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# The Malacologist

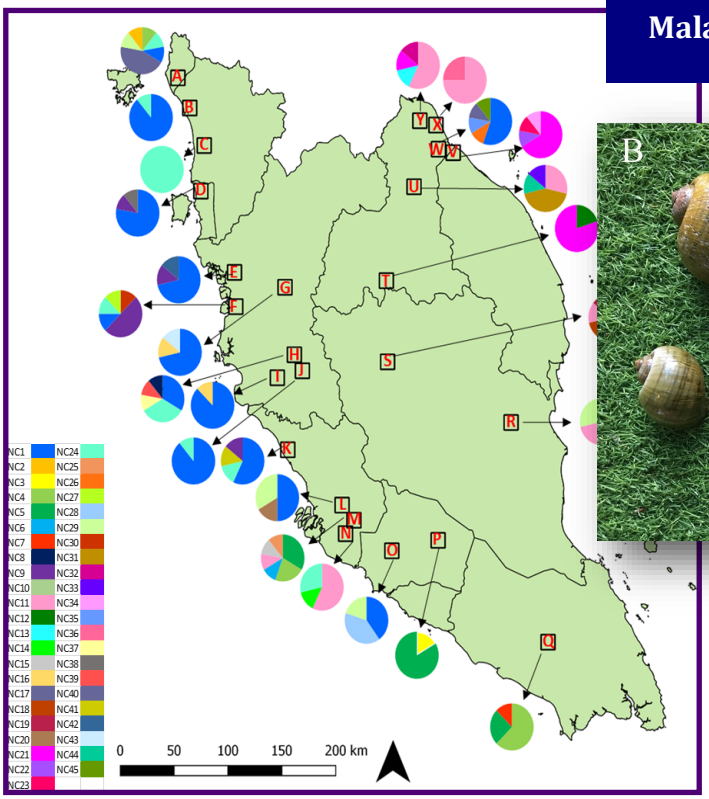
## The Bulletin of The Malacological Society of London

NUMBER 73 AUGUST 2019

**Contents**



**Includes a report of the 126th AGM of the Malacological Society of London**





**These illustrations are from "Population genetic diversity of invasive apple snails, *Pomacea canaliculata*, in Peninsular Malaysia" by Suganiya Rama Rao of Sunway University, Malaysia. The full article is on page 17.**

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

## EDITORIAL

The Malacological Society of London has issued awards since its Centenary in 1993. In 2017, these resolved into Travel Grants, Senior Research Grants and Early Career Research Grants plus others. It is encouraging to see these awards bear fruit. Four award winning reports are presented in this issue (on cone snails by Philip Vogt - p.13; on population genetic diversity of invasive apple snails- p17, on terrestrial gastropods of Ulu Temburong in Brunei by Werner de Gier - p 20 and on shell microstructures of planktonic gastropods by Paula Ramos-Silva- p. 22). It is disappointing however, that there were no submissions for the Annual Award (for a PhD thesis) this year. If you are a supervisor, please consider this £500 award; the nomination process is easy. It just takes a nominating letter from a member of the Society (p.34).

My personal interest in molluscs in general is rekindled each year by the eclectic mix of presentations at the Malacologist's Forum. At last year's Forum, I took the editorial liberty of inviting two of the speakers, who presented stunningly illustrated talks, to submit an extended article, as opposed to abstracts which appeared in the last issue of *The Malacologist*. Both articles reach beyond malacology—for example, that of Cessa Rauch into the realms of Citizen Science(p. 23) and that of Alex Ball into technical developments in visualising science over the last twenty years (p. 28).

Finally, please don't forget that two excellent meetings are in prospect. Firstly, the **Malacologists Forum** is approaching fast (Thursday 21st November 2019 at the National History Museum in London—see p.31). In the new year, alongside the AGM there will be a conference on the the **Biology of Limpets** (17th to 19th March 2020 - see page 4). This is the third such limpet conference organised by the Society.

**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.*].

Prof. Georges Dussart
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## NOTICES

**Molluscs 2018 - Malacological Society of Australasia**

The Malacological Society of Australasia is pleased to announce that registration for our upcoming conference
Come and join us in Wellington, New Zealand, from December 2-5, 2018, for an exciting program covering the latest advances in molluscan research. Find all the details at http://www.malsocaus.org/?page_id=1063. This is the first time that the MSA is hosting a conference outside Australia, and we hope that many of you are able to attend. Grants are available to assist students with the costs of attending the conference. Full details can be found on the conference website.
*Carmel McDougall – Molluscs 2018 organising committee*

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**The Molluscan Forum 2019**

The Molluscan Forum 2019 takes place on Thursday the 21st of November in the Flett lecture theatre at the Natural History Museum, London.
For those not already registered, the deadline for registrations and papers is **Friday the 18th of October** and the application form can be found attached to this email. Registration is **free** but please do so in advance so that we can provide lunch, refreshments throughout the day and wine for the evening reception.
*Dr Phil Hollyman Office: 01223 221300 Mobile: 07500016443*

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**Florida United Malacologists (FUM 2020)**

The eleventh meeting of Florida United Malacologists (FUM 2020) will take place on Saturday, February 15, 2020, at the renovated Bailey-Matthews National Shell Museum, on Sanibel Island, Florida. The one-day gathering includes presentations by researchers, collectors, citizen scientists, educators, and students, covering a broad swath of mollusc-related topics. More details to follow soon!
*José H. Leal, Ph.D. Editor, The Nautilus (239)395-2233*

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**Elisabeth Tova Bailey - *The Sound of a Wild Snail Eating*,**

Elisabeth Tova Bailey's memoir, *The Sound of a Wild Snail Eating*, has just been published in Spanish and Catalan. The memoir recounts her year-long observation of a forest snail *Neohelix albolabris*. In Catalan, the publisher is Més Libres, and in Spain it is Capitán Swing. The Spanish edition will also be distributed in Mexico, Colombia, Peru, Costa Rica, Chile, Uruguay, and Argentina.
Spanish edition: https://capitanswing.com/libros/el-sonido-de-un-caracol-salvaje-al-comer/Catalan edition: https://mesllibres.cat/elisabeth-tova-bailey/7289-el-soroll-que-fa-un-cargol-salvatge-quan-menja-9788417353155.html
More information about the film and each festival can be found at wildsnailfilm.org
*Elisabeth Tova Bailey elisabethtovabailey.net*

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**Annotated catalogue of the types of Triphoridae in the Natural History Museum, London**

After more than five years of work, the catalogue of type specimens of Triphoridae in the Natural History Museum in London has finally been published: https://zse.pensoft.net/article/32803/list/1/. The paper is open access, kindly funded by the University of Vienna. Almost 150 pages and 132 species free to enjoy!

*Dr. Paolo G. ALBANO, Ph.D. University of Vienna paolo.albano@univie.ac.at*

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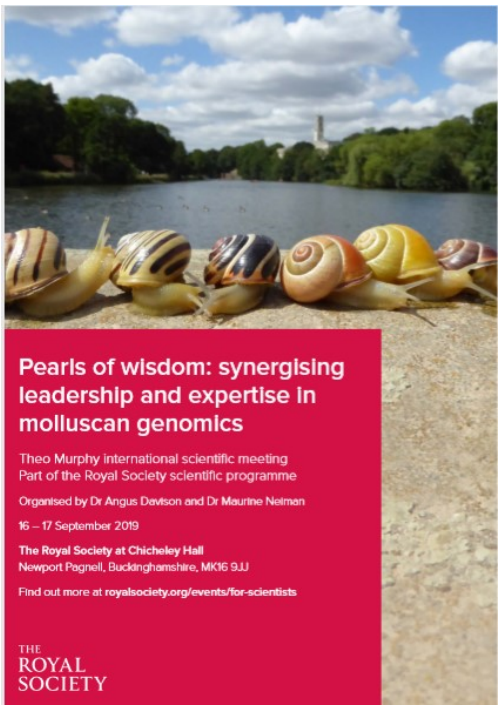
**Pearls of Wisdom", tconference on molluscan genomics, the Royal Society of London**

The draft programme is now out for "Pearls of Wisdom", the first conference focused on molluscan genomics, at the Royal Society of London's Chicheley Hall, UK, 16th-17th September 2019. Co-organised by Dr Angus Davison, University of Nottingham and Dr Maurine Neiman, University of Iowa. While all speaker slots have been allocated, we still have plenty of space for attendees. Posters welcome. Please request an invite via the Royal Society web page: https://royalsociety.org/science-events-and-lectures/2019/09/pearls-of-wisdom/. There is no registration fee. We anticipate that some funding may be available, especially to early-career scientists - email Angus for UK/EU-based scientists and Maurine for graduate students or postdocs who are US citizens or green-card holders.

Confirmed speakers: Menno Schilthuizen @schilthuizen, Suzanne Saenko , Jeanne Serb @jeanne_serb, Mark Blaxter, Carrie Albertin @CarrieOcto, Jin Sun, Matt Loose @mattloose, Andrew Calcino @AndrewCalcino, Marina Panova, Noriyuki Satoh, Marie-Agnes Coutellec, Peter Fields @peterdfields, Maurine Neiman @mneiman (co-organiser), Coen Adema, Otto Seppala @otto_seppala, Michael McCartney, Yale Passamanek, Kim Perry, Ximing Guo, Angus Davison @angus_davison (co-organiser)

Provisional programme: https://royalsociety.org/science-events-and-lectures/2019/09/pearls-of-wisdom/

*Dr Angus Davison, University of Nottingham (angus.davison@nottingham.ac.uk) and Dr Maurine Neiman, University of Iowa (maurine-neiman@uiowa.edu).*

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**Hardcopy publications of the FWGNA Project**

We are pleased to announce that the first hardcopy publications of the FWGNA Project are now available from all the usual online outlets, and directly from the publisher at a substantial discount. Volume 1, by Dillon, Ashton, Reeves, Smith, Stewart and Watson, reports the results of a comprehensive survey of the freshwater snail fauna conducted in Atlantic drainages from Georgia through Pennsylvania, providing a full-color figures, a dichotomous key, range maps, and natural history notes for all 70 species recovered, updating the taxonomy to modern standards. A new, objective system of conservation status ranking is proposed, and a new species of pleurocerid snail described in the appendix. Accompanying the Volume 1 survey are three volumes of essays intended to support the scientific findings, offering additional evolutionary, ecological, and systematic notes for the fauna. Volume 2 collects 29 essays on the systematics and evolution of the freshwater pulmonates of North America, Volume 3 comprises 37 essays on the systematics and evolution of the prosobranchs, and Volume 4 collects 38 essays reviewing ecological and biogeographical themes. All four volumes are available for a package price of $99.95


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# Limpets 2020: Biology of Limpets: evolution, adaptation, ecology and environmental impacts

(Joint Meeting of the Malacological Society of London and the Marine Biological Association UK)

## Second Announcement

## 17th to 19th March 2020

**Venue: Marine Biological Association, The Laboratory, Citadel Hill, Plymouth UK, PL1 2PB**

**Meeting Organisers**

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

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

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

**Registration Fees**

(Registration includes tea/coffee upon arrival, refreshment breaks, poster reception (day 1), lunch (day 2 & 3), late afternoon Devon cream tea (on day 3)

**Early-Bird rates - £80** (Members of MBA, Malacological Society, Students) or **£45** (without conference dinner on day 2): **£90** (Non-members) or **£55** (without conference dinner on day 2)
**Standard rates - (after November 1st), £90** (Members etc.)**, £100** (Non-members)
**£35** for additional guest or partner to Conference Dinner

**Deadline dates**

**Abstract or Presentation Title Submission – by September 1st 2019 (or as soon as possible after)**
**Early Bird Registration – by November 1st 2019**

**Student Travel Grants**

**The Malacological Society of London** have a limited number of travel grants available to students presenting at the meeting. For applications go to **http://malacsoc.org.uk/awards-and-grants/travel-grants/**
**MBA Student Members** attending will be eligible to apply for MBA meeting bursaries (registration cost / travel assistance up to £200). There will be three opportunities to apply; this summer, late autumn & early 2020.

**Registration closes on January 31st 2020 or at 80 delegates**

**Provisional Programme**

**Day 1** 12.30 – 13.30 Arrival & Registration, tea/coffee
13.30 – 15.30 Welcome, Keynote Paper,
**General Open Session *("Orton and his legacy - molluscan and marine biological talks on any aspect that would have interested Orton"*)**
15.30 – 16.00 Tea/Coffee
**16.00 – 17.00 AGM of Malacological Society of London**
16.00 – 17.00 Poster Session
17.00 – 18.00 Open Session
18.00 – 18.30 Keynote Paper
Evening Free to explore Barbican pubs and restaurants.

**Day 2** 09.30 – 10.00 Keynote Paper
10.00 – 11.00 Limpet Session 1
11.00 – 11.30 Tea/Coffee
11.30 – 13.00 Limpet Session 2
13.00 – 14.00 Lunch
14.00 – 15.30 Limpet Session 3
15.30 – 16.00 Tea/Coffee
16.00 – 17.30 Limpet Session 4
17.30 – 18.00 Keynote Paper
18.00 – 18.30 Posters
Conference Dinner at MBA (19.00 for 19.30)

**Day 3** 09.30 – 10.00 Keynote Paper
10.00 – 11.00 Limpet Session 5
11.00 – 11.30 Tea/Coffee
11.30 – 13.00 Limpet Session 6
13.00 – 14.00 Lunch
14.00 – 15.30 Limpet Session 7
15.30 – 16.00 Keynote Paper
16.00 – 16.10 Concluding Remarks
16.10 – Devon Cream Tea & Conference Ends
Delegates return home or meet informally in the evening

Contributed Spoken Papers – 15 minutes are currently allocated, speakers should allow at least 3 minutes for questions.

Poster Papers – Posters should be A0 in size and portrait orientation.

**How to Register For Limpets 2020**

Go to https://www.eventbrite.co.uk/e/limpets-2020-biology-of-limpets-evolution-adaptation-ecology-environmental-impacts-tickets-60205706890
***Then click on the Tickets button***

**Accommodation**

Delegates should make their own accommodation arrangements as there are many Hotels and Bed & Breakfast establishments in the city that are within walking distance of the MBA. Special rates are available to delegates at some, if visiting the MBA is mentioned at time of booking (see attached list).

**Transportation**

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

**Abstract or Title Submission (Deadline by September 1st 2019 or as soon as possible after)**

Abstracts should be submitted by email to Alan Hodgson (a.hodgson@ru.ac.za) as an MS Word document. When submitting the abstract please indicate whether you would like to present as a spoken paper or poster paper.
**NB**: please also indicate whether you would prefer your presentation to be in one of the "Open" sessions on Day 1, or in the "Limpet" sessions (Days 2 and 3).

Abstracts should be about 200 words in length (excluding title, author name(s) & affiliation(s)) and in 12 point Times New Roman font. Format abstracts as follows:-

**Title** (in bold, left justified)
**Author(s) name(s) (first name and surname i.e. James Orton, Alan Southward & James Dodd)** (in bold, left justified. Where more than one author use an asterisk (*) to indicate presenting author)
*Affiliations* (in italics)

Body of Abstract (about 200 words, left justify only, do not use paragraphs).

Abstracts will appear in the August issue of *The Malacologist.* Papers from the meeting will not be published in a special issue but delegates are encouraged to submit their work to either *Journal of Molluscan Studies* or the *Journal of the Marine Biological Association of the UK.*

UNIVERSITY OF PLYMOUTH
Marine Institute

Meeting sponsor University of Plymouth Marine Institute

**AGM of the Malacological Society of London 2019, Eike Neubert presenting. The President of the Council , John Grahame is at bottom right, next to Philip Hollyman.**




On behalf of the Organizing Committee of the Third Argentine Congress of Malacology (3CAM) and the Asociación Argentina de Malacología, I have the pleasure of inviting you to the 3CAM, which will take place in the city of Bahía Blanca (Argentina) from December 4 to 6, 2019, at the Universidad Nacional del Sur. This congress is organized by the Argentine Association of Malacology and brings together most of the malacologists from Argentina and several colleagues from neighbouring countries. It would be nice to share conferences, symposiums, workshops, talks and posters.
You can visit our website (http://malacoargentina.com.ar) and our facebook Asociación Argentina de Malacología( https://www.facebook.com/Asociacion-Argentina-de-Malacologia-126689074100681/ ) to keep up to date with the latest news.
*Dr. Pablo R. Martín Universidad Nacional del Sur, Argentina*

# Annual report of Malacological Society Council for 2018/19

## delivered by the President, John Grahame



**Membership (report by Tom White)**

The introduction of new GDPR legislation last year required the MSL to develop a privacy policy that both protected the rights of its members and allowed it to continue to operate in the interests of those members. The resulting policy was drafted after consulting with GDPR professionals and taking advice from other societies of a similar size. The full text is available via the MSL website. Membership levels have remained stable at around 120 members.

**Finance for the financial year ending 31st December 2018 (report by Katrin Linse)**

The finances of the Malacological Society have not been pleasing during 2018 with an overall loss of £14062. This loss is explained by a loss in the investment funds caused by lowered Fixed Interest rates and by the Society's resources used (£64,8k) in 2018 being higher than their incoming resources (£53,8k). The increased resource use is linked to the expenses for the two anniversary research meetings. The Society's overall carried forward funds remain healthy with £325,093.

Our investments had an overall loss of £3,098 (comparing market value at 31 December 2017 with market value at 31 December 2018), with the COIF Investment Fund making a gain of £1,259 and the COIF Fixed Interest Fund a loss of £4358. During 2018, no funds were transferred from the current account to savings accounts.

Separately, the profit-share from the publication of the *Journal of Molluscan Studies* in 2018 provided the Society with the majority of its income contributing £43.2k. The Editor of the Journal, Dr David Reid, and the Assistant Editors are to be commended for their hard work contributing to the publication of our scientific journal. In addition, sales of the digital archives provided over £4.2k of income.

In 2018, celebrating 125 years of the Malacological Society of London and the 20th Malacological Forum, more funds were used for awards (£31.1k) in 2018 compared to £22.6k 2017, with research awards, travel awards to society meetings (AGM and Molluscan Forum) increased while the spending on travel awards decreased. The Society spent overall over £10k more money in 2018 compared to 2017 mainly based on meeting charges (hosting two anniversary meetings) and JMS colour figures and MSL internal manuscript edit charges. In 2018 we were charged significantly less by OUP for JMS expenses.

**Meetings**

**125th AGM Symposium on New Perspectives in Evolution in Molluscs** – a symposium co-hosted by the Society together with the Natural History Museum. Six international speakers gave presentations ranging from 'Shell function and the history of life' (Prof. Geerat J. Vermeij) through 'Venomous fish-hunting *Conus*' (Prof. Toto Olivera) to 'The molecular basis of molluscan biomineralization (Dr Carmel McDougall). There is a more detailed report including abstracts of the presentations in *The Malacologist* (number 71).

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**The Forum (report by Andreia Salvador)**

On the 22nd November 2018 the Annual Molluscan Forum was held in the Flett Lecture Theatre at the Natural History Museum, London, organized by Andreia Salvador, with help from Katrin Linse, Jon Ablett, Tom White and the President. A total of 72 people from 12 countries attended the 20th Anniversary Molluscan Forum 2018. To celebrate this important date we invited 3 special speakers, Dr Katrin Linse, Dr Alex Ball and Dr Cristina Vina-Herbon, former presenters at the 1st Molluscan Forum, who provided an overview of their 20 years' career.

Travel awards amounting to £1,337 were given to 12 students. There were 16 speakers (including the 3 invited speakers) and 12 posters. Franziska S. Bergmeier (Systematic Zoology, LMU Munich, Germany) was awarded the Oxford Prize for Malacology for her talk '*Bathyal slope to hadal trench: diversity and biogeography of Solenogastres (Mollusca) in the Northwest Pacific*'.

The Society provided lunch for all attendees and this served to create a cohesive meeting, with excellent opportunity to discuss the posters. The Forum was again held consecutively with the Young Systematists' Forum, affording an opportunity for students to attend both meetings. A full report of the Forum appears in number 72 of *The Malacologist*.

**Publications – *The Malacologist*, (report by Georges Dussart)**

*The Malacologist* is the on-line bulletin of the MSL The editorial policy is to use research grant reports, travel grant reports, and abstracts of conferences and symposia to showcase the support given by the Society to malacology and malacologists. To this end, the publication offers a colourful and eclectic mix of malacological news; unfortunately, by its nature, the publication has to include obituaries.

The August 2018 issue (Number 71) of *The Malacologist* was twenty pages long, the prime content being the President's report of Council and abstracts of presentations at the AGM symposium on *New Perspectives in Evolution of Molluscs*; *from fossils to next generation sequencing*. By contrast, the February 2019 issue (number 72) was more than twice as long at forty five pages. The abstracts of the November 2018 Forum occupied nineteen pages. A significant part of the issue was taken up with four research grant reports. It is always encouraging to see these reports appear in *The Malacologist* since they represent an end-point for the significant effort made by the Society to promote malacological research. The reports included submissions from Rodrigo Brincalepe Salvador on *Palaeogene land snails of Europe,* Robert Fernandez-Vilert on *Tylodinae species complex in the Mediterranean Sea and Eastern Atlantic*, Sydney Lundquist on Freshwater *mussels as environmental indicators in UK river systems using a sclerochronological approach* and Kasper Hendriks on *Fieldwork to sample microsnails for diet and microbiome studies along the Kinabatangan River, Sabah, Malaysian Borneo*. There was also a travel grant report from Franziska Bergmeier on the 15th Deep-Sea Biology Symposium in Monterey Bay California (USA). Obituaries for Charles F Sturm and Colin Redfearn were also significant in this issue.

Although *The Malacologist* is issued on line, a limited number of paper copies are produced for various libraries worldwide, including the British Library.

***Journal of Molluscan Studies* (reported by Dinarzarde Raheem)**

The ISI impact factor for the *Journal* in 2017 increased to 1.483 (compared with 1.250 in 2016, 1.185 in 2015, 1.326 in 2014 and 1.495 in 2013). The *Journal* stands at number 53 in the ISI list of 166 zoological journals (it was 65 out of 162 in the previous year). Our chief competitor, *Malacologia*, had a higher impact factor in 2017 (1.657). The *Journal* continues to be truly international in terms of the geographical distribution of its authors; for volume 83 (2017) the corresponding authors represented 22 countries (of which the leaders were 13% USA and 9% Germany).

Circulation for the Journal in 2018 was 41 institutional (of which 19 were online-only and 13 print-only) and 156 membership subscriptions (compared with 46 and 154, respectively, for 2017). In addition, a further 2,497 institutions have electronic access to the Journal through publishers' consortia (includes migrated figures; compared with 2,569 in 2017). As in 2016, 1,092 institutions had access to the *Journal* through Oxford University Press's Developing Countries Initiative. As of 2018, OUP offers its full collection to participating institutions, meaning the *Journal* is now accessible at over 5,500 sites (for details see https://academic.oup.com/journals/pages/librarians/developing_countries). This means that the *Journal* is now available to a total of 8,194 member and institutional subscribers (compared with 3,861 in 2017).

The new pricing structure has been fixed for 2019. The cost for a combined print plus online institutional subscription is £660; an online-only subscription is £513 and print-only subscription is £609.

Volume 84 (2018) contained 55 papers, research notes and review articles, totalling 497 pages (a slight increase on the 483 pages of the preceding volume). The mean delay between acceptance of a manuscript and electronic publication was 4.2 weeks. In total, 139 manuscripts were submitted in 2018 and the acceptance rate was approximately 40%. Compared with the previous year, submissions decreased by 21%, while the acceptance rate rose by 25%, which shows that the quality of manuscripts improved, since editing standards remain unchanged. The image of the sacoglossan sea slug *Elysia crispata* on the cover of Volume 85 was kindly donated by Ellen Muller.

Our board of Associate Editors is now: Coenraad Adema (immunology, genomics, parasitology), Thierry Backeljau (molecular phylogenetics and genetics), Liz Boulding (population and reproductive biology), Robert Cameron (ecology and genetics of terrestrial gastropods), Richard Cook (agricultural malacology, physiology, feeding behaviour), Simon Cragg (life histories, sense organs), Mark Davies (marine ecology and behaviour), Dan Graf (freshwater bivalves), John Grahame (population genetics, morphometrics), Liz Harper (marine bivalves), Gerhard Haszprunar (microanatomy, 3D reconstruction, minor molluscan classes), Bernhard Hausdorf (terrestrial gastropods), Michal Horsák (ecology and biogeography of terrestrial gastropods), Yasunori Kano (systematics of vetigastropods, tropical ecology), Joris Koene (reproductive behaviour of gastropods), Manuel Malaquias (opisthobranchs), Peter Marko (marine biogeography and phylogenetics), Pablo Martín (freshwater ecology, life history), Ellinor Michel (ecology, freshwater gastropods), Jeff Nekola (community ecology

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of terrestrial gastropods), Nicolas Puillandre (neogastropods), Ellen Strong (freshwater and marine caenogastropods), Janet Voight (cephalopods), Janice Voltzow (microscopic anatomy), Heike Wägele (opisthobranch biology), Tony Walker (biochemistry, immunology, cytology), Suzanne Williams (molecular phylogenetics and genetics), Nerida Wilson (opisthobranchs, deep-sea and Antarctic molluscs) and Yoichi Yusa (general ecology and behaviour). Four Associate Editors resigned or retired in 2018, John Davenport, Robert Hershler, Mikael Thollesson and Kurt Jordaens, and I would like to thank them for their service to the *Journal*.

I would also like to thank all the members of the editorial board, those members of the international malacological community who have contributed to the review process, the staff of Oxford University Press and the typesetting team at MPS Ltd, Chennai, India, led by Robin Raj, for their work on behalf of the *Journal*.

After completing 16 years as Editor-in-chief of the *Journal*, David Reid retired at the end of 2018. During his time as Editor (more than 16 years all told), David has worked extraordinarily hard to promote and maintain the highest standards of editorial and scientific excellence and to support and foster young and up-coming malacologists. I would like to take this opportunity to thank David for his unstinting and dedicated service and to wish him all the very best for his retirement. I would also like to thank him for all the generous guidance and support he has provided to me during the period of editorial transition (July–December 2018) and continues to provide as I begin my tenure as Editor. Under David's editorship, the *Journal* has made enormous strides in advancing malacology in parts of the world where it is still a new and developing field. I hope that the *Journal* can build on this magnificent legacy and continue to be a leader in its field.

**The Society's Website, http://malacsoc.org.uk/ (report by Tom White)**

There are no major issues with the website. Additional pages were created for the MSL's privacy policy (see Membership Secretary's report) and for content arising from meetings. The inclusion of video content on the latter has been difficult due to a limit on the size of files that can be uploaded to our current server. The possibility of increasing the capacity of our server storage is being looked into.

**The Society's Facebook page, https://www.facebook.com/malacsoc/ (report by Chong Chen)**

The Society's Facebook page continues to perform well. We now have 2,229 followers on the page, an increase of 120 from last year. This means we have a direct outreach population of over 2,200 people/organisations who sees our posts; the posts this year had an average confirmed view by just over 1,000 people/organisations.

Again, although the Facebook page is doing well so far, it will benefit greatly from an increased number and variety of posts. If you come across items of potential interest for our Facebook audience, please e-mail me (cchen@jamstec.go.jp) with recommendations and I will generate posts. Also, if you have a Facebook account and would like to join the admin team with posting rights and see the performance stats, just let me know which e-mail address you used to register for Facebook, and I will add you as an admin.

If you have suggestions / comments on the Facebook page, please do not hesitate to contact me.

**Awards (report by Jon Ablett)**

Overall, the Society is very pleased with the number of applications that it receives for Travel Awards and Research Grants. The schemes seem to be achieving their global aim to enable young scientists to engage in malacological research activity both in the laboratory/field and at meetings. Reports from researchers funded through both schemes appear in *The Malacologist*. Application forms and guidance notes for both schemes have been updated recently and can be downloaded from The Society's website.

The Society aims to make the following awards annually.
Travel Awards - at least 5 each of up to £500 for Society members, £300 for non-members
Research Grants - at least 5 each of up to £1500

**Travel Awards**

In 2018 there were 2 rounds of Travel Awards, June and December. The Society received 12 applications for awards to travel and was able to fund all of these requests. All Travel Award applications are reviewed by an Awards Committee. The Society is pleased to have announced the following awards.

*June Travel Awards*

Franziska S. Bergmeier (Ludwig-Maximilians-Universität München)
**£300** for the '*15th Deep Sea Biology Symposium'.* USA

Monisha Bharate (Bombay Natural History Society)
**£300** for the '"*VI International Heterobranch Workshop*". Australia

Motiur Chowdhury (Universily of Jyvaskyla)
**£500** for the "*FMCS lnternational Freshwater Mollusk Meeting*". Italy

Amy Healey (Aberystwyth University)
**£500** for the "*Cephalopod International Advisory Council Conference*". USA

Alexandra Lischka (Auckland University of Technology)
**£500** for the "*Cephalopod International Advisory Council Conference*". USA

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AWARDS CONTINUED >

Vanessa Modesto (University of Minho)
**£300** for the "*FMCS lnternational Freshwater Mollusk Meeting*". Italy

Kristen Soong Giun Yee (University of the Ryukyus)
**£297** for travel to a workshop on *Internal morphology of nudibranch studies. USA*

*December Travel Awards*

Imogen Cavadino (RHS)
**£500** for the "*World Congress of Malacology*". USA

Charlotte Nisha Colvin (Bangor University)
**£500** for the '*5th International Sclerochronology Conference'*. Croatia

Paula Ramos-Silva (Naturalis)
**£300** for travel to a workshop on *Shell structures of three pelagic mollusks*. France

Randi L. Rollins (University of Hawai)
**£500** for the "*World Congress of Malacology*". USA

Lauren Sumner-Rooney (Oxford University)
**£500** for the "*World Congress of Malacology*". USA

A total of **£4997** was allocated by The Society for Travel Awards. All applicants have been notified of the outcome. Note that this amount does not necessarily reflect actual 'spend' as occasionally students withdraw from the intended visit.

**Research Grants for 2018 - Senior Research Grants & Early Career Research Grants**

The MSL council decided to restructure the research grants from 2016 by awarding Senior Research Grants and Early Career Research Grant. Early Career Research Grants are conferred on students and researchers without professional positions, but without regard to nationality or membership of The Society. Senior Research Awards are aimed at established researchers in professional positions, but without regard to nationality. Applicants for Senior Research Awards must be members of The Society. Early Career Research Grants will be reviewed by MSL council members and Senior Research Grants will be reviewed by a Reviewers Panel including both council and non-council members invited for that purpose.

**Early Career Research Grants**
By the closing date of 15th December 2018 the Society had received 29 applications from workers from 21 institutions in 12 different countries. In general, the scientific quality of the research projects submitted was excellent. On behalf of the Society, I would like to formally thank the members of the Grants Review Panel for their hard work in reviewing all applications. The Panel has agreed the following awards, in alphabetical order.

Alda, P. (University of Montpellier, France), **£1404.48**
'*Biogeography of cryptic Galba snails (Hygrophila, Lymnaeidae)*'

Bullis, D. (State University of NY College of Environmental Science and Forestry, USA), **£1500**
*'The Endodontoid Land Snails of Belau: Phylogenetics and Morphological Trait Evolution'*

Egger, C. (LMU Munich, Munich), **£1500**
'*Molecular phylogeny of meiofaunal Caecidae snails (Truncatelloidea, Caenogastropoda)'*

de Gier, W. (Naturalis Biodiversity Center, Netherlands), **£1500**
'*First survey of the terrestrial gastropods of Ulu Temburong National Park, Brunei Darussalam'*

Ramesh, K. (Sven Loven Centre for Marine Infrastructure, Sweden), **£1500**
'*The genetic mechanisms underlying larval shell deposition in calcium limited environments'*

Rollins, R. (University of Hawaii, USA), **£1474**
'*The gut microbiome of snails and how it is influenced by infection with rat lungworm'*

Taite, M. (National University of Ireland, Ireland), **£1472**
'*Under the skin – CT scanning Cirrate octopods'*

Winebarger, M. (University of Alabama, USA), **£803**
*'The Role of Parasites in Consumer Driven Nutrient Cycling'*

Therefore **8** Research Grants have been funded at a total cost of **£11,153.48.** The success rate was **28%**. The Grants Review Panel would like to emphasise that the quality of all applications was high and that it funded as many excellent projects as possible. Applicants will be formally notified of the outcome of their application within 3 weeks of the AGM.

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**Senior Research Grants**

By the closing date of 15th June 2018 the Society had received only 1 application for the Senior Research Grants. On behalf of the Society, I would again like to formally thank the members of the Grants Review Panel for their hard work in reviewing all applications. The Panel has agreed the following award:-

Andrew A. David, Clarkson University (USA) **£1404**
*'The Effects of CO2- mediated Acidification on Freshwater Molluscs from a Temperate Aquatic Community'*

**The Annual Award**

The Society received no nominations for the 2019 Annual Award.

**The Oxford Prize for Malacology**

The Oxford Prize for Malacology is awarded annually for the best presentation at the Molluscan Forum, is generously supported by Oxford University Press, publisher of the Society's journal. The 2018 winner is Franziska S. Bergmeier for her talk entitled '*Bathyal slope to hadal trench: diversity and biogeography of Solenogastres (Mollusca) in the Northwest Pacific'.*

**Officers and Council**

This has been my first year as President, and it has been a learning curve, off which I would have fallen without the timely and welcome help of many of you. Thank you! It's been a successful year, marked by the 125th AGM, and the 20th anniversary of the Forum. The Forum has continued to be a most rewarding and informative day.
Our Council now, and nominations for going forward, were on the Agenda Paper, and appear below.

| Year of existence | 2018-2019 | 2019-2020 |
|---|---|---|
| | 125 | 126 |
| President | John Grahame (1) | John Grahame (2) |
| Vice Presidents | Richard Preece (3) | Robert Cameron (2) |
| | Robert Cameron (1) | Philip Fenburg (1) |
| Ex officio | Suzanne Williams | |
| Councillors | Aidan Emery (2) | Aidan Emery (3) |
| | Phil Fenberg (3) | Harriet Wood (3) |
| | Harriet Wood (2) | Andreia Salvador (2) |
| | Debbie Wall Palmer (3) | Fiona Allen (2) |
| | Andreia Salvador (1) | Philip Hollyman (1) |
| | Fiona Allen (1) | Lauren Sumner Rooney (1) |
| Co-opted | | Debbie Wall Palmer |
| | | Alan Hodgson |
| Journal Editor | Dinazarde Raheem/David Reid | Dinazarde Raheem |
| Bulletin Editor | Georges Dussart | Georges Dussart |
| Treasurer | Katrin Linse | Katrin Linse |
| Membership Secretary | Tom White | Tom White |
| Hon.Secretary | Rowan Whittle | Rowan Whittle |
| Web manager | Tom White/Chong Chen | Tom White/Chong Chen |
| Awards Officer | Jon Ablett | Jon Ablett |

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

# SYMPOSIUM WHICH ACCOMPANIED THE AGM

## *Aspects of mollusc conservation*

### Wednesday 27 March 2019 1345h

**126th AGM Malacological Society of London**

**Flett Theatre, Natural History Museum, London**

In order to celebrate the 126th AGM of the Malacological Society of London, MSL together with the Natural History Museum co-hosted a short symposium on aspects of conservation of molluscs. After hearing from our invited speakers, there was a celebratory glass of wine.

### Redlisting the non-marine molluscs of Europe

**Eike Neubert**

Department of Invertebrate Animals, Naturhistorisches Museum der Burgergemeinde Bern, Bernastrasse 15, CH-3005 Switzerland
eike.neubert@nmbe.ch

Terrestrial molluscs have been the target of red list activities for almost 3 decades, with sporadic and taxonomically scattered entries from the 1970's. Prerequisite to any redlisting, a scientifically well-tested and foreseeable stable taxonomic backbone was needed. Fortunately, this backbone for Europe was created in parallel through the MolluscaBase project, which was fed by fundamentally revised data retrieved from the Fauna Europaea list. The terrestrial gastropods are represented by 57 families, with the Clausiliidae being the largest group comprising 429 species.
Since 2009, the complete non-marine malacofauna of Europe has been screened using the knowledge of almost 50 experts. The threat status was assessed against the standard categories and criteria of the IUCN Red List (IUCN version 3.1). Today, we can present data on the current conservation status of 3332 species of terrestrial and freshwater molluscs. These data were made visible through the IUCN Red List database in November 2017 (www.iucnredlist.org), presenting a lot of hitherto unpublished information on the species including as a novelty a distribution map for almost all species. For the terrestrial molluscs, there is good news: of the ca. 2.476 species, only 19.5% have a threatened category, and slightly more than 50% are considered Least Concern. Freshwater molluscs were assessed in 2011, and an update is urgently needed as recently described species are not assessed. So the latest numbers from 2011 stay with ca. 40% of the species having a threatened category, contrasted by only 22% of Least Concern species. As could be expected, the Balkans turned out to represent the area with the highest biodiversity. The Macaronesian Islands with all the small-range species show a very similar pattern in species richness. The major threats identified against terrestrial molluscs in Europe are grazing, increased incidence of fires, deforestation, agriculture and encroaching urbanisation.

### *Partula* snail conservation breeding and reintroduction and some wider species initiatives.

**Paul Pearce-Kelly**
Senior Curator, Ectotherms. Zoological Society of London
IUCN Climate Change Specialist Group Information Search and Synthesis work theme Leader
Email: ppk@zsl.org

The *Partula* tree snail conservation breeding programme was established over 30 years ago in response to widespread *Partula* extinctions in the 1970s and 1980s from the introduced predator *Euglandina rosea.* The programme currently includes 15 species and sub-species (the majority of which have *Extinct in the Wild* Red List status). A long-term collaboration between the French Polynesian environment department and the zoo conservation breeding programme has enabled 10 species and 2 subspecies to be reintroduced. This presentation updated colleagues on progress to date, lessons learned and follow up initiatives. It also summarised some future conservation environment considerations for this and wider species recovery efforts.



# Early career research grant reports



## Comparing the geographical structure of cone snail species in a marine biodiversity hotspot

**Philip Vogt**

### INTRODUCTION

Marine cone snails (Conidae) are famous for their anatomical as well as behavioral features, including harpoon-like radula teeth used to inject highly prey-specific neurotoxins into their prey. They have often featured in "*The Malacologist"* and elsewhere for their pharmaceutical potential as analgesics. However, another key characteristic of the group is their high biodiversity, featuring up to 900 species, the majority of which are found as reef dwellers in the intertidal and shallow subtidal of the Indo-Australian Archipelago (IAA). Dispersal is based on drifting planktonic larvae and range expansion is therefore thought to be highly dependent on the prevailing oceanographic patterns of this region.

The existence of ontogenetically and ecologically (feeding behavior) similar and widespread, co-occurring species (Barber *et al.,* 2006), makes the Conidae an ideal system to investigate the effects of the historically ever-changing coastal outline of this archipelago on the marine invertebrate biodiversity. Pleistocene sea-level fluctuations have been hypothesized to have repeatedly connected and isolated geographically distant oceanographic regions (Voris, 2000). While previous studies exist for a variety of marine animals and invertebrates from within this region (Carpenter *et al.,* 2011), studies on this topic on cone snails were performed exclusively outside of Indonesia (Duda & Kohn, 2005; Atlantic Ocean: Cunha *et al*., 2005, 2008, 2014; Duda & Rolan, 2005; Abalde *et al.,* 2017; Pacific Ocean: Duda & Lee, 2009; Duda & Lessios, 2009; Duda *et al.,* 2009; Duda *et al.,* 2012). This study presents the first comparative analysis of the distribution of mitochondrial haplotypes for a variety of cone snail species from within the Indonesian archipelago. It investigates the existence of a previously proposed marine 'Wallace Line' (Barber *et al.,* 2000; Lourie & Vincent, 2004; Sulaiman & Ovenden, 2010), a term commonly applied for the terrestrial demarcation between the Asian and Wallacean fauna. The sampling performed on this field trip provided the basis for a population genetic analysis applying demographic methods to investigate the evolutionary and phylogeographical history of this fascinating group in the IAA biodiversity hotspot.

### METHODS

#### Sampling

I sampled species of genus *Conus* together with Mark Phuong, from October until December 2015 at key locations across Indonesia (see Fig. 1). With respect to the genetic breaks found in previous studies, we covered 12 sites, putting emphasis on localities associated with the Indonesian Throughflow (ITF), the seasonally shifting currents of the Java and Banda Sea, or the Halmahera Eddy (HE). Once collected in the field, all specimens were preliminary identified based on morphology and subsequently photographed to document the colour patterns of the shell and animal itself. Each specimen was photographed laterally and measured in length to keep morphometric characters for subsequent analysis. Following the morphological documentation, the shell of the specimen was cracked with a bench vice and the tissue dissected and kept in alcohol (96%). We kept up to five specimens of each species from each locality. Species identifications were cross-checked using the species descriptions given in Röckel (*et al*, 1995) and reference sequences from Genbank (NCBI).

#### DNA sequence data

DNA was extracted from 541 individuals applying the E.Z.N.A. Mollusc DNA Kit (Omega Bio-Tek, Doraville, Georgia, USA) and isolation success evaluated using gel electrophoresis. Fragments of the COI region of the mitochondrial DNA were amplified with the universal primers LCO1490 and HCO2198 (Folmer *et al*., 1994), using a 25 µl mastermix of 19.8 µl $ddH^20$, 2.5 µl 10x Buffer, 0.5 µl Primer 1, 0.5 µl Primer 2, 0.5 µl dNTPs, 0.2 µl Taq-Polymerase and 1 µl DNA template. As the amplification success varied between species, the concentration of the DNA template was adjusted to yield sufficient target amplification. To avoid the amplification of pseudogenes, a different protocol and customized primers were applied to members of the *C. sponsalis* species complex (*C. sponsalis*, *nanus*, *parvatus* and *musicus*) following Duda *et al., (*2008). The amplicons were concentrated with a Concentrator Plus (Eppendorf, Germany) and sent for sequencing at Macrogen (Amsterdam, Netherlands). Sequencing was performed via Sanger sequencing in both directions. The retrieved sequences were quality-checked and edited within single species alignments with CodonCode Aligner (Version 5.1.5, CodonCode Corporation).

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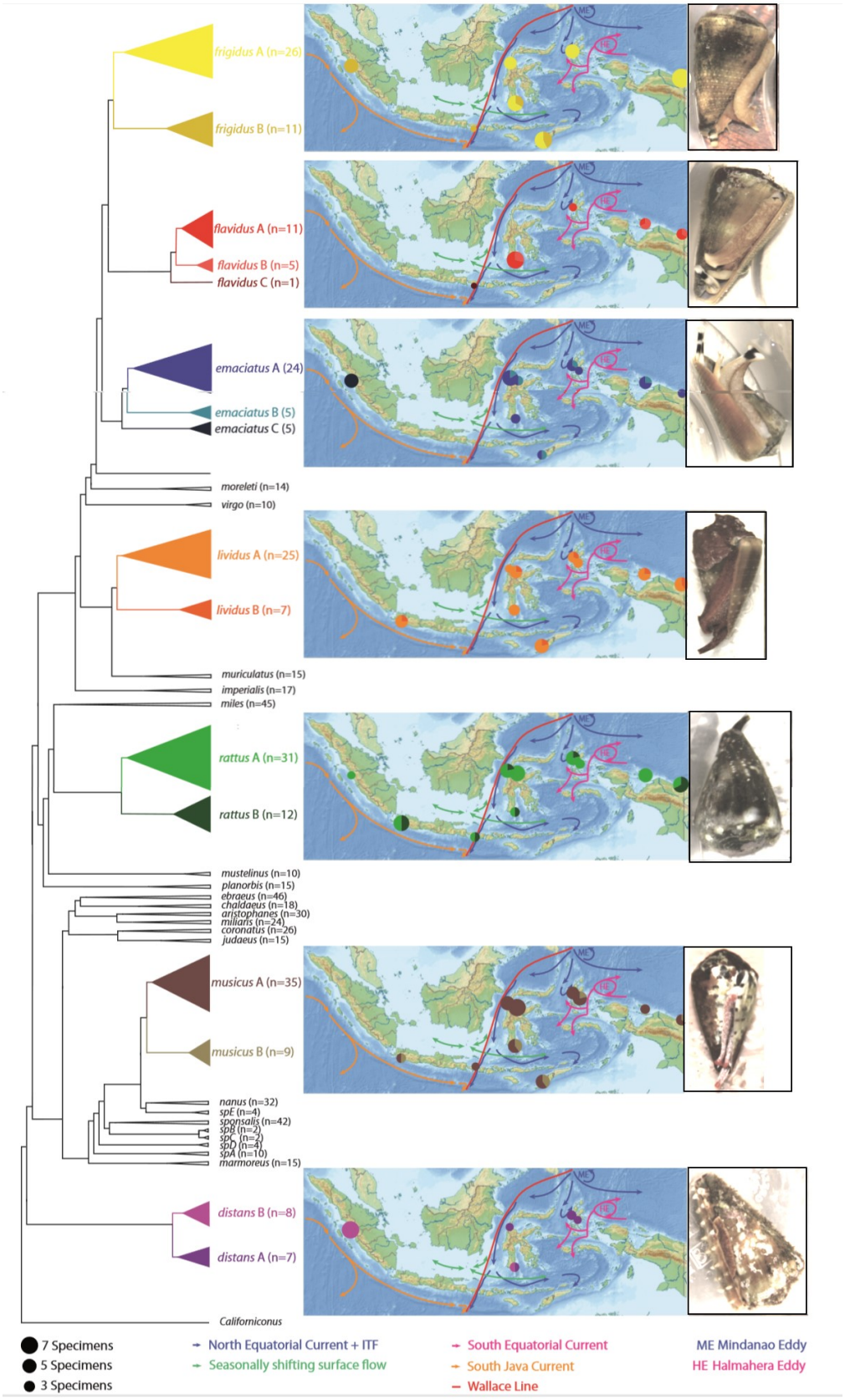


**Figure 1** Neighbour-Joining tree showing the clustering of haplotypes of 28 *Conus* morphospecies based on p-distance. The terminal ends of the tree were collapsed and the MOTU and number of the specimens per MOTU are given. Each morphospecies comprising distinct haplotype clusters features a map and a picture of a specimen. The map indicates the haplotype distribution within the IAA by pie charts, giving the color code and total number of all the haplotypes sampled at this locality as well as the location and flow direction of the prevailing currents and the Wallace Line. The tree was rooted with *Californiconus* as the outgroup.

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### Neighbour-Joining and pairwise distances

A COI gene alignment of 624 individuals was used for a phylogenetic reconstruction via Neighbour-Joining (MEGA 7.0.18; Muscle, 1000 bootstrap replicates, p-distance, d:transitions + transversions, gamma distributed rates with invariant sites (G+I), pairwise deletions). The terminal ends of the phylogeny represent haplotypes clustered by genetic distance. Each of these haplotype clusters was cross-checked for identity with the corresponding morphological vouchers and to see if they contained all and only sequences of the same species. Genetic structure was inferred when members of a morphospecies were contained within distinct haplotype clusters, each representing distinct molecular operational taxonomic units (MOTUs). Pairwise distances (p-distances) were calculated for all haplotype clusters using MEGA.

## RESULTS

### Haplotype clusters and p-distances

Whereas most of the observed species lacked genetic structure in their relationships, three distinct haplotypes were found for *Conus flavidus* and *C. emaciatus,* and two for *C. frigidus*, *C. lividus*, *C. rattus*, *C. musicus* and *C. distans*. The maximum p-distances between any clusters containing haplotypes of the same morphospecies vary from 0.011 (*C. lividus*) to 0.073 (*C. distans).* Apart from *C. rattus* and *C. distans,* the maximum p-distance does not exceed the 4% threshold for differentiation of evolutionary significant units as discussed in Meyer & Paulay (2005; see also Duda *et al.,* 2008). Furthermore, the minimum within and maximum between p-distances were found to overlap in the case of *C. flavidus*, *C. lividus*, *C. rattus* and *C. musicus* (Table 1) and underline the enigmatic taxonomic character of the corresponding species and MOTUs. The latter two species show a high degree of genetic intra-MOTU variability as expressed by the maximum within p-distance.

| | Cluster Comparison | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I vs. II | | | I vs. III | | | II vs. III | | |
| Species | max. between | max. within | min. between | max. between | max. within | min. between | max. between | max. within | min. between |
| *C. distans* | 0.073 | 0.012 | 0.063 | - | - | - | - | - | - |
| *C. emaciatus* | 0.017 | 0.008 | 0.011 | 0.032 | 0.011 | 0.021 | 0.033 | 0.011 | 0.024 |
| *C. flavidus* | 0.021 | 0.013 | 0.006 | 0.030 | 0.013 | 0.024 | 0.035 | 0.008 | 0.029 |
| *C. frigidus* | 0.035 | 0.011 | 0.021 | - | - | - | - | - | - |
| *C. lividus* | 0.011 | 0.009 | 0.003 | - | - | - | - | - | - |
| *C. musicus* | 0.027 | 0.025 | 0.006 | - | - | - | - | - | - |
| *C. rattus* | 0.060 | 0.036 | 0.032 | - | - | - | - | - | - |

**Table 1: Minimum and maximum p-distances calculated for the haplotype clusters for the species for which multiple MOTUs were found.**

### Haplotype distribution

The differentiated haplotypes of *C. lividus* and *C. rattus* occurred together at multiple localities and show a ubiquitous distribution throughout the IAA. This may be due to the long planktonic phase of the corresponding species' larvae (28-29 and 25 -26 days respectively) which potentially enabled bringing once separated populations, and the differentiated haplotypes, into secondary contact.

*C. distans* and *C. frigidus* feature two very distinct haplotypes, which show some degree of geographic structure. For both species, one haplotype was found at West Sumatra exclusively. They were found together however, with members of their other haplotype-cluster at the site of South Sulawesi. Furthermore, both *C. frigidus* haplotypes were found together at the site of Kupang, Timur.

*C. flavidus* and *C. emaciatus* show strong geographic structure and a haplotype distribution that follows the hypothesized Wallace Line. Comparable with the results for *C. distans* and *C. frigidus,* one haplotype of *C. emaciatus* was found at the West Sumatra site exclusively. However, its two other haplotypes are found to co-occur at various sites east of the Wallace Line. Furthermore, two haplotypes of *C. flavidus* were found together at the majority of the sampling sites east of the Wallace Line, whereas one haplotype was found west of it, at Bali only.

## DISCUSSION

### Genetic structuring and species delimitations

In this comparative phylogeographic analysis of 28 *Conus* species in the IAA, we found a variety of contrasting patterns of genetic structuring. In some species we found strong support for the existence of relatively deep within-species genetic clusters (either sympatric or geographically co-occurring), whereas for others we found no detectable structuring across the entire sampling area. The enigmatic character of the haplotype clusters or MOTUs found in some species highlights the need for further integrative study of the corresponding species, including morphological and morphometric analysis to test the hypothesis of the existence of distinct evolutionary significant units – and potentially new cryptic species - within some of the studied taxa.

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For a variety of species (*C. imperialis*, *C. moreleti*, *C. planorbis*, *C.varius, C. frigidus, C. flavidus*) very distinct haplotypes were found, which contribute to a high intraspecific genetic variation. Despite these high genetic differences, the corresponding haplotypes are identified as members of the same species in Genbank. Many *Conus* taxa, especially closely related species, have morphologically ambiguous characters and are difficult to distinguish from each other. Some taxa are referred to as either a form or a variety of already described species and/or assigned as cryptic members of species complexes (i.e. *Conus nanus*; Röckel *et al*., 1995), until further investigation has been performed (Duda *et al.,* 2008; Duda *et al*., 2009; Lawler & Duda, 2017). This ambiguity of species identification is maintained in many Genbank reference sequences.

**GEOGRAPHICAL STRUCTURE**

The hypothesis of genetic differentiation between populations located east and west of the IAA (i.e. the 'marine Wallace line') cannot be rejected for *C. distans, C. frigidus*, *C. emaciatus* and *C. flavidus*. However, the exact location of this genetic break may be difficult to demarcate for the first two species and does not strictly follow the Wallace Line. Nevertheless, *C. distans, C. frigidus* and *C. emaciatus* feature a genetically distinct population at the site of Padang, West Sumatra. This genetic break may have been induced by limited gene flow due to the recurring isolation of ocean basins during Pleistocene sea-level fluctuations (Voris, 2000). A similar break has previously been found at this locality for populations of the giant clams *Tridacna crocea* (DeBoer *et al.,* 2008) and *Tridacna maxima* (Nuryanto & Kochzius, 2009) and the false clownfish *Amphiprion ocellaris* (Nelson *et al.* 2000; Timm & Kochzius, 2008).

The maintenance of genetic isolation is more likely for species featuring larval retention or short-living larvae with low dispersal potential (Kirkendale & Meyer, 2004; Cunha *et al.,* 2005; Imron *et al,* 2007) and may thus not be the case for the *Conus* species observed in this study. Furthermore, the omnipresence of coral reef habitat in the present time since the last sea level fluctuations may have provided stepping stones to quickly erase any population genetic boundaries to gene flow and differences in haplotype distribution between those species (Kirkendale & Meyer, 2004; Imron *et al.,* 2007). Nevertheless, the genetic signature of past vicariance is observed to be retained by distinct haplotypes, but obscured by varying degrees of re-admixture. Hence, the corresponding haplotypes may not yet have re-established archipelago wide representation following sea level rise and reestablished connectivity.

Interestingly, however, *C. distans* (28 days), *C. flavidus* (23 days) and *C. frigidus* (22-24 days) show larval durations comparable to, but with haplotype distributions different from, *C. lividus* (28-29 days) and *C. rattus* (25-30 days), which have ubiquitous haplotypes. Taking further into account that *C. distans*, *C. flavidus* and *C. frigidus* feature a similar ecology, feeding on (terebellid) polychaetes and dwelling in the intertidal and shallow subtidal habitats of the coral reef, it can be hypothesized that similar other environmental factors may be responsible for maintaining the congruent genetic and geographical structure as it was found in this study. For example, ecological factors such as the availability of suitable habitat and prey, and subtle differences in dispersal ability and/or ecological requirements, may influence the rate of gene flow and genetic connectivity between populations (Crandall *et al.,* 2008).

The geographical location of allopatric populations, which may facilitate dispersal due to the flow direction of the prevailing ocean currents, may also have played a role. Isolation of the populations at West Sumatra may be maintained by present day flow direction of the South Java Current, which flows along the southern coasts of Sumatra and Java to the southeast. Due to the current flow direction out of the Java Sea between Sumatra and Java, access into this region and to the east of the IAA may also be limited. The ITF prevents dispersal into northern Indonesia via the Makassar Strait (Wyrtki 1961; Hendiarti *et al.* 2004).

Finally, the amount of time since differentiation of the haplotype groups and the subsequent chance for re-admixture by the re-established connectivity of marine populations could have been a factor. This issue will be addressed via molecular clock analysis and correlated with the geographical and oceanographical history of the IAA, to be published in a future study. These results may also be due to insufficient sampling, so future work will be needed including more individuals and more sites, which additionally feature a higher number of microhabitats.

**ACKNOWLEDGEMENTS**

I thank the Malacological Society of London for providing funds (Early Career Research Grant 2016), which covered expenses for the amplification and sequencing of the sampled specimens, Dr. Mark Phuong and Dr. Thomas von Rintelen for the realization of the sampling and together with Dr. Luis Valente for the ongoing support and critical feedback to realize this work.

**REFERENCES**

Abalde, Samuel, *et al.* 2017 Mitogenomic phylogeny of cone snails endemic to Senegal. *Molecular phylogenetics and evolution* 112: 79-87.

Barber, Paul H., e*t al.* 2000 Biogeography: a marine Wallace's line? *Nature* 406.6797: 692.

Barber, Paul H., Mark V. Erdmann & Stephen R. Palumbi. 2006 Comparative phylogeography of three codistributed stomatopods: origins and timing of regional lineage diversification in the coral triangle. *Evolution* 60: 1825-1839.

Carpenter, Kent E., *et al.* 2011 Comparative phylogeography of the Coral Triangle and implications for marine management. *Journal of Marine Biology* 2011.

Crandall, Eric D., *et al.* 2008 Contrasting demographic history and phylogeographical patterns in two Indo-Pacific gastropods. *Molecular ecology* 17: 611-626.

Cunha, Regina L., *et al.* 2005 Patterns of cladogenesis in the venomous marine gastropod genus *Conus* from the Cape Verde Islands." *Systematic biology* 54: 634-650.

Cunha, Regina L., et al. 2008 Replaying the tape: recurring biogeographical patterns in Cape Verde *Conus* after 12 million years." *Molecular Ecology* 17: 885-901.

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Cunha, Regina L. *et al.* 2014 Evolution at a different pace: distinctive phylogenetic patterns of cone snails from two ancient oceanic archipelagos." *Systematic biology* 63: 971-987.
DeBOER, TIMERY S. *et al.* 2008 Phylogeography and limited genetic connectivity in the endangered boring giant clam across the Coral Triangle. *Conservation Biology* 22: 1255-1266.
Duda Jr, Thomas F. & Alan J. Kohn. 2005 Species-level phylogeography and evolutionary history of the hyperdiverse marine gastropod genus Co*nus. Molecular phylogenetics and evolution* 34: 257-272.
Duda Jr, Thomas F. & Emilio Rolan. 2005 Explosive radiation of Cape Verde *Conus*, a marine species flock. *Molecular ecology* 14: 267-272.
Duda Jr, Thomas F. *et al.* 2008 Hidden diversity in a hyperdiverse gastropod genus: discovery of previously unidentified members of a *Conus* species complex. *Molecular Phylogenetics and Evolution* 49: 867-876.
Duda, Thomas Franklin & Taehwan Lee. 2009 Isolation and population divergence of a widespread Indo-West Pacific marine gastropod at Easter Island. *Marine biology* 156: 1193-1202.
Duda, T. F. & Harilaos A. Lessios. 2009 Connectivity of populations within and between major biogeographic regions of the tropical Pacific in Conus ebraeus, a widespread marine gastropod. *Coral Reefs* 28: 651-659.
Duda Jr, Thomas F. *et al.* 2009 Geographic variation in venom allelic composition and diets of the widespread predatory marine gastropod *Conus ebraeus. PLoS One* 4: e6245.
Duda, Thomas F. *et al.* 2012 Patterns of population structure and historical demography of *Conus* species in the tropical Pacific. *American Malacological Bulletin* 30: 175-188.
Folmer, O. *et al.* 1994 Conserved primers for PCR amplification of mitochondrial DNA from different invertebrate phyla. *Molecular Marine Biology and Biotechnology* 3: 294-299.
Hendiarti, Nani, Herbert Siegel & Thomas Ohde. 2004 Investigation of different coastal processes in Indonesian waters using SeaWiFS data." *Deep Sea Research Part II: Topical Studies in Oceanography* 51.1-3: 85-97.
Imron et al. 2007 Pleistocene isolation and recent gene flow in *Haliotis asinina*, an Indo-Pacific vetigastropod with limited dispersal capacity. *Molecular Ecology* 16: 289-304.
Kirkendale, Lisa A. & Christopher P. Meyer. 2004 Phylogeography of the Patelloida profunda group (Gastropoda: Lottidae): diversification in a dispersal-driven marine system. *Molecular Ecology* 13: 2749-2762.
Lourie, Sara A., & Amanda CJ Vincent. 2004 Using biogeography to help set priorities in marine conservation. *Conservation Biology* 18: 1004-1020.
Meyer, Christopher P. & Gustav Paulay. 2005 DNA barcoding: error rates based on comprehensive sampling. PLoS biology 3: e422.
Sulaiman, Zohrah Haji, and Jennifer R. Ovenden. 2010 Population genetic evidence for the east–west division of the narrow-barred Spanish mackerel (*Scomberomorus commerson*, Perciformes: Teleostei) along Wallace's Line." *Biodiversity and Conservation* 19: 563-574.
Voris, Harold K. 2000 Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems and time durations. *Journal of Biogeography* 27: 1153-1167.
Wyrtki, Klaus. 1961 The thermohaline circulation in relation to the general circulation in the oceans. *Deep Sea Research* 8: 39-64.



## Population genetic diversity of invasive apple snails, *Pomacea canaliculata*, in Peninsular Malaysia

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### INTRODUCTION

Invasive species are one of the key threats to global biodiversity and impose massive economic costs for their control and eradication. *P. canaliculata*, the golden apple snail, is ranked as one of the world's 100 worst invaders and has spread into multiple ponds, lakes, and agricultural wetlands especially rice fields in Malaysia. (Figs1 & 2) The first documentation of *Pomacea canaliculata* in Malaysia was in the year 1990. Also, a closely related species, *Pomacea maculata*, the island apple snail, was documented later in Peninsular Malaysia. *P. maculata* is listed as the 58th worst alien species in Europe (Nentwig e*t al.* 2018). is a key element of biodiversity and allows measurement of the level of genetic variability within individuals and populations, and between populations.

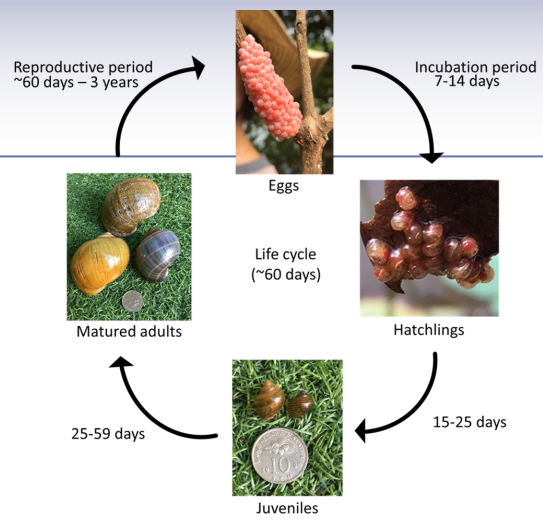


**Figure 1: Life cycle of *Pomacea* spp.**

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*Pomacea* has attracted worldwide attention because of its economic impacts on rice and taro agriculture and its ability to reproduce and spread rapidly. Damage to Malaysia's rice agro-industry from *Pomacea* in 2009 was estimated to be 590 thousand $USD in non-granary areas and approximately 11 million $USD in granary areas (Yahaya *et al.* 2017).

To date, studies on *Pomacea* spp. in Peninsular Malaysia have been confined to systematics and population control in the field, but little is known about their origins of introduction and routes of invasion. Patterns of distribution and genetic diversity of the two species of *Pomacea* can tell us about potential sites of introduction, gene flow, and the capacity for evolution and adaptation, which would help in efficient measures of control. Genetic diversity is a key element of biodiversity and measures the level of genetic variability within individuals and populations, and among populations.

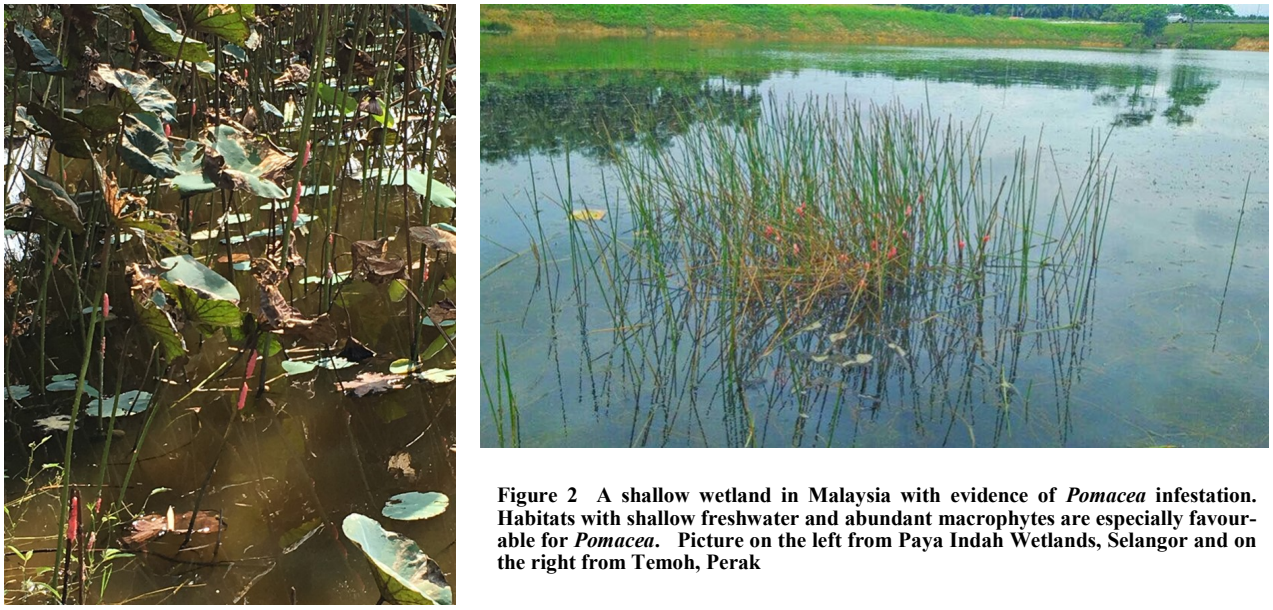

**Figure 2 A shallow wetland in Malaysia with evidence of *Pomacea* infestation. Habitats with shallow freshwater and abundant macrophytes are especially favourable for *Pomacea*. Picture on the left from Paya Indah Wetlands, Selangor and on the right from Temoh, Perak**

The level of genetic diversity within a population may affect the sustainability, growth, productivity, and also interspecific interactions within communities and ecosystem-level process (Hughes *et al.* 2008).

Genetic tools such as DNA-based molecular markers play an important role in assessing the genetic diversity of *Pomacea* spp. in Malaysia. Mitochondria markers have long served as the tool of choice for questions of taxonomy, species identification, genetic diversity, and phylogeny in animal and plant populations (Hayes *et al.* 2009, Galtier *et al.* 2009). Many genetic diversity and phylogeographic studies were based solely on mitochondrial markers. However, nuclear markers may be more informative to infer the evolutionary history of many groups (e.g., Hare *et al*. 2002, Dantas *et al*. 2012).

Mitochondrial and nuclear markers have different modes of inheritance; thus, demographic events mould variation of these molecular markers differently. Generally, mitochondrial genes do not undergo recombination and are maternally inherited; thus the history of the population is based on female demographic patterns alone. Nuclear markers, on the other hand, experience recombination, reflecting both male and female demographic histories, and have deeper coalescence times (Dantas *et al*. 2012). Therefore, the use of mitochondrial and nuclear markers gives us a more accurate evolutionary history of the group that is being investigated. In this study, we used both mitochondrial cytochrome oxidase subunit 1 (COI) and the nuclear ribosomal internal transcribed spacer (ITS) to study the genetic diversity of *Pomacea canaliculata*. Once we understand the route of invasion, the genetic lineages and divergence of the snails, development of effective management of *Pomacea* spp. in agriculture and native wetland would be easier and this could minimize their spread.

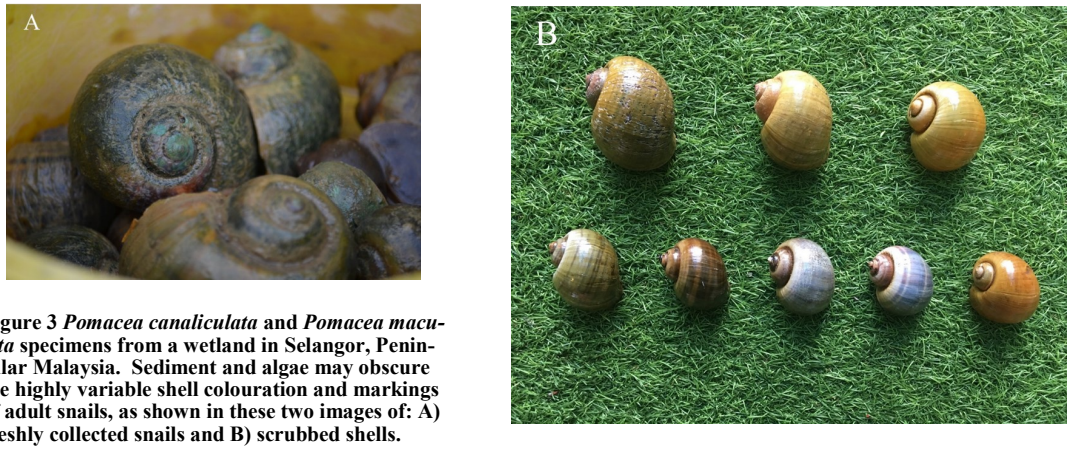


**Figure 3 *Pomacea canaliculata* and *Pomacea maculata* specimens from a wetland in Selangor, Peninsular Malaysia. Sediment and algae may obscure the highly variable shell colouration and markings of adult snails, as shown in these two images of: A) freshly collected snails and B) scrubbed shells.**

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In the present study, 184 *P. canaliculata* specimens were collected from 25 locations in Peninsular Malaysia. We used two different markers: a mitochondrial cytochrome c oxidase subunit (COI) and nuclear ribosomal DNA Internal Transcribed Spacer (ITS) to study the population genetic diversity of *Pomacea* spp.

The statistical parsimony network of 184 taxa of the COI gene revealed eight haplotypes based on the specimen collected from 25 geographic localities (Fig. 4). The intraspecific nucleotide differences of *P. canaliculata* ranged from 0-30 bp over 648 bp with haplotype diversity, (h) 0.2657 and nucleotide diversity, π 0.00676. Among the examined haplotypes, MC1 was the hypothetical ancestral with 155 individuals. We can observe that location A and B share the same haplotypes, followed by unique haplotypes shared in site K, L, M, P and Q with site M and K having the most number of haplotypes (Fig. 4).

The ITS marker revealed 45 haplotypes from 184 *P. canaliculata* specimens (Fig. 5). The intraspecific nucleotide variation of *P. canaliculata* ranged from 0-48 bp over 565 bp with haplotype diversity, (h) 0.8467and nucleotide diversity, π 0.01493. Haplotype NC1 is inferred as the hypothetical ancestral with 61 individuals. Site A and M have the most number of haplotypes which shows similar results with the COI marker suggesting the probable site of introduction. Besides, haplotypes on the east coast of Peninsular Malaysia are slightly different from the west coast of Peninsular Malaysia which may be due to the different topography because there are no natural routes of dispersal, It could be artificial dispersal however, which accounts for some of the shared haplotypes. Some of the busiest shipping ports are located in the west coast of Peninsular Malaysia which explains the unique haplotypes found in the north, middle and south side of west Peninsular Malaysia.

This study represents the first extensive genetic diversity study of invasive snail *Pomacea canaliculata* in Peninsular Malaysia. The findings of this study showed that nuclear ITS comprises a potential marker that can be used to study the population genetic diversity of *Pomacea* spp. as it is more variable compared to the mitochondrial COI gene. Besides, the presence of two or more haplotypes at a single site suggests more than one independent introduction, evolutionary change, or dispersal. This essential information provides insight into the origin and evolutionary relationships of *P. canaliculata* in Peninsular Malaysia.

**REFERENCES**


Hayes, K., H. Cowie, R., & C. Thiengo, S. 2009 A global phylogeny of apple snails: Gondwanan origin, generic relationships, and the influence of outgroup choice (Caenogastropoda: Ampullariidae). *Biological Journal of the Linnean Society*, 98, 61–76.

Dantas, G. P. de M., Meyer, D., Godinho, R., Ferrand, N., & Morgante, J. S. 2012 Genetic variability in mitochondrial and nuclear genes of Larus dominicanus (Charadriiformes, laridae) from the Brazilian coast. *Genetics and Molecular Biology*, 35(4), 874–885. https://doi.org/10.1590/S1415-47572012005000065

Galtier, N., Nabholz, B., GlÉmin, S., & Hurst, G. D. 2009 Mitochondrial DNA as a marker of molecular diversity: A reappraisal. *Molecular Ecology*, 18(22), 4541–4550. https://doi.org/10.1111/j.1365-294X.2009.04380.x

Hare, M. P., Cipriano, F., Palumbi, S. R., & Palumbi, R. 2002 Genetic evidence on the demography of speciation in allopatric dolphin species, 56(4), 804–816.

Hughes, A. R., Brian, D., Johnson, M. T. J., & Underwood, N. 2008 Review and ecological consequences of genetic diversity, 609–623. https://doi.org/10.1111/j.1461-0248.2008.01179.x

Nentwig, W., Bacher, S., Kumschick, S., Pyšek, P., & Vilà, M. 2018 More than "100 worst" alien species in Europe. *Biological Invasions*, 20(6), 1611–1621. https://doi.org/10.1007/s10530-017-1651-6

Yahaya, H & Amzah, Badrulhadza & Sivapragasam, Annamalai & Nordin, M & N Muhamad Hisham, M & Misrudin, H. 2017 Invasive apple snails in Malaysia. In book: *Biology and management of invasive apple snails*, 2nd edition,


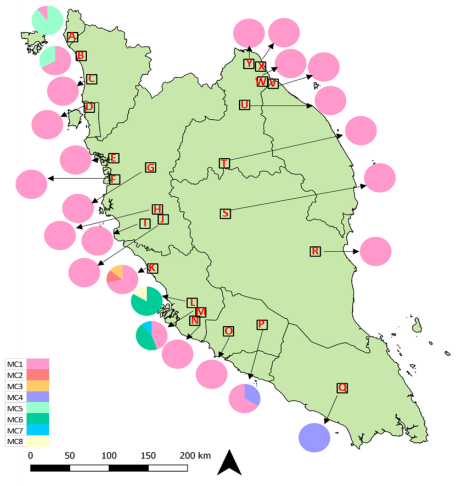


**Figure 4 Haplotype distribution and proportion of the mitochondrial COI gene for *Pomacea canaliculata* from Peninsular Malaysia. Colours in the pie chart indicate the different haplotypes.**

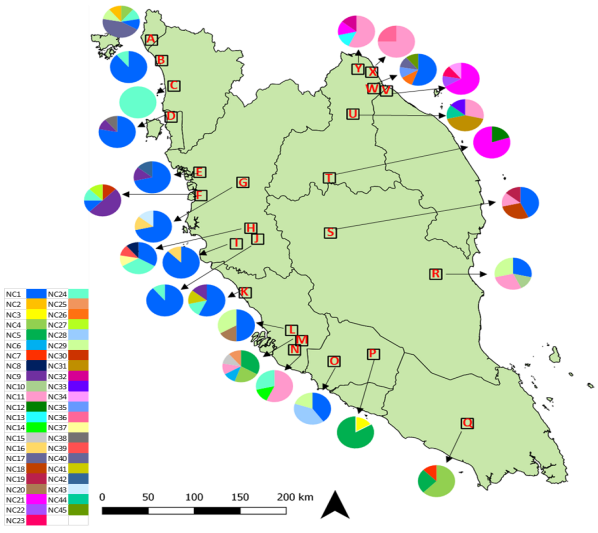


**Figure 5 Map of Peninsular Malaysia indicating distribution and proportion of the nuclear ITS haplotypes for *Pomacea canaliculata*. Colours in the pie chart indicate the different haplotypes.**

# First survey of the terrestrial gastropods of Ulu Temburong National Park, Brunei Darussalam

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## INTRODUCTION

The sultanate of Brunei Darussalam covers a small area on the northern part of the island of Borneo and lies roughly in between the Malaysian states of Sabah and Sarawak. Brunei is unusual in that it, thanks to its great oil reserves, has never been forced to exploit its timber resources to any great extent. It therefore still holds large tracts of undisturbed dipterocarp lowland forest. Sabah and Sarawak have been the focus of multiple malacological studies on taxonomy, community ecology, biogeography, and conservation (e.g. Meijaard & Douglas, 2007), but Brunei Darussalam so far has hardly been studied malacologically, although located in the centre of the biodiversity hotspot of North Borneo. As land snails in Borneo are often endemic to minute ranges, it is likely that Brunei harbours previously unknown species, as well as species known from Sabah and Sarawak for which the full range was incompletely known (Schilthuizen *et al*., 2013; papers since 1991 until today by Schilthuizen, Vermeulen, and Liew as cited in Phung, Yu & Liew (2017).

Taxon expeditions (*sensu* Schilthuizen *et al.,* 2017) are tropical field trips for non-scientists in order to generate scientific knowledge in the form of biodiversity assessments and new-species descriptions of invertebrate species (e.g. Freitag, Pangantihon & Njunjić, 2018). The expeditions previously organized to Malaysian Borneo and Montenegro resulted in media coverage, social-media content, species-distribution information and scientific papers in open-access journals. The survey of the land and freshwater snails of Ulu Temburong national park in Brunei Darussalam described here will result in an open-access checklist which gives new insights into the distribution, ecology, and biology of the terrestrial gastropods of the area, will give valuable information about the conservation-status of the snails, and will draw public attention to land-snail diversity, citizen science, and biodiversity studies in Brunei Darussalam in general.

## MATERIALS AND METHODS

During the 25th September to 6th October, 2018, fieldwork trip of Taxon Expeditions to the Ulu Temburong National Park, organized from the Kuala Belalong Field Studies Centre (KBFSC), gastropods, among other invertebrate groups, were collected using manual collecting by day and by night, and by leaf-litter sieving and Winkler bagging. Several locations around the KBFSC were sampled (Fig. 1). Empty shells as well as fresh, living snails were collected. Living snails were preserved in 96% ethanol after relaxing (drowning). Tissue samples of a few snail species were taken for DNA-barcoding purposes. Snail species were initially sorted into morphospecies using light-microscopy (dissection microscopes), with the help of citizen-scientists.

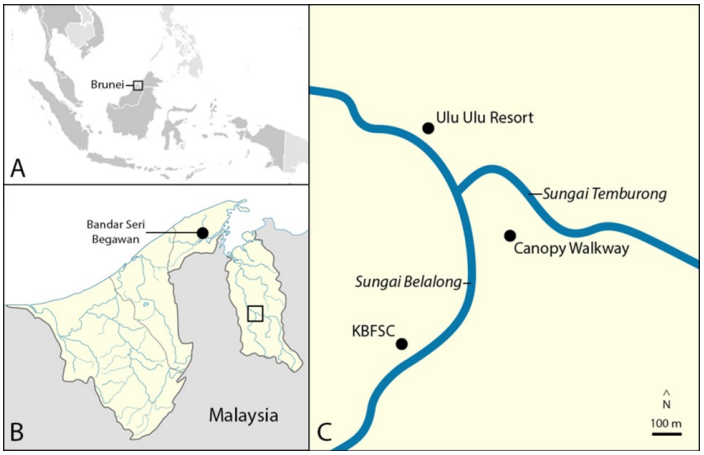


**Fig. 1: Map of the sampling localities around the Kuala Belalong Field Studies Centre (KBFSC). A. Map of South-East Asia, B. Map of the Sultanate Brunei Darussalam with inset C, C. Schematic map of the sampling areas around the Ulu Ulu Resort, the Canopy Walkway and the KBFSC.**

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Identification was performed using external morphological (shell) characters as well as anatomy, using the complete set of heritage and contemporary literature for Borneo, available in digital form in the Taxon Expeditions field laboratory. With the help of experienced malacologists on site, DNA was extracted in the mobile DNA lab of Taxon Expeditions, and analysed using next-gen sequencing techniques and a MinION Nanopore hand-held sequencing machine (Menegon *et al*., 2017). All physical shells of gastropod species were digitally linked to identifications, photographs, locality information, time and date of capture and if possible, DNA sequences. The physical collections were curated and stored in the collection of University of Brunei Darussalam (Gadong, Brunei Darussalam) and the Naturalis Biodiversity Center (Leiden, the Netherlands) after the fieldwork trip. All records will be uploaded to the web-based taxonomy site Bornean Terrestrial Molluscs (http://borneanlandsnails.myspecies.info/).

**PRELIMINARY RESULTS**

During the two-week collection period, a total of 83 snails belonging to at least sixteen different morphospecies of terrestrial or freshwater gastropods were collected and, where possible, identified. Sizes ranged from large (5 cm shell diameter) *Hemiplecta* species to very small (2 mm) *Microcystina* snails (both Ariophantidae). Like the Ariophantidae, the families Dyakiidae and Cyclophoridae were well-represented in the Bruneian rainforest (Table 1). The most abundant species by far was the bright-red *Schistoloma anostoma* (Benson, 1852), previously not yet recorded from Brunei. While some species could easily be identified using Schilthuizen, Vermeulen & Liew (2005; unpublished field guide), three species might be new to science, like the *Leptopoma* species figured here (Fig. 2), which resembles, but may not be conspecific with, *L. sericatum* (Pfeiffer, 1851).

**Table 1 Sampled families, number of species and the number of collected snails from those families**

| Family | Nr. of species | Nr. of collected snails |
|---|---|---|
| Ariophantidae | 5 | 21 |
| Chronidae | 1 | 4 |
| Cyclophoridae | 4 | 14 |
| Dyakiidae | 3 | 5 |
| Nassariidae | 1 | 8 |
| Pupinidae | 1 | 30 |
| Trochomorphidae | 1 | 1 |


**Figure 2 *Leptopoma* sp. found along one of the streams of the Sungai Temburong. Photo credit: Pierre Escoubas (RivieraMacro) for Taxon Expeditions, 2018**

**REFERENCES**

Freitag H, Pangantihon CV, Njunjić I (2018) Three new species of Grouvellinus Champion, 1923 from Maliau Basin, Sabah, Borneo, discovered by citizen scientists during the first Taxon Expedition (Insecta, Coleoptera, Elmidae). *ZooKeys* 754: 1–21 https://doi.org/10.3897/zookeys.754.24276

Meijaard E, Douglas S (2007) Is wildlife research useful for wildlife conservation in the tropics? A review for Borneo with global implications. *Biodiversity and Conservation* 16: 3053. https://doi.org/10.1007/s10531-007-9161-y

Menegon M, Cantaloni C, Rodriguez-Prieto A, Centomo C, Abdelfattah A, Rossato M, et al. (2017) On site DNA barcoding by nanopore sequencing. *PLoS ONE* 12(10): e0184741. https://doi.org/10.1371/journal.pone.0184741

Schilthuizen M, Liew TS, Liew TH, Berlin P, King JP, Lakim M (2013) Species diversity patterns in insular land snail communities of Borneo. *Journal of the Geological Society* 170(3): 539–545 http://dx.doi.org/10.1144/jgs2012-014

Schilthuizen M, Seip L, Otani S, Njunjić I (2017) Three new minute leaf litter beetles discovered by citizen scientists in Maliau Basin, Malaysian Borneo (Coleoptera: Leiodidae, Chrysomelidae). *Biodiversity Data Journal* 5: e21947. https://doi.org/10.3897/BDJ.5.e21947

Phung CC, Yu FTY, Liew TS (2017) A checklist of land snails from the west coast islands of Sabah, Borneo (Mollusca, Gastropoda). *Zookeys* 673: 49–104 https://doi.org/10.3897/zookeys.673.12422.

# Travel grant report

## Shell microstructures of planktonic gastropods

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Pteropods comprise a group of holoplanktonic gastropods that build thin and delicate shells of aragonite, a calcium carbonate polymorph. Shelled pteropods have received great attention over the last decade — they are reported to decrease calcification and experience shell dissolution under high $CO_2$ levels, which is why they are proposed as bioindicators of the effects of ocean acidification.

Similar to other molluscs, pteropods build shells through a biomineralisation process. Studying their shell microstructures is especially informative — it provides insights on shell formation and the underlying biological control of the process. My research is focused on biomineralisation genes in pteropods including *Limacina*, *Heliconoides* and *Diacria* species. In parallel, I study their shell microstructures in order to elucidate how shell structural diversity relates with the *'genetic toolkit'* found to be required for biomineralisation. For the characterisation of planktonic shell microstructures I started collaborating with Dr. Frédéric Marin, who has been dedicated to the study of biominerals for more than 20 years. In February 2019 I visited his laboratory based at the University of Burgundy-Franche-Comté, France. There we were able to prepare pteropod shells for Scanning Electron Microscopy observations. Our sample preparation included fresh cuts on shells but also polished cuts. For polished cuts we fixed shells in epoxy resin and carefully sectioned them to avoid cracking, while cutting at different angles to have a detailed view of the microstructures at different shell locations.

The Travel Award from the Malacological Society was important to support my travel expenses during this research visit. I am very grateful for this contribution from the Society. It is my plan to continue this fruitful collaboration as a Marie Curie post-doc hosted by Naturalis Biodiversity Center working on the project EPIC: "*The evolution and future of planktonic gastropod calcification".*

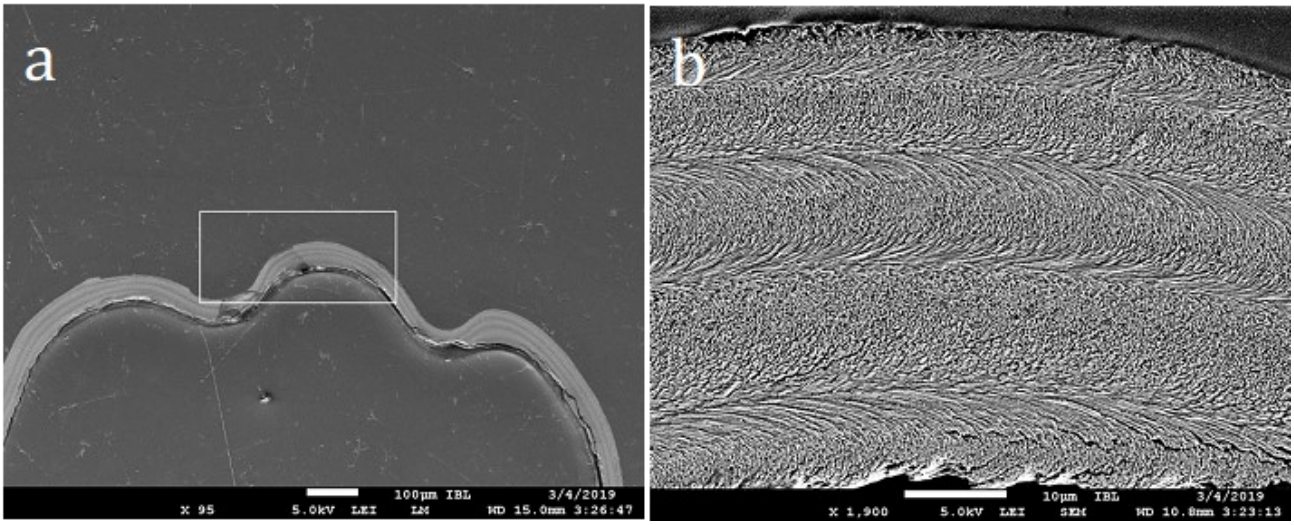


**Figure: Microstructure visualization with SEM (a) view of the microstructure of a polished cut from the shell of the pteropod *Diacria costata*. (b) polished cut at higher magnification highlighting the layers with helical microstructure of *Diacria costata*.**

## In Memoriam

# Andrzej Wiktor (1931-2018)

Professor Andrzej Wiktor died on the very last day of 2018. To anyone concerned with the biology and taxonomy of terrestrial slugs, he was a master; his numerous monographs, meticulous observations and magnificent drawings will remain as memorials to his achievement. His work constitutes the basis on which the younger generation of molecular systematists are building.

A schoolboy in the terrible conditions of occupied Poland in the Second World War, Andrzej Wiktor started his University studies at Poznań University, continuing to a Master's degree (1954) at the University of Wrocław, and his PhD in 1962. In these early years, his research was essentially a "spare time activity", carried out while having heavy teaching and administrative duties at the Medical University of Wrocław. He then moved to the Natural History Museum at Wrocław, becoming its Director in 1980 until his retirement in 2002. He became a State Professor in 1989. He continued to work at the museum for many years after his retirement.

For those of us working in more tranquil environments, it is a revelation to consider some of the constraints that working within the Communist system entailed. In 1984 he was elected Rector Magnificus (the equivalent of Vice-Chancellor) of the University of Wrocław, but for political reasons (the fact that he was never a member of any political organisation and known to be opposed to the communist system; Martial Law was in operation) the then Minister of Science and Higher Education refused to endorse the election on the ground that Wiktor as rector "would not ensure the proper socialist upbringing of the students".

He is an author or co-author of more than 100 publications, the great majority on slugs. While his early work concerned all the gastropod fauna of Poland, slugs became his passion, starting with those of Poland, but extending worldwide. Most contained his meticulous drawings, and were written in German or English. Both on his own and in collaboration, he wrote monographs on the slugs of Poland, Bulgaria, Greece, Pakistan and others. Sometimes with others he described around 60 new species and revised the systematics of many families (Milacidae, Parmacellidae, Anadenidae, Agrilimacidae and Limacidae). After retirement he also wrote an illustrated guide to the terrestrial molluscs of Poland (2004).

A more comprehensive account of his achievements, including a complete bibliography, is given in the Polish journal *Folia Malacologica,* 19 (4), 2011, a volume serving as a *festschrift* presented to him on his 80th birthday. It remains only to add that Andrzej Wiktor was someone who inspired enthusiasm, who went out of his way to help others, and whose passing affects many of us, in many countries. I can testify to the help, advice and encouragement I received on my first visits to Poland, help given even to a heretic who studied snails.

My thanks go to my Polish colleagues Beata Pokryszko, Andrzej Lesicki and Ewa Stworzewicz, who have allowed me to use parts of a longer appreciation to appear in *Folia Malacologica* later this year.



## Sea slugs of Southern Norway – an example of citizens contributing to science

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**ABSTRACT**

Citizen scientist are volunteers who help out scientists by providing them with data as a hobby. The concept originated in the USA and UK during the 1990s in an attempt to open up science to the public. Some examples of successful projects are the online platform iNaturalist with around 1.0 million users, Zooniverse with 1.7 million users and eBird with roughly 411K users (as of July 2018). Although Citizen Science also has it pitfalls, its success means that the concept is extensively spread. In Norway: *Sea slugs of Southern Norway* is such an example of a Citizen Science project. With a tiny but tight community of around 135 active members, the project focusses on sea slugs that live along the coast between the Bergen area southwards to the Swedish border. For nearly 80 years, no dedicated survey and scientific work on these animals has taken place in southern Norway and this part of the country is especially vulnerable for the arrival and establishing of alien species. The goal is to establish an image and genetic library of all collected species, explore the occurrence of cryptic species complexes, and monitor the presence of alien species. Southern Norway alone has a coastline of about 8000 Km, which makes it a particularly challenging task to get a proper overview of the sea slug diversity. Thanks to our established network of Citizen Scientists however, the project already registered 90 different species and a total of 1400 new entries in our database. This successful relationship is due to the fact that we actively involve Citizen Scientists in the project by providing sea slug courses, regular updates and discussions via our online Social Media platforms, and participation in club gatherings where we present our work. The *Sea Slugs of Southern Norway* research project is a prime example of how citizens can decisively contribute to the success of a scientific endeavour, making the experience challenging, dynamic and rich!

## SEA SLUGS OF SOUTHERN NORWAY

As of now, Norway has roughly 148 species of sea slugs, which comprise 45 species of the order Cephalaspidea, 7 species of Sacoglossa, 3 species of Pleurobranchomorpha, 2 species of Anaspidea and 91 species Nudibranchia (Fig. 1), which by far represent the biggest majority of the sea slug diversity in Norway. Norway's' past recognizes a number of scientist studying and describing sea slug species since the second half of the 19th century; like the renowned M. Sars, G. O. Sars, S. L. Lovén, N. Odhner, C. Dons among others. The golden times for sea slug species description ended by the middle of the 20th century, and it was not until the end of the century and beginning of the 21st, almost 60–80 years later when scientists like T. Bakken, J. Evertsen, B. Picton and A. Martynov described and inventoried sea slug species (in this case mostly Nudibranchia) in Norway. However, most of these recent works were carried out and based on records off the region between Sogn og Fjordane and Nord-Trøndelag and the Trondheim area (Fig. 2). This left Southern Norway mostly untouched for many more years.

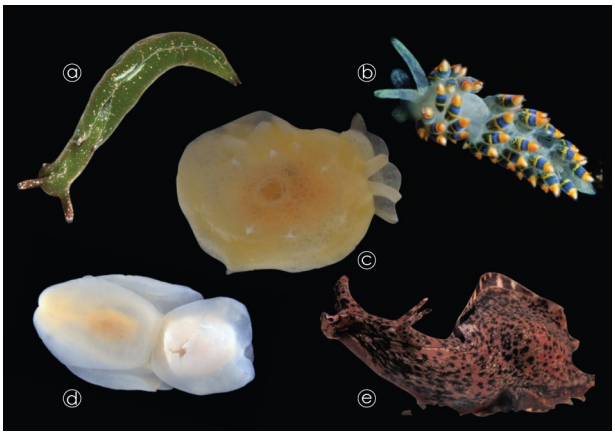


**Figure 1. Norway has roughly 148 species of sea slugs represented by the following 5 orders; (a) the Sacoglossa, (b) the Nudibranchia, (c) the Pleurobranchomorpha, (d) the Cephalaspidea and (e) the Anaspidea.**

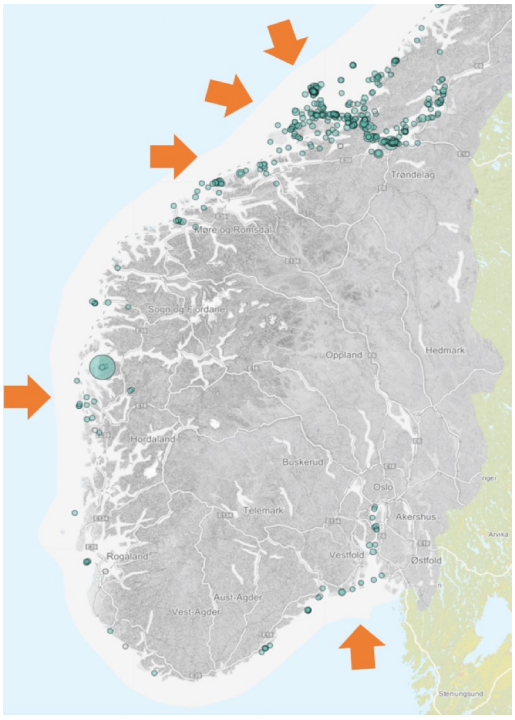


**Figure 2. The registered locations (green dots) of museum specimens of sea slugs of Norway; most locations concentrate around the Trondheim area, and a little in the South with exception for the Oslofjord area (source Artsdatabanken, June 2018)**

We define Southern Norway as the area that stretches from Hordaland county (Bergen region) to the Swedish border. This area is particularly of interest due to the high influx and possible establishment of alien, or non-native species, due to the high amount of ship traffic and the more temperate, somewhat mild conditions of the water. In fact, one of the goals of the project is to monitor and eventually detect the possible occurrence of non-native (alien) species. Furthermore, we aim to register what sea slug species are present in this part of Norway. We want to define the morphological and chromatic characters that distinguish the species and also define the geographic distribution. We also characterise the species habitat and establish a library of species images. And last but not least, we contribute towards a DNA-library of the Norwegian sea slug fauna.

## CITIZEN SCIENCE

The term 'citizen science' was first used in the United States of America and the United Kingdom during the 1990s in an attempt to make science more accessible for the general public. With the rise and increased accessibility of the internet, many citizen scientist projects running through internet platforms gained popularity. SciStarter reported an increase in projects and events based on citizen-science throughout the years; from just a few in 2009 to hundreds of projects in 2018 (Irwin 2018). Even though citizen science has its pitfalls, it is due to its success that it is still gaining popularity. In Norway; *Sea Slugs of Southern Norway* is a project that was able to create an active citizen science community of ca. 200 members who actively participate and contribute in the study of the Norwegian sea slug fauna.

## MATERIAL AND METHODS

We start with collecting the material. Collecting sea slugs can be done in various ways, such as boat dredging, tide pooling or snorkelling but the most efficient is by means of SCUBA (self- contained underwater breathing apparatus). SCUBA divers can very precisely pick the animals and register the exact habitat and depth range, without disturbing the surroundings too much. After collection, the animals are sorted based on morphotypes, registered with museum numbers, photographed and measured. The depth-range, habitat and other remarks are annotated. Afterwards, the animals are frozen overnight, and then defrosted and transferred into absolute ethanol. This procedure helps maintain their natural shape and minimizes autotomization of parts of the body (e.g. shedding off cerata). This makes future anatomical studies much easier. After collecting and fixation, all samples are clipped for tissue for DNA extraction in order to generate a barcoding library of the sea slugs of Norway. This is in collaboration with the Norwegian Barcode of Life project (NorBOL).

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## CITIZEN SCIENCE AND SEA SLUGS

Southern Norway is estimated to have a coastline of ca. 8000km, which poses challenges to properly sample all the potentially interesting areas. Nevertheless, sea slugs are a popular group of molluscs for underwater photographers and SCUBA diving enthusiasts (Fig. 3 & Fig. 4). We therefore contacted several dive clubs and underwater photographers either directly or via social media platforms. Many of them were willing to help out.

In order to reach out to our citizen scientists' community we started a *Sea Slugs of Southern Norway* Facebook group and an Instagram profile and regularly publish popular articles in blogs, magazines and newspapers. For example, we got featured in the national dive magazine *DYKKING* and a local newspaper in Egersund (*Dalende tide*) about our quest for mapping the Southern Norwegian sea slug fauna. We also managed to organize a workshop about sea slugs in March 2019, in which participation was possible for anyone wanting to learn more about sea slugs. Also, whenever there is a chance, we make presentations about the project at dive clubs (Fig. 5). The success of Citizen Science has mostly to do with the enthusiasm and willingness of the volunteers to help out. In return, the project offers participation in fieldwork, possible co-authorships on papers, and acknowledgments.

Initially, samples were taken which had no scientific value because important data like locations, data, depth rang and description of habitats were missing. We also noticed deviations from standard protocols, and obvious biases in choice of sampling sites. This made us sceptical about the citizen-generated data. It inspired us to design a sampling kit in an effort to standardize the method by which sea slugs were collected and inventoried.

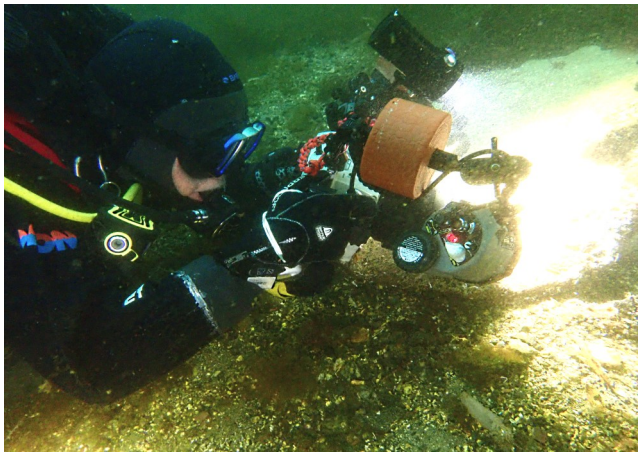

**Figure 3. One of the citizen scientists photographing sea slugs as a hobby, in this case photographer and SCUBA diver Nils Aukan.**

**Figure 4. Sea slugs are a very popular group of molluscs for underwater photographers and SCUBA diving enthusiasts due to their many colours. Species represented here are; top, left to right: *Limacia clavigera* (Nudibranchia); *Hermaea bifida* (Sacoglossa). Bottom, left to right: *Placida dendritica* (Sacoglossa), *Facelina auriculata* (Nudibranchia), *Edmundsella pedata* (Nudibranchia). Photographed by Bjørnar Nygård.**


**Figure 5.**
**Examples of efforts in outreach, consisting of social media platforms (a, c), magazines (d), local news-papers (b) and giving talks (e).**

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## THE SAMPLING KIT

The sampling kit became one of the core strengths of the project, since it improved the data quality, the data recruitment was simplified and no room was left for deviations from the standard protocols. The sampling kit consists of a few features that structure the way how citizen scientist collect material and register data. It includes an information sheet that contains an overview off the kits' content, a welcoming word, a 'did-you-know' fact section and the sampling itself is explained in 10 simple and illustrated steps. Furthermore, the kit contains 20 sampling jars of different sizes, including pre-printed labels that can be filled in by the volunteers to add to the sampling jar. There is a 1L of fixative (>98% 2-proponol) and two pairs of laboratory gloves in different sizes. There is also a 35GB USB flash drive in which citizen scientists can upload their pictures and fill in the preset Excel file with data on the samples collected, which will be almost identical to the information written down on the labels that are with the samples in the collection jars (Fig. 6). What we do not include is a collection jar for sampling in the field, as we found out that each person has their own preferences and strategies. We do however make a suggestion in the information-sheet based on what more experienced collectors usually end up using.

**Figure 6.**
**Example of the content of a sampling kit for citizen scientists.**

## SUCCESS

Before the *Sea Slugs of Southern Norway* project started in 2018, the museum collection, based on previous gathering efforts of museum curators and historic sampling since the 19th century, comprised 872 registered museum samples. Since then, the museum collection grew from 872 to 2079 registered samples. Of these, 426 registered museum items were the result of fieldwork organised by the project itself, often with the participation of citizen scientists. The other 781 registered museum samples are the result of the contribution of citizen scientist using the sampling kit (Fig. 7). This represents a 65% increase in the museum collection of sea slugs in just over a year. Besides the sampling and registering efforts, they also cover at least 83 different species, 36 more than what the museum collection initially had. The University Museum of Bergen now contains a valuable asset of 109 different species of sea slugs, curated according to the highest standards, which will constitute a public resource available to anyone interested in the study of marine biodiversity.

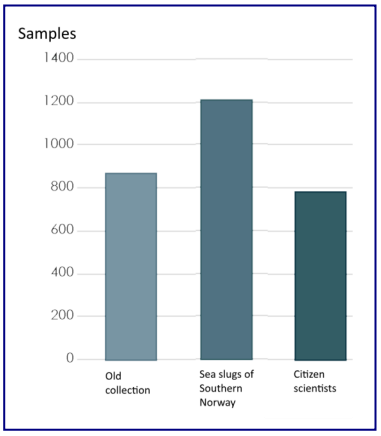


**Figure 7. Impact of the collection efforts of the citizen scientists since May 2018. From the 2079 registered museum samples, more than half were collected in less than 2 years, in comparison with the original museum collection that dates back to the beginning of the 19th century.**

## ONGOING RESEARCH

Besides the development of the genetic and image library of species, we have two Master's students carrying on their research projects in collaboration with the project, namely on the Nudibranchia genera *Jorunna* and *Polycera*. Currently 5–6 species of the genus *Jorunna* are recognized as valid in European waters. Among those only the species *J. tomentosa* is known to occur in Scandinavian waters and displays a variety of different morphotypes (Camacho-García & Gosliner 2008; Marcus 1976; Picton & Morrow 1994; Thompson 1988). Varying from nearly white with dark blotches scattered on the body to more beige with small light-brown spots (Fig. 8). A combination of molecular phylogenetics and morphological approaches are used to study the taxonomic status of the various colour morphs found in *J. tomentosa* across its geographical distribution. Preliminary molecular barcoding of specimens points to the possible occurrence of cryptic species in this taxon.

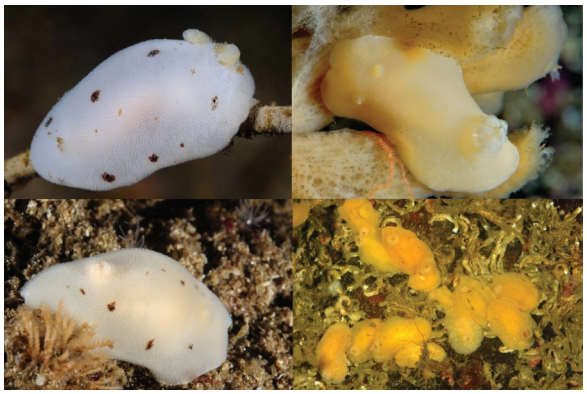

**Figure 8. Different occurring morphotypes of *Jorunna tomentosa*; varying from nearly white with dark blotches scattered on the body to more beige with small light-brown spots.**

**Figure 9. Different occurring morphotypes of *Polycera quadrilineata*; varying from nearly white to almost black with lines and/or spots varying from orange to yellow.**

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The other study investigates the species *Polycera quadrilineata* which is one of the five European species of the genus and is distributed between northern Norway (Lofoten), the Mediterranean Sea, the archipelagos of the Azores, Madeira, and the Canaries. It has its type locality in the Oslofjord, Norway and the species is known for its incredible colour variation (Bergan & Anthon 1977; Cervera *et al.* 2004; Evertsen & Bakken 2005; Trainito 2005). Specimen morphotypes can range from nearly white to almost black with lines and/or spots varying from orange to yellow (Figure 9). Up to now this chromatic polymorphism has been interpreted as part of the natural variation of the species, but preliminary molecular barcoding of specimens, points towards the occurrence of possibly two species.

## CONCLUSION

We have found a way with the help of enthusiastic volunteers (i.e. citizen scientists), to gather significant amounts of data in a relatively short amount of time from a large area. What originated as an ultimate necessity for the project *Sea Slugs of Southern Norway,* turned out to be enriching on both professional and personal levels. *Sea Slugs of Southern Norway* could never have become the project it is, without the enthusiasm and interest of dozens of volunteers. The project became a flagship for research on the sea slug Norwegian fauna and biodiversity in general and proved itself to be a true example of citizens contributing to science (Fig. 10).

## ACKNOWLEDGEMENTS

We are thankful to a network of Norwegian citizen scientists and international colleagues that helped collect specimens, especially to Anders Schouw, Erling Svensen, Heine Jensen, Katrine Kongshavn, Nils Aukan, Ole C. Meldahl, Roy Dahl, Viktor V. Grøtan, Tine Kvamme, Bernard Picton, Marina Poddubetskaia Ossokine, and Juan L. Cervera. The sea slugs of Southern Norway project is funded by the Norwegian Taxonomy Initiative (Artsdatabanken), Proj. No. 812038.

**Figure 10. Group photo of the latest expedition in collaboration with the local Mandal dive club and the participation of citizen scientists, many of them travelling across the country to be part of the project experience.**

## REFERENCES

Bergan, K. & Anthon, H. 1977. *138. Polycera quadrilineata*. Livet i Fjæra (7th ed.) pp.38 & 113, Oslo; J.W.Cappelens Forlag

Camacho-García. Y.E. & Gosliner, T.M. 2008. Systematic revision of Jorunna Bergh, 1876 (Nudibranchia: Discodorididae) with a morphological phylogenetic analysis. *Journal of Molluscan Studies,* 74: 143–181.

Cervera, J.L., Calado, G., Gavaia, C., Malaquias, M.A., Templado, J., Ballesteros, M.B.V., García-Gómez, J.C. and Megina, C., 2004. An annotated and updated checklist of the ophisthobranchs ((Mollusca: Gastropoda) from Spain and Portugal (includingislands and archipelagos). *Boletín del Instituto Espaņol de Oceanografía,* 20: 1-4, p. 1-122.

Evertsen, J., & Bakken, T. 2005. Nudibranch diversity (Gastropoda, Heterobranchia) along the coast of Norway. *Fauna norvegica,* 25, 1.

Huelsenbeck, J.P. & Ronquist, F. 2001. MRBAYES: Bayesian inference of phylogenetic trees. *Bioinformatics,* 17: 754–755.

Irwin, A. 2018. No PhDs needed: how citizen science is transforming research. *Nature*, 562: 480-482.

Kumar S, Stecher G, Li M, Knyaz C, & Tamura K. 2018. MEGA X: Molecular evolutionary genetics analysis across computing platforms. *Molecular Biology and Evolution* 35:1547-1549.

Marcus, E. 1976. On *Kentrodoris* and *Jorunna* (Gastropoda Opisthobranchia). *Bolm. Zool. Biol. Mar.,* 1: 11–68.

Picton, B.E. & Morrow, C.C. 1994. *A Field Guide to the Nudibranchs of the British Isles.* Immel Publishing Limited, London.

Puillandre, N., Lambert, A., Brouillet, S. & Achaz, G. 2012. ABGD, Automatic Barcode Gap Discovery for primary species delimitation. *Molecular Ecology,* 21: 1864–1877.

Rake, A. V. (1972). Isopropanol preservation of biological samples for subsequent DNA extraction and reassociation studies. *Analytical biochemistry*, 48(2): 365-368.

Thompson, T.E. 1988. *Molluscs: Benthic Opisthobranchs.* (D. M. Kermack & R. S. K.Barnes, eds). Brill, E.J. and Dr. W. Backhuys, Bristol.

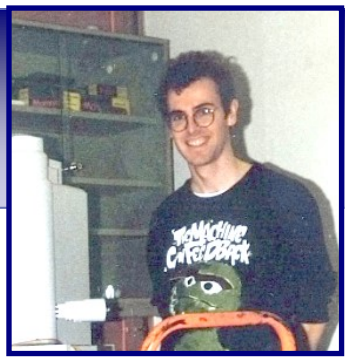
Trainito E., 2005. "*Nudibranchi del Mediterraneo. Guida ai molluschi opistobranchi."* Il Castello, pp.96.

INVITED ARTICLET

# 20 years later, what is the state of the art in imaging and analysis now?

**Alexander D. Ball**

Imaging and Analysis Centre, Core Research Laboratories, Natural History Museum, London

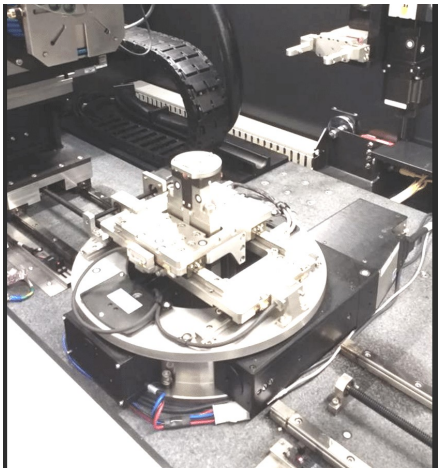


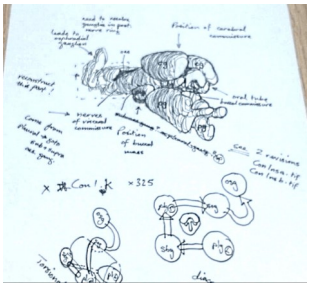
**26-year old Dr Ball, looking very professional in his first "proper" job.**

Back in the early 1990's as a PhD student studying molluscan anatomy and development at the Natural History Museum, my supervisor, Prof John Taylor, "strong-armed" me and a fellow student (Steve Ridgeway) into organizing an annual seminar series for students studying malacology – and thus the "*Young Malacologists Forum"* was born. I continued to organize the forum for a number of years, throughout the remainder of my PhD and into my post-doctoral career before finally admitting to myself that I was no longer a "young malacologist" and that someone else should take over its organization. As my career developed, I moved away from studying molluscs and concentrated more on imaging techniques, particularly light and electron microscopy, but continued to collaborate with John and to keep vaguely in touch with the Malacological Society.

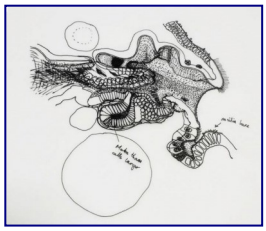
Some twenty years later I was surprised to get an invite to speak at the now re-named "*Malacologists Forum".* Trying to think of a suitable subject , I realized that when I completed my PhD in 1994 I was using a series of techniques which were, for their time, relatively cutting edge, so I decided to have a look at the techniques that were available to me then and to compare them to what are available the current generation of researchers. On the way I hoped to raise a few laughs with how ridiculously antiquated some of the equipment I used then would look now.

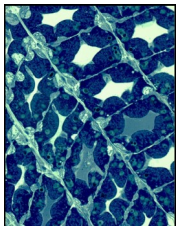
My PhD research focused on following the development of *Nucella lapillus* embryos. *Nucella* lays its eggs in capsules on rocks in the intertidal zone, so by collecting and preserving the capsules at intervals it's possible to collect the whole development sequence. Once I had the embryonic stages I either imaged them whole through SEM, or embedded them in resin, cutting serial sections at 1micron intervals and then using a computer to reconstruct the anatomy in 3D from the slices. I was incredibly lucky since my PhD was jointly held at the NHM and at Royal Holloway and Bedford New College and both sites had amazing electron microscopy facilities and provided incredible opportunities for training.





In practice, the majority of my PhD seemed to involve cutting literally thousands of sections of these tiny embryonic snails using an ultramicrotome and glass knives (my budget didn't stretch to a diamond knife), floating the sections off into a tiny water bath (about 1cm by 2cm) and capturing every section individually using a wire loop about 3mm in diameter and then transferring each individual section onto a microscope slide. I could fit about 30-40 sections to each slide and a typical embryo required anywhere from 300 to 600 sections. I got *very* good at cutting serial sections! To compare that to today – diamond knives are much cheaper and for serial section work have been replaced with dedicated histology knives made from sapphire which have a much larger water bath to collect the sections (up to 6cm by 2cm). Another advance that was developed after I'd finished my PhD was a technique to treat the top and bottom of the block with an adhesive to help the sections form "ribbons" which could then be easily picked up and transferred to slides. The introduction of "correlative





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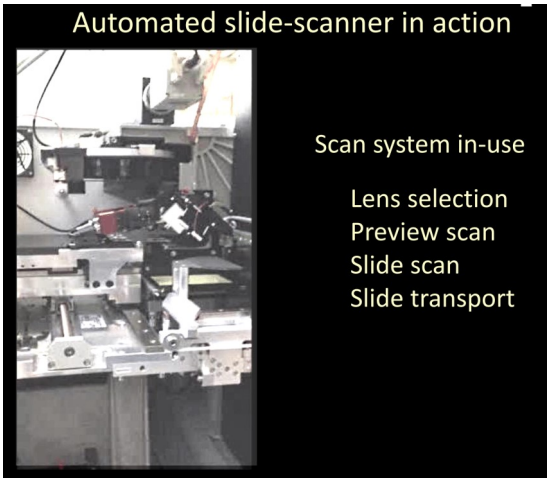
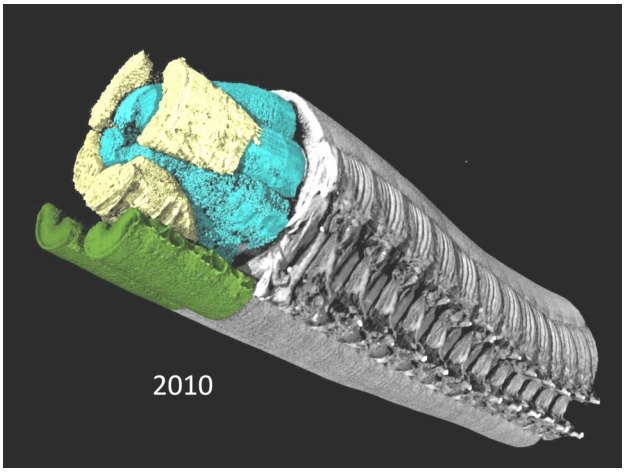
microscopy" as a specific discipline means there are now automated microtomes which transfer sections onto tape allowing a researcher to set up the microtome and leave it to cut sections automatically for hours with no further attention. Every generation of "old timers" will tell the current generation about how easy they have it now – I'm no exception!
After I'd cut the sections I needed some mechanism to "digitise" them for 3D reconstruction. Today I'd just load all of my slides into a digital microscope, or even a dedicated slide scanner, programme the system and come back a day or two later to a hard drive full of images.




In the 1990s there were no digital cameras! Every section had to be hand-drawn using a *camera lucida* to project an image onto a piece of paper. By looking down the microscope eye piece I could see the paper, my hand and the pen superimposed onto an image of the microscope slide. For every section, I hand-traced the outline of all of the relevant pieces of tissue onto the sheet of paper to create a drawing of a single section (one of 200-600 sections *for that individual embryo!*). I annotated all my drawings, developing a code to allow me to keep track of the specimen number and section and colour-coding the different tissue types to allow me to follow them as they wound their way through tissue captured in the sequence of sections.




These drawings then needed to be aligned from one section to the next and transferred onto a drawing tablet to be retraced into the computer. To do this, I had to transfer every drawing onto tracing paper and then trace them again into the PC. So by the time I'd got them into the computer everything had been drawn at least three times. I tried directly drawing onto tracing paper, but it was too dark to see the lines in the *camera lucida*, and it proved impossible to come up with a way to align the paper drawings with each other, whereas the tracings could be overlaid on a light box, so this repetitive process was the only way I could work.

The computer program I was using (PC3D) ran on a generic PC running DOS with 1MB of RAM and a 20MB hard drive. Each reconstruction had to be hand-entered as a rotational sequence (rotate the image stack by a certain number of degrees in X, Y and Z) to align the model in a particular orientation, with each part of the specimen defined in a different colour according to a table. Parts of the specimen could be made transparent to show internal detail, but the program could only display the slices as slightly thickened shapes, rotated as instructed, so the resulting reconstruction resembled a stack of distorted coins rather than a smooth 3D dimensional reconstruction.

To obtain a colour copy of the output, I had to use a pen plotter, but this only allowed 5 colours (plus black). This needed special paper which was expensive. The plotter was often in use, so I normally worked from a black and white print-out which I then traced over and laboriously converted into a stippled and shaded hand-drawn perspective drawing. Compared to modern software, which is able to fully shade and colour the specimen and which outputs publication quality illustrations, it was incredibly laborious and primitive.

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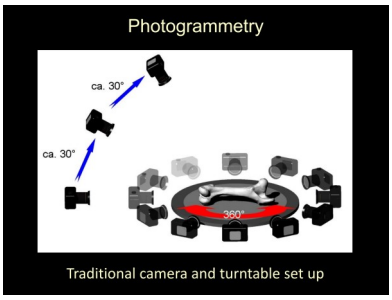
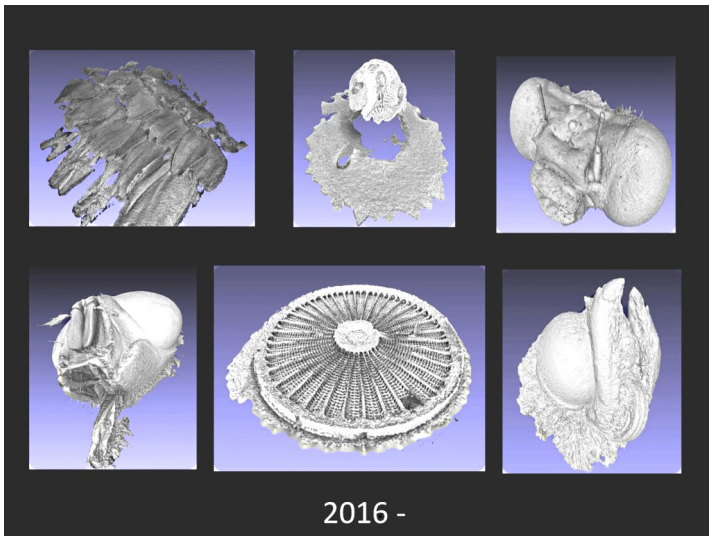
The rest of my research focused on either scanning or transmission electron microscopy. Once again, the microscopes were a lot less sophisticated than modern instruments, with small monochromatic or green CRT displays. Images were saved as photographic negatives which had to be printed by hand. Preparing plates involved a lot of cutting and trimming of photographs and liberal use of Letraset rub-down lettering.

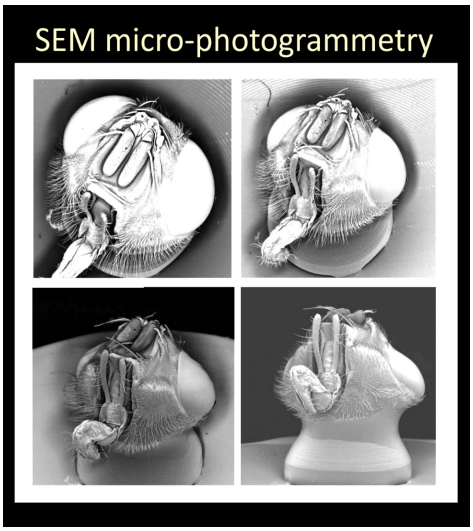
By the early 2000s I was using computer graphics programs and digital imaging for the microscopy, but reconstructing specimens in 3D still required serial sections to be prepared, so remained very labour intensive. By 2008 a revolution in 3D imaging had become accessible and the Museum purchased its first micro-CT scanner. Micro-CT uses a beam of X-rays to capture data on the specimen by projecting several thousand X-rays, each captured at a different angle, onto a detector panel. The composite images are then reconstructed to form slices and then reprocessed to create 3D volumes. Within the 3D volumes the different tissue types can often be identified, but then need to be laboriously hand-traced out using either a mouse, or graphics tablet and pen. So yes, 20 years later, we still have to manually "segment" our data, but the results are stunning and the various taxonomic journals now routinely feature beautiful 3D renders of anatomical features with realistic, colour-coded images, artistic cut-aways revealing hidden features and even movies flying around and through the specimen.

Micro-CT has completely revolutionised taxonomic description by allowing for the non-destructive imaging of specimens in 3D. Our newly-created lab was quickly inundated with requests and we are now one of the busiest labs in the Museum – we were lucky enough to obtain funding for a new and even more advanced micro-CT scanner recently which enables us to directly obtain 3D data with similar resolution to my laborious serial-section process of twenty years earlier!



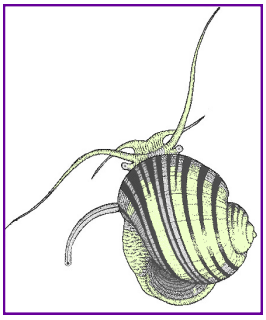

So what of me and my career?
After my PhD I stayed close to the Museum, taking a brief post-doctoral position at the Field Museum in Chicago working on molluscan micro-anatomy with Rudiger Bieler and then coming back to work with John Taylor on another negoastropod project, this time on conoidean development. During this project I was offered the chance to step in and provide maternity cover for one of the staff in the electron microscope unit at the NHM and not long after that I took a permanent job in the Museum as a staff electron microscopist. Since then I've worked my way up the career ladder, first running the entire EM Unit as lab manager and now running all of the Imaging and Analytical laboratories as head of the Imaging and Analysis Centre. In those past twenty years I have founded three new laboratories, increased the staff head count from 12 to 16 people and am now responsible for over 50 instruments. I have put my experience in conference organisation to good work and have organized conferences in light microscopy, electron microscopy, cultural heritage imaging, micro-CT and staff training. The experiences I gained through my PhD prepared me well for the career I was able to follow and perhaps the best surprise about attending the molluscan forum was seeing how many of the students that attended the first Young Malacologists Forum are still in research and are now encouraging their own students to attend the Forum.



## Forthcoming meetings

**The Malacological Society of London**
HTTP://WWW.MALACSOC.ORG.UK



# *Molluscan Forum*

Thursday 21st November 2019
9:00 am – 6.30 pm
Flett Lecture Theatre
Natural History Museum, London

## CALL FOR REGISTRATIONS AND PAPERS

This informal, annual, and successful meeting is designed to bring together people starting their research on molluscs, to give them the opportunity to present and discuss their work and to compare notes on methods and problems. **The Forum will be held the day before the Young Systematists' Forum (www.systass.org/ysf), which will also take place at the Natural History Museum.** This has been arranged so both meetings can be attended, although if attending both you will have to register for both meetings separately.

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

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

Lunch will be provided and The Forum will end with a wine reception, both sponsored by The Malacological Society of London.

THERE IS **NO** REGISTRATION FEE AND A LIMITED AMOUNT OF HELP WITH TRAVEL COSTS WILL BE AVAILABLE FOR PRESENTERS WHO CANNOT CLAIM THEM FROM ELSEWHERE.

**Enquiries and registrations to:**
Phil Hollyman, Fisheries Ecologist, British Antarctic Survey (phyman@bas.ac.uk)

**Non-presenters:** please let us know you will be coming so that we can estimate numbers.

CONTINUED >

# The Malacological Society of London

## Molluscan Forum, Thursday 21st November 2019
## 9:00 am – 6.30 pm
## Flett Lecture Theatre, Natural History Museum, London

## REGISTRATION FORM

**Return before 18th October 2019, by email to:**

Phil Hollyman, Fisheries Ecologist, British Antarctic Survey (phyman@bas.ac.uk)

Name.....

Address.....

.....

Tel. No.....

Email.....

**Status:** Research Student / Undergraduate / Post-doctoral researcher / amateur (delete as appropriate)

'Other' (please state) .....

Will you attend the Young Systematists' Forum on 26th November 2016? .....

I wish to give a paper / poster (delete as appropriate) entitled:

.....

.....

**Please attach, as a Microsoft Word attachment, an abstract of not more than 350 words, TOGETHER WITH TWO .JPG IMAGES IN SUPPORT OF THE ABSTRACT Abstracts and images of accepted contributions will be published in the Society's ISSN bulletin, *The Malacologist*, and on its website.**

Posters should be roll-ups or mounted on stiff cards, and should require no more than a 1 metre x 1 metre display area. They will be mounted on boards (velcro supplied).

If you are unable to get financial support from elsewhere (students and amateurs only) and need assistance with travel costs, please enter here the cost of the cheapest possible public transport return fare to London (maximum amount £250). Please note that you will received the money on the day of the Forum so attendance is essential.

**£.....**

Funding is not guaranteed but we endeavour to support as many presenters as possible. Late registrations may miss the opportunity for financial support. The support will be limited, so funding from elsewhere should be sought first. A provisional programme and confirmation of registration will be sent out late October.

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**Abstract submission**

Abstracts submitted for the Molluscan Forum should be sent as Microsoft Word files.

Please use the following format:

Title (12pt, left justified)
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Authors (10 pt, left justified, presenting author underlined; use superscript numbers to indicate institutional affiliation)
<blank line>
Institutions (10pt, left justified; in this order: Number (superscript), Department, Institution, City, Country)
Presenting Author email
<blank line>
Abstract (11pt, no indentation, left justified, 350 words maximum)

## EXAMPLE ABSTRACT

### The geographic scale of speciation in *Stramonita* (Neogastropoda: Muricidae)

**Martine Claremont[1,2], Suzanne T. Williams[1], Timothy G. Barraclough[2], and David G. Reid[1]**

[1]Deptartment of Zoology, Natural History Museum, London, UK
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*Stramonita* is a relatively small, well-defined genus of muricid marine gastropods limited to the tropical Eastern Pacific and the Atlantic. The type species, *S. haemastoma*, is known to have teleplanic larvae and is estimated to remain in the water column for several weeks. *Stramonita haemastoma* shows regional variation, and this has led to the recognition of five geographical subspecies: *S. h. haemastoma*, from the Mediterranean and Eastern Atlantic to Brazil, *S. h. floridiana*, on the east coast of Florida and in the Eastern Caribbean, *S. h. caniculata* on the west coast of Florida and the Gulf of Mexico, *S. h. rustica* in the Western Caribbean and *S. h. biserialis* in the Eastern Pacific. The protoconch has been shown to be similar across the *S. haemastoma* complex, implying that all subspecies have equally long lived larvae. Within these subspecies, cryptic variation is suspected. For example, *S. h. biserialis* is suggested to be differentiated North/South on a small scale. In the presence of teleplanic larvae, speciation on such a small scale seems paradoxical. Various explanations for this paradox are possible. Actual (or realized) dispersal of *Stramonita* species may be more limited than presently believed, leading to allopatric differentiation. Alternatively, morphological differentiation may not be a reliable indicator of genetic differentiation, and *S. haemastoma* (*sensu lato*) might indeed prove to be a single taxon. It is also possible that ecological speciation could result in geographical speciation on a small scale in the presence of wide dispersal. My results suggest that five species of *Stramonita* are present in the Caribbean, at least three of which occur sympatrically. Gene flow is maintained between Caribbean and Mediterranean populations in at least one species, while no genetic differentiation was found along the Eastern Pacific coast. The implications of these results are discussed.

**NOTE THAT ABSTRACTS ARE PUBLISHED IN *THE MALACOLOGIST* WHICH IS THE BULLETIN OF THE SOCIETY AND HAS AN ISSN NUMBER.**

**BEFORE THE FORUM, PLEASE EMAIL TO THE EDITOR OF *THE MALACOLOGIST* TWO IMAGES TO ACCOMPANY YOUR ABSTRACT. TRY TO MAKE THESE IMAGES ONES THAT YOU WOULD NOT USE IN AN EVENTUAL FULL PAPER.**
**EDITOR OF *THE MALACOLOGIST* georges.dussart@canterbury.ac.uk**

## Grants and Awards

# Malacological Society of London Awards and Grants

The Research Awards Scheme was established to commemorate the Society's Centenary in 1993. Under this scheme, the Society gives awards to support research on molluscs that is likely to lead to publication. The closing date for applications each year is 15th December. Grants are preferentially conferred on students and researchers without regard to nationality or membership of the Society. Preference is also given to discrete research projects that fall within the subject areas covered by the Society's *Journal of Molluscan Studies*. Applications will be assessed by scientific merit, value of the project and for student applicants, the extent to which the research will benefit the applicant's scientific aspirations. The successful applicants will be notified by 31st March and announced at the Annual General Meeting. Awardees are encouraged to publish their work in the *Journal of Molluscan Studies* (full papers) or *The Malacologist* (travel award reports, research award reports, news of ongoing research etc) as appropriate,

***Early Career Research grants***

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

***Sir Charles Maurice Yonge Award***

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

***Senior Research Awards***

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

***Travel Grants***

Travel Awards are available as bursaries to support attendance at a conference or workshop relevant to malacology. Grants are preferentially conferred on students but researchers without professional positions may also apply. The maximum amount for one of these awards is £500 for Society members and £300 for non-members. Preference will be given to members of the Society. There are two closing dates each year, 30th June for travel starting between 1st September of the current year and 28th February of the following year, and 15th December for travel starting between 1st March and 31st August of the following year.

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

***Annual Award***

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

***Applications***

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

# Malacological Society of London—Membership notices

**Objects**

The objects of the Society are to advance education and research for the public benefit by the study of molluscs from both pure and applied aspects. We welcome as members all who are interested in the scientific study of molluscs. There are Ordinary Members, Student Members and Honorary Members. Members are entitled to receive a digital &/or paper copies of the *Journal of Molluscan Studies* and such circulars as may be issued during their membership. The society's Web Site is at: http://www.Malacsoc.org.uk

**Publications**

The Society has a continuous record of publishing important scientific papers on molluscs in the *Proceedings*, which evolved with Volume 42 into the *Journal of Molluscan Studies*. The *Journal* is published in annual volumes consisting of four parts which are available on-line by members and student members. A paper copy of the Journal is available for ordinary members who are willing to pay a hard-copy premium. Members also receive access to *The Malacologist*, which is the bulletin of the Society, issued twice a year, in February and August.

**Meetings**

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

**Personal Subscription**

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

From 2018 subscription rates are:

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

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

Application to join the Society

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

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

Email: membership@malacsoc.org.uk

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**Membership Renewal**

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

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Online payment using Credit or Debit Card (Mastercard, Visa, American Express)
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**Institutional Subscriptions**

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