

Annual Award Winner Alexandra Zieritz describes her work.

### Variability, function and phylogenetic significance of unionoid shell characters

Freshwater mussels of the order Unionoida show a wide variability in shell features (Fig. 1), but our understanding of which factors determine which trends in shell morphology is poor. The aim of my PhD thesis was to improve our knowledge on the phylogenetic significance and functional morphologies of unionoid shell characters; or in other words, to answer the question “Why does a mussel look the way it does?”. A good understanding of morphological differences between and within species is not only needed to resolve unanswered questions on unionoid evolution but can also be helpful for other fields of research, including palaeontology, ecology and conservation of these highly threatened animals.

#### Intraspecific patterns in shell morphologies and their use for palaeontological reconstructions

If we knew which environmental conditions or other factors a given shell morphotype is associated with, we could reconstruct a mussel’s (former) habitat and/or biological characteristics by merely looking at its shell. Taxa producing hard parts that persist in sedimentary deposits can additionally be used to recover information about ancient populations and environments. Unfortunately, our incomplete understanding of which factors cause which patterns in morphology has so far limited the use of unionoids in such reconstructions of both the present and the past. This is where I come in: Applying a novel morphometric technique (Fourier shape analysis), I detected the first consistent habitat-associated trend in shell shape (Zieritz & Aldridge, 2009). This finding has particular use in palaeoenvironmental reconstructions, in which fossilised shell morphotypes are compared with modern ones. I also investigated to what extent sex and infection by parasites determines intraspecific differences in freshwater mussel shell morphology (Zieritz & Aldridge, online early). The pronounced dimorphic patterns elucidated in that study could be powerful tools in reconstructing sex ratios and

parasitic levels of both modern and ancient unionoid populations.

*Continued on page 3*



Fig. 1. Shell form variability in the Painter's Mussel *Unio pictorum*.

#### Contents

EDITORIAL .....	2
NEWS .....	2, 20, 24, 25, 27
ANNUAL AWARD: ALEXANDRA ZIERITZ.....	1, 3
MEETING: CHEMOSYMBIOTIC MOLLUSCS .....	4
JOHN E MORTON 1923-2011.....	6
OLIVER PAGET 1922-2011 .....	7
RESEARCH GRANT REPORTS:	
Phylogeny of Cancellariidae - Maria Modica .....	8
<i>Olivella minuta</i> species complex - Cleo Oliviera .....	10
Sclerochronology of NZ turritellids - Ursula Smith .....	12

Predator effects on clam distribution - Miranda Wilson .....	14
Troglobytic Carychiidae - Adrienne Jochum .....	16
F and M types in mussels - Frederico Batista .....	19
BRIEF COMMUNICATION: <i>Succinea oblonga</i> in Finland .....	20
ANNUAL REPORT OF COUNCIL FOR 2010 .....	21
WINNERS OF AWARDS AND GRANTS .....	22
MEMBERS OF COUNCIL .....	23
FORTHCOMING MEETINGS .....	26
BOOK NEWS .....	26
SOCIETY NOTICES .....	27
SOCIETY AWARDS AND GRANTS .....	28

## EDITORIAL

**Change of Editor**

This is the last issue of *The Malacologist* which I shall edit. Future issues will be edited by Professor Georges Dussart, and copy for the next issue (February 2012) should be sent to him at georges.dussart@canterbury.ac.uk by the end of January. We are swapping roles - I take over as Archivist.

I have edited *The Malacologist* (then called the *Bulletin*) since August 1993 (Number 21), taking over from June Chatfield. The newsletter has grown in size from 16 pages to around 28, mainly with copy from the abstracts of the Forums and the reports of Research Award holders. The newsletter added colour in February 2004, and was first distributed as an electronic pdf one year ago. I had been feeling that I was, at last, getting consistent quality and the job was settling into a routine, although keeping up to date is more difficult since retirement. But routine can turn into rut, and I am sure Georges will bring a fresh approach to the job.

Please don't forget to tell Georges or the membership secretary (R.COOK@KINGSTON.AC.UK) if you change your email address.

Short original articles, reviews and news items are welcome, as well as reports of recent or forthcoming meetings. Time-sensitive information, e.g. about forthcoming meetings, for inclusion in the email Updates for April, June, October or December are required by the start of the relevant month.

Please remember to keep articles and abstracts "as short as possible but as long as necessary" and avoid or explain specialist terms. Where appropriate, include a reference to a more detailed account, and illustrations. Copyright on all illustrations remains with the originator.

Dr S E R ('Bill') Bailey  
61 Carlton Rd, Sale, Cheshire M33 6WY, U.K.  
0161 962 2573  
S.Bailey@M336WY.freemove.co.uk

**TAXONOMIC/NOMENCLATURE DISCLAIMER**

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

## NEWS

**The late George Crawford**

George Crawford, President of the Malacological Society 1960-62, died earlier this year, aged 100. An obituary will appear in the next issue.

**Citizen Science reveals Evolutionary Change in *Cepaea***

The banded helixid snail *Cepaea nemoralis*, is sensitive to its thermal environment and many European populations exhibit polymorphisms of shell ground colour and banding pattern affecting its albedo. A test for changes in shell albedo possibly driven by climate warming over the last half century was made by compiling an historical dataset of 6,515 populations and comparing this with new data on nearly 3,000 populations sampled in 2009 through Evolution MegaLab, a citizen science project engaging thousands of volunteers in 15 countries. A known geographic cline in frequency of yellows has persisted, and a difference in colour frequency between woodland and open habitats was confirmed. However, there was no general increase in yellows, perhaps because snails show behavioural thermoregulation. There was an unexpected decline in frequency of unbandeds and increase in mid-bandeds. These suggest other selective agents, possibly changing predation pressure and habitat change.

Silvertown J, Cook L, Cameron R, Dodd M, McConway K. *et al.* 2011. PLoS ONE 6(4): e18927.

**More protection needed for horse mussels in N Ireland**

N. Ireland's environment minister has joined the call for more protection for Strangford Lough, following a research report by Queen's University Belfast. The horse mussels form large reefs providing a critical habitat for many other species and are a key reason why the Lough has Special Area of Conservation status. Nearly 4 square kilometres of beds have been lost since 1992, probably due to disturbance by mobile fishing gear. The Department of Environment and Department of Agriculture (which protects the interests of local fishermen) have been in discord over non-disturbance and fishery exclusion zones.

Source: [www.bbc.co.uk/news/uk-noirthern-ireland-14323798](http://www.bbc.co.uk/news/uk-noirthern-ireland-14323798)

**Think Global, Act Local on Ocean Acidification**

In the long term, curbing carbon emissions is the only way to halt the rising amounts of CO<sub>2</sub> in seawater and maintain a pH around 8.2 to protect coral and shell-forming marine organisms. However, local acidification has a disproportionately large effect on coastal communities, and a group of scientists and lawyers in the US claim local initiatives can be effective. For example, putting crushed shells into the sediments has reversed the decline of the northern quahog in Chesapeake Bay. Further, and enforcing existing laws on coastal erosion and river water quality can reduce local acidifying pollution. Kelly RP *et al.* 2011. *Science* 332(6033): 1036-7.

**Phylogeny and androgenesis in *Corbicula***

There are 3 morphotypes of the invasive *Corbicula* in W. Europe associated with 3 mitochondrial lineages and 3 genotypes. Form R shares the same COI haplotype as American form A and Japanese *C. leana*. Form S and American form C have the same haplotype although their morphologies seem divergent. European form R1c belongs to the same mitochondrial lineage as American form B and Asian *C. fluminea*. Within each haplotype/genotype or lineage, no genetic diversity was found. Some rare mismatches were found between mtDNA and nrDNA, indicating androgenesis and mitochondrial capture between form R and form S. A global analysis reveals that sexual *Corbicula* lineages are restricted to native areas, while androgenetic relatives are widespread and highly invasive. L-M Pigneur *et al.* 2011. *BMC Evol. Biol.* 11, 147.

**Rare gene capture in *Corbicula* clams**

Although asexuality has short-term advantages, the lack of genetic recombination leads over time to the accumulation of deleterious mutations. Androgenesis is a form of asexual reproduction in which the maternal genes are ejected from the eggs, effectively parasitising them, so that the offspring are clones of their father. It is possible that the parasitising clam may steal genes from the host's eggs. This rare capture of genetic material through reproduction with other species of clam may allow androgenic lineages of *Corbicula* to reduce the accumulation of deleterious genes.

Hedtke S M, Glaubrecht M, Hillis DM. 2011. PNAS DOI: 10.1073/pnas.1106742108.

Continued on page 20

Continued from front page

### Unravelling interactions of geno- and phenotypes

To be able to resolve the many open questions on unionoid taxonomy and evolution, we need to know whether and which intraspecific trends in shell morphology are based on differences in genotype or caused by plasticity of the phenotype. Using Amplified Fragment Length Polymorphism (AFLP) markers, Zieritz *et al.* (2010) provides the first profound molecular evidence for phenotypic plasticity in a freshwater mussel species (*Unio pictorum*). The study shows that unionoid shell ecophenotypes are not associated with the genetic composition of the respective individuals, thereby answering a question that has been subject to considerable scientific debate.

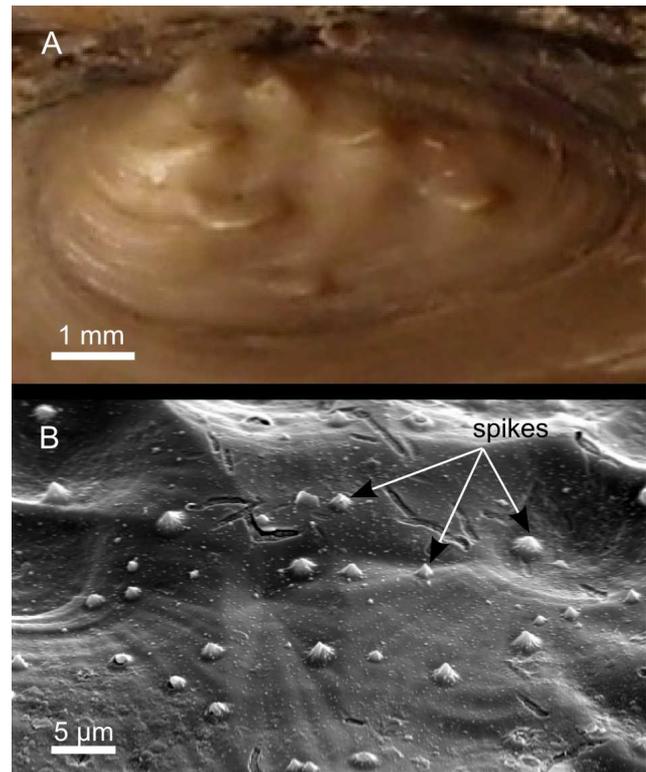
### Phylogenetic and functional significance of shell sculptures

Besides studying intraspecific patterns in gross shell morphology, I am also interested in phylogenetic signals and function(s) of shell sculptures. Zieritz, Bogan & Aldridge (in review) investigates interspecific patterns in so-called umbonal sculptures, i.e. ornaments that are restricted to the earliest shell region (Fig. 2A). Based on examination of more than 150 species, I developed a new model for the evolution of this interesting but poorly studied shell character. On the microscale, Zieritz *et al.* (2011) describes and discusses the phylogenetic and functional significance of periostracal microprojections. Using scanning electron microscopy, my collaborators and I identified three types of periostracal microprojections: completely or predominantly organic (1) microridges and (2) microfringes, and (3) calcified spikes (Fig. 2B). These minute structures are completely new to science and may serve in protecting the periostracum and shell underneath, and / or stabilising life position by increasing shell friction.

### Acknowledgements

Working on this PhD thesis has truly been a pleasure which to a great part is thanks to the people I have had the honour to get to know and collaborate with. My genuine thanks go to my supervisor David Aldridge for his guidance, encouragement and continuous support. My secondary advisors Elizabeth Harper and Richard Preece provided invaluable additional malacological expertise and were always there when I needed them. There are a number of additional people who I am indebted to but I would like to especially mention my collaborators William Amos, Joseph Hoffman, Antonio Checa and Arthur Bogan. My subsistence costs during this PhD were predominantly covered by studentships of the *Austrian Federal Ministry of Science and Research* and the *Cambridge European Trust*. Finally, I sincerely thank the *Malacological Society of London* for generous travel grants that enabled me to present my work at several international conferences and for all the support it is giving to us “young” malacologists.

Since completing my PhD last year in September, I went on to do a 10 months, DAAD-funded Postdoc at the Technische Universität München, Germany (Jürgen Geist, Technical University Munich) to continue my work on freshwater mussels. In September 2011, I will be leaving for Kasetsart University Bangkok, Thailand, where I will be collaborating with Uthaiwan and Satit Kovitvadhi.



**Fig. 2.** (A) Umbonal sculpture in *Unio pictorum*. (B) Periostracal spikes in *Anodonta cygnea*.

### References

- Zieritz A. & Aldridge DC. 2009. Identification of ecophenotypic trends within three European freshwater mussel species (Bivalvia: Unionoida) using traditional and modern morphometric techniques. *Biol J Linn Soc.* **98**: 814–825.
- Zieritz A. & Aldridge DC. (online early). Sexual, habitat-constrained and parasite-induced dimorphism in the shell of a freshwater mussel (*Anodonta anatina*, Unionoidae). *J Morph.*
- Zieritz A, Bogan AE & Aldridge DC (in review). Variability and a new model for character evolution of umbonal sculptures in the Unionoida.
- Zieritz A, Checa AG, Aldridge DC & Harper EM 2011. Variability, function and phylogenetic significance of periostracal microprojections in unionoid bivalves. *J Zool Syst and Evol Res.* **49**: 6–15.
- Zieritz A., Hoffmann JI., Amos W. & Aldridge DC. 2010. Phenotypic plasticity and genetic isolation-by-distance in the freshwater mussel *Unio pictorum* (Mollusca: Unionoida). *Evol Ecol.* **24**: 923–938.



Alexandra Zieritz measuring mussels beside the River Thames.



The Malacological Society of London Annual Meeting

**Chemosymbiotic molluscs and their environments: from intertidal to hydrothermal vents**

The Natural History Museum, London 7-8 April 2011

The discovery of hydrothermal vents in the late 1970s triggered an enormous biological interest in chemoautotrophic organisms dependant on previously unknown symbioses with sulphide and methane oxidising bacteria. The initial focus on vents was succeeded by discoveries of similar communities at hydrocarbon seeps and later at whale falls and other organic accumulations. It was also recognized that chemosymbiotic molluscs are often abundant in many shallow water habitats. Molluscs, particularly bivalves, are the most diverse and widespread group of chemosymbiotic animals ranging from the intertidal to hadal depths. No longer rare and exotic it is estimated that there are over 700 species of chemosymbiotic bivalves classified into six separate families.

This meeting organized jointly by the Malacological Society and NHM Zoology Department and also sponsored by the Palaeontological Association brought together an international group of researchers from a wide range of disciplines to review the biology, diversity, evolution, host-symbiont interactions and habitats of these molluscs

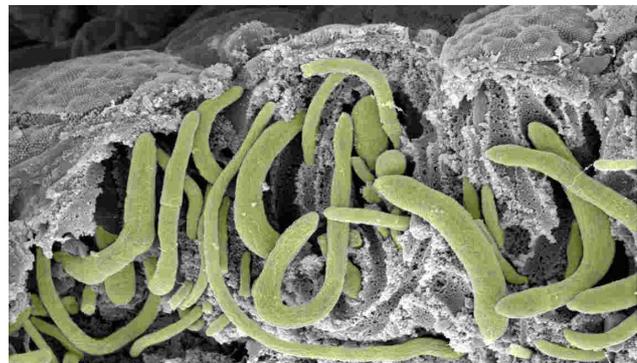
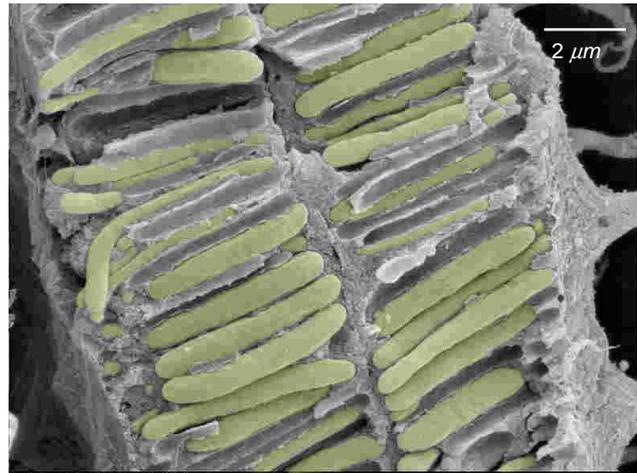
Sarah Samadi (MNHN, Paris) reviewed new discoveries from the West Pacific of the remarkable diversity of deep-sea mussels associated with sunken wood and other organic material. Molecular phylogenetic studies of Bathymodiolineae confirm that deep-sea mussels were first associated with organic falls and then colonized hydrothermal vents and cold seeps involving multiple invasion events.

Sebastien Duperron (Université Pierre et Marie Curie, Paris) highlighted the diversity of symbionts associated with bathymodioline mussels with some host species harbouring both methane and sulphide-oxidizing bacteria. The two types respond rapidly to fluctuating chemical environments. He explored the hypothesis that symbiosis may have initially originated as a detoxification adaptation in suboxic environments.

The southern seas of western Europe have yielded surprises with the discovery of many mud volcanoes in the Gulf of Cadiz and Clara Rodrigues (Universidade de Aviero) reviewed the remarkable diversity of chemosymbiotic bivalves associated with mud volcanoes in the area including new species of Solemyidae, Vesicomidae, Thyasiridae and Lucinidae.

Graham Oliver (National Museum of Wales) reviewed the Thyasiridae one of the most abundant and widespread groups of chemosymbiotic bivalves, represented by over 100 mainly small, living species living in habitats from the intertidal to deep-sea. Although some species are associated with hydrocarbon seeps and hydrothermal vents most species occur in normal ocean floor sediments. There are symbiotic and non-symbiotic species and the symbiont-bearing species show a range of apparent stages of the integration of the bacteria into host cells.

The first discoveries of hydrothermal vents in the East Pacific revealed spectacular dense aggregations of large white clams, *Calyptogena magnifica* reaching lengths of 25 cm. They belong to the Vesicomidae, a previously obscure family known from only a few shells dredged by deep-sea expeditions. Continuing investigations of vents and cold seeps



**Fig 1 from top:** *Solemyarina velesiana* Moreton Bay, Queensland. Section of gill filament of *Solemyarina velesiana* with symbiotic bacteria (false coloured).

Bacteriocyte of the lucinid *Pegophysema philippiana* with abundant symbionts (false coloured).

*Calyptogena magnifica* paratype specimen from 2492 metres on Galapagos Rift (Museum of Comparative Zoology, Harvard University).

around the world have recovered around 100 species of vesicomys. Elena Krylova (Institute of Oceanology, Moscow) and Heiko Sahling (University of Bremen) have been responsible for new systematic analyses of these species and showed that morphological studies and molecular analyses are teasing apart relationships of the species originally usually lumped together as '*Calyplogena*' divided so far into 16 genera. Details are emerging of the chemical environments occupied by the different vesicomys species.

The fossil record of chemosymbiotic bivalves was reviewed by Steffen Kiel (University of Göttingen) including the fauna from fossil seeps, vents, mud volcanoes, wood and whale falls. Lucinidae and Solemyidae originated in the Lower Palaeozoic but Mesozoic records of Vesicomysidae are now reinterpreted as lucinids and Bathymodiolinae first appeared in the early Cenozoic. He also showed beautifully preserved wood associated, cellulolytic-symbiont bearing Xylophaginae.

John Taylor and Emily Glover (Natural History Museum, London) contrasted the diversification histories of Solemyidae and Lucinidae. The former represented today by around about 30 shallow and deep water species first appeared in the early Ordovician. Despite the fragile shells the fossil record indicates that the family has never been species-rich but long associated with dysaerobic habitats. The Lucinidae with over 400 living species are by far the most diverse chemosymbiotic family and date from the late Silurian. They have a poor fossil record through the late Palaeozoic but increased in diversity through the Mesozoic with a mid-Jurassic association with hydrocarbon seeps and a massive shallow water radiation through the Cenozoic. On-going molecular analyses are teasing apart relationships. Matthijs van der Geest (Royal Netherlands Institute for Sea Research) highlighted the ecological importance of lucinids in seagrass systems with a study of massive abundance of *Loripes lacteus* in coastal Mauritania where the bivalve forms an important food for migratory wading birds. Symbionts of Lucinidae are known to be acquired from the environment and Caroline Verna (Max Planck Institute of Marine Biology, Bremen) has analysed symbionts from many lucinids and compared them with a phylogeny of host species. There is no close co-evolutionary pattern but some lucinids have specific symbionts. Gastropods are also diverse and abundant components of vent faunas and Jenna Judge (University of California, Berkeley) analysed diversification patterns based on ecological and phylogenetic and biogeographic data. Adrian Glover (NHM, London) concluded the first day with spectacular video-images of the fauna populating recently discovered hydrothermal vents around the Scotia Arc, Antarctica.

Five posters were exhibited – Luciana Genio et al. (University of Aveiro) highlighted the diversity and relationships of gastropods from the Gulf of Cadiz mud volcanoes. Justine Thubaut (MNHN, Paris) showed new molecular results for the phylogenetic relationships of the *Bathymodiolus thermophilus* lineage. From a Venezuelan Cenozoic

seep, Fiona Gill (University of Leeds) displayed a new genus and species of large Lucinidae. Krzysztof Hryniewicz et al. (University of Oslo) showed bivalves collected from newly discovered fossil hydrocarbon seeps at the Jurassic-Cretaceous boundary on Svalbard. Capsiconchiid bivalves occur frequently at late Mesozoic cold-seeps and Robert Jenkins et al. (University of Tokyo) discussed their palaeoecology, morphology and relationships.

The talks continued into 8th April where Paul Dando (Marine Biological Association, Plymouth) showed in a long term study in Bergen Fjord how previously dense populations of *Thyasira* associated with organic rich sediment from marine sewage disposal declined after changes in the sewage treatment regime. The fauna associated with oil drilling activities in the North Sea was described by John Hartley (Hartley Anderson, Aberdeen). Initially the mud impregnated by lubricating oil around the drilling rigs was colonized by a large population of the chemosymbiotic mussel *Idas simpsoni* a species usually associated with sunken whale bones. The mussel populations disappeared after cessation of drilling activity. Karina van der Heijden (Max Planck Institute of Marine Biology, Bremen) examined the biogeography of mussels and their symbionts from mid Atlantic Ridge vents and Eastern Atlantic seeps. Graham Oliver and John Taylor (National Museum of Wales and NHM London) showed for the first time morphological evidence of bacterial symbionts in the gills of two Arabian Sea species of the Nucinellidae a family of usually minute bivalves thought to be related to the solemyids.

In a stimulating final discussion session topics ranged from the possible recognition signals between host and symbiont, the mechanisms by which symbiosis developed, and how to identify possible chemosymbiosis in entirely fossil groups. Two bivalve families seem suitable target subjects for examining the evolution of chemosymbiosis - Thyasiridae and Mytilidae for in both families there are asymbiotic and symbiotic species, and with the symbiotic species showing varying degrees of integration of symbionts to the hosts.

Chapters in the recently published review volume provide a useful introduction to the subject.

Kiel S, ed. 2010 *The Vent and Seep Biota – from Microbes to Ecosystems. Topics in Geobiology*, 33. Springer. Heidelberg

John Taylor and Emily Glover  
The Natural History Museum, London



## Obituary: John Edward Morton (18 July 1923 - 6 March 2011)

Brian Morton

Department of Zoology, The Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

e-mail: [prof\\_bmorton@hotmail.co.uk](mailto:prof_bmorton@hotmail.co.uk)

John Edward Morton was born on 18 July 1923 in the small town of Morrinsville, near Waikato on the north island of New Zealand and attended university in Auckland, obtaining an honours degree in Zoology in 1945 and a M.Sc. in 1948 with a dissertation on the Struthiolariidae. Subsequently, John stayed on at the University of Auckland to continue his malacological studies. He researched the stomach of the turbinid *Lunella smaragda*, the commensal bivalve *Scintillona zelandica* and, most importantly, the anatomy of the New Zealand Vermetidae and continued working on the Struthiolariidae. In 1949, John met Maurice Yonge (1899-1986) who was in Auckland attending the Seventh Pacific Science Congress and the two spent much time talking "molluscs". Following this meeting, Maurice was instrumental in bringing John to Great Britain where he studied for his Ph.D. on the evolution of marine pulmonates at Birkbeck College, University of London, under the supervision of Alastair Graham (1906-2000). Following graduation in 1952, he became a junior lecturer in Zoology at Queen Mary College, also University of London. During this time, John's malacological career blossomed. He became a member of the Malacological Society of London in 1952 and in the same year and post Ph.D. occupied the University of London's bench at the Plymouth Marine Laboratory where he undertook re-

search on the crevice fauna of the rocky shore at Wembury and completed a series of classic papers on *Lasaea rubra*. He also researched feeding and digestion in the scaphopod *Dentalium entalis*. Here too he commenced research on the pelagic *Clione limacina* and *Akera bullata* and soon became an authority on the Pteropoda, writing them up for the Benguela Current in the Discovery Reports (1954). Also in 1952, he researched the nassariid *Cyclope neritea* on the French Basque coast at St. Jean de Luz. Amongst all this and other research activities, John found time to write "*Molluscs*" (1958: London, Hutchison University Library), essentially an undergraduate text that any zoology student of my generation will remember. This was so popular it went into nine editions. As well as the pelagic gastropods, he wrote a series of papers on the Vermetidae, some in co-operation with the eminent American malacologist Myra Keen, and, hence, over a ten-year period, he had not only written research papers on representatives of the major molluscan groups but become an authority on many of them, not forgetting, of course, the Ellobiidae. Within a period of ten years study in England, therefore, he was on a reputational par with his mentors Maurice Yonge and Alastair Graham in terms of academic and intellectual status.

John returned to New Zealand in 1960, with a D.Sc. from the University of London, as the University of Auckland's Founda-

tion Professor of Zoology, the appointment being from 1959. With his appointment to its chair, the Zoology Department at Auckland became much more marine oriented and John's research interests began to diversify and broaden. His interest in feeding and digestion was retained, however, and resulted in publication of "*Guts*" (1967: London, Alfred Arnold) in which he compared and contrasted the spectra of invertebrate digestive systems.

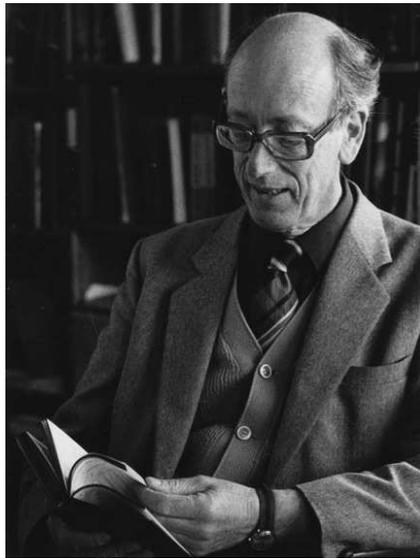


Fig. 1. John Morton in Hong Kong in 1975.

In New Zealand, marine science had traditionally been focused around the Portobello Marine Laboratory of the University of Otago at Dunedin. There was no comparable laboratory on the north island. To vitalize the study of marine biology at the University of Auckland, therefore, John recognized the need for a marine laboratory actually on the coast, as at Portobello and, accordingly, the Leigh Marine Station was built and opened in 1965. Bill Ballantine had been recruited from England in 1961 to work with John on the project and he became the Station's first director in 1965.

In 1965 too, John participated in the Royal Society's Solomon Island Expedition in which he led the marine party and where he undertook his first, six month long, research on Pacific island shores. These exciting new research initiatives largely released him from malacology and henceforth he devoted himself to intertidal ecology and conservation and he published (with Michael Miller) his groundbreaking researches on New Zealand's shores – the "*New Zealand Sea Shore*" (1968: London & Auckland, Collins). In 1969, he was elected a fellow of the Royal Society of New Zealand. To ensure the success of the Leigh Marine Laboratory, John recognized that the waters surrounding it had to be protected and he provided justification for the reserve with the assistance of V.J. Chapman, then Professor of Botany at the University of Auckland, in a little (44 page) book "*Rocky Shore Ecology of the Leigh Area, North Auckland*" (1968: University of Auckland). The Cape Rodney to Okakari Point Marine Reserve, encompassing Goat Island, just offshore, was established in 1975 and became New Zealand's first marine reserve securing the success of the marine laboratory at its heart.

I first met John in 1972 when I was awarded a Leverhulme Fellowship to work in his laboratory at the University of Auckland for three months. Subsequently, with the support of C.M. Yonge, John was awarded a Royal Society Fellowship that would enable him to spend time in Hong Kong with me. Over his three-month stay in 1975 (Fig. 1), we produced the diagrams for and subsequently wrote "*The Sea Shore Ecology of Hong Kong*" (1983: Hong Kong, Hong Kong University Press). In 1985, under the auspices of the Association of Commonwealth

Universities, I made a two-month long tour of Southeast Asia, Australia, Fiji and New Zealand visiting marine laboratories in preparation for the designing of the Swire Marine Laboratory (now the Swire Institute of Marine Science) in Hong Kong. Of the marine stations visited, the Leigh Laboratory was undoubtedly the model upon which the University of Hong Kong facility would eventually be based and officially opened in 1990. It too, located on the Cape d'Aguilar Peninsula on the southeastern tip of Hong Kong Island, is encompassed by Hong Kong's only marine reserve (designated in 1995).

Urban sprawl in New Zealand, especially around Auckland and its beautiful coastline, stimulated John to write (with David Thom and Ron Locker) "*Seacoast in the Seventies*" (1973: Auckland, Hodder and Stoughton Ltd.), which was, in essence, a plea for more sensitive coastal planning. Subsequently, he and Ron Cometti wrote "*Margins of the sea*" (1985, Auckland, Hodder & Stoughton Ltd), which was an exploration of New Zealand's beautiful coastline, and later edited "*A natural history of Auckland*" (1993) illustrated in the style he had made his own but with wonderful paintings of the city parks and its surrounding land and seascapes, again by Ron Cometti. Published, just over 30 years after John's return to New Zealand, the book is actually a testimony to his insights, research and persuasive powers such that at the time of its writing a network of parks was in existence in Auckland covering 12,000 hectares in sixteen locations and encompassed by ninety kilometres of captivating coastline. Today, some 10% of New Zealand's shoreline is now protected.

Between 1977 and 1983, John lead groups of University of Auckland undergraduates to Fiji for a fortnight's field camp investigating southern Pacific shores. Subsequently, he wrote, in co-operation with Uday Raj, "*The shore ecology of Suva and South Viti Levu*" (1985, University of the South Pacific, Fiji). He also worked in Samoa, the Cook Islands, New Caledonia and Papua New Guinea and, in 1977, taught and researched at St Andrew's University, New Brunswick, Canada. Here, he edited,

with J.C. Roff and M. Beverley-Burton, "*Shore life between Fundy tides*" (1994 Toronto, Canadian Scholars Press). This lifetime's accumulated wealth of intertidal information culminated in the publication of his final work – "*Seashore ecology of New Zealand and the Pacific*" (2004, Auckland, David Bateman).

John Morton described his sojourn in England as the happiest period of his life and his heroes were Maurice Yonge, Alister Hardy (1896-1995) and Alan Stephenson (1898-1961), respectively, in terms of molluscs, plankton and, later, spiritualism, and the intertidal. Certainly, therefore, John was an 'old school' malacologist and coastal ecologist but he was a genius at inspiring the people of New Zealand and local and national politicians and administrators to protect many beautiful areas, particularly coastlines, of New Zealand. Later in life he also took up the cause of native tree and forest conservation. Because of his endeavours, John Morton left behind him a better New Zealand environment than the one he had returned to from England fifty years previously. Not just this, but in conquering and then escaping from the academic confines of malacology, he also left behind him a New Zealand public that is far more aware of environmental issues, particularly conservation, and one can be sure that in his native country his legacy will be remembered for a long time to come.

John Morton was a devout Christian who wrote three theological books dealing with the relationships between religion, creation, evolution the environment and conservation. Appropriately, therefore, a funeral service celebrating the life of John Morton was held on 11 March 2011 at St Mary's Cathedral in Auckland. John's wife of 55 years, Pat, died but 11 days later. Their two children, Clare (b. 1957) and Rob (b. 1958), and grandchildren, Matthew, Sam and Tilde, survive them.

---

## Obituary: Dr Oliver Paget 1922-2011

Oliver Paget was born in Vienna, studied there and worked there, but he travelled widely and had contacts and friends in many countries. After graduation he held several posts in the university, mainly involving studies on the genetics of *Drosophila* and mice. He joined the staff of the Natural History Museum in 1955 and was put in charge of the mollusc collections which had been neglected for some years. He reorganised the exhibits and developed a particular interest in the terrestrial molluscs of the Eastern Alps and the Balkans. In 1972 he became Director of the Invertebrate Division of the Museum and in 1979 he was appointed First Director of the Museum.

He will be remembered by older members for his role in the early years of *Unitas Malacologica*. He attended the first congress in London in 1962. He was President during 1965-68 and organised the successful Third Congress in Vienna in 1968. From 1971 to 1986 he served as Secretary of *Unitas* and, in my view, it was his energy and enthusiasm that was largely responsible for keeping the soci-

ety alive at a time when funds seemed to be a perpetual problem. There was no *Unitas* Newsletter at that time but we received occasional circular letters from Dr Paget with news of events.

Dr Paget was particularly interested in tracing his family history and the Paget line was largely in England, based around Great Yarmouth. He traced the main line back to the early 17C and a sideline back to the 13C. He had several distinguished relatives in this country, notably Sir James Paget, who was a surgeon to Queen Victoria and after whom Paget's Disease was named. He also enjoyed classical music and photography.

Oliver Payer died in March after a short period in hospital. He will be greatly missed by his family, colleagues and friends.

Alasdair Berrie

---

## A multigene molecular approach to the phylogeny of nutmeg shells (Cancellariidae)

Maria Vittoria Modica

Department of Biology and Biotechnologies 'Charles Darwin', 'La Sapienza' University of Rome, Viale dell'Università 32, 00185 Roma, Italy.

Nutmeg shells or Cancellariidae is a worldwide family of neogastropod, with the highest diversity in the Indo-West Pacific and Eastern Pacific. They are well represented in the fossil record, with about 1200 nominal species. The ca. 300 living species are soft bottom dwellers and reported to feed on body fluids of fish and mollusks and on cephalopod egg capsules (O'Sullivan *et al.*, 1987; Talmadge, 1972). Suctorial feeding is made possible by the presence of a highly specialized nematoglossan radula, able to efficiently pierce target tissues.

The cancellariid shell is quite variable, with considerable variations from the "typical" structure of a solid biconical shell with a cancellate sculpture, an elliptical aperture with strong columellar plaits and a short siphonal canal. Shell characters were the basis of the traditional subdivision of the family in three subfamilies (Bouchet & Rocroi, 2005): Cancellariinae (including Trigonostomatinae Cossmann, 1899), Admetinae and the recently described Plesiotritoninae (Beu & Maxwell, 1987).

The relationships between these groups as well as the genus-level classification are rather confused, partly due to the recurrent homoplasies in shell characters, and partly to the paucity of other kinds of information such as molecular and anatomical data. Sequences from only eight species are recorded in GenBank, while only a few papers describe Cancellariidae anatomy, beside radular structure (Graham, 1966; Harasewych & Petit, 1982, 1984, 1986; Strong, 2003; Modica *et al.*, 2009, and 2011; Verhecken *et al.*, submitted). Living cancellariids are rather infrequent, and alcohol preserved tissues are generally not present in reference collections.

A remarkable exception to this situation is constituted by the malacological collection of the Muséum National d'Histoire Naturelle (Paris), which includes a considerable number of wet specimens properly fixed for subsequent anatomical and molecular studies, thanks to significant collection efforts in the Indo-West Pacific. This material was studied in the framework of a Synthesys research grant. Additional material was personally collected in Eastern Pacific.

The aim of this project was to propose a robust molecular phylogeny for Cancellariidae, which may constitute the basis of further anatomical and evolutionary studies. Furthermore, as Cancellariidae probably represent the earlier off-shoot of Neogastropod radiation (Kantor, 1996; Oliverio & Modica, 2008), our results may be the basis of a clarification of the early evolutionary history of the whole Neogastropoda, the most successful living marine gastropod clade.

### Materials and methods

98 specimens belonging to 49 putative morphospecies, representative of 22 genera of the three recognized subfamilies were investigated in this study.

Specimens were identified based on shell morphology. Nominotypical genera were available for all subfamilies, and the type species were included for 10 of the 22

analyzed genera. To assess the phylogenetic representativeness of our sample we used a formal approach recently proposed by Plazzi *et al.* (2010), based on the Average Taxonomic Distinctness (AvTD) (Clarke & Warwick, 1998). Total DNA was extracted using various protocols, and fragments of three mitochondrial genes were PCR amplified using primers from literature: (1) domains II and III of the 12S ribosomal DNA (rDNA); (2) the 3' fragment of the 16S rDNA gene; and (3) 709 bp of Cytochrome Oxidase I (COI).

PCR products were purified using a standard Exo-Sap method and sequenced with both PCR primers. Sequences were edited and aligned; ambiguously aligned positions were identified in the 16S and 12S alignments using the software Gblocks and excluded from subsequent analyses.

Phylogenetic analyses were done on each gene partition and on two concatenated datasets: CONC1 included all the 98 specimens represented in our dataset, including those for which only a single fragment was available; CONC2 included all the specimens for which at least two fragments were available. These datasets were analyzed using both a partitioned Maximum Likelihood and a partitioned Bayesian approach. Moreover, the ML trees obtained from single partitions and from the CONC2 dataset were combined in a Robinson-Foulds supertree using the software RF-SPR (Bansal *et al.*, 2010), to evaluate the possibility of a misleading effect caused by the missing gene fragments on the phylogeny obtained for the CONC1 dataset.

### Results and discussion

Results from Average Taxonomic Distinctness test and Variation in Taxonomic Distinctness test confirm that our sample is a statistically representative subsample of the Cancellariidae.

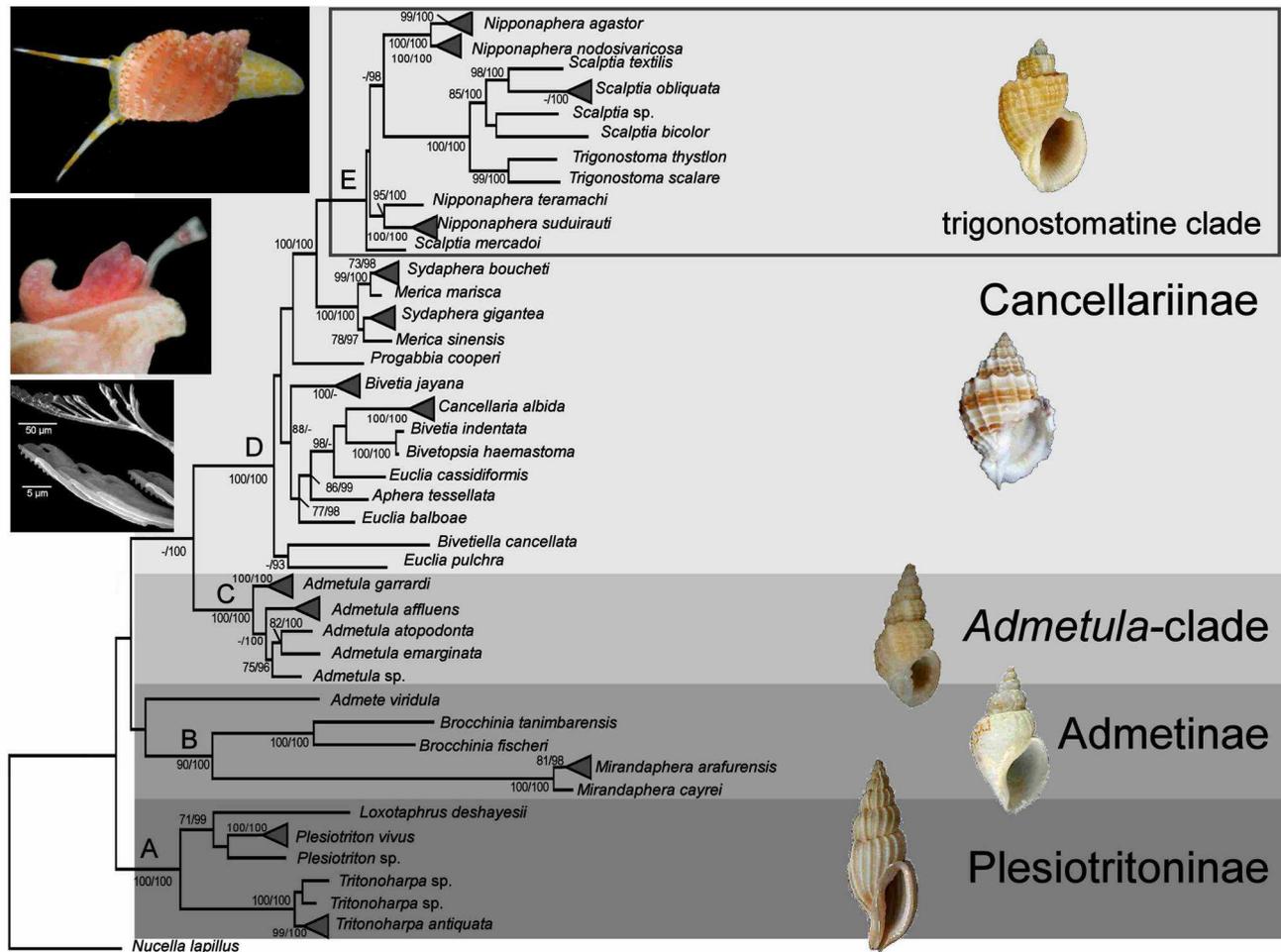
Single gene analyses included 78 ingroup specimens for 12S, 83 for 16S and 64 for COI and provided generally rather consistent trees, both with ML and BI approaches, with very few differences in the nesting of the deepest nodes.

A comparison between CONC1 and RF supertree evidenced a reduced number of differences, which nevertheless indicated that the placement of the specimens represented by a single gene only is better described by the RF supertree, due to a possible misleading effect of the missing data in the CONC1 dataset.

All the analyses carried out were fairly consistent for subfamilial relationships and can be summarized as follows:

1) Plesiotritoninae emerged as the sister to the rest of the cancellariid radiation, as already proposed in previous works (Modica *et al.*, 2009) and consistently with the fossil record, attesting the presence of *Plesiotriton* from the upper Cretaceous (Maastrichtian) (Beu & Maxwell, 1987).

2) Admetinae, as currently conceived following Cossmann (1899), are not retrieved as monophyletic, due to the placement of the *Admetula* which never



Graphical abstract, reprinted with permission from Modica et al., 2011 doi: 10.1016/j.ympcv.2011.03.022

grouped together with *Admete* and were instead always sister to the cancellariine radiation.

3) A reasonably well supported clade includes the genera *Mirandaphera*+*Brocchinia* which are deep-water taxa, sharing the presence of an intritacalx (a chalky, soft layer covering the shell surface, the systematic significance of which is unclear).

4) Cancellariinae exclusive of the *Mirandaphera*+*Brocchinia* clade proved monophyletic and included the ‘trigonostomatines’.

5) The ‘trigonostomatine’ genera (i.e. *Trigonostoma*, *Scalptia*, *Fusiaphera*, *Nipponaphera*) which share a number of common conchological features (e.g. the strongly shouldered shell, the open umbilicus and 2-3 columellar plaits) resulted as a clade internal to the Cancellariinae, which might be ranked as a tribe.

For a number of genera our results contradict their currently accepted taxonomic extension, highlighting the homoplasy of many shell characters traditionally used in cancellariid systematics. This is the case e.g. of *Nipponaphera*, which was paraphyletic with a first clade including the two sympatric West Pacific *N. agastor* and *N. nodosivaricosa* and a second clade including *N. suduirauti* and *N. teramachii*; *Merica* and *Sydaphera*, whose generic separation is not supported by our results; *Bivettia* which is not monophyletic due to the separation of *B. jayana* and *B. indentata*.

The results obtained will be combined with current on-

going research on Cancellariidae anatomy, to get a picture of the main evolutionary patterns of the family.

Present results are included in:

Modica, M.V., Bouchet, P., Cruaud, C., Utge, J., Oliverio, M. (2011), Molecular phylogeny of the nutmeg shells (Neogastropoda, Cancellariidae), *Molecular Phylogenetics and Evolution* doi: 10.1016/j.ympcv.2011.03.022

Modica, MV, Verhecken, A. and Oliverio, M. (2011) The relationships of the enigmatic neogastropod *Loxotaphrus* (Cancellariidae), *New Zealand Journal of Geology and Geophysics*, 54: 1, 115 — 124 DOI: 10.1080/00288306.2011.537610

**References**

Beu AG & Maxwell PA .1987. *New Zeal. Geol. Surv. Paleontol. Bull.* 54, 1-140.

Bouchet P and Rocroi J-P. 2005. *Malacologia* 47(1-2), 1–397.

Clarke KR & Warwick RM. 1998. *J. Appl. Ecol.*, 35, 523–531.

Graham A. 1966. *Stud. Trop. Oceanogr.* 4, 134–151.

Harasewych MG & Petit RE. 1982. *The Nautilus* 96(3), 104–113.

Harasewych MG & Petit RE. 1984. *The Nautilus* 98(1), 37–44.

Harasewych MG & Petit RE. 1986. *The Nautilus* 100(3), 85–91.

Kantor YI 1996. In: *Origin and evolutionary radiation of the Mollusca* (Taylor J. ed.), 221–230, Oxford University Press.

Modica MV, Kosyan A, Oliverio M. 2009. *The Nautilus* 123(3), 177–188.

Oliverio M and Modica MV. 2010. *Zool. J. Linn. Soc.* 158, 779–800.

O’Sullivan JB, McConnaughey RR & Huber ME. 1987. *Biol. Bull.* 172, 362–366.

Plazzi F. et al. 2010. *BMC Bioinformatics*, 11, 209.

Talmadge R. 1972. *Pinky. Of Sea and Shore*, 3, 189 & 200.

Verhecken A., Prell G, Modica MV. Submitted to *The Nautilus*



## Systematics of the cryptic species complex *Olivella minuta* (Gastropoda, Olividae)

Cléo Dilnei de Castro Oliveira

Universidade Federal do Rio de Janeiro, Instituto de Biologia, Departamento de Zoologia, Laboratório de Malacologia, Rio de Janeiro, RJ, Brasil. E-mail: cleo.oliveira@gmail.com

The family Olividae Latreille, 1825 are small marine gastropods mollusks (10-100m). Except for a few deep-sea species (Absalão & Pimenta, 2003), most of them are found on continental shelf.

Despite the increased number of studies with this family in the last decade (e.g. Kantor R, 1991; Absalão & Pimenta, 2003 and Pastorino, 2003), there is little information on anatomical data were provided (e.g. Risbec, 1955; Kilburn, 1981; Kantor, 1991; Pimenta, 2005) and the main diagnostic characters used in the taxonomy are strongly based on the shell features and, to some extent, on the radular apparatus (Absalão & Garcia, 2009).

The genus *Olivella* Swainson, 1831 is widely distributed and well represented in tropical Atlantic Ocean (Olsson, 1956). Despite some studies on anatomical features (e.g. Marcus & Marcus, 1959; Kantor, 1991; Absalão & Garcia, 2009), the taxonomy of the genus *Olivella* was essentially established on shell features and largely based on the work of Olsson (1956), who proposed and established most currently accepted subgenera.

*Olivella minuta* (Link, 1807) is a very common Atlantic species, characterized by small size (~10mm), a spindle-shaped shell with a polished surface, elevated spire, channeled suture, parietal region with strong parietal callus and with a brown to yellow background below a matrix of dark zigzag stripes.

Unfortunately, the type-specimen of *O. minuta* is lost and the type-locality was reported as "Caribbean", with no more detail on locality. Nowadays, the geographical range attributed to this species extends from the south Caribbean Sea to Paraná state, Brazil.

Marcus & Marcus (1959), in a pioneering study, gave a detailed account on the anatomy of *O. verreauxi* (Duclos, 1857) (a junior synonym of *O. minuta*) collected in São Sebastião, São Paulo state, Brazil. Although their technique of anatomical reconstruction from serial histological sections apparently modified the interpretation of some organ systems, this study is the only data published on the anatomy of *O. minuta*. It is noteworthy that, besides the scarcity of published studies on anatomy of this species, preliminary analysis (Absalão, pers. comm.; Pimenta, 2005) suggests intra- and interpopulational anatomical divergences in specimens throughout the known occurrence area. Additionally, I have observed variations in conchological features, mainly differences in color patterns and general outline of the shell (Fig. 1). There are no published molecular approaches dealing with *O. minuta*.

There are six junior synonyms attributed to *O. minuta* (i.e. *Voluta nitidula* Dillwyn, 1817; *Oliva zigzag* Duclos, 1835; *Oliva caerulea* Reeve, 1850; *Oliva cyanea* Reeve, 1850; *Oliva strigata* Reeve, 1850; *Olivella verreauxii* (Duclos, 1857)). This reinforces the possibility of the existence of sibling species under the name *Olivella minuta* and points for the necessity of a more detailed account on this subject. An analysis of conchological and anatomical data reinforced by molecular studies comparing DNA sequences is necessary to understand the relationship of the different



Figure 1. Example of variation in chromatic pattern and shell morphology in three specimens of *O. minuta*. Scale bar: 2 mm.

morphotypes signed up by the name *Olivella minuta* throughout its area of occurrence. This is the goal of this project.

A number of live specimens have been collected in strategic locations throughout the distribution area of this species (Fig. 2): Rio de Janeiro state: Arraial do Cabo (AC) (22°57'S, 42°01'W), Cabo Frio (CF) (22°52'S, 42°00'W); Bahia state: Ilha de Itaparica (IIP) (12°55'S, 38°39'W); Ceará state: Cumbuco (CU) (03°37'S, 38°43'W).

After being photographed, the shell of each specimen is broken to permit anatomical studies of the soft parts, following Pimenta, 2005. Molecular studies using COI rRNA (modified from Damato & Corach, 1996; Leite et al. 2008) are being performed. Both anatomical and molecular studies are ongoing and preliminary results from the molecular data suggest the existence of a complex of species (Fig. 3).

The evolutionary history was inferred using the Neighbour-Joining method (NJ). Maximum Likelihood

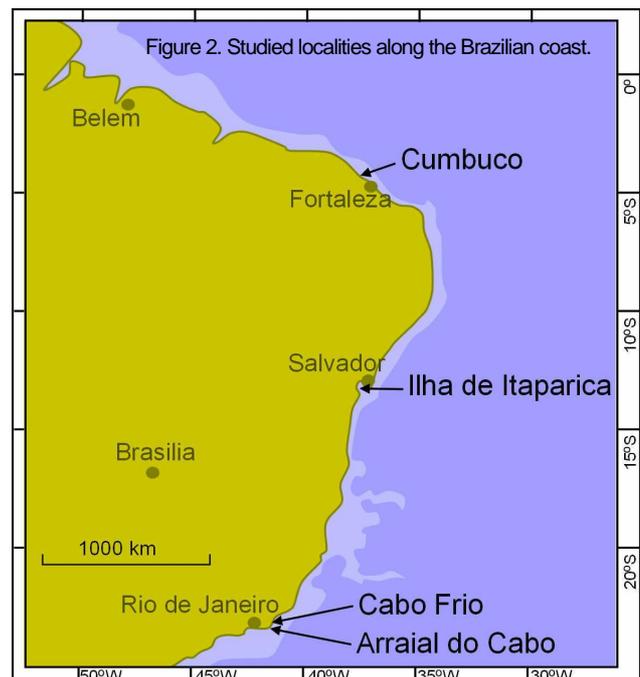
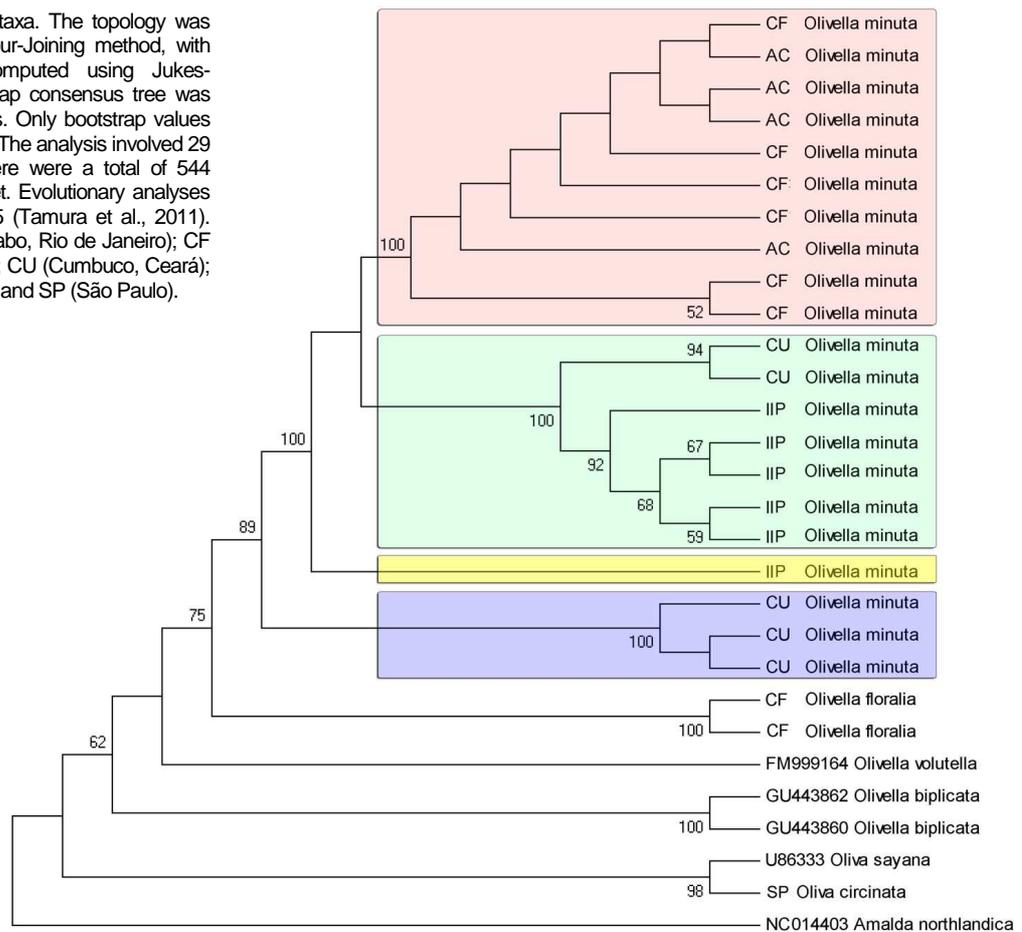


Figure 3. Relationships of taxa. The topology was inferred using the Neighbour-Joining method, with evolutionary distances computed using Jukes-Cantor (1969). The bootstrap consensus tree was inferred from 500 replicates. Only bootstrap values above 50% were exhibited. The analysis involved 29 nucleotide sequences. There were a total of 544 positions in the final dataset. Evolutionary analyses were conducted in MEGA5 (Tamura et al., 2011). Localities: AC (Arraial do Cabo, Rio de Janeiro); CF (Cabo Frio, Rio de Janeiro); CU (Cumbuco, Ceará); IIP (Ilha de Itaparica, Bahia) and SP (São Paulo).



and Maximum Parsimony treatments gave similar outcomes. Closely related taxa were used as outgroups, i.e. *Olivella volutella* (Lamarck, 1811) (GenBank Accession No: FM999164), *Olivella biplicata* (Sowerby, 1825) (GenBank Accession Nos: GU443860, GU443862), *Oliva sayana* Ravenel, 1834 (GenBank Accession No: U86333), *Amalda northlandica* Hart, 1995 (GenBank Accession No: NC014403).

Three clades were recognized and strongly supported by bootstrap values (Fig. 3). The preliminary analysis revealed a group formed by specimens from Cabo Frio and Arraial do Cabo, both localities in Rio de Janeiro state (Fig. 3, pink rectangle). Such results corroborate previous judgements, based on analysis of chromatic pattern and general shell shape, and indicates the existence of a single taxon in the region. A second group, consisting of specimens from Cumbuco, Ceará and Ilha de Itaparica, Bahia (Fig. 3, green rectangle), proposes the existence of a taxon widely distributed in the North and Northeastern Brazil. A third group, also from Cumbuco (Fig. 3, blue rectangle), emerges as another taxon exclusive to this locality and sympatric with the second group. A single branch from Ilha de Itaparica (Fig. III, yellow rectangle) comes to light as another taxon sympatric with the second group. Additional specimens are being analyzed in order to corroborate or refute the existence of this fourth taxon.

Despite the preliminary nature of the present results, they suggest the existence of four populations with discontinuous gene flow occurring along the Brazilian coast, confirming our initial expectations that more than one taxon could be present under the epithet *minuta*. It is very possible that this number will be further increased when additional fresh samples are analyzed.

These results indicate that mistakes of identification have persisted for some time, underestimating the true diversity of *Olivella* in the Southwest Atlantic and making clear the need for more studies on alpha taxonomy, even for species supposedly well resolved. Molecular analyses are in progress with additional material from the Caribbean and from new localities along the Brazilian coast. Furthermore, anatomical and conchological studies, developed in parallel with molecular analysis, are in course with the goal of adding as much information as necessary to permit the construction of topologies that help to understand the real diversity of the group and the geographical distribution patterns according to their evolutionary history.

I would like to thank the Malacological Society of London for supporting this research project which is still in progress.

#### References

- Absalão RS & Garcia FJG 2009. *Boll Malacol*, 45 (2): 129-135.  
 Absalão RS & Pimenta AD 2003. *Zoosystema* 25: 177-185.  
 Damato ME & Corach D. 1996. *J Crust Biol* 16: 650-655.  
 Kantor YI 1991. *Ruthenica* 1: 17-52.  
 Kilburn RN. 1981. *Ann Natal Mus* 24: 349-463.  
 Lette TS et al. 2008. *J Moll Stud* 74: 63-74.  
 Marcus E. & Marcus E. 1959. *Boletim Faculdade de Filosofia, Ciências e Letras da Universidade de São Paulo*. 232: 99-188.  
 Olsson AA 1956. *Proc. Acad Nat Sci Philadelphia*. 155-225.  
 Pastorino G. 2003. *The Nautilus* 117: 15-22.  
 Pimenta AD 2005. *Tese de Doutorado, Universidade Federal do Rio de Janeiro, Museu Nacional*.  
 Risbec J. 1955. *J Conchyl* 95: 45-82.  
 Tamura K et al. 2011. *Mol Biol Evol* (In Press).



## Sclerochronology of New Zealand turritellid gastropods

Ursula Smith

Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY 14850, USA. ues4@cornell.edu

The turritellids of New Zealand represent an ideal system in which to investigate many macroevolutionary questions. In addition to the abundant, well studied and well understood Cenozoic fossil record of the family, New Zealand is one of the few places in the world where there are also species from multiple genera found in the local fossil record still living around the coast today (Figures 1, 2 and 3). The Pliocene and Pleistocene fossil record is particularly good with many diverse and abundant shell beds, (figure 2) but the fossil record extends back to at least the first stage of the Cenozoic (up to ~46-65Mya, e.g. figure 3). Despite the well understood faunas and environments turritellids are found in, however, it is often the case that little is known about the species themselves. The work described here, funded in part by a London Malacological Research Grant aimed to discover the age and growth rates of several species of New Zealand turritellids. This is useful not only in providing information about how these species live but also facilitates the identification of comparable ontogenetic stages between species, an important first step towards allowing detailed study of heterochrony in the family.

### Turritellids and sclerochronology

Turritellids exhibit indeterminate growth and do not produce periodic features that allow easy ageing of individual shells. The only objective way to determine the age of both fossil and recent specimens, therefore, is to carry out a sclerochronology study. This involves measuring the  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  of the shell carbonate at intervals through the growth of an individual's shell in the hope that the values reflect a seasonal change in temperature that can be used to count how many seasons an individual has lived (Jones 1988).

There have been a number on species from fossil and Recent specimens from around the world (e.g. Jones, 1998; Andreasson & Schmitz, 1996) suggesting that species which vary in size across a similar range seen in the Recent New Zealand species, live 3-5 years. This seems consistent across species of varying sizes indicating that larger size is due to more rapid growth rather than longer life spans. In New Zealand, *Maoricolpus roseus* (Quoy & Gaimard, 1834) is the only species for which stable isotope sclerochronology has been carried out (Allmon et al., 1994).

Of the three genera living in the coastal waters of New Zealand today (*Maoricolpus*, *Zeacolpus* and *Stiracolpus*), *Stiracolpus* species are consistently the smallest (e.g., see figure 4) but it is not clear if this is due to life span or growth rate. The larger species, *Maoricolpus roseus* and *Zeacolpus vittatus* (Hutton, 1873) do add more whorls to their shells than most of the smaller species in *Stiracolpus* (up to ~20 rather than ~15) but by itself this is not enough to account for the size difference either as at the same whorl number they are already larger due to a more rapid increase in whorl height.

### Sclerochronology

As the  $\delta^{18}\text{O}$  of water varies with temperature and the  $\delta^{18}\text{O}$  of the shell carbonate reflects that of the water, those individuals that lived in an area with a seasonal change in water temperature should, barring diagenetic alteration to the shell, show a roughly sinusoidal seasonal variation in the  $\delta^{18}\text{O}$  values (and  $\delta^{13}\text{C}$ ) of their shells through growth.



Fig. 1: Recent *Maoricolpus roseus* can be collected easily around the New Zealand coast from a variety of bottom types. Here they are visible in the soft sediment of Mill Bay near Auckland at low tide.

Fig. 2: Pleistocene shell bed from the Pleistocene at Castlecliff Beach (~1.5-2Mya). Turritellids from three genera still found around the New Zealand coast today are found in these beds. 2a shows a close up of the shell bed, 2b shows the cliff the unit is from.

Fig. 3: Fossil shell bed. This unit is Altonian in age (Middle Miocene ~18Mya) from the South Island and contains abundant turritellids of multiple species, the most obvious of which seen here is the large *Amplicolpus cavershamensis*.

To measure the age of a shell, therefore, it is necessary to drill samples of shell material at intervals from the protoconch/teleoconch boundary to the aperture for measurement of the  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  of the carbonate.

A suitable shell, therefore, should be as unbroken as possible and should include the protoconch. Of the three species proposed in the initial grant proposal it was only possible to find suitable specimens for two. All *Stiracolpus propagoda* (Laws, 1940) specimens examined were broken and only five or six whorls long at most (compared to the 15-20) and therefore additional sampling was carried out on *Stiracolpus symmetricus* (Hutton, 1873) and *Stiracolpus pagoda* (Reeve, 1849). Money from the grant provided here was also combined with funds from the Exxon-Mobil Student Research Grant to allow sampling of the other modern New Zealand turrillid species, *Zeacolpus vittatus* (comparable in size to *Maoricolpus roseus*). Individuals of the three species sampled here can be seen in figure 4.

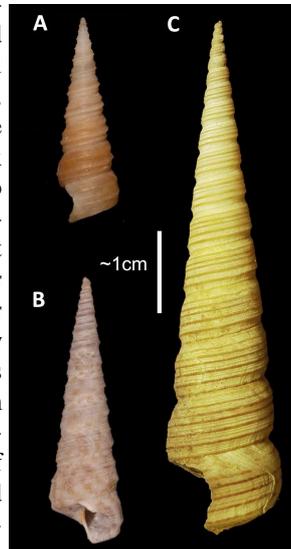


Fig. 4: (A) *Stiracolpus symmetricus*, (B) *Stiracolpus pagoda*, (C) *Zeacolpus vittatus*.

**Results**

Of the *Stiracolpus* species sampled, only the Recent *S. pagoda* produced data suggestive of a seasonal cyclicity in  $\delta^{18}\text{O}$  and, to a lesser degree,  $\delta^{13}\text{C}$  (figure 5). This individual appears to have lived for around 2.5-3 years. None of the individuals of *Stiracolpus symmetricus* sampled produced curves that could be interpreted as showing seasonal variations. It is unclear why this is the case, but the lack of correlation between the  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  in one specimen suggests perhaps diagenetic alteration had occurred to the shell carbonate rather than a lack of original seasonality.

Figure 6 shows a plot for a *Zeacolpus vittatus* specimen. Though the  $\delta^{13}\text{C}$  curve is less clear than the  $\delta^{18}\text{O}$ , this also seems to suggest a life span of around 2.5 years, similar to that of the *Stiracolpus pagoda* specimen in figure 5.

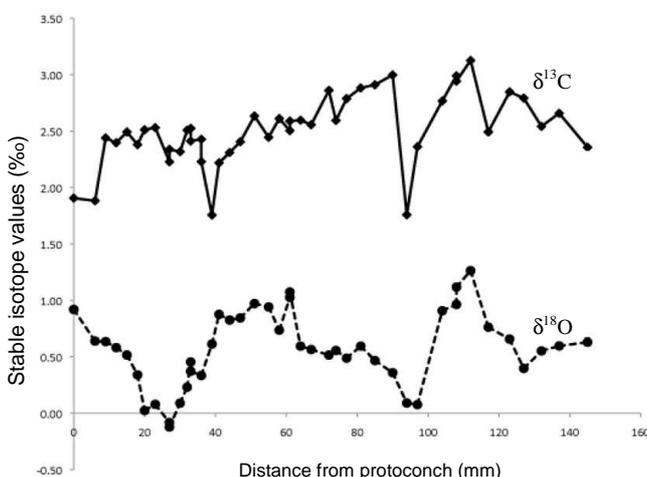


Fig. 5:  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  curves for an individual of *Stiracolpus pagoda*.

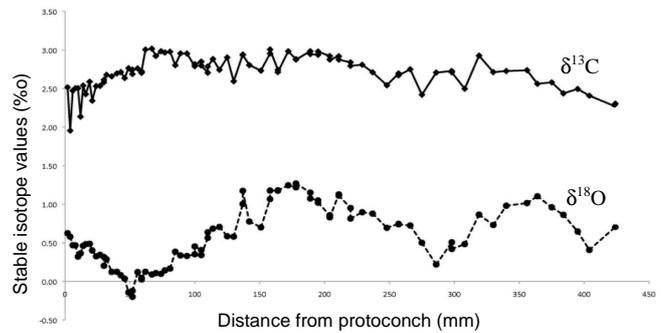


Fig. 6:  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  curves for an individual of *Zeacolpus vittatus*.

**Conclusions and further work**

The results presented here suggest that *Stiracolpus symmetricus* and *Zeacolpus vittatus* both live around 2-3 years despite their differences in shell size. This is similar, though perhaps at the lower end of the age range, to other turrillid species for which sclerochronology has been carried out. *Zeacolpus vittatus* apparently grows faster than *Stiracolpus pagoda*, and presumably, other *Stiracolpus* species of similar size – though this will require sampling from more species of *Stiracolpus* to confirm.

Ideally, more sampling needs to be carried out on more Recent individuals of these species to confirm these data as well as extending to other species. Fossil individuals of those species discussed here should also be sampled to see if there have been significant changes in ages or growth rates over the geological span of each (up to around 8My for these species).

Any study of heterochrony requires, in addition to the age data discussed above, a robust phylogeny of the species in question. Turrillids have a paucity of discrete shell characters making the construction of a phylogeny based on traditional characters difficult. Work is ongoing in generating a suitable phylogeny with both fossil and Recent species, using geometric morphometric methods to generate morphological characters and to obtain living individuals for molecular sequencing and soft-part anatomical study to produce a combined molecular and morphological analysis.

**Acknowledgements:**

I would like to thank The Malacological Society of London for the award that made the stable isotope sampling possible and also Exxon-Mobil for their Student Research Grant, part of which supported these analyses. I would also like to thank Linda Ivany, Jocelyn Sessa and Nadia Pierrehumbert at Syracuse University. The carbonate samples were analysed at the Michigan University Stable Isotope Laboratory and I would like to thank the lab manager, Lora Wingate, for all her help. Additionally, thanks need to be extended to John Simes, the Collection Manager at GNS Science for allowing me access to and permission to sample from, specimens in the GNS collections. My adviser, Warren Allmon has been endlessly supportive and deserves many thanks for everything he's done over the course of my PhD work.

**References**

Allmon, W. D. et al., 1994. *The Veliger* 37(3):267-279.  
 Andresson, F. P. and Schmitz, B. 1996. *Geology* 24(12):1067-1070.  
 Jones, D. S. 1988. Sclerochronology and the size versus age problem. In: McKinney, M. L. *Heterochrony in evolution: A multidisciplinary approach*. New York and London, Plenum Press. 348 pp.  
 Jones, D.S., 1998, Isotopic determination of growth and longevity in fossil and modern invertebrates. In: Nomis, R. D., & Corfield, R. M., eds., *Isotope paleobiology and paleoecology. The Paleontological Society papers*, v. 4., Paleontological Society, Fayetteville, AR. 285 pp.



## Predator effects modify within-patch clam distribution by increasing clam movement

Miranda L. Wilson, School of Biology, Georgia Institute of Technology, GA, USA

The distribution of clam populations within estuaries can be non-uniform, both at the estuary and patch scale; having impacts on feeding, reproduction, and survival. Although relatively little is known about the mechanisms driving the spatial distribution of clams within patches in the field, predators may be one mechanism that can mediate these patterns both indirectly (via chemical cues) and directly (predation events). Blue crabs (*Callinectes sapidus*) are primary predators of the hard clam (*Mercenaria mercenaria*) in southeastern U.S. estuaries (Walker and Tenore 1984), and can locate prey patches via odor-mediated processes (Weissburg and Zimmer-Faust 1993). Their ability to locate patches is dependent on the distribution of prey clams within patches; patches containing randomly distributed clams are harder for blue crabs to locate than patches containing aggregated clams, resulting in higher predation rates in patches containing random distributions (Wilson 2011).

Clams are known to respond to predator odors with a variety of behaviors that reduce the ability of predators to locate or consume individual clams, including cessation of feeding (Smee and Weissburg 2006) and burrowing deeper (Doering 1982, Blundon and Kennedy 1982). It is unknown whether these or other behavioral responses to predators will result in within-patch distributions that reduce predation pressure. If clams assume within-patch distributions that are harder for blue crab predators to locate it could result in a negative feedback loop where blue crabs cause changes to within-patch clam distributions that are harder for future predators to locate.

### Methods:

I assessed the influence of predator odor cues and actively foraging predators on clam distributions in the Skidaway River, Wassaw Sound, Georgia, USA. I exposed patches of 30 juvenile hard clams ( $28.16 \pm 2.89$  cm) in 1 m x 1 m x 0.25 m cages (1.5 cm<sup>2</sup> mesh) to four predator treatments in a randomized block design. Predator treatments consisted of: a full cage, a full cage with blue crab predators caged 0.5 m upstream and downstream (20 cm diameter x 30 cm high; see Smee and Weissburg 2006), a half cage (two sides open) that allowed predator entry, and a half cage (two sides open) with empty blue crab cages (placement similar to full cage treatment, but no predator present) that allowed predator entry. Clam patches were created by placing individually labeled clams in an area 30 cm by 36 cm centered in the middle of the cage area, with 6 cm separating individuals (uniform distribution). All cages were placed at the mean low tide level. Predators were fed clams every three days to ensure a continuous release of odor cues throughout the experiment.

Patches were left in the field for up to 30 days to assess how clam movement and distribution varied as a function of exposure time and predator treatment. Clams were retrieved after exposure by probing the substrate by hand and the final x and y coordinates for each individual were recorded. The distance that individual clams moved over the course of the experiment and their resulting nearest neighbor distances were calculated and standardized to exposure time.

Clam distribution within patches was then assessed by examining the relationship between lacunarity and spatial scale. Lacunarity analysis uses a variable-sized sliding box method which assesses the number of individuals within a viewing box at each sliding step and box size ( $r$ ) to determine distribution patterns at

different spatial scales (Plotnick *et al.* 1996; Fortin and Dale 2005). The shape of the resulting log-log plot can be used to determine the distribution characteristics of patches and the spatial scales at which they manifest (Plotnick *et al.* 1996; Malhi and Roman-Cuesta 2008; Figure 1). The shape of the curve produced using lacunarity analysis was compared for patch distributions before and after exposure to predators in the field, as well as between caging treatments.

### Results

There was a significant effect of predator treatment on the average distance that clams moved per day ( $F_{3,24} = 6.13$ ,  $P = 0.003$ ; ANOVA with block; Figure 2A), with clams in half cage treatments with predator access moving more than those in full cage treatments, regardless of predator odors. There was a significant effect of predator treatment on average nearest neighbor distance ( $F_{3,18} = 3.68$ ,  $P = 0.031$ ; ANOVA with block; Figure 2B). There were no significant differences between full cage treatments regardless of predator odors or between the full cage treatment without odor cues and the half cage treatment without predator cages, although the latter is most likely because of high variance for half cage treatments.

Clams exposed to actively foraging predators assumed random

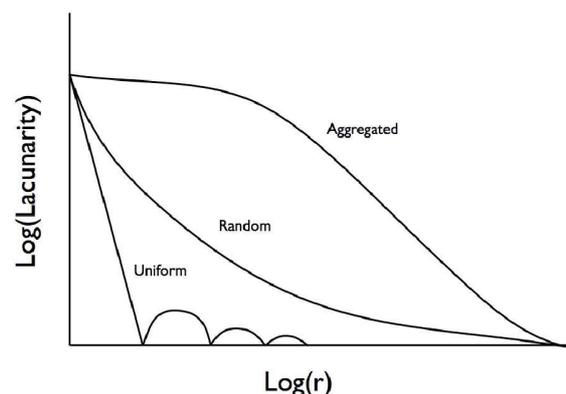


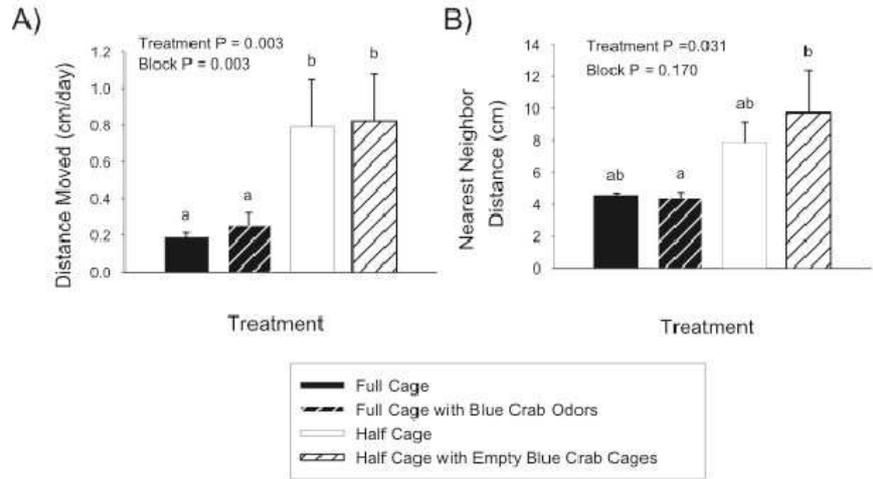
Fig. 1: Visualization of Lacunarity as a function of gliding box size viewed in a log-log plot. Curves represent idealized situations of aggregated, random, and uniform distributions.

distributions, but clams in treatments that denied predator access maintained aggregated characteristics similar to the original patch distribution (Figure 3). A concave relationship between log (lacunarity) and log(box size), typical of a random distribution (Plotnick *et al.* 1996; Seifan and Kadmon 2006; Malhi and Roman-Cuesta 2008), was seen for clams exposed to actively foraging predators (Figure 3, arrow A). Lacunarity analysis for clams in full cage treatments that denied predator access showed a convex curve at a scale of approximately 30 cm (Figure 3, arrow B) that is similar to that in the original distribution, indicating that clams in full cage treatments did not significantly change their distribution relative to the original patch characteristics. Evidence of the original uniform spacing (6 cm; Figure 3, arrow C) was not retained in any experimental treatment.

### Discussion:

Increases in clam movement are likely a response to disturbance by actively foraging predators as opposed to an active escape mechanism or behaviors that reduce prey apparency. Or-

Fig. 2: Average distance traveled by clams (A, standardized to exposure time) and the resulting average distance between neighboring individuals (B) is shown. Error bars represent one standard error. Statistical significance was determined for both analyses using an ANOVA with a blocking factor and post-hoc Tukey tests. N = 9 for both analyses.



ganisms commonly respond to predator odor cues or disturbance by reducing feeding behavior (Smee and Weissburg 2006) and horizontal movement (Kats and Dill 1998; Mitchell and Lima 2002) to reduce group apparency. This study suggests an opposite response where clams increase their movement in response to actively foraging predators (Figure 2A), but these responses do not seem to represent an active escape mechanism for clams, as differences in mobility between blue crab predators and clam prey suggest that movement by clams would be an ineffective escape strategy.

Changes in clam distribution seem to be a product of enhanced movement in response to actively foraging predators. Clam distributions are significantly more random in treatments exposed to foraging predators than in caged controls, but exposure to predator odor cues did not result in differences in distribution relative to caged controls (see Results; Figure 3). This is in contrast to other studies showing that prey actively change their distribution in response to predator odor cues (Cote and Jelnikar 1999; Ishida

and Iwasaki 2003; Kobak *et al.* 2010). Many organisms also assume aggregated distributions in response to predators as ways to reduce individual risk through prey dilution or predator confusion effects (Turchin and Kareiva 1989; Ioannou *et al.* 2007), although changes in prey distribution in response to predators did not result in aggregated distributions in this study. There is no evidence to suggest that foraging blue crabs would remove clams from the sediment and move them without consuming them (Micheli 1996), indicating that changes in distribution likely result from active movement by individual clams and not predator manipulation.

This study suggests that the formation of random clam distributions (mediated by predators) will have indirect negative effects on future foraging bouts by blue crabs, as patches containing randomly distributed individuals are harder for blue crabs to locate. This negative feedback loop could reduce predation pressure on clam populations and mediate the abundance of different clam patch types in natural settings.

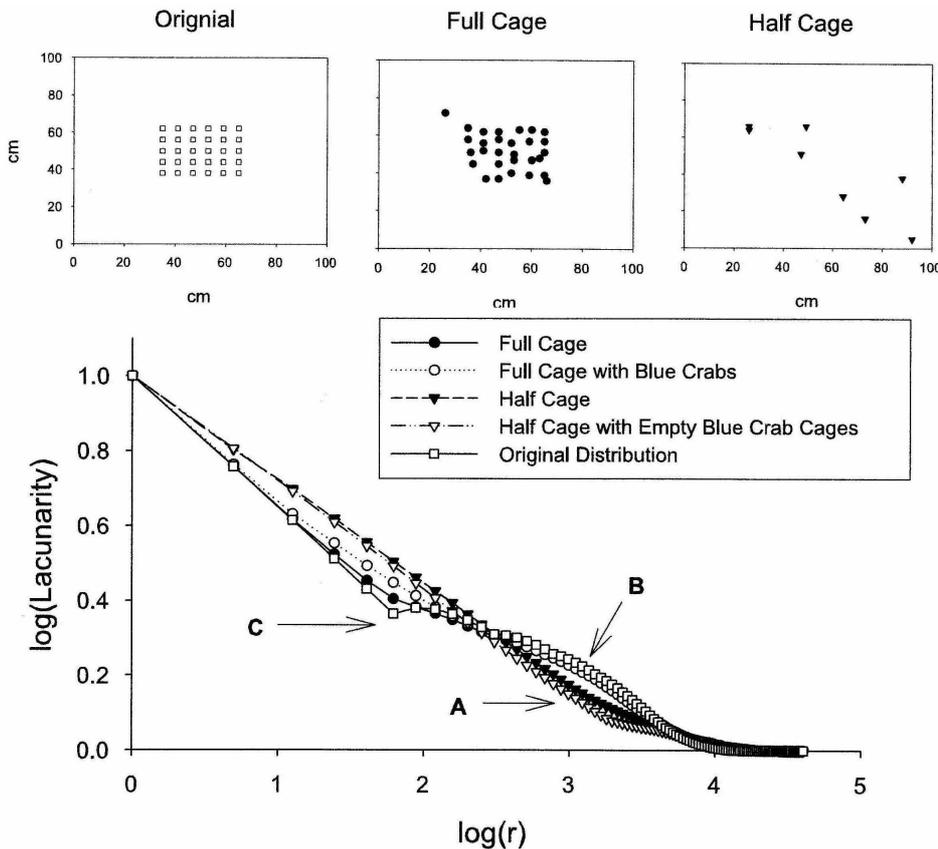


Fig. 3: Visualization of lacunarity for patches after exposure in the field. Circles and triangles represent full and half cage treatments, respectively. The original distribution of clams for all treatments is plotted using squares. Example plots are shown for clams in the original, full cage, and half cage treatments in the top panels. A, B, and C refer to random characteristics, aggregation characteristics, and uniform characteristics of the curves, respectively. All log(lacunarity) values are normalized to a maximum value of 1 for comparison.

**Acknowledgements:**

Thanks to the Malacological Society of London for their financial support. Thanks also to the Skidaway Institute of Oceanography for housing and operational support. Jay Fripp maintained our boat operation. Thanks to my advisor Dr. Marc Weissburg for numerous scientific discussions related to this project and thanks to field help provided by Jennifer Hill.

**References:**

- Blundon J and Kennedy VS (1982). *J Exp Mar Biol Ecol.* **65**: 67-81.  
 Cote I.M and Jelnikar E. (1999). *J Exp Mar Biol Ecol.* **235**: 201-211.  
 Doering PH (1982). *Estuaries.* **5**: 310-315.  
 Fortin MJ and Dale MRT (2005). *Spatial analysis: a guide for ecologists.* Cambridge, New York: Cambridge University Press.  
 Ioannou, CC *et al.* (2008). *Behav Ecol.* **19**: 126-130.  
 Ishida S and Iwasaki K. (2003). *J Ethol.* **21**: 117-122.  
 Kats LB and Dill LM. (1998). *Ecoscience.* **5**: 361-394.

- Kobak J *et al.* M., (2010). *Hydrobiologia.* **644**: 195-206.  
 Malhi Y and Roman-Cuesta RM. (2008) *Remote Sensing of Environment.* **112**: 2074-2087.  
 Micheli, F (1996) *Mar Ecol Prog Ser.* **141**: 295-302.  
 Mitchell WA and Lima SL., (2002) *OIKOS.* **99**: 249-259.  
 Plotnick RE *et al.* (1996) *Physic Rev E.* **53**: 5461-5468.  
 Seifan M and Kadmon, R., (2006) *Basic Appl Ecol.* **7**: 496-506.  
 Smee DL and Weissburg MJ. (2006) *Ecology.* **87**: 1587-1598.  
 Turchin P and Kareiva P. (1989) *Ecology.* **70**: 1008-1016.  
 Walker RL and Tenore KR. (1984) *Estuaries.* **7**: 19-27.  
 Weissburg MJ and Zimmer-Faust RK. (1993). *Ecology.* **74**: 1428-1443.  
 Wilson ML. (2011) Ph.D. Thesis. Georgia Institute of Technology, Atlanta, Georgia.

## Evolution and diversity of the troglobitic Carychiidae – A morphological and phylogenetic investigation of the terrestrial ellobiid genera, *Carychium* and *Zospeum*

Adrienne Jochum

Goethe University, Institute for Ecology, Evolution and Diversity, Siesmayerstrasse 70, 60323 Frankfurt am Main, Germany. E-mail: Jochum@bio.uni-frankfurt.de

The Carychiidae Jeffreys, 1830 (Gastropoda, Pulmonata, Ellobioidea) are minute terrestrial snails (< 2 mm shell height) with a Holarctic distribution (Pilsbry 1948; Morton 1955) inhabiting two distinct ecological niches. They are one of a few gastropod lineages to have migrated onto land (Martins 1996; Vermeij & Dudley 2000; Klussmann-Kolb *et al.* 2008; Dayrat *et al.* 2011) independently of the Stylommatophora. This research attempts to address the morphological aspects of the migration onto land and its phylogenetic history, which presumably occurred during the Palaeozoic era (542-250 Mya) (Barker 2001).

*Carychium* Müller, 1774 lives in the moist habitats of riparian zones, fens and the interstitial layers of forest leaf litter. *Zospeum* Bourguignat, 1856 is exclusively troglobitic and until recently has been known only from limestone caves in the Cantabrian Mountains, Pyrenees, southern European Alps and Dinaric Alps (Watson & Verdcourt 1953; Gittenberger 1980; Doll 1982; Slapnik & Ozimec 2004). Recently, *Zospeum* shells have been found in South Korea (Prozorova *et al.* 2010) and in caves of Guangxi China (Deharveng pers. comm. 2010).

How did climate change and the ever-changing environment influence diversity of the Carychiidae? Which spatial (ie. ecosystem structure) and temporal (ie. geology, location and climate) processes enabled this ellobiid family to colonize epigean (*Carychium*) and subterranean (*Zospeum*) domains? Moreover, which adaptations have the Carychiidae manifested to inhabit these niches?

**Research Approach**

In order to address these questions, a multifaceted, comprehensive approach is currently being conducted. Also, since most museums possess very limited, fresh (less than 3 years old), spirit-preserved material for (COI) molecular taxonomic analyses, we are obliged to do much sampling as well as rely upon the kindness of carychiid-savvy field biologists to collect for us. Molecular taxonomy via DNA barcoding (Weigand *et al.* 2011), anatomical analyses via histological sectioning, 3D reconstruction via AMIRA graphic software (Dörge 2010), morphological analyses of the shell and radulae via scanning electron microscopy (SEM) and research into the scanty fos-

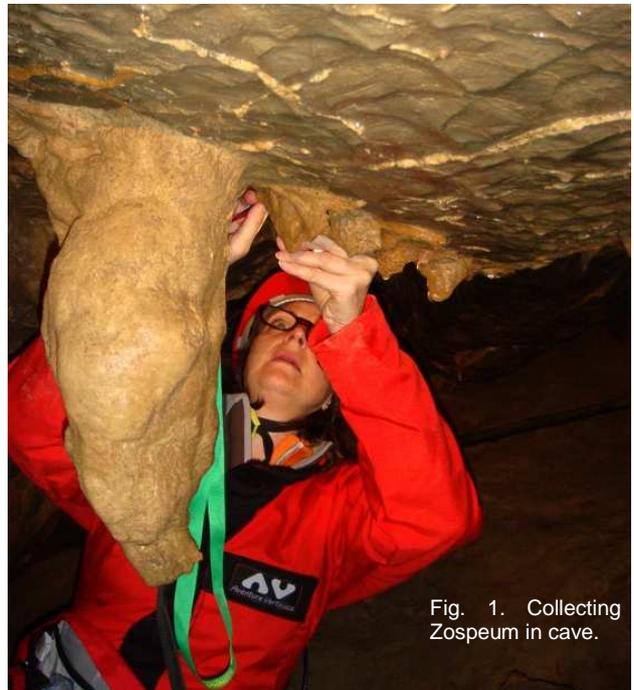


Fig. 1. Collecting *Zospeum* in cave.

sil record are all enabling an exciting, ongoing 21st Century view of this enigmatic taxon.

**Results & Discussion**

Between 2006 and 2010, 113 specimens from 41 populations representing 21 nominal taxa of Carychiidae were collected throughout their Holarctic range. The results have been reported in the first molecular survey of the Carychiidae (Weigand & Jochum 2010; Weigand *et al.* 2011). This investigation included the biospeleological collection of live *Zospeum* in Slovenian and Croatian caves. After this initial survey, living *Carychium* populations have continued to be sampled in north and central America, Europe (including Macaronesia and the Caucasus) and Asia. Further sampling for *Zospeum* in Slovenian, Croatian, Italian, and Spanish caves has continued (Figure 1). Since Carychiidae consist of very ephemeral populations or just single individuals, locating and collecting these minute snails truly involves more than what meets the eye.

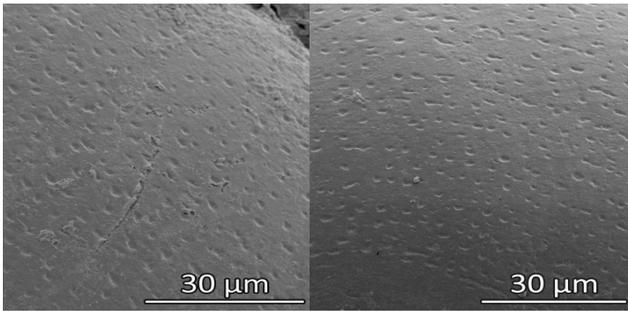


Fig 2a. Pitting on protoconch of (L) *Carychium minimum* and (R) *C. stygium*.

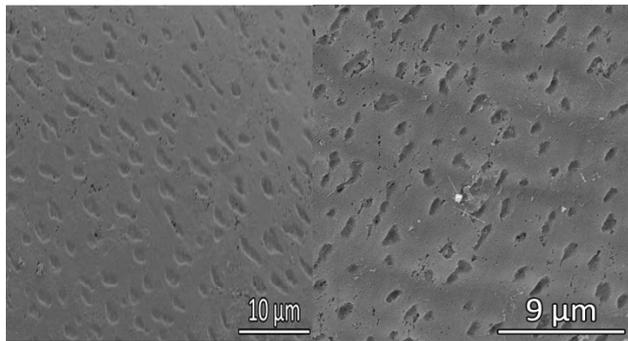


Fig. 2b. Pitting on protoconch of (L) *Zospeum frauenfeldi* and (R) *Z. isselianum*.

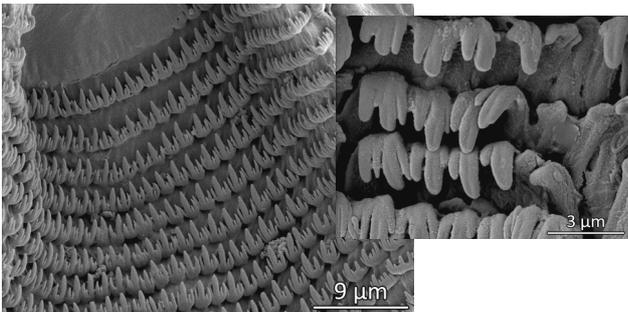


Fig. 3 Radulae of (L) *C. stygium* and (R) *Z. isselianum*.

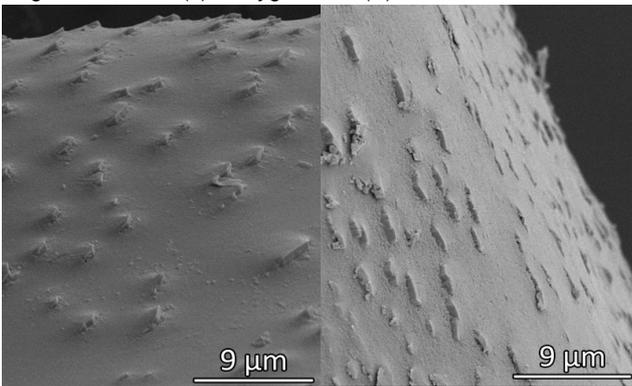


Fig. 4a. Crystallographic wedges on columellar lamellae of (L) *C. minimum* and (R) *C. stygium*.

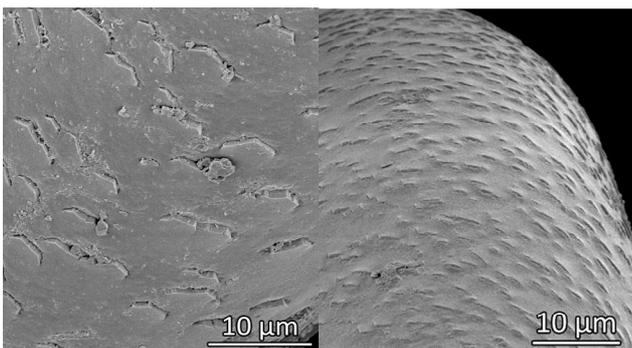


Fig. 4a. Crystallographic wedges on columellar lamellae of (L) *Z. spelaeum* and (R) *Z. frauenfeldi*

The Malacological Society of London generously financed the scanning electron micrographic (SEM) analyses conducted on *Carychium* and *Zospeum* shells and radulae. Since the Carychiidae lack absolute conchological features on the one hand, while the sheer smallness of these diaphanous snails complicates species delimitation on the other, these scanning electron micrographs provide a significant, first time record of superficial pitting as a structurally consistent carychiid feature. Concentric pitting on the surface of the carychiid protoconch (Figures 2a – 2b), which has up to now been reported for only a few members of the Ellobioidea (Bank & Gittenberger 1985; Martins 2007), can clearly be identified throughout this taxon. In addition, the radulae of troglobitic species such as “*Carychium stygium*” from Tennessee and Kentucky, USA (Figure 3a) and “*Zospeum isselianum*” from the Kamnik-Savinja Alps of Slovenia (Figure 3b) demonstrate the tricuspidate “*Carychium*-type” version of the pulmonate rhipidoglossate radula described by Martins (2007), in which the cusps of the lateral and marginal teeth are flanked by an apposed additional denticle (Figures 3a & 3b). My SEM analyses enabled a first time view of the radulae of these subterranean species. The Carychiidae are known to possess the simplest ellobioid radula (Martins 2007), which bears the typical, symmetrical middle tooth accompanied by a series of lateral teeth and about the same number of densely aligned flabellate marginal teeth.

Another first record and seemingly consistent carychiid feature is the presence of angular, staple-like, crystallographic calcite wedges, projecting from the columellar lamellae (Figures 4a & 4b). These wedged structures may well serve to increase surface area aiding traction of the columellar muscle

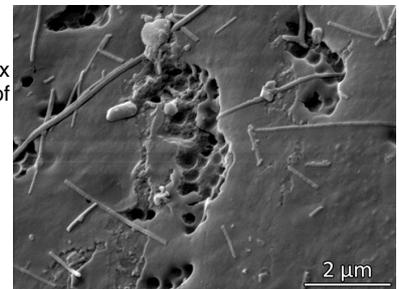


Fig. 5. Cavity matrix perforating the shell of *Z. isselianum*.

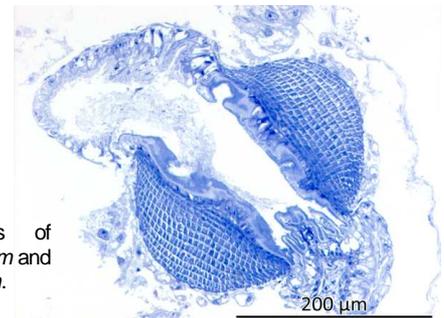
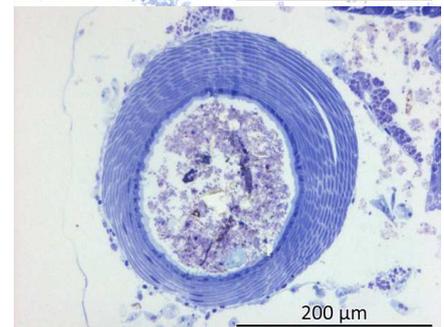


Fig. 6. Muscular gizzards of (above) *Z. isselianum* and (below) *Z. spelaeum*.



in the vertical turning and positioning of the shell. The columnar lamellae of other members of the Ellobioidea as well as other pulmonate gastropods will need to be studied to consider these structures more thoroughly. Another unique feature has been observed in shells of "*Zospeum isselianum*", collected from a cave at 2000 m elevation in the Kamnik Savinja Alps of Slovenia. These shells are pockmarked with unusual exogenous cavities, like Swedish knäckebröd, (Figure 5). This cavity matrix corresponds to the presence of an unusually high concentration of SiCa<sub>2</sub> reported for this species in the higher elevations of the Kamnik Savinja Alps (Slapnik & Medakovic 2007). Much like vertebrate trabecular bone (Zysset 1994), this meshed cavity matrix probably plays a major role in shell strength while serving to reduce shell weight at higher altitudes. In turn, this economical aspect most likely enables "*Z. isselianum*" to conserve energy by reducing the production of shell material.

Histological analyses via serial sectioning and 3D reconstruction using AMIRA software (Dörge 2010) have shown that Carychiidae possess a relatively very large kidney. This large size may well be associated with osmoregulation and influence the ability of these minute snails to tolerate fluctuations in water potentials in seasonally flooded environments. These minuscule snails have a remarkably muscular gizzard of (Figure 6). Barker (2001) reported that this demonstrates a feature common in many basal pulmonates namely, trend towards structural isolation of the gizzard from the rest of the stomach. Additional serial histological sections (*C. stygium*, *C. minimum*, *Z. isselianum* and *Z. spelaeum*) have been produced to reveal insights into the structure of the reproductive system, radular complex, pharyngeal complex and the CNS.

### Conclusion

Our comprehensive approach stresses the importance of a multifaceted strategy in understanding carychiid diversity, taxonomy and evolution. Earlier taxonomic concepts and investigations of the Carychiidae have emphasized the use of conchological characters alone (Pilsbry 1948; Burch & Van Devender 1980; Bank & Gittenberger 1985; Harry 1998). Additional consideration of their ecology and varying environmental conditions respective to superficial subterranean (leaf litter for *Carychium*) and cave habitats (*Zospeum*) as well as their influence on species morphology, i.e. phenotypic plasticity must be stressed to achieve a bigger picture of this taxon (West-Eberhard 1989; Pfenninger & Magnin 2001; Nekola & Barthel 2002; Culver & Pipan 2009). SEM and histological analyses used in congruence with DNA barcoding provide a combined taxonomic, multi-level knowledge platform for understanding the Carychiidae. In addition, 3D reconstruction via AMIRA graphic software provides an advantageous view of the internal positioning and size of anatomical structures within the minute carychiid shell. Comparisons of these structures and their interactions in respect to their ecology can provide further information regarding the ellobioid transition via the Carychiidae onto land (Barker, 2001) and their evolution in caves. Hypotheses regarding their evolutionary role within the Pulmonata will be assessed. Continued epigeal, biospeleological and taxonomic investigations will reveal more information about the evolution and ecology of this enigmatic group of terrestrial Ellobioidea.

This work has been presented at the 5th Congress of the European Malacological Societies (Azores, Portugal, 2-6 Sept.,

2008), the 75<sup>th</sup> American Malacological Society Meeting (Ithaca, NY, USA, July 19-23, 2009), World Congress of Malacology 2010 (Phuket, Thailand, 18-24 July 2010), 20th International Conference on Subterranean Biology (ICSB) (Postojna, Slovenia, Aug 29–Sept 3, 2010), The Malacological Society of London Molluscan Forum (NHM London, UK., Nov. 30, 2010), BioSystematics Berlin 2011 (Berlin, Germany, 21-27 February, 2011) and to Der Deutschen Malakozoologischen Gesellschaft 50<sup>th</sup> Spring Meeting (Hofgeismar, Germany, June 10-13, 2011). Results of this research have been published in *Checklist* (2010) and *Molecular Ecology Resources* (2011).

### Acknowledgements

I thank The Malacological Society of London for their financial support of the SEM analyses. I am indebted to the BiK-F Biodiversity and Climate Research Center for funding a large part of this project. Special gratitude goes to Annette Klussmann-Kolb for her confidence and support of my research. I am indebted to Alexander Weigand for his valuable insights and numerous contributions as well as to a large global network of collectors and biospeleologists, without whose cooperation this work could not be realized. I thank Claudia Nesselhauf, Dorian Dörge and Manfred Ruppel for their technical assistance. Last but not least, I am grateful to Rajko Slapnik, who introduced me to biospeleology and ventured with me into the first cave to collect *Zospeum* in 2007.

### References

- Bank R A & Gittenberger E. 1985. *Basteria*, 49 (4/6): 85-100.
- Barker G M. 2001. *The Biology of Terrestrial Molluscs*. CABI Publishing, London: 48-60.
- Burch J B & Van Devender A S. 1980. *Walkerana*, 1: 60-80.
- Culver D C & Pipan T. 2009. *The Biology of Caves and Other Subterranean Habitats*, Oxford University Press Inc., New York, pp. 142-145.
- Dayrat B *et al.* 2011. *Molec Phylogenet Evol* doi: 10.1016/j.jmpev.2011.02.014 1-13.
- Doll W. 1982. *Archiv für Molluskenkunde*, 112: 1-8.
- Dörge D. 2010. *Vergleich der Anatomie und Histologie zweier Mikroschneckenarten, Carychium minimum Müller, 1774 und Zospeum isselianum Pollonera, 1887 (Gastropoda, Pulmonata, Ellobiidae)*. Goethe-University, Institute for Ecology, Evolution and Diversity, Phylogeny and Systematics, Frankfurt am Main: 33 pp.
- Gittenberger E. 1980. *Zoologische Mededelingen (Leiden)*, 55: 201-213
- Harry H W. 1998 *Walkerana*, 9: 1-104.
- Klussmann-Kolb A. *et al.* 2008. *BMC Evolutionary Biology*, 8: 57.
- Martins A M de Frias. 2007. *Vita Malacologica suppl. Basteria*, 4.
- Martins A M de Frias. 1996. Relationships within the Ellobiidae. In: *Origin and Evolutionary Radiation of the Mollusca* (ed. Taylor J), Oxford University Press, London: pp. 285-294.
- Morton J E. 1955. *Proc Zool Soc London*, 125 (1): 127-168.
- Nekola J C. & Barthel M. 2002. *J Conchol*, 37(5): 515-531.
- Pfenninger M & Magnin F. (2001) *Molec Ecol*, 10: 2541-2554.
- Pilsbry H A. 1939-1948. *Land Mollusca of North America (North of México)*, Academy of Natural Sciences of Philadelphia, Monographs Number 3, Philadelphia: 1113 pp.
- Prozorova L *et al.* 2010. *Trop Nat Hist (Suppl. 3)*: 135.
- Slapnik R & Ozimec R. 2004. *Natura Croatica*, 13: 115-135.
- Slapnik R & Medakovic D. 2007. *Mollusca*, 25 (2): 125-129.
- Vermeij G & Dudley R. 2000. *Biol J Linn Soc*, 70: 541-554.
- Watson H & Verdcourt B. J. 1953. *J Conchol*, 23 (9): 306-324.
- Weigand A & Jochum A. 2010. *Check List*, 6 (4): 517-518.
- Weigand A *et al.* 2011. *Molec Ecol Resources*, 11: 255-265.
- West-Eberhard M J. 1989. *Ann Rev Ecol Syst*, 20: 249-278.
- Zysset P. 1994. *A constitutive law for trabecular bone*. École Polytechnique Fédérale de Lausanne, Lausanne: 220 pp.

## Relative quantification of F and M types in the mussels *Mytilus edulis*, *M. galloprovincialis* and their F1 hybrids

Frederico M. Batista<sup>1,2</sup> and Andy. R. Beaumont<sup>1</sup>

<sup>1</sup> School of Ocean Sciences, College of Natural Sciences, Bangor University, Menai Bridge, Anglesey, LL59 5AB, UK

<sup>2</sup> Institute for Biotechnology and Bioengineering, Centre of Genetics and Biotechnology, University of Trás-os-Montes and

Mitochondrial (mt) DNA in animals is usually inherited exclusively through the female line (Birky, 1995). Some bivalve molluscs, such as the marine mussels of the genus *Mytilus*, are unusual in that there are two types of mtDNA namely female (F) and male (M) types. It is thought that the F type is transmitted from mothers to both sons and daughters, and the M type is mainly transmitted from fathers to sons. This transmission system has been named Doubly Uniparental Inheritance (DUI) (Skibinski *et al.*, 1994; Zouros *et al.*, 1994). In general, female individuals contain only the F mtDNA in all their tissues while males contain F mtDNA in somatic tissues and M mtDNA is the exclusive form in spermatozoa (Stewart *et al.*, 1995). However, heteroplasmic females and males with M and F types in somatic tissues have also been observed in presumed pure *Mytilus* sp. populations (Fisher and Skibinski, 1990; Garrido-Ramos *et al.*, 1998). A recent study by Obata *et al.* (2006) not only reported the occurrence of heteroplasmic *M. galloprovincialis* females for the F and M-types but also that the M-type was detected in all females analysed. Moreover, Sano *et al.* (2007) observed a surprisingly high M/F ratio in the adductor muscle of some *M. galloprovincialis* females. The breakdown of DUI has been reported in *M. edulis* x *M. trossulus* hybrids (Zouros *et al.* 1994) and in *M. edulis* x *M. galloprovincialis* hybrids (Rawson *et al.*, 1996; Wood *et al.* 2003). In these studies, females carrying the M-type and males lacking the M-type have been observed using conventional PCR methods. In order to have a better insight about the presence of the M type in *M. edulis* and *M. galloprovincialis* females as well as breakdown of DUI in hybrids it is necessary to use molecular tools that allow not only the detection of the different mitotypes but also their quantification. Real-time PCR can detect and quantify very small amounts of specific nucleic acid sequences. Moreover, the sensitivity is higher in real time PCR in comparison to conventional PCR. The main objective of the present project was to develop a real-time PCR assay for the detection of the F and M-types in *M. edulis* and *M. galloprovincialis* from East Atlantic region. Moreover, this methodology was used to study the disruption of DUI in

*M. edulis* x *M. galloprovincialis* hybrids. We developed a real-time PCR assay for relative quantification of F and M types in adductor muscle of *M. edulis* and *M. galloprovincialis* males and females from northern east Atlantic coast. Dissociation curve analysis showed a single peak for the F and M primer pairs. The qPCR assay had a mean inter- and intra-assay coefficient of variation of less than 5%. This assay was published in the Journal of Molluscan studies (Batista *et al.*, 2010). We observed that in the majority of *M. edulis* females (75%) and *M. galloprovincialis* (89%) the M type is absent in the adductor muscle and when present it is in low amounts. In females where the M type was detected, the M/F ratio in the adductor muscle of *M. edulis* females ranged from 0.00002 to 0.00005. In *M. galloprovincialis* the only female in which the M type was detected had a M/F ratio of 0.0003. In males the M type was always present in the adductor muscle. In *M. edulis* males the M/F ratio ranged from 0.005 to 1.667 whereas in *M. galloprovincialis* males it ranged from 0.0127 to 0.0325. Our results support the passive model for the fate of paternal mitochondria in females (Cao *et al.*, 2004), in which the M type would be subject to stochastic elimination or random presence at low levels in the various female tissues (such as the adductor muscle). In order to study the disruption of DUI in hybrids, laboratory crosses were done between *M. edulis* and *M. galloprovincialis* to produce pure species and hybrids. These groups were reared under controlled laboratory conditions until the mussels reach sexual maturity (18 months after fertilization). The relative quantification of M and F types by real time PCR showed that the amount of M type present was the expected for male (high levels of the M type) and female (absence or low levels of the M type) mussels in both pure species and hybrids (figure 1). Hence, our results suggest that hybridization between *M. edulis* and *M. galloprovincialis* from the Northern east Atlantic coast do not affect DUI.

### Acknowledgement

This study was funded by a research grant from The Malacological Society of London. F.M.B. was supported by fellowship grant (SFRH/BPD/27113/2006) from the Portuguese Foundation for Science and Technology (FCT).

### References

- Batista FM, Lallias D, Taris N, Guedes-Pinto H, Beaumont AR. 2010. Relative quantification of the M and F mitochondrial DNA types in the blue mussel *Mytilus edulis* by real-time PCR. *J Moll Stud* 77(1): 24-29
- Birky CWJ. 1995. *Proc Nat Acad Sci. USA*, 92, 11331-11338.
- Cao L. *et al.* 2004. *Genetics*, 166: 883-894.
- Fisher C & Skibinski DOF1990. *Proc Roy Soc London B* 242, 149-156.
- Garrido-Ramos M.A *et al.* 1998. *Genome* 41, 818-824.
- Obata M *et al.* 2006. *Dev Growth Differ* 48: 253-261.
- Rawson PD *et al.* 1996. *Genetics* 144, 241-248.
- Sano N *et al.* 2007. *Dev Growth Differ* 49: 67-72.
- Stewart DT *et al.* 1995. *Mol Biol Evol* 12, 735-747.
- Skibinski DO *et al.* 1994. *Genetics* 138, 801-809.
- Wood AR *et al.* 2003. *Heredity* 91, 354-360.

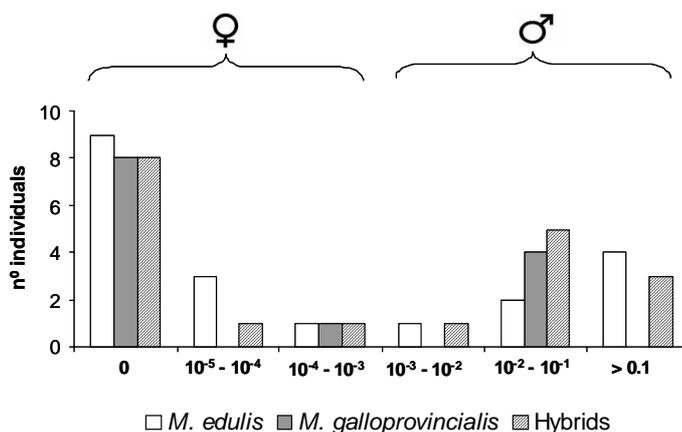


Fig. 1. M/F ratio in adductor muscle of females and males of *M. edulis*, *M. galloprovincialis* and their F1 hybrids (pool data of broodstock and progenies).



## ***Succinea oblonga* (Draparnaud, 1801) in Finland\***

Irene Routio, Zoological Museum, University of Turku, FI-20014 Turku, Finland  
Matti Valta, E-mail: luontosade.valta@elisanet.fi

In September 2009 we once again surveyed and studied land snails around the City of Turku. We found an extensive colony of *Succinea oblonga* in the Käräsämäki section (Finnish Uniform Grid coordinates 67145:2413) of the city. The species has never before been encountered in Finland.

In Käräsämäki, hundreds of living *S. oblonga* usually appear individually in an area of about 360 x 100 meters. The area is mainly a lush meadow where birches, aspens and willows grow in clusters. There are also a few dirt roads and an abandoned railroad track. The flora in the habitat comprises chiefly *Epilobium angustifolium*, *Urtica dioica*, *Rubus idaeus* and *Poaceae* species. *S. oblonga* lives also on the edge of a parkland forest in a rather dry forest meadow area. The occurrence is the most extensive ever and borders on fields and asphalted areas. Other land snails in the area include *Arianta arbustorum*, *Cochlicopa lubrica*, *Trochulus hispidus*, *Vallonia excentrica*, *Vallonia pulchella* and *Oxychilus celarius*.

In October 2009, another occurrence of *S. oblonga* was spotted in the Artukainen section of Turku (Finnish Uniform Grid coordinates 67113:2357) in an area of about 370 x 100 meters. Here too, several hundreds of living specimens can be seen as a colony here and there. The area has sparsely growing birch, willow and rowan trees, and it is located on both sides of the Raisiojoki River. Most of the habitat in Artukainen is drier than that in Käräsämäki; it is an old moss-covered, barren area, the flora of which is characterized by *Tanacetum vulgare*, *Melilotus albus*, *Potentilla argentea* and *Achillea millefolium*. In the forested, fresh area, the dominant species are *E. angustifolium*, *Geum urbanum*, *Trifolium medium* and *Poaceae* species. The *A. arbustorum*, *V. excentrica* and *T. hispidus* are accompany the land snails and in moister areas *Succinea putris*.

More of the species was found in the Kastu section of the city in 2010, about 2.3 km SW (Finnish Uniform Grid coordinates 67135:2406) of the colony in Käräsämäki. Fourteen living specimens were found in an area measur-

ing 200 x 20 meters. The habitat is surrounded by a residential area and is a rather dry, moss-covered grassy meadow, the flora of which is once again characterized by *T. vulgare*, *M. albus*, *T. medium*, *Solidago virgaurea*, *Cirsium arvense* and *Poaceae* species.

Approximately 400 meters E of the aforementioned occurrence, near the Vähäjoki River (Finnish Uniform Grid coordinates 671346:24112), two specimens were found in the company of the *O. cellarius*, *C. lubrica* and *A. arbustorum* land snails. After having survived the winter, *S. oblonga* specimen do not come out of hibernation until the end of May. Approximately 80 % of the specimens found in each area of occurrence were dead. The empty shells of *Succinea* remain identifiable in the soil in Finland for 3–4 years.

In Estonia, *Succinea oblonga* is rather common on the western islands and the mainland where they occur in many types of habitats (A.Ehlvest pers comm).

In Sweden, the species is rare and categorized as NT for endangered species. It occurs in several different biotopes and the occurrences are ecologically patchy. The species can be found in dry broad-leaved trees forests and cultural biotopes, for example in churchyards (T. von Proschwitz pers. comm.)

The occurrences in Turku are old cultural occurrences and their origin can only be speculated. The species may have come to Finland from Sweden or Central Europe along with people in many different ways. The species may be more common Finland than what we know; being rather small, 6–8 mm, it may not be noticed in grassy meadows. Researchers should look for the species in different habitats in Finland in a systematic way.

### **Acknowledgements**

Adrian Norris, Anneli Ehlvest and Ted von Proschwitz.

\*This article was received on October 12th 2010 and should have appeared in the previous issue. The editor apologises to the authors for the delay.

News, continued from page 2

### **Reproductive isolation in *Physa***

The widely distributed freshwater snail *Physa acuta* is a model organism for mating systems. *Physa carolinae* is a sister species of *P. acuta*, both derived from *P. pomilia*, and an earlier split of the *acuta/carolinae/pomilia* ancestor to *P. gyrina*. Based on sterility of progeny in cross mating experiments, it is possible that hybrid sterility originated before hybrid inviability, and that speciation between *P. pomilia* and *P. acuta* may have been reinforced by selection for prezygotic reproductive isolation.

Dillon R T *et al.* 2011. BMC Evol Biol. 11, 144.

### **Opisthobranch mating rate unrelated to mate availability**

Female selectivity generally increases at higher population densities, and in water striders and dung beetles, where males force

matings, mating rates increase with population density. However, if females control mating, mating rates should not follow population density, because females can maintain mating rate close to their reproductive optimum. Although theory suggests that mating rates in simultaneous hermaphrodites are driven by the male function (because for one thing this has a steeper fitness gain with increasing mating success), and although this seems to be the case with the flatworm *Macrostomum*, in the simultaneous hermaphrodite opisthobranch *Chelidonura sandrana*, mating followed the female fitness optimum and was independent of experimentally manipulated density and social group size.

Sprenger D *et al.* 2011. BMC Evol Biol 11:107.

Continued on page 24

## The Malacological Society of London Annual General Meeting 2011

### Annual Report of Council for 2010

The Annual report was delivered by the Vice-President, Suzanne Williams. The President sent his apologies for his absence, and thanked John Taylor and Emily Glover for organising the 2-day meeting on *Chemosymbiotic molluscs and their environments: from intertidal to hydrothermal vents* at The Natural History Museum.

#### Membership (reported by Richard Cook and Mark Davies)

The Society had 193 paid up members in 2006, 182 in 2007, 158 in 2008, 151 in 2009. At the end of 2010 The Society had 137 members, 24 of whom were student members. Although new members join the Society each year, membership continues to show a general downward trend. Given the financial health of the Society and the steady move towards cross-phyla integration of zoological topics, the Council is not, at present, concerned at the level of membership.

Fifteen new members joined the Society during the year, and two long-standing members resigned. The reasons for non-renewals are unclear; some are oversights, which are occasionally corrected after a period of time, while others almost certainly reflect the more austere financial environments and consequent changing priorities for members.

#### Finance (reported by Katrin Linse and Elizabeth Platts)

The financial statements for the year ending 31st December 2009 were published in the February *Malacologist*.

The finances of the Society have continued to be satisfactory during 2010. Our investments – the COIF Investment Fund and COIF Fixed Interest Fund – have made modest gains as the economic downturn stabilised. However, the profit-share from the publication of the *Journal* provided the Society with the major proportion of its income. The Editor of the *Journal*, David Reid, and the Associate Editors are to be commended for the hard work involved in publishing an increasingly-valued scientific journal. Once again sales of the digital archive provided over £13,000 of income, although most countries do now appear to have bought it and future sales are likely to be much less. *The Malacologist* is now being published electronically only, saving more than 60 % of the cost of producing hard copy.

The Society increased the value of its various awards in 2010, particularly the research grants, the travel bursaries and travel awards to the *Molluscan Forum*. There will be increased funds available in 2011 for all awards if suitable candidates apply.

Dr Katrin Linse is the new Hon Treasurer but, due to work commitments, was not able to take the role over fully until after the 2010 accounts were finalised. The Society also has a new auditor, Alison Walters. As the retiring Honorary Treasurer, I [Elizabeth Platts] am delighted to pass The Society's finances into the competent hands of Katrin and Alison. I should also like to thank my colleagues and Trustees on Council for always being such a pleasure to work with over the years.



A hand-crafted gift from the new treasurer to the retiring treasurer

#### Meetings

The Society organized a symposium at St Catherine's College, University of Cambridge on 14 April 2010 on *Molluscs as environmental indicators*, organised by Richard Preece and David Aldridge. This was also the date and place of the Society's AGM. The thirteenth annual *Molluscan Forum* was organized by Martine Claremont and the President and held at the Natural History Museum, London on 30 November 2010. 15 papers and 18 posters were presented; presenters came from 9 European states plus the USA. The Forum was held consecutively with the Young Systematists' Forum, affording an opportunity for students to attend both meetings. In July 2010 many members of the Society attended the Unitas/World Congress of Malacology meeting in Phuket, Thailand.

#### Publications

##### *The Malacologist* (reported by Stuart Bailey)

Issues 55 and 56 of *The Malacologist*, the Bulletin of The Malacological Society of London, were produced in August 2010 and February 2011. These were distributed to most members as pdfs, although a small number of paper copies (20 for #55, 25 for #56) were also produced and distributed to copyright and other libraries, some museums and a few members. Issue 55 was 24 pages, issue 56 was 28 pages plus a 2 page meeting flyer. The use of electronic mail reduced the cost of producing and distributing the two issues to £242, compared to £1,653 for the previous two issues. The publications covered the Society's meetings including the Annual Meeting in Cambridge on *Molluscs as environmental indicators* and the *Molluscan Forum*. There were also research grant reports, and accounts from award winners, as well as the annual report of council, notices of forthcoming meetings, book news and reviews, news from the popular and scientific press, and Society notices.

In addition, short *Malacologist Updates* were issued by email two and four months after *The Malacologist*, with news of forthcoming meetings and other time-sensitive information.

##### *Journal of Molluscan Studies* (reported by David Reid)

The ISI impact factor for the *Journal* in 2009 fell slightly, to 1.074 (compared with 1.408 in 2008, 1.032 in 2007, 0.968 in 2006 and 0.758 in 2005). The *Journal* stands at number 60 in the ISI list of 127 zoological journals (down from 40 in the previous year). Circulation for the *Journal* in 2010 was 127 institutional (of which 39 were online-only and 53 print-only) and 132 membership subscriptions (compare 143 and 157 respectively for 2009). In addition a further 2304 institutions have electronic access to the *Journal* through publishers' consortia (compare 2339 in 2009), and 950 (compare 749 in 2009) have access through OUP's Developing Countries Offer (for details see [http://www.oxfordjournals.org/access\\_purchase/developing\\_countries.html](http://www.oxfordjournals.org/access_purchase/developing_countries.html)). This means

that the *Journal* is now available to 3513 personal and institutional subscribers (compare 3388 in 2009 and 3386 in 2008). The new pricing structure has been fixed for 2011. The cost for a combined print plus online institutional subscription is £386 (\$774); online-only subscriptions are £322 and print-only subscriptions are £354.

Volume 76 contained 45 papers and research notes, totalling 406 pages. The delay between acceptance of a manuscript and electronic publication was 7–8 weeks. Submission of manuscripts rose by 6% to 205, and the acceptance rate was 22%. 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 gastropods), 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 gastropods), Yasunori Kano (systematics of veti-gastropods, tropical ecology), Fred Naggs (systematics and conservation of terrestrial gastropods), Manuel Malaquias (opisthobranchs), Pablo Martín (freshwater ecology, life history), Ellinor Michel (ecology, freshwater gastropods), Peter Mordan (terrestrial gastropods), Jeff Nekola (community ecology of terrestrial gastropods), Diarmaid Ó Foighil (genetics, freshwater bivalves), John Taylor (Neogastropoda, mineralogy, ultrastructure), Mikael Tholleson (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 – Malacsoc.org.uk

(reported by Tony Cook)

The Society's website continues to house information pages and the electronic version of the *The Malacologist*, which is now circulated to members as a pdf file. During this year the website has been re-designed with the help of an external consultant and will "go-live" in the near future. While the current design has served its purpose well it is starting to show its age with some broken links and others referring to outdated information. The new website will maintain access to back numbers of *The Malacologist* which provides a valuable electronic resource of both articles and photographs.

In the last calendar year (2010) there were 157,363 unique visits to the website with only a 1% bounce rate (i.e. visitors who only visited one page). The number of visits has about doubled in the last 5 years. During the year the number of visits is fairly constant at around 12,000 per month. There are slight peaks but the timing of these varies from year to year. This year there was a winter peak.

From the data provided by the Internet Service Provider we can examine the origins of our visitors and how they use the website. This year direct traffic constituted 71% of visitors. This is the proportion of visits from those who have either entered the site name into their browser or from the favourites facility in the browser. A further 20% arrived via links on other pages and the remaining 9% arrived from search engines. Visitors mostly arrive from .com or .net web pages (69%) and their geographic location is unknown. Visits from the following countries constitute more than 1% of visits: UK, Germany, USA, Poland, Netherlands, France and Austria.

Visitors landed mostly on the society's homepage but pages from back numbers of *The Malacologist* were also frequently accessed (Argonauts from *The Malacologist* v. 46, snail borne diseases from *The Malacologist* v. 45 and the essay on aquaculture).

Web pages are updated on request. There may be greater delay in future until the current Web manager finds his way around the new web site.

### Awards and Research Grants (reported by Tony Walker)

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, which is 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 2010, The Society received twelve applications from researchers 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 five awards:

- **Leandro Perez** (£450), Museum de la Plata (Argentina) to attend VIII Latin American Congress of Malacology in Argentina (June 2011)
- **Gisele Introini** (£500), University Estadual de Campinas (Brazil) to attend VIII Latin American Congress of Malacology in Argentina (June 2011)
- **Maria Seabra** (£497), University de Evora (Portugal) to attend the 9<sup>th</sup> International Temperate Reefs Symposium in the UK (June-July 2011)
- **Coraline Chapperon** (£495), Flinders University (Australia) to attend the 9<sup>th</sup> International Temperate Reefs Symposium in the UK (June-July 2011)
- **Clara Lazo** (£500), IFAPA Agua del Pino (Spain) to attend the 6<sup>th</sup> Congress of The European Malacological Societies in Spain (July 2011)

Therefore a total of **£2,442** 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<sup>th</sup> December The Society had received eleven applications from workers in six different countries. As in previous years, the scientific quality of the research projects submitted was excellent.

On behalf of the Society, I would like to formally thank the members of the Grants Review Panel for their hard work reviewing all applications. The following awards have been agreed by the Panel:

- **Gregory McCullagh**, St Francis Xavier University, Canada - £1,465. "Sensory integration during odour-based navigation in the nudibranch mollusc, *Tritonia diomedea*"
- **Kathryn Smith**, University of Southampton, UK - £1,500. "Ontogenetic impacts of a high-CO<sub>2</sub> future ocean in Icelandic common whelks *Buccinum undatum*"
- **Vainora Zukaite**, Kingston University, UK - £1,500. "Protein kinase C signalling during *Lymnaea stagnalis* embryonic development"
- **Evgeniya Vekhova**, A V Zhirmunsky Institute of Marine Biology, Russia, and **Iiya Temkin**, National Museum of Natural History, Washington, USA - £1,000. "Comparative morphology and evolutionary significance of the byssus in Pterioidea"
- **Thomas Kunze**, Ludwig-Maximilians University, Germany - £1500. "Molecular phylogeny and anatomy of the vetigastropod genera *Skenea* and *Margarites* (Trochoidea)"
- **Halime Arican**, Brunel University, UK - £1000. "Presence and function of nuclear structures in molluscs"

Therefore six Research Grants have been funded at a total cost of **£7,965**. The success rate was 55%. The Awards 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 with the next three weeks.

## The Annual Award

The Society will be notified of the winner of the Annual Award at the AGM.

## Other prizes

Council agreed that prizes of £200 plus two years membership of the Society be offered to the best student oral and poster presentations at the Unitas/World Congress of Malacology meeting in Phuket, Thailand, July 2010.

The recipients were:

ORAL: **Nicole Webster**, Leiden University, *Phylogenetic reconstruction and shell evolution of the subfamily Diplommatininae (Gastropoda: Caenogastropoda: Diplommatinidae)*.

POSTER: **Torsten Hauffe**, Justus Liebig University, *Spatial modelling of faunal turnover of gastropod composition reveals vertical and horizontal zones within the watershed of ancient Lake Ohrid*.

## Officers and Council

The continued success of the Society is, of course, owing to work done on a voluntary basis by the Soci-

ety's Officers and Councillors. On behalf of the membership, the President thanked all Council members, who have given freely and worked hard on publications, finances, membership, administration, the website and the awards. It would be wrong to allocate special praise, but the Society should be especially proud of its external faces, the *Journal* and *The Malacologist*, which are small works of art in their own right and pack a heavy scientific punch. Shortly after the 117<sup>th</sup> AGM, Tom White agreed to become The Society's Honorary Secretary. The President thanked Tom both for his offer to serve the Society and for his good works thus far.

## Members of Council 2011-2012

(numbers in brackets indicate year of office. President, vice-presidents and councillors serve for 3 years. Any member may nominate members for council: please send nominations to any councillor by 31st December.)

President	Mark Davies (3) mark.davies@sunderland.ac.uk
Vice-presidents	Suzanne Williams (3) suzaw@nhm.ac.uk David Aldridge (2) d.aldridge@zoo.cam.ac.uk
Councillors	Jon Ablett (1) j.ablett@nhm.ac.uk Robert Cameron (1) radc@blueyonder.co.uk Ellinor Michel (3) e.michel@nhm.ac.uk Elizabeth Platts (2) elizaplatts@yahoo.co.uk Richard Preece (2) rcp1001@cus.cam.ac.uk Fred Naggs (2) fren@nhm.ac.uk
Journal Editor	David Reid d.reid@nhm.ac.uk
Malacologist Editor	Stuart Bailey S.Bailey@m336wy.freeseve.co.uk
Treasurer	Katrin Linse k.linse@bas.ac.uk
Membership Secretary	Richard Cook r.cook@kingston.ac.uk
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
Archivist	Georges Dussart georges.dussart@canterbury.ac.uk
Co-opted Members of Council	Martine Claremont and Simon Cragg



News, continued from page 20

### Neuroecology of Chemical Defenses

This review looks at recent advances in determining the identity of defensive chemicals, the roles they play, and how these interactions can lead to structuring of communities as in the case of molecules of keystone significance such as saxitoxin and tetrodotoxin. These potent poisons are introduced into a community by very few host species. Resistant consumers however, reuse these compounds for defense or for communication, in a cascade of effects throughout the community. (A key paper in this field is 'Neuroecology, chemical defense and the keystone species concept' by Richard Zimmer and Ryan Ferrer in *Biol. Bull.* 213, 208-225.) The diversity of molecules and mechanisms of action mediating the production of sea hare's ink as chemical defenses to predators and alarm cues to conspecifics is also discussed.

Derby CD & Aggio JF. 2011. *Integr Comp Biol* doi: 10.1093/icb/acr063

### Pain and suffering in molluscs

Most animals have nociceptive receptors and reflexes which protect them from tissue damage, but this is different from the capacity to experience pain. Because pain encompasses a subjective component, pain-like experiences may be difficult to detect in invertebrates. However, some molluscs appear to show motivational states and cognitive capabilities consistent with a capacity to experience pain, beyond basic nociception. Contributors to a collection of papers on *Spineless Wonders: Welfare and use of invertebrates in the laboratory and classroom*, suggest that the welfare of molluscs should therefore follow practices similar to those for vertebrates.

Crook RJ and Walters ET 'Nociceptive Behavior and physiology of molluscs: animal welfare implications', and Elwood RW 'Pain and suffering in Invertebrates?' in *Ilar Journal* 52(2) (2011)

### Magnetic reception in a nudibranch

The nudibranch *Tritonia diomedea* orients to the earth's magnetic field. Identified brain cells fire when the magnetic field is changed but these neurons are not the primary magnetoreceptors. Recordings from peripheral nerves in a preparation from which the brain was removed found both excitatory and inhibitory responses to changes in the direction of the magnetic field. The primary receptors are not concentrated in any particular organ, but widely dispersed in peripheral tissues.

Pavlova GA, Glantz RM, Willows AOD. 2011. *J.Comp. Physiol A*. doi: 10.1007/s00359-011-0659-0

### Snail statocyst response to space travel

The paired gastropod statocysts are the predominant gravity sensor, with a statoconia of calcium carbonate, an epithelial layer of supporting cells with microvilli and giant sensory hair cells with true (9+2 type) kinocilia. As in vertebrates, there are efferent fibres projecting to the statocysts from other neural areas. With the advent of space flight, it is possible to ask key questions such as 'How do animals adapt to altered gravity?' *Helix aspersa* and *H. lucorum* were subjected to microgravity on Russian spacecraft and soon after their behavioural and electrophysiological responses to tilting were tested. Body re-orientation after sudden head-down pitch was faster in post-flight snails, and a positive relation between tilt speed and firing rate was significantly larger in post-flight snails than in controls, indicating enhanced sensi-

tivity to gravity. Statocyst receptor cells express a pedal peptide, and when levels were monitored to see if the gene responsible was regulated, the expression of the gene encoding the peptide Hpep in statoreceptors was enhanced in post-flight snails.

Balaban P M *et al.* 2011. *PLoS ONE* 6(3), e17710

### Whiff sniffing snails

A waterworks in St Petersburg, Russia, has recruited African land snails to monitor the air quality from its waste incinerator. It is possible the pulmonates may respond to bad air sooner than the regular chemical sensors. Half the snails are exposed to clean air, the other half to diluted air from the plant's chimney. The snails, tethered above floating balls which rotate as the animals crawl, are attached to sensors which monitor heart rate and behaviour.

Source: [www.reuters.com/video/2011/02/03/african-snails-the-latest-weapon-in-poll?videoId=184375845](http://www.reuters.com/video/2011/02/03/african-snails-the-latest-weapon-in-poll?videoId=184375845)

### Chiton eyes

The eyes which penetrate the plates of chitons are shadow and motion detectors, with lenses of birefringent aragonite and focus both in and out of water.

Land M F 2011. *Curr Biol* 21(8), R273-4.

### *Lymnaea* perchances to dream?

*Lymnaea stagnalis* appears to be a suitable model system for the study of cellular aspects of sleep. The pond snails spontaneously enter brief, quiescent state of relaxation, with cessation of rasping. This was reversed by sucrose solution or tactile stimuli, but responsiveness was lower than in active snails. Quiescent bouts were clustered, but only weakly allied to time of day, a cluster lasting ca 13 h and separated by almost continuous activity lasting c 37 h.

Stephenson R and Lewis V, 2011. *J. Exp. Biol.* 214(5), 747-56.

### Oyster activity rhythms

Valve opening was monitored over a year *in situ* in *Crassostrea gigas* and showed a strong coupling to the sun-moon-earth rotations. Permanently immersed *C gigas* follow a strong tidal rhythm, its intensity modulated by neap-spring cycles. The impact of light in the solar cycle is secondary to the tidal component.

Tran D *et al.* 2011. *Chronobiol Int.* 28(4), 307-17.

### Oestradiol perpetuates freshwater gastropod reproduction

Oestrogenic contaminants in freshwaters have been suggested to affect molluscs only after the main spawning or leading up to maturation of the gametes. Two seasonally reproductive gastropods, *Planorbium corneum* and *Viviparus viviparus*, were exposed to 10 or 100 ng/L oestradiol in an outdoor mesocosm. Both species produced similar numbers of offspring as control groups in summer, but the 10ng/L groups had higher autumn reproductivity and the 100 ng/L groups had higher autumn mortality.

Benstead RS *et al.* 2011. *Aquat. Toxicol.* 101(2), 326-34.

### Genetics of oyster mass mortality

Adults of the Pacific oyster *Crassostrea gigas* have been subject to frequent and extreme mass mortalities for the last 50 years. Haemolymph samples from individual oysters collected prior to a mortality event were used to identify a

gene expression signature that distinguished oysters that would survive from those that would die. Those that would die had elevated expressions of genes associated with cell death, lysosomal proteolysis, and cellular assembly and organization.

Chaney ML & Gracey AY 2011. *Mol. Ecol.* 20(14), 2924-54.

### Apoptosis in mussels

Apoptosis, an essential process in developing and maintaining immunity, is initiated or effected by caspase proteins. Apoptosis in molluscs is as complex as in vertebrates, but with unique features which may relate to recurrent exposure of these sedentary animals to pollutants and pathogens. Two initiator and four executioner caspases are described in *Mytilus galloprovincialis*. They show structural distinctions from caspases previously described. The caspase genes are highly expressed in glands and gills, where apoptosis is very active in clearing damaged cells. Hemocytes also show high activity, due to their role in defence against pathogens.

Romero A *et al.* 2011. *PLoS One*, 6(2), e17003.

### Ostreid herpesvirus 1

Ostreid herpesvirus 1 (OsHP-1) has been regularly detected in *Crassostrea gigas* in France. Starting in 1998, the French National Network for Surveillance and Monitoring of Mollusc Health carried out two surveys in juvenile *C. gigas*. The first was an epidemiological inquiry into reported mortality outbreaks on oyster farms. The second survey showed a specific pattern of mortality outbreaks associated with detected OsHV-1. OsHP-1 was detected mainly in summer, with a patchy distribution in the field. A relationship between OsHP-1 detection and spat mortality was shown, especially in sheltered and closed environments.

Garcia C *et al.* 2011. *Vet. Res.* 42(1), 73.

### Abalone mother-of-pearl

Studies of formation and mechanical behaviour of growth lines in abalones show that, compared to nacre, they have basic structures, form rapidly and are harder – subserving their protective role.

Sumitomo T *et al.* 2011. *J. Struct. Biol.* 174(1), 31-36.

### Hairy snails

The calcareous shell is covered by a thin organic periostracum, which in some pulmonates bears distinct architecture including hairs. In *Trochulus* and *Helicodonta*, the secretion and arrangement of hairs result from a complex mechanism in which the hair is first formed in the periostracal groove independently of the periostracum and then attached to the edge of the shell, drawn out and finally swivelled to the upper side of the periostracum.

Allgaier C. 2011. *J. Morphol.* 272(9), 1131-1143.

### Climate change and distribution of *Pomacea*

*P. canaliculata* has a wide native range in S America, as far south as Buenos Aires. It was deliberately introduced into North and Central America and Hawaii. The possible influence of climate in establishment of the species in Patagonia has been studied. Climatic changes in precipitation in N. Patagonia could have been beneficial for the settlement of the species in this new area, where precipitation increased to values similar to those in the

southernmost area of its distribution.

Darrigran G *et al.* 2011. *Braz. J. Biol.* 71(1), 8-13.

### Species energy relationships in deep sea molluscs

The deep sea ecosystem has simplified energy inputs and thus provides an opportunity to study how energy and factors influencing its use control biodiversity patterns. Two of those factors are levels of particulate organic carbon (POC) on the seafloor and temperature. These have been related to regional patterns of benthic molluscan diversity in the North Atlantic. Spatial regression analyses indicated that POC flux was more important than temperature in gastropods and protobranchs, unlike studies of temporal variation in fossil diversity which showed temperature to be more significant.

Tittensor DP *et al.* 2011 Mar 23. *Biol. Lett.*

### Thyasirid environmental preferences

A study of 12 species of thyasirid from SW Norway shows their potential as indicators of environmental enrichment. The presence of *Thyasira sarsi* together with a low biodiversity indicates organic enrichment, while high thyasirid diversity indicates good environmental conditions

Keuning R *et al.* 2011. *Mar Pollut Bull* 62(4), 786-91.

### Cryptic species of Indo-Pacific arminid nudibranchs

Based on 43 morphological characters, of 35 known arminids and 20 new species of *Dermatobranchus*, the phylogenetic relationships have been analysed. Radular morphology is particularly important – its diversity reflects the diverse feeding habits of members of the clade on octocorals.

Gosliner T M & Fahey S J 2011. *Zool J Linn Soc* 161(2), 245-356.

### Cephalopod origin and evolution

Growing evidence from fossils, embryology and molecular divergence estimates show that cephalopods evolved in the Cambrian from a monoplacophoran-like mollusc in which the conical shell was modified into a chambered buoyancy apparatus. Cephalopods diverged into nautiloids and coleoids in the mid-Palaeozoic. Coleoids internalised the shell and in the late Palaeozoic diverged into vampyropods and decabranchs. Reduction and loss of the shell occurred several times in different coleoid lineages, reflecting selection for active modes of life and complex behaviour.

Kröger B *et al.* 2011. *Bioessays* 33(8), 602-613.

### Genetics of large Danish *Arion*

The recent establishment of the Iberian slug *A. lusitanicus* in Denmark has been compared to the population structure of the native *Arion ater ater* and *A. a. rufus*, introduced in the early 1900s. None of the three taxa reproduce primarily by selfing; for both *A. lusitanicus* and *A.a.rufus*, gene diversity in Denmark is lower than in S. Germany, indicating bottlenecks in establishment of the Danish populations; physical linkage occurs between the loci of PGI, MDH-1 and MDH-2; for *A. a. rufus* and *A. lusitanicus*, there are indications of strong local genetic subdivision but little restriction in gene flow from other areas. For all three taxa, population structure is dominated by ongoing founder effects, local extinctions and colonisations and genetic drift.

Engelke S *et al.* 2011. *Genetica* 139(6), 709-21.

## FORTHCOMING MEETINGS

Wednesday 30 November 2011  
 Malacological Society of London  
**Molluscan Forum**  
 10 am to 6.30 pm, Flett Theatre, Natural History Museum,  
 Cromwell Road, London

### CALL FOR REGISTRATION AND PAPERS

This informal, annual and successful 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. Again the Forum will be held the day before the **Young Systematists' Forum** ([www.systass.org/ysf](http://www.systass.org/ysf)), also at the Natural History Museum. This has been arranged so both meetings can be attended.

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 books and other items 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.

Enquiries and registrations to: Prof. Mark Davies, Faculty of Applied Sciences, University of Sunderland, Sunderland, SR1 3SD, UK. Tel UK(44) + 191 515 2517 [mark.davies@sunderland.ac.uk](mailto:mark.davies@sunderland.ac.uk). Non-presenters: please let us know you will be coming so that we may estimate numbers.

Friday-Saturday 20 & 21 April 2012  
 Malacological Society of London  
 Annual Meeting  
**Molluscan Life Histories**  
 Institute of Marine Sciences, Portsmouth

### CALL FOR PRESENTATIONS:

The organizer, Simon Cragg ([Simon.Cragg@port.ac.uk](mailto:Simon.Cragg@port.ac.uk)) invites offers of talks or posters. Key contributors already expressing themselves keen to attend include:

Gerhard Haszprunar (larval anatomy),  
 Janet Voigt (Xylophagainid life histories),  
 Paul Tyler (life histories of deep sea bivalves),  
 Alan Hodgson (sperm structure and gametogenesis)  
 and John Todd (palaeontology of molluscan larvae).  
 There will be postgraduate contributors from Portsmouth and Southampton.

Start time is planned to be 11.00 to allow early morning travellers to arrive, and the finish time around 3.30 to allow an evening return. The Institute is located at the tip of the peninsula at bottom right of map at <http://www.port.ac.uk/aboutus/contact/maps/portsmouth/>

The **AGM** of the Society will be held during this meeting.

**A registration form for the Forum is attached to this newsletter.**

## BOOK NEWS

### *Thalassas 27(2) (2011)*

This volume of the electronic journal contains 13 selected papers from the **Third International Workshop on Opisthobranchs** in Vigo 2010. Full text of all issues can be downloaded free from [http://webs.uvigo.es/thalassas\\_marco%20principal.htm](http://webs.uvigo.es/thalassas_marco%20principal.htm)

### *Catalogue of Recent and fossil worm-snails*

Rudiger Bieler and Richard Petit

This catalogue researches nearly 1500 nominal species of Vermetidae, Siliquariidae and Vermiculariinae, and is available on open access from **Zootaxa No 2948** at <http://www.mapress.com/zootaxa/2011/f/zt02948p103.pdf>

### *Tentacle 18*

The latest and largest issue of Tentacle, the newsletter of the IUCN - Species Survival Commission - Mollusc Specialist Group is now available at <http://www.hawaii.edu/cowielab>.

### *Neogene paleontology of the northern Dominican Republic. 24. Propeamussidae and Pectinidae of the Cibao Valley*

By Thomas R Waller. 2011

Publication 381 of Bulletins of American Paleontology. 198 pp., 24 tables, 18 plates, ISBN 978-0-87710-494-0. Retail \$60.00. Order online at [www.priweb.org](http://www.priweb.org), or contact Paula Mikkelsen at [pmm37@cornell.edu](mailto:pmm37@cornell.edu) for a *pro forma* invoice.

### *MalaCo 7*

MalaCo (ISSN 1776-3941) is a free electronic French newsletter on ecology, biology, systematics and conservation of continental molluscs. Issue 7 (July 2011) includes an annotated reference list of molluscs of continental France. At <http://www-journal-malaco.fr>

## 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*.

### Subscriptions

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

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

### Methods of Payment

(1) Sterling cheque 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.

**Awards and Grants** - see back page.

### 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 /Zip 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.



### NEWS *continued from page 25*

#### Pulmonate phylogeny

Relationships between 96 species of pulmonate have been reconstructed, based on 1 nuclear marker (a complete ribosomal 18S) and 2 mitochondrial markers (part ribosomal 16S and COI). The onchidiids and veronicellids are monophyletic, as are the ellobiids (including *Trimusculus*, *Otina* and *Smeagol*). However, deep nodes are still uncertain. Dayrat B *et al.* 2011. *Mol. Phylogenet. Evol.* 59(2), 425-37.

#### Convergent and parallel evolution of life habit in scallops

Pectinids have six types of life habit: nestling (byssal attachment to coral which overgrows scallop), cementing (permanent attachment as new shell grows), byssal (temporary), recess (excavating cavity in soft substrate), free-living (resting above substrate), gliding (active swimming >5m, and gliding). Temporary attachment by byssal threads is the ancestral condition, but nearly all transitions

were repeated, mostly the result of parallel evolution from byssate ancestors. Convergent evolution also occurred producing two gliding clades and two recess living lineages.

Alejandrino A, Puslednik L and Serb J M. 2011. *BMC Evol. Biol.* 11, 164

#### Parallel evolution in ammonoids

Two Devonian ammonite lineages, Auguritidae and Pinacitidae, both display a shift towards more involute coiling, larger body size, more complex suture lines and the development of an umbilical lid in more derived taxa. Increased involution towards shells with a closed umbilicus reflects improved shell hydrodynamics, and this may also apply to the umbilical lid. Increasingly complex sutures probably result from constructional constraints arising from the trend to increased size and whorl overlap.

Monnet C, De Baets K, Klug C. 2011. *BMC Evol. Biol.* 11, 115.



## 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](http://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](http://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](mailto:T.Walker@Kingston.ac.uk)