ISSN 1011-2375

UNITAS MALACOLOGICA

FOUNDED 1962

Newsletter

Number 37
February 2023

What's Inside

Dear members,

During the celebration of WCM22 in Munich the Council asked me about the possibility to reactivate the Newsletter. At that moment I realized that it hadn't been published for some years. And my response was certainly positive.

My idea as Editor is very simple, the UNITAS Newsletter must be a vehicle for the communication between the Council and all of us. The webpage and the social media networks are very useful to communicate, receive and send news, but I think that the "traditional" Newsletter must not be forgotten.

In summary, I will try to create a short Newsletter with the basic information from the Council. I believe that it will be used by many of us as another resource when it comes to communicating the achievements of UNITAS and, where appropriate, news from other affiliated malacological societies, elections, reports, books, etc. Both, the social media networks, and the Newsletter, can and must "survive" together.

In principle, it will be edited twice per year, the first one being in January/February. In this first issue we will publish the calls for the annual Research awards, and in the year before the celebration of WCM, we will publish the call for travel grants. Of course, all this information will also be published on the website, and the form is filled in directly on the website.

The second issue will be optional and will be published in second semester as a bonus.

This is all for now, feel free to send me any malacological news or announcement from your country. All the best for 2023.

JST

Our aim is to further the study of Mollusca by individuals, societies and institutions world-wide

Affiliated Organisations

American Malacological Society | Asociación Argentina de Malacología | Conchology, Inc. | Deutsche Malakozoologische Gesellschaft | Hungarian Malacological Society | Instituto Português de Malacologia | Koninklijke Belgische Vereniging voor Conchyliologie | Latvian Malacological Society | Malacological Society of Australasia Ltd | The Malacological Society of Japan | The Malacological Society of London | Malacological Society of the Philippines | Nederlandse Malacologische Vereniging | Sociedade Brasileira de Malacologia | Sociedad Española de Malacología | Sociedad Malacológica de Chile | Società Italiana di Malacologia | Société belge de Malacologie | Society for the Study of Molluscan Diversity, Japan |

Newsletter Editor: Jesús Souza TRONCOSO
Department of Ecology and Animal Biology
University of Vigo; 36310 Vigo; SPAIN
t. +34 986 812621
f. +34 986 812556
e. troncoso@uvigo.es

Council of Unitas Malacologica

President

Lenita de Freitas Tallarico
Laboratory of Parasitology-Malacology
Butantan Institute, São Paulo
BRASIL

t. +55 11 26279770
e. letallarico@gmail.com

Secretary

Yasunori Kano
Atmosphere and Ocean Research Institute
The University of Tokyo, Chiba
JAPAN

e. kano@aori.u-tokyo.ac.jp

Treasurer

Bernhard Ruthensteiner
SNSB – Bavarian State Collection of Zoology
ZSM, 81247, München
GERMANY

e. Ruthensteiner@snsb.de

Past President

Gerhard Haszprunar
SNSB – Bavarian State Scientific Collections
ZSM, 81247, München
GERMANY

t. +49 (089) 8107-104
f. +49 (089) 8107-300
e. haszprunar@snsb.de

Members of Council

Tauana Junqueira Cunha
Field Museum, Chicago
USA

t. +1 (312) 665-7546
e. tcunha@fieldmuseum.org

Andrzej Kaim
Institute of Paleobiology, Polish Academy of Sciences, Warsaw
Poland

e. kaim@twarda.pan.pl

Kevin Kocot
Department of Biological Sciences
University of Alabama, Tuscaloosa
USA

e. kmkocot@ua.edu

Carmel McDougall
Scottish Oceans Institute
University of St Andrews, St Andrews
Scotland

t. +44 (0)1334 46 3446
e. cm107@st-andrews.ac.uk

President's Message

World Congress of Malacology (2025): A moment to get closer to South America

Dear UNITAS members, it is a great satisfaction to host in São Paulo (Brazil) the 22nd edition of the World Congress of Malacology. The proposal for the meeting organization was presented to all during the closing assembly of the last event, on August 5th of last year, at the Luís Maximiliano University of Munich (LMU) in Germany. I would like to thank President Gerhard Haszprunar and his team for their welcome, as well as the UNITAS council for support us in this moment. I believe that in addition to scientific quality, the meeting allows us to exchange a lot of information and integrate people with common interests and objectives.

I was very excited, as it will be the first time that WCM will be held in a Latin American country. It will be a very important moment, not only for our country, but to open even more the borders between the continents, with scientific dissemination of the diverse malacological studies carried out in the Americas and in the world.

São Paulo is known as the city that never sleeps and has many qualities. A typically urban multifaceted metropolis, avant-garde and innovative, with arts and cuisine made up of the union of more than 70 nationalities and regional traditions. In addition to being one ten largest economic centers in the world, is also the capital of culture in Latin America, with an offer of leisure, gastronomy, tourism and entertainment without equal. To give you an idea of magnitude, the city has more than 105 parks, 100 museums, 280 cinemas, 140 libraries, 180 theaters, 15,000 restaurants, 20,000 bars and about 40 cultural centers, numerous popular festivals and free fairs. Our intention is to hold the event in the first half of August 2025 at the Rebouças Convention Center, near Paulista Avenue, a region easily accessible by car, metro and bus. In addition, close to a large number of accommodations.

The various conferences held, as well as the significant scientific production of our country's researchers, are foundations for us to develop WCM in a unique and warm way. We have the support of Brazilians and Latin American researchers for the event construction and we are very anxious for this moment of congregation.

I wish to all of you a happy 2023, with all the sadness and problems replaced by smiles, gratitude, affection, a lot of positive energy and a new year full of good times and health.

Lenita de Freitas Tallarico
UM President

Past President's Message

Report WCM 2022 in Munich, July 31st to August 5th

This WCM may have been the most difficult of all so far to be prepared and organized: (1) Close to New Year, the upcoming Omicron-wave of Corona abolished all hopes that the pandemic will be finally finished by early 2022. (2) The start of the aggression war of Russia against the Ukraine end of February caused an additional element of uncertainty whether or not the Congress could take place as planned in the previous two years. Nevertheless, the organizing team decided in spring to take the risk and to let the WCM2022 happen.

We heartily acknowledge that the Ludwig-Maximilians-University of Munich (LMU) and the Staatliche Naturwissenschaftliche Sammlungen Bayerns (SNSB) provided rooms and facilities for the icebreaker in the Botanical Garden and the lecture rooms at the Biozentrum in Martinsried free of charge. The Congress Centre of the LMU helped significantly in formalities and setting up the webpage. The SNSB and the GeoBio-Center of LMU provided welcomed financial help.

I have to thank the whole organizing team for numerous hours of work over weeks and months, but there is one outstanding role: Mrs. Heidemarie Gensler, technician of my Chair at LMU, was the heart, the skeleton, and the musculature of the whole organization. Most important and despite of certain days of resignation, Heidi restlessly organized everything and in particular the food - and we all enjoyed it so much. Without you, Heidi, the WCM2022 would not became reality – THANK YOU SO MUCH! Michael Schrödl (SNSB-ZSM), Timea Neusser (LMU), Juan Moles (SNSB-ZSM), Zeyuan Chen (SNSB-ZSM), Basti Brenzinger (SNSB-ZSM) und Franzi Bergmeier (LMU) assisted and were mainly responsible for establishing the program; Jürgen Geist and Andreas Dobler (both Technical University Munich; TUM) organized the Science Slam; Alexander Nützel (SNSB-BSPG) was our main help concerning all aspects of palaeontology; Martin Hess (LMU) formed the centre of PowerPoint Presentation and poster files and edited the poster volumes; and Bernhard Ruthensteiner (SNSB-ZSM) in his role as Treasurer of UNITAS MALACOLOGICA solved a good number of otherwise crucial formal and financial disasters. Also the student crew (12) was highly engaged and did an excellent job as responded by the final applause at the Congress Dinner.

Aside of free lectures, the WCM 2022 consisted of no less than ten symposia:

(1) The Evo-Devo-Corner organized by Tim Wollesen.
(2) Exploration, Biodiversity of Systematics of Molluscs – a Symposium in Honor of Philippe Bouchet organized by Nicolas Puillandre, Ellen Strong, and Yuri Kantor. Philippe responded in taking over the costs of the aperitif of the Congress Dinner – again a big thank you!
(3) Continental Molluscs Facing Environmental Changes organized by Quentin Wackenheim, Salome Granai, Lucie Jurickova, and Ondrej Korabek.
(4) Systematics and Evolution of (not only marine) Heterobranchia organized by Michael Schrödl, Timea Neusser, Bastian Brenzinger, and Juan Moles.

(5) Insular Ecosystems as Cradles of Mollusc Biodiversity and Evolution organized by Björn Stelbrink, Kostas Triantis, and Christian Albrecht.
(6) Molluscs as Parasites and Victims of Parasitism organized by Kenneth De Baets and Aleksandra Skawina.
(7) The Ecology of Fossil and Extant Molluscs organized by Simon Schneider, Andrzej Kaim, and Thomas Neubauer.
(8) Mollusc Evolutionary History organized by Alexander Nützel, Katie Collins, and Mariel Ferrari.
(9) Molluscan Conservation (American Malacological Society president´s Symposium) organized by Kenneth A. Hayes.
(10) Volunteers in Malacology orgaznized by Anna Holmes and Ben Rowson.

The WCM2022 started in late afternoon of July 31st 2022 with the Registration and the Ice-Breaker Party at the Botanical Garden in München-Nymphenburg. There we enjoyed beautiful weather and good food and drinks. But most of all we enjoyed to meet each other in person after such a long time of isolation. Each of the four lecture days (Monday, Tuesday, Thursday, Friday) started with two plenary lectures. After the morning coffee break four parallel scientific session followed. A total of 211 lectures and 85 posters provided the audience with scientific results from across the field of malacology.

The poster session (of course with lots of foods and drinks) took place at Monday afternoon. Tuesday evening was occupied by a (truly long) honorary lecture by Philippe Bouchet followed by a Science Slam and a combined AMS/UNITAS auction. Wednesday, the excursion day offered various guided tours in Munich, to the Neuschwanstein Castle, a visit to the Jura-Museum in Eichstätt with a fossil collecting tour, a floodplain tour to Kelheim, pre-alpine collecting, freshwater pearl mussels, and to the various museums and collections of SNSB (botany, palaeontology, zoology). Thursday evening faced the general assembly of UNITAS and AMS. Finally, the Congress Dinner with all student prices was celebrated at Friday evening in the Augustiner Beer Cellar near the center of Munich.

Despite of the difficulties mentioned above the WCM2022 attracted more than 320 participants from no less than 38 countries, 89 from Germany, followed by 51 from the USA and 35 from the UK. Significant numbers came from Spain (16), Japan (14), Poland (13), France (13), Greece (10), Our slogan “meeting of generations” (and the generous travel grants provided by UNITAS and several other malacological societies) was fulfilled by the participation of 140 students.

The results of the WCM2022 have been documented as supplement volumes of the zoological journal Spixiana so that each contribution can be cited: (1) The book of abstracts includes the program and all abstracts of oral or poster contributions. (2) The book of posters provides PDFs of all posters being provided to the organizers. Both volumes are open access at: https://pfeil-verlag.de/publikationen/spixiana-supplement-30a-world-congress-of-malacology-munich-2022/ and https://pfeil-verlag.de/publikationen/spixiana-supplement-30b-world-congress-of-malacology-munich-2022/

Dear colleagues: let me finally again thank all those who have in any way contributed to make the WCM2022 to such a success: Heidi and the organizer team, the student´s crew, the administrator people (in part), and you, who came to Munich. Let´s meet again 2025 in São Paulo!

Munich, at 25th January 2023

Gerhard Haszprunar *– Past President of UNITAS MALACOLOGIA*

Group Picture WCM2022

Copyright Carolin-Bleese

Closure Dinner WCM2022

Photo Bernhard Ruthensteiner

The prize winners (best orals and posters) WCM2022

Photo Bernhard Ruthensteiner

The Munich Team (local organizers) WMC2022

Photo Jesus Troncoso

Treasurer's Report

I took over this office in an emergency situation at the beginning of 2021 when the treasury was still in the hands of Jackie van Goethem, who had wanted to give up this office for some time. My start was marked by a number of tricky tasks: The creation of a bank account in Munich and a Paypal account was quite difficult due to the legally ambiguous status of the UM. The membership list was not particularly up to date; it had to be carefully checked and transferred into a database format. The transfer of data and funds from Jackie (Brussels) to me (Munich) was additionally hampered by the restrictions of the Covid crisis. My already planned trip to Brussels at the end of 2021 was cancelled at the last moment, because a new Covid wave was on the way.
Eventually, Jackie sent me everything by bank transfer, internet and snail mail, which in the end worked out very well.
At this point the UM and I have to express our deepest gratitude to Jackie van Goethem. From 1986 to 2021, he managed the UM Treasury for an incredible period of 35 years!!
On the basis of his documentation I confirm that he did that with care and prudence. As a small thank you for this great achievement, we sent him a surprise gift in the form of a case of good red wine as a farewell gift.
I did not adopt the division of bank accounts into a current account and an endowment fund, like Jackie had in Brussels. For payments from overseas, I have set up a Paypal account, which can also be used for credit card payments.

At the general assembly at the WCM2022, I provided a financial report for the period of 2019-2021, only about half of which relates to my own activities. It is recapitulated here in brief: Total receipts of €43,480 (all figures rounded) with total expenditure of €21,360 resulted in a total cash balance of €59,940 at the end of 2021. The main income items are made up of donations (€965), membership fees (€5,330) and income related to the WCM2019 (€35,980). Most of the donations came from the Malacological Society of Japan (many thanks!). A large part of the membership fees came from participants of the WCM2019. Revenues related to the WCM2019 totalled € 34,440. Many thanks to Terry Gosliner for this financially successful handling of his WCM! The main expenses consist of student awards. €15,560 were awarded in form of travel grants to 12 students for participating at the WCM2019. In 2021, a total of €3,960 was paid as research awards to Taro Yoshimura, Xochitl Guadalupe Vital, Olivia Stogner.

The following is a brief financial report for the past year 2022. Income of €49,930 compares to expenditure of €47,760. Among the income, the donations should be mentioned first. Again, the Malacological Society of Japan was in the lead with €660. The Malacological Society of London donated €250 and the Sociedade Brasileira de Malacologia €60. Many thanks to all donors! Membership fees raised €8,790 of which about €3,500 is directly related to the registration for WCM2022. Notable items of expenditure were again the student awards. Laia Burgues Palau, Jose Pardos Blas, Alessia Carini each received €1,500 as research awards. The enormous amount of €27,540 was awarded as travel grants to 27 students to participate at the WCM2022.
Large parts of the income and expenditure in 2022, which however extend into the current year 2023, directly concern the WCM2022, whose finances are also highlighted here. With income of €28,530 (grant from the German Science Foundation, sponsors, congress fees, T-shirt business, etc.) and expenses of €9,430 (personnel (mainly), public transport tickets, etc.), a surplus of €19,100 was generated. This profit is in the middle range compared to previous WCMs, but could be regarded as quite remarkable considering the adverse circumstances (e.g. Covid crisis). Gerhard Haszprunar's team, of which I am also a

member, may therefore claim to have done a decent job in financial terms as well.

Finally, a few words about the members of the UM. Last year I contacted many (former) members who were in arrears with their dues (for years). Many remained in the society and almost all of them paid the missing fees. Many thanks to those who decided to remain members of the UM! At this point it should be mentioned that there are differing opinions on the handling of membership – also within the UM council. Some would prefer to handle it "congress based", i.e. membership would last for one congress period and then expire, as is the case with some other societies. I am in favor of retaining the classic variant, with continuous membership that lasts until resignation – like is also stated in the current UM bylaws. **Here I would like to remind you to pay your fees, ideally by adding a donation.** I will also take the liberty of requesting payment from members who are in arrears with their fees. Currently there are 211 members, including 7 associated societies, which is less than in previous decades when up to 400 members were registered. However, the number has increased again compared to the time of WCM2019 and is therefore not a cause for concern.

In summary I can state that Unitas Malacologica is still in good financial condition. However, there are challenges ahead in the form of a new constitution and modification of the society status to improve the legal basis of our finances.

Bernhard Ruthensteiner
UM Treasurer

Secretary´s Report

UNITAS MALACOLOGICA

MINUTES OF GENERAL ASSEMBLY

B00.019, Biocenter LMU, Munich, Germany
17:45–18:45, Thursday, 4th August 2022

1. President's report
Gerhard Haszprunar opened the meeting and welcomed members. He reported that (1) 317 malacologists participated in WCM 2022 despite difficulties in traveling with the persisting COVID-19 pandemic and Russia–Ukraine war, and (2) the UM Council held a total of six council meetings in the last three-year period, all on Zoom. He thanked the Council for its support in organising the Unitas Congress.

2. Treasurer's report
At a Zoom meeting in March 2021 the Council appointed Bernhard Ruthensteiner to succeed Katharina Mason who earlier resigned the Treasurer's position. Bernhard presented the detailed accounts for the UM finances; key financial data are shown elsewhere in this Newsletter (No. 37). He thanked Jackie Van Goethem who served for 35 years as the Treasurer and handed over relevant records with great details. The savings of UM were safely transferred to a new bank account in Munich. Records of members' status and deposit/withdrawal details have been digitized.

3. Auditors' report
Bastian Brenzinger and Timea Neusser certified that the accounts were in order and that the financial statement was an accurate record of UM's financial position. Gerhard moved to

approve the treasurer's report and the motion carried with one member opposed.

4. Secretary's report

Yasunori Kano reported on the 2020 and 2021 Student Research Awards and 2022 Travel Grants. For 2020 ten applications were submitted from Australia, Brazil, Japan, México, Spain and USA, and three winners received a total of €3,690. For 2021 there were five applications from Hong Kong, Netherlands, Nigeria and Spain and three received €1,500 each, totalling €4,500. Details of the awardees and their results are shown elsewhere in this Newsletter (No. 37).

Twenty-seven Travel Grants were made to support the attendance of students and other early-career researchers to WCM 2022. There were 45 applications from 17 countries, including Argentina, Australia, Canada, Chile, Greece, India, Japan, Mexico, Nigeria, Norway, Oman, Philippines, Portugal, Spain, Russia, UK and USA. UM allocated for these travel grants a total sum of €27,540, an increase of €11,540 from 2019.

Regarding elections, 78 anonymous votes were cast and counted for the new Council members:

Nominee	yes	no	abstain
Lenita de Freitas Tallarico (President)	63	8	7
Andrzej Kaim (Councilor)	71	0	7
Carmel McDougall (Councilor)	67	1	10
Yasunori Kano (Secretary, 2nd term)	77	1	0
Bernhard Ruthensteiner (Treasurer, 2nd term)	78	0	0

All nominees were thus duly elected. Gerhard and Yasunori welcomed the new Council members and thanked retiring members, Terry Gosliner (Past President), Gonzalo Giribet and Suzanne Williams (Council members), for their excellent contribution to UM over the last six years. Gerhard, Kevin Kocot and Tauana Cunha, elected in 2019, serve for three more years as the members of the new Council.

5. Venue for 2025 Congress

The incoming President Lenita de Freitas Tallarico introduced São Paulo and malacological communities in Brazil and other South American countries. Gerhard congratulated her on WCM 2025, which will finally be held in the South American Continent for the first time in the 60-year history of UM.

6. Proposals and any other business

The President Gerhard Haszprunar, by representing the Council, proposed a near-future amendment to the Constitution of UM to establish its legal status and foundation in Germany with no other major changes to the concept of the Constitution. Introduction of annual Zoom-based General Assemblies (in years without WCM), including one for the amendment as a replacement of voting by snail mail, was also proposed by him and the Council and was approved by the attending members of UM with a few abstentions.

Also announced by Gerhard was re-establishment of the UM Newsletter as an online-only publication, with Jesús Souza Troncoso who volunteered for the post of the Newsletter Editor.

Yasunori Kano, Secretary of Unitas Malacologica

Others from Secretary

2020 Student Research Award Winners (total: €3,690)

Olivia Stogner (USA): Detecting *Toxoplasma gondii* in the giant African snail (*Lissachatina fulica*) in O'ahu, Hawai'i.

Xochitl Vital (Mexico): Light preference of a

photosynthetic sea slug: The acclimation state of chloroplasts matter.

Taro Yoshimura (Japan): How do animals secrete carbonates in the hadal zone? A novel insight from the chemosymbiotic bivalve "*Axinulus*" hadalis (Thyasiridae).

2021 Student Research Award Winners (total: €4,500)

Laia Burgués Palau (Netherlands): Effects of light stress on tropical solar-powered slugs

Alessia Carini (Hong Kong): Blueprints of biological complexity: Decoding molecular pathways and the evolution of molluscan shell biomineralization

José Ramón Pardos Blas (Spain): Insights into conotoxin gene regulation in cone snails through DNA methylation analysis

2022 Travel Grants (total: €27,540)

Najat Al Fudhaili (Oman)
Monisha Bharate (Norway)
Verena Diana Bökenhans (Argentina)
Lynn Bonomo (USA)
Lauren Rose Eggleton (UK)
Robert Fernandez Vilert (Spain)
Carles Galià-Camps (Spain)
Darya Grishina (Russia)
Mariana Grossmann (Chile)
Anushree Jadhav (India)
Vanessa Knutson (USA)
Harold Lipae (Philippines)
Jesús Martínez-Sanjuán (Spain)
Abdulhammed Oropo (Nigeria)
Martina Panisi (Portugal)
Marc Peralta Serrano (Sapin)
Kinsley Meg Perez (Philippines)
John Gerhardt Phillips (USA)
Lina Marie Raubold (Germany)
Evangelia Rentoumi (Greece)
Karla Zurisadai Rubio Sandoval (Germany)
Sherry Lyn Sayco (Japan)
Corinna Sickinger (Germany)
Nancy Yolimar Suarez Mozo (Mexico)
Danae Thivaiou (Greece)
Meghan Yap-Chiongco (USA)
Taro Yoshimura (Japan)

Prizes for student presentations at WCM 2022

Congratulations to the UM Student Presentation Prize winners!

Talks
1st Prize: Alison Irwin (UK)
2nd Prize: Sherry Lyn Sayco (Japan)
3rd Prize: Carles Galià-Camps (Spain)

Posters
1st Prize: Taro Yoshimura (Japan)
2nd Prize: Giacomo Chiappa (Italy)
3rd Prize: Karin Inoue (Japan)

The Malacological Society of London and The American Malacological Society also awarded their prizes:
MSL Prize for Best Oral Presentation: Lauren Eggleton (UK)
MSL Prize for Best Poster Presentation: Elisa Nocella (Italy)
AMS Constance Boone Awards: Meghan Yap-Chiongco (USA) and Xochitl Vital (Mexico)

In addition to certificates, prize money and malacological books as awards to these ten prize winners, they all were cordially invited by the UM President Lenita de Freitas Tallarico to attend WCM 2025 in São Paulo — registration fees will be waived for them!

2023 UM Student Research Awards

Unitas Malacologica has been supporting student research on molluscs since 2000. **Applications for the 2023 Unitas Malacologica Student Research Award are now open**. Up to three awards of up to 1,500 euro will be made.

The application form and instructions can be found at:
https://universityofalabama.az1.qualtrics.com/jfe/form/SV_81WgMksnCmvuFKK

One letter of recommendation by the student's research mentor should be sent directly to Dr. Yasunori Kano (kano@aori.u-tokyo.ac.jp). The deadline for submission of the form and required letter of recommendation is 30 April 2023. Non-members are not eligible for student research awards.

We strongly favor self-contained projects, which are fully funded by the award, though the project may be a component of a broader research program. Projects that have commercial applications are not eligible for funding. A report summarizing the results of the work funded is to be submitted for publication on the UM website and Newsletter at the end of the award period.

Yasunori Kano
UM Secretary

Keep in touch…

Keep an eye on our webpage and Twitter account for Unitas Malacologica news and some of our favorite molluscan content. If you have a new publication or announcement you would like us to help spread the word about, please direct message us on Twitter or e-mail kmkocot@ua.edu with information.

Webpage:
http://www.unitasmalacologica.org/

Follow us on **Twitter**: @malacologica

Kevin Kocot
Webmaster - Social Network Manager

Other issues

2023 American Malacological Society Meeting

Submitted by Kevin Kocot, AMS President

The 89th American Malacological Society meeting will take place from 1-5 August 2023 in Tuscaloosa, Alabama at The University of Alabama and the Alabama Museum of Natural History. Registration for the meeting will open in late January and early-bird (by 30 April) registration costs for in-person attendees are anticipated to be $225 for full members and $125 for student members with additional costs for the banquet and field trip.

The meeting will open the evening of 1 August with a welcome reception in the Grand Gallery of the Alabama Museum of Natural History. This beautiful space features the 60-foot skeleton of the fossil whale Basilosaurus cetoides, the only meteorite known to have directly injured a human by its impact, and, of course, several exhibits on molluscs.

Given the incredible diversity of freshwater molluscs in Alabama, the topic of the President's Symposium (2 August) will be “Freshwater Mollusk Diversity in a Biodiversity Hotspot.” This symposium is organized by Dr. Carla Atkinson (University of Alabama) and confirmed speakers include Dr. Art Bogan (North Carolina Museum of Natural History), Dr. Alexa Maine (Confederated Tribes of the Umatilla Indian Reservation; CTUIR), Dr. Dave Strayer (Cary Institute), Dr. Ellen Strong (Smithsonian Institution), Dr. Caryn Vaughn (University of Oklahoma), and Dr. Nathan Whelan (Auburn University and USFWS).

Contributed oral presentations (3-4 August) and posters (evening of 2 August) are expected to span diverse sub-disciplines of malacology with work on molluscan genomics, phylogenetics, and freshwater molluscan ecology expected to be particularly well-represented. Contributed oral presentations will be allocated 15-minutes each including time for questions. Please plan your actual

presentation to be completed in 12 minutes to allow plenty of time for questions and transitions between speakers. Time limits will be strictly enforced. Posters should be in landscape or orientation and no larger than 48" X 36". The deadline for submission of abstracts for posters and talks is 23 June.

Student-centered events will include a student mixer at a local brewery (after the poster session on 3 August) and a student-mentor networking program (during lunch on 4 August). The meeting will also include a panel discussion on inclusive fieldwork and field courses hosted by the Society's Justice, Equity, Diversity, and Inclusion (JEDI) Committee (during lunch on 3 August). Panelists will discuss ways for research teams to integrate principles of inclusion into fieldwork planning, navigate issues that arise in the field, and effectively debrief post-fieldwork. Topics covered may include reproductive functions (e.g. menstruation, pregnancy, lactation), mobility constraints and disability, race and nationality, harassment and discrimination prevention and response, and audience questions. This panel is aimed at malacologists of all career stages.

We will be holding the annual AMS Auction (on 3 August). This is a favorite of many AMS attendees that showcases the generosity of the malacological community – from those willing to donate prized keepsakes for auction to those willing to spend hard-earned dollars on garish snail-themed salt and pepper shakers or squid print underwear – all to support travel and research awards for AMS student members! Please consider donating items to be auctioned off. Contact Kevin Kocot (kmkocot@ua.edu) for more information.

The meeting will close with a banquet and awards ceremony in the Grand Gallery of the Alabama Museum of Natural History (on the evening of 4 August). An optional field trip (on 5 August) will allow participants an opportunity to see some of Alabama's 204 species of freshwater snails and 180 species of freshwater mussels. You will get wet on this ride.

We hope you will join us in Tuscaloosa! However, in the interest of inclusivity, all oral presentations will be streamed live to the web for viewing by remote participants who are unable to attend the meeting in-person. Early-bird (by 30 April) registration costs for remote participants will be $25 to support the costs of equipment rental and tech support. Please note: only in-person presentations will be possible and events other than oral presentations and the JEDI panel will not be livestreamed.

Tuscaloosa is located just one hour from Birmingham Shuttlesworth International Airport in Birmingham, AL and is easily and affordably accessible by commuter shuttle. A block of rooms is reserved at Hotel Capstone, which is located immediately adjacent to the Bryant Conference and just a 10-minute walk from the Alabama Museum of Natural History. There are many other hotels nearby in addition to other options for accommodations through vacation home rental websites. Additional information about AMS 2023 can be found on the AMS website or by contacting Kevin Kocot (kmkocot@ua.edu).

We thank the University of Alabama Department of Biological Sciences, Alabama Museum of Natural History, and Alabama Water Center for their sponsorship of AMS 2023. The 89th AMS meeting logo was designed by David Galinat (Alabama Water Institute). It depicts Anamenia farcimen (Heath, 1911) (Mollusca, Aplacophora, Solenogastres) on its cnidarian prey. Image reproduced from: Heath, H. 1911. The Solenogastres. Memoirs of the Museum of Comparative Zoology at Harvard College XLV(1).

Research Award Report (2020 Winners)

Note: Students reports are not scientific publications to be cited. The results will be or have been published elsewhere as original articles.

Light preference of a photosynthetic sea slug: The acclimation state of chloroplasts matter

Xochitl G. Vital

Unitas Student Research Award 2020, Report. July 6th, 2022

Introduction

Some sacoglossan slugs can sequester the chloroplasts they ingest from the algae they feed on and keep them functional (kleptoplasty), thereby becoming photosynthetic animals [1]. As any photosynthetic organism, they develop a "love and hate" relationship with light: they need it to photosynthesize, but too much light can damage the chloroplasts [2]. Recent studies have described a photoprotective behavior in different species of *Elysia* in response to diverse light conditions [3,4]. *Elysia crispata* Mörch, 1863 keeps functional chloroplasts for several weeks, becoming an important model to investigate kleptoplasty in metazoans. To better comprehend the advantages of obtaining "help" from stolen organelles in this group of mollusks, behavioral studies to delimit the functionality of chloroplasts under different light scenarios need to be performed. The aim of this project was to assess the preference of *E. crispata* for different color and intensity of light and establish whether such preference was related to the light condition to which algae had been acclimated.

Three preference (active selection) experiments were conducted (Table 1; Fig. 1): Experiments 1 and 2 assessed slug preference for light color and intensity, respectively. Experiment 3 evaluated whether consuming algae acclimated to high light (HL=425 μmol m^{-2} s^{-1}) determined slug choice for either high or low light intensity (LL=60 μmol m^{-2} s^{-1}). Light intensities used herein were defined based on previous results, together with those of Exp. 2. Acclimation state in algae (*Bryopsis pennata* J.V.Lamouroux, 1809) and sea slugs were confirmed using analysis of pigments.

Table 1. Description of trials, treatments and lamp configuration in the light preference experiments. Slugs were individually placed at the center of a cross maze with either four or two different light

conditions (choice trials CH). A condition with the same experimental set up but with no light was used as control trials in all experiments (NCH). The duration of each trial was 30 min.

Experiment		Choice (CH) Light on*	No Choice (NCH) Light out	Replicates (n)
1	Color (nm)	Blue (450)	B	CH= 31 NCH= 34
		Green (517)	G	
		Yellow (520 y 650)	Y	
		Red (665)	R	
2	Intensity (µmol m^{-2} s^{-1})	I. 60	I	CH= 27 NCH= 29
		II. 180	II	
		III. 425	III	
		IV. 1400	IV	
3	LL vs. HL (µmol m^{-2} s^{-1})	LL = 60	LL	CH= 15 NCH= 15
		HL = 425	HL	

*All lamps had the same light intensity in Exp. 1 (~29 µmol m^{-2} s^{-1}) and same color spectrum in Exp. 2 and 3.

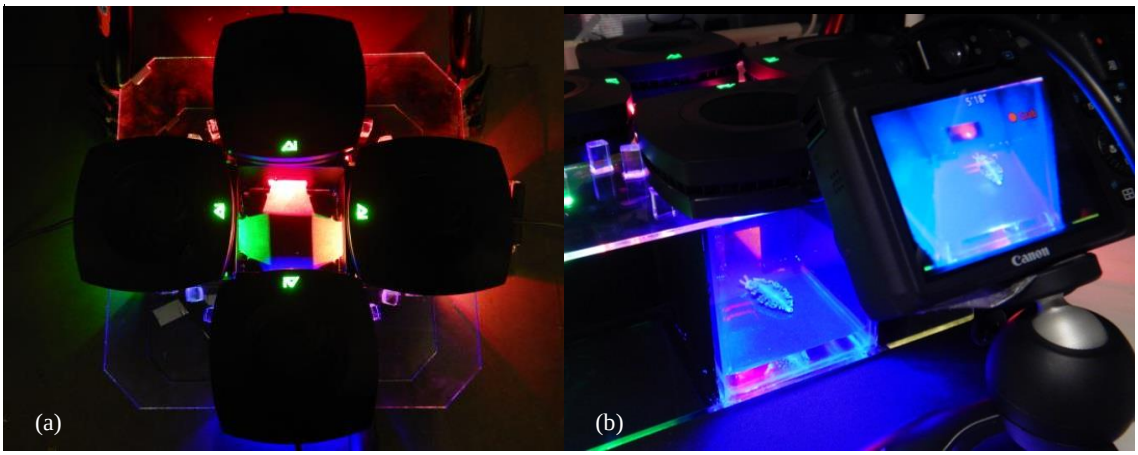


Figure 1. Experimental set-up for light preference experiments in *Elysia crispata.* Apical view of the prototype with lights turned on (a). Example of one of the lateral views and the position of one of the cameras during the CH trials in experiment 1 (b).

Results

Overall, results indicate that *E. crispata* actively rejects red and high light intensities (425-1400 µmol m^{-2} s^{-1}). However, slugs did not reject HL intensities when fed algae acclimated to that light intensity, indicating a change in preference depending on the algae's acclimation condition.

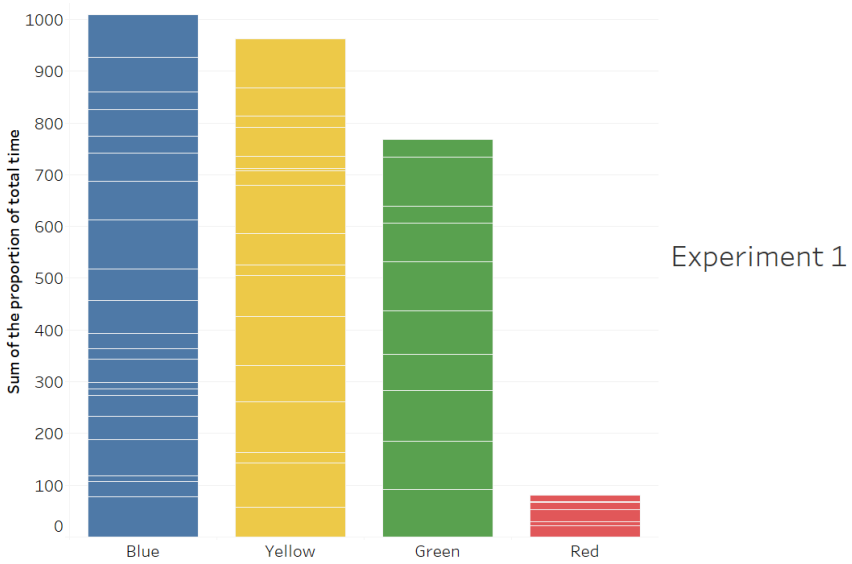
Analysis of the trans-neoxanthin/Chl *a* ratio confirmed the HL acclimation state of *B. pennata* and *E. crispata,* as mean ± SD values of the HL algae were 0.379 ± 0.027 (n=2), and 0.462 ± 0.192 (n=10) in the HL slugs, compared to 0.041 ± 0.004 (n=2) of the LL algae and 0.107 ±

0.058 of LL slugs (n=5).

The frequency (number of organisms) at the end of Exp. 1 in the trials with lights on (CH) was higher in blue (35.4%), followed by yellow (32.2%), green (29%), and only one organism was found in red (3.2%). These results match the proportion of time spent in each color (Fig. 2), as more slugs spent more time in blue and yellow (4:00 h in both cases), followed by green (1:39 h), and less time in red (8:43 min).

The number of organisms at the end of experiment 2 (light intensity preference) in the trials with lights on (CH) was higher (48.1%) at the lowest intensity (60 µmol m^{-2} s^{-1}) and at the II intensity (37%), while only two organisms (7.4%) were found at each of the highest intensities (III and IV). The proportion of time spent at each intensity did not completely agree with these results, because slugs spent more time at intensity II (4:44 h), rather than intensity I (4:23 h). The difference in time ratio between these two intensities with respect to intensities III and IV (1:32 h and 48 min, respectively) was evident (Fig. 2).

When slugs had been feeding on algae acclimated to HL, however, the frequency in the trial with lights on (CH) was nine individuals at HL, this is twice as many as those recorded at LL. When all the organisms used during CH trials are considered, slugs spent markedly more time in HL (07:22 h) compared to time spent in LL (03:38 h; Fig. 2).



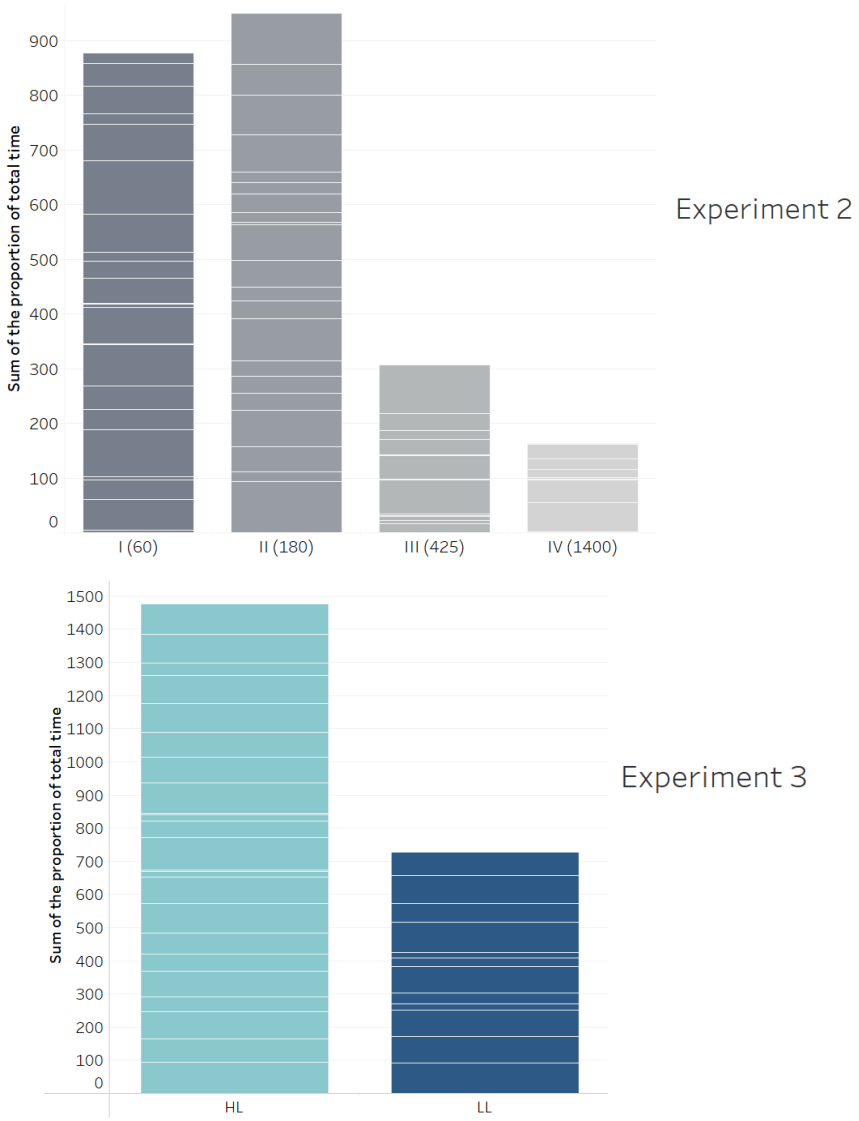


Figure 2. Results of light preference in *Elysia crispata*, showing the sum of the proportion of time (total per trial = 30 min) that slugs spent in each option (treatment CH= lights on) in each experiment. Each line of the bars separates the proportion between organisms (Exp. 1: n=31; Exp. 2: n= 27; Exp. 3: n=30). Light intensity units are in µmol m^{-2} s^{-1}.

Discussion

Experiments showed that the quantity and quality of light is relevant for *Elysia crispata*'s behavior. Here, we report lower light intensities (60-180 vs. 200-300 µmol m^{-2} s^{-1}) and different color preferences (B>Y>G>R vs. R<Y>B=G) than previously described by Weaver and Clark [5]. Positive phototaxis has been recorded in other sea slugs, including sacoglossans [4,6]. This behavior is not exclusive of photosynthetic sea slugs, but differences between long-term retention species and short-term or not retaining species have been observed [3,4].

We also found that the acclimation state of chloroplasts within the algae is relevant in determining the light preferences of *E. crispata*. In other species of *Elysia*, *E. timida* and *E.*

viridis, the acclimation state defined the opening/closure of parapodia and also influenced its light preference in the latter [3,7].

Photoreceptors must be present in *E. crispata* to detect the different types and amounts of light. The only sacoglossan species where this has been studied is *E. timida* [8]. In that species, authors reported that the eyes perceived light intensities (high or low) but pointed out that some other extraocular receptors ought to be present. Results obtained through this project contributed to the understanding of these unique biological models.

References

1. Wägele, H.; Martin, W.F. Endosymbioses in Sacoglossan sea slugs: Plastid-Bearing Animals that Keep Photosynthetic Organelles Without Borrowing Genes. In *Endosymbiosis*; Löffelhardt, W., Ed.; Springer-Verlag Wien, 2014; pp. 291–324 ISBN 978-3-7091-1302-8.
2. Cruz, S.; Calado, R.; Serôdio, J.; Cartaxana, P. Crawling leaves: Photosynthesis in sacoglossan sea slugs. *J. Exp. Bot.* **2013**, *64*, 3999–4009, doi:10.1093/jxb/ert197.
3. Cartaxana, P.; Morelli, L.; Quintaneiro, C.; Calado, G.; Calado, R.; Cruz, S. Kleptoplasts photoacclimation state modulates the photobehaviour of the solar- powered sea slug *Elysia viridis*. *J. Exp. Biol.* **2018**, *221*, doi:10.1242/jeb.180463.
4. Schmitt, V.; Wägele, H. Behavioral adaptations in relation to long-term retention of endosymbiotic chloroplasts in the sea slug *Elysia timida* (Opisthobranchia, Sacoglossa). *Thalassas* **2011**, *27*, 225–238.
5. Weaver, S.; Clark, K.B. Light intensity and color preferences of five Ascoglossan (=Sacoglossan) Molluscs (Gastropoda: Opisthobranchia): a comparison of chloroplast-symbiotic and aposymbiotic species. *Mar. Behav. Physiol.* **1981**, *7*, 297–306.
6. Miyamoto, A.; Sakai, A.; Nakano, R.; Yusa, Y. Phototaxis of sacoglossan sea slugs with different photosynthetic abilities: a test of the 'crawling leaves' hypothesis. *Mar. Biol.* **2015**, *162*, 1343–1349, doi:10.1007/s00227-015-2673-1.
7. Cartaxana, P.; Morelli, L.; Jesus, B.; Calado, G.; Calado, R.; Cruz, S. The photon menace: Kleptoplast protection in the photosynthetic sea slug *Elysia timida*. *J. Exp. Biol.* **2019**, *222*, 3–6, doi:10.1242/jeb.202580.
8. Rahat, P.M.; Monselise, E.B.-I. Photobiology of the chloroplast hosting mollusc *Elysia timida*- (Opisthobranchia). *J. Exp. Biol.* **1979**, *79*, 225–233.

##########

Detecting *Toxoplasma gondii* in the giant African snail (*Lissachatina fulica*) in O‘ahu, Hawai‘i

By Olivia Stogner

Auburn University | College of Forestry, Wildlife and Environment

August 2022

Introduction

Toxoplasmosis is one of the most common parasitic foodborne diseases in the world (Flegr et al. 2014; Hill and Dubey 2002; Alizadeh et al. 2018) and has severe negative impacts on humans (Park and Nam 2013; Jones and Holland 2010; Chaudhry et al. 2014; Alday and Doggett 2017; Zhou et al. 2011; Wang et al. 2017; Mousavi et al. 2018) and causes mortality in several wildlife species (Epiphanio et al. 2003; Cedillo-Pelaez et al. 2011; Dubey and Crutchley 2008; Krusor et al. 2015; Dubey et al. 2006; Casagrande et al. 2015; Jokelainen and Vikoren 2014). Felids are the only definitive host of the disease-causing agent, *Toxoplasma gondii*, and once infected, shed millions of oocysts through their feces (Shapiro et al. 2019). Several mechanical vectors can disperse these oocysts, but it is unknown if invasive land snails can act as mechanical vectors. My goal was to demonstrate if *T. gondii* DNA and intact *T. gondii* oocysts can be detected in *Lissachatina fulica* feces to determine if *L. fulica* can act as a mechanical vector for *T. gondii*. To complete this goal, I fed 500 deactivated *T. gondii* oocysts to four *Lissachatina fulica* and used conventional PCR to detect the presence/absence of *T. gondii* DNA in the resulting feces. I used genetic sequencing to confirm positive samples and light microscopy to detect full *T. gondii* oocysts. I also collected 127 *L. fulica* from three feral cat congregation sites in Honolulu, Hawai‘i and used conventional PCR targeting the 529 bp repeat fragment and nested PCR targeting the ITS1 region to detect the presence/absence of *T. gondii* DNA in the resulting feces. I used DNA sequencing to confirm positive samples and light microscopy to detect full *T. gondii* oocysts.

Results

For the four *L. fulica* I fed *T. gondii* oocysts, two fecal samples were collected from each snail. Of these eight fecal samples, four amplified positive for *T. gondii* DNA. All four samples were the first fecal sample collected for each snail directly after ingesting the oocysts. No oocysts were observed during light microscopy for the samples.

Of the 127 wild caught *L. fulica* snails, 41 fecal samples tested positive for *T. gondii* DNA through conventional PCR targeting the 529 bp repeat fragment. One of these samples could be sent for DNA sequencing, which was successful at 95.06% similarity. Four of the other 40 positive samples were amplified for the ITS1 region using nested PCR and three of the four samples could be sent for DNA sequencing. Only one of these sequenced successfully, with 93% similarity. The results for the

remaining 37 samples are pending.

Table 1.1 Wild caught *L. fulica* fecal samples that tested positive for *T. gondii* DNA.

	Total # of Snails/Fecal samples	Conventional PCR (529 bp repeat fragment)	Nested PCR (ITS1 region)*	DNA Sequencing	Light Microscopy
UH Manoa	39	11	0	0	0
Archi Baker Mini Park	28	10	4	1	**
Honolulu Zoo	61	20	0	1	0
Total	127	41	4	2	0

* Results are pending for 37 samples. 4 samples have been screened for this locus and are represented on this table.

**Results are pending

Discussion

Overall, I have shown support for the first part of my hypothesis, that *T. gondii* DNA can be detected in *L. fulica* feces, but not for full intact *T. gondii* oocysts. A mechanical vector is characterized by physically carrying a disease-causing agent from one location to another, causing an increased chance of infection to wildlife species and human populations (Graczyk et al. 2005; Chalkowski et al. 2018). Finding *T. gondii* oocysts through light microscopy is considered an irrefutable standard for detecting the parasite (Liu et al. 2015), which differentiates the results between environmental DNA or DNA from degraded oocysts from intact oocysts that could theoretically cause illness. Therefore, I cannot conclude that *L. fulica* can act as mechanical vectors of *T. gondii*. However, since the research shows that *T. gondii* DNA can be detected in *L. fulica* fecal samples, it is possible that *L. fulica* could serve as a biosentinel for *T. gondii*.

Several different species are used as biosentinels for *T. gondii*, such as arctic (*Vulpus lagopus*) and red foxes (*Vulpes vulpes*) (Bouchard et al. 2022), domestic dogs (Cabezon et al. 2010), and domestic chickens (*Gallus domesticus*) (Dubey et al. 2015; More et al. 2012). Molecular and serological methods are used to detect *T. gondii* DNA or antibodies against *T. gondii* in the sentinel species, which can be used to determine areas of concern (Cabezon et al. 2010; Dubey et al. 2015) or rate of exposure over certain periods of time (More et al. 2012). This has recently been done with feral chickens (*Gallus gallus*) on Kauaʻi to understand environmental factors that could contribute to *T. gondii* prevalence in different environments (Chalkowski et al. 2020). Collecting and screening *L. fulica* for *T. gondii* could provide important additional information of prevalence, environmental factors, and recent shedding of oocysts, particularly if snails are collected near feral cat defecation areas. Since cats tend to defecate in the same areas (Shapiro et a. 2019; Alfonso et al. 2008), collecting *L. fulica* from identified latrines might be an efficient way to monitor patterns and timing of shedding, especially since environmental

surveillance of *T. gondii* is difficult (Dumetre and Darde et al. 2003).

To the best of my knowledge, this is the first research project that has fed *T. gondii* oocysts to *L. fulica* and used conventional PCR to test the resulting feces for *T. gondii* DNA. This is also the first research project screening wild caught *L. fulica* for *T. gondii* DNA and a promising start to the possibility of using *L. fulica* as a biosentinel for *T. gondii*.

##

How do animals secrete carbonates in the hadal zone? A novel insight from the chemosymbiotic bivalve "*Axinulus" hadalis* (Thyasiridae)

Taro Yoshimura

Unitas Student Research Award 2020, Report. 31st January 2023

Introduction

The hadal zone (>6,000 m depth) represents a harsh environment below the Carbonate Compensation Depth (CCD: 3,000-5,000 m), where animals struggle to form and maintain calcium carbonate skeletons. Nonetheless, in a departure from the situation in most species, the hadal chemosymbiotic clam *"Axinulus" hadalis* (Fig. 1A; Bivalvia: Thyasiridae) living in

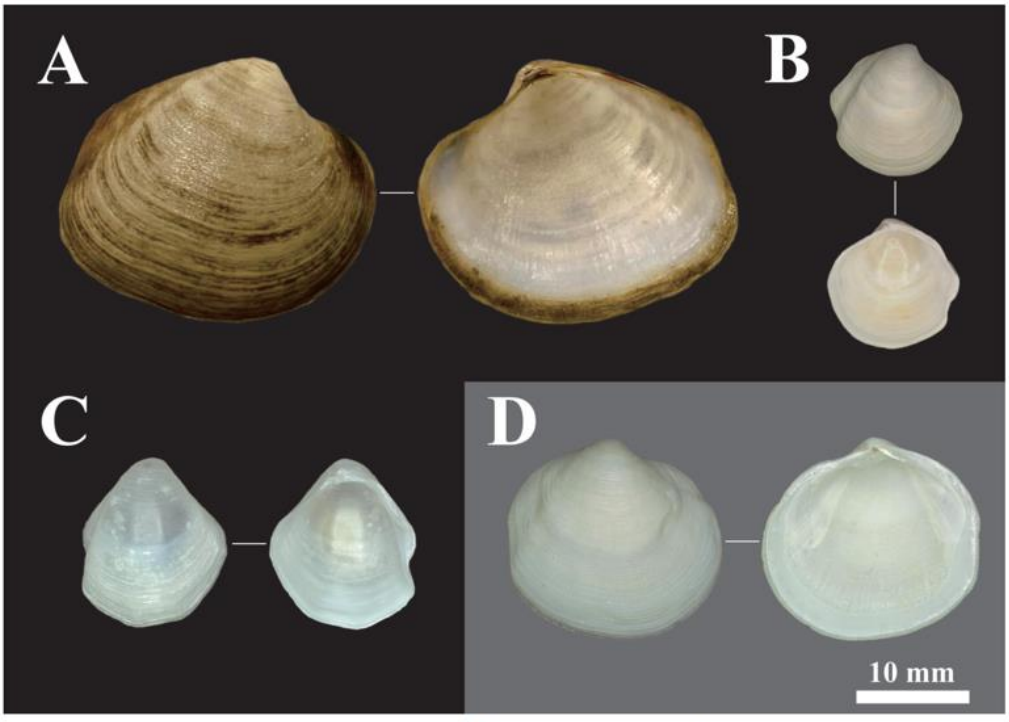


Figure 1. Hadal chemosynthetic bivalve and comparisons. Family Thyasiridae **A.** *'Axinulus' hadalis*. Japan Trench 7,434 m, **B.** *Thyasira tokunagai* Otsuchi Bay, Iwate Pref. (10 m), **C.** *T. kawamurai* Kushimoto, Wakayama Pref. (80 m), Family Lucinidae **D.** *Wallucina* sp. Shimoda, Shizuoka Pref. (129 m). All bivalves are symbiotic with sulfur-oxidizing bacteria.

depths to over 7,400 m in the Japan Trench possesses exceptionally larger and well-calcified shells than shallow-water species (Fig. 1B-D) within its phylogeny. *"A." hadalis* relies on chemosynthetic energy by supplying hydrogen sulfide from seawater to sulfur-oxidizing bacteria that living symbiotically in the gills (Fujiwara et al. 2001). However, in term of increasing body size, there has been far less recent interest in what might be thought of as how they overcome the above-mentioned obstacles in seawater chemistry at depths below the CCD. Here, we investigate this species with the aim to reveal how efficiently it secretes calcium carbonate in the hadal zone. To further examine the evolutionary background of shell enlargement, we conducted in vitro reproduction experiments of shell crystals under high hydrostatic pressure conditions and evaluated the mechanical properties at the crystal order.

Results

Shell microstructure and crystal-structure

The outer layer is composed of a spherulitic structure (not radial crystal growth as in e.g. Harper, 1992), and the inner layer has an irregular complex crossed lamellar structure (Carter & Clark 1985). EBSD results also show that *"A." hadalis* shells are heterogeneous in crystalline orientation in both the outer and inner layers. XRD (Fig. 2B) and Raman spectroscopy show that both the outer and inner shell layers in *"A." hadalis* and the shallow-water species are composed of aragonite. However, XRD peak comparisons show that the shells of *"A." hadalis* have a significant peak shift, indicating that the crystal is considerably distorted. The shells are also less crystalline than those of the shallow-water species and the mineral aragonite. This is thought to be due to sulphate ions substituted into the crystal lattice, which will be discussed below.

Chemical composition and sulfur isotope ratios

With regard to the composition of the shells in *"A." hadalis*, a notable feature is the high sulfur content. In the spherulites in outer layer and the granules in inner layer, the average S/Ca ratios were 0.49 and 0.79, respectively. It was not possible to detect sulfur by SEM-EDS in the shells of the compared shallow-water species. On the other hand, the prodissoconchs contain very little sulfur, with a uniform elemental distribution rich in carbon and nitrogen. Also, the TEM-EELS (Fig. 2A) results indicate that the chemical state of sulfur in the dissoconch exists as a minus divalent sulphate ion. The peak shift state is most similar to that of the reference calcium sulphate.

The results of stable sulfur isotope ratio analyses using NanoSIMS (Fig. 2C) indicate that

the δ34S values in the *"A." hadalis* shells are around -5 to 0‰, which is significantly lower than the 20‰ isotope ratio of seawater and soft tissue. This suggests that the sulfur in shells is not simply taken up from seawater, but is a sulfur metabolite that has undergone sulfur oxidation, as in the scaly-foot gastropods (Okada et al., 2019).

In-vitro crystal synthesis

According to the results of XRD, the aragonite crystals synthesized after addition of sulphate ions have a wide FWHM and are clearly less crystalline than aragonite without addition. The crystals also show a pronounced peak shift in the negative direction, suggesting distortion of the crystal lattice. This feature is similar for aragonite crystals synthesized under 75 MPa pressure condition. SEM observations show aragonite crystals with sulphate ion addition were found to be large rod-shaped crystals than aragonite without addition, with a large variation in aspect ratio.

From the results of condition-specific tests of pressure and reaction time, the amount of crystal formation increases with increasing sulphate ion addition, indicating that the presence

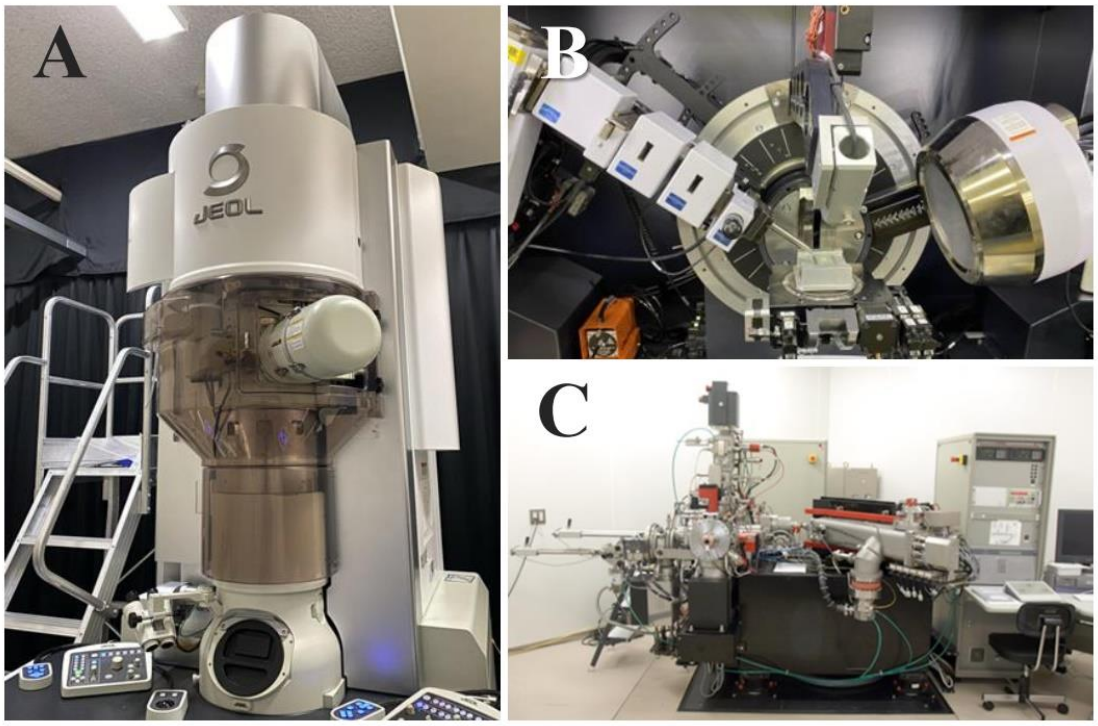


Figure 2. Equipment for the analysis funded by the grant. **A.** Electron energy loss spectroscopy (EELS) on TEM. **B.** X-ray diffraction (XRD) measuring instrument. **C.** High lateral resolution secondary ion mass spectrometry (NanoSIMS). **A, C** and **B** are those under the jurisdiction of The University of Tokyo and Keio University respectively.

of the additive causes rapid crystal formation. Also, the time taken for crystal growth is much faster than in the case of no additives.

Mechanical property

Nanoindentation results show that the mechanical properties of the shells of *"A." hadalis* are not superior at the crystalline level, with significantly lower hardness and Young's modulus in both the outer (spherulitic-like structure) and inner (irregular complex crossed lamellar structure) layers when compared to the shallow-sea species. Area analysis also shows that the mechanical properties of the shells of *"A." hadalis* show significant displacement within the same crystalline layer compared to the shallow-water species.

Comparisons of the in-vitro synthesized aragonite crystals with and without sulphate ions revealed that the aragonite crystals without addition had significantly higher hardness and Young's modulus. This result is consistent with the above results comparing the shells of *"A." hadalis* with sulphate ions with those of a shallow-water species without sulphate ions.

Discussion

The sulfate-containing shells observed in *"A." hadalis* are a feature not found in closely related species inhabiting shallow waters. Therefore, we have identified this shell feature as an evolutionary neomorph acquired by this species during its expansion and adaptation to the hadal zone, probably in association with intracellular chemosymbiosis.

Isotope ratio analyses suggest that the sulfur in the shell is a metabolite of the symbiont that underwent sulfur oxidation, and furthermore, the prodissoconch of *"A." hadalis* does not contain sulfide. From the above, we have concluded that the specialized shell containing sulfate ions is based on chemosynthetic ecology.

In vitro synthesis experiments indicate that aragonite crystallization in the presence of sulfate ions is notably rapid. This phenomenon provides a crystallographic explanation for why *"A." hadalis* can form aggressive shells in environments with low calcium carbonate saturation below the CCD.

Turning to the mechanical properties, *"A." hadalis* shells containing sulfate ions are significantly inferior to shallow-water species. This suggests that the special biomineralization of *"A." hadalis* can exist only in the hadal zone, where predation pressure is extremely low.

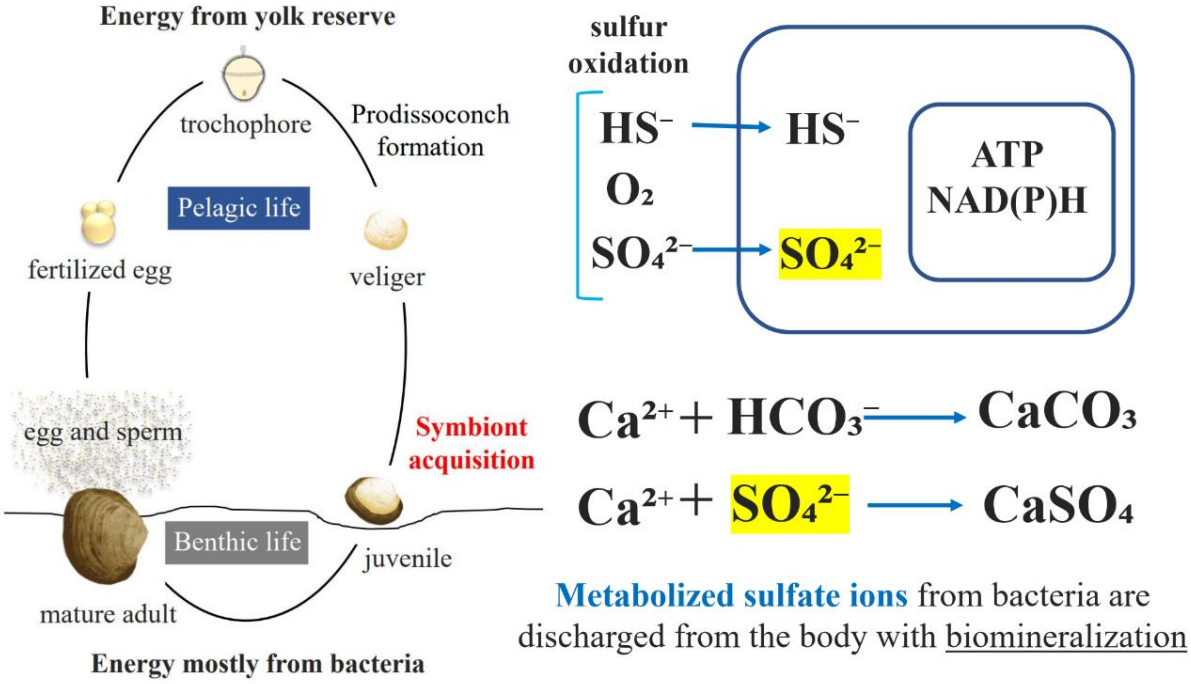


Figure 3. Efficient shell formation using sulfate ions in chemosynbiotic ecology.

References

Carter, J. G., & Clark, G. R. (1985). Classification and phylogenetic significance of molluscan shell microstructure. *Series in Geology, Notes for Short Course*, **13**: 50-71.

Fujiwara, Y., Kato, C., Masui, N., Fujikura, K., & Kojima, S. (2001). Dual symbiosis in the cold-seep thyasirid clam *Maorithyas hadalis* from the hadal zone in the Japan Trench, western Pacific. *Marine Ecology Progress Series*, **214**: 151-159.

Harper, E. M. (1992). Post-larval cementation in the Ostreidae and its implications for other cementing Bivalvia. *Journal of Molluscan Studies*, **58**: 37-47.

Okada, S., Chen, C., Watsuji, T. O., Nishizawa, M., Suzuki, Y., Sano, Y., Bissessur, D., Deguchi, S., & Takai, K. (2019). The making of natural iron sulfide nanoparticles in a hot vent snail. *Proceedings of the National Academy of Sciences*, **116**: 20376-20381.

##########

Some years ago, Trond won the prize, he sent us his report on time, but it has never been published. Well, below we can read the report he sent in July 2016.

Speciation and biogeography in the deep sea: a systematic review and phylogenetic analysis of the gastropod genus *Scaphander*

Trond R. Oskars

Background

The main goal of this research is to Study the drivers of speciation and the biogeographic patterns in the deep sea using *Scaphander* gastropods as a model group. There are very few molecular phylogenies of benthic deep-sea genera with complete taxon sampling, and the few available works have a regional focus, restricted to the Indo-West Pacific (e.g. Puillandre et al., 2010; Cabezas et al., 2012; Dueñas et al., 2014) or the Atlantic (Eilertsen & Malaquias, 2013; 2015) This project is the first to attempt a complete global phylogeny of a deep-sea group of invertebrates at a worldwide scale.

Samples

Material borrowed from the Natural History Museum of Paris; hail mainly from the Indo-West Pacific. Additional material has also been borrowed from the Zoologische Staatssammlung München/Staatliche Naturwissenschaftliche Sammlungen Bayerns originating in the North-West Pacific off Kamchatka. Specimens from the South-West Pacific have also been obtained from the Museum of New Zealand and National Institute of Water and Atmospheric Research, NZ, and I am also in the process of obtaining specimens from South Australia. Additional material from the South East Atlantic off Argentina has also been studied to expand the Atlantic dataset used by Eilertsen & Malaquias (2013, 2015). The East Pacific is still unrepresented by specimens that can produce sequences, but I am in contact with sampling cruises in the area that may yield specimens, and contacting Museums to procure specimens.

The number of species and their relationships is currently being investigated through anatomical

dissection of the specimens and molecular phylogenetics. The latter method accounts for most of the expenses covered by the received research grant. At the moment there is no published output as the project is still ongoing, however thus far 30 specimens have been dissected, and 21 specimens have been successfully yielded DNA. Of these specimens, 18 specimens have been sequenced for the mitochondrial genes COI and 16S rRNA and the nuclear genes 18S rRNA and 28S rRNA, the remaining specimens and additional sequencing of nuclearHistone-3 gene are in progress.

Preliminary results

The material from the IWP, was initially thought to consist of eight species, representing about 40% of the traditionally recognized worldwide diversity of *Scaphander*, however the preliminary molecular results combined with the dissections imply greater than anticipated species diversity.

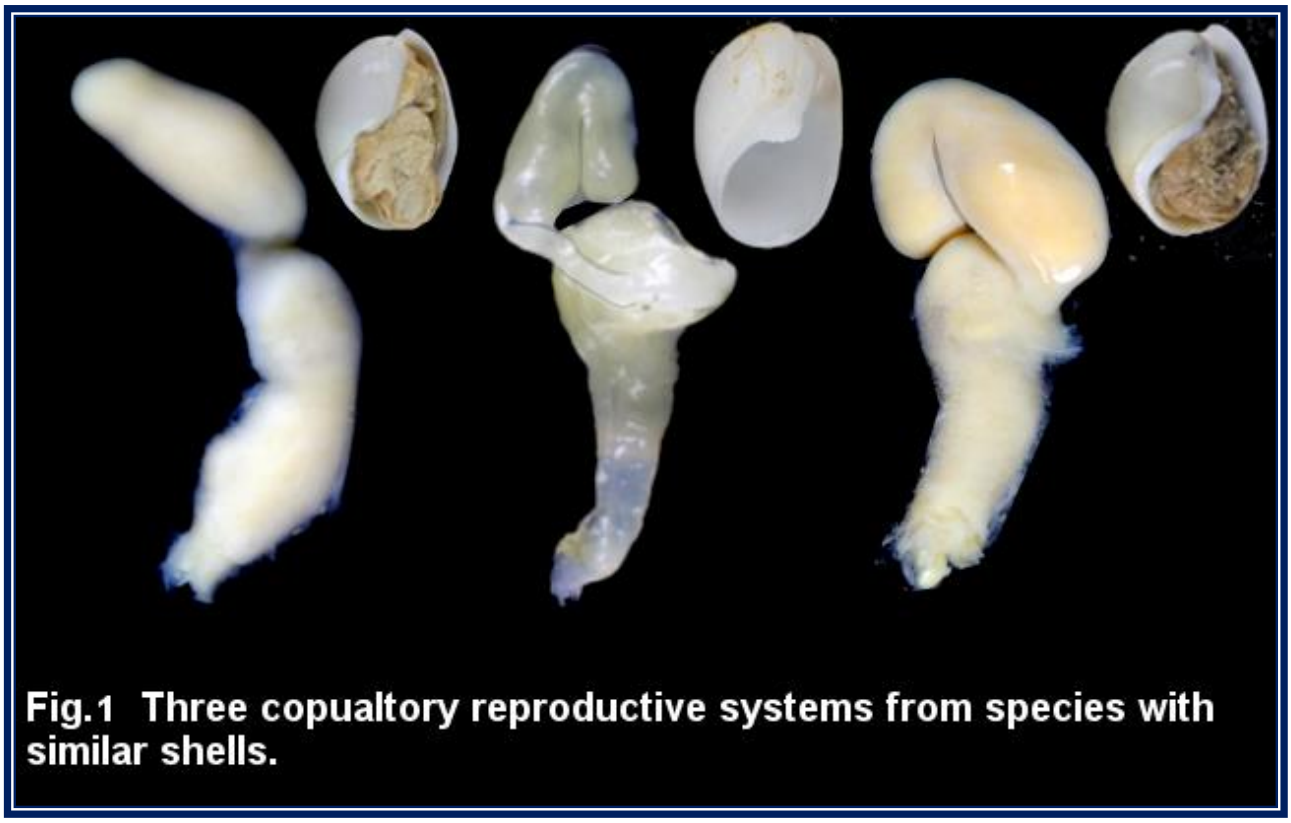


Fig.1 Three copualtory reproductive systems from species with similar shells.

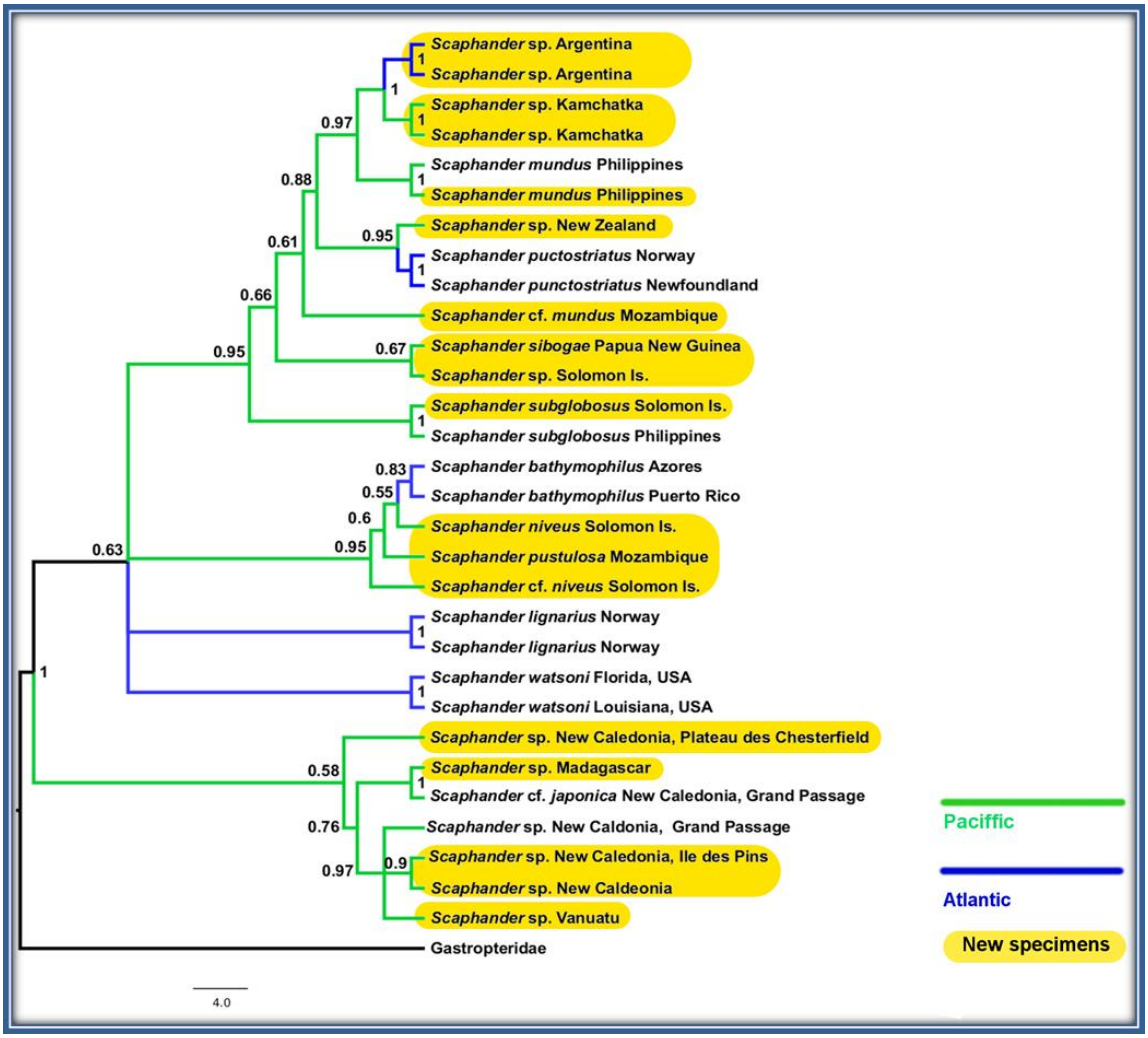


Fig. 2 Bayesian Phylogeny, based on a concatenation of COI, 16S, 18S & 28s

Several specimens with close to identical shells had drastically different copulatory reproductive systems, indicating them to be different species (Fig. 1). Eilertsen & Malaquias (2015) found that the species in the Atlantic and the Pacific did not form clades consistent with Ocean regions. This was the sister species *S. mundus* (Pacific) and *S. nobilis* (Atlantic), the latter is not included as it only has one gene marker (16S) and it corrupted the resolution of the tree.

My results also show this for three further clades with representatives in both the Atlantic and the Pacific (Fig. 2). The exact reason for these patterns is still unknown, but hopefully the evolutionary and biogeographic basis for these patterns will be revealed as the study progresses. The results, which were directly dependent on the received grant, and will be presented as one or two publications with a phylogenetic foundation, focusing on the systematics, taxonomic revision and biogeographic analyses of the genus.

References

Cabezas, P., Sanmartín, I., Paulay, G., Macpherson, E., & Machordom, A. (2012). Deep under The Sea: Unraveling The Evolutionary History Of The Deep-Sea Squat Lobster *Paramunida* (Decapoda, Munididae). *Evolution*, *66*(6), 1878-1896.

Dueñas, L. F., Alderslade, P., & Sánchez, J. A. (2014). Molecular systematics of the deep-sea bamboo corals (Octocorallia: Isididae: Keratoisidinae) from New Zealand with descriptions of two new species of Keratoisis. *Molecular phylogenetics and evolution*, *74*, 15-28.

Eilertsen, M. H., & Malaquias, M. A. E. (2013). Systematic revision of the genus Scaphander (Gastropoda, Cephalaspidea) in the Atlantic Ocean, with a molecular phylogenetic hypothesis. *Zoological journal of the Linnean Society*, *167*(3), 389-429.

Eilertsen, M. H., & Malaquias, M. A. E. (2015). Speciation in the dark: diversification and biogeography of the deep-sea gastropod genus Scaphander in the Atlantic Ocean. *Journal of Biogeography*, *42*(5), 843-855.

Puillandre, N., Sysoev, A. V., Olivera, B. M., Couloux, A., & Bouchet, P. (2010). Loss of planktotrophy and speciation: geographical fragmentation in the deep-water gastropod genus Bathytoma (Gastropoda, Conoidea) in the western Pacific. *Systematics and Biodiversity*, *8*(3), 371-394.

##

UNITAS
MALACOLOGICA

FOUNDED 1962