ISSN 1759-1406

The Malacologist

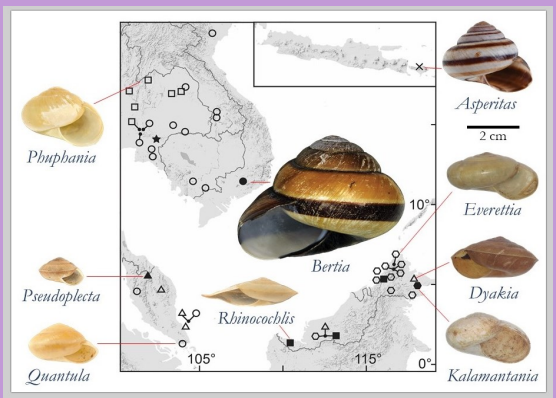
The Bulletin of The Malacological Society of London

NUMBER 78 FEBRUARY 2022

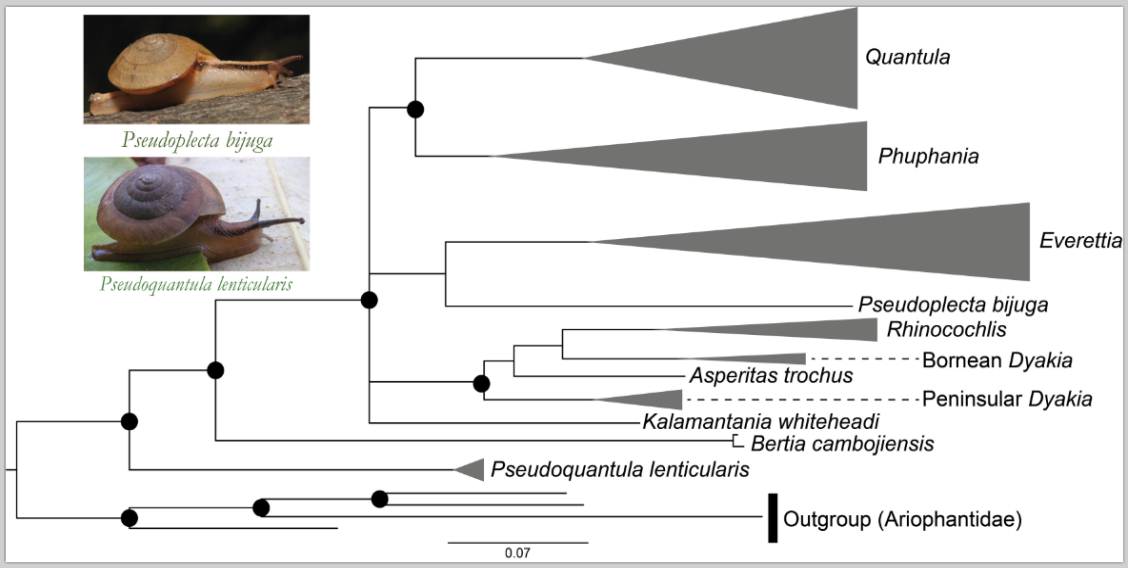
Contents

Molluscan Forum 2021

Last November an international group of young malacologists took part in the 22nd Malacological Forum at the Natural History Museum. The abstracts of the twenty seven presentations start inside on page 9

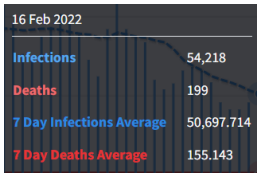


These images are from *Molecular phylogeny of the limacoid snail family Dyakiidae in Southeast Asia* by Parin Jirapatrasilp *et al.* The full abstract is given on page 14



The Malacological Society of London was founded in 1893 and registered as a charity in 1978
(Charity Number 275980)

EDITORIAL



At the time of writing this editorial, there are more than twice as many covid infections and deaths than at this time last year (12,718 cases and and 78 deaths in 2020). Nevertheless, the Government has removed all covid restrictions and declared that we are back in normal times. Nevertheless, the Malacological Society of London (Malacsoc) will hold the AGM and associated conference on *Tropical Biodiversity* as a virtual event on Zoom on 16 March 2021. Details can be seen on the Malacsoc Facebook site and in this issue on Pages 33-34.

In the light of the ongoing pandemic and the success of last year's virtual forum, this year's Malacological Forum in November 2021 had a hybrid format. The event was held in the Flett lecture theatre of the Natural History Museum, London for UK based attendees who wished to attend in person. In-person talks were broadcast through Zoom and there were virtual sessions throughout the day, with presentations from contributors who were unable to attend in person. If the COVID situation within the UK had deteriorated prior to the forum, or the Natural History Museum decided that it was not possible to accommodate external attendees, the organisers had the option of moving the whole Forum to a virtual format as was done last year. *In lieu* of posters, there were 5 minute (3 slide maximum) Quick-fire powerpoint presentations.

As well as benefitting from access to meetings, the *Journal of Molluscan Studies, The Malacologist* and financial support for research and travel, Malacsoc members can have access to the Radley Library. The Radley bequest comprises *circa* 500 malacological books housed in the library of University College London. By virtue of the bequest, Malacsoc members have both reader and borrowing rights at the UCL science library. More information about the Radley library is given below in the News and Notes section. Applications for membership of the library can be made on-line via the membership team at lib-membership@ucl.ac.uk

A major function of the MSL is to provide funding for malacological research and travel. It is encouraging to see the fruits of this investment in the form of reports in *The Malacologist* and papers in the *Journal of Molluscan Studies.* In this issue of *The Malacologist,* there are research reports from Alice Buckner on *The immunological response of a gastropod mollusc to infection with a compatible trematode parasite,* Quiaz Hua on *Assessing population genetic structure and diversity of commercially harvested octopuses by use of conservation genetics* and Olga Utrilla Ojeda on *The molluscan fauna of mud volcanoes of the North Eastern Gulf of Cádiz: biodiversity and eco-biological effects*

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TAXONOMIC/NOMENCLATURAL DISCLAIMER

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

News and notes

The Radley Library at University College London - free access for members of the Malacological Society of London

Applications for membership of the library can be made on-line via the membership team at lib-membership@ucl.ac.uk

In addition, proposals are invited for a 2022 Visiting Fellowship, which offers an opportunity for a scholar in any field of study to visit UCL to conduct research on a topic focused on the UCL Special Collections holdings. The appointee could work on the Malacological Society Library, which is held at UCL.

Further information can be found at:
https://www.ucl.ac.uk/library/collections/special-collections/visiting-us/ucl-special-collections-visiting-fellowship

Erika Delbecque, Head of Rare Books, Special Collections,
UCL Library Services
e.delbecque@ucl.ac.uk

Graduate Research Assistant(s) – MSc or PhD, Southeast Conservation Genetics Lab, Auburn University

The Whelan Lab at Auburn University and the U.S. Fish and Wildlife Service Southeast Conservation Genetics Lab (SECGL) are seeking graduate student applications for the MSc or PhD degree to study freshwater invertebrate evolution and conservation. At least one MSc and one PhD position will be available to start in January or August 2022.

Potential masters and PhD projects include conservation genetics and molecular ecology of freshwater mollusks, phylogenetics and systematics of freshwater gastropods, and phylogenomics of Myxobolidae fish parasites. Students will work in museum, lab, and field environments. SECGL is a joint U.S. Fish and Wildlife Service and Auburn University research lab. We are located in Swingle Hall on Auburn University's main campus. Our research includes both basic and applied science, and students work in an academic research environment while collaborating with government researchers and on-the-ground conservation scientists. Students will have the opportunity to work directly with conservation practitioners and perform cutting-edge research.

Current research projects in the lab include (1) phylogenomics of freshwater gastropods, with an emphasis on Pleuroceridae, (2) conservation genomics and molecular ecology of freshwater molluscs, including threatened and endangered mussels and snails, (3) taxonomy of terrestrial snails, freshwater mussels, and freshwater snails, (4) freshwater gastropod life history evolution, and (5) taxonomy of metazoan fish and mollusc parasites. We also work with the National Fish Hatchery program and use genetic data to evaluate and improve hatchery efforts.

SECGL has outstanding facilities, equipment, and capacity for lab- and field-based research. We have all the equipment needed for next-generation library prep and other molecular data generation, including an Agilent Fragment Analyzer, Blue Pippen, Quibit, and Opentrons OT-2 liquid handling robot. We also have multiple computers for bioinformatics (e.g., an 80-core, 512GB RAM machine) and access to additional computing resources through Auburn University and the Alabama Supercomputer Authority. The lab has a 4WD SUV and other equipment for fieldwork.

Auburn University is a public land-, sea-, and space-grant institution with internationally recognized research and academics. Auburn and nearby Opelika, Alabama are vibrant towns with excellent quality of life and a relatively low cost of living. GRA Stipends and Start Dates: Students will receive a stipend of $1,900/month and a tuition waiver.

Available start dates are January 2022 or August 2022. To apply: Send a letter of interest, current CV, contact information for 2-3 references, and unofficial transcripts to: Dr. Nathan Whelan, nathan_whelan@fws.gov. Members of historically under-represented groups are particularly encouraged to apply.

Nathan Whelan, nathan_whelan@fws.gov, nwhelan@auburn.edu

Molluscum contagiosum

Molluscum contagiosum (MC) is a viral infection that affects the skin. Around 9 out of 10 cases happen in children although it can occur at any age.
MC is generally a harmless condition that normally gets better in a few months without any specific treatment.

However, it's common for the condition to spread around the body, so it can take up to 18 months or more for the condition to clear completely.

Symptoms of molluscum contagiosum
Usually, the only symptom of MC is a number of small, firm, raised papules (spots) on the skin with a characteristic small dimple in the middle. The spots are not painful, but can be itchy.
The spots may develop in small clusters and can be spread across different parts of the body. They're most often found in the armpit, behind the knees or on the groin.
MC can affect a person on more than 1 occasion, but this is uncommon.

Why did the oyster leave the party early?

Because he'd pulled a mussel!

Image from Aardvark Animations

The short film ***The Sound of a Wild Snail Eating,*** based on the book by Elisabeth Tova Bailey, was available in October 2021 at the Princeton Environmental Film Festival. Bailey's encounter with the snails is available as a slide show with narration at https://www.youtube.com/watch?v=NbjCq730Rgg
The delicate, inspiring and beautifully paced story is told with a light touch, exactly right for the context and narrative. Recommend it, especially if you are feeling stressed or out-of-sorts.

Do you need to keep up your spirits with a mollusc joke?
Tim Pearce tells mollusc jokes at www.tiktok.com@carnegiemnh

Eco warrior Biff Whipster from Canterbury fights to save tiny snail in path of planned Sturry bypass

An environmental campaigner says he is prepared to "die in a ditch" to protect a tiny snail living in the path of a planned £30 million bypass.

Biff Whipster has discovered the Desmoulin's whorl snail in reeds where the Sturry relief road near **Canterbury** will cross, but claims its presence has been "glossed over" in an ecology report.

Now, the 54-year-old dad, who is a volunteer river warden for the Kentish Stour Countryside Partnership, insists the controversial relief road viaduct must be abandoned.

"Sometimes you have to die in a ditch for what you believe and I am prepared to do what it takes to stop this new road," he said.

The relief road was recently granted planning permission at the 11th hour, securing a special funding contribution following intense debate and objections.

A 0.9-mile viaduct will stretch over the River Stour from Sturry Road to Broad Oak Road, connecting to the other half of the bypass, which will take drivers through a new housing estate in Sturry.

It is designed to relieve traffic tailbacks at the village's level crossing.

From Kent On-line https://www.kentonline.co.uk

Mr Whipster says the KCC-commissioned environmental impact report is fair and did flag up the snails in a location 150 yards away from the proposed viaduct.

But he claims the authority ignored a crucial footnote in the report which said that following two dry summers – during which the snails had concentrated their population in a damp ditch – it was believed they would spread again when the weather was more typically wetter.

"They chose to 'green-wash' that bit, which happens all too often when authority's select evidence to suit their own agendas," said Mr Whipster.

"It's not just about a small snail, but the protection of our whole ecosystem, which is under threat."

Response


The planned Sturry relief road

A Kent County Council spokesman said: "Environmental surveys for the Sturry bypass have shown Desmoulin's whorl snails in an area close to the construction site.

"KCC included information on mitigation as part of this application within the Environmental Impact Assessment, which has now been before the planning committee.

"Officers are aware of concerns surrounding possible sightings of further populations on the site itself.

"While this has not yet been verified, additional surveys will be completed to monitor the distribution of snails and inform an up-to-date mitigation strategy ahead of construction planned for autumn 2023."

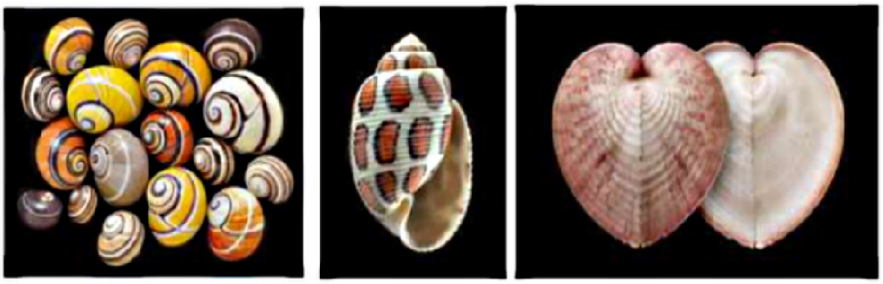
According to the government's own wildlife conservation advisors, Desmoulin's whorl snail is the largest vertigo species, with a shell height up to about 2.6 mm.

It is restricted to calcareous wetlands, usually bordering lakes or rivers, or in fens with high humidity important in determining its distribution.

It normally lives on reed-grasses and sedges, such as reed sweet-grass and tussocks of greater and lesser pond-sedge where it feeds on the microflora.

The species was more widespread during the early post-glacial period but climatic change and destruction of its habitats for agriculture caused a contraction in its range.

A sizeable population of the snails also lives beside ditches within pasture on the floodplain of the River Stour in Stodmarsh.



16th March 2022

The Society's 129th Annual General Meeting (AGM) will take place virtually on Zoom, on Wednesday March 16th 2022.

There will be a morning and afternoon symposium on the theme of "*Tropical Biodiversity*" to accompany the AGM, also on Zoom. The meeting is free but registration is necessary. Please register by sending an email to president@malacsoc.org.uk
See pages 33-34 for further details

Proposed changes to the Malacological Society of London Council

Changes to the Council membership will be proposed at the forthcoming AGM on **March 16th 2022.**

The 2022 AGM will be held virtually on Zoom and the link will be emailed to all members. In addition, Council will put forward a motion to include **a new student/early career post** on the Council to better reflect the needs and views of these important society members and to assist with the running of our annual Molluscan Forum conference.

If you are a PhD student or early career researcher (less than 5 years after completion of PhD) and would be interested in taking on this new position, if approved, please contact the President for information and details on how to apply.

President - Dr John Ablett j.ablett@nhm.ac.uk

	2021-2022	2022-2023
Year of existence	128	129
		Proposed
President	Jon Ablett (1)	Jon Ablett (2)
Vice Presidents	Phil Fenberg (3)	Fiona Allen (2)
	Fiona Allen (1)	Phillip Hollyman (1)
Ex officio	John Grahame	
Councillors	Phillip Hollyman (3)	Alan Hodgson (3)
	Alan Hodgson (2)	Aidan Emery (2)
	Aidan Emery (1)	Robert Cameron (2)
	Robert Cameron (1)	Victoria Sleight (2)
	Victoria Sleight (1)	Katie Collins (2)
	Katie Collins (1)	Rowan Whittle (1)
		John Grahame (1)
		EC-Rep (1)*
Co-opted	Rowan Whittle (1)	Phil Fenberg (1)

* CM post to be agreed at AGM and potential suggestion elected

Molluscan Forum 2021

Natural History Museum, London
took place on 18th November 2021

Convened by

PHIL HOLLYMAN
Council member of the Malacological Society of London
Fisheries Ecologist, British Antarctic Survey
email: phyman@bas.ac.uk

JONATHAN ABLETT
President of the Malacological Society of London
Senior Curator in Charge, Mollusca
Natural History Museum
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ALAN HODGSON
Council member of the Malacological Society of London
Emeritus Professor, Department of Zoology & Entomology,
Rhodes University, South Africa.
email: a.hodgson@ru.ac.za

This year the Forum was held virtually over Zoom for the first time. Joining details were sent to all delegates on the day before the meeting.

Questions to presenters

There was time for short questions following each full talk (Sessions I, II & III). The chat function within Zoom was used to pose questions directly to the speakers.

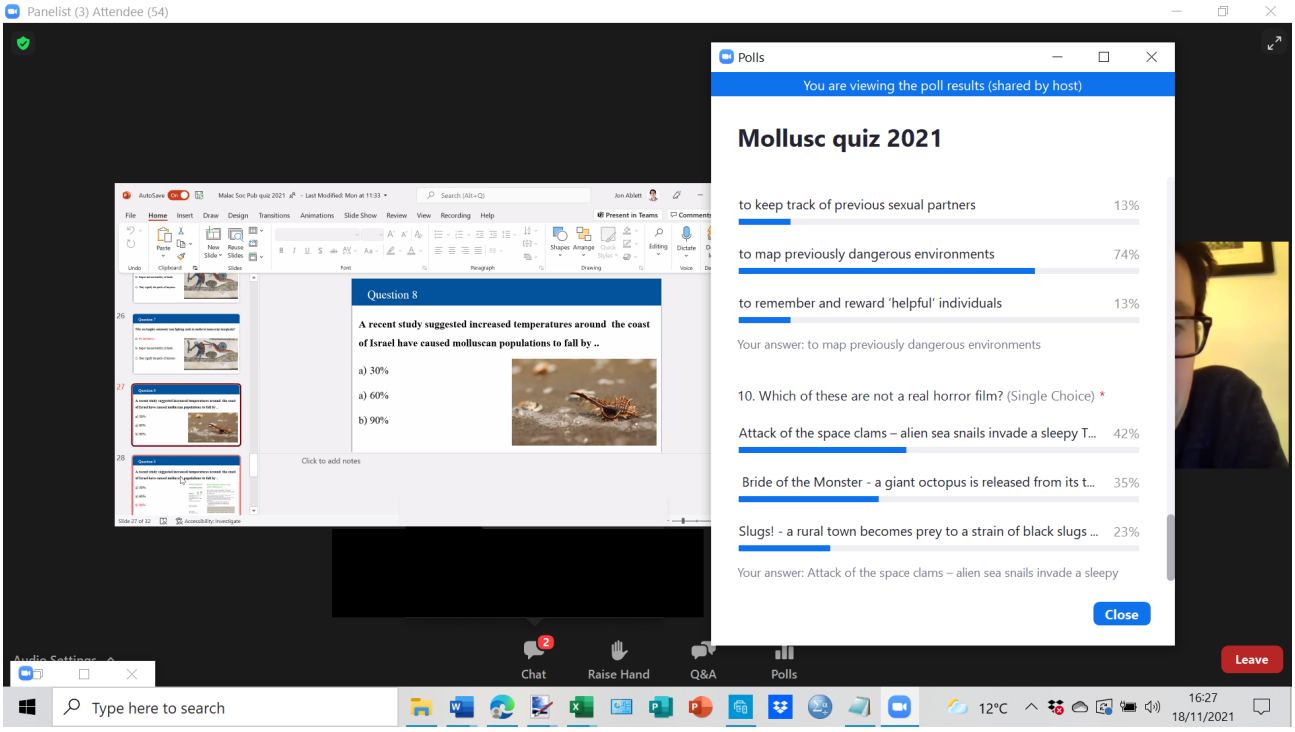
For quick-fire talks (Quick-fire sessions I, II & III) questions were not taken directly after each talk.

There were scheduled breaks including a 45 minute lunch. It was hoped that during these times, there would be discussion and questions for the presenters in the preceding sessions.

'The notional wine reception'

The Forum would traditionally finish with a wine reception to socialize and discuss the day's events. *In lieu* of this, the day finished with a short mollusc-themed quiz, during which participants were encouraged to bring a drink of their choice (even if it was just a cup of tea). Following that, there was an announcement of prizes for talks and the meeting then closed.

Screen grab of the quiz



Schedule

09.45 - 10.00 Meeting open and welcome

10.00- 11.15 Session I

10.00 SHANG PING YAU: Fine-tuned Transcriptional Regulation Underpins Adaptive Thermal Plasticity of Intertidal Snails in Tropical Extreme Environments

10.15 PARIN JIRAPATRASILP: Molecular phylogeny of the limacoid snail family Dyakiidae in Southeast Asia

10.30 SUPHATSARA SANGPHUEAK: Behavioural and physiological adaptations to thermal stress of intertidal limpets: *Patelloida saccharina* (Patellogastropoda) and *Siphonaria guamensis* (Heterobranchia) from Southern Thailand.

10.45 JANE EARLAND: Investigating the application of temporal variations in growth rates of *Arctica islandica* as a shell dating method

11.00 ELEA GIRAUD: Physiology and feeding strategies of *Berghia stephanieae* (Nudibranchia: Aeolidiodea)

11.15 - 11.30 Break and discussion

11.30 - 12.05 Quick-fire session I

11.30 FRETZELJANE O. POGADO: Macro Land Snail Diversity in Selected Forest Fragments of Leyte Island, Philippines

11.35 HAROLD LIPAE: Land Snail Diversity in Karst Ecosystems of Samar Island, Philippines

11.40 WAN TENG LIM: Updating the Distribution of Freshwater Molluscs in Singapore

11.45 RIO CARLA E. DEL ROSARIO: Species Composition of Cultured Teredinidae (Bivalvia) at Verde Island, Batangas, Philippines

11.50 FUJI ANANDI: Preliminary study on active compounds and toxicity test of LC50 of the mucus from land snail species *Hemiplecta humphreysiana*

11.55 JIMIWELL R. BERNABE: A Systematic Review on the use of Snail Mucin from *Cornu aspersum* and *Achatina fulica* as a Topical Treatment for Wound Healing

12.05 - 13.50 Session II

12.05 YUMI NAKADERA: Dynamics of seminal fluid replenishment after mating

13.45 ALEJANDRO LEÓN-CRISTÓBAL: The role of the marine environment within the last prehistoric hunter societies and the first farming communities in the Iberian peninsula: an anthropological perspective

13.50 JULIA GABRYSIAK: Freshwater snails and digenean trematodes - some aspects of their relationship exemplified by Strigeidae family

13.55 ŁUKASZ MIGDALSKI: Larval trematodes (Digenea) of planorbid snails (Gastropoda: Pulmonata) in Poland

14.00 MAC ELIKEM NUTSUAKOR: Land snail faunas of the Bobiri Forest Reserve and Butterfly Sanctuary, Ghana and its implications for conservation.

14.05 MADELINE P. B. C. ANDERSON: Macrobenthic Mollusca of the Prince Gustav Channel, Eastern Antarctic Peninsula: An Area Undergoing Colonisation

14.15 - 15.30 Session III

14.15 MARTINA PANISI: Snails, forest and people: ecology and conservation of terrestrial molluscs in a tropical island

14.30 KALLEN SULLIVAN: *In vivo* Labelling of Molluscan Haemocytes: Do Haemocytes have a Functional Role in Biomineralization?

14.45 W.A.N.U ABEYRATHNA: Morphogenetic characterization and connectivity of the invasive snail, *Viviparus georgianus* in the New York Great Lakes Basin

15.00 HEATHER L. KOSTICK: Evaluating and Understanding Biodiversity of Urban Cemeteries in Philadelphia, PA, USA

15.15 DOMINICK DICKERSON: Comparative Neuroanatomy in Cephalopoda via Contrast Enhanced μCT

15.30 - 15.45 Break and discussion

15.45 - 16.15 Quick-fire session III

15.45 CHARLIE MOUNTAIN: Trial of intertidal and subtidal structures to mitigate saltmarsh erosion and increase bivalve settlement rates within the Hamble estuary.

15.50 EILIDH J. PLAYER: Shell repair assays and in vivo haemocyte labelling methods to study molluscan biomineralization

15.55 CRISTHIANE OLIVEIRA DA FONSECA: Phenotypic characterization of digestive gland cells of Biomphalaria glabrata (Mollusca: Gastropoda) susceptible and partially resistant to Schistosoma mansoni (Trematoda: Digenea)

16.00 DIEGO SIMEONE: Novel insights into habitat suitability for Amazonian freshwater mussels linked with hydraulic and landscape drivers

16.05 EMILY L. MCLAUGHLIN: A global DNA barcode library for Solenogastres (Mollusca, Aplacophora)

16.15 - 17.00 Meeting close, mollusc quiz and prize giving

Abstracts
Alphabetical by presenter

Morphogenetic characterization and connectivity of the invasive snail *Viviparus georgianus* in the New York Great Lakes Basin

W.A.N.U Abeyrathna, Andrew A. David
Clarkson University Department of Biology Potsdam NY USA
Email: abeyranu@clarkson.edu

Apertural and sub-apertural views of *Viviparus*

W.A.N.U Abeyrathna sampling for *Viviparus georgianus*

The banded mystery snail (*Viviparus georgianus*) is an invasive aquatic snail species established in North America. Accurate identification of invasive species is often crucial to implement effective management strategies due to the presence of cryptic species complexes. In the southern US, where *V. georgianus* is native, it was thought to be part of a cryptic species complex within its introduced ranges in the northeastern US. Exploring genetic connectivity patterns in *V.georgianus* is equally important because it will help to understand the long-term viability of this species by addressing several questions, including the source population, gene flow patterns, genetic diversity, potential vectors and barriers to dispersal. To explore morphological variation, phylogenetic patterns, and genetic connectivity in invasive populations of *V. georgianus* in the New York Great Lakes Basin, we sampled and collected snails from twenty different waterways across the Great Lakes region from May - September 2021. Shells were measured and gDNA was extracted from each population. Two genetic markers, mitochondrial DNA marker: CO1 (cytochrome c oxidase) and a microsatellite marker library (10 microsatellite markers in total will be developed as a microsatellite library), will be used to genotype the individuals in each population. Phylogenetic analyses will then be used to explore crypticity within invasive *V. georgianus* populations in North America. Finally, we will use phylogeographic analyses to explore genetic structuring or admixture in *V. georgianus* by identifying potential natural or anthropogenic barriers (i.e., dams) and vectors (i.e., boats) that could influence dispersal.

A preliminary study on active compounds and toxicity test of LC_{50} of the mucus from land snail species *Hemiplecta humphreysiana*

Fuji Anandi[1], Jessima Pratiwi[1], Pamungkas Rizki Ferdian[2], Narti Fitriana[1], Ayu Savitri Nurinsiyah[2]
[1]Program Studi Biologi, Fakultas Sains dan Teknologi, Universitas Islam Syarief Hidayatullah. Jl. Ir. H. Juanda No. 95, Ciputat, Banten, Indonesia
[2]Museum Zoologicum Bogoriense, Research Centre for Biology, Indonesian Institute of Sciences, Jl. Raya Jakarta-Bogor No.Km.46, Cibinong, Bogor, Jawa Barat 16911, Indonesia
Email: fujianandi3424@gmail.com

The use of land snails' mucus for cosmetic products has been widely developed by the global community. Land snail mucus is known to have active compounds to nourish and repair damaged skin. Currently, the use of land snail mucus is still limited to a few species, for instance *Cornu aspersum*, *Lissachatina fulica* and *Hemiplecta disctincta*. *Hemiplecta humphreysiana* has the potential to produce abundant mucus, but utilization is not yet optimum due to lack of information regarding the mucus content. This study aimed to determine the content of the active compound group and the cytotoxicity of the land snail mucus *Hemiplecta humphreysiana* by screening of active compounds and by use of LC_{50} toxicity tests. The research was performed in the Research Center for Biology, BRIN from January to May 2021. Mucus production was stimulated by carbonate buffer solution at pH 9.0. The mucus was then separated from any dirt and was dried using a freeze dryer until it formed a lyophobic sample. There are two approaches for screening samples for active compounds, namely (1) the lyophobic sample method and (2) the fresh sample method. Active compounds were qualitatively screened by testing for alkaloids, flavonoids, terpenoids, steroids, saponins, tannins, and peptides. An LC_{50} toxicity test was carried out using a Brine Shrimp Lethality Test. The results showed that from both types of samples (lyophobic and fresh), the mucus of the land snail *Hemiplecta humphreysiana* was positive for steroid-triterpenoid and peptide compounds.

Macrobenthic Mollusca of the Prince Gustav Channel, Eastern Antarctic Peninsula: an area undergoing colonization

Madeline P. B. C. Anderson [1, 2], Phillip B. Fenberg[1], Huw J. Griffiths[2], Katrin Linse[2]

[1] School of Ocean and Earth Science, University of Southampton Waterfront Campus, National Oceanography Centre, Southampton, United Kingdom
[2] Biodiversity, Evolution & Adaptation Team, British Antarctic Survey, Cambridge, United Kingdom
Email: ma8g17@soton.ac.uk

In 2018, RRS James Clark Ross investigated the marine benthic biodiversity of the Prince Gustav Channel area which separates the eastern coast of the Antarctic Peninsula from James Ross Island. The southern end of this channel was covered by the Prince Gustav Ice Shelf until the shelf collapsed in 1995. Benthic samples were collected by an epibenthic sledge at six stations (200 to 1200m depth) in the channel and the adjacent Duse Bay. In total 20,307 live-collected mollusc specimens belonging to 50 species and 4 classes (Solenogastres, Bivalvia, Gastropoda and Scaphopoda) were identified. The area was characterised by low species richness (ranging from 7-39 species per station) but high abundances (specifically of the Scaphopods with 11,331 specimens). The functional traits of the community were dominated by motile development and mobility type. Assemblage analyses of the molluscan species abundances within the Prince Gustav Channel stations showed the communities were distinct, with no pattern by depth or location. However, when bivalve assemblages were analysed with reference to the wider Weddell Gyre region (15 stations from 300 to 2000m depth), the Prince Gustav Channel was distinct from the other Weddell Gyre stations, with a higher dissimilarity between deeper or more geographically distant areas. The Prince Gustav Channel is undergoing colonization following the recent ice shelf collapse. With many Antarctic ice shelves threatened by climate warming, with future monitoring, this area may serve as a case study of benthic faunal succession.

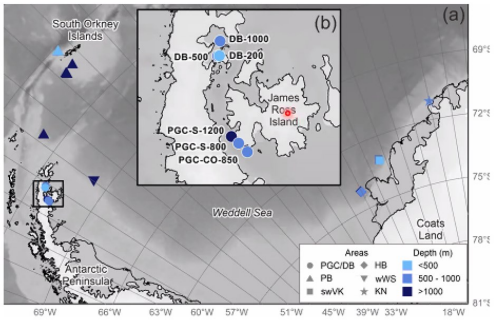


Figure 1. Location of stations within the study area, (a) the western Weddell Gyre region including the Weddell Sea and South Orkney Islands, DB – Duse Bay, PGC – Prince Gustav Channel, PB – Powell Basin, swVK – southwest of Vestkapp, HB – Halley Bay, wWS – western Weddell Sea, KN – Kap Norvegia (b) the Prince Gustav

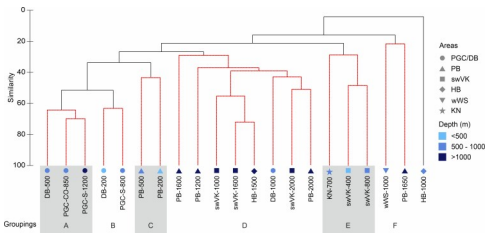


Figure 2. Weddell Gyre region similarity species cluster analysis by station. DB – Duse Bay, PGC – Prince Gustav Channel, PB – Powell Basin, swVK – southwest of Vestkapp, HB – Halley Bay, wWS – western Weddell Sea, KN – Kap Norvegia, DB – Duse Bay, PGC – Prince Gustav Channel, S – South, CO – Cape Obelisk. Fourth root transformation and Bray Curtis similarity of resemblance. SIMPROF groupings in red

A systematic review of the use of snail mucin from *Cornu aspersum* and *Achatina fulica* as a topical treatment for wound healing

Jimiwell R. Bernabe, Marian Jeremy D. Aggabao & Noel A. Saguil

Department of Biology, Polytechnic University of the Philippines, Manila, Philippines
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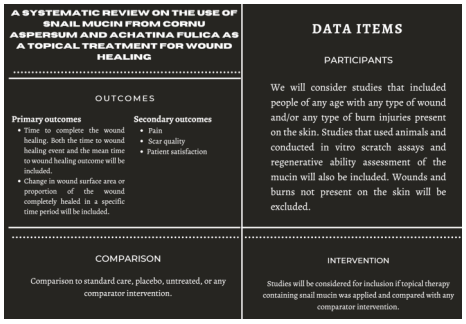
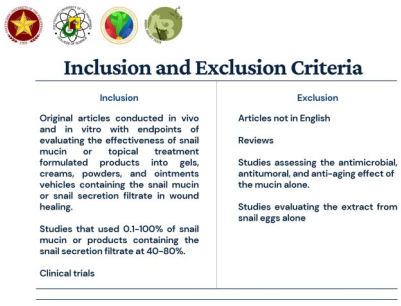
Snail mucin is a popular ingredient in Asian beauty culture and can be found in different products ranging from cleansers to moisturizers due to its skin soothing and humectant properties. Snail secretion filtrates that are commonly used in beauty products come from two species of snails, namely the garden snail *Cornu aspersum* (previously known as *Cryptomphalus aspersa* or *Helix aspersa)* and *Achatina fulica* (the giant African snail). This study aims to conduct a systematic review regarding the use of snail mucin from *A. fulica* and *C. aspersum* as a topical treatment for wound healing. A systematic search will be conducted using PubMed and Google Scholar with key search terms including *Achatina fulica* and *Achatina fulica* mucin, *Helix aspersa* and *Helix aspersa* mucin, *Cryptomphalus aspersa*, snail mucin and wound healing. The search will be duplicate-filtered and will be limited to studies reported in English. Two authors will independently assess and screen the titles and abstracts for relevance. Data extraction will be conducted by one author and verified by the other author. This systematic review aims to be a qualitative study that would provide a summary of merged findings concluding on the efficacy of snail mucin extracted from *A. fulica* and *C. aspersum* as a topical treatment for wound healing. A narrative synthesis will be used to evaluate the various results.





Comparative neuroanatomy in Cephalopoda via Contrast Enhanced µCT

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Cephalopods are notable amongst molluscs and indeed all non-vertebrates for the degree of complexity and centralization of their nervous system and corresponding richness in their behavioral repertoire. The cephalopod "brain" comprise a ring of lobes encircling the oesophagus, adjacent and connected to which lie the optical lobes. The other primary components are arm nerve-cords and the inter-brachial commissure which may act as a "second brain", coordinating and processing information from the arms. Visceral and stellate ganglia innervate the aboral end of the animal, controlling location and respiration. Contrast Enhanced µCT (CE µCT) allows for the non-destructive examination of both internal and external anatomy as well as allowing for the creation of cybertypes, enabling digital distribution and maximizing open-source access to valuable morphological data. Our work so far has been focussed on establishing an optimal staining method in adult *Octopus rubescens*, with scans of adult *Octopus chierchieae* and *Muusoctopus leioderma* as well as para-larval *Enteroctopus dolfeni* and sub-adult market squid. Preliminary work using phosphotungstic acid (PTA) in conjunction with several fixatives (ethanol, neutral buffered formalin and Bouin's fluid) is promising, revealing the gross internal anatomy in fine detail (analysis and replication in process). Following staining and scanning, data are processed via segmentation into features of interest, which then can be visualized as 3D isometric models. The data are subject to morphometric analysis. Models can be viewed digitally or can be made into physical models via 3D printing. Future direction of this work includes: 1) exploring different combinations of fixatives/contrast agents in adult cephalopod tissue, 2) establishing a neural network to assist in segmentation and classification, 3) exploring the viability of established heritage collections as a source for scanning and 4) establishing a digital catalogue of cephalopod anatomy and morphology. By combining tomography with photogrammetry we hope the open- source compendium will eventually comprise living representatives from the entire class of Cephalopoda.

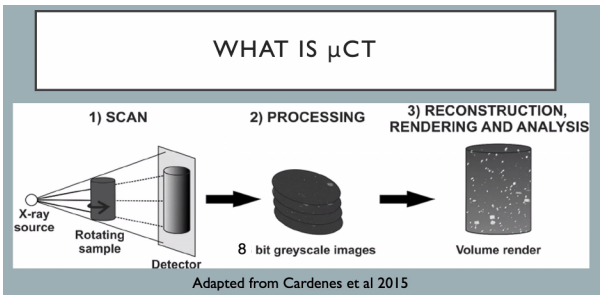

Figure 1: Volume Rendering of *O.bimaculoides* stained in PTA, lobes of brain segmented out and inset within

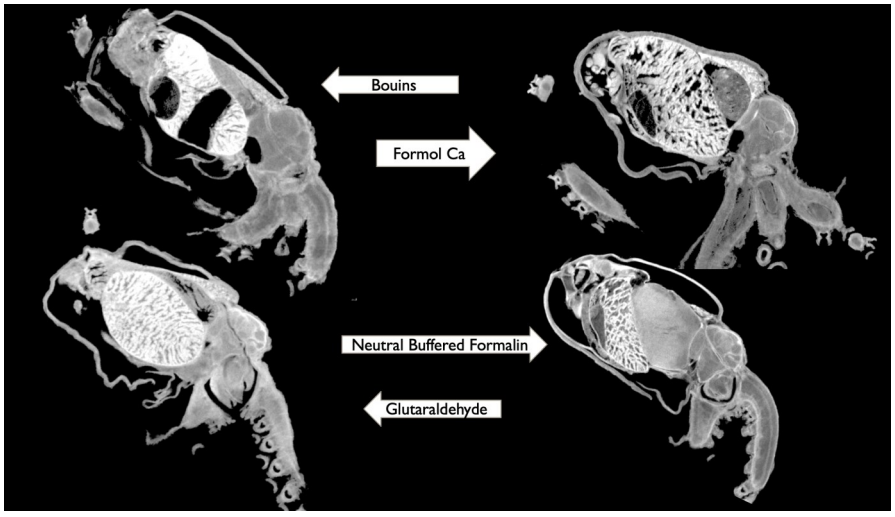

Figure 2: Comparison of attenuation for *O. bimaculoides* fixed in 4 different treatment.

Investigating the application of temporal variations in growth rates of *Arctica islandica* as a shell dating method

Jane Earland, Alejandro Román González, Paul Butler, James Scourse

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The bivalve mollusc *Arctica islandica* is an essential species for sclerochronological reconstructions of the historic environment. When completing sclerochronological research, the approximate time period in which dead collected shell samples were living needs to be determined prior to crossmatching analysis. The current methods for determining this are primarily through radiocarbon dating, which is often costly, or by analysing taphonomic characteristics of a shell sample, which can be unreliable. This study presents a potential alternative method of shell dating using temporal variations in growth rates. First, the growth rate of two populations from the Fladen Ground (North Sea), one from the last millennium and one from the early Holocene, were modelled using a linear regression of maximum height and biological age to model growth rate. The data were compared using a two-way ANOVA. The growth rate of the early Holocene population was significantly higher than for the last millennium population. The significant difference in growth rate between the two populations meant it was possible to test the method of predicting the geological age of a sample based on growth rates. A 99% prediction interval was produced for both the last millennium and the early Holocene regression models. This interval provides a prediction of the upper and lower maximum height value for each biological age. Samples of dead material of unknown geological age from the Fladen Ground were prepared using standard sclerochronological techniques to determine the maximum height and biological age. These values were substituted into the prediction interval for each time period. The geological age of each specimen could then be inferred in cases where the measured height of a sample fell within the range of predicted height values for one of the time periods. Results from this study suggested that two samples were living during the early Holocene, and one in the last millennium. The remaining five samples could not be attributed to either time period due to overlapping prediction intervals. Future research will test the three suggested geological ages through radiocarbon dating, and thus the validity of this technique for future sclerochronological work.

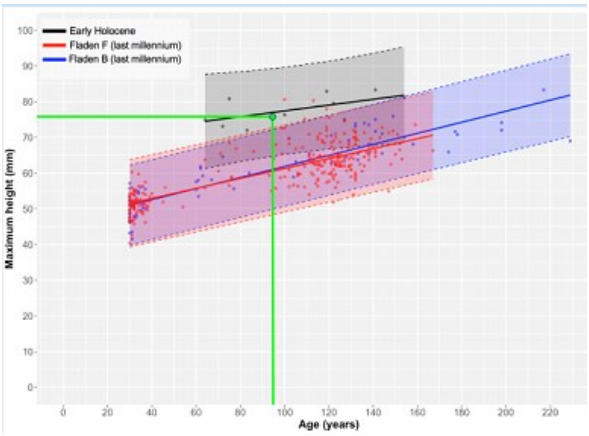
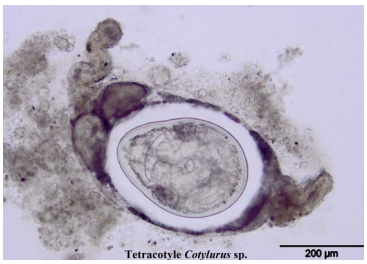


Figure 1: Growth rates of North Sea *A. islandica* from the early Holocene and the last millennium with 99% prediction interval. Green line demonstrates the substitution of height and biological age values of a shell of unknown geological into the regression, illustrating that this sample predicted to have been living during the early Holocene

Freshwater snails and digenean trematodes - some aspects of their relationship exemplified by the family Strigeidae



Julia Gabrysiak[1], Ewa Pyrka[1], Witold Jeżewski[2], Gerard Kanarek[3] & Joanna Hildebrand[4]

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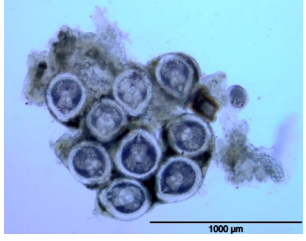
Freshwater snails have important roles in the complex life cycles of digenean trematodes. Most studies focus on their significant role as the first intermediate host. However, an interesting issue that requires more attention is their role as the second intermediate host. Our research focuses on the family Strigeidae. Some representatives, e.g. species of the genus *Cotylurus*, use water snails as both first and second hosts while definitive hosts are waterfowl. In total, 258 snail individuals were collected from several sampling sites in specific aquatic environments of high biodiversity located in two regions of Poland: Gdańsk Pomerania (north of the country) and Lower Silesia (south-western part). These areas, with a great variety of species of water birds and invertebrates including molluscs, create perfect conditions for the effective circulation of different parasites. Ten species of snails were identified and tested including *Anisus spirorbis*, *Anisus vortex*, *Bithynia tentaculata*, *Lymnea stagnalis*, *Planorbarius corneus*, *Planorbis planorbis*, *Radix auricularia*, *Radix balthica*, *Radix labiata* and *Viviparus viviparus*. During necropsy, the characteristic metacercariae of tetracotyle type were recorded. In the preliminary study described here, Strigeidae tetracotyle were detected in 51 specimens, giving an overall prevalence 19.8% (18.3% in Gdańsk Pomerania and 21.5% in Lower Silesia). Among the tested snail species, the greatest prevalence was for *L. stagnalis* in Pomerania and *R. auricularia* in Lower Silesia, which may suggest differences in the host specificity depending on the studied area. Additionally, we carried out a molecular taxonomic verification of tetracotyle and conducted phylogenetic and ecological analyses, taking into account the snail host species.



Physiology and feeding strategies of *Berghia stephanieae* (Nudibranchia: Aeolidiodea)

Elea Giraud & Simon Cragg

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Berghia stephanieae is a small nudibranch of the aeolid family, known to feed voraciously on the anemone *Aiptasia pallida*, which is itself a common pest in tropical aquaria. *Berghia* is sold in the aquarium trade for anemone density control. Though well-documented in the aquarium context, studies on *Berghia-Aipatsia* interactions in the natural environment are more scarce. Being a specialised predator (as are most nudibranchs) that feeds exclusively on *A. pallida*, it is unclear how both species can coexist in the natural environment without *B. stephanieae* causing local extinction. Building on the discovery of kleptopredation in 2017 in the aeolid nudibranch *Cratena peregrina*, our current research investigates the possibility of this mechanism being used by other nudibranch species, here *B. stephanieae*. *C. peregrina* is a highly specialised predator known to feed exclusively on hydroid *E. racemosum* polyps, yet half of their diet was found to consist of planktonic prey acquired through kleptopredation. The current research investigates the feeding strategy of *B. stephanieae*, and the possibility of kleptopredation.

B. stephanieae were reared and fed in the laboratory with either kleptopredation treatment (recently- fed anemones) or control diet treatment (unfed anemones). Their physiology was studied over time under each treatment condition, to assess the possible benefits of kleptopredation on the energy budget. Preliminary results suggest kleptopredation is exhibited by *Berghia stephanieae*. Growth, spawning, and respiration measurements show that this feeding strategy could provide energetic benefit to the nudibranch predator by allowing more energy to be invested in growth and reproduction.

Function and evolution of high-resolution spatial vision within Stromboidea

Award Winner Best Student Presentation

Alison R. Irwin [1,2], Suzanne T. Williams [1], Daniel I.Speiser [3], and Nicholas W. Roberts [1]

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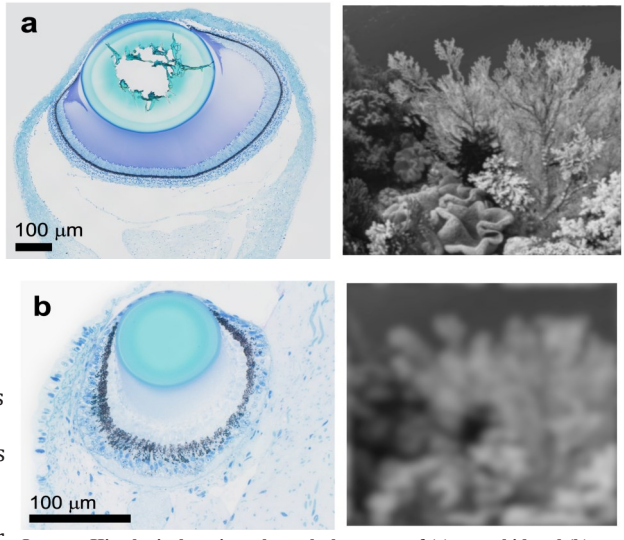
All species within the conch snail family Strombidae possess camera-type eyes of surprising size and sophistication compared with those of other gastropods. Although strombid eyes are known to be structurally complex, little research on their visual function has been conducted. Here, we use isoluminant looming visual stimuli to test for behavioural evidence of high spatial resolution in a strombid, *Conomurex luhuanus*. Using these stimuli, we show that this species responds to objects as small as 1° in its visual field, which is fine resolution vision for an invertebrate; for example, this resolution is similar to that of a worker bee which uses vision for complex flight maneuvers. Although perhaps surprising, these findings are consistent with calculations of spatial resolution from histological data. We also use serial block-face scanning electron microscopy to reconstruct the complexity of the retina structure which gives rise to this high-resolution vision. We compare these results to estimates of spatial resolution for the eyes of other families within the superfamily Stromboidea, three of which have much smaller eyes compared with those of strombids such as *C. luhuanus*, and a spatial resolution about five times coarser. This disparity in visual capabilities and eye structures within the superfamily raises exciting new questions about why strombids have such fine spatial resolution. These results also demonstrate that the Stromboidea are an excellent group for studying trends in eye evolution; however, a robust phylogenetic framework of the relationships between genera within each family is lacking. We therefore use Sanger sequencing data to produce an initial phylogeny of the group, to begin to investigate trends in the evolution of these amazing eyes.



Images: Histological sections through the centre of (a) strombid and (b) xenophorid eyes. Accompanying images of a reef are blurred according to what each animal can see with respect to spatial resolution, as estimated from measurements taken from histological data.

Molecular phylogeny of the limacoid snail family Dyakiidae in Southeast Asia

Parin Jirapatrasilp[1], Piyoros Tongkerd[1], Ekgachai Jeratthitikul[2], Thor-Seng Liew[3], Arthit Pholyotha[1], Chirasak Sutcharit[1] & Somsak Panha[1,4]

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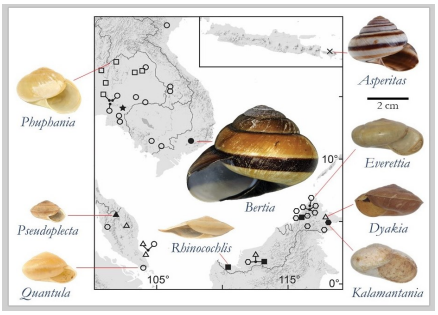
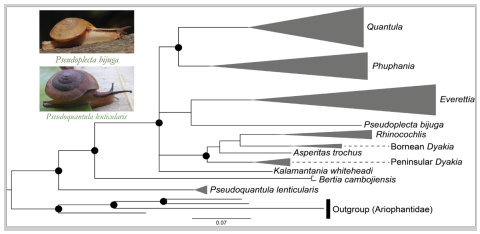


The terrestrial snail family Dyakiidae contains 12 genera that are restricted to Southeast Asia and show a distinct geographical distribution pattern. Members of Dyakiidae exhibit both dextral and sinistral forms and various shell shapes, ranging from lens-shaped, subglobose to trochiform, and possess different degrees of complexity in their amatorial organ gland. This study illustrates the first molecular phylogeny of 10 of the 12 genera in this family, constructed from two mitochondrial (COI and 16S rDNA) and one nuclear (28S rDNA) markers. The results uncovered a new genus and species, *Pseudoquantula lenticularis* Jirapatrasilp & Panha, 2020, based on its distinct morphological characters and molecular divergence from the other genera. This species possesses a depressed conic and thin shell, with a sharp peripheral keel and strong radial ridges on the upper shell surface. The genitalia also contain a well-developed amatorial organ gland consisting of two major lobes with two amatorial gland ducts. The phylogenetic analyses revealed that all dyakiid genera were monophyletic, except for *Dyakia*, which separated into peninsular Malaysia and Borneo clades. Cladistic analysis showed that all 14 shell, radular, and genitalia characters used in this study were homoplastic, whereby the similarity in shell shape and coiling, and genitalia configuration was probably a result of convergent evolution. The amatorial organ lobes without a common duct were plesiomorphic, whereas the common amatorial organ duct found in *Dyakia* and *Quantula* is apomorphic but was retrieved as homoplastic. These results disagree with the previous amatorial organ transformation series, in which *Pseudoplecta*, which lacks an amatorial organ gland, was not ancestral to the other genera but exhibited a secondary loss. Mainland Southeast Asia was inferred to be the ancestral range of the Dyakiidae, and later the lineages dispersed to, and diversified in, Borneo. At least one lineage dispersed to Bali. The position of the Bornean taxa at the terminal part of the tree agrees with the later accretion of Borneo to Sundaland in the Cretaceous-Cenozoic.



Evaluating and understanding the biodiversity of urban cemeteries in Philadelphia, PA, USA

Heather L. Kostick & Dane C. Ward

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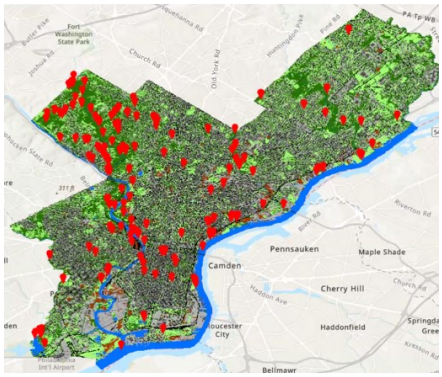
Cemeteries and burial grounds are an often overlooked part of green space in an urban environment. In recent years however, they've been found to be local hotspots of biodiversity. Studies in Europe suggests that cemeteries can provide habitat for hundreds of species, including rare species, in an urban environment and that species richness and composition varied across urban cemeteries. depending upon management intensity and available vegetation structures. This study aims to evaluate and understand biodiversity of three urban cemeteries in Philadelphia, PA. The main objectives of this research are to measure biodiversity; compare urban cemetery biodiversity data with other Ward Lab (Drexel University) urban green space study site data and collect human social data to better understand the human use or activities of these spaces and how urban cemetery green space is managed. Measuring biodiversity of cemeteries not only provides useful information to land and cemetery managers, but documents species and gives a fuller picture of biodiversity in urban spaces. Comparing our cemetery data with data from other urban green spaces will allow us to better understand how comparable the urban green spaces are, and how these different land management techniques may or may not result in varying levels of biodiversity. This information will also provide insight to stakeholders on how to better manage the green spaces for increased biodiversity. Human use of these cemeteries and how cemeteries are managed in different parts of the city will provide insight into how human use and socioeconomics may also affect biodiversity. Taxonomic data for birds, plants, arthropods, and terrestrial mollusks were collected using methods appropriate for each taxon. Data collected for Autumn 2021 is still being processed and analyzed, but preliminary analysis suggests that Mount Moriah Cemetery may be more diverse than Laurel Hill and The Woodlands cemeteries, which may be due to the differences in land management styles and site history.



The role of the marine environment within the last prehistoric hunter societies and the first farming communities in the Iberian Peninsula: an anthropological perspective

Alejandro León-Cristóbal, Asier García-Escárzaga & Miguel Ángel Fano

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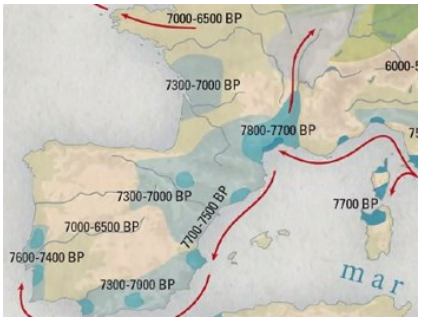

We describe an innovative and multidisciplinary methodological approach to investigate the role of marine environments during the Mesolithic and Neolithic periods in the Iberian Peninsula. Recent archaeological information has cleared up some uncertainties regarding the exploitation of the coastal environment. There are, however, several questions. Although cutting-edge methodologies have allowed a notable increase in knowledge of the last foragers and first farmers in Iberia, neither ethnographic nor ethno-historical knowledge have been assessed in the study of Early Holocene populations. The aim of our work is to create new knowledge about those societies through a review of historical sources. In combination with cutting-edge geochemical analyses on faunal and humans remains, this might allow the development of new hypotheses. These approaches will grant a greater ethnographical perspective on coastal groups during the Mesolithic and Neolithic periods in the Iberian Peninsula. Despite previous studies, coastal populations still raise issues such as (1) the degree of coastal exploitation intensity after new food production patterns were adopted, (2) the reconstruction of both coastal exploitation and mobility patterns of the coastal peoples during the Mesolithic and Neolithic periods and (3) the definition of the diet of coastal groups during such times. Moreover, this work aims to establish a north-south comparison of the role played by the marine environment, considering similarities and differences between the various littoral locations. Archaeo-malacological analysis of ancient shellfish remains will be carried out and stable oxygen isotope analyses on marine mollusc shells will allow us to determine the season of capture of these food items in the different coastal regions. Geochemical analyses might also help to decipher the importance of marine resources in the human groups' diets, as well as the mobility of these groups. Stable carbon and nitrogen isotope analyses of bone collagen and human teeth will help to identify the origin of the ingested proteins. Finally, we also plan to applied strontium isotope analysis to reconstruct the movements of these human groups.

Updating knowledge on the distribution of freshwater molluscs in Singapore

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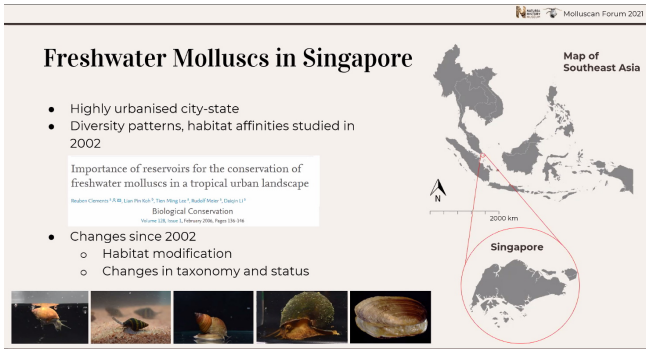
Freshwater molluscs are among the most diverse groups of macroinvertebrates in Southeast Asia. They are ecologically and economically important, but are also highly threatened and poorly studied. Specifically in Singapore, there has only been one comprehensive study of the diversity and habitat ecology of molluscs across various freshwater environments, conducted almost two decades ago. This previous study found that estuarine reservoirs had the highest molluscan richness, with area being the best predictor of molluscan richness. Since then, however, there have been several revisions to the taxonomy and status of local freshwater malacofauna. This could potentially undermine knowledge of the current diversity and distributional patterns of local freshwater molluscs and by extension, their conservation and management (e.g., spread of introduced species, key habitats as potential conservation zones). Our study therefore aims to provide updated information on the local distribution of freshwater molluscs and their general habitat affinities. This will be done through field surveys and an assessment of the variation in malacofaunal assemblages with environmental conditions of different habitat types, and how these associations have changed relative to the previous study. Molluscs and environmental parameters are sampled in the littoral zones along the banks of different habitat types (reservoirs, ponds, storm canals, and streams). Specimens collected are enumerated and identified morphologically to the lowest possible taxonomic level to investigate how the assemblages differ in abundance, richness and diversity. Sampling completeness for each habitat type will subsequently be assessed using rarefaction and extrapolation sampling curves. ANOVA tests will be performed to test for differences in species richness, abundance and diversity between habitat types. Lastly, a canonical correspondence analysis will determine correlations between environmental variables and mollusc assemblages, and linear regression for site variables influencing molluscan diversity. Altogether, this ongoing project serves as an important updated baseline study, providing a preliminary overview of the possible diversity patterns of local fresh water molluscs. We hope to reinforce previous findings of key environmental parameters, or highlight new considerations, facilitating future conservation efforts.



Land snail diversity in karst ecosystems of Samar Island in the Philippines

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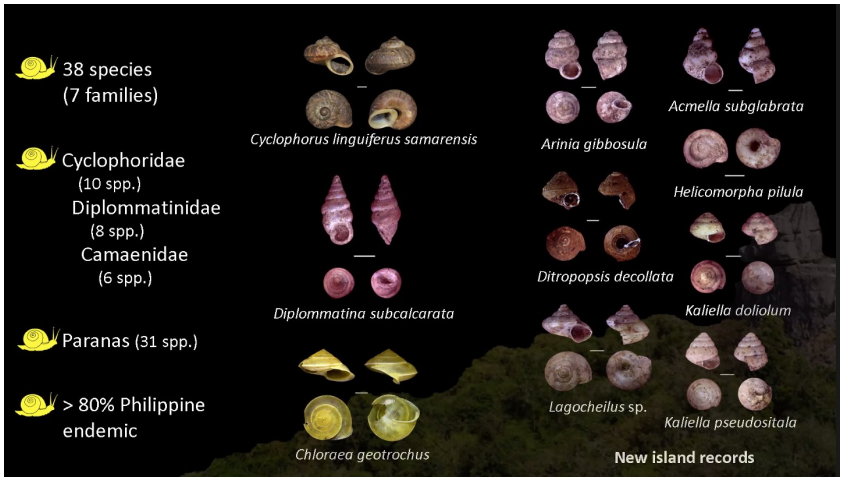

Limestone ecosystems in the Philippines have a huge information gap regarding malacofaunal diversity despite their high potential for discovery of new species. There is also limited taxonomic data on land snails, most of which are based on literature from previous centuries and focussed only on a few major islands. To address this, terrestrial snails were collected from selected karst forests in four municipalities (Basey, Guiuan, Paranas, and Taft) of Samar Island, Philippines. An opportunistic method was used to sample macro-snails (> 5mm). For micro-snails (< 5mm), soil samples (~5 L) were collected from random points within each site and were dried before passing through a series of cascade sieving using 3-, 2-, and 1 mm metal mesh. Segregated shells were then examined under a stereomicroscope for identification. A total of 38 species from seven families (Achatinidae, Assimineidae, Camaenidae, Chronidae, Cyclophoridae, Diplommatinidae, and Trochomorphidae) were collected from all areas, the majority of which are endemic to the Philippines. The most speciose family was the Cyclophoridae with 10 spp. followed by Diplommatinidae and Camaenidae with 8 and 6 species respectively. From the four sites, Paranas was found to have the highest number of species (31). Notable records include an island endemic species (*Diplommatina subcalcarata*), an endemic subspecies (*Cyclophorus linguiferus samarensis*), and seven new distribution records of micro-snails namely: *Arinia gibbosula*, *Helicomorpha pulila*, *Acmella subglabrata*, *Ditropopsis decollata*, *Kaliella dolliolum*, *K. pseudositala*, and *Lagocheilus* sp. Unidentified species are still subjected to further morphological identification. Novel species and subspecies may be discovered with further analyses and intensive sampling of the island. Nonetheless, this is a new report on land snails of Samar Island since the late 19th and early 20th centuries, providing new information on Philippine terrestrial malacology.

A global DNA barcode library for Solenogastres (Mollusca, Aplacophora)

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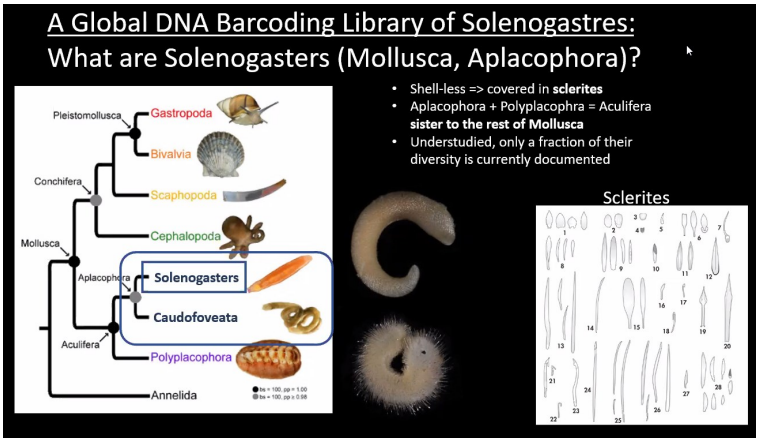

Solenogastres (Mollusca, Aplacophora) species have been described from all around the world. Many regions and depths are completely unexplored with respect to this group however, and new species are still being discovered from even relatively well-known areas. Therefore, the true extent of their diversity is thought to be many times more than what is currently described. Classical identification of solenogasters generally requires the work of a trained specialist and the time-consuming technique of histology. The development of new tools is essential to speed their identification. For many taxa, DNA barcoding has been shown to be effective for identifying specimens to even the species level. However, the vast majority of solenogaster taxa have been described from only morphological features, and too few aplacophoran barcodes are currently available for DNA-based identification to even higher-level taxonomic groups. With this project, we aim to develop a broadly sampled DNA barcode library for solenogasters for the mitochondrial genes cytochrome c oxidase subunit I (COI), and 16S rRNA (16S). We will connect morphological and molecular data by first creating phylogenetic trees based on the barcoding data and thereafter using histology to identify unknown specimens. Here we provide 168 new sequences for COI and 90 new sequences for 16S. Using these data, we conducted phylogenetic analyses and found that COI is a surprisingly informative molecular marker for Solenogastres, with most nodes (both deep and shallow) in the resulting tree being strongly supported. Taken together, these results should be useful for non-experts seeking to identify aplacophorans using molecular tools in the future.

Larval trematodes (Digenea) of planorbid snails (Gastropoda: Pulmonata) in Poland

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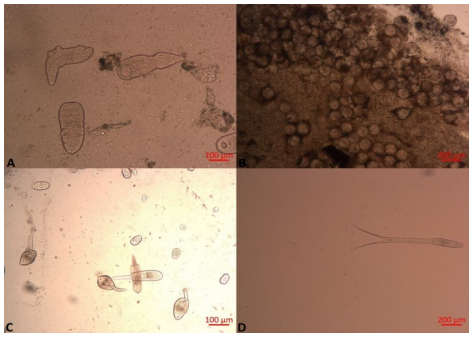
Freshwater snails from the family Planorbidae play a key role in the life cycle of digenetic trematodes and release a large number of infective larvae. Some members of this family (e.g. *Planorbarius corneus*, *Planorbis planorbis* or *Anisus leucostomus*) are extremely drought-resistant and this can be significant in transmission of those parasites that can adapt to surviving inside their snail hosts during unfavorable periods. On the other hand, infected individuals are usually killed by the parasites. The main reason for our interest in planorbids is their participation in transmission parasites of veterinary, medical or economic importance. For example, *Bilharziella polonica* is a bird schistosome species which is thought to cause cercarial dermatitis (swimmer's itch). Another example is the cercariae of *Tylodelphys* spp. which are an ecological factor of tylodelphysosis in fish populations. *Tylodelphys* spp. may cause blindness of fishes and increase their susceptibility to predation. The aim of my work was to determine the biodiversity of digenean larvae in the planorbid populations from Jezioro Czaplino – one of the Polish lakes in Warmian-Masurian Voivodeship region. 363 snails from 5 species of Planorbidae were examined for the presence of larvae. The overall digenean prevalence was 26.44%. Four parasite species were found, as well as unidentified xifidiocercariae and metacercarie, sporocysts or rediae with immature cercariae. The dominant species found as cercariae were *Asymphylodora* sp. and *Rubenstrema exasperatum* / *Neoglyphe locellus*. The most infected hosts were *Gyraulus* sp. (36,36%), *Planorbis carinatus* (29.70%) and *Planorbarius corneus* (22.64%). Most of the trematode species reported mature in fishes and are widely distributed in other parts of Europe. These studies of trematode prevalence in planorbid populations will be continued. Further research will focus on small species whose parasite-fauna is still poorly understood.



A – Asymphylodora sp., B - intense invasion of metacercariae, C – xyfidiocercariae, D - Tylodelphys

Trial of intertidal and subtidal structures to mitigate saltmarsh erosion and increase bivalve settlement rates within the Hamble estuary

Charlie Mountain[1], Joanne Preston[1], Gordon Watson[1], Federica Raggazola[1] & Tim Sykes[2]

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Saltmarsh and oyster reefs provide ecosystem services such as coastal protection and biodiversity enhancement for species upon which humans depend. Outside the UK, it has been observed that fish and invertebrate production can be enhanced by each of these habitats, and that sediment stability can be enhanced by restored oyster reefs, thereby mitigating shoreline erosion. However, a combined approach to restoring and monitoring both of these habitat types is yet to be developed in the UK, particularly in the Solent, where small scale restoration of both salt marsh and oyster habitats is well underway and gaining traction. The project aims to trial structures designed for saltmarsh and bivalve restoration in the intertidal zone, monitoring the effect on biodiversity and sedimentation, as well as the effect of tidal height on *Ostrea edulis* settlement. Eventually we hope to develop a framework for future integrated restoration practice. Two main experiments will be conducted to test the ability of these structures to restore coastal habitats; (1) observing the saltmarsh and ecosystem response to structures placed at immediate shoreline edge, and (2) *O. edulis* / general bivalve settlement on cultch at varying heights along the intertidal. Settlement experiments will involve monitoring of reef areal dimensions, reef height, live oyster density, and bivalve size-frequency distribution. The saltmarsh experiment metrics monitored are more extensive, including biodiversity of saltmarsh, invertebrate, fish, and water bird species, shoreline change, wave attenuation, water quality, carbon system, and sediment analysis. So far, we have deploymed both saltmarsh and oyster related structures, and have collected baseline data for the metrics outlined above. Drone flyovers of sites have also been conducted. The following will be discussed once appropriate data have been collected; influence of structures on biodiversity and shoreline in terms of loss/gain/height profile, sediment changes induced by structures and wave attenuating properties of structures, optimal tidal height to encourage native oyster settlement, the importance of stakeholder engagement and implications for future trials/larger scale integrated projects.

Dynamics of seminal fluid replenishment after mating

Yvonne Kortsmit[1,2], Janine Mariën[1], Joris M. Koene[1]&Yumi Nakadera[1]

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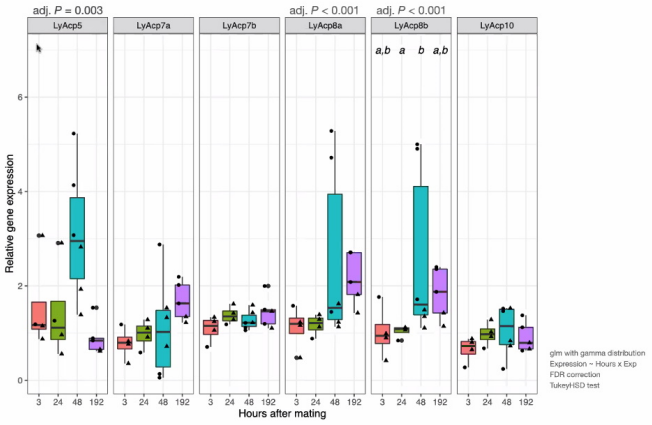
Copulation in *L. stagnalis*

Seminal fluid proteins (SFPs) play vital roles in optimizing reproductive success in diverse animals. Underlining their significance, SFP production and transfer are highly plastic, for example - depending on the presence of rivals or mating status of partners. Surprisingly little is known about replenishing SFPs after mating however. It is especially relevant in multiple mating species, as they would continuously produce and use SFPs throughout their reproductive life. Here we examined the expression pattern of SFP genes after mating in the great pond snail, *Lymnaea stagnalis*. Our results show that three out of the six SFP genes investigated here were up-regulated after mating, indicating that *L. stagnalis* replenishes seminal fluid in a protein-specific manner. In addition, we suggest that SFP replenishment is plastic depending on the mating history of female-acting snails. Our results shed light on unexplored aspects of SFP replenishment, thereby expanding the understanding of reproductive strategies in animals.



- *LyAcp8b* increased expression 48h after mating
- 3 out of 6 genes did not show any sign of expression change after mating
- Expression at 192h after mating is not as low as expected, while prostate is fully replenished

Land snail faunas of the Bobiri Forest Reserve and Butterfly Sanctuary, Ghana and its implications for conservation

Mac Elikem Nutsuakor [1], Bright O. Kankam[2], Emmanuel Danquah[1] and William Oduro[1]

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This paper presents the first land snails species checklist for the Bobiri Forest Reserve and Butterfly Sanctuary (BFRBS). This reserve and sanctuary has been the subject of many systematic studies of invertebrate groups but with little or no attention to land-snails. Sampling was carried out in 20 randomly selected 400m² plots using a combination of direct searching (2 person- hours) and fixed-volume litter- sieving techniques. The results were that 462 individuals belonging to 35 species of 23 genera and 8 families of pulmonate molluscs were documented. A few (3) species were abundant, few rare (9), while most were intermediate (13) in abundance. Families Streptexidae 12 (34.2%) and Subulinidae 10 (28.57%) were the most species-rich families and contributed 22 (62.85%) of species richness. Overall, the area has a relatively high species richness and diversity compared with other related studies in the west African sub-region though most of the species could not be identified to the species level because of insufficient reference specimen. Given the fact that the Ghanain rainforest is under enormous anthropogenic pressures such as commercial logging and deforestation for plantation agriculture, the high number of species and high heterogeneity observed are amongst some of the factors in favour of protection of this forest. A great deal therefore remains to be discovered to complete our understanding of the land snail faunas, not only in documenting species diversity, but also by investigating molluscan ecology, evolution and population dynamism for proper conservation planning and management.

Streptexidae

Subulinidae

Phenotypic characterization of digestive gland cells of *Biomphalaria glabrata* (Mollusca: Gastropoda) susceptible and partially resistant to *Schistosoma mansoni* (Trematoda: Digenea)

Cristhiane Oliveira da Fonseca[1], Andréa Teixeira- Carvalho[2], Lângia Colli Montresor[1,3] Bruna Estefânia Diniz Frias[2], Paulo Marcos Zech Coelho[4] & Roberta Lima Caldeira[1]

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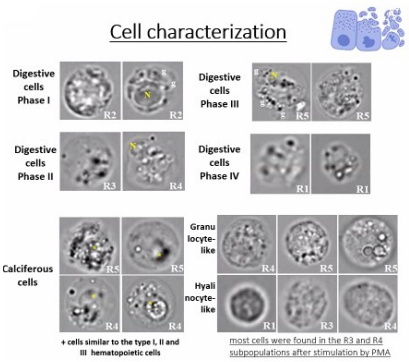

Profiles of cell populations present in digestive gland pools (N=36/sample) of susceptible (BB-02, left) and partially resistant (BS-16, right) *Biomphalaria glabrata* in the presence of medium (upper part) and after stimulation *in vitro* with PMA (lower part). The graphs represent the selection of subpopulations of interest, and to the right are representative images of cells observed in each of the regions. SSC- side scater, related to the lateral scattering of light, which generates information about cellular complexity or granularity. Images in 600X magnification.

The freshwater snailspecies *Biomphalaria glabrata* (Say, 1818) is important in the transmission, in the Americas, of the parasite *Schistosoma mansoni* Sambon, 1907 which causes schistosomiasis. The disease is considered a major public health problem and mainly affects populations with poor sanitary conditions. Since the parasite must pass through *Biomphalaria* snails (Preston, 1910), the control of these invertebrate hosts is an important part of strategies for the elimination of the disease. Therefore, studies that seek a better understanding of the invertebrate host-parasite interactions are important. In this context, it was observed that digestive gland (DG) cells of *Biomphalaria tenagophila* Taim (Orbigny, 1835), a population of snail completely resistant to *S. mansoni*, were able to destroy the parasite after 24 hours of *in vitro* interaction. In other studies, resistant snail cells were differentially labelled with the lectin WGA (from wheat germ) and PNA (from peanuts). It was possible that these lectins were involved in the immune responses of the snails. The aim of this study was, therefore, to phenotypically characterize the cells present in the DG of partially resistant *B. glabrata* (BS-16 – from Salvador/Brazil) and highly susceptible *B. glabrata* (BB-02 – from Belo Horizonte/Brazil). DG cells from snails BS-16 and BB-02 were recovered by a series of mechanical and enzymatic digestions, Through image flow cytometry (ImageStream Mark II), the cells were morphologically characterized. The cells were then analyzed in the absence (control) and after *in vitro* stimulation with phorbol myristic acid (PMA) and labeled by the lectins PNA-FITC and WGA-AlexaFluor 555. Five cell subpopulations (R1-R5) were characterized by cytometry, with a predominance of smaller diameter cells. Digestive cells in four stages of maturation, and calciferous cells, were identified, in addition to cells similar to those of *Biomphalaria* defense but at a lower frequency. Cells from all analyzed groups exhibited membrane carbohydrates binding to PNA and WGA in practically the entire cell area. After activation by PMA, there were no significant differences in cell composition and membrane carbohydrate. Further analysis using DG cells from snails previously exposed to the parasite may result in the identification of significant morphological and functional differences between the analyzed snail populations.

Snails, forest and people: ecology and conservation of terrestrial molluscs in a tropical island

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Habitat loss and the introduction of exotic species are the main drivers of change in ecosystems worldwide, especially on islands. Land molluscs are one of the animal groups with the highest numbers of known anthropogenic extinctions. Land snails endemic to oceanic islands have been most affected. São Tomé Island, in Central Africa, hosts a high proportion of endemic species in many taxonomic groups, and the terrestrial Mollusca group is particularly distinctive, with 59 species, of which 44% are single-island endemics. In this presentation, I describe how I propose to explore the links between land molluscs, their habitats and people living in São Tomé Island, with a focus on the effects of habitat modification and exotic species, which represent key threats to endemic species. Little is known about the malacofauna of São Tomé and not knowing the consequences of human activities makes it hard to establish conservation priorities for this group. Giant land snails, in particular, have an additional importance among people in the island. One introduced species has important nutritional and economical value, highlighting the critical need to integrate the perspective of human populations in the management of exotic species for conservation.

Shell repair assays and *in vivo* haemocyte labelling methods to study molluscan biomineralization

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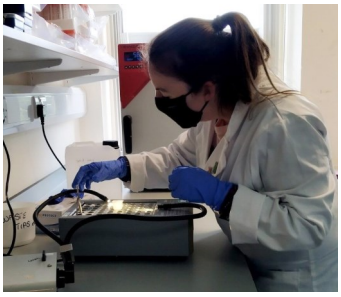
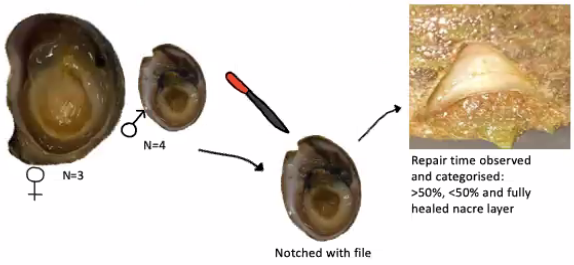


Embedding tissues samples into wax

Most molluscs have a shell but we have an incomplete understanding of the biomineralization process. Many studies investigating how molluscs build their shells have focussed on bivalves since they are a commercially important food source. In this study however, the Slipper Snail (*Crepidula fornicata*) was used as a model system to test the longstanding hypothesis that haemocyte cells participate in biomineralization. *C. fornicata* is invasive to the UK and is famous as an embryological model system but, to date, has not been used to investigate biomineralization. *C. fornicata* is a good model system because 1-celled embryos are easy to obtain and microinject, and adult animals can be kept in the laboratory. The aim of this study was to create standardised methods for shell-damage repair experiments and labelling haemocytes *in vivo*. To test if there was a difference in shell repair capacity between male and female slipper snails, shells were notched using a file and repair time was observed and categorised. Males healed significantly faster than females. We next trialled a preliminary CM-Dil *in vivo* experiment to label haemocytes. CM-Dil was injected into the foot and was effective in labelling haemocytes, which retained their label. These hemocytes circulated in the snail and were detected in the mantle. In order to make meaningful comparisons across species and elucidate the evolutionary patterns in biomineralization and shell repair, a standardised assay to stimulate biomineralization should be developed that takes into account sex, life history, spatial location and type of damage. In addition, we suggest that CM-Dil could be a useful label to track and visual haemocyte activity *in vivo* via histology and live imaging.

Female and Male Healing Rate Experiment



Macro– land snail diversity in selected forest fragments of Leyte Island, Philippines

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The diversity of land snails in Leyte Island has not been examined in the past few years. To address this, an inventory of macro- land snails in selected forest fragments of Leyte was conducted. A total of 120 quadrats (5x5 m) were set in three sites (Inopacan, Baybay, and Maasin). A total of 592 individuals belonging to 22 species were identified, with Maasin having the highest species counts (21). The macro land snail assemblage was dominated by endemic species of eupulmonates (Order Stylommatophora) and caenogastropods (Order Architaenioglossa). *Lisachatina fulica*, an invasive land snail, was also documented in all sites. Among eupulmonates, Family Camaenidae had the highest species richness (10) , followed by Trocomorphidae and Achatinidae with two species each, and Helicarionidae with one species. For caenogastropods, all seven species were in the Family Cyclophoridae. *Cyclophorus appenidiculatus* was the most abundant, representing 9.97% of the total number of individuals. Inopacan had the highest index of diversity (H'=2.74), followed by Maasin (H'=2.23) and Baybay (H'=1.98). Species accumulation curves revealed a β-dominated community while sampling efficiency using completeness ratio (CR) was for Maasin (1.00), Inopacan (0.99), and for Baybay was adequate. This study provided an updated list of land snail species in the fragmented forests of Leyte which is important in local malacofaunal conservation and management.

Amphidromus - Leyte

Geotrocus—Maasin Forest Park

Species composition of cultured Teredinidae (Bivalvia) at Verde Island, Batangas, Philippines

Rio Carla E. Del Rosario, Rhenalyn V. Bo, Thea Elizabeth V. Merjudio, Ercel John M. Paracale & Ruthela P. Payawal

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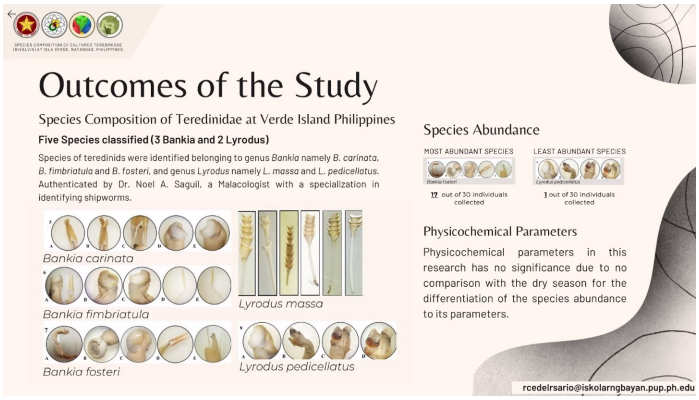

The Teredinidae is a family of marine bivalve molusks commonly known as Shipworms. They are unique for their worm-like appearance and wood-burrowing habits. Shipworms are responsible for the fragmentation and breakdown of wood submerged in water. This process is ecologically important as it makes the turnover of organic material easy for other organisms. This activity causes extensive damage to the wood structures necessary for economy and daily life activity. Shipworms are widely distributed across the world but there are still limited studies with regard to their geographic range and distribution. To date, there are currently 17 known genera of the Teredinidae family, including approximately 65 species. It is important to know the current species composition of the Teredinidae family in the Philippines, specifically in Isla Verde, Batangas, as it will serve as a baseline study for researchers who are pursuing studies of the species. In addition, there is an increasing interest in shipworm species, as recent studies have discovered a rich symbiotic bacterial community living in the gills of the animal. This bacterial community is responsible for the production of wood-degrading enzymes that are now being used for various drug development. Our study provides information on the occurrence of shipworms on the island of Isla Verde in Batangas. In this study, 15 logs of *Swietenia macrophylla* (Mahogany) were used as a culture medium. The logs were submerged for 15 weeks at five different sites along the shore of Isla Verde. Physicochemical parameters (temperature, conductivity, pH) were measured during the culturing and collection period. A total of five species from two genera, *Bankia* and *Lyrodus*, were collected. *B. carinata*, *L. massa*, and *L. pedicellatus* were previously recorded to be present in the Philippines in 1968 and 1994 surveys. *B. fimbriatula* and *B. fosteri* are two new species records in the Philippines. *B. fosteri* was the dominant species in the survey.

Shell palaeoproteomics: characterisation of ancient proteins preserved in archaeological mollusc shells

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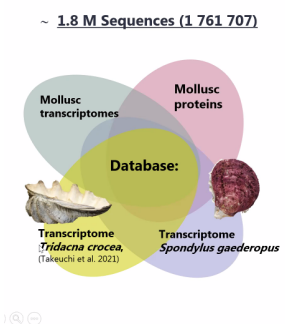
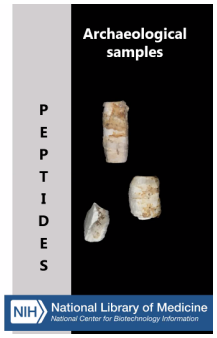
Mollusc shells possess exceptional material properties and aesthetic features which have been highly valued since prehistoric times, e.g. for making tools or shell jewellery. Archaeological shell ornaments are widespread, portable and prized for the insight they give into behaviour and exchange but the identification of shell type used is often dubious, as many are found heavily worked and/or degraded. Here I present our recent application of palaeoproteomics to intracrystalline shell proteins, extracted from ~9 000 year-old shell ornaments from Ba'ja settlement in southern Jordan. We used these proteins as a source of molecular information to determine their biological origin. The application of palaeoproteomics to mollusc shells is grounded in decades of expertise in biomineralization (known as 'shellomics') and amino acid racemization research. However, shell palaeoproteomics poses many challenges such as (1) rapid but not well-known evolutionary patterns of 'shellomes', (2) scarcity of genomics data for different species and (3) limited knowledge about the diagenetic stability of shell proteins. Shellomics data are particularly lacking for species that are not of commercial importance, but were widely used in prehistory, such as *Spondylus, Tridacna, Cerastoderma, Glycymeris, Unio* among others. I present insights into advancing the methodological approaches for shell palaeoproteomics and the study of shell protein stability to predict survival in the fossil record. Our research demonstrates that ancient mollusc shell proteins can help to address far-reaching archaeological and palaeontological questions.





Behavioural and physiological adaptations to thermal stress in intertidal limpets: *Patelloida saccharina* (Patellogastropoda) and *Siphonaria guamensis* (Heterobranchia) from Southern Thailand

Suphatsara Sangphueak[1], Gray A. Williams[2] & Kringpaka Wangkulangkul[1]

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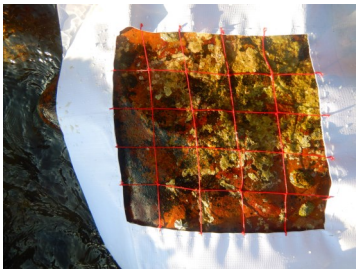
Two common grazers that co-occur on rocky shore of southern Thailand; *Patelloida saccharina* Linnaeus, 1758 and *Siphonaria guamensis* Quoy and Gaimard, 1833

Temperature is an abiotic factor that plays a key role in regulating the distribution and abundance of tropical intertidal organisms. These organisms exhibit several behavioural and physiological adaptations to cope with thermal stress during exposure to an extremely hot environment and to increase survivorship until the next tidal immersion. This study aims to elucidate whether there are variations in vertical distribution patterns, rates of water loss and cardiac performance when facing high temperature of two limpets, *Patelloida saccharina* (Patellogastropoda) and *Siphonaria guamensis* (Heterobranchia). They are common grazers that co-occur on rocky shore of southern Thailand. Results suggested that *S. guamensis* inhabited the high shore while *P. saccharina* were found lower on the shore where temperature was generally cooler. At 50 °C, the rate of water loss of *S. guamensis*, even inhabiting a high zone, was higher than *P. saccharina*. *S. guamensis* died at higher temperature (49.0±0.56 °C) than *P. saccharina* (45.8±0.45°C). In addition, it seems from our study that metabolic depression occurred in heart rate traces of both species in this study. Understanding physiological processes might help explain different vertical distribution patterns on shores and offers some insights into the biology of these two distinct groups of gastropods that co-exist on tropical intertidal rocky shores.



A plastic sheet quadrat was laid on the contour of the rock before

Novel insights into habitat suitability for Amazonian freshwater mussels linked with hydraulic and landscape drivers

Diego Simeone, Claudia Helena Tagliaro & Colin Robert Beasley

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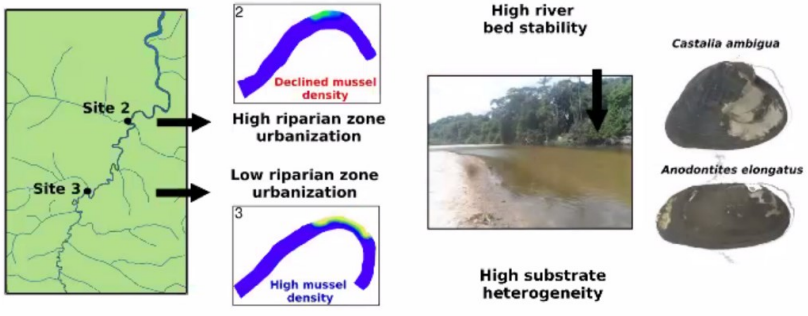
Diego Simeone conducting mussel fieldwork in the Caeté river, Bragança, Pará, Brazil.

Novel insights into habitat suitability for two Unionida freshwater mussels, *Castalia ambigua* Lamarck, 1819 (Hyriidae) and *Anodontites elongatus* (Swainson, 1823) (Mycetopodidae), are presented on the basis of hydraulic variables linked with the riverbed in six 500-m reaches in an eastern Amazonian river basin. Within the reaches, there was strong habitat heterogeneity in hydrodynamics and substrate composition. In addition, we investigated stressors based on landscape modification that are associated with declines in mussel density. We measured hydraulic variables for each 500-m reach, and landscape stressors at two spatial scales (subcatchment and riparian buffer forest). We used the Random Forest algorithm, a tree-based model, to predict the hydraulic variables linked with habitat suitability for mussels, and to predict which landscape stressors were most closely associated with mussel density decline. Both mussel species were linked with low substrate heterogeneity and greater riverbed stability (low Froude and Reynolds numbers), especially at high flow (low stream power). Different sediment grain-size preferences were observed between mussel species: *C. ambigua* was associated with medium sand and *A. elongatus* with medium and fine sand. Declines in mussel density were associated with modifications linked to urbanization at small scales (riparian buffer forest), especially with percent of, and distance from, rural settlements, distance to the nearest street, and road density. In summary, the high variance explained in both hydraulic and landscape models indicated high predictive power, suggesting that our findings may be extrapolated and used as a baseline to test hypotheses of habitat suitability in other Amazonian rivers for *C. ambigua* and *A. elongatus* and also for other freshwater mussel species. Our results highlight the urgent need for aquatic habitat conservation to maintain sheltered habitats during high flow as well as mitigate the effects of landscape modifications at the riparian buffer scale, both of which are important for maintaining dense mussel populations and habitat quality.



Habitat suitability drivers for the Amazonian freshwater mussels *Castalia ambigua* and *Anodontites elongatus*.

In vivo labelling of molluscan haemocytes: do haemocytes have a functional role in biomineralization?

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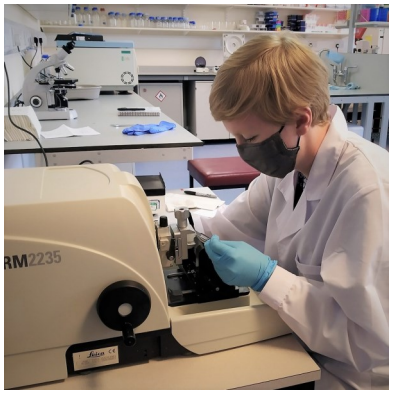

Shelled marine molluscs have two main defences: their shells, as a calcareous external defence, and their immune system, mainly comprised of haemocyte cells. It has been hypothesised that haemocytes may have additional capabilities outside immune function, specifically aiding in the shell biomineralization process. Yet, to date, the mechanisms by which haemocytes participate in biomineralization have not been functionally characterised. To the best of our knowledge, no *in vivo* investigations, such as live imaging or systematic histological examination of the mantle tissue during repair, have been conducted. To investigate whether haemocytes mediate shell biomineralization, this study aimed to develop a method to label and track the circulating haemocytes of the slipper snail, *Crepidula fornicata, in vivo* using a fluorescent dye, CM-DiI. Once the candidacy of CM- DiI to exclusively label circulating haemocytes was confirmed, it was applied to a series of shell-notching experiments to provide preliminary insight on the number haemocytes found within the mantle tissue adjacent to newly damaged and actively healing shells. These experiments aimed to differentiate the involvement of haemocytes in shell biomineralization from their known roles in immunity, within the mantle tissues and at the periostracal groove. The number of labelled haemocytes in the mantle tissue adjacent to the shell injury did not significantly increase in the first 24-hours. However, 13 days after injury, once the shell-notch began to re-mineralise, there were significantly more labelled haemocytes in the mantle tissues adjacent to the site of shell healing than in tissues distanced from the shell-notch ($P = 0.02$), supporting the hypothesis that haemocytes may have a functional role in biomineralization. The future methodological developments required and potential application of *in vivo* haemocyte labelling with CM-DiI was discussed.

Fine-tuned transcriptional regulation underpins adaptive thermal plasticity of intertidal snails in tropical extreme environments

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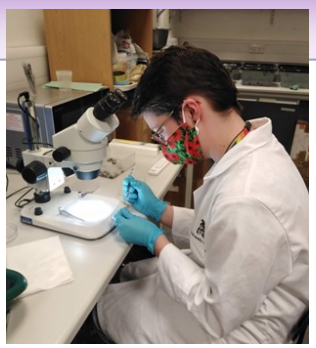
The tropical marine intertidal snail *Echinolittorina malaccana* is known for its extraordinary thermal resilience. Being the dominant species inhabiting the high shore region, individuals are able to tolerate extreme high temperatures in summer day time. They could enter a special physiological state called *thermal insensitive metabolism,* which allows them to maintain a relatively low metabolic rate under a range of high temperatures. As in winter, this species could still survive well. This study is an attempt to adopt a functional transcriptomic approach to reveal the physiological mechanism behind such high thermal plasticity to the broad thermal range. mRNA of the individuals exposed to high and low temperatures was extracted and sequenced for analysis of the physiological pathways. The expression patterns in the high temperature and low temperature treatment groups revealed distinct pathways matching their physiological responses under different thermal conditions. The results suggest that both of the extreme temperatures are unfavourable to the species, despite their high thermal tolerance. The tolerance to high temperature of *E. malaccana* and low damage by low temperature above freezing point may account for the high thermal plasticity of the species. Limitations of the adaptation mechanisms were suggested. Details and implications of the outcome were discussed.

DNA extraction in progress

Reports on research funded by the Malacological Society of London

The immunological response of a gastropod mollusc to infection with a compatible trematode parasite



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Introduction

Gastropod molluscs and digenetic trematode parasites are intrinsically linked with compatible snails needed for specific trematodes to complete their life cycle (Lockyer *et al.*, 2004). One example is the relationship between *Fasciola hepatica* and its snail hosts of the Lymnaeid family when, after infection, it is able to produce hundreds of progeny that cause the widespread, zoonotic, and economically draining disease, fascioliasis, in ruminants (Taylor *et al.*, 2016). The immune system of the snail host consists mainly of white blood cell homologues, haemocytes, and other immune mediators such as reactive oxygen species and proteins (Al-Khalaifah & Al-Nasser, 2016),. However the parasite is still able to survive in its host and avoid attack. My research aimed to investigate the immunological effect of *F. hepatica* infection on a compatible snail host, *Lymnaea stagnalis* (Kendall, 1949; Vignoles *et al.,* 2016; Yakhchali *et al.,* 2015). The main host of *F. hepatica* globally is *Galba truncatula*; however this species is difficult to obtain, examine, and culture (Charlier *et al.*, 2014; Moazeni *et al.*, 2018), meaning the model organism *L. stagnalis* was chosen instead (Fodor *et al.*, 2020; Kuroda & Abe, 2020).

Methods and materials

A colony of *L. stagnalis* was compiled from several online suppliers and randomly split into four treatment groups (Figure 1). The first was infected with live, newly attached *F. hepatica* larvae via injection. The second was infected with dead *F. hepatica* or eggs. The third was injected with only distilled water, and the fourth group underwent no intervention. Three replicates of each treatment were monitored for 14 days and fed lettuce *ad lib*, after which their haemolymph was extracted (Sminia, 1972), and pooled into two replicates for each of the 12 groups (three per treatment). The immune assays carried out included haemocyte counts using disposable haemocytometers, and total haemolymph protein measured against a BSA standard measured at 600nm using a plate reader. Phenoloxidase levels were quantified through the addition of chymotrypsin and dopamine measured at 492nm, and levels of nitrate and nitrite were measured using the Griess reaction and colorimetric measurement at 570nm. Finally, clearance zones in *Micrococcus lysodeitikus*-laced agar were used to determine levels of lysozymes against a hen egg white lysozyme standard. Statistical analysis was carried out using R (v1.2.5019) (R Core Team, 2021), with linear models (Signorell, 2021) and survival analysis (Kassambara *et al.*, 2021; Therneau, 2021; Therneau & Grambsch, 2000) employed to determine the effect of treatment on various immunological indicators.

Results

There was no significant effect of treatment on egg masses laid by snail per day ($F_{3,8}$=0.1642, P=0.9175, R^2=5.8%), haemocyte count ($F_{3,44}$=0.8442, P=0.4771, R^2=5.4%), nitrite levels ($F_{3,44}$=0.9227, P=0.4378, R^2=5.9%), or surviving individuals (P=0.104) (Figure 1). However, haemolymph protein ($F_{3,44}$=8.924, P<0.001, R^2 37.8%) and phenoloxidase levels ($F_{3,44}$=5.396, P=0.003, R^2=26.9%) did significantly vary across treatments, though there was no link between the level of phenoloxidase per mg of protein ($F_{3,44}$= 1.499, P=0.2279, R^2= 9.3%) and treatment (Figure 2). The starting size of the snails significantly differed between the treatments, despite them having been randomly distributed ($F_{3,175}$=4.907, P=0.003, R^2=7.8%). The latter low R^2 score indicates, however, that this variation explains little of the difference between treatment. Unfortunately, no results were obtained for the nitrate and lysozyme assays. The standard failed for the former, and no clearance zones were seen in the samples for the latter

Discussion

The lack of a significant difference in haemocyte count and nitrite levels may have been due to the snails having been left too long before haemolymph extraction and assaying. Previous studies which had noted differences in haemocyte count (Alba *et al.,* 2020; Barçante *et al*., 2012; Martin-Souza *et al.,* 2009; Russo & Lagadic, 2000) and nitrite levels (Mendes *et al.,* 2020; Zahoor *et al*., 2009) tested for this at an earlier time post-infection. The opposite may be true for the number of eggs laid, with the parasite not yet affecting the snail's reproductive organs (Meier & Meier-Brook, 1981; Serbina, 2015; Wilson & Denison, 1980). In addition, no difference in survival rate was observed between treatments, supporting the idea that it would be unwise for a parasite to actively reduce the longevity of its host, however this effect may depend on age at, and level of, infection (Sorensen & Minchella, 2001).

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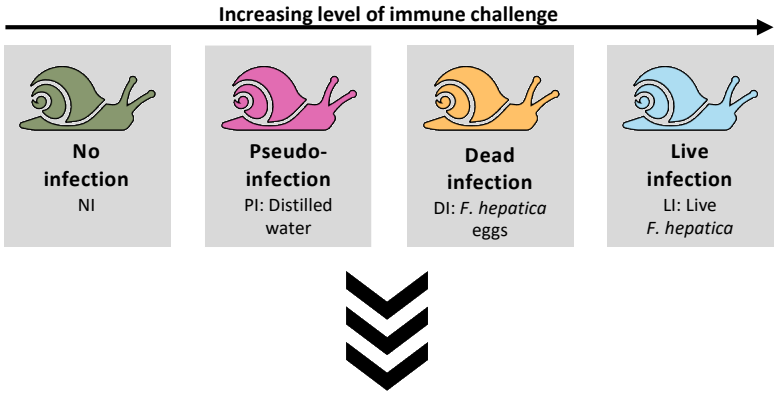

Haemocyte count	Haemolymph protein	Phenoloxidase (PO)	Nitric oxide (NO)	Eggs laid	Survival
Phagocytosis and production of immune mediators (e.g. PO, Nitrite)	Mainly found as haemocyanin, but also include lectins and FREPs (antibody homologues)	Exists as proPO which is converted to PO – involved in production of melanin and toxic intermediates	Nitrite and nitrate measured as a proxy of NO levels which is produced on infection with a pathogen	No effect of treatment on number of egg masses laid per snail per day	No difference in longevity of snails between treatment types Highest in **NI**, lowest in **LI**
No effect of treatment on haemocyte count Lowest in **NI**, highest in **LI**	Decreasing with increased immune challenge (in the order **NI**, **PI**, **DI**, **LI**)	Highest in **NI**, lowest in **PI**, intermediate **DI** and **LI**	No difference in nitrite levels by treatment		

Figure 1: Outcome of the immune assays carried out on each treatment group. A brief overview of the immunological activity of each assayed component is given compiled from Al-Khalaifah & Al-Nasser (2016), Barker (2001), Cerenius & Söderhäll (2004), Gordy *et al.* (2015), Petrova *et al.* (2016), Rivero (2006), Söderhäll & Cerenius (1998), Targett (1962). FREPs; fibrinogen-related proteins.

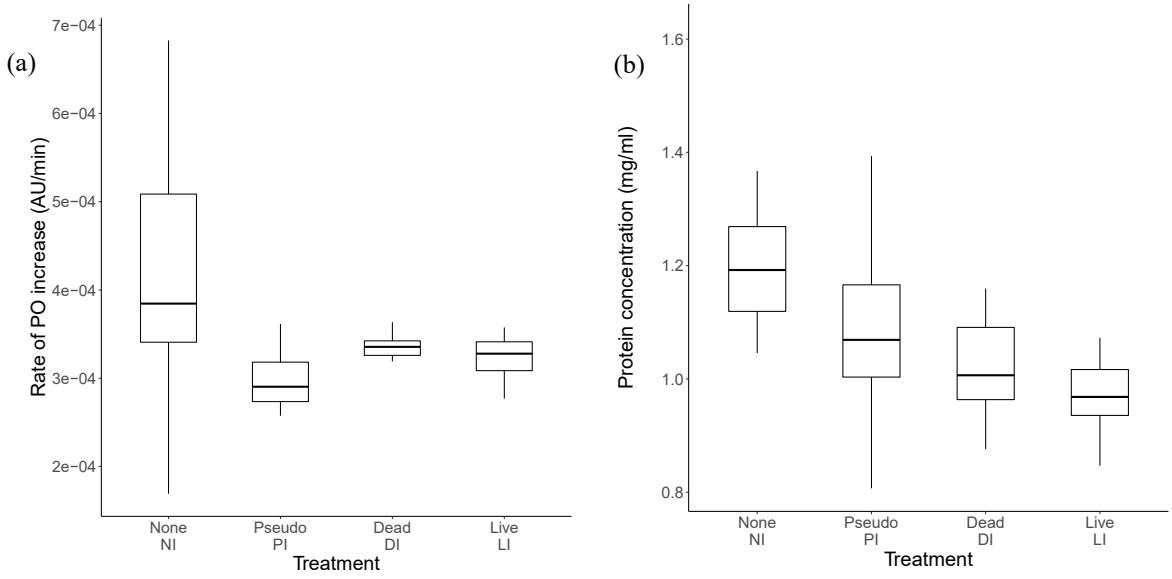

Figure 2: Rate of phenoloxidase increase (a) and concentration of haemolymph protein (b) by treatment. NI indicates no intervention (green), PI underwent pseudo-infection (pink), DI were infected with dead *F. hepatica* , and LI with live *F. hepatica*. AU; arbitrary units

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Phenoloxidase level and protein concentration differed significantly between treatments, with lower levels occurring in immune challenged snails. Previous research has shown both increases and decreases in phenoloxidase levels (Le Clec'h *et al*., 2016; Unlu &Ecki, 2021), and general increases in protein concentration (Suwannatrai *et al.,* 2016; Yaraghi *et al*., 2011), on parasite infection. However, phenoloxidase and haemocyte levels may have changed and returned to normal before haemolymph was taken, as suggested by the studies mentioned earlier. Haemocyte levels did not change, since their associated haemocyanin is the most prevalent protein in the haemolymph (Petrova *et al*., 2016; Targett, 1962). The alteration of other protein types, or general protein reallocation (Kanost, 2009), may have led to this decrease.

Conclusion

Further study in this field is essential, firstly to understand the intricate interactions between trematodes and snails, secondly to better understand their evolutionary biology and ecology and thirdly to control the pathogenic parasites they transmit (Esch & Fernandez, 1994; Lockyer *et al.,* 2004; Sorensen & Minchella, 2001). Focus on this area and interdisciplinary collaboration could eventually lead to the development of transgenic trematode-resistant snails (Lockyer *et al*., 2004), or highly specific snail population monitoring methods (Adema *et al.,* 2012; Żbikowska & Nowak, 2009). These methodologies could in turn keep track of the prevalence of trematode-associated disease transmission in areas at risk. This is key for the control of diseases plaguing both humans and animals worldwide (Shrestha *et al.,* 2020; WHO, 2017) whilst preserving the careful ecological balance of the snail population and habitat (Adema *et al*., 2012).

Acknowledgements

This work was carried out at the University of Lincoln as part of an MSc in Bio-veterinary Science by Research under the supervision of Dr Sheena Cotter and Dr Simon Clegg. Funds were provided by the Malacological Society of London through their Early Career Research Grant process.

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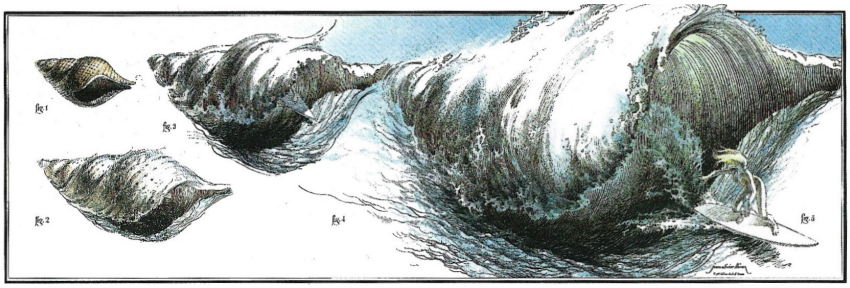
How surfboards are made



Drawn by Jean Olivier Heron

Assessing population genetic structure and diversity of commercially harvested octopuses by use of conservation genetics

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Introduction

Over 150 species of benthic octopuses have been described within the 'catch-all' *Octopus* genus (Family: Octopodidae) and yet many *Octopus* species remain unidentified due to morphological similarities. As global fish stocks decline due to climate change and overharvesting (Sauer *et al.*, 2019), octopus fisheries, are emerging worldwide. Global catch statistics place the 2018 global capture production of octopuses at 377,358 tonnes, worth US$1.78 billion in exports (FAO, 2020). Small-scale octopus fisheries are developing worldwide, including in Australia, despite limited information on the species harvested; this imposes a risk of over-harvesting genetically distinct individuals from any one species group. Several shallow-water species are known to be distributed in southeast Australia including *Octopus berrima* (Stranks & Norman, 1992), *Octopus pallidus* (Hoyle, 1885), *Macroctopus maorum* (Hutton, 1880), *Octopus kaurna* (Stranks, 1990), *Octopus tetricus* (Gould, 1852) and *Octopus bunurong* (Stranks, 1990). While it is known that *Octopus pallidus* is mainly harvested in Tasmania, there is no information on the species landed in the rest of southeast Australia, or how each species from different geographical populations varies genetically and morphometrically.

This unresolved taxonomy has resulted in the majority of species being placed in the *Octopus* genus, despite the genus being polyphyletic and being in need of major revision (Guzik, Norman & Crozier, 2005). Many species currently placed in this genus are similar in their structural morphology, making their identification, and the resolution of evolutionary relationships, even more challenging (Norman & Hochberg, 2005). The use of both molecular methods and morphometrics has however, allowed the tackling of unresolved taxa, as well as allowing the identification of cryptic speciation (Amor, Norman, Cameron, & Strugnell, 2014; Guerra *et al*., 2010).

Within species, there is limited information on how populations differ genetically and at what level gene flow occurs. Despite spanning vast geographical distances, the seascape is typically characterized by a lack of conspicuous physical barriers to gene flow, especially with oceanic currents contributing to population connectivity in larval organisms (Palumbi, 1994) . These barriers can also exist in other forms however, such as seasons, species-level differences, and environmental gradients. Octopuses adopt two different life history strategies that have a direct influence on population connectivity. They are either *holobenthic* or *merobenthic*. The former have large, well-developed hatchlings that immediately adopt a benthic lifestyle. The latter have small planktonic hatchlings that drift with the currents and settle later in life. Hence, holobenthic species typically have lower rates of dispersal and thus gene flow, resulting in higher levels of population structuring compared with merobenthic species (Higgins, Semmens, Doubleday, & Burridge, 2013). Since accurate depictions of population structuring have direct implications for fisheries management, our study employed next-generation sequencing technology, specifically double-digest restriction site-associated DNA sequencing (ddRADseq) that generates thousands of single nucleotide polymorphisms (SNPs). Compared with traditional markers like microsatellites and mitochondrial DNA, these genome-wide SNPs provide higher-resolution data, thereby allowing the detection of finer-scale population patterns.

Methods

Ten lines of hand-made octopus pots, weighted by bricks, were deployed at each of two sites, 145km apart along Gulf St Vincent (near Adelaide, South Australia). It appeared that these locations were not targeted by any commercial octopus fisheries, hence little is known about the octopus species present in this area, let alone population patterns. Within a month however, I received a stream of phone calls and text messages informing me that my buoys and bricks had been found 50km north of where the lines were set. All 20 lines had been deliberately cut off. As the waters around Victor Harbour are rough, and following local advice, we could not expect to find the lines that were now no longer attached to their bright orange buoy and weight. I hoped that lines may still be retrieved at the other site. With an experienced colleagues and coxswain, under the best conditions possible, all that could be retrieved was one line of empty pots; many lines had already drifted from the recorded GPS coordinates. Those that could be sighted were retrieved by use of a grappling hook from a depth of 15m. Options of SCUBA diving and free-diving for retrieval of pots was deemed unsafe due to the presence in the area of great white and bronze whaler sharks. At this point, funding and time was running out, so I decided to proceed with the lab. work using material from another project (from a local fisher) plus purchased ones from fishers in Victoria and Tasmania. I sequenced mitochondrial DNA cytochrome oxidase III (COIII) as well as genome-wide single nucleotide polymorphisms (SNPs) using a high-resolution method, double digest restriction site-associated DNA sequencing (ddRADseq).

View having deployed ten lines at Victor Harbour

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Results

Despite the lost equipment and missing data, we were able to identify two species that are commercially harvested by octopus fisheries in southeast Australia (5 sampling sites in western South Australia, 1 site eastern Victoria, and 1 site northern Tasmania). These comprised the Southern Keeled Octopus (*Octopus berrima*) and Pale Octopus (*Octopus pallidus*), both of which are holobenthic species. Both species could be differentiated using a principal component analysis (PCA) of eight and eleven morphological traits for females and males respectively, in which wet weight was the most reliable indicator in distinguishing the two species.

Discussion and Conclusion

This implies that local fishermen could document the species of their catches solely by using weight. In addition, while ddRADseq analyses are still ongoing, preliminary results show that gene flow occurs between Eely Point and Mount Dutton Bay, Tumby Bay and Port Lincoln, and Victoria and Tasmania. Collectively, this potentially means there are 3 metapopulations in *O. berrima* and 2 metapopulations in *O. pallidus*.

Acknowledgements

My team and I are thankful for financial support from the Malacological Society of London's Early Career Research Grant. Without it, we would still be left wondering which octopus species are being taken every year.

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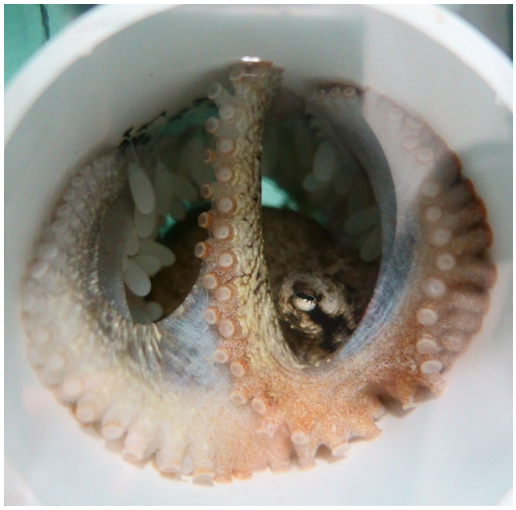
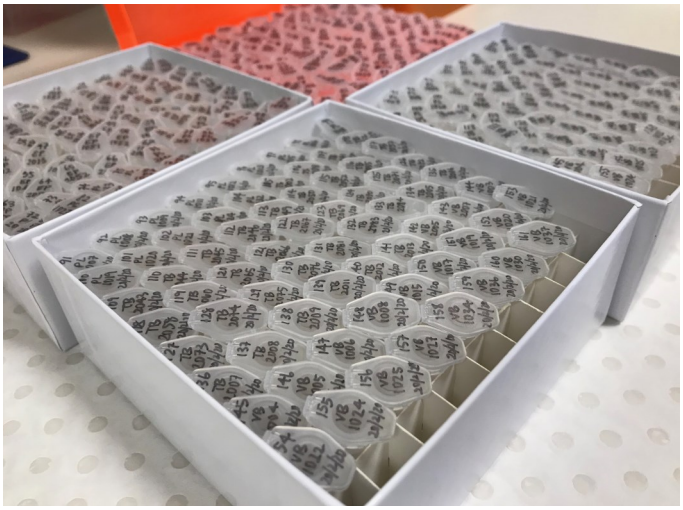


The type of catch that had been hoped for….



Prepared samples of octopus DNA

Molluscan fauna of mud volcanoes of the North Eastern Gulf of Cádiz: biodiversity and eco-biological effects

Olga Utrilla Ojeda
Department of Animal Biology, University of Málaga, Spain.
Email: olutrilla@gmail.com

Introduction

The Gulf of Cádiz (GoC) is an important seepage area located off southern Spain, where there are mud volcanoes and other sea-floor structures caused by fluid venting. This area has great physiographical variety and is strongly influenced by the exchange of Mediterranean and Atlantic water masses (Díaz del Río *et al*., 2014). Species from different biogeographical regions converge in the GoC due to its location; there is therefore a high biodiversity. Cold seep areas are considered hotspots of biological diversity because of their uniqueness (Mastrototaro *et al*., 2010). They constitute a marine habitat listed in Annex 1 of the EU Habitat Directive (1992/43/EEC) "Submarine structures caused by leaking gases, habitat 1180". On this basis, the Spanish margin of the GoC was declared a Site of Community Importance (SCI) "Volcanes de fango del Golfo de Cádiz" (ESZZ16002). Information regarding the associated deep sea faunal communities is limited however. As a step towards filling this gap of knowledge, my project focussed on the malacofauna of the SCI.

Methods and materials

Samples from different fluid venting seafloor edifices in the SCI "Volcanes de fango del Golfo de Cádiz" were studied. The material examined was collected during INDEMARES/CHICA 0610, 0211 and 0412 cruises on board R/V Emma Bardán, Cornide de Saavedra and Ramón Margalef, respectively. Samples were collected with a beam-trawl (BT), benthic dredge (BD) and box-corer (BC), from 340 to 1115 meters water depth. Also, I participated in the INTEMARES A4 CAD expedition, where specimens of bivalves associated with fluid venting (*Solemya elarraichensis*) were collected to study anatomy.

The molluscs were sorted to species level, identified to the lowest possible taxonomic level, and quantified. A standardized matrix including abundance of the live-taken species was constructed, and another with the thanatocoenoses (death assemblage) data. The molluscan assemblages were compared by applying different predefined factors, such as the depth (deep or shallow) or the sectors (edifice or adjacent bottoms). Species richness, abundances, evenness and Shannon-Wiener diversity index, and dominances and frequency indexes were calculated using the PRIMER v.6 software. A multivariate analysis based on qualitative similarities (Bray-Curtis measure) was carried out. Finally, the anatomy of *Solemya elarraichensis* was examined with histological techniques and optical microscopy.

Results

Material originating from the Gazul mud volcano was published (Utrilla *et al*. 2020), including 232 species identified from the taxocoenosis and thanatocoenosis, 86 new records for the Spanish margin of the GoC (three of them new for Spanish waters overall) and two species new to science. The ongoing study on other fluid venting seafloor edifices encompasses a total of 121 samples, in which 195 species were identified so far, with 2479 individuals collected alive and 9387 shells. Nine species are further new records for the Spanish part of the GoC and one species (*Myonera* sp.) is possibly new for science.

The most dominant species were the gastropod *Gibberula turgidula* and the bivalves *Bathyarca philippiana*, and *Limopsis aurita,* and the most frequent ones were *B. philippiana*, *L. aurita* and *Abra longicallus*. In the thanatocoenosis, the most dominant species were *Kelliella miliaris*, *Solariella amabilis* and *Ledella messanensis*, and the most frequent were A*. longicallus*, *Pagodula echinata* and *Alvania electa*. The composition of this thanatocoenosis seems to depart from that of the living community, and also comprised, with low frequency, species that are typical of northern latitudes, such as *Chlamys islandica* or *Neptunea contraria*.

In the results, mollusc assemblages could not be clearly differentiated according to depth or sector (submarine structure proper or adjacent bottoms). For samples collected with the box corer however, the abundance of species was significantly higher in the shallow samples than in the deeper ones, supported by the ANOSIM test. For the samples collected with the beam trawl, there were also significant differences in abundance, according to both depth and sectors. Furthermore, the SIMPER analysis showed high dissimilarities between samples (>91% dissimilarity), although this was lower for those collected with the benthic dredge (68.26% dissimilarity).

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Additionally, some specimens of the chemosymbiotic bivalve *Solemya elarraichensis* were studied by microscopy following a histological protocol. Bacteriocytes (Cavanaugh, 1983) were observed in the tissues, mainly in the gills (Fig. 1), where an elevated number of chemoautotrophic bacteria are concentrated. These bacteria live within the *Solemya* cells, decompose sulphurous components and fix the carbon, supporting the nutritional requirements of the host. Thus, these bacteria cause the detoxification of toxic sulphide and make possible the life of these bivalves (Stewart and Cavanaugh, 2006).

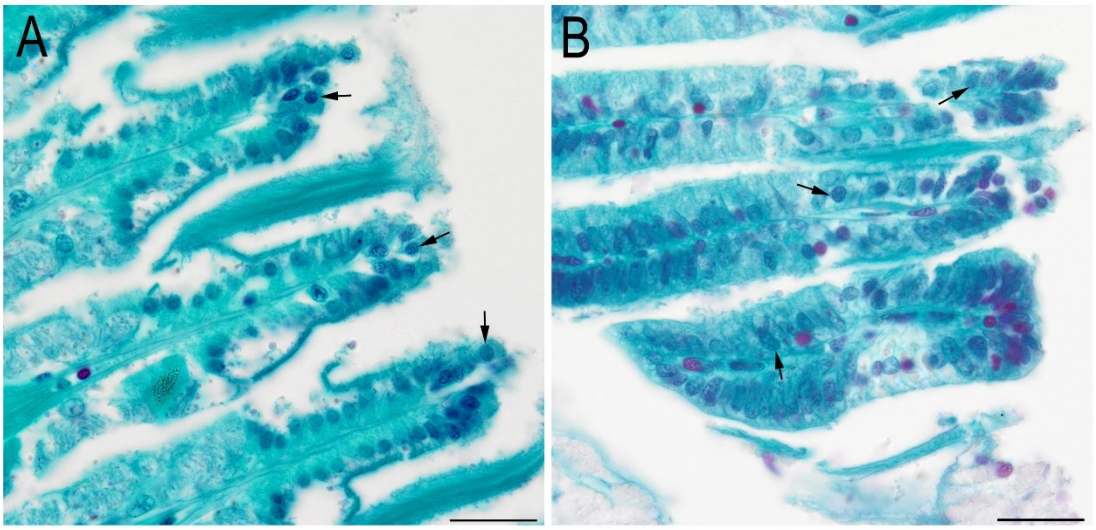

Figure 1. Optical microscopic view of the gills of *Solemya elarraichensis* with bacteriocytes (black arrows). Histological sections were stained with Carazzi's hematoxylin-VOF. Bar corresponds to 20 µm in both A and B.

Conclusion

The high richness of mollusc species in the SCI "Volcanes de fango del Golfo de Cádiz" suggests that there may be a high-level biodiversity for other faunal groups in the area, since molluscs are a good proxy for the biodiversity (Appeltans *et al*., 2012). This ongoing study therefore, is important in increasing our knowledge about deep-benthic habitats and their associated fauna, and supports the conservation of these sensitive areas.

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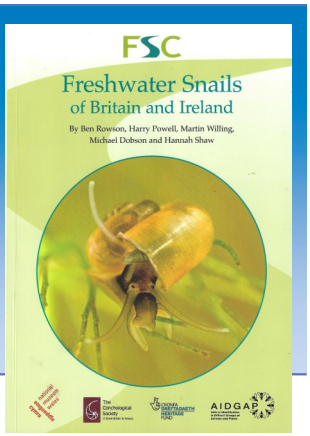
Book review

Freshwater snails of Britain and Ireland

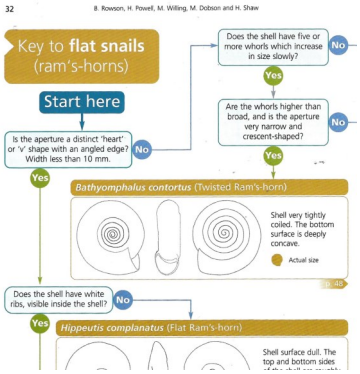
Rowson, B., Powell, Willing, M., Dobson, M. & Shaw H.

Published by the FSC publications, Telford
Produced by an association between the Field Studies Council, the National Museum of Wales, the Conchological Society, Cronfa Dreftadaeth Heritage Fund, the Freshwater Habitats Trust and the Malacological Society of London.

pp 191 Paperback Jul 2021
ISBN 978 1 908819 58 1

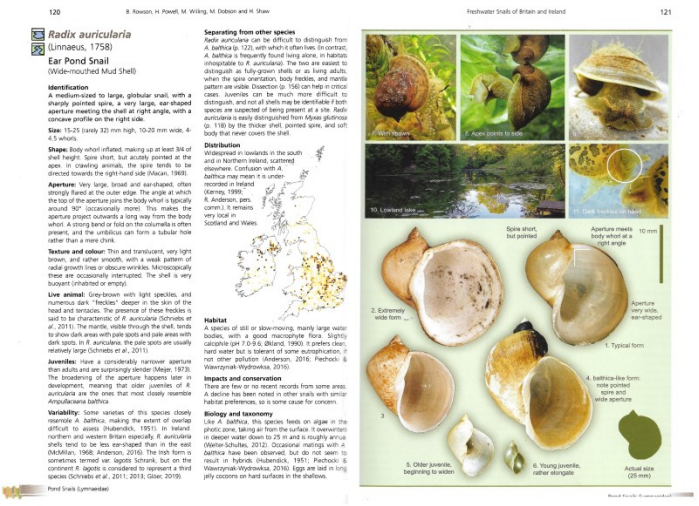


As a young postgraduate researcher in 1970, I had to cancel plans to work on freshwater malacology in Uganda due to the accession to power of the despotic Idi Amin. The research project was re-orientated towards the freshwater malacology of Northwest England, focussing on the relationship between freshwater molluscan ecology and water chemistry. As a novice malacologist, I turned to a paperback key to fresh and brackish water gastropods written by T. T. Macan and published by the Freshwater Biological Association in 1949 as part of a series. This key, beautifully illustrated by Douglas Cooper, was a seminal publication for anyone hoping to identify freshwater molluscs in the UK over the next fifty years. It now has a rival however, since the publication of a worthy successor by the Field Studies Council guide. This paperback book by Rowson, Powell, Willing, Dobson & Shaw is part of the AIDGAP project, which offers accessible guides to those needing to undertake field and identification of animals and plants. As a new freshwater-snail guide, the book is aesthetically pleasing, with high production values for the text, the images and the layout. The book isn't restricted entirely to freshwater; brackish water and hothouse species are also included.



The guide begins with a comprehensive and clear introduction to the biology of freshwater snails, their predators, parasites and ecology, and also summarises the ecological conditions under which particular taxa might be found. Thirteen such conditions are presented, which means that a field biologist can rapidly narrow down the number of species they might be expected to find. Sections on conservation, aliens and field survey techniques mean that all relevant areas are covered. The classification criteria one should use when trying to identify freshwater-snail are clearly and comprehensively presented.

The introduction is followed by an unambiguous key to species. For each species in the key, there is an outline drawing, a life-sized silhouette and then a direction to a detailed account of that species further in the book. Each species account comprises a two-page spread. On the first of these pages are sections on the identification, shape, aperture, texture and colour, live animal, juveniles, variability, possible confusions with other species, distribution (with a map), habitat, conservation and biology. The facing page presents exquisite photographs of each a shell, pictured in a range of dimensions and magnifications. Each species-account also includes photographs identifying aspects of the living animal and a particularly useful photograph of a typical habitat in which the snail might live. Macan's key included a single dissection guide to the internal anatomy of '*Lymnaea peregra*' and this new guide goes much further, providing dissection photographs of several taxa at family level. The guide addresses the issue of snail eggs, offering photographs of egg-masses from several species; it even has a small section, with photographs, on snail droppings.



The book concludes with a comprehensive list of references, though I feel the text is a little too reliant on a few 'key' publications. Also it would have been helpful if there had been more information on the defunct names for species, for example *Hydrobia jenkinsi* for *Potamopyrgus antipodarum* so that this guide could be more easily cross matched to older keys. These are, however, extremely minor quibbles for what is an exquisite book.

Macan's book will stay on my shelf for old time's sake but this is the book I'll be using in future, because, besides being both easy to read and to use, it is aesthetically beautiful. I look forward to it being frequently to hand and regret that it wasn't available in 1970.

Prof GBJ Dussart,
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Kent CT1 1QU

The Malacological Society of London

Annual General Meeting

and conference on

Molluscan Tropical Biodiversity

16th March 2022

The Society's 129th Annual General Meeting (AGM) and symposium will take place virtually via Zoom.

Morning Session

11.00: Introduction

11.15: Dr **Nur Leena Wong** W.S., International Institute of Aquaculture & Aquatic Sciences. Malaysia.
'Eating an undescribed species for 160 years - the problem with tropical cryptic species'

12.00: Dr **Liew Thor Seng**, Universiti Malaysia Sabah, Malaysia.
'Past, present and future challenges in tropical land snail diversity research - two decades of work in Malaysia'

12.45: AGM (all members welcome)

Afternoon Session

14.30: Introduction

14.45 – **Dr Rebecca J. Rundell**, State University of New York. USA.
'Conservation and evolution of land snails in the lowland tropical rainforests of Belau (Republic of Palau, Oceania)'

15.30: **Vanessa Knutson**, Department of Organismic and Evolutionary Biology, Harvard University. USA.
'Many species, but few names: phylogenetics and species delimitation of the (mostly) tropical nudibranch genus *Gymnodoris'*

16.15: Break

16.30: **Dr Christine Parent**, University of Idaho. USA.
'Drivers and constraints of diversification in Galápagos endemic land snails'

The event is free to attend and non–members are welcome to attend the talks
Please register by sending an email to **president@malacsoc.org.uk**
http://malacsoc.org.uk/meetings/

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Membership Notices

THE MALACOLOGICAL SOCIETY OF LONDON

Registered Charity No. 275980

Hon. Secretary - Debbie Wall Palmer

The 129th Annual General Meeting of the Malacological Society of London (MSL) will take on 16th March 2022 at 1245h. The AGM will take place during a symposium organized by the MSL entitled *Molluscan Tropical Biodiversity*

Agenda for the AGM

Apologies for absence
Minutes of the last (128th) AGM
Matters arising
Financial report
Annual report of Council (delivered by the President)
Awards
Election of Council
Any other business

	2021-2022	2022-2023
Year of existence	128	129
President	Jon Ablett (1)	Jon Ablett (2)
Vice Presidents	Phil Fenberg (3)	Fiona Allen (2)
	Fiona Allen (1)	Phillip Hollyman (1)
Ex officio	John Grahame	
Councillors	Phillip Hollyman (3)	Alan Hodgson (3)
	Alan Hodgson (2)	Aidan Emery (2)
	Aidan Emery (1)	Robert Cameron (2)
	Robert Cameron (1)	Victoria Sleight (2)
	Victoria Sleight (1)	Katie Collins (2)
	Katie Collins (1)	Rowan Whittle (1)
		John Grahame (1)
		Thomas Goulding—Student rep (1)
Co-opted	Rowan Whittle (1)	Phil Fenberg (1)
		Crispin Little (1)
Journal Editor	Dinarzarde Raheem	Dinarzarde Raheem
Bulletin Editor	Georges Dussart	Georges Dussart
Treasurer	Katrin Linse	Katrin Linse (final year)
Membership Secretary	Harriet Wood (1)	Harriet Wood (2)
Hon.Secretary	Debbie Wall-Palmer (1)	Debbie Wall-Palmer (2)
Web manager	John Grahame/Chong Chen	John Grahame/Chong Chen
Facebook		Chong Chen
Awards Officer & Twitter	Lauren Summner-Rooney (1)	Lauren Summner-Rooney (2)
Archivist	Andreia Salvador (1)	Andreia Salvador (2)
* CM post to be agreed by AGM and potential suggestion elected		

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

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. From December 2021, the Society also offers additional awards to a) applicants from developing and transition countries (as according to the UN), and b) UK/EU applicants from Black, Asian, or any other underrepresented ethnic background.

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. The award is to support attendance at 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

These 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 15th December. 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, Lauren Sumner-Rooney,
Museum für Naturkunde, Invalidenstrasse 43, Berlin 10115, Germany.
For further information, guidance notes and to access the grant application form see http://malacsoc.org.uk/awards-and-grants/research-grants

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 copy 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 to members and student members. The Society no longer produces paper copies of the Journal.

Members also receive on-line access to *The Malacologist*, which is the bulletin of the Society, issued twice a year, in February and August. *The Malacologist* is published on the website of the Society.

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 volumes of the *Journal*.

Subscriptions

Membership fee structure

Ordinary Members: Journal on-line only £45
Student Members: Journal on-line only £25

Methods of Payment

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

(2) Banker's standing order to: HSBC (Sort code 40-16-08 Account no. 54268210) 63-64 St Andrew's Street, Cambridge C32 3BZ

(3) Overseas members wishing to pay electronically should should use

IBAN GB54MIDL4016084268210
SWIFT/BIC MIDL GB22

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

Institutional Subscriptions to the Journal

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

Change of Member's Address

Please inform the Membership Secretary of a change of postal or email address

Membership secretary
Harriet Wood membership@malacsoc.org.uk

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

Harriet Wood membership@malacsoc.org.uk