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The Malacologist

The Bulletin of The Malacological Society of London

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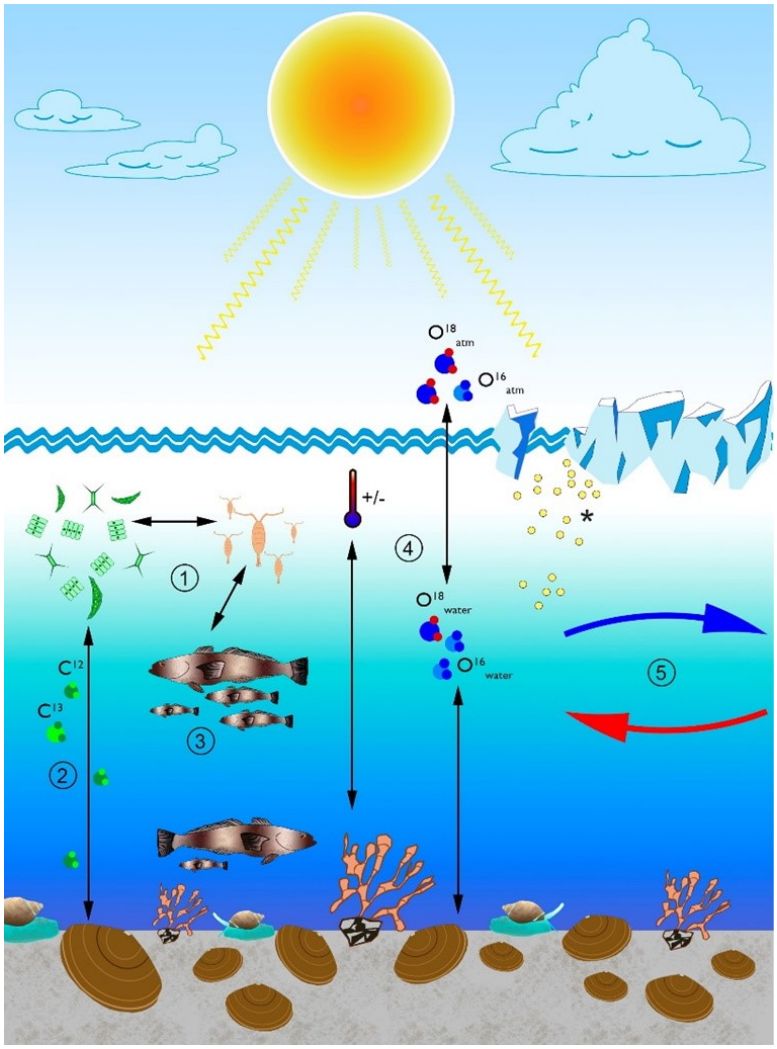
Contents

Molluscan Forum 2019

Last November young malacologists from across Europe took part in the Malacological Forum at the Natural History Museum. The abstracts of the thirty one presentations start inside, starting on page 8.



This image encapsulates the cycling processes in the Southern Ocean which are vulnerable to climate change. See the abstract entitled *Shell structure and composition of poorly studied Southern Ocean mollusc bivalves with a special focus on sclerochronology* by Alejandro Roman Gonzalez & James Scourse on page 19.

EDITORIAL

As usual, the February issue carries the abstracts of the presentations which took place at the Malacologists Forum. As is customary at these meetings, the audience was positive and attentive. My zoological education goes back a long way. We spent a lot of time dissecting and drawing animals and 'molecular biology' had not yet appeared in the vocabulary (nor had computers). I was ruefully amazed therefore to find this sentence in one of the abstracts. *"In this work, an expanded taxon set of specimens from across the geographical distribution of P. quadrilineata was assembled and the gene cytochrome c oxydase subunit I was used to generate a Bayesian phylogenetic tree, perform species delimitation analysis based on the Automatic Barcode Gap Discovery method, and to generate a haplotype network."* It is well written and I know what it means but put it before any biology student thirty years ago and they would have been lost. My amazement stems from appreciating how far, and fast we have come in the biological sciences in general, and malacology in particular. As ever, the abstracts published in this issue cover an eclectic mix of malacology ranging from parasitism to shellfisheries management to cannibalism to plastics pollution. Among other things they illustrate the contribution being made by malacology to understanding climate change (for example Alejandro Gonzalez & James Scourse on page 19) and past environments (for example Quentin Wackenheim on page 23).

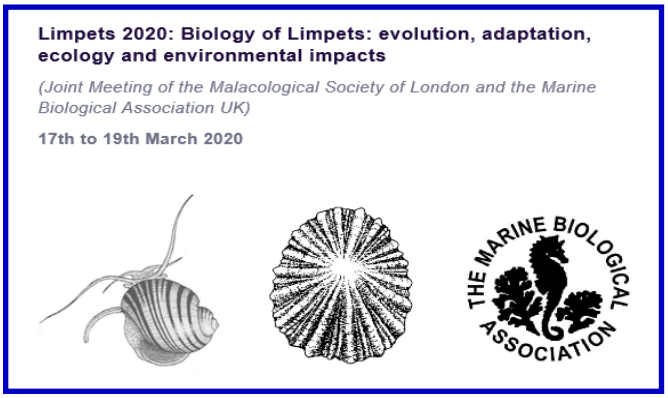
The Society, its publications and its meetings need to be managed and there is a dedicated group of people who do this as the Council of the Society. On page 6 you can see most of the Council, photographed at a recent Council meeting.

A PLEA The Council would like to digitise issues of the Newsletter, which predated both *The Malacologist* and the malacological *Bulletin*. If any members have copies of the Newsletter (particularly numbers 1-7), could they please contact me.

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

Emeritus Prof. Georges Dussart
Canterbury Christ Church University
North Holmes Rd.,
Canterbury
Kent
CT1 3JZ
UK
georges.dussart@canterbury.ac.uk

News and notes



See pages 31 and 32 in this issue for details of this meeting and the Annual General Meeting.

ICIM-5: 5th International Congress on Invertebrate Morphology, August 2-7, 2020
See congress website for details on the program, speakers, social events, and much more here:
https://icim5-2020.univie.ac.at

Prof. DDr. Andreas Wanninger, University of Vienna
Wanninger Andreas <andreas.wanninger@univie.ac.at

FREE TO GOOD HOME

Proceedings of the Malacological Society of London / Journal of Molluscan Studies, complete from Vol 40 (1972) to Vol 82 (2016) including Supplements 1-7, 9, 11, 15.
ALSO
Journal of the Marine Biological Association of the UK, mostly complete (a few early issues missing) from 6 (new series, 1900) to 84 (2004), plus most annual reports.
Recipient must collect, from north-east England. Contact mark.davies@sunderland.ac.uk

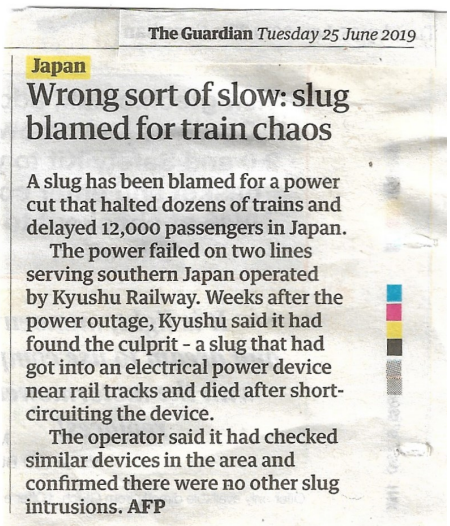
Bailey-Matthews National Shell Museum, Florida

After eight months, The Shell Museum will reopen for visitors on Saturday, December 21, 2019. The Museum is still putting the finishing touches on its general construction, but will be open for all visitors beginning on Saturday 12/21 with more programs, exhibits, and activities than ever before, including a new exhibit: Coral Reefs: Nurseries of the Sea.
The New Living Gallery (aquarium) will open in March, 2020. Visitors are encouraged to check the website: www.shellmuseum.org for updates or call the Museum at 239-395-2233. Daily Beach walks are always available and may be reserved by calling the Museum. Regular hours will be daily 10am – 5pm
Bailey-Matthews National Shell Museum | 3075 Sanibel-Captiva Road, Sanibel, FL 33957

Littorina littorea shells

A graduate student in one of my courses used Littorina littorea shells as part of a published study.
https://blaypublishers.files.wordpress.com/2019/05/ye-leb63.pdf
I have ca. a dozen of his specimens and would like to donate the, as vouchers, to a suitable museum. The specimens have geographical provenance and day of collection.
If anyone is interested, please feel free to email me at: blayjorge@gmail.com

Jorge A. Santiago-Blay, PhD
http://paleobiology.si.edu/staff/individuals/santiagoblay.cfm



The Guardian *Tuesday 25 June 2019*

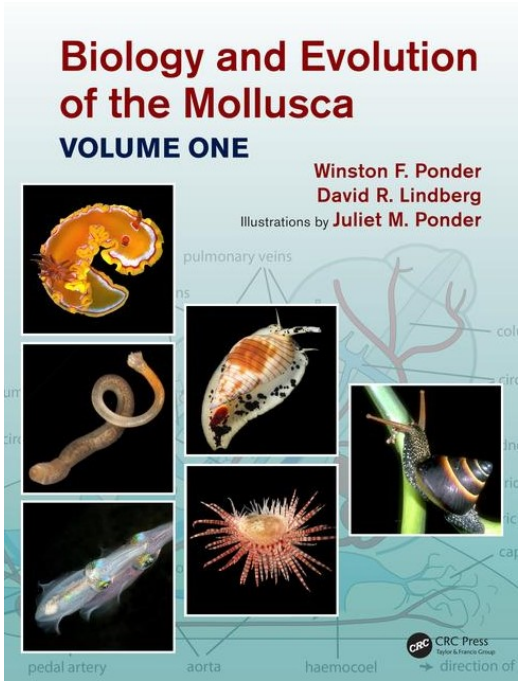
Japan

Wrong sort of slow: slug blamed for train chaos

A slug has been blamed for a power cut that halted dozens of trains and delayed 12,000 passengers in Japan.

The power failed on two lines serving southern Japan operated by Kyushu Railway. Weeks after the power outage, Kyushu said it had found the culprit - a slug that had got into an electrical power device near rail tracks and died after short-circuiting the device.

The operator said it had checked similar devices in the area and confirmed there were no other slug intrusions. AFP



Conference - *Non-marine snails and slugs: from extinction to invasion*

We are pleased to invite you to participate in International scientific conference "Non-marine snails and slugs: from extinction to invasion", that will take place from 25th to 28th of August 2020 in Riga, Latvia.

This Conference hosted by Institute of Horticulture, Latvia University of Life Sciences and Technologies in cooperation with the Latvian Malacological Society.

The aim of the meeting is to bring together the latest advances in research on the non-marine snails and slugs, and to provide an opportunity to exchange information and ideas and stimulate joint research and collaboration. The official language of the conference will be English. More information is available at the conference website:

https://www.darzkopibasinstituts.lv/en/international-scientific-conference-non-marine-snails-and-slugs-from-extinction-to-invasion

The latest Conference updates will be available via the Conference website.

Arturs Stalažs
Researcher; secretary of conference
Institute of Horticulture
Graudu iela 1, Ceriņi, Krimūnu pagasts, Dobeles novads, LV-3701, LATVIA

POSTDOCTORAL RESEARCH POSITION IN EVOLUTIONARY BIOLOGY / GENOMICS

TOPIC: Drivers of diversification in predatory gastropods

One full-time postdoctoral position for 2 years is available at the Muséum National d'Histoire Naturelle (MNHN), located in Paris, France. The position will start the 1st of June 2020. A one-year extension is negotiable.

The post-doctoral fellow will work in the framework of the ERC project "Hyperdiverse" (ERC-COG-2019, # 865101), who seeks at identifying the drivers of diversification in a group of marine predatory snails, the neogastropods. One of the goals of the project is to sequence 15 genomes of species characterized by various feeding and developmental strategies, two characters that might have influenced the evolutionary success of the group. These genomes would be the first for neogastropods (except for some low-quality, poorly assembled genomes), which are also known to have a large genome size (2-5Gb), with many repeated elements. The post-doc fellow will have to assemble the genomes, combining data from various sequencing technologies (Illumina, Minion, PacBio), and will also be in charge of the genome annotation, in particular to identify candidate genes involved in feeding (e.g. toxins, anaesthetics, etc…) and in larval development, integrating population genomics approaches. Within the "Institut de Systématique, Evolution et Biodiversité" of the MNHN, the post-doc fellow will work in the team 3E ("Exploration, Espèces, Evolution"), working on the systematics and evolution of benthic marine invertebrates. The team regularly organizes expeditions that the post-doc fellow may join, to enrich the MNHN collections and provide data for a highly active international network of taxonomists and evolutionists with which the fellow will collaborate.

QUALIFICATIONS - PhD in Biology. The candidates are expected to have a good experience in genome assembly and annotation.

SALARY – 2650€ per month

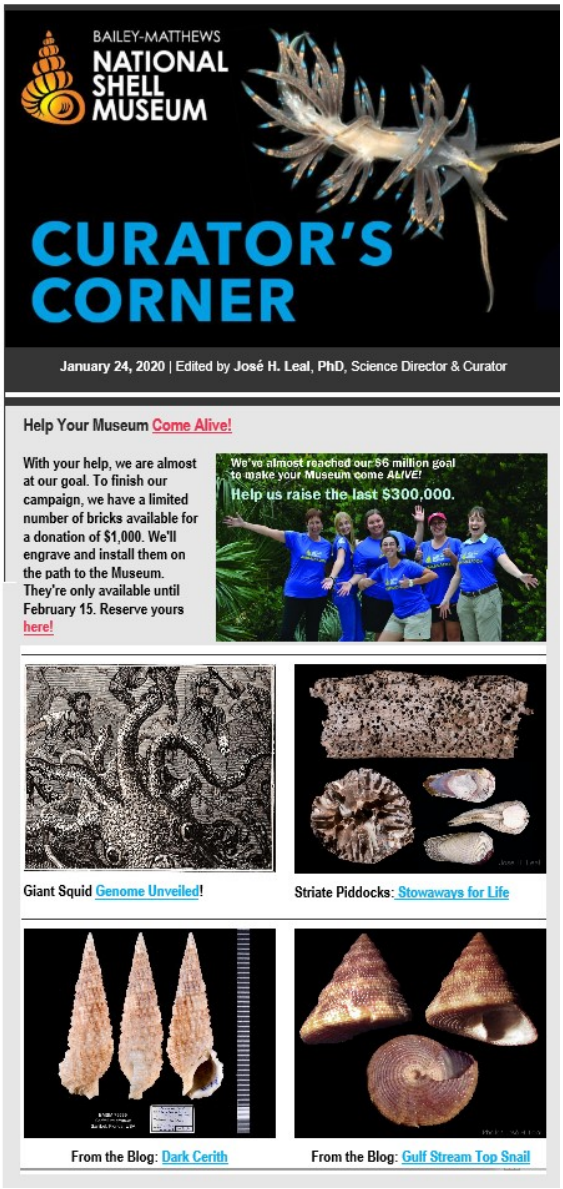
APPLICATION PROCEDURE: Please submit a CV, detailing your experience in genome sequencing, assembly and annotation. Email your application to puillandre@mnhn.fr, before the 10th of March.

For informal enquires and more details, email puillandre@mnhn.fr

Innovative malacology in museums

Our *Sponsored Field Trip* program is donor-funded, and brings Lee County fourth graders from Title One schools to Bailey-Matthews National Shell Museum on Sanibel for a fun, educational field trip at no cost to the school. Before the field trip, students view a thirty-minute locally filmed educational video called *Molluscs in Action* to learn how molluscs eat, move, and protect themselves. During their visit, students can touch live molluscs while identifying major parts of their anatomy, learn about molluscs' growth, reproduction and habitats, and express their creativity by completing a shell-themed art project.

Molluscs on the Move is an interactive STEM presentation experience, in which a Museum staff member brings LIVE molluscs to schools, outdoor festivals, and community events. A marine educator sets up a live tank and allow guests to visit and ask questions about our local mollusc species. Program subject matter aligns to the Sunshine State Next Generation Science Standards. For schools (Grades K-5), the presentation focuses on the importance of observing the natural world, mollusc feeding habits and reproduction, and marine conservation and protection. As a reward for participating in this program, each student receives a shell guide and a local shell to start their very own scientific collection. Scholarships are available for Title One schools throughout Lee and Collier Counties.



The 13th International Symposium on Littorinid Biology and Evolution (ISOLBE)
will be hosted by Rhodes University, South Africa,
and held at

Lalibela Game Reserve

in the Eastern Cape (https://lalibela.net/)

3-6th August 2020

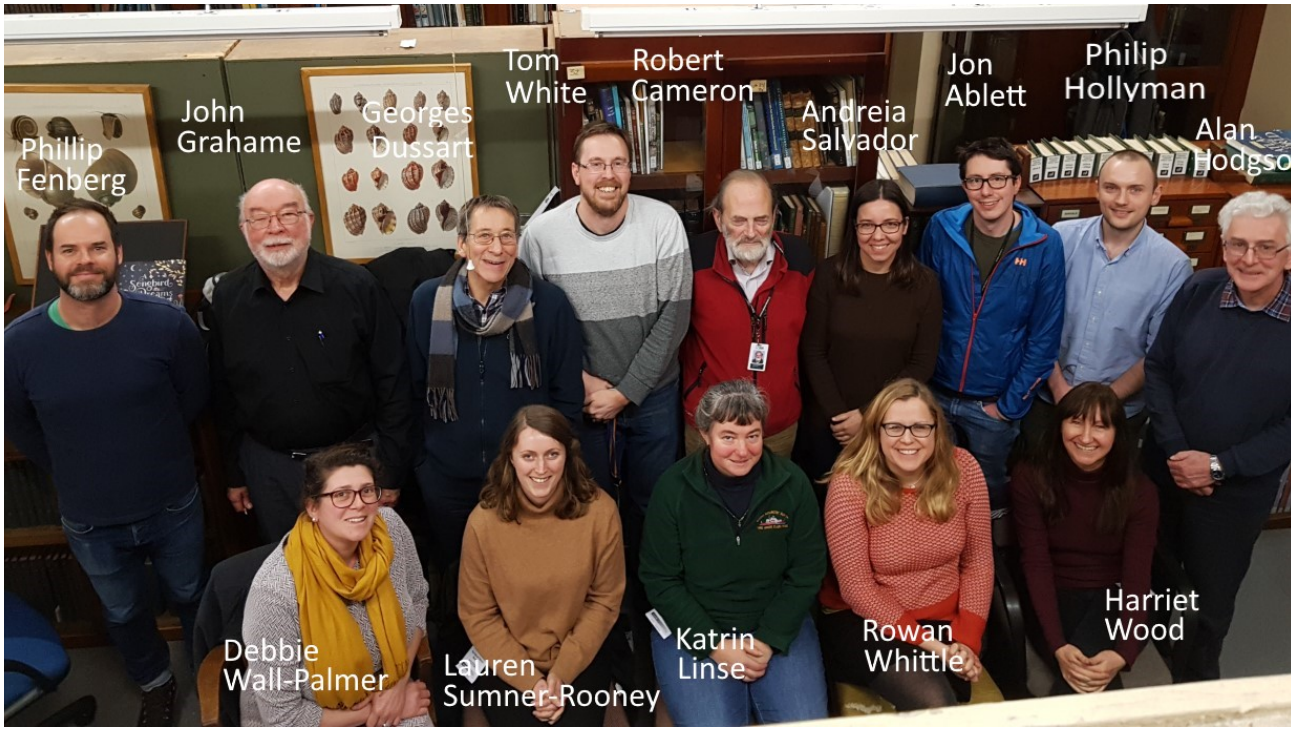
This promises to be an exceptional conference experience and we anticipate great interest, but there are limited spaces available. Consequently, we will have to take a first-come first-served approach. Interested researchers are invited to submit Abstracts as soon as possible through our web site at

http://www.isolbe.co.za/

Do please take advantage of this unique opportunity for an exciting meeting in an exceptional place by sending your abstracts as soon as possible. As they say in the travel brochures "Book early to avoid disappointment".

The deadline for Abstracts will be 16 January 2020

The current Council of the Malacological Society of London (almost all …..)



Photographed at a Council meeting at the Natural History Museum, London

Molluscan Forum 2019

Natural History Museum, London
21 November 2019

Convened by

Dr PHIL HOLLYMAN, Organiser
Council member of the Malacological Society of London
Fisheries Ecologist, British Antarctic Survey (email: phyan@bas.ac.uk)

Dr JOHN GRAHAME, Organiser
President of the Malacological Society of London (email:J.W.Grahame@leeds.ac.uk)

ORAL PRESENTATIONS

Session I

10.00	JOHN GRAHAME: Welcome and introduction to the day
10.10	PAOLO ALBANO: The decline of native molluscs on the Israeli shallow shelf
10.25	EDGAR BARAJAS LEDESMA: Gastropod mucus: relating structure to function through protein hydration
10.40	SARAH BORSETTI: A Life history parameters and reproductive timing of common whelk (*Buccinum undatum*) on the U.S. Mid-Atlantic continental shelf
10.55	IMOGEN CAVADINO: "Slugs count" mapping slug diversity in UK gardens
11.10 - 11.40	Coffee & poster viewing

Session II

11.40	CHARLOTTE COLVIN: Shell growth and repair in *Buccinum undatum*
11.55	ADELYN SA. ESCOBAR: Community structure of intertidal muricids (Mollusca: *Muricidae*) present in Verde Island, Batangas City, Batangas, Philippines
12.10	JAKE GOODALL: Population genetic structuring in the common whelk, *Buccinum undatum*, across Iceland and the North Atlantic, as revealed by RAD sequencing9
12.25	JORGE HERNÁNDEZ-URCERA: Citizen science provides new insights on cannibalistic behaviour of *Octopus vulgaris*
12.40	ALISON IRWIN: The evolution and diversification of vision in strombid Gastropods
12.55	JOHN GRAHAME: Announcements, Arrangements and Awards etc.
13.00 - 14.00	Lunch break

Session III

14.00	HANNAH JACKSON: Variation in banding patterns of *Cepaea* spp.
14.15	HEATHER KOSTICK: Dispersal and vagility of Jamaican terrestrial molluscs
14.30	JENNY LARSSON: ShellShaper - a program for making 3D snail shell models from 2D images
14.45	REBECCA L. MOORE: Microplastic abundance in blue mussels (*Mytilus edulis* cultured for human consumption, sold in United Kingdom supermarkets
15.00	HARRY POWELL: Brought to the surface: a new beginning for freshwater snail identification in Britain and Ireland
15 - 15.45	Tea break & poster viewing

Session IV

15.45	ALEJANDRO ROMAN GONZALEZ: What can shell geochemistry from Southern Ocean mollusc bivalves tell us about their environment?
16.00	SEAN STANKOWSKI: Life-history evolution and speciation in *Littorina*
16.15	ELIN ANGHARAD THOMAS: Red Listing can protect deep-sea biodiversity
16.30	QUENTIN WACKENHEIM: A new palaeo-environmental reconstruction from a Mid-Holocene molluscan succession in the Middle Atlas (Aït-Said-ou-Idder, Morocco)
16.45	JOHN GRAHAME: Closing remarks
17.00 - 18.30	Wine social & final poster viewing

POSTER PRESENTATIONS

LOUISE BARTRAM: Investigating spermatozeugmata structure and release in the freshwater pearl mussel *Margaritifera margaritifera*

MARINA FERRAND: Land snails from 'The Catacombs of Paris': original insight from an unexplored subterranean fauna

TEREZA FLEGROVÁ: Infrapopulation structure of dicyemids, parasites of cephalopods

TEREZA KOSOVÁ Central-European phylogeographic crossroads: phylogeography of *Monachoides incarnatus*

DANIELA KOTALOVÁ: Population structure of octopus *Eledone moschata* in to the Mediterranean Sea on the basis of RAD sequence data

ANNA MARSZEWSKA: *Potamopyrgus antipodarum* (Gray, 1843) (Gastropoda: Tateidae) as a potential control factor for "swimmer's itch"

HUBERT MARSZEWSKA: *Unionidae* as hosts of digenetic trematodes

DENNIS MAYK: Business as usual? Investigation in the calcite microstructure of wild and repaired shell in *Nucella lapillus* (Linnaeus, 1758)

TOM PENNANCE: Investigating the island biodiversity of *Bulinus globosus*, the intermediate freshwater snails host of veterinary and medically important *Schistosoma haematobium* group parasites on Pemba Island (Zanzibar, United Republic of Tanzania)

ALEJANDRO ROMAN GONZALEZ: The shell structure and composition of poorly studied Southern Ocean mollusc bivalves with a special focus on sclerochronology

JASNA SIMONOVÁ: Snails can fly with birds - more evidence for snail endozoochory

CECILIE G. SØRENSEN: Using molecular and morphological tools to interpret the coloour polymorphism of the European nudibranch species *Polycera quadrilineata* (O. F. Müller, 1776)

Abstracts

Alphabetical by presenter

The decline of native molluscs on the Israeli shallow shelf

Paolo G. Albano[1], Jan Steger[1], Marija Bošnjak[1,2], Beata Dunne[1], Zara Guifarro[1], Anna Hinterplattner[1], Bella S. Galil[3], Martin Zuschin[1]

[1] Department of Palaeontology, University of Vienna, Austria

[2] Croatian Natural History Museum, Zagreb, Croatia

[3] The Steinhardt Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, Tel Aviv, Israel

Email: pgalbano@gmail.com

The Levantine basin in the eastern-most Mediterranean Sea hosts hundreds of non- indigenous species introduced after the opening of the Suez Canal. An equally dramatic phenomenon is the disappearance of native molluscs. Here we quantify this decline on the Israeli Mediterranean soft-substrate shelf based on sampling along two transects off northern and southern Israel in Autumn 2016 and Spring 2017 at 10-40 m depth. We compared the living assemblages with 1) a comprehensive literature-based checklist of Israeli molluscs filtered by appropriate substrate and depth, and 2) the composition of the death-assemblage collected with the living organisms. We used a small mesh size (0.5 mm) to retain small sized and juvenile individuals and deployed an intense identification effort, including tracing the morphology of early post-larval stages. Our sampling intercepted only 24% of the historically recorded species, notwithstanding a sample coverage of 99.4%.

At individual sites, the living assemblage native richness is between 2.9% and 18.5% of the death assemblage native richness. By contrast, we intercepted 54% of the historically recorded non-indigenous species. At individual sites, the living assemblage non-indigenous richness ranges between 7.1% and 80.2% (mean 42%) of the death assemblage, with lower values in deeper stations. The abundance of native species peaks in spring (80%, 934 individuals) but drops in autumn to only 15% (279 individuals, notwithstanding that two additional replicates were collected) suggesting a mass mortality during summer. The comparison of size-frequency distributions from living and death assemblages showed that most native species are represented by small living individuals that do not reach the large sizes of the past, suggesting that while recruitment does occur, death occurs prematurely, for some species possibly before maturity. By contrast, for most non-indigenous species the size range of living individuals overlaps with the dead ones. These two results combined suggest that current environmental conditions (likely including the locally rapid climate warming) disproportionally favour non-indigenous species and that native species reproduction may be hindered, with recruitment potentially coming from deeper waters or other sectors of the basin.

Gastropod mucus: relating structure to function through protein hydration

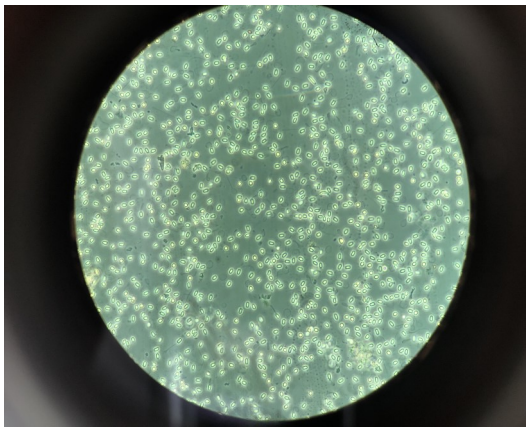
Edgar Barajas Ledesma[1], Gwen Reilly[1, 2], Chris Holland[1]
[1]Department of Materials Science and Engineering, University of Sheffield, Sheffield, UK
[2]INSIGNEO Institute for in silico Medicine, University of Sheffield, Sheffield, UK
Email: ebarajasledesma1@sheffield.ac.uk

Mucus enables both locomotion and adhesion to a surface for the gastropod that produces it. Whilst water is the major component of mucus (>98%) it is the minor one, namely mucins which are highly glycosylated proteins, that give this material it´s fascinating properties. Mucin performance relies on its structure, which is determined by how it interacts with its local environment to maintain its function. However, there has yet to be a comprehensive comparative study of the performance ranges of several different gastropod species. Such a study would be important as it will provide insights not only into mucus evolution and specialization for different habitats, but also provides a source of bioinspiration for a range of novel bioadhesives and lubricants.

Our study attempts to address this challenge by comparing native mucus produced by 6 species: *Achatina fulica*, *Cornu aspersum*, *Cepaea nemoralis*, *Arion ater*, *Arion hortensis* and *Limax flavus*. Mucus was investigated using a range of molecular and spectroscopic techniques to determine its structure and composition (SDS-PAGE, UV-vis, FTIR), and then mucus was subjected to a change in environment by altering the temperature (TGA, DSC), or subjecting it to flow (rheology). All mucus tested comprised of glycosylated proteins (41-377 kDa) which adopted a random coil structure acting as weak gels (1.58-36.33 Pa s at 1 rad s^{-1}), that changed upon heating and subsequent denaturation (65.78-72.06 °C, 0.08- 2.17 J g^{-1}).Results indicate that when compared to the other 5 species, *A. fulica* mucus shows only a small structural change, requiring more energy input to remove water from the proteins present, and also has the lowest protein content, which may be a result of its natural tropical habitat. At the other end of the scale, *A. hortensis* slug mucus has the highest protein content and the lowest enthalpy of denaturation, implying that this mucus contains a lot of less stable proteins in order to maintain its natural function. We believe our comparative evolutionary study of gastropod mucus will shed light onto how nature has optimized protein structure and hydration to maintain function across a range of environments which may lead us to new bioinspired materials based on these

Investigating spermatozeugmata structure and release in the freshwater pearl mussel *Margaritifera margaritifera*

Louise Bartram
University of Cumbria, Ambleside, Cumbria, UK
Email: louisebartram@live.com

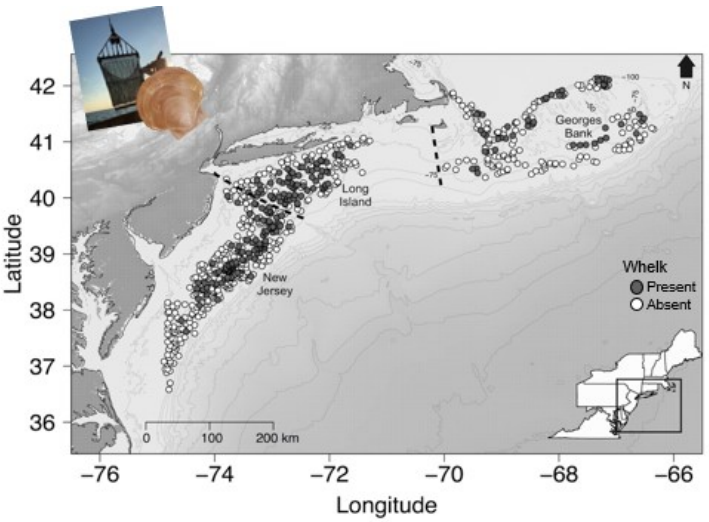


Active spermatozoa (head length of 3.46 microns) observed under a high-power inverted microscope.

A study was carried out to identify the release timing of spermatozeugmata from the freshwater pearl mussel *Margaritifera margaritifera*. The Spermatozeugmata (sperm sphere) is a circular membrane containing spermatozoa. Spermatozeugmata have been identified through histological studies in many species of freshwater mussel with the average size being 100-120µm, depending on species. The literature suggests that freshwater mussels typically release the spermatozeugmata into the water column when temperatures in the environment reach around 16°c. There is currently little information on the release and structure of spermatozeugmata of *M. margaritifera*, despite the increasing interest in the reproductive lifecycle. T his information would be valuable to institutions and researchers that are currently taking action to protect this endangered species through propagation techniques. My study aimed to identify whether the release of spermatozeugmata in *M. margaritifera* was temperature dependent and varied between different mussel populations. Once identified, structure and motility variation over time would be recorded. The experiment would take place at the Freshwater Biological Association (FBA), Cumbria, UK, which is currently an Ark site for this species, holding six different populations. The original study involved taking daily water samples using plankton nets (75, 100 and 125µm) and recording daily water temperatures. No spermatozeugmata were found during five weeks of daily water sampling. Fifty mussels were translocated from a river in West Cumbria to the FBA in July 2019. During this translocation, spermatozeugmata were found in a container holding 25 mussels. The spermatozeugmata were 60 microns in diameter at an estimated post release of three hours. Videos and images were taken of the spheres, and motility was recorded over the following 48 hours. The motility of the spermatozeugmata decreased over the 48-hour time period, while the overall size of the structure increased. This observation was followed by a stress-induction experiment on a population held at the FBA, to see if these mussels released spermatozeugmata. This proved to be unsuccessful but a glochidia check will take place on the host fish in September 2019.

Life history parameters and reproductive timing of common whelk (*Buccinum undatum*) on the U.S. Mid-Atlantic continental shelf

Sarah Borsetti[1], Eleanor A. Bochenek[1], David B. Rudders[2], Colin Dobson[3], Jui-Han Chang4, Daphne M. Munroe[1]
[1]Haskin Shellfish Research Laboratory, Rutgers University, Port Norris, USA
[2]Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, USA
[3]Woods Hole Oceanographic Institution, Woods Hole, USA
[4]Northeast Fisheries Science Center, NOAA, Woods Hole, USA
Email: sarahbor@rutgers.edu



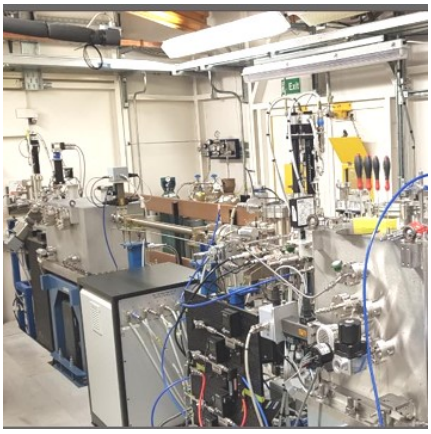
Recent development of the common whelk (*Buccinum undatum*) fishery within the United States Mid-Atlantic continental shelf region has spurred investigation into biological and population attributes of the species. Limited adult dispersal and lack of a planktonic larval stage has the potential to create spatially distinct and highly vulnerable populations. Additionally, maturation and reproductive timing vary by location for this species and are likely linked to bottom water- temperature. During the summer of 2015, a comprehensive survey was undertaken to evaluate population structure, sex ratio, relative abundance, and size of sexual maturity for whelk in the Mid-Atlantic. Estimates of size of sexual maturity for *B. undatum* from other regions of the world were compiled, demonstrating that the size of maturity for this species is highly variable, and current minimum landing size regulations tend to fall below the estimated size of sexual maturity, potentially increasing the risk of recruitment overfishing. More focussed sampling, in the southern-most extent of this species' range in the Atlantic, occurred throughout 2017 to examine the seasonal fluctuations in relevant body metrics and gonadosomatic index in relation to bottom temperature to assess reproductive timing of *B. undatum*. Unique oceanographic dynamics, such as strong seasonal stratification result in large changes in annual bottom temperature appear to link closely to the reproductive cycle in this region. To date, no formal fishery management plan exists for *B. undatum* in the U.S., these findings are directly relevant for future management of common whelk along the U.S. Mid-Atlantic continental shelf.

"Slugs count" - mapping slug diversity in UK gardens

Imogen Cavadino [1,2], Hayley Jones[1], Gordon Port[2], Helen Roy[3], Gerard Clover[1]
[1]Royal Horticultural Society, RHS Garden Wisley, Woking, Surrey GU23 6QB, UK
[2]Newcastle University, Newcastle upon Tyne, Tyne and Wear, NE1 7RU, UK
[3]Centre for Ecology & Hydrology, Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB UK
Email: imogencavadino@rhs.org.uk

Slugs and snails are notorious horticultural pests, widely detested by gardeners and are frequently the most common pest enquiry to the RHS Gardening Advice service. However, not all species of slug and snail found in the UK are considered plant pests, with many species playing important roles in breaking down decaying material and recycling nutrients into the soil. In domestic gardens the presence of these pests is usually recognized by feeding damage, with the culprit species not identified. Little is known about which slug and snail species are present in UK gardens. Using citizen science, this project seeks to engage with gardeners in the UK and empower them to identify species of slug found in their garden. Through the RHS "cellar slug survey" (www.rhs. org.uk/slugsurvey) we are monitoring the decline and spread of two slug species throughout the UK, whilst conveying an important message about the different roles slugs play in gardens. A second survey is soon to launch, using standardized survey methods to investigate what slug species are found in UK gardens. By identifying what species occur in UK gardens, we can map the spread of invasive species and try to understand the garden features that may influence the presence of these species. The data provided by citizen scientists will be used to feedback information on locally abundant pest and non-pest species, allowing control methods to be targeted to problem species, reducing negative impacts on other wildlife.

Shell growth and repair in *Buccinum undatum*



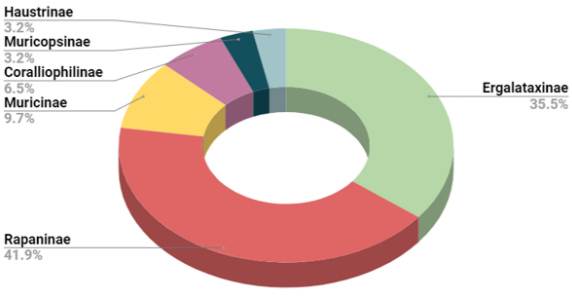
Charlotte Colvin [1], Phil Hollyman [2,3], Simon Chenery [3], Chris Richardson [1], Konstantin Ignatyev [4], & Ian McCarthy[1]
[1]School of Ocean Sciences, College of Natural Science, Bangor University, Anglesey, UK
[2]British Antarctic Survey, High Cross, Cambridge, UK
[3]Centre for Environmental Geochemistry, British Geological Survey, Nottingham, UK
[4]Diamond Light Source, Harwell Science and Innovation, Campus, Oxfordshire, UK
Email: c.n.colvin@bangor.ac.uk

Trace element variations in mollusc shells are often studied as proxies for historical environmental conditions, for example seawater temperature. The effectiveness of these can vary as a result of physiological influences and shell mineralogy. The common European whelk, *Buccinum undatum* is a commercially important gastropod mollusc which frequently experiences anthropogenic as well as predatory damage to its shell. These impacts combine to delay normal shell growth and thicken the shell through periods of re-growth. Throughout a series of laboratory experiments, timings of shell growth and repair have been monitored following periods of controlled mechanical damage to assess the impacts of rapid shell growth on individual whelks. Under varying environmental conditions and feeding regimes, the effects of individual size, age and previous shell damage has been analysed, with results showing repair rate differences in the variety of biological factors in addition to differing temperature and feeding regimes. In order to look further into the structure and implications of damage incidents, shell structure and composition was analysed. The shell itself is characterised by 4 distinct layers of the mineral aragonite, formed around a central columella, with each layer showing distinct different chemical compositions, amplified during episodes of rapid shell growth or repair. Crystallographic (μXRD), fluorescence (μXRF) and absorption (μXANES/EXAFS) techniques on the Diamond I-18 microspectroscopy beamline were used to establish differences in shell mineralogy and crystal structure in response to laboratory-controlled shell damage and re-growth. μXRD data confirmed the shell structure mineralogy (aragonite) and showed mineralogical changes between layers of rapid and normal growth to be minimal. However, mapped Sr and Ca concentrations from μXRF highlighted differences in elemental distributions between these layers.

Community structure of intertidal muricids (Mollusca: *Muricidae*) in Verde Island, Batangas City, Batangas, Philippines

Adelyn SA. Escobar, Brian B. Valencia, Karl Arbie B. Borrero, Ruthela P. Payawal
Undergraduate student, Department of Biology, College of Science, Polytechnic University of the Philippines, Sta. Mesa, Manila
Email: elyescobarrr@gmail.com

The Muricidae comprise a well-known family of predatory marine snails and is the second largest family in the Order Neogastropoda. They are also an important family of marine gastropods ecologically, by the role they serve in marine communities and also economically, by their therapeutically useful compounds. Verde Island, located in Batangas City, Philippines, is one of the richest biodiversity areas in the world. However, there is no existing record regarding the diversity of *Muricidae*. This study aimed to provide baseline information about the community structure of family *Muricidae* in Verde Island. Sampling was conducted during wet and dry seasons. Stations were limited to six barangays of the island and was carried out by collection from seven 20- meter transects with ten 1x1 m quadrats in each barangay. Physicochemical parameters of the sea water (temperature, dissolved oxygen, pH, and conductivity), abundance, frequency and relative values of each species were recorded. A total of thirty-one species belonging to six sub-families composed the *Muricidae* community in Verde Island. Furthermore, the barangays of San Agustin West and Liponpon have the most abundant and diverse species composition among the barangays. Analysis of variance revealed that there is no significant difference variation of species diversity of intertidal muricids across seasons (P=0.736). However, there is a statistically significant variation in the species diversity of intertidal muricids across the different barangays of Verde Island (P=0.001). Canonical Correlation Analysis showed that both diversity and abundance of different species were influenced by physicochemical properties of the island environment.



Land snails from 'the Catacombs of Paris': original insight from an unexplored subterranean fauna

Marina Ferrand [1], Quentin Wackenheim[2], Yann Bussière[3]
[1]27 Avenue Louis Pasteur 92220 Bagneux, France
[2]Laboratoire de Géographie Physique, UMR 8591 CNRS, Univ.Paris 1 & UPEC, Meudon, France
[3]12 avenue Pierre Semard, 18500 Mehun sur Yèvre, France
Email : marinakafka@gmail.com

Since the birth of the discipline in the nineteenth century, biospeleologists have studied all groups of invertebrate (included non-marine mollusc), living in subterranean ecosystem. In France, karst areas show a strong potential of endemism with more than dozens of stygobite snails and one troglobite species. Like natural caves, artificial cavities (i.e. quarries) are suitable habitats with a peculiar underground fauna which is however, poorly known. Underground quarries seem indeed little investigated because of their poorer malacological biodiversity. At 10 to 30 meters-depth beneath Paris, more than 300 kilometers of galleries result from the former exploitation of limestone used for building the city. These ancient quarries have been commonly called 'catacombs' because a small part was used to store human bones during the nineteenth century. For centuries, the whole underground network has been used and frequented. Since 2017, inventories of invertebrates below Paris have been carried out. Regarding molluscs, 8 troglophiles and 1 endogean taxa were identified. *Oxychilus* species, *Discus rotundatus*, *Limax. maximus, Deroceras reticulatum* and *Cecicliodes acicula* are commonly known as living in subterranean environments. But in artificial cavities, the discovery of living population of *Zonitoides arboreus* and *Zonitoides excavatus* is unusual. The distribution of both zonitid species are restricted in France and their occurrence in Paris is also unusual. This suggests that human activities (quarrying and catacomb frequentation) have an impact on mollusc biodiversity within the Paris catacombs. Mechanisms involved could include both involuntary introduction of new species and development of favourable specific ecosystems.

http://catacombes.paris.fr/en

Infrapopulation structure of dicyemids, parasites of cephalopods

Tereza Flegrová [1,2], Marie Drábková[21], Václav Hypša[1], Jan Štefka [1,2]
[1]Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic
[2]Biology Centre, CAS, v.v.i., České Budějovice, Czech Republic
Email: flegrovat@gmail.com

Dicyemida are microscopic, wormlike organisms living in the renal organs of cephalopods. Dicyemida are capable of both asexual and sexual reproduction. The role that each reproduction mode plays in their life cycle is unknown however. For example, it remains to be revealed whether asexual reproduction drives the level of their infrapopulation structure (diversity within their host). In the present study, we used a molecular approach, specifically microsatellites, to identify (1) whether dicyemids reproduce predominantly sexually or asexually and (2) to explore their infrapopulation structure. We selected a set of eight microsatellite loci from a draft genome sequence of *Dicyema moschatum* (Whitman, 1883), an organism living mostly in *Eledone moschata* (Lamarck, 1798), which is a medium-sized muscular octopus living in the Mediterranean Sea. Using samples from several hosts from two regions - Italy (Naples) and Croatia (Pula) – we were able to compare the level of population structure between samples from individual cephalopod hosts. We identified 2 to 4 genetic clusters, mostly concordant with the geographic origin of the samples. Allele patterns seen in individual dicyemid genotypes revealed that although dicyemids inside one host individual show low genetic variance, they do not represent genetically identical clones. These results suggest that the host is infected by several dicyemid larvae within its lifetime and that sexual reproduction of dicyemids occurs inside the host.

An attentive audience at the Forum

Population genetic structuring in the common whelk, *Buccinum undatum* across Iceland and the North Atlantic as revealed by RAD sequencing

Jake Goodall[1,2], Zophonías O. Jónsson[1], Kristen MarieWestfall[3], Hildur Magnúsdóttir [1,2], Snæbjörn Pálsson[1],
Erla Björk Örnólfsdóttir[2]

[1]Faculty of Life and Environmental Sciences, The University of Iceland, 101 Reykjavik, Iceland

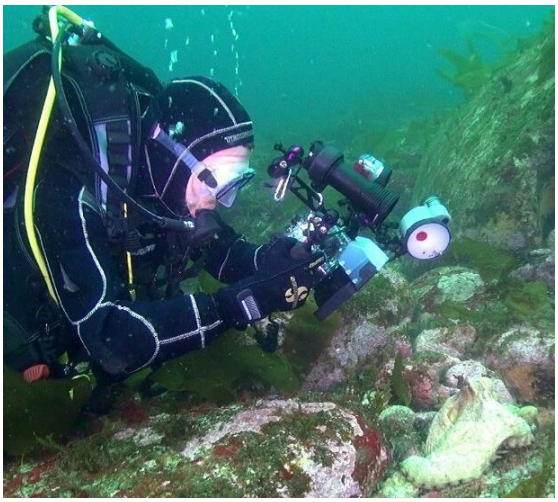
[2]Departme nt of Aquaculture and Fish Biology, Hólar University, 551 Sauðárkrókur, Iceland

[3]Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, Canada
Email: jake@hi.is

The common whelk, *Buccinum undatum*, is a commercially significant gastropod species distributed throughout the North Atlantic. Throughout its distribution, *B. undatum* exhibits clear variation in several phenotypic shell traits, including colour, shape, and thickness. West Iceland's populations, in particular, display a degree of colour diversity (seven morphotypes) that far exceeds that described across the species' wider distribution (three morphotypes). RNA- Seq analyses are currently underway to characterize the genetic and regulatory factors underlying Iceland's unique shell- colour diversity. However, for RNA-Seq studies to accurately describe the genetic factors underlying shell colour in Iceland potential associations between genetic variation and population structure must first be identified and accounted for. Whilst multiple studies have sought to delineate population structure in *B. undatum* (albeit across varying geographic scales), all studies to date have examined population structure using a finite number of microsatellite and/or mitochondrial markers; severely limiting researcher's capacity to infer genome-wide trends in genomic diversity and/ or characterize genotype-phenotype associations. Here we present an analysis of population genetic structure of *B. undatum* using RAD-Seq, a technology that facilitates the genotyping of potentially millions of SNP across the entirety of the genome. Notably, our analyses focused on resolving population genetic structure across two distinct geographical and/or population scales: (a) within the Bay of Breiðafjörður (West Iceland); and (b) across the North Atlantic (Iceland, Faroe Islands, England, and Canada). Highlights of this study include the detection of novel population genetic structure within Iceland, the detection of variable scales of genetic divergence across the North Atlantic, and support for a cryptic species complex contained within the North Atlantic population. An overview of ongoingresearchaimed at characterizing genetic and phenotypic variation in *B. undatum* is discussed briefly, with an emphasis on RAD-Seq analysis of population genetic structure.

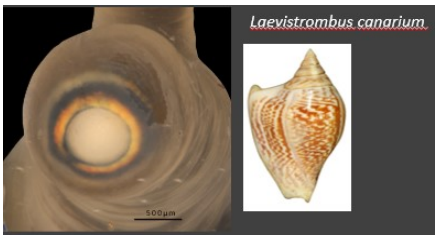
Citizen science provides new insights on the cannibalistic behaviour of *Octopus vulgaris*

Jorge Hernández-Urcera[1], David Scheel[2]
[1]Department of Ecology and Marine Resources, Instituto de Investigaciones Marinas (CSIC), Vigo, Spain
[2]Institute of Culture and the Environment, Alaskan Pacific University, Anchorage, USA
Email: jurcera@iim.csic.es



Cannibalism refers to the consumption of a conspecific and is common in many taxa. In addition to conferring advantages for a predator's growth, reproductive efficiency and survival, cannibalism is an important link between individual and population level processes. Based primarily on the study of stomach contents, it is known that cannibalism is widespread in cephalopods. Cannibalism thus potentially may be an important component of natural mortality,and natural mortality is a key factor in the limitation of populations and management of exploited resources. Cannibalism in octopuses has been recorded only infrequently, and available anecdotal observations of cannibalism in the wild are confined to sexual cannibalism. The common octopus, *Octopus vulgaris*, is exploited in the Mediterranean Sea, central and northeast Atlantic Ocean, as well as along the coasts of the Caribbean, Brazil, South Africa and Japan. Improved knowledge of this behaviour is important for understanding the ecology of this species and its management. Here, from records made by two recreational divers, we report on two separate observations of attacks made by *O. vulgaris* on conspecifics in Caribbean coral reefs. To our knowledge, the cannibalistic attack behaviour described here for this species has not been observed before. Although some details of cannibalistic behaviour have been reported for this species, it is unclear if these preliminary observations were of active cannibalism or of living octopuses feeding on dead animals. The two new records presented here each describe the encounter, pursuit and capture of a smaller, juvenile octopus by a larger (adult) octopus, with the predator making repeated attempts to capture the prey. Although the predatory and escape responses of octopuses are complex, the similarities noted in the two episodes of cannibalistic attack suggest that simpler patterns may underlie the complexity. This work shows that citizen science can be used to elucidate important aspects of the behavioural ecology of cannibalism in octopuses.

Evolution and diversification of vision in strombid gastropods



Alison Irwin [1,3], Ellen Strong[2], Nicholas Roberts[3], Elizabeth Harper[4] & Suzanne Williams[1]
[1]Department of Zoology, Natural History Museum, London, UK
[2]Department of Invertebrate Zoology, Smithsonian National Museum of Natural History, Washington, D.C., USA
[3]School of Biological Sciences, University of Bristol, UK
[4]School of Earth Sciences, University of Cambridge, UK
Email: a.irwin@nhm.ac.uk

The *Strombidae* is a family of charismatic marine snails with many bizarre and beautiful shell morphologies. The family can be recognised by the presence of a 'stromboid notch' – a fluting of the outer lip that allows the second of its two long eyestalks to peer out from under the shell. These large, conspicuous camera eyes are thought to provide surprisingly good visual acuity, second only in Mollusca to the predatory Cephalopoda and Pterotracheoidea, which use vision for prey pursuit. It is extraordinary that such sophisticated eyes are found within the slow-moving, herbivorous strombids. These complex eyes probably contributed to the success of the lineage, yet vary enormously in size and structure across the family *Strombidae* and even more so within the superfamily *Stromboidea*. However, the diversity and evolution of strombid eyes have not yet been investigated. This project addresses the issue by integrating morphological, molecular and behavioural approaches within a phylogenetic framework. We use mitogenomics and Sanger sequencing to recover a robust phylogenetic history of the family *Strombidae*, and test for monophyly of *Stromboidea*, key families and genera. We then investigate the evolution of camera-type eyes by building a database of morphological traits from key taxa, obtained by computed tomography and histological methods, and map these traits onto the phylogeny. This approach shows that the morphology of eye components varies across families in *Stromboidea*, and within *Strombidae*. Our data enhance the current understanding of strombid visual capabilities, giving a new perspective on how strombids see their surroundings, and add to our knowledge of the evolution of vision in Mollusca.

Highest resolution	Common name	Species name	Angular resolution
	Octopus	*Octopus vulgaris*	0.02° (1)
	Heteropod snail	*Pterotrachea coronata*	0.2° (2)
	Conch snail	*Strombus raninus*	0.5° (3)
	Scallop	*Argopecten irradians*	2° (4)
	Periwinkle	*Littorina littorea*	2° (5)
	Nautilus	*Nautilus pomilius*	6.5° (6)
	Chiton	*Acanthopleura granulata*	10° (7)
	Giant clam	*Tridacna maxima*	16.5° (8)

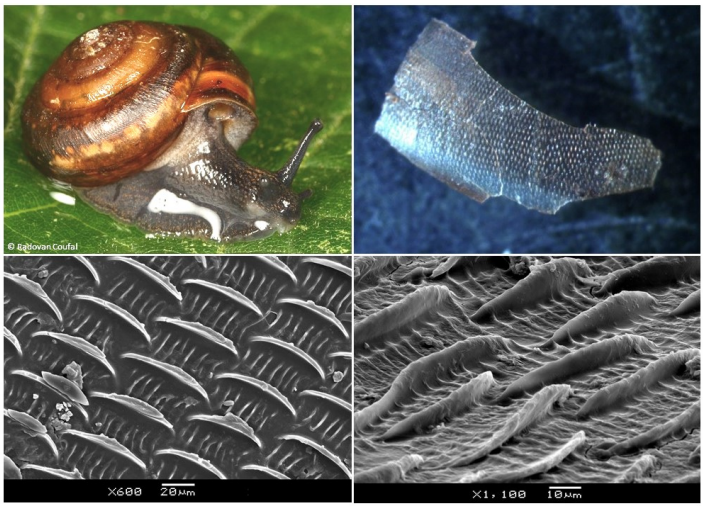
Variation in banding patterns of *Cepaea* spp.

Hannah Jackson, Angus Davison
School of Life Sciences, University of Nottingham, Nottingham, NG7 2RD, UK
Email: Hannah.Jackson1@nottingham.ac.uk

Terrestrial gastropods provide a useful system for understanding how inherited variation is established and maintained within a population, because the shell preserves the ontogeny of shape, colour and banding patterns. In *Cepaea nemoralis* and the sister taxon *C. hortensis*, the traditional focus has been on qualitative scoring of ground colour variation and banding. Recent quantitative measures of colour have determined that variation is continuously distributed in colour space, but scoring of banding phenotypes has received little attention, with sparse knowledge regarding the mechanisms that control the position of bands, or how bands may interact with one another. Here, we use a straightforward method to measure quantitative variation in the position and widths of bands in *Cepaea nemoralis* and *C. hortensis*. The single band ina mid-banded snail is equally variable in width and in almost the same position as the corresponding band in a five-banded individual. This implies that the genes that suppress four bands to make the mid-banded phenotype act late in the banding pathway. Measures of band width and the spaces between bands gives some clues as to how band position and width is determined. Determining how and why banding patterns vary in *Cepaea* will ultimately aid in understanding the mechanisms which underpin the genetic basis of the variation.

Central-European phylogeographic crossroads: phylogeography of *Monachoides incarnatus*

Tereza Kosová[1], Ondřej Korábek[2] & Lucie Juřičková[1]
[1]Department of Zoology, Faculty of Science, Charles University, Prague, Czech Republic
[2]Department of Ecology, Faculty of Science, Charles University, Prague, Czech Republic
Email: terez.kosova@gmail.com



***Monachoides incarnatus* - living individual, the fragment of the shell and two scanning electron microscopy photos of shell surface microsculpture**

Quaternary changes in species range limits are essential to comprehend the dynamic range of species distributions. Preserved shells of land snails allow us to supplement molecular phylogeography data with physical evidence of their past distributions and reconstruct the range dynamics. *Monachoides incarnatus* is an abundant euryvalent land snail limited from east and west to Central Europe. In the quaternary paleoreconstruction it is used as one of the important indicators of the forest. In the Holocene, however, *M. incarnatus* adapted very well to human influence and is able to use substitute semi-ruderal sites in urban and suburban zones. We aim to identify the glacial refugia and directions of postglacial colonization. The first results of phylogenetic analyses (COI mitochondrial gene) of *M. incarnatus* indicate the origin and glacial refugia south of the Alps and colonization of the Czech Republic by two groups – distributed predominantly in the west and south-east of its range, respectively. Also, it appears that the Balkan part of its range is a result of colonization from the north. In combination with results of a previous study on *Helix pomatia,* the project promises the first interspecific comparison of phylogeographic histories of Central-European land snails with similar distributions and ecological requirements.

Dispersal and vagility of Jamaican terrestrial molluscs

Heather L. Kostick[1,2] & Gary Rosenberg[1]
[1]Department of Malacology, Academy of Natural Sciences of Philadelphia, Philadelphia, PA, USA
[2]Department of Biodiversity, Earth, and Environmental Sciences, Drexel University, Philadelphia, PA, USA
Email: hlk35@drexel.edu

Josh Powell, field assistant, marking a snail (*Adamsiellops ignilabris*) in Sawyers,

Terrestrial molluscs have the highest extinction rate of any group of organisms. Jamaican terrestrial molluscs have not yet experienced this high level of extinction as most of the 500+ endemic species are still extant, and provide an opportunity to study traits that might be associated with extinction. Extinction resistance is thought to correlate with range size in some species. Looking at vagility and dispersal of molluscs is a way to begin to understand this relationship. Some land snails have been shown to be good at passive dispersal, but many Jamaican species have small ranges, which indicates that active dispersal may be more important for their distribution. Snail vagility and dispersal may also differ among kinds of snails (i.e., pulmonate vs. operculate). Range size would presumably be affected by the ability of the animal to move within its environment. If a species has higher levels of vagility, it would be expected to have a larger range size, other factors being equal. Annulariidae and Pleurodontidae (Mollusca) are the target taxa of this study – chosen because they have molecular phylogenies, which is important for connecting ecological data to phylogenetic patterns, have many endemic species, and are widely distributed on Jamaica. High sympatric diversity in Jamaica makes it possible to collect data on many species in one area. Snail instantaneous crawling speed and distance crawled per active period will be used to quantify vagility. In September 2019, instantaneous crawling speed data were collected for *Colobostylus bronnii* and *Adamsiellops ignilabris* (Annulariidae), and *Thelidomus aspera* and *Dentellaria sloaneana* (Pleurodontidae). Initial results show that different species were active at different times; measurement of crawling speed must be completed on what a snail considers to be a natural surface; and mating and feeding behaviors were interspersed with crawling, making it harder to isolate the latter. Future work will score behaviors captured on video in gridded natural arenas to address this problem and will also consider whether snails have homing ability and natal or mating dispersal.

Population structure of octopus *Eledone moschata* in the Mediterranean Sea on the basis of RAD seq data

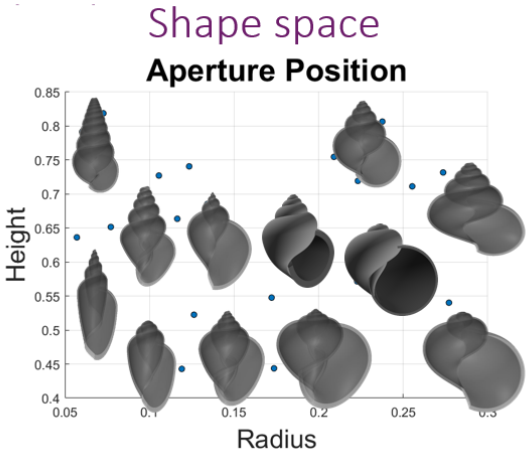
Daniela Kotalová [1], Pavlína Kočová, Marie Drábková [1,2] & Jan Štefka [1,2]
[1]Faculty of Science, University of South Bohemia, Ceske Budejovice
[2]Institute of Parasitology, Biology Centre CAS, Ceske Budejovice
Email: dada.kotalova@centrum.cz

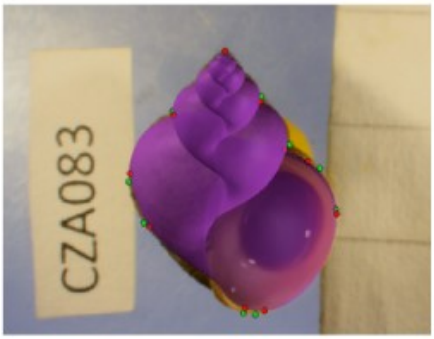
Cephalopods have an important role in marine trophic nets and ecosystems but relatively few studies have investigated their population genetic structures. Here, we studied populations of octopuses belonging to the genus *Eledone*, which can be recognized by possessing only one row of suckers on their arms. More specifically, we focused on *Eledone moschata*, a species limited to the Mediterranean Sea. By the analysis of mitochondrial DNA combined with the reduced representation genomic method (ddRADseq), this study explores the population structure of *E. moschata* in the western Mediterranean, especially in the Tyrrhenian and Adriatic Seas. A 1035 bp of the Cytochrome oxidase I (COI) gene and 75866 SNPs from RADseq were obtained for 16 individuals from 7 localities. Firstly, the study examines population structure using classical gene marker, the COI gene. Secondly, the population is studied using genetic markers obtained from the whole genome by the RADseq method. Population structure was reconstructed and summary statistics were calculated for the stocks in each sea. Both types of data showed population structuring between Tyrrhenian and Adriatic Seas. The pattern was more pronounced however in the RADseq dataset. This study is interesting for its uniqueness because, to our knowledge, the population structure of octopuses by RADseq has not been studied yet. Results of this pilot study also show that a significant amount of genetic data obtained from genomic methods has higher information value and is advantageous for distinguishing small population differences.

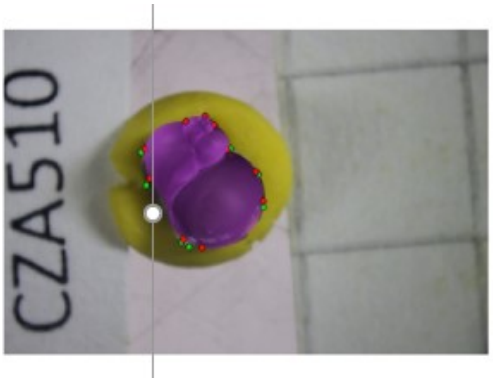
ShellShaper - a program for making 3D snail shell models from 2D images

Jenny Larsson [1], Torbjörn Lundh[2], & Roger K. Butlin[1,3]
[1]Department of Animal and Plant Sciences, University of Sheffield, Sheffield, UK
[2]Department of Mathematical Sciences, Chalmers University of Technology and University of Gothenburg, Sweden
[3]Department of Marine Sciences, University of Gothenburg, Strömstad, Sweden
Email: jslarsson1@sheffield.ac.uk

Mollusc shells come in many intricate shapes and forms, but most of them are constructed using similar underlying growth patterns. The shells are built from incremental deposition of material at the aperture, which makes it possible to trace the ontogenetic changes of an individual from its final shape. Since there is also an extensive fossil record of shells, having a method for biologically informative quantification of shell shape should provide a useful tool to improve the understanding of both the development and the evolution of gastropods. By taking advantage of mathematical properties that closely approximate the growth pattern of most gastropod shells, we developed a program which can use data from a single 2D image of a shell to recreate the full 3D structure and is applicable to a wide variety of species. The biologically descriptive parameters we obtain can be analysed to quantify the shape of single shells or capture the variation within and between species in a way that relates directly to the shell construction process, and results can therefore easily be compared between studies.







Potamopyrgus antipodarum (Gray, 1843) (Gastropoda: Tateidae) as a potential control factor for "swimmer's itch"

Anna Marszewska, Anna Cichy & Elżbieta Żbikowska
Faculty of Biological and Veterinary Sciences, Dept. of Invertebrate Zoology & Parasitology, Nicolaus Copernicus University in Torun, Torun, Poland
Email: anna.marszewska@umk.pl

Alien species of both animals and plants are considered a real threat to native fauna and flora. This is due to the fact that the introduced species are often resistant to the natural enemies of a native competitor. Nevertheless, alien species can also be allies, e.g. when they interfere with the interaction of a native parasite with a host. We tested this hypothesis at the level of the first larval stages of bird schistosomes. Bird schistosomes are a serious medical problem associated with water recreation. The symptom of these parasites invasion in humans is dermatititis known as "swimmer's itch". The skin area with the rash is swollen, warmer and painful to the touch. In extreme cases, this parasitosis may be accompanied by anaphylactic shock and disorders of the respiratory system. It should be emphasized that although the parasite development in the human body has not been described so far, in experimental conditions they overcome the barrier of the mammal's skin and reach internal organs. The main objective of the presented research was to check whether the presence of an alien snail species in recreational water reservoirs can be a natural protection against "swimmer's itch". Our research included experimental infection of snails belonging to the *Lymnaeidae* family with miracidia of bird schistosomes in the presence of increasing density of *Potamopyrgus antipodarum* specimens. The results indicate that as the density of an alien snail species population increases, the success of a specific host invasion decreases; also, *P. antipodarum* can not be the source of invasive larvae of bird schistosomes. It is necessary to conduct basic research on the disruption of the life cycle of bird schistosomes, firstly because of the widespread occurrence of final and intermediate hosts (waterfowl and snails), secondly because of an increasing number of recorded cases of "swimmer's itch" - especially in children, and thirdly because the fate of parasites in the human body is uncertain.

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The Unionidae as hosts of digenetic trematodes

Hubert Marszewska
UTP University of Science and Technology, Bydgoszcz, Poland
Email: hubmar003@utp.edu.pl

The Unionidae family includes freshwater mussel species noted in the flowing and stagnant waters of Europe, Africa, Asia and North America (in total, nearly 700 species). In Poland, Unionidae are represented by four genera: *Unio*, *Anodonta*, *Pseudanodonta* and *Sinanodonta*. Half of the native species of *Unionidae* in Poland are under protection. The last mentioned genus is represented by an alien species. Unionidae are an important element of freshwater ecosystems, for example because of their filtration capacity. One reason for their reduction in the natural environment may be parasites since the mussels are the first and second hosts of digenetic trematodes. Studies conducted in Europe show that the species richness of Digenea in the Unionidae is quite low and includes mainly two families - *Bucephalidae* and *Gorgoderidae*. Representatives of the first family include *Rhipidocotyle fennica* found in *A. anatina*, and *R. campanula* found in *A. anatina* and *U. pictorum*, as well as in *S. woodiana* (alien species). The second family - *Gorgoderidae*, in European Unionidae was noted for *A. anatina* (*Phyllodistomum* sp.) and *A. cygnea* (*Phyllodistomum elongatum*). The presence of Digenea inside Unionidae causes partial or complete castration, distortion of shells, disorders of their heart function and increased mortality - especially at higher temperature. Unionidae play an important role in freshwater ecosystems, therefore it is necessary to control their parasitic diseases, or do we leave it as "business as usual"?

Investigation in the calcite microstructure of wild and repaired shell in *Nucella lapillus*

Dennis Mayk [1,2], Lloyd Peck[2], Erika Griesshaber[3], Wolfgang W. Schmahl[3] & Elizabeth M. Harper[1]
[1]University of Cambridge, Downing Street, Cambridge CB2 3EQ, United Kingdom
[2]British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, United Kingdom
[3]Ludwig-Maximilians-University Munich, Theresienstr. 41, 80333 Munich, Germany
Email: dm807@cam.ac.uk ORCID: https://orcid.org/0000-0002-5017-1495

Notching (experiments in which notches are cut into the shells of e.g., marine invertebrates) is a common method to investigate shell formation and repair rates under e.g., recent and future pH conditions. Despite its common use, little is known about potential changes in the shell's microstructure between the "wild" shell and the regrown notches which complicates interpretations of repair rates and may limit the method's applicability to investigate shell formation patterns under future pH conditions all together. In this study we investigate the calcite microstructure of the "wild" and the regrown shell in the common intertidal gastropod *Nucella lapillus* (Linnaeus, 1758)as observed by EBSD, TGA and SEM analysis. *N. lapillus* is a predatory species feeding on for example, blue mussels and barnacles. It builds a massive calcium carbonate shell that

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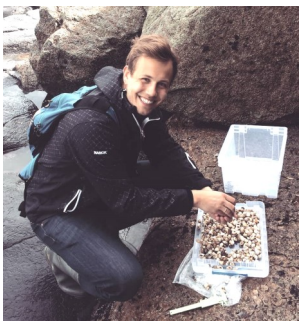
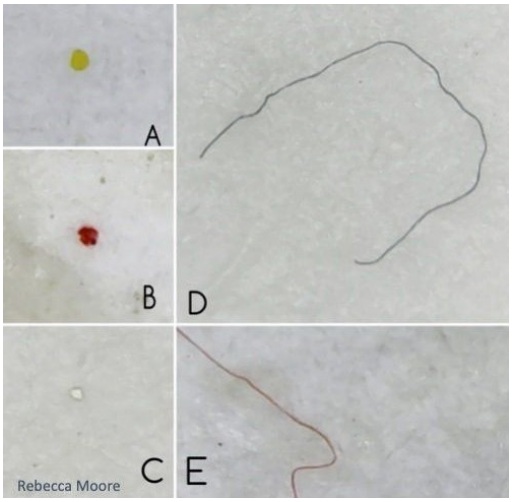


shelters it from predators and other environmental hazards. Our results show that the calcite microstructure in *N. lapillus* is not homogeneous as previously reported in other studies but rather consists of elongated irregular crystals that are similar to those which have been described in other molluscs, e.g., heterodont bivalve *Chama arcana*. It has a low organic content of > 1% which suggests low biological and predominantly physical control on crystal growth through crystal competition. Calcite crystals in the regrown notches exhibit slightly higher co-orientation than the wild shell but are generally found to be very similar. Four stages of shell repair are outlined and discussed.

Microplastic abundance in blue mussels (*Mytilus Edulis*) cultured for human consumption, sold in UK supermarkets

Rebecca Moore
Department of Science, Natural resources and Outdoor Studies, University of Cumbria, Cumbria, UK.
Email: RMooreConservation@gmail.com



This research investigates the microplastic abundance in commercially cultured blue mussels (*Mytilus edulis*) sold in supermarkets, in the United Kingdom. Samples were purchased from multiple supermarkets around the Lancashire area, all mussels originating from United Kingdom coastal waters. Hydrogen peroxide was used to digest these samples, and then filtered and dried . Samples were then examined under a microscope for plastic enumeration. Further comparisons are made between mussels which have undergone different methods of food processing; frozen, chilled, pickled, vacuum-packed and live. Results show the highest microplastics abundance in the cooked mussels, with an average of 128.5 items per sample. The lowest abundance of microplastics was recorded in live mussels, with an average of 51.7 items per sample. Microplastics were categorised by shape and colour. The most abundant form of microplastic was fibres, with an average of 33.2 items per sample. Microspheres were the least abundant, with an average of 23.5 items per sample. Black plastic was the most abundant whilst the colours orange, white and brown had the lowest abundances. Results suggest that blue mussels ingest microplastics in our oceans, and this is now entering our human food chain. The implications of these findings for blue mussels and humans are discussed.

Island biodiversity of *Bulinus globosus*, the intermediate freshwater snails host of veterinary and medically important *Schistosoma haematobium* parasites on Pemba Island (Zanzibar, United Republic of Tanzania)

Tom Pennance[1,2], Fiona Allan[1], Toby Landeryou[1], Aidan Emery[1], Muriel Rabone[1], Shaali Ame[3], Jo Cable[2], David Rollinson[1] & Bonnie L. Webster[1]
[1]Parasites and Vectors, Natural History Museum, Cromwell Rd, South Kensington, London, SW7 5BD,
[2]School of Biosciences, Cardiff University, CF10 3AX, Cardiff, Wales
[3]Public Health Laboratory, Chake Chake, Pemba, United Republic of Tanzania
Email: t.pennance@nhm.ac.uk

Schistosomiasis is the most important freshwater parasitic disease of humans, with an estimated 180-200 million people being infected. Of the 25 recognised species of *Schistosoma* causing human and animal infections, nine species belong to the *S. haematobium* group that all utilise a *Bulinus* spp. snail intermediate host across Sub-Saharan Africa (SSA). On the Zanzibar archipelago, *B. globosus* is the most medically and veterinary important intermediate snail host, transmitting *S. haematobium* and *S. bovis,* causing human urogenital and cattle intestinal schistosomiasis respectively. *B. globosus* also transmits these *Schistosoma* species across SSA, but geographical variability of these snails potentially supports allopatric speciation. To explore this intra- species diversity, novel mitochondrial genomes will be produced using Illumina NextSeq Technology for ~40 *B. globosus* strains and other closely related species from Pemba and Unguja Island, mainland Tanzania, Uganda, Malawi, Madagascar, Kenya, Côte d'Ivoire, Nigeria, Senegal and Niger. Mitogenomes will be analysed to investigate intra-population diversity of *B. globosus* from freshwater habitats distributed across Pemba Island, and to explore the geographical variation of *B. globosus* from SSA. This will further resolve the geographical interrelationships within *B. globosus* whilst also providing a fine-scale analysis of intra-population variation in relation to Pemba Island biodiversity.

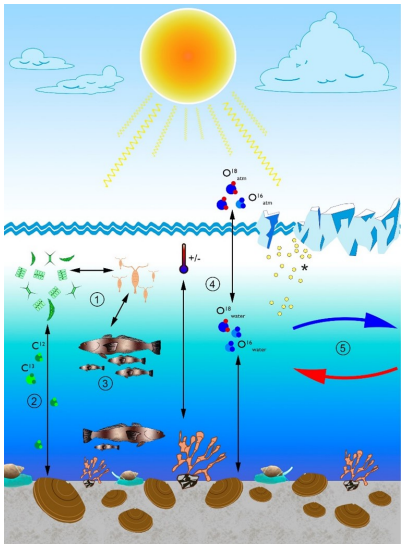
Brought to the Surface: A New Beginning for Freshwater Snail Identification in Britain and Ireland

Harry Powell[1], Ben Rowson[1], Michael Dobson, Martin Willing[2], Rebecca Farley-Brown[3] & Hannah Shaw[4]
[1]Natural Sciences Department, Amgueddfa Cymru – National Museum of Wales, Cardiff, UK
[2]Conchological Society of Great Britain and Ireland, Midhurst, UK
[3]Publications, Field Studies Council, Telford, UK
[4]Freshwater Habitats Trust, Oxford, UK
Email: harry.powell@museumwales.ac.uk

There is currently a gap in our knowledge and ability to identify the different species of freshwater snails of Britain and Ireland. Whilst many useful and modern identification tools have been produced for other animals, no such comprehensive guide exists for freshwater snails. This National Lottery Heritage Fund project (2018-2020) aims to develop an identification guide which will provide this under-appreciated group with the attention it deserves. Working in partnership with key environmental organisations, we have surveyed more than 120 sites across the UK and have successfully located and recorded approximately 73% of the freshwater snail species known to Britain and Ireland. As a result, the freshwater parts of the Museums' mollusc collection, which have suffered relative neglect in recent years, have been bolstered with the addition of new snail shells and spirit samples. The non-native Trumpet Ram's-Horn (*Menetus dilatatus*) and Whirlpool Ram's-Horn (*Anisus vortex*) were recorded in Cardiganshire and Caernarvonshire respectively for the first time and the only known location of living populations of brackish water species: *Heleobia stagnorum*, in the UK was investigated in September of 2019. Coincidentally, the invasive Asian clam (*Corbicula fluminea*) was found in Cardiff Bay for the first time– only its second recorded sighting in Wales. A bilingual display was developed at the Museum of Wales showcasing the diversity and importance of freshwater snails, adding a missing group and habitat type to the existing displays on molluscs. Public engagement has also consisted of numerous snail identification and pond dipping events for local community groups and young people as well as five practical training workshops, during which a draft identification key was tested. Throughout these five 'snail days' attendants showed demonstrable improvement in distinguishing and recognising freshwater snail species. One hundred percent of the 40 self-proclaimed beginners and more experienced naturalists who attended claimed that their knowledge of freshwater snails had improved having used the draft key. With this same key, the average user identified more specimens correctly within a set period of time than with any other publically available guide. The progress and future goals of the project are discussed.

The shell structure and composition of poorly studied Southern Ocean mollusc bivalves with a special focus on sclerochronology

Alejandro Roman Gonzalez & James Scourse
Centre for Geography and Environmental Science, University of Exeter, Penryn campus, Penryn, UK
Email: a.roman-gonzalez@exeter.ac.uk

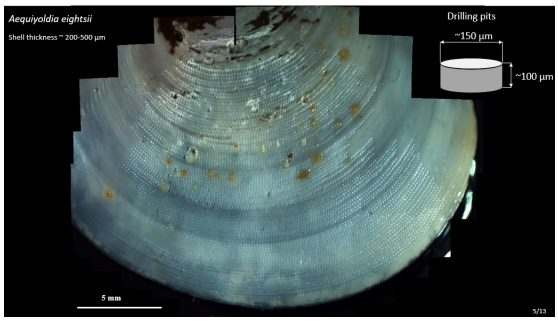


Remoteness, extreme environmental conditions and challenging logistical operations have limited our understanding of Antarctic benthic ecosystems. To date only a handful of the most common Antarctic bivalves have been studied in detail. Basic knowledge, such as internal shell structure and composition and longevity is for many Antarctic molluscs limited or non-existent. Antarctic coastal ecosystems are changing rapidly due to climate change. Benthic sessile species are especially vulnerable to iceberg scouring, increased sedimentation related to deglaciation and strong temperature (i.e. cooling or warming) and salinity (e.g. hyposaline meltwater lenses) anomalies. In addition, Antarctic marine calcifying organisms are especially sensitive to ocean acidification, which is expected to increase with climate change. Understanding basic information about the shell structure of Antarctic marine bivalves is a necessary step in order to assess their resilience to a changing environment. We present here the preliminary results of the analysis of shell material from a range of species (*Thracia meridionalis*, *Nuculana inaesquisculpta*, *Mysella antarctica*, *Cyamiomactra laminifera*, *Yoldiella sabrina* and *Propelada longicaudata*) of specimens collected along the West Antarctic Peninsula. Basic information about the shell structure (number of layers, internal shell morphology), composition (i.e. calcium carbonate morphotype) and estimations of longevity using sclerochronological techniques are presented.

What can shell geochemistry from Southern Ocean mollusc bivalves tell us about their environment?

Alejandro Roman Gonzalez [1,2], James Scourse[1], Paul Butler[1], Lloyd Peck[3], Caroline Lear[2], Mike Meredith[3], Hugh Venables[3] & Ian Hall[2]
[1]Centre for Geography and Environmental Science, University of Exeter, Penryn campus, Penryn, UK
[2]School of Earth and Ocean Sciences, Cardiff University, Cardiff, UK
[3]British Antarctic Survey, Cambridge, UK
Email: a.roman-gonzalez@exeter.ac.uk

The shells of marine molluscs act in many ways as environmental recorders of the physico-chemical conditions of the seawater in which they are formed. In the fortunate instances where long-term instrumental records are available, it is possible to investigate the contribution of the biological and environmental drivers to shell growth. The remoteness and extreme environmental conditions of the Southern Ocean have prevented during most of human history the establishment of long-term year-round environmental monitoring programs. Therefore calibration studies are required in regions where in situ climate and oceanographic data are available and the studied species are present. This first calibration step permits the investigation of environmental conditions over long periods of time, especially when long-lived species are considered, from Southern Ocean regions lacking monitoring programs. Ultimately the data obtained feed into the wider climate and oceanographic research community, providing valuable information for global and Southern Ocean climate models. We present here the results of stable oxygen and carbon isotope analysis of shell material from modern and historically-collected specimens of the Antarctic marine mollusc *Aequiyoldia eightsii*, collected from the South Orkney Islands and from Ryder Bay, West Antarctic Peninsula. A detailed description of the analytical method applied to these nail-sized shells is provided. Three analytical experiments were carried out: i) subannual resolution, ii) annual resolution and iii) lateral fractionation. The subannual resolution sampling shows seasonal cycles, which are related to seawater temperature and salinity changes. The comparison between subannual and annual samples shows similar interannual variability, except in a few cases. This allows the construction of long-term geochemical records from these shells. The lateral fractionation analysis shows that the intra - increment variability in stable oxygen and carbon isotope ratios is negligible. This is especially important given the way these shells have to be drilled in order to extract the shell powder samples.



Snails can fly with birds - More evidence for snail endozoochory

Jasna Simonová[1], Ondřej Simon[2], Lucie Bohatá[3], Lukáš Nehasil[4], Šimon Kapic[5], Michal Horsák[6] & Lucie Juřičková[1]
[1]Department of Zoology, Charles University, Prague, Czech Republic
[2]Department of Ecology, Czech University of Life Science, Prague, Czech Republic
[3]Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Science, Prague, Czech Republic
[4]Department of Rehabilitation and Sports Medicine, Charles University, Prague, Czech Republic
[5]Faculty of Forestry and Wood Sciences, Czech University of Life Science, Prague, Czech Republic
[6]Department of Botany and Zoology, Masaryk University, Brno, Czech Republic
Email: simonova.jasna@gmail.com

Passive dispersal is a fundamental mode of land snail dispersion as their ability of active dispersal is very limited. Birds are known to be important vectors of snail dispersal. However, direct evidence of this process is rare and mostly anecdotal. Snails can be dispersed both attached externally to a bird (ectozoochory) or being swallowed by bird and then expelled alive (endozoochory). The possibility of endoozoochory has been studied for only a few species, all of them minute (>4 mm). We examined the ability of larger species (up to ca. 17 mm in maximum shell dimension) to survive the passage through digestive tracts of various bird species. Snails were offered to birds in laboratory conditions and to those kept in animal rescue stations. Faeces and regurgitated food were then collected and searched for snail shells. Viability of undamaged shells was examined. Out of 4519 snails of 15 species offered, 62 % were consumed by birds and 240 individuals (5.3 % of those offered) were found undamaged in faeces. A total of 27 individuals of four species (*Clausiliidae*: *Alinda biplicata*; *Chondrinidae*: *Chondrina avenacea*; *Vertiginidae*: *Vertigo antivertigo*, *V. pygmaea*) were found alive. Some birds also regurgitated consumed snails. A total of 121 individuals (2.7 % of consumed) of four species were regurgitated undamaged. Altogether, 35 snails of all four regurgitated species (*Chondrinidae*: *Chondrina avenacea*; *Clausiliidae*: *Alinda biplicata* and *Bulgarica nitidosa*; *Pomatiidae*: *Pomatias elegans*) were regurgitated alive. The species of snails with a smaller shell (<8 mm) passed through the bird gut alive with a higher probability. *Chondrina avenacea* was the most successful snail species. Snails expelled by young blackbirds had the highest probability of survival. Results of the experiments have proved that avian endozoochory could be considered as an explanation for the examined species ability to colonize isolated sites.

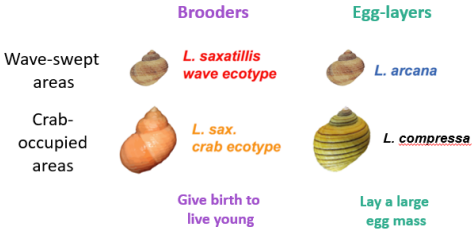
Using molecular and morphological tools to interpret the colour polymorphism of the European nudibranch species *Polycera quadrilineata* (O. F. Müller, 1776)

Cecilie G. Sørensen[1], Cessa Rauch[1], Marta Pola[2] & Manuel A. E. Malaquias[1]
[1]Section of Taxonomy and Evolution, Department of Natural History, University Museum of Bergen University of Bergen, PB7800 5020 Bergen, Norway
[2]Departamento de Biología, Edificio de Biología, Universidad Autónoma de Madrid, Campus de Excelencia Internacional UAM + CSIC, Madrid, Spain
E-mail: ceciliegs94@hotmail.com

The nudibranch species *Polycera quadrilineata* (family *Polyceridae*) is one of the five European species of the genus, distributed between Northern Norway (Lofoten), the Mediterranean Sea, and the archipelagos of the Azores, Madeira, and Canary Islands, with type locality in the Oslofjord, Norway. The species is well known by its remarkable colour variation with specimens ranging from nearly white to almost black. The dominate colour morphs are those characterized by a white background with lines and/or spots of orange or yellow. Up to now this chromatic polymorphism has been interpreted as part of the natural variation of the species, but preliminary molecular barcoding of specimens attributed to *P. quadrilineata* conformed with the occurrence of two lineages. In this work an expanded taxon set of specimens from across the geographical distribution of *P. quadrilineata* was assembled and the gene cytochrome c oxydase subunit I was used to generate a Bayesian phylogenetic tree, perform species delimitation analysis based on the Automatic Barcode Gap Discovery method, and to generate a haplotype network. The analyses support the hypothesis that there are two species with nearly distinct colour morphs, but the fact that a range of patterns occur in both species makies diagnosis based on external features not always possible. This is further complicated by the fact that both species can be sympatric and occur side by side in nature.

Life-history evolution and speciation in *Littorina*

Sean Stankowski[1], Anja M. Westram[2], Zuzanna B. Zagrodzka[1], Isobel Eyres[1], Thomas Broquet[3] & Roger K. Butlin[1]
[1]Department of Animal and Plant Sciences, University of Sheffield, Sheffield, UK
[2]Institute of Science and Technology Austria (IST Austria), Klosterneuburg, Austria
[3]CNRS & Sorbonne Université, UMR 7144, Station Biologique de Roscoff, 29680 Roscoff, France
E-mail: s.stankowski@sheffield.ac.uk



The genus *Littorina* is an excellent system for studying how ecological differences can drive the evolution of reproductive isolation. Most work in the genus has focused on parallel adaption and speciation in *Littorina saxatillis* across the north Atlantic, where several ecotypes are often maintained by divergent selection acting among different shore habitats. However, other closely related taxa share these habitats with *L. saxatallis*, indicating that additional barriers to gene flow must maintain diversity within the group. Divergence in the mode of female reproduction may be a key barrier between some taxa. *L. saxatillis* is unique, in that females brood their offspring and give birth to a few live young at a time. The alternative, ancestral strategy, used by all other closely related species, is to lay a large egg- mass. This difference in reproductive strategy is one of the few traits that distinguishes *L. saxatillis* from its closest relative, *L. arcana*. Where these two species coexist in the same parts of the shore, they are morphologically cryptic with the exception of the female reproductive tract. Although they have been described as separate species, little is known about (i) the level to which they are reproductively isolated, and (ii) genomic, morphological and ecological basis of isolation. I will represent comprehensive genomic data that sheds light on these questions, and calls the taxonomic status of *L. saxatillis* into question..

Red Listing can protect deep-sea biodiversity

Elin Angharad Thomas[1], Chong Chen[2], A. Louise Allcock[3], Monika Böhm[4], Mary Seddon[5] & Julia D. Sigwart[1]
[1]Queen's University Belfast Marine Laboratory, Portaferry, Northern Ireland
[2]X-STAR, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Kanagawa, Japan
[3]National University of Ireland, Galway, Ireland
[4]Institute of Zoology, Zoological Society of London, UK
[5]IUCN SSC Mollusc Specialist Group, International Union for the Conservation of Nature, Devon, UK
Email: ethomas07@qub.ac.uk

Life at hydrothermal vents (Dr Chong Chen, JAMSTEC)

Niner *et al.* 2018 *Front. Mar. Sci.* 5: 53 Sigwart *et al.* 2019 *Nat. Ecol. Evol.* 3: 1134

Hydrothermal vents are rare deep-sea oases which house faunal assemblages with the same density of life as coral reefs. Only approximately 600 of these hot spots are known worldwide, each only a third of a football pitch in size. With the advancement of the deep-sea mining industry, there is an urgent need to protect these unique, insular ecosystems and their specialist endemic faunas. Taxon-based conservation tools such as the IUCN's Red List of Threatened Species are central to this initiative, however, only a handful of over 600 vent-endemic species have been previously assessed under IUCN criteria. The 'Vent Red List' project aims to complete Red List assessments for all described hydrothermal vent species, to ensure globally- recognised conservation status for animals which can easily be disregarded as out of sight and out of mind. As Red List criteria have been successfully applied to many terrestrial and freshwater molluscs, a pilot set of fifteen vent-endemic mollusc species was identified to establish a working method for the application of standardised IUCN criteria to such an insular environment. All fifteen molluscs have now been assessed as either Critically Endangered, Endangered or Vulnerable based on the restricted number of locations that each species occupy and the potential for a future threat to suddenly drive these species closer to extinction. As such, we present the first deep-sea species to be officially classified as threatened based on the potential impact of deep- sea mining – *Chrysomallon squamiferum*, the Scaly- foot Snail. This study demonstrates the importance of taxonomically-driven conservation in the deep sea and considers the implications of assigning Red List status for the management of deep-sea resources.

Some of the vent-endemic mollusc species identified for the Vent Red List (Dr Chong Chen, JAMSTEC)

A new palaeoenvironmental reconstruction from a Mid-Holocene molluscan succession in the Middle Atlas (Aït-Said-ou-Idder, Morocco)

Quentin Wackenheim [1,2], Nicole Limondin-Lozouet[1], Julie Dabkowski[1], Larbi Boudad[3] & Jean-François Berger[4]
[1]Laboratoire de Géographie Physique, UMR 8591 CNRS-Univ. Paris 1-UPEC, Meudon, France.
[2]Trajectoires, UMR 8215 CNRS & Univ. Paris 1, Nanterre, France.
[3]Département de Géologie, Univ. Moulay Ismail, Meknès, Maroc
[4]Environnement, Ville et Société-IRG, UMR 5600 CNRS, Univ. de Lyon 2, France
Email: quentin.wackenheim@gmail.com

The Mediterranean area is particularly sensitive to environmental and climatic changes. In the Mediterranean basin, research undertaken over the past 30 years has shown that non-marine molluscs are useful bioindicators to document the Holocene environmental evolution. However, in Morocco and other Magrebine countries, palaeoenvironmental reconstructions using land snails are in the early stage of research. Analyses of fossil molluscan assemblages are based on a palaeoecological approach which needs good knowledge of modern malacofauna and their habitats. In Northern Africa, however, lack of accurate and exhaustive palaeoecological investigation makes the work challenging. At Aït Said ou Idder, a 3 meter-high tufa sequence, rich in shells, was discovered in 2015. Geomorphological, chronostratigraphical and malacological investigations were carried out on this Middle Holocene tufa sequence during my masters degree work. Malacological results obtained on 36 samples covering the 6600 – 4600 cal. B.P. succession are presented here: 36 taxa were identified, including 24 terrestrial species. Three main environmental phases of the Middle Holocene were identified. Between 6600 and 6100 cal. BP, a mesophilic environment was characterized by open and dry areas (*Otala tingitana*, *Cochlicella barbara*, *Truncatellina cylindrical* and a geomitrid species) with some paludal zone (with *Succinelle oblonga*, *Oxyloma elegans*, *Vertigo angustior*, *Zonitoides nitidus*). Between 6100 and 5600 cal. BP, a durable marshland developed characterised by *Oxyloma elegans*, *Vertigo moulinsiana*, *Vertigo antivertigo*, *Vallonia enniensis* and *Carychium minimum*. Between 5600 and 4600 cal. BP, the paludal zone tended to disappear while an open and sclerophyllous environment developed with the rising proportion of geomitrid species and *Cochlicella barbara*. A geochemical study was concurrently undertaken and allow ed the comparison of malacological results with carbon and oxygen stable isotope data. Geochemical results support the evidence for these environmental patterns. The data from Aït Said ou Idder tufa is relatively complete and new for Morocco. The malacological study contributes to the reconstruction of the Middle Holocene environmental history of the Mediterranean area and helps to document Holocene Moroccan malacofauna.

Attendees of the World Congress of Malacology 2019 (Photo - Imogen Cavadino)

TRAVEL GRANT REPORT

World Congress of Malacology 2019, Pacific Grove, California (USA)

MAPPING SLUG DIVERSITY UK IN GARDENS

Imogen Cavadino
Royal Horticultural Society (RHS), RHS Garden Wisley, Surrey, UK
School of Natural and Environmental Sciences, Newcastle University, Newcastle upon Tyne, UK
Email: imogencavadino@rhs.org.uk

Imogen presents her paper

The World Congress of Malacology occurs every three years, inviting researchers, students, curators and collections managers from around the world to present their research on molluscs through talks and posters. The 2019 conference took place between Sunday 11th to Friday 16th August at Asilomar Conference Grounds in Pacific Grove, California, USA. The congress was organised by Unitas Malacologia, with support from the American Malacological Society, the Western Society of Malacologists, the Malacological Society of London and California Academy of Sciences among others. The 2019 conference was attended by over 260 delegates, with over 220 papers and 65 posters presented. I was delighted to receive financial support from the Malacological Society of London travel award and the RHS Gurney Wilson Bursary Fund .

The plenary speaker presentations took place on Monday, with symposiums running as parallel sessions throughout the rest of the week. Symposiums covered a diverse range of topics including; molluscs as key ecological players, systematics, molluscan collections, physiology, biogeography, evolution of molluscan weirdness, molluscs in citizen science, utility of molluscan genomics, evolution of toxins in molluscs, colour and vision in molluscs and novel approaches to managing invasive and pest molluscs. On Wednesday we were offered the opportunity to participate in field trips, and I opted to join a trip exploring the local terrestrial slug and snail fauna. The conference also included an exciting and sociable event involving much hilarity – the famous American Malacological Society (AMS) auction hosted by Paul Callomon from the Academy of Natural Sciences Philadelphia, with donated items sold to raise money for the AMS student grant scheme. Items ranged from beautiful rare sets of books on molluscs, to kitsch mollusc themed items such as shower curtains, watering cans, pyjamas, trinkets and games. Other additional events included a panel session run for students, where students from undergraduate to postgraduate level were encouraged to ask questions to a panel of established researchers.

The conference gave me the opportunity to present my PhD research in the symposium on Molluscs in Citizen Science, on using citizen science to better understand the diversity of terrestrial slugs and snails in UK gardens. The main topic of my presentation was an actively running project asking gardeners to send in photos of green cellar slugs (*Limacus maculatus*) and yellow cellar slugs (*Limacus flavus*) from their gardens, along with details on garden features to better understand the current distribution and range of these two species. As the target species are detritivores and not known to attack live plant material, they are also a suitable flagship species for raising the profile of the positive roles slugs may play in the garden ecosystem.

My presentation demonstrated that an audience of gardeners who may be disinclined to like or appreciate the study animal can be motivated to answer questions we have about slug diversity in gardens. It also highlighted how a citizen science approach allows the study of a group of species on private property at low cost without having to gain access permissions. My presentation was highly relevant to the symposium, but also prompted comments from other researchers on how they could incorporate similar elements into their own work to gather data. I also encountered some comments on how different it was to see a gardening charity researching slugs in a more positive way, encouraging tolerance of them and a nuanced approach to control for gardeners.

Many of the other talks at the conference were extremely interesting and informative for my own research. I also met a diverse set of people at different stages of their careers with whom I could exchange research ideas and plan future collaborations. I particularly enjoyed the opportunity to discuss research methods with other students, coming away with lots of ideas and information on DNA methods I could use in my research to understand the diets of slugs in gardens. I am very grateful for the support I received from MSL and the RHS allowing me to attend this conference.

TRAVEL GRANT REPORT

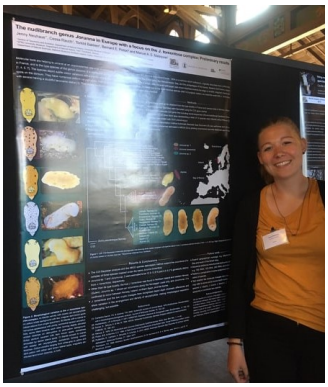
World Congress of Malacology 2019, Pacific Grove, California (USA)

Award Winner Best Student Poster

The nudibranch genus *Jorunna* in Europe with a focus on the *J. tomentosa* complex

Jenny Neuhaus[1], Cessa Rauch[1], Torkild Bakken[2], Bernard Picton[3] & Manuel A. E. Malaquias[1]

[1]Section of Taxonomy and Evolution, Department of Natural History, University Museum of Bergen, University of Bergen, PB7800 5020 Bergen, Norway
[2]NTNU University Museum, Department of Natural History, 7491 Trondheim, Norway
[3]Department of Natural Sciences, National Museums Northern Ireland, Cultra, Holywood, Co. Down, BT18 0EU
E-mail: Jenny.Neuhaus@student.uib.no



Jorunna is a genus of nudibranch sea slugs in the family Discodorididae with 5–6 species recognized as valid in European waters. Among those the type species of the genus *J. tomentosa* is the only one known to occur in Scandinavian waters. This species can depict distinct colour patterns from nearly white with dark blotches scattered on the body to the more typical colouration of beige with small light-brown spots. Preliminary molecular barcoding of Norwegian specimens suggest that this taxon as currently recognised may include more than one species. In this work a combination of molecular phylogenetics and morphological approaches is used to investigate the taxonomic status of the various colour morphs found in *J. tomentosa* across its geographical distribution and to compare it with other European congeneric species. The results assembled so far point to the occurrence of a second species of *Jorunna* in Scandinavia.

Sun, sea and solenogastres: the World Congress of Malacology 2019, Asilomar, USA

Lauren Sumner-Rooney
Oxford University Museum of Natural History, University of Oxford, UK

Back in August 2019, hundreds of malacologists from across the globe gathering in the stunning setting of the Asilomar conference ground in Monterey, California, for the triennial World Congress of Malacology. Against a backdrop of beautiful coastline and Monterey pine, we were treated to four days of talks and posters on everything from citizen science to genomics to molluscan weirdness, with a social day in between for wine tasting, beach walks and whale watching. The quality of the symposia was exceptionally high, and coffee break and lunchtime discussions were vibrant and lively. The Congress always offers a truly familial social atmosphere, and this year was no exception: the margaritas flowed at the conference dinner at the end of the week, and the traditional auction of malacological delights from across the world drew a large and enthusiastic crowd, with fierce battles to take home items including toys, homewares and a very fetching pyjama set (mostly won by Ellen). The programme was crammed with diverse and exciting talks, personal highlights of which included a vast collection of 3D digital bivalves, arm loss in octopus, cancers in clams and a full symposium on molluscan weirdness. As well as a superb line-up of talks, the programme was sprinkled with bonus cultural goodies including a literary tour and a screening of 'The sound of a wild snail eating'. The Travel Award from the Malacological Society was crucial to my being able to accept an invitation to take part in their sponsored symposium. This led to many interesting discussions with other researchers, including several new friends and potential collaborators, on which I would otherwise have missed out. Thank you MalacSoc!

'The sound of a wild snail eating', a short film by Elizabeth Tova Bailey, was screened before the MalSoc-sponsored symposium 'Colour and Vision in Molluscs'.

The first symposium on molluscan weirdness, organised by Julia Sigwart, gave a fun and insightful new perspective on our favourite group.

RESEARCH GRANT REPORT

[1]

Cuban Cupids: mating behaviour and physiology of dart-possessing land snails

Joris M. Koene[1] & Bernardo Reyes-Tur[2]
[1]Department of Ecological Science, Faculty of Science, Vrije Universiteit, Amsterdam (The Netherlands)
[2]Department of Biology & Geography, Faculty of Natural & Exact Sciences, Universidad de Oriente, Santiago de Cuba (Cuba)

Reproductive strategies of molluscs are extremely diverse. In this project, we focussed on one of the most enigmatic of these strategies: love dart shooting in land snails. While over the past years, knowledge has accumulated for a few European and Asian species (Lodi & Koene 2016), some pulmonate gastropod snails with love darts have remained underexposed. However, it is especially by looking at the similarities and differences between different families of dart-possessing snails that we can properly understand its evolution, so such comparison is needed wherever possible. In this respect the endemic Cuban species are of particular interest because, besides having a rather different use of the dart apparatus during mating, they have evolved several glands that accompany the dart apparatus and presumably release their content during its use (peduncular, bilobular and atrial gland). Therefore, our aim was to explore the possibilities of obtaining a better understanding of the function of these different secretions during mating of these species.

Given the short time that we had available for this research visit, we focussed on testing and adapting some recently-refined methods for use on these Cuban species in such a way that a minimal amount of high-tech equipment was needed. To develop the technique, we used a common Cuban species, *Coryda alauda*, as our focal species. Like all dart-possessing species, this is a simultaneous hermaphrodite that mates reciprocally, meaning that sperm is exchanged between mating partners. The dart sac is used during courtship, copulation and post-copulation, and has been described to perform 'wiping', 'rubbing' and 'stabbing' (Reyes-Tur & Koene 2007). At least the latter involves full use of the love dart, which can be used repeatedly to stab the partner's body wall or everted genitalia. The advantage of starting with this species is that it is not endangered, in contrast to some of the other Cuban species that we are interested in. By first establishing the method in this species, we will eventually be able to address the same questions in the endangered species but will only need to sacrifice a minimal number of individuals.

So, for *Coryda alauda*, together with local experts Camila Bosch Díaz and Mario J. Gordillo Pérez, we tested the physiological approach of Lodi *et al.* (2016) and the experimental approach of Kimura *et al.* (2014). While following the latter approach, we had to find the best way to anaethetise this species with an injection of magnesium chloride. The protocol works now but at the time, we did not have time to perform enough replicates to draw any conclusion from the results. For the physiological experiment, which involved testing muscular responses in the female reproductive system, we tested homogenates of each of the three glands separately and in combination. The muscle contractions were recorded using a webcam and these digital files were analysed afterwards. A quick first comparison between the situation before application of a homogenate and five minutes after application, reveals that the spermatophore receiving organ (bursa tract and bursa copulatrix, where digestion of receive sperm takes place) lengthens in response to extracts from one of the glands, while another seems to shorten it. While this is also still very preliminary, it is tempting to speculate about the possible function of these responses. For example, the shortening of the bursa tract might result in a shorter route for sperm to the sperm storage organ (at the posterior end of the spermoviduct), which is an effect that has been reported for other species (Lodi *et al.* 2017).

So, to conclude on the scientific part of this project, preliminary evidence indicates that the bursa tract responds to the application of mucus from at least two of the glands that are involved in the use of the dart apparatus, potentially indicating a conserved function that hints at the presence of the love dart allohormone (Stewart *et al.* ,2016). Obviously, besides replication of the physiological study, this will also requires a genomic or proteomic approach in order to identify the involved allohormones in the glands. In addition, effects of the other glands, and their mixtures, need further exploring in a larger follow-up project. This is of particular interest because the way in which these gland products are applied to the partner during mating suggest that they can potentially counteract each other's effects. We are already combining this with behavioural analyses of the sequence of events in several Cuban species, in order to test whether we can identify behavioural effects that are induced by the dart during courtship and copulation. Additional work remains to be done at the behavioural level because the repeated dart stabbing differs drastically from better-studied land snail species, so we expect this to also offer insight into the evolution of this enigmatic reproductive trait. The first findings were already presented on a poster at the NWO Life2019 conference in The Netherlands.

To end, we want to spend a few words on the importance of having received a small research grant for this collaboration. Firstly, understanding the reproduction of these Cuban snail species will contribute to the maintenance of Cuban biodiversity, especially given that several endemic species, such as the Cuban national snail *Polymita picta*, are threatened by extinction (Reyes-Tur et al. 2015). In addition, these snails provide an important ecosystem service that can benefit agriculture (including coffee production) since they eat moss, lichens and sooty mould fungi on bark that can threaten plant health. Secondly, the use of a simple setup to transfer skills and methods is of great value and enables making significant scientific advances with limited financial means. These initial findings are crucial for moving ahead with this research and will obviously lead to more complex question, some of which will require follow-up research with more sophisticated methods; laying such a foundation is needed to convince that investment in such collaborative projects is worthwhile. Finally, after having collaborated and exchanged ideas for many years, the Senior Research Grant from the Malacological Society of London (MSL) finally enabled us to have two weeks of dedicated time in which we could test some of our ideas and approaches, and above all discuss face-to-face for longer and in much more depth than is possible in day-to-day life across an ocean. We are very grateful for having been given this opportunity, and also thank Tino Sauer and the NABU agency for their general support, and we see a bright future in which we intend to intensify and strengthen this collaboration via student projects and research grants.

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Grants and Awards

The Research Awards Scheme was established to commemorate the Society's Centenary in 1993. Under this scheme, the Society gives awards 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 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 for student applicants, 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. Awardees are encouraged to publish their work in the *Journal of Molluscan Studies* (full papers) or *The Malacologist* (travel award reports, research award reports, news of ongoing research etc) as appropriate,

Early Career Research grants

Eligibility is restricted to those investigators at the outset of their independent scientific career. Applications must therefore be 1) postgraduate students, 2) within five years of being awarded their PhD (adjustable for career breaks), or 3) independent researchers not having a PhD. Early Career Research Grants will only be awarded to individuals twice, but not within 3 years of receiving a first award

Sir Charles Maurice Yonge Award

There is no application process for Sir Charles Maurice Yonge Awards. These awards are given for the best Travel Award application on bivalves, by a member of the Society to attend an international meeting (not including the Molluscan Forum). Authors of exceptional studies on bivalves in *the Journal of Molluscan Studies* may on occasion also be given this award. The Editor will nominate such papers as he/she sees fit. The award covers the costs requested in a Travel Award, or for open access publication of the paper. Members of the Society will also receive a personal cash prize of £300. Non-members will receive a personal cash prize of £250 plus one year's membership to the Society. If a paper is multi-authored, the award will be made to the corresponding author.

Senior Research Awards

are aimed at established researchers in professional positions, but without regard to nationality. Applicants for Senior Research Awards must be members of the Malacological Society of London. The Society currently awards up to five Senior Research Grants per year, each with a value of up to £1,500, to support research on molluscs that is likely to lead to publication. The maximum amount available should not be considered as a 'target'; rather requests should reflect the research that is proposed. The grants are reviewed by a Reviewers Panel including both Council and non-Council members invited for that purpose.

Travel Grants

Travel Awards are available as bursaries to support attendance at a conference or workshop relevant to malacology. Grants are preferentially conferred on students but researchers without professional positions may also apply. The maximum amount for one of these awards is £500 for Society members and £300 for non-members. Preference will be given to members of the Society. 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.

For further information, guidance notes and to access the application form see here - http://malacsoc.org.uk/awards-and-grants/travel-grants

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 to the Honorary Awards Secretary, Jonathan Ablett, Division of Invertebrates, Department of Life Sciences, Natural History Museum, London, SW7 5BD For further information, guidance notes and to access the grant application form see http://malacsoc.org.uk/awards-and-grants/research-grants Please note that all applications must be sent by email to MSL_awards@nhm.ac.uk.

Malacological Society of London—Membership notices

Objects
The objects 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 digital &/or paper copies of the *Journal of Molluscan Studies* 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 into the *Journal of Molluscan Studies*. The *Journal* is published in annual volumes consisting of four parts which are available on-line by members and student members. A paper copy of the Journal is available for ordinary members who are willing to pay a hard-copy premium. Members also receive access to *The Malacologist*, which is the bulletin of the Society, issued twice a year, in February and August.

Meetings
In addition to traditional research on molluscan biology, physiological, chemical, molecular techniques are amongst the topics considered for discussion meetings and papers for publication in future volumes of the *Journal*.

Personal Subscription

Personal subscribers gain access to the online archive of *Journal of Molluscan Studies* and receive *The Malacologist* twice a year; subscriptions including printed editions of *JMS* (four parts per year) are charged at a higher rate. Members are eligible to vote at the Annual General Meeting and to elect the Officers of The Society. The Annual Subscription for Ordinary Members and Student Members is due on 1st January each year.

From 2018 subscription rates are:

Ordinary Member (journal online and in print)	**£90**
Ordinary Member (journal online only)	**£45**
Student Member (journal online only)	**£25**

Membership subscriptions can be paid as instructed below and are valid from 1st January for a single calendar year. **Please remember that a subscription paid in December will therefore only be valid for one month and will have to be renewed the following January.**

Application to join the Society

Please complete the application form below and send it to the Membership Secretary:

Dr Tom S. White, Membership Secretary, Malacological Society of London, Department of Life Sciences, Natural History Museum, London, SW7 5BD

Email: membership@malacsoc.org.uk

Membership Renewal
Existing members can renew their subscriptions from January 1st each year via online payment.

Methods of Payment
Payment may be made by:
- Online payment using Credit or Debit Card (Mastercard, Visa, American Express)
- Cheque (please fill in the Application Form above)

Changes of Address
Please use the address slip on the Journal wrapper to inform us, through Oxford University Press, of a change of address, or write to the Membership Secretary (see details above).

Institutional Subscriptions
Orders and requests should be made directly to Oxford University Press
See: Publisher's information (Oxford University Press). http://mollus.oxfordjournals.org/

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Journal of Molluscan Studies (ISSN 0260-1230) is published quarterly in February, May, August and November by Oxford University Press, Oxford, UK.

Membership Application Form

I wish to apply for Ordinary*/Student* Membership (*please delete as applicable).
I enclose a cheque (payable to "The Malacological Society of London") for my first annual subscription.
Title: ……..
Name: ……
*Department: ……

*Institution: ……

Street: …… City: ……

Post Code/Zip: …… Country: ……

Telephone: …… Fax: …… Email: ……

Malacological interests: ……

Signature: …… Date: ……

For student membership: Confirmation of student status from Supervisor/Advisor:

Name: …… Signature: ……
*where applicable

Please email or post the completed form and payment to the Membership Secretary
Email: membership@malacsoc.org.uk

Find the mollusc ?

Limpets 2020

Biology of Limpets: evolution, adaptation, ecology and environmental impacts

Joint Meeting of the Malacological Society of London and the Marine Biological Association UK and incorporating the Annual General Meeting of the Malacological Society of London

Meeting Organisers

Professor Steve Hawkins (Plymouth MBA & University of Southampton, UK),
Professor Alan Hodgson (Rhodes University, South Africa),
Dr Louise Firth (University of Plymouth, UK),
Dr Phillip Fenberg (University of Southampton, UK),
Mrs Hannah Parry-Wilson (MBA & University of Southampton, UK)

In 1920 JH Orton published two important papers, one examining the importance of sea temperature on the breeding and distribution of marine animals, and the second on sex change in limpets. To mark the centenary of this work, Orton's contribution to marine biology in general and limpets in particular, as well his legacy, we are pleased to announce Limpets 2020. The aim of this meeting is to provide a forum for the discussion of recent findings on all aspects of the biology of limpets. Presentations of research in which limpets have been used as model animals in evolutionary, adaptational (morphology, physiology, reproductive biology, behaviour), ecological and environmental impact studies are especially encouraged. There will also be a general session in which papers on any aspect of molluscan or marine biology are welcome.

NOTE: Meeting Capacity – 80 delegates on a "first come first served" basis.

Registration Fees

Registration includes: tea/coffee upon arrival, refreshment breaks, poster reception (day 1), lunch (day 2 & 3), late afternoon Devon cream tea on day 3
Early-Bird rates (until November 1st 2019)

- Members of MBA, Malacological Society, Students: £80 (inc. conference dinner) or £45 (without conference dinner on day 2)
- Non-members: £90 (inc. conference dinner) or £55 (without conference dinner on day 2)

Accommodation

Delegates should make their own accommodation arrangements as there are many Hotels and Bed & Breakfast establishments in the city that are within walking distance of the MBA. Special rates are available to delegates at some, if visiting the MBA is mentioned at time of booking.
A list of recommended accommodation providers can be found here.

Transportation

If overseas delegate s do not wish to drive to Plymouth (about 3.5 hrs), those flying into Heathrow airport can reach Plymouth either by bus (e.g. National Express, journey time = about 4hrs 15 minutes) or GWR train (about 4 hrs via Heathrow Express to Paddington or Railair Bus to Reading). Bristol Airport has links by bus (direct Falcon bus) and train (via Bristol Templemeads) to Plymouth. There will be no parking available at the MBA except for disabled access. There are smaller regional airports at Newquay or Exeter. Gatwick is best avoided, but there is a train from Gatwick to Reading for connections to Plymouth on GWR.

Please note that parking at the venue is strictly limited and must be reserved in advance by emailing: reception@mba.ac.uk. There are a number of car parks in the city centre within walking distance of the venue. these nearest is here: https://goo.gl/maps/5C7GSE1yB922

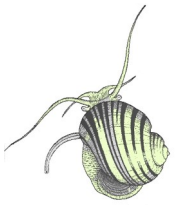
THE MARINE BIOLOGICAL ASSOCIATION

UNIVERSITY OF PLYMOUTH
Marine Institute

Annual General Meeting—Announcement

THE MALACOLOGICAL SOCIETY OF LONDON

Registered Charity No. 275980



Hon. Secretary
Dr Rowan J. Whittle

The 127th Annual General Meeting of the Malacological Society of London (MSL) will take on Tuesday 17th March 2020 from 16:00 to 17:00. Location - Wolfsom Room, The Marine Biological Association, Citadel Hill, Plymouth, PL1 2PB. The AGM will take place during a symposium organized jointly by the MSL and the Marine Biological Association UK entitled *Biology of Limpets: evolution, adaptation, ecology and environmental impacts*

Agenda for AGM

Apologies for absence
Minutes of the last (126th) AGM
Matters arising
Financial report
Annual report of Council (delivered by the President)
Awards
Election of Council
Any other business

Year of existence	2019-2020	2019-2021
	126	126
President	John Grahame (2)	John Grahame (3)
Vice Presidents	Robert Cameron (2)	Robert Cameron (3)
	Philip Fenburg (1)	Philip Fenburg (2)
Councillors	Aidan Emery (3)	tbc
	Harriet Wood (3)	tbc
	Andreia Salvador (2)	Andreia Salvador (3)
	Fiona Allen (2)	Fiona Allen (3)
	Philip Hollyman (1)	Philip Hollyman (2)
	Lauren Sumner Rooney (1)	Lauren Sumner Rooney (2)
Co-opted	Debbie Wall Palmer	tbc
	Alan Hodgson	tbc
Journal Editor	Dinazarde Raheem	Dinazarde Raheem
Bulletin Editor	Georges Dussart	Georges Dussart
Treasurer	Katrin Linse	Katrin Linse
Membership Secretary	Tom White	Tom White
Hon.Secretary	Rowan Whittle	Rowan Whittle
Web manager	Tom White/Chong Chen	Tom White/Chong Chen
Awards Officer	Jon Ablett	Jon Ablett

Numbers indicate years in post; posts are for 3 years.