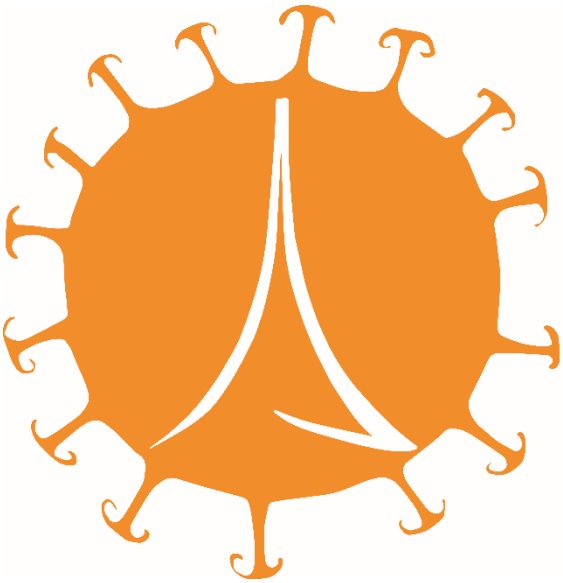
IBA



18TH INTERNATIONAL BRYOZOOLOGY ASSOCIATION CONFERENCE

Liberec 16 to 22 June 2019

ABSTRACT VOLUME

TECHNICKÁ UNIVERZITA V LIBERCI
Fakulta přírodovědně-humanitní
a pedagogická

CONFERENCE PROGRAM

Pre-Conference Field Trip: Fossil Bryozoans, Hungary, Slovakia, Austria, Moravia, Bohemia

June 9-15, 2019

Program:

9th June 2019

- Hungarian Natural History Museum, Ludovika ter 2-6, Budapest.
- Mátyashegy – Eocene bryozoan site; Fót – Miocene bryozoan site
- sightseeing Budapest

10th June 2019

- Szentkút – Miocene bryozoan site
- Fiľakovo – mediaeval castle; Banská Bystrica – museum of SNP and city center
- Štrba – Eocene bryozoan site

11th June 2019

- Vlkolínec – UNESCO site; Bojnice – castle; Bratislava – sightseeing

12th June 2019

- Sandberg, Eisestadt, Hlohovec – Miocene bryozoan sites
- Rajsna + other UNESCO sites – sightseeing
- Mikulov – vine testing

13th June 2019

- Holubice, Podbřežovice – Miocene bryozoan site
- Slavkov – castle
- Pratecký vrch – battFflustrelle field and bryozoans site

14th June 2019

- Litomyšl – USECO site; Hradec Králové – battle site, sightseeing;
- Chrtníky – Cretaceous bryozoan site
- Koněprusy – cave and Devonian bryozoan site

15th June 2019

- Loděnice – Devonian bryozoan site
- Prague – sightseeing

Sunday, June 16th 2019

Ice Break Party: Kino Varšava - Frýdlantská 285/16,

from 17:00 to 22:00(???) ;-)

The route to the Varšava cinema is indicted from Pytloun hotel. If you are accommodated in different place, please find your way yourself. The address is Frýdlantská 285/16 (Kino Varšava). The entrance will be indicated by arrows.

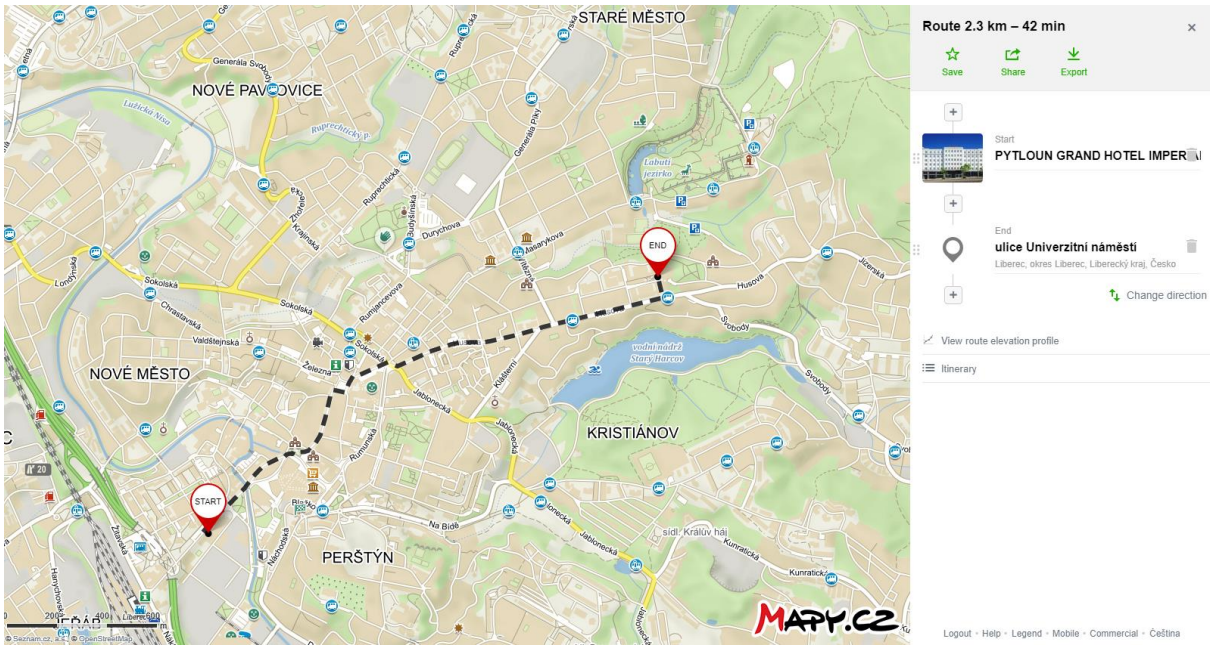
Free beer/water/vine and small refreshment is offered.

Please come!

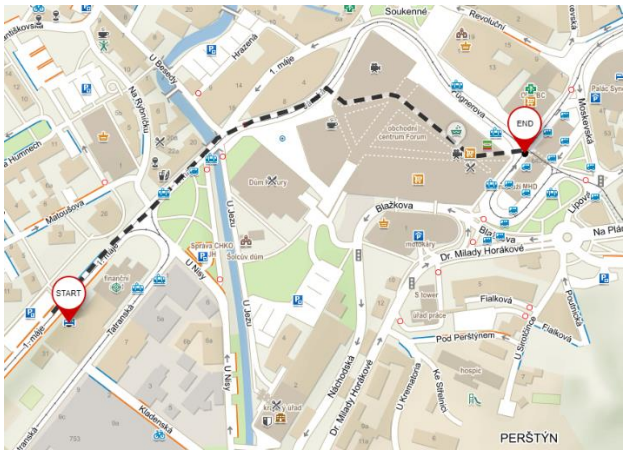
Monday, June 17th 2019

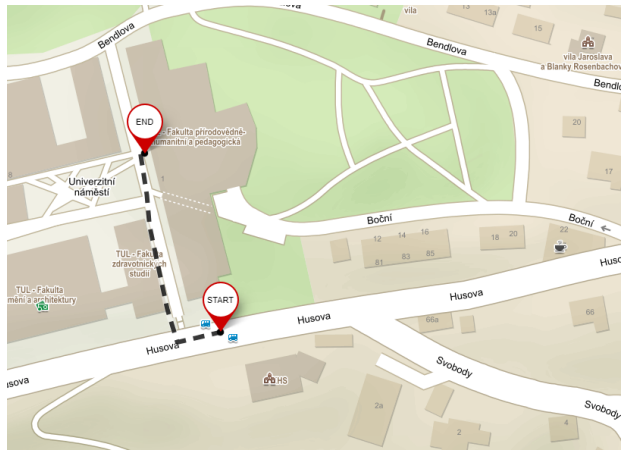
08:00 IBA registration - Foyer in front of the main conference hall (*Aula*).

Poster set-up.



The route from Pytloun hotel is about 30-40 minutes walking.





You can alternatively use the public transport from Fugnerova nám (walk from Pytloun Hotel about 600m or tram number 2 or 3) and then using bus number 15 to station “Technická univerzita” and walk 100m.

The foyer and Aula is situated in the Univerzitní nám. 1, building G, 3rd floor.

09:30 Welcome by rector of the University Doc. Miroslav Brzezina, dean of the Faculty Prof. Ján Picek and head of the Liberec district Martin Půta.

09:40 **Håkansson, E.**, O'Dea, A., Rosso, A.

KEYNOTE: The free-living cheilostome bryozoans - pursuing the unobtainable.

10:30 *Coffee break*

Reproduction and Development: Marcus Key

11:00 **Ostrovsky, A.**, Moosbrugger, M., Schwaha, T.F.

Placental nourishment in ctenostome bryozoans: ultrastructural evidence.

11:20 **Nekliudova, U.A.**

Placental nourishment in cyclostome bryozoans.

11:40 **Shevchenko, E.T**., Ostrovsky, A.

Comparative analysis of oogenesis in cheilostome bryozoans.

12:00 **Kvach, A.**, Kutiumov, V., Varfolomeeva, M., Kotenko, O., Ostrovsky, A.

Life cycle and reproduction of stenostome bryozoan *Flustrellidra hispida* in the White Sea.

12:20 **Bibermair, J**., Ostrovsky, A., Wanninger, A., Schwaha, T.

The embryonic development of the freshwater bryozoan, Plumatella casmiana.

12:40 *Lunch*

Growth and Morphology: Leandro Manzoni Vieira

13:50 **Di Martino, E.**, Liow, L.H.

Somatic versus reproductive investment in *Antarctothoa tongima* over 2 million years

14:10 **Piwoni-Piórewics, A**., Krzemińska, M., Achilleos, K., Boonzaaier,M.K., Cumming, R.L., Figuerola, B., Florence, W.K., Gordon, D., Gudmundsson, G., Hageman, S., Liow, L.H., Lombardi, C., Mello, H., Novosel, M., O'Dea, A., Ostrovsky, A., Porter, J.S., Shunatova, N., Smith, A.N., Vieira, L.M., Waeschenbach, A.

Revealing a global pattern in bryozoan skeletal mineralogy - an overview of the project

14:30 **Achilleos, K.**, Brown, C., Smith, A.M.

Biochemical pathways involved in calcification of marine invertebrates: focus on *Cellaria immersa*.

14:50 **Tamberg, Y.**, Smith, A.M.

Skeletal and polypide characteristics of Cyclostomatids: elusive species of a straightforward order.

15:10 *Coffee break*

15:40 **Belikova, E.V.**, Schwaha, T.F., Temereva, E.N., Ostrovsky, A.N.

Muscular system of cyclostome bryozoans.

16:00 **Wyse Jackson, P.N.**, Key, M, Jr.

Bryozoan skeletalisation index (BSI): a measure of the degree of calcification in stenolaemate bryozoans.

Southern Hemisphere: Mark Wilson

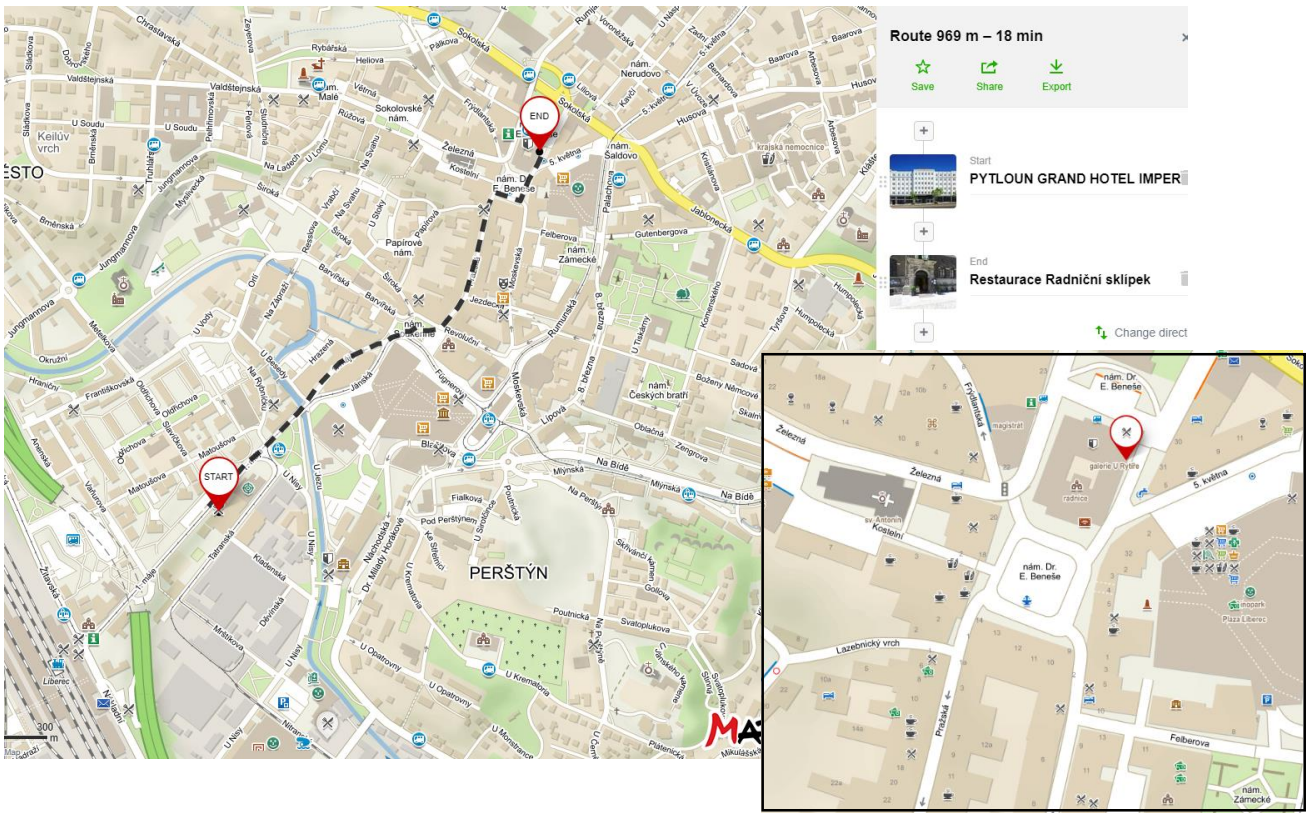
16:20 **Almeida, A.C.S.**, Souza, F.B.C., Vieira, L.M.

Diversity of marine brytozoans (Bryozoa, Gymnolaemata) from Bahia State, Northeast Brazil.

16:40 **Nascimento, K.B.**, Gordon, D.P., Migotto, A.E., Vieira, L.M.

Re-evaluating the genus Beania in New Zealand.

19:00 *Conference Dinner*



Conference dinner is in Restaurant Radniční sklípek, directly in the building of the city hall, entrance of the right side of the building. The details about menu is on website, please register for a menu.

Tuesday, June 18, 2019

Phylogeny: Andrea Waeschenbach

09:00 **Orr, R.J.**, Berning, B., Cumming, R., Di Martino, E., Gordon, D., Haugen, M., Kotenko, O., Kuklinski, P. Jenkins, H., Mello, H. Obst, M., Ostrovsky, A. Ramsfjell, M., Sannum, M., Smith, A., Taylor, P., Waeschenbach, A., Liow, L.

Cheilostome phylogeny: 300 taxa and growing.

09:20 **Sannum, M**., Boessenkool, S., Orr, R.J.S., Liow, L.H.

Museomic diamonds in the rough: Developing methods for exploiting museum specimens in bryozoan molecular phylogenetic research.

09:40 **Temereva, E.N.**

Lophophore neuroanatomy supports the relationship of bryozoans and phoronids.

10:00 **Haugen, M.N.**, Berning, B., Cumming, R., Hirose, M., Sannum, M., Waeschenbach, A., Liow, L.H., Orr, R.J.S.

The first phylogeny of family Adeonidae based solely on genome skimmed data.

10:20 **Kutyumov, V.A.**, Maltseva, A.L., Starunov, V.V., Belikova, E.V., Ostrovsky, A.N.

The mitochondrial genome of freshwater bryozoan *Cristatella mucedo*.

10:40 *Coffee break*

Ecology: Masato Hirose

11h10 **Schack, C.R.**, Gordon, D.P., Ryan, K.G.

Depth gradients characterize polymorphism in New Zealand.

11h30 **Baptista, L.**, Berning, B., Santos, A., Curto, M., Melo, C., Ávila, S.P.

Bryozoa in isolated volcanic oceanic islands: evaluating their evolution and population dynamics in the Azores Archipelago.

11:50 **Kotenko, O.N.**, Nekliudova, U.S., Vichnyakov, A.E., Ostrovsky, A.N.

First evidence of the association of symbiotic bacteria with cyclostome bryozoans.

12:10 **Karagodina,N.P.,** Belikova, E.V., Vishcyakov, A.E., Ostrovsky, A.N.

Bacteriophages as part of the symbiotic system of bryozoans and their bacterial symbionts.

12:30 *Lunch, group photo*

Ecology (continued): Javier Souto Derungs

14:00 **Buttler, C.J.**, Taylor, P.D.

Review of symbioses between bryozoans and primary and secondaryoccupants of gastropod shells in the fossil record.

14:20 **Mello, H.L.,** Smith, A.M., Wood, A.C.L., Tidey, E., Gordon, D.P.

Protecting the small: Does marine protection save bryozoan thickets?

14:40 **Sebastian, D.**, Wanninger, A., Schwaha, T.

Pherusella minima, a new ctenostome species from the Mediterranean Sea.

15:00 **Okamura, B.**

How freshwater bryozoans can influence biodiversity, ecosystem function, and food security.

15:20 **Reid, C.M.**, Tamberg, Y.

Order level trophic structuring across Permian Gondwanan fauna.

15:40 *Coffee break*

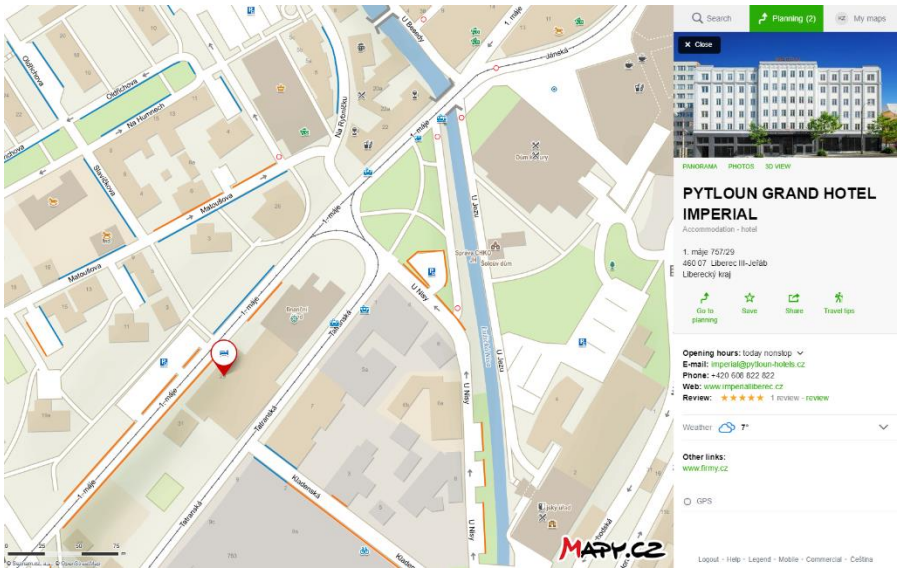
16:10 *Poster session*

17:00 IBA Council Meeting in the dean small room (*"zasedačka"*) – 4th floor building G

17:00 Brainstorming meeting to discuss databasing publications, images and "occurrence data." See Lee Hsiang Liow for details.

Wednesday, June 19, 2019: Mid-Conference Field Trip

Bus leaving from Pytloun Hotel main entrance at 9:00



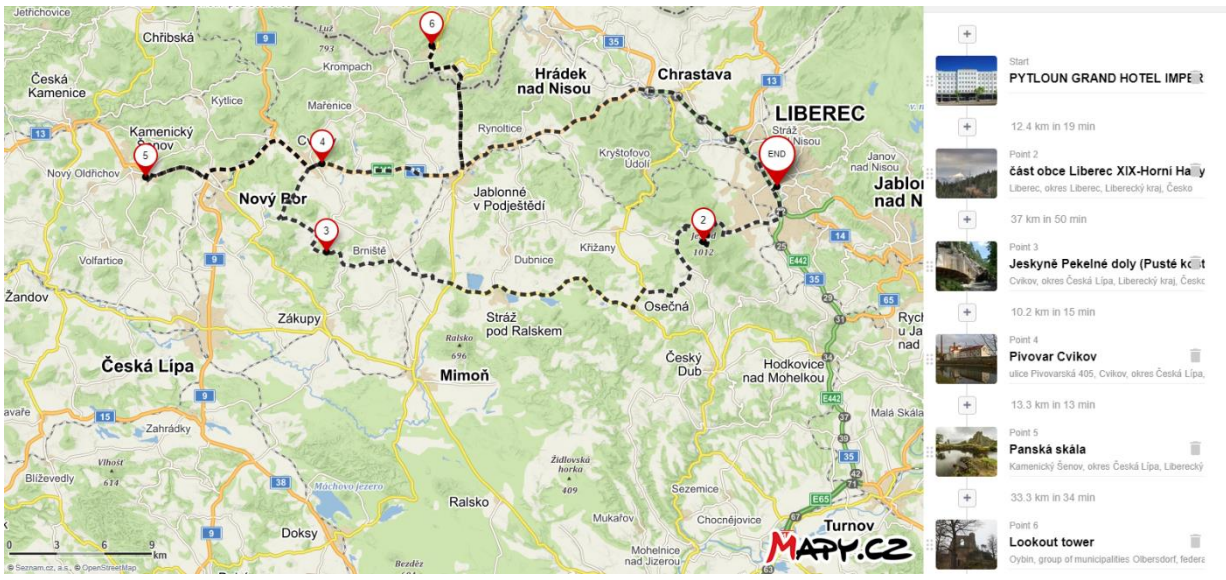
We will visit the main dominance of Liberec, the Ještěd hill and viewing platform. After that we move to Cretaceous sediment showing the characteristic sedimentary sequences of platform marine sediment.

The lunch in planed in Cvikov brewery with tentative excursion into the brewery.

After lunch we will continue to the most touristic place in Liberec area, the Panská skála natural monument – tertiary basalt volcano.

If time allow, we will also visit the north margin of the Cretaceous basin in Germany with viewing point in Oybin.

We will be back in Pytloun Hotel around 17:00-18:00



Tentative itinerary is here: https://en.mapy.cz/s/3rZOE

Thursday, June 20, 2019

Historical Records, Bryodiversity: Hannah Mello

9:00 **Winston, J.E.**

Zoological nomenclature and bryozoology: what you need to know.

9:20 **Spencer Jones, M.E**., McGlynn, K., Mills, S.

Old specimens in a new light: the Challenger reteporids.

9:40 **Håkansson, E.**, Gordon, D.P., Taylor, P.D.

A newly discovered bryozoan fauna from the Maastrichtian Korojon Formation, Western Australia

10:00 **Denisenko, N.V.**, Blicher, M.E.

Diversity and biogeographic patterns of the bryozoan fauna of Greenland waters.

10:20 **Novosel, M.**, Hageman, S.J., Novosel, A.

Bryodiversity along the Croatian coast of the Adriatic Sea.

10:40 *Coffee break*

Paleozoic bryozoans, Climate change: Yuta Tamberg

11:00 **Nakrem, H.A.**, Ernst, A.

Ordovician bryozoans from the Oslo region – preliminary findings.

11:20 **Ernst, A.,** Haig, D., Håkansson, E., Nakrem, H.A., Reid, C

Early Permian bryozon fauna of the East Gondwana Rift system.

11:40 **Porter, J.S**., Spencer Jones, M.

Working towards a Blue Carbon Audit of Orkney Waters; contribution of Bryozoa.

12:00 **Lombardi, C.**, Raiteri, G., Cocito, S., Bordone, A., Taylor, P.D., Ragazzola, F., Montagna, P., Spirandelli, E., Bruzzone, G., Marin, F., Kuklinski, P.

Antarctic biomineralizers as proxies of climate change: a transplantation experiment in one of the most extreme underwater natural laboratories.

12:20 **Kuklinski, P**., Waeschenbach, A., Balazy, P., Chelchowski, M., Porter, J., Schwaha, T., Spencer Jones, M, Hop, H.

Current diversity of bryozoans in the changing environment of the Arctic Archipelago – Svalbard

12:40 *Lunch*

Paleozoic bryozoans, Climate change (continued):

Emanuela Di Martino

13:40 **Hara,U.**, Furrer, H.

Early Valanginian-Early Aptian bryozoan biota of the northern Tethyan carbonate platform (Alpstein area, northeastern Switzerland).

14:00 **Taylor, P.D.**, Skupien, P., Zagorsek, K.

Bryozoans from the late Jurassic-early Cretacean Štramberk Limestone of the Czech Republic.

14:20 **Wilson, M.A.**, Schwartzberg, G.B., Taylor, P.D., Killian, E.G.

Paleoecology of a bryozoan-rich sclerobiont fauna in the Middle Jurassic (Bajocian) of southwestern Utah.

14:40 **Villier, L.**, Taylor, P.D., Desmares, D.

Changes in bryozoan diversity in shallow water deposits of the Le Mans area during the Cenomanian-Turonian transition.

15:00 **Vávra, N.**

Celleporidae from the Early Miocene of Austria

15:20 *Coffee break*

Growth / Morphology: Norbert Vávra

15:40 **Schwaha, T.**

CSI Bryozoa: An investigation of pores, cords, and other evidence.

16:00 **Hirose, M.**, Ide, A., Shirai, K.

The growth of *Celleporina attenuata* estimated based on the oxygen isotopic compositions and microfocus x-ray CT imaging analysis.

16:20 **Key, M.M., Jr.**

Estimating colony age from colony size in encrusting cheilostomes.

16:40 **Smith, A.M**., Key, M.M,

Geometry of bryozoan colonial growth and implications for colonial growth rate.

17:00 Optional walk in Liberec with explanation of the history and development of the city. Meeting point Univerzitní nám. – in the front of the building G. The guide will be Dr. Hynek Böhm

Dinner individual

Friday, June 21, 2019

Evolution and Ecology: Olga Kotenko

09:00 **Hageman, S.J.**, Ernst, A

Occupation of morpho-ecospace during the radiation of a new phylum (Bryozoa, Ordovician)

09:20 **Lidgard, S.**, Kopperud, B.T., Zagorsek, K., Liow, L.H.

Fossil bryozoan diversity dynamics: new approaches and revisions.

09:40 **Waeschenbach, A.**, Jenkins, H.L., Taylor, P.D., Gordon, D.P., Spencer Jones, M., Martha, S.O., Di Martino, E., Cooper, N., Kuklinski, P., Vieira, L.M., Porter, J.S., Berning, B., Florence, W., Smith, A,M., Ostrovsky, A.N., Souto Derungs, J., Krzemińska, M., Håkansson, E., Bock, P., Grant, H., Harmelin, J.G., Kotenko, O.N., Liow, L.H., Orr, R.S.,

Cheilostome bryozoan evolution through time – insights from a time-calibrated family-level phylogeny.

10:00 **Ma, J.**, Taylor, P.D., Buttler, C.J.

Sclerobionts associated with the earliest trepostome Orbiramus from the Early Ordovician

10:20 **Suarez Andrés, J.L**., Sendino, C., Wilson, M.A.

Coral-bryozoan associations through the fossil record: glimpses of a rare friendship?

10:40 *Coffee break*

Evolution and Ecology (continued): Lara Baptista

11:00 **Porto, A.**, Voje, K.L.

Morphological evolution of a single lineage through 2 million years: a study on *Steginoporella magnifica*.

11:20 **Orellana, M.C.**, Cancino, J.M., Wood, T.S., Chaichana, R.

Feeding and faecal pellet production in *Plumatella casmiana* Oka, at Laem Phak Bia, Thailand.

11:40 **Cancino, J.M**., Orellana, M.C., Wood, T.S., Chaichana, R.

An energy budget for *Plumatella casmiana* Oka, 1907 at Laem Phak Bia, Thailand.

12:00 **Ramalho, L.V**., Moraes, F.C., Amado-Filho, G., Moura, R.I.

First taxonomic records of bryozoans from the Amazon River mouth: associated fauna to rhodoliths and sponges

12:20 **Vieira, L.M.,** Nascimento, K.B., Almeida, A.C.S.

Marine Bryozoa from Brazil: past, present, and future.

12:40 *Lunch*

Final Thoughts: Juan Luis Suárez Andrés

13:40 **Scholz, J.**, Jacob, D.E., Ruthensteiner, B., Trimby, P., Henry, H., Martha, S.O., Leitner, J., Otter, L.M.

Architecture and biomineralization of *Anoteropora latirostris*.

14:00 **Hara, U.**

Early Cenozoic bryozoan biota as biogenic and environmental indicators of climate change: West Antarctica

14:20 **Sivaramasamy, E**., Zágoršek, K., Picek, J.

Investigation on intercolony variation of zooid size at Miocene of Paratethys using modern statistical tools.

14:40 **Zágoršek, K.**, Liu, H., Liu, X.

Cyclostome Bryozoa from Qingdao, South Yellow Sea, China.

15:00 **Gordon, D.P.**, Sanner, J.

Is lunulitiform *Schizorthosecos radiatum* the earliest euthyrisellid?

15:20 *Coffee break*

15:40 **Schwaha, T.**

The boring world of bryozoans.

16:00 **Wood, T.S.**

What phylactolaemate bryozoans actually eat.

16:20 *IBA Business Meeting*

19:00 *Leaving Party*

Post-Conference Field Trip: Recent Bryozoa, Adriatic

June 22-29, 2019

Post-conference excursion will be organized along the Croatian coast of the central Adriatic Sea and will focus on recent marine bryozoans. Participants will stay on diving boat „Vranjak I“ with organized diving, snorkeling and swiming stops. Trip will start on Saturday 22 in small town **Rogoznica**. On Sunday we will cruise toward **Vis** island and **Komiža** town. Next day we will visit **Hvar** island and town **Stari grad**. On Tuesday we will go to **Brač** island and visit famous **Blaca desert** and monastery and **Milna** town. On Thursday we plan to visit **Split** city and its famous Roman Emperor **Diocletian Palace** and Institute of Oceanography and Fisheries in Split. In the afternoon going to **Zlarin**, an island of red corals, where handmade jewelry processing of coral is still maintained. On Friday we go to **Šibenik** city and will visit **National Park Krka**. In the afternoon going to **National Park Kornati**, to **Levrnaka** island. Last day will be organized diving and snorkeling on Levrnaka island. Then cruise toward **Zadar** city. The trip will finish in nearby **Sukošan** town on Saturday June 29.

ABSTRACTS

ORAL PRESENTATIONS

BIOCHEMICAL PATHWAYS INVOLVED IN CALCIFICATION OF MARINE INVERTEBRATES: FOCUS ON *CELLARIA IMMERSA*

Achilleos K.[1,] Brown C.[2], Smith A.M.[1]

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[2]*Department of Biochemistry, University of Otago, PO Box 56, Dunedin 9054, New Zealand.*

*achka774@student.otago.ac.nz (**student**)*

ABSTRACT

One of the most salient features of marine bryozoans is their well-calcified skeleton, and studies have elucidated both morphological and mineralogical variation in this phylum. Although it has been suggested in other calcified marine animals that the process of calcification is closely genetically controlled, the biochemical pathways involved in bryozoan's calcification are not understood and are largely unknown. Therefore, in this study we performed de novo transcriptome assembly from erect articulated *Cellaria immersa* colonies collected in New Zealand, which resulted in over 359000 assembled trascripts. Subsequent protein identification and annotation was carried out through a bioinformatics pipeline. Transcripts were optimized, filtered and annotated with Gene Ontology in order to identify the pathways involved. This new genomic data will form the basis of future studies in this potentially rich field of bryozoology.

Keywords: *Cellaria immersa*, transcriptomes, calcification, New Zealand

DIVERSITY OF MARINE BRYOZOANS (BRYOZOA, GYMNOLAEMATA) FROM BAHIA STATE, NORTHEAST BRAZIL

Almeida, A.C.S.[1,2]

Souza, F.B.C.[2]

Vieira, L.M.[1]

[1]*LAEBry, Universidade Federal de Pernambuco, Brazil*

[2]*Museu de Zoologia da Universidade Federal da Bahia, Brazil*

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ABSTRACT

Bryozoans are the most common lophophorates in benthic communities, particularly in the marine environments. In Brazil, most studies were carried out in the southeast region, with few studies on fauna from northeast. Thus, this study aims to perform a faunistic survey and a morphological characterization of the marine bryozoans from Bahia State, NE Brazil, including analyses on spatial distribution and relationship between bryozoans and substrata. More than 3,000 lots of specimens from the intertidal to the continental shelf of Bahia and deposited in different national and international institutions were examined. The bryozoans were morphologically characterized under stereoscopic microscope, and based on data from scanning electron microscopy and morphometry. A total of 174 species, 95 genera and 59 families were identified. The majority of species belongs to the Order Cheilostomata, and only eight species belong to the Order Ctenostomata. Among these, 35 new, 10 exotic and four cryptogenic taxa were recognized. The bryozoan fauna from Bahia includes all colonial morphologies reported for this phylum (except foliose erect form); encrusting colonies are the most common growth form in the studied area. Bryozoans were found growing on many types of natural (algae, sponges, rhodoliths, corals, shells, etc.) and artificial (oil platforms, concrete structures, experimental panels, etc.) substrata. Mostly bryozoans are reported on corals (77 species), calcareous nodules (74 species) and rhodoliths (63 species); other substrata, such as algae, bryozoans, sponges, mollusk shells hydrozoan and sand grains were colonized by few bryozoan species (between 18 and 34 species). New integrative studies on morphology and molecular data are needed to help elucidate the classification of species classified as species complexes, cryptogenic species and taxa not classified according to their origin.

Keywords: Cheilostomata, Ctenostomata, exotic species, new species, substrata, species complexes.

BRYOZOA IN ISOLATED VOLCANIC OCEANIC ISLANDS: EVALUATING THEIR EVOLUTION AND POPULATION DYNAMICS IN THE AZORES ARCHIPELAGO

L. Baptista

B. Berning, A. M. Santos, M. Curto, C. Melo, S. P. Ávila

CIBIO, Research Centre in Biodiversity and Genetic Resources, InBIO Associate Laboratory, Azores Pole, University of the Azores, Portugal

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ABSTRACT

Their geographic isolation and relatively young age make volcanic oceanic islands important for understanding evolutionary and biogeographic processes. While apparently easily reachable for marine planktotrophic organisms, those with short-lived non-planktotrophic larvae are expected to be underrepresented in remote islands such as the Azores Archipelago. At least in shallow waters, however, non-planktotrophic marine invertebrates may passively disperse over long distances by phoresy or rafting of egg-masses, juveniles or adults. To date, biogeographic patterns and evolutionary processes in North Atlantic bryozoans (and marine invertebrates in general) are still shadowy. Nevertheless, several clues have already emerged from studies on the Azorean fauna: 1) a great number of non-planktotrophic taxa exist in the archipelago (e.g. >200 spp. of brooding bryozoans reported); 2) the Azorean marine fauna is closely related to European/Mediterranean taxa, despite the predominant eastward flow of the Gulf Stream – the "Azorean Biogeographical Paradox"; and 3) single-island marine endemics are apparently absent from the marine Azorean fauna. To investigate these issues more thoroughly, we will analyse the population genetic structure and the phylogeny of the speciose genus *Reteporella* in the North Atlantic, with a special focus on the Azores. Eleven *Reteporella* species are reported from the Azores, but this number is not certain nor are their phylogenetic relationships. Therefore, we aim to: 1) enlighten the invasion history and geographic origin of the archipelago's bryofauna by inferring demographic patterns and genetic distance between North Atlantic species; 2) clarify the genetic connectivity of populations among islands' groups, plus the potential occurrence of unrecorded cryptic endemics and adaptive radiations; 3) identify causes for the prevalent geographic and evolutionary patterns, as critical distance between suitable habitats and the speed/direction of ocean currents.

Keywords: Bryofauna, Azores, North Atlantic, Population genetics, Biogeographic patterns.

MUSCULAR SYSTEM OF CYCLOSTOME BRYOZOANS

Belikova E.V.[1],

Schwaha T.F.[2], Temereva E.N.[3], Ostrovsky A.N. [1,2]

[1] Saint Petersburg State University, Department of Invertebrate Zoology, Russia
[2] University of Vienna, Department of Palaeontology, Austria
[3]Moscow State University, Department of Invertebrate Zoology, Russia
belikova.elena0901@gmail.com ***(PhD student)***

ABSTRACT

Order Cyclostomata is a diverse group of ancient sedentary filter-feeders, whose muscle system remains understudied by modern methods. Its reconstruction by histological technique is a difficult task due to the small size of the zooids. Confocal laser scanning microscopy (CLSM) added by transmission electron microscopy (TEM) allow visualization of a complex system of thin muscle fibers, their number and position with much better resolution For this study we have chosen four cyclostome species from four distant families (Crisiidae, Tubuliporida, Lichenoporida, Plagioeciidae). Colonies of *Crisia eburnea*, *Tubulipora* sp., *Disporella* sp., and *Diplosolen obelia var. arctica* were collected at the White Sea by SCUBA diving, and fixed for both, CLSM and TEM.

In all studied species we identified five main muscle groups: apertural muscles, muscles of the membraneous sac, muscles of tentacles and lophophore base, retractors of the polypide and muscles of the digestive tract. Within these groups apertural muscles are the most variable possibly due to the differences in the structure of vestibulum. Other muscle groups are relatively uniform in the studied species. Polypide retractors, muscles of the tentacles and of the pharynx are striated, while the other muscle groups consist of only smooth muscles.

Keywords: Cyclostomata, musculature, CLSM, TEM

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THE EMBRYONIC DEVELOPMENT OF THE FRESHWATER BRYOZOAN *PLUMATELLA CASMIANA*

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Presentation Category: ***Oral presentation***

ABSTRACT

Phylactolaemates are a small group of bryozoans occurring exclusively in freshwater. Little information is available on the reproduction, in particular its sexual reproduction. All examined taxa to date show embryos being brooded in internal embryo sacs. These form from an invagination of the body wall close to the ovary and where probably fertilized oocytes are transferred into. The only profound studies that examined phylactolaemate development was on a fredericellid and plumatellid, and date back to the 19th and beginning of the 20th century. Consequently, there are several gaps in our understanding of the developmental processes in this clade. The present study focuses on the embryonic development of *Plumatella casmiana* by analysing reproductive zooids and different developmental stages via sectioning methods and 3D-reconstruction. In sum, there are several unanswered questions the current study tries to address. These include how the oocyte is transferred to the embryo sac and how and when is it fertilised, how embryos develop and how are they nourished. Increase of embryonic size indicates that phylactolaemates are matrotrophic and are partly placental brooders. Distinct ultrastructural evidence of this nutrition is wanting, and the current study aims to analyse these placental-cells to prove that these provide nutrient supply to the embryo. This study is thus the first to reconstruct the complete embryonic development by more modern methods and the first to analyse ultrastructure of phylactolaemate reproduction

ZOOGEOGRAPHY OF MARINE BRYOZOA (PHYLUM) OF SOUTH AFRICA, WITH NOVEL TAXA DISCOVERED IN THE HISTORICAL BACKLOGS

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ABSTRACT

The zoogeographical patterns and richness of bryozoan fauna around South Africa were investigated using published distribution records from the literature, museum catalogues and examining previously un-worked bryozoan material from existing collections housed mainly in the Iziko South African Museum, Cape Town (SAMC). Distribution data for 286 validated species were used and revealed that there is a clear biogeographic structure to the regional bryozoan fauna of South Africa. Species richness is lowest on the west coast (104 species) and highest on the south coast (174 species), while local peaks in richness are observed in the Cape Peninsula/False Bay area, at East London, Durban and St. Lucia, which coincide with distinct phylogeographic breaks for some marine taxa. The northward-flowing Benguela Current and strong upwelling centres may influence the low diversity on the west coast. On the south coast, the high diversity may be attributed to the Agulhas Current that can carry larvae southwards and eastward-flowing counter currents produce great variability in bryozoan communities in this region. Within any biogeographic region, bryozoan diversity was higher in shallower (< 500 m) than deeper waters, which may be attributed to sampling effort and heterogeneity (e.g. variable substrate and wave action) in shallower waters. During this study, novel taxa were discovered and is being prepared for separate publication. We describe one new genus, *Khulisa* **n. gen**, and 12 new species of Bryozoa from South Africa. In addition, one species previously assigned to the genus *Chaperia* is re-assigned to *Chaperiopsis* (*Chaperiopsis familiaris* **n. comb.**) and four genera, *Favosipora*, *Biflustra*, *Phidolopora* and *Triphyllozoon*, are newly recorded from South Africa. This study further highlights knowledge gaps that exist in parts of the coastline where sampling is required and the need for specialist taxonomists to determine historical backlogs within museums.

Keywords: Bryozoa, South Africa, zoogeography, species richness, new species

REVIEW OF SYMBIOSES BETWEEN BRYOZOANS AND PRIMARY AND SECONDARY OCCUPANTS OF GASTROPOD SHELLS IN THE FOSSIL RECORD

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ABSTRACT

Gastropod shells have been utilized as substrates by bryozoans since Ordovician times. Their use falls into three categories: (1) empty shells of dead gastropods; (2) shells of living gastropods; and (3) shells of dead gastropods housing secondary occupants, termed 'conchicoles' by Vermeij. Criteria are identified to recognize the different interactions in the fossil record; some are strong and unequivocal, but others are weak and can only tentatively identify the relationship. The categories are not exclusive: bryozoans encrusting the shells of living gastropods can continue to grow after the gastropod has died and the shell is empty or contains a conchicole. Categories (2) and (3) represent symbioses between the bryozoans and the primary or secondary shell occupants, respectively. The commonest conchicoles at the present-day are hermit crabs (paguroids). Numerous examples of inferred bryozoan-paguroid symbioses are known in the Cenozoic fossil record, along with a few examples from the Mesozoic of which the earliest comes from the Middle Jurassic soon after the first appearance of paguroids. Identities of Palaeozoic conchicoles are equivocal, but may include sipunculan worms and possibly non-paguroid arthropods. While the bryozoans profit from their attachment to substrates that are less likely to be buried than inert substrates, the conchicoles can benefit by being provided with domiciles that increase in size as the bryozoan grows beyond the original shell aperture. Most individual bryozoan-conchicole symbioses are non-obligatory and have short geological durations. There is little or no evidence for coevolution

Keywords: bryozoans, gastropods, symbiosis, conchicoles, paguroids

AN ENERGY BUDGET FOR *PLUMATELLA CASMIANA* OKA, 1907 AT LAEM PHAK BIA, THAILAND

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ABSTRACT

Plumatella casmiana is abundant in the sewage oxidizing ponds at Laem Phak Bia, Petchburi Province, Thailand. Environmental conditions in the ponds are suitable for blooms of *Spirulina platensis* (Nordstedt) Geitler, a cyanobacteria representing up to 90% of the phytoplankton, which in the appropriated size range is readily ingested by the bryozoan. The food eaten passes through the gut in less than an hour, and looks apparently intact in faecal pellets. The present study was carried out to determine assimilation rate and the basic physiological parameters for calculating an energy budget for this species.

The study was carried out in summertime, 2017, using colonies generated from leptoblasts and kept in laboratory conditions, (27.54 ± 0.44 °C., pH 8.77 ± 0.23), fed on food particles <25 μm at the natural concentrations present in oxidizing pond number 2. Oxygen consumption rate (mg O_2 z^{-1} h^{-1}) and ammonia excretion rate (mg NH_4 z^{-1} h^{-1}) were determined using 55ml, air tight tubes filled with well oxygenated filtered pond water, in which colonies with a known number of zooids were placed. Experimental tubes were kept in darkness, at room temperature (30° C) for 3h, and with an orbital movement of 70rpm to ensure water mixing. Oxygen consumption and excretion rates were transformed to metabolic energy requirements multiplying by 13.59 J per mg O_2 consumed, and 2.43 J per mg NH_4 excreted. Digestibility was calculated using the equation by Montgomery & Gerking (1980), based on percentage of ash content in food and faecal pellets. Ingestion rate, originally determined as number of particles ingested x $zooid^{-1}$ x h^{-1} was converted to energy (J) using the information of total number of food particles (<25μm) per L of water, dry weight of the pellets generated from that same water, total energy content per mg of dry food sample (from biochemical determinations) and the calculated assimilation rate of food.

With the above information, on ingestion (I), oxygen consumption rate (M) and ammonia excretion rate, (expressed all as rate in J x $zooid^{-1}$ x h^{-1}) the Scope for Growth (SG) was calculated as: SG (J) = I- (M+E). Faecal pellets have a higher ash content, and a lower concentration of glucose and protein, but a similar amount of lipids than food particles. The average digestibility, determined based on ash content in food and faeces, was 19.8%. Twelve calculations of Scope for Growth (SG) were possible. Nine of those calculations gave positive values, the other 3, corresponding to colonies with less than 4 zooids, had negative values. The fact that colonies grow and produce statoblasts, under the culture conditions of the present study, indicate that scope for growth is always positive for all colony sizes. Calculated negative values certainly represent lack of accuracy of methods to measure such small energy values.

DIVERSITY AND BIOGEOGRAPHIC PATTERNS OF THE BRYOZOAN FAUNA OF THE GREENLAND WATERS

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Presentation Category: ***Oral presentation***

ABSTRACT

For many years in the Greenland waters, the intensive investigations were provided and a number of the expeditions have collected material on bryozoans. But the studies were mostly occasional. That information did not allow to estimate the bryozoan fauna diversity in whole in the area and it cannot provide a possibility for estimation of fauna variations along geographic and oceanographic gradients. The goal of our study is to ascertain the species composition and to analyze the variation of the bryozoan richness around Greenland. In 2016, during one navigational season, several expeditions were conducted in the waters surrounding Greenland from south-east, south and west. In the study area, bryozoans were found at 146 stations from 200 sites sampled by trawl. Treatment of the new material and a combination it with already published data, indicate the presence of 266 species in this part of the Arctic region. In general, the bryozoan fauna richness is comparable with the richness of this phylum in other areas included in the Arctic zone. Oceanographic data, taken at the same stations, allowed to analyze the changes species richness along gradients of depth and temperature. It was found that species diversity, around Greenland, decrease significantly with depth. At the same time, the temperature is not resistive environmental parameter for the decline of species number. Analysis of variation of the species richness along geographic gradient (latitude) indicated the decline of species number to the northern direction. In bryozoan fauna, in general, the species of boreo-arctic affiliation predominated above the boreal and the Arctic species in more than two times. In turn, the number of the Arctic species was twice as large as the boreal species. However, the proportion of two last biogeographic groups changed considerably in south-eastern (SE) part of the study area, where the boreal species predominate above the Arctic species. Clusterization and MDS analysis indicated the separation of the fauna of SE part from faunas of the rest areas of Greenland. The result supports the belonging of the SE part to the Atlantic boreal biogeographic realm and the belonging of the rest areas around Greenland to the Arctic biogeographic realm.

Keywords: Bryozoans, Diversity, Biogeography, Greenland, Arctic

SOMATIC VERSUS REPRODUCTIVE INVESTMENT IN *ANTARCTOTHOA TONGIMA* OVER 2 MILLION YEARS

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ABSTRACT

Life history traits affect the fitness of any given organism and they include size at birth, growth rate, size or age at maturity, the number and size of offspring, reproductive effort, recruitment and survival. Life history strategies are commonly framed as trade-offs, subject to the ecological challenges presented by the environment and constraints imposed by the biology of the organism in question. Life history theory and quantitative studies on empirical systems largely focus on solitary organisms, while comparable research using colonial organisms as models are limited. Although a lot of comparative-anatomical work on sexual reproduction has been done for cheilostome bryozoans, only a few species (e.g. *Celleporella hyalina*, *Bugula neritina*, *Stylopoma* spp.) have been studied quantitatively in detail to characterize their life histories in situ or in breeding-experiments. Even less is known about how life histories vary in a species or lineage over timescales relevant to macroevolutionary change. However, some morphological characters routinely preserved in the calcium carbonate skeleton of bryozoans could be meaningful approximations for the life history traits of colonies. In this pilot study, we use the hippothoid *Antarctothoa tongima* to track temporal changes in life history traits over more than 2 million years. In addition to its common presence in the fossilized shell beds of the Wanganui Basin in New Zealand, *A. tongima* is an ideal candidate for studying life history trait variation because we can use its dimorphic male and female zooids to estimate its investment in reproductive resources, and we can refer to the closely-related, well-studied *Celleporella hyalina* as an analogue. Based on a suite of colony-level traits, including the density of autozooids, male and female zooids and the size of zooids and ovicells, we aim to answer the following questions: (1) How stable is the somatic versus reproductive investment through time? (2) Are variations in trade-offs in life-history traits influenced by the local environment (e.g. at shell scale)? (3) What is the relationship between investment in reproduction versus somatic growth given variation in overgrowth competition?

Keywords: Paleoecology, paleobiology, clonal organisms, marine invertebrates

EARLY PERMIAN BRYOZOAN FAUNAS OF THE EAST GONDWANA RIFT SYSTEM

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ABSTRACT

The deglaciation episodes during the Early Permian enabled migration of bryozoans into the East Gondwana Interior Rift System (EGIRS). Two bryozoan faunas are prominent in outcrops in the northern part of the EGIRS in Western Australia; those of the Callytharra Formation (54 bryozoan species identified, upper Sakmarian-lower Artinskian), and Noonkanbah Formation (27 bryozoan species identified, upper Artinskian-Kungurian). The Callytharra Fm bryozoans show closer relations to the Sakmarian-Artinskian cool-water faunas of Eastern Australia, followed by Thailand, Timor, and Iran. In contrast, Noonkanbah fauna show stronger connections to comparatively warmer water faunas from Tibet, Oman, Indonesia, and Malaysia, with the genus *Timanotrypa* indicating strong connection to the bryozoan faunas of the Eurasian realm. Thus, these two faunal assemblages demonstrate distinct vertical and horizontal faunal transitions in the Southern Hemisphere during the Early Permian post-glacial period, with the cool-water related faunas restricted to paleo-latitudes of 55-60° S, while the slightly younger, warmer water related faunas were located at approximately 45° S. It is noteworthy that the significant change in taxonomic composition during this transition, did not affect the general structure of the fauna (zooid size, colony size and growth forms), which remained largely constant. Hence, it appears that, within the depositional system of a comparatively narrow, interior sea, change in climate had little effect on the overall ecological structure of a fauna adapted to this distinctive depositional environment. Micro-borings in bryozoan skeletons from the two faunas - interpreted as fungal and algal, respectively - further corroborate a climatic distinction between the two Lower Permian faunas the Australian part of EGIRS.

Keywords: Lower Permian, Western Australia, palaeobiogeography, palaeoecology, bryozoans

REVISION OF THE DISCOIDAL NORTH AMERICAN EOCENE CHEILOSTOME GENUS *SCHIZORTHOSECOS*— RECOGNITION OF S. RADIATUM AS TYPE OF A NEW GENUS AND FAMILY OF EUTHYRISELLOIDEA, WITH A DISCUSSION OF NEOEUTHYRIS (NEOEUTHYRIDIDAE FAM. NOV.)

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ABSTRACT

The North American discoidal genus *Schizorthosecos* Canu & Bassler, 1917, currently unplaced as to family, includes four species. Of these, the type species, *S. interstitia* (Lee, 1833), differs markedly from *S. radiatum* Canu & Bassler, 1920, which has a radiate suboral process ('radiate bar'), associated with a subfrontal hypostegal coelom in life, almost identical to that in the erect branching euthyrisellid genus *Pseudoplatyglena* Gordon & d'Hondt, 1997. The conclusion is that Eocene *S. radiatum* is the earliest member of Euthyriselloidea and represents a new genus (*Clathrolunula*) and family (Clathrolunulidae) of this otherwise Recent Indo–Western Pacific superfamily, which did not previously have a fossil record. A new family of Mamilloporoidea, Schizorthosecidae, is established for *Schizorthosecos* and *Stenosipora* Canu and Bassler, 1927. Neoeuthyrididae fam. nov. is included in Euthyriselloidea, which now comprises three families.

Keywords: Euthyriselloidea, subhypostegal coelom, Eocene, North America, Indo–Western Pacific

OCCUPATION OF MORPHO-ECOSPACE DURING THE RADIATION OF A NEW PHYLUM (BRYOZOA, ORDOVICIAN)

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ABSTRACT

The Phylum Bryozoa, with a first appearance in Early Ordovician, is the only skeletonized phylum without a record in the Cambrian. Because of their benthic marine habitat with skeletons composed mostly of calcite, bryozoans have a very good fossil record. These features allow for the opportunity to document and access patterns and rates of radiation of a new phylum into disparate morpho-ecospace through the Great Ordovician Biodiversification Event (GOBE). We have characterized the colonial growth habits of all known bryozoan species from the Early and Middle Ordovician using a new method based on fundamental processes of colony growth, rather than the resulting morphology. These categories are: orientation, primary growth dimensions, colony width, zooecial layers, substrate relationships, space occupation, secondary skeleton, plus sub-categories of orientation based on their geometry. Eighty-five unique growth habits are identified by the end of the Middle Ordovician, and about 30% of the morpho-ecospace defined by two subsets of the characters had been occupied by five bryozoan orders (represented by 37 families, 80 genera). When data are plotted by time-slices of about 2.2 million year intervals, a sharp increase in taxonomic and growth habit occurrence is observed at the Early-Middle Ordovician transition, earlier than in other invertebrate groups. Individual growth habit character states also show significant changes at this transition. Early Ordovician taxonomic and growth habit richness are low, in part because of sampling bias. However, even with improved collecting methods, we believe that the overall trends observed in this study are robust.

Keywords: bryozoan, GOBE, diversification, growth-form, paleoecology

THE FREE-LIVING CHEILOSTOME BRYOZOANS – PURSUING THE UNOBTAINABLE

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ABSTRACT

The free-living cheilostome bryozoans are united by a unique combination of characteristics clearly offsetting them from all other bryozoans, some of them with roots back to the Turonian. The existence of several distinct free-living taxonomic groups is well established, but new evolutionary pathways towards this mode of life are still being discovered. The common driving force behind the evolution of most colony-types in bryozoans is essentially competition for the two fundamental resources, space and food, and this is also the case for the numerous evolutionary series of free-living bryozoans. In these clades, however, both objectives are pursued in a novel way – the escape away from the constraint of finite substrates out onto the essentially unrestricted, continuous realm provided by the particulate, soft sediments constituting the dominant sea-floor type of most shelf seas. To achieve this outcome a number of fairly fundamental bryozoan traits have been traded off – or exploited in novel ways. The talk will provide an overview on the current standing on the free-living bryozoans illustrated by a broad selection of case stories centred around the main topics:

Mode of life – free lying or free moving on soft, particulate sea-floor
Functional morphology – disc- to cup-shaped colonies, with or without setal support, radiating or fan-shaped budding
Reproduction – ranging from 100% sexual to predominantly asexual trough fragmentation or colonial budding
Larva, metamorphosis & colony initiation – brooding ubiquitous, in ovicells or internal 'ovisacs'; larvae always(?) short-lived, exceptionally with extended 'parental care'; colony initiation through larval metamorphosis, with or without substrate support, leading to an ancestrula or an ancestrular complex comprising up to 12 autozooids
Population dynamics – essentially paralleling the range found for non-cemented, solitary benthic invertebrates
Evolutionary trends – large scale temporal trends include an overall shift from calcitic to aragonitic skeleton and a complete loss of a substrate requirement; in broad terms valid for the free-living cheilostomes in general, only occasionally demonstrable within single clades
Phylogeny – iterative 're-invention' of the fundamental free-living body-plan; the single, most outstanding question regarding the phylogeny within the free-living cheilostome bryozoans relates to the Mesozoic-Cenozoic faunal transition – how many clades made it into the Cenozoic? – and for how long?

A NEWLY DISCOVERED BRYOZOAN FAUNA FROM THE MAASTRICHTIAN KOROJON FORMATION, WESTERN AUSTRALIA

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ABSTRACT

We report from the ongoing investigation of a newly collected Lower Maastrichtian bryozoan fauna from the Korojon Formation, accumulating at moderate depth in the proximal part of a wide carbonate ramp. The bryozoans constitute a prominent element in a diverse sclerobiont community, based entirely on monospecific clusters of inoceramids. Complete shells (> 70 cm) preserved in life position are conspicuous in these clusters, but the bulk of the bryozoan species appear to be encrusting the abundant, more or less randomly oriented inoceramid fragments also present in these clusters. The distributional patterns recorded for the individual sclerobiont taxa allow speculation with regard to the presence of distinct '*in vivo*' and '*post-mortem*' tiers in relation to the inoceramid skeletons, with an overwhelming dominance of a '*post-mortem*' relation for all bryozoans. Although the bryozoan part of the fauna constitutes more than 50% of the taxonomic diversity recorded thus far, they are mostly inconspicuous, dominated by small colonies with spot-, runner-, and ribbon-like growth forms. The overall coverage by epibionts is low, and records of competitive overgrowth in the '*post mortem*' community are rare. In terms of taxonomic composition, the Korojon fauna comprises an absolute dominance of taxa related to the comparatively few Gondwana related faunas known, with several species of *Aspidostoma* being very conspicuous. Several new genera of cheilostomes are present, and the fossil record of the extant anascan genus *Macropora* is extended back into the Cretaceous.

Keywords: Upper Cretaceous, bryozoans, Southern Hemisphere, sclerobionts, inoceramids

EARLY VALANGINIAN–EARLY APTIAN BRYOZOAN BIOTA OF THE NORTHERN TETHYAN CARBONATE PLATFORM (ALPSTEIN AREA, NORTHEASTERN SWITZERLAND)

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ABSTRACT

The newly described bryozoans from the Alpstein area in the northern Alpine Helvetic thrust and fold belt (Hara and Furrer, 2018) ranges from the Upper Berriasian Öhrli Formation to the Upper Barremian/Lower Aptian Schrattenkalk Formation. The bryozoans from the Alpstein belong to four distinctive assemblages, which are mostly differentiated in their biodiversity. The scarce bryozoans of the Late Berriasian are characterized by the presence of the thick, branched colonies of *Multizonopora* d'Orbigny, 1853. The rich Early Valanginian fauna from the sandy facies of the Pygurus Member (Betlis Formation) contain mainly large branched and spherical multilamellar sturdy colonies. This assemblage is represented by a few genera (*Chartecytis* Canu and Bassler, 1926, *Multizonopora* d'Orbigny, 1853, *Diplocava* Canu and Bassler, 1926, *Tretocycloecia* Canu, 1919 and *Reptomulticava* d'Orbigny, 1854) belonging to such families as Cavidae, Cytitidae, Cerioporidae, Tretocycloeciidae and *incertae sedis*. The Altmann Member of the Tierwis Formation with latest Hauterivian-Early Barremian age is mainly characterized by *Reptomulticava* d'Orbigny and *Defranciopora* Hamm (Cerioporidae), both building strong multilamellar colonies, however, branched colonies of *Chartecytis* also occur. The youngest assemblage of the studied Alpstein material belongs to the Schrattenkalk Formation (Late Barremian-Early Aptian) with only one taxon of *Reptomulticava* showing a distinct internal layering.

The Alpstein assemblages include mostly free-walled taxa, which show strong branched or spherical colonies, that may prefer shallow-water conditions, moderate to strong hydrodynamics and warm to temperate climate.

The new bryozoan fauna of the northern Tethyan carbonate platform (Alpstein, northeastern Switzerland) should be compared with the similar fauna from the Helvetic realm of southeastern Germany, western Austria, eastern France and southern part of the Jura mountains of western Switzerland (canton Vaud).

Keywords: Bryozoans, Cyclostomata, Cretaceous, Alpstein area, northern Switzerland

EARLY CENOZOIC BRYOZOAN BIOTA AS A BIOGENIC AND ENVIRONMENTAL INDICATORS FOR THE CLIMATIC CHANGES: WEST ANTARCTICA

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ABSTRACT

The basal, initial marine transgressive facies of the la Meseta Formation (Telm1) on Seymour Island resulted in the greatest diversity and abundance of the cyclostomes and ascophoran cheilostomes, which both form spectacular, massive, multilamellar colonies acquired mainly sub-spherical shape.

The occurrence of distinct, free-living lunulitiform bryozoans, represented by *Lunulites* and *Otionellina*, which developed disc-shaped colonies, is characteristic of the middle part of the LMF (Telm4-5). Environmentally, lunulitids live on unstable loose, granular substrata, overwhelmingly associated with sand fauna settings, in a shallow shelf conditions (2.5-190 m), with temperatures of 10-29ºC on coarse, sandy to muddy bottoms, with low to moderate deposition, in quiet to agitated regimes. They are absent in rocky areas with high turbulence, in water with salinities >37‰ and/or bottom temperatures consistently lower than 10-12ºC. Palaeoenvironmentally, the presence of free-living bryozoans may be informative particularly for the temperate shelf environment, sandy often shifting substrate and diagenetic history that allows for preservation of aragonite. Their skeletons are formed of intermediate–Mg calcite (IMC) with 4.5mol% MgCO3 content. The X-ray diffraction (XRD) and the Laser Raman spectroscopy stressed their bimineralic skeletons showing the distribution of calcite, strontium apatite and aragonite. The presence of a mold of the basal wall in *Otionellina* may suggest that aragonite was added to the basal side and then leached showing the loss of this part of the skeleton (Hara et.al., 2018)

The changes in the taxonomic composition, biodiversity, as well as colony growth-forms of the early Eocene-late Eocene bryozoan fauna in the stratigraphical column of the LMF (Telm1-7) of Seymour Island shows that bryozoans are important biogenic markers for the reconstruction of the climatic events (EECO, MECO and EOT).

Reference

Hara, U., Mörs T., Hagström J., and Reguero M.A. 2018. Eocene bryozoan assemblages from the La Meseta Formation of Seymour Island, Antarctica. Geological Quarterly 62: 705-728.

THE FIRST PHYLOGENY OF FAMILY ADEONIDAE BASED SOLELY ON SKIMMED GENOME DATA

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ABSTRACT

The family Adeonidae, Busk 1884, which is found globally in shallow waters, is divided into 10 extant genera: *Adeona, Adeonellopsis, Adeonella, Anarthropora, Bracebridgia, Dimorphocella, Laminopora, Kubaninella, Reptadeonella* and *Triporula,* with currently 106 accepted species names. The family's systematics and evolutionary relationships have been discussed and questioned for many decades, as some genera of this family have significantly disparate morphologies, especially in terms of the frontal shield and the frontal pore complex. Based on these large morphological differences, the family was previously separated in two distinct families, namely Adeonidae and Adeonellidae. However, there are no molecular studies providing independent information to test the validity of the family Adeonidae. In addition, recent molecular studies found that frontal shields have evolved independently on multiple occasions, questioning the robustness of frontal shields as a trait for higher-level cheilostome systematics.

Aiming at resolving the interrelationships of the adeonids, we here present the first multigene phylogeny, consisting of thirty-six genome skimmed adeonid taxa. With a highly resolved phylogeny, we will be able to answer, for the first time, questions regarding their evolutionary relationships and systematics based on molecular data.

THE GROWTH OF *CELLEPORINA ATTENUATA* ESTIMATED BASED ON THE OXYGEN ISOTOPIC COMPOSITIONS AND MICROFOCUS X-RAY CT IMAGING ANALYSIS

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ABSTRACT

A robust erect colony of *Celleporina attenuata* (Ortmann, 1890) is abundant in the rocky reef of the Otsuchi Bay, Iwate Prefecture. The preliminary study found distinct growth bands inside the branch and revealed those bands correspond with the stable isotopic compositions. In this study, we observed growth bands in several branches within a single colony of *C. attenuata* using microfocus X-ray CT, and also analyzed stable isotopic compositions of a single branch. A single colony was observed by microfocus X-ray CT; three branches (approximately 4.5 cm long for each) were selected, and the linear distances between observed growth bands were measured for each branch. The strength of the calcification of each growth band was also analyzed based on the CT image. Thereafter, we selected a single branch for isotope analysis and created a 1.5 mm thick slice. Totally 92 samples were collected at intervals of 0.5 mm along the central growth line of the branch using a micro-milling drill system. The samples were analyzed using a mass spectrometer with an automated carbonate preparation system. At least eleven growth bands were recognized in CT images for each branch; the linear distance between each growth band was 2.0–6.3 mm in a single branch. Some growth bands were less calcified than the others in the same branch. Eight growth bands were corresponding with the lighter values of $\delta^{18}O$. The rest three growth bands did not correspond; these bands were also less calcified than the others. The results indicate that most growth bands were formed during summer but some bands were also formed during other seasons and those bands were less calcified than the regular bands.

Keywords: *Celleporina*, growth bands, calcification, microfocus X-ray CT, isotopic composition

REVEALING THE MUSCULATURE AND NERVOUS SYSTEM OF THE CHEILOSTOME BRYOZOAN *TRICELLARIA INOPINATA*.

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Presentation Category: ***Poster presentation***

ABSTRACT

Neuro-muscular system diversity in adult bryozoans is being revealed through the recent application of histochemical staining and advanced imaging techniques. Here, we present details of the musculature and neurotransmitter distribution of the cheilostome bryozoan Tricellaria inopinata, obtained using such methods. Myoanatomical features including those associated with the body wall, lophophore and digestive tract are shown. Furthermore, the distribution of the serotonergic nervous system is observed in the lophophore and avicularia. These results demonstrate the potential of T. inopinata for use as a model organism in which to perform standard techniques. Expanding on this work to create of an atlas of the T. inopinata polypide, cystid and associated internal structures, using cell- and tissue-specific markers, will aid orientation in future targeted gene expression studies using in-situ hybridization. This research supports a recently funded project that seeks to reveal the genetic and developmental pathways underlying budding processes in T. inopinata. This will combine comparative transcriptomics and imaging techniques to identify key developmental and stem cell marker genes involved in budding, and locate candidate stem cells in the colony growth zone.

Keywords: Phalloidin, serotonin, muscle, nerve, budding

BACTERIOPHAGES AS PART OF SYMBIOTIC SYSTEM OF BRYOZOANS AND THEIR BACTERIAL SYMBIONTS

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ABSTRACT

Many marine colonial invertebrates host bacterial symbionts. They were also described in several bryozoan species, but details of their interaction with host tissues studied very fragmentarily.

Ultrastructural research on two closely related cheilostome bryozoans – *Aquiloniella scabra* and *Paralicornia sinuosa* have revealed the presence of symbiotic bacteria inside so-called 'funicular bodies', that are swollen parts of funicular strands providing transport function within and between zooids. Funicular bodies are morphologically similar in both species. The size of the bodies correlates with the number of symbionts inside of them. Presence of the electron dense matrix in the gaps between symbionts and cytoplasmic processes of the host cells, as well as an increase of the funicular bodies in size, may indicate trophic relationships between the bryozoan tissues and bacteria. Thus, funicular bodies can serve as a reservoir for the maintenance of the vital activity of bacteria and their multiplication.

Viral particles were detected in the cytoplasm of bacterial symbionts of *P. sinuosa*. Presence of viruses in bryozoans has not yet been detected. Amount of bacteriophages differs in the bacteria from different funicular bodies. We found intact bacterial cells, cells with virions in the cytoplasm and disrupted bacteria containing virions. Differences can be associated with the asynchronous occurrence of the lytic cycle in bacteria from different funicular bodies. Interestingly, viral particles possess a larger and more complex capsid then those of most bacteriophages known.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Keywords: Symbiosis, bacteria, viruses, bacteriophages

ESTIMATING COLONY AGE FROM COLONY SIZE IN ENCRUSTING CHEILOSTOMES

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ABSTRACT

The goal of this study was to develop a method of estimating colony age in encrusting cheilostomes from colony size. This will be useful for estimating colony age of small encrusting epibiotic bryozoans on ephemeral motile host animal substrates (e.g., exoskeletons of crabs that are susceptible to molting). Colony age (i.e., number of days) was modelled from colony size (i.e., number of zooids) from data collected by Xixing et al. (2001) on five cheilostome species grown in the lab. The growth of each species was measured in two different seasons for a total of 10 growth curves. The curves were best modelled by the following power function: $y = 0.2053x^{2.2663}$ (y = number of zooids, x = number of days, $R^2 = 0.97$). This function was then used to estimate the ages of encrusting epibiotic cheilostome bryozoan colonies from the author's previous studies on extant and extinct epibiotic bryozoans found on ephemeral motile host animal substrates. When using these kinds of predictive growth curves, it is important to remember that bryozoan growth rates are a function of several variables and so an estimated colony age range is recommended rather than simply a single "best guess" age.

Keywords: Modelling, colony age, size, encrusting, cheilostomes

FIRST EVIDENCE OF THE ASSOCIATION OF SYMBIOTIC BACTERIA WITH CYCLOSTOME BRYOZOANS

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Studies of the last decades confirm that symbiosis is more likely a rule than an exception (the so called "holobiont concept") and some symbiotic bacteria are crucial for the development and for the completion of host life cycle (Gilbert et al. 2012, 2015). In Bryozoa, bacteria were found in both, larvae and colonies of several marine species from the order Cheilostomata (Gymnolaemata) (Karagodina et al., 2017). Importantly, until now bacteria were not described in *cyclostome bryozoans* (Stenolaemata). Using both TEM and FISH methods we described, for the first time, the association of symbiotic bacteria with the common cyclostome *Patinella verrucaria* from the White Sea. Rod-shaped bacteria were detected scattered on the surface of the larva in connection with microvilli, under the surface cells and in a deep anterior invagination of the larva, inside the ancestrula. In the fully-formed incubation chamber bacteria found in the various parts of colonial hypostegal cavity, inside the vacuoles of the placental syncytium, and in the close proximity with embryos and early larvae. Larvae are colonized by symbiotic microbial cells in the later stages of development in the incubation chamber; subsequently bacteria are likely to be enclosed under the epithelium of metamorphosing preancestrula along with coronal cells and other provisional structures. Presence of bacteria in association with all *Patinella*'s life cycle stages suggests a vertical mode of transmission of the symbionts. However, we still know little about the complex interactions between cyclostome bryozoans and its symbionts. The questions are how exactly this community is maintaining between generations and how much is it species specific. Our current research is particularly focused on these issues.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Keywords: Stenolaemata, bacteria, symbiosis, life-cycle, larva, ultrastructure, FISH-technique

CURRENT DIVERSITY OF BRYOZOANS IN THE CHANGING ENVIRONMENT OF THE ARCTIC ARCHIPELAGO - SVALBARD

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ABSTRACT

The Arctic is changing rapidly because of progressing global warming. These changes include rising water temperatures, which lead to reductions in the seasonal ice cap of the Arctic Ocean and increased heat exchange between the ocean and air. Importantly, with a warming Arctic Ocean there is a risk that true Arctic cold-water organisms will vanish and that warmer-water species will invade from lower latitudes. The consequences of such a scenario are hard to predict. There is a need, therefore to monitor continuously the current species composition of key areas. The Svalbard Archipelago is located next to Fram Strait, which is a gateway for transport of heat and organisms to the Arctic Ocean. Here, the warm waters of the Atlantic Ocean meet the cold waters of the Arctic, providing a potential entry point for lower latitude species to invade the polar region. The aim of this study was to investigate the current bryozoan species composition along the western coast of Spitsbergen - the largest island in Svalbard and the most influenced by the warm-water current originating from the Atlantic. In 2017 and 2018, sites ranging in depth from 6 to 200 m were surveyed by SCUBA diving and dredging from RV *Oceania.* In total 131 bryozoan species were recorded from 12 sampling locations. All of them had been previously recorded in Svalbard waters, and none were classified as invasive. The species composition differed between shallow and deeper waters, what confirmed patterns shown by previous studies. Thus, the bryozoan fauna of Svalbard is still composed of species that are considered local inhabitants.

Keywords: Bryozoa , global change, biodiversity, SCUBA, dredges, Svalbard

THE MITOCHONDRIAL GENOME OF FRESHWATER BRYOZOAN *CRISTATELLA MUCEDO*

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ABSTRACT

Mitochondrial genes are widely used for phylogenetic analysis. However, the use of this data harbors a number of difficulties which must be considered for qualitative phylogenetic reconstruction. In some cases phylogenetic signal may be obscured by biases which are associated with gene rearrangements and high substitution rates in some taxa. So, problematic "long branched" taxa are clearly correlated with high variability in gene order and nucleotide frequency. Since we are in need of comprehensive phylogenetic analysis it seems to be reasonable to take into account the substitution rates and the gene order diversity as another source of phylogenetic information. Bryozoans are known as one of these most problematic groups among Metazoa with extremely high rearrangement rate as one of several factors affecting phylogenetic biases. Freshwater bryozoans (Phylactolaemata) are of the exceptional importance due to their basal position on the bryozoan phylogenetic tree. We performed full-genome sequencing of freshwater bryozoan *Cristatella mucedo* using short and long reads, further obtaining mitochondrial DNA from these data. Assembly and analysis showed that mitochondrial genome of *C. mucedo* includes both, all the standard set of genes as well as unique gene arrangement when compared to marine bryozoans. Whereas mitochondrial genomes of marine species are all different, gene order of the studied species is identical to that of another freshwater bryozoan, *Pectinatella magnifica*, belonging to another family. This may be explained in two ways: it may indicate that these families diverged relatively recently, and phylactolaemates passed through a bottleneck of reduced taxonomic diversity, or that high rearrangement rate is characteristic only for marine bryozoans.

Financial support was provided by the Russian Foundation for Basic Research (grant 18-34-00863\18) and by the Russian Science Foundation (grant 18-14-00086).

Keywords: Mitochondrial genomes, gene rearrangement, freshwater bryozoans

LIFE CYCLE AND REPRODUCTION OF CTENOSTOME BRYOZOAN *FLUSTRELLIDRA HUSPIDA* IN THE WHITE SEA

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ABSTRACT

Members of the order Ctenostomata presumably possess many ancestral traits, therefore the study of their reproductive biology takes a special place in the discussion on the evolution of bryozoan sexual reproduction. Our study is focused on the reconstruction of the life-history and details of oogenesis in *Flustrellidra hispida* in the White sea (Kandalaksha Bay). Colonies were collected during the spring-summer period (May-August) during 2013-2017 years and once in winter (January 2018). To study the life-history we used the methods of multivariate statistics (nMDS) and generalized additive models (GAM) to analyze the dynamics of the zooidal composition in the colonies during the season. Oogenesis was studied using light and transmission electron microscopy.

Comparing our results with the published data on *F. hispida* from the Irish Sea (Menai strait), we showed that the life-history of this species is similar in both seas. Colonies are dormant in winter consisting of zooids with degenerated polypides. Reproduction in the colonies begins at the first significant warming of the ambient water and continues throughout the summer alternately in different parts of the colony. One ovary contains 3-13 oocytes, and two ovaries of different ages were incidentally met in one zooid. Oocytes are macrolecithal. During brooding in modified tentacle sheath, embryos are increased in volume. However, the walls of the brood pouch at the light-optical level have no signs of hypertrophy.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Keywords: Ctenostomata, sexual reproduction, oogenesis, brooding

FOSSIL BRYOZOAN DIVERSITY DYNAMICS: NEW APPROACHES AND REVISIONS

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ABSTRACT

Fossil records yield not only a history of living diversity, but also awareness of the dynamics of diversification and extinction patterns, things that could never be deduced from the living biota alone. They provide important clues to factors that constrain or enhance the diversity of some groups but not others. While fossil biodiversity histories for animal phyla like Bryozoa will always be imperfect, they are nonetheless fundamental to broader understanding of phylogeny, evolution and biogeography. And inferences of fossil dynamics do improve with access to more data, systematic revisions, computational resources and methods to help counteract sampling error and the biases of the fossil record. Here we introduce a newly expanded dataset of published bryozoan fossil genera and species occurrences over the past 150 million years. This ongoing project aims to compare different perspectives of diversity trends in cheilostomes and cyclostomes: raw species richness in individual assemblages, cumulative counts of genera in successive time intervals, and statistically estimated diversity dynamics and sampling rates. Taxonomic names are validated and revised using the World Register of Marine Species and other resources. We then apply capture-mark-recapture approaches to estimate bryozoan extinction, speciation and net diversification rates while simultaneously modeling sampling rates. Lastly, we discuss new methods for automated information retrieval from published articles using machine learning in data capture, and pros and cons of these approaches.

ANTARCTIC BIOMINERALIZERS AS PROXIES OF CLIMATE CHANGE: A TRANSPLANTATION EXPERIMENT IN ONE OF THE MOST EXTREME UNDERWATER NATURAL LABORATORIES

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ABSTRACT

The Southern Ocean, including our study area in the Ross Sea, is expected to be particularly vulnerable to changes in carbon export resulting from anthropogenic climatic warming as the extensive effects of ocean acidification are predicted to be observed first in high-latitude seas. The Italian National Program for Antarctic Research 'IceClimaLizers' project uses an experimental approach to investigate the relationship between environmental variables and the geochemical signals incorporated into the skeletons/thalli of various model organisms including bryozoans. During the first Antarctic campaign conducted in November 2018 in western Ross Sea, 18 dives were performed under the ice pack under the logistic supervision of Navy Technical Divers for sample collections and experimental site set-up. Forty pebbles covered with the encrusting coralline algae were collected via Scuba diving at 24 m of depth. 50 individuals of the bivalve Adamussium colbecki covered with encrusting bryozoans belonging to the genera Fenestrulina and Micropora were collected as well as the erect species of Cellarinella nutti and Reteporella cf. antarctica were collected by Scuba diving at 18 m of depth. In addition, several branches of a deep-water species of Cellarinella cf. njegovanae were collected at 110 m by using an ROV. Prior to deployment, the coralline algae and bryozoans were stained by using Alizarin Red S and photographed, then placed in 12 cages. A squared metal frame with the cages and a multi-parametric probe (recording temperature, salinity, oxygen, pH) were deployed by Scuba diving at 25.5 m of depth to complete the experimental site. The whole structure will be left underwater initially for one year, after which it will be recovered and biomineralization processes studied (at molecular level).

Keywords: Antarctica, Ross Sea, Experiment, Biomineralization, Coralline algae, Bryozoan, Geochemistry

SCLEROBIONTS ASSOCIATED WITH THE EARLIEST TREPOSTOME ORBIRAMUS FROM THE EARLY ORDOVICIAN

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ABSTRACT

In addition to a marked rise in the biodiversity of marine organisms, the Ordovician also witnessed the most profound increase in the complexity of marine ecosystems in the history of Earth, including tiering and enhanced biotic interactions. In order to understand these changes, it is important to study palaeoecological relationships among organisms at the onset of the Great Ordovician Biodiversification Event (GOBE). Sclerobionts associated with bryozoans were found recently in the earliest known trepostome, *Orbiramus* from the Fenhsiang Formation (Late Tremadocian, Early Ordovician). The sclerobionts are diverse and include borings (such as the ichnogenera *Trypanites*, *Sanctum* and *Gastrochaenolites*), bioclaustrations and fouling of living bryozoans by phosphatic corals. Intricate palaeoecological relationships between bryozoans and other metazoans were therefore established by the Tremadocian, contributing to the hard substrate revolution during the GOBE.

Key words: Sclerobiont, palaeoecology, Tremadoc, trepostome, boring, phosphatic coral

PROTECTING THE SMALL: DOES MARINE PROTECTION SAVE BRYOZOAN THICKETS?

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ABSTRACT

Parts of the seafloor surrounding Aotearoa New Zealand are dominated by bryozoan thickets which provide ecosystem services such as refugia and substrate stability to a diverse assemblage of marine species. Commercially-valuable species such as blue cod (*Parapercis colias* Forster, 1801) and tarakihi (*Nemadactylus macropterus* Vooren, 1975) rely on bryozoan thickets as nursery grounds for vulnerable young. These thickets, like many benthic habitats, have been damaged by anthropogenic activities such as anchoring and trawling over the last century. Eliminating the use of destructive fishing practices, as well as designating marine reserves and benthic protection areas, may encourage bryozoan thicket recovery. Alternatively, habitat damage may be unrecoverable, and biogenic habitats may never return to pre-impact conditions. While protecting damaged ecosystems is important for re-establishing dynamic marine habitats and large motile organisms, it is unclear whether current management practices are sufficient for reestablishment of bryozoan thickets. This study compares bryozoan communities in 2003 with their counterparts in 2019 on the Otago Shelf, South Island/Te Waipounamu, Aotearoa New Zealand (45° 50’ S, 170° 50’ E, 60-110m) using benthic images. By comparing fauna recorded on these images, we determine the effect of a 17-year voluntary trawl ban on the diversity and abundance of habitat-forming bryozoans on the Otago shelf, as well as providing baseline monitoring data and recommendations for a proposed Marine Protected Area designed to conserve them.

Keywords: New Zealand, habitat-forming, marine protection

ORDOVICIAN BRYOZOANS FROM THE OSLO REGION – PRELIMINARY FINDINGS

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ABSTRACT

The Ordovician succession of the Oslo Region comprises c. 400 m of fossiliferous, alternating limestone and shale units. Well documented chitinozoans, acritarchs, graptolites, trilobites and conodonts date these strata. The lowermost bryozoans are known from the Tøyen Formation but are more common in the Huk and Elnes formations covering the Floian to Darriwilian stages of the Baltic terminology. Bryozoans are common in the Sandbian Arnestad Fm. as well as in the Katian Solvang and Nakkholmen fms and also in the Hirnantian Langøyene Fm. The investigated rock sections represent various depositional setting, from high energy shallow water carbonate dominated units to more shaley quiet water environments. Bryozoans collected during field work (> than 60 samples) and museum collections (Oslo) (>240 specimens) have been studied from petrographic thin sections and acetate peels.

Very few bryozoans have previously been described from the Ordovician of the Oslo Region (to our knowledge only three systematic papers). Our work so far has revealed a rich bryozoan fauna with taxa including esthonioporate, trepostome, cystoporate, cryptostome, and phylloporinine species. Especially remarkable are large hemispheric colonies of esthonioporates (*Dianulites*) and trepostomes (*Diplotrypa*, *Mesotrypa*). Various branched colonies are represented by trepostomes (*Hallopora*, *Parvohallopora*, *Eridotrypa*, etc.). Ptilodictyine cryptostomes are common (e.g. *Oanduellina*, *Ptilodictya*, *Astrovidictya*, *Graptodictya*), whereas cystoporates, fenestrates, and rhabdomesine cryptostomes are rather rare. The ubiquitous cyclostome *Kukersella borealis* is frequently found in the Katian strata from Norway. In general, the taxonomic composition of the bryozoan fauna from the Oslo Region is well comparable with those described from contemporary deposits of Sweden, Estonia and Russia.

The current study started in 2018 and will continue through 2020 and include field work which will provide new material from localities in Norway, Sweden, Estonia and Russia.

Keywords: Bryozoa, Ordovician, Oslo Region, Baltica

REEVALUATING THE GENUS *BEANIA* IN NEW ZEALAND

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ABSTRACT

Beania Johnston, 1840 (Cheilostomata: Beaniidae) comprises a heterogeneous genus with about 70 species, 18 of which were recorded to New Zealand, 13 being endemic to this country and adjacent waters (Australia and surrounding islands). In order to review the species of the genus recorded for the area, we analyzed specimens held in the collections of the Museums Victoria (Melbourne, Australia), National Institute of Water and Atmospheric Research (Wellington, New Zealand), and Natural History Museum (London, UK), by morphological methods using scanning electron microscopy. Comparative morphological analysis of specimens belonging to 14 (13 of which are type specimens) of the 18 species of *Beania* recorded for the region revealed the existence of 15 new species (to be formally described) and one new record for New Zealand, *B. crotali* (Busk, 1852). Among the specimens examined there were representatives of two species, until now considered endemic for New Zealand, that where collected in Indonesia and the Kerguelen islands. Additionally, *B. hirtissima* (Heller, 1857) and *B. magellanica* (Busk, 1852), two species previously assigned to New Zealand and recognized as having widespread distribution, were not located in the studied collections. However, there were other specimens with similar morphology to those species, which suggest these species belong to species complexes. Although the bryozoan fauna of New Zealand has been comprehensively studied along the last 40 years, being one of the most well-known in the world, our work increased the number of species of the genus *Beania* for the region – the total number of species is now 29. Therefore, we emphasize the importance of analyzing scientific collections of previously collected and unidentified specimens and carrying out extensive taxonomic reviews based on detailed morphological studies.

Keywords: *Beania*; New Zealand; new species; review; taxonomy.

PLACENTAL NOURISHMENT IN CYCLOSTOME BRYOZOANS

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ABSTRACT

Our study is focused on the sexual reproduction of Cyclostomata, one of the most ancient bryozoan taxa, still diverse and abundant in modern seas. Their unique reproductive pattern includes intracoelomic incubation of embryos (viviparity), matrotrophic nourishment (via placentation) and polyembryony (multiple clonal development of embryos from a single fertilized egg). Till now sexual reproduction of cyclostomes has been studied using only light microscopy, however. Our aim was to provide new data on the nutritive and developmental processes accompanying embryonic growth in different cyclostomes.

Colonies of four common boreal cyclostome species from three distant families: Crisiidae, Tubuliporidae and Lichenoporidae were collected in the White Sea. Detailed study of the anatomy and ultrastructure of functioning gonozooids was performed using light and transmission electron microscopy. The general structure of incubation chambers, while showing basic similarities, differs in three families studied. The main distinctions concern shape, size, growth direction, origin (one or few gonozooids involved) and number of brooding chambers in a colony. Placental analogues develop during embryonic incubation displaying high synthetic activity and disintegrate after larval release. Developing embryos and larvae are directly embedded into the “nutritive tissue” which is a complex syncytium of peritoneal origin also including some solitary (presumably, totipotential) cells. Nutrients are transferred to the embryos via exo- and endocytosis, diffusion and active transport are suggested too. Thus, cyclostome bryozoans show a combination of histotrophy and placentotrophy.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Keywords: Cyclostomata, sexual reproduction, placentation, polyembryony

BRYODIVERSITY ALONG THE CROATIAN COAST OF THE ADRIATIC SEA

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ABSTRACT

Hard-bottom bryozoans along the Croatian coast of the Adriatic Sea were surveyed at 73 localities. Altogheter 3.298 colonies have been sampled and 211 bryozoan species were found. From total number of found species, 36% have been found along the entire Croatian Adriatic coast. We analyzed species according to their abundance, depth distribution and type of substrate on which they grow. Maximum bryozoan diversity was found on deep escarpments with strong currents. Depth distribution of bryozoans showed division into species that inhabit exposed, e.g. shallower habitats of the infralittoral zone, and those that grew in more shadowed hard substratum of the circalittoral zone. Only 7% of species were found growing non-selectively in both infralittoral and circalittoral zones. Much greater insight to understanding morphology and behavior of bryozoans will be gained from environments with low diversity but high abundance of each species. In high diversity settings, species richness itself is a more important environmental indicator than colonial morphology of any constituent.

Keywords: Bryozoa, depth distribution, diversity

HOW FRESHWATER BRYOZOANS CAN INFLUENCE BIODIVERSITY, ECOSYSTEM FUNCTION AND FOOD SECURITY

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ABSTRACT

Freshwater bryozoans in the Class Phylactolaemata comprise a relatively small group (some 70 described species) in comparison to their marine relatives in the Classes Gymnolaemata and Stenolaemata (which collectively comprise some 6,500 described species). Despite this low species diversity, phylactolaemates are common residents of freshwater habitats. It is now clear that by acting as invertebrate hosts of endoparasites (Phylum: Cnidaria; Subphylum: Myxozoa; Class Malacosporea) with complex life cycles, freshwater bryozoans are currently playing a major role in the spread and severity of the devastating proliferative kidney disease (PKD) of salmonid fish. This view is supported by a long term programme of research focusing on bryozoan-myxozoan interactions and by observations of PKD outbreaks in new geographic regions in the northern hemisphere (e.g. Montana, Washington, Norway, Iceland, Austria, Estonia). The aim of this presentation is to illustrate the ecological implications of freshwater bryozoans hosting parasites that also exploit fish hosts. I will describe how our work demonstrates a diversity of bryozoan-associated myxozoans and how these parasites are able to co-disperse with bryozoan hosts. I will then consider how catastrophic outbreaks of PKD in salmonids could impact both food webs and food security and the possibility that environmental change could result in similar disease outbreaks in other fish. By stressing the fundamental role played by freshwater bryozoans as sources of fish disease and as vehicles for parasite dispersal I will illustrate how a limited radiation of bryozoans is nevertheless linked to major ecological impacts.

Keywords: parasites, dispersal, statoblasts, fish disease, freshwater communities

FEEDING AND FAECAL PELLET PRODUCTION IN *PLUMATELLA CASMIANA* OKA, AT LAEM PHAK BIA, THAILAND.

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ABSTRACT

Phylactolaemate bryozoans are abundant in the wastewater treatment ponds at Laem Phak Bia Wetland, an oxidation ponds system in Petchburi province, Thailand. The ponds provide adequate conditions for phytoplankton blooms, mainly of *Spirulina platensis* (Nordstedt) Geitler, a cyanobacteria representing up to 90% of phytoplankton present, which in the appropriated size range is readily ingested by *Plumatella casmiana* Oka. Since key information to understand the role of *P. casmiana* in this system is not available in the literature, the objective of the present study was to determine its feeding rate, food throughput time, defecation rate and fate of faecal pellets.

The study was carried out in summertime, 2017, using colonies generated from leptoblasts and kept in laboratory conditions, (27.54 ± 0.44 °C., pH 8.77 ± 0.23), fed on natural food particles <25 μm at pond concentration. Feeding rate was measured both, by direct observation under the stereo microscope and by determining clearance rate of particles <25 μm. Results were expressed as number of particles eaten per zooid per h. Faecal pellet production was determined by direct zooid observation under binocular microscope and also by counting the numbers of pellets produce by groups of colonies. Food throughput time was measured in starved colonies using natural food color as a marker. Fate of faecal pellets was studied by observing at regular intervals, for 24 h the proportion of them either floating, sunken to the bottom of the glass plate or disintegrated into the water.

A zooid of *P. casmiana* eats near 2 thousand particles per h (average 2032.9 food particles z^{-1} h^{-1} SD=1923.5; N=38), produces a faecal pellet every 45- 60 min (average 48.49 min, SD= 9.97; N=24) Food throughput time is 45 min. Faecal pellet production depends on the duration of the previous starving period. 36 h starved colonies produce their first faecal pellet 45 minutes after reinitiating feeding. All pellets are green and initially float near the water surface, they then float vertically into the water column, and subsequently they drop to the bottom and 24h after released almost all them have disintegrated into the water.

Using the above information we can say that 1000 feeding zooids of *P. casmiana* will ingest $2x10^6$ food particles, and produce $1,2x\ 10^3$ faecal pellets per h, which could be eaten by planktonic or benthic organisms or contribute to dissolved organic matter content in the water column.

With financial support from Dirección de Investigación UCSC and The King's Royally Initiated Laem Phak Bia Environmental Research and Development Project.

CHEILOSTOME PHYLOGENY: 300 TAXA AND GROWING

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ABSTRACT

Phylogenies are often crucial to answering questions on phenotypic evolution on macroevolutionary time scales. Bryozoans have been used as model organisms to tackle questions on phenomena such as punctuated equilibria and assumptions such as the biological validity of morphological species. However, published phylogenies of Bryozoa based on data which are independent of the very morphological traits we are studying are few. Here, we present updates of a large-scale sequencing project underway in our lab, BLEED (Bryozoan Lab for Ecology, Evolution and Development) in Oslo, that aims at building a cheilostome phylogeny that is based on sequence data. While we are optimistically trying to sequence at least one representative species of each and every described extant cheilostome genus, this endeavor is currently limited by sample availability. The secondary goal of the project is to sequence all described cheilostome species from New Zealand waters. In this presentation, we briefly describe the wet lab pipelines we have been using to produce data which we then subject to bioinformatic pipelines to extract the sequences of high-copy genes. Our current state of knowledge of cheilostome phylogenetics will be briefly summarized in this presentation.

PLACENTAL NOURISHMENT IN CTENOSTOME BRYOZOANS: ULTRASTRUCTURAL EVIDENCE

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ABSTRACT

Bryozoa is an extraordinary example of wide distribution of extraembryonic nutrition (matrotrophy) among aquatic invertebrates. In particular, placental nourishment during incubation is characteristic of all studied Phylactolaemata, presumably all Cyclostomata (Stenolaemata) and many Gymnolaemata. Ultrastructural evidence of matrotrophy is provided for Cheilostomata and was recently obtained for cyclostomes. Phylactolaemates and ctenostomates were not studied in this respect. Here we use an ultrastructural approach to report first evidence of placentation in a ctenostome bryozoan, *Amathia verticillata*. This species incubates its progeny in the tentacle sheath transformed into a brood chamber. During incubation the tentacle sheath wall is modified into a placental analogue (embryophore) via cell multiplication and hypertrophy. The embryophore cells develop a massive synthetic apparatus and their apical membranes become 'microvillous' indicating the presence of exocytosis. The surface cells of the embryo also form a complex network of irregular projections and foldings. Coated pits beneath this network indicate active endocytosis. The narrow slit between the developing embryo and the placental analogue is filled with dense (presumably nutritive) material. The embryo increases up to 24-fold in size together with ultrastructural evidence indicating substantial matrotrophic provisioning. Finally, considering the differences in the incubation mode, reproductive patterns and the current position of matrotrophic ctenostomes on the phylogenetic tree, extraembryonic nutrition could have evolved five times in this group.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Key words**:** matrotrophy, placenta, brooding, Ctenostomata

REVEALING A GLOBAL PATTERN IN BRYOZOAN SKELETAL MINERALOGY – AN OVERVIEW OF THE PROJECT

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ABSTRACT

In many areas of the world ocean bryozoans are important carbonate producers. Evidence suggests that in colder high-latitude marine environments most bryozoan species precipitate in most cases low-magnesium calcite (≤4 mol% $MgCO_3$), while secretion of aragonite and high-magnesium calcite (≥12 mol% $MgCO_3$) are largely restricted to warmer low-latitude waters. This pattern is widely cited but not robustly confirmed. One major question that requires answering is to what extent the biomineralization process is determined by intrinsic biological processes versus environmental factors. Our study explores whether there are correlations between environmental factors, mainly latitudinally changing temperature, and skeletal mineralogy in an attempt to improve our understanding of the mineralogical properties of marine bryozoan skeletons. Thus, current and future sampling is being carried out across a temperature gradient, ranging from cold waters around Iceland, South Africa, east Antarctica and European Arctic, to warmer waters e.g. New Zealand, Australia, Mediterranean Sea, Brazil, Panama, Maldives and Singapore. Here we provide an overview of the project including goals achieved so far, as well as future challenges. Data obtained so far show the calcareous skeletons of bryozoans from cold regions are dominantly calcitic (98%) with low and intermediate levels of $MgCO_3$. This supports the latitudinal trend of calcite being the main carbonate form precipitated by calcifiers in cold waters.

Keywords: Bryozoans, calcium carbonate, calcite, aragonite, magnesium

WORKING TOWARDS A BLUE CARBON AUDIT OF ORKNEY WATERS; CONTRIBUTION OF BRYOZOA

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ABSTRACT

As part of a tender awarded by Scottish Government, we are pulling together a protocol for collating a Fully Quantified Audit of Blue Carbon resources in Orkney waters. As part of the method development we are looking at the techniques and available information for mapping of some of the better known Blue Carbon habitats, including maerl beds, kelp forest, seagrass meadows, salt marshes, biogenic reefs and marine sediments. In addition to this we are also looking into methods for assessing the contribution of some lesser known habitats including Bryozoan thickets/meadows and Brittlestar beds. Preliminary maps of the known Bryozoan resource in Orkney waters are collated using GIS mapping tools, Carbon content of the key species (e.g. *Flustra foliacea*, *Securiflustra securifrons*) is assessed using a muffle furnace to perform burn up experiments and sequestration rate of carbon is investigated using literature information on growth parameters. This information is combined into a model to calculate key parameters for the carbon audit, such as standing stock. This is a preliminary attempt to design a method for building a carbon budget that will be incorporated into the wider project to address information gaps as specified in the tender from Scottish Government. Results are discussed in the wider policy context.

Keywords: Bryozoan thicket, blue carbon, standing stock, sequestration

MORPHOLOGICAL EVOLUTION OF A SINGLE LINEAGE THROUGH 2 MILLION YEARS: A STUDY ON *STEGINOPORELLA MAGNIFICA*

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ABSTRACT

Bryozoans are an excellent model system for the study of long term morphological evolution, largely in part due to their extensive fossil record and complex skeletal features. As a consequence, this group should be at the forefront of current discussions on the nature of evolvability, such as: Why are rates of evolution so different between short- and long-term studies? What factors make certain species exceptional evolvers? What constraining mechanisms are shaping the evolutionary diversification of certain lineages?

However, uncertainties in the phylogenetic placement of fossil species, together with significant bottlenecks in the acquisition of multivariate trait data, have often prevented Bryozoans from making a more direct contribution to many of these discussions. Here, we apply a machine learning-based phenotyping method developed in-house to collect high-dimensional skeletal data in a stratigraphically rich Bryozoan lineage (*Steginoporella magnifica*), encompassing a two million year timespan. We then test several different models of trait evolution using this dataset and interpret the evolutionary diversification of this lineage in light of the interaction between natural selection and genetic/developmental constraints. Our work suggests that ignoring genetic and developmental constraints leads to inaccurate inferences regarding the drivers of morphological evolution and that these constraints help explain the disconnect between short- and long-term studies.

FIRST TAXONOMIC RECORDS OF BRYOZOANS FROM THE AMAZON RIVER MOUTH: ASSOCIATED FAUNA TO RHODOLITHS AND SPONGES

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ABSTRACT

The reef system at the Amazon River mouth extending since Brazil-French Guiana border to Maranhão State (Brazil) encompasses more than 10,000 km^2. This reef system extends in a mosaic of habitats formed mainly by rhodolith beds, sponge bottoms and high-relief hard structures. Several species of algae (40 spp.), sponges (61 spp.), cnidarians (26 spp.) and reef fishes (73 spp.) have been recorded in the region, including new to science, rare and endemic ones. Yet, the bryozoan fauna remained unknown until the present study, even with the previous indicative of the importance of this group to habitat formation in the area's inner shelf. Sampling was conducted onboard NHo Cruzeiro do Sul (September 2014) using bottom trawl nets and dredges, from 23 to 120 m depth along the northern, central and southern sectors of the Amazon River mouth. Rhodolith and sponge samples were fixed in 90% ethanol or dried, and deposited at the Porifera Collection in Museu Nacional (MNRJ) and at the herbarium of the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Thirty sponges and 11 rhodoliths were searched for associated bryozoan specimens under stereomicroscope. Bryozoan colonies were taken from these samples, fixed in 70% ethanol and deposited at the Bryozoa Collection in MNRJ. The species were characterized under Scanning Electron Microscopy. A total of 65 taxa were identified, including the classes Gymnolaemata and Stenolaemata. Cheilostomata was represented by 57 taxa, Ctenostomata by 3 spp. and Stenolaemata 5 spp. One species (*Puellina smitti*) and two genera (*Cranosina* and *Thornelya*) are new records for Brazilian waters, while 15 species are new to science and will be described in the sequence. The families Smittinidae, Calloporidae (6 spp. each) and Phidoloporidae (5 spp.) showed the highest species diversity, followed by Candidae (4 spp.). Regarding just the bryozoan fauna associated to rhodoliths and sponges, the Amazon River mouth reef system represents a high diversity area for this group. This result highlights the importance and uniqueness of this reef system for marine biodiversity and reinforces the need for further scientific research in the area.

Keywords: Atlantic ocean; Amazon reef; coral ecosystem; Bryozoan fauna.

ORDER LEVEL TROPHIC STRUCTURING ACROSS PERMIAN GONDWANAN FAUNAS

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ABSTRACT

Gondwanan Permian bryozoan faunas show distinctly different diversity characteristics. Tethyan warm-water faunas of Thailand are diverse with all Palaeozoic stenolaemate orders represented, whereas cold-water eastern Australian faunas have limited diversity, and some orders are rare or absent. This study investigates the differences in trophic structure between these two faunas by inferring soft-part morphology from skeletal structures. Initial findings show the overall mouth and lophophore size in both of these Permian faunas is comparable, however size characteristics differ at order level. In warm-water Thai faunas mouth and lophophore size increase from fenestrates through to cryptostomes and trepostomes having similar mid-range sizes, to cystoporates, which exhibit the largest mouth and lophophore sizes overall. This implies that these groups are utilizing different sized food particles from available suspended material, with fenestrates consuming the smallest food particles and cystoporates being able to consume larger particles and a larger particle size range. By contrast, cystoporate and cryptostome taxa from cold-water eastern Australian faunas are of low diversity and abundance. Here the upper size limit of the mouth and lophophore of both fenestrate and trepostome bryozoans is extended, and encompass the larger particle feeding capacity of the essentially absent cystoporates. Additionally, when comparing Permian stenolaemate to modern cyclostome stenolaemate mouth sizes, fossil forms have similar lower size limits, but tend to have a larger upper size range, more comparable to modern gymnolaemates, which are absent in Palaeozoic faunas.

Keywords: Stenolaemates, Permian, Tasmanian bryozoans, trophic structure

MUSEOMIC DIAMONDS IN THE ROUGH: DEVELOPING METHODS FOR EXPLOITING MUSEUM SPECIMENS IN BRYOZOAN MOLECULAR PHYLOGENETIC RESEARCH

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ABSTRACT

Trying to resolve the relationships among species using molecular data can be extra challenging when fresh samples for DNA sequencing are not available. For instance, previously collected and stored museum specimens are often preserved in ways that are not beneficial for DNA preservation. Poor DNA quality increases the difficulty of extracting DNA and processing sequence data from the samples. Identifying improved methods for DNA isolation and bioinformatic pipelines specialized for handling sequence data generated from these suboptimal DNA samples will therefore be of great value for expanding our knowledge about the evolutionary history of different organisms, including bryozoans.

The cheilostome family Adeonidae consists mainly of shallow water species that often occur as large colonies. Because of their size and accessibility, they are a prominent part of several museum collections. The Adeonidae are therefore a great practical example to use for our project to develop DNA isolation techniques and bioinformatic pipelines for bryozoan samples with poor DNA quality. Our aim in this work is to extract genes useful for phylogenetic reconstruction from museum samples using the mitochondrial and rRNA sequences from references assembled from high-quality DNA.

So far, we have isolated DNA from adenoid samples with high weight (unfragmented) and high concentration DNA (>10ng), and from those with low weight (fragmented) and low concentration DNA (<10ng), as found in museum collections. We are currently testing library preparation methods for these low-quality samples before moving to the sequence assembly stage. Here we will use mitochondrial genome and rRNA operon references from high quality adenoid samples which we will use to identify orthologues from the poorer quality data. Our most current results will be presented at the conference.

DEPTH GRADIENTS CHARACTERIZE POLYMORPHISM IN NEW ZEALAND CHEILOSTOMES

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ABSTRACT

Bryozoans are an excellent model system for studying macroevolution, and this can be enhanced by studying the traits and conditions that determine success in modern species. Environmental filtering influences community assembly by excluding ill-adapted species resulting in communities with similar functional traits and can be used to pinpoint "key innovations" leading to species radiations. If polymorphs are not filtered by the environment, incidence of polymorphism may instead relate to environmental stability (ergonomic hypothesis), suggesting increased extinction rates in polymorphic lineages. An RLQ (a three-way ordination) incorporating spatial data was run on a dataset of 644 species of cheilostomes (Bryozoa) from 789 New Zealand sites to investigate environmental filtering of colony form and zooid polymorphism. This revealed a trend of increasing complexity with depth and provides support for the idea that polymorphism should be more favorable in stable environments. Colony attachment (cementing vs rooted) is filtered by the presence of hard substrata, while colony orientation shifts from encrusting to erect with increasing depth and distance from shore. Despite circumventing the need for hard substrata, it is unlikely that rootlets contributed significantly to the Late-Mesozoic radiation of cheilostomes. Brood chambers in both erect and encrusting taxa become more immersed with decreasing depth and hard substrata. In encrusting bryozoans, shallow-water taxa tend to exhibit multilaminate growth and lack spines. Additional analyses revealed similar levels of polymorphism in erect and encrusting species, though more encrusters had jointed spines, while more erect species had avicularia with pointed and setose mandibles.

Keywords: polymorphism, environmental filtering, community assembly, modularity

ARCHITECTURE AND BIOMINERALIZATION OF *ANOTEROPORA LATIROSTRIS*

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ABSTRACT

Cheilostome Bryozoa *Anoteropora latirostris* (RV Meteor samples, Gulf of Aden) constructs its skeleton from calcite and aragonite. Correlated multi-scale electron microscopy, micro-computed tomography, electron backscatter diffraction and NanoSIMS mapping show primary, coarse grained platy calcitic lateral walls covered by fine-grained fibrous aragonite on their distal side only, while basal and frontal walls of the colonies are fully aragonitic. This type of asymmetric mineralization of lateral walls results from the vertical arrangement of the zooids at the growth margins of the colony and represents a type of biomineralization previously unknown in cheilostome bryozoans. NanoSIMS mapping across the aragonite-calcite interface indicates an organic membrane between both mineral phases, likely representing an organic template for biomineralization of aragonite on the calcite layer. Analysis of crystallographic orientations show a moderately strong crystallographic preferred orientation (CPO) for calcite (7 times random orientation) and an overall weaker CPO for aragonite (2.3 times random orientation) with a high degree of twinning (45%) of the aragonite grains. The calculated Young's modulus for the CPO map shows a weak mechanical direction perpendicular to the colony's upper surface facilitating this organism's strategy of clonal reproduction by fragmentation.

Keywords: Biomineralization, Bimineralic. *Anoteropora latirostris*

CSI BRYOZOA: AN INVESTIGATION OF PORES, CORDS AND OTHER EVIDENCE

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ABSTRACT

As exclusively colonial organisms, bryozoans require a system for the exchange of information and nutrients. This Colonial System of Integration (CSI) varies among the different bryozoan clades and thus also their degree on integration. Body cavities of phylactolaemates are widely connected, whereas they are individually constricted by pore complexes in myolaemates. Phylactolaemates show a regular neuronal plexus in their body walls in contrast to myolaemates, which only show little body wall innervation according to recent data. Gymnolaemate bryozoans are often considered to be interconnected by a set of funicular cords, which are connected to the interzooidal pore plates and supposedly involved in interzooidal metabolite transport and communication. A broader survey on funicular systems of ctenostomes shows, however, that interconnecting zooidal cords are not present in most ctenostomes and seems to be restricted to species with enlarged peristomial tubes. Pore plates of gymnolaemates are either single pored, as in most ctenostomes, or multiporous, as in cheilostomes. Only few ctenostomes show multiporous pore plates and increasing evidence shows that these probably only evolved once in this group. Most multiporate ctenostomes show a flat encrusting colony form similar to cheilostomes, and in addition pherusellids and flustrellids show bilateral apertures often pronounced with lip-like structures. Ultimately, these groups show a high similarity to cheilostomes in many characters and possibly might represent the closest relatives of recent ctenostomes to cheilostomes. In this talk I present new data on the funicular system of ctenostomes, a possibly monophyletic ‘Multiporata’ and additional morphological structures such as the nervous system.

THE BORING WORLD OF BRYOZOANS

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ABSTRACT

Several genera of ctenostome bryozoans evolved a boring lifestyle that can either be achieved by mechanical boring into softer substrates or tissue, or more frequently into hard calcified structures such as shells via chemical means. Since ctenostomes have unmineralized cuticles, borings forms are one of the few that are present in the fossil record and that date even back to the Paleozoic. It is thus evident that a boring life has been quite a successful life style and evolved multiple times within ctenostomes. However, little is known about the biology and ecology of boring bryozoans, and the latest summary is over 40 years ago. Last year I successfully managed and documented live boring bryozoans occurring in the shells of live mollusks. Life in a shell poses serious problems in the investigation of these forms, because in most cases only few pores are discernable on the outside. These restrictions apply to observations of live animals, but also any morphological or molecular analysis, which will require removal of the colonies or zooids from the shells. In this presentation I review these problems and possible workarounds for studying boring bryozoans. The application of μCT in boring research is demonstrated on some examples, and the first neuro-muscular stainings of boring bryozoans will be presented.

PHERUSELLA MINIMA, A NEW CTENOSTOME SPECIES FROM THE MEDITERRANEAN SEA

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ABSTRACT

The epiphytic community on the endemic seagrass *Posidonia oceanica* from the Mediterranean Sea is well studied, but still harbors some little investigated epiphytic bryozoans. From the ctenostome family Pherusellidae, only *Pherusella tubulosa* was reported as a member of the Mediterranean fauna, inhabiting several species of algae and the rhizome of *Posidonia oceanica*. In 2004 small colonies inhabiting the leaves of *Posidonia oceanica* in Sicilian waters were identified as *Pherusella brevituba*, a species originally described from the Eastern Pacific. First observations of this species in the Northern Adriatic Sea were taken over a short period of the year and colonies always were small consisting of only few zooids. The aim of this study was to observe and study this species over a longer period of the year in order to gain information on its life history, colonial development and reproduction. In addition, the autozooidal morphology was also studied in more detail owing to the complete lack of modern data on the genus. Numerous characters such as the colony pattern, colony size and life cycle altogether with its specific habitat and distribution range, indicate that the species under examination is in fact a new species, *Pherusella minima*, instead. This study yields one of the first longtime observations about the lifecycle and colonial growth of a ctenostome bryozoan, including new morphological data of an otherwise incompletely known group of bryozoans.

Keywords: *Pherusellidae*, *Posidonia oceanica*, epiphytic, life cycle

COMPARATIVE ANALYSIS OF OOGENESIS IN CHEILOSTOME BRYOZOANS

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ABSTRACT

Ovarian anatomy and ultrastructure as well as major features of oogenesis were comparatively studied in four species of cheilostome Bryozoa from the White and Black Seas. Those species were selected based on their distant phylogenetic position and contrasting reproductive patterns. Ovary in the representative of the most ancient and morphologicaly primitive taxon of Cheilostomata (Malacostegina) *Electra pilosa* produces large number of small microlecital oocytes, developing without brooding to planktotrophic larvae (cyphonautes). In contrast, members of more advanced Flustrina, anascan *Callopora craticula* and ascophoran *Arctonula arctica*, produce from one to few large macrolecithal oocytes. Each oocyte develops together with a nurse cell, further being transferred to the brood chamber (ovicell) where lecithotrophic larvae is formed. Oogenesis of *Tendra zostericola* shows an intermediate variant: several solitary mesolecithal oocytes are developed in the ovary being further moved to acantjhostogous brood chamber in which lecithotrophic larvae are formed. The general scheme of the ovarian structure in all four species is not fundamentally different. Those anatomical and ultrastructural differences that were revealed are most likely connected with parameters of oogenesis. Thus, the main trends in the evolution of the ovarian structure and oogenesis in Cheilostomata are a decrease in the number of oocytes, an increase in their size and the amount of yolk and a transition to development with a nurse cell. Also, the shift from micro- to macrolecithal oogenesis resulted in a transition from planktotrophic to lecithotrophic larva.

Financial support was provided by the Russian Science Foundation (grant 18-14-00086).

Keywords: Oogenesis, Cheilostomata, evolution

INVESTIGATION ON INTERCOLONY VARIATION OF ZOOID SIZE AT MIOCENE OF PARATETHYS USING MODERN STATISTICAL TOOLS

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ABSTRACT

Miocene bryozoans are among the most diverse group of organisms in the world and the colonies have an enormous range of shapes and sizes. These animals are uniquely valuable in their ability to constrain paleoecological hypotheses as well as host's behavior and environment. Bryozoans are an important phylum to research in terms of how potential changes in water chemistry due to ocean acidification could affect species with different shell compositions. However, the temporal changes (unfavorable environmental condition) most often affects its abundance, richness and growth (zooid size and shape), especially when the temperature falls below 9°C. It seems that most of the mature colonies are broke up and died after this temperature variation and the reasons remain unclear. Though there were few researchers have been investigated on these issues, but the data on temperature variations still lacking. Hence, it is essential to defend the impacts due to environmental changes, most concern with temperature. Owing to this, the present study is aimed to investigate the abundance (or) diversity, and phylogenetic relationships of these Miocene bryozoans, intracolony variation in zooid size in cheilostomatous bryozoans, evaluate the zooid size and embryo development (before and after free swimming larva) during temperature variations in different latitude and longitude subtropical zone. In addition, reconstruct the abiotic components (e.g. water chemistry, water temperature and depth), identified the areas where the habitat forming bryozoans. Further, the data will be analyzed through ArcGIS advanced statistical methods to use both unique and important information in local and global environmental changes as well as the specific insights into bryozoan life history.

Keywords: Cheilostomata, zooid size, Miocene, Paratethys, paleoenvironmental reconstruction.

GEOMETRY OF BRYOZOAN COLONIAL GROWTH AND IMPLICATIONS FOR COLONIAL GROWTH RATE

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ABSTRACT

The relationship between age and size in colonial organisms is problematic. While growth of individual zooids may be measured fairly easily, the growth rates of colonies can be variable, complex, and difficult to measure. We need this information in order to manage and protect ecosystems involving bryozoans, grow them for bioactive compounds, and understand the history of environmental change recorded in them. Bryozoan colonial growth form is determined by the pattern of addition of zooids, whether it is simple sequential addition of modules, or the formation of primary modules that are repeated in a secondary structural design. Most bryozoan colonies fall within a small group of typical forms, suited to improve feeding, colony integration, strength, and/or larval dispersal. A bryozoan colony can be reproductively mature at any size from 1 to >8000 mm^2. Measurement of size depends on the colony form: length (radius, height), area, and volume are all used, causing difficulties in comparing rates among colonies. Colonies can be quite short-lived (three months) or very long-lived, especially polar species which can reach >50y old. Astogeny, comprising both addition of zooids and extrazooidal calcification, can be linear, two-dimensional across an area, or three-dimensional. In seasonal climates, bryozoans may exhibit a growth check in winter, which, like an annual "tree-ring", exhibits interannual variation. Most other bryozoans must be measured using chemical markers (stable isotopes), direct observation both in culture and in the wild, or by inference. Comparison of growth measurements in bryozoans suggests that the results are to some extent dependent on the method of measurement. It is difficult to compare growth rates between, for example, a sheet-like encruster, a robust-branching tree, and multilaminar sub-spherical mound. Calcification rate (in g $CaCO_3$/y) offers a way to compare growth among different growth forms which expand in different ways. If the carbonate per zooid is fairly predictable, it can be directly related to zooids/time. All these difficulties point to the need for a coordinated, controlled, large-scale study on bryozoan growth and calcification.

Keywords: Growth, Size, Age, Calcification

OLD SPECIMENS IN A NEW LIGHT: THE *CHALLENGER* RETEPORIDS

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ABSTRACT

The Natural History Museum, London holds approximately 1,500 bryozoan samples, which were collected by the HMS *Challenger* during the famous oceanographic research voyage between 1872 and 1876. This material was described by George Busk (1884, 1886) and Arthur Waters (1890) and the specimens reflect the wide range of the expedition's circumnavigation with bryozoans collected from 77 locations and depths varying between 5-2650 fathoms. A project is underway to digitize this vast collection, especially the types, and to try to clarify the systematic position of certain taxa. In the first *Challenger* report, Busk (1884) described 19 new species of *Retepora*. Many of these taxa have now been re-assigned to other genera within the family Phidoloporidae; however, three are still considered *taxon inquirendum*. Using original drawings and descriptions documented by George Busk in his notebooks, and new SEM images, the taxonomic positions of *Retepora cavernosa* from the Crozet Plateau, *Retepora delicatula* from the Arafura Sea and *Retepora margaritacea* from the North Fiji Basin are discussed.

Keywords: HMS *Challenger*, George Busk, *Retepora*, *taxon inquirendum*

CORAL-BRYOZOAN ASSOCIATIONS THROUGH THE FOSSIL RECORD: GLIMPSES OF A RARE FRIENDSHIP?

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ABSTRACT

The purpose of this study is the search for patterns in the coral-bryozoan associations through the fossil record. Though bryozoans are a widespread, occasionally abundant component of fossil faunas present in the fossil record since the Ordovician, palaeobiological aspects such as the development of symbiotic associations with other organisms remain largely unknown. Studies focused on symbiosis in fossil bryozoans have been carried out mostly in the last three decades with a seemingly increasing interest during the last one. A recently discovered rugosan-bryozoan symbiotic intergrowth from the Lower Devonian of Spain is compared with previously reported associations between bryozoans and corals from the Late Ordovician of Estonia and USA and from the Neogene of Western Europe. Cases are exceptional and scattered through the fossil record. Available data suggest that some degree of specificity was common and that there is no evidence of negative effects for partners. Corals allegedly benefitted from a stable substrate and food supply from the bryozoan feeding currents, while the latter received additional protection against predators. The associations originated by settlement of coral larvae on living bryozoan colonies that bioclaustrated (bryoimmured) the growing infester, and were facultative for both partners except for the Neogene *Culicia-Celleporaria* association, in which the coral is not known to occur isolated from the bryozoan. This case shows a high integration between partners in contrast with the Palaeozoic associations, particularly the Ordovician ones. It is not possible to determine which factors caused these associations to be extremely rare, but colony-wide feeding currents generated by bryozoans may have played a role in preventing larval settlement on living colonies.

Keywords: Bryozoans, Corals, Symbiosis, Bioclaustration, Intergrowth

SKELETAL AND POLYPIDE CHARACTERISTICS OF CYCLOSTOMATIDS:

ELUSIVE SPECIES OF A STRAIGHTFORWARD ORDER

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ABSTRACT

Most taxa of the bryozoan class Stenolaemata are extinct, but the cyclostomatids still flourish in benthic habitats around the globe, especially in the Southern Hemisphere. Their feeding apparatus is on average the smallest within the phylum, comprising a crown of about 10 tentacles 150-450 μm long. It has been shown in gymnolaemates that the parameters of the feeding apparatus (e.g. crown diameter, length and number of the tentacles) are directly related to the dimensions of captured food and generated flow (current speed, clearance rate), but also depend on cystid parameters. Although a number of studies have reported cyclostome polypide morphology, little is known about its relationship with skeletal characteristics. We addressed this gap by measuring orifice width and parameters of the tentacle crown and mouth in living, feeding colonies of 13 shelf-depth species, collected in 2018 from Otago shelf of New Zealand. The animals were relaxed in a mixture of sea water and isotonic $MgCl_2$ solution, and their everted polypides were photographed under dissecting microscope. Morphological traits of each species were measured from 20-200 photographs. In addition, zooid measurements from published sources were compiled into a dataset with a single entry for every species. Contrary to expectations, skeletal and polypide characteristics were correlated weakly or not at all (R^2 = 0–0.37) within individual species. At this level, morphometric values were best predicted simply by applying the species-specific means. At the level of orders, however, the underlying trends were much clearer. Cyclostomatida display a strong positive linear relationship between orifice width and all polypide characteristics (R^2 = 0.66–0.93, $p < 0.001$), making some meaningful paleontological reconstructions possible.

Keywords: Cyclostomatida, paleontology, morphometry, feeding apparatus, orifice diameter

BRYOZOANS FROM THE LATE JURASSIC–EARLY CRETACEOUS ŠTRAMBERK LIMESTONE OF THE CZECH REPUBLIC

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ABSTRACT

The fossil record of bryozoans close to the Jurassic-Cretaceous boundary is extremely sparse. A minor mass extinction event has been recognized in some other groups at the end of the Jurassic but the poor bryozoan record means that it is unknown whether bryozoans were affected by this event. The most diverse bryozoan biota described from the terminal Tithonian stage of the Jurassic is from the Portland Beds of southern England and comprises five species of cyclostomes and one cheilostome. Apparently, only one bryozoan species has been formally described from the basal Berriasian stage of the Cretaceous, a bioimmured ctenostome from the Crimea. Therefore, the bryozoans of the Štramberk Limestone, an allochthonous unit of latest Jurassic–earliest Cretaceous age, have particular importance. Bryozoans have long been recorded but never formally described from this peri-reefal talus deposit outcropping in the Carpathian Outer Flysch of the Czech Republic. Our studies of historical material in the Naturhistoriches Museum, Vienna, together with collections made more recently, have revealed the presence of about ten cyclostome species in the Štramberk Limestone encrusting corals, bivalves and other biogenic substrates. The exact age of the historical material is unknown but in-situ collections of bryozoans have been made from the Early Berriasian part of the Štramberk Limestone at the Kotouč Quarry in Štramberk. Preservation is poor to mediocre, reflecting both tectonism and the intense diagenesis of the limestone. However, a new species of the distinctive cyclostome *Reptoclausa* can be recognised.

Keywords: bryozoans, Jurassic, Cretaceous, taxonomy, preservation

THE LOPHOPHORE NEUROANATOMY SUPPORTS THE RELATIONSHIP OF BRYOZOANS AND PHORONIDS

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ABSTRACT

Neuroanatomy is traditionally used for phylogenetic reconstruction. Because the lophophore is the main feature of all lophophophorates, whose monophyly is recently actively discussed, neuroanatomy of the lophophore may help clarify the status of the Lophophorata and provide new information on the early evolution of the group. Original data on organization of the lophophore nervous system is obtained in several phoronids. Comparative analysis revealed the presence of homologous elements in the nervous system of the lophophore in phoronids and bryozoans. In species from both groups, the lophophore has several main nerves that are homologous. The dorsal ganglion of phoronids is homologous to the cerebral ganglion of bryozoans. The minor nerve ring of phoronids is homologous to the circum oral nerve of bryozoans. The tentacular nerve ring of phoronids is homologous to the outer nerve of ctenostome and cyclostome bryozoans. In phoronids and in bryozoans, there are intertentacular serotonin-like immunoreactive perikarya associated with the inner nerve ring. Tentacles are innervated from the intertentacular nerves, which start from the inner nerve ring. In both phoronids and bryozoans there are peritoneal neurites in the tentacles. These new results suggest the presence of two nerve centers and two nerve rings in the last common ancestor of phoronids and bryozoans. During evolution, bryozoans may have lost the outer nerve center and outer nerve ring, whereas phoronids may have lost the inner nerve center and inner nerve ring. These morphological results evidence the close relationship of phoronids and bryozoans, support the traditional view of the lophophorates monophyly, and contradict new concept of Polyzoa as clade that includes three phyla: Bryozoa, Entoprocta, and Cycliophora. This study is supported by Russian Science Foundation (#18-14-00082).

Keywords: Lophophorata, nervous system, evolution, Polyzoa

CELLEPORIDAE FROM THE EARLY MIOCENE OF AUSTRIA

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As already stated by KÜHN (1925) in his rather short monographic description of bryozoa from the Early Miocene (Eggenburgian) of Austria, Celleporidae are in the Basin of Eggenburg the most common and also the most conspicuous group of bryozoa. To give just one example: a fauna recently studied from Sigmundsherberg yielded about 75 (weight) % of celleporid zoaria. Neverthless – mainly due to their mostly rather poor state of preservation they are still largely understudied however. After more than 40 years of collecting at various localities in Lower Austria the situation has changed considerably now. On the basis of careful comparisons of numerous specimens from different localities, a few of which having also yielded rather well-preserved material, a number of determinations have become possible.

As the most urgent topic a revision of *Turbicellepora krahuletzi* – probably the most common species at many oft he localities studied – has been done; the basis of such investigations has been rather hopeless at the beginning: type specimen lost, extremely poor state of preservation of available material, and completely insufficient descriptions – this has been the situation at the very beginning of such studies.

In addition *Cellepora polythele* – a rather rare taxon in the Early Miocene – could be confirmed; possible colonies of *Cellepora pumicosa* are tentatively identified too. In addition finds of „pisifiorm" zoaria of rather tiny celleporid colonies have been studied in detail: they are obviously similar to celleporid taxa as recently described by HAYWARD & McKINNEY (2002) from the Adriatic Sea. Realizing various facts on the basis of literature these taxa referring to the genus *Celleporina* may have a considerable stratigraphic range however: possibly from the Priabonian to Recent. Further studies have to be done in this respect however.

Studies concerning the so-called *„Cellepora globularis"*- problem have been started moreover; first results are given. Especially these investigations have only preliminary character however, further studies will follow.

References:

KÜHN, O. (1925): Die Bryozoen des Miocäns von Eggenburg. – in: SCHAFFER, F.X.: Das Miocän von Eggenburg. – Abh. k.k. Geol. Reichsanst. 22 (3): 21 – 39, Wien.

HAYWARD,P. J. & McKINNEY, F.K. (2002): Northern Adriatic Bryozoa from the Vicinity of Rovinj, Croatia. – Bull. American Mus. Natural Hist., 270: 139 pp.

MARINE BRYOZOA FROM BRAZIL: PAST, PRESENT AND FUTURE

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ABSTRACT

Studies on taxonomy of Brazilian bryozoans began at the first half of the 19th century, with few studies focused on marine bryozoans. Most of the knowledge of 20th century on Brazilian bryozoans, however, is result of the extensive study realized by Ernst G.G. Marcus, who reported 179 species of marine bryozoans, the majority collected between 0 to 20 meters depth in littoral of São Paulo State, describing 51 new species to science. At the end of the 20th century, taxonomic studies on the phylum practically ceased. In Brazil, the recovery of taxonomic studies on marine bryozoans was highlighted in the past decade with new researchers, whose national and international collaborations have contributed significantly to knowledge of the Bryozoan diversity. Until now, publications from these authors provided the description of more than 100 new species to the Brazilian coast. In present work we summarize data on the biodiversity of marine Bryozoans from Brazil under the project SISBIOTA BRASIL. This synthesis aims to present the historical analysis of the studies on Brazilian bryozoans, including evaluations of the current knowledge and human resources available at the country. More than 440 species of marine bryozoans were reported in Brazilian coast. The high diversity is found at littoral zone of São Paulo State (approximately 50% of the known species). Despite the remarkable increase in the number of species described and/or recorded in recent years mainly due the formation of new researchers at the country, some regions remain poorly sampled and studied. Encouraging the development of human resources and the expansion of scientific collections are crucial for the implementation of new researches on marine bryozoans that will contribute to the taxonomic bias found in some regions of Brazil.

Keywords: Atlantic, Biodiversity, bryozoans, SISBIOTA BRASIL, synopsis.

CHANGES IN BRYOZOAN DIVERSITY IN SHALLOW WATER DEPOSITS OF THE LE MANS AREA DURING THE CENOMANIAN-TURONIAN TRANSITION

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ABSTRACT

94 million years ago, major environmental changes are globally recorded at the transition between the Cenomanian and the Turonian stages. Mean temperatures were at least 5°C higher than nowadays, sea level rose to a level never later exceeded, and the widespread accumulation of organic-rich sediments reflects a major perturbation of the Carbon cycle. The hypothesis of an Oceanic Anoxic Event (OAE) explains many of the observed changed in deep shelf environments. Sections of the Cenomanian type area near Le Mans (France) offer a good geological record of the shallow marine history. We analyzed bryozoan diversity in continuous sequences covering the mid Cenomanian to early Turonian time interval. Bryozoans are the most diverse and abundant component of the benthic taxa. Middle Cenomanian assemblages were found relatively homogenous, including 19 species representing the Cenomanian fauna listed in *Paléontologie Française* by d'Orbigny. Two-thirds of the species have erect colonies and one-third are encrusting. There is a progressive shift in the assemblages during the Late Cenomanian with loss of most of the Middle Cenomanian forms and replacement by other species, often belonging to the same genera. There is a progressive loss of encrusting forms in the upper Cenomanian. The number of species is minimal at the stratigraphical level corresponding with the OAE, with 6 species, five of which were present at lower levels. Cheilostomata and Cyclostomata are present in similar frequencies and encrusting forms are lacking. A richer fauna appeared progressively in the Turonian with eleven species recorded, including five absent from the Cenomanian. The low diversity of bryozoans during the OAE may be related to an unfavourable temperature increase, while other benthic organisms retained a high diversity and planktonic crinoids, benthic foraminifera and sponges were plentiful. The ecological replacement may reflect a response to higher temperatures and changes in the food webs in both planktonic and benthic ecosystems, but there is no evidence of depleted oxygen conditions or of diversity drop.

Keywords: Cretaceous, France, palaeoecology, Oceanic Anoxic Event.

CHEILOSTOME BRYOZOAN EVOLUTION THROUGH TIME – INSIGHTS FROM A TIME-CALIBRATED FAMILY-LEVEL PHYLOGENY

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ABSTRACT

Recent years have seen the development of exciting methodologies that enable the combination of neontological and fossil evidence to produce time-calibrated molecular phylogenetic trees and to study the patterns and processes of diversification through time. Yet, there have been few studies that apply these methodologies to invertebrates in the marine realm. Cheilostome bryozoans with their extensive fossil record (~5000 species) present a so far untapped resource to fill this gap. Importantly, cheilostomes bear numerous and diverse skeletal characters that preserve well in the fossil record, thereby facilitating total-evidence analyses that include morphological characters of both fossil and living species. Furthermore, cheilostomes, the most speciose clade of bryozoans today, have evolved a number of morphological and functional novelties since their origin ~160 million years ago, which are thought to have led to their evolutionary success, compared to other less diverse bryozoan groups. Here, we present the results from analyses based on a genome-skimming dataset (mitogenomes; nuclear ribosomal operon) for ~250 taxa (sampling across 80% of Recent families) and a morphological matrix for all molecular taxa as well as for ~100 fossils, and explore diversification dynamics through time, including trait-dependent diversification.

Keywords: phylogeny, genome-skimming, time-calibration, total-evidence, diversification, Cheilostomata

PALEOECOLOGY OF A BRYOZOAN-RICH SCLEROBIONT FAUNA IN THE MIDDLE JURASSIC (BAJOCIAN) OF SOUTHWESTERN UTAH

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ABSTRACT

The radiation of bryozoans following the Permian Extinction began with cyclostomes in the Middle Jurassic. Most of our information on these bryozoans is from northern Europe. The Carmel Formation (Bajocian) of southwestern Utah, USA, has a diverse and abundant bryozoan fauna attached to shells and carbonate hardgrounds. It is the largest assemblage of bryozoans in the Jurassic of North America. Seven encrusting cyclostome species (and one ctenostome) were described earlier. We can now place these bryozoans in a paleoecological context to understand their paleobiology and why this assemblage is unique. The Carmel Formation comprises primarily carbonates and mudstones deposited in restricted, shallow environments at the end of a long inland seaway. The majority of sclerobionts occur in the Co-op Creek Limestone Member, which contains a few beds of abundant bivalves (particularly *Liostrea* and *Camptonectes*) and hardgrounds. The restricted environments are indicated by desiccation cracks, gypsum nodules, and salt crystal casts, as well as the lack of characteristic Jurassic fauna such as cephalopods and brachiopods (with the exception of thecideides and discinisicids). Numerous other sclerobionts occur with the bryozoans, including the aforementioned brachiopods, and sabellid and serpulid tubeworms. Borings include *Gastrochaenolites* (mytilids) and *Talpina* (phoronids). Circumrotatory ostreoliths contain examples of almost all the sclerobiont taxa and are unique to the Carmel Formation. The bryozoan fauna is dominated by *Microeciella duofluvina*, which is found primarily on cryptic surfaces. Storms were a significant disturbance in this depositional system. The Carmel Formation sclerobionts represent an unusual oyster-bryozoan community in a restricted shallow seaway. The bryozoans show affinities with European faunas and are endemic only at low taxonomic levels.

Keywords: Bryozoa, cyclostomes, Jurassic, Bajocian, Utah, sclerobionts

ZOOLOGICAL NOMENCLATURE AND BRYOZOOLOGY: WHAT YOU NEED TO KNOW

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ABSTRACT

Almost everyone who studies bryozoans will have to deal with a nomenclatural issue at some time in their career. The advent of all-electronic publication for nomenclatural acts has resulted in changes that are important to know. *ZooBank* became the "Official Register of Zoological Nomenclature," in 2012, and it became possible to publish new names entirely electronically by proactive entry of the work into *ZooBank*. In addition to following the rules for publishing new names and nomenclatural acts as set out in the Fourth Edition of the ICZN (1999): (1) the work must be registered in *ZooBank* before it is published, (2) the work itself must state the date of publication with evidence that *ZooBank* registration has occurred, and (3) the *ZooBank* registration must state both the name of an electronic archive intended to preserve the work and the ISSN or ISBN associated with the work. Future goals for the ICZN include a faster version of *ZooBank* and its development to perform additional functions. Right now *ZooBank* is only required to register works, the e-journals or other publications in which new names or acts are published. Do we want to follow the botanists and register names directly? How will current international initiatives to develop interlinked global databases affect bryozoology? I will be attending the ICZN Commission meeting shortly before the IBA in June and look forward to sharing the results with you in Liberec.

Keywords: Nomenclature, Electronic publication, Bryozoology.

WHAT PHYLACTOLAEMATE BRYOZOANS ACTUALLY EAT

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Early accounts of the phylactolaemate digestive system were often accompanied by the casual observation that certain items sometimes pass through the gut virtually intact and often alive. In fact, the phenomenon has been understated. Most of the fecal pellet volume is occupied by undamaged organisms. Green algae and cyanobacteria from fecal pellets can still be cultured. Rotifers, nematodes, mites and even protozoans often escape from fecal pellets and swim away. Wriggling bacteria are easily observed. There are two explanations for these findings: First, digestion in phylactolaemates is a batch process. As a fecal pellet waits in the rectum to be eliminated, small ingested particles gradually accumulate in the stomach. When the stomach is full, the fecal pellet is expelled and the stomach pushes all its contents into the empty rectum. This includes particles that had been churning in the stomach for as long as an hour as well as those acquired more recently that may have remained for only a few minutes. It is not surprising that the more recent arrivals may still be motile when they are shoved into the rectum with older stomach contents.

The second explanation is that little if any photosynthetic material and organic detritus is broken down in the phylactolaemate gut. Experimental colonies of plumatellids and lophopodids feeding on a variety of foods suggest that most of the nutrition is derived from meiofauna, especially small rotifers and protozoans. These are crushed by powerful peristaltic contractions of the stomach, and their contents are absorbed. There is evidence that certain diatoms and unprotected cyanobacteria also may be partially digested, but this is not yet confirmed. Although actively swimming meiofauna may escape the lophophore in still water, they are more frequently ingested in turbulent conditions. Fredericellid bryozoans often prevent the escape of active organisms by bringing together the tips of the tentacles. Once ingested, both external and internal digestion is likely.

SEM observations reveal the stomach to be densely lined with microvilli. These are arranged in rosettes, with central pits leading to shallow internal chambers. The chambers are likewise lined with microvilli, further magnifying the absorptive surface. In addition, the rectum also is lined with microvilli but lacking rosettes. This extensive internal surface area of the gut may at least partially offset the relative inefficiency of batch method for handling food.

Key words: Phylactolaemata, digestion, meiofauna

BRYOZOAN SKELETALISATION INDEX (BSI): A MEASURE OF THE DEGREE OF CALCIFICATION IN STENOLAEMATE BRYOZOANS

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ABSTRACT

In stenolaemate bryozoans the degree of skeletalisation has implications for the strength of colonies and their overall dimensions, their resistance to being bored by endoskeletozoans, and their taphonomic and preservation potential. Quantification of the level of skeletisation is provided by the Bryozoan Skeletalisation Index (BSI) which is derived from measurement of three characters readily obtainable from colonies: (1) maximum autozooecial apertural diameter at the zoarial surface or in shallow tangential section [MZD], (2) thickness of the apertural wall between adjacent autozooecia [ZWT], and (3) the thickness of the exozone [EW] in the formula:

BSI = ((EW*ZWT)/MZD)*100

This provides a measure of the relative measure of the proportion of skeleton to open space in the exozonal portion of the colony, and the endozonal skeletal contribution to the overall colony skeletal budget is regarded as being minimal. Measurement of intrazooecial characters and zooecial chamber volume might generate greater accuracy in BSI but such parameter dimensions are difficult to obtain from colonies or are not consistently recorded in taxonomic studies on these bryozoans.

The Upper Ordovician of the Cincinnati Arch region of the United States has yielded a highly diverse bryozoan fauna that has been extensively reported since the 1850s, and which provides an excellent data source for use in this study that proposes a novel measure of the degree of skeletalisation in Palaeozoic stenolaemate bryozoans. This study is based on 53 bryozoan species in 17 trepostome genera and one cystoporate genus described from the Dillsboro Formation (Maysvillian to early Richmondian, Cincinnatian) of Indiana and 36 species in 22 genera (16 trepostomes and six cystoporates) from the Lexington Limestone and Clays Ferry Formation (Middle to Upper Ordovician respectively) of Kentucky. In this study the differences observed in BSI between trepostome and cystoporate species in the Cincinnatian is significant, while ramose colonies show a higher BSI than encrusting zoaria in the same fauna.

Keywords: Bryozoan Skeletalisation Index, calcification, stenolaemates

CYCLOSTOME BRYOZOA FROM QINGDAO, SOUTH YELLOW SEA, CHINA

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ABSTRACT

Twenty-one species of cyclostome bryozoans are described from the coast of Qingdao (South Yellow Sea, China), belonging to 11 genera (*Filicrisia*, *Crisia*, *Tubulipora*, *Exidmonea*, *Idmidronea*, *Qingdaoella*, *Nevianipora*, *Hemipustulopora*, *Microeciella*, *Patinella* and *Disporella*). One genus (*Qingdaoella* gen. nov.) and 10 species are new, while one additional species is reported for the first time from China. The most similar bryozoan assemblages to the Chinese cyclostomes described here are reported from the Sea of Japan and the western Pacific.

Keywords: Cyclostomata, Yellow Sea, new species, new genus.

ABSTRACTS

POSTERS

DYNAMIC COLONY SCULPTING IN HORNERID CYCLOSTOMES: EVOLUTIONARY CONVERGENCE WITH TERRESTRIAL TREES

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ABSTRACT

Hornerid colonies are commonly tree-like in appearance, and their plasticity has long confounded taxonomists. We have investigated the underlying causes of morphoplasticity and have found an elaborate mechanism for dynamic 'arboriform' colony sculpting. In *Hornera* and other hornerids, branch abscission and shedding (cladoptosis) and selective branch regrowth, are ubiquitous during colony life. Iterated throughout ontogeny, the shedding process eventually leads to a characteristic tree-like colony form. Our study provides the first evidence of this biologically consequential growth mode outside the vascular plants.

In *Hornera robusta* branch cladoptosis proceeds as follows: (1) *en masse* polypide regression within the incipient shedding segment; (2) proximal translocation of liberated metabolites and migration of cystidal cells down the branch; (3) progressive sealing of vacated zooidal chambers by serial transverse cuticular diaphragms, which may function as bulkheads; (4) development of a zone of skeletal resorption across the branch to form a transverse abscission plane; (5) formation of a new body wall across the incipient stump; (6) detachment of the abscised branch segment; and (7) regeneration of polypides at the stump, *or* sealing of the newly exposed stump to form an abscission scar.

At the colony scale, there are three distinct and adaptive patterns of branch cladoptosis, paralleling those of terrestrial trees: ontogenetic 'self pruning', stress-induced 'downsizing' and localised epibiont-induced shedding (autotomy). We also found routine shedding of other zooidal parts: peristomes, gonozooids, adventitious struts and other secondary calcified structures. Our results show that some cyclostomes have taken a unique route towards high levels of colony individuation, one that does not make extensive use of polymorphism. Hornerid colony-level function appears optimised for large colony sizes and long lifespans, and may be 'protosystemic' in nature.

Keywords: Horneridae, *Hornera*, cladoptosis, arboriform, branch-shedding, convergent evolution

A TAXONOMIC STUDY ON THE FRESHWATER BRYOZOANS FROM KOREA

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ABSTRACT

Pectinatella magnifica (Leidy, 1851), a freshwater bryozoan that has been discovered in large amounts in the four major rivers of Korea: Hangang river, Geumgang river, Nakdonggang river and Youngsnagang river, has received a lot of media attention in 2014 for the unusually large size of its colony and the terrible smell that it emits after death. Timothy S. Wood contributed to the 2014 IBA Bulletin under the title "Bryozoan Panic in Korea" of this phenomenon about *Pectinatella magnifica*. Only one species of freshwater bryozoans has become an issue in Korea. Also, Korean scientists had tended to focus on the more diverse and rich marine bryozoans, there has been relatively little study conducted on freshwater bryozoans. We began a taxonomic study of freshwater bryozoans from Korean. We have concluded that Korean freshwater bryozoans are 19 species, including 16 phylactolaemates and three gymnolaemates, 4 of which are reported in Korea in this study. Three species belonging to the genus *Plumatella* (Phylactolaemata) indentified as *Plumatella fungosa* (Pallas, 1768), *Plumatella repens* (Linnaeus, 1758) and *Plumatella reticulata* Wood, 1988 are newly added to the Korean bryozoan fauna, and *Fredericella* n. sp. is new to science. This study aims to provide brief descriptions of these with photographs of colonies for some, distributional data and scanning electron microscopy (SEM) of statoblasts. Also, a taxonomic key to the species of Korean freshwater bryozoans is provided.

Keywords: Korea, freshwater bryozoan, *Plumatella*, *Fredericella*, new species, new record.

RARE LICHENOPORIDS AND QUESTIONABLE HORNERIDS (CYCLOSTOMIDA) AMONG COMMON BRANCHING AND RETICULATE RETEPORIDS (CHEILOSTOMIDA) LIVING ON SEKISEI REEF, SOUTHWESTERNMOST JAPAN

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Bryozoologists were urged *(IBA Bulletin 13[3]16-18)* to seek living cyclostome colonies to advance their studies in new directions. We report such an occurrence, on a concrete block submerged on Sekisei Reef, for Suzuki's water temperature measurements. When later sawed in half by Kan, its holes contained many erect branching bryozoans, which Cuffey, Batson, and Smith identified with the help of optical photography by Miller and scanning electron microscopy by Mathur. Some determinations are firm, but others remain tentative.

Our concrete block was set out for a full year on Sekisei Reef lagoon at 24º17.957'N, 123º56.861'E, in the southwestern part of the barrier reef between Iriomote and Ishigaki, Ryukyus, 2/3 of the way from Okinawa southwest toward Taiwan. It was placed 13 m below mean sea level, on a coral-covered sloping bottom, with water temperature 21—30ºC during the year, but salinity normal marine (34.3-34.7).

One purple encrusting disk is *Lichenopora/Patinella radiata*, so common on the modern Bermuda reefs. Another tiny broken-off branch fragment has a reverse-side ovicell somewhat like that figured for *Hornera spinigera*. However, this branch's surface is smooth, not striated, suggesting reteporid, and its frontal surface may have one avicularium; its affinities are thus questionable. Another questionable: a large, compactly branched frond, also hornerid-like, some of whose younger branches bear peristomial spines like those illustrated for that same species, but with smooth reteporid-like reverse surfaces.

Many other large branching colonies here superficially resemble hornerids, but SEM reveals that some bear avicularia, hence are cheilostomes, consistent with their lack of striated surface textures. Avicularian shape suggests that three may be *Reteporellina capistrata*, one possibly *Reteporellina directa*, and several others also branching reteporids but not matching any species in the literature available to us.

Canu & Bassler (1920) remarked that "variations in [*Hornera*] are extraordinary and it is often useless to attempt to determine an isolated specimen". Moreover, these branching reteporids so resemble branching hornerids that The Who's 1971 song "Won't Get Fooled Again!" seems an appropriate caution.

Still other conspicuous colonies are erect, shallow-conical, reticulate expansions, the reteporid *Triphyllozoon magniscutulatum*. Similar reticulate reteporids are known from other Pacific reefs.

Finally, a few small, erect, thinly branched colonies are other cheilostomes, but not identifiable because inaccessibly deep within the concrete block's cavities.

Key Words: lichenoporids, hornerids, reteporids, Sekisei-Reef, Japan, Recent.

RECENT *PARASMITTINA* OSBURN, 1952 (BRYOZOA, CHEILOSTOMATA) FROM BRAZIL: NEW, NATIVE AND NON-INDIGENOUS SPECIES

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ABSTRACT

Smittinidae Levinsen, 1909 is among the most diverse cheilostome families reported from Brazil, comprising more than 15 taxa. In that family, most species belong to the genus *Parasmittina* Osburn, 1950. Here we present a taxonomic review *Parasmittina* species reported in Brazil. We examined new *Parasmittina* samples, and comparative material deposited in Museum collections. Ten species were recognized, four known only from Brazilian coast (*P. alba* Ramalho, Muricy & Taylor, 2011, *P. ligulata* (Ridley, 1881), *P. simpulata* Winston, Vieira & Woollacott, 2014 and *P.* n. sp.1) and six other mainly known from the Indo-Pacific and Red Sea (*P. bimucronata* (Hincks, 1884b), *P. egyptiaca* (Waters, 1909), *P. glomerata* (Thornely, 1912), *P. longirostrata* Liu in Liu, Yin & Ma, 2001, *P. serrula* Soule & Soule, 1973 and *P. winstonae* Liu in Liu, Yin & Ma, 2001). Among these widespread species, three are considered exotic in Brazilian coast (*P. glomerata*, *P. longirostrata* and *P. serrula*), and three are cryptogenic (*P. bimucronata*, *P. egyptiaca* and *P. winstonae*). The cryptogenic species are widespread along Brazil and found on natural substrata. The exotic species were typically found on artificial substrata near harbors areas. Records previously attributed to *P. munita* (Hincks, 1884a), *P. nitida* (Verrill, 1875) and *P. trispinosa* (Johnston, 1838), truly belong to *P.* n. sp.1, *P. egyptiaca* and *P. bimucronata*, respectively. Other recently described *Parasmittina* from Brazil (i.e. *P. abrolhosensis* Ramalho, Taylor & Moraes, 2018, *P. distincta* Ramalho, Taylor & Moraes, 2018 and *P. loxoides* Winston, Vieira & Woollacott, 2014) correspond to *P. ligulata*, *P. glomerata* and *P. winstonae*, respectively.

EPIPHYTIC BRYOZOANS ON CORALLINE ALGAE FROM SHALLOW WATERS IN LA GUAJIRA, COLOMBIAN CARIBBEAN

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ABSTRACT

Most studies on bryozoans in Colombia have focused on soft-bottom habitats, while other environments have received little attention. On the carbonate shelf of the La Guajira Peninsula, located in the northern Colombian Caribbean coast, the coralline algae are dominant component between 10 and 20 m depth. These calcareous algae provide a hard substrate suitable for the settlement of diverse bryozoans. Both groups are favoured by the seasonal upwelling in the region, and together are important sediment producers on the shelf. This study explores the diversity of epiphytic bryozoans on the coralline algae and provides information about the ecological relationships between the two groups. About 3200 samples of algae were collected with a trawling net at 15 sampling stations parallel to the shoreline. Coralline algae display varied morphologies (foliose, encrusting, warty, lumpy, fruticose and branching) in plants belonging to the genera *Lithophyllum*, *Lithothamnion*, *Mesophyllum* and *Phymatolithon*. Preliminary identifications show that encrusting Cheilostomes are the most common bryozoans, with more than 30 species. The colonies vary in size, from a few millimeters to several centimeters, covering, in some cases, up to 100% of the algal surface. Bryozoan colonies interlayered with algae contribute to the growth of the algal nodules (rhodoliths). Species such as *Reptadeonella tubulifera*, *Biflustra tenuis*, *Exechonella antillea* and *Stylophora* spp. are the most common. The coralline algae host around 30% of the bryozoan fauna recorded on La Guajira continental shelf.

Keywords: Biodiversity, Caribbean, Hard substrate, Ecological associations.

BRYOZOANS ON THE SHELF BREAK IN THE PARQUE NACIONAL NATURAL CORALES DE PROFUNDIDAD, COLOMBIAN CARIBBEAN

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ABSTRACT

Mesophotic and deep-sea coral ecosystems of the Parque Nacional Natural Corales de Profundidad, located offshore the southern Colombian Caribbean, host a highly diverse associated biota. Biological communities and sedimentary facies of these ecosystems were investigated during the Invemar-Marcoral expedition in 2005. The bryozoan species composition, its distribution and roles in deep tropical habitats are the subjects of this study. Bryozoans are common producers of fossil and modern marine carbonate sediments, and a main component of bioclastic deposits. In the area studied, bryozoan skeletons represent around 1% of the sediments, which have mainly been characterized as sandy muds. Samples were collected from the continental shelf break, at depths of between 100 and 300 m, with a Van Veen dredge (28 effective collections) and a rock dredge (4 samples). The sediment samples collected were washed and sieved through a 2 mm mesh. Bryozoan specimens appear in 19 of the 32 sampled stations. A total of 76 species have been identified, 70 belonging to the order Cheilostomatida and six to Cyclostomatida. The principal colony-forms were encrusting (69%), narrow branched (11%), free-living (7%), foliose (5%), palmate (5%) and articulated (3%). Although tissue, membranes, and chitinous appendages are not preserved in the examined specimens, the damage of skeletons is relatively low, suggesting that colonies of the identified species may thrive close to the sampling point. The encrusting colonies were mainly found growing on the rubble of the calcareous green alga *Halimeda* sp. and the red macroalgae *Peyssonnelia* sp. and *Lithoporella* sp., as well as attached to fragments of mollusc shells, other bryozoans, corals, polychaete tubes, foraminifera, and pebbles. Twelve species are new records to the Colombian Caribbean Sea.

Keywords: Biodiversity, Marine Protected Area, Mesophotic, Deep-Sea.

ACTIVE SUBSTANCES FROM *CRYPTOSULA ZAVJALOVENSIS* KUBANIN, 1976 FROM JAPANESE WATERS

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ABSTRACT

Marine bryozoans may be used as new resources for antibacterial agents as alternatives to antibiotics in the treatment of pathogenic bacteria. Up to now, only a relatively small number of investigations covering bryozoan's antibacterial activity have been carried out. So, the antibacterial activity of most bryozoan species still remains largely unknown. This study aimed to investigate the antibacterial activity of the marine bryozoan *Cryptosula zavjalovensis*. Samples from Akkeshi (Japan Pacific coast) were used to obtain two types of extracts through water and methanol extraction methods which were then tested against 11 laboratory stoke bacterial strains (*Shigella* spp., *E. coli, Salmonella* spp., *Klebsiella* spp., *Xanthomonas* spp., *Bacillus* spp, *Enterobacteria* spp., *Pseudomonas* spp., *Actinobater* spp., *Staphylococcus* spp., *Vibrio* spp.). Bioassay results showed that both extracts exhibited antibacterial activity (inferred from the tested microorganism Zone Of Inhibition = ZOI) against all tested bacteria. Water extracts presented the highest activity against *Enterobacteria* spp. (ZOI=21mm) and lowest against *Xanthomonas* spp. (ZOI=15mm), whereas methanol extracts showed highest activity against *Bacillus* spp. (ZOI=24mm) and lowest against *E.coli* (ZOI=15mm). Moreover, all extracts exhibited a broad spectrum of antibacterial activity mostly against gram-negative bacterial strains indicating the potential use of this bryozoan as an antibacterial drug source against emerging pathogenic bacteria thus allowing a better strategy in the search for new antibiotic compounds.

Keywords: *Cryptosula zavjalovensis*, metabolites, antibacterial activity

PREDATOR-ANTIFOULING INDUCED POLYPHENISM IN FENESTRATE BRYOZOA FROM THE CARBONIFEROUS OF OAXACA, MEXICO

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ABSTRACT

Bryozoans have evolved a number of strategies to counteract the damaging affects of predation and antifouling. Recent forms can display a variety of polypides with different functions, grow skeletal structures such as spines through to the production of chemical metabolites. Skeletal structures that are inferred to have been developed as a response to potential predation and antifouling have been recognized in the fossil record. Outcrops of the Ixtaltepec Formation (Mississippian-Pennsylvanian) in the Santiago Ixtaltepec area, Oaxaca State, southern Mexico, have yielded fenestrate bryozoans with two distinct forms of such skeletal structures preserved on the obverse surface of colonies. Both morphotypes originate from pillar like structures, one forming simple straight radial arm like expansions, the other forming a much larger reticulate meshwork. These distinctive structures known as palaecorynid-type appendages, have historically been considered to be hydrozoans, algae, or independent bryozoans attached to fenestellid bryozoans. The preservation of these relatively delicate structures is very rare in the fossil record, and hitherto are known only from several species of fenestrate bryozoans from the Carboniferous of Great Britain, Europe and Canada. For the first time these palaeocorynid-type appendages are described in Mexico, and the reticulate form is the first recorded occurrence outside of Great Britain. These palaeocorynid-type appendages have been interpreted as structures that aided the protection of autozooecial polypides, acting as a surface deterrent to predators by providing a cover under which the bryozoan polypides could perform their normal feeding activities and maintain normal water flow, and thus by implication was an antifouling mechanism. Their development is interpreted as a predator-antifouling induced polyphenism analogous to those seen in living organisms.

Keywords: Mexico, Carboniferous, Fenestrate, Palaeocorynid, predation, polyphenism.

REPTADEONELLA IN EUROPEAN WATERS: THERE'S MORE IN IT THAN MEETS THE EYE

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ABSTRACT

In Europe, the tropical to warm-temperate genus *Reptadeonella* is represented by two Recent species: the elusive, offshore *Reptadeonella insidiosa* (Jullien), and the ubiquitous *Reptadeonella violacea* (Johnston), which has been recorded from its type locality, the southern British Isles, to the Mediterranean Sea and West Africa, as well as from the western Atlantic and eastern Pacific coasts of Central and North America. While this extremely wide geographic distribution suggests that the species was misidentified and/or represents a non-indigenous species in at least two of these biogeographic regions, close inspection of material from within Europe shows that the diversity even in the Temperate Northern Atlantic realm (TNA) is greater than hitherto acknowledged.

While the overall zooecial morphology is very similar to *R. violacea*, colonies from the southeastern Adriatic Sea (southern Croatia) are black instead of deep purple when living, most of the zooids have a much larger suboral avicularium, and they also produce small, tubular, interzooidal kenozooids that are unknown in *R. violacea* (but present in, for instance, *R. insidiosa*).

Another population that is morphologically even more similar to *R. violacea* occurs in the Azores (central North Atlantic). These colonies, however, are light-grey to blackish in colour, and also possess tubular kenozooids, suggesting that another distinct species is present in European waters, thus doubling the previously known number of Recent *Reptadeonella* species in the TNA.

EXPERIMENTAL STUDY ON THE EFFECT OF TEMPERATURE, FLOW VELOCITY, AND PARTICLE CONCENTRATION ON FEEDING AND DIGESTION IN *BUGULA NERITINA*

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ABSTRACT

A large amount of *Bugula neritina* may cause competition of food resources against the cultured oysters in Matsushima Bay. In this study, we investigate the difference in feeding activity and digestibility of *B. neritina* under different temperature, flow velocity, and food particle concentration. The number of lophophore and fecal pellets were used as an indicator of feeding activity and food intake, respectively; and the number of digested cells in the fecal pellets was also used as an indicator of digestibility. The colonies of *B. neritina* were collected in Matsushima Bay; various environmental data were also recorded at the same locality. After all feces were excreted in filtered seawater, branches for the experiment were obtained from a single colony. Each branch was washed and placed in a plastic case with a cultured dinoflagellate *Prorocentrum micans*. Five different temperatures of 5, 10, 15, 20, and 25ºC were set for the temperature experiment; three different flow velocities of 1 to 2, 5 to 6, and 9 to 10 cm/s under 25ºC were set for the experiment on flow velocity. The number of lophophores and fecal pellets were counted every two hours. In addition, at maximum 20 fecal pellets were selected and the number of digested and undigested cells in the fecal pellets were counted. Higher temperature, slower flow velocities, and higher particle concentration were found to increase both numbers of lophophore and fecal pellets. There were no differences in digestibility between the examined environments. These results suggest that the environment does not affect the digestibility of *B. neritina*, and the number of extended lophophores is directly linked to the bryozoan food intake and digestion volume.

Keywords: *Bugula neritina*, feeding activity, digestibility, temperature, flow velocity, particle concentration

THE LAST CRYPTOSTOME BRYOZOAN- *TEBITOPORA* FROM THE TIBETAN TRIASSIC

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ABSTRACT

Palaeostomates were the dominant bryozoans of the Palaeozoic but following the Permian mass extinction fewer than twenty genera are known from the Triassic and by the end this period the superorder was extinct. Cryptostome bryozoans are well known from the rocks of the Lower Ordovician to the Permian but in the Triassic only one genus – *Tebitopora* – has been described. *Tebitopora* was originally identified by Hu (1984) from Tibet and placed in the trepostome family Dyscritellidae; however, subsequent workers have considered it to be a cryptostome. Two species were originally described by Hu from Tibet but our investigations of the original thin sections suggests they are synonymous. *Tebitopora orientalis*, the last surviving species of the order Cryptostomata, has also been described from India and New Zealand. Although the etymology of *Tebitopora* was not stated when the genus was introduced by Hu, it seems very likely to have been derived from Tibet. Indeed, the handwritten labels on the thin sections give the name as "*Tibetopora*". In view of the fact that it has been spelled *Tebitopor*a in several subsequent publications, it seems better to retain prevailing use for the sake of nomenclatural stability.

Keywords: Cryptostome, Tibet, Triassic, taxonomy, nomenclature

TAXONOMIC STUDY ON PHIDOLOPORIDAE (BRYOZOA: CHEILOSTOMATA) FROM KOREA

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Poster presentation

ABSTRACT

The family Phidoloporidae Gabb & Horn, 1862, showing unique colony features rming a lacy network with zooids, is sometimes confused with lace corals by the scuba divers in Korea. Species of Phidoloporidae were found in shelf and coastal environments from the seas around Korea, but phidoloporid diversity is still unknown. Three species, *Iodictyum axillare* (Ortmann, 1890), *Phidolopora pacifica* (Robertson, 1908) and *Reteporellina denticulata* (Busk, 1884) have been reported from Korean waters so far. We have been keeping many unidentified phidoloporid Bryozoa, collected from many years of investigation, in the collection known as the Marine Bryozoans Resources Bank of Korea (MBRBK). Also, national institutions frequently request information on newly discovered lacy colonies for the purpose of tourism resource development. This study aims to investigate the Korean Phidoloporidae. As results of the present study, Korean Phidoloporidae (Bryozoa: Cheilostomata) were found to be seven species and four genera. Of which, one species, *Phidolopora elongata* (Smitt, 1866) is newly added to the Korean bryozoan fauna, and *Phidolopora* n. sp., *Triphyllozoon* n. sp. 1 and *Triphyllozoon* n. sp. 2 are new to science. The genus *Triphyllozoon* Canu & Bassler, 1917 is reported in Korean waters for the first time.

Keywords: Korea, Phidoloporidae, *Phidolopora*, *Triphyllozoon*, new species, new record.

BRYOZOANS FROM THE "SECO DE LOS OLIVOS" SEAMOUNT (CHELLA BANK) (SW MEDITERRANEAN SEA)

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ABSTRACT

Seco de los Olivos, also known as Chella Bank, is a volcanic submarine elevation located about 10 miles off the southern coast of Spain, within the Alboran Sea. This seamount is located in an Atlantic-Mediterranean marine transition area and a biodiversity hot spot within the European context, and harbors more than 600 species, including sponges, corals, polychaetes, decapods, algae, mammals, fishes and turtles. During the MEDWAVES expedition, within the framework of the EU H2020 ATLAS project, several deep areas of the Seco de los Olivos were investigated, which represented a good opportunity to improve the study of the biodiversity of different phyla, including the bryozoan fauna. Samples were collected with a Van Veen grab (11 samples) covering different bottom types, from which bryozoan individuals were extracted. A total of 31 specimens have been identified so far in hemipelagic muddy bottoms and coral rubble bottoms, including 23 Cheilostomatas and eight Cyclostomatas. Among them, two species are being described as new to science (*Scrupocellaria* and *Palmicellaria*) and three species are reported for the first time in the Mediterranean Sea (*Terminoflustra baleei*, *Marguetta pulchra*, and *Schizomavella linearis profunda*). Some species showed a high frequency of occurrence in the samples, such as in the case of *Reteporella pelecanus* that was found in the eight Van Veen samples analyzed so far and in the three samples collected by ROV, *Adeonellopsis distoma* that occurred in seven samples and the new species of *Palmicellaria* that was collected in six samples. Besides a high frequency, these species together with *Tervia* sp. showed high abundance values in the samples.

Keywords: Bryozoan fauna; Alboran Sea; coral rubble.

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CHEILOSTOME DIVERSITY FROM FIVE PLIO-PLEISTOCENE FORMATIONS IN THE WANGANUI BASIN OF NEW ZEALAND.

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ABSTRACT

The documentation of the diversity of fossil organisms is the basis from which hypotheses and models of how evolution has shaped communities over time can be built. Cheilostome bryozoans have an exceptional fossil record in the sense that it is even possible to discern interspecies differences in fossilized colonies such that species-level data can be collected from ancient communities. New Zealand has a particularly rich bryozoan diversity with more than 900 described extant and over 360 fossil species. The Pleistocene formations of the Wanganui Basin in New Zealand provide us with an excellent opportunity to study bryozoan faunas in the past. While recent studies have utilized the opportunity this rich diversity provides, the detailed documentation of this relatively well-studied fauna is far from complete. This work represents the continuing documentation of the fossil cheilostome diversity from the Wanganui Basin by closing some gaps within the time range for which we already have substantial data, but also by extending it. We do so by focusing on five formations: the Tainui Shellbed (~0.4 Ma) the Kaikokopu Shell Grit (0.77 Ma), the Okehu Shell Grit (0.90 Ma), Butlers Shell Conglomerate (0.98 Ma) and the Hautawa Shellbed (2.46 Ma). Specifically, we are accumulating data on species occurrences and intercolony interactions. The ultimate aims of this work are to further our knowledge on fossil cheilostome distribution, and also to contribute to our growing knowledge of the patterns and processes underlying competitive interactions among these sessile organisms.

Keywords: Paleodiversity, spatial competition,

THE GENUS *STYLOPOMA* (BRYOZOA, CHEILOSTOMATA) FROM BAHIA, NORTHEAST BRAZIL

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ABSTRACT

The genus *Stylopoma* Levinsen, 1909 comprises about 42 described species of bryozoans, including seven fossil species. This speciose genus is widely reported in tropical and subtropical waters, mainly in reefs area. Seven *Stylopoma* species were reported in Brazilian waters, including four species described in the last decade. In this study, we conduct a survey on the biodiversity of bryozoan species of *Stylopoma* genus in Bahia state, NE Brazil, including morphological characterization and comparison with other species of that genus. The specimens were deposited at the Zoology Museum of the Federal University of Bahia, Brazil (MZUFBA) and in the Bryozoa Collection of the Universidade Federal de Pernambuco, Brazil (UFPE). We found four species from Bahia coast: *Stylopoma aurantiacum* Canu & Bassler, 1928, *Stylopoma carioca* Winston, Vieira & Woollacott, 2014, *Stylopoma hastata* Ramalho, Taylor. & Moraes, 2018 and *Stylopoma rotundum* Winston, Vieira & Woollacott, 2014. Other four species were classified as new species. *Stylopoma aurantiacum* is the most common species in shallow waters of Bahia. More studies are needed to assess the diversity of genus *Stylopoma* in Brazilian coast, including undersampled area.

Keywords: Atlantic, Diversity, new species, Schizoporellidae, taxonomy

TURBICELLEPORA AVICULARIS-CORALLIUM RUBRUM RELATIONSHIPS FROM NW SARDINIA (MEDITERRANEAN)

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ABSTRACT

In present-day environments bryozoans are sometimes reported in association with gorgonaceans, and especially with basal stems or main branches, which remain partly exposed, especially after mass mortality events. The same association is often hypothesised for centimetre-sized fossil celleporiform colonies showing internal tubular cavities, which were originally the site of stem-like unpreserved substrata, sometimes corresponding to the horny axial skeletons of gorgonaceans.

On the other hand, the association of large bryozoans with the precious coral (*Corallium rubrum*) was only mentioned in some monitoring researches documenting damaged coral colonies. Samples from present-day Mediterranean point to the existence of complex relationships between *C. rubrum* and bryozoans. We examined material collected in summer 2002 along the NW coast of Sardinia, at *c.* 80 m depth, at the base of a circalittoral cliff with living red coral populations. Based on freshly broken and largely alive fragments, we present evidence of relationships between the red coral and the bryozoan *Turbicellepora avicularis*, a species forming large-sized celleporiform colonies. *T. avicularis* covers exposed skeletal portions but also encrusts coral branches coated with living tissues. Sections of few fragments show successions of interlayering mm-thick skeletons of *C. rubrum* and *T. avicularis*. Basal portions of small red coral colonies encrust the external surface of the celleporiform bryozoan. This points to complex relationships between these two large-sized, engineer species, including competition for space. Their bioconstructions provide “space” for further species, including several small-sized, mostly encrusting to celleporiform bryozoans.

FIRST MORPHOLOGICAL ANALYSIS OF AN ARACHNIDIOIDEAN: *ARACHNIDIUM FIBROSUM*

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ABSTRACT

The ctenostome superfamily Arachnidioidea contains very heterogenous colony and zooids, and are commonly characterized by cystid appendages capable of anastomosing. Two of its families are solitary, one boring and two are regular colonial ones, the Nolellidae and Arachnidiidae. The latter is a little investigated family with few genera that like the entire superfamily requires thorough revision. The origin of cheilostomes is often deducted from an arachnidioidean-like ctenostome ancestors, but morphological data on recent members of the Arachnidiidae is completely missing with the exception of some general information on colony structure. Therefore, we conducted the first morphological analysis of the arachnidiid *Arachnidium fibrosum* from European waters. *Arachnidium fibrosum* forms flat encrusting colonies with distinct cystid appendages on the basal side, but also characteristically distributed over the frontal surface of zooids. Focus of the current pioneer study is to study zooidal anatomy via serial semithin sections and 3d reconstructions. Detailed structure of the digestive tract, muscular system and interzooidal communication will be presented and compared to other gymnolaemates.

Keywords: Single, Paragraph, Summarizes, words indentation (maximum 6 words)

PREDATOR-ANTIFOULING INDUCED POLYPHENISM IN FENESTRATE BRYOZOA FROM THE CARBONIFEROUS OF OAXACA, MEXICO

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ABSTRACT

Bryozoans have evolved a number of strategies to counteract the damaging affects of predation and antifouling. Recent forms can display a variety of polypides with different functions, grow skeletal structures such as spines through to the production of chemical metabolites. Skeletal structures that are inferred to have been developed as a response to potential predation and antifouling have been recognized in the fossil record. Outcrops of the Ixtaltepec Formation (Mississippian-Pennsylvanian) in the Santiago Ixtaltepec area, Oaxaca State, southern Mexico, have yielded fenestrate bryozoans with two distinct forms of such skeletal structures preserved on the obverse surface of colonies. Both morphotypes originate from pillar like structures, one forming simple straight radial arm like expansions, the other forming a much larger reticulate meshwork. These distinctive structures known as palaecorynid-type appendages, have historically been considered to be hydrozoans, algae, or independent bryozoans attached to fenestellid bryozoans. The preservation of these relatively delicate structures is very rare in the fossil record, and hitherto are known only from several species of fenestrate bryozoans from the Carboniferous of Great Britain, Europe and Canada. For the first time these palaeocorynid-type appendages are described in Mexico, and the reticulate form is the first recorded occurrence outside of Great Britain. These palaeocorynid-type appendages have been interpreted as structures that aided the protection of autozooecial polypides, acting as a surface deterrent to predators by providing a cover under which the bryozoan polypides could perform their normal feeding activities and maintain normal water flow, and thus by implication was an antifouling mechanism. Their development is interpreted as a predator-antifouling induced polyphenism analogous to those seen in living organisms.

Keywords: Mexico, Carboniferous, Fenestrate, Palaeocorynid, predation, polyphenism.

FROM SHALLOW TO DEEP: BATHYMETRIC PATTERNS OF DISTRIBUTION OF BRYOZOANS FROM THE NORTHEASTERN ATLANTIC

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ABSTRACT

Fauna distribution and diversity along environmental gradients are topics of a number of studies in marine ecosystems; among these environmental factors, depth plays an important drive in the distribution of the fauna. Here, preliminary results about the study of the vertical diversity and patterns of distribution of Bryozoans are presented. For this study, 6531 records of 394 species distributed on 834 localities along the Atlantic Iberian margin, from the intertidal to 2789 m depth, are analyzed. Atlantic Iberian margin is oceanographically very similar along the latitudinal range, with the same currents and water masses all along. The general pattern is the reduction of the number of species with the depth but with a drastic reduction of diversity in the first 100 meters. The exception is a small increase of the number of species between 400 and 600 m of depth, probably related with the occurrence of rocky substrates in the continental slope. Bryozoan assemblages exhibit four main bathymetric discontinuities, around 100, 300, 600 and 1100 m, being similar to what is observed in other invertebrates. Besides, a small correlation between the minimum depth of the species range and the width of the vertical range of the distribution is observed, as deeper species tend to show wider ranges.

MYOANATOMY OF THE LOPHOPHORE IN BRYOZOANS AND PHORONIDS SUPPORTS THE LOPHOPHORATES MONOPHYLY

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ABSTRACT

The lophophore is the main synapomorphy of the lophophorates, whose monophyly is not supported by many recent data of molecular phylogeny. At the same time, some morphological data evidence the presence of homologous elements in the nervous system of the lophophore in phoronids, brachiopods, and bryozoans. Because the organization of the lophophoral musculature may also provide insight into lophophorates relationship, myoanatomy of poorly studied groups such as phoronids warrants detailed investigation. Original data on phoronid lophophoral myoanatomy were obtained in four phoronid species with different morphology of the lophophore: *Phoronis ovalis*, *Phoronis ijimai*, *Phoronis australis*, *Phoronopsis harmeri*. Although the myoanatomy of the lophophore differs in details, it exhibits the similar ground plan, which is four-partitioned and includes (i) frontal and abfrontal muscles of the tentacles that connect to (ii) distal paired groups of muscles of tentacular lamina and (iii) longitudinal muscles of tentacular lamina that connect with (iv) the circular muscle. Comparative analysis revealed that the same four-partitioned ground plan may be found in all main groups of bryozoans; it includes (i) frontal and abfrontal tentacle muscles that connect with (ii) paired muscle sets, either one pair of inverted V-shaped muscles (in Stenolaemata and Phylactolaemata) or two pairs of V- and then inverted V-shaped muscles (in Gymnolaemata); and (iii) a single median muscle (most often referred to as buccal or oral dilatator) that connects to (iv) the pharyngeal circular muscles. The four-partitioned ground plan of the lophophoral musculature in phoronids and in bryozoans indicates the homology of the lophophore and the monophyly of the lophophorates as a united clade that includes Phoronida, Bryozoa, and Brachiopoda. This study is supported by Russian Science Foundation (#18-14-00082).

Keywords: Phoronida, Brachiopoda, musculature, evolution, Lophophorata

ORGANIZATION OF THE NERVOUS SYSTEM IN CYCLOSTOME *CRISIA EBURNEA* AND EVOLUTION OF THE CEREBRAL GANGLION IN BRYOZOANS

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ABSTRACT

Among bryozoans, cyclostome anatomy is the least studied by modern methods. New data on the nervous system make morphological analysis much more fruitful to resolve some questions of bryozoan evolution and phylogeny. The nervous system of cyclostome *Crisia eburnea* was studied by transmission electron microscopy and confocal laser scanning microscopy. The cerebral ganglion has an upper concavity and a small inner cavity filled with cilia and microvilli, thus exhibiting features of neuroepithelium. The cerebral ganglion is associated to the circumoral nerve ring, the circumpharyngeal nerve ring, and the outer nerve ring. Each tentacle has six longitudinal neurite bundles. The body wall is innervated by thick paired longitudinal nerves. The nervous system of the cyclostome *C. eburnea* combines phylactolaemate and gymnolaemate features. Innervation of tentacles by six neurite bundles is similar of that in Phylactolaemata. The presence of circumpharyngeal nerve ring and outer nerve ring is characteristic of both, Cyclostomata and Gymnolaemata. The structure of the cerebral ganglion may be regarded as a result of transformation of hypothetical ancestral neuroepithelium. This transformation may be traced within recent bryozoans: the primitive ganglion with large upper concavity and inner cavity in Cyclostomata, the ganglion with large inner cavity filled with cilia and microvilly in Ctenostomata, the ganglion with small inner cavity that lacks cilia and microvilli in Phylactolaemata, and the solid ganglion without inner cavity in most of Gymnolaemata. Primitive cerebral ganglion and combination of nerve plexus and cords in the nervous system of *C. eburnea* allows to suggest that the nerve system topography of *C. eburnea* may represent an ancestral state of nervous system organization in Bryozoa. This study is supported by Russian Science Foundation (#18-14-00082).

Keywords: nervous system, lophophore, evolution, cerebral ganglion

TYPES AND FIGURED BRYOZOAN SPECIMENS OF THE HISTORICAL COLLECTIONS OF THE MUSÉUM NATIONAL D'HISTOIRE NATURELLE (PARIS) NOW ONLINE THROUGH THE DIGITIZING PROGRAM RECOLNAT

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ABSTRACT

Recolnat is a national program aiming at digitizing and making available collection information and images of type and figured specimens housed in Natural History collections of France. The treatment of Bryozoan collections of the Muséum National d'Histoire Naturelle in Paris started in 2018. All together the paleontology and biology collection departments gather 18152 types or figured bryozoan specimens. The paleontological collections are of major values, including the specimens published by A. d'Orbigny F. Canu, E. Buge, G. Lecointre, O. Balavoine, major authors for fossil bryozoan taxonomy. Numerous types were taken from the historical collections of J.B. Lamarck, H. Michelin, A. Tournouër, R. Fourtau, F. Ameghino, J.V.F. Lamouroux, H. Milne Edwards, etc. The biology collections were assembled mostly through ocean exploration by French vessels, and recent programs of marine biodiversity description. Bryozoans were studied extensively during the 20th century by authors like J. Julien, L. Calvet, J.-L. d'Hondt, V. Gauthier, J.-G. Harmelin, L. David, G. Echallier. A total of 3333 pictures are currently available online, associated to specimen information of the Museum collection database (https://science.mnhn.fr/). Part of the pictures are taken on SEM using modern publication standards (thanks to S. Martha), other were made on a high-resolution optical microscope are offer a direct observation of colony characters (Recolnat Team). All images are available for research and can be used in publication, with citation of the source data. We expect the database to become a valuable resource for all bryozoan taxonomists.

Keywords: database, pictures, MNHN, paleontology, biology, collections.

A NEW COLLECTION OF PHYLACTOLAEMATE BRYOZOANS FROM THE AMAZON

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In May, 2018 we conducted a new bryozoan survey in the Amazon River system in the vicinities of Manaus and Santarém. Collecting was done from an outboard skiff, examining substrata of submerged wood, macrophytes, floating buoys and plastic debris. At the time of this abstract preparation the results include:

- At least five distinctive, undescribed species, including a fredericellid and four plumatellids;
- The first collection of colonies for *Plumatella marcusi*, *P. osborni*, and *P. siolii*;
- The first collection of sessoblasts for *Plumatella marcusi*;
- Other known species: *Plumatella casmiana*, *P. emarginata*, and *P. jariensis;*
- The first known collection of the ctenostome, *Potsiella erecta* in the Amazon..

In additional to *Pottsiella erecta*, ctenostomes included *Hislopia corderoi*, *Timwoodienella natans*, and a species tentatively identified as *Hislopia lacustris*. Two of the new phylactolaemate species were encountered only once, suggesting the strong likelihood that additional bryozoan species in the Amazon are yet to be found.

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