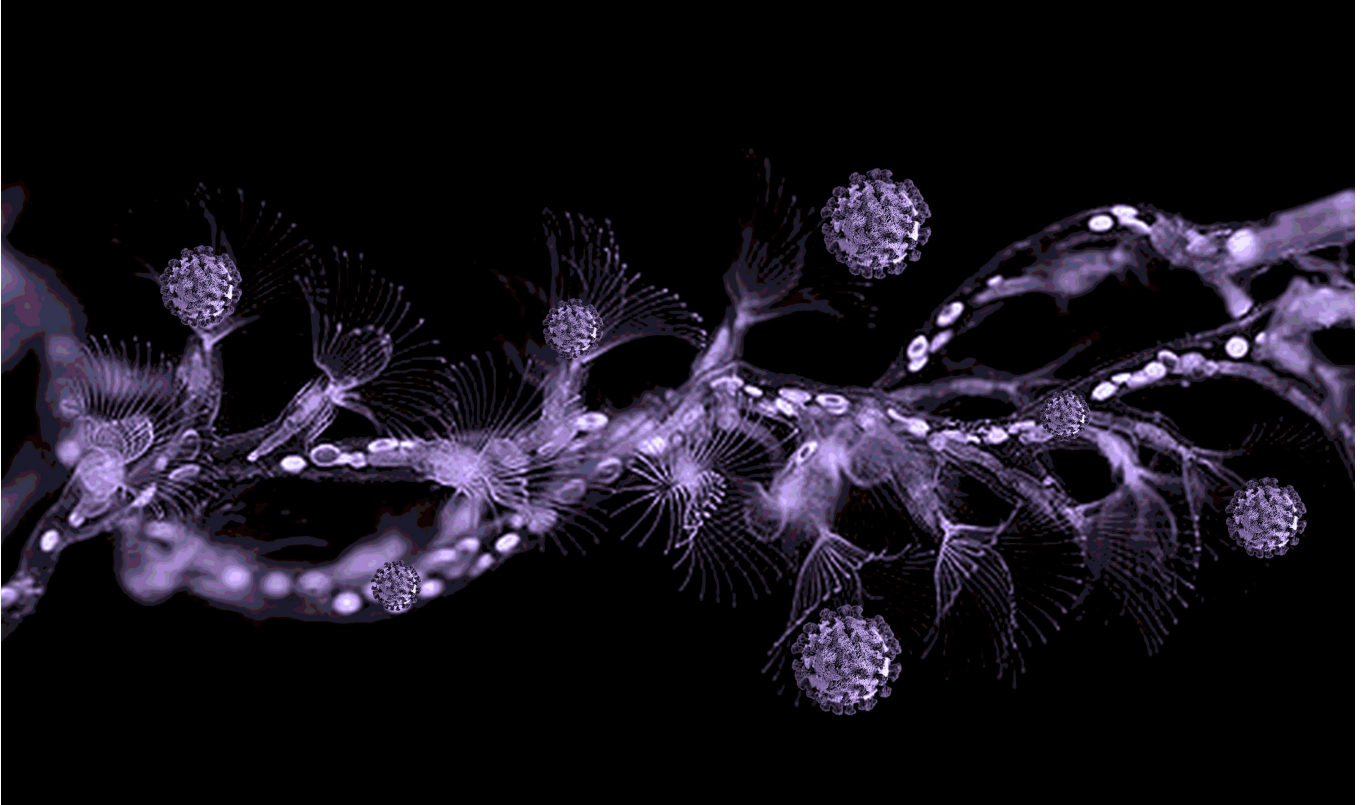


WEB LARWOOD 2020



BRYOZOOLOGISTS VS COVID-19

ABSTRACTS

MONDAY 5TH OCTOBER 2020
SESSION 1
START: 7.30 GMT

CHAIRS
PETER BATSON
HELEN JENKINS

CHARACTERIZATION OF THE SKELETAL MATRIX OF THREE ANTARCTIC BRYOZOANS
(TERRA NOVA BAY, ROSS SEA)

Chiara Lombardi¹, C. Mazzoli², P. Kuklinski³, F. Marin⁴

1 Marine Environment Research Centre ENEA, Via Forte Santa Teresa, 19032 Pozzuolo di Lerici, La Spezia, Italy

2 Department of Geosciences, University of Padova, Padova, Italy

3 IOPAN Sopot, Poland

4 UMR CNRS 6282 Biogéosciences, Bâtiment des Sciences Gabriel, Université de Bourgogne – Franche-Comté (UBFC), Dijon, France

Contact person: chiara.lombardi@enea.it

At the southwest edge of the Ross Sea, the centre of the highest productivity of the Southern Ocean, is located Terra Nova Bay (TNB), with an extension of 6000 km². The bay is characterized by *polynyas* persisting during wintertime, formed and preserved by strong katabatic winds that keep the area free of ice and responsible for temperature drops. Analogously to the Ross Sea, TNB experiences big phytoplankton blooms during summer months, due to the ice melting, with important consequences on planktonic and rich benthic communities. Also, climate changes, occurring rapidly in polar areas are accelerating this phenomenon, with consequences on marine communities. Erect bryozoans are part of them, by aggregating different species and forming small forests, they promote biodiversity and play an important role in carbon immobilization (Barnes 2015, Lombardi et al. 2020). How bryozoans form their skeletons and how the skeletal matrix is affected by environmental conditions is still unknown. 'IceClimaLizers' project, funded by Italian National Program for Antarctic Research, aims to investigate the role of bryozoans as proxies of climate change and to clarify some gaps in biomineralization processes. Hundreds of different proteins have been identified in the skeletal matrix of representatives of calcifying marine invertebrates (cnidarians, molluscs, echinoderms) (Marin et al. 2016) but almost nothing is known about the macromolecules of bryozoan skeletal matrices (Hunt 1972, Jeuniaux 1982). The proteins are key to understanding biomineralization mechanisms and they are also implicated in the control of skeletal carbonate polymorph (aragonite and calcite) precipitation. We investigate the proteinaceous components of bryozoan skeletal matrices of three bioconstructional Antarctic bryozoans. Three species of bioconstructional bryozoans have been collected during XXXIV Italian Expedition to Antarctica (November 2018) in Tethys Bay (TNB) by means of Scuba diving at 20 m of depth and by using a Remotely Operated underwater vehicle at 110 m of depth. The three species have been taxonomically identified (SEM and micro CT-Scan), then their respective skeletal matrices have been extracted and studied by SDS-PAGE, FT-IR Spectroscopy, Enzyme-Linked Lectin Assay (ELLA) and proteomics. Morphological investigations reveal two different *Cellarinella* species, *C. nutti* and *C. njegovane*, collected at 20 and 110 m respectively, with growth check lines indicating approximately 5 years old colonies, and *Reteporella frigida* Waters 1904, collected at 20m. Despite the different depth, the two *Cellarinella* species show rather similar - but not superimposable - lectin profiles, with strong signals recorded with 8 to 10 lectins, in particular jacalin (a lectin that binds to D-galactose or oligosaccharides terminating with this sugar), and with WGA, LEL and STL, these three lectins being considered as chitin-binding lectins. The main differences between the two *Cellarinella* genera relate to the high affinity of *C. njegovane* matrix to succinylated WGA and to DSL, while *C. nutti* matrix is unreactive with these two lectins. The lectin profile of *Reteporella frigida* is significantly different, with LEL and STL as the most reactive lectins, followed by jacalin, DSL and WGA, all the other lectins being poorly or not reactive. Finally, proteomics was performed on different matrix fractions (soluble, insoluble) of these three species and the results are under analysis.

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Type of contribute: Regular Talk

BRYOZOAN DIVERSITY OF THE INDIAN EEZ

Soja Louis ¹

¹ Assistant Professor, Department of Zoology, St. Teresa's College (Autonomous), Ernakulam, Kochi, Kerala, INDIA

Contact person: sojalouis@yahoo.co.in

Bryozoans constitute a vital component of the benthic community and forms an integral part of the continental shelves so as to regulate the ecology of the marine environment. They are found from subtidal to the great ocean depths. The Indian Ocean as a whole is a more understandable subregion, bounded by great continental landmasses but even this is illusory, as on its eastern side tropical water flows continuously to the Pacific Ocean (Sheppard, 2000). India being a continent surrounded by Indian Ocean on all three sides, mainly by the Arabian Sea on its west and Bay of Bengal on its east, has a well-defined vast coastline of about 7500 km and an EEZ of 2,172 million square km (NIO, 2018). Designated as a tropical country accounts for the reef associated biodiversity as well. This clearly suggests the possible immense bryozoan diversity the continental shelves of the country can hold.

41 stations of the Indian EEZ were investigated and the 70% of dredged samples were encrusted by bryozoans, which also confirms that they are well distributed in Indian waters. They show more exceptional levels of species diversity than any other taxonomic group of organisms known today. In spite of the enormous amount of progress in various aspects of research, these enigmatic creatures remain neglected. This paper brings forth the diversity of bryozoans reported to date from the Indian EEZ. Extensive studies have revealed that more than 300 species occur in the continental shelf region of the SW and SE coasts of India (Menon, 1967; Menon and Menon, 2006; Soja 2007; Soja and Menon, 2009; Venkataram *et al.*, 2016; Soja *et al.*, 2017; Maria *et al.*, 2018; 2019). The taxonomic identifications of 135 bryozoans from the east coast and 174 from the west coast of India are reported.

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Type of contribution: Regular Talk

BRYOZOAN REEFS OF WESTERN PORT, VICTORIA, AUSTRALIA

Adrian Flynn ¹, D. Donnelly ¹, T. Dutka ², N. Wilson ², A. Fejer ¹

¹ Fathom Pacific, Australia

² La Trobe University

Contact person: philbock1@gmail.com, adrian.flynn@fathompacific.com

The tide-dominated inlet of Western Port in southern Australia is notable for sea-grass beds, tidal flats, and mangrove habitats. A series of reefs have been encountered in the tidal channels of the eastern part of the bay.

Many of these have been constructed by bryozoans, principally *Celleporaria foliata*, *Triphyllozoon umbonatum* and *T. moniliferum*. Investigations have been accomplished by diving, and with multibeam sonar. The bryozoan mounds extend from about 2 to 7 metres depth. Across 62 sites, 31 have been identified as bryozoan constructions. These have proved to be a habitat for a wide variety of other animals. These exceptional environments are considered to be vulnerable to damage, either from anchor damage, or from sediment accumulation. A proposal for environmental protection is under preparation.

Type of contribution: Digital Object

IN SITU GROWTH OF *CELLARIA* *IMMERSA*

Katerina Achilleos¹, A. M. Smith¹

¹ Department of Marine Science, University of Otago, P. O. Box 56, Dunedin 9054, New Zealand

Contact person: achka774@student.otago.ac.nz

Fifteen colonies of *Cellaria immersa* were deployed on the Otago shelf, off Dunedin, New Zealand in order to study their growth *in situ*. A mark-recapture method was followed to measure the colonies' growth. Specimens were collected off Otago (170.79 E, 45.84 S) at 56 m depth. Large healthy living colonies were immersed in seawater with calcein (300 mg/L) on board for about 6 hours. The colonies were then mounted on a purpose-built frame, called "Odyssey", deployed back at the collection point and left out on the shelf for three months in the Austral summer (November–February). Water temperature was recorded throughout the deployment using a temperature logger. Despite storms and rapid currents, we were able to relocate and recover ten fragmented colonies. After the collection of the specimens, the colonies were examined under a light microscope to observe the state of the colonies. They were subsequently inspected under a microscope under 495 nm excitation frequency in order to observe the calcein markings. Specimens that were never immersed in calcein were also inspected and used as negative controls. Temperature for the three months varied between 9–15.9 °C. The maximum growth recorded was three longitudinal zooid series, about 0.7mm, while other living internodes showed less than that or even no growth at all. This growth variation among the internodes, suggests that the distribution of nutrients is not equal between the internodes but rather selective, for reasons that are not yet understood. Also, newly-settled colonies did not show any growth during the three months suggesting that colonies of that age might choose to first secure the young colonies by growing more rhizoids and further deposition of minerals horizontally rather than investing in upright vertical growth.

The growth rate observed herein is slower compared to other cellariid species such as *C. incula* and *Melicerita chathamensis* that are found in the area, and other temperate species such as *C. sinuosa*. This raises several questions whether the slower growth rate observed for *C. immersa* is indeed species specific, or whether chemical markers tend to overestimate the growth rate of other cellariid. On the other hand, considering that the growth rate is not consistent among the internodes, the growth rate observed here could potentially not represent the entire duration of the three months if the colony "chose" at a certain point to use the nutrients elsewhere.

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Type of contribution: Regular Talk

DIVERSITY DYNAMICS OF CHEILOSTOME BRYOZOANS

Paul D. Taylor¹, F. Moharrek¹, H. L. Jenkins^{1,2}, D. Silvestro³,
D. P. Gordon⁴, A. Waeschenbach¹

¹ Department of Life Sciences, Natural History Museum, London SW7 5BD, UK

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

³ Department of Biology, University of Fribourg, Ch. de Musee 10, CH-1700 Fribourg, Switzerland

⁴ National Institute of Water & Atmospheric Research, Private Bag 14901, Kilbirnie, Wellington 6022, New Zealand

Contact person: p.taylor@nhm.ac.uk

Cheilostomes are overwhelmingly the most diverse and ecologically dominant order of bryozoans living today in the sea. Yet, cheilostomes first appeared as recently as the Late Jurassic (c. 155 Ma), more than 300 million years after the other orders. Genus-level range compilations have been used previously to show the pattern of cheilostome diversification. As part of a project funded by the Leverhulme Trust, we have compiled new and more comprehensive data on generic diversity through time, which are compared to earlier results, including those from a recent paper employing machine learning (Kopperud et al. 2019). In addition, we have analysed corrected and augmented assemblage occurrence data from the Paleobiology Database (PBDB) using PyRate, a probabilistic framework that jointly estimates the temporal dynamics of origination and extinction as well as preservation (comprising fossilization, sampling and taxonomic identification models).

Despite substantial differences in estimates of the times of origination and extinction, the cheilostome generic diversity pattern found in the new compilation closely resembles those from earlier studies. However, re-dating of numerous supposed Maastrichtian originations as Campanian in age dampens down the Maastrichtian as an outlier of high generic diversity. Broadly similar diversity dynamics are also evident when the PyRate analyses of PBDB-derived data are compared with the revised range data.

Multivariate birth-death model correlations of origination and extinction rates with continuous abiotic variables revealed that sea surface temperature was positively correlated with origination rates, whereas sea level and dissolved oxygen were negatively correlated with extinction rates. Furthermore, cheilostomes own diversity showed a negative correlation with origination rates, indicating a diversity-dependent slowdown of diversification in the clade.

Further improvement in our understanding of cheilostome diversity dynamics can only be achieved through detailed taxonomic research on newly collected fossils from unsampled localities worldwide as well as neglected material held in museum collections.

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Type of contribution: Regular Talk

FINE STRUCTURE OF THE MEMBRANOUS SAC IN *HORNERA*
(STENOLAEMATA: CYCLOSTOMATIDA)

Yuta Tamberg¹, P. B. Batson¹, A. M. Smith¹

¹ Department of Marine Science, University of Otago, PO Box 56, Dunedin, New Zealand

Contact person: yutamberg@gmail.com

Unlike other bryozoans, the polypide of cyclostomates is surrounded by a membranous sac (MS), which splits the main body cavity into the exosaccal and the endosaccal (=coelomic) compartments (Nielsen & Pedersen, 1979). Previous studies demonstrated that MS includes a single peritoneal layer, extracellular matrix (ECM) and circular muscles. It is anchored to the skeleton proximally at the origins of the retractor muscles and funiculus, and distally with vestibular ligaments, all of which stabilise the polypide during protrusion and retraction.

We studied five species of Hornerids from southern New Zealand; polypides were fixed in retracted and expanded states and examined with light microscopy and TEM.

All examined species have two proximal MS attachments in common. *Hornera robusta* has no additional anchoring, but others have well-defined vestibular ligaments.

The membranous sac undergoes significant shape changes with eversion–retraction of the polypide, as it moves 300–500 µm in the zooid tube. The distance from aperture to polypide attachments is conserved in all zooids, indicating progressive polypide cycles (*sensu* Boardman, 1998) in *Hornera*. As the zooid grows, degenerated polypides accumulate proximally and a new polypide is always budded distally.

The outer surface of the MS is often overlaid with large squamous cells. Although we saw no cell polarization or cell contacts (hallmarks of epithelial organisation), the exosaccal surface is not a "naked" ECM, reported in *Crisia*.

The anchoring structures of the membranous sac show a striking uniformity: in all cases specialized endocyst cells of similar morphology are interposed between the ECM of the MS and the skeletal wall. The nucleated somata are displaced sidewise, like the handle of a frying pan, whereas central thin portions are sandwiched between ECM and the skeleton. Numerous hemidesmosomes are scattered on the apical and basal membranes and give rise to long bundles of tonofilaments.

The membranous sac is often interpreted as a peritoneal lining "peeled off" from the epidermis. Indeed, the endocyst epithelium is devoid of ECM throughout the colony. The only areas reminiscent of the original condition (epidermis–ECM–peritoneum) are found in the MS anchoring sites. However, localised tensile forces during retraction and eversion of the polypides must have required significant specialization, converting normal epidermal cells into tendon cells. We speculate that in polypide degeneration–regeneration cycle, old tendon cells release the brown body, and new tendon cells are formed distally during polypide regeneration, although this has never been examined.

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Type of contribution: Regular Talk

RELATIONSHIP BETWEEN ENVIRONMENTAL FACTORS AND THE REPRODUCTIVE STRATEGY OF
BUGULA NERITINA (PHYLUM: BRYOZOA)

Vanessa Yepes-Narváez ¹, R. Preziosi ¹

¹ Ecology and Environment Research Centre, Manchester Metropolitan University, Manchester M1 5GD
United Kingdom.

Contact person: vanbryozoa@gmail.com

Bryozoans have the evolutionary ability to reproduce sexually and asexually and to switch between these strategies in response to changes in the environment. The degree of adaptability of individual species is reflected in its ability to produce sexual structures such as ovicells in response to natural fluctuations in its environment.

To examine this in a widely distributed bryozoan, several colonies of *Bugula neritina* were collected in contrasting geographical areas of the Atlantic and Pacific Oceans from 1 to 5 m depth. This sampling approach allowed us to evaluate the reproductive strategies developed under different climatic seasons, substrates, and environmental factors and determine if there is a relationship between these factors and reproduction. The reproductive strategies were evaluated as means of ovicell density, their position within the colony, zooid and colony size.

Our results showed that colonies inhabiting similar ecosystems with contrasting environmental factors differed in their reproductive strategies and morphometry. In addition, we suggested a possible trade-off between zooid features and ovicell production, when colonies invested in sexual polymorphisms, a reduction in zooid and colony size was observed. The significant environmental factors that affect *B. neritina* reproductive strategy were salinity, temperature and primary productivity. These factors were both modelled and collected *in situ*. Specimens in the Colombian Caribbean reproduce sexually during the dry season and invest in colony growth by budding during the rainy season.

Type of contribution: Regular Talk

ORIGIN, FUNCTION AND MAINTENANCE OF THE FRONTAL BODY WALL
IN A FREE-WALLED CYCLOSTOME

Peter B. Batson¹, Y. Tamberg¹, P. D. Taylor², D. P. Gordon³

¹ Department of Marine Science, University of Otago, 310 Castle Street, Dunedin, 9054, New Zealand

² Departments of Earth & Life Sciences, Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

³ NIWA, Private Bag 14901, Kilbirnie, Wellington, 6241, New Zealand

Contact person: peter.batson@postgrad.otago.ac.nz

Hornerids have a free-walled (=interior) frontal body wall. Because the hypostegal cavity of this wall is continuous with the exosacal cavities of the autozooids, it must retain colony-wide integrity throughout colony life (~10+ years). With this in mind, we investigated the topologically outer body wall (OBW) of *H. robusta* to better understand the roles and capabilities of this delicate structure.

Origin: TEM of protoecia and ancestrulae suggests that the hornerid interior-walled OBW configuration may form *de novo* soon after metamorphosis, rather than by later retroflexive growth over an established exterior-walled ancestrula (cf. trepostomes, fenestrates).

Morphology: In *Hornera*, the skeleton-secreting and cuticle-secreting epithelia form two, mostly separated, layers. Our findings confirm Nielsen and Pedersen's prediction about composition of these layers in a free-wall cyclostome (epidermis only, no basement membrane/coelothelium). In addition to classical epidermis, various atypical cells and extracellular structures are distributed non-randomly across the OBW.

Epithelial degeneration/regeneration: Epithelial cells of the OBW undergo terminal transformation into "foamy" bodies (identical to those arising in the lophophoral epidermis during the early phase of polypide degeneration), implying a corresponding replenishing of cell layers.

Moultling: OBW cuticle is only ~65 nm thick, yet it must persist for years. To achieve this, *Hornera* undergoes cuticle replacement via moultling (first record in the Stenolaemata).

Wall integrity: Mechanical damage to the OBW presents the risk of loss of fluid from the hypostegal cavity and/or ingress of pathogens. OBW epithelia have the ability to secrete new cuticle and bind it directly to the skeleton to form watertight bulkheads, sealing the wall when needed.

Metabolite storage and transport in the body wall: Large, osmiophilic and lipid-stain-positive vesicular cell aggregations are concentrated within skeletal sulci (grooves) at the openings of cancelli, suggesting a metabolite storage role. The hypostegal cavity is available for metabolite translocation through the colony, most likely by diffusion. Gradients in the hypostegal cavity may directly affect cancellus development, mapping resource allocation dynamics within the colony.

Part shedding: *Hornera* actively sheds a variety of skeletal parts (branches, gonozooids, peristomes and adventitious struts). This process involves an orchestrated OBW response implemented in concert with zooidal regression and skeletal resorption.

Although more investigation is needed, it is evident that the OBW is a complex, dynamic and multi-functional organ with self-renewal and repair capabilities. As living analogues of extinct palaeostomates, all of which were free-walled, hornerids may offer insights into the roles and capabilities of ancient body walls.

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Type of contribution: Regular Talk

BRYOZOANS ON TV

Abigail M. Smith ¹

¹ Marine Science, University of Otago, Dunedin, NZ

Contact person: abby.smith@otago.ac.nz

In 2016, the popular BBC documentary programme *Coast* came to NZ. Neil Oliver and various local broadcasters worked together to produce three seasons of *Coast New Zealand*, shining their enthusiastic light on historical, cultural, and natural wonders in various part of the country.

Series 3, Episode 4 focused on North Otago, broadcast in March 2018.

This was where bryozoans got their moment!

I will show you the entire 4:11 film clip. Those of you who have been to the Whitestone City of Oamaru will recognise it. You'll also discover how many bryozoans it takes to make a limestone quarry.

Type of contribution: Speed Talk

DIVERSITY AND DISTRIBUTION OF FRESHWATER BRYOZOA IN INDIA: A REVIEW

Satish Mokalsh¹, H. Ananta²

¹ Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India, 431004

² Department of Zoology, New Arts, Commerce and Science College, Ahmednagar, Maharashtra, India, 414001

Contact person mokalsh@rediffmail.com

The article reviews the diversity and distribution records of freshwater Bryozoa in India.

The two classes namely Gymnolaemata and Phylactolaemata are represented by 29 species. The Gymnolaemata are represented by four species whereas Phylactolaemata are represented by 25 species. Three out of these species are reported for the first time from this region. Distribution records of all species are available for 18 states and 1 union territory of India and reveal that information is missing for some areas. These areas have to be explored in order to understand the real pattern of diversity and distribution of freshwater bryozoans in India.

Type of contribution: Regular Talk

BIMINERALIC BRYOZOANS: WHO, WHAT, WHERE, WHEN, WHY?

Abigail M. Smith¹, J. Loxton², M. M. Key Jr³¹ Department of Marine Science, University of Otago, Dunedin, New Zealand² School of Geoscience, University of Edinburgh, Edinburgh, Scotland, UK³ Department of Geology, Dickinson College, Carlisle, PA, USAContact person: abby.smith@otago.ac.nz

One of the useful applications of biologically precipitated carbonate is as a record of past environmental conditions. While biomineralisation can be controlled by environment, many invertebrates exert biological control over the calcification process, micro-managing nucleation, ultrastructure, and composition. At the same time, calcification can change and develop along with ontogeny/astogeny (Smith & Lawton 2010) or be determined by phylogenetic factors (Smith et al. 2012). Even highly-controlling mineralisers, however, may be partly influenced by environmental parameters such as temperature, salinity, depth or pH (Lombardi et al. 2011; Figuerola et al. 2015; Smith et al. 2016).

Marine bryozoans, a so-called “minor” phylum with a limited profile and many unknowns, are nevertheless the most-studied and best-known of calcifying invertebrates in terms of skeletal composition. Unlike some groups, where only a handful of species have actually been measured (e.g., 29 chiton species; Peebles et al. 2017), marine bryozoans have been extensively studied at both ends of the Earth (e.g. Smith et al. 2006; Kulinski & Taylor 2009; Krzeminska et al. 2016; Loxton et al. 2018), such that the mineralogies of at least 4000 specimens of over 850 species have been reported.

Bryozoan skeletons are mineralogically variable: they can be entirely calcitic, entirely aragonitic, or bimineralic, including both CaCO₃ polymorphs or two distinct calcites with different Mg levels (Smith et al. 2006). There is a wide range of Mg content in bryozoan calcite, ranging from nearly-pure calcite (0-1 wt% MgCO₃) to low-Mg calcite (LMC, 1-4 wt% MgCO₃), intermediate-Mg calcite (IMC, 4-8 wt% MgCO₃) to high-Mg calcite (HMC, ≥8 wt% MgCO₃).

The combination of large volumes of published data and high levels of natural variation makes bryozoans the ideal system in which to investigate influences and controls on calcification and mineralogy. Here we report on patterns of carbonate mineralogy in bryozoans of the order Cheilostomatida (where most of the variation occurs), using only Recent species (to avoid diagenetic issues) with bimineral skeletons (the most variable) and at least five different specimens tested (for statistical robustness).

Among the questions we hope to explore with these data are:

Who? To what extent is phylogenetic position a predictor of a bimineral mineralogy?

What? What are the different modes of bimineralism, and how common are they?

Where? How much does environment affect bimineral skeletal mineralogy?

When? How does mineralogy vary with age/growth/astogeny?

Why? What are the advantages of a bimineral skeleton?

Our overarching goal is to understand more about the influences and controls on skeletal carbonate mineralogy in the Bryozoa, and by extension among marine invertebrates generally.

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Type of contribution: Regular Talk

TUESDAY 6TH OCTOBER 2020
SESSION 1
START: 13:00 GMT

CHAIRS
JASMINE FERRARIO
SEBASTIAN DECKER

**MAD MART ANALYSIS OF ENVIRONMENTAL (TEMPERATURE) CHANGE:
INSIGHTS BRYOZOANS FROM A LATITUDINAL GRADIENT (60-79°N)
IN THE NORTH ATLANTIC**

Steven J. Hageman¹, A. Stepien², P. Kukliński³, M. Włodarska-Kowalczyk³

¹ Appalachian State University, Boone, North Carolina USA

² University of Łódź, Łódź, POLAND,

³ Institute of Oceanology, Polish Academy of Sciences, Sopot, POLAND

Contact person: hagemansj@appstate.edu

MART analysis (Mean Annual Range of Temperature) applies the empirical observation that in many groups body size is inversely correlated with temperature (O'Dea and Okamura 2000; mathematically revised by McClelland et al. 2014). MART analysis in bryozoans does not seek to determine absolute ambient temperatures, but rather to estimate the MART range as a proxy for the relative seasonality that a contemporaneous bryozoan fauna experienced during their life history. MART analysis is based on the normalized amount of within-colony variation of zooid body size, averaged across as many bryozoan species as possible and thus represents a faunal level signal, rather than details of individual zooids, colonies or species (O'Dea and Okamura 2000). MART analysis has generated valuable insights about paleoseasonality, primarily in the Cenozoic (see Okamura et al. 2011 for review), but questions remain about the degree of interspecies variation in body size response to temperature change and the complexities of interpreting the driving factors of temperature change at the oceanographic level, e.g. recognition of major paleo-current systems and the degree of impact that local environmental variation can have on zooid body size (Hageman and Todd, 2017).

In a study of encrusting, shallow marine bryozoans in a latitudinal gradient from the Shetland Island to Spitsbergen in the northern Atlantic, we performed traditional MART analysis on 149 colonies, from 13 species and five Regions in an area of expectedly low MART (4.5–9.0°C) using methods of O'Dea and Okamura (2000), Okamura et al. (2011), and McClelland et al. (2014). In addition, we explored the Mean Absolute Deviation (MAD) of the coefficient of variation (CV) zooid body size ($ZI \times Zw$). MAD analysis can be thought of as an assessment of the relative amount of variation that exists in the CV of the body size, i.e. a nonparametric version of the coefficient of variation of multiple CVs. MAD analysis allows for evaluation differences in CVs of colonies or species based on relatively low sample size. MAD analysis as applied here is not a replacement of MART, but rather an expansion of the method that allows for exploration of responses of body size to changing temperature conditions, i.e. identify which species conform most closely to the theory, or which sample locations exhibit greater variation, regardless of trends of averages.

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Type of contribution: Regular Talk

MORPHOLOGY OF THE BORING:
FIRST DATA ON THE BRYOZOAN FAMILY PENETRANTIDAE

Sebastian Decker¹, T. Schwaha¹

¹ Integrative Zoology, Department of Evolutionary Biology, University of Vienna,

Contact person: decker-s@gmx.de

An endolithic lifestyle within mineralized substrates has many advantages and thus evolved multiple times in various different taxa of organisms. Such a peculiar lifestyle also evolved multiple times within the benthic suspension feeding phylum Bryozoa.

Among bryozoans these are all from the paraphyletic ctenostome gymnolaemates and colonize predominantly the shells of living and dead molluscs.

The family Penetrantiidae is particularly interesting and includes one genus with approximately a dozen species. Based on the presence of an operculum and other morphological characters, the genus *Penetrantia* was debated to be either a ctenostome or cheilostome bryozoan. The most recent, wider morphological analysis dates back to the 40ies' of the last century.

Consequently, the aim of this study is to analyze the morphology of the genus *Penetrantia* with more sophisticated and modern methods such as micro-CT imaging for investigations on the colonial architecture, together with immunocytochemistry and confocal laser scanning microscopy in order to gain a more detailed perspective on zooidal morphological characters of the genus and to assess whether these are supporting a closer relationship to ctenostome or cheilostome bryozoans.

Type of contribution: Regular Talk

NEW SPECIES OF BRYOZOAN INVADERS IN THE FRESHWATER COMMUNITIES OF
PROTECTED NATIONAL AREAS IN EUROPEAN PART OF RUSSIA

Valentina I. Gontar ¹

¹Laboratory of brackish water hydrobiology, Zoological Institute RAS, Saint Petersburg, University Quay, 1, 199034

Contact person: gontarvi@gmail.com

Spreading of species (biological invasions) has been taking place since the Neolithic times due to the removal of geographic and environmental barriers that limited the natural spread. Scientific and practical interest in the process of spreading of species (biological invasions) is determined by its evident influence on the current state of terrestrial and aquatic ecosystems. The flexibility (multivariable) of the overall strategy is manifested, among other things, through the implementation of various patterns of the seasonal dynamics of the resettlement stages. Brackish water conditions, warming and the involvement of the Finnish Bay region in a system of international shipping may enhance the spread of alien marine and freshwater species, including fouling.

The freshwater Bryozoa *Plumatella geimermassardi* Wood & Okamura, 2004 was found for the first time in the Kopora Bay of the Gulf of Finland in the Baltic Sea at the border of the reserve fouling on artificial substrate. Alien species are being implemented on biodiversity and ecosystem functions.

To aid accurate estimates, observations of the bottom populations were carried out and the freshwater bryozoan *Plumatella similirepens* Wood, 2001 was found on the southern shore of the specially protected natural area, Udomlya Lake, fouling on stones. Both species are the first findings in the European part and new for the freshwater bryozoan fauna of Russia. The conditions for the formation of fouling of *Plumatella similirepens* can be described in Lake Udomlya. Under the pattern, we understood the totality of time ("timing") and quantitative characteristics.

The structural and functional parameters of marginal communities depend on both technological and biotic factors in the techno-ecosystems of thermal and nuclear power plants in terms of their composition, spatial structure, development in the conditions of lotic/lentic, and change in time. Consequently, knowledge can be relevant to classify the encountered bryozoans, as a number of species that have a flexible survival strategy, in the changing environmental conditions that are formed under the influence of increasing power station capacity. Probably, a flexible strategy for the survival of these bryozoans is the reason for the successful development by phylactolaemates of diverse global water bodies and the rapid recolonization of ecosystems disturbed as a result of techno genic transformation by separate species, which leads to environmental impacts and economic costs, for example due to biofouling.

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Type of contribution: Digital Object

ONYCHOCELLID CHEILOSTOME BRYOZOANS WITH PROXIMALLY ORIENTED AVICULARIA FROM
THE CAMPANIAN AND THE MAASTRICHTIAN OF UZBEKISTAN

Anna V. Koromyslova ¹

¹ Borissiak Paleontological Institute of the Russian Academy of Science, Profsoyuznaya st. 123,
117997 Moscow, Russian Federation

Contact person: koromyslova.anna@mail.ru

Onychocellid cheilostome bryozoans, *Onychocella retroversa* Favorskaya, 1992 and *Onychocella insueta* Favorskaya, 1985 have proximally oriented avicularia. The first species comes from the lower Campanian (*Cibicidoides temirensis/Bolivinooides decoratus decoratus* Zone) of the southern Aral Sea region in Uzbekistan; the latter species comes from the Maastrichtian of the central Kyzyl Kum Desert in Uzbekistan. Both species are represented by two specimens each, which are deposited in F.N. Chernyshev Central Research Geological Survey Museum (TsNIGR Museum), St. Petersburg, coll. nos. 12582 and 12048.

Avicularia of *O. retroversa* are proximally oriented, vicarious, sparse, drop-shaped, smaller than autozooids; rostrum short, slightly asymmetrical, channelled and with pointed apex; proximal part rounded, longer and wider than rostrum; cryptocyst pustulose, concave; opesia large, roundish.

Avicularia of *O. insueta* are proximally oriented, vicarious, sparse, rhomboidal, same length as autozooids; rostrum asymmetrical, lapping onto cryptocyst of proximolateral autozooid, channelled and with pointed apex; proximal part rounded, shorter and wider than rostrum; cryptocyst pustulose, concave; opesia large, oval.

Based on a revision by Taylor et al. (2018), both species cannot be allocated in the genus *Onychocella* Jullien, 1882. Indeed, *Onychocella* has encrusting colonies and bell-shaped opesia of autozooids, while *O. retroversa* and *O. insueta* have erect bifoliate colonies, and opesia of autozooids subcircular in *O. retroversa* and semielliptical with indentations at the proximolateral corners in *O. insueta*. Records of onychocellid bryozoans having avicularia contrasting autozooid's orientation are scarce. Among them, *Sonarina tamilensis* Taylor and Di Martino, 2018 from the late Campanian or the early Maastrichtian of India, and *Tyloporella smithi* Di Martino and Taylor, 2013 from the late Campanian to the Maastrichtian of the United Arab Emirates, having proximolaterally oriented avicularia. However, *O. retroversa* and *O. insueta* differ from the genus *Sonarina* in having erect bifoliate rather than encrusting colonies, and lacking avicularia associated with row bifurcations and reticulate ornamentation covering the cryptocyst. Both species differ from the genus *Tyloporella* Voigt, 1989 in having avicularia that are vicarious and much larger.

O. retroversa can be tentatively assigned to the genus *Dictuonia* Jullien, 1882 because of its autozooids hexagonal or diamond shaped having subcircular opesia and missing opesicular indentations and lateral constrictions. *O. insueta* is instead more closely related to some species in the genus *Rhagasostoma* Koschinsky, 1885 having erect bifoliate colonies and opesia of autozooids with indentations at the proximolateral corners (Taylor et al., 2018; Koromyslova et al., 2018).

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Type of contribution: Regular Talk

NEW RECORDS OF BRYOZOANS
IN THE ALBORAN PLATFORM (NW MEDITERRANEAN SEA)

Laís V. Ramalho ¹, R. Rodrigues Aporta ²

¹. Museu Nacional – Universidad Federal do Rio de Janeiro. Quinta da Boa Vista s/n, RJ Rio de Janeiro, Brazil.

² Universidad de Málaga – Facultad de Ciencias Biológicas, Departamento de Biología Animal. Málaga, Spain.

Contact person: laisvr10@yahoo.com

The Alboran Sea, located in the Western Mediterranean Sea between the southern Iberian Peninsula and northern Africa, is connected to the Atlantic Ocean, through the Strait of Gibraltar. Due to this location and its higher productivity, the Alboran basin has been considered one of the main biodiversity hotspots of the Mediterranean Sea (Templado 2011; Gofas et al. 2012; Ramalho et al. 2020). Alborán platform, located at Alboran Sea (35°56'20"– 35° 56'35" N y 3°01'45"– 3° 02'10"W) is a small and volcanic island with a part emerged (ca. 70,000 m²) and it is rounded by a plateau, relatively shallow, ca. 200 m depth. Previous taxonomic studies carried out around the Alboran Island (Harmelin & d'Hondt 1992a, b; Alvarez 1992, 1994) mentioned a total of 70 species collected between 28 and 480 m depth. More recently, new expeditions throughout the INDEMARES project sampled different areas from the Alborán Sea, including the Alborán platform (Gofas et al. 2012). Some taxonomic studies were carried out, recording the molluscs, sponges, cnidarians, polychaetes, crustaceans, echinoderms. Bryozoans were not analysed, besides the mention that this group was very well represented in the material (Gofas et al. 2012). So, here we show the results of the analyses from four samples collected at depths between 95 and 120 meters on a biogenic gravel bottom (e.g. small rocks and shells). The original material, firstly fixed in formol 4%, was washed and then dried; whole colonies fixed on different substrates and dead/alive fragments of bryozoan were picked and then prepared to be photographed using scanning electronic microscopy at the Málaga University (Spain). Sixty-six taxa belonging to 52 genera and 32 families have been identified. One species is proposed here as new (*Escharella* sp. nov.), nine taxa were identified at generic level (*Chorizopora* sp., *Hemicyclopora* sp., *Cupuladria* sp., *Hippothoa* sp., *Schizomavella* sp., *Stomatopora* sp., *Tubulipora* sp., *Exidmonea* sp., and *Crisia* sp.) of which two may be undescribed species, and one remains at family level (Lichenoporidae). Among the 55 species identified, 21 are new records for the Alboran platform. The result here referred, covered only a small part of the material sampled (4 from the 44 samples), suggesting the number of bryozoan species in the Alboran platform is higher than known until now, showing the importance of this area to the bryodiversity.

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Type of contribute: Regular Talk

FIRST MODERN MORPHOLOGICAL DATA ON LOPHOPODID PHYLACTOLAEMATA:
IMPLICATIONS FOR THE NEURO-MUSCULAR GROUND PATTERN OF THE CLADE

Julian Bibermaid¹, T. S. Wood², T. Schwaha¹

¹Department of Evolutionary Biology, University of Vienna

²Department of Biological Sciences, Wright State University

Contact person: Julian.Bibermaid@univie.ac.at

Phylactolaemates are an exclusively limnetic small group within bryozoans, with approximately 90 species subdivided into 6–7 families. Phylactolaemate colonial growth patterns range from spherical, including a cluster-like arrangement of the zooids (*Cristatellidae*, *Lophopodidae*, *Pectinatellidae*) to branching colonies with serial arranged, often chitinous/ encrusted zooids (*Fredericellidae*, *Plumatellidae*).

Traditional phylogenies considered clustered phylactolaemates as late-branching compared to the early-branching plumatellids/fredericellids.

Recent molecular analyses, however, suggest the clades with clustered colonies to be earlier branching.

Lophopodid phylactolaemates are one of the earliest branches among this clade. The morphology of this family remains little investigated but important for a ground pattern reconstruction of the clade.

Consequently, the aim of this study is to provide a morphological analysis of the lophopodid *Asajirella gelatinosa*. More complete morphological analyses of this species date back to the 19th century and allows, and emphasizes, the necessity of newer data on this species. The morphology of *A. gelatinosa* is analysed with histological sections and 3D-reconstruction, as well as immunocytochemical stainings and confocal microscopy for details on the neuro-muscular system.

The new data will represent an essential piece for phylactolaemate character evolution and shed more light into the morphological ground pattern of phylactolaemates.

Type of contribution: Regular Talk

PLACING LEAVES ON BRANCHES: GENOME-SKIMMING
REVEALS THE RELATIONSHIPS BETWEEN NEW ZEALAND CHEILOSTOMES

Russell J.S. Orr¹, E. Di Martino¹, M.H. Ramsfjell¹, D. P. Gordon², A. M. Smith³, L. H. Liow^{1,4}

¹ Natural History Museum, University of Oslo, Oslo, Norway

² National Institute of Water and Atmospheric Research, Wellington, New Zealand

³ Department of Marine Science, University of Otago, Dunedin, New Zealand

⁴ Centre for Ecological and Evolutionary Synthesis, Department of Biosciences, University of Oslo, Oslo, Norway

Contact person: rjsorr@ulrik.uio.no

The New Zealand cheilostome bryozoan fauna is taxonomically, functionally and ecologically diverse and better characterized than many other such faunas in the world.

In this presentation, we present a 17 gene phylogeny of >250 cheilostome bryozoan taxa from New Zealand waters assembled from our ongoing genome-skimming work.

Some genera represented by multiple species in our tree, including *Steginoporella*, *Macropora*, *Dimetopia*, *Crepidacantha*, *Chaperiopsis*, *Microporella*, *Rhynchozoon*, form supported monophylies. Some families represented by multiple genera, such as Catenicellidae are also proving to be monophyletic in our dataset.

In contrast, other family groups are separated into polyphylies, such as Microporidae. Our statistically well-supported New Zealand molecular phylogeny lends credit to existing phylogenetic hypotheses based on morphological observations, especially at lower taxonomic levels, but does not wholly conform to the current high-level classification of cheilostomes.

This work illustrates a general need for rethinking of bryozoan higher-level systematics, ideally based on both morphological and molecular data. We also discuss the challenges in building a cheilostome tree that will facilitate further evolutionary research including those pertaining to trait evolution and diversification rates and an emerging understanding of the phylogenetic history of cheilostomes.

Type of contribution: Regular Talk

ARE RED SEA MARINAS A SOURCE OF BRYOZOANS TO THE MEDITERRANEAN SEA?

Jasmine Ferrario ¹, J. Souto-Derungs ², M. El-Metwally ³, A. Marchini ¹, A. Occhipinti-Ambrogi ¹

¹ Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy

² Institut für Paläontologie, Geozentrum, Universität Wien, Vienna, Austria

³ National Institute of Oceanography and Fisheries (NIOF), Hurghada, Egypt

Contact person: jasmine.ferrario@unipv.it

In this work we investigated fouling communities along the Egyptian coast of the Red Sea, especially focussing on species that are known to have been introduced in the Mediterranean Sea. A survey on fouling species colonizing artificial substrates in 7 Red Sea marinas was conducted in summer 2017. Samples were collected with two methods: PVC panels (3 months of colonization) and by scraping different artificial substrates.

In total, more than 100 species were identified, Bryozoa being one of the most represented taxonomic groups. Bryozoa are generally considered a significant component in fouling communities: many species encrust submerged artificial structures, displaying opportunistic and tolerant attitudes (Wisley 1962; Gordon & Mawatari 1992; Marchini et al. 2015).

In the investigated area a total of 23 bryozoans were observed, out of which 15 could be identified at species level: *Amathia* cf. *gracilis*, *Amathia verticillata*, *Amathia* cf. *tortuosa*, *Bugula neritina*, *Bugula vectifera*, *Celleporaria inaudita*, *Cradoscrupocellaria bertholletii*, *Hippopodina* sp. A (sensu Ulman et al. 2017), *Parasmittina egyptiaca*, *Parasmittina raigii*, *Parasmittina spondylicola*, *Savignyella lafontii*, *Schizoporella errata*, *Trematooecia persica*, *Watersipora subtorquata*.

Among the 15 species identified: 6 were considered native, 1 non-indigenous for the Red Sea (namely *A. verticillata*), and 8 cryptogenic (Powell 1967, 1969; Ostrovsky et al. 2011). Interestingly, 12 out of the 15 species identified are also present in the Mediterranean Sea, and 4 are considered NIS in the basin: *A. verticillata*, *Hippopodina* sp. A, *P. egyptiaca* and *P. spondylicola* (Harmelin et al. 2009; Harmelin 2014; Marchini et al. 2015; Ulman et al. 2017; Ferrario et al. 2018). In general, this result supports the hypothesis that these species could have been introduced by boats departing from marinas located in the Red Sea. The same vector could have supported the spreading of cryptogenic bryozoans, contributing to their cosmopolitan distribution.

In view of these preliminary results, a broader monitoring in Red Sea port habitats and an estimation of the traffic of vessels across the Suez Canal should be performed to clarify the ongoing alteration of the distribution of marine biota caused by human activities.

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Type of contribution: Speed Talk

MONITORING AND MANAGEMENT PRIORITIES
FOR NEW ZEALAND HABITAT-FORMING BRYOZOANS

Hannah Mello¹, A. M. Smith¹

¹ Department of Marine Science, University of Otago, Dunedin, New Zealand

Contact person: melha265@student.otago.ac.nz

New Zealand has one of the largest exclusive economic zones in the world, with 96% of NZ territory underwater (Jarvis and Young 2019). Bryozoan-dominated biogenic habitat are both abundant and diverse on the New Zealand continental shelf; bryozoan thickets cover an estimated total area of seafloor greater than 1500 km² (Wood 2014). Bryozoan thickets are often used as habitat by commercially-valuable species, which can result in heavy fishing of the thickets (Bradstock and Gordon 1983, Batson and Probert 2000). Bottom fishing has caused a decrease in abundance of bryozoan thickets around New Zealand (Cranfield et al. 2003, Wood et al. 2013), although the extent of this damage is unknown. It is thought that a marine reserve where bottom fishing is restricted will prevent additional damage to the bryozoan colonies and let previously damaged colonies recover. It is uncertain, however, what “recovery” might look like for New Zealand habitat-forming bryozoans post-protection (Collier et al. 2016, Gillespie and Vincent 2019). This knowledge gap inhibits our ability to design effective restoration programs, as an ecological understanding of the system that is being managed is required to support management practices (Egoh et al. 2014, Crouzeilles et al. 2016).

Existing protected areas that focus on heavily-calcified bryozoans have no targeted monitoring programs or recovery targets (McCrone 2001), which has made it impossible to quantify success of management practices. Looking forward, new marine reserves should have well-defined, informed management goals, statistically-sound monitoring strategies, and a thorough understanding of the biology and ecology of target species to make reasonable management decisions that result in significant positive change to bryozoan thickets. These strategies should complement existing conservation policy objectives, both nationally (Department of Conservation 2000, Jarvis and Young 2019) and globally (Secretariat of the Convention on Biological Diversity 2005). Here, we overview current priorities in conservation management, describe possible management and monitoring strategies for future marine reserves, and suggest complementary biological and ecological investigations of New Zealand habitat-forming bryozoans. From this, we aim to create a standardized framework so management entities can create robust datasets that maintain their value with changing social, political, and environmental conditions.

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Type of contribution: Regular Talk

A FAMILY-LEVEL MOLECULAR PHYLOGENY OF CHEILOSTOME BRYOZOANS

Helen L. Jenkins^{1,2}, R. Graham¹, A. Hall¹, P.D. Taylor¹, D.P. Gordon³, F. Moharrek¹, M. Spencer Jones¹, P. Kukliński⁶, L.M. Vieira⁵, J.S. Porter⁶, A.C. Almeida⁵, B. Berning⁷, W. Florence⁸, A.M. Smith⁹, A.N. Ostrovsky^{10,11}, J. Souto Derungs¹⁰, M. Krzemińska⁴, E. Di Martino¹², E. Håkansson¹³, P. Bock¹⁴, H. Grant¹⁵, J.-G. Harmelin¹⁶, O.N. Kotenko¹¹, A. O'Dea¹⁷, A. Waeschenbach¹

¹ Department of Life Sciences, Natural History Museum, London, UK

² Marine Biological Association, The Laboratory, Citadel Hill, Plymouth, UK

³ National Institute of Water and Atmospheric Research, Wellington, New Zealand

⁴ Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland

⁵ Department of Zoology, Federal University of Pernambuco, Recife, Brazil

⁶ International Centre for Island Technology, Heriot-Watt University, Orkney, UK

⁷ Geoscience Collections, Upper Austrian State Museum, Austria

⁸ Natural History Department, Iziko South African Museum, Cape Town, South Africa

⁹ Department of Marine Science, University of Otago, Dunedin, New Zealand

¹⁰ University of Vienna, Department of Palaeontology, Vienna, Austria

¹¹ Saint Petersburg State University, Department of Invertebrate Zoology, Saint Petersburg, Russia

¹² Natural History Museum, University of Oslo, Oslo, Norway

¹³ University of Western Australia, School of Earth Sciences, Perth, Australia

¹⁴ Museums Victoria, Melbourne, Australia

¹⁵ Institute of Evolutionary Biology, University of Edinburgh, Edinburgh, UK

¹⁶ OSU Pytheas, MIO, Station Marine d'Endoume, 13007 Marseille, France

¹⁷ Smithsonian Tropical Institute, Panama City, Republic of Panama

Contact person: helen.jenkins@nhm.ac.uk

A core goal of our Leverhulme Trust funded project *Molecules meet fossils – an integrated approach to studying palaeodiversity* is to produce a family-level molecular phylogeny of cheilostome bryozoans. After three intense years of fieldwork, specimen solicitation, sequencing and data analysis, we have now reached this goal.

Our current phylogeny includes representatives for 103 families, equating to ~76% of all currently known cheilostome families. Our genome-skimming approach enabled us to include material with a chequered and suboptimal preservation history and that yielded as little as 10 ng of total DNA in some cases. We will present overall evolutionary patterns, as well as focus on parts of the tree of particular interest. This tree will ultimately be time-calibrated using a total-evidence approach, which will utilise a morphological matrix of 145 fossil and all sequenced Recent taxa. The time-calibrated tree will be used to estimate rates of speciation and extinction through time, which will be explored in light of palaeoenvironmental conditions, the origin(s) of morphological and functional traits and increased competition through the cumulative filling of ecological niches through time. These results will be compared and contrasted with inferences based on the fossil record alone, which indicate that self-diversity, sea surface temperature, sea level and dissolved oxygen have played an important role in shaping the evolution of cheilostome bryozoans (see Taylor et al. presentation).

Type of contribution: Regular Talk

ACKNOWLEDGEMENTS

We would like to thank A. Waeschenbach for suggesting the idea of a WebMeeting. This gave us the opportunity to 'share' two days discussing about bryozoans, even if remotely. The Web Larwood enables all IBA members to actually participate, making it possible to meet virtually colleagues from all over the world. We are grateful to P. Batson for support in scheduling the timetable, N. Sokolover and M. Spencer Jones for checking the abstracts, and the four chairpersons (P. Batson, S. Decker, J. Ferrario and H. Jenkins) for leading the sessions. We are especially grateful to C. Reid for her daily support in communication to all IBA members. We would like to acknowledge the University of Catania for hosting this meeting on its TEAMS platform and in particular its IT staff (especially R.M. Raffa and the responsible E. Commis) for the valuable support. Finally, we thank all participants taking part in this WebMeeting, bringing contributions from all over the globe, sharing their latest findings on bryozoans, despite the difficulties caused by the COVID-19 crisis.

SCHEDULE

5th
October

	TIME (GMT)	Type of contribute	Speaker	Title	Country
	06:30		Chiara	Opening WebLarwood	
<i>Chairs</i>					
<i>Peter</i>	6:45-	Regular Talk	Chiara	Characterization of the skeletal matrix of three Antarctic bryozoans (Terra Nova Bay, Ross Sea)	Italy
<i>Batson</i>	7:00-		Lombardi, Frederic Marin		
	7:00-	Regular Talk	Soja Louis	Bryozoan diversity of the Indian EEZ	India
	7:15-				
	7:15-	Digital Object	Phil Bock	Bryozoan Reefs of Western Port, Victoria, Australia	AU
	7:25-				
	7:30-	Regular Talk	Katerina Achilleos	In situ growth of <i>Cellaria immersa</i>	NZ
	7:45-				
	7:45-	Regular Talk	Paul D. Taylor	Diversity dynamics of Cheilostome bryozoans	UK
	8:00-				
	15'		<i>breake</i>		
<i>Helen</i>	8:15-	Regular Talk	Yuta Tamberg	Fine structure of the membranous sac in <i>Hornera</i> (Stenolaemata: Cyclostomatida)	NZ
<i>Jenckins</i>	8:30-				
	8:30-	Regular Talk	Vanessa Yepes- Narvaez	Relationship between environmental factors and reproductive strategy of <i>Bugula neritina</i> (Phylum: Bryozoa)	UK
	8:45-				
	8:45-	Regular Talk	Peter B. Batson	Origin, function and maintenance of the frontal body wall in a free-walled cyclostome	NZ
	9:00-				
	9:00-	Speed Talk	Abigail M Smith	Bryozoans on TV	NZ
	9:10-				
	9:15-	Regular Talk	Satish Mokashe	Diversity and Distribution of freshwater Bryozoa in India: A Review	India
	9:30-				
	9:30-	Regular Talk	Abigail M Smith	Bimineralic Bryozoans: Who, What, Where, When, Why?	NZ
	9:45-				
	9:45-		Abigail	<i>Speech as treasurer</i>	
	9:50-				

6th
October

Chairs
Jasmine
Ferrario

TIME (GMT)	Type of contribute	Speaker	Title	Country
13:00-13:15	Regular Talk	Steven J. Hageman	MAD MART analysis of environmental (temperature) change: insights bryozoans from a latitudinal gradient (60-79°N) in the North Atlantic	USA
13:15-13:30	Regular Talk	Sebastian Decker	Morphology of the boring: first data on the bryozoan family Penetrantidae	Austria
13:30-13:40	Digital Object	Valentina I Gontar	New species of bryozoan invaders in the freshwater communities of protected national areas in European part of Russia	Russia
13:45-14:00	Regular Talk	Anna V. Koromyslova	Onychocellid cheilostome bryozoans with proximally oriented avicularia from the Campanian and the Maastrichtian of Uzbekistan	Russia
14:00-14:15	Regular Talk	Laís V. Ramalho	New records about Bryozoans in the Alboran Island (NW Mediterranean Sea)	Spain
15'		<i>breake</i>		
14:30-14:45	Regular Talk	Julian Bibermaier	First modern morphological data on lophopodid Phylactolaemata: Implications for the neuromuscular ground pattern of the clade	Austria
14:45-15:00	Regular Talk	Russell JS Orr	Placing leaves on branches: Genome-skimming reveals the relationships between New Zealand cheilostomes	Norway
15:00-15:10	Speed Talk	Jasmine Ferrario	Are Red Sea marinas a source of bryozoans to the Mediterranean Sea?	IT
15:15-15:30	Regular Talk	Hannah Mello	Monitoring and management priorities for New Zealand habitat-forming bryozoans	USA
15:30-15:45	Regular Talk	Helen Jenkins	A family-level molecular phylogeny of cheilostome bryozoans	UK
16:00		Antonietta, Chiara and Silvia	<i>End of the meeting</i>	