ISSN 1759-1406

The Malacologist

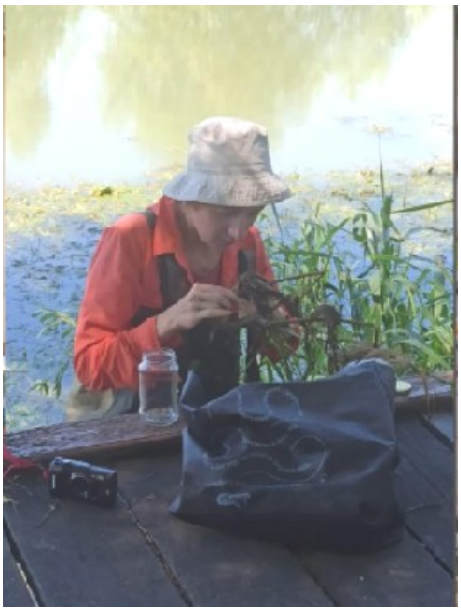
The Bulletin of The Malacological Society of London

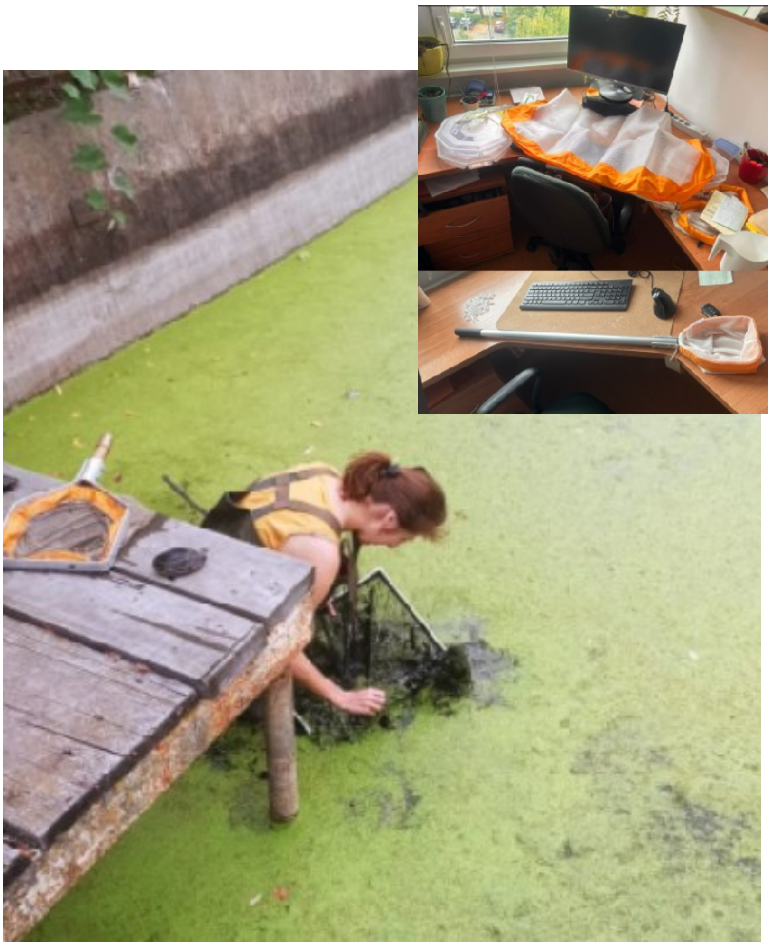
NUMBER 83 AUGUST 2024

Contents

EDITORIAL ……. 2
NOTICES ……..……2
Relaxing terrestrial molluscs for scientific study …….5
ANNUAL GENERAL MEETING—SPRING 2024
Annual Report of Council 8
Elected officers……13
REPORT OF THE AGM CONFERENCE ON THE BIOLOGY OF LIMPETS; evolution, adaptation, ecology and environmental impacts ……. ……..…….....14
ABSTRACTS OF THE CONFERENCE……17-29
SENIOR RESEARCH AWARD REPORTS
Estimation of mutation rates in the Venus clam *Chamelea gallina.* Chiara Papetti ….……..……..…..29
Species evolution in *Unio crassus* and the role of current versus historical gene flow in species genetic diversity in different basins. Halyna Morhun ….……..……..…….. 30
INVITED ARTICLE
J.H. Orton and his legacy: Limpets and the Plymouth/Liverpool connection
Alan Hodgson ……..33
FORTHCOMING MEETINGS
Molluscan Forum 37
GRANTS AND AWARDS OF THE SOCIETY.....40
MEMBERSHIP NOTICES ……..…..…42

This issue includes a report of the 131st AGM of the Malacological Society of London and the accompanying conference on the Biology of Limpets





Images from the senior research grant report by Halyna Morhun *Species evolution in Unio crassus and the role of current versus historical gene flow in species genetic diversity in different basins* (page 30)

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

EDITORIAL

In 2024, the Malacological Society of London (MSL) has 76 members and student membership stands at 27. The Society is a registered charity and in 2023, it funded nine ECR and two SCR research projects to a total value off £15,812. The Society also supported conference attendance for eighteen students and ten students were supported in their attendance at the Molluscan Forum in London to a value of £7806. In addition, the Society supported three malacological conferences (£4,965), as well as covering printing costs of a book on Benson's malacological biodiversity work in Asia (£6,727). It is amazing that this tiny, taxonomically-based society achieves so much. The MSL awarded a senior research grant (SRG) to Chiara Papetti for research on the estimation of mutation rates in the Venus clam *Chamelea gallina* and a report is presented on page 29. Halyna Morhun was also awarded a SRG and, on page 30 reports on species evolution in *Union crassus* and the role of current versus historical gene flow in species genetic diversity in different basins.

The Annual General Meeting is an important event for any society and the minutes of the AGM can be found on pages 8-13 where they form an important record of the activities of the Society in 2023-2024. Each year, the MSL endeavours to stage the AGM alongside a conference, symposium or workshop. The 2024 AGM was paired with a conference entitled *Biology of Limpets: evolution, adaptation, ecology and environmental impacts* which took place on the 5th & 6th March 2024 at the Natural History Museum, London. The AGM conference was attended both in-person and on-line by participants from a wide range of countries. As usual for modern meetings, the standards of presentation were high across the range of expertise, from undergraduates to senior academics. The meeting was opened by Emeritus Professor Alan Hodgson who gave a fascinating talk on the malacological studies of J. H. Orton, a seminal worker in the field of limpets and oysters. The abstracts from the conference presentations form a major part of this issue (pages 17 –29), and Alan Hodgson's invited article on Orton is presented on page 33

Details of the forthcoming Malacological Forum and registration forms are presented on and after page 37. Please circulate to any of your colleagues or students who might be interested. It is a unique opportunity for a young malacologist at any level to broadcast their interest and hear about the work and enthusiasms of other young malacologists (and old ones). The atmosphere is always friendly and supportive.. No hard questions are asked!

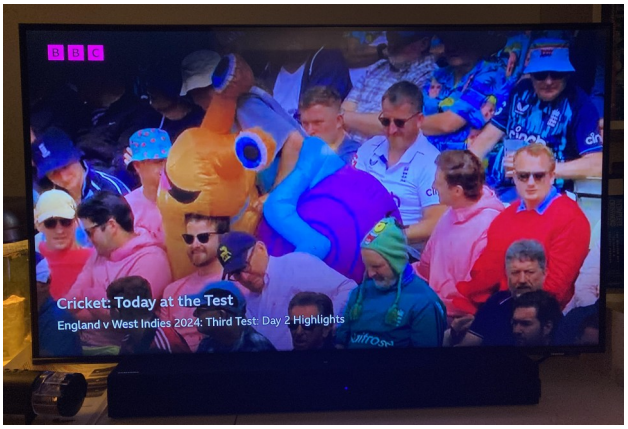
TAXONOMIC/NOMENCLATURAL DISCLAIMER
This publication is not deemed to be valid for taxonomic/nomenclatural purposes [see Article 8b in the International Code of Zoological Nomenclature 3rd Edition (1985), edited by W.D. Ride *et al.*].

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

Annual Award of the Malacological Society of London (MLS)

The winner of the 2023 Annual Award was Dr Imogen Cavadino for her PhD thesis, submitted to Newcastle University and entitled *"Garden Gastropods: using citizen science to understand the diversity, role and impact of slug and snail species in British gardens"* The reviewers agreed that the interdisciplinary nature, creativity, and far-reaching community impact of Cavadino's work made her a very worthy recipient. 'Cavadino's thesis brings together a seriously impressive range of laboratory experiments, field experiments, field surveys and citizen science surveys that altogether make an outstanding thesis that is a major contribution to the field of terrestrial British molluscs.'

Spotted - A mollusc at the cricket Test Match!



Spotted—molluscs on the radio

Published on Thursday, 3rd March 2022. Podcasts from *The Curious Cases of Rutherford & Fry.*

Downloadable at http://www.listenersguide.org.uk/bbc/episode/?p=b07dx75g&e=m0014xty

---

Spotted—a giant mollusc on the seadhore

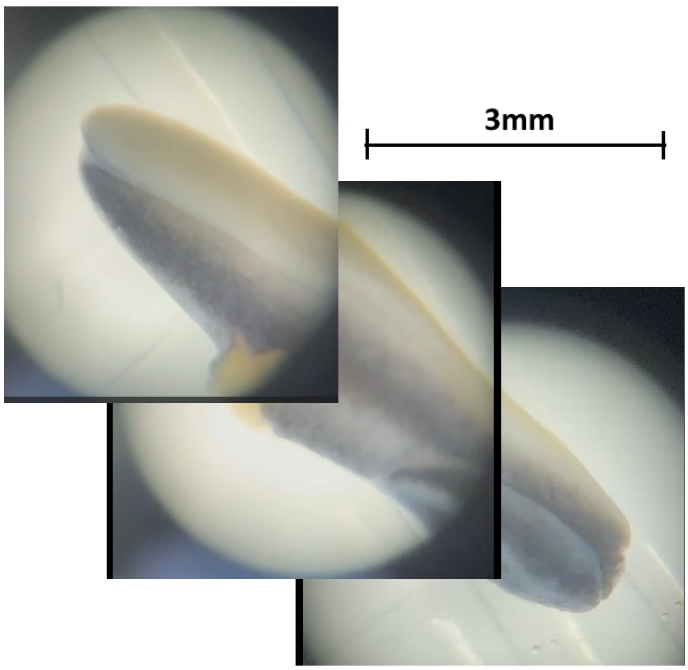
Spotted on the seashore by Emeritus Prof. Alan Hodgson who poses the following question…..

'This 2003 sculpture of a scallop on a shingle beach by British artist Maggi Hambling is located on Aldeburgh beach, Suffolk, in an Area of Outstanding Natural Beauty. It is a tribute to a British composer.

Name the composer. Answer at the end of this issue

Spotted - a slug in a carton of milk

This slug was found in his carton of milk by Luka Gorchov-Brearley who took the composite pictures (from video) with a dissecting microscope. It did not appear to be alive, though it was well preserved. He found it so interesting that he didn't complain to the retailer.



Spotted—a giant clam in the daily news (The Guardian)

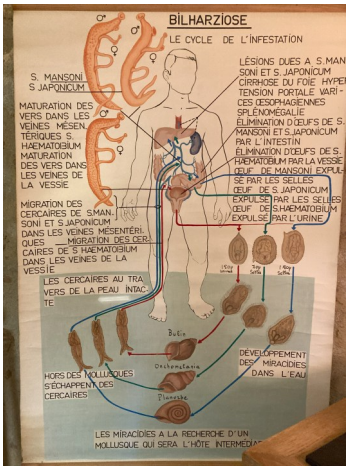
The nature of …. Marine Life **by Helen Sullivan**
"A clam: made of light and all the while afraid of the dark"

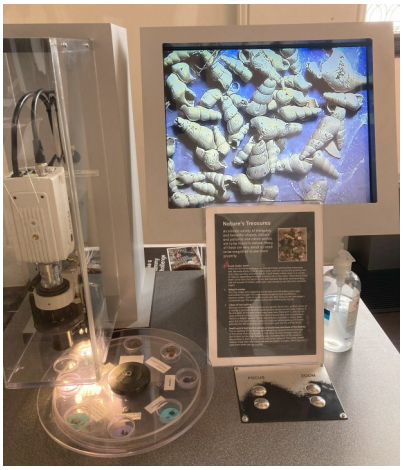
https://www.theguardian.com/environment/commentisfree/article/2024/aug/20/a-clam-made-of-light-and-all-the-while-afraid-of-the-dark?CMP=Share_iOSApp_Other

---

Spotted—molluscs in a science escape room curated at the University of Poitiers, France

The escape room at the University of Poitiers, France is curated by Timon Olivier *et al*. can be visited by special arrangement. It hosts a range of artefacts, many of malacological significance and all related to historical and current research at the university.





Malacological journals in the Biodiversity Heritage Library (BHL)

As part of ongoing efforts to bring additional malacological journals into the Biodiversity Heritage Library (BHL), all issues of the *Comunicaciones de la Sociedad Malacológica del Uruguay* are now available at
https://www.biodiversitylibrary.org/bibliography/209382
Special thanks go to Fabrizio Scarabino who, on behalf of the Uruguayan malacological society, helped secure the copyright release. Scanning was provided by Field Museum's library, one of the founding BHL members. The next one in line (with the copyright release already secured – thank you, Team Michigan!) is a complete set of *Malacological Review* and its supplementary volumes.
If you can help with the copyright release of any other malacological serial publication that is not yet in BHL, please contact...
Rüdiger Bieler, PhD
Curator of Zoology/Invertebrates
Negaunee Integrative Research Center, Field Museum of Natural History
1400 S. DuSable Lake Shore Drive, Chicago, IL 60605-2496, U.S.A.

Mediterranean nudibranch found in a rock pool in Devon, UK

Reported by Andrew Segal of BBC News, South West on 13 August 2024
A nature enthusiast and her father made a colourful discovery of a sea slug usually found in the Mediterranean.
Devon Wildlife Trust said Felix, 15y , and her father Ashley found the "beautiful" rainbow sea slug close to Wembury, near Plymouth in what was believed to be the first time the animal had been recorded in Devon.

https://www.bbc.com/news/articles/cg79zg53r4zo.amp

The ash black slug (*Limax cinereoniger)* – contender for invertebrate of the year

https://www.theguardian.com/environment/2024/apr/09/ash-black-slug-magnificent-gastropod-epitome-grace?CMP=Share_iOSApp_Other

---

On view - Adorned by the sea – Shells in fashion

Special exhibition at the Bailey-Matthews National Shell Museum and Aquarium
3075 Sanibel Captive Road, Sanibel, Florida 33957, USA
info@shellmuseum.org

African land snail eating egg yolk

https://www.facebook.com/reel/681863624031384

Half-a-billion-year-old slug with spikes reveals origins of molluscs

https://news.sky.com/story/half-a-billion-year-old-slug-with-spikes-reveals-origins-of-molluscs-13188853

Culture and release of *Helix pomatia*

Helix pomatia (the Roman snail or Burgundy snail) has been cultured and released at Montacute House, Somerset. See *Countryfile* 7 July 2024 on BBC iplayer

https://www.bbc.co.uk/iplayer/episode/m0020znj/countryfile-montacute-house

A 'thank you', appreciated by the Society

Nipu Kumar das recently submitted a report on his research. This report appeared in *The Malacologist* 81 2023 p18. It is available on the website …
https://malacsoc.org.uk/wp/wp-content/uploads/2023/10/AAA-23-09-22-The-Malacologist-81-AUGUST-2023.pdf
In a letter to the Editor, he writes:-

"I am writing this email to inform you about my recent paper published in the latest special issue of the *Records of Zoological Survey of India* journal. This paper is an outcome of your generous support for my small project of taxonomic sampling in Meghalaya. A few more papers are still under preparation. Thank you so much.
Please find the article here in this link: https://zsi.org.in/uploads/Records-of-Zoological-Survey-of-India-A-Journal-of-Indian-Zoology.pdf (Page 120-125)
Thank you."
Nipu Kumar Das
Ph.D. Candidate,
SM Sehgal Foundation Center for Biodiversity and Conservation,
Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore,
Royal Enclave, Jakkur, 560064, Karnataka, India.

Relaxing terrestrial molluscs for scientific study – notes of an online discussion

This discussion was triggered by a post from Julia Sigwarts on the mollusca listserver. This is an edited transcript.
It is presented here as it offers useful information that deserves a wide circulation amongst malacologists

Dear molluscs
I am looking for advice about the best ways to make nice relaxed specimens of land snails, so that the optic tentacles are completely relaxed and out. This has to work for large animals, my target specimens are adult Helix pomatia.
Why? Because we have a pet unicorn (I say pet, but we are still a museum, and must plan for the inevitable).
There is a photo here:
https://www.senckenberg.de/de/institute/senckenberg-gesellschaft-fuer-naturforschung-frankfurt-main/abt-marine-zoologie/sekt-malakologie/malakologie-forschung/
So you will see it is crucial that the eyes look good.
I have previously tried drowning in dilute EtOH with mixed results and once in water which memorably did not work for a very long time. I vaguely remember successfully using tobacco in water (or maybe ethanol) to make nice specimens as a student, but I am not confident about this. Advice from more experienced experts on land snails would be very gratefully received. p.s. they are called Wanda
All the best from Frankfurt
Cheers,

CONTINUED>

>CONTINUED

Dear Julia et al.,
For smaller species I recommend a technique described here:
Craze, P.G. & Barr, A.G. (2002) The use of electrical-component freezing spray as a method of killing and preparing snails. Journal of Molluscan Studies 68: 191–192.
Then only slowly replace the ice with alcohol as described in:
Allgaier, C. (2015). How can two soft bodied animals be precisely connected? a miniature quick?connect system in the slugs, A rion lusitanicus and A rion rufus. Journal of Morphology, 276(6), 631-648.
I use this to kill copulating slugs: their genitalia remain nicely everted. However, two warnings. My experience is that it is not usually quite quick enough to stop tentacles retracting a bit. And it does not work so well with larger species such as Arion ater, so H. pomatia might also be a challenge. With larger species boiling water works better than freezing spray, but it is not fast enough to stop tentacles retracting.
With slugs, carbonated water is the best and quickest means to kill them in a relaxed state, tentacles everted, but it does not work with snails. Warm water is also worth experimenting with.
John Hutchinson
Senckenberg Museum of Natural History Görlitz

In a separate email to me (Editor), John also writes…
"Something perhaps to add is that liquid nitrogen is too cold and the slugs shatter. But I am here relying on what Heike has told me from work long ago, so I ought to check that with her."

Hi Julia,
I've had best results immersing land snails in water with menthol crystals in them. Pop a chunk into the water and make sure there is no air at the surface before you put the lid on. Most often the snail dies extended with the tentacles extended (usually but not always).
Jon Ablett

Hi Julia
I used menthol crystals a few times in grad school and also tried gradually increasing ethanol concentrations, starting at about 5% ethanol. Both worked better when I changed concentrations slowly. So, slow down when they start producing mucus.
I just saw Paul suggested menthol steam, and that sounds even better than what I did.
Good luck,
Elizabeth Davis Berg
Professor and Chair, Department of Science and Mathematics
Columbia College Chicago

Dear Julia,
I have been narcotizing land snails for a while, using some menthol crystals in the water for drowning. I leave them over-night, and just two or three small crystals (2-3 mm in length) are enough. It's so effective that sometimes they relax to the point where the penis evaginates.I'm also sending you a reference on relaxation techniques. It is specifically for freshwater snails, but I got the idea of using menthol crystals for land snails from this paper. I hope it can help.
Araujo, R., Remon, J., Moreno, D., Ramos, M. 1995. Relaxing techniques for freshwater molluscs: Trials for evaluation of different methods. Malacologia 36: 29–41.
Best regards,
Jonathan P. Miller, PhD
Museo Nacional de Ciencias Naturales
Dpto. Biodiversidad y Biología Evolutiva
C/ José Gutierrez Abascal, 2
28006 Madrid, España

Hello Julia,
In Brazil, we use menthol with water. Any Halls (literally the cough drops) or menthol itself can relax them, and you can add the EtOH after a couple of hours in exchange with water. I hope this works for you.
Your Wanda is the cutest ever!
Cheers,
Giovanna Omura

How about Niku Nuki? Pouring boiling water over crawling animal (See Zoosymposia 1 (2008): Niku-nuki: a useful method for anatomical and DNA studies on shell-bearing molluscs HIROSHI FUKUDA, TAKUMA HAGA & YUKI TATARA (JAPAN).
Best wishes
Daniel Geiger

CONTINUED>

>CONTINUED

Dousing minute landsnails in subzero (Celsius) ethanol can preserve them extended, but larger land snails like Helix pomatia will not likely freeze fast enough to prevent retraction. Perhaps a combination of relaxing and then subzero ethanol would work?
Timothy A. Pearce
Assistant Curator, Section of Mollusks
Carnegie Museum of Natural History
4400 Forbes Ave, Pittsburgh, PA 15213-4080, USA

You might try MgCl2 prepared iso-osmotic to the animal's blood. Or thymol. It would certainly be less cruel than most of the other scary suggestions.
Rhanor Gillette

Hi Julia,
Lidocaine … each veterinarian can provide you with some if you explain why you need it … I use it with my earthworms.
Best
Marcel Koken

One classic relaxation medium is menthol. Dissolve crystals (buy them from any pharma supplier, e. g. Fisher) in boiling water, then suffuse the snail in the steam. Clears your sinuses too, a bonus.
Back in the day one could use Sodium Pentathol or Lidocaine, neither of which can be purchased over the counter anymore…
Paul Callomon
Collection Manager, Malacology and General Invertebrates
Academy of Natural Sciences of Drexel University, Philadelphia

---

Dear Julia,
Incidentally, I see your message and maybe I have a few suggestions. My experience is with Orthalicoidea, which ranges from very small to very big (shell height 80 mm, sometimes even more).
My experience in the field is adding tobacco is a useful thing to relax specimens, especially during fieldwork in developing countries where other stuff might be hard to find. I also used Nembutal (a veterinarian narcotizing powder) with good results. Overnight in water (ensure there is no air below the lid of the vial) should be enough.
Success!
cheers,
Bram Breure

Hi Julia/Jon
If no one has already mentioned it, I recall Jon Ablett telling me that an injection of sodium pentabarbital can have the desired effect on land snail tentacles. However I believe it is a strictly controlled substance.
There are two things I have tried on slugs that did not work very well – drops of menthol solution, and drops of 18mg/ml nicotine vape fluid. It was not a very careful experiment, but I found that neither had much of an effect on Ambigolimax slugs in water.
Best wishes
Ben Rowson
National Museum of Wales

Hi Julia,
Oh yes I forgot about that (thanks Ben) – I have used 1ml sodium pentabarbital in 1 litre of water when menthol crystals haven't worked.
I'm not sure how 'restricted' it is – I checked with our H&S officer when there was a big audit and they didn't seem bothered but of course may be different in Germany.
I hope that helps
Jon Ablett

Annual report of the Malacological Society Council for 2023/2024

delivered by the President, Dr Jon Ablett

The 131st Annual General Meeting of the Malacological Society of London took place on the 6th March 2024 13:00 to 14:00 in the Flett Theatre at the Natural History Museum of London alongside the Biology of Limpets 2024 conference.

Present in person: Jon Ablett, Fiona Allan, Katie Collins, Aidan Emery, Phil Fenberg, John Grahame, Alan Hodgson, Andreia Salvador, Victoria Sleight, Rowan Whittle, James Witts,

Present online: Georges Dussart, Phil Hollyman, Crispin Little, Dinarzarde Raheem, Giada Spagliardi, Debbie Wall-Palmer, Harriet Wood, Emily Ball, Jamila Rizgalla.

Apologies for Absence:
Apologies were received from: Robert Cameron, Thomas Goulding, Katrin Linse.

2. Corrections to the Minutes of the 130th AGM
The minutes were circulated, and no changes were proposed.
Proposed: Aidan Emery
Seconded: Katie Collins and Alan Hodgson

3. Matters arising
There are no matters arising.

4. Financial report
Please note, financial report was presented on 12th June 2024 at a mini-AGM due to unforeseen delays. The report was circulated to the Council by Katrin Linse and is summarised below in the Annual report of Council.

5. Annual report of Council for 2023/2024, delivered by the President, Jonathan Ablett

Membership (report by Harriet Wood)

At the close of 2023, the Malacological Society of London (MSL) had 99 members. This was up by 25 from the previous year, mostly from an increase in the student membership. The membership was made up of 59 ordinary members, 37 students and 3 honorary members (including the journal Editor), with the proportion of members from non-UK countries increasing from 38% in 2022 to 48% in 2023.

Currently we have 76 members for 2024, down from 85 this time last year, but the student membership is still high at 27. The second round of the Broadening Access Membership Scheme (BAMS) was advertised in November 2023 and the uptake has been good with 7 places awarded, and 3 currently remaining available: (Broadening Access Membership Scheme - The Malacological Society of London (malacsoc.org.uk)). Applicants have come from a much greater range of countries during this round, with many from the African continent. There are also 4 students carrying on from the BAMS award the previous year. In addition, there was the annual Oxford Prize at the Molluscan Forum 2023, which includes free membership to the Society for another lucky student.

Oxford University Press (OUP) have continued to support us with access to the *Journal of Molluscan Studies* for our members and have quickly resolved any known issues. We have made great steps with the 'member level referral access' between the MSL and OUP websites and, although it wasn't quite ready for the new membership year in January, it is now up and running for members with a MSL login. You will see a new section on the OUP website 'Sign in' page, specifically for MSL members. This system will make the processing of new members and their access to the journal more seamless and automated in the future.

Many thanks for supporting the Society through your membership and please do encourage anyone else you know in this field to become a member too.

The President thanked HW for her hard work and for her efforts to increase membership numbers.

CONTINUED>

>CONTINUED

Finance for the financial year ending 31st December 2023 (report by Katrin Linse)

Please note, financial report was presented on 12th June 2024 at a mini-AGM due to unforeseen delays.

The finances of the Malacological Society have been pleasing during 2023 with an overall gain of £42,372. This gain is explained by a gain in the Fixed Interest and Investment funds and despite significantly higher awards and meeting expenditure compared to 2022.

The total funds of the Malacological Society are £528,256, of which £101,033 are in cash deposits and £440,531 in unrestricted funds.

Our investments had an overall gain of £42,372 (comparing market value at 31 December 2023 with market value at 31 December 2022), with the COIF Investment Fund making a gain of £37,255 and the COIF Fixed Interest Fund a gain of £5,117. During 2023, no funds were transferred from the current account to savings accounts.

In 2023 the main charitable activities were the funding of nine ECR and two SCR research projects, of which all were claimed, (total cost of £15,812), the support of eighteen students to attend conferences and ten students to attend the Molluscan Forum (£7806), and support to the organization of three malacological conferences (£4,965), as well as covering printing costs of a book on Benson's malacological biodiversity work in Asia (£6,727).

Separately, the profit-share from the publication of the Journal of Molluscan Studies in 2023 provided the Society with most of its income contributing £44,092, compared to £43,431 in 2022. This year OUP provided information on sales of the digital archives (£1,119). The Editor of the Journal, Dr Dinarzarde Raheem, and the Assistant Editors are to be commended for their hard work contributing to the publication of our scientific journal.

In 2023, significantly more funds were spent on travel- and meeting-related spending, being £9,815 / £8,577 in 2023 compared with £2840 / £6423 in 2022, while spending for research awards, (£15,812) adjusted to pre-pandemic levels. The Society (MSL) spent more money in 2023 compared to 2022; this was mainly based on more expenses paid for research, travel and meeting awards, as well as the Benson book.

The President thanked KL for her hard work as Treasurer.

Meetings

The AGM (report by Jon Ablett)

The 131th AGM was held as an person meeting with virtual access on the 6th March 2024. To coincide with the AGM a symposium was held on the theme of '*Limpets 2024. Biology of Limpets: Evolution, Adaptation, Ecology and Environmental impacts*.' We had 3 invited speakers and over 40 people have registered to attend. The meeting was organised by Alan Hodgson, Steven Hawkins, Phil Fenberg, Louise Firth and Jonathan Ablett.

The invited talks were from:
Louise Firth: *What have limpets ever done for us? On the past and present provisioning and cultural services of limpets*.
Fernando Lima: *Robolimpets: origin, evolution, and applications*.
Juan Sempere-Valverde: *Surviving the urbanised world: ecological implications of shoreline artificialisation on limpet population conservation.*

The Molluscan Forum (reported by Phil Hollyman)

The annual Molluscan Forum was held on the 16th of November 2023, as a hybrid meeting on teams, and in person at the Flett Lecture theatre, Natural History Museum. Over 100 people registered in advance for the event with over half attending in person. Similar to previous years, the addition of virtual sessions and online broadcasting via teams had a clear impact on accessibility for international delegates, improving the ability of many people to attend and give presentations.

Overall, there were 57 applications for full talks, quick-fire talks and posters, of which we were able to accommodate 37 presentations throughout the day. The Oxford prize, awarded annually for the best early career talk, was given to Giada Spagliardi (Naturalis Biodiversity Center, Leiden, The Netherlands) for her talk titled: *More than meets the eye: integrative taxonomy uncovers hidden diversity in the Limacina species complex.*

CONTINUED>

>CONTINUED

*'Bivalves where are we going?' meeting (*report by John Taylor)

This International *in person* meeting organised by Elizabeth Harper, John Taylor, Emily Glover and Katie Collins and was held at Gonville & Caius College, University of Cambridge from the 5-8 September 2023. It attracted 104 participants from around the world including Japan, Singapore, India, Australia, Canada and USA as well as many from Europe (France, Spain, Italy, Germany, The Netherlands, Croatia, Sweden, Denmark).

The full programme included 62 talks and 30 posters. A welcoming reception was held in the Sedgwick Museum with two evening poster sessions and the final banquet in Gonville and Caius College. Abstracts of talks and posters are available at: https://bivalves.esc.cam.ac.uk

Some of the papers presented are scheduled to be published in a special issue of *Journal of Molluscan Studies*. The organisers are very grateful to the Malacological Society for their generous support of the meeting that contributed to its success.

Publications

The Malacologist (report by Georges Dussart)

Issue 81 (August 2023) of *The Malacologist* came out on time and contained 36 pages. The Malacological Society of London (MSL) awarded a senior research grant to Louise Firth to further such a project and issue 81 included her report entitled *Standing on the shoulders of giants: archiving Rosemary Bowman's historical limpet data.*

The Malacological Forum which took place in November 2023 was given notice in this issue. The MSL also supports early career research and Nipu Das presented a report on *Non-marine molluscs of anthropogenically impacted caves of Meghalaya*. MSL funded travel award reports were also presented here, including reports on *Reducing shipworm larval settlement on wood modified by furfurylation* by Lucy Martin, *Angiostrongylus malaysiensis in gastropod and rat population at recreational parks of Kuala Lumpur* by Suey Yee Low, *Connectivity patterns of invasive snails Callinina georgiana and Heterogen japonica* by W.A.N.U Nimanthi Abeyrathna and *Developing a nationwide baseline of giant clam population densities across the coral reefs of Thailand* by Matthias Desmolles. The issue also included an obituary of Maryna Plesoway.

As usual, the major substance of issue 82 (February 2024) of *The Malacologist* was the report on the Molluscan Forum, held on the 16 November 2023. The Forum was a hybrid meeting, a format which allowed for thirty-three oral and poster presentations. Abstracts covered 21 pages in *The Malacologist*, and it was encouraging to see that almost all contributors supplied images to support their abstract. The hybrid format ensured an enhanced number of participants and contributors which means that at 40 pages, issue 82 of *The Malacologist* was a little bulkier than usual. *The Malacologist* is an important organ for advertising MSL business and contained an announcement of the symposium on the biology of limpets and the 2024 AGM plus a list of nominations to Council, to be ratified at the 2024 AGM.

Recipients of financial awards from the MSL are required, as a *quid pro quo*, to supply a report on what they have achieved with their grant. This issue featured a report from Kumudu Wijesooriya of the University of Peradeniya, Sri Lanka who reported on his attendance at a meeting on Molluscs of South Asia: Research, Conservation, and Livelihoods - Commemorating the life and work of H.H. Godwin-Austen, held in Bangalore in 2023. His presentation was entitled *Taxonomic review of the enigmatic Sri Lankan land snail genus Acavus* (Eupulmonata: Acavidae). Samuel Tan from the University of Maine reports on his attendance in 2023 at a conference at Cambridge University UK entitled Bivalves – Where Are We Going? ; there he presented a paper on *Unravelling the Brachidontes variabilis species complex* (Bivalvia: Mytilidae). The MSL occasionally proves financial support for the organisation of symposia etc. Dinarzarde Raheem reports on just such an award for a *Residential workshop at Kanneliya Forest, southwestern Sri Lankan*, 1-3 September 2023 organized by herself, Oshan Wedage & Kumudu Wijesooriya of Rajarata University of Sri Lanka and the University of Sri Jayewardenepura, Sri Lanka. Issue 81 also included a book review of *Animals under logs and stones* by Wheater, Read & Wheater which includes a significant section on molluscs. The President thanked GD for his continued hard work on *The Malacologist*.

The Journal of Molluscan Studies reported on by Dinarzarde Raheem

The ISI impact factor for the *Journal* in 2022 increased to 1.2 (compared with 1.631 in 2021, 1.348 in 2020, 1.461 in 2019 and 1.345 in 2018). The *Journal* stands at number 92 in the ISI list of 176 zoological journals (it was 82 out of 176 in the previous year). The *Journal* continues to be truly international in terms of the geographical distribution of its authors; for volume 88 (2022) the corresponding authors represented 25 countries (of which the leaders were 22% USA and 12% Japan). Circulation for the Journal in 2023 was 28 institutional and 100 membership subscriptions (compared with 28 and 87 respectively for 2022). In addition, a further 2,368 institutions have electronic access to the Journal through publishers' collections (includes migrated figures; compared with 2,551 in 2022) and around 7,000 institutions have access through OUP's Developing Countries Offer, which constitutes 103 eligible countries with either free or reduced rate access (for details see http://www.oxfordjournals.org/access_purchase/developing_countries.html).

A new pricing structure has been fixed for 2024. The cost for an online-only subscription is £627/$1193/€942 for institutional subscriptions and £785/$1489/€1175 for corporate subscriptions. Please see https://academic.oup.com/mollus/subscribe for more information.

Volume **89** (2023) contained 38 papers, research notes and review articles. In total, 94 manuscripts were submitted in 2022 (a decrease of 7.7% on the 122 in 2021) and the acceptance rate was 40%. The image of the cowrie on the cover of Volume **90** was kindly donated by David Massemin.

CONTINUED>

>CONTINUED

Our board of Associate Editors now comprises: Coenraad Adema (immunology, genomics, parasitology), Thierry Backeljau (molecular phylogenetics and genetics), Liz Boulding (population and reproductive biology), 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), Kara Layton (heterobranch systematics and biology), Nicole Limondin-Lozouet (palaeoecology), Manuel Malaquias (opisthobranchs), Peter Marko (marine biogeography and phylogenetics), Pablo Martín (freshwater ecology, life history), Ellinor Michel (ecology, freshwater gastropods), Jeff Nekola (community ecology of terrestrial gastropods), Nicolas Puillandre (neogastropods), Ellen Strong (freshwater and marine caenogastropods), Janet Voight (cephalopods), Janice Voltzow (microscopic anatomy), Tony Walker (biochemistry, immunology, cytology), Suzanne Williams (molecular phylogenetics and genetics) and Yoichi Yusa (general ecology and behaviour). Robert Cameron and Heike Wägele have stepped down from the editorial board and my grateful thanks to them for their many years of dedicated service to the journal.

I would like to thank all the members of the editorial board and those members of the international malacological community who have contributed to the review process. At Oxford University Press, I would like to thank Sadie Griffiths (Publisher); Chloe Francis (Journal Manager); Jennifer Paxton-Boyd (Publishing Director for Science); Cindy Hyde (JMS editorial office); Matt Senderling (Marketing Coordinator); and Hannah Chippendale and Amy Young (OUP production specialist team). My thanks also to Gulshan Kumar and the production team at Aptara Incorporated for their work on behalf of the *Journal*.

Website reported on by John Grahame
There has been minor administrative progress in keeping the website up to date in respect of changes to Award procedures and documentation, Council membership, *The Malacologist,* and Meetings. There are still outstanding matters concerning some of our pages, it is intended to tackle these in the coming year.
JA thanked JG for his hard work on the website.

Facebook & Twitter reported on by Jon Ablett
The Society's Facebook page (http://www.facebook.com/malacsoc/) continues to perform well. We currently have 3,307 followers on the page, continuing the trend of gradual increase over the years. We therefore have a direct outreach population of over 3,000 people/organisations who receive notifications about our posts. In terms of countries represented, we have the most followers from USA (508), followed by Mexico (336), the UK (262), and Brazil (190).
The Society's twitter account currently has 911 followers and is another useful resource for communications.

Awards reported by Lauren Sumner-Rooney

Awards granted
Following disruptions, one ECR award recipient requested, and was granted, an extension on their research project.

Award applications
We received 13 applications for Early Career Research Awards in December 2023. Of these, five were eligible for the Global Development Award, three were eligible for the Equity and Inclusion Award, and three were eligible for the Maurice Yonge Award. The Society shifted its deadlines for Travel Awards in 2023 to allow more time to apply for funding in advance of the summer conference season. One application was received by the new 1st September 2023 deadline, which was granted. Two eligible applications were received by the 1st March 2024 deadline, both were granted. Four ineligible applications were received for travel taking place before the 1st June. Finally, two applications for Senior Research Grants made in June 2023 were awarded.

The Society received two nominations for the Annual Award before the new deadline of the 1st December. The winner of the 2023 Annual Award was Dr Imogen Cavadino, for her PhD thesis, submitted to Newcastle University and titled; *"Garden Gastropods: using citizen science to understand the diversity, role and impact of slug and snail species in British gardens"* The reviewers agreed that the interdisciplinary nature, creativity, and far-reaching community impact of Cavadino's work made her a very worthy recipient. 'Cavadino's thesis brings together a seriously impressive range of laboratory experiments, field experiments, field surveys and citizen science surveys that altogether make an outstanding thesis that is a major contribution to the field of terrestrial British molluscs.' The President congratulated Dr Imogen Cavadino and thanked L S-R for her work on the awards.

CONTINUED>

>CONTINUED

President's Report of Council

In my final year as President, I would like to start by thanking the wonderful people that make up the Council. It has been a true honour to be President for the last 3 years and it has been made possible to do this role with my fellow Council members who have helped me with so many issues and made the whole experience productive and enjoyable. I'd particularly like to thank John Grahame for the excellent handover and support and Katrin Linse for answering all my queries and questions about any and all aspects of the Society and its work.

Over the last few years, I have enjoyed hosting the *Tropical Biodiversity* meeting and the *William Henry Benson* symposium, two topics I have been interested in and would like to thank all the speakers and those who assisted with the preparation on the day. I would also like to thank Alan Hodgson, Phil Fenberg, Louise Firth and Steven Hawkins for their work on the *Limpets* 2024 meeting which I am sure will be a great success.

As I have said before I think the Molluscan Forum and the awards, we supply are some of the most important roles the Society plays. The meetings provide a great space not only for students and early career researchers to share their work but also allow a chance for people to discuss problems and issues, learn from each other and to network. I hope the Society will continue to invest time and money in both these areas, as I feel that encouraging research and researchers in malacology is a truly worthwhile cause.

As my term ends a number of people are stepping back from roles which have allowed the society to excel and flourish. I would like to thank Lauren Sumner-Rooney for all her hard work as Awards officer and her role in championing Diversity and Inclusion which I feel will have a lasting impact on the direction and work of the society. I would also like to thank Debbie Wall-Palmer for her sterling work as Secretary and for keeping the Council informed and on track. As Katrin Linse steps back from her role as Treasurer, I would like to thank her on behalf of the Council as a whole for her outstanding work as Treasurer, I am not sure what we would have done without her work on our finances and on a personal note I would like to thank Katrin for all the advice and guidance with OUP, rules, regulations aside from the wonderful work she has done as Treasurer.

Lastly, as Robert Cameron steps down from Council I would like to thank him for all he has done for the Society over many years. Robert was President from 2000-2003 but since I have been on Council, and many of you have been on for much longer, he has never failed to provide advice and assistance whether to meetings, awards, funding or the direction of the Society. It is truly fitting that Robert is offered Honorary Membership.

It has been an honour to be the President and I look forward to handing over the role to Dr Fiona Allan who will surely be a huge asset to the society. Thanks again to the membership and the whole Council for all you contribute to the Society and I look forward to working with everyone in my role as '*ex-officio*' in the forthcoming year.

End of Report

6. Awards

See above

7. Election of Council for 2024-25

See next page

8. Honorary Memberships

Professor Robert Cameron will be stepping down from the Council of the MSL after many years of service and support. In recognition of this and to thank Robert for all his hard work, on suggestion to the membership, the Council and I would like to put him forward as lifetime Honorary member. JA proposed to make Robert Cameron an Honorary Member.

Proposed: Fiona Allen
Seconded: Phil Fenburg

9. Any other business

Change to Membership Costs of the Society

Due to an increase in costs from our journal publisher OUP, our membership costs will be increased, so for 2025 student membership fees are proposed as £29. Full membership fees are proposed to increase to £50.

Proposed: Aiden Emery
Seconded: John Grahame

Andreia Salvador noted that the Society does not have any archives prior to 1939. AS requests whether anyone knows where the pre-1939 records are kept.

AS requested to use correspondence from the MSL archives as examples of past handwriting for a project. AS will email Council with details so that a decision can be made.

CONTINUED>

>CONTINUED

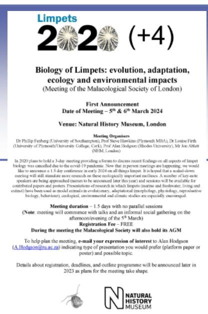
Year of existence	2023-2024	2024-2025 proposed
	130	**131**
President	Jon Ablett (3)	Fiona Allan* (1)
Vice Presidents	Fiona Allan (3)	Phillip Hollyman (3)
	Phillip Hollyman (2)	Aidan Emery* (1)
Ex officio		Jon Ablett (1)
Councillors (6)	Aidan Emery (3)	Rowan Whittle (3)
	Robert Cameron (3)	John Grahame (3)
	Victoria Sleight (3)	Phil Fenburg (1)
	Katie Collins (3)	Crispin Little (1)
	Rowan Whittle (2)	Katie Collins* (1)
	John Grahame (2)	James Witts* (1)
EC-Rep	Thomas Goulding (2)	Giada Spagliardi*
Co-opted (4)	Phil Fenburg (2)	Victoria Sleight (1)
	Crispin Little (2)	Katrin Linse (1)
	Alan Hodgson (1)	Lauren Sumner-Rooney (1)
Journal Editor	Dinazarde Raheem	Dinazarde Raheem
Bulletin Editor	Georges Dussart	Georges Dussart
Hon.Treasurer	Katrin Linse (final year)	Tom White* (1)
Membership Secretary	Harriet Wood	Harriet Wood
Hon. Secretary	Debbie Wall-Palmer (3)	TBC
Web manager	John Grahame (web)/ Victoria Sleight (Facebook)	John Grahame (web)/ Victoria Sleight (Facebook)
Awards Officer	Lauren Sumner Rooney (3)	Alan Hodgson* (1)
Archivist	Andreia Salvador	Andreia Salvador

Numbers indicate years in post; posts are for 3 years.
* Co-option

Proposed: Georges Dussart
Seconded: Andreia Salvador

Report of the meeting on *Biology of Limpets*

This meeting accompanied the AGM of the Malacological Society of London



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

Meeting Organisers
Dr Phillip Fenberg (University of Southampton), Prof Steve Hawkins (Plymouth MBA), Dr Louise Firth (University of Plymouth/University College, Cork), Prof Alan Hodgson (Rhodes University), Mr Jon Ablett (NHM, London)

In 2020 plans to hold a 3-day meeting providing a forum at the Marine Biological Association in Plymouth to discuss recent findings on all aspects of limpet biology was cancelled due to the covid-19 pandemic. Four years later, in March of this year, some limpet biologists were able to assemble at the Natural History Museum in London for a shorter 1.5-day conference. Previous limpet meetings had been held in 1993 (London), 2003 (Millport, Scotland) and 2010 (Phuket, Thailand). This year's meeting was attended by 40 delegates from 8 countries and began after welcome refreshments on the afternoon of the 5th of March. Louise Firth began with a presentation on the environmental history of limpets, which was followed by research talks by some of the conference organisers as well as a presentation by Helen Garbett on her art-based limpet research – The Limpetarium. Delegates then gathered at a local pub for informal discussions, before moving on to local restaurants.

The next day included a full programme of talks including excellent invited talks from Fernando Lima (*Robolimpets*) and Juan Sempere-Valverde (*Ecological implications of shoreline artificialisation on limpet population conservation*). Contributed talks were very varied with topics ranging from the effects of stress (including climate change) on limpets and how to measure it, aspects of the population dynamics and range expansion of limpets, management and conservation of limpets, and limpet diversity in India. Many of the presentations were by postgraduate students which bodes well for the future of limpet research. The conference concluded with a poster session accompanied by suitable refreshments. By the end of the meeting research on over 20 species of limpet (including one enigmatic limpet-like bivalve, *Enigmonia aenigmatica*) had been presented.

No date was set for the next limpet meeting, but no doubt there will be one in the near future. The conference programme and abstracts from the 2024 meeting follow.

Report by Prof. Alan Hodgson

Conference Programme

Tuesday 5th March	**FLETT THEATRE, NATURAL HISTORY MUSEUM, LONDON**
15.00 – 15.20	Arrival at NHM, registration, refreshments, put up posters & load talks
15.20 – 15.30	Welcome – **Jon Ablett** (President MSL)
15.30 – 15.40	**Alan Hodgson -** Welcome and short introduction "Orton & His Legacy".
15.40 – 16.10	**Invited Talk** **Louise Firth**: What have limpets ever done for us? On the past and present provisioning and cultural services of limpets.
16.10 – 16.30	**Phil Fenberg**: Giving a Hoot: range shifts, phylogeography, and genetic vulnerability of the Owl Limpet, *Lottia gigantea*.
16.30 – 17.00	**Steve Hawkins**: Long-term changes in populations of *Patella depressa* towards its poleward range edge (44 years of chucking quadrats).
17.00 - 17.30	**Helen Garbett**: The Human Limpet Project: On being enchanted by limpets of all forms.
17.30 onwards	Social gathering at local ale house.

Wednesday 6th March	**FLETT THEATRE, NATURAL HISTORY MUSEUM, LONDON**
09.30 – 09.45	Registration, load talks
SESSION 1	Chair: Jessica Allen
09.45 - 10.15	**Invited Talk** **Fernando Lima**: Robolimpets: origin, evolution, and applications.
10.15 - 10.30	**Ignacio A. Cienfuegos**: Growth in the margins: field measured protein metabolism rates in the keystone, intertidal limpet, *Patella vulgata*.
10.30 - 10.45	**Andre Ampuero**: Limpet stories through shells and anatomy.
10.45 - 11.00	**Mar Humet Caballero**: Assessing basal thermal stress in a natural population in a non-invasive way.
11.00-11.30	**Refreshment Break**
SESSION 2	Chair: Ignacio Cienfuegos
11.30 – 11.45	**Javier Guallart**: Why so many efforts to justify unsuccessful translocations of the endangered limpet *Patella ferruginea*?
11.45 - 12.00	**Camilla Della Torre**: Investigating the adaptive mechanisms to ocean acidification in the limpet *Patella caerulea* from the CO_2 vent systems of Ischia (Italy).
12.00 – 12.15	**Alvaro Sabino-Lorenzo**: When the population of an endangered marine mollusc (*Patella ferruginea*) increases almost three-fold in ten years. Reality or fiction?
12.15 – 12.25	**Conference photograph**
12.25 - 13.00	**Informal Discussions and LUNCH**
13.00 – 14.00	**Malacological Society AGM, Non-members free to continue discussions or explore Natural History Museum**

CONTINUED>

>CONTINUED

SESSION 3	Chair: Franz Bauer
14.00-14.30	**Invited Talk** **Juan Sempere-Valverde**: Surviving the urbanised world: ecological implications of shoreline artificialisation on limpet population conservation.
14.30-14.45	**Karolina Zarzyczny**: The ecological and evolutionary consequences of tropicalisation: a case study from limpets.
14.45-15.00	**Maria Inês Seabra:** Limpet dynamics within and beyond eco-engineered rockpools: a ten-year study on rock-armour structures in the Port of Sines (SW Portugal).
15.00-15.15	**Bhavik Vakani**: Diversity of true gastropod limpets of mainland coastal India.
15.15 – 15.45	**Refreshment Break**
SESSION 4	Chair: Javier Guallart
15.45-15.50	**Debora Borges**: Insights for addressing climate change effects on *Patella* spp. early life stages.
15.50-15.55	**Sarah Hinckley**: The role of mucus in patellid limpet distribution.
15.55-16.00	**Rocío Nieto-Vilela**: Unveiling climate-driven shifts: exploring range expansion and thermal limits of *Siphonaria pectinata* in NW Iberia rocky shores.
16.00-16.15	**Julia Sigwart**: Observations on the enigmatic mangrove limpet.
SESSION 5	
16.15-17.30	**Poster session, discussions with refreshments**, closing remarks
17.30	Conference closure, Depart Conference Venue, Evening Free

Poster Papers

Franz Bauer, Antony M. Knights, John N. Griffin, Mick E. Hanley, Andy Foggo, Austin Brown, Emma Jones, Louise B. Firth. Superficial, but sophisticated - How does surface topography determine abundance and spatial distribution of key benthic species?

Charlotte Clubley, Jessica Allen. An investigation into the influence of eco-engineered tiles on the biota and biodiversity of artificial shores.

Aeden Cooper, Sandalia Walker, Juan Sempere-Valverde, Chris Moocarme, Antony M. Knights, Louise B. Firth. How limpets affect succession in an artificial environment.

J. Guallart, M.P. Ferranti, M. Chiantore. Larval development of *Patella rustica* in the laboratory: how it can help us to understand clues about the threatened *P. ferruginea*.

Sally Henderson, John Griffin, Matthew Perkins, Louise Firth. Self-cleaning slipways: harnessing species interactions for sustainable management of coastal infrastructure.

Jack Hollister, Phil Fenberg. Computer vision-based morphological assessment of limpet species along the Baja California coast.

A.Martín-Zorrill a, E. Ostalé-Valriberas, A. Sabino-Lorenzo, A. A. Pavón-Paneque, J. Sempere-Valverde, G. A. Rivera-Ingraham, J. C. García-Gómez, F. Espinosa. Predicting the fate of the most endangered marine invertebrate of the Mediterranean: The power of long-term monitoring in conservation biology.

E. Ostalé-Valriberas, J. Sempere-Valverde, A. Pavón-Paneque, S. Coppa, F. Espinosa, J. C. García-Gómez. Artificial marine micro-reserves as a new ecosystem-based management tool for marine conservation: The case of *Patella ferruginea* (Gastropoda, Patellidae), one of the most endangered marine invertebrates of the Mediterranean.

E. Ostalé-Valriberas, A. Martín-Zorrilla, A. Pavón-Paneque, A. Sabino-Lorenzo, J. C. García-Gómez. Advances in the management and translocation methodology of the endangered mollusc *Patella ferruginea* in artificial habitats of port infrastructures: implications for its conservation.

Sandalia Walker. Understanding the effects of man-made artificial structures on the population-size structures of a keystone species *Patella vulgata*.

CONTINUED>

ABSTRACTS

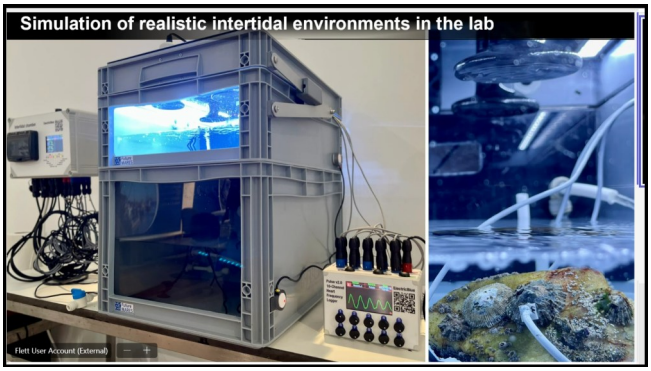
Alphabetical by type of presentation (Presenting author is underlined)

What have limpets ever done for us? On the past and present provisioning and cultural services of limpets

Louise B. Firth
School of Biological, Earth and Environmental Sciences, University College Cork, Ireland.

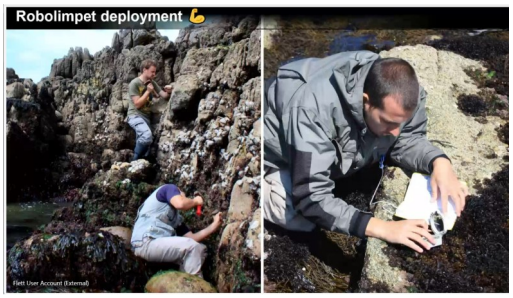
Limpets are one of the most abundant and familiar rocky shore organisms globally. They are perhaps most famous for their ability to cling onto rocks, but they are also well known for their grazing activity, which has an important structuring function. In contrast to other molluscs, such as oysters and mussels, which are celebrated for their gastronomic and cultural importance, little is known about the provisioning and cultural services of the humble limpet, and they are often referred to as 'famine food'. In this talk, I will provide an overview of the importance of limpets in the diets and cultures of humans globally. Not only were limpets often the dominant shellfish eaten by early modern humans, but also they sustained the poor during times of famine and destitution. Today, they are considered a delicacy in many cultures. They were popular as bait and their shells have been used for a wide variety of uses, including tools, currency, offerings, traditional medicine, jewellery and artworks. They have important spiritual and religious relevance, featuring in myriad traditions, superstitions and folklore. Whilst limpets are not exploited on a global scale, there are many regions where populations are vulnerable to over-exploitation and possible extinction. Appropriate management is required if we are to protect these underappreciated animals.
For more information the full paper can be accessed at
https://press-files.anu.edu.au/downloads/press/n9154/pdf/01_firth.pdf:
Firth LB. (2021). What have limpets ever done for us? On the provisioning and cultural services of limpets. *International Review of Environmental History*, 7: 5-46.

Robolimpets: origin, evolution, and applications



Fernando P. Lima
CIBIO/BIOPOLIS, Porto, Portugal

Despite steady advances in remote temperature sensing, it is now clear that natural and human-altered thermal environments often exhibit intricate, small-scale complexities in both spatial and temporal dimensions, which can only be adequately resolved through *in situ* monitoring. This is most apparent in coastal areas, which are among the most thermally dynamic environments on Earth but also notoriously difficult to monitor. Consequently, many studies rely on broad-scale spatial and temporal averages, overlooking the fact that organisms respond to changing local conditions rather than to overall global temperature patterns, reducing the impact of most analyses and forecasts. Here I describe progress in creating reliable and miniaturized autonomous data loggers. These devices were designed to effortlessly gather fine-scale data in extreme conditions, such as being submerged in saltwater, battered by waves, and subjected to temperature extremes, UV radiation, and ice scouring. Originally inspired by limpets (hence the name "robolimpets"), these loggers have since evolved and diversified. Today, we have access to a wide range of temperature loggers, each tailored for specific functions. I use various field examples to highlight the advantages, opportunities, and limitations of this innovative family of instruments.



CONTINUED>

>CONTINUED

Surviving the urbanised world: ecological implications of shoreline artificialisation on limpet populations conservation

Juan Sempere-Valverde[1,2]; Enrique Ostalé-Valriberas[1]; Free Espinosa[1]
[1]*Laboratorio de Biología Marina, Departamento de Zoología, Universidad de Sevilla,Avda, Spain*
[2]*Biological and Environmental Sciences and Engineering (BESE), Red Sea Research Center (RSRC), King Abdullah University of Science and Technology (KAUST), Saudi Arabia*

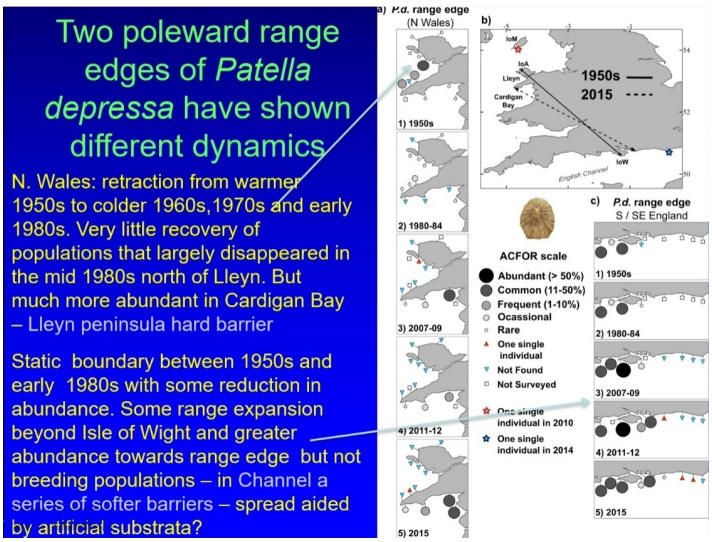
Limpets are important habitat engineer species in marine zones that are often subject to extensive anthropogenic impacts such as pollution, coastal sprawl, and human collection. The increasing presence of artificial structures in coastal ecosystems can cause population fragmentation, limiting the genetic flow and dispersion capacity of limpets. Moreover, limpets colonising artificial structures can differ in population demography from natural reefs, which affects their reproductive potential. However, these structures also present a managerial opportunity for mitigation of impacts and, in particular cases, to conserve the limpet species that naturally settle on them. This includes the restoration of our degraded, artificialized shorelines, to better approximate those on natural shores, although there is still much to learn to effectively minimize and mitigate the impacts on limpet populations and other marine life. In the face of rapid urbanisation and anthropogenic global change, the study of limpets' adaptation to shoreline features offers valuable insights into the ecological implications of coastal artificialisation. It underscores the importance of balancing ecological, social, and governmental principles for achieving sustainable development.

Long-term changes in populations of Patella depressa towards its poleward range edge – 44 years of chucking quadrats

S.J. Hawkins[1,2,3,4,5,6], M. Orostica, N. Mieszkowska[1,3], S.R. Jenkins[1,5], P.M. Moore[1,8], M.T. Burrows[3,7], L.B. Firth [4,5,6,9]
[1]*Marine Biological Association of the UK,*
[2]*University of Manchester,*
[3]*University of Liverpool,*
[4]*University of Southampton,*
[5]*University of Bangor,*
[6]*University of Plymouth,*
[7]*Scottish Association for Marine Science,*
[8]*University of Newcastle.*
[9]*University College Cork*

Long-term changes in the relative proportions of warmer water *Patella depressa* and colder water *Patella vulgata* in limpet populations on the mid shore have been charted on the rocky shores of the British Isles since the 1950s (Crisp & Southward), and from December 1979 by SJH. In the early 1980s following the cold spell from 1962-1963, the proportion of *Patella depressa* was lower on many shores. From around 1988 onwards warming conditions led to an increase in *Patella depressa* in south-west England.

Re-surveys at range edges from the 2000s-2020s onwards found modest range expansion *Patella depressa* in the English Channel with breeding populations in the eastern Isle of Wight and established on an artificial shore at Southsea in Portsmouth, with scattered individuals along the south coast. In N. Wales by contrast, the range edge populations extending as far north as Anglesey in the 1950s, with scattered individuals still present in the 1980s, has retracted mostly to south of the Llyn peninsula.

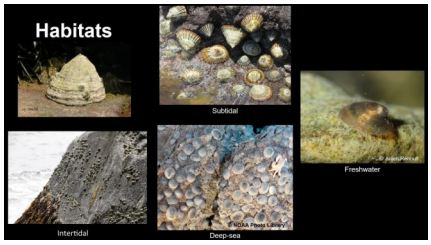


Whilst the ultimate factor of climate change is driving relative abundance of the two species, proximate factors such as hydrographic barriers and habitat suitability are setting range limits. The Llyn seems to be a hard barrier in contrast to those present in Southern England where proliferation of artificial habitat may be aiding spread (also in *P. ulyssiponensis*). Parallel observations on growth and mortality show strong performance by *P. depressa* at its range edges. Experiments show that intraspecific competition is stronger than interspecific competition except under simulated canopies where *P. depressa* is negatively impacted by *P. vulgata*.

>CONTINUED

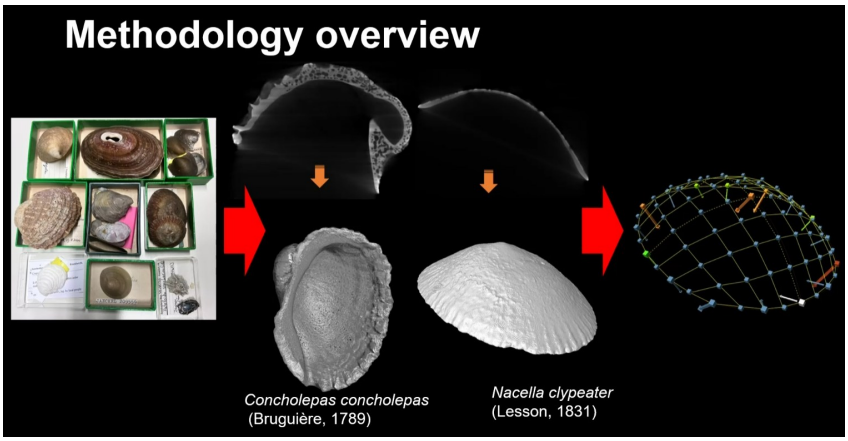
>CONTINUED

Limpet stories through shells and anatomy



Andre Ampuero, Julia Sigwart
Department of Marine Zoology, Senckenberg Research Institute, Frankfurt am Main, Germany

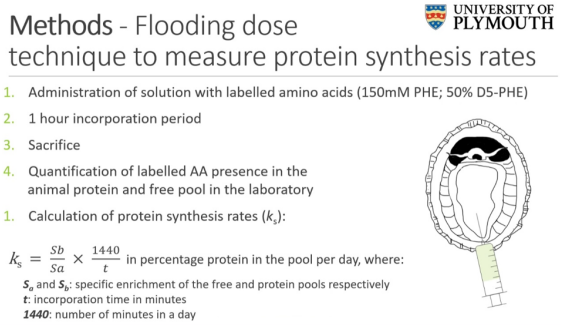
Limpet shape is broadly extended not only in Gastropoda, but other groups within and outside Mollusca. Animals that fall into this condition possess a flattened armour protecting its soft parts, which attaches firmly to the substratum. Its prevalence suggests advantages like shielding against predators and wave forces which partly explains why it has evolved multiple times. This study looks into the limits and potential of limpet evolution in Gastropoda by studying a diverse set of information, including µCT scans of shells and soft body parts, to understand how limpets have changed over different clades including extinct forms. We are especially interested in how the degree of shell coiling affects the soft body inside, for example, how much the shell has changed across different taxa. We have examined specimens from scientific collections to review not only limpet taxa, but also coiled shell species where this limpet shape appears. We are obtaining shells µCT scans of most genera of limpet. For anatomical comparison, we are using literature review and studying anatomy of limpets with poor or no information available using µCT scan and histology. By exploring these facets, we aim to disentangle the evolutionary narrative of limpets and their anatomical adaptations.



Growth in the margins: field measured protein metabolism rates in the keystone, intertidal limpet, *Patella vulgata*

Ignacio A. Cienfuegos[1], Benjamin J. Ciotti[1], Richard A. Billington[1], Paul A. Sutton[2], Keiron P.P. Fraser[1]
[1]*School of Biological and Marine Sciences, University of Plymouth, U.K.*
[2]*School of Geography, Earth and Environmental Sciences, University of Plymouth, U.K.*

Seasonality in both shell and soft tissue growth has been reported in intertidal molluscs since early rocky shore studies. Reproductive cycle, shore height and annual changes in food availability and temperature, among other factors, have an effect on growth in these species. Protein metabolism, a key biological process responsible for tissue growth, has also proven to be aligned with seasonal changes in temperature and food availability in other species. However, to date, no studies have measured protein metabolism in the field in any organism. The common limpet *Patella vulgata* is ubiquitous to North-Eastern Atlantic intertidal rocky shores. Growth is reduced in summer, during gametogenesis, and in winter compared to autumn and spring. Low shore populations, formed by younger individuals, show faster growth compared to their higher shore conspecifics. No studies had previously examined protein metabolism in *P. vulgata*, and it was unclear whether growth patterns would extrapolate to protein synthesis (k_s), degradation (k_d) and growth (k_g) rates. Here, we measured growth, protein metabolism and oxidative stress in *P. vulgata* in the field over a year, at three different shore heights. Shore height had a significant effect on k_s and mass growth and there were significant seasonal variations in protein metabolism, mass growth and oxidative stress. k_s was highest in spring, whereas k_g peaked in summer and decreased in spring due to increased k_d. Total mass growth rates were higher in winter, especially in low shore animals. Tissue mass growth rates were higher in spring/summer compared to winter/autumn. This study demonstrates that the reproductive cycle appears to drive seasonal variations in protein metabolism and tissue growth in *P. vulgata*.

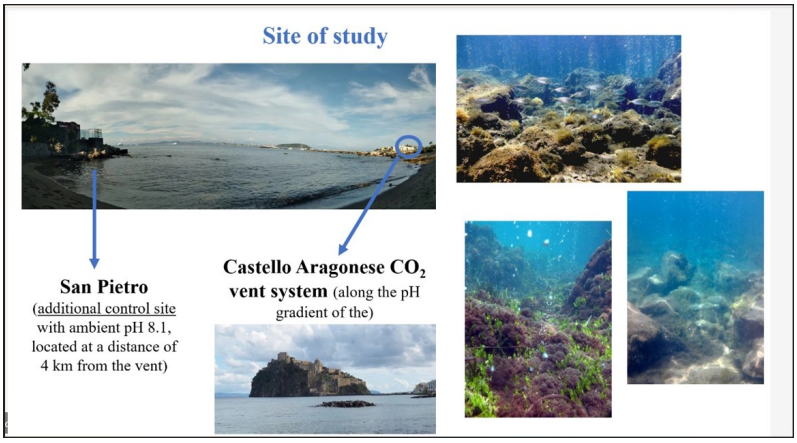


CONTINUED>

Investigating the adaptive mechanisms to ocean acidification in the limpet *Patella caerulea* from the CO_2 vent systems of Ischia (Italy)

Camilla Della Torre[1,2*], Silvia Giorgia Signorini[1,2], Fabio Crocetta[2], Lara Nigro[1], Ilaria D'Aniello[4], Marco Munari[2,4]
[1]*Department of Biosciences, University of Milan, Milan, Italy*
[2]*Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy*
[3]*Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, Italy*
[4]*Department of Biology, Stazione Idrobiologica Umberto d'Ancona, University of Padova, Chioggia (Venice), Italy*

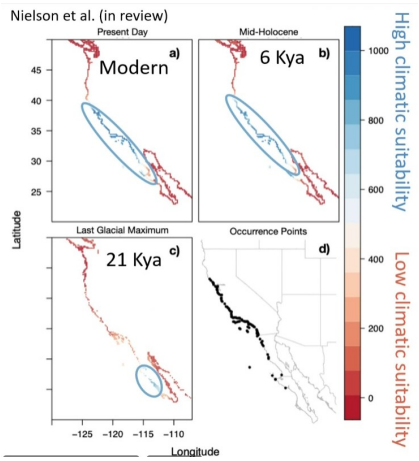
The continuous increase in CO_2 emissions in the atmosphere generates ocean acidification (OA). Based on laboratory studies, OA has several detrimental effects across many taxa. However, different investigations performed in CO_2 vent systems demonstrated the ability of some species, including calcifying organisms, to survive even in the most acidified areas. In particular, the gastropod limpets of the genus *Patella* occur also under naturally acidified conditions at the CO_2 vents of the Castello Aragonese (Ischia Island, Italy). Nonetheless, the complex mechanisms that allow survival and adaptation to natural OA conditions still need to be understood. In this study, specimens of *Patella caerulea* were collected along the pH gradient of the Castello Aragonese vent (N1 pH 8.1 – N2 pH 7.7 – N3 pH 7.4) and from a nearby control site to investigate the mechanisms that allow survival and may be involved in acclimation/adaptation. Biomarkers related to oxidative stress and physiological traits were assessed, together with an untargeted metabolomics analysis. Limpets sampled in the acidified sites N2 and N3 displayed higher shell length and soft-body weight with respect to organisms collected in the ambient pH sites. Moreover, a significant increase in carnitine and in 11 of its metabolites was assessed in specimens collected under acidified conditions. Finally, limpets in N3 significantly boosted their respiration rate in comparison with all other sites, and a slight induction of oxidative stress was detected along the pH gradient.



Giving a Hoot: range shifts, phylogeography, and genetic vulnerability of the Owl Limpet, *Lottia gigantea*

Phillip B Fenberg
School of Ocean and Earth Science, National Oceanography Centre, University of Southampton, U.K.

The Giant Owl Limpet, *Lottia gigantea*, is perhaps the most well-studied limpet of the west coast of North America. Not only is it the largest limpet in the genus, it is also an important space occupier because of its territoriality, a sequential hermaphrodite, and has been size-selectively harvested by coastal human communities for millennia. In this talk, I review the latest research on *L. gigantea*, including recent observations of range changes at both its poleward and equatorward range limits, and present new research on its population genetics and phylogeography. I conclude by discussing the conservation implications of these results, including the possibility of the loss of genetically unique equatorward populations with ongoing climate warming.



CONTINUED>

>CONTINUED

The Human Limpet Project: On being enchanted by limpets of all forms

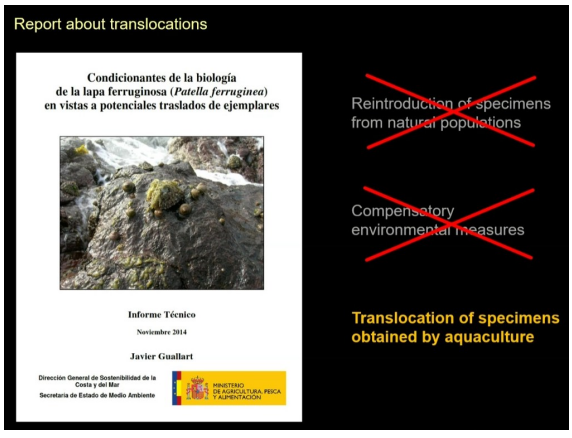
Helen Garbett
University of the Highlands and Islands, Centre for Island Creativity, Shetland Institute of Archaeology, Orkney

The story of limpets, when told through socially engaged, art-based research reveals an accessible, captivating, richly entangled, human-nonhuman tale which unfolds over thousands of years. If given careful, prolonged attention, room to express themselves and an open-minded, receptive audience, limpets can engender a sense of curiosity and wonder, enchanting people with potentially life affirming consequences (Bennett, 2001). A methodology comprised of *Limpeteering*, *Corresponding* and *Wunderkammering*, underpinned by new materialist thinking enrols limpets in a process of questioning the habitual ways by which we know and conduct ourselves towards the natural world. Stimulating an original form of public dialogue and creating *The Limpetarium*, a contemporary, limpet-focussed wunderkammer or wonder-room, this long-term undertaking is creating new connections between art, archaeology and marine ecology, contributing to interdisciplinary research and knowledge-making both now and in the future.

Reference:
Bennett, Jane. *The Enchantment of Modern Life: Attachments, Crossings, and Ethics*. 1st paperback edition., Princeton University Press, 2001.

Why so many efforts to justify unsuccessful translocations of the endangered limpet *Patella ferruginea*?

Javier Guallart
Independent researcher, Valencia, Spain



The ferruginous limpet *Patella ferruginea* is one of the most endangered Mediterranean marine invertebrates, threatened mainly by over-harvesting and habitat destruction and fragmentation. Its recovery has been considered hampered by its supposed low capacity for natural dispersal, and reinforcement with specimens in areas where it was previously present has been considered the best strategy for recovery of this species. Translocation of individuals between natural populations has been repeatedly attempted over the last 20 years but has generally resulted in low survival. Consequently, the strategy for the conservation of this species in Spain (updated in 2023) discouraged such translocations among natural populations as a conservation or compensatory measure. Instead, it recommends the development of aquaculture techniques for the production of recruits (juveniles) by controlled reproduction to be used for eventual reintroduction or restocking projects. However, several recent papers attempt to demonstrate that translocations from natural populations are feasible with a "reasonable" mortality rate. A critical review of all translocation attempts made so far in this species is presented, discussing the different methodologies used and analysing their results. The reasons for trying to justify the interest of translocations as a conservation measure are also discussed, distinguishing between those attempting to translocate juveniles obtained from aquaculture and those transferring specimens from natural populations.

CONTINUED>

>CONTINUED

Assessing basal thermal stress in a natural population in a non-invasive way

Mar Humet[1,2], Rocío Nieto-Vilela[1,2], Fernando P. Lima[1,2], Rui Seabra[1,2]
[1] *CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado*
[2] *BIOPOLIS Program in Genomics, Biodiversity and Land Planning*

The intertidal zone is among the most physically demanding environments on the planet and has long served as a model for examining the role of environmental stressors. Temperature is one of the most determinantal modulators of animal physiological performance and survival. Therefore, accurate assessments of thermal stress in rocky intertidal natural populations are critical for forecasting the likely impacts of extreme events driven by climate change. Here, we explore the usability and applicability of a non-invasive method to assess thermal stress in *Patella depressa*, a key species on the ecology of the rocky intertidal coast of the NE Atlantic. We measured heartbeat frequency using a portable system equipped with an infrared sensor connected to a smartphone running a dedicated mobile app. We show how heartbeat measurements of *Patella depressa* made *in situ* reveal patterns of thermal stress, presenting a strong correlation between heart rate and temperature. We also documented a deviation of the heartbeat baseline simultaneous with a marine heat wave. Additionally, we found implications in the thermal stress response related to solar exposure (i.e., animals exposed to the sun/animals in shaded locations) and to the animal size. This simple and user-friendly technique creates new possibilities for monitoring physiological responses to sub-lethal stress levels in a changing environment.

When the population of an endangered marine mollusc (*Patella ferruginea*) increases almost three-fold in ten years. Reality or fiction?

A. Sabino-Lorenzo[1], A. Ali-Ahmed[1], A. Pavón-Paneque[1], J. Sempere-Valverde[1], F. Espinosa[1], J. C. García-Gómez[1], E. Ostalé-Valriberas[1]
[1] *Laboratorio de Biología Marina de la Universidad de Sevilla (LBMUS)/Área de Investigación I+D+i del Acuario de Sevilla/ Estación de Biología Marina del Estrecho (Ceuta), Universidad de Sevilla, Seville, Spain.*

Over the past decade, the temporal change of the critically endangered species *Patella ferruginea* (Gastropoda, Patellidae), endemic to the western Mediterranean, has been monitored (structure and density) using exhaustive censuses along Ceuta's coast (Strait of Gibraltar). This study focuses on the population dynamics of *P. ferruginea* in Ceuta and the environmental factors that affect the structure of this population, such as wave exposure, coastline heterogeneity, substratum roughness, substratum lithology, and chlorophyll-a concentration, as the statistical modelling has shown in the study. Different potential negative interactions were also considered: angling, shell fishing, and recreational activities. The results have shown in a ten-year period, 2011-2021, the estimated size of *P. ferruginea* population has increased by 300 %, from 55,902 to 168,463 individuals (of which 131,776 are adults). The subpopulation with the greatest increase in these years was the one settled inside Ceuta's harbour. The results of the study indicate that Ceuta hosts the main population of this endangered species through its natural distributional range, being a source population on the Southern Iberian Peninsula that its preservation must be prioritized. These results also support "Artificial Marine Micro-Reserves" as a new area-based conservation measure that could promote genetic flow among populations, with eventual recolonization.

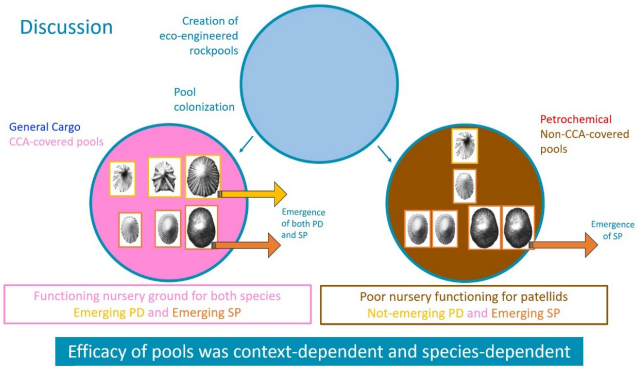
CONTINUED>

>CONTINUED

Limpet dynamics within and beyond eco-engineered rockpools: a ten-year study on rock-armour structures in the Port of Sines (SW Portugal)

Maria Inês Seabra[a], Stephen J. Hawkins[bcd], Cristina Espírito-Santo [a], Susana Celestino [a], Alina Sousa[a], Marta Mamede[a], André Costa[a], Nuno Mamede[a], Teresa Silva[a], João J. Castro[ae], Teresa Cruz [ae]
[a] *Marine and Environmental Sciences Centre (MARE)/Aquatic Research Network (ARNET), Laboratório de Ciências do Mar, Universidade de Évora, Apartado 190, 7521-903 Sines, Portugal*
[b] *Marine Biological Association of the UK, Citadel Hill, Plymouth, PL1 2PB, UK*
[c] *School of Ocean and Earth Science, University of Southampton, Waterfront Campus, European Way, Southampton SO14 3ZH, UK*
[d] *School of Biological and Marine Sciences, University of Plymouth, Plymouth, United Kingdom*
[e] *Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal*

Rockpools are nurseries for intertidal limpets. Limpet abundance is low on mid-tidal levels of rock-armour structures in the Port of Sines (Portugal), where rockpools are scarce. Eco-engineered rockpools were created on two locations inside this port (General Cargo and Petrochemical Terminals), by drill-coring mid-tidal boulders of rock-armour structures. Within cored (with pools) boulders, we monitored the cover of sessile organisms in pool-bottom surfaces, the recruitment of limpets onto the pools, and the density and size-structure of limpets on open-rock surrounding pools (Around) and away from pools (Away). Limpets were also censused on Control (without pools, unmanipulated) boulders. We tested whether there was a proximity effect (Away vs. Around) and a landscape-unit effect (Cored vs. Control boulders) of eco-engineered rockpools on the abundance of *P. depressa* and *S. pectinata* on mid-tidal open-rock over ten-years (2010-2020). Both the abundance of crustose corallines and the recruitment of patellids were low at Petrochemical. For *P. depressa*, a significant landscape-unit effect was found at General Cargo whereas no proximity effect was detected. Proximity and landscape-unit effects were significant on both locations for *S. pectinata*. Eco-engineered rockpools can provide nursery-grounds and source-areas of emigration to adjacent open-rock, enhancing limpet populations over long-time and across distinct microhabitats.



Observations on the enigmatic mangrove limpet

Julia Sigwart[1], Leena Wong[2]
[1]*Senckenberg Research Institute and Museum, Frankfurt*
[2]*Universiti Putra Malaysia*

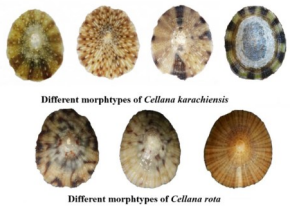
Enigmonia aenigmatica represents the farthest reaches of the limpet form: a motile anomiid and often referred to as a bivalve limpet. The species is widespread in the Indo-West Pacific, occurring in coastal mangrove. Thus, they are also the only known arboreal limpet, or arboreal bivalve. New observations from two populations in peninsular Malaysia confirm this species is moderately mobile, the juveniles actively crawl in laboratory conditions and in the field are mainly found attached onto larger adults. Adults can reattach and reorient but would not readily move. The movement is unlike gastropods, not a smooth gliding but rather inching forward pulled by the long foot. Adults occur above the mean high-water mark but depend on periodic immersion for filter feeding and grow well in captivity when fully submerged. We present here the first video of this limpet like behaviour in *Enigmonia.*

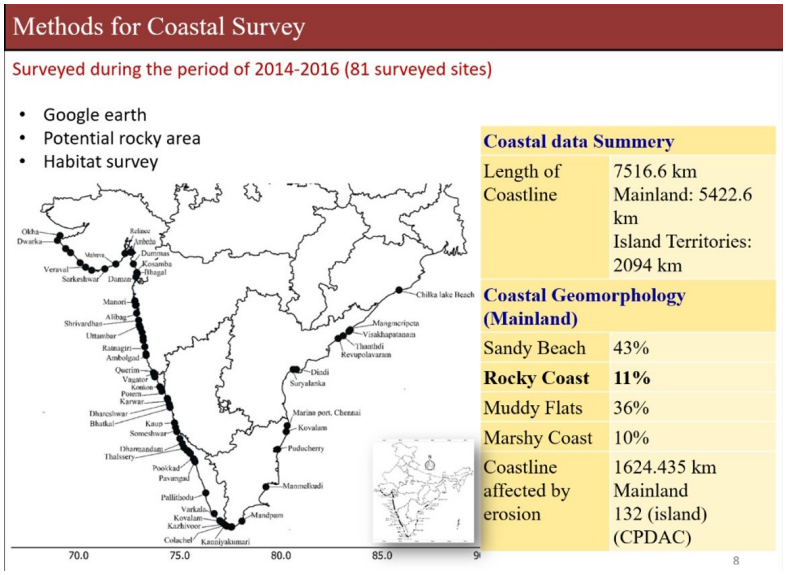
CONTINUED>

>CONTINUED

Diversity of true gastropod limpets of mainland coastal India

Bhavik Vakani, Rahul Kundu
Department of Biosciences, Saurashtra University, Rajkot – 360005.



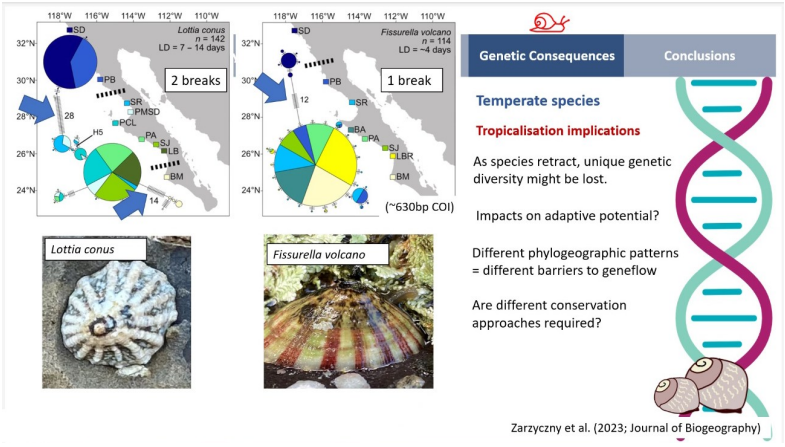


The ecological importance and worldwide diversity of patellogastropods have attracted researchers from numerous biological disciplines. For a review of the current status of the diversity of true limpets of the Indian coastline, 77 coastal areas in the Gujarat, Western and Eastern Ghats having a rocky shoreline or rocky outcrops were surveyed during December 2014 to December 2016. From the study, seven species of true limpets were recorded from the entire mainland Indian coastline. The initial study and analysis of the observed limpets revealed that all of them have many morphs (variants) and creates taxonomic confusion within their species complex. Our study provides annotated taxonomical and ecological characters for identification to resolve species complexes. Results of the study also found the need for better tools for identification of species complexes by the combination of molecular phylogenetic with traditional taxonomy.

The ecological and evolutionary consequences of tropicalisation: a case study from limpets

Karolina M. Zarzyczny[1,2]*, Michael E. Hellberg[3], Elena B. Lugli[2], Moira MacLean[1], David A. Paz-García[4, 5], Marc Rius[6,7], Ethan G. Ross[1,8], Erick X. Treviño Balandra[5], James Vanstone[1], Suzanne T. Williams[2], Phillip B. Fenberg[1,2]
[1]*School of Ocean and Earth Science, National Oceanography Centre, University of Southampton, Southampton, U.K.*
[2]*Department of Science, Natural History Museum, London, UK.*
[3]*Department of Biological Sciences, Louisiana State University, USA.*
[4]*CONACyT-Centro de Investigaciones Biológicas del Noroeste (CIBNOR). Av. Instituto Politécnico Nacional 195, México.*
[5]*Laboratorio de Necton y Ecología de Arrecifes, CIBNOR. Av. Instituto Politécnico Nacional 195, México.*
[6]*Centre for Advanced Studies of Blanes (CEAB, CSIC), Spain.*
[7]*Department of Zoology, Centre for Ecological Genomics and Wildlife Conservation, University of Johannesburg, South Africa.*
[8]*School of Biological Sciences, University of Aberdeen, U.K.*

Tropicalisation is a marine phenomenon arising from contemporary climate change. It is characterised by the range expansion of tropical species and the retraction of temperate species, and has a multitude of ecological consequences for species and communities. However, to date, tropicalisation has been predominantly studied in charismatic subtidal species, with minimal focus on intertidal gastropods, particularly limpets. Moreover, our understanding of its evolutionary consequences remains largely limited. We used distributional data obtained from field surveys spanning over 3,000km along the eastern Pacific rocky coastline, museum collections, and genetic data from partial COI gene to document tropicalisation and assess its implications on phylogeographic patterns of multiple limpet species. We detected tropicalisation along the rocky shore coastline and provided baseline distributions for previously understudied limpet species to allow for future tropicalisation monitoring. We showed that tropicalisation may lead to genetic erosion of evolutionarily distinct lineages through range contraction in some limpets. Whilst some range extending gastropods can maintain high levels of genetic diversity, this was not the case for some limpets. We highlight that more investigation into species-specific larval development is necessary as species-specific barriers to dispersal are likely to influence patterns of tropicalisation and its consequences in the future.



CONTINUED>

>CONTINUED

Insights for addressing climate change effects on *Patella* spp. early life stages

Diana Freitas [1, 2], Francisco Arenas[1], Isabel Sousa-Pinto [1,3], Débora Borges[1]
[1]*Interdisciplinary Centre of Marine and Environmental Research of the University of Porto (CIIMAR), Matosinhos, Portugal*
[2]*School of Medicine and Biomedical Sciences (ICBAS), University of Porto, Porto, Portugal*
[3]*Faculty of Sciences, University of Porto, Porto, Portugal*

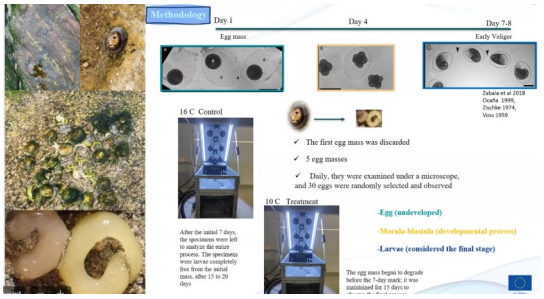
Larval and juvenile stages of invertebrates are more sensitive to environmental stress than adults. Therefore, climate change will very likely have a negative impact on the early stages of limpets by reducing juvenile survival and growth, that might extend into adulthood and reduce limpet population fitness. Previous *Patella* spp. studies have investigated the effects of climate change on the biology and distribution of adults. However, studying the effects of climate change on different life stages is fundamental to fully comprehend its impact on marine assemblages. To investigate these possible effects, a set of specific objectives were defined: comparison of current limpet abundance and reproductive cycles with historical data; optimization of methodologies to induce spawning, development of larvae and settlement of spat; and assessment of climate change stressors effects on larvae and spat survival. The methods to be implemented to achieve these objectives will be presented to promote exchange of knowledge and practices. This research constitutes the first approach to understanding how climate change affects survival and settlement of early life stages of the most common limpet species from the northwest Portuguese coast.

The role of mucus in patellid limpet distribution

S.L. Hinckley[1], K.P.P. Fraser[1], L.B. Firth[1], S.J. Hawkins[2], M. Reverter[1]
[1]*School of Biological and Marine Sciences, University of Plymouth, U.K.*
[2]*Ocean and Earth Science, University of Southampton, U.K.*

Patellid limpets are influential gastropod grazers that provide top-down control and contribute to the structure of intertidal communities. In Britain, three species (*Patella vulgata*, *P. ulyssiponensis* and *P. depressa*) co-exist in the same environmental conditions but show species specific distributions across spatial and temporal scales. Within this, each species also displays further segregation according to life stage, as well as differing group behaviours such as random aggregations like *P. vulgata*, or uniform distributions as seen in *P. ulyssiponensis* populations.
The observed differences in patellid limpet distribution can be partially attributed to physical interspecific interactions. However, another important driver of behaviour, chemical mediation, is less understood in this group. The use of mucus trails in communication and navigation has been documented in many intertidal gastropod species, such as littorinid, neretid and haliotid species, but remains poorly understood in patellids. Preliminary results on behavioural experiments investigating the attractant or deterrent role of UK patellid mucus trails in conspecifics and heterospecific interactions will be presented.

Unveiling climate-driven shifts: exploring range expansion and thermal limits of *Siphonaria pectinata* in NW Iberia rocky shores

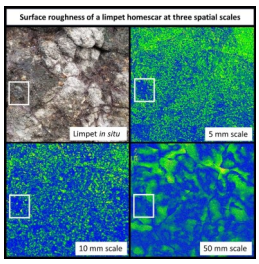


Rocío Nieto-Vilela[1,2], Rita Da Silva[1,2], Maike Kaffenberger[3]; Mar Humet[1,2], Catia Monteiro[1,2], João Nunes[1,2], Rui Seabra[1,2], Francisco Arenas[1,2,4], Fernando P Lima[1,2]
[1]*CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado*
[2]*BIOPOLIS Program in Genomics, Biodiversity and Land Planning*
[3]*Universität Bremen*
[4]*CIIMAR Centro Interdisciplinar de Investigação Marinha e Ambiental*

Changes in the physiology, ecology, and, ultimately, biogeography of several native and non-native species have been related to climate change. One notable trend among non-native species is their expanding distributional range, most commonly poleward, concurrent with increasing temperatures. As winter warming is projected to increase in the mid and high latitudes of the northern hemisphere, an increased likelihood and dominance of warm-adapted species is expected, and these regions are emerging as 'hotspots' for non-native species. Notably, on the rocky shores of NW Iberia, warm-adapted sub-tropical and Mediterranean species, like the gastropod *Siphonaria pectinata*, are proliferating. Compared to its historical distribution, this species has significantly extended its range northwards along the Iberian Peninsula. Our research is focused on understanding the potential distribution potential of *S. pectinata* by exploring the thermal tolerance of its larvae. We experimentally subjected eggs to low temperatures and monitored larval development, revealing a critical tolerance threshold at 10 ± 2°C and suggesting this temperature as a pivot limiting factor determining the species distribution and change. This study contributes to our comprehension of climate-induced species shifts and highlights the importance of considering cold thermal tolerance when predicting the expansion potential of warm-adapted species.

CONTINUED>

>CONTINUED



Superficial, but sophisticated - How does surface topography determine abundance and spatial distribution of key benthic species?

Franz Bauer [a *], Antony M. Knights [a, b], John N. Griffin [c], Mick E. Hanley [a], Andy Foggo [a], Austin Brown [d], Emma Jones [a], Louise B. Firth [a, b]
a. School of Biological and Marine Sciences, University of Plymouth, Drake Circus, Plymouth PL4 8AA, UK
b. School of Biological, Earth and Environmental Sciences, University College Cork, Cork, Ireland
c. Department of Biosciences, Faculty of Science and Engineering, Swansea University, Swansea SA2 8PP, UK
d. Department of Ecology, Arup, London W1T 4BJ, UK

In response to ongoing coastal urbanization, it is critical to develop effective methods to improve the biodiversity and ecological sustainability of artificial shorelines. Enhancing the topographic complexity of coastal infrastructure through the mimicry of natural substrata may facilitate the establishment of ecosystem engineering species and associated biogenic habitat formation. However, interactions between ecosystem engineers and their substratum are likely determined by organismal size and resource needs, thus making responses to topography highly scale-dependent. Here, we assessed the topographic properties (rugosity, surface area, micro-surface orientations) that underpin the abundance and distribution of two ecosystem engineers (fucoids, limpets) across six spatial scales (1-500 mm). Furthermore, we assessed the 'biogenic' rugosity created by barnacle matrices across fine scales (1-20 mm). Field surveys and 3D scanning, conducted across natural and artificial substrata, showed major effects of rugosity and associated topographic variables on ecosystem engineer assemblages and spatial occupancy, while additional abiotic environmental factors (compass direction, wave exposure) and biotic associations only had weak influences. Natural substrata exhibited ≤67% higher rugosity than artificial ones. Fucoid-covered patches were predominantly associated with high-rugosity substrata and horizontal micro-surfaces, while homescars of limpets (≥15 mm shell length) predominated on smoother substratum patches. Barnacle-driven rugosity homogenized substrata at scales ≤10 mm. Our findings suggest that scale-dependent rugosity is a key driver of fucoid habitat formation and limpet habitat use, with wider eco-engineering applications for mimicking ecologically impactful topography on coastal infrastructure.

[Publication: Bauer, F., Knights, A.M., Griffin, J.N., Hanley, M.E., Foggo, A., Brown, A., Jones, E., Firth, L.B., 2024. Scale-dependent topographic complexity underpins abundance and spatial distribution of ecosystem engineers on natural and artificial structures. Sci. Total Environ. 938, 173519. https://doi.org/10.1016/j.scitotenv.2024.173519]

An investigation into the influence of eco-engineered tiles on the biota and biodiversity of artificial shores

Charlotte Clubley, Jessica Allen
School of Biological and Marine Sciences, University of Plymouth, U.K.

Hard infrastructure is becoming increasingly prolific along global coastlines in to meet growing demand of coastal resources; however artificial shores support lower biodiversity than their natural counterparts. Ecological engineering initiatives are altering coastal infrastructure to make artificial structures better suited to the survivorship of taxa. The aim of this study was to identify whether differing complexity of four eco-engineered tiles, and the presence or absence of limpets, would impact biotic communities on eco-engineered tiles after a seven-month deployment in Torquay Marina. Flat, rippled and two complex tiles, with either 2.5 cm crevices or 5 cm crevices, were photographed alongside concrete controls. Half of the tiles were protected from limpet grazing, while the remaining tiles had limpets transplanted onto them to investigate potential grazing impact. Percent cover of biota was broken down by taxa, with calculations of species richness and Shannon Diversity index used to quantify biodiversity. There was a positive relationship between tile complexity and both live coverage and biodiversity. Low survivorship of transplanted limpets was attributed to mud accumulation, and thus insights into limpet grazing impacts were limited. It was concluded that in a different location the impact of limpet grazing on biodiversity may have greater influence.

How limpets affect succession in an artificial environment

Aeden Cooper[1], Sandalia Walker[2], Juan Sempere-Valverde[3], Chris Moocarme[1], Antony M. Knights[1], Louise B. Firth[1]
[1]*School of Biological and Marine Sciences, University of Plymouth, Plymouth, United Kingdom*
[2]*Ocean and Earth Science, National Oceanography Centre Southampton, University of Southampton, United Kingdom*
[3]*Laboratorio de Biología Marina, Facultad de Biología, Universidad de Sevilla, Sevilla, Spain*

Limpets are key structuring agents on rocky shores globally. Their grazing exerts strong control over the cover of algae with cascading ecosystem effects. Topographically smooth coastal infrastructure such as breakwaters favour limpets, which may explain why such artificial habitats support lower biodiversity than their natural counterparts. Since 1954 large concrete blocks have been added annually on Plymouth Breakwater for erosion protection. Over time, the blocks deteriorate and become more topographically complex. Through surveying blocks of different ages (1-30 years old) we examined successional patterns and tested the hypothesis that limpet and algal abundances would change over time and would be inversely related. Specifically, we expected older, more complex blocks to support fewer limpets and greater algal cover. Analyses revealed that ephemeral green, then fucoid algae dominated early successional stages. After 2 years, limpets arrive and graze down

CONTINUED>

>CONTINUED

algae and prevent other taxa from establishing, creating long-term limpet barrens. Pitted, older blocks supported fewer limpets and greater cover of non-ephemeral algae. The role of complexity in moderating limpet grazing is discussed. The unique long-term nature of this study sheds light on successional changes over time on concrete infrastructure. These results are informative for planning biodiversity management on marine artificial structures.

Larval development of *Patella rustica* in the laboratory: how it can help us to understand clues about the threatened *P. ferruginea*

J. Guallart[1], M.P. Ferranti[2], M. Chiantore[2]
[1]*Independent researcher, Valencia, Spain*
[2]*DiSTAV, Department for Earth, Environment and Life Sciences, University of Genoa, Genoa, Italy*

The larval development of *Patella rustica* is described, from fertilization to the post-larval phase, achieved in the laboratory from specimens from the Ligurian Sea within the framework of the ReLife project, aimed at the controlled reproduction of *P. ferruginea*. The results obtained generally show a great similarity to the larval development of *P. ferruginea* achieved within the project: (1) the timing of larval development is similar, reaching at about 20°C the crawling-pediveliger phase approximately 72 h.p.f.; (2) the morphology of the larvae is macroscopically very similar in both species and does not allow the identification between them. However, we did not achieve spawning stimulation using the techniques successfully developed for *P. ferruginea*, and the gametes were obtained by dissecting mature specimens. This difference with respect to *P. ferruginea* may be due to the habitat it occupies, at a higher tidal level, so that, although the reproductive cycle is seasonally almost identical, the spawning stimuli may be slightly different. Apart from describing for the first time the larval development of *P. rustica*, the results show that the cause of the regression of *P. ferruginea* cannot be attributed to some specific biological constraints as has been suggested. The similarity of the biological parameters with the coexisting, abundant and widely distributed *P. rustica*, seems to confirm that human collection is the main cause of the current state of *P. ferruginea*.

Self-cleaning slipways: harnessing species interactions for sustainable management of coastal infrastructure

Sally Henderson[1], John Griffin[1], Matthew Perkins[1], Louise Firth[2,3]
[1]*Biosciences Department, Swansea University, U.K.*
[2]*School of Biological and Marine Science, University of Plymouth, U.K.*
[3]*University College Cork*

Combining intertidal molluscan grazers with ecological engineering could provide a nature-based solution to socio-environmental challenges of slipway maintenance. Slipways must be periodically cleaned to prevent algal growth and meet health and safety regulations. Current maintenance is expensive and environmentally damaging, utilising short-term solutions such as chemicals and scrapers. The foraging activity of molluscan grazers, such as the common limpet (*Patella vulgata*) plays an important role in structuring the ecological state of rocky shores around the UK. *P. vulgata* graze efficiently on smooth, flat surfaces often maintaining algae-free states. However, smooth surfaces enhance slip hazards and do not protect grazers from physical harm or biological stressors such as desiccation. Providing refuge on slipways as surface features can reduce these issues but may also collect sediment and water, reducing grazing efficiency and encouraging algal growth. This project investigates whether *P. vulgata* can be used as a longer-term, ecological solution to manage algal growth and create 'self-cleaning' slipways. In this study, topographic influences on grazing and algal growth are being tested in Pembrokeshire, Wales. Data will be presented from this experiment alongside an overview of the experimental design.

Computer vision-based morphological assessment of limpet species along the Baja California coast

Jack Hollister, Phil Fenberg
University of Southampton and Natural History Museum (London)

The Baja California peninsula harbours a variety of limpet species. Along this coastline, several geographical barriers have led to the isolation of some of these species' populations, resulting in phylogeographic breaks. Deciphering if there are morphological variations between these populations are challenging to discern through visual methods, and it remains unclear whether significant morphological differences exist between populations separated by a phylogeographic break. In this study, we utilise computer vision techniques to demonstrate if a specially crafted image classification model can learn to identify morphological features between populations. Additionally, we investigate which pixels and corresponding morphological features the model used to make their decisions. Limpet specimens (from the genera *Lottia* and *Fissurella*) were collected from various sites across the peninsula and southern California from populations north and south of phylogeographic breaks. Additional specimens were sourced from the Natural History Museum of Los Angeles, supplementing our study with their in-house collection of limpets from the same regions.

CONTINUED>

>CONTINUED

Predicting the fate of the most endangered marine invertebrate of the Mediterranean: The power of long-term monitoring in conservation biology

A.Martín-Zorrilla[1], E. Ostalé-Valriberas[1], A. Sabino-Lorenzo[1], A. A. Pavón-Paneque[1], J. Sempere-Valverde[1], G. A. Rivera-Ingraham[2], J. C. García-Gómez[1], F. Espinosa[1]
[1]*Laboratorio de Biología Marina de la Universidad de Sevilla (LBMUS)/Área de Investigación I+D+i del Acuario de Sevilla/Estación de Biología Marina del Estrecho (Ceuta), Universidad de Sevilla, Seville, Spain.*
[2]*Laboratoire Environnement de Petit Saut, HYDRECO, BP 823,Kourou, 97388 Guyane, France*

Patella ferruginea is the most endangered endemic marine invertebrate of the western Mediterranean coasts according to the European Union Directive 92/43. The present temporary monitoring program commenced in 2007 aims to know the dynamics and ecology of this species. The methodology used consists of establishing 11 monitoring stations in the city of Ceuta (Strait of Gibraltar), each of which consists of three ten- meter transects. To understand variations in mean size, age structure, and sex of the population, the longitudinal axis of the shell was measured with calipers for all individuals within each transect. The proportion of females in the population remained below 10% (ranging from 4.35% to 8.82%) until 2017, but in subsequent years exceeded this proportion, reaching 12% in 2019. The station with the highest number of individuals was found inside the port of Ceuta, reaching 130.57 ind/m in 2022. In general, the population numbers of *P. ferruginea* have shown a highly positive trend due to high recruitment rates in 2009, 2011 and 2013, the latter years being those with the highest density of adults and overall number of individuals, reaching a density of 33.36 ind/m in 2021 and a density of adults of 18.65 ind/m in 2022.

Artificial marine micro-reserves as a new ecosystem-based management tool for marine conservation: The case of *Patella ferruginea* (Gastropoda, Patellidae), one of the most endangered marine invertebrates of the Mediterranean

E. Ostalé-Valriberas[1]*, J. Sempere-Valverde[1], A. Pavón-Paneque[1], S. Coppa[2], F. Espinosa[1], J. C. García-Gómez[1]
[1]*Laboratorio de Biología Marina de la Universidad de Sevilla (LBMUS)/´Area de Investigaci´on I+D+i del Acuario de Sevilla/ Estaci´on de Biología Marina del Estrecho (Ceuta), Seville, Spain.*
[2]*Consiglio Nazionale delle Ricerche, Istituto per lo studio degli impatti Antropici e Sostenibilit`a in ambiente marino (CNR-IAS), Oristano, Italy.*

Among the different factors that affect the natural environment, fragmentation of ecosystems by urbanization processes can cause a reduction in species population sizes, thus enhancing their risk of extinction. Nevertheless, some species can maintain stable populations in these urbanized ecosystems. This is the case of the intertidal mollusc *Patella ferruginea* (Gmelin, 1791), a broadcast spawner, and a sequential protandrous hermaphrodite limpet, whose populations have been historically decimated due to human harvesting. In this study, we analyse the benefits of a new marine conservation tool called ¨Artificial Marine Micro-Reserves¨ (AMMR) for *P. ferruginea*, one of the most endangered marine invertebrates of the Mediterranean Sea. The present study was conducted in Ceuta (North Africa, Gibraltar Area), and among its varying results, it shows that in the same body of water inside the port, the proportion of females of *P. ferruginea* in the area without accessibility (high protection) was 4.68 and 43.54 times higher than in the medium and low accessibility (non-protected areas), respectively. Therefore, the effective protection of these artificial areas has a positive effect on population size structures, as the female's percentage in the population is crucial for fostering the creation of genetic bridges for the recolonization of natural habitats.

Understanding the effects of man-made artificial structures on the population-size structures of a keystone species *Patella vulgate*

Sandalia Walker
School of Biological Sciences, University of Southampton, U.K.

Coastal environments are important as they provide a wide range of ecological services and benefits both socially and economically. Humans populating these areas have resulted in the addition of coastal urbanisation and sea defences. These artificial structures, including sea walls, sea armour and sea groynes, have a variety of impacts on the organisms and ecosystems originally there. This study uses the relationship between the body mass/size and abundance at sites across the south coast of England to better understand the relationship between body mass/size and abundance of *Patella vulgata* and how this varies across natural and artificial rocky shores. A non-destructive sampling method was used to avoid removing a key species from the shoreline. A selection of samples was weighed on-site to create a mass vs volume conversion curve. The study found that there were significant differences in abundance, length and mass across the two site types, with more limpets located at the artificial sites than at the natural sites. Moreover, those found at the artificial site were, on average, smaller than those found at the natural sites in both mass and length. The results showed no correlation between the abundance and mass/length.

CONTINUED>

>CONTINUED

Advances in the management and translocation methodology of the endangered mollusc *Patella ferruginea* in artificial habitats of port infrastructures: implications for its conservation

E. Ostalé-Valriberas[1], A. Martín-Zorrilla[1], A. Pavón-Paneque[1], A. Sabino-Lorenzo[1], J. C. García-Gómez[1]
[1]*Laboratorio de Biología Marina de la Universidad de Sevilla (LBMUS)/Área de Investigación I+D+i del Acuario de Sevilla/ Estación de Biología Marina del Estrecho (Ceuta), Seville, Spain.*

The limpet (*Patella ferruginea*), endemic to the western Mediterranean, is the most endangered intertidal mollusc listed in the Habitats Directive (EU). The translocation methodology of this species is a scientific challenge faced by those port infrastructures – where there are established breeding subpopulations - that may be subject to emergency works, restoration, or extension of breakwaters. The present study was conducted in Ceuta (North Africa, Gibraltar Area), and show the results of an innovative methodology used to relocate individuals of this species from artificial coastal defense structures to natural protected areas. The translocation program for these specimens was implemented due to emergency works to repair the damage inflicted by the seasonal storms of March and April 2022 on certain artificial structures along the coast of Ceuta. In the course of the current project involving the extraction, transfer, and relocation of ferruginous limpet individuals, a total of 76 specimens of different sizes were selected for transfer. Unfortunately, two specimens died prior to their transfer, five perished during the extraction process (usually small individuals) and five during the resettlement process in the receiving area. As of 14 months post-transfer and settlement of the 64 remaining individuals, 13 have died and there are now 51 surviving specimens in the receiving area, reflecting a survival rate of 79.69%. Survival of the control individuals in the receiving area was 92.93%. If we apply this natural mortality (correction factor) to the transferred individuals, survival during this first 14 months of monitoring has been 86.77%.

Senior research award reports

Research financially supported by the Malacological Society of London

Estimation of mutation rates in the Venus clam *Chamelea gallina*

Chiara Papetti

Biology Department of the University of Padova (Italy)
In collaboration with Carlos Saavedra
Instituto de Acuicultura "Torre dela Sal" – IATS, Spanish National Research Council – CSIC
chiara.papetti@unipd.it

Fundamental aspects of the genetics of non-model organisms are often difficult to study because of long generation times, low fecundity or lack of sibling groups or pedigrees. One of these neglected aspects is mutation rate. Mutations are the ultimate source of genetic variability that allow species to adapt to changing environments. Mutation rates are essential parameters of population genetics and evolutionary models. However, detailed knowledge of this parameter in animals is restricted to model or highly priced organisms (e.g.: Keightley *et al.,* 2014; Panagiotopoulou *et al.,* 2017). Moreover, the mutation rate is highly variable along the genome, and estimates for some types of DNA fragments, such as coding regions, are not useful when dealing with other genome parts, such as repeat-enriched regions like microsatellites (Baer *et al.,* 2007). Estimates of mutation rates are not available in bivalves, although indirect estimates have been offered (Plough 2016). This research funded by a Senior Research Grant of The Malacological Society of London was aimed at estimating mutation rates in a species of bivalve mollusc, the valuable commercial Venus clam (*Chamelea gallina*) making use of samples obtained from the first controlled experiment of reproductive conditioning of the species. This study provides relevant background information for meaningful conservation of a declining species and in resource management applications aimed at guarantying production of spat carrying high genetic variability, thus ensuring that reintroduced populations carry enough potential for adaptation to changing environment (Allendorf *et al*., 2010).

Overfishing and several irregular mortality events have led to a drastic decrease in *C. gallina* populations and a resultant loss in economic returns (Romanelli *et al*., 2009). In the Adriatic Sea, the species is genetically homogenous, and a low number of breeders (low effective population size) drives recruitment suggesting very high variability in reproductive success and larval mortality (Papetti *et al.,* 2018). This study funded by the Malacological Society of London is framed in a wider research aimed to develop hatchery procedures and a population and quantitative genetics study of the species. *Chamelea gallina* could be reared under specific conditions in aquaculture facilities for production of juveniles for stock-enhancement programmes. This study is currently being carried out in Spain by Dr. Carlos Saavedra (at the Instituto de Acuicultura Torre de la Sal –IATS, Spanish National Research Council – CSIC).

To study the mutation rate in *C. gallina,* we planned to genotype microsatellites (previously optimized in Papetti et al. 2018) in parents and offspring individuals and verify changes in alleles from F0 to F1. The production of juveniles at IATS-CSIC has generated ca. 300 individuals (Fig. 1) from 11 parents. So far, we have scored all parents and part of the progeny individually for 6 microsatellites. Current work is aimed at increasing the number of microsatellites to ten and scoring the

CONTINUED>

>CONTINUED

remaining offspring for all markers. The progeny carrying alleles not present in the parents, which are the result of a mutation in one of the parents' germ line, will be identified. This will provide a set of mutations for each marker and the frequency of the mutation (mutation rate) will be estimated. These values are expected to be high, according to indirect estimates available from substitution rates and viability studies (Plough, 2016; Plough *et al.,* 2016). This study will provide an experimental confirmation or rejection of these estimates.

Future work will be aimed at developing Single Nucleotide Polymorphisms (SNPs) by a double-digest RADseq (ddRAD) protocol (Peterson *et al.,* 2012) with modifications to minimize the risk of high variance in the number of reads (sequences) per individual within a pool. These genetic markers will also be used for studying the parental contributions to the progeny and for quantitative genetics.

Key references

Allendorf F.W. *et al*. (2010) doi:10.1038/nrg2844; Baer C *et al*. (2007) doi:10.1038/nrg2158; Keightley PD *et al*. (2014) doi:10.1534/genetics.113.158758; Markaide P. *et al*. (2021) doi:10.1016/j.aquaculture.2021.736824; Panagiotopoulou H *et al.* (2017) doi:10.1093/jhered/esx057; Papetti C *et al*. (2018) doi:10.1016/j.fishres.2018.01.006; Peterson BK *et al.* (2012) doi:10.1371/journal.pone.0037135; Plough L.V. (2016) doi:10.1093/cz/zow096; Plough L.V. *et al*. (2016) doi:10.1111/mec.13524; Romanelli M. *et al*. (2009) *Acta Adriatica* **50**: 171-205.

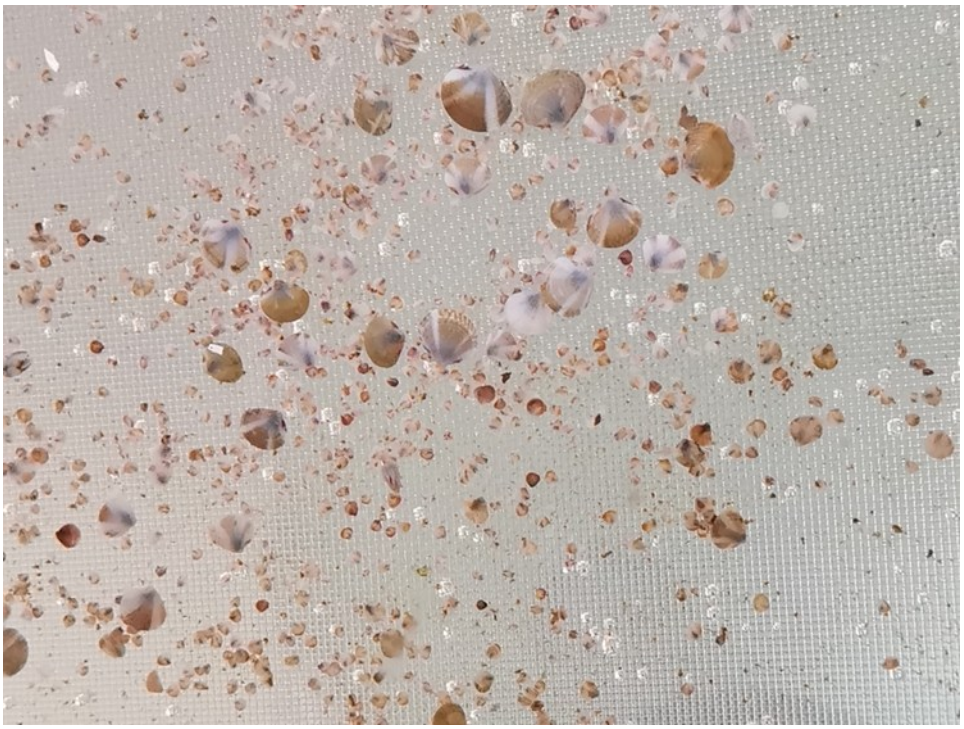


Figure 1. ***Chamelea gallina*** **juveniles (3-month-old) produced at IATS-CSIC. The picture shows the large size differences and hence growth rates among juveniles of the same age (mesh size 300 µm, picture credits Dr. Carlos Saavedra, IATS-CSIC).**

Species evolution in *Unio crassus* and the role of current versus historical gene flow in species genetic diversity in different basins.

Halyna Morhun [1, 2]

[1]Institute of Marine Biology of the National Academy of Sciences of Ukraine, Odesa, Ukraine
[2]Department of Ecology and Vertebrate Zoology, University of Lodz, Lodz, Poland

Introduction

Unio crassus Philipsson, 1788, is an example of a species whose populations have significantly decreased in Europe due to deteriorating water quality and the harmful effects of human activities such as water pollution and river alteration. It has become an important species for conservation efforts (Zettler & Jueg, 2007; Cuttelod, 2011) and is listed as vulnerable in the IUCN Red List (IUCN, 2020) of Threatened Species and is protected in Europe, e.g. in the European Union by the attached Appendices II and IV of the Habitats Directive.

CONTINUED>

>CONTINUED

Sampling methodology

While many Unionides occur widely throughout the steppe ecoregion of Ukraine, the biggest population of *U. crassus* inhibits Southern Bug rapids only. This place in the context of its geological history and ecological conditions is important. Firstly, rapids were formed as a result of the uplift of the ancient Ukrainian Crystalline Massif, leading to the surface of the channel turning into a cluster of rocky canyons, waterfalls, and piles of boulders, providing both fast river flow and an additional aeration which increased oxygen content. Thus, the Southern Bug's rapids are the most important refugia for the species requiring such conditions, such as *Unio crassus*. This region is a part of the Buzk's Gard National Nature Park and is covered by the Emerald Area UA0000040 (under Bern Convention).

Biodiversity management plays a critical role in protecting individual taxa and their genetic diversity. Only a limited number of individuals of *U. crassus* and other Unionids have been studied using molecular methods in Ukraine to date. The gap in understanding of their genetic population status is crucial for developing an appropriate conservation strategy (Machordom *et al.,* 2003; Geist *et al.,* 2003; 10a, b;Geist & Kueh, 2008; Geist, 2011).

The research grant aimed to support study of the genetic diversity and population structure of the endangered mussel *Unio crassus* as well as other Unionids collected in Ukraine.

Methods and materials

Samples of mussels of Unionids were collected with a hand net and drags from several localities in Ukraine and then processed at the CIBIO laboratory at the University of Porto, Portugal in the molecular laboratory. A total of 213 samples were used to isolate DNA using the saline method. PCR was conducted following a protocol described in Hou *et al.* (2007) using HCO1408 and LCO2198 primers (Folmer *et al.,* 1994). Amplicons were sequenced using the Sanger method. The obtained Chromatograms were cleaned in ChromasPro v.2.1.10.1 software and then sequences were blasted for identification (blast.ncbi.nlm.nih.gov/Blast.cgi)and registered in the public repository BOLD System (http://www.boldsystems.org/).

Results & Discussion

Habitats in which molluscs live vary, with sands, clay or stony substrates. The *U. crassus* species prefer places with river flow and high amount of oxygen (up to 13 ml) while *U. tumidus*, *U. pictorum*, *A. anadonta*, *S. woodiana* inhibit more stagnant rivers (Figure 2). Mollusks were also found buried in gravel.

The largest population of *U. crassus* and other Unionids collected in Ukraine from 2010 to 2023 was studied molecularly and submitted to the BOLD repository. Preliminary results revealed that complex glacial history and numerous fluctuations of the Pontic region reflected in the phylogenetic pattern of the genus, causing numerous radiations.

The obtained genetic data are expected to be analyzed with a dataset of other Unionides from Europe, particularly with data from neighboring areas (Poland and Lithuania, published in Kilikowska *et al*., 2020), and results published in a Q1-2 scientific journal, contributing to the understanding of species evolution and the role of current versus historical gene flow in the distribution of species genetic diversity in different basins.

Acknowledgements

Funds for this study were partly provided by the Malacological Society of London through their Senior Career Research Grant, as well as COST Action 18239 CONFREMUS.

References

Cuttelod, A., Seddon, M., & Neubert, E. (2011). European red list of non-marine molluscs (p. 97). Luxembourg: Publications Office of the European Union.

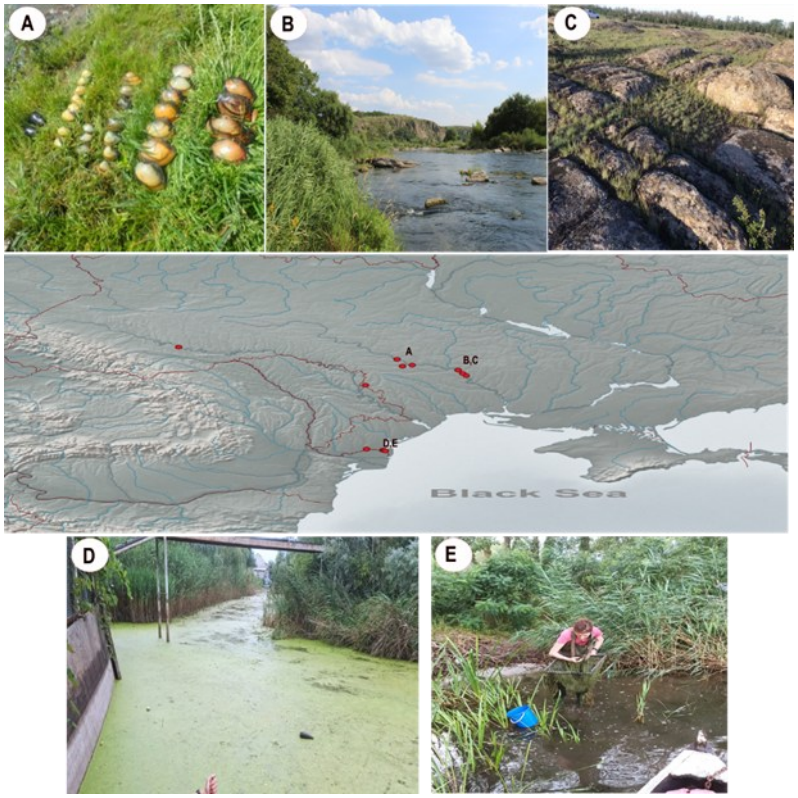
Folmer, O., Black, M., Hoeh, W., Lutz, R., & Vrijenhoek, R. (1994). DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, **3(5)** 294–299.

IUCN (2020). The IUCN Red List of Threatened Species. Version 2020-2. Available online: https://www.iucnredlist.org (accessed on 21 June 2024).

CONTINUED>

>CONTINUED

Geist, J. & Kuehn, R. (2005). Genetic diversity and differentiation of central European freshwater pearl mussel (*M. margaritifera* L.) populations: Implications for conservation and management. *Molecular Ecology*, **14** 425–439.
Geist, J., Rottmann, O., Schröder, W. & Kühn, R. (2003). Development of microsatellite markers for the he endangered freshwater pearl mussel *Margaritifera margaritifera* L. (Bivalvia: Unionoidea). *Molecular Ecology Notes*, **3** 444–446
Geist, J., Geismar, J. & Kuehn, R. 2010a. Isolation and characterization of the first microsatellite markers for the endangered swan mussel *Anodonta cygnea* L. (Bivalvia: Unionoidea). *Conservation Genetics*, **11** 1103–1106.
Geist, J., Söderberg, H., Karlberg, A. & Kuehn, R. (2010b). Drainage-independent genetic structure and high genetic diversity of endangered freshwater pearl mussels (*Margaritifera margaritifera*) in northern Europe. *Conservation Genetics*, **11** 1339–1350.
Geist, J. (2011). Integrative freshwater ecology and biodiversity conservation. *Ecological Indicators*, **11(6)** 1507–1516.
Hou, Z.G., Fu, J.H. & Li, S.Q. (2007). A molecular phylogeny of the genus *Gammarus* (Crustacea: Amphipoda) based on mitochondrial and nuclear gene sequences. *Molecular Phylogenetics and Evolution*, **45** 596–611
Kilikowska, A., Mioduchowska, M., Wysocka, A., Kaczmarczyk-Ziemba, A., Rychlińska, J., Zając, K., Zając, T., Ivinskis, P. & Sell, J. (2020). The patterns and puzzles of genetic diversity of endangered freshwater mussel *Unio crassus* Philipsson, 1788 populations from Vistula and Neman drainages (Eastern Central Europe). *Life*, **10(7)** 119.
Machordom, A., Araujo, R., Erpenbeck, D., & Ramos M. Á. (2003). Phylogeography and conservation genetics of endangered European Margaritiferidae (Bivalvia: Unionoidea). *Biological Journal of the Linnean Society*, **78(2)** 235–252.
Zettler, M.L. & Jueg, U. (2007). The situation of the freshwater mussel *Unio crassus* (Philipsson, 1788) in north-east Germany and its monitoring in terms of the EC Habitats Directive. *Mollusca*, **25** 165–174.



Localities from which samples of Unionides were collected and their habitats.

Invited article

Background note: This article was presented in shortened format as part of the Biology of Limpets 2020+4 meeting (5th & 6th March 2024) at the Natural History Museum in London.

J.H. Orton and his legacy: Limpets and the Plymouth/Liverpool connection

Alan N Hodgson[1] & Stephen J Hawkins[2, 3]

[1]*Department of Zoology & Entomology, Rhodes University, Grahamstown, South Africa*
[2]*School of Ocean & Earth Science, University of Southampton, U.K.*
[3]*The Marine Biological Association of the United Kingdom, Plymouth, U.K.*

Introduction

James Herbert Orton's (1884-1953) work during the first half of the 20th century, which still has great relevance today, provided a foundation for many studies that followed. In this paper we will first explore Orton's unusual early educational background and his university career. We will then go on to examine Orton's contributions to several fields of marine biological research, especially his work on oysters and limpets, whilst employed as a naturalist at the Marine Biological Association in Plymouth from 1910 to 1929. The final part of this article highlights his achievements during the last 20 years of his career as Professor of Zoology and Director of the Port Erin Marine Laboratory at Liverpool University. In particular, we examine the legacy of limpet research started by Orton through his research, and the training of two key students.

The early years

James Orton was born in Bradford (Yorkshire) on 11 March 1884, the fourth child in a family that would eventually include six brothers and six sisters (although five did not reach adulthood). Despite growing up in an industrial town noted for its cotton mills, the young Orton spent his Sunday's hunting for amphibia and birds' nests. His early education was at White Abbey Board School in Bradford, but by the time he was 11 years old he was working half-time as an errand boy to help the family finances. At this point we need to explain that by the time of the 1844 Factory Act, half-time schooling was common in Yorkshire (especially Bradford) and Lancashire where there were textile industries. Children between the ages of six and thirteen were permitted to work in mills for 6.5 hrs per day if they attended school for three full days or six half days (Jackson, 2015). Therefore, Orton was one of many half-timers.

At age 13, Orton left school to become an apprentice to a mechanical dentist. Such dentists specialised in the construction of appliances to replace natural teeth. It is possible that this apprenticeship stimulated Orton's interest in biology because such dentistry required some knowledge of anatomy and physiology. Perhaps it is no coincidence that the earliest research carried out by Orton was on the radula of slipper limpets (see below). Orton served as an apprentice until he was 21; but during this time he attended night school at Bradford Technical School (now the University of Bradford) where he completed his London University Matriculation exam. He also won a National Scholarship in Biology in 1906 that enabled him to study at the Royal College of Science (now Imperial College London).

University Years (1906-1910)

The university environment was one that clearly suited Orton. He was not only academically gifted, but also a hard worker, often arriving before the college door was open. In 1909 Orton's dedication to his studies paid off and he graduated with a 1st Class Associate degree in Zoology. That same year he secured a scholarship to study for a further year, and in 1910 graduated with a first-class honours' degree. It was during his undergraduate training that Orton was introduced to molluscs, and to *Crepidula* by Professor Arthur Dendy (best known for his work on sponges and *Peripatus*). Dendy gave the young Orton a collection of radulae of the oyster pest *C. fornicata,* suggesting that he compared the radulae of American and English populations. However, Orton was aware of Professor Edwin Conklin's work on *Crepidula* reproduction. Conklin had suggested that sex change might occur in this slipper limpet and Orton was able to prove that this was so. Remarkably, Orton published these findings on molluscan sex change whilst still an undergraduate student (Orton, J.H. 1909. On the occurrence of protandric hermaphroditism in the mollusc *Crepidula fornicata*. *Proc. Roy. Soc. B.* **81:** 468.)

Orton was not just gifted academically, but also an excellent sportsman, and was the centre forward for the college 1st football team. His enthusiasm for sport remained throughout his life with him excelling in both cricket and hockey.

The Plymouth Years (1910 to 1929)

Upon graduating, Orton was offered the position of Assistant Naturalist at the Marine Biological Association in Plymouth. He was to spend the next 19 years of his career at the MBA, rising to the position of Senior Naturalist. At Plymouth he continued his work on *Crepidula* anatomy and feeding. His careful studies showed that this gastropod was a ciliary feeder and that the radula's function was grasping and not rasping. He not only extended these studies to *Calyptraea and Capulus*, showing that they had similar feeding mechanisms to *Crepidula*, but also investigated ciliary feeding mechanisms in bivalves, polychaetes, brachiopods, tunicates and *Amphioxus*. Between 1911 and 1914 he published several papers on the subject. Although Orton never obtained a Ph.D., he was awarded his D.Sc. from the Royal College of Science in 1914 for his research at Plymouth and that same year received the Huxley Medal, also from the RCS.

CONTINUED>

>CONTINUED

Shortly after arriving at Plymouth, Orton began to collect data on growth and life histories of marine invertebrates. He was particularly interested in invertebrate sex change. This research was interrupted by WWI, Orton serving as a Captain at one of the Artillery signalling depots. After the end of this war, Orton returned to Plymouth and by 1920 was publishing papers on sex change in molluscs (primarily limpets and oysters) and crustaceans. Of note was his paper on sex change in *Patella vulgata* (Orton, J.H. 1920. Sex phenomena in the common limpet (*Patella vulgata*). *Nature, Lond*. **104**: 373.), as well as his seminal paper on the effect of sea temperature on breeding and distribution of marine animals (Orton, J.H. 1920. *J. Mar. Biol. Assoc. U.K*. **12:** 339-366.) This latter work is one of the most highly cited of the earlier papers published in JMBA (Dando, P.R. & Southward, E.C. 2020. The history of the Journal of the Marine Biological Association of the United Kingdom and the influence of the publication on marine research. *J. Mar. Biol. Assoc. U.K.* **100**: 3-26). Whilst at Plymouth, Orton collected a large amount of data on breeding and growth in *Patella*, although the main focus of his studies was on various aspects of the biology and ecology of oysters. The results of the oyster studies paved the way for future investigations by others including C.M. Yonge, who was appointed to the staff at the MBA on Orton's recommendation.

As well as his invertebrate life history and growth studies, Orton undertook pioneering experimental work on anti-fouling paints. This work was begun in 1919, continued for several years and was eventually published in 1930 (Orton, J.H. 1930. Experiments in the sea on the growth-inhibitive and preservative value of poisonous paints and other substances. *J. Mar. Biol. Assoc. U.K.* **16**: 373-452.).

Orton, although primarily research focussed, played an important role in undergraduate student training. In 1914 he took charge of the week-long Easter Courses that were started by Walter Garstang in 1895. Through these popular courses Orton influenced the careers of many biologists (at least 8 directors of marine laboratories) including C.F.A. Pantin FRS (President of the MBA 1960-1966), Sir Frederick Russell FRS (appointed MBA director in 1945) and John Colman (Director of the Port Erin Marine Laboratory 1950-1971). These courses had a strong field component that included sampling within the intertidal, pelagic organisms and subtidal benthos.

J.H. Orton, Assistant Naturalist in the MBA research aquarium. Source: Marine Biological Association library

J.H. Orton (Senior Naturalist) towards the end of his tenure (year unknown) at the MBA. Source: Marine Biological Association library archives.

Participants in two MBA Easter Courses (years unknown). In the left hand photo, J.H. Orton is seated in the front row, centre. Source: Marine Biological Association library archives.

CONTINUED>

>CONTINUED

MBA Easter Course benthic sampling. It is believed that J.H. Orton has his back to the camera. Source: Marine Biological Association library archives.

The University of Liverpool Years (1929-1949)

In 1929 Orton left Plymouth and moved to Liverpool University where he had been appointed as Professor of Zoology. By 1939 he was also appointed Director of the university's Marine Biological Station at Port Erin on the Isle of Man. During his early years at Liverpool, Orton continued to publish work (mainly oyster related) from his time at Plymouth. Despite having a high administrative and teaching workload, as well as 6 years of military service in World War II, he was able to grow the Port Erin marine station, including playing a major role in persuading the University of Liverpool to purchase a sea-going research vessel, the *William Herdman*. At the end of the war Orton returned to his studies of breeding and spawning of limpets, collecting a large amount of data on all three British species of *Patella*, work that continued after his retirement in 1949. However, much of this work was only published after his death in 1953 by Dr. Alan Southward and Professor James (Jimmie) Dodd.

J.H. Orton shortly before his retirement. (From the Annual Report for 1952 of the Marine Biological Station at Port Erin, Isle of Man. University Press of Liverpool)

An important legacy of Orton was his mentoring of research students who in turn would pass on the research baton to their research descendants. Two of Orton's students need special mention - Norman Jones and Alan Southward. Both carried out pioneering manipulative field experiments on the rocky shores of the Isle of Man that paved the way for other studies by many marine ecologists especially those investigating limpets. Through a limpet removal experiment, Jones showed the importance of limpet grazing in controlling algal growth (Jones N.S. 1948. Observations and experiments on the biology of *Patella vulgata* at Port St, Mary, Isle of Man. *Proc. Trans. Liv. Biol. Soc.* **56**: 60-77.). For his Ph.D., which was completed in 1951, Southward undertook intertidal field experiments in which species were either removed or transplanted. In doing so he was able to study biological interactions, contributing hugely to ecological theory. Alan Southward's work on the

CONTINUED>

>CONTINUED

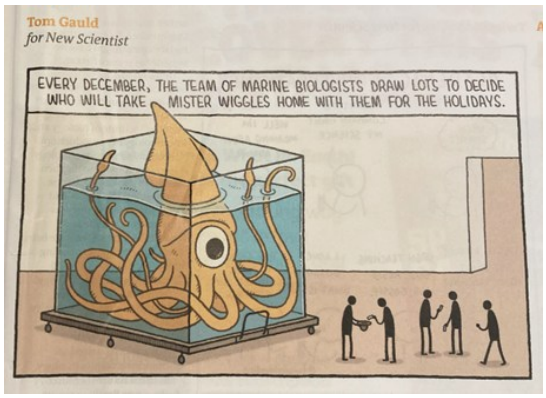
Torrey Canyon oil spill (1967) and the impacts of overuse of toxic dispersants also highlighted how limpet mass mortality led to algal proliferation and long-term impacts on rocky shores. Jones mentored Richard Hartnoll who in turn has expanded limpet studies worldwide through his own studies and supervision of local (Wright, Hawkins) and international students. Southward was also an important mentor of many young scientists working on many aspects of molluscan biology both on the seashore and in the deep sea, whilst having fewer chances to formally supervise students as a research institute scientist. One of the authors (SJH) is very proud to be part of the Orton lineage (great grandson), going on to supervise numerous students (e.g., Burrows, Davies, Thompson, Jenkins, Moore, Mieszkowska) and hosting several post-docs (e.g., Williams, Firth) working on molluscs in general and limpet ecology in particular. John Day (an authority on polychaetes) also studied for his Ph.D. in Liverpool during the Orton period, before going to South Africa and supervising George Branch (who mentored the lead author, ANH) and setting off the South African clade of molluscan biologists (e.g. McQuaid). The lineage is by no means extinct and still globally radiating!

Acknowledgments

We would like to thank the library and librarians of the Marine Biological Association for access to photographic archives. Special thanks to the late Dr Eve Southward for her recollections of James Orton.

Sources of Information

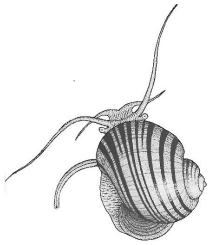
Colman, J.S. 1953. James Herbert Orton. *Annual Report for 1952 of the Marine Biological Station at Port Erin, Isle of Man*. 65: 5.
Jackson, J.C. 2015. *Elementary school attendance in Bradford 1863 – 1903: a study using school log books*. Master of Philosophy Thesis, University of Bradford. Pp. 138.
Norton, T.A., Brand, A.R. and Hawkins, S.J. 1992. A brief history of the Port Erin Marine Laboratory. Pages 4-16. In: *Dredging up the past* (A. Brand and S. Hawkins (eds). Centenary Committee, Port Erin Marine Laboratory, University of Liverpool.
Russell, F.S. 1954. James Herbert Orton 1884-1953. *Obituary Notices of Fellows of the Royal Society*. **9**: 201-215.
Southward, A.J. and Dodd, J.M. 1956. Studies on the biology of limpets I. The late J.H. Orton's work on *Patella*. *Journal of the Marine Biological Association of the United Kingdom*. **35**: 145-147.



The Malacological Society of London
WWW.MALACSOC.ORG.UK

Molluscan Forum

Wednesday 20th November 2024
9.00 – 6.30
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.

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.

Talks (~12 minutes), quick fire talks (~3 minutes) 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.

This year we will be returning to our historical format of in-person only talks, which will be broadcast virtually for those not able to attend.

THERE IS **NO** REGISTRATION FEE.

Enquiries and registrations to:
events@malacsoc.org.uk

Non-presenters:
Virtual attendance of talk sessions for non-presenters will be possible (poster sessions will be in person), so please indicate whether you will be attending in person or virtually. Please let us know you will be coming so that we can estimate numbers.

The Malacological Society of London

Molluscan Forum, Wednesday 20th November 2024
9.00 – 6.30
Flett Lecture Theatre, Natural History Museum, London

REGISTRATION FORM

Return before 13th September 2024, by email to:

events@malacsoc.org.uk

Name.....……

Institute.....……..…

.....……

Email.....…….....

Status: PhD student / Masters student / Undergraduate / Post-doctoral researcher / amateur (delete as appropriate)

'Other' (please state) ……..

I wish to give a talk (12 min)/ quick fire talk (3 Min)/ poster (delete as appropriate) entitled:

.....……

.....……...

Please attach, as a Microsoft Word attachment, an abstract of not more than 300 words, TOGETHER WITH TWO .JPG IMAGES IN SUPPORT OF THE ABSTRACT. Abstracts and images of accepted contributions will be published in the Society's online bulletin which is called *The Malacologist. The Malacologist* has an ISSN number and is published and archived on the website of the MSL.

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 £250).

£.....

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 will be sent out late October.

>CONTINUED

Abstract submission

Abstracts submitted for the Molluscan Forum should be sent as Microsoft Word files.
Please use the following format:

Title (12pt, centred)
<blank line>
Authors (10 pt, centred, presenting author underlined; use superscript numbers to indicate institutional affiliation)
<blank line>
Institutions (10pt, centred; in this order: Number (superscript), Department, Institution, City, Country)
Presenting Author email
<blank line>
Abstract (11pt, no indentation, 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]Department of Zoology, Natural History Museum, London, UK
[2]Department of Biology, Imperial College London, Berkshire, UK
Email: m.claremont@nhm.ac.uk

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 taxa. 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. *THE MALACOLOGIST* HAS AN ISSN NUMBER.

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

Grants and Awards

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

Early Career Research grants

Eligibility is restricted to those investigators at the outset of their independent scientific career. Applications must therefore be 1) postgraduate students, 2) within five years of being awarded their PhD (adjustable for career breaks), or 3) independent researchers not having a PhD. Early Career Research Grants will only be awarded to individuals twice, but not within 3 years of receiving a first award. From December 2021, the Society also offers additional awards, under its Global Participation Postgraduate Student Scheme, to a) applicants from developing and transition countries (as according to the UN), and b) UK/EU applicants from Black, Asian, or any other underrepresented ethnic background (see next page for application procedures)

Sir Charles Maurice Yonge Award

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

Senior Research Awards

These are aimed at established researchers in professional positions, but without regard to nationality. Applicants for Senior Research Awards must be members of the Malacological Society of London. The Society currently awards up to five Senior Research Grants per year, each with a value of up to £1,800, to support research on molluscs that is probably 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, The deadlines are 1st March, for travel scheduled between 1st June and 30th November, and 1st September for travel scheduled between 1st December and 31st May.

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

Annual Award

This Award is made each year for an exceptionally promising initial contribution to the study of molluscs. This is often a thesis or collection of publications. The value of the Award is £500. Candidates need not be a member of the Society but must be nominated by a member. There is no application form: the nominating member should send the material for evaluation with a covering letter or letter of support to the Honorary Awards Secretary. The closing date each year is 15th December. The winner(s) will be notified by 31st March, and announced at the Annual General Meeting.

Applications

Applications for Research Awards and Travel Grants should be sent to the
Honorary Awards Secretary,
Prof. Alan Hodgson, MSL_awards@nhm.ac.uk

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

Global Participation Postgraduate Student Scheme

This is an initiative of the Malacological Society of London to help support more students from across the world in their malacological studies.
The scheme will run every year, so each year ten new students will be given free membership for a 3 year period. So, in 2023 there will be 10 students, in 2024 there will be 20 and in 2025 and thereafter there will be 30.

We are offering 10 students each year free membership to *The Malacological Society of London* for a period of 3 years. Students who are studying a postgraduate malacology-related course in countries designated 'developing economies' are invited to apply for this award with the support of their supervisor. Applications are open immediately and will close when all 10 memberships have been allocated. Membership of the first round starting on 1st January 2023 and ending on 31st December 2025.

The scheme will run on a yearly basis and applications will open again next autumn.
Successful candidates will benefit from:

- online access to entire archive of *Journal of Molluscan Studies* (back to 1893)
- electronic delivery of Society's bulletin, *The Malacologist*
- access to a higher rate of travel grant
- regular communication from MSL about the Society's themed meetings and the annual Molluscan Forum

Application procedure

Please send applications and proof of course registration to the Membership Secretary: membership@malacsoc.org.uk

Selection criteria

Applicants must fulfil the conditions stated below and will be selected on a first-come basis.

Conditions

- Students must be registered for their postgraduate course in a country designated as a 'developing economy'.
- The course must have a strong malacological focus.
- Students must have the support of their supervisor and must send proof of course registration with their application and for each membership year.
- Membership will last for a maximum of 3 years, not the duration of a course, and an individual can only receive the award once.
- If there is a gap in a student's study their membership will stop, but if a course is upgraded (e.g., from MSc to PhD) and the student's study is continuous, then the membership can continue for the full duration of the scheme.
- Students on part-time courses and those undertaking coursework-only courses can also apply.

Malacological Society of London – Subscription and Membership

Objects

The objects of the Society are to advance education and research for the public benefit by the study of molluscs from both pure and applied aspects. We welcome as members all who are interested in the scientific study of molluscs. There are Ordinary Members, Student Members and Honorary Members. Members are entitled to receive a digital copy of the *Journal of Molluscan Studies* and such circulars as may be issued during their membership. The Society's website 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. The Society no longer produces paper copies of the Journal. Members also receive access to *The Malacologist*, which is the bulletin of the Society, issued twice a year, in February and August. *The Malacologist* is published online on the website of the Society.

Meetings and articles

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*.

Subscriptions

Membership subscriptions are valid from **1st January** for a single calendar year.

Membership fee structure

Ordinary Members: Journal on-line only £50
Student Members: Journal on-line only £29

Methods of Payment

New Members:
To join the Society for the first time please fill in the Membership Form on the MSL website and make your payment using a Credit or Debit Card (Mastercard, Visa, American Express):
https://malacsoc.org.uk/membership-form/

***Existing Members*:**
If you already have an account on the MSL website please **login** to renew your membership and make your payment using a Credit or Debit Card (Mastercard, Visa, American Express).

OR

If you have already set up a standing order you may continue to pay in this way. We do not encourage members who have a MSL account on the website, or any new members, to set up a standing order.

Institutional Subscriptions to the Journal

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

For any membership queries please contact the Membership Secretary: membership@malacsoc.org.uk

Broadening Access Membership Scheme

The Malacological Society of London helps to support postgraduate students from countries listed as developing economies in their malacological studies.

We offer **10 postgraduate students, each year , free membership** to *The Malacological Society of London* for a period of 3 years under the new Broadening Access Membership Scheme (BAMS). Students who are studying a postgraduate malacology-related course in countries designated 'developing economies' are invited to apply for this award with the support of their supervisor. Applications open each autumn and will close when all 10 memberships have been allocated.

Successful candidates will benefit from:

- online access to entire archive of *Journal of Molluscan Studies* (back to 1893)
- electronic delivery of Society's bulletin, *The Malacologist*
- access to a higher rate of travel grant
- regular communication from MSL about the Society's themed meetings and the annual Molluscan Forum

Application procedure:
To find out more about the scheme, who is eligible and how to apply, please go to the following page on our website: https://malacsoc.org.uk/developing-economies-membership-scheme/

Answer to the puzzle of the shell on the beach - Answer = Benjamin Britten