.8%), *Gammarus chevreuxi* (3.9%) and *Gammarus* sp1 (2.7%), while other 27 species contributed to the remaining 11.0%. A total of 2651 specimens belonging to 50 species were collected at the freshwater sites. The five most abundant taxa were Enchytraeidae sp1 (34.1% of the total individuals present in the upper estuarine area), Lumbriculidae sp1 (19.5%), Chironomidae (19.2), Tubificidae (11.2%), Hydropsychidae (2.4%), while other 45 contributed to the remaining 13.6%.

The nMDS ordination suggested a clear distinction between brackish and freshwater areas, separating the assemblages in three distinct groups: one represented by the freshwater area, one by the brackish area during spring and winter seasons, and the other by the brackish area during the summer (Fig. 1).

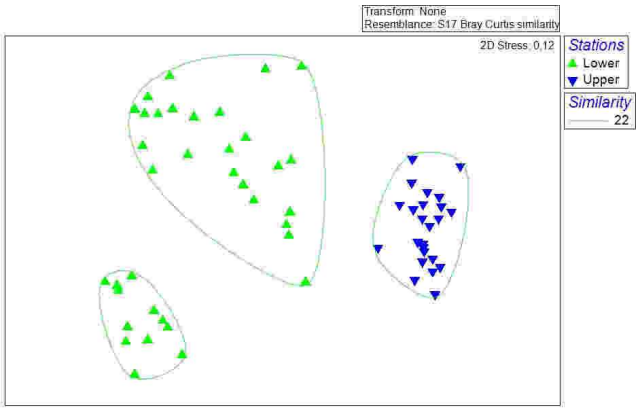


Fig. 1. Non-Metric Multi-Dimensional (nMDS) plot of the macrozoobenthos associated to *C. fluminea* in the brackish and freshwater areas, during three different seasons.

Positive correlations were found between the density of *C. fluminea* and macrozoobenthic community descriptors (density, species richness, biomass and Shannon/Wiener index) at the brackish and freshwater areas (Fig. 2). Exception was summer Shannon/Wiener index at the brackish area. Peak macrozoobenthic density and biomass at the brackish sites were observed during the summer, corresponding to amphipod recruitment. Peak density and biomass values at the freshwater sites were observed during the winter in association to higher Oligochaeta density.

Significant between-site differences in the density of crustaceans and insects were observed, at the brackish area irrespective of the time of the year. The same happened with gastropods in the freshwater area.

Discussion

This study clearly showed a positive relationship between *C. fluminea* densities and macrozoobenthic density, species richness, biomass, and Shannon/Wiener index. Among all *C. fluminea* engineering traits, the introduction or addition of massive amounts of shells to the substrate is possibly the one that provides the most obvious physical change in the invaded area. These shells form a rigid three dimensional structure into an otherwise relatively smooth, soft, featureless bottom (Sousa et al. 2009). Despite the fact that the invasive bivalve shells are different from previously existing native substrates (e.g. rocks, wood or other bivalve shells), they certainly exert great influence as structural elements by providing conditions not present elsewhere in the landscape (Sousa et al. 2009). Shell production can affect other organisms by the provision of substrata for attachment, the provision of refuges to avoid predators, competitors,

physical and/or physiological stress, and by affecting the transport of particles and solutes in the benthic environment (Gutiérrez et al. 2003). However, the creation of novel three-dimensional structure is not the only physical change caused by this NIS. *C. fluminea* also has high filtration rates and a great capacity for sediment reworking, which can lead to a variety of abiotic changes (e.g. water clarity, oxygen, redox potential, amount of organic matter, particle size) that can reverberate in alterations in the macrozoobenthic composition. Additionally, by changing water and sediment fluxes at the water-sediment interface, sediment reworking can lead to significantly modifications in sediment chemistry, grain size and organic matter content.

Crustacea, Insecta and Gastropoda increased their density and biomass with increased *C. fluminea* density. In the case of Crustacea (particularly amphipods), *C. fluminea* shells might be serving as refuge from water flow and predators. In addition, it is possible that the Crustaceans benefit from organic matter availability due to *C. fluminea* biodeposits. Similar arguments may also apply to insects (particularly Chironomid larvae). Gastropods probably use *C. fluminea* shells as hard substrate for attachment and grazing, using interstitial habitats as refugia as well. Moreover, in some cases shells are also used as oviposition sites. It should be pointed out that bivalves were negatively affected by *C. fluminea* densities while Oligochaeta were not affected. Native bivalves are displaced by *C. fluminea* presumably via settlement inhibition (Sousa et al. 2008c and d) or unsuitable abiotic conditions for juveniles development. Oligochaetes, on the other hand, may be much more influenced by organic matter content available in the sediments, which may depend on watershed scale inputs from terrestrial areas rather than local *C. fluminea* activity.

The results presented in this study are consistent with others studies performed with non-indigenous bivalves suggesting that invasive ecosystem engineers, on a local scale, may positively influences the habitat heterogeneity modifying the diversity of the macrozoobenthic assemblages (Sousa et al. 2009). The evaluation of the influence of invasive ecosystem engineer species is of extreme importance, particularly the ones that can play an important role in structuring the macrozobenthic assemblages.

Acknowledgments

This work was partially funded by The Malacological Society of London.

References

Gutiérrez JL, Jones CG, Strayer DL (2003) Mollusks as ecosystem engineers: the role of shell production in aquatic habitats. *Oikos* 101:79-90

Sousa R, Antunes C, Guilhermino L (2007) Species composition and monthly variation of the Molluscan fauna in the freshwater subtidal area of the River Minho estuary. *Estuarine, Coastal and Shelf Science* 75:90-100

Sousa, R, Rufino M, Gaspar M, Antunes C, Guilhermino L (2008a) Abiotic impacts on spatial and temporal distribution of *Corbicula fluminea* (Müller, 1774) in the River Minho estuary, Portugal. Aquatic Conservation: *Marine and Freshwater Ecosystems* 18:98-110

Sousa R, Antunes C, Guilhermino L (2008b) Ecology of the invasive Asian clam *Corbicula fluminea* (Müller, 1774) in aquatic ecosystems: an overview. *Annales de Limnologie - International Journal of Limnology* 44: 43-52

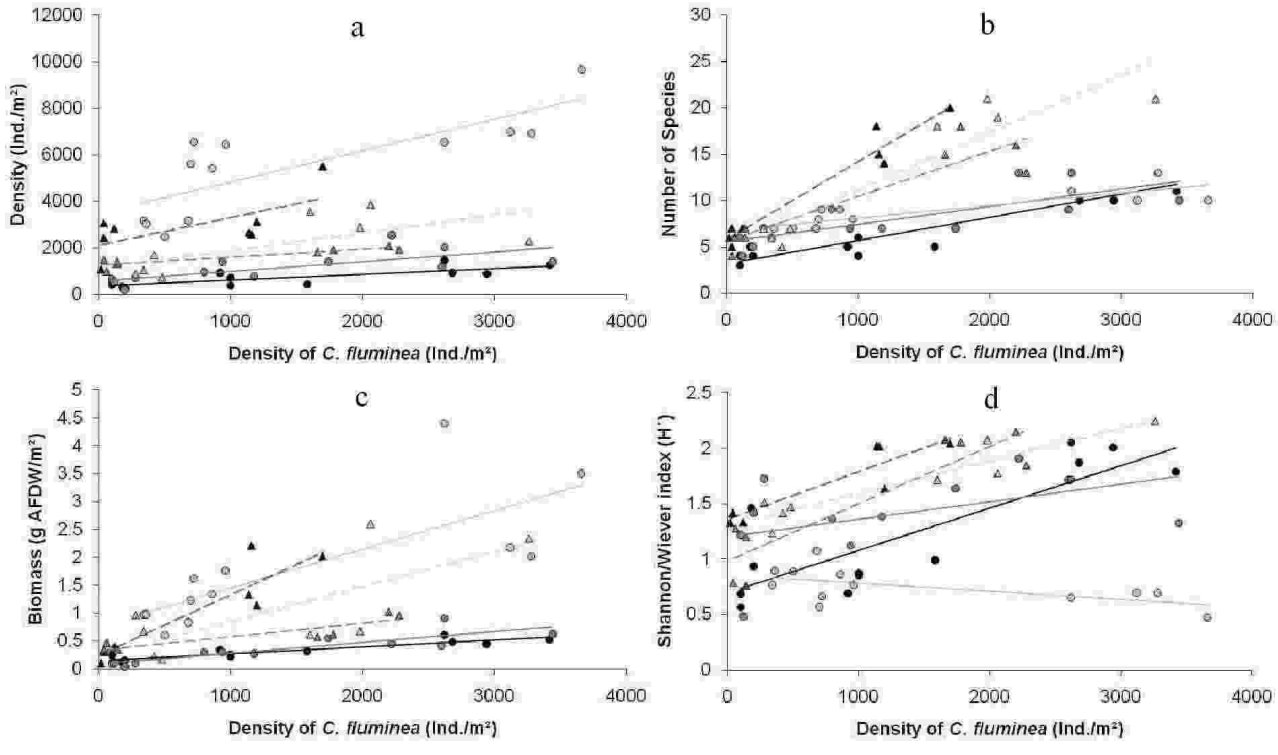
Sousa R, Dias S, Guilhermino L, Antunes C (2008c) Minho River tidal freshwater wetlands: threats to faunal biodiversity. *Aquatic Biology* 3:237-250

Sousa R, Nogueira AJA, Gaspar M, Antunes C, Guilhermino L (2008d) Growth and extremely high production of the non-indigenous invasive species *Corbicula fluminea* (Müller, 1774): possible implications for ecosystem functioning. *Estuarine, Coastal and Shelf Science* 80:289-295

Sousa R, Dias S, Freitas V, Antunes C (2008e) Subtidal macrozoobenthic assemblages along the River Minho estuarine gradient (northwest Iberian Peninsula). *Aquatic Conservation: Marine and Freshwater Ecosystems* 18:1063-1077

Sousa R, Gutiérrez, JL, Aldridge, D (2009) Non indiginous bivalves as ecosystem engineers. *Biological Invasions* 11:2367-2385

Fig. 2 Linear regressions of *C. fluminea* density and the macrozoobenthos density (a), species richness (b), biomass (c), and Shannon/Wiever index (d) of the brackish (represented by the full lines and circles) and freshwater (represented by the dashed lines and triangles) sites, during three different seasons (Winter = black lines, Spring = dark grey lines and Summer = grey lines.



RESEARCH GRANT REPORT

Reconstructing the pollution history of freshwaters using unionid shells

Nicole Spann

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Bivalve shells are very appealing as natural records of the environment in which they were formed as they incorporate elements from their surroundings into their shell permanently (Wilbur and Saleuddin 1983; Lingard *et al.* 1992). Marine bivalve shells have been used to reconstruct the palaeoenvironment (e.g. temperature, salinity, phytoplankton blooms; Stecher *et al.* 1996; Toland et al. 2000; Van der Putten *et al.* 2000; Langlet *et al.* 2007), in addition, the shells present an opportunity to monitor concentrations of anthropogenically introduced elements, like toxic heavy metals (e.g. cadmium, copper, zinc; Richardson *et al.* 2001; Markich *et al.* 2002; Barats *et al.* 2007; Bellotto and Miekeley 2007). Unionids in temperate freshwater environments like the UK can live for decades (Bauer 2001), attain a large size (up to 120mm)(Killeen *et al.* 2004) and produce distinct annual growth rings in the shell (see e.g. Fig. 1a) (Mutvei and Westermark 2001). With micro-analysis techniques such as laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS) one can therefore obtain a spatial resolution for metal analysis in the shell which corresponds to a monthly sampling. This provides a new and exciting opportunity for environmental monitoring, although only a few attempts have been made so far to use this technique in freshwater bivalves (see e.g. Schettler and Pearce 1996; Carroll and Romanek 2008). The scope of my project is to assess the potential of freshwater mussels for long-term monitoring of metals by looking at the distribution of a wide range of environmentally relevant elements in shells of the Painter's mussel (*Unio pictorum*) and how these relate to water and sediment levels from their habitat.

Unio pictorum specimens were collected in the Rivers Yare (52°35'13"N, 1°28'01"E) and Waveney (52°28'41"N, 1°35'16" E), Norfolk Broads, UK, in March 2010. The soft tissue was removed from the shells and the shells cleaned. Afterwards, shell valves of four specimens from each river were embedded in polyester resin, 2-3 mm thick cross-sections cut, polished and mounted on glass slides (Fig. 1). The samples were then analysed by LA ICP-MS (spot size 80 or 120 µm, ^{43}Ca as an internal standard, calibration with standard material NIST 610) to determine the concentrations of the following elements: magnesium, aluminium, chromium, manganese, iron, cobalt, nickel, copper, zinc, arsenic, strontium, cadmium, tin, barium, lead and uranium. Sample spots for the laser were chosen along the outside of the shell in the prismatic layer (Fig. 1b). Annual growth rings for each shell where assigned by external growth checks and through the sections. Their annual deposition was verified by analysis of the oxygen stable isotope ratio, δ^{18}O, for one shell from each river. The samples were drilled from the outside of the shell and analysed by mass spectrometry (corrected against the standard VPDB).

The eight analysed shells had ages of seven to nine years, thus spanning the period of 2002 to 2010. The δ^{18}O ratio showed peak values at the visible growth checks in both analysed shells, which relates to lower water temperatures in the winter months (Rye and Sommer II 1980; Witbaard *et al.* 1994).

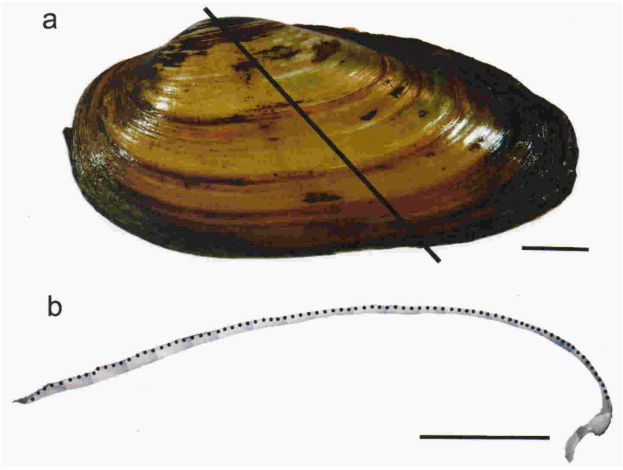


Fig. 1 a: Shell valve of one *Unio pictorum* specimen from the River Yare. The black line marks the position of the cross section which is shown in part b; **b**: Cross section of the shell shown in part a which was used for LA ICP-MS analysis. The position of laser sample spots is depicted by black dots. Scale bars are 1 cm.

With the very good spatial resolution of the LA ICP-MS technique I was able to sample seven to 25 spots per year ring for various elements, depending on its length in the section. This translates to a roughly monthly or even twice monthly sampling regime during the lifetime of the mussel. The mass spectrometer was able to detect the concentrations for many elements very well. Only the levels of chromium and cadmium in the shells were low so that about two thirds of the sampled spots had concentrations below the detection limit, whereas for aluminium, arsenic, lead and uranium only about half the values were below the detection limit. In conclusion it is feasible to attain high spatial, i.e. temporal, resolution measurements of many environmentally relevant metals in freshwater mussel shells. The next step will be to see how these shell concentrations relate to water and/or sediment levels in their home rivers.

Copper concentrations in two shells, one from each river, are shown in Fig. 2 alongside water copper concentrations from the two sampling sites. The copper concentrations in the newer parts of the shells were very variable ranging from 1.7 to 37.3 mg/kg in the years 2009 and 2010 for the River Waveney shell and 1.4 to 45.5 mg/kg for the Yare shell. In the older parts the variation was much smaller, ranging only from 0.8 to 17.4 mg/kg and 0.1 to 7.8 mg/kg for the Rivers Waveney and Yare shells respectively. A similar pattern was also present in the other six shells for Cu and was also seen for zinc. The water concentrations for the time period covered by the shells showed very variable copper water levels in the range of 1.3 to 5.8 µg/l for the Waveney and 1.9 to 13.1 µg/l for the Yare (with one high value at 69 µg/l at the end of 2008). The water concentrations of copper in both rivers had one to two peaks a year. This yearly cycle cannot be seen in the shells. There was a peak copper concentration in the Yare shell coinciding with the peak in the water, but this was only displayed by two out of four shells from the

Yare. Sediment copper levels for the two sampling sites were twice as high for the Yare, 46 mg/kg, than the Waveney with 24 mg/kg (measured in September 2004; Broads Authority 2007). There was no difference between copper levels in shells for the two rivers which might relate to the fact that either the mussels did not take up copper from the sediment or that shell levels were not related to environmental concentrations, but were controlled by the metabolism of the animal. Also for other elements the concentrations were found to be highly variable between sampled shells and between years which made it difficult to relate the shell concentrations to water or sediment levels, but doing a more detailed analysis of the data will give better results. Other studies by Richardson *et al.* (2001) and Gillikin *et al.* (2005) have also reported this high inter- and intra-annual variability for marine species and Gillikin *et al.* (2005) conclude that it is still possible to use bivalve shells to reconstruct changes in environmental metal concentrations if enough specimens are pooled.

Acknowledgements I would like to thank the Malacological Society of London for a research grant which made this project, which is one part of my PhD thesis, possible and the Biotechnology and Biological Sciences Research Council, the Cambridge European Trust and the Balfour Fund for funding my PhD. I am also extremely grateful to my supervisors on this project Dr David Aldridge and Dr Elizabeth Harper. Kai Ristau (Bielefeld, Germany) was a great assistant and brought me luck during the fieldwork. My thanks also go to the Environment Agency and the Broads Authority for providing me with water and sediment metal concentrations. I want to say thank you as well to Christina Bouthillier (Dep. of Archaeology) and Arnaud Bizard (Dep. of Engineering) for advice and help on preparing the sections, to Dr Jason Day (Dep. of Earth Sciences) for help, advice and usage of the LA ICP-MS and to the Godwin Laboratory for the stable isotope analysis (all University of Cambridge).

References

Barats, A., Pécheyran, C., Amouroux, D., Dubascoux, S., Chauvaud, L. and Donard, O. F. X. 2007. *Anal. Bioanal. Chem.* **387**: 1131-1140.

Bauer, G. 2001. *Life-history on different taxonomic levels of naiads.* In: Bauer, G. and Wächtler, K. (Ed.). *Ecology and Evolution of the Freshwater Mussels Unionoida*, Springer, Berlin, Heidelberg, pp. 83-91.

Bellotto, V. R. and Miekeley, N. 2007. *Anal. Bioanal. Chem.* **389**: 769-776.

Broads Authority 2007. *Sediment Management Strategy*. Norwich, UK.

Carroll, M. and Romanek, C. 2008. . *Geo-Marine Letters* **28**: 369-381.

Gillikin, D. P., Dehairs, F., Baeyens, W., Navez, J., Lorrain, A. and André, L. 2005. *Mar. Pollut. Bull.* **50**: 1530-1540.

Killeen, I., Aldridge, D. C. and Oliver, G. 2004. *Freshwater Bivalves of Britain and Ireland*. Field Studies Council, Shrewsbury.

Langlet, D., Alleman, L. Y., Plisnier, P. D., Hughes, H. and Andre, L. 2007. *Biogeosciences* **4**: 195-203.

Lingard, S., Evans, R. and Bourgoin, B. 1992. *Bull. Environ. Contam. Toxicol.* **48**: 179-184.

Markich, S., Jeffree, R. and Burke, P. 2002. *Environ. Sci. Technol.* **36**: 821-832.

Mutvei, H. and Westermark, T. 2001. *How environmental information can be obtained from Naiad shells.* In: Bauer, G. and Wächtler, K. (Ed.). *Ecology and Evolution of the Freshwater Mussels Unionoida*, Springer, Berlin, Heidelberg, pp. 367-379.

Richardson, C. A., Chenery, S. R. N. and Cook, J. M. 2001. *Mar. Ecol. Progr. Ser.* **211**: 157-167.

Rye, D. and Sommer II, M. 1980. *Reconstructing palaeotemperature and palaeosalinity regimes with oxygen isotopes.* In: Rhoads, D. and Lutz, R. (Ed.). *Skeletal growth of aquatic organisms: Biological records of environmental change*, Plenum Press, New York, London, pp. 169-202.

Schettler, G. and Pearce, N. J. G. 1996. *Hydrobiologia* **317**: 1-11.

Stecher, H. A., Krantz, D. E., Lord, C. J., Luther, G. W. and Bock, K. W. 1996. *Geochim. Cosmochim. Acta* **60**: 3445-3456.

Toland, H., Perkins, B., Pearce, N., Keenan, F. and Leng, M. J. 2000. *J. Anal. At. Spectrom.* **15**: 1143-1148.

Van der Putten, E., Dehairs, F., Keppens, E. and Baeyens, W. 2000. *Geochim. Cosmochim. Acta* **64**: 997-1011.

Wilbur, K. M. and Saleuddin, A. S. M. 1983. *Shell Formation.* In: Wilbur, K. M. and Saleuddin, A. S. M. (Ed.). *The Mollusca*, Academic Press, London, pp. 236-287.

Witbaard, R., Jenness, M., Van der Borg, K. and Ganssen, G. 1994. *Netherlands Journal of Sea Research* **33**: 91-101.

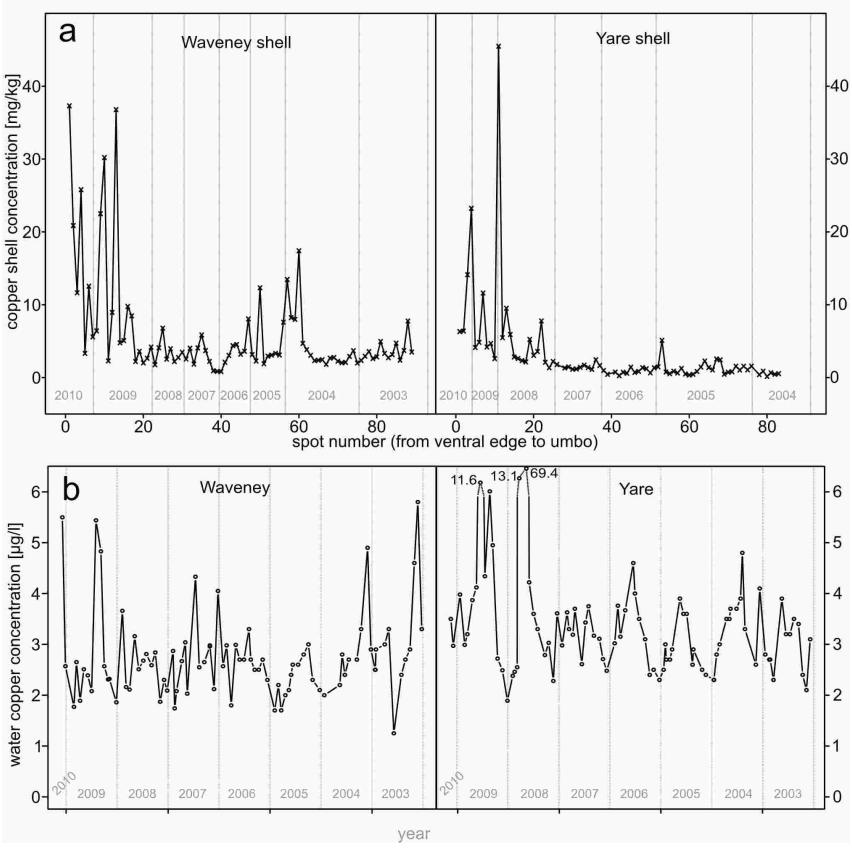


Fig. 2 a: Copper concentrations measured in laser ablation spots by ICP-MS taken along the outside of two Unio pictorum shells one each from the Rivers Waveney and Yare; **b**: Total water concentrations of copper at the same sampling sites where the shells shown in graph a were collected. Grey lines mark the boundary between two years. Water concentrations © Environment Agency database right 2010. All rights reserved.

RESEARCH GRANT REPORT

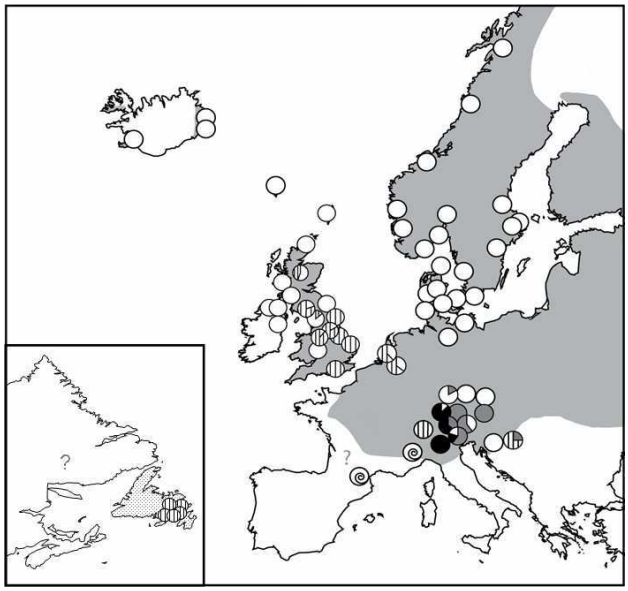
The origin of populations of the European land snail *Arianta arbustorum* on North Atlantic islands and the east coast of North America

Adele Grindon, Institute of Genetics, University of Nottingham

The European helicid land snail species *Arianta arbustorum* (Figure 1) is found in a variety of habitats that range from low to high altitude. Its preference is a damp environment with the species being rare or absent from areas with a hot, dry climate (Kerney and Cameron, 1979). Presently, it is located in northern parts of Western Europe, Scandinavia, and across the North Atlantic islands i.e. the Faeroe Isles and Iceland (Kerney and Cameron, 1979). It is also found on the east coast of North America, where it is thought to have been introduced recently (Whiteaves, 1904; Dundee, 1974; McAlpine *et al.*, 2009) (Figure 2). The origin of these populations outside of mainland Western Europe is unknown. Hence, the main aim of this project, part-funded by The Malacological Society of London, was to determine the source of *A. arbustorum* populations on the North Atlantic islands and on the east coast of North America using phylogeographic methods.

Fig. 1. *Arianta arbustorum*

Fig. 2. Map to show the present day range (shaded area) of *Arianta arbustorum* and the distribution of the main COI lineages



Helicid land snails are ideal for phylogeographic analyses, as populations display an extreme genetic structuring, with limited gene flow between populations, potentially making it possible to assign them to a precise source(s) (Thomaz *et al.*, 1996). Also, this species is common and widespread across its distribution range and therefore easy to collect in large numbers.

Field work

The majority of samples were obtained through a volunteer network; however, experience showed that it was necessary for me to collect specimens from remote areas. During the summer of 2006 I conducted a transect along the Scandinavian coastline, down parts of the east coast of North America from Newfoundland to Maine, and also in Iceland (Figure 2). Where possible I collected 10 to 30 individuals from each of the 35 sites sampled, from an area no larger than 10 x 10m. Populations were located by thorough inspection of suitable habitats, and care was taken so as not to sample near places where recent introductions are likely, i.e. agriculture areas, parks or private gardens. Samples were returned to the lab and frozen on arrival.

Phylogenetics

To date, 487 sequences of the mitochondrial (mt) DNA gene cytochrome oxidase subunit I (COI) have been aligned and analysed (Figure 3). The results indicate that individuals from Iceland, the Faeroe Isles, the British Isles and Scandinavia share a number of COI haplotypes (Table 1 and Figures 2 and 3). Conversely, populations from the east coast of North America seem to have similar haplotypes to individuals from mainland Britain and the Nether-

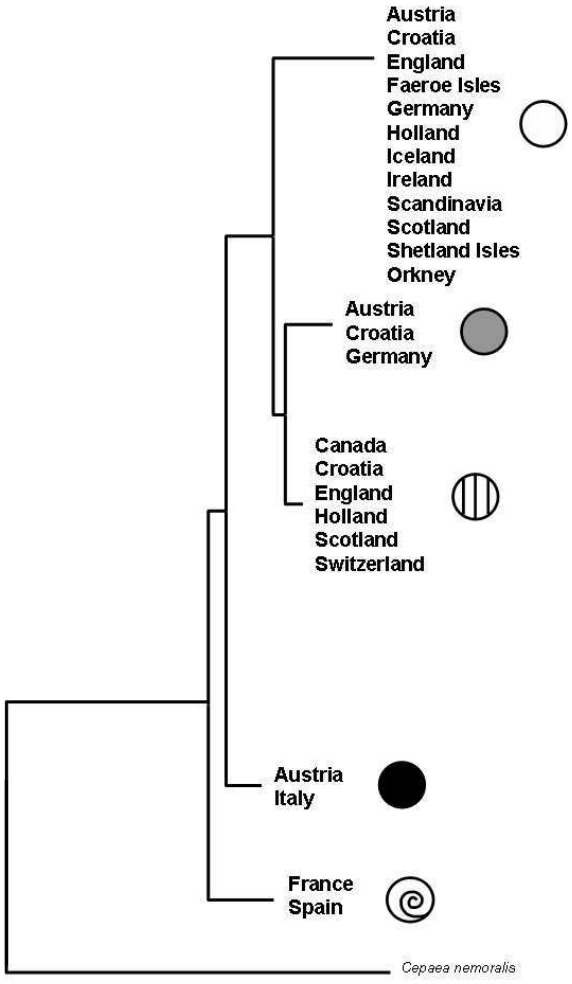


Figure 3. Summarised phylogeny for COI haplotypes The methods used to construct the phylogenetics were neighbour-joining, maximum-likelihood and Bayesian. Circles adjacent to each lineage correspond to the circles on the lineage map.

Table 1. Table of shared COI haplotypes

Shared Haplotype	Country	Population
A10	Denmark	Aalborg Arhus Roskilde Vejle
	Norway	Bergen Bodo Halden Kristainsand Ørsta Osøyro Tonsberg Trondheim
	Sweden	Falkenberg Vasteras
	Faeroe Isles	Hoyvik Nolsoy Torhavn (West)
	Iceland	Egilsstadir Neskaupstadur Reykjavik
	Scotland	Moffat Orkney Shetland Isles
	England	Stratford upon Avon
	Ireland	Murlough Bay
A22	Faeroe Isles	Hoyvik Torshavn (South)
	Sweden	Ystad
	Denmark	Naestved Svendborg
	Germany	Mecklenberg
A77	Denmark	Ribe
	Iceland	Reykjavik
A86	Denmark	Naestved
	Faeroe Isles	Torshavn (West)
	Canada	Syme's Bridge, Waterford River
	Netherlands	Wijde Aa

lands (Table 1 and Figures 2 and 3).

Conclusions

The North Atlantic islands

Individuals of *A. arbustorum* from the North Atlantic islands may have originated from mainland Britain and/or Scandinavia. This is in common with a number of other species that are spread across these islands, i.e. the house mouse and various insect species (Lupton and Wykes, 1938; Davis, 1983; Bengtson *et al.*, 1986; Buckland, 1988; Saddler, 1999; Searle *et al.*, 2009).

Colonisation of these remote islands most likely occurred in the Holocene (Buckland, 1991; Berry, 1992; Saddler, 1999), as during the Pleistocene glaciations the majority of the North Atlantic islands, the British Isles, and Scandinavia were covered by an ice sheet, resulting in the mass extinction of biota. Unfortunately a lack of archaeological evidence means it is not possible to determine exactly when or how *A. arbustorum* reached these islands; however, individuals could not have migrated by their own means, as there were no land bridges connecting these islands to a continent during the Holocene (Egisdottir, 2000). Therefore, this species must have been introduced by passive transport i.e. attached to floating debris, blown by strong wind currents, or transported by birds/humans.

Introduction by humans, either in recent or ancient times, has been suggested to explain the presence of other species on these islands i.e. the wood mouse, the house mouse, the brown rat, and various invertebrate species (Solhoy, 1981; McGovern *et al.*, 1983; Bengtson *et al.*, 1986; Buckland, 1988; Saddler and Skidmore, 1995; Searle *et al.*, 2009). It is plausible that people also transported land snails to these remote islands, perhaps in the feed and/or bedding used when shipping livestock (Saddler, 1999), as archaeological evidence from a Bronze Age ship wreck indicates that humans have previously transported land snails on boats (Welter-Schultes, 2008), either accidentally (i.e. stowaways) or intentionally (i.e. a food source). Moreover, there would have been plenty of opportunity for this to occur, as humans have been travelling around these islands since at least the 9th Century (e.g. Vikings), and possibly earlier (i.e. Irish monks) (Hermanns-Audardottir, 1991; Wallace, 1991; Hannon *et al.*, 2001), with links between islands having been in place ever since (Lindroth, 1957; Gad, 1973; Saddler, 1999).

North America

Molecular evidence implies that North America was colonised separately from the North Atlantic islands. Potentially, this supports the suggestion that North American *A. arbustorum* has been transported by trade ships in recent times (McAlpine *et al.*, 2009), as individuals could have been shipped across from mainland Britain and/or the Netherlands. Archaeological evidence is needed, however, to confirm exactly when and how this species was introduced.

Future work

The conclusions of this study are based only on mtDNA, therefore, to strengthen the findings it will be necessary to sequence a nuclear gene. Also, further samples need to be collected across the species' range and archaeological evidence obtained.

Finally, over 20 different mollusc species are currently found spread across the remote islands of the North Atlantic (i.e. Iceland, the Faeroe Isles, the

Continued on page 16

Scenes from the
World Congress of Malacology 2010
Phuket, Thailand, 18-24 July.

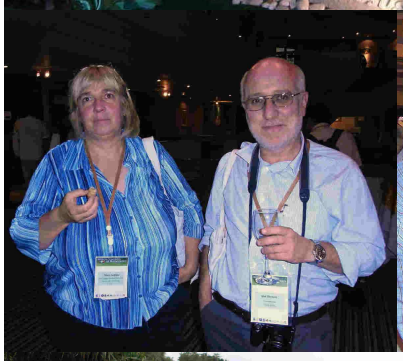
Winners of the Society's Unitas Awards 2010

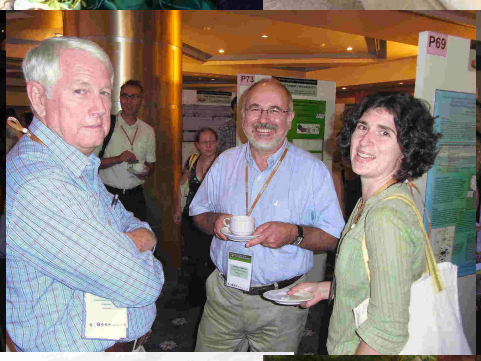
Best Poster
Spatial modelling of faunal turnover of gastropod composition reveals vertical and horizontal zones within the watershed of ancient Lake Ohrid

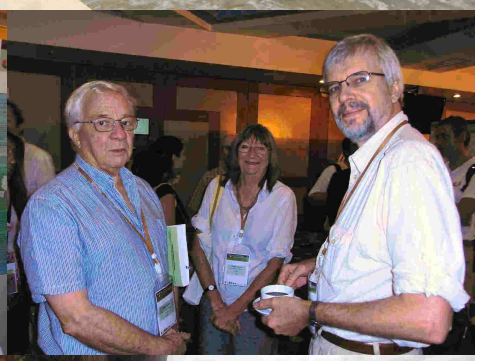
Mr Torsten Hauffe
Department of Animal Ecology and Systematics
Justus Liebig Univesitäat Giessen, Germany

Best Oral Presentation
Phylogenetic reconstruction and shell evolution of the subfamily Diplommatininae (Gastropoda: Caenogastropoda: Diplommatinidae)

Ms Nicole Webster
Institute Biology Lieden, The Netherlands.







Left to Right, from top: Kitithorn Sanpanich, Somsak Panah (Unitas President) and Monthon Ganmanee; at Conference venue; frontage of dinner venue; Mary Seddon and Dai Herbert; Fred Wells, Phillipe Bouchet and Julia Sigwart; John Taylor, Emily Glover and Rudiger Bieler; Mary Seddon, Peter Tattersfield, Ben Rowson, Robert Cameron and Susie Naggs; Shashikant Magare, Deepak Apte, Aravind, Prem Budha, Chris Oke

Left to Right, from top: Fred Naggs and Winston Ponder; Georges Dussart and Alan Hodgkinson; Tony Frias Martins, new Unitas President; Martine Claremont; Suzanne Williams, Molly and Georges Dussart; Andre Sartori; Simit Patel, Mark Davies and Gray Williams; Malacologists in the rain , James Bond Island; a solitary mangrove tree provides rich pickings for David Reid; delegates on a visit to Phuket Marine Biodiversity Centre.

Continued from page 13

Table 2. Table of mollusc species present on the North Atlantic islands

Species	Iceland	Faeroe Isles	Shetland Isles	Orkney	Norway	Scotland
Cochlicopa lubrica	X	X	X	X	X	X
Columella aspersa	X	X	X	X	X	X
Punctum pygmaeum	X	X	X	X	X	X
Vitrea contracta	X	X	X	X	X	X
Aegopinella nitidula	/	X	X	X	X	X
Lauria cylindracea	/	X	X	X	X	X
Oxychilus cellarius	/	X	X	X	X	X
Vitrina pellucida	X	X	X	X	X	X
Limax marginatus	X	X	X	X	X	X
Oxychilus alliarius	X	X	X	X	X	X
Aegopinella pura	X	X	X	X	X	X
Nesovitrea hammonis	X	X	X	X	X	X
Deroceras laeve	X	X	X	X	X	X
Deroceras agreste	X	X	/	/	X	X
Deroceras reticulatum	X	X	X	X	X	X
Arion ater	X	X	X	X	X	X
Arion fuscus	X	X	X	X	X	X
Arion sylvaticus	X	X	X	X	X	X
Arion distinctus	X	X	X	X	X	X
Arion intermedius	X	X	X	X	X	X
Arianta arbustorum	X	X	X	X	X	X

Shetland Isles and Orkney) (Table 2; Solhoy, 1981); hence, investigations into these species' origins would be useful for comparative purposes.

Acknowledgements

I am extremely grateful to the Malacological Society of London, the Genetics Society, the Carr Scholarship, and the American Malacological Society for helping to fund my field work in the summer of 2006. I would also like to thank my supervisor, Dr. Angus Davison, for his help and advice on the project, and for funding the lab work.

References

Bengtson, S. A., Brinck-Lindroth, G., Lundqvist, L., Nilsson, A., and Rundgren, S. (**1986**). "Ectoparasites on small mammals in Iceland: Origin and population characteristics of a species-poor insular community," *Holarctic Ecology* **9**, 143-148.

Berry, R. J. (**1992**). "The significance of island biotas," *Biological Journal of the Linnean Society* **46**, 3 - 12.

Buckland, P. C. (**1988**). "North Atlantic connections: introductions or endemics," *Entomologica Scandinavica Supplement* **32**, 7 - 29.

Davis, S. J. M. (**1983**). "Morphometric variation of populations of House mice, *Mus domesticus* in Britain and Faroe," *Journal of Zoology London* **199**, 521-534.

Dundee, D. S. (**1974**). Catalog of introduced molluscs of eastern North America (north of Mexico). *Sterkiana* **55**.

Gad., F. (**1973**). *A history of Greenland Vol. 2.* (David Hurst, London).

Hannon, G. E., Wastegard, S., Bradshaw, E., and Bradshaw, R. H. W. (**2001**). "Human impact and landscape degradation on the Faroe Islands," Biology and environment: *Proceedings of the Royal Irish Academy* **101B**, 129 - 139.

Hermanns-Audardo´ ttir, M. (**1991**). "The early settlement of Iceland," *Norwegian Archaeological Review* **241**, 1 - 9.

Kerney, M. P. & Cameron, R. A. D. (**1979**). *A field guide to the land snails of Britain and North-West Europe.* Collins, London.

Lindroth, C. H. (**1957**). *Faunal connections between Europe and North America* (Almqvist and Wiksell, Stockholm).

Lupton, P., and Wykes, U. (**1938**). The Field Mice of Iceland, *The Journal of Animal Ecology* **7**, 22 - 26.

McAlpine, D. F., Schueler, F. W., Maunder, J. E., Noseworthy, R. G. & Sollows, M. C. (**2009**). Establishment and persistence of the copse snail, *Arianta arbustorum* (Linnaeus, 1758) (Gastropoda: Helicidae) in Canada. *Nautilus* **123**: 14-18.

McGovern, T. H., Buckland, P.C., Savory, D., Sveinbjarnardottir, G., Andeasen, C., and Skidmore, P. (**1983**). "A study of the faunal and floral remains from two Norse farms in the Western Settlement, Greenland," *Arctic Anthropology* **20**, 93 - 120.

Saddler, J. P. (**1999**). "Biodiversity on oceanic islands: a palaeoecological assessment," *Journal of Biogeography* **26**, 75-87.

Saddler, J. P., and Skidmore, P. (**1995**). "Introductions, extinctions or continuity: faunal change in the North Atlantic," in *Human impact and adaptation: ecological relations in historical time* Edited by Butlin, R., and Roberts, N. (Blackwell, Oxford). pp. 206–225.

Searle, J. B., Jones, C. S., Gunduz, I., Scascitelli, M., Jones, E. P., Herman, J. S., Rambau, R. V., Noble, L. R., Berry, R. J., Gimenez, M. D., and Johannesdottir, F. (**2009**). "Of mice and (Viking?) men: phylogeography of British and Irish house mice," *Proceedings of the Royal Society B Biological Sciences* **276**, 201-207.

Solhoy, T. (**1981**). "Terrestrial invertebrates of the Faroe Islands: IV. Slugs and snails (Gastropda): Checklist, distribution, and habitats," *Fauna norv. Ser.* **A2**, 14-27.

Thomaz, D., Guiller, A., and Clarke, B. (**1996**). "Extreme divergence of mitochondrial DNA within species of pulmonate land snails," *Proceedings of the Royal Society of London Series B-Biological Sciences* **263**, 363-368.

BOOK REVIEWS

New Zealand Coastal Marine Invertebrates Volume 1

General Editor Steve de C. Cook
Canterbury University Press, Christchurch

2010 Hardback NZ$150. ISBN 978-1877257-60-5
640 pp. 1700 colour and b/w illustr. 22 x 29 cm

This is the first of a two-volume work that will be the largest and most comprehensive identification guide to the marine macroinvertebrates of New Zealand. Together, the two volumes will cover 1500 species, in contributions from 38 international taxonomic specialists. The format is admirably clear, following a straightforward systematic arrangement. Each major group is introduced by a brief account of its biology and structure, illustrated by excellent line drawings. Elsewhere, the policy has been to illustrate the living animals in colour in their natural habitat, supplemented by drawings or scrubbed shell specimens only when necessary for identification. Among the many pictures from underwater photographers are some images of striking beauty, particularly among the sponges, cnidarians and ctenophores. Other groups included in this first volume are platyhelminthes, nemerteans and molluscs. The descriptive text on each taxon is supplemented by lists of synonyms and taxonomic references.

The 266 molluscan pages are by R.C. Willan, S. de C. Cook, H.C. Spencer, R.G. Creese, S.J. O'Shea and G.D. Jackson. Species of less than 10 mm are scarcely mentioned. Where they are, the images in the natural habitat give a realistic impression of the difficulty of locating the animals in the field (seek out the *Risellopsis varia* on p. 361!). Nevertheless, it is the pictures of the living, crawling, burrowing and swimming animals that make this book so attractive, to beachcomber and professional alike. Nor are the cephalopods and opisthobranchs the only stars; living *Alcithoe*, *Haliotis*, *Scutus*, *Philippia* and *Austrovenus* are all striking.

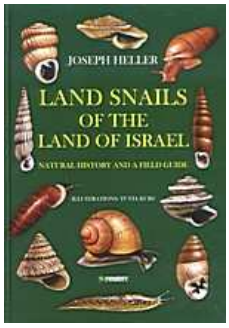
For the molluscan specialist, the content is at times disappointing. The classification is relatively traditional (for example Prosobranchia and Docoglossa appear; Cephalaspidea contains acteonoids; Anomalodesmata is a subclass). The inclusion of synonyms is welcome, but their citation (lacking vital punctuation) does not distinguish among misidentifications, alternative combinations and specific synonyms. Taxonomic references are given, but these are mainly to the classic works of Suter, Powell, Morton, Miller, Ponder and Rudman. Coverage of the literature of the past 10 years is erratic; some of the molecular systematic works of H.G. Spencer and coauthors are listed, but not the monograph of austral muricids by K.S. Tan or studies of cephalaspids by M. Malaquias. Minor errors are the mesodesmatid bivalves in place of the opisthobranch *Melanochlamys* (p. 425) and a sinistral *Cantharidus* on the Mollusca frontispiece (p. 295).

Nevertheless, this is an impressive compilation. It will be invaluable for the marine naturalist in New Zealand.

David G. Reid

Land Snails of the Land of Israel Natural History and a Field Guide

By Joseph Heller with a contribution by Zeev Arad; illustrations by Tuvia Kurz



2009 Pensoft Sofia Moscow.
Pensoft Series Faunistica No 83
ISSN 1312-0174,165 x 240,
ISBN 978-954-642-511-9.
174 hand-drawn colour illustrations, 64 colour photographs, 80b/w illustrations and 80 distribution maps, index, Hardback, 320pp, In English. Can be ordered directly online at www.pensoft.net or via email orders@pensoft.net. €70+ P+P.

Joseph Heller has compiled a sometimes informal and, in many ways, a personal review of a life time's work on the land snails of Israel that is informative and a delight to read. Faunal studies such as this provide a particularly valuable and fresh perspective of land snail diversity for workers familiar with very different fauna! assemblages. The coverage ranges widely and a description of the content follows.

Allow me to deal with some critical comments first and get them out of the way. With the introduction on global land snail diversity and classification Heller seems to be on very shaky ground, which is not helped by the transposition of figures 2 and 3 showing morphological and molecular trees. The claim that phylogenies produced from morphological and molecular data are broadly similar overlooks the fact that molecular classifications show a quite distinct pattern of higher level relationships within the Stylommatophora that were not even suspected from morphological data such as an early split between achatinoid and non-achatinoid groups. The claim that species of operculate snails are abundant in the American tropics is true enough, but they are far more numerous in Asia. The Eupulmonata are described as a minor group at the base of the Stylommatophora whereas they are a major pulmonate group and include the Stylommatophora. I also have a couple of basic quibbles in that Heller ignores the convention that only genera are treated in the singular and other groups in the taxonomic hierarchy treated in the plural and elsewhere his reference to muscle attachment does not conform with the convention that muscles originate from the 'fixed' position and 'insert' on the mobile muscle connection. The figures are, to put it mildly, of variable quality. Where it really counts, in the field guide, they are excellent but the rest range widely with a number barely acceptable; some should have been left out and figure 142, at least in my review copy, should never have seen the light of day.

Moving on to shell form and function Heller gives a succinct and informative account, with particularly clear descriptions of the form and function of the reproductive systems of several snail groups but I cannot allow the claim that only a few hundred snail species have sinistral shells pass unchallenged. Nearly all of the species rich Clausilioidea are sinistral as are many Limacoid genera and other groups; the total must be well in excess of a thousand species. An authorative section on snail activity in an arid environment for selected species is followed by a chapter on resistance to desiccation and heat by Zeev Arad. The following chapters on predators and a snail's defenses against predation are based on interesting local examples. The chapter on biogeography is a fairly detailed and for me a fascinating account that ends with informative sections on regional historical biogeography and endemic in relation to widespread groups. A short section follows on human interactions: pest species and their control and use of snails for food. Land snail conservation is the next topic and Heller focuses on a system that he developed with U.N. Sarriel for assessing conservation priorities by a method of numerical scoring.

For anyone guided by the book's title it will come as a surprise to find that the next section is devoted to Israel's fresh water snails. Fifty four pages with a systematic account of the various taxonomic groups, detailed comments on life history and behaviour, brief sections on reproduction, fly predation and patterns of distribution. Pests and disease transmission are considered and the final sections on biogeography are very informative, detailed and even include a brief review of the regional fossil record.

A selective and entertaining general account of the historical study of land snails leads to a discussion of contributors to knowledge of the regional fauna. A full reference section brings us to the end of the book? Wrong, just to the end of part one, that comes under the book's subtitle, natural history. Part two, the field guide, follows. A systematic list of native species precedes species descriptions of each species accompanied by a distribution map and excellent figures. The absence of a figure of *Deroceras libanoticum* is explained by the fact that it is known only from two preserved specimens and *Ferussacia kervillei* by the information that its recorded presence in Israel is doubted, but the absence of a figure for the widely distributed *Hohenwartiana hohenwarti* is unexplained. A glossary and detailed index really do bring this work to an end.

While I could not avoid mentioning what I consider to be flaws, some trivial and some perhaps not so trivial, my overall assessment is that this book is wide-ranging, often fascinating, informative and not to be missed; it is a most welcome addition to my bookshelf.

Fred Naggs

BOOK NEWS

Neogene Tonnoidean Gastropods of Tropical and South America: Contributions to the Dominican Republic and Panama Paleontology Projects and Uplift of theCentral Ameican Isthmus

by A. G. Beu.
Bulletin of Paleontology 377-8
550 pp., 79 pls, ISBN 978-0-87710-487-2.
US$80.00.

Revision of 142 species of tonnoideans (Bursidae, Ranellidae, Cassidae) from Neogene to Recent. Occurences of the atlantiphile *Linatella caudate* and paciphile *Malea ringens* indicate a shallow seaway allowing intermittent transport of planktotrophic larvae between E Pacidfic and W Atlantic in late Pliocene-early Pleistocene when the isthmus would have alternated between a landbridge during glacials and a shallow seaway in interglacialsuntil rising permanently around 2 Ma.

Fossiele Schelpen van de Nederlandse Stranden en Zeegaten

(Fossil shells of the Dutch beaches)
Enquiries to NMV Treasurer at buijse@zeelandnet.nl

Folia conchyliologica

A new French electronic journal dedicated to land and freshwater molluscs. May and July issues are on line at http://cernuelle.com/download.php?lng=fr

News continued from page 7

shell thickness was depressed by 26%, the plasticity of this trait was depressed by 48%.
Auld JR & Relyea RA. (2010) *Biol. Letters* 6(2), 222-224.

Parasites and wave action interact on hydrobiid shell

Sporocysts and metacercariae of the fluke *Microphallus simillimus* parasitize the gonad and digestive gland of *Heleobia australis* in an Argentinian estuary. Infection is higher in the outer estuary than from the inner part. Infected snails had narrower shells, and those from the outer estuary were smaller, perhaps due to greater wave action or allocation of more energy to reproduction in response to parasitic castrators.
Alda P *et al.* (2010) *Estuar. Coast. Shelf Sci.* 87(2), 305-310.

Dogwhelks adapt to prey availability

The delivery of nutrients and larvae from nearshore currents at scales of tens to hundreds of miles has clear ecological effects, but may also impose varying selection. The dogwhelk *Nucella canaliculata* is locally adapted to the persistent differences in prey supplied to two adjacent regions – California and Oregon. Acorn barnacles and mussels are 10-1000 times more abundant in Oregon than California. Oregon dogwhelks rarely drill the thick shells of *Mytilus californianus*, while Californian ones do. Animals from both populations were lab-reared for 2 generations to minimize any non-genetic effects and then reciprocally transplanted. Oregon snails transplanted to California failed to drill *Mytilus* and showed little growth, whereas Californian snails

Continued on page 22

The Malacological Society of London Annual General Meeting 2010

Annual report of Council for 2009

The President, Professor Mark Davies, delivered the Annual Report of Council at the 117th Annual General Meeting. He thanked Richard Preece and David Aldridge for organising the day's meeting on "Molluscs as environmental indicators" at St Catharine's College, University of Cambridge, 14th April 2010.

Membership (report prepared by Richard Cook)
The Society had 193 paid up members in 2006, 182 in 2007 and 158 in 2008. To date, this year's membership stands at 151 paid-up members, including eight new members. There a clear decline in membership, and the Society works hard to encourage lapsed members to renew. Nonetheless, the declining membership does not have a negative impact on the Society's finances.

We note with sadness the death of Jørgen Knudsen. His obituary appeared in *The Malacologist* in February 2010.

Meetings
The Society organized a symposium at the Linnean Society on 2 April 2009 *on Molluscs in Ancient Lakes – an ecological perspective*, organised by Ellinor Michel. This was also the date and place of the Society's AGM. The twelfth annual *Molluscan Forum* was organized by Martine Claremont, Claire Standley and the President and held at the Natural History Museum, London on 12 November 2009: 14 papers and 13 posters were presented. In July 2010 many members of the Society will attend the Unitas/World Congress of Malacology meeting in Phuket, Thailand.

Publications
The Malacologist (reported by Stuart Bailey)
Issues 53 and 54 of *The Malacologist*, the Bulletin of The Malacological Society of London, were produced in August 2009 and February 2010. Each issue was of 28 pages. The issues contain reports of the Society's meetings on *Molluscs in Ancient Lakes* and the *Molluscan Forum*, with notices of future meetings, together with nine research grant reports, and the annual report of Council, and news and book news. The cost to the Society was £1647, of which £471 was for postage and stationery.

Council decided in February 2010 that starting with the August 2010 issue, *The Malacologist* will be sent to members as PDFs by email, although members who let the editor know that they cannot receive PDFs will be sent paper copies. The savings will be used to upgrade and maintain the Society's website.

Journal of Molluscan Studies (reported by David Reid)
It is good to be able to report that the ISI impact factor for the *Journal* in 2008 has risen once again, to 1.408 (compared with 1.032 in 2007,0.968 in 2006 and 0.758 in 2005). The *Journal* is now restored to its leading position among malacological journals in the ISI ranking tables, and stands at number 40 in the list of 125 zoological journals (up from 56 in the previous year).

Circulation for the *Journal* in 2009 was 142 institutional (of which 41 were online-only and 61 print-only) and 151 membership subscriptions (163 and 170, respectively for 2008). In addition a further 2339 (2352 in 2008) institutions have electronic access to the *Journal* through publishers' consortia, and 749 (701 in 2008) have access through OUP's Developing Countries Offer (for details see littp://www.oxfordjournals.org/access_purchase/developing _countries.html). This means that the *Journal* is now available to 3381 personal and institutional subscribers (3386 in 2008 and 2825 in 2007).

The new pricing structure has been fixed for 2010. The cost for a combined print plus online institutional subscription is £372 ($744); online-only subscriptions are £310 and print-only subscriptions are £341.

Volume 75 contained 55 papers and research notes, totalling 421 pages. The delay between acceptance of a manuscript and electronic publication was about 5 months. Submission of manuscripts rose by 10% to 194, and the acceptance rate was 28%.

Members are reminded that they can access the entire electronic archive *of Journal of Molluscan Studies* (and its precursor *Proceedings of the Malacological Society of London).* Full instructions describing how to access this archive were published in *The Malacologist* in August 2007.

Our board of Associate Editors is now: Thierry Backeljau (molecular phylogenetics and genetics), Liz Boulding (population and reproductive biology), Robert Cameron (ecology and genetics of terrestrial Mollusca), Simon Cragg (life histories, sense organs), John Davenport (marine ecology and physiology), Mark Davies (marine ecology and behaviour), Villie Flari (physiology and behaviour), Dan Graf (freshwater bivalves), Liz Harper (marine bivalves), Robert Hershler (freshwater gastropods), Kurt Jordaens (systematics, ecology and pest control of terrestrial Mollusca), Yasunori Kano (systematics of vetigastropods, tropical ecology), Manuel Malaquias (opisthobranchs), Ellinor Michel (ecology, freshwater gastropods), Peter Mordan (terrestrial Mollusca), Jeff Nekola (community ecology of land snails), Diarmaid ó Foighil (genetics, freshwater bivalves), John Taylor (Neogastropoda, mineralogy, ultrastructure), Mikael Thollesson (opisthobranchs), Janet Voight (cephalopods), Janice Voltzow (microscopic anatomy), Tony Walker (biochemistry) and Suzanne Williams (molecular phylogenetics and genetics). I am extremely grateful for the hard work and support of all these colleagues.

The Society's website (reported by Tony Cook)
The website Malacsoc.org.uk continued to house the electronic version of *The Malacologist* and information pages. There are two issues of *The Malacologist* each year and occasional announcements and updates. In

2009 there were 164,817 unique visits to the website (i.e. visitors to more than one page). This is up from 143,236 in 2008 and continued a trend of increased usage since the website was established. Usage over the year is fairly constant although there tends to be a lull in the summer with visitor numbers dropping to ~ 12,000 per month. At other times there are 14,000 - 15,000 visits per month. Well over half the visitors come from internet providers with the .com domain name, indicating that they are private users. Thus Yahoo.com, aol.com and ntl.com are popular internet providers among our visitors. While the website, therefore, is serving the education and research communities with .ac.uk and .edu domain names prominent, these locations do not constitute a large proportion of visitors. It is not possible to locate the origin of .com and .net visitors but of the remainder, 25 countries registered more than 100 visitors in the year.

The Society's website is mainly located from Google URLs, indicating that it is regularly highlighted by search engines. The Home Page is most often accessed but *The Malacologist* is increasing in popularity with over 24,000 direct hits onto its pages. Two of the Society's mini reviews, *Aquaculture* and *Reproductive Hormones*, received around 1900 and 1200 hits, respectively.

Spin off activity from the website increased during the year with a number of organisations contacting the Society through the website. Active links to other malacological websites have been maintained. Malacological requests were passed on to relevant members of the Society when specialist expertise was required or dealt with by reference to information already available.

From 2010-11 *The Malacologist* will be published online and it is Council's intention to upgrade the Society's web presence.

Awards and Research Grants

(prepared by A J Walker, Awards Secretary)

Overall, the Society is very pleased with the number of applications that it receives for Travel Awards and Research Grants. The schemes seem to be achieving their global aim to enable young scientists to engage in malacological research both in the laboratory and at meetings. Reports from researchers funded through both schemes appear in *The Malacologist*.

The Society aims to make the following awards annually:

- Travel Awards - at least 5 each of up to £500
- Research Grants - at least 5 each of up to £1500

Application forms and guidance notes for both schemes can be downloaded from the Society's website.

Travel Awards

Since the AGM in 2009, twelve applications were received for awards to travel to meetings or to undertake research in laboratories away from the applicants' home country. All Travel Award applications are reviewed by an Awards Committee. The Society is pleased to have made the following ten awards:

- **Thomas Kunze** (£500), Museum of Natural History (Sweden) to attend a Marine Benthic Fauna of Svalbard course (Aug-Sept 2009)
- **Katrin Bolstad** (£440), Auckland University of Technology (New Zealand) to attend the Triennial Cephalopod International Advisory Council Symposium (Spain; 2 – 10 Sept 2009)
- **Viktorija Kuznecova** (£300), Vilnius University (Lithuania) to attend the IOBC Slug and Snail meeting (UK, 23-25 March 2010)
- **Viktorija Grajevskaja** (£300), Vilnius University (Lithuania) to attend the IOBC Slug and Snail meeting (UK, 23-25 March 2010)
- **Alvin Alejandrino** (£350), Iowa State University (USA) to attend the World Congress of Malacology (Thailand; 18-24 July 2010)
- **Anita Krause** (£350), Iowa State University (USA) to attend the World Congress of Malacology (Thailand; 18-24 July 2010)
- **Autum Pairett** (£350), Iowa State University (USA) to attend the World Congress of Malacology (Thailand; 18-24 July 2010)
- **Gleisse Nunes** (£500), Rio de Janeiro (Brazil) to attend the World Congress of Malacology (Thailand; 18-24 July 2010)
- **Dinarzarde Raheem** (£500), Natural History Museum, London (UK) to attend the World Congress of Malacology (Thailand; 18-24 July 2010)
- **Jennifer Smith Robertson** (£400), University of Aberdeen (UK) to attend The International Cephalopod Fishery Symposium (China; 20 – 23 May 2010)

Therefore a total of **£3,990** has been allocated by the Society for Travel Awards. All applicants have been notified of the outcome.

Research Grants

By the closing date of 15 December the Society had received sixteen applications from eleven countries. On behalf of the Society, I formally thank the members of the Grants Review Panel for their hard work reviewing all applications. The following awards were agreed by the Panel:

- **Adrienne Jochum**, Goethe University, Germany - £918. "Evolution and diversity of the troglobitic Carychiidae – A morphological and phylogenetic investigation of the terrestrial ellobiid genera, *Carychium* and *Zospeum*"
- **Max Maliska**, University of Washington, USA - £1421 "The evolution of larval forms in *Littorina* phylogeny"
- **Magdelena Marzec**, Museum of Natural History, Wroclaw, Poland - £750 "Microhabitat preferences of co-existing forest Clausiliidae"
- **Cleo Oliveira**, Universidade Federal do Rio de Janeiro - £1500 "Systematics of the cryptic species complex *Olivella minuta*"
- **Dinarzarde Raheem**, Natural History Museum, London, UK - £1500. "Species Diversification in Rainforest"
- **Reuben Shipway**, University of Portsmouth, UK - £1461. "Maternal feeding of larvae during brooding, in the wood boring bivalves of the Teredinidae

- **Conor Wilson**, Quercus, Queens University Belfast, UK - £849. "An experimental approach to investigate group living in freshwater mussels"
- **Miranda Wilson**, Georgia Institute of Technology, USA. The formation and impact of hard clam (*M. mercenaria*) spatial distributions with respect to predation"

Therefore eight Research Grants have been funded at a total cost of **£9399**. The success rate was 50 %. The Grants Review Panel would like to emphasise that the quality of all applications was high and that it funded as many excellent projects as possible. Applicants will be formally notified of the outcome of their application within the next two weeks.

The Annual Award

There was only one submission for the Annual Award this year. Despite the lack of competition, the adjudicators, John Taylor and Stuart Bailey, considered the submitted work to be of excellent quality, and the Award is made to André F. Sartori, Emmanuel College, University of Cambridge, for his doctoral thesis *Comparative morphology and phylogeny of anomalodesmatan bivalves*. See page 6.

Other prizes

Council agreed that prizes of £50 be offered to the best student oral and poster presentations at the IOBC Slug and Snail Meeting, Cardiff, March 2010. The recipients were:

ORAL - Adam Powell, Cardiff University,
Predation and scavenging by the generalist predator Pterostichus melanarius

POSTER - Marleena Hagner, University of Helsinki,
Birch tar oil is an effective mollusk repellent: field and laboratory experiments using Arianta arbustorum *(Gastropoda: Helicidae) and* Arion lusitanicus *(Gastropoda: Arionidae).*

See also the Unitas awards on page 14.

The Education Award

There were no submissions for the Education Award.

Officers and Council

Despite the fall in membership, the Society has had another successful year. This success is owing to the continued hard work of the Society's Officers and Councillors. On behalf of the membership, the President thanked all Council members, who have dealt so admirably with publications, finances, membership, administration, the website and the awards. Katrin Linse is replacing Elizabeth Platts as Hon. Treasurer, having 'shadowed' Elizabeth in the past year. Elizabeth is proposed as a member of Council, and we give her an enormous vote of thanks for her good works over several years. The Hon. Secretary, Jackie Trigwell, is also retiring from council, and is also thanked for her diligent work. No replacement has been found for the post of Hon. Secretary*.

*After the AGM, Mr Tom White, a PhD student at University of Cambridge, agreed with the President to take on the post of Honorary Secretary.

Members of Council 2010-2011

(number in brackets denotes year of office. The President, Vice-Presidents and **Councillors serve for 3 years. Any member may nominate members for council: please send nominations to any councillor by 31 December**)

President	Mark Davies (2) mark.davies@sunderland.ac.uk
Vice Presidents	Suzanne Williams (2) suzaw@nhm.ac.uk
	David Aldridge (1) d.aldridge@zoo.cam.ac.uk
Councillors	Manuel Malaquias (3) Manuel.Malaquias@bm.uib.no
	Simon Cragg (3) simon.cragg@port.ac.uk
	Ellinor Michel (2) e.michel@nhm.ac.uk
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	Fred Naggs (1) fren@nhm.ac.uk
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Membership Secretary	Richard Cook r.cook@kingston.ac.uk
Hon.Secretary	Tom White t.white@zoo.cam.ac.uk
Web Manager	Tony Cook a.cook@ulster.ac.uk
Awards Officer	Tony Walker t.walker@kingston.ac.uk
Hon. Archivist	Georges Dussart georges.dussart@canterbury.ac.uk

Co-opted members of Council:
Profs Robert Cameron (radc@blueyonder.co.uk)
John Taylor (j.taylor@nhm.ac.uk)
and Ms Martine Claremont, organiser of the Molluscan Forum (m.claremont@nhm.ac.uk),
were co-opted onto Council for the coming year.

FORTHCOMING MEETINGS

Tuesday 30 November 2010

Malacological Society of London

Molluscan Forum

Natural History Museum, London 10 am to 6 pm

This informal annual meeting is designed to bring together people starting their research on molluscs, to give them the opportunity to present and discuss their work and to compare notes on methods and problems. **This year, the Forum is held the day before the Young Systematists' Forum (www.systass.org/ysf), also at the Natural History Museum.** This has been arranged so that participants can attend both meetings.

Attendance is open to all, but speakers and poster presenters should be **research students, post-doctoral researchers, undergraduate students** starting molluscan projects or dissertations, **and amateurs** engaged in substantial projects that have not yet been published. Any topic related to molluscs is acceptable: palaeontological, physiological, behavioural, ecological, systematic, morphological or molecular.

Short talks (15 min) or posters may be offered. They need not be polished accounts of completed work: descriptions of new methods, work in progress, appeals for assistance with unsolved problems are equally acceptable.

In addition to talks and posters, there may be opportunities to acquire reprints contributed by members of the Society. The Forum will end with a wine reception sponsored by The Malacological Society of London.

There is **NO** registration fee and a limited amount of help with travel costs will be available for presenters who cannot claim them from elsewhere. Registration forms and abstract submission forms are available on the Society's website: http://www.Malacsoc.org.uk

Enquiries and registration to:

Prof. Mark Davies, Fleming Building, University of Sunderland, Sunderland SR1 3SD, UK. Tel. UK(44) + 191 515 2517 Email: mark.davies@sunderland.ac.uk

Thursday 7th April 2011

The Malacological Society of London

Chemosymbiosis in Molluscs

Flett Theatre, Natural History Museum, London

No registration is required.

Organiser Prof. John Taylor j.taylor@nhm.ac.uk

Thursday 7th April 2011

The Malacological Society of London

ANNUAL GENERAL MEETING

This will be held at lunchtime in conjunction with the Chemosymbiosis meeting

12-17 June 2011

8th Internationaql Conference on Molluscan Shellfish Safety

University of Prince Edward Island

Charlotteville, Prince Edward Island, Canada

Website: http://www.gov.pe.ca/ICMSS2011

18-22 July 2011

6th Congress of the European Malacological Societies (CEMS)

Alava Campus , University of the Basque Country, Vitoria-Gasteiz, Spain

Website: http://www.euromalacol2011.eu

Symposia will include:

- Endangered species and hotspots of Biodiversity
- Biogeography and phylogeography of the Mediterranean region and Macaronesia
- Systematics and taxonomy of Western-Palaearctic Mollusca
- Biology, Reproduction and culture of Molluscs
- Ecology
- Invasive Alien Species
- Miscellaneous

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drilled mussels and grew well. This suggests the ability of Californian snails to drill mussels allows them to succeed where resources of alternative preferred prey are scarce.

Sanford E & Worth DJ (2010) *Ecology* 91(3), 891-901.

Dual system in snail olfactory system

Few of the primary sensory neurons from the sensory pads project direct to the cerebral ganglia, where they terminated in the metacerebrum, suggesting these are mechanosensory not chemosensory. Most synapse outide the cerebral ganglia. None projected to the procerebrum, the supposed centre of olfactory processing. This suggests separate mechano- and chemosensory sub-systems, with different projection targets.

Ierusalimsky VN & Balaban PM (2010) *Brain Res.* 1326, 68-74.

Regeneration of visual system in gastropods

Several central visual projections have been identified in gastropods. These are extensive across the brain and connect with other systems, including, probably, non-ocular skin photoreceptors, and are probably involved in integration of signals from different sensors.

Tuchina O & Meyer-Rochow VB (2010) Invertebr. Biol. 129(1), 27-38.

Blood-feeding snails and Neogastropod affinities

The marine genus *Colubraria* includes species known to feed on fish blood. A phylogenetic framework for the Neogastropods is proposed that indicates that the Cancellaridae are a basal offshoot of the monophyletic Neogastropoda and the Conoidea are sister group to the Rachiglossa. The colubrariid clade within the Rachiglossa show clear buccinoid affinitiwes, and their peculiar anatomical features are related to their blood feeding habit.

Oliviero M & Modica MV (2010) *Zool. J. Linn. Soc.* 158(4), 779-800.

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SOCIETY NOTICES

The objectives of the Society are to advance education and research for the public benefit by the study of molluscs from both pure and applied aspects. We welcome as members all who are interested in the scientific study of molluscs. There are Ordinary Members, Student Members and Honorary Members. Members are entitled to receive a copy of the *Journal* and such circulars as may be issued during their membership. The society's Web Site is at:

http://www.Malacsoc.org.uk

Publications

The Society has a continuous record of publishing important scientific papers on molluscs in the *Proceedings*, which evolved with Volume 42 (1976) into the *Journal of Molluscan Studies*. The *Journal* is published in annual volumes consisting of four parts which are received by fully paid-up members and student members. Members also receive The *Malacologist*, the Bulletin of the Society, twice a year.

Meetings

In addition to the traditional researches on taxonomy and systematics, new experimental, chemical and molecular techniques are amongst the topics considered for discussion meetings and papers for publication in future volumes of the *Journal*.

Awards and Grants See back page.

Subscriptions

The Annual Subscription is due on 1st January each year.

- Ordinary Members £45 for 2005 (or US$ equivalent)
- Student Members £25 (or US$ equivalent)

Methods of Payment

(1) Sterling cheque payable to "The Malacological Society of London".

(2) Banker's standing order to: The Northern Bank (Sort code 95-01-49), 49-51 University Road, Belfast BT7 1ND, for the credit of "The Malacological Society of London" (a/c 70030422).

(3) Credit card: Overseas members ONLY may pay by credit card: the Society can accept VISA and MasterCard payments only. Please provide the Membership Secretary with your card number and expiry date, card type (VISA or MasterCard.), the name on the card, and the cardholder's address (if this differs from your institutional address). Receipts will only be sent if specifically requested.

(4) Overseas members wishing to pay electronically-should contact the Membership Secretary (R.COOK@KINGSTON.AC.UK) for SWIFT/BIC and IBAN numbers of our bank.

Institutional Subscriptions to the Journal

Enquiries should be addressed directly to Oxford University Press, Walton Street, Oxford OX2 6DP, U.K.

Change of Member's Address

Please use the address slip on the *Journal* wrapper to inform us, through Oxford University Press, of a change of address, or inform the Membership Secretary.

APPLICATION FOR MEMBERSHIP OF THE MALACOLOGICAL SOCIETY OF LONDON

I wish to apply for Ordinary*/Student* Membership (* delete one)
I enclose a cheque (payable to The Malacological Society of London) for my first annual subscription.

Title . . . . . Name . . . . . .

Department . . . . . .Institution . . . . . .

Street . . . . . City . . . . . .

Post Code . . . . . Country . . . . . Email. . . . . .

Malacological Interests . . . . . .

Signature . . . . Date . . . . . .

Please send the completed form and cheque to the Membership Secretary:
Dr Richard Cook, School of Life Sciences, Kingston University, Penrhyn Road, Kingston-upon-Thames, Surrey KT1 2EE, U.K.
Phone: 0181 547 2000 ext 2901, Fax: 0181 547 7562. Email: R.COOK@KINGSTON.AC.UK

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N T launches hunt for Mediterranean hitchhiking snail

The Mediterranean clausiliid *Papillifera bidens* (previously *P. papillaris*) was recently discovered on the National Trust's Cliveden estate in Bukinghamshire where it arrived on a stone balustrade imported from the Villa Borghese in Rome in 1896 (*The Malacologist* 53, p.7). It has now turned up on the Trust's Brownsea Island in Dorset on rock brought from Greece in the 1880s. The NT is now carrying out an audit of its properties and asks the public to help establish the snail's distribution. The large amounts of statuary, rocks and brickwork imported from the Mediterranean by the Victorians and Edwardians suggest other species could lie undiscovered. The Guardian website includes a video of the snail.
http://www.guardian.co.uk/environment/2010/aug/26/tiny-mediterranean-snail-discovered

Basal mollusc *Wirenia* and trochozoan larvae

Larval characters are key to discussions of derived or basal situation of Solenogastres. The trochophore like larvae of *Wirenia* provides no evidence of a derived status within Mollusca.
Todt C & Wanninger A (2010) *Frontiers in Zoology* 7:6

Society Awards and Grants

The Malacological Society of London makes a number of Awards and Grants. These are in addition to financial support for meetings, including travel bursaries to the Molluscan Forum.

Research Grants

The Research Grants Scheme was established to commemorate the Society's Centenary in 1993. Under this scheme, the Society anticipates making **at least five awards each year**, each with a value of **up to £1500** to support research on molluscs that is likely to lead to publication. The closing date for applications each year is **15th December**. Grants are preferentially conferred on students and researchers without professional positions, without regard to nationality or membership of the Society. Preference is also given to discrete research projects that fall within the subject areas covered by the Society's *Journal of Molluscan Studies*. Applications will be assessed by scientific merit, value of the project, and the extent to which the research will benefit the applicant's scientific aspirations. The successful applicants will be notified by 31st March and announced at the Annual General Meeting. The conditions of the award, notes of guidance and an application form are on the Society's website at **www.Malacsoc.org.uk**

Travel Grants

Travel Grants are available as bursaries to support attendance at a conference or workshop relevant to malacology. Grants are preferentially conferred on students and researchers without professional positions. The value of each of these awards is **up to £500**, and the Society anticipates that **at least five awards** will be made annually. The application should have the support of the project supervisor. In years when a UNITAS Congress is held, a number of these awards are likely to be used to support participation at this meeting. There are two closing dates each year, **30th June** for travel starting between 1st September of the current year and 28th February of the following year, and **15th December** for travel starting between 1st March and 31st August of the following year. The conditions of the grant, notes of guidance and an application form are on the Society's website at **www.Malacsoc.org.uk** Preference will be given to members of the Society.

Sir Charles Maurice Yonge Awards

Successful applications for Research Grants or Travel Awards that are concerned with the study of **Bivalvia** may be awarded as Sir Charles Maurice Yonge Awards.

Annual Award

This Award is made each year for an exceptionally promising **initial contribution** to the study of molluscs. This is often a thesis or collection of publications. The value of the Award is **£500**. Candidates need not be a member of the Society but must be nominated by a member. There is no application form: the nominating member should send the material for evaluation with a covering letter or letter of support to the Honorary Awards Secretary. The closing date each year is **1st November**. The winner(s) will be notified by 31st March, and announced at the Annual General Meeting.

Applications

Applications for Research Awards and Travel Grants should be sent by post, not email, to the **Honorary Awards Secretary,** Dr Tony Walker, School of Life Sciences, Kingston University, Penrhyn Road, Kingston-upon-Thames, Surrey KT1 2EE. Enquiries may be made by post, or by email to T.Walker@Kingston.ac.uk

Education Awards

In order to promote interest in the study of molluscs, The Malacological Society of London is introducing awards for a completed practical project in which the primary focus was molluscs. **Up to three prizes of £200** will be awarded annually for projects which are original, scientifically sound, well-presented and which would promote interest in the study of molluscs. The project must primarily involve the active participation of one or more children. However, the nomination should come via an adult who is familiar with the project. The report on the project can be in any medium - including a paper report, video, or Powerpoint presentation. The report must be in English and should include a title, aims and objectives, methods, results and interpretation, and names and addresses of the participants. There should be a statement of how the work could be extended within the context of malacology. For an application form, contact Prof. G. Dussart, Canterbury Christ Church University, Canterbury, Kent CT1 1QU gbd1@cant.ac.uk. Final submissions should be sent to **Prof. Dussart by 1st March**.