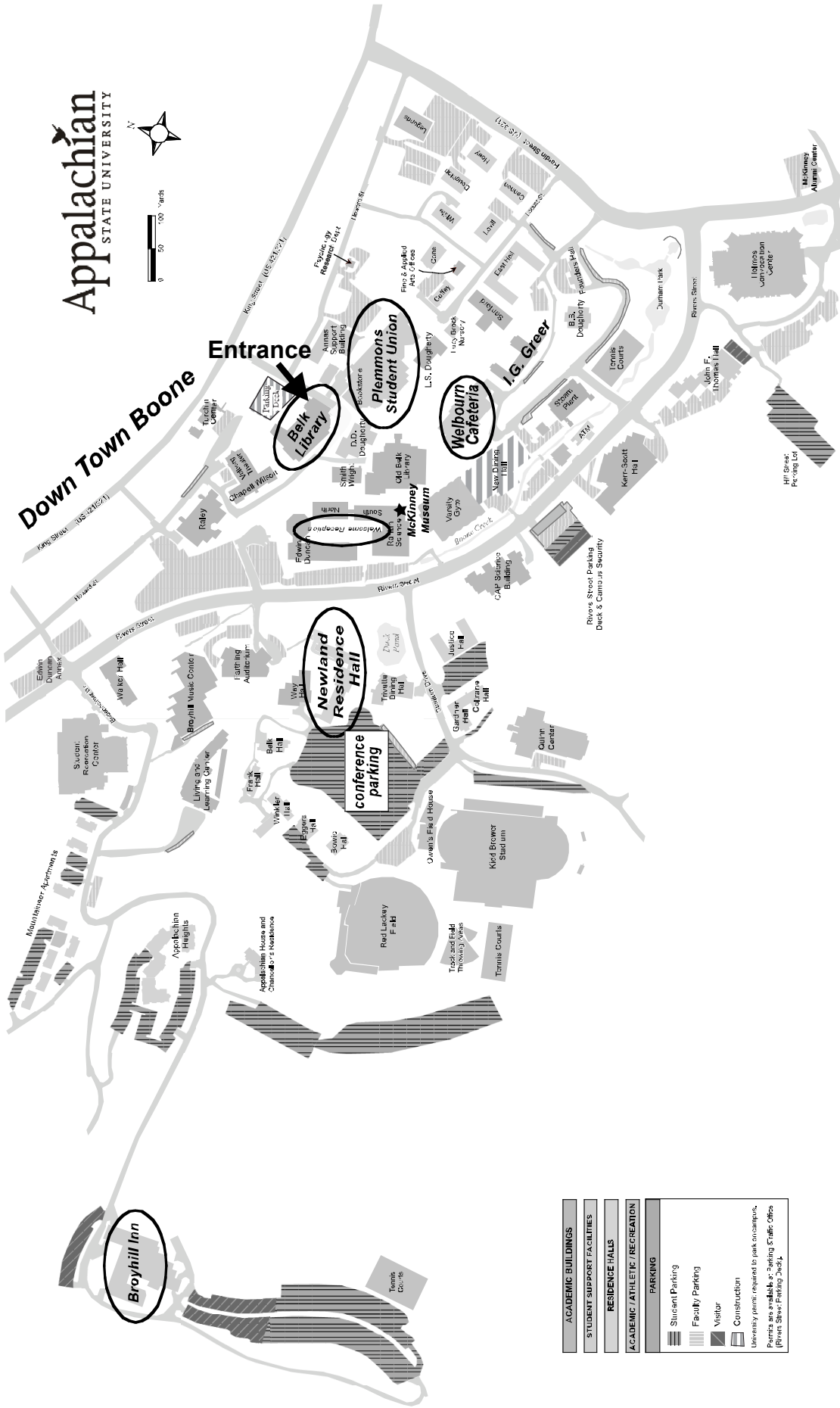


**Abstracts with Program:  
14th Meeting of the International Bryozoology Association**

**Editors  
Department of Geology, Appalachian State University**

**Boone, North Carolina  
July 1- 6, 2007**

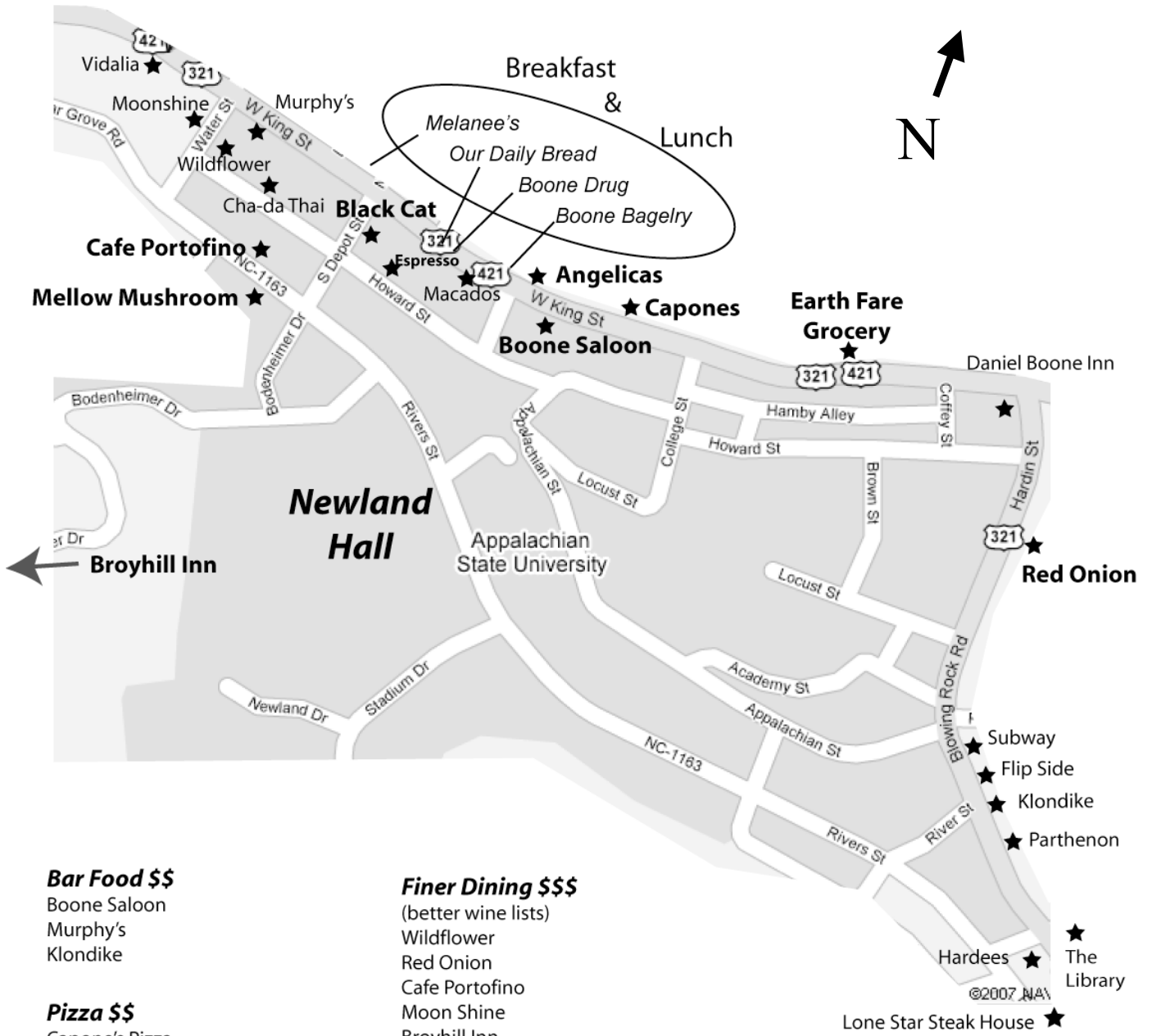




ACADEMIC BUILDINGS
STUDENT SUPPORT FACILITIES
RESIDENCE HALLS
ACADEMIC / ATHLETIC / RECREATION
PARKING
Student Parking
Faculty Parking
Visitor
Construction

University permit required to park on campus.  
 Permits are available at "Parking Office" (Powers Street Parking Deck).

# Suggested Evening Dining in Down Town Boone



## Bar Food \$\$

Boone Saloon  
Murphy's  
Klondike

## Pizza \$\$

Capone's Pizza  
Mellow Mushroom  
Cafe Portofino  
Flip Side

## Vegetarian specials \$\$

Angelica's  
Moon Shine  
Black Cat Burrito  
Cafe Portofino  
(most others have some veg.)

## Finer Dining \$\$\$

(better wine lists)  
Wildflower  
Red Onion  
Cafe Portofino  
Moon Shine  
Broyhill Inn

## Others

Cha-da Thai (Thai & wine list) \$\$\$  
Parthenon (Greek) \$\$  
Macado's (Sandwiches) \$\$  
Vidalia (Southern style) \$\$  
Daniel Boone (Southern-Family style) \$\$  
The Library (waitresses in costume) \$\$  
Lone Star Steak House (Beef) \$\$\$

## Budget \$

Subway Sandwich  
Hardees  
Campus Cafeterias  
Follow "More Fast Food" to the south

\$ 5.00 - 7.00  
\$\$ 7.00 - 15.00  
\$\$\$ 15.00 - 25.00

Most restaurants serve beer & wine.  
No restaurants in Boone serve spirits or mixed drinks.

**Please add a 15% tip** (gratuity) for restaurants with table service.  
This is the waiter's primary income and is expected.

More Fast Food

Sunday, July 1

## IBA Workshops

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

### Morning Session

9:00 – 12:30 Molecular Biology (Part I) – Jo Porter  
Room 023 – Rankin Science West

9:00 – 12:30 Freshwater Bryozoa (Part I) – Tim Wood  
Fieldtrip – meet vas at Newland Residence Hall

9:00 – 12:30 Fenestrate Bryozoa – Ken McKinney & Patrick Wyse Jackson  
Room 118 – Rankin Science South

12:30 – 1:30 Lunch (meal plan) Welbourn Cafeteria

1:30 – 5:00 Molecular Biology (Part II) – Jo Porter  
Room 023 – Rankin Science West

1:30 – 5:00 Freshwater Bryozoa (Part II) – Tim Wood  
Room 116 – Rankin Science South

1:30 – 5:00 Cyclostome Bryozoa – Paul Taylor  
Room 118 – Rankin Science South

5:00 – 6:00 Submission of Manuscripts – Judy Winston & Marcus Key  
(McKinney Museum, Rankin Science South)

6:00 – 7:30 **Welcome – Bar-b-que Dinner** (for all registrants and guests)  
Courtyard between Rankin Science & Edwin Duncan Hall  
Steve Hageman, 14th IBA Meeting Host  
Dr. Kenneth Peakcock, Chancellor, Appalachian State University  
Loretta Clawson, Mayor, Town of Boone  
Mountain Music by *Boss Hawg*

## Monday, July 2

### Morning

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

8:30 – 9:00 IBA Business Desk (settle accounts) – *Lobby, Belk Library*  
Submission of Manuscripts – Judy Winston & Marcus Key

**Welcome and Introduction** –*Rm. 114, Belk Library*

9:00 Steven J. Hageman, 14th IBA Conference Host  
Stanley Aeschelman, Provost and Executive Vice Chancellor  
Frank (Ken) McKinney, Emeritus Professor of Geology

**Plenary Lecture** –*Rm. 114, Belk Library (Introduction S.J. Hageman)*

9:15 **Margo Haygood** (29)  
Bacterial symbioses in bryozoans: *Bugula* and *Watersipora*

**Interactions, Life Histories and Distributions** –*Rm. 114, Belk Library (S.J. Hageman chair)*

10:00 **Jasmine H. Sharp**, Michael K. Winson and Joanne S. Porter (72)  
Micro-communities in a macro-world: A comparison of bacterial communities between sibling larvae and their adult colony

10:20 **Beth Okamura**, Samantha L.L. Hill and Sylvie Tops (55)  
Endoparasitism in colonial hosts

10:40 **Coffee and Tea Break**

11:00 **Timothy S. Wood** (89)  
Development and metamorphosis of cyphonautes larvae in the freshwater ctenostome bryozoan, *Hislopia malayensis* Annandale, 1916

11:20 **Emmy R. Wöss** (88)  
The relative importance of different modes of reproduction and dispersal in *Plumatella fungosa* (Phylactolaemata: Plumatellidae)

11:40 **Hanna-Leena M. Hartikainen** and Samantha L.L. Hill (25)  
Distribution and conservation of *Lophopus crystallinus* in the UK

12:00 **Lunch** – *Welbourn Cafeteria (meal plan)*

## Monday, July 2

Afternoon

### *Recruitment and substrates –Rm. 114, Belk Library (A.N. Ostrovsky chair)*

- 1:30 **Chris L. Schneider** (69)  
Settlement behavior and substrate preferences of Late Devonian *Hederella* from the Midcontinent USA
- 1:50 **Antonietta Rosso** (65A)  
Mediterranean setoselliniforms and the exploitation of small-sized substrates
- 2:10 Dorothy F. Soule (*deceased*), **Penny A. Morris** and Henry Chaney (75)  
Bryozoans and Black Corals
- 2:30 **Yvonne Bone**, Kirsty Brown (*deceased*), Rolf Schmidt and Noel James (5)  
Bryozoans as epiphytes on sea-grasses in South Australia, and their significance as carbonate sediment producers in coastal environments
- 2:50 **Yasser A. El Safori** (16)  
Recent bryozoans from the coastal sediments of the Red Sea and Gulf of Suez, Egypt
- 3:10 *Coffee and Tea Break*

### *Considering phylogeny –Rm. 114, Belk Library (A. Rosso, chair)*

- 3:30 **Eckart Håkansson** (26A)  
The role of frontal wall architecture in the development of a cheilostome phylogeny – and the Cretaceous-Tertiary boundary
- 3:50 **Matthias Obst** and Judith Fuchs (53)  
Investigations on the phylogeny of Bryozoa using molecular data
- 4:10 **Alexander Gruhl** and Thomas Bartolomaeus (23)  
Structure, function, and phylogenetic significance of muscular systems in gymnolaemate larvae
- 4:30 **Andrew N. Ostrovsky** (56)  
Cheilostome brood chambers: diversity, evolutionary trends and revised terminology
- 4:50 **Amalia Herrera-Cubilla**, Felix Rodriguez, Aaron O’Dea and Jerney B.C. Jackson  
Ongoing results on the phylogeny of recent Cupuladriidae, from Panama (30)
- 5:10 **Dennis P. Gordon** and Andrew Hosie (24)  
Post-2000 detection of warm-water alien bryozoan species in New Zealand

### *Announcements (S.J. Hageman)*

- 5:20 **BRY-TV Abby Smith**
- 5:45 IBA Council Meeting** location tbd

**McKInney home Reception I** (van departs from Newland Hall 6:00 – return 7:30)

**Tuesday, July 3**  
Morning

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

***Environment, genetics and the phenotype*** –Rm. 114, Belk Library (A. Smith, chair)

- 9:00 Aaron O’Dea and **Eckart Håkansson** (54)  
Zoooid sizes suggest dramatic oceanographic perturbations immediately before the K-T mass extinction
- 9:20 **Scott Tompsett** (82)  
Defining morphometric characters in schizoporelloidean cheilostomes using SEM techniques: an approach applied to the primary orifice
- 9:40 **Ann-Margret Amui**, Uri Frank, and Wallace Arthur (1)  
Gene expression in *Membranipora membranacea*
- 10:00 Maja Novocel and **Steven J. Hageman** (50)  
Variation of zooecia size within colonies and among environments
- 10:20 ***Coffee and Tea Break***

***Higher latitudes*** –Rm. 114, Belk Library (E. Håkansson, chair)

- 10:40 **Hans Arne Nakrem** and Andrej Ernst (47)  
Lower Triassic bryozoans of the Canadian Arctic and adjacent areas
- 11:00 **Abigail M. Smith** (73)  
Carbonate production by erect rigid bryozoans in Antarctica
- 11:20 **Catherine M. Reid** and Noel P. James (63)  
Climatic response of late Palaeozoic bryozoans: diversity and composition of cool-water faunas from Gondwana
- 11:40 **Piotr Kuklinski** and Paul D. Taylor (37)  
Are bryozoans adapted for living in the Arctic?
- 12:00 ***Lunch*** – Welbourn Cafeteria (meal plan)

## Tuesday, July 3

Afternoon

**12:00 – 1:30 Poster set up** – Grandfather Mountain Ballroom, Plemmons Union

**Biogeography** –Rm. 114, Belk Library (H. A. Nakrem, chair)

- 1:30 **Björn Berning** (3)  
Miocene, Pliocene, Anthropocene: contrasting biogeographic patterns and processes
- 1:50 C. Lombardi, S. Cocito, A. Occhipinti-Ambrogi, S.C. Wade, **J.S. Porter**  
*Pentapora* taxonomy: a morphological and molecular comparison between Mediterranean and Atlantic specimens (40)
- 2:10 **Andrej Ernst** (19)  
Devonian bryozoans of Europe: Diversity dynamics and paleogeographical relations
- 2:30 **L.D. McCann**, J.A. Mackie and G.M. Ruiz (42)  
Preliminary results of DNA bar coding with *Conopeum chesapeakeensis* and implications for invasions and biogeography
- 2:50 **Ariunchimeg Yarinpil** (91)  
Paleozoic bryozoans from Mongolia: geographical distribution and stratigraphical significance

**Announcements** (S.J. Hageman, Wednesday Excursion Information)

3:10 **Group Photograph** – meet in Lobby outside Rm. 114 Belk Library

**Poster Session and Reception** Grandfather Mountain Ballroom, Plemmons Union

3:20 – 5:30 **See next page for listing.**

**McKinney home Reception II** (van departs from Newland Hall 5:45 – return 7:15)



**Poster Sessions** (*posters up Tuesday noon to Thursday 9:45 AM*)

*Grandfather Mountain Ballroom, Plemmons Union*

**Tuesday 3:20 – 5:30** *wine, beer, soft drinks and snacks*

**Thursday 8:30am – 9:50am** *coffee, tea and muffin snacks*

**Giampietro Braga** (6)

Atlas of Cenozoic Bryozoa of Northeastern Italy (Venetia region)

**Caroline J. Buttler**, Patrick N. Wyse Jackson and Marcus M. Key Jr (7)

Bryozoa from the Ordovician (Caradoc) of Courtown, Co. Wexford, Ireland

**Michelle Carter**, Dennis, P. Gordon, and Jonathan Gardner (9)

Avicularian imagery

**Roger J. Cuffey** (11)

An unexpected addition to the Antarctic fossil bryozoan fauna (encrusting cheilostome, Eocene, Ushuaia and Seymour Island)

Oscar Delgadillo-Garzón and **Paola Flórez-Romero** (12)

Bryozoans associated to artificial collectors in Santa Marta region, colombian Caribbean

Nina Denisenko and **Piotr Kuklinski** (13)

History of investigations and current state of knowledge of bryozoan species diversity in the Chukchi Sea

**Yasser A. El Safori** (17)

Santonian bryozoans from West Central Sinai, Egypt

**Yasser A. El Safori** (15)

Cretaceous bryozoans from Abu Roash area, West Cairo, Egypt

**Yasser A. El Safori** and Muftah M. Ahmed (18)

New Oligocene bryozoans from Libya

**Andrej Ernst** and Cor F. Winkler Prins (20)

Pennsylvanian stenolaemate bryozoans from the Cantabrian Mountains, NW Spain

**Paola Flórez Romero** (21)

Bryozoan fauna associated on gas platforms offshore in Colombian Caribbean

Paola Flórez Romero and **Erika Montoya-Cadauid** (22)

Recent bryozoans collected on soft bottoms in Colombian Caribbean

**Eckart Håkansson**, Martin Abrahamsson and Erik Thomsen (26B)

Colonial budding in free-living bryozoans from the Miocene of Denmark

**Hanna-Leena M. Hartikainen** and Beth Okamura (28)

Zoid size and tentacle number in relation to nutrient levels in a freshwater bryozoan

**Andrea Jiménez-Sánchez** and Enrique Villas (32)

New Monticuliporidae (Trepotomata) from the upper Ordovician limestones of the Iberian Chains (NE Spain)

*Poster Session Continued*

**Scott Lidgard** (38)

BryoZone: A unified bryozoan reference

**Tanya Knowles**, Paul D. Taylor, Mark Williams, Alan M. Haywood and Beth Okamura  
Using bryozoan zooid size and General Circulation Models (GCMs) to infer North Atlantic shelf sea temperatures during the mid Pliocene (35)

**Piotr Kuklinski** and David. K.A. Barnes (36)

Gastropod shells, hermit crabs and Arctic richness

R. Maia, A.R.G. Tomás and **Laís V. Ramalho** (41)

Demographic explosions of Bryozoans in Santos Bay, São Paulo, Brazil for the Western Atlantic

**L.D. McCann**, N.G. Hitchcock, J.E. Winston and G.M. Ruiz (43)

Non-native bryozoans in coastal embayments of the Southern United States: New records

**Frank K. McKinney** (44)

Taxonomic notes on *Semicoscium* Prout and some other 19<sup>th</sup> century fenestrate Bryozoa from the USA

**Erika Montoya-Cadavid** and Paola Flórez Romero (45)

Advances in the inventory of marine Bryozoa of the Columbian Caribbean

Ronald Nalin and **Giampietro Braga** (46)

Late Pleistocene bryozoans from the deposits of Capo (99) Colonna marine terrace (Calabria, Central Mediterranean)

**Elena Nikulina** and Priska Schäfer (49)

Phylogenetic analyses of mitochondrial and nuclear ribosomal genes provided evidence for a paraphyly in the genus *Electra* Lamouroux

**Maja Novosel**, Blanka Radićand and Antonieta Požar-Domac (51)

Amazing bryozoan diversity along the cliff of Sušac Island in the Adriatic Sea

**Joseph F. Pachut** and Robert L. Anstey (57)

A coded character based analysis of evolutionary modes in the Middle and Upper Ordovician bryozoan genus *Peronopora*

**William Rader**, JoAnn Sanner and Paul D. Taylor (60)

Bryozoans from the mid-Cretaceous Glen Rose Formation of Texas: prelude to the neocheilostome radiation

**Laís V. Ramalho**, Guilherme Muricy and Paul D. Taylor (62)

Two new species of Bitectiporidae (Bryozoa, Ascophora) from Rio de Janeiro State, Brazil.

**June R.P. Ross** and Charles A. Ross (64)

Tasmanian Ordovician Bryozoa

**Antonietta Rosso** (65B)

Bryozoans associated with white corals from the Mediterranean Sea.

*Poster Session Continued*

**Abigail M. Smith** (74)

Corrections to the known global distribution of *Hornera pectinata* (Bryozoa: Horneridae)

**Mary E. Spencer Jones** and Wyse Jackson, P.N. (78)

Where is that bryozoan collection?

**Mary E. Spencer Jones** and Laís V. Ramalho (77)

The NHM Marcus Collection

**Mary E. Spencer Jones** (76)

The wet Bryozoa and Entoprocta collections at the NHM

Margret Steinhorsdottir, **Patrick N. Wyse Jackson**, Steven J. Hageman, Aaron Abernethy (80)

Phenotypic variation in a rhabdomesine bryozoan from the Mississippian of Ireland

**Judith E. Winston** (86)

Common and scientific names of aquatic invertebrates from United States and Canada:

Bryozoa (preliminary list for American Fisheries Society publication series)

**Emmy R. Wöss** (87)

Neptunschleier & Co. – a Bryozoan Exhibition

**Patrick N. Wyse Jackson** (90)

The earliest thin-section of a fossil bryozoan

**Ariunchimeg Yarinpil** (92)

Permian bryozoans from Mongolia.



**Wednesday, July 4**

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

9:00 a.m to 4:00 p.m.

Excursion to village of Blowing Rock  
and the Blue Ridge Parkway  
with flexible departure and return times  
from Newland Residence Hall

Boxed lunch provided.

**Thursday, July 5**  
Morning

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

***Poster Session with Tea and Coffee***

***Grandfather Mountain Ballroom, Plemmons Union***

8:30 –9:45

9:45 Break down posters

***Historical Perspectives –Rm. 114, Belk Library*** (P. Taylor, chair)

10:00 **M.E. Spencer Jones**, V. Holmes and C. Thomas (79)  
Darwin's bryozoans

10:20 **Mary A.B. Sears** and Robert M. Woollacott (70)  
Alice Robertson: marine zoologist and educator

10:40 **Michelle Carter**, Dennis P. Gordon and Jonathan Gardner (10)  
Unraveling the mystery of the birds-head avicularium

***Video Presentation***

11:00 **Adritic Bryozoa** Anjelko and **Maja Novocel**

***IBA Business Meeting***

11:40 Paul Taylor, IBA President  
Announcement of new IBA Councilors  
IBA Kiel, 2010 up date – Priska Schäfer  
Invitation presentations for IBA Meeting 2013

12:15 **Lunch** – *Welbourn Cafeteria (meal plan)*

## Thursday, July 5

Afternoon

*Faunas* –Rm. 114, Belk Library (J. Scholz, chair)

- 1:30 **Norbert Vávra** (83)  
Bryozoans of Retz-Formation (Early Miocene, Austria) –  
a high energy environment case study
- 1:50 Matthias Obst and **Judith Fuchs** (52)  
Taxonomic studies of the Swedish Bryozoa
- 2:10 Abdelmohsen Ziko, **Y.A. El Safori**, A.A. Zalat, N. El-Dera., N. Saber  
and S. El-Khawaga (93)  
Recent Bryozoa from the Egyptian Mediterranean coast, East Nile Delta, Egypt
- 2:30 **Françoise P. Bigey** (4)  
Bryozoan diversity in Upper Silurian and Devonian of France
- 2:50 **Judith E. Winston** (85)  
Bryozoans of the Mangreef, a unique and threatened habitat in the  
Pelican Cays, Belize
- 3:10 *Coffee and Tea Break*

*Approaching the irreducible unit* –Rm. 114, Belk Library (J. Winston, chair)

- 3:30 **Joachim Scholz**, Ehrhard Voigt (*deceased*) and Gilbert Larwood (*deceased*) (67)  
Palaeoecological, morphological and taxonomical aspects of the pelmatoporinid  
genus *Ubagsia* JULLIEN from the Maastricht Chalk
- 3:50 **Matthew H. Dick** (14)  
Taxonomy, diversity, and distribution of *Monoporella* (Bryozoa: Cheilostomata)  
species in the Aleutian Islands, Alaska, USA
- 4:10 **Tanya Knowles** (34)  
The cheilostome bryozoan *Floridina* from Plio-Pleistocene deposits of the  
Coastal Plain of North America
- 4:30 **Masato Hirose**, Matthew H. Dick and S.F. Mawatari (31)  
Molecular phylogenetic analysis of Plumatellidae (Bryozoa: Phylactolaemata)  
based on mtDNA sequences
- 4:50 Paul D. Taylor and **Mark A. Wilson** (81)  
Morphology and affinities of hederelloid ‘bryozoans’

*Announcements* (S.J. Hageman, P.D. Taylor)

- 5:10 *Video Presentation* – **Oda Film, Joachim Scholtz**

## Friday, July 6

### Morning

7:30 – 9:00 Breakfast served (meal plan) Welbourn Cafeteria

#### *Ecological Perturbations –Rm. 114, Belk Library (E. Wöss, chair)*

9:00 **Rolf Schmidt** (68)

Extinction and recovery of Bryozoa from the Cretaceous-Palaeogene crisis:  
Fresh evidence from Australia towards a new global hypothesis

9:20 **Catherine M. Powers** and David J. Bottjer (59)

Unraveling mass extinctions: Permian-Jurassic onshore-offshore trends  
of bryozoans

10:00 **Laís V. Ramalho** and F.L. Diehl (61)

Great problem of bryozoans washing up on the beach of Balneário Camboriú  
Santa Catarina State, Brazil

10:20 **Scott Lidgard** (39)

How should we consider predation risk in bryozoans?

10:40 *Coffee and Tea Break*

#### *Biology of Bryozoans –Rm. 114, Belk Library (L.V. Ramalho, chair)*

11:00 **Joseph F. Pacht** and Robert L. Anstey (58)

Rates of anagenetic evolution in three morphometric characters in species of  
*Peronopora* from the Middle and Upper Ordovician

11:20 **Michelle Carter**, Dennis P. Gordon and Jonathan Gardner (8)

A preliminary analysis of avicularian morphology

11:40 Stephan Handschuh, Norma Z. Neszi, Thomas Schwaha, Manfred G. Walzl  
and **Emmy R Wöss** (27)

Advantages of 3D - reconstruction in bryozoan development research: tissue  
formation in germinating statoblasts of *Plumatella fungosa* (Pallas, 1768)  
(Plumatellidae, Phylactolaemata)

12:00 *Lunch – Welbourn Cafeteria (meal plan)*

## Friday, July 6

Afternoon

***Bryochemistry and skeletons*** –Rm. 114, Belk Library (C. M. Powers, chair)

- 1:30 Slavomír Nehyba, **Kamil Zágoršek** and Katarína Holcová (48)  
Stable isotope composition of bryozoan skeletons from the locality Podbřežice  
(Middle Miocene, Central Paratethys, South Moravia, Czech Republic)
- 1:50 **Marcus M. Key Jr.**, Patrick N. Wyse Jackson, Kristen E. Miller  
and William P. Patterson (33)  
A stable isotopic test for the origin of fossil brown bodies in trepostome  
bryozoans from the Ordovician of Estonia
- 2:10 Vladimír Bermanec, Hrvoje Posilović, **Maja Novosel** and Antonieta Požar-Domac  
Variations in skeletal structure of recent bryozoan *Pentapora fascialis*  
from different environments in the Adriatic Sea (2)
- 2:30 **Michael K. Winson**, Jasmine H. Sharp, Heather P. Moore and Joanne S. Porter  
Detecting bryozoan metabolites and bacterial quorum sensing factors (84)
- 2:50 **Priska Schäfer** and Beate Bader (66)  
Geochemical composition and variability in the skeleton of the bryozoan  
*Cellaria sinuosa* (HASSALL): Biological vs. environmental control
- 3:10 ***Coffee and Tea Break***
- 3:30 ***IBA Business Meeting*** – Rm. 114 Belk Library  
  
*Paul Taylor IBA President*  
*General Business*  
*Selection of location for 2013 IBA meeting*  
*Nomination of IBA officers*
- 4:00 ***IBA Council Meeting*** – Rm. 114 Belk Library

McKinney home Reception for Post-Conference Trip Participants  
(van departs from Newland Hall 5:30 – returns 7:00)

**First Friday Art Crawl** – Turchin Art Gallery and Downtown Boone

## **Gene expression in *Membranipora membranacea***

**Amui, Ann-Margret** and Frank, Uri

Department of Zoology & Martin Ryan Institute, National University of Ireland,  
Galway, Ireland. a.amui1@nuigalway.ie; uri.frank@nuigalway.ie

Arthur, Wallace

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wallace.arthur@nuigalway.ie

Bryozoans have traditionally been studied mainly from a (paleo)ecological perspective. Other aspects of bryozoan biology, such as developmental biology, physiology and immunology have been neglected relative to other animal phyla. The numbers of bryozoan nuclear protein-coding genes in GenBank have been very low (<20). An additional problem in the study of contemporary bryozoans is the lack of established laboratory model organisms that would facilitate studies in the broad areas mentioned above. As a response to this problem we have selected the common, north Atlantic intertidal bryozoan *Membranipora membranacea* as a prospective model organism. The biology of this animal is relatively well studied. After establishing animal cultures in the lab we have started to work on the molecular biology of this species. We have cloned, sequenced and analyzed several developmental genes. Here we show their expression pattern using *in-situ* hybridization for the first time in bryozoans.



## **Variations in skeletal structure of recent bryozoan *Pentapora fascialis* from different environments in the Adriatic Sea**

Bermanec, Vladimir and Posilović, Hrvoje

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vladimir.bermanec@jagor.srce.hr; h\_posilovic@yahoo.com

**Novosel, Maja** and Požar-Domac, Antonieta

Department of Biology, Faculty of Science, University of Zagreb, Zagreb, Croatia.  
maja@biol.pmf.hr; antonieta.pozar-domac@zg.htnet.hr

*Pentapora fascialis* (Pallas, 1766) is the largest and most conspicuous calcified bryozoan in the Adriatic Sea. Three different samples of bryozoan *P. fascialis* were collected at three different localities in the Adriatic: in the Velebit Channel, on Jabuka Shoal and at Korčula Island. Along the coast of the Velebit Channel in the North Adriatic, large colonies of *P. fascialis* were particularly abundant. There, *P. fascialis* colonies grew only in the vicinity of submarine freshwater springs on sandy-detritic bottom, between 1 m and 35 m depth. Those colonies are always wide-branched and are the biggest colonies ever found in the Adriatic, up to 200 cm in diameter. On Jabuka Shoal, in the Central Adriatic, only small and narrow-branched colonies (10 to 20 cm in diameter) were observed, within the depth range from 20 m to 50 m. But large colonies of *P. fascialis* were also observed in the South on Korčula Island where the location was narrow passage between small islands Badija and Lučnjak characterized by constant and very strong currents. There, large and numerous colonies of *P. fascialis* (50 to 80 cm in diameter) grew in both forms, as wide- and narrow-branched colonies.

Morphologic observations of the zooid crosssections were carried out with scanning electron microscope (SEM). The same SEM microscope equipped with an energy dispersive spectrometer (EDS) was used for elemental distribution analysis in the samples. On the crosssection of the zooid wall according to the substituted cation it is possible to distinguish inner Mg-calcite and outer aragonite structure of the zooid skeleton wall. Calcite shows substitution of calcium for magnesium, while aragonite contains traces of strontium. Variations in the aragonite to calcite ratios between sample from Jabuka Shoal and two other samples emerge from different thickness of the aragonitic part of the zooid wall. Volume of the zooid and calcite part of the zooid wall is constant for all samples and only variation is in the volume of the aragonite. Samples from the Jabuka Shoal built of igneous rocks shows increased content of trace elements. The differences could originate from geological environment, because Jabuka Shoal is built of igneous rocks which are not very common in the Adriatic Sea.

## **Miocene, Pliocene, Anthropocene: contrasting biogeographic patterns and processes**

**Berning, Björn**

Institute for Earth Sciences, University of Graz, Graz, Austria. bjoern.berning@uni-graz.at

Owing to their relatively short-lived, non-planktotrophic larvae, species of brooding cheilostome bryozoans are postulated to have a comparatively restricted range of geographic distribution. This can be tested by comparing species distributions through time in regions in which Recent faunas, the fossil record, and paleoceanographic conditions are well documented, such as in the Mediterranean Sea and NE Atlantic.

During the Late Miocene and Pliocene the interchange of species between the Mediterranean region and the eastern Atlantic (France, North Sea Basin [NSB]) was fairly restricted. This is particularly demonstrated by a comparison of faunas from the Pliocene NSB (the British Coralline Crag and contemporaneous Dutch and Belgian sediments) with those of coeval Mediterranean ones. Of the 141 species recorded in the NSB, only six (= 4%) also occur in the Mediterranean region, which suggests that oceanographic barriers impeded a regular exchange.

In contrast, Recent faunas from the same areas share a much greater number of species (97 = 63% of 155 species recorded off SE England). The discrepancy between fossil and Recent faunal similarities and species ranges, however, cannot be explained by changes in natural oceanographic processes. It is therefore concluded that (1) since the beginning of seafaring (i.e. several thousands of years ago), shallow marine (bryozoan) faunal compositions and geographic species ranges have been drastically altered; (2) analysis of the biogeographic distributions of Recent species is likely not to reflect the natural pre-nautical pattern and consulting the fossil record may prove to be indispensable for certain taxa and regions; (3) the restricted geographic distribution of bryozoans allows to reveal paleobiogeographic patterns and to reconstruct oceanographic pathways and barriers at a very fine scale.

## **Bryozoan diversity in Upper Silurian and Devonian of France**

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The best known Upper Silurian bryozoan fauna comes from Artois (Northern France) in the Liévin area. It is provided by borings from the Liévin Group (Noulette Formation), Pridoli in age. Diversity seems low because trepostomes dominate: halloporids, trematoporids, amplexoporids, atactotoechids and stenoporids. Lack of fenestrates may be due to the carbonate shale environment.

Most Devonian bryozoan faunas of the Armorican Massif are located in the Central Synclinorium. In the eastern part (Laval area), the Saint-Cénére Formation (Pragian) yields a balanced diversity between fistuliporids, trepostomes (halloporids, stenoporids) and fenestrates. More westerly (Gahard), the Marettes Formation (Emsian) yields a quite diverse fauna of fistuliporids, trepostomes (halloporids, heterotrypids, trematoporids, amplexoporids, atactotoechids), fenestrates, rhabdomesids and ptilodictyids as well. The best preserved bryozoan fauna occurs in the western part (Roads of Brest area), especially from the reefal environment from the Armorique Formation (Pragian) with a good diversity : trepostomes (heterotrypids, trematoporids), fenestrates and rhabdomesids.

One of the best regions that yielded Middle and Upper Devonian bryozoan faunas is Boulonnais (Northern France). The diversity exists in the Blacourt (Givetian), Beaulieu and Ferques Formations (Frasnian) respectively. Trepostomes (amplexoporids, atactotoechids) are more pronounced in the Beaulieu Formation and fenestrates and rhabdomesids in the Ferques Formation.

In Montagne Noire (Southern France) bryozoan localities are more scattered. In the Cabrières klippen, bryozoan diversity from the Falgairas Formation (Pragian) is not significant unlike in Mont Peyroux where the Bissounel Formation (Emsian) shows bryozoan-rich build-ups, dominated by fenestrates.

The current knowledge of bryozoan diversity is dependent upon sedimentary environment. Tectonics also are important because of disruption of the strata.

## **Bryozoans as epiphytes on sea-grasses in South Australia, and their significance as carbonate sediment producers in coastal environments**

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Bryozoans have been significant producers in accumulations of sea-floor sediments throughout their history. Those inhabiting sea-grass beds in shallow-water environment, usually coastal, are the subjects of this study. Sea-grasses act as the substrate for predominantly encrusting and erect bryozoans, with larvae settling on the sea-grass blades, developing and spending their entire life attached to the sea-grass. They do not obtain nutrient from their “host”, nor are they detrimental to it: they are true epiphytes. Two sea-grass genera act as substrates in South Australia: *Posidonia* (blades arising from a surface/subsurface sheath, living ~ 4 months) and *Amphibolis* (small leaves shed, within 4 months, fanning out from a woody stem, life of ~ 2 years. Why do bryozoans use a short-lived substrate, resulting in colony death within a short time? Advantages include (i) waving of the blades increases volume of water the colony can access for feeding, (ii) wider dispersal of larvae, (iii) decreased susceptibility to prey and (iv) blades have an attractive biofilm surface.

Overall, 17.4% of SA calcareous epiphytes are bryozoans, increasing to 30.8% for *Amphibolis* stems. They tolerate increasing depth, salinity and temperature better than other epiphytic phyla. Non-calcareous flora are stronger space competitors at <10 m depth. They produce up to 33.6% by weight of calcareous epiphytic carbonate. There were 61 species (47 genera), with *Heterooecium* (most abundant but only 1.2% of carbonate production), *Thairopora*, *Celleporaria*, *Orthoscuticella*, *Diaperoecia*, *Crisia*, *Disporella*, *Mychopletra*, *Favospira* and *Iodictyum* (21% of carbonate production) important. Carbonate production is dependent on sea-grass type, its density and that of the shoots/blades and crops/year. Carbonate is calculated as either wt/sea-grass area or wt/kg sea-grass and /bryozoan species or genera. It is estimated that ~50% of the bryozoans are passively transported coastward upon “death” of the sea-grass. The sea-grass rots but the bryozoans are retained in the accumulating sediment, thus becoming a significant contributor to the rock record in terms of components and environmental indicators, especially those bryozoans restricted to sea-grass substrates. Estimated accumulation rate is 7.4 cm/ky.

## **Atlas of Cenozoic Bryozoa of Northeastern Italy (Venetia region)**

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In Cenozoic sequences of the Veneto and Southern Trentino areas (Northeastern Italy) there are many outcrops rich in bryozoan fauna. The most important occurrences, both from a stratigraphic and paleogeographic perspective, are preserved in formations lying at the Upper Eocene-Lower Oligocene boundary. These Paleogene layers rich in bryozoans, well known already in the XIXth century and studied extensively by A.E. Reuss, were called *Bryozoen Mergel* or *Bryozoen schichten* and are now cited in the stratigraphic literature as *Marne a Briozi* (Lessini Mountains) or *Marne di Brendola* (Berici Mountains). These bryozoan associations were located along the margin of the Venetia shelf, and, according to sedimentological characters, faunal content, growth form parameters, and inferences concerning the species now in life, they developed within the photic zone from the inner to the outer shelf, at depths not in excess of 100 metres. Judging from the high number of different bryozoan species, amounting always to more than 80-100 taxa, seawater was well oxygenated, warm-temperate or subtropical, with normal salinity.

Despite the fact that these bryozoan-rich facies exhibit some lithological variability, they represent an important index layer, isochronous not only in all the examined sections, but also in the eastern Tethys basins (i.e. Romania, Hungary, Poland).

The atlas consists of an illustrated review, by mean of SEM micrographs, of all the bryozoan species studied and described in the literature and collected from Northeastern Italy outcrops.

## **Bryozoa from the Ordovician (Caradoc) of Courtown, Co. Wexford, Ireland**

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The Courtown Limestone Formation of the Duncannon Group comprises a sequence 50 m thick of blue to white fossiliferous limestones, calcareous sandstones and siltstones, with a basal conglomerate developed in places. It has been heavily deformed which resulted in a well-developed cleavage. It crops out at various localities close to the village of Courtown, County Wexford, south east Ireland. The type locality is in a quarry at Courtown Harbour which is now flooded and inaccessible. In the nineteenth century the area was mapped by the Geological Survey of Ireland who reported the occurrence of fossils at various localities; many of these are now difficult to locate precisely.

The Courtown Limestone Formation lies unconformably on reddish-purple mudstones and siltstones of the Riverchapel Formation - the youngest part of the Ribband Group (Tremadoc - Arenig), dated as Lower Arenig from graptolites. The age of the Courtown Limestone Formation has been the subject of debate and most recently has been located within the Aurelucian Stage of the Caradoc.

A moderately rich brachiopod - trilobite fauna has been described from the Courtown Limestone Formation. Bryozoans were reported from the formation when it was first mapped but not systematically described. *Stenopora fibrosa* var. *ramosa* and var. *lycoperdon* was noted in 1887 from twelve localities in the immediate Courtown area. These two bryozoans were widely reported from localities in the Ordovician of the British Isles in the nineteenth century, where the name was applied to dome-shaped and ramose colonies respectively. It has subsequently become clear that "*S. fibrosa*" contains more than two taxa. Later investigations examining the Courtown Limestone Formation stated that "bryozoa occur in most exposures". This study has revealed that the bryozoan fauna is moderately diverse containing trepostomes and cryptostomes, all specimens are abraded and broken. The fauna compares biogeographically with others from south Wales and Baltica.

## **A preliminary analysis of avicularian morphology**

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The function of avicularia has been the subject of intensive speculation and has remained an enigma for over 150 years since Charles Darwin coined the term ‘avicularium’ following his observations on *Bugula avicularia*. Their overall complexity provides no intuitive answers regarding their function, with avicularia exhibiting extensive morphological diversity and variable size. A colony may possess more than one type arguing for a variety of roles.

Avicularian function represents a substantial gap in the knowledge of cheilostome biology. This study aims to address this problem by analysing the morphology of avicularia collected from around New Zealand shores with a quantitative analysis of morphometric variation of the three types of avicularia: adventitious (including vibracula), interzooidal, and vicarious. The length of avicularium, palate, and avicularian orifice were measured from scanning electron microscopy images.

The results revealed very little overall variation among the avicularian types when the length of the avicularian orifice was analysed as a function of avicularium length. Interzooidal and adventitious forms were more similar to each other with very little similarity between vicarious and adventitious forms. The length of avicularia contributed to most of the variability in the data with vicarious forms significantly different to interzooidal and adventitious forms. The vibracula of *Caberea* and the vicarious avicularium of *Euthyroides jellyi* were the main contributors of this variability.

The results from this study have quantitatively shown that despite morphological variation in orifice structure (e.g. cilia, pore, and tubular prominence) and size and shape of avicularium, the overall allometric design of avicularia has remained conserved through evolution. The constraints in such a design may offer some insight into their function as further research unfolds.

## **Avicularian imagery**

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The function of avicularia has been the subject of extensive speculation and has remained an enigma for over 150 years since Charles Darwin coined the term 'avicularium' following his observations on *Bugula avicularia*. Their overall complexity provides no intuitive answers regarding their function, with avicularia displaying extensive morphological diversity and variable size. A colony may possess more than one type, arguing for a variety of roles.

Avicularian function represents a substantial gap in the knowledge of cheilostome biology. This study aims to address this problem by examining the morphology of avicularia by scanning electron microscopy (SEM). Colonies were collected from around New Zealand and at a variety of depths. All the different forms of avicularia are represented: adventitious (including vibracula), interzooidal, and vicarious. The morphological differences are extensive and include the avicularian orifice where structures comprise of cilia, pores, and/or tubular projections. Such extensive morphological diversity argues for a range of functions.



## Unraveling the mystery of the birds-head avicularium

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The function of avicularia has been the subject of intensive speculation and has remained an enigma for over 150 years since Charles Darwin coined the term ‘avicularium’ following his observations on *Bugula avicularia*. The diversity of size and shape only add to their complexity and provides no intuitive answers regarding their function. In addition, their taxonomic distribution is a mystery; a colony may possess more than one type suggesting avicularia may have a variety of roles.

Avicularia represent a substantial gap in the knowledge of cheilostome biology. This study aims to address this problem by examining in detail the gross and ultra-structural anatomy of the birds-head avicularium of *Bugula flabellata*.

Scanning electron microscopy (SEM) shows a tuft of cilia emerging from the avicularian orifice whilst transmission electron microscopy (TEM) of the vestigial polypide reveals two cytologically distinct regions. The anterior cells possess the cilia that emerge through an orifice into the environment. These cells also contain numerous lysosomes, Golgi bodies, and mitochondria, indicative of a metabolically active organ. Confocal microscopy was used to visualise the musculature of the avicularium using a fluorescently stained Phalloidin dye to target F-actin. The birds-head avicularium has an extensive muscular system; the adductor muscle predominates, converging alongside the vestigial polypide into a ligament that attaches to the lower mandible. Two muscle fibres extend from the adductor and attach either side of the vestigial polypide. A ring of muscle encircles the orifice where the cilia emerge.

## **An unexpected addition to the Antarctic fossil bryozoan fauna (encrusting cheilostome, Eocene, Ushuaia and Seymour Island)**

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Obtaining paleobiological materials from Antarctica poses challenges more severe than collecting elsewhere. One unexpected problem is the existence of potentially significant fossil bryozoans housed in non-standard repositories not normally considered part of the usual systematic resource base.

Many living bryozoans from Antarctic waters have been reported over the past half-century by workers from Rogick to Moyano. Fossil bryozoans are much rarer, known from only few specimens from Lower Devonian (Ohio Range), Lower Cretaceous (Alexander Island), and several Cenozoic horizons/localities (scattered around the continent's margins), but from many colonies from the Eocene (Seymour Island) monographed by Hara '01. These last are especially noteworthy for their abundant massive/globular, multilaminar colonies, both cyclostomes and cheilostomes. All these fossils are curated in established taxonomic collections.

In sharp contrast to both the normal repositories and the dominant massive colonies is a fossil encrusting bryozoan, probably from the Eocene shallow-marine clastics of Seymour Island, on the Argentine Navy base at the east end of Ushuaia (southernmost Argentina).

This bryozoan is a thin, unilaminar sheet, encrusting half of a flat echinoid (sand-dollar). Zooecia equidimensional to rectangular; lateral walls thick, and slightly swollen at zooecial corners; frontal/top open (opesium) with no skeletal shelf (cryptocyst) within it. Because from so far south, this likely represents an endemic taxon (possibly undescribed), but overall resembling *Conopeum* Gray 1848 or *Eokotosokum* Taylor & Cuffey 1992, thus a membraniporoid or malacostegan anascan cheilostome.

The bryozoan in question is on the bottom (floor-level) shelf of a glass cabinet in the small ("Darwin's") room at the south end of the upper floor of the southwest wing of the Presidio now the Ushuaia Maritime Museum, which houses exhibits on the navy's history, especially its role in polar exploration. The bryozoan is among fossils (large pelecypods, filled crab burrows, flat echinoids) retrieved by Argentine ships some years ago.

Although little documentation is presently available for this Antarctic fossil bryozoan in Ushuaia, it is sufficiently different from previously reported forms that further inquiry should be encouraged.

## **Bryozoans on artificial collectors in Santa Marta region, colombian Caribbean**

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### **Flórez-Romero, Paola**

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Bryozoans are an interesting biological group with a variety of applications in geology, ecology, evolution, experimental biology and biotechnology. However, knowledge about bryozoans in Colombia is scarce. This paper records bryozoan species found in suspended artificial collectors on coastal waters of Santa Marta region. The artificial habitats were deployed in the Pozos Colorados (PC), Isla Pelicano (IP) and Taganga sites during November 2002 by Sila Kangama Foundation, with the aim of spiny lobster (*Panulirus argus*) recruitment. Since March 2003 to February 2004, a total of 11 species representing 9 families were recorded in the habitats: *Acanthodesia savartii*, *Bugula neritina*, *Bugula turrata*, *Amathia distans*, *Amathia vidovici*, *Vitaticella uberrima*, *Savigniella lafontii*, *Scrupocellaria carmabi*, *Alcyonidium mamillatum*, *Aetea truncata* and *Rhinchozoon sp.* Great abundance and richness of bryozoans was observed in the rainy season, while during wet months, *A. savartii* was the unique species. IP presented high richness, PC had the greater abundance and T had little abundance and species composition. This pattern was a response to environmental factors in each site. PC had constant influence of river sedimentation and this feature decreased in the others stations. IP was a mixture of clear and silt waters with strong currents, while Taganga had calm and clear waters typical of seagrass and coral reef ecosystems presents in this bay. On the other hand, the species *B. neritina*, *B. turrata*, *A. mamillatum*, *S. carmabi*, *S. lafontii* and the genus *Rhinchozoon sp.* are new records to the Colombian Caribbean. The artificial collectors are potential tools for ecological, taxonomic and diversity research in fouling organisms.

## **History of investigations and current state of knowledge of bryozoan species diversity in the Chukchi Sea**

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Bryozoan fauna of the Chukchi Sea have not been the focus of many investigations. Moreover, the Chukchi Sea is still the least studied area among all Arctic seas. A study by A. Stuxberg provided the first published information about bryozoans from this region. These first records were the result of his research conducted during the “Vega” expeditions along the Siberian Coast between 1875 and 1878. New information about bryozoan fauna of this region appeared more than 30 years after Stuxberg’s publication. In 1923 and 1955 R. Osburn published results collected by Canadian Arctic Expeditions (1913-1918). These studies covered several locations in Chukchi Sea including: Point Barrow, northeast of the Icy Cape and some other sites of the northern coast of America. However the most detailed and comprehensive bryozoan study in this area was carried out by Russian bryozoologist G. Kluge. Material used for his investigations was collected in various locations of the Chukchi Sea during eight Russian expeditions between years 1910 and 1938. His broad investigation of the area resulted in the knowledge that 126 species inhabit the Chukchi shelf area, many of which were new for science. His comprehensive studies of all Arctic Seas led to the conclusion that the Chukchi Sea has a low diversity of bryozoans in comparison to other parts of the Arctic.

Current research involving literature searches, studies of unpublished data and additional sampling revealed higher levels of diversity than previously recorded. At present, the bryozoan fauna of the Chukchi Sea includes 165 species (20 cyclostomes, 12 ctenostomes, and 133 cheilostomes).

At the same time, our preliminary results point to the need for taxonomic revision of many taxa with the use of a scanning microscope, as this is likely to result in even higher number of species recorded in that area.

## **Taxonomy, diversity, and distribution of *Monoporella* (Bryozoa: Cheilostomata) species in the Aleutian Islands, Alaska, USA**

**Dick, Matthew H.**

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I examined the bryozoans in 52 trawl catches from shelf areas in the western and western-central Aleutian Islands, Alaska, USA. Specimens of species of *Monoporella* occurred in 12 of these samples and comprised six previously undescribed species (A-F). Two species form erect colonies (A, bilaminar sheets; B, branched, with flexible nodes and cylindrical internodes), and four (C-F) form unilaminar, encrusting colonies, the only type previously reported in *Monoporella*. Taxonomically informative characters included colony morphology and color; zooid size; orifice size and shape; presence or absence of oral spines; frontal-wall sculpturing; type of oecium-forming distal zooid; and characters of the ovicell.

The species appear to vary in depth and geographic distributions. Species F was found at only one locality, at a depth of 189 m. Among the five species with more than one depth record, unilaminar species C-E ranged from a minimum depth of 93–95 m to a maximum of 227–355 m; erect species A was restricted to depths of 81–94 m close to islands; and erect species B was recorded only at depths of 181 and 227 m. All six species occurred in the western Aleutians. Species F was found only on Stalemate Bank; B and C had distributions almost spanning, but restricted to, the western Aleutians; and A, D, and E had relatively short ranges spanning Amchitka Pass, the boundary between the central and western Aleutians.

Only four Recent species of *Monoporella* have been formally described, all from tropical areas, although several additional, unnamed species have been reported in the literature. The literature indicates no more than four species in the genus occurring in any local region of the world. The high Aleutian diversity compared to other regions suggests that a local radiation of *Monoporella* occurred in this region. Similarity between the two erect species, and among the four encrusting species, indicates that as few as two founding ancestors could have contributed to a putative radiation. This study included specimens from stations covering ~ 800 km, less than half the 1,700-km length of the Aleutian archipelago. Examination of additional collections from the central and eastern Aleutians will likely detect additional species, strengthening the hypothesis of a local, northern radiation of *Monoporella*.

15 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **Cretaceous bryozoans from Abu Roash area, West Cairo, Egypt**

El Safori, Yasser A.

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Cretaceous bryozoans of Abu Roash area were first investigated as early as 1904 by Canu, with six bryozoan species identified from the Turonian and Santonian successions. New material was collected from Abu Roash area (Aub Roash Village and Hasana Dome) to re-evaluate Canu's assemblage. The Coniacian-Santonian succession is laid down in low relief areas between the Turonian structural highs of the Abu Roash area. The sediments of the investigated succession are represented by sandy and marly limestones with oyster banks. The Turonian bryozoans are erect and included in the regressive marls of the Turonian highstand limestones. The encrusting bryozoans are collected from the Santonian oyster banks. Canu's species beside the additional ones are scanned and systematically studied.

16 – (TALK) Monday 2:50

## **Recent bryozoans from the coastal sediments of the Red Sea and Gulf of Suez, Egypt**

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Recent bryozoans were collected from the Egyptian Red Sea coast, as well as the eastern and western coasts of the Gulf of Suez. Encrusting bryozoans were collected from molluscan shells and different substrates of rock fragments. However, the erect bryozoans were collected from the coastal sediments along the sea shore of the studied sites. The studied coastal sediments are composed of quartz sands, granules, shell debris, and rock fragments. Some of these coastal areas are occupied by coral reefs or oolites. Additional and re-sampling from some sites of the Gulf of Suez shows unexpected increases in the collected bryozoan species. These sites witnessed increases of human activities as new shores for summer vacations. The paleobiogeography of the studied bryozoans indicates their Indopacific affinity. Except to *Membranipora savartii*, none of the studied assemblage, so far, is recorded from the Egyptian coast of the Mediterranean Sea.

17 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **Santonian bryozoans from West Central Sinai, Egypt**

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Cretaceous bryozoans from West Central Sinai are preserved in the Coniacian/Santonian sequence (Matulla Formation). The Coniacian succession is represented by fluviomarine claystones intercalated with transgressive sandy carbonates and oyster banks. The Coniacian sequence is devoid of bryozoans and represented by a thick succession (70m). However, the Santonian succession (40-60m) is represented by transgressive marls with many fossil horizons containing bryozoans. Two stratigraphic sections (Wadi Matulla and Wadi Sudr) are studied to investigate their bryozoan biostratigraphic horizons. Ten bryozoan species are collected from four stratigraphic horizons and correlated in both studied sections.

18 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **New Oligocene bryozoans from Libya**

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Twenty five bryozoan species are identified from the Oligocene succession (Faidiya Formation) of Al Jabal Akhdar, East Libya. They represent one of the minor records of the marine Oligocene sediments of North Africa. Some of the studied species are considered endemic species and new records. Paleo-biogeographically, the studied bryozoans have an Atlantic/Mediterranean affinity. A relatively large number of the studied species (*Steginoporella jacksonica*, *Hippomenella cutomostoma*, *Retrepora ramose*, *Osthmosia glomasta*) is already recorded from the Late Eocene sediments of North America. This points to shallow marine connections between the African and the North American plates during the Oligocene time. Three of the species are considered new: *Teuchopora zikoi*, *Adeona libyaensis*, and *Porina symmetrica*.

## **Devonian bryozoans of Europe: Diversity dynamics and paleogeographical relations**

**Ernst, Andrej**

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Marine Devonian deposits are widely distributed in Europe. They were deposited in the Rheic Ocean and belong to the Old World Realm (OWR). They display different facies, from onshore reefs to deep water environments. Bryozoans were reported from different Devonian localities in Europe. Bryozoan faunas are well known from the Czech Republic, France, Poland, Belgium, and British Isles. However, our knowledge about Devonian bryozoans from Germany, Spain and Morocco is still quite poor. In the course of the present investigation extensive material from Devonian localities in Germany, Spain, Czech Republic and Morocco was studied. These results are involved in a total compilation of bryozoan species and genera known from the Devonian of the European region.

Devonian bryozoans in Germany are scarcely investigated despite a long tradition of Devonian research here. Few publications deal with fenestrate and hederelloid taxa. Some trepostome and cystoporate bryozoans were mentioned as corals in older works. The bulk of the current material comes from different localities in Rhine Slate Mountains, Middle Devonian (Eifelian – Givetian) in age. These samples contain surprisingly rich bryozoan fauna dominated by bifoliate cryptostome and rhabdomesine species (*Intrapora*, *Acanthoclema*, *Nematopora*). Several localities contain almost monospecific associations of branched trepostome bryozoans.

Devonian rocks in NW-Spain (Cantabrian Mts.) are very rich in bryozoans. However, this fauna remains almost unstudied. The available material comes from the Lower Devonian (Emsian) La Vid Formation. It contains various trepostomes, fenestrates as well as fistuliporids and rather exotic bifoliate cryptostomes and rhabdomesines (*Intrapora*, *Acanthoclema*, *Orthopora*).

Material from the Koněprusy reef, Czech Republic (Lower Devonian, Pragian) contains beside fenestrates, trepostomes, and fistuliporids also interesting bifoliate and rhabdomesine cryptostomes. The Middle Devonian reefs from the Sabkhat Lafayrina reef complex contain a rich bryozoan fauna, numbering more than 30 genera. Interestingly the bifoliate cryptostome genus *Euspilopora*, known previously only from the Middle Devonian of Eastern American Realm (EAR), is present. The age of the complex is estimated as uppermost Givetian (Middle Devonian).

According to the analysis of the reported taxa and to my own material, bryozoan faunas in the Devonian of Europe number more than 160 species of at least 70 genera. The bryozoan faunas are dominated usually by fenestrates followed by trepostomes and cystoporates, as well as bifoliate and rhabdomesine cryptostomes. The bifoliate cryptostome *Intrapora* and rhabdomesine *Acanthoclema* are found in most Devonian localities of Europe and in Morocco. *Intrapora* is known previously from the Lower to Middle Devonian of North America and the Upper Devonian and Lower Carboniferous of Kazakhstan. Most bryozoan species from the Devonian of Europe are endemic, but others display connections with North America (Eastern Americas Realm).



## **Pennsylvanian stenolaemate bryozoans from the Cantabrian Mountains, NW Spain**

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Marine Pennsylvanian sediments are widely distributed in the Cantabrian Mountains (NW Spain), and are well documented there. These are mostly platform carbonates and flysch-like, carbonate-clastic sediments, often undergone wide-spread silicification. They contain locally rich fossil fauna. Bryozoans are also very abundant and diverse in these communities. However, in contrast to other fossils like brachiopods and corals, bryozoans were neglected for a long time. Some few special publications were done on bryozoans from the Pennsylvanian of Cantabrian Mountains in the last decades. We have investigated extensive material deposited at Nationaal Natuurhistorisch Museum (Leiden). This material includes silicified bryozoans gained by solution of rock samples in acid as well as calcified samples, suitable for preparation of thin sections. Investigated samples come from the Valdeteja-Formation (Namur – Westphal A, Bashkir – Vereisky) and Lebeña-Formation (Kasimov, lower Stephan). The total number of bryozoans from this material exceeds 50 species. They include cystoporates, trepostomes, rhabdomesid cryptostomes and fenestrates. Some of these bryozoans are well known from the Late Carboniferous and Early Permian of Europe and North America (*Clausotrypa monticola*, *Rhombopora lepidodendroides*, *R. corticata*). Some other species appear to be rather exotic, revealing unusual morphologies. The bryozoan fauna shows paleogeographical relations to the North American Province (Appalachians) and to the Russian Plate.

## **Bryozoan fauna associated with gas platforms offshore in Colombian Caribbean**

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During the project “Chuchupa gas extraction platforms associated biodiversity” carried out by the Marine and Coastal Research Institute INVEMAR and Ecopetrol S.A., in November 2005, bryozoans associated with gas extraction platforms were identified. Two platforms called “Chuchupa A and B” are localized on the continental shelf, 2 km away off La Guajira, in the northern coast of the Colombian Caribbean. Samples were collected by SCUBA diving, scraping 0.09m<sup>2</sup> on the platform structure at different depths and at the bottom, up to 18 and 33 m depth on the platforms A and B, respectively. A total of 30 species, belonging to 24 families, were identified, mostly Cheilostomata order (93.3%) and the rest Cyclostomata (6.6%). *Aetea truncata*, *Crepidachanta poissonii*, *Membranipora arborescens*, *Reginella floridiana*, *Rhynchozoon spicatum* and *Schizoporella unicornis* are first records for the Colombian Caribbean. Most species were observed growing on other organisms, such as sponges and bivalve shells mainly. The highest richness was found on the rubble bottom.

## **Recent bryozoans collected on soft bottoms in Colombian Caribbean**

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Bryozoan faunal studies in the Colombian Caribbean are scarce and relatively recent. The most studied ecosystems are soft bottoms, in which bryozoans growing on different substrata types or building frameworks together with other organisms such as sponges and gorgonians have been found. Osburn in two localities of northern Colombian Caribbean carried out the first study in Colombia during Allan Hancock expedition in 1939, when 54 specimens were recorded. Then in 2001 Macrofauna II expedition was performed between 20 and 500 m depth along the continental shelf and the upper slope of Colombian Caribbean, being the most representative survey because of its geographical coverage. In 2005 Marcoral expedition was carried out and the fauna of continental shelf margin was surveyed at a site off San Bernardo between 90 and 300 m depth, where evidence of the presence of deep-sea coral reefs exists. The same year, Corpoguajira expedition studied the material, which was collected between 10 and 50 m depth off La Guajira coasts, where a great amount of bioconstructor species associated with sponges were observed. Up to date 145 species in 34 genera have been identified in these ecosystems. Other samples were not identified yet and 42% are first records for Colombian Caribbean.

## **Structure, function, and phylogenetic significance of muscular systems in gymnolaemate larvae**

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Three-dimensional structure of the musculature in gymnolaemate larvae as well as muscle mediated movements during metamorphosis were investigated by means of fluorescence staining and cLSM. Although both larval morphology and metamorphosis have gained much attention by earlier workers, this relatively new technique provides the opportunity to obtain a more detailed and complete picture of the larval muscular system than serial sectioning alone. Musculature is surprisingly complex in all bryozoan larvae. Especially lecithotrophic larvae, which have a very short pelagic phase with seldom muscle-mediated movements have a set of muscles that primarily acts during metamorphosis. Parts of muscles act when the larva stops swimming and starts to inspect the substratum in a creeping manner. This is along with protrusion of parts of the pyriform organ and, especially in coronate larvae with constriction of the larval body to a more or less elongate shape. At the onset of metamorphosis the muscles and ciliary beat cause a rapid reorganization of larval tissues.

A comparison of the morphology of larval muscular systems and their functioning during metamorphosis among different representatives of several gymnolaemate subtaxa and larval types allows homologizing only few muscles. Such a comparison rather unravels striking differences especially between the various types of coronate larvae. Type E (classification of larval types following Zimmer & Woollacott 1974) coronate larvae of *Alcyonidium gelatinosum* for example share more similarities with shelled lecithotrophic larvae than with other types of coronate larvae. These results are in accordance with the widely held view that lecithotrophic larvae evolved convergently multiple times within Bryozoa. Nevertheless it has to be emphasized that assumptions like this have to be based on a reliable phylogenetic system, which is still not available for the Bryozoa at the moment.

## Post-2000 detection of warm-water alien bryozoan species in New Zealand

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Since 2000, twenty-six species of alien bryozoans have been detected in New Zealand waters. All have a natural home range in, or were first described from, tropical or subtropical waters (with the possible exception of four of uncertain identity). So far, only five of the species (*Biflustra grandicella*, *Electra xiamenensis*, *Membraniporopsis tubigera*, *Celleporaria nodulosa*, *Celleporaria* sp.) give evidence of having reproduced in New Zealand waters, but their long-term survival remains to be ascertained. Five others (*Electra papillorum*, *Sinoflustra annae*, *Celleporaria sibogae*, *Hippoporina indica*, *Hippopodina feegeensis*), detected in hull samples taken from vessels in 2006 and 2007, were alive at the time of collection. The latter two species had mature embryos in ovicells and appeared likely to have been releasing larvae into the New Zealand port environment where the vessels were berthed. Perhaps significantly, these were North Island ports north of 37° S where mean summer sea-surface temperatures can exceed 20° C. Sixteen of the alien species discovered since 2000 have been detected in the course of a program of surveillance of the hulls of overseas vessels visiting New Zealand's major ports and harbours. Inasmuch as this program also records ports of origin and destination of vessels in the months prior to coming to New Zealand, it addresses the key questions concerning provenance and vector. Two other species (*Biflustra grandicella*, *Membraniporopsis tubigera*) were found in coastal embayments not subject to surveillance but were discovered when their numbers and bulk started to affect human livelihoods (scallop dredging and set-net fishing). Three alien species were found on settlement panels set out independently of the surveillance program and five others (one live — *Brettiella culmosa*) were found attached to the wreck of a Taiwanese fishing vessel that drifted close to the northeastern coast of the North Island.

## **Distribution and conservation of *Lophopus crystallinus* in the UK**

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The freshwater bryozoan *Lophopus crystallinus* is considered rare in the United Kingdom and is thought to have undergone a worldwide decline over the past century. Currently there are three known populations of *L. crystallinus* in the U.K. Recent work, based on the presence of statoblasts in flood debris samples, has revealed a wider distribution but does not locate where the actual populations reside. Nevertheless, for the establishment of effective conservation measures, the location and habitat requirements of the adult colonies must be known.

We report results from field surveys for colonies and statoblasts of *L. crystallinus* in 2005/6 and 2006/7. Surveys took place in sites where statoblasts had been previously recorded. Statoblasts were encountered in debris from all sites surveyed, including in debris from two rivers in which occurrence had not previously been documented. The presence of statoblasts in debris samples over two years in some sites suggests that the *L. crystallinus* populations are persistent.

Live colonies were discovered on a floating branch in one site. Sampling of flood debris upstream from these colonies suggested that the main population occurred in an inaccessible pond and also that most statoblasts are transported over very short distances. The use of successive debris sampling to inform on the location of populations in two other sites suggested that colonies are located either in ponds or lakes or in the associated tributaries and ditches leading in to rivers. Our work indicates that high statoblast concentrations in debris samples should warrant searches for populations in the near vicinity and provides further evidence that *L. crystallinus* is less rare than previously thought.

## **The role of frontal wall architecture in the development of a cheilostome phylogeny – and the Cretaceous-Tertiary boundary**

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Frontal walls in cheilostome bryozoans are not only fundamental to the key function of individual zooids, but also a high proportion of the total skeletal complexity in the group is associated with this wall. Hence variations in frontal wall architecture have invariably played a prominent role in developing a viable cheilostome taxonomy, that has progressed unevenly with an increasing emphasis on phylogeny over time.

The basic element in all cheilostome frontal walls is a flexible area, which allows constriction of the body cavity necessary to force out the feeding lophophore. In some groups the entire frontal wall remains flexible, commonly with simple skeletal reinforcement in the form of overarched spines or an internal cryptocyst in the more advanced forms. In other groups skeletal reinforcement of the frontal wall is more complex necessitating a modification of the flexible part.

In principle there are three ways to reinforce the cheilostome frontal wall: an internal wall, underlying the frontal membrane (a simple cryptocystal wall), direct calcification of (part of) the frontal membrane (a gymnocystal wall), and an overarched wall with an associated hypostegal coelome (an advanced cryptostomal wall). In their initial, simpler versions none of these requires very fundamental changes in overall zooidal architecture, hence it may be worth investigating whether they have in fact evolved more than once through cheilostome history.

Cheilostome evolution may be characterized by two bursts of radiation separated by a brief, impoverished episode of stasis during the Paleocene. The primary burst was by and large confined to the carbonate environments of the Late Cretaceous Boreal Chalk Sea in northern and eastern Europe, and mounting evidence supports the proposition that many or most of the involved clades were essentially terminated in a series of extinctions at the *Maastrichtian-Danian boundary*, at the *Danian-Selandian boundary*, and at the *Paleocene-Eocene boundary*. In contrast, the second burst, culminating in the Eocene, was pandemic in scale, but at present the root of this new burst is still not clear. However, within a number of families strong ties have been established with the scattered Southern Hemisphere Paleocene faunas, giving support to a notion of deriving most or all of the later bryozoan faunas from the Southern Hemisphere and, in consequence, cheilostome taxa presently recorded from BOTH the Upper Cretaceous AND the Eocene (or later) may therefore potentially be regarded pairs of non-related 'look-alikes'.

## Colonial budding in free-living bryozoans from the Miocene of Denmark

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Colonial organisms routinely employ fission as a means of reproduction, usually by haphazard fragmentation sometimes favoured or enhanced by the constructional design of the colony. Actual colonial budding have also been described from a few Recent forms; however, to our knowledge colonial budding has been reported only once in a fossil species, the cupuladriid bryozoan *Reussirella haidingeri* from the Upper Miocene Gram Formation in Denmark, deduced from the skeletal morphology of the colonies (Håkansson & Thomsen 2001). We report here on the recent find of a small piece of Gram Fm clay exposing a total of 11 mature colonies of this species with 24 associated colonial buds preserved in life position within about 5cm<sup>2</sup> of what may be inferred to be the original Gram Formation sea floor. The buds are found evenly distributed around the margin of 7 *Reussirella haidingeri* colonies; 19 are still in place and, except for one, apparently in an undisturbed position. Four buds are slightly detached, albeit still in obvious relation to the maternal colony, and a single newly budded colony is completely detached, with undeterminable maternal relations. Almost all colonial buds are oriented with their frontal side in accord with their maternal colony.

Observations from the new population confirm previous inferences regarding the reproduction biology of this fossil species, in particular the fact that budding is not only taking place, but also that it is indeed frequent. Furthermore, the fact that all colonies with buds have reached approximately the same stage in their development, i.e. are in the process of, or have just released their buds, would indicate that extrinsic factors such as seasonality or environmental stress have a strong controlling role in the budding process.



**Advantages of 3D - reconstruction in bryozoan development research: tissue formation in germinating statoblasts of *Plumatella fungosa* (Pallas, 1768) (Plumatellidae, Phylactolaemata)**

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Freshwater bryozoans belonging to the class of Phylactolaemates are characterised by the formation of special dormant buds, so-called statoblasts. These resting stages are asexually produced and can be classified in different categories such as ptioblasts, sessoblasts and floatoblasts. The goal of this study is to give a three-dimensional description of the process of germination in floatoblasts. The floatoblasts for investigation were taken from colonies of *Plumatella fungosa*, a common species in nutrient rich ponds and backwaters. Different stages of germination were serially semi-thin sectioned and three-dimensionally reconstructed (Amira 3.1) in order to demonstrate the position of developing tissues in 3D-models. Lophophore, tentacles, digestive system, ganglion, funiculus, retractor muscles and budding zone are presented at several different stages of germination in regard to position of body axes.

## **Zooid size and tentacle number in relation to nutrient levels in a freshwater bryozoan**

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Variation in zooid size and number of tentacles in the branching freshwater bryozoan *Fredericella sultana* was investigated using laboratory experiments. Low, medium and high nutrient concentrations were implemented by additions of inorganic phosphorus and nitrogen to replicated mesocosms containing water from a pond with natural planktonic communities.

A significant trend for increasing numbers of tentacles per lophophore in larger colonies was observed in all nutrient treatments. When the effect of colony size on lophophore number was accounted for, the number of tentacles was found to be significantly reduced in colonies exposed to low nutrient concentrations. Why fewer tentacles were produced in low nutrient concentrations is unclear. It may reflect avoiding the high costs of producing a large lophophore or that particle capture by smaller lophophores is more energetically efficient.

Zooids with two daughter zooids were significantly larger than zooids with only one daughter zooid irrespective of the nutrient treatment. Analysis that accounted for this colony level variation revealed no significant differences in zooid areas or lengths between the nutrient treatments.

Our results indicate that nutrient concentration and hence food availability do not influence the overall zooid size in *F. sultana*. A reliable approximate measure of the absolute colony growth rate can therefore be obtained by determining the rate of change in number of zooids per colony.

## **Bacterial symbioses in bryozoans: *Bugula* and *Watersipora***

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Several species of cheilostome bryozoans in the genus *Bugula* harbor specific uncultivated gamma proteobacterial symbionts in the genus *Endobugula*. In the *B. neritina*/*E. sertula* association there is now strong evidence that the bacterial symbionts participate in the biosynthesis of defensive compounds, bryostatins, which protect the swimming larvae from predation. Phylogenetic analysis of host and symbiont gene sequences in several species suggests co-divergence, consistent with an obligate symbiosis, accompanied by frequent symbiont loss, resulting in aposymbiotic *Bugula* species such as *B. turrita*. A large biosynthetic gene cluster whose structure is consistent with bryostatin biosynthesis has been isolated from the *E. sertula* genome. We devised a molecular target-based detection method for microscopic visualization of bryostatins. Combined with conventional *in situ* hybridization for symbiont localization, this method revealed a population of *E. sertula* in funicular cords in the ovicells associated with high bryostatin levels in the ovicell during brooding; thus this is a site of active bryostatin biosynthesis. When released from the ovicell, the swimming larvae possess a surface layer containing bryostatins that persists after settlement and is shed late in development. The symbionts, which are confined to the pallial sinus in swimming larvae, were observed to move with the pallial epithelium during development, subsequently migrating into newly budding zooids in the ancestrula. *E. sertula* cells are also seen in funicular cords in the rhizoids, and bryostatins are present on the surface of rhizoids, suggesting that bryostatins may also defend the adult colony.

An independently evolved specific association between several bryozoan species in the genus *Watersipora* and uncultivated alpha proteobacterial symbionts in the genus *Endowatersipora* provides a contrast to the *B. neritina*/*E. sertula* association. Bacterial symbionts are carried in swimming larvae, but in a different structure, the supracoronal groove. The bacterial clusters found in the adults are not closely associated with the developing embryo until just before release, suggesting that they are not involved in manufacturing a protective coating for the larva. The role of these symbionts in the biology of the hosts is currently unknown.

## Ongoing results on the phylogeny of recent Cupuladriidae, from the Isthmus of Panama

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We used up to 30 quantitative morphological characters to distinguish eight species of *Cupuladria* and seven species of *Discoporella* by linear discriminant analyses of zooid, vicarious and colony-level characters from 260 entire colony specimens collected from both coasts of the Isthmus of Panama. The first series of linear discriminant analyses separated *Cupuladria* species taxonomically into two groups by the presence or absence of vicarious avicularia. The second series of linear discriminant analyses separated *Discoporella* species ecophenotypically in two oceans (Caribbean and eastern Pacific) based in size and basal granule density. Further analysis using 20 of a total of 30 of the quantitative characters that could be statistically coded for cladistics, provided three maximally parsimonious groups for the fifteen species. However less than one quarter of the diagnostic characters do not involve vicarious avicularia, which is insufficient to resolve the cladistic relationship among the clades that lack this morphological feature. Separat cladistic analyses of *Cupuladria* and of *Discoporella* are required to understand better the phylogeny of Cupuladriidae.

## **Molecular phylogenetic analysis of Plumatellidae (Bryozoa: Phylactolaemata) based on mtDNA sequences**

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Family Plumatellidae, with seven genera and about 40 species, is the largest group of phylactolaemate bryozoans. Taxonomic problems in this family arise from poor original descriptions, losses of type material, ecophenotypic variation in some characters, and different concepts among taxonomists of which characters are diagnostic for genera and species.

Plumatellid colonies and statoblasts from numerous localities in Japan, specimens from the collections of Japanese phylactolaemate researchers Hideo Mukai and Makoto Toriumi, and specimens from other parts of the world were identified by light microscopy, sectioning, and/or scanning electron microscopy (SEM). Fifteen plumatellid species were found in Japan, including four *Plumatella* species new to Japan (*P. fungosa*, *P. javanica*, *P. reticulata*, *P. rugosa*) and two undescribed species from Okinawa Island.

To study the phylogenetic position and monophyly of Plumatellidae, and relationships among plumatellids, a molecular phylogenetic analysis of 24 phylactolaemate species was conducted, including 15 plumatellids in the genera *Plumatella*, *Hyalinella*, and *Gelatinella*. Partial sequences of the mitochondrial 16S and 12S rRNA genes were used to reconstruct the relationships among genera, and of the cytochrome b gene to reconstruct the relationships among plumatellid species. The primary results of these analyses were: (1) Plumatellidae was well supported as a monophyletic group, and (2) *Plumatella minuta*, *Plumatella vorstmani*, and *Plumatella* spp. 1 and 2 from Okinawa formed the sister group to a clade of other plumatellids that included *Hyalinella punctata* and *Gelatinella toanensis*. Possibilities for addressing the second result include establishing a new genus containing *P. minuta*, *P. vorstmani*, and the two new species (*Plumatella* sp. 1 and sp. 2) from Okinawa, or leaving *Plumatella* as a paraphyletic group.

The histology of the epidermal cells of several species in different families was also examined. Epidermal cells of plumatellids were different from those of representatives of other families, a result congruent with monophyly of Plumatellidae, but this character was uninformative regarding the two main clades of plumatellids.

## **New Monticuliporidae (Trepostomata) from the Upper Ordovician limestones of the Iberian Chains (NE Spain)**

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Bryozoans are among the most abundant fossil groups in the limestone horizons that characterize the pre-Hirnantian Upper Ordovician of southwestern Europe. Nevertheless, only in Sardinia has a detailed modern systematic study been carried out on them. Here, we present the first results of a systematic study on the rich bryozoan associations from the Upper Ordovician limestones of the Iberian Chains (NE Spain).

The studied bryozoans were collected in the surroundings of Fombuena (Zaragoza province), in the basal member of the Cystoid Limestone Formation. This member displays a maximum thickness of 12 m. It is composed of alternating shales and marly limestones, consisting mainly of thin-bedded packstones rich in pelmatozoans and bryozoans, and a pelmatozoan wackestone. This formation has been dated as upper Katian (mid Asghill) by means of conodonts, brachiopods and trilobites. The family Monticuliporidae (Trepostomata) is one of the most frequent within the studied associations, and its systematic study is presented here.

Five species of the genera *Monticulipora*, *Orbignyella* and *Prasopora* have been identified. Besides *Monticulipora kolaluensis* Jaroshinskaja and *Prasopora gotlandica* Hennig, known exclusively in Siberia and Baltoscandia, respectively, and one undetermined species of *Prasopora*, two new species of *Monticulipora* and *Orbignyella* are described. *Monticulipora* and *Prasopora* are very closely related genera in need of revision, since they share many diagnostic features that make the generic assignment of several of their species difficult. This is the case of one of the new species provisionally assigned to *Monticulipora*. The new monticuliporid species assigned to *Orbignyella* displays a wall which is not laminated, a feature unknown until now in the genus, which requires an emendation of its diagnosis.

The three studied genera are natives of the paleoequatorial palecontinents Avalonia-Baltica, Laurentia, South China, Siberia and Altai-Sayan, having arrived in the Mediterranean region during the upper Katian. . The genus *Orbignyella* is identified here for the first time in southwestern Europe. Of the two remaining genera, *Prasopora* is the one which has the widest geographical distribution in this region, having been reported in the Montagne Noire (France), Carnic Alps and Sardinia (Italy), always in correlative horizons to the Cystoid Limestone Fm. *Monticulipora* had also been previously identified in upper Katian horizons from the eastern Pyrenees (Spain) and the Carnic Alps.

**A stable isotopic test for the origin of fossil brown bodies in trepostome bryozoans from the Ordovician of Estonia**

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This study provides a novel test of the brown body origin of brown deposits in fossil bryozoans. We use carbon and stable isotopes of inorganic carbonate from separate samples of brown deposits, skeletal walls, matrix, and diagenetic cements from trepostome bryozoans from the Ordovician of Estonia. Our sampling technology improves on the spatial resolution of previous studies to minimize contamination from the various carbonate sources. Samples from brown deposits display lower  $\delta^{13}\text{C}$  values indicating the presence of originally organic material. The granular texture, reddish-brown color, 80  $\mu\text{m}$  diameter size, and circular cross-sectional shape of the deposits as well as their location in the zooecial chambers relative to diaphragms support the isotope results in demonstrating the brown deposits are the diagenetic remnants of original brown bodies.

## **The cheilostome bryozoan *Floridina* from Plio-Pleistocene deposits of the Coastal Plain of North America**

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The Plio-Pleistocene Coastal Plain deposits of North America contain several species of the anascan cheilostome *Floridina*, Jullien, 1883 that were described by Canu and Bassler (1923). Scanning electron microscopy of the type and other specimens of three *Floridina* species has highlighted key differences and allowed taxonomic revision of the commonest species, *F. regularis* Canu and Bassler (1923). The endozoecial ovicells and vicarious avicularia are described, as is the early budding pattern and primary zone of astogenetic change. The size of this zone is delimited through the examination of replicate colonies from the Pliocene and early Pleistocene of Virginia and North Carolina. Clarifying the extent of the primary zone of astogenetic change is important to avoid inappropriate measurements of zooid size for taxonomic descriptions and use in MART analyses.



## **Using bryozoan zooid size and General Circulation Models (GCMs) to infer North Atlantic shelf sea temperatures during the mid Pliocene**

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The mid Pliocene (3.29-2.97 Ma) was a time broadly characterised by global warmth and high sea levels. It represents the last time in Earth history when the level of atmospheric CO<sub>2</sub> was similar to today (ca 380 ppm) and as such, it may provide a model for future global warming. The Mean Annual Range of Temperature (MART) experienced by a bryozoan colony can be estimated utilising the inverse relationship between zooid size in cheilostome bryozoans and water temperature at the time of budding (O’Dea and Okamura, 2000). In this study the technique is applied to Pliocene bryozoan material from the UK (Coralline Crag Formation), Virginia and North Carolina (Yorktown and Chowan River Formations), Florida (Lower Tamiami Formation), Costa Rica (Rio Banano Formation) and Panama (Cayo Agua Formation). These data, from a range of latitudes, provide information about shelf sea surface temperatures that can be used to test mid Pliocene climate scenarios generated by numerical models of climate (General Circulation Models). Here bryozoan MART data, collected from over 130 colonies in five main regions of the North Atlantic, are compared with model outputs from six General Circulation Models.

## **Gastropod shells, hermit crabs and Arctic richness**

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The basins of the Arctic are characteristically shallow, muddy and species-poor. For many groups of animals, especially bryozoans, presence of suitable substratum is of paramount importance. Habitat type and area strongly influences bryozoan species composition, abundance and species richness in the Arctic. We investigated a potentially crucial source of hard (and mobile) substratum for bryozoans, the shells of sub Arctic and Arctic hermit crabs. Our first hypothesis was that shells would be richer in epifauna than local abiotic substrata (pebbles) of similar total area due to stability. The second hypothesis was that bryozoan richness on hermit crab shells would simply be highest at the location where shells were largest. We investigated the influence of factors including site, gastropod shell size and species on abundance and species richness on epifaunal bryozoans. We collected ~50 hermit crabs from each of Northern Norway (Tromsø - 68°N) and three sites in Spitsbergen (Hornsund - 76°N, Belsund - 77°N, Isfjorden - 78°N). These sites largely differed in hydrology and a decreasing regional bryozoan species pool northwards.

Shells were colonized by more than twice the number of colonies and species as rocks of the same area, so our first hypothesis was accepted. The Hornsund and Tromsø sites were the richest in gastropod shell species (11). Hermit crabs from Hornsund and Tromsø had also the biggest shell sizes (mass used as a proxy) at 250 g (mean 5.21 g) and 85 g (mean 1.70 g) respectively. On the 26 species of shells in total we found 53 bryozoan species. Despite the regional trend in species richness bryozoan species richness and abundance was highest at the northernmost site and lowest at the southernmost site. Bryozoans were most abundant (total 354, mean 7.2) and rich (total 41, mean 3.8) on shells at Hornsund. Tromsø had the lowest abundance (total 54, mean 1.0) and bryozoan species number (total 13, mean 0.7). We did find a general relationship between shell size and bryozoan abundance as well as species richness (ANOVA,  $F_4 > 17$ ,  $p < 0.05$ ) except at the Tromsø site where strangely larger shells did not support more colonies or species (ANOVA,  $F_5 < 0.8$ ,  $p > 0.5$ ). Hermit crab shells are more important for biodiversity than would be predicted by their shell area and follow species area curves in the Arctic. We suggest that the breakdown of normal species area curves on sub Arctic (Tromsø) shells is due to the rapid growth of founder colonists, a hypothesis we are currently testing. Locally, hydrological and biological conditions seem to be more important in shaping bryozoan assemblages than regional scale species pools.

## Are bryozoans adapted for living in the Arctic?

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Geologically, the Arctic is a young environment and is considered still to be under colonization by marine organisms from lower latitudes. Although the species richness of bryozoans in polar regions is less than elsewhere, they are nevertheless abundant components of many benthic communities. Here we investigate potential adaptations (*sensu lato*) of bryozoans for coping with life in the Arctic. As predation and competition pressures are likely to be relatively less important than physical stresses and disturbance in the Arctic, investment in defence should be reduced. Autozooids are expected to be larger in accordance with the well-known size-temperature relationship which probably has an energetic basis. The lower seawater temperatures should favour secretion of skeletons of calcite with low magnesium content over more soluble high magnesium calcite or aragonite skeletons. We therefore hypothesized that, compared with congeners from elsewhere, Arctic species of cheilostome bryozoan genera will have: (1) fewer types of avicularia; (2) smaller avicularia; (3) larger autozooids; and (4) calcitic skeletons with low magnesium contents.

To test the morphological hypotheses (1-3) we selected eight cheilostome genera with wide geographical ranges. The number of types of avicularia was lower in Arctic species in five of these genera but there was no latitudinal trend in the other three genera. The ratio of avicularium to autozooid size increased towards the tropics in four of seven investigated genera, while in the remaining three there was no trend. In the majority of cases the predicted difference in autozooid size was found: for six genera autozooids were larger in the Arctic than at lower latitudes but in two genera no difference could be detected. Mineralogical analyses of selected genera revealed a dominance of calcite in the skeletons of Arctic bryozoans. No species were found with entirely aragonitic skeletons and only two species were bimineralic. Congeneric species from lower latitudes often had either aragonitic or bimineralic skeletons. Only two of the investigated genera (*Scrupocellaria* and *Reteporella*) had the same mineralogy from the Arctic to the tropics. However, individual bryozoan species ranging from the Arctic into the lower latitudes maintained the same mineralogy across latitudes. In all investigated cases Arctic specimens had on average lower magnesium contents than specimens of the same species and genera from the lower latitudes.

These results support most of our hypotheses, leading to the conclusion that, in spite of the young age of the Arctic, bryozoans frequently show adaptations for living in this polar region.

38 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **BryoZone: A unified bryozoan reference**

**Lidgard, Scott**

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BryoZone is an interactive web-served database intended to provide a community-wide clearing house for information on bryozoan taxonomy, distribution, bibliography, and images. The first stage ([www.bryozone.com](http://www.bryozone.com)) features a searchable higher taxonomy, plus families and genera of cheilostomate and cyclostomate bryozoans. The project will eventually deliver (1) updated species nomenclature with authorities and synonymies; (2) family and genus names with synonymies; and (3) a searchable list of references. It will also continue the development of (4) a digital SEM image library component and other ancillary data sets. This initial stage was developed under a grant from the Global Biodiversity Information Facility, as a team effort with P. Bock, D. Gordon, R. Schmidt, and J. Winston. We now hope to move the project forward with discussion of community participation, future development and funding opportunities; we welcome your input!

39 – (TALK) Friday 10:20

## **How should we consider predation risk in bryozoans?**

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Bryozoans are exposed to different levels of predation risk as they develop from larvae to recruits to juveniles to mature colonies that mostly produce brooded larvae. Suites of predators change through these life history stages as well, though most antagonistic interactions are known only from experiments and reports of single consumers at a single life history stage. The probability of lethal predation seemingly changes dramatically through life history stages, and is likely a complex function of probability of encounter, mechanism of predation, consumer size, prey size and other factors.

Here I summarize recent work on functional groups of bryozoan colony predators and their roles as potential lethal and sublethal predators, as well as what little is known of predators and survivorship during early life history stages. As bryozoans develop through different stages, the likelihoods of encounter with consumers increases, of lethal predation decreases, while that of sublethal predation increases, though these changes may be nonlinear. I suggest several ways in which changing predation risks might be better quantified in future studies. I propose that these changing risks and different suites of predators can have profound impacts on bryozoan resource allocation, morphological and developmental lability, and traits closely associated with avoidance, defense and tolerance manifested at different life history stages.

## ***Pentapora* taxonomy: a morphological and molecular comparison between Mediterranean and Atlantic specimens**

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The ascophoran cheilostome bryozoan *Pentapora fascialis* is often a dominant part of the benthos on hard subtidal bottoms from a depth of 1 to 80 m, distributed from the North Atlantic to the Mediterranean (Hayward and Ryland 1999; Mustapha et al. 2002). Groups of colonies can form extensive “micro-reef” constructions up to 7 m across. Individual colonies have dicotomic or laminar branches and a diameter of 20–30 cm some reaching up to 1 m (Hayward and Ryland 1998; Cocito et al. 2004).

Detailed morphological studies have refined *Pentaporidae* taxonomy over the years. Gautier (1962) considered *P. fascialis* and *P. foliacea* to be different species, later the two species have been given subspecific rank (Zabala and Maluquer, 1988; Alvarez, 1991) and recently the two forms were classified as a single species *P. fascialis* (Hayward and Ryland, 1999; Chimenz-Gusso *et al.*, 2005). Growth seasonality and growth rate variation in European specimens has been evaluated using the growth bands present on the lamina (Pätzold *et al.* 1987; O’Dea 2005; Lombardi *et al.* 2006). The aim of our research is to establish the taxonomy of *Pentapora fascialis* by combining morphological analyses and phylogeographical methods on recent specimens collected from different parts of the distributional range throughout Europe. Collections of *Pentapora* colonies were made from Croatia (North Adriatic), Italy (Ligurian Sea) and UK (St. George Channel) populations in June 2001, July and August 2006. Detection of winter and the summer growth bands (Lombardi et al. 2006) was conducted using X-Ray imaging on dried samples from Grmač (North Adriatic), Tino Island (Ligurian Sea) and Watwick Bay (UK). Comparisons of zooidal morphological features between the bands from the different localities were made using a Hitachi FESEM microscope. For molecular analysis, DNA was extracted from fresh samples and standard molecular techniques utilised. This comprised PCR and sequencing of the Cytochrome Oxidase I mitochondrial gene. Phylogeographic analysis was performed on the DNA sequence data. Results obtained so far will be discussed in relation to geography and environmental conditions.

## **Demographic explosions of bryozoans in Santos Bay, São Paulo, Brazil**

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Santos Bay is a semi-enclosed polyhaline area situated in the middle coast of São Paulo State (23°57'39"S degrees/46°20'01"W degrees). São Vicente Island (which includes Santos and São Vicente cities) occupies its major extension and it is sided by two channels, the northern used by Santos Harbor, the biggest in Latin America. Since the beginning of 2002, abnormal biomasses of bryozoans were reported stranded in Itararé Beach (an urbanized beach in São Vicente County), generating an extra effort for the beach cleaning service and affecting tourism. From November 2002 to March 2006, more than 155 tonnes were collected. Samples were identified as *Electra belulla* (Hincks, 1881). Besides this, it was noticed that the gillnet and trawl fisheries acting in external area of Santos Bay (up to 20 meters deeper) were also negatively affected by the presence of another bryozoan species, identified as *Catenicella uberrima* Harmer, 1957, which reduces the effectiveness of the nets and ingrown the labor on board to clean them after any fishery haul. Interviews done to recuperate the ancient data resulted in non-cyclical events. It is discussed if the dispersion of dumping dredged material of the navigation channel of Santos harbor or some other anthropic fact may be a reason to that. Further studies must be done to evaluate the main reasons of those demographic explosions.

## **Preliminary results of DNA bar coding with *Conopeum chesapeakensis* and implications for invasions and biogeography**

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The members of the cosmopolitan genus *Conopeum* can be difficult to separate to species, and sometimes even to genus, on the basis of morphological characteristics alone. We are using molecular and morphological characters of *Conopeum chesapeakensis* to characterize its relationship to other species, including: *Conopeum reticulum*, *Conopeum osburni*, *Conopeum tenuissimum*, and *Conopeum seurati*. We aim to characterize the biogeography of *Conopeum* in North America and to test for recent introductions. Populations from both coasts of North America will be sampled, spanning environmental gradients including salinity. Sample sites include: St. Johns River, Florida, James River, Virginia, (lower Chesapeake Bay), San Francisco Bay, California, Tampa Bay, Florida (Gulf of Mexico), Coos Bay, Oregon, and Narragansett Bay, Rhode Island. 16S and COI nucleotide variation will be analyzed to distinguish phylogenetic histories. Initial COI data provide evidence of a recent transport of *Conopeum chesapeakensis* from the East Coast to the West Coast, indicating a previously unrecognized introduction.

## **Non-native bryozoans in coastal embayments of the Southern United States: New records for the Western Atlantic**

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Bryozoans are among the most common fouling organisms in coastal marine environments around the world, yet their distribution in many coastal areas is not well known. We surveyed the bryozoans in shallow coastal estuaries in the southern United States, focusing on Texas and Florida. We deployed settlement plates across six different estuaries at 61 sites. Thirty five species of bryozoans were identified, including four non-native species described here for the first time from the United States: *Hippoporina indica* (Pillai, 1978), *Electra bengalensis* (Stoliczka, 1869), *Sinoflustra annae* (Osburn, 1953), and *Celleporaria pilaefera* (Canu and Bassler, 1929). At all six estuaries, non-native species were among the most common bryozoans. *Hippoporina indica* was the most abundant bryozoan, occurring in all estuaries sampled. In Jacksonville, Florida, *Electra bengalensis* and *Sinoflustra annae* dominated both the numbers and biomass of bryozoans. All four species have probable Indo-West Pacific origins. A literature-based analysis identified 39 additional non-native species of marine invertebrates and algae already established in the region, and over half are considered to have an Indo-West Pacific origin. Ships from Asia are regular visitors to Florida and the Gulf of Mexico, providing a possible mechanism of introduction for the non-native bryozoans.



## **Taxonomic notes on *Semicoscinium* Prout and some other 19<sup>th</sup> century fenestrate Bryozoa from the USA**

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Several fenestrate bryozoan genera named from North America during the 19<sup>th</sup> century have an uncertain basis because the original specimens either have been lost or have not been described in greater detail than the original brief description of colony exterior surfaces. Some of these genera are widely known with numerous species assigned to them across several continents. Perhaps the most important of these is *Semicoscinium*, to which numerous species from around the world have been assigned. The genus *Semicoscinium* and single species *S. rhomboideum* were established by H. A. Prout (1859) based on silicified specimens from the Falls of the Ohio, Indiana, and the original specimens apparently are lost. In order to have a sound concept of the genus, a suite of silicified specimens of *Semicoscinium rhomboideum* from the Falls of the Ohio is here described and a neotype selected. In addition, a neotype of the type species of *Fenestralia* Prout, 1858, and lectotypes of type species of *Flabelliporella* Simpson, 1897, and *Cubifenestella* Snyder, 1991, are designated herein.

## **Advances in the inventory of marine Bryozoa of the Colombian Caribbean**

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The bryozoans are a diverse group and frequents in different environments throughout the Colombian Caribbean. Nevertheless to the date little information with respect to its situation in the country exists. Through the ABC fellowship for the knowledge of the biodiversity sponsored by the INVEMAR-IAvH, one proposal was carrying out with the intention to give continuity to the recent works. For it a listing of the bryozoa presents in the Colombian Caribbean that serves like referring official was made by means the search, compilation, revision and update of the species from the documented registries (1939-2005) and of the material deposited in the Museum of Marine Natural History of Colombia (MHNMC) as well. Altogether 99 species included in 52 families and 10 suborders were confirmed. From that 88% are Cheilostomata, Cyclostomata 7% and Ctenostomata 5%. The species are distributed between 0 and 500 m of depth in eight eco-regions throughout the continental platform of the Colombian Caribbean. Excelling Guajira like the eco-region with greater number of species (73%). The results suggest increase in the values as complements the inventory, because numerous species not yet are confirmed or identified in the MHNMC. Additionally it exists material collected in Colombia deposited in foreign collections was not reviewed. The information was entered to the Information system on Biodiversity (SIB) that allows the electronic consultation of the general public.

## **Late Pleistocene bryozoans from the deposits of Capo Colonna marine terrace (Calabria, Central Mediterranean)**

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Palaeoecological analysis of bryozoan assemblages is mostly based on actualistic approaches centred on the ecology of extant species, because inherent and unequivocal information is rarely available from the geological and sedimentological context of fossil associations. The Late Pleistocene (Marine Isotope Stage 5a; approximately 100,000 years ago) deposits of Capo Colonna marine terrace (Calabria, Central Mediterranean) provide the uncommon opportunity of studying a bryozoan association whose location on the original shelf profile, depth of growth, and substrate type may confidently be inferred from a continuous and freshly exposed transect oriented normally to the palaeoshoreline.

The examined bryozoan assemblage developed at a maximum water depth of ~ 35 m and only gave rise to volumetrically significant accumulation more than 1 km seaward from the palaeoshoreline. There are three lithofacies where bryozoans occur as autochthonous or parautochthonous accumulations: a) extensive coralligenous banks mainly constructed by coralline red algae; b) small (max. 30 cm high) bryozoan-dominated bioherms attached on boulders lying on the original sea-bottom; c) bryozoan wackestone, also rich in branched and irregularly shaped rhodoliths, laterally adjacent to the bioherms. Twelve samples were collected from the three lithofacies and bryozoans were quantitatively investigated for species diversity and abundance, and for colonial growth form distribution. A total of 40 taxa were identified. On the basis of species diversity and abundance, samples may be clustered in two distinct groups. Alpha-diversity between these two groups seems to be primarily correlated with differences in substrate type and depth of growth, as confirmed by zoarial growth form analysis. Depth ranges and preferred habitat of the Late Pleistocene bryozoans of Capo Colonna are consistent with available data collected in ecological surveys of the Central Mediterranean. The only notable difference is the presence of species with tropical affinity (such as *Biflustra savartii* and *Metrarabdotos moniliferum*) in the fossil assemblage, which reflect the warmer water temperature that characterized the Mediterranean during MIS 5a.

## Lower Triassic bryozoans of the Canadian Arctic and adjacent areas

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Bryozoans of the orders Trepostomata, Cystoporata, Cryptostomata and Fenestrata were widespread and diverse in the Permian of both Boreal and Tethyan seas, but few genera survived the Permian/Triassic boundary, and only two new genera evolved during the Early Triassic: *Arcticopora* originally described from Ellesmere Island and *Dyscritellopsis* originally described from New Zealand. Until now only six undisputed Early Triassic bryozoan species have formally been described, all from the Boreal region. This is in strong contrast to the increased diversity through the Middle and Late Triassic with a total number of more than 40 species

Two occurrences of supposed *Arcticopora* in younger Triassic rocks of the European Tethys have been synonymised with species of *Dyscritella* and *Pseudobatostomella*. Accordingly *Arcticopora* is confined to the Lower Triassic of the Boreal region. During the present study the type material of *Arcticopora* was re-studied, and new material from several localities in NW Ellesmere Island has been thin sectioned and analysed. The systematic position of *Arcticopora* will be discussed in light of new data.

## **Stable isotope composition of bryozoan skeletons from the locality Podbřežice (Middle Miocene, Central Paratethys, South Moravia, Czech Republic)**

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Materials from Podbřežice were analyzed for C and O stable isotopes: 21 whole rock samples, 98 samples of eight bryozoan species (3 cyclostomatous and 5 cheilostomatous) and 19 samples of the foraminifer *Amphistegina*.

Post-depositional processes (mainly recrystallization) changed the stable isotopic composition of rock samples.  $\delta^{13}\text{C}$  varies within all studied bryozoans gradually between 0 to 1.7. Two bryozoan groups can be however distinguished based on different  $\delta^{18}\text{O}$  values: cyclostomatous bryozoans yield distinctly lower values than the cheilostomatous ones. The values shown by foraminiferal tests are closer to cyclostomatous Bryozoa. In contrast, the calculated paleotemperature for cheilostomatous bryozoans corresponds to paleotemperature data of other authors for the studied area. We are unable to recognize whether the difference among the cheilostomatous and cyclostomatous genera is due to skeletal ultrastructures, diagenesis or vital effects. We suggest that for paleoecological interpretations the cheilostomatous species *Cellaria fistulosa*, *Myriapora truncata* and *Smittina cervicornis*, are more valuable but we do not have enough data to prove this.

## **Phylogenetic analyses of mitochondrial and nuclear ribosomal genes provided evidence for paraphyly in the genus *Electra* Lamouroux**

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Molecular genetic study of nine *Electra* species based both on mitochondrial (LSU) and nuclear (SSU) ribosomal genes revealed two clusters of species, which are paraphyletic in respect to *Eucratea*. The first cluster consists of multispine *Electra* (*E. pilosa*, *E. posidoniae*, *E. monostachys*, *E. sp.1*) and *Eucratea*, the second cluster consist of the *Electra crustulenta* species group - species possessing a single poximedial spine and a calcareous operculum (*E. crustulenta*, *E. arctica*, *E. korobokkura*, *E. sp.2*). Both genes provided concordant high-supported phylogenetic trees, obtained by four different methods (maximum likelihood, maximum parsimony, neighbor-joining and Bayesian inference). Dividing of the genus *Electra* into two taxa can be justified not only by genetic but also by morphological data.

## Variation of zoecia size within colonies and among environments

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The relationship between the coefficient of variation (CV) of zoecial length within colonies was evaluated for 23 Bryozoa species through a latitudinal gradient in the Adriatic. Only 26.1% of the species analyzed display trends of within colony variation predicted by a linear regression of CV of zoecial size and seasonality (observed Mean Annual Range of Temperature; MART 12 to 15 from south to north).

Evaluation of variation within colonies of *Electra pilosa* (L.) for zoecial area in a laboratory setting controlled for temperature, produce a correlation of zoecia area variance through levels increased variation of available nutrition (same genotype). In laboratory conditions with temperature held constant and varied nutritional levels, within colony zoecial size variation has predicted MART value of 5.1°. With temperature and nutrition levels held the constant the predicted MART value was 0.72°, suggesting that within colony zoecial size variation displays a degree of correlation with variation in available nutrition levels.

Reasons that results from correlation of within colony zoecium size variation may not reflect Mean Annual Range of Temperature in this study include: 1). correlation between zoecium size and temperature may not be universal; 2). correlation between zoecium size and temperature is one of several factors that can control variation of zoecium size; 3). The relationship between MART and zoecia size CV is strong, but protocols for its application are more complex than previously acknowledged, for example, a). uncertain influence of variance of water temperature with depth and/or major seasonal currents; b.) unclear criteria used to calculate MART for a given location; c) insufficient understanding of the timing of colony growth (assumed to be continuous but may be seasonal); and d) phylogenetic controls may exist at the species level in bryozoans. Results call for careful evaluation and documentation of the suitability of each bryozoan species used for MART analysis in paleoecological studies.

## Amazing bryozoan diversity along the cliff of Sušac Island in the Adriatic Sea

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Sušac Island is small and remote island located in the Central Adriatic. Bryozoans were sampled by SCUBA divers from the cliff exposed to the open sea, at 20 m depth. Within the quadrant frame sized 50 x 50 cm all biogenic substrate was carefully scraped from the carbonate rock. Altogether 60 bryozoan species were identified at the sampled surface of only 250 cm<sup>2</sup>. Ten species are for the first time recorded in the Central Adriatic, while two species of cyclostomes (*Mecynoecia delicatula* and *Tubulipora notomale*) are for the first time recorded in the Adriatic Sea. The most numerous bryozoans were *Schizotheca serratimargo* (23 colonies), *Fenestrulina malusii* (18 colonies) and *Celleporina caminata* (15 colonies), while 15 species were recorded by only one specimen. The dominant growth form of the colonies was encrusting, followed by erect and tubuliporiform, while the least number of species were reteporiform. Most of the species grew on carbonate rock and calcified algae (29), while the next favorable substrate was bryozoan *S. serratimargo* (12). Other substrates that bryozoans settled on were shells (7 species on exposed and 4 on sheltered side), green algae (5) and polychaete tubes (3). Six bryozoans were found as epibionts on other bryozoan species. Is this indeed large bryozoan diversity on Adriatic cliffs we cannot say, since it is the first time this sampling method has been applied in order to study bryozoan fauna. However, in other studies, where bryozoans were sampled haphazardly along the cliffs from surface to 40 m depth, 57 species were identified at nearby Lastovo Island (South Adriatic) and 50 on Prvić Island (North Adriatic). We argue which sampling method is better for determination of bryozoan diversity.



## **Taxonomic studies of the Swedish Bryozoa**

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Although bryozoans have an important function as filter feeders on hard bottom seafloors they are seldom included in marine ecological studies in Sweden. This is partly due to the lack of basic knowledge, as for example it is not known which species are present in Swedish waters and the determination keys are incomplete. The Swedish Taxonomy Initiative which aims to describe the Swedish flora and fauna within a time period of 20 years regards bryozoans as a high priority group that needs to be better investigated. As a part of this venture we are currently generating a detailed species and distribution record for bryozoans along the west coast of Sweden (incl. Kattegat and Skagerrak). The results of this survey will be presented as a volume on bryozoans in the "The Encyclopedia of the Swedish Flora and Fauna" and the web-based species record "Dynamisk Taxa". Our taxonomic record will facilitate regional comparison of filter feeding marine fauna between Skagerrak and Kattegat, and provides a baseline for tracing changes in the faunal composition in the future. Ultimately, we will be able to point out diversity hot spots and areas with rare species.

Here, we present our results from the three collection cruises during the first year of this project. Up to this point we have compiled a species record which includes the abundance and distribution of more than 55 species over 135 localities in Skagerrak and Kattegat. Eleven of these species have not been known from Swedish waters before, according to the current species lists.

## **Investigations on the phylogeny of Bryozoa using molecular data**

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From an evolutionary point of view bryozoans are one of the most enigmatic invertebrate groups in the animal kingdom. Today the phylum Bryozoa contains over 5000 extant species, but there is an extensive fossil record beginning 500 million b.p., with at least three times as many species. The evolutionary relationships of bryozoans are still under much controversy. Traditionally these animals have been united with brachiopods and phoronids in the superphylum Lophophorata. In recent years molecular studies united lophophorates with annelids and mollusks in a group named Lophotrochozoa. However, at the same time bryozoans usually separate as an independent evolutionary lineage from phoronids and brachiopods. Whereas the placement of brachiopods and phoronids close to annelids and mollusks has been confirmed by multiple sources of data, only sparse data have been assembled to date for analyzing the placement of bryozoans.

We are currently assembling genomic data from bryozoans in order to reconstruct the inter- and intraphyletic relationships of bryozoans. The material was mainly collected along the Swedish west coast during the inventories of the Swedish Taxonomy Initiative. Here we present a preliminary phylogeny of bryozoans using a partial DNA sequence data set, including three nuclear (28S rRNA, 18S rRNA, histone H3) and one mitochondrial loci (cytochrome *c* oxidase I) from 20 bryozoan species (including phylactolaemates, cyclostomes, ctenostomes, and cheilostomes). Until this point the data have been analyzed in PAUP using maximum likelihood.

## **Zooid sizes suggest dramatic oceanographic perturbations immediately before the K-T mass extinction**

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Zooid size within modern and Neogene cheilostome bryozoan colonies has been documented to vary in response to fluctuations in ambient temperature (O'Dea and Okamura 2000). In this study we document zooid size changes in four species of cheilostome bryozoan through the topmost few meters of chalk below the K-T boundary in the Nye Kløv section, northwestern Denmark. This outcrop reveals in detail the end of the apparently stable and continuous deposition of 2000m of Upper Cretaceous chalk in the Danish Basin, and as such it has been subjected to some of the most detailed studies of the global faunal turnover at the end of the Cretaceous period (Håkansson & Thomsen 1999).

Mean zooid size in four cheilostome species remained fairly stable through most of the section, but approximately 15cm below the boundary, zooid size decreased dramatically in all four species. If ocean temperature was the cause, these results suggest an appreciable warming event some considerable time before the extinction. The conclusion that major environmental perturbations occurred prior to the K-T boundary contradicts the seemingly stable depositional environment of the chalk, as well hypotheses of simultaneous, sudden environmental change being the sole cause of the end Cretaceous extinction. Furthermore, the fluctuations in zooid size provide independent support to previous isotope studies suggesting that significant oceanographic events occurred prior to the K-T boundary. We conclude that the events surrounding the collapse of the chalk eco-system in the Danish basin and the mass-extinction at the K-T boundary may not have been as abrupt as previously believed.

## Endoparasitism in colonial hosts

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Research on the evolutionary ecology of host-parasite interactions has made great progress since the fundamental theory was developed concerning the population dynamical consequences of host and parasite interactions. For parasites this research has focused on life history trade-offs associated with patterns of virulence and transmission. For hosts the research has investigated trade-offs that maximise future reproductive success by minimizing the effects of parasitism on fitness components such as survival, growth and reproduction. The majority of studies on host-parasite interactions have involved unitary, exclusively sexually-reproducing animal hosts (such as *Drosophila*, other non-social insects, snails and vertebrates) and hosts that incorporate parthenogenesis in their life cycles (*Daphnia* and bumble bees). However, to achieve a general overview of the evolutionary ecology of hosts and parasites, it is important to study a range of systems. While parasitism in colonial animals has received some investigation at the population level (e.g. emerging diseases of corals), there is a notable lack of studies on life history strategies and trade-offs. Our work on novel host-parasite systems (myxozoan endoparasites of freshwater bryozoans) begins to redress the lack of knowledge of the interactions between colonial hosts and their parasites. Field- and laboratory-based studies provide evidence for high levels of vertical transmission achieved through colony fission and the infection of statoblasts. Increased fission rates may be a strategy for hosts to escape from parasites but the parasite can also exploit the fragmentation of bryozoans to gain vertical transmission and dispersal. This research provides evidence that opportunities and constraints for host-parasite coevolution can be highly dependent on organismal body plans and that low virulence may be associated with exploitation of colonial hosts.

## **Cheilostome brood chambers: diversity, evolutionary trends and revised terminology**

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The necessity to revise current terminology, used in describing the diversity of cheilostome brood chambers, is obvious. Despite more than two centuries of research, the structure of the chambers for embryonic incubation is poorly understood and relatively few species have been studied. At the same time, these structures are among the most important in bryozoan taxonomy. Based on new data, an attempt to summarize a diversity of the cheilostome brooding devices and revise current terminology was undertaken. Cheilostome brood chambers are described in terms of their position and wall composition, and ovicells – in terms of oecium origin, position of brooding cavity relative to the colonial surface, and closure of the ovicell opening. Some major trends in the evolution of the ovicells are recognized. Among those are trends towards (1) reduction of the distal, oecium-producing zooid, (2) immersion of the brooding cavity and reduction of the oecial fold, and (3) transition from non-cleithral to cleithral ovicells. It is stressed that ovicells are obviously non-homologous throughout Cheilostomata.

## **A coded character based analysis of evolutionary modes in the Middle and Upper Ordovician bryozoan genus *Peronopora***

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Paleobiologists have been interested in the tempos and modes of evolution observed in the fossil record for more than 60 years. We utilize a cladistic analysis of 211 specimens of *Peronopora*, spanning a 9.1 MY interval of the Middle and Upper Ordovician, to provide a framework for a character-level analysis of evolutionary mode within the genus. Sixteen species-level taxa were recognized using 34 coded morphologic characteristics. Eight taxa were monophyletic species and 8 were phenetically-distinct but non-monophyletic metaspecies, providing 15 possible ancestor-descendant species pairs. Thirteen species had adequate sample sizes that were evaluated for static (constant), fluctuating (represent oscillating stasis and/or are statistically random), and anagenetic (progressively changing) evolutionary modes using cladistic rank, or distance above the base of the cladogram, that is congruent with the observed stratigraphic position of each specimen.

Estimates of the frequencies of evolutionary modes vary widely within both species and characters. Within species, static patterns occur in 3% to 38% of characters, anagenetic between 3% and 41%, and fluctuating between 26% and 94%. Similarly, within characters, frequencies across species vary between 0% and 58% for static and anagenetic modes whereas 38% to 100% of modes are fluctuating. Across species and characters, 17.4% display static, 18.3% anagenetic, and 64.3% fluctuating modes. The incidence of anagenesis based on character states is similar to that calculated using the Hurst Estimate, a measure of the deviation of metric sample means drawn from a sequential series from those expected to occur in a random walk through a character space. In contrast, stasis is considerably less common when based on character state patterns than based on the Hurst calculations. Some character state fluctuations may conform, mathematically, to static series and account for most or all of the differences between estimates.

## **Rates of anagenetic evolution in three morphometric characters in species of *Peronopora* from the Middle and Upper Ordovician**

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Estimating rates of both long-term and short-term evolution has been a goal of biologists and paleobiologists for more than sixty years. Cladistic branching pattern was used to evaluate both evolutionary modes and rates for three morphologic characters in species of the trepostome genus *Peronopora* over a 9.1 MY interval of time. Sixteen species-rank taxa were recognized within eight unbranched evolutionary sequences that had an estimated average temporal spacing of 48,107 years per branch node. Within evolutionary sequences, evolutionary modes were evaluated, mathematically, and determined to reflect stasis, patterns indistinguishable from a random walk, or anagenesis.

Evolutionary rates were calculated for three morphologic characters that displayed anagenesis from two evolutionary sequences using a bootstrapping technique. Rates were calculated in haldanes, expressing evolutionary change in units of variation (standard deviations) per generation. Anagenesis characterized most of sequence 1 for wall thicknesses between adjacent zooecia (WTZZ). The calculated rate of evolution across this 8 species sequence was  $5.9 \times 10^{-7}$  haldanes. In contrast, rates for zooecial surface area (Z2M) and the zoarial wall volume (PPW) across *Peronopora sparsa*\* and *P. browni* of sequence 2, were considerably higher at  $8.6 \times 10^{-1}$  and  $2.0 \times 10^{-4}$  haldanes, respectively.

These rates are nearly identical to those measured in both living and fossil species. Studies ranged from short-term laboratory- and field-based experiments ( $10^{-3}$  to  $10^0$ ), to microevolution in genetic and phenotypic traits in living organisms ( $10^{-3}$  and  $10^{-1}$  over 1-140 generations), to size increases in Miocene stickleback fish (average rate of  $5.97 \times 10^{-6}$  haldanes), to two species transitions in Eocene whales (mean rates of  $10^{-5.57}$  to  $10^{-5.14}$  haldanes). A recent study calculated an expected average rate of  $10^{-6.36}$  haldanes for similar paleontological studies made on the same estimated generation timescale. Rates for both PPW and Z2M are considerably higher than this average suggesting a faster pace of evolution in *Peronopora* for those characteristics.

## **Unraveling mass extinctions: Permian-Jurassic onshore-offshore trends of bryozoans**

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Fossil marine bryozoans are diverse, geographically widespread, and abundant in a range of environmental settings. Their Phanerozoic diversity, which parallels the trends documented by Sepkoski (1981) for all marine invertebrates, is also punctuated by five major mass extinctions. For these reasons, we propose that bryozoan paleoecology can provide a unique approach to evaluate marine mass extinction intervals by exploring the relationship between global diversity and paleoenvironmental patterns. The method involves documenting spatio-temporal changes in the assemblage generic richness of marine bryozoans, determining the degree to which these changes might be linked to extinction-related environmental stress, and applying the results to current extinction scenarios.

The methodology is applied to the Permian/Triassic (P/T) and Triassic/Jurassic (T/J) mass extinction intervals. We compiled the global time-environmental history of marine stenolaemate bryozoan genera and orders within 396 Permian through Early Jurassic assemblages. Bryozoan assemblage generic richness declined significantly in offshore settings in advance of the P/T and T/J mass extinctions, starting as early as 8 million years before the P/T and 4 million years before the T/J. Prior to these declines, bryozoan clades occupied all environments but their frequency distribution across these environments varied according to clade membership. These results indicate both extinctions were part of two prolonged intervals of environmental stress and that during times of reduced stress, intrinsic biological processes largely drove the paleoenvironmental distribution of bryozoans. Finally, the disappearance of bryozoans from deep-water settings suggests that environmental stress resulted from the gradual encroachment of some deep-water phenomenon onto the shelves. These patterns support long-term oceanographic, rather than extraterrestrial, extinction mechanisms for these marine environments.



## **Bryozoans from the mid-Cretaceous Glen Rose Formation of Texas: prelude to the neocheilostome radiation**

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The Glen Rose Formation represents the second phase of Early Cretaceous carbonate shelf sedimentation that extended from Florida to Mexico. The formation ranges in age from uppermost Aptian to near the top of the Early Albian. In Texas, the Glen Rose Formation is the uppermost stratigraphic unit of the Trinity Division. It overlies the Hensel Sand and underlies the Walnut Formation of the Fredricksburg Group. Limestone, dolomite, marl, calcareous shale, and evaporite beds make up the Glen Rose. The formation has been formally divided into a Lower Member and an Upper Member, which have a combined thickness of approximately 192 m (630 ft) in central Texas. Fossiliferous beds in the Lower Member consist of stromatolite mudstone, coral-rudist biostromes, rudist bioherms, and dinosaur trackways, whereas fossiliferous beds in the Upper Member consist mostly of extensively bioturbated foraminiferan marl that contains a diverse molluscan and echinoid fauna.

Bryozoans have not been previously described from the Glen Rose Fm. Yet the formation contains a bryozoan fauna that is potentially of considerable importance in view of its Late Aptian to Early Albian age, immediately antedating the onset of the spectacular evolutionary radiation of bryozoans. As the Glen Rose underlies the Fredericksburg and Washita groups, which contain *Wilbertopora*, the oldest known neocheilostome and the first cheilostome with ovicells and avicularia, this adds further to the significance of its cheilostome fauna. Three Glen Rose cheilostome species are here recognized, provisionally identified as *Pyripora*, cf. *Spinicharixa* and '*Conopeum*' s.l. All are apparently malacostegan-grade taxa lacking ovicells and avicularia. The characteristic closure plates present in cf. *Spinicharixa* and '*Conopeum*' s.l. allow orifice size to be estimated. In addition to the cheilostomes, there are at least five species of cyclostomes that, like the cheilostomes, are encrusters.

## **Great problem of bryozoans washing up on the beach of Balneário Camboriú, Santa Catarina State, Brazil**

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The main goal of this study is to report bryozoans washed up in great amounts at the Balneário Camboriú inlet (27°00'S, 048°36'W), Santa Catarina, Brazil. This location, 80 km northwards from Florianópolis (capital of Santa Catarina State), is formed by an inlet which receives fluvial discharge from Camboriú River. Due to natural attractions and a wealth infrastructure, Balneário Camboriú receives tourists coming from Brazil, Latin-American and other continents. The number of inhabitants during the year is approximately 60 thousands but during summer this number ranges up to one million people. Two bryozoans species were reported in these local accumulations: *Membraniporopsis tubigera* (Osburn, 1940) and *Electra bellula* (Hinks, 1881). Both are not native to Brazil. *Membraniporopsis tubigera* was firstly described along the North America coast and it was recorded for the first time in Brazil at 1997 on Santa Catarina, Paraná, São Paulo and Espírito Santo States, found washed up on beach. *Electra bellula* is recorded from Brazil since 1937 in the same places cited above, colonizing algae. The accumulations on Balneário Camboriú have been reported since 2003 in great amounts, sometimes up to 30 tonnes (Bryozoan, algae and other plants from mangrove). The cleaning costs of the beach are a burden that Balneário Camboriú have accepted, seeing that it is one of the principal tourist points of Santa Catarina coast. The reasons for these beach accumulations are not known, but two hypotheses are being analyzed: (1) a cyclic/natural event as *M. tubigera* has been recorded washed up in several other places in Brazil, and specific to *E. bellula* in São Paulo coast. (2) Caused by environmental modifications in the inlet: In June-August/2002 it received beach nourishment of 50,000m<sup>3</sup> of sediments coming from dredging of the Camboriú River to enlarge the shore face. This process resulted in the morphodynamic modification of the beach and in the death of *Tivela mactroides* (Mollusca, Bivalve). Dives have been made in the inlet to search for the attachment places of these colonies (*M. tubigera* and *E. bellula*) to study the life history and behavior of both species in relation to environmental modifications in Balneário Camboriú.

## Two new species of Bitectiporidae (Bryozoa, Ascophora) from Rio de Janeiro State, Brazil

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Bitectiporidae are 'schizoporelloidean' cheilostomes in which both ovicellular layers are calcified and unfused, and suboral avicularia are present. The aim of this work is describe two new bitectiporid species from the South Atlantic: *Parkermavella spathata* sp. nov. collected from 23°49.63'S, 41°42.51'W at 341 meters depth; and *Hippomonavella brasiliensis* sp. nov. found at Arraial do Cabo (23°00'S, 42°01'W) at 10 meters depth. *Parkermavella spathata* has small circular colonies, initially encrusting but becoming free at their distal edges; autozooids have prominent boundary walls; the orifice possesses small condyles, the sinus is large and shallow and there are five to six oral spines; the suboral avicularium is tiny, slightly elongate with a spatulate mandible directed downward. Compared with the austral species *P. punctigera* (MacGillivray, 1883) and *P. incurvata* (Uttley and Bullivant, 1972), the new species has a much shallower sinus. *Hippomonavella brasiliensis* has an erect bilaminate colony; the autozooidal frontal shield has coarse nodes and 6-12 large areolar pores along each margin; two narrow oral spines are present in young zooids; the ovicell is perforated by numerous irregular pores and the distal edge is overgrown by frontal shield calcification extending from the adjacent autozooids; the suboral avicularium is median, directed downwards and has a short but prominent triangular rostrum, a complete cross-bar and a triangular mandible rounded at the tip. It is very similar to *H. formosa* (MacGillivray, 1887), a southern Australian species. Neither *Parkermavella* nor *Hippomonavella* have been previously recorded from the Brazilian coast and they therefore add to the biodiversity of Brazilian bryozoans.

## **Climatic response of late Palaeozoic bryozoans: diversity and composition of cool-water faunas from Gondwana**

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Late Palaeozoic bryozoans had a known global distribution through all climate zones, with clear development of faunal provinces and boreal, notal and tropical zones. Closer examination of the southern hemisphere notal zone shows a further differentiation in Permian bryozoan biogeography between cool and truly polar faunas.

Within the notal zone bryozoan faunas show a clear trend in composition and diversity that is coupled with temperature. Polar limestones of Tasmania, Australia, contain abundant and often large bryozoans. Diversity, however, is low with a total of 15 genera. Biotas are dominated by cosmopolitan fenestrates and trepostomes; a fauna typified by *Rectifenestella*, *Polypora*, *Polyporella*, *Parapolypora*, *Stenopora* and *Dyscritella*. Northward diversity increases in contemporaneous deeper water rocks in the Sydney Basin. Diversity is expanded over the Tasmanian fauna and includes common *Laxifenestella*, *Minilya* and *Paucipora*, in conjunction with sparse occurrence of rhabdomesids and cystoporates. These rocks are still of cold-water environments. Faunas least influenced by glacial climates in the eastern Australian notal zone, in the Bowen Basin, show the highest diversity, with 36 genera across all orders. Only half the fauna is of cosmopolitan genera and fenestrate diversity expands to include common *Spinofenestella*, *Synocladia*, *Acanthocladia* and *Penniretepora*, and frequent occurrences of the rhabdomesid *Streblascopora* and the cystoporate *Fistulipora*.

Contemporaneous tropical bryozoan faunas from southern Thailand are abundant and diverse, with few cosmopolitan forms in the 50+ genera. The fauna is typified by fine fenestrates *Spinofenestella*, *Alternifenestella*, *Fabifenestella* and *Penniretepora* along with *Kingopora*, *Septapora* and *Acanthocladia*; cystoporates *Goniocladia*, *Fistulipora* and *Cyclotrypa*; and rhabdomesids *Ascopora* and *Streblascopora*.

The Gondwanan fauna shows a clear trend of decreased diversity coupled with a shift to fenestrate and trepostome dominance with decreased temperature (and increasing latitude). This trend is not seen in the northern hemisphere boreal zone. Here truly glacial conditions were not widespread and wide mid-latitude east-west oriented shelves allowed development of complex faunas that were nutrient supported during Permian cooling.

## Tasmanian Ordovician Bryozoa

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Ordovician rocks of the Gordon Limestone Group are distributed across much of the western half of Tasmania and in its middle and upper parts contain a varied fauna of bryozoans, brachiopods, trilobites, cephalopods, corals, conodonts, and, locally, graptolites. Based on their faunas, the bryozoan-bearing rocks are upper Middle Ordovician (Darriwilian) and Upper Ordovician (Gisbornian, Eastonian, and Bolindian). The rock succession continues into the lower part of the Lower Silurian Llandoveryan (Ruddanian and Aeronian?) as mostly fine clastic units.

Bryozoans are most common and most diverse in the uppermost several hundred meters of the Benjamin Limestone Formation that form the top of the Gordon Group, apparently forming three widely distributed zones. The lowest zone contains abundant *Stictopora* spp., *Ptilodictya* sp., *Rhombotrypa* spp., *Escharopora?* sp., *Batostoma* sp., other trepostomes, and rare, unidentified cryptostomes. The middle zone has abundant corals *Palaeophyllum* and *Bajgolia*, heliolitids, and brachiopods, including *Hebertella dinorthoides*, and bryozoans *Rhombotrypa*, *Jordanopora?* or *Lamottopora?*, *Ptilodictya*, several unidentified trepostomes, a rhinidictyid, *Stictopora* sp. (abundant), *Heterotrypa*, *Batostoma*, several *Bythopora* spp., *Phylloporina*, other phylloporinids, arthrostylids spp., ptilodictyid? and *Fenestella?* sp. The highest zone contains *Favistina cerioides*, along with the first appearances of favositids (*Favosites marginatus*), halysitids (*Falsicatenipora chillagoensis*), and also atrypid brachiopods. *Stictopora* spp. is abundant, along with other cryptostomes, including a rhinidictyid, *Rhombotrypa* cf. *R. multitabulata* (abundant), *Monticulipora* sp., *Homotrypa* sp. (with robust cylindrical zoarium), *Homotrypella* sp. (a large, thick stemmed trepostome), two or three other trepostomes (several species with large colonies), *Constellaria?* sp., *Amplexopora* sp., *Ptilodictya* spp., unidentified ptilodictyids, *Peronopora?* sp., *Eridotrypa* sp., *Jordanopora?*, *Lamottopora*, and *Cyphotrypa?* sp. This fauna has large specimens and is very fragmented, with the large colonies being rolled and redistributed locally in a muddy calcarenitic facies.

These three zones correlate with the Whitewater Formation and Elkhorn beds (above the major unconformity at the top of the Liberty Formation ) of the upper Richmondian (upper Cincinnati) of North American. On a global scale, the latest Ordovician was a time of several major sea-level fluctuations, shallow-marine sequence deposition, deep weathering, and extensive erosion attributed to latest Ordovician-earliest Silurian glacial events.

## **Mediterranean setoselliniforms and the exploitation of small-sized substrates**

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Setoselliniforms were introduced by Lagaaij & Gautier (1965) for small-sized encrusting (membraniporiform) colonies growing “exclusively on small foreign particles, coarse quartz grains, small shell fragments limited to very calcareous sands in deep waters” in the Rhône delta area, although also present in waters as shallow as about 15 metres. They characteristically show a spiral budding pattern on minute substrates that do not become incorporated in the adult colony even if some species develop one-two astogenetic generations beyond the edge of the initial substrate.

In the present-day Mediterranean Sea setoselliniforms include species of *Setosella* and *Setosellina* thriving in shelf and slope environments, to which *Heliodoma* adds from deep-water Pleistocene sediments. The presence of setoselliniform growths has been investigated in relation to depth, physiography and bottom features, mostly sediment grain size.

Differences are obvious within genera as *Setosellina* and *Heliodoma* seem restricted to sandy clasts and granules whereas *Setosella* species exhibit a range of adaptations from rocks and large bioclasts through small-sized substrates up to apparently free growths on particulate bottoms. Furthermore, the best ability in covering the original substrate and even in extending colonies beyond the substrate edges is performed by *Setosellina* species that become able to live freely in/on soft bottoms.

## **Bryozoans associated with white corals from the Mediterranean Sea**

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Bryozoans from Mediterranean bathyal environments are still poorly known, mostly from sparse samples from the Alboran Sea, the northern Tyrrhenian-Balearic basin and the Sicily Straits. Even less information is available for bryofaunas from deep-water scleractinian corals. The re-discovery of deep-water corals (considered in regression or virtually absent from the Mediterranean, until recently) in the Ionian Sea and their intensive survey and sampling allowed associated bryozoans to be analysed, also in relation to bottom features and the presence of living and dead colonies and fragments.

A total of 20 living bryozoan taxa have been recovered with dominating cheilostomes (14 species, 1 new) and subordinate cyclostomes (4 taxa, 2 new) and ctenostomes (1 single indeterminable taxon).

Bryozoans account for a negligible biomass. Living colonies mostly colonise exposed skeletal portions of living coral colonies, skeletal and hard-ground fragments, mainly exhibiting encrusting and erect, both rigid and flexible, growths. Erect rigid species are small-sized and poorly branched whereas the flexible ones are densely branched bushes. Encrusting species develop unilaminar, usually spot-like, colonies or grow as uniserial runners.

Only a few species constitute the bulk of the bryozoan associations, namely *Scrupocellaria delilii*, *Tessaradoma boreale*, *Copidozoum exiguum*, *Idmidronea* sp. 1 and *Tervia barrieri*. Other species, except for *Smittina crystallina* and *Herentia* sp.1, are represented by sporadic specimens.

Most species have a Recent Atlantic-Mediterranean distribution, except for few ones seemingly restricted to the Mediterranean. Taxa are typically bathyal or extend into shallower waters to comprise part of the shelf, a few ones being also known from submarine dark caves.

Assemblages are less rich and diversified than those (35 species with 29 cheilostomes and 7 cyclostomes) reported from the Catalonia slope (180-350m) by Zabala *et al.* (1993) and, although shearing some species, show a decidedly deep-water character.

## **Geochemical composition and variability in the skeleton of the bryozoan *Cellaria sinuosa* (HASSALL): Biological vs. environmental control**

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Skeletal carbonate mineralogy in marine bryozoans is known to be highly variable between and within clades. While cyclostomes and fossil stenolaemates developed their LMg-calcite skeletons already in the Ordovician, cheilostomes much later developed calcite skeletons containing varying amounts of Mg, and even aragonite may co-occur in some species. This and the observation that dual-calcite skeletons are restricted to the Neocheilostomata (Smith et al. 2006) counts for the phylogenetic control of bryozoan skeletal mineralogy (Smith et al. 2006).

Geochemical composition and variability were studied using microprobe analysis in skeletons of the anascan cheilostome *Cellaria sinuosa* (Hassall) from Roscoff, outer English Channel, where the colonies of this upright, flexible-branching species are one of the most important constituents of benthic communities and carbonate sediments deposited on the open shelf in 70 to 80 m water depth (Bader 2001).

The species secretes a dual-calcite skeleton combining an inner, LMg-calcite primary wall layer and an HMg-calcite secondary wall layer. LMg- and HMg-calcites are combined with different crystallographic mineralogies. Despite the different chemical composition of consecutively secreted wall layers, variations along the growth axis of the colony branches indicates that also seasonal changes in temperature in addition to phylogenetic and probably functional factors control the incorporation of Magnesium into the bryozoan skeleton.

Bader, B. (2001): Modern BRYOMOL sediments in a cool-water, high-energy setting: the inner shelf off North Brittany. – *Facies*, 44: 81-103.

Smith, A. M., Key, M.M. & Gordon, D.P. (2006): Skeletal mineralogy of bryozoans: Taxonomy and temporal patterns. – *Earth Science Reviews*, **78** (2006): 287-306.



## **Palaeoecological, morphological and taxonomical aspects of the pematoporinid genus *Ubaghsia* JULLIEN from the Maastricht Chalk**

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Voigt, Ehrhard (deceased) and Larwood, Gilbert (deceased)

The manuscript on the cribriomorph (pematoporinid) genus *Ubaghsia* was initiated by the late GILBERT LARWOOD, who in October 1993 came to Hamburg to study *Ubaghsia* specimens in the Coll. E.VOIGT. He produced numerous beautiful pencil illustrations and hand-written notes, but would not live to finish this. As EHRHARD VOIGT was dying, he was trying to complete his friend's manuscript, focussing on *Ubaghsia reticulata* (JULLIEN) and *Ubaghsia ornata* (GOLDFUSS), occurring together at the same localities and quite restricted horizons in the Maastricht area (Netherlands).

The unfinished manuscript of these two great bryozoologists was found in a fairly advanced stage among the bryozoan legacy of EHRHARD VOIGT when the collection, literature, manuscripts and notes were moved to Frankfurt. The article has now been reconstructed as EHRHARD VOIGT left it, and updated by one of the authors (J.S.).

Specimens of *Ubaghsia* are only a relatively rare component of the rich fauna of the Maastricht Chalk even though well over 600 specimens have now been collected. The delicate tertiary frontal wall structures and the extended tubercles of *U. reticulata* survived the taphonomical processes because the zoarial fragments became washed into burrows which afforded protection.

The taxonomical diagnosis of *U. ornata* and *U. reticulata* is revised. According to the analysis of morphological features, and their comparison with recent bryozoans, *U. reticulata* may have lived attached to algal fronds or in protected hollows of hardground surfaces. In contrast, *U. ornata* is a far more robust species, perhaps preferring rather exposed microhabitats. Zoarial fragments are often worn, and can be found in accumulations of calcarenities.

## **Extinction and recovery of Bryozoa from the Cretaceous-Palaeogene crisis: Fresh evidence from Australia towards a new global hypothesis**

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The geographic origins of modern animal lineages after the Cretaceous-Palaeogene (K-Pg) extinction event are of great interest. A new hypothesis (put forward in IGCP Project 522) proposes that many major taxa originated largely from survivors in the southern hemisphere (basically the remnants of Gondwana). The Bryozoa of the Cretaceous, in particular the rapidly diversifying cheilostomes, were strongly centred on the abundant and diverse faunas of north eastern Europe. These faunas were all but wiped out by the K-Pg event. In recent years, strong ties have been established within a number of pandemic modern families to the scattered Southern Hemisphere Paleocene faunas, giving support to a notion of deriving most of the modern bryozoan faunas from the Southern Hemisphere. This hypothesis has been difficult to test, due to the paucity of Cretaceous and Paleocene bryozoan occurrences in the southern hemisphere. Only five localities have been researched and published, namely South Africa, Madagascar, the Chatham Islands and two in India. Unpublished occurrences of Cretaceous Bryozoa are also known from Seymour Island (Antarctica), Patagonia, and Australia. The Eromanga Basin in north-western Australia is of particular interest as it hosts sediments with Bryozoa of almost every geological Stage from the Late Cretaceous through almost to the Recent (the notable exception is the Danian Stage). The Cretaceous fauna, though relatively sparse, is more diverse than often acknowledged. Preliminary studies also show that the Paleocene fauna is very diverse and overall distinct from later Australian fossil faunas. A more thorough survey of this region in future will contribute a large piece to the puzzle.

## **Settlement Behavior and Substrate Preferences of Late Devonian *Hederella* from the Midcontinent USA**

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The colonial *Hederella* were common encrusting organisms in Late Devonian marine ecosystems. Like many ancient and marine sclerobionts, the larva of *Hederella* likely had preferences for surface textures during settlement. In well-preserved settings, these preferences can be revealed in the fossil record.

*Hederella* behavior – specifically, preferences for substrate texture and for hederellid neighbors – was investigated at numerous localities from three Givetian and Frasnian rock units in the Midcontinent USA: Solon Limestone, Iowa; Lime Creek Shale, Iowa; and the Silica Shale of Ohio and Michigan. No attempt was made to determine whether the brachiopod was alive or dead at the time of encrustation; for the purposes of this study, the host brachiopod was considered inert substrate for the *Hederella* colony.

*Hederella* commonly was attached to large alate spirifers (Solon, Silica Shale; chi square,  $p < 0.01$ ) or brachiopods with finely ribbed surface texture (Solon, Lime Creek, Silica Shale; chi square,  $p < 0.01$ ). Across all localities sampled, conspecific co-occurrence within *Hederella* was statistically insignificant, although *Hederella* did co-occur with congeners (Lime Creek, Silica Shale; LarvProb,  $p < 0.01$ ). However, this significance only holds up when the entire brachiopod is considered; when dorsal or ventral valves are tested (e.g., pedicle- or brachial-only encrustation), hederellids do not significantly co-occur on either dorsal or ventral valves. In addition, *Hederella* does not significantly co-occur with any other sclerobiont in the brachiopod assemblages studied.

Assuming that preservation is similar within each locality across all hederellids and their brachiopod hosts, and that the assemblage represents larval preferences for settlement, *Hederella* avoided punctate brachiopods and preferred large hosts, such as large, alate spiriferides or those with finely striated surface texture. *Hederella* avoided colonizing brachiopods that already bore a conspecific, but would settle on the opposing valve from a congeneric colony. This settlement on an opposing valve may result from a *Hederella* larva avoiding established *Hederella*, or may arise from post-mortem flipping of brachiopod individuals, burying one *Hederella* colony in the sediment and exposing the opposite valve for encrustation.

## **Alice Robertson: marine zoologist and educator**

**Sears, Mary A.B. and Woollacott, Robert M.**

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Many mysteries surround the life and relatively brief scientific career of Alice Robertson. She was born in Pennsylvania circa 1855, though sources conflict about the exact year. Census and directory data suggest that she was a teacher in Pennsylvania in the 1870s and 80s. The record of Robertson's scientific life begins in 1898 when she received the B.S. degree from the University of California at Berkeley. In 1902, she completed her Ph.D at Berkeley, with a dissertation on polyembryony in *Crisia*, under Wm. E. Ritter, founder of the Scripps Institution of Oceanography. Also in 1902, she published a paper "Geometric-Optical Illusions in Touch", part of a series from the Psychological Laboratory of the University of California.

She remained at Berkeley until 1906, when she joined the faculty of Wellesley College in Massachusetts. At Wellesley, Robertson was department chair from 1909-1918 and was viewed as an inspiring teacher. Because of a prolonged illness in 1918, she retired from teaching and returned to the west coast. After recuperating in Seattle, which she considered her home, she joined Charles A. Kofoid at Berkeley to work on dinoflagellates. In June of 1922, Robertson accepted a request from E.L. Mark, founder of the Bermuda Biological Station, to publish a general survey of the bryozoans of Bermuda. She died three months later, on September 14, 1922 of peritonitis four days following abdominal surgery.

Between 1900 and 1921, Robertson published eight papers on bryozoans and entoprocts. She described as new to science one genus, 42 species, and three subspecies of bryozoans and one genus and two species of entoprocts. The first of these studies (1900) was a report of the bryozoans collected on the Harriman Alaska Expedition attended by Ritter. Her final paper (1921) was a survey of bryozoans of the Bay of Bengal. She is best known, however, for a series of four papers on the marine bryozoans and entoprocts from the west coast of North America. These papers focused on all major extant groups with the exception of the Ctenostomata, a curious omission. Correspondence between Robertson and Samuel Henshaw of the Museum of Comparative Zoology reveals that she had the ctenostome material with her at Wellesley and was working on a manuscript when this collection and all of her library were destroyed by fire in 1914.

## **A First Record of *Bantariella bocki* (Ctenostomata) from Korean waters**

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Jejudo Island located in the south end of South Korea is the biggest island of South Korea. The southern part of Jejudo Island is somewhat subtropical and shows a variety of marine species, especially soft corals.

In the last few years, it was observed that the colonies of some black corals such as *Antipathes japonica*, *A. lata*, *A. sp.* and some sea fans were covered all over with fluffy growths. Moreover, polyps of corals detached when they were touched. Huge numbers of the growths were first collected from the southern part of Jejudo Island in December, 2005 and were found to be colonies of *Mimosella bocki*, which was newly reported from Bonin Islands, far southward from the main land of Japan in 1942.

According to Banta (1968), *M. bocki* with two other species *M. gracilis* and *M. bigeminata*, belongs to the first group of the genus *Mimosella*. Gordon (1984) mentioned that all species belonging to Banta's second group other than the two species, *M. cookae* and *M. tenuis*, should be transferred into the genus *Bantariella*. However, *M. bocki* is also repect, with a zooid arising mostly from short branches of a single kenozooid showing the characteristics of the genus *Bantariella*. Thus *M. bocki* is transferred into the genus *Bantariella* here.

Bonin Islands are located in the similar latitude to Taiwan, which means that the Bonin Islands occur at the boundary between subtropical and tropical waters. The southern part of Jejudo Island in Korean waters seems to be getting warm, allowing *B. bocki* to inhabit Korean waters.

## **Micro-communities in a macro-world: A comparison of bacterial communities between sibling larvae and their adult colony**

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Bacteria are found in all marine habitats, both free-living in the water column and growing attached to abiotic and biotic surfaces. Bacteria can grow on the exterior and interior surfaces of all organisms, including bryozoans. Bryozoan larvae have also been found to contain bacteria (Woollacott, 1981). The bacterial communities growing on bryozoa can be profiled using the molecular PCR-DGGE (polymerase chain reaction-denaturing gradient gel electrophoresis) technique (Muzyer et al., 1993; Kittelmann & Harder, 2005). This allows bacterial communities between bryozoan colonies and species to be compared. In this study, bacterial community profiles of bryozoan larvae and their respective adult colonies are compared using PCR-DGGE to determine whether sibling larvae have identical bacterial profiles and to what extent bacterial communities from larvae are similar to those from the parent colony.

DNA was harvested from larvae and adult tissue collected from several British bryozoan species. The 16S bacterial fraction of the total DNA was amplified by PCR using universal 16S bacterial primers. Bacterial community profiles were obtained using DGGE and analysed by pairwise comparisons between individual samples. The analysis was visualised using multidimensional scaling and both UPGMA and neighbour-joining trees. The identities of individual bacterial species were determined by sequencing bands separated during DGGE.

In this study sibling larvae were found to have very similar, although usually not identical, bacterial community profiles. Sibling larvae from a different adult colony of the same species exhibited readily distinguishable bacterial community profiles. In some bryozoan species (e.g. *Flustrellidra hispida*), bacterial community profiles between larvae of the same species but different colonies were more similar to each other than to the bacterial communities of their respective adult colonies. However, in other species studied (e.g. *Callopora lineata*), bacterial communities from the larvae were more similar to those from their adult colony than to bacterial communities from non-sibling larvae. Specificity of bacterial communities to their host may have ecological implications in areas such as nutrient exchange, and defence against fouling or predation.

## Carbonate production by erect rigid bryozoans in Antarctica

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Well-calcified marine bryozoans are often important producers of temperate and polar shelf carbonate sediments. In cold waters, bryozoans can be long-lived and their skeletons therefore reflect many years of growth and carbonate production. In this study we examine growth, age, and calcification in three species of Antarctic bryozoans from the Ross Sea (77° 53.394' S and 166° 40.286' E, 500 m water depth). *Cellarinella nutti* and *C. nodulata*, erect branching bryozoans in the family Sclerodomidae, reached a maximum age of 18 y, grew 1 to 8 mm/y and added new carbonate at a rate of 3 to 57 mg/y. *Swanomia belgica*, family Cellariidae, reached a maximum age of 23 y, grew 1 to 4.4 mm/y and calcified at 1 to 23 mg/y. Antarctic bryozoans can be quite long-lived (up to 50 y), but they exhibit slower growth rates than their temperate counterparts, perhaps due to the shortness of the growing season. Seasonal growth checks in many erect Antarctic bryozoans may result from low food availability in winter. There is a clear relationship between growth rate and age, where the polar cellariid bryozoans that live the longest are the slowest-growing. The combination of slow growth, long life-spans, and seasonal growth checks make Antarctic erect bryozoans excellent recorders of environmental conditions and benthic calcification. Calcification rates in Antarctic cellarinellids are generally low: 10-20 g CaCO<sub>3</sub>/y, with sedimentation rates of about 0.3 to 1.0 g CaCO<sub>3</sub>/m<sup>2</sup>/y. *Melicerita obliqua* may produce carbonate at about 0.6 to 3.0 g CaCO<sub>3</sub>/m<sup>2</sup>/y, and *Swanomia belgica* even less, 0.06 to 1.2 g CaCO<sub>3</sub>/m<sup>2</sup>/y. Antarctic bryozoans are older, slower-growing, and less productive calcifiers than their temperate counterparts. Carbonate sediments in which bryozoans are a significant component must accumulate at very slow rates indeed in the Antarctic.

## **Corrections to the known global distribution of *Hornera pectinata* (Bryozoa: Horneridae)**

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*Hornera pectinata* Busk, 1861, of the family Horneridae, is a small erect frondose cyclostome bryozoan originally described from Madeira, and subsequently identified from the Canary Islands, Borneo, southern California and New Zealand. Examination of the type, other specimens, and literature suggests that the material from Borneo more closely resembles *Hornera pinnata* Canu & Bassler, 1929. The material from southern California, too, does not correspond to the type of the species. It is likely that the fenestrate material from New Zealand is *Hornera foliacea* MacGillivray, 1868. Thus the distribution of *Hornera pectinata*, far from being widespread, is limited to the subtropical east Atlantic, particularly Madeira and the Canary Islands.



## **Bryozoans and black corals**

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In the 1960's John and Dorothy Soule collected extensively in the Hawaiian Islands. During their collecting trips they met a group of divers, now called the Maui Divers, who in 1958 discovered large tree-like growths of the black coral *Antipathes dichotoma* and *Antipathes grandis* growing on the steep slopes of the Au Au Channel. Mature tree-like colonies, reaching heights of over 3 m and living in depths up to 120 m, are probably 50 years old. Black corals thrive in environments with light intensities ranging from 25% to 60% lower than the surface waters. In addition the steep channels of the Au Au Channel have a significant influx of sediments and potential nutrients. The corals are a mecca for a number of other species, including crustaceans, molluscs and worms. They represent an ideal bryozoan substrate as there are limited hard surface substrates in the steep channel slopes and bryozoans prefer areas shaded from the direct rays of the Sun in the equatorial latitudes. The corals are flexible, composed of protein and chitin and lack the zooxanthellae of their shallow water stony coral relatives.

Initial investigations indicate approximately 12 species of Anascina, 2-3 species of Cribomorphina, 28 species of Ascophorina and 13 species of Cyclostomatida and at least one new genus. Most of the bryozoans are found on other islands and incrusting other types of substrates, but some appear to be restricted to black corals. The two most common bryozoan groups are represented by the pink to orange colored retoporids and blackish green crusts of celleporarids. There is a variety of colony forms exhibited and vary from erect to incrusting. The relatively inflexible erect cabbage shaped retoporid colonies have a "chicken wire" appearance while other species such as *Bugula* and *Cabarea* are flexible. Some incrusting bryozoans, for example *Hippoporella*, are cup-like while others such as the celleporarids form small crusts. At least one incrusting species, tentatively identified by the Soules as "Robertsonidra", has hook-like extensions on the dorsal surface for attachment to the substrate.

The bryozoans of Au Au Channel, as part of a larger ecosystem, are largely dependent on the continued existence of the fragile black coral. Our talk will be directed towards representing this diversity, including species that are apparently restricted to the black corals, and discussing the populations relation to the larger ecosystem.

76 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **The wet Bryozoa and Entoprocta collections at the NHM**

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The wet Bryozoa and Entoprocta collection at the Natural History Museum, London (NHM) is one of the smaller collections that make up the 22 million "spirit" items within the Department of Zoology. The material first dates from around the 1840s, when the "British Zoophytes" collection of Dr George Johnston of Berwick-upon-Tweed was acquired. Today, the named collection consists of nearly seven thousand items.

In 2001 the material was moved into new storage facilities within the new Darwin Centre, and in the summer of 2006 a condition survey was undertaken. This survey centred on establishing, for the first time, the total number of items in the named collection and how much of this was type or figured material. The history and use of wet collections is discussed, details concerning the condition survey are presented, and an overview of the NHM wet Bryozoa collection is given.

77 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **The NHM Marcus collection**

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In 1948, the Natural History Museum, London (NHM) received eighty one lots of wet material in an exchange between Ernest Marcus, Universidade de São Paulo (USP), Brazil and Anna B. Hastings, NHM.

Until recently, when material was rediscovered (material not deposited in Museum or material not catalogued) at the Universidade de São Paulo, it was thought that the NHM specimens were the only extant examples of Marcus designations. The USP collection, however, does not contain all the specimens described by Ernest Marcus, and, therefore, the NHM collection remains important for the preservation of Marcus holotypes. A brief history about the exchange is present and an overview of the systematic reassessment of the NHM collection is given.

78 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## Where is that bryozoan collection?

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Although many general collection location indexes and catalogues have been published (Sherbourn, 1940; Cleevely, 1983; FENSCORE), none have exclusively dealt with the location of bryozoan collections. A provisional list of bryozoan collectors, voyages and expeditions, with location, is given. The authors would like to encourage IBA members to annotate the list adding any missing people; the location of material, etc. All data received will be used to produce a complete listing which will be published in the *Annals of Bryozoology* at a future date.

79 – (TALK) Thursday 10:00

## Darwin's bryozoans

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Charles Darwin's voyage on H.M.S. *Beagle* (1831-1836), and the subsequent publication of "*Origin of Species*" in 1858 are regarded as pivotal moments in science. Darwin's interest in zoophytes, however, started much earlier during his studies at Edinburgh University.

Material from the historic *Beagle* cruise was entrusted to Dr George Busk, who described a collection of 40 species in his "*Catalogues of Marine Polyzoa in the collection of the British Museum*" (1852, 1854, 1875). What happened to the collection between 1836 and 1852 remains unclear, but specimens, pertaining to the catalogues, were deposited at the Natural History Museum in 1854 and 1875 respectively. After Busk's death in 1884, more material was received, when Busk's entire collection was presented to the museum in 1899.

The NHM Darwin bryozoan collection has recently been re-curated, conserved and photographed using light and scanning techniques, as the first part to constructing a complete pictorial catalogue of the *British Museum Catalogue* material. The catalogue will contain specimen images and information, original descriptions and drawings, and taxonomic information on each species. It is envisaged that this data will be accessible through the Internet.

## **Phenotypic variation in a rhabdomesine bryozoan from the Mississippian of Ireland**

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It is unusual to find cryptostome bryozoans preserved in the fossil record, as they are generally delicate and often found as short disarticulated branch fragments. Thus under normal conditions of preservation it is difficult to determine if all fragments found in close proximity to each other actually were derived from one colony. This project utilises an almost entire rhabdomesine colony collected from the Mississippian limestone of Hook Head, Ireland which comprises over a dozen well-preserved branches that diverge at a high angle from the holdfast region.

The complete colony allows for the measurement of variation in the genotype, and any variance seen can be attributed to microenvironmental factors acting on the colony. In this study three morphometric characters were measured which reflect the size and spacing of autozoecia. In addition the nature of branch division, primary branching or secondary branching was examined.

Of the sixteen branches examined thirteen produced meaningful data for 294. PCA showed that systematic phenotypic variation occurs within the colony. A single fragment from this colony would not represent the entire phenotype possible from the single genotype. It is possible to select two fragments that are discrete in this morphospace.

## **Morphology and affinities of hederelloid ‘bryozoans’**

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Hederelloidea are a diverse group of colonial encrusters found on marine hard substrates from the Silurian into the Permian, and represented by single, questionable occurrences in the Ordovician and Triassic. They are especially abundant in Devonian shallow water deposits where they are prominent members of sclerobiont communities. Hederelloid colonies are irregular, runner-like and uniserial or pauciserial. They have tubular, typically curved zooids and simple terminal apertures. Zooidal walls are composed of non-porous calcite with a finely prismatic microstructure, and appear to have been exterior walls secreted from the inner side only (i.e. exterior walls). New zooids were budded laterally from either normal zooids or elongate stolozoids forming the central axes of the branches. Zooid size varies greatly between species, width ranging from about 0.15 to 1.5 mm and length from 0.5 up to at least 6 mm. Terminal diaphragms and zoecial blades are occasionally present. The protozoid has a bulb-like proximal end.

Hederelloids have been traditionally classified as cyclostome bryozoans, mostly because of their similarity to runner-like genera, such as *Stomatopora* and *Corynotrypa*, and the proximal end of the protozoid that resembles a stenolaemate protoecium. However, hederelloid zooids can be considerably larger than those of unequivocal cyclostomes, budding patterns are not stenolaemate-like, and the microprismatic walls contrast with the lamellar fabrics found in stenolaemate skeletal walls. Hederelloids have also been affiliated previously with phylactolaemates and auloporid corals. Comparisons are here made with all of these groups as well as colonial phoronids and pseudocolonial filigranid polychaetes. We favour a close relationship with phoronids, tentatively interpreting hederelloids as colonial, phoronid-like invertebrates with retractable lophophores. Along with microconchids and cornulitids, hederelloids may have been part of a mid-Paleozoic acme of lophophorate ‘worms’.

## **Defining morphometric characters in schizoporelloidean cheilostomes using SEM techniques: an approach applied to the primary orifice**

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Cryptic speciation in cheilostomes is a subject of ongoing debate. Clearly the resolution of this question depends on the wider application of modern genetic techniques in bryozoan taxonomy. However, it also depends on the accurate description and distinction of species based on morphological characteristics. Current research on fossil and recent species of *Schizoporella* and *Schizomavella* from Europe utilises a combination of morphometric and genetic methods. A central part of this study is the application of SEM studies to make accurate measurements that can be used in statistical analyses (e.g. discriminant analysis). The high resolution afforded by SEM can also make defining structural outlines more ambiguous, as has been found with the primary orifice of *Schizoporella*, which is regarded as an important taxonomic character. Several simple practical methods may overcome such ambiguities. The intact opercula of unbleached samples provide a clear outline for measurement. This is of particular use if measurements need to be taken from type specimens. Alternatively, the underside of the primary orifice may offer a more clearly defined shape than the exterior. Further accuracy can potentially be achieved by the application of new stereomicroscopic software. Setting out clear methodologies for measuring individual zooidal characters will contribute to more accurate definition of species using the multiplicity of morphological and genetic characters that are available.

## **Bryozoans of Retz-Formation (Early Miocene, Austria) – a high energy environment case study**

**Vávra, Norbert**

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Austria's Neogene sediments have yielded a number of excellent Bryozoan localities, nearly all of them attributed either to Early or Middle Miocene. Faunas studied show outstanding differences depending on their biostratigraphical position, differences which can be explained mainly by means of a general biogeographical situation undergoing frequent changes during Miocene for the Paratethys area. Within a new project funded by the 'Fonds zur Förderung der wissenschaftlichen Forschung' (Vienna, P19337-B17 - 'Biodiversity and faunal interchange: Bryozoans of Paratethys') biological studies of relevant Recent taxa and paleontological data will be combined to achieve a better and detailed understanding of faunal development for the Paratethys during the Miocene.

Bryozoan material from Early Miocene sediments has been collected at different localities in the surrounding of Eggenburg, a small city situated in the NW part of Lower Austria. Following the local stage concept for the Paratethys area, these sediments belong to the 'Eggenburgian', corresponding to N5 and the lower part of N6 according to Blow's foraminiferal zones. These sediments lie in their type area transgressively on crystalline rocks of the Bohemian Massif. Many local facies differences enable – in addition to biogeographical comparisons – detailed studies in respect to paleoecology. An interesting case, representing a high energy environment is the sand facies of the Retz-Formation. A near coast environment (eulitoral to shallow sublitoral) has yielded a rich bryozoan fauna at a few localities. The biodiversity being rather restricted, the fauna is nevertheless also of interest to taxonomy in general. From one of these localities the cribrimorph genus *Cillia* had been described, abundant occurrences of Cerioporids and *Tetrocycloecia* are a challenge for specialists too. Unusual growth forms of *Myriapora*, preserved mostly as small fragments only, together with extremely small colonies of Celleporids can be interpreted as a result of strong water movements and high energy environment.

## **Detecting bryozoan metabolites and bacterial quorum sensing factors**

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The decrease in the discovery rate of novel terrestrial bioactives has increased attention on the marine environment as a source of compounds with potential for development into pharmaceuticals. However, in terms of the numbers of compounds identified, the Bryozoa represents a significantly understudied invertebrate phylum when compared to Porifera and Cnidaria.

In many cases where bioactive compounds have been isolated from the marine environment, the resemblance between the structures of these compounds and those previously identified from terrestrial and marine microbes suggests that they may derive from the same source. Salomon et al (2004) have reviewed the evidence for the possibility that a number of different polyketides isolated from marine invertebrates and microbes may share a common origin and this is supported by molecular genetic approaches involving cloning and expression of gene clusters. The best example of the association of a bryozoan with a microbial symbiont for the production of a bioactive is the anti-cancer therapeutic, bryostatin.

In terrestrial microbes, many antibiotic biosynthesis pathways are known to be regulated at the genetic level by bacterial intercellular communication known as ‘quorum sensing’ (QS). QS-regulated interaction with higher organisms plays an important role in key relationships between bacteria and plants involved in the control of nitrogen fixation and gene transfer and between bacteria and marine organisms in the phenomenon of bioluminescence.

In our current investigations our aims are to identify and characterize bacterial isolates associated with bryozoans and exploit bacterial bioluminescent sensors for detecting antibacterial activities, QS activating factors or QS inhibitors in extracts from bryozoans. These sensor systems, based on the triggering of expression of recombinant bioluminescence genes can be extremely sensitive to low levels of natural compounds and provide a rapid and sensitive assay for screening large numbers of different bryozoan species and associated microbes.



## **Bryozoans of the Mangreef, a unique and threatened habitat in the Pelican Cays, Belize**

**Winston, Judith E.**

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Thirty-one species of bryozoans were found in mangrove communities of the Pelican Cays. Only at one site was the dominant bryozoan a common Caribbean fouling species, *Schizoporella pungens*. At the other cays bryozoan species normally associated with shallow reef habitats formed extensive colonies on the submerged hanging roots of red mangroves. *Stylopoma* sp., *Steginoporella magnilabris*, *Trematooecia aviculifera*, *Hippopodina feegeensis*, and *Rhynchozoon verruculatum* were the most abundant species overall.

The overlapping thalli of *Lobophora variegata* also covered much surface area in well-shaded areas. The undersides of the thalli hosted a cryptic bryozoan fauna, consisting of delicate branching and encrusting colonies, which shared some species with both mangrove root and seagrass bryozoan assemblages.

Despite the uniqueness of the habitat and its status as a protected area, clearing and sand pumping for resort development have already started on two of the cays, and it is unlikely this mangrove-reef community will persist much longer.

**Common and Scientific Names of Aquatic Invertebrates from United States and Canada: Bryozoa (preliminary list for American Fisheries Society publication series)**

**Winston, Judith E.**

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This poster consists of a preliminary list for a volume on bryozoans from United States waters (including non-contiguous states and territories of the USA. Canada isn't done yet). A number of people already have been asked to help with the project, but assistance from IBA attendees is most welcome. The list so far is posted here, please make comments on the worksheets: additions, corrections, additional references. You will (if you so choose) then be added to the list of authors in the final publication.

87 – (POSTER) Tuesday 3:30-5:30; Thursday 8:30-9:45 AM

## **Neptunschleier & Co. – a Bryozoan Exhibition**

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Despite the unusual theme, the Oberösterreichische Landesmuseen devoted one of their two special annual exhibitions to bryozoology. The bryozoan exhibition “Neptunschleier & Co.” took place at the Biologiezentrum in Linz, Austria, from 22 April – 25 September 2005; one year later it was shown in the Natural History Museum in Zagreb, Croatia. This exhibition focused particularly on freshwater bryozoans from Central Europe, although a small section was devoted to recent and fossil marine bryozoans in habitats ranging from the Arctic to the tropics. This brief documentation provides an overview of the various topics represented at the exhibition.

88 – (TALK) Monday 11:20

## **The relative importance of different modes of reproduction and dispersal in *Plumatella fungosa* (Phylactolaemata: Plumatellidae)**

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Among benthic freshwater invertebrates, bryozoans have developed the highest complexity in regard to reproduction and dispersal of colonies. They form a great variety of asexual propagules, whereby in the class Phylactolaemata different types of statoblasts play a key role. This study describes propagation in *Plumatella fungosa*, a phylactolaemate species occurring in high abundances in nutrient-rich water-bodies in eastern Austria. *P. fungosa* reproduces asexually by sessoblasts, which stick to the substrate by an attachment apparatus, and by floatoblasts, which drift on the water surface with their gas-filled swim-ring. The investment in the different modes of reproduction is indicated by the formation of sessoblasts, floatoblasts and larvae in the zooids over the course of the year. The reproductive success of the different propagules is demonstrated by analysing the origin of newly recruited colonies.

## **Development and metamorphosis of cyphonautes larvae in the freshwater ctenostome bryozoan, *Hislopia malayensis* Annandale, 1916**

**Wood, Timothy S.**

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The ctenostome bryozoan, *Hislopia malayensis*, is one of two hislopiid species in Thailand and one of the most common freshwater bryozoans in Southeast Asia. Colonies are hermaphroditic, forming sperm first and then eggs, the two phases often overlapping. Eggs are released around nightfall through a mechanism not yet determined. There is no intertentacular organ. Eggs initially measure 0.07 mm in diameter, expanding to 0.16 mm with the rise of a smooth fertilization membrane. Radial cleavage produces 4 tiers of 4 equal blastomeres by the 3<sup>rd</sup> division. A distinct blastocoel appears at the 32-cell stage. Mesoderm formation is not yet entirely clear.

At 28° C a swimming cyphonautes larva is formed within 14 hours. It measures 0.09 mm along the base and 0.09 mm high. The apical organ is well developed, but there is no internal sac. The stomach and intestine are combined in a single unit; vibratile cilia and a small pyriform organ appear only after the larva grows much larger. Larval longevity is estimated to be at least 10 days. Metamorphosis occurs after the larva reaches a length of about 0.2 mm at the base. Following attachment to a suitable substratum, strong muscular contractions pull the larval tissues away from the bivalve shell, and the shell valves are often discarded at that point. The larval structure appears to expand, and the adhering base creeps outwards in all directions. As tissues reorganize the entire larval stomach remains intact, slowly digesting the food contents and apparently providing continuous energy for metamorphosis. The larval stomach is eventually integrated fully into the adult gut between the newly formed proventriculus (“gizzard”) and intestine.

This is the first description of a cyphonautes larva in fresh water. The retention of a complete larval organ in the adult is interpreted as an ancient feature, suggesting significant evolutionary stasis in *Hislopia*. This developmental feature has been suggested but never before reported in any bryozoan.

## **The earliest thin-section of a fossil bryozoan**

**Wyse Jackson, Patrick N.**

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Most students of Palaeozoic bryozoans would at one time or another have made thin-sections which are necessary as they reveal important details of skeletal microstructure and internal skeletal characters often of taxonomic importance. The general adoption of thin-sections in such studies can be dated back to the 1880s when H.A. Nicholson began to produce them for his work on Cincinnatian and other bryozoans. Soon afterwards Edgar Oscar Ulrich and Ray Smith Bassler first began to manufacture bryozoan thin-sections in large numbers, and many of these they sold to augment their incomes. By 1890 the use of thin-sections in bryozoan studies was routine.

However the Cincinnatian bryozoologists were not the first to produce thin-sections in bryozoans. The first thin-sections made of any fossil were those produced of petrified wood in 1828 by the Scotsman William Nichol (after whom the prism is named).

The first bryozoan thin section dates from the 1840s and is almost certainly that of a specimen of *Diplotrypa petropolitana* Nicholson from the Ordovician of the Sias River, south of Lake Ladoga in Russia. It was described (as *Chaetetes Petropolitanus* – a coral) and illustrated by William Lonsdale in an appendix to Roderick Impey Murchison's *The Geology of Russia in Europe and the Ural Mountains* published in 1845. Lonsdale, the curator and librarian of the Geological Society of London, was an expert on fossil corals and is well-known for his descriptions of fossil material collected by Charles Darwin and others from Tasmania. Lonsdale's thin section is in the collections of the Natural History Museum, London.

## **Paleozoic bryozoans from Mongolia: geographical distribution and stratigraphical significance**

**Yarinpil, Ariunchimeg**

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This report summarized all data obtained in the study of the Paleozoic bryozoans from Mongolia. Bryozoa is one of the widespread invertebrate fossils in the Paleozoic deposits. The first report of the bryozoans was in 1926. Remarkably little has been published on Paleozoic bryozoans until the beginning of the activity of Soviet-Mongolian Paleontological joint expedition. By that time, totally 162 bryozoans genera containing 484 species have been reported from 13 Ordovician, 32 Silurian, 90 Devonian, 48 Carboniferous and 31 Permian localities.

The Paleozoic deposits of Mongolia are divided into 21 regional stratigraphic units ranked as horizons. Incomplete bryozoan distribution in the sections makes it difficult to distinguish uninterrupted zonal sequences. However, the bryozoans from well studied Paleozoic type sections are analysed and the following 30 local biostratigraphic units, beds with bryozoans, are established. The Ordovician bryozoans consist of four beds with bryozoans, one from the late Caradocian and three from the Ashgillian. Six beds with bryozoans are observed in Silurian deposits. Eight beds with bryozoans – Lochkovian, Pragian, two Emsian, Eifelian, Givetian, Frasnian and Famennian are established in Devonian. Bryozoans from the Carboniferous type sections are analysed and seven beds with bryozoans, three of which are from the Upper Carboniferous are described. Permian bryozoans were studied from nine sections, and six beds with bryozoans are determined.

Mongolia is subdivided into 44 terranes. The presence of bryozoans characteristic associations in different tectonic terranes makes possible to trace and correlate these bryozoa-bearing beds widely.

## **Permian bryozoans from Mongolia**

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Permian marine sequences of Mongolia are developed in two separate basins. One is in the central and northeastern parts where the Permian stratigraphy and marine faunas bear strong similarities with those of the Transbaikalian region of Russia. The other is in the southeastern part where the Permian marine faunas and rock sequences are closest to those of northeast China and southern Primorye of Far East Russia. Accordingly, the Permian bryozoan associations are different in these two basins.

In the northern basin one lower Permian, Sakmarian-Artinskian, bryozoan assemblage is distributed near Adaatsag sum. Also two middle Permian, Roadian and Wordian, bryozoan-bearing beds are recognized at Burd gol and Binder sum sections accordingly. In the southern basin at the Hovsgol-Bairimovoo depression two lower Permian, Sarmatian-Artinskian and Kungurian bryozoan assemblages are established. Middle Permian, Roadian bryozoan assemblages are widely distributed in the Dalan uul -Lugin gol zone from the Huryn Chiv hudag in the west to the Jirem uul locality in the east. The bryozoan assemblages found near the Har Erdene uul in the Sulinheer zone assigned to be Capitanian in age. Both Middle Permian bryozoan associations from the southeastern part of Mongolia are characterized by the mixed cool- and warm-water species.

Altogether, 65 bryozoan species which belong to 43 genera, 18 families from 5 orders are determined in the Permian deposits of Mongolia.

## **Recent Bryozoa from the Egyptian Mediterranean coast, East Nile Delta, Egypt**

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Thirty two Recent bryozoan species are identified from three shore sites along the eastern side of the Egyptian Mediterranean coast (Ras El-Bar, Damietta, and Port Said). Most of the studied species are collected from the Ras El-Bar site, which lies at the eastern apex of the Nile delta. However, only two species (*Membranipora savartii* & *Stomachetosella condylata*) are collected from the sites of Damietta, and Port Said, which lie north of the Manzala Lake. The studied species are mostly encrusting cheilostomates, with Mediterranean/Atlantic biogeography.