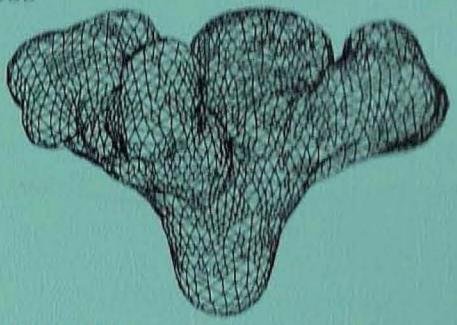
# SPONGES IN TIME AND SPACE

4th International Porifera Congress



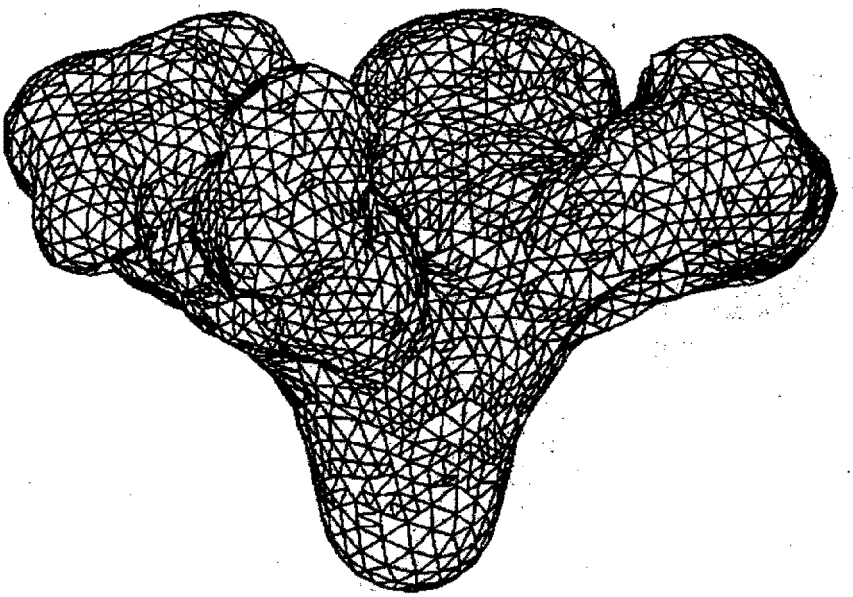
April 19 - 23, 1993
ITZ, University of Amsterdam

# 4th International Porifera Congress

# SPONGES IN TIME AND SPACE

## April 19-23, 1993, Amsterdam

# Book of Abstracts



Institute of Taxonomic Zoology
(Zoölogisch Museum)
University of Amsterdam (NL)

## CONTENTS

**PROGRAM 4TH INTERNATIONAL PORIFERA CONGRESS 19-23 APRIL 1993**

(Program parts with * are uncertain)

**SUNDAY April 18**

14.00. Start of registration at the Institute of Taxonomic Zoology, Mauritskade 57.
17.00-18.30. Welcoming drinks at the Institute of Taxonomic Zoology, Mauritskade 57.
22.00. Closure of registration office.

**MONDAY April 19**: Lecture Hall C, Roetersstraat 15.

09.00. OPENING by the Rector Magnificus of the University of Amsterdam, Prof. Dr P.W.M. de Meijer

09.10-09.55. PLENARY ADDRESS by Prof. Dr. Patricia R. Bergquist, School of Biological Sciences,University of Auckland, New Zealand: "Onwards and upwards with sponges"(invited).

1. GENERAL SESSION: Chair Dr Rob van Soest

09.55-10.25. Dr J. Keith Rigby, Brigham Young University, Provo, U.S.A.: "Fossils in time: the record and its interpretation "(invited).

10.25-10.45. Coffee break.

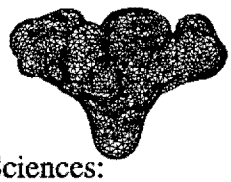
10.45-11.15 Dr Jaap A. Kaandorp, University of Amsterdam : "Sponges in space: Growth models of sponges using geometric modelling techniques" (invited).
11.15-11.45. Dr R. Sluys , ETI, University of Amsterdam. "ETI : database and identification systems for biodiversity"(invited)
11.45-12.05. Dr K. Tabachnick, Institute of Oceanology, Moscow: *"Horizontal distribution of recent Hexactinellida".

2. PALEOSPONGOLOGY
Session 1. Chair Dr. Joachim Reitner.

12.05-12.25. Dr Françoise Debrenne, Muséum National d'Histoire Naturelle, Paris: "Archaeocyathan affinity: How deep can we go into the systematic affiliation of an extinct group?"
12.25-12.45. Dr Paul Copper, Laurentian University, Sudbury, Canada: "Paleoecology of giant Late Ordovician cylindrical sponges from Anticosti, East Canada".

12.45-14.00. Lunch

14.00-14.20. Prof. Carl W. Stock, University of Alabama, Tuscaloosa, U.S.A.: "Stromatoporoid palaeobiogeography of the Eastern American Realm during the Lochkovian Age (Earlier Devonian)".
14.20-14.40. Dr Ursula Rehfeld, Freie Universität Berlin, Germany: "Development of spongiolitic limestones near the Bajocian/Bathonian boundary of N-Spain (Sierra de la Demanda, S-Cantabrian Mountains) and their bearing on other spongiolitic environments".



14.40-15.00. Dr Andrzej Pisera, Institute of Paleobiology, Polish Academy of Sciences: "Siliceous sponges from the Middle Jurassic of the Mecsek Mountains (southern Hungary)".

15.00-15.20. Tea break.

Session 2: Chair Dr Th. M. G. van Kempen.

15.20-15.40. Dr Adam Bodzioch, A. Mickiewicz University, Poznan, Poland: "Paleoecology of Hexactinellid sponges from the epicontinental Triassic of Poland".

15.40-16.00. Dr Manfred Krautter, Institut f.Paläontologie, Stuttgart, Germany: "Siliceous sponge facies from the Upper Jurassic of Iberia".

16.00-16.20. Dr Joachim Reitner, Freie Universität, Berlin: "Skeletal formation in *Spirastrella (Acanthochaetetes) wellsi* (Demospongiae, Porifera)".

16.20-16.40. Dr M.M. Ivanik, Academy of Science, Kiev, Ukraine: "Paleogene sponge spicules from the Ukraine and their parataxonomic classification".

16.40-17.00. Coffee break.

3. BIOGEOGRAPHY : Chair Dr Jean Vacelet.

17.00-17.20. Prof. Dr Gerald J. Bakus, Allan Hancock Foundation, Los Angeles, U.S.A.: "Species richness and dominance in marine sponges of Madang, Papua New Guinea".

17.20-17.40. Dr. Ruth Desqueyroux-Faundez, Muséum d'Histoire Naturelle, Genève, Switzerland: "Biogeography of Chilean Marine Sponges (Porifera-Demospongiae)".

17.40-18.00. Dr Chung-Ja Sim, Han Nam University, Taejon, Korea: "Sponges from Cheju Island in Korea".

18.00-18.20. Dr J.N.A. Hooper, Queensland Museum, Brisbane, Australia: "Biogeography of Indo-West Pacific sponges: Microcionidae, Raspailiidae, Axinellidae".

18.20-18.40. Dr R.W.M. van Soest, University of Amsterdam, The Netherlands: "Demosponge distribution patterns".

**TUESDAY April 20**

4. CELL BIOLOGY AND BIOCHEMISTRY: Chair Dr Shirley A. Pomponi.

09.00-09.20. Dr Elda Gaino, Università di Genova, Italy: "Various morphological aspects of dissociated sponge cells in relation to different biological substrata".

09.20-09.40. Dr. Hazime Mizoguchi, Rissho University, Saitama, Japan: "Effect of 5-bromodeoxyuridin and aminopterin on cell proliferation and morphogenesis of the freshwater sponge *Ephydatia fluviatilis* ".

09.40-10.00. Dr Robert Garrone, Université Claude Bernard, Lyon, France: "Molecular data on cytoskeletal proteins of freshwater sponges".

10.00-10.20. Prof. Dr W.E.G. Müller, Universität Mainz, Germany: "Identification and characterization of an S-type lectin in the marine sponge *Geodia cydonium* ".

10.20-10.40. Coffee Break.

5. NATURAL PRODUCTS WORKSHOP
Session 1: BIOSYNTHESIS. Chair Dr P. Crews.

10.40-11.30. Prof. M. Garson , University of Queensland, St. Lucia, Australia: "Biosynthesis of sponge secondary metabolites and why it is important" (invited).
11.30-11.50. Prof. D. John Faulkner, Scripps Institution of Oceanography, La Jolla, U.S.A.: "New metabolites from *Dysidea herbacea* and their cellular localization ?".
11.50-12.10. Dr Shirley A. Pomponi, Harbor Branch Oceanographic Institute, Fort Pierce,U.S.A.: "Sponge cell culture for production of bioactive metabolites".

12.10-13.30. Lunch.

Session 2: ISOLATION. Chair Prof. D. J.Faulkner.

13.30-14.20. Dr D. Daloze, Université Libre, Brussels, Belgium: "Separation techniques: Application to isolation of sponge metabolites" (invited).
14.20-14.40. Prof. Nobuhiro Fusetani, University of Tokyo, Japan: "Theostatins, highly cytotoxic polypeptides from the marine sponge*Theonella swinhoei* ".
14.40-15.00. Dr Phil Crews, University of California at Santa Cruz: "Are sponge microbial associants a source of secondary metabolites ?"

15.00-15.20. Tea break.

Session 3: BIOLOGY. Chair Prof. N.Fusetani.

15.20-16.10. Prof. G. Sodano, Università di Salerno, Italy: "Transfer of secondary metabolites to predators" (invited)
16.10-16.30. Dr Raymond J. Andersen, University of British Columbia, Vancouver, Canada: "Novel terpenoid metabolites from the Northeastern Pacific Nudibranch *Cadlina luteomarginata* and three sponges in its diet".
16.30-16.50. Dr C.N. Battershill, New Zealand Oceanographic Institute, Wellington, New Zealand: "The chemical ecology of polar, temperate and tropical sponges".

17.30-19.00. RECEPTION at the Historical Museum hosted by the Mayor of Amsterdam.

**WEDNESDAY April 21**

Session 4: BENEFITS FOR MAN. Chair Prof. R. Andersen.

09.00-09.50. Dr Murray H. Munro, University of Canterbury, Christchurch, New Zealand: "From Seabed to Sickbed" (invited).
09.50-10.10. MSc Peter Willemsen, TNO Coatings, Den Helder, The Netherlands: "Anti-fouling compounds from sponges".

10.10-10.30. Coffee-break.

Session 5: CONCLUSIONS. Chair Prof. J-C. Braekman.

10.30-11.20. Dr Francis J. Schmitz, University of Oklahoma, Norman, U.S.A.: "Cytotoxic compounds from sponges and from their associated microfauna" (invited).
11.20-12.10. Panel session: Concluding remarks and discussion: Dr J.C. Braekman, chair, Dr F.J. Schmitz, Dr Murray H. Munro & Prof. P.R. Bergquist.

12.10 -12.25. PHOTO SESSION on the corner of Roetersstraat and Sarphatistraat.

12.25-13.30. Lunch

13.30-17.00. POSTER SESSIONS A & B (Coffee break at 15.00).

6. Session A: ECOLOGY AND SYSTEMATICS. Chair Dr Sven Zea.

MSc Lisanne A.M. Aerts, INVEMAR, Santa Marta, Colombia/University of Amsterdam, The Netherlands: "The functional role of sponge-coral interactions in stressed reef communities in NE Colombia".

Dr Dagmar Barthel, Institut für Meereskunde, Kiel, Germany: "The boring sponge *Cliona vastifica* in a subarctic population of *Chlamys islandica*".

MSc Maria Cristina Díaz ,UCSC, Santa Cruz, U.S.A."The Plakinidae: a systematic review".

MSc Freerk Hiemstra, University of Amsterdam, The Netherlands: "Post Oligocene radiation of tropical sponge genera".

MSc Margriet Kielman, INVEMAR, Santa Marta, Colombia: "Reef communities along the NE coast of Colombia and Curaçao related to abiotic circumstances".

MSc Mario De Kluijver, University of Amsterdam, The Netherlands: "Distribution of NE European shallow water sponges".

Dr Manfred Krautter ,Institut f.Paläontologie, Stuttgart, Germany: "Observations on *Eudea cribraria* (Fromentel), Calcarea".

Dr Henry Reiswig, Redpath Museum, Montreal, Canada: "A new collection prompts the return of *Leptophragmella* (Craticulariidae) to *Chonelasma* (Euretidae)(Hexactinellida)".

Dr Joachim Reitner, Freie Universität Berlin, Germany: "Sponge communities of the Arctic Vesteris Banken Seamount (NE Greenland sea). RV "Polarstern"Expedition ARK VII/1, 1990".

Dr Joachim Reitner, Freie Universität Berlin, Germany: "Sponges from the Tommotian (Lowermost Cambrian) of China (N-Hunan). An access to the early beginning of sponge history".

Dr Dolors Rosell, CEAB, Blanes, Spain: "Inter- and intraspecific relationships of the burrowing patterns of two clionid sponges".

MSc Christine Schönberg, Institut für Meereskunde, Kiel, Germany:"*Halichondria panicea* Pallas: Seasonality of spicule development".

Dr Rob van Soest, University of Amsterdam, The Netherlands: "Distribution of phototrophic sponges in the Seychelles".

Dr Ole Tendal, Zoologisk Museum Copenhagen, Denmark: "Calcareous sponges in the abyssal Greenland, Norwegian and Iceland Seas".

Dr Maria-Jesus Uriz, CEAB, Blanes, Spain: "Chemical and structural defenses vs growth and regeneration in encrusting sponges: *Crambe crambe* (Poecilosclerida) and *Scopalina lophyropoda* (?Halichondrida)".

MSc Ursula Witte, Institut für Meereskunde, Kiel, Germany: "Reproduction of *Halichondria panicea* (Pallas) in the Kiel Bight".

7. Session B: BIOLOGY, PHYLOGENY, CHEMISTRY. Chair Dr Nicole Boury-Esnault.

MSc Belinda Alvarez, University of Australia, Sydney, Australia: "Preliminary phylogenetic analysis of some Axinellid sponges".

Dr Paul Fell, Connecticutt College, New London, U.S.A.: "Dormancy of the gemmules of *Eunapius fragilis* and *Ephydatia muelleri* from New England".

Dr Michèle Guyot, Muséum National d'Histoire Naturelle, Paris, France "Individual variation in the chemical composition of *Ircinia variabilis*".

MSc Eduardo Hajdu, University of Amsterdam, The Netherlands and CNPq-Brazil: "The significance of including chelae-bearing sponges within the Haplosclerida".

Ms Lisa Hunter, UCSC, Santa Cruz, U.S.A.: "Databases as tools for dereplication in sponge natural products".

Dr Michelle Klautau, UFRJ, Rio de Janeiro, Brazil: "Establishment of long-term cell cultures ".

Dr Michelle Klautau, UFRJ, Rio de Janeiro, Brazil: "Antigenic properties of sponge collagen and their potential use in taxonomy".

Dr Manuel Maldonado, Blanes, Spain: "Spicule microfeatures of *Crambe* (Demospongiae, Poecilosclerida) as a clue for its relationships with "living"fossils".

Dr Dorthe Mehl, Freie Universität Berlin, Germany: "Is the flagellar velum a constituent character of Porifera?".

Dr Dorthe Mehl , Freie Universität Berlin, Germany: "Monophyly and Systematics of the Porifera".

Dr Murray H. Munro, Univ. of Canterbury, New Zealand: "MarinLit: A marine literature database".

Dr Stuart Noble, University of Auckland, New Zealand: "Applications of genomic walking PCR to molecular studies of sponges".

Dr Shirley Sorokin, AIMS, Townsville, Australia: "Microbial contamination and cell nutrition in sponge cell culture".

Dr Daisuke Uemura, Shizuoka University, Japan.: "Bioactive metabolites from the black sponge*Halichondria okadai* "

Dr Yoko Watanabe, Ochanomizu University, Japan: "Embryonic development of *Sycon calcaravis*".

Dr Philippe Willenz, Institut Royal des Sciences Naturelles, Brussel, Belgium: "Ultrastructure of parenchymella larvae and their armoured follicle in the coralline sponge*Calcifibrospongia actinostromarioides* Hartman".

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| 18.00-19.00. | CANAL BOAT TRIP |
| 19.00-20.30. | RECEPTION at the Lutherse Kerk, Singel 411, hosted by the University of Amsterdam. |
| 20.30. | CONFERENCE DINNER (Indonesian ricetable) at the restaurant "Indonesia". |

**THURSDAY April 22**

8. FRESHWATER SPONGE BIOLOGY.
Session 1. Chair Prof. Gisèle Van de Vyver.

09.00-09.20. Dr Roberto Pronzato, Università di Genova, Italy:
"Life history of *Ephydatia fluviatilis* : a model for adaptive strategies in discontinuous habitats".

09.20-09.40. Dr Roberto Pronzato,Università di Genova, Italy:
"Quiescence and dispersal: a different strategy in gemmule production by *Ephydatia fluviatilis* ".

09.40-10.00. Dr Renata Manconi, Università di Sassari, Italy:
"Distribution of spongillids on Mediterranean Islands".

10.00-10.20. Dr Georg Imsiecke, Universität Mainz, Germany:
"Ingestion and digestion of *Chlamydomonas reinhardti* (Dangeard)(Protozoa, Phytoflagellata) by the freshwater sponge *Spongilla lacustris* (Porifera, Spongillidae)".

10.20-10.40. Coffee break.

Session 2.Chair Dr Y. Watanabe.

10.40-11.00. Prof. Gisèle Van de Vyver, Université Libre de Bruxelles, Belgium:
"Some aspects of the ecology of Belgian freshwater sponges".

11.00-11.20. Ms E.Richelle-Maurer, Université Libre de Bruxelles, Belgium.
"Some aspects of heavy metal tolerance in freshwater sponges".

11.20-11.40. Dr G.C. Coutinho, Université Libre de Bruxelles, Belgium:
"Looking for homeobox genes in the freshwater sponge *Ephydatia fluviatilis* ."

11.40-12.00. Dr Henry M. Reiswig, Redpath Museum, Montreal, Canada:
Taxonomy, distribution and ecology of *Corvospongilla novaeterrae* " (Porifera, Spongillidae), a problematic freshwater sponge from eastern Canada.

9. SPONGE ECOLOGY
Session 1 . REPRODUCTIVE ECOLOGY. Chair Dr Maria-Jesús Uriz.

12.00-12.20. Dr Christopher N. Battershill, New Zealand Oceanographic Institute,Wellington, New Zealand: "Sex in the sea and how to avoid it".

12.20-13.30. Lunch.

13.30-13.50. Dr Micha Ilan, Tel Aviv University, Israel:
"Sponge reproductive strategies".

13.50-14.10. Dr Jane Fromont, James Cook University, Townsville, Australia:
"The reproductive biology of tropical species of Haplosclerida and Petrosida on the Great Barrier Reef"

Session 2. Chair Prof. Michele Sarà.

14.10-14.30. Dr Dagmar Barthel, Institut für Meereskunde, Kiel, Germany:
"The sponge association of the deep Norwegian-Greenland sea: sponge/ substrate relationships".

14.30-14.50. MSc Ursula Witte, Institut für Meereskunde, Kiel, Germany:
"Biology and ecology of the deep sea sponge *Thenea abyssorum* "

14.50-15.10. Dr Ole S. Tendal, Zoologisk Museum, Copenhagen, Denmark:
"Mass occurrences of sponges along the Northeast Atlantic shelf and slope: distribution characteristics and possible causes".

15.10-15.30. Tea break.

15.30-15.50. MSc Yasmine Göbel, Institut für Meereskunde, Kiel, Germany:
"Size spectra of particles taken up by several marine demosponge species".

15.50-16.10. Dr Floyd Sandford, Coe College, Cedar Rapids, U.S.A.:
"Preliminary studies of the Florida hermit crab sponge".

16.10-16.30. Dr Janie L. Wulff, Williams College, Mystic, U.S.A.:
"Sponge-feeding by Caribbean Angelfishes, Trunkfishes, and Filefishes".

16.30-16.50. Dr Klaus Rützler, Smithsonian Institution, Washington, U.S.A.:
"Sponges growing on trees".

Session 3. SPONGES IN STRESSED CONDITIONS. Chair Dr K.Rützler.

16.50-17.10. Dr Clifford Jones, University College of North Wales, United Kingdom:
"Process-formation by aquarium-kept sponges and its relevance to sponge ecology and taxonomy".

17.10-17.30. Dr Sven Zea, INVEMAR, Santa Marta, Colombia:
"Patterns of coral and sponge abundance in degraded vs.still healthy coral reefs at Santa Marta, Colombian Caribbean".

17.30-17.50. MSc. Mario J. De Kluijver, University of Amsterdam, The Netherlands:
*"Sponge populations in SW Netherlands during major coastal engineering projects of the 1980's".

17.50-18.10. Dr Jean Vacelet, Station Marine d'Endoume, Marseille, France:
"Bacterial attack of spongin skeleton during the 1986-1990 Mediterranean sponge disease".

**FRIDAY April 23**

10. HEXACTINELLIDS. Chair Dr H.M. Reiswig.

09.00-09.20. Ms Sally P. Leys, University of Victoria, British Columbia, Canada:
"Cytoplasmic streaming in the Hexactinellid sponge *Rhabdocalyptus dawsoni* ".

09.20-09.40. Dr Dorthe Mehl, Freie Universität Berlin, Germany:
"New aspects on the living lychniscid sponge *Neoaulocystis grayi* (Bowerbank,1869) and the Lychniscosa (Hexactinellida)".

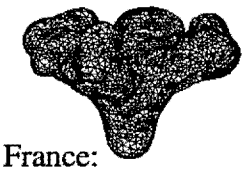
09.40-10.00. Dr Nicole Boury-Esnault, Station Marine d'Endoume, Marseille, France:
"Structure of the Hexactinellid *Oopsacas minuta* Topsent,1927".

10.00-10.20. Dr Jean Vacelet, Station Marine d'Endoume, Marseille, France:
"On the development of a hexactinellid sponge, *Oopsacas minuta* Topsent".

10.20-10.40. Coffee break.

11. MOLECULAR SYSTEMATICS. Chair Dr Wallie H. de Weerdt.

10.40-11.00. Dr Allen Rodrigo, University of Auckland, New Zealand:
"Are sponges animals? An investigation into the vagaries of molecular phylogenetic inference".



11.00-11.20. Dr Nicole Boury-Esnault, Station Marine d'Endoume, Marseille, France: "An analysis of 28S ribosomal RNA sequences suggests early radiations within the Phylum Porifera".

11.20-11.40. Dr Michelle Kelly-Borges, Harbor Branch Oceanographic Institution, Fort Pierce,U.S.A.: "Molecular systematics of the Lithistida".

11.40-12.00. Dr.Antonio M. Solé-Cava, UFRJ, Rio de Janeiro, Brazil: "Genetics of marine sponges".

12.00-12.20. Dr Russell G. Kerr, Florida Atlantic University, Boca Raton, U.S.A.: "Is *Xestospongia muta* a multi-species group ?".

12.20-13.30. Lunch.

12. PHYLOGENY AND EVOLUTION. Chair Dr John N.A. Hooper.

13.30-13.50. Prof. Dr Michele Sarà, Università di Genova, Italy: "Evolutionary hypotheses and phylogenetic reconstructions in the family Tethyidae (Porifera ,Demospongiae)".

13.50-14.10. Dr Maurizio Pansini, Università di Genova, Italy: "The variability and taxonomic status of different*Petrosia* -like sponges in the Mediterranean Sea".

14.10-14.30. Ms Elise V. Robinson, Harbor Branch Oceanographic Institution, Fort Pierce, U.S.A.: "The Lithistid genus *Discodermia* (Tetracladina: Theonellidae) from the Atlantic".

14.30-14.50. MSc Eduardo Hajdu, CNPq-Brazil/University of Amsterdam: "Poecilosclerid phylogeny revisited: Evidence for the polyphyly of Desmacidids".

14.50-15.10. Tea break.

15.10-15.30. Dr Michelle Kelly-Borges, Harbor Branch Oceanographic Institution, Fort Pierce,U.S.A.: "The genus *Ianthella* (Verongida: Ianthellidae) in the South Wes Pacific".

15.30-15.50. MSc Marta Domingo, CEAB, Blanes, Spain "SPONG-IA :a rule based expert system for the identification of North-Atlanto-Mediterranean sponges".

15.50-17.00. PANEL SESSION: The status of sponge systematics: Prof. P.R. Bergquist (chair), Dr N. Boury-Esnault, Prof. K. Rigby & Dr Henry Reiswig.

17.00. Closing remarks by the Chairman.

## 1. GENERAL SESSION

Prof. Dr. **Patricia R. Bergquist**, School of Biological Sciences, University of Auckland, New Zealand:
"Onwards and upwards with sponges" (invited).

Dr **J. Keith Rigby**, Brigham Young University, Provo, U.S.A.:
"Fossils in time: the record and its interpretation "(invited).

Dr. **Jaap A. Kaandorp**, Faculties of Informatica & Biology, University of Amsterdam :
"Sponges in space: Growth models of sponges using geometric modelling techniques" (invited).

Dr **R. Sluys** , ETI, c/o Institute of Taxonomic Zoology, University of Amsterdam:
"ETI : database and identifications systems for biodiversity" (invited).

Dr **K.R. Tabachnick**, Institute of Oceanology, Moscow:
"Sponges in space: Horizontal distribution of recent Hexactinellida".

## Growth models of sponges using geometric modelling techniques

Jaap A. Kaandorp

Faculty Mathematics and Informatica, and Institute of Taxonomic Zoology, University of Amsterdam, P.O. Box 4766 1009 AT Amsterdam, The Netherlands.

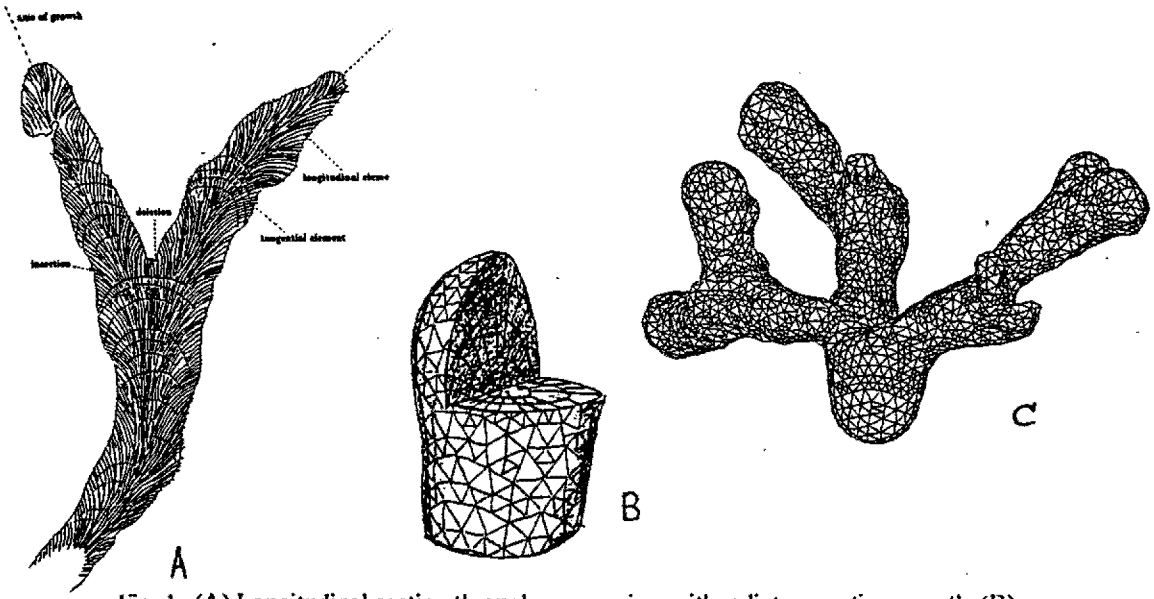



Fig. 1. (A) Longitudinal section through an organism with radiate accretive growth. (B) Simulated branch of an organism. (C) More evolved simulation.

Fig. 1. (A) Longitudinal section through an organism with radiate accretive growth. (B) Simulated branch of an organism. (C) More evolved simulation.

The emergence of forms in the growth process of biological objects is one of the most fundamental problems in biology. A very natural way to describe a growth process is a morphological model in which the addition of material during the growth process is simulated. In this talk two- and three-dimensional models will be discussed which simulate a certain type of growth process (radiate accretive growth), which can be found among organisms as sponges and corals. In a radiate accretive growth process the growth form emerges in an iterative process in which layers of material are added on top of the preceding growth stages of the organisms. In the growth process the preceding growth stages remain unchanged. In a longitudinal section, parallel the axis of growth, the layered structure is revealed, from which it is possible to distinguish the form of the organism in an earlier growth stage (see Fig 1A). In radiate accretive growth the longitudinal elements are set perpendicular to the preceding growth stages, while the surface of the organism is tesselated with tangential elements. The thickness of a newly secreted layer is the

highest when the angle between the surface normal and the direction of the growth axis is 90°, while a zero or minimal thicknes is attained at larger angles.

Marine organisms are a very suitable case study for developing morphological simulation models of growth processes, since the growth process itself is relatively simple as well as the influence of the physical environment (water movement, supply of nutrients etc.) The addition of new layers of material is modelled using iterative geometric constructions. In the simulation models the addition of tangential and longitudinal elements is mimicked, an example of a simulated branch of an organism with radiate accretive is shown in Fig 1B. In this figure part of the object is removed in order to reveal the layered structure. A more evolved simulation, in which several branches have developed, is depicted in Fig. 1C. The influence of the physical environment is simulated with (for example) diffusion equations and light intensity functions. Examples of simulated growth processes and the influence of the physical environment, will be shown on video.

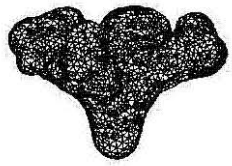
## ETI: database and identification systems for biodiversity

R. Sluys

Expert-center for Taxonomic Identification, Institute of Taxonomic Zoology, University of Amsterdam, P.O. Box 4766, 1009 AT Amsterdam, The Netherlands

Goals of ETI: ETI aims (1) to concentrate and preserve taxonomic expertise, and (2) to make this biological knowledge available to users by electronic means. The ETI project involves the development and implementation of a userfiendly multimedia database system for storage of biological information (text, photos, line drawings, sounds, videos) suitable for all sorts of organisms (plants, animals, protists, bacteria, fungi). A multiple entry identification system facilitates and greatly simplifies identifications done by experts as well as by lay persons. A geographic program enables the storage, searching, and comparison of distributional data. Subsets of the data, concerning taxonomic groups or geographic regions (Topic Oriented Sections - TOS) shall be distributed on CD-ROMS, optical laserdiscs, or on floppies. At a later stage of development, the complete biodiversity database at ETI can be consulted on-line. ETI software is platform independent in that users of MacIntosh, Windows, and NeXT shall have access to the system. The central biodiversity database concerns a Sybase system.
Cooperation with ETI: ETI sets up scientific (taxonomic) networks (the ETI Partner Program) to gather biological data. With this data we build TOSes as well as fill the central Biodiversity Database of ETI. Collaborating institutes/scientists supply their own hardware and ETI will supply the ETI software for data entry and local database building. The data belong to both the collaborating institute (that input the data) and to ETI for general use in its main database and remain the property of science. Actually ETI exchanges software for data in order to be able to build up the central Biodiversity Database. It should be noted that ETI is not (and won't be) a commercial organization, but is a non-profit foundation supported by the Dutch Government, the University of Amsterdam, UNESCO, and the consortium of European Natural History Museums. Collaborating institutes/scientists will receive and may use the CD-ROM on their specific group free of charge, while third parties may purchase it for only the nominal fee of costs of production. The data are electronically copyrighted by ETI to be able to produce the CD-ROMS and make broad access to the main database possible. However, those that put in the data may always use their data for any purpose.
Data entry program: Linnaeus II. ETI has developed a general data entry program enabling participating scientists to build their own database as well as to transfer information to ETI. This program is presently available for MacIntosh, but shall operate also under Windows; it is made available for free to all participants.

Identification program: ETI has just finished the test version of its sophisticated computer identification program. This software package allows both the construction of a set of identification characters for groups of taxa and the performance of the actual identification process. The actual identification process is extremely fast and works on text characters, visual characteristics and sound characters



## 2. PALEOSPONGOLOGY

Dr **Françoise Debrenne**, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris, France:
"Archaeocyathan affinity: How deep can we go into the systematic affiliation of an extinct group?"

Dr **Paul Copper**, Laurentian University, Sudbury, Canada:
"Paleoecology of giant Late Ordovician cylindrical sponges from Anticosti, East Canada".

Prof. **Carl W. Stock**, University of Alabama, Tuscaloosa, U.S.A.:
"Stromatoporoid palaeobiogeography of the Eastern American Realm during the Lochkovian Age (Earlier Devonian)".

Dr **Ursula Rehfeld**, Institut für Paläontologie, Freie Universität Berlin, Germany:
"Development of spongiolitic limestones near the Bajocian/Bathonian boundary of N-Spain (Sierra de la Demanda, S-Cantabrian Mountains) and their bearing on other spongiolitic environments".

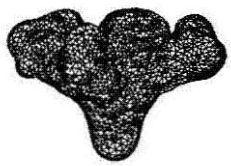
Dr **Andrzej Pisera**, Institute of Paleobiology, Polish Academy of Sciences, Warszawa, Poland:
"Siliceous sponges from the Middle Jurassic of the Mecsek Mountains (southern Hungary)".

Dr **Adam Bodzioch**, A. Mickiewicz University, Poznan, Poland:
"Paleoecology of Hexactinellid sponges from the epicontinental Triassic of Poland".

Dr **Manfred Krautter**, Institut f.Paläontologie, Stuttgart, Germany:
"Siliceous sponge facies from the Upper Jurassic of Iberia".

Dr **Joachim Reitner**, Institut f.Paläontologie, Freie Universität, Berlin:
"Skeletal formation in *Spirastrella (Acanthochaetetes) wellsi* (Demospongiae, Porifera)".

Dr **M.M. Ivanik**, Academy of Science, Kiev, Ukraine
"Paleogene sponge spicules from the Ukraine and their parataxonomic classification".



**Archaeocyathan affinity: how deep can we go into the systematic affiliation of an extinct group ?**

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Archaeocyatha, being one of the most important Cambrian groups of marine organisms, have a calcareous skeleton without spicules. Owing to the general external similarities of their skeletal remains with skeletons of various other organisms, archaeocyaths have been attributed for over a hundred years to protists, algae, sponges and cnidarians.They have also been distinguished as a separate phylum, or were even considered as a separate kingdom, both the Aphrosalpingids (sponges of thalamid grade) and Receptaculitids (possible algae).

The affinity of archaeocyaths with sponges was established by different authors since 1984 and based on in-depth considerations of the skeletal microstructures, functional morphology and evolutionary trends. The question remains, however, whether it is possible or not to fix the archaeocyath systematic position among sponges. Vacelet (1985) supposed that archaeocyaths are close to the Hexactinellida because of the complexity of their respective skeletons. We now suggest to consider the possible affinities of archaeocyaths with Demospongiae.

Archaeocyaths display several types of growth patterns: radial, thalamid and chaetetid. Archaeocyaths which possess a chaetetid growth pattern have a special intercalicle budding in addition to other archaeocyathan and poriferan forms of asexual reproduction. Such a budding resembles the development of buds in some calcified Demosponges and suggests the presence of cryptic storage cells in Archaeocyatha.

Immune responses of Archaeocyaths, which range from an almost complete indifference to severe damages and rejection, recall the immune behaviour of Demosponges.

Judging on the intercalicle budding together with specific immunity responses, some peculiar morphological structures, a special type of asexual reproduction and the lack of spicules, Archaeocyatha therefore possibly have close affinities with Demosponges.

**SPONG-IA: a rule-based expert system for the identification of north-atlanto-mediterranean sponges**

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The aim of this paper is to present an artificial intelligence device to help in the identification of marine sponges. SPONG-IA is a rule-based expert system, implemented in the context of the MILORD II programming environment. The basic structural unit of MILORD II expert system is the *module*, that encapsulates a set of knowledge units (*faxts, rules, meta-rules*) concerning the knowledge of the studied domain. A *knowledge base* is, then, understood as a set of such modules. Large and complex domains such as Porifera can be systematically approached and progressively covered with high accuracy by defining hierarchies of MILORD I modules. In our application, the module hierarchy matches the taxonomic hierarchy (where controversy of taxa exists, documentation of the adopted criterion is given). Another correlated hierarchy of modules involved only in control tasks performs the problem-solving that in our case is based on a simple classification strategy. So, the classification starts at the highest level in the taxonomical hierarchy (root module) and progressively follows down the more promising taxa (son modules). This separation between taxonomy and classification problem-solving would eventually permit the use of the problem-solving modular structure for the construction of knowledge bases concerning other biological domains.

## Earth's earliest Metazoan reefs

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Tommotian bioherms within tortuose Subzone argillaceous limestones of the Pestrotsvet Formation (southeastern Siberian Platform) are intergrowths of archaeocyaths and calcimicrobes in lime mudstone which was cemented early on the sea floor. Bioherms consist of mounds one half to two metres in diameter, occurring either singly or stacked together. The mounds can be categorised into component domains occupied by associations of lime mud, archaeocyaths, calcimicrobes (especially Renalcis) and cement, in order of abundance:

Association 1 - disoriented archaeocyaths + mud
2 - upright sticklike archaeocyaths + fibrous cement
3 - disoriented sticklike archaeocyaths + Renalcis
4 - disoriented archaeocyaths + fibrous cement
5 - oriented ramose archaeocyaths + mud
6 - archaeocyaths + stereoplasm + mud

Each mound is a conglomeration of domains of these associations, with no discernible pattern in their distribution. Renalcis and fibrous cement are the critical framework contributors - archaeocyaths by themselves rarely produce a framework, except where stereoplasm is abundant. Yet the archaeocyaths are necessary as a substrate for the Renalcis and cement.

Interbiohermal sediment is interbedded argillaceous limestone and calcareous siltstone, bearing trace fossils and small shelly fossils respectively. Peribiohermal sediment of intermediate composition immediately surrounds bioherms, extending 1-2 m outward. It is characterised by prostrate 'big stick' archaeocyaths and hyoliths.

With the possible exception of latest Proterozoic Cloudina occurrences, the Tommotian archaeocyathan-calcimicrobial bioherms represent Earth's earliest metazoan-mediated bioconstructions.

**Paleoecology of giant Late Ordovician cylindrical sponges from Anticosti, E. Canada**

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The most widespread and abundant stromatoporoids from the Ellis Bay Formation (Ashgill) of Anticosti Island are the aulacerids. They occurred in an offshore, tropical platform carbonate setting, in water depths estimated to have been at or below fairweather wave base. Aulacerids were most abundant on the eastern side of the island, and scarcer in the western outcrops c. 240 km away. At the eastern end of the outcrop belt, storm disturbed deposits include 'log jams' of aulacerids with broken 'trunks' up to 35 cm diameter and 1-2 m long. Aulacerids appear to have had a relatively dense and heavy aragonitic skeleton: several genera are represented on Anticosti, ranging from forms with a wide core of large cysts, surrounded by smaller cysts, to those having a concentric lamellar surface penetrated by pillars. Their external morphology varied from smooth, to undulose, to nodular or finely pustular species: astrorhizae have not been discovered. Their mode of life is enigmatic: they grew in a vertical position, since numerous broken attachment bases were found. The bases were usually concave, rarely conical, lacking any root-like or spreading attachment site. There is a strong evidence, consisting of nodular, concretionary growths around coenosteum bases, penetrated by penecomtemporaneous borings, that they remained upright with the technique of 'fence posting', i.e. reinforcement of their base by cementation processes in a carbonate substrate. Post-mortem encrustation of toppled aulacerids, by bryozoans, tabulate corals and crinoids, appears to indicate that growth stopped once the skeletons collapsed on the substrate.

**Stromatoporoid paleobiogeography of the Eastern Americas Realm during the Lochkovian Age (Early Devonian)**

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Early Devonian stromatoporoids occurred in two faunal realms, the Old World Realm and the Eastern Americas Realm. During the Lochkovian Age the Eastern Americas Realm included: 1) the Appalachian basin from Virginia to New York; 2) deposits upon exotic terranes in parts of Maine and New Brunswick; 3) northern Spain; and perhaps 4) Bathurst Island in Arctic Canada, where Lochkovian reefal blocks on the western edge of the Boothia Uplift are found in a Pragian matrix. The Lochkovian of New York contains two stromatoporoid-bearing units, the Manlius Formation, and the overlying Coeymans Formation. The Manlius is dominated by two species of *Habrostroma*, but the Coeymans contains a more diverse assemblage, including *Habrostroma*, *Parallelostroma*, *Coenostroma*, *Columnostroma*, and *Petridiostroma*(?). The more abundant of the two species of *Habrostroma* from New York is also found in the uppermost part of the Keyser Formation in Virginia. The Beck Pond Limestone of Maine contains mostly *Habrostroma*, *Coenostroma*, and *Columnostroma*. Only one species of *Columnostroma* is known from the Dalhousie Formation of New Brunswick, and one species of *Coenostroma*(?) has been reported from the Lebanza Formation of Spain. The Stuart Bay Formation of Bathurst Island contains species assigned to *Parallelostroma*, *Atopostroma*, *Gerronostroma*(?), *Syringostroma*, and *Syringostromella*, all of which bear some resemblance to specimens from the Beck Pond Limestone, and some of which are similar to the Coeymans Formations specimens; however, the Stuart Bay also contains species of *Actinodictyon*, *Belemnostroma*, and *Amnestostroma*, not found in the U.S. The difference between the Canadian Arctic assemblage, and those from the U.S. is most likely due to either a greater diversity of depositional environments available during Stuart Bay deposition, or to the geographic separation of the two areas at that time.

**Development of spongiolitic limestones near the Bajocian/Bathonian boundary of N-Spain (Sierra de la Demanda, S-Cantabrian Mountains) and their bearing on other spongiolitic environments**

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Spongiolites fringing especially the northern epicontinental margins of the Tethyan realm were widely distributed during Jurassic times. They may be regarded as an unique community of "reef" organisms that are mainly composed of sponges and microbial crusts which, in that particular composition and distribution, never construct buildups neither before nor after that time. For the first time spongiolites were reported from the Middle Liassic of Morocco, then spread during the Middle Jurassic (Spain and England) and reached their acme during Oxfordian and Kimmeridgian times (Spain, Southern Germany, Swiss and French Jura, Poland and Rumania).
Though Jurassic spongiolitic rocks are a familiar appearance little is known about conditions and requirements sponges needed to develop such extensive buildups.
Reasons for studying these structures are at least twofold:
1.There is very little or no knowledge from recent investigations what sponges feed on and
2.with respect to ancient environments the substrate on which sponges at first developed, either as biostromal meadows or as buildups, is hardly ever exposed and has not yet been sufficiently investigated yet.
The latter problem will be elucidated here in the discussion on Middle Jurassic spongiolites of N-Spain. Spongiolites mostly appear as biostromal layers with well defined subjacent beds on which they developed to near the Bajocian/Bathonian boundary. Superjacent to an alternate bedding of marls and limestones (the*humphriesianum*-zone) of possibly turbiditic origin (Schaaf, 1986), a condensed section of ammonitic limestones (the*subfurcatum*- to *parkinsoni*-zone) developed. These ammonite floatstones interfinger upwardly with onkoidal and/or tuberoidic wacke-packstones both laterally and vertically. In this very part of the succession the first sponge layers or patches appear composed of a very dense micritic limestone. Microfacies data of the Spanish sections will be presented and partly transferred to a better interpretation of the Upper Jurassic spongiolitic limestones especially of Southern Germany.

**Siliceous sponges from the Middle Jurassic of the Mecsek Mountains (southern Hungary)**

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The sponge fauna of the Middle Jurassic of the Mecsek Mountains is known for over 100 years since its first description by Pocta (1886). Pocta assigned his sponges to 5 hexactinellid genera, *Tremadictyon* (with two species), *Sporadopyle* (with as many as four species), *Verrucocoelia, Cypelia* and*Craticularia* (each with one species), and one demosponge lithistid genus *Hyalotragos.* Unfortunately, closer examination results in rejection of most of the determinations.

The newly investigated material comes mostly from the Obanya Limestone Formation developed as green to red nodular calcareous marls, up to 11 meters thick, which is Upper Bajocian - Bathonian in age. However, some sponges were also collected from the yellowish siliceous limestone from above Obanya Limestones which are Callovian in age.

The outer morphology of the sponges is well-preserved, while only a small fraction of the spicules can be observed. All spicules are calcitized and can be investigated in thin sections only. Despite this inconvenience one can estimate that a dozen species are represented, most of them being new. The assemblage is dominated by hexactinosan sponges; only few lychniscosan sponges and one lithistid demosponge have been identified. There are probably also some lyssakinosan forms as well.

This is the first known diversified sponge assemblage with bodily preserved sponges from "Ammonitico Rosso"-like facies and it is interpreted as a deep-water counterpart of the Middle-Upper Jurassic sponge assemblages widely distributed in epicontinental facies. This fauna contains also the oldest known (Upper Bajocian) lychniscosan (*Pachyteichisma*-like) sponge.

**Paleoecology of Hexactinellid sponges from the epicontinental Triassic of Poland**

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In the Muschelkalk of the Holy Cross Mts. and Upper Silesia, lyssacinosan sponges (*Hexactinoderma trammeri, H. wolicensis, H.* sp., *Silesiaspongia rimosa* and *Calycomorpha triasina*) occur. Sedimentological data show that particular species occupied settings of different turbulence, which corresponds to paleontological characteristics of each species. *H. trammeri* lived in most turbulent conditions, at tops of shoals composed of skeletal sand. These sponges possess virgate shapes, a thick wall, a rigid skeleton, "roots", and external layers built of large hexactines covering entirely canal openings. Other species of the genus *Hexactinoderma* lived in conditions of lower turbulence, at the flat bottom of a carbonate ramp. The structure of their skeletons is similar to *H. trammeri*, but their wall is thinner and they anchored to muddy substrata with loose diacts. *C. triasina* settled similar environments also attached to muddy substrata but with a stalk. Moreover, they have a small spongocoel and numerous long diacts protruding into the paragastral cavity, thus additionally diminishing its capacity. *S. rimosa* developed in conditions of lowermost turbulence, at the bottom of depressions between shoals settled by *H. trammeri*. Apart from a rigid skeleton, these flat-shaped sponges do not have any other features which could protect them against strong wave action.

Virgate-shaped sponges settled areas of higher energy than flat-shaped ones. This could be a protection against burial by a high amount of accidentally deposited sediment.

**Siliceous sponge facies from the Upper Jurassic of Iberia ***

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The Upper Jurassic European epicontinental sponge facies belt extends from Rumania to Portugal, including Poland, Southern Germany, Swiss and French Jura chains and eastern Spain. The Iberian occurrences exhibit very variable facies and are suited to establish a siliceous sponge facies classification which is thought to be useful for the interpretation of other occurrences as well. The classification presented here is based on occurrences of eastern Spain (Celtiberian and Prebetic zone) as well as of southern and central Portugal (eastern Algarve and Lusitanian Basin, resp.). The following facies types can be discriminated: (1) marly or calcareous siliceous sponge meadows, characterized by cup-shaped or platy dictyids or "lithistids", rarely both; (2) siliceous sponge/microbial crust-mudmounds of various dimensions, containing dictyid and "lithistid" sponges; (3) microbial thrombolites with occasional, mostly dictyid, sponges, almost mud-free; (4) microbial thrombolites with transitions from an accompanying siliceous sponge to coral fauna, occasionally with co-occurrence of both siliceous sponges and corals; (5) mixed coral/siliceous sponge biostromal and biohermal debris facies. The sponge fauna of 4 and 5 is dominated by "lithistid" and lychniskid sponges, corals are commonly dominated by microsolenids. All types occur both in Portugal and Spain. However, the dominant type in Spain is the meadow type, whereas thrombolithic types are most frequent in Portugal. Type 2 sponge mudmounds which are very widespread in the well known South German sponge facies are not frequent. Iberian sponge facies is related to distinct levels characterized by low sedimentation rate, which can be related to transgressive phases. Differences in sedimentation rate control the amount of crust formation and hence the development of meadows or mounds. Bathymetric gradients between the deeper siliceous sponge and the shallow coral facies can be established by analyzing distribution, diversity and functional morphology patterns of the reef biota. In Portugal, the often rapid transitions from siliceous sponge-rich to coral-rich facies can be partly explained by steep shelf slopes. Glauconite richness and the occurrence of dysaerobic bivalves (*Aulacomyella*) indicates that trophic and oxygen fluctuations represent another important factor for explaining the dominance of thrombolites and the

small-scale, partly repetitive transitions from crust-sponge to coral facies at certain levels. Such fluctuations can be again related to rapid sea-level rises (of third and lower order) and their effects on climatic nivellation.

* Contribution to the priority program of the German Research Foundation (DFG) "Global and regional controlling factors of biogenic sedimentation - Evolution of Reefs", Project Le 580/4.

## Skeletal Formation in *Spirastrella (Acanthochaetetes) wellsi* (Demospongiae, Porifera)

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*Spirastrella(Acanthochaetetes) wellsi* is a hadromerid sponge with a high-Mg calcite basal skeleton and a chaetetid organisation. This taxon is known since the lower Cretaceous.

The formation of the high-Mg calcite crystals takes place between the exopinacoderm and the uppermost part of the calcareous skeleton. Further calcification sites were observed on the bottom of the calicles where organic tabula become mineralized. These areas were detected by using different fluorochromes (UV-epifluorescence). This technique allowed to recognize a different staining behaviour of the calcareous skeleton due to the locations and amount of different organic compounds within the skeleton.

Hardpart microtome sections, TEM and SEM observations of these areas exhibit a concentration of large cells with a lot of spherical vacuoles (lcg-cells) filled with reserve material (sugars?). These cells are responsible for the secretion of thick collagenous fibers (CF). These CF are fixed on the growing surfaces of the calcareous skeleton and become entrapped during skeletal growth. The CF are the frame-building matrix (= insoluble matrix) of the skeleton.

Crystal nucleation happens only when the lcg-cells are present. Crystal growth and microstructural arrangements happen within an extracellular space filled with a mucus (soluble matrix) between the baso-pinacoderm and the mature calcareous skeleton. The extracellular crystal growth is in equilibrium with the surrounding seawater (delta 13C +3 for calcite).

Insoluble (IM) and soluble matrices (SM) were extracted from the calcareous skeleton for determination of their main features (molecular weights, charges, amino acids). The IM exhibits the collagenous nature as expected. The SM is a mixture of low-molecular weight acidic proteins (LMWAP) (aspartic-, glutamic-rich) and heavy-molecular weight glycoproteins (HMWGP). Within the youngest part of the skeleton a high amount of LMWAP and a lack of heavier molecules is observed. The older skeletal areas beyond the living tissue exhibit an increase of HMWGP.

The LMWAP within the active growing zones support the idea that these type of molecules are responsible for crystal nucleation by coating an IM (collagenic frame) and trapping divalent cations (Ca2+, Mg2+) forming an initial crystal plane (001).

## Paleogene sponge spicules from the Ukraine and their parataxonomic classification

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Isolated sponge spicules belonging to the Cornacuspongida, Tetraxonida and Triaxonida are widely distributed in Paleogene siliceous, carbonateless sediments. Sponge spicules are the only organic remains occurring in many Paleogene sediments of the East-European platform. However, the presence of only isolated sponge spicules in sedimentary rocks makes it almost imposssible to use them for stratigraphic subdivision. Therefore, the author developed a parataxonomic classification of the sponge spicules based on the overall morphology of the fossil sponge spicules found in the Paleogene sediments of the Ukraine. This parataxonomic classification deals with the analysis of the morphological characters and their range of variation, and reviews their hierarchy. Denominations of sponge spicules, both living and fossil, known from the literature were used as far as possible .According to this parataxonomic classification a morpho-phylum Spongiospicula is subdivided in two morphoclasses: Megasclera and Microsclera. In the morpho-class Megasclera the morpho-orders Monaxonida, Triaxonida, and Tetraxonida were distinguished. In the morphoclass Microsclera the following morpho-orders were distinguished: Asterida, Sigmatoida and Cheloida. The lower taxonomic units consist of: 17 morpho-families, 11 morpho-subfamilies, 69 morpho-genera, 169 morpho-species, 17 morpho-subspecies.
This parataxonomic classification allows:

1. To make a stratigraphical subdivision of the Ukraine siliceous sediments from the Lowermost Paleocene through to the upper Oligocene;
2. To distinguish characteristic sponge spicule assemblages;
3. To make a broad correlation of the Paleogene sediments of the East-European platform from the Volga region to the Carpathians and from the Baltic region to the Crimea.

## 3. BIOGEOGRAPHY

Prof. Dr **Gerald J. Bakus**, Allan Hancock Foundation, Los Angeles, U.S.A.:
"Species richness and dominance in marine sponges of Madang, Papua New Guinea".

Dr. **Ruth Desqueyroux-Faundez**, Muséum d'Histoire Naturelle, Genève, Switzerland:
"Biogeography of Chilean Marine Sponges (Porifera-Demospongiae)".

Dr **Chung-Ja Sim**, Han Nam University, Taejon, Korea:
"Sponges from Cheju Island in Korea".

Dr **John N.A. Hooper**, Queensland Museum, Brisbane, Australia:
"Biogeography of Indo-West Pacific sponges: Microcionidae, Raspailiidae, Axinellidae".

Dr **Rob W.M. van Soest**, Institute of Taxonomic Zoology, University of Amsterdam, The Netherlands:
"Demosponge distribution patterns".

**Species richness and dominance in marine sponges of Madang, Papua New Guinea**[1]

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Sixty-seven species of exposed macrofaunal sponges were collected from Madang, Papua New Guinea, during June-July 1989.
Approximately 55% of these are new to science. Dominance in *Xestospongia pacifica* is attributed to its toxicity and unpalatability to fishes. Comparisons are made between species rich northern Papua New Guinea (NPNG) and species poor northeastern Gulf of Alaska (NEGOA). Among the factors that may contribute to the high species richness of NPNG is the survival of the Tethyan fauna (from Late Jurassic) in refuges, the isolation of populations in marine basins and by land bridges of the East Indies during the Eocene to Pliocene periods, high physical heterogeneity of coral reefs and the evolution of species rich cryptobiota and infauna, and high intensity predation by fishes with the evolution of allelochemical defenses. Factors that are responsible for the low species richness of coastal NEGOA include disturbance by recent glaciation, exposure of intertidal organisms to subfreezing temperatures for half the year, sedimentation effects of fine silts and clays, and scouring by sediment and ice.

[1] Christensen Research Laboratory, Contribution No. 64

# Biogeography of Chilean Marine Sponges (Porifera: Demospongiae)

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Abstract

The DEMOSPONGIAE fauna constitute an important element of the Chilean coastal benthos. Some 200 species are recognised from Chilean continental coast of South America, oceanic islands (Isla de Pascua and Juan Fernández Archipelago) and Antarctic Chile. It is the purpose of the present work to discover whether these species demonstrate distinct geographic distribution patterns as found in different groups of invertebrates e.g. Mollusca (Stuardo, 1964), Echinoidea (Pawson, 1966) Bryozoa (Viviani, 1969, Moyano, 1991) for the Chilean coasts. The method used is Parsimony analysis of endemicicity (Rosen, 1988) which involves analysing a matrix of localities and species with a parsimony computer program, in this case PAUP (Swofford, 1985). The analysis yeldied the recognition of five discrete areas: Isla de Pascua, Juan Fernández Archipelago, North Chile north of 33°S, central Chile, 33°S-41°S and South Chile, south of 42°S, including Tierra del Fuego. The Chilean sponge areas were compared using the same method with adjacent sponge areas to the south and east (Antarctica and Fakland or Malvinas Islands). From this analysis appears that the central and Southern Chile areas form a unit and closer relationships appear with Antarctica and Falkland Islands.

Chilean oceanic islands, Isla de Pascua and Juan Fernández Archipelago, appear like isolated groups; their fauna is uncompletly known.

## Biogeography of Chilean Marine Sponges (Porifera: Demospongiae)

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The Demospongiae fauna constitutes an important element of the Chilean coastal benthos. Some 200 species are recognised from continental, oceanic islands and antarctic Chile. It is the purpose of the present work to discover whether these species demonstrate distinct geographic distribution patterns as found in different groups of invertebrates e.g. Bryozoa (see Moyano, 1992) for the coasts of Chile. The method used is Parsimony Analysis of Endemicity (Rosen, 1988), which involves analyzing a matrix of localities and species with a parsimony computer program, in this case PAUP (Swofford, 1985). The analysis yielded the recognition of six discrete areas: Isla de Pascua, Archipielago Juan Fernandez, North Chile north of 26°S (including neighbouring Peru), two areas in Middle Chile, 26-38°S and 38-46°S respectively, and South Chile south of 46°S (including Tierra del Fuego). The Chilean sponge areas were compared using the same method with adjacent sponge areas to the south and east (Antarctica and the Falkland or Malvinas Islands). From this analysis it appears that the South Chile area is more similar to the latter two areas, than to Middle Chile areas and the oceanic islands. This is in accordance with results for other marine invertebrate groups.

**Sponges from Cheju Island in Korea**

Chung-Ja Sim

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The present study on marine sponges is based on material from Cheju Island, Korea.
Cheju Island is located between latitude $33^0$ 06' 31'' to $34^0$ 00' 00'' and longitude $126^0$ 08' 43'' to $126^0$ 58' 20''. Cheju Island is characterized by volcanic activities from the late Tertiary to the early Quaternary.
Cheju island is affected by the Tsushima current, which is a branch of the Kuroshio warm current. This is a unique area compared with other coastal seas, such as the Sea of Japan and the Yellow Sea. Here thrives a rich fauna of marine invertebrates. A large number of sponges have been collected from Cheju Island. It becomes increasingly hard to collect more material, since this island undergoes a rapid development. I am urged to classify as many specimens as possible before the whole island will have become changed.
Dredge fishing and SCUBA were used to collect material. The number of identified sponges totals 151 species, 65 genera and 37 families. That is 80% of a total of 190 species of Korean sponges collected from three coastal seas, 87 species of which come exclusively from the island of Cheju and are not found in any of the other coastal seas of Korea.

## Biogeography of Indo-West Pacific sponges: Microcionidae, Raspailiidae, Axinellidae

John N.A. Hooper[1] & Claude Lévi[2]

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Preliminary biogeographical analysis of the New Caledonian sponge fauna (Lévi,1979)hypothesised that most of the shallow-water sponges in this region were probably 'widely distributed' tropical Indo-West Pacific species, with only a small proportion (< 20%) of endemic species, many with ancestral links to the Cretaceous of New Zealand. More recent studies on Poecilosclerida and 'Axinellida' in this fauna (Hooper & Lévi, 1993 a,b) found substantially greater levels of endemism in the shallow-water fauna than predicted (65% and 52%, resp.). Affinities of the New Caledonian fauna are examined in the context of the wider Indo-West Pacific fauna, using three families as case studies (Microcionidae, Raspailiidae and Axinellidae). Each family differed slightly in their precise affinities: Microcionidae are thought to be related to both the N. and S. Australian fauna and the N.New Zealand fauna (with 60% endemism for all species; 67% endemic shallow-water species; no endemic deeper-water species); shallow-water Raspailiidae were strictly related to N. Australia (both Dampierian and Solanderian provinces), whereas deeper-water species had both higher levels of endemism and more widely dispersed populations (Japan and W. Indian Ocean) (43%; 33%; 50%, resp.); the major affinities of the shallow-water Axinellidae was with the NE Australian and Indo-Malay provinces, including a truly 'widely distributed'Indo-Pacific species, *Axinella carteri* (Dendy), found throughout coral reefs of the W. and E. Indian Ocean, the Indo-West Pacific and the W. Pacific rim, whereas the deeper-water fauna contained both more endemic species and Indo-West Pacific species (53%; 67%; 67%, resp.). Other so-called 'cosmopolitan' species previously indicated for this fauna, were generally found to be allopatric, cryptic sibling species. For all families the non-endemic fauna represented the easternmost extent of species' distributions in the Indo-West Pacific; the endemic species were also usually immediately recognisable as (transformed) sister species from Australian and Indo-West Pacific provinces; and vicarance biogeographic analysis suggests that there has been previous genetic contact with both temperate and tropical Australian and N. New Zealand faunas, but gene flow is now apparently restricted to the tropical Australasian fauna alone.

## Demosponge distribution patterns

Rob W.M. van Soest

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A database containing a virtually complete set of distribution data of all recent Demosponges over a grid of 36 areas covering the coastal seas of the world yielded the following distribution patterns: Ordinal distributions are either cosmopolitan (all except five) or restricted to warm-tropical areas of all three oceans (Agelasida, Ceratoporellida, Desmophorida, Lithistida, and Verongida). Family distributions likewise are cosmopolitan excepting a few (Thrombidae, Coppatiidae, Timeidae, Hemiasterellidae, Chondrosiidae, Desmoxyidae, Callyspongiidae, Spongiidae, and the families belonging to above mentioned orders), and these are again mostly restricted to warm-tropical areas. Generic distributions, determined by tracing 217 genera with more or less unchallenged synapomorphies, fall into five major patterns (excepting 5.1 % unclassified genera): Cosmopolitan, i.e. occurring in all or most areas, without distinct centres of diversity : 6.5 %. Tethyan, i.e. occurring in all three oceans, with distinct tropical diversity centres, lacking or rare in cold water areas: 47.0 % Some further subdivisions of this pattern are apparent based on more wide-spread or more restricted distributions. Indo-Australian, i.e. restricted to the Indo-Pacific, with a distinct diversity centre in this area: 13.3 %. Further subdivisions of this pattern are apparent based on more wide-spread or more restricted distributions. Cold-water, i.e. with distinct diversity centres in colder waters, rare or lacking in the shallow-water tropics: 22.8 %. Three variants are apparent, based on restricted or disjunct patterns. Disjunct Atlantic-Australian, possibly an artefact : 4.6 % .The generic patterns are confirmed by a PAE (Rosen, 1988) analysis using absence, presence, and dominance as matrix entries. Species distributions: these are generally restricted to single areas or parts of them. Some wide-spread distributions form a pattern: Indo-West Pacific, Mediterranean-Atlantic, Central West Atlantic, Arctic-Boreal, Antarctic-Antiboreal. Many other more disjunct wide-spread distributions are suspect and need revision. General diversity pattern: high diversity centres are the Indo- Malayan area and the Caribbean, the Western Indian Ocean, Japan-China area, the Mediterranean and South Australia, all with species numbers exceeding 500. Most other larger areas have species numbers between 300 and 400; some smaller or less known areas have less.These patterns conform to those of other benthic marine groups. Areas that stand out as being poorly known are NE Australia, NW Atlantic, Pacific coasts of South America.

## 4. CELL BIOLOGY AND BIOCHEMISTRY

Dr **Elda Gaino**, Università di Genova, Italy:
"Various morphological aspects of dissociated sponge cells in relation to different biological substrata".

Dr. **Hazime Mizoguchi**, Rissho University, Saitama, Japan:
"Effect of 5-bromodeoxyuridine and aminopterin on cell proliferation and morphogenesis of the freshwater sponge *Ephydatia fluviatilis* ".

Dr **Robert Garrone**, Université Claude Bernard, Lyon, France:
"Molecular data on cytoskeletal proteins of freshwater sponges".

Prof. Dr **W.E.G. Müller**, Universität Mainz, Germany:
"Identification and characterization of an S-type lectin in the marine sponge *Geodia cydonium* ".

**Various morphological aspects of dissociated sponge cells in relation to different biological substrata**

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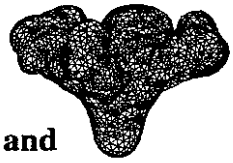
Dissociated sponge cells have often been utilized in order to obtain information on structural and molecular elements involved in cell locomotion, recognition and aggregation. Less attention has been paid to cell-to-substratum interactions, which may give insight into the cell's ability to transduce signals into its interior and to react through intracellular events.
The possible influence of the substratum on sponge-cell modulation was tested *in vitro* by studying the morphology of cells plated on substrata of differing compositions.
Firstly, cells were layered on organic substrata: laminin, collagen type I (both film and gel), and fibronectin. Such different experimental substrata induce modifications in the same cell type by eliciting qualitative and quantitative variations in its typical protrusions (scleropodia and lamellipodia).
The study went on to investigate cell behaviour in interaction with substrata of Poriferan source. Fibres of spongin and sponge collagen were used in this part of the experiment. Dissociated cells show a variety of cytoplasmic protrusions, but tend to conserve a rounded shape.
Differences in cell morphology reflect a stimulator effect of the substrata, suggesting cytoskeletal-matrix interactions and thereby affecting the mechanics of movement. Cell migration and differentiative state modulation are essential to assuring the dynamic body plan in sponges, which are characterized by continuous remodeling processes.



**Effect of 5-bromodeoxyuridine and aminopterin on cell proliferation and morphogenesis of the freshwater sponge *Ephydatia fluviatilis***

Hazime Mizoguchi[1] & Yoko Watanabe[2]

[1] Laboratory of Biology, Junior College of Rissho University, 1700, Magechi, Kumagaya-City, Saitama, 360-01, Japan. Telephone: 0485-36-3998 Ext.1385, fax: 0485-36-2522.

[2] Department of Biology, Ochanomizu University, 2-1-1, Otsuka, Bunkyo-Ku, Tokyo, 112, Japan. Telephone: 03-3943-3151 Ext.576
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Aminopterin , an inhibitor of tetrahydrofolate dehydrogenase, is known to decrease a level of dTTP. In the freshwater sponge *Ephydatia fluviatilis*, reared with 25 µg/ml aminopterin from the time of gemmule incubation, basopinacocyte spreading and inhibition of the formation of aquiferous system were observed. The effect of aminopterin on morphogenesis was dose dependent. Another addition of excess thymidine to the gemmule culture containing aminopterin allowed them to develop normally. Treatment of the gemmule with 2.0 mM of 5-bromodeoxyuridine (BrdU), an analogue of thymidine,when started just after gemmule incubation, resulted in spreading of basopinacocytes and inhibition of the formation of choanocyte chambers. BrdU-caused inhibition of choanocyte chamber formation was canceled by excess thymidine. Effect of BrdU on morphogenesis was also dose dependent. Based on these results, a cell proliferation study was performed to clarify the cellular mechanism of the morphogenesis of a freshwater sponge during development. Quantitative measurements of cell proliferation were done following BrdU (0.1 mM) labelling, assayed by immunocytochemistry using monoclonal antibodies against BrdU and streptavidin-biotin-peroxidase of FITC labeled anti-IgG antibody. At a concentration of 0.1 mM of BrdU, no harmful effects on cell proliferation and morphogenesis were observed. Detection of S phase cells was possible by this method. S phase cells were found at spreading basopinacocytes and archaeocytes in the control sponge. The relative number of S phase cells was decreased in aminopterin of BrdU treated gemmules. It seems that inhibition of the formation of the aquiferous systems by treatment of aminopterin or BrdU was due to interference of the progress of cell cycles during development.

**Molecular data on cytoskeletal proteins of freshwater sponges**

Patricia Ducy & Robert Garrone

Institute of Biology and Chemistry of proteins, CNRS and University Claude Bernard,
7, Passage du Vercors, 69367 Lyon Cedex 07, France

We have investigated the freshwater sponge *Ephydatia muelleri* in order to characterize actin and its related coding genes.

The genomic Southern blot, using an heterologous probe (cytoplasmic gene A3 from *Bombyx mori*), indicated that *E. muelleri* has probably more than 8 sequences related to actin in its genome.

By screening a cDNA library of *E. muelleri* RNA has RNAs at 3 days of culture with the *B. mori* probe, we have isolated an 1.2 kb clone (EMA 1). It corresponds to a 3' segment of an actin probe, mRNA, including a coding sequence from amino acid 73 to stop codon and the entire 3' untranslated region. Comparisons of this putative translated sequence with amino acid sequences of vertebrate actin isoforms showed at least 96% of homology and 2 amino acid changes not yet described.

Then, EMA1 insert and EMA1 3' UTR specific synthetic oligonucleotide have been used as probes for Northern blots on total RNA extracted from sponges at early stages of development. At each of the stages, only one signal at 1.4 kb had been detected with the two probes, but its intensity is dramatically increased during the first stages.

Actin from sponges at 6 days of culture was further isolated by affinity chromatography on DNase I-Sepharose. After two-dimensional gel electrophoresis and identification on immunoblots by an anti-actin monoclonal antibody, we detected at this stage three major isoforms of actin (A2, A3, A4) and two minor species (A1, A5). By *in vitro* experiments on total RNAs at gradual stages of development, we have observed that only A4 is expressed before hatching, whereas A5 and A3 become evidend after 3 and 4 days of culture, respectively . Because EMA1 specific oligonucleotide probe reacts positively on Northern blot with total RNAs from gemmule stage, we have concluded that the A4 isoform is encoded by mRNA corresponding to EMA1.

**Identification and characterization of an S-type lectin in the marine sponge *Geodia cydonium***

Werner E.G. Müller[1], Durdica Ugarkovic[2], Hagen Bretting[3] & Karin Pfeifer[1]

[1] Institut für Physiologische Chemie, Universität, Duesbergweg 6, D-6500 Mainz, Germany.
Telephone: +6131-395910, fax: +6131-395243.

[2] Institute Ruder Boskovic, Center for Organic Chemistry and Biochemistry, 41001 Zagreb, Croatia.

[3] Zoologisches Institut, Universität Hamburg, D-2000 Hamburg, Germany.

Vertebrate lectins are categorized on the basis of their functional and structural characteristics to the "C-type" lectins, which are $Ca^{2+}$-dependent and contain a long binding domain of 130 amino acids. Members of the second group comprise "S-type" lectins and the third group is represented by lectins differing from C- and S-type lectins with respect to the conserved residues. The vertebrate S-type lectins are active in the absence of $Ca^{2+}$.
Previously we have isolated a galactose/lactose-specific lectin from the marine sponge *Geodia cydonium* which is present extracellularly. It consists of three subunits with mol. wt. of 11.8 - 15 kDa. The lectin acts in the absence of $Ca^{2+}$ as a mitogen in t he homologous *G. cydonium* system. In the presence of $Ca^{2+}$ the *G. cydonium* lectin undergoes a conformational change and "polymerizes". In this conformation the lectin functions as a cell-matrix adhesion molecule by binding to the cell membrane-bound lectin receptor . Now we report the complete nucleotide and partial amino acid sequence of the *G. cydonium* lectin. Analysis of the sequence shows that the sponge lectin belongs to the S-type lectins and demonstrates for the first time the presence of this type of lectins in invertebrates.

## 5. NATURAL PRODUCTS WORKSHOP

Prof. **M. Garson** , University of Queensland, St. Lucia, Australia:
"Biosynthesis of sponge secondary metabolites and why it is important" (invited).

Prof. **D. John Faulkner**, Scripps Institution of Oceanography, La Jolla, U.S.A.:
New metabolites from *Dysidea herbacea* and their cellular localization ?".

Dr **Shirley A. Pomponi**, Harbor Branch Oceanographic Institute, Fort Pierce, U.S.A.:
"Sponge cell culture for production of bioactive metabolites".

Dr **D. Daloze**, Université Libre, Brussels, Belgium:
"Separation techniques: Application to isolation of sponge metabolites" (invited).

Prof. **Nobuhiro Fusetani**, University of Tokyo, Japan:
"Theostatins, highly cytotoxic polypeptides from the marine sponge *Theonella swinhoei* ".

Dr **Phil Crews**, University of California at Santa Cruz, U.S.A.:
"Are sponge microbial associants a source of secondary metabolites ?".

Prof. **Guido Sodano**, Università di Salerno, Italy:
"Transfer of secondary metabolites to predators" (invited).

Dr **Raymond J. Andersen**, University of British Columbia, Vancouver, Canada:
"Novel terpenoid metabolites from the Northeastern Pacific Nudibranch *Cadlina luteomarginata* and three sponges in its diet".

Dr **Christopher N. Battershill**, New Zealand Oceanographic Institute, Wellington, New Zealand
"The chemical ecology of polar, temperate and tropical sponges".

Dr **Murray H. Munro**, University of Canterbury, Christchurch, New Zealand:
"From Seabed to Sickbed" (invited).

MSc **Peter Willemsen**, TNO Coatings, Den Helder, The Netherlands:
"Anti-fouling compounds from sponges".

Dr **Francis J. Schmitz**, University of Oklahoma, Norman, U.S.A.:
"Cytotoxic compounds from sponges and from their associated microfauna" (invited).

## New Metabolites from *Dysidea herbacea* and their cellular localization?

D. John Faulkner & Mia D. Unson

Scripps Institution of Oceanography, University of California, San Diego
La Jolla, CA 92093-0212, U.S.A.
Telephone: 619-534-4259, fax: 619-534-2997.

Circumstantial evidence suggests that some metabolites isolated from marine sponges may be produced by symbiotic micro-organisms. The most frequently cited evidence is that a "sponge" compound is identical or similar to one found in a micro-organism or that compounds produced by unrelated invertebrates, often from different phyla, must have a common biosynthetic source such as a symbiont. However, there is little experimental evidence to support these hypotheses. The situation is further complicated because sponges are filter feeders and may concentrate metabolites from dietary sources or even from epibionts. In order to examine the role of symbionts in the production of "sponge" metabolites we chose to examine specimens of *Dysidea herbacea*, for which a symbiotic relationship had been clearly defined.

The sponge *Dysidea herbacea* Keller (order Dictyoceratida, family Dysideidae) is a common shallow-water sponge of the Indo-Pacific. Previous chemical studies of *D. herbacea* had resulted in the isolation of three classes of secondary metabolites: furano-sesquiterpenes, polybrominated diphenyl ethers, and polychlorinated amino-acid derivatives. We isolated several new polychlorinated amino-acid derivatives from *D. herbacea* specimens collected in Palau and Pohnpei. All new compounds were identified by spectroscopic methods and the absolute configurations were determined by X-ray crystallography, performed by J. Clardy at Cornell University. Some known furano-sesquiterpenes co-occurred with the polychlorinated amino-acid derivatives.

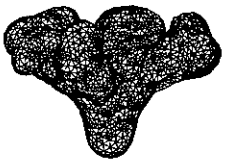
*Dysidea herbacea* contains a filamentous multicellular blue-green algal symbiont identified on the basis of ultrastructural studies as *Oscillatoria spongeliae* (Schulze) Hauck. Some of the polychlorinated amino-acid derivatives from *D. herbacea* are considered to resemble compounds from the marine blue-green alga *Lyngbya majuscula*. It was therefore suggested that the polychlorinated metabolites are produced by the blue-green algal cells and the sesquiterpenes by the sponge cells. Analysis of the chemical contents of algal and sponge cells that were separated by cell cytometry supported this hypothesis.

**Sponge cell culture for production of bioactive metabolites**

Shirley A. Pomponi & Robin Willoughby

Harbor Branch Oceanographic Institution, Inc., 5600 U.S.1 North, Fort Pierce, Florida 34936, USA

Primary cultures of several species of shallow water marine sponges have been initiated to determine the feasibility of cell culture for bulk production of bioactive secondary metabolites. Selective cell enrichment and determination of cell-type specific localization of bioactive metabolites are accomplished by density gradient separation and chromatographic analyses of cell fractions. Microbial contamination has been controlled through the use of antibiotics; analysis of dose-response curves for inhibition of microbial contamination and effect on sponge cell viability has resulted in establishment of optimal antibiotic concentrations for culture initiation and maintenance. Culture optimization studies to enhance biomass and/or metabolite production are in progress. The effects of growth factors, variations in nutrients and physical culture parameters (e.g., light, temperature, pH) on increase in cell number, production of secondary metabolites, and metabolic processes are monitored by direct cell counts, chromatographic techniques, and flow cytometric analyses of cell constituents and functions (e.g., DNA, RNA, protein synthesis, mitochondrial activity, membrane potential, intracellular pH, calcium concentration, and lysosomal activity). Results to date indicate that doubling times can be significantly reduced in response to mitogens, and cells will continue to produce secondary metabolites in culture. These results suggest that sponge cell culture may be feasible for bulk production of bioactive secondary metabolites.



**Establishment of long-term cell cultures from marine sponges**

Michelle Klautau, Márcio R. Custódio & Radovan Borojevic

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We have established long-term cell cultures from *Clathrina aurea, Polymastia janeirensis, Mycale microsigmatosa* and *Chondrilla sp.* Cultures were started from mechanically-obtained cell suspensions, maintained in low density, in sterile sea water, supplemented during the first two weeks with antibiotics. Cells were fed with heat-killed bacteria; they could not be maintained in standard liquid nutrient culture media. All the cells expressed the stable amebocyte phenotype, without differentiation into choanocytes nor spiculogenesis. Cells had a stable proliferation rate, that could be increased by addition of dibutyryl-cAMP into the culture medium. They incorporated radiolabeled thymidine from the medium, in ratio lower than that observed for mammalian cells. They controlled the culture density through soluble factor(s), that inhibited proliferation and maintained cultures in the stationary phase of growth, independently of cell-cell contact and before reaching the confluence. Cells moved actively in culture; although they could temporarily assemble into small groups, they did not differentiate into multicellular tissue-like structures. Comparative study of isoenzymes obtained from the original sponge tissue (*C. aurea*) and the cultured cells has shown the identity of electrophoretic migration for acid phosphatase and glucose isomerase, and divergence for A-esterase. Sponge cell cultures may be used now to study early steps of metabolic and structural integration in the evolution of multicellular organization.

**Theostatins, Highly Cytotoxic Polypeptides from the Marine Sponge *Theonella swinhoei***

T. Hamada, T. Sugawara, S. Matsunaga & N. Fusetani

Laboratory of Marine Biochemistry, Faculty of Agriculture University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113, Japan.
Telephone: 813-3812-2111, fax: 813-5684-0622.

The marine sponge *Theonella swinhoei*, collected off Hachijo-jima Island, 300 km south of Tokyo, has proved to be extremely productive; we have isolated from this particular sponge a variety of bioactive metabolites including theopederins, onnamides, cyclotheonamides, nazumamide A, orbiculamide A, and aurantodes. We also found highly cytotoxic substances in the non-polar fraction of the ethanol extract of the sponge. Bioassay-guided isolation afforded three active compounds named theostatins A - C.

The $Et_2O$ soluble materials of the EtOH extract were fractionated by ODS flash chromatography. The $CHCl_3$-MeOH (1:1) eluate was further purified by gel filtration and repeated reversed phase HPLC to yield theostatins A - C.

The major theostatin A was cytotoxic against L1210 with an $IC_{50}$ <4 ng/mL. Its molecular weight was estimated to be as high as 5100 by the ESI-MS spectrum. Upon standard acid hydrolysis theostatin A released Ala, Asp, Glu, Gly, Ile, *tL*eu, Ser, Thr, Val, and b-hydroxy Val, along with $MeNH_2$. Extensive analyses of 2D NMR including HOHAHA, HMQC, and HMBC confirmed the presence of not only these amino acids, but also of some unusual amino acids. Chiral GC/MS analysis of the acid hydrolyzates revealed the stereochemistry of usual amino acids and the presence of D-*a*Thr.

Identification of unknown amino acids (or unknown lipophilic moieties) as well as sequencing of amino acids are in progress by means of spectroscopic and chemical methods.

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**Are Sponge Microbial Associants a Source of Secondary Metabolites ?**

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Many clinically effective agents including antibiotics (e.g. clarithromycin and other members of the erythromycin family) and anticancer agents (e.g. mithramycin, bleomycin, doxorubicin) have been obtained from terrestrial fungal cultures. By contrast, little is known about the fundamentals of marine fungi bioorganic chemistry. The possibility that sponge derived fungi could be a source of secondary metabolites is one that is intriguing to us.

There is only one recorded case in the literature of fungi being cultured from marine sponges. Interestingly, there are no natural products reported from marine sponge-derived fungi, and the overall information base of marine fungal natural products is meager and includes less than a dozen metabolites. The structures of this small collection of metabolites is quite varied and includes terpenoids, polyketides, polypeptides and complex alkaloids. We have obtained preliminary results which are both positive and encouraging and include (a) establishing a library of more than 56 fungi from marine sponges, and (b) scale-up broth culture of one sponge-derived fungus has yielded new and known members of a natural products class reported to have both antibiotic and cytotoxic properties.

## Transfer of sponge secondary metabolites to predators

Guido Cimino[1] & Guido Sodano[2]

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[2] Dipartimento di Fisica, Università di Salerno, 84081 Baronissi (SA), Italy.

The best studied sponge predators are the opistobranch molluscs, chiefly the nudibranchs. The interest in this topic originates from the now widely accepted view that the nudibranchs have developed during their evolution the ability of defending themselves by using chemicals either derived from the diet or biosynthesized de novo [1-5]. However, the majority of the defensive substances so far isolated from nudibranchs comes from predation on sponges and bioassays have been used in order to demonstrate the efficacy of the defense compounds as toxins or antifeedants. The comparative examination of secondary metabolites of predators-prey pairs provides evidence that most of the nudibranchs are very specialized predators. In some instances it has been reported that the molluscs are able to selectively concentrate sponge metabolites and, in few cases, of modifying them.

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[2] Karuso, P. (1987) "Chemical ecology of the nudibranchs". In: Scheuer, P.J. (ed.) Bioorganic Marine Chemistry (vol. 1), Springer-Verlag,New York, p.31.

[3] Faulkner, D.J. (1988) "Feeding deterrents in molluscs". In: Fautin, D.G. (ed.) Biomedical Importance of Martine Organisms, California Academy of Sciences, p. 29.

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[5] Cimino, G. and Sodano, G. "Biosynthesis of secondary metabolites in marine molluscs:. In: Scheuer, P.J. (ed.) Marine Natural Products - Diversity and Biosynthesis, Springer-Verlag Current Topics in Chemistry Series, in press.

**Novel terpenoid metabolites from the Northeastern Pacific Nudibranch *Cadlina luteomarginata* and three sponges in its diet**

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The dorid nudibranch *Cadlina luteomarginata* is commonly encountered in subtidal and intertidal habitats all along the west coast of North America. *C. luteomarginata* feeds on a wide variety of sponges and it sequesters secondary metabolites from its prey to use for its own defensive purposes. Over thirty terpenoid metabolites have been isolated from *C. luteomarginata* skin extracts and a number represent the first examples of new carbon skeletons. One of the most striking features of *C. luteomarginata* skin chemistry is the dramatic variation in metabolite content with the location of the collecting site, reflecting the change in sponge diet with location. We have investigated the geographical variation in the chemistry of *C. luteomarginata* and the chemistry of the sponges in its diet. The structures of several novel terpenoids isolated from *C. luteomarginata* will be presented. These will include albicanyl di- and tri- acetates, two new sesquiterpenoids which were found in the nudibranch's egg masses, and cadlinaldehyde, a twenty one carbon terpenoid with a new carbon skeleton. The chemistry of three dietary sponges, *Aplysilla glacialis*, an undescribed *Acanthella* sp. and an undescribed *Pleraplysilla* sp. will also be presented. Extracts of *Acanthella* sp. yielded a rich mixture of sesquiterpenoids containing chloride, isonitrile, formamide, isothiocyanate and isocyanate functionalities, as well as substantial concentrations of violacene, a metabolite of the red alga *Plocamium* sp. Extracts of the *Pleraplysilla* sp. yielded a new 9,11-secosteroid and a family of oxidized sesquiterpenoids, while *A. glacialis* extracts were the source of a variety of diterpenoids and 9,11-secosteroids. The discussion will focus on the relationship between the nudibranch skin chemistry and the chemistry of its sponge diet and it will illustrate how a non-selective sponge feeding nudibranch like *C. luteomarginta* can be a useful probe to obtain information about the chemistry of the sponges in its diet that might not be available by direct study of the sponges.

## The chemical ecology of polar, temperate and tropical sponges

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The role of bioactive metabolites elicited by sponges from Antarctic, temperate and tropical reef communities was examined *in situ* using both quantitative ecological survey techniques and experimentation. Particular attention was placed on those species which generated compounds exhibiting anti-viral or anti-tumour activity. By examination results from studies carried out on benthic communities from locations spanning over 60° of latitude, a number of unique comparisons may be made which allow generation of hypotheses pertaining to the use of such chemicals in nature. This has allowed for a significance advance in determining the ecological role of such compounds. It is also proposed that with this information, we are better able to optimise our search procedures for new chemical leads from marine invertebrates, and are well placed to develop culture and enhancement techniques for increasing biomass of those organisms which produce chemicals with pharmaceutical or industrial application.

The presence or absence of bioactive metabolites in sponges and more importantly the mode of activity of these compounds was found to be highly correlated to microenvironmental biological and physical conditions influencing each sponge individual. Similar biological activities were demonstrated by metabolites from sponges found in equivalent ecological conditions, or with similar morphology, irrespective of extremes in latitudinal location of the sponges examined. Different ecological roles are proposed for metabolites eliciting different types of activity. These hypotheses were developed by examining the occurrence of bioactive metabolites producing species on a range of reefs and contrasting the associated physical and community differences between polar, temperate and tropical environments. *In situ* and laboratory experiments designed to test these hypotheses resulted in identification of two prime modes of bioactive response which equate to quite distinct defensive roles; in response to cellular challenge, and to deter predation.

**Antifouling compounds from sponges: a bio-assay guided purification - Preliminary results**

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Antifouling coatings based on organotin compounds pose a severe world-wide threat to the environment and due to growing restrictions there is a need for environmentally safer antifouling systems.
Sponges and other marine organisms seem to prevent overgrowth by producing metabolites with antifouling properties. TNO is working on the development of environmentally safe, antifouling systems by using compounds from sponges and is setting up a bio-assay guided purification program of sponge extracts using a settlement assay with cypris larvae of the barnacle *Balanus amphitrite* .
Forty-three sponges were collected around Curaçao in the Caribbean and preliminary settlement assays were performed with the crude ethylacetate extracts of the first six sponges. Extracts of three sponges (*Iotrochota birotulata, Ectyoplasia ferox* and *Callyspongia plicifera* ) inhibited and of one sponge (*Niphates erecta* ) facilitated larval settlement. Extract solutions of *Xestospongia muta* did not significantly influence larval attachment. These results give an initial indication of the potential antifouling activity of sponge extracts.

## 6. POSTER SESSION A: ECOLOGY AND SYSTEMATICS

Msc **Lisanne A.M. Aerts**, Santa Marta, Colombia/University of Amsterdam, The Netherlands:
"The functional role of sponge-coral interactions in stressed reef communities in NE Colombia"

Dr **Dagmar Barthel**, Institut für Meereskunde, Kiel, Germany:
"The boring sponge *Cliona vastifica* in a subarctic population of *Chlamys islandica*".

MSc **Cristina Díaz**, UCSC, Santa Cruz, U.S.A.:
"The Plakinidae: a systematic review".

MSc **Freerk Hiemstra**, Institute of Taxonomic Zoology, University of Amsterdam, The Netherlands:
"Post Oligocene radiation of tropical sponge genera".

MSc **Margriet Kielman**, Santa Marta , Colombia /University of Amsterdam, The Netherlands:
"Reef communities along the NE coast of Colombia and Curaçao related to abiotic circumstances".

MSc **Mario De Kluijver**, Institute of Taxonomic Zoology, University of Amsterdam, The Netherlands:
"Distribution of NE European shallow water sponges".

Dr **Manfred Krautter,** Institut für Paläontologie, Stuttgart, Germany:
"Observations on *Eudea cribraria* (Fromentel), Calcarea."

Dr **Henry M. Reiswig**, Redpath Museum Montreal, Canada:
"A new collection prompts the return of *Leptophragmella* (Craticulariidae) to *Chonelasma* (Euretidae (Hexactinellida)".

Dr **Joachim Reitner**, Freie Universität Berlin, Germany:
"Sponge communities of the Arctic Vesteris Banken Seamount (NE Greenland sea). RV "Polarstern" Expedition ARK VII/1, 1990"

Dr **Joachim Reitner**, Freie Universität Berlin, Germany:
"Sponges from the Tommotian (Lowermost Cambrian) of China (N-Hunan). An access to the early beginning of sponge history".

MSc **Dolors Rosell,** CEAB, Blanes, Spain:
"Inter- and intraspecific relationships of the burrowing patterns of two clionid sponges".

MSc **Christine Schönberg**, Institut für Meereskunde, Kiel, Germany:
"*Halichondria panicea* Pallas: Seasonality of spicule development"

Dr **Rob van Soest**, University of Amsterdam, The Netherlands:
"Distribution of phototrophic sponges in the Seychelles"

Dr **Ole S. Tendal**, Zoologisk Museum Copenhagen, Denmark
"Calcareous sponges in the abyssal Greenland, Norwegian and Iceland Seas".

Dr **Maria-Jesus Uriz**, CEAB, Blanes, Spain :
"Chemical and structural defenses vs growth and regeneration in encrusting sponges: *Crambe crambe* (Poecilosclerida) and *Scopalina lophyropoda* (?Halichondrida)".

MSc **Ursula Witte**, Institut für Meereskunde, Kiel, Germany:
"Reproduction of *Halichondria panicea* (Pallas) in the Kiel Bight".

**The functional role of sponge-coral interactions in stressed reef communities in NE Colombia.**

L.A.M. Aerts

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The hard substrate communities in the Santa Marta area, NE Colombia are reefs under abiotic stress, coping with seasonally low temperatures and high sediment load. This results even at low depths in a low coral cover and relatively high sponge cover (Kielman, in prep.). In well developed reefs, at optimal depths (0-30 m) sponges occur in numbers far inferior to corals. Many authors demonstrated individual sponges to have allelopathic effects on corals (Jackson & Buss, 1975; Sullivan et al., 1983); Porter & Targett, 1988). Possibly sponges actively conquer and maintain their position on the substrate vacated by the death of corals. There are indications that aggressive interactions between sponges and corals may increase and end in more success for sponges when there is abiotic stress on reefs (Bryan, 1973). But so far no direct evidence exists whether this phenomenon plays an important role at community level.

It is the purpose of this study to quantify the occurrence of sponge coral interactions in a gradient of increased abiotic stress in order to determine its role in structuring coral reefs communities. Sponge-coral interactions are quantified by means of a quadrant of 1 $m^2$ which is placed along a line transect at a certain depth. At 5 localities along the Santa Marta coast and on three depths the number of times a sponge grows within 5 cm of a coral is counted (after Porter & Targett, 1988) and the interacting species are identified. Furthermore are noted: the nature of the interactions (avoidance, overgrowth, necrosis and no (visible) interaction), the coral outline available for sponge interactions, total pieces of corals and sponges, % cover of all sponges and of all corals and the % cover of sand, rubble and bare hard substrate. Also the abiotic parameters sedimentation, temperature, light and current velocity are measured at each locality and depth.

At this moment 150 m2 has been sampled in which 1253 interactions are found. The frequency of occurrence of different kind of interactions are shown in figure 1.

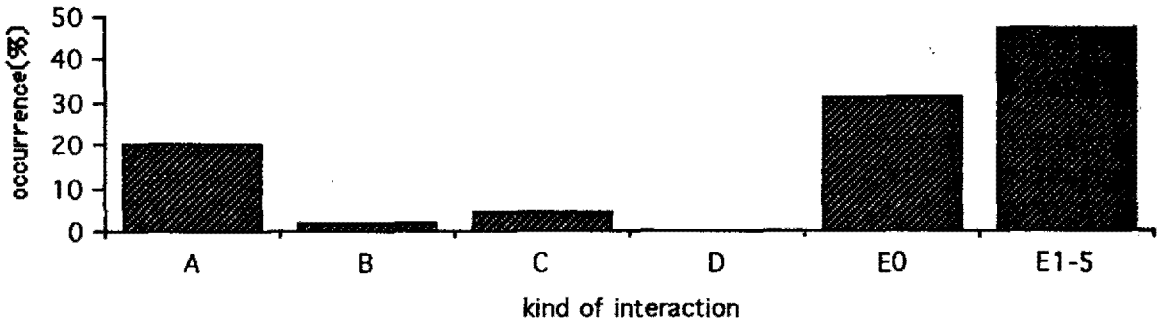


Figure 1: The frequency of occurrence of different kind of interactions.
A = avoidance, B = overgrowth, with coraltissue still living, C = overgrowth with dead coral tissue, D = necrosis and E = no visible interaction, the figures indicate the distance between the coral and the sponge in cm.

Besides quantification of sponge-coral interaction the abiotic factors sedimentation, light, temperature and water movement will be measured. Also permanent observation and experiments will be done. The same subjects will also be studied at the reefs of Curaçao in order to compare the stressed reefs of Colombia with the well developed reefs of Curaçao.

## The boring sponge *Cliona vastifica* in a subarctic population of *Chlamys islandica*

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The investigation was performed on a population of the edible icelandic clam *Chlamys islandica* in the subarctic Balsfjord, Tromsö, northern Norway. Several hundred *Chlamys* specimens were collected and fresh weight of the soft parts and dry weight of the shell, height of the shell, age of the animal and number of holes bored into each valve were determined. The population was found to be heavily infected by the boring sponge *Cliona vastifica* Hancock. Nearly 90% of all clams had borings in their shells. Only specimens with an age of 3 years and less and a shell height of 35 mm or less did not show any signs of infection. 100% of clams aged 16 years or more carry *C. vastifica* in their shells. The average degree of infection as judged by the number of borings in the shell increases with age. However, multiple component analysis of the relation of number of borings to both clam body mass and shell weight at certain shell sizes indicates that *C. vastifica* does not impair the development of its host clams.

**The Plakinidae: a systematic review**

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The finding of an encrusting sponge bearing *Plakortis* - like triods and diods, and a complementary spiculation of amphiaster-like microscleres, lead us to a puzzling question: is this species a Plakinid with an unusual microsclere complement or a Choristid-Pachastrellidae lacking the characteristic megasclere spiculation ? To approach this problem, it was necessary to evaluate first the Plakinid generic diagnoses in an attempt to reconcile incongruencies between the characters (e.g. possession of spicule size classes and microscleres) cited for the family and its genera.

Of nine currently recognized Plakinid genera two are synonymized and two are removed to Choristid families leaving five valid genera: *Plakortis, Plakina, Plakinastrella* (with junior synonym *Dercitopsis* ), *Placinolopha* (with junior synonym *Diactinolopha* ), and *Corticium* ; *Astroplakina* and *Corticellopsis* are considered incertae sedis because they have true euasters. The possession of size categories of diods or derivates and/or a complementary spiculation (e.g. lophocalthrops and candelabra) are found to be consistent generic diagnostic characters. The possession of diactinal microscleres (microrhabds and streptoscleres) is found to vary inside a genus (e.g. microrhabds in *Plakortis lita* ), thus this is considered a useful character for species recognition.

Preliminary comparisons of choanocyte chamber morphology of some Plakinid genera seem to indicate that the aquiferous system could yield useful generic diagnostic characters.

The morphology and biogeography of the species of *Plakortis* is studied and a new species of that genus is described. Several *Plakortis* spp. seem to have a cosmopolitan distribution. The validity of this observation awaits corroboration by embryological or genetic studies. Several possible phylogenetic relationships between the Homosclerophorida and other Demospongiae groups are discussed.

**Post Oligocene radiation of tropical sponge genera**

Freerk Hiemstra

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Of the different areas that made up the former circum-tropical Tethys sea, the Indo-West Pacific contains the greatest diversity of shallow water organisms. This can be explained with the general area-species diversity relationship (MacArthur & Wilson). For sponges this is the normal pattern, too. However some genera of reef sponges show a greater diversity in the much smaller Caribbean region. It is thought that a massive Neogene extinction event, followed by new radiation out of the few surviving genera, has caused this pattern.In order to find out whether this has been the case, attempts were made to discover whether the West Indian species are closer related to each other (share one or more synapomorphic characters), than their Indo-West Pacific counterparts. The genera *Agelas* (Agelasidae, Agelasida) and *Aplysina* (Aplysinidae, Verongida) were analysed cladistically. Both genera exhibit a Caribbean cluster of species, in fact *Aplysina* seems to be confined to the New World tropics, except for one Mediterranean-Atlantic species. All other described *Aplysina*'s of the Old World must be regarded as *Pseudoceratina*. Close to *Aplysina*, and taken within the analysis is the genus *Verongula*, which is unique among the genera of Demosponges in being restricted to the West Indies. Enzyme electrophoresis was carried out to get some better insight in how close the species within the West Indian clusters of *Agelas* and *Aplysina* are. The outcome was disappointing in that it showed almost no difference between the species. In order to get an idea of how far this Caribbean radiation seen in sponges is restricted to sponges alone, or whether it is a more general phenomenon, some research was carried out in other benthic groups, viz. soft- and stony corals (Octocorallia and Hexacorallia). The genera *Gorgonia*, *Pterogorgia* and *Pseudopterogorgia* of the Octocorallia (sea fans etc...) are either completely restricted to the West Indies or have only a few additional species in the Pacific,with a distinct Caribbean cluster. For the stony corals several genera show this Caribbean radiation pattern (*Porites*, *Agaricia*, *Montastrea*). In an enzyme electroforesis study of morphologically almost identical *Porites* species, Potts & Garthwaite (1991) found no differences in fixed alleles. However, the closely related species showed distinct and consistent differences in allele frequencies, proving that no gene flow is taking place. It is suspected that this might also be the case for the Caribbean species of *Agelas*, *Aplysina*, *Verongula* and probably the seafans as well.

Further research on a larger number of freshly frozen specimens from Curaçao and Bonaire is in progress. If this pattern proves to exist in all mentioned genera, it must be realised that it would be representative for the Caribbean reef communities because the species concerned are dominant organisms on the reefs, both in numbers and size. All are modular organisms, so apparently the radiation event had a special impact on such animals. It seems tlikely that the radiation is a relatively recent event.

**Reef communities along the NE coast of Colombia and Curaçao related to abiotic circumstances**

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Between June 1989 and December 1991, a total of 44 stations in three distinct Caribbean areas were investigated upon their biotic and abiotic characteristics: in Colombia in the Santa Marta region (6 locations) and on the archipelago Islas del Rosario (3 locations) and on the Dutch Antillean island of Curaçao (3 locations).
Belt-transect (10x1) m.) in the Santa Marta area were positioned parellel to the 5, 10, 15, 20 and 25 meter isobath of each location; for the other two areas parallel to the 5, 15 and 25 meter isobath. On all transects, % cover of all bottom components, sedimentation rate, submarine light penetration, waterturbulence, salinity and temperature were measured. Using the Detrended Reciprocal Analysis (DRA) (Hill and Gauch, 1980) stations were ordinated based upon species group abundance (% cover of stony corals, sponges, octocorals, macro-algae, filamentous algae and total cover of algae).
In the Santa Marta area, cover of stony corals is negatively correlated with that of sponges; in the archipelago Islas del Rosario, the cover of sponges and stony corals are not correlated. Both however are negatively correlated with that of macroalgae (calcareous and non-calcareous) - which are the most abundant species group - and octocorals. Total algal cover is highly correlated to that of the macro-algae.
The abiotic factor with major influence upon the general station ordination seems to be the sedimentation rate in the rainy season. In the Islas del Rosario, where a relatively low sedimenation rate in the rainy season (3.5 - 23.5 gr/m$^2$/day) is combined with a variable light penetration (coeff. of extinction 0.02 - 0.18), the abundance of macro-algae (and with that the total algal cover) is positively correlated with the increasing light penetration. Cover of stony corals is highly negatively correlated with the rise in temperature and the fall in the salinity, as occurs especially near the watersurface during the rainy season.

## The distribution of sponges over NW Europe

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During the years 1981-1992 sublittoral communities on hard substrata were investigated along the North Sea coast and at two localities along the Atlantic coast. During this investigation 95 different sponge species were recorded. The distribution of the sponges was analyzed using the qualitative Sørensen index. Compared to the localities at the Atlantic coast, the number of species in the North Sea was rather low. In total 53 species were recorded in the North Sea and 74 in the Atlantic Ocean. During the first cycles of the analysis, the Orkney islands were fused with St Abbs, the Oosterschelde estuary with Helgoland, Norway with Sweden and Ireland with France. In the North Sea, the Orkney and St Abbs clustered together with Helgoland and the Oosterschelde estuary. Frequently occurring species were *Cliona celata, Haliclona oculata, Leucosolenia variabilis, Halichondria panicea, Haliclona rosea, Scypha ciliata* and *Myxilla incrustans*. 4 species were restricted to the Dutch estuary (*Mycale micracanthoxea, Haliclona xena, Suberites massa* and *Scypha scaldiensis*), two species to the Helgoland region (*Leuconia johnstonia* and *Suberites ficus*), one to the Orkney (*Isodictya palmata*) and one to the St Abbs area (*Clathria gradalis*). These areas were grouped in the next fusion together with the Atlantic localities. The Atlantic localities shared 22 species. 11 species were restricted to the Irish location and 24 to the French one. The last cycle fused the Norwegian and Swedish localities with this group. Both localities shared 7 species. Species restricted to the fiords south of Bergen were *Crella rosea, Tricheurypon* sp., *Aplysilla rosea* and *Plakortis simplex*, while *Mycale lingua, Tragosia infundibulum, Haliclona implexa* and *Clathria ctenichela* were restricted to the Gullmar Fiord. This distribution pattern is caused by differences in the temperature range in the investigated regions and by the individual preference of the different sponge species. In each region different abiotic factors determined the sponges distribution. Quantitative analyses showed that the importance of the sponges in community composition increased from North to South. This analyses showed the importance of the investigation of different types of habitats as well. Sponges displayed a preference for the aphotic zone over the photic zone. The water movement in the photic zone is mainly wind induced and therefore predominantly turbulent. Although, at least some water movement is required, in the aphotic zone at places with turbulent water movement a lower percentage cover was found than in places with strong tidal currents. These preferences were clearly expressed in the Oosterschelde estuary, where by human interferences, the tidal currents were strongly decreased. The decrease of tidal currents was bound to an increase in the amount of sedimentation.

## Observations on *Eudea cribraria* (Fromentel), Calcarea *

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Within the marly Alcobaça formation (Kimmeridgian, Lusitanian Basin, Portugal) the calcareous sponge *Eudea cribraria* (Fromentel) is very abundant.
A lot of very well preserved specimens of *Eudea cribraria* give us new data concerning interaction of the sponge and its environment.
The small tube-shaped and occasionally branching sponge *Eudea cribraria* was able to close inactive ostias with a solid wall during lifetime. All transitions between completely opened and completely closed ostias can be observed. The newly formed walls have a hemispherical shape and protrude about 1 mm (maximum). The wall exhibits the same structure and thickness as the cortex.
The sealing of all basal ostias can be considered as a response to high sedimentation rates. In order to prevent infiltration of sediment into the choanoderm. Sealing at only one side is diagnostic for the toppling of sponge specimens into the soft marl substrate during lifetime.
Although other Calcarea need low sedimentation rates and clear water (often together with hermatypic corals), *Eudea cribraria* can stand - at least for a short time - higher sedimentation rates in a muddy environment.

* Contribution to the priority program of the German Research Foundation (DFG) "Global and regional controlling factors of biogenic sedimentation - Evolution of Reefs", Project Le 580/4.

## A new collection prompts the return of *Leptophragmella* (Craticulariidae) to *Chonelasma* (Euretidae)(Hexactinellida)

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A large lamellate hexactinellid, recently discovered living on the wreck of the *S.S. Central America* at 2200 m depth off South Carolina, U.S.A., has been sampled by the robot submersible *Nemo*. Macroscopic inspection of fresh material reveals the quadrunx pattern of the family Laocaetidae (= Craticulariidae). Analysis of cleaned skeletons, however, proves that the apparent gastral aporhyses are not true canalizations of the skeletal frame, but reflections of choanosomal tissues. In all skeletal features, the specimen agrees with the limited descriptions of *Leptophragmella choanoides* (Schulze and Kirkpatrick, 1910), originally *Chonelasma lamella choanoides*, known from the Antarctic *Gauss* and North Atlantic *Ingolf* collections, and we assign the specimen to that species. Examination of the lectotype of *Chonelasma lamella* Schulze, 1887, shows that it possesses the same suite of free spicules and skeletal framework features, including the distinctive transverse skeletal lamellae of *Leptophragmella choanoides*. The lectotype, however, has shallow canalization of both surfaces, instead of only the dermal surface as in all *L. choanoides*. Because *Leptophragmella* lacks skeletal features (skeletal aporhysis) required for inclusion in Laocaetidae and agrees so closely to *C. lamella* in skeletal detail, we consider *Leptophragmella* to be a junior synonym of *Chonelasma* and the two species *C. lamella* and *C. choanoides* retain identity. Electron microscopy of sub-optimally fixed tissues confirms that *C. choanoides* possesses the distinctive perforate septal partition (plug) known in several Hexactinellida.

# Sponge communities of the Arctic Vesterisbanken-Seamount (NE Greenland Sea) RV-"Polarstern"-Expedition ARK VII/1, 1990

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During the "Polarstern"-expedition ARK VII/1 in June 1990 the seamount Vesterisbanken (73° 30'N 9° 15'W) was investigated. It is a 3000 m high submarine non-active volcano. Its peak is ca.130 m below the water surface. The seamount was surveyed with an underwater camera system ("OFOS"-ocean floor observation system) including a videosystem and a normal camera using 35 mm colour reversal films. The seamount is located within the arctic East Greenland cold water current and over the seamount a Taylor current regime is developed. This current is responsible for the downslope nutrient transport which allows a dense settlement of benthic communities down to more than 2000m. The main facies belts are:

1. Biogenic sponge spicule mat with bryozoans and serpulids down to approximatly 300m. The sponges are concentrated in small mounds and hedges. The sponge community is formed by large *Thenea* div.spp, large specimens of *Geodia* div.spp. and the common lyssakine hexactinellid *Schaudinnia* sp.
2. The following zone (300-450m) is characterized by a small free living bivalve (*Pecten* sp.) which is lying on a stable sandy soft bottom. Sponges are rare and only *Polymastia* is common. Within zone 1 and 2 the demosponges are with more than 60% the dominant element of the sponge fauna.
3. Between a depth of 500-1100 m bryozoans, sponges, ascidians, and crinoids (*Heliometra glacialis*) are common. The general sponge community is the same as observed in the shallower parts of the seamount, but the amount of hexactinellids is much higher (over 60% of the sponge fauna)
4. In depths between 1100 and 2000 m the volcanic basement is present (e.g. pillow lava) and partly not covered by sediments. Between the pillow structures a abyssal plain soft bottom is developed. On the firm grounds of the pillow lavas a rich fauna of amphiscophoran hexactinellids (*Hyalonema* sp.), lyssacine hexactinellids (*Schaudinnia*, *Caulophacus*), poecilosclerid demosponges (*Cladorhiza*, "*Clathria*"), and some tetractinellid demosponges (*Thenea*) are very abundant. The soft bottoms are settled by octocorals and stalked crinioids (*Bathycrinus*).
5. The deep water areas (3000m) are characterized by small soft bottom dwelling sponges (*Thenea abyssorum*, "*Polymastia*" *sol*, small myxillid demosponges) and small calcareous sponges which are growing on large foraminifera.

# Sponges from the Tommotian (Lowermost Cambrian) of China (N-Hunan) An access to the early beginning of sponge history

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From the Lower Cambrian of the northern Hunan province of China a well preserved fauna of completely preserved sponges was recently discovered by M.Steiner. The section of Sanzha starts with Sinian sediments (Late Precambrian) and is definitely older than Chengjiang-Lagerstätten in Yunnan. The early Cambrian sediments are very fine pelitic material completely free of carbonate. The sponges are enriched within certain layers but they occur in all places except at the base of the section.

The sponges exhibit their entire shape and spicule arrangements. Remains of the soft tissues are preserved as dark halos. The spicules are preserved as silica pseudomorphs, casts, or as open, only partly cemented holes.

In a few layers thin spicule mats are present including a few small young sponges.

At the base of the Tommotian sponge-like structures occur which are ball-shaped (5 cm diameter) and exhibit only few spicule remains.

In the middle part of the Tommotian section the sponges demonstrate a very prominent spicular skeleton and it is possible to distinguish three main types:

The first observed type is definitely a hexactinellid with protospongiid characters. The sponges are small (1-5 cm), possess a long root spicule (2-3 cm) and exhibit one layer of stauractine and occasionally also hexactine spicules. The sponges are fixed on top of the big spicule. The sponge is very common and is represented by different ontogenetic stages.

The second observed sponge type is characterized by long monaxonic spicules which are demonstrating a pseudo-stauractine arrangement. This is definitely a lyssakine hexactinellid.

The third type of sponges is constructed of long (several cm) monaxonic spicules in an irregular manner. Some of the spicules are arranged in plumose bundles. This type exhibits some demosponge characters.

There are a few other sponge types which are not under study at the moment . The relatively high diversity of sponges at the base of the Cambrian supports the idea that sponges are surviving Precambrian Metazoa.

## Inter- and intraspecific relationships of the burrowing patterns of two clionid sponges

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Specimens of the burrowing sponges *Cliona vastifica* and *C. lobata* from 200m. deep (North-Western Mediterranean) show a similar appearance. Although their spicule complement is very different, their external morphology could cause some confusion over their taxonomic identification. In order to find other measurable differences than spiculation, we have looked at their burrowing patterns: area of inhalant and exhalant papillae (water exchange area), area of choanosome (area of the largest section of the chambers of the burrowed galeries), mean number of papillae per chamber, mean number of chambers per $cm^2$ and biomass.
Chambers and papillae were larger in *C. lobata* ($60 \pm 18.1$ $mm^2$ and $0.80 \pm 0.14$ $mm^2$, respectively) than in *C. vastifica* ($40 \pm 15.9$ $mm^2$ and $0.44 \pm 0.08$ $mm^2$, respectively). The density of chambers inside the substratum was higher in *C. vastifica* ($10.6 \pm 6.3$ per $cm^2$) than in *C. lobata* ($6.5 \pm 2$ per $cm^2$). Nevertheless, other studied relationships fit similar patterns for both species. The number of chambers per $cm^2$ and the area of the chambers were negatively correlated, whilst the total exchange area per $cm^2$ and the total area of choanosome per $cm^2$ were positively correlated for both *Cliona* species. As a result, a ratio permitting an easier way to obtain an approach to the biomass of the specimens on the basis of the number of papillae is suggested.

## *Halichondria panicea* Pallas: Seasonality of Spicule Development - Preliminary results of an ecological study

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Central question of the study is whether there is an influence of seasons on the spicule development in *Halichondria panicea* Pallas analysing both relative amount of skeletal material and mean size class of the spicules per month. First concern was a reevaluation of methods and statistical design. The minimal number of spicule measurements necessary to produce reliable results for this species was found to be 70 per sponge. Length and width were taken of the first 70 intact and normally formed elements along one of 6 transects chosen by throwing dice. Also, production of permanent preparations was improved to avoid sorting of size across the slides. Samples were obtained by monthly random dredges in the Western Baltic Sea (Kiel Bight area) and random selection of 15 sponges for weight analyses, of which 6 were also used for spicule measurements. Data on proportion of skeletal material compared to dry weight and on dimensions of spicules throughout the year are presented.

## Distribution of phototrophic sponges in the Seychelles

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Phototrophic sponges (Wilkinson, 1983) are sponges living in symbiosis with cyanobacteria in a way comparable to that of corals and zooxanthellae. They share a similar morphology in that they have a thin-bladed form equipped to collect ultraviolet radiation. More than 50 % of the nutrient supply of these sponges is accounted for by the symbionts and thus these organisms are in effect primary producers. Wilkinson & Cheshire (1989) have made a transect over the Great Barrier Reef from west to east and found a distinct correlation between the occurrence and abundance of these phototrophic sponges and the distance to the continental shore. In oceanic oligotrophic waters they abound, in inshore nutrient-enriched areas they are rare or absent.
A recent collecting trip to the Seychelles-Amirante area offered a unique possibility to check whether such a pattern is more general. The geographic situation is dramatically different from that of the Great Barrier Reef area, but there are high granitic islands with terrigenous effluents providing extra nutrients, as well as low carbonate islands surrounded by oligotrophic waters. Three species which are known to be phototrophic (Wilkinson, 1985)were found: *Dysidea herbacea, Carteriospongia foliascens* and *Phyllospongia* cf. *alcicornis* , and their distribution over the visited localities was noted. In three cases, where the abundance was sufficiently great, substrate cover in 100 $m^2$ was estimated by quadrat sampling. Conclusions are that all the high islands (especially Mahé has been studied intensively ) lack the three phototrophs. With the exception of Desroches and Desnoeufs, which were only visited glancingly, all low carbonate islands, including Bird Island which is close to the granitic islands, demonstrated abundant populations of these curious sponges, confirming the validity of Wilkinson's observations.

**Chemical and structural defenses versus growth and regeneration in encrusting sponges: *Crambe crambe* (Poecilosclerida) and *Scopalina lophyropoda* (Halichondrida ?)**

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The Mediterranean encrusting sponges *C. crambe* and *S. lophyropoda* display different ecological distributions in the shallow rocky littoral: whereas the first species is widespread along all the littoral, *S. lophyropoda* show a patchy distribution being abundant in some zones but absent from most areas.

Longterm monitoring of both species dwelling together in a rocky wall at the Blanes littoral (Iberian Peninsula) permitted to detect an increasing prevalence of *S. lophyropoda* at the expense of *C. crambe*. Searching for the reason, comparative studies on chemical and structural defenses, larval behaviour and regeneration rates of both species were conducted.

*S. lophyropoda* showed marked seasonal growth and regression, was very sensitive to physical disturbance, presented high regeneration rates, lacked chemical defenses (against larvae of *C. crambe*, sea-urchin embryos and bacteria), and exibited few structural defenses (spicules). Larvae displayed a conservative behaviour keeping close to mother sponges by swimming toward the substratum inmediately after releasing.

On the other hand, *C. crambe* did not show conspicuous seasonal growth nor regression, was resistent to physical disturbance, exhibited low regeneration rates (often margin regression at the disturbed outline), strong structural (spicules) and chemical defenses (against larvae of *S. lophyropoda*, sea-urchin embryos and bacteria). Larvae were photophilic and widely dispersed.

As can be shown, *S. lophyropoda* behaved as an opportunistic species except for the larval behaviour and its restricted ecological distribution, whereas *C. crambe* would be a clear specialist also but for the larval behaviour and its wide distribution.

Concepts of r-and K-selected species seem to break down in encrusting sponges as in other modular organisms. This "mixing" of life-strategies would explain the longterm prevalence of a mostly opportunistic organism due to some propitious changes in the environment (eutrophication) and a strong habitat selection by its larvae.

## Reproduction of *Halichondria panicea* Pallas in the Kiel Bight, Germany

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This study deals with the seasonal pattern of the production of reproductive units in a Baltic Sea population of *Halichondria panicea.*

1. Oogenesis starts in late summer/early autumn and can be divided into two phases. During a first growth period from approximately October to February oocytes reach a diameter of 30-50 µm and achieve a rounded shape. During this phase the cell nucleus is located in the center of the cell and surrounded by large aggregations of mitochondria and dictyosomes. During the second developmental phase oocytes take up yolk material by phagocytosis of nurse cells and grow to their final size of 90-120 µm in diameter. At the beginning only small yolk granules are found. Oocytes are now surrounded by a follicle epithelium and occur singly as well as in groups of 2-6 mm. At the end of this phase larger yolk granules (5-8 µm) are found, the nucleus has moved to the cell periphery. Oogenesis occurs simultaneously throughout the population.

2. The reproductive cycle in 1988/89 started with growth in October 1988. Spermatic cysts occurred simultaneously with ripe oocytes in March, embryos and larvae were first found in April, and in June no more reproductive stages could be found at all. During the time of spermatogenesis all checked individuals contained reproductive stages.

3. From the observations of 10 tagged specimens throughout the reproduction period it is concluded that *H. panicea* exhibits complete gonochorism in the Kiel Bight. More male than female individuals were found, the sex ratio was 2:1.

4. 'Postlarval' reproduction was not observed. 10 tagged 'postlarval' sponges were observed from autumn 1988 until July 1989 and did not produce any gametes at all. One-year old *H. panicea* obviously do not participate in sexual reproduction in the Kiel Bight.

5. Oblong larvae released from sponges in the laboratory exhibited negative phototaxis and swam with clockwise rotation. After one week the now pear-like larvae had attached themselves firmly to the bottom of the container. Mean larval size was 180-250 µm.

## 7. POSTER SESSION B: BIOLOGY, PHYLOGENY, CHEMISTRY

MSc **Belinda Alvarez**, University of Australia, Canberra, Australia:
"A preliminary analysis of the phylogenetic relationships of some Axinellid sponges".

Dr **Paul E. Fell**, Connecticutt College, New London, U.S.A.:
"Dormancy of the gemmules of *Eunapius fragilis* and *Ephydatia muelleri* from New England".

Dr **Michèle Guyot**, Muséum National d'Histoire Naturelle Paris, France:
"Individual variation in the chemical composition of *Ircinia variabilis*".

MSc **Eduardo Hajdu**, University of Amsterdam and CNPq-Brazil:
"The significance of including chelae-bearing sponges within the Haplosclerida".

Dr **John N.A. Hooper**, Queensland Museum,South Brisbane, Australia:
"A remarkable oscular structure in an *Oceanapia* (Haplosclerida)".

Ms **Lisa Hunter**, UCSC, Santa Cruz, U.S.A.:
"Databases as tools for dereplication in sponge natural products".

Dr **Michelle Klautau**, UFRJ, Rio de Janeiro, Brazil:
"Establishment of long-term cell cultures from marine sponges".

Dr **Michelle Klautau** , UFRJ, Rio de Janeiro, Brazil:
"Antigenic properties of sponge collagen and their potential use in taxonomy".

Dr **Manuel Maldonado**, CEAB, Blanes, Spain:
"Spicule microfeatures of *Crambe* (Demospongiae, Poecilosclerida) as a clue for its relationships with "living"fossils".

Dr **Dorthe Mehl**, Institut für Paläontologie, Freie Universität Berlin, Germany:
"Is the flagellar velum a constituent character of Porifera ?

Dr **Dorthe Mehl** , Institut für Paläontologie, Freie Universität Berlin, Germany:
"Monophyly and Systematics of the Porifera".

Dr **Murray H. Munro**, University of Canterbury, New Zealand: "MarinLit: A marine literature database".

MSc **Guilherme Muricy**, UFRJ, Rio de Janeiro, Brasil: "Application of a key-making software to the Brazilian Poecilosclerida".

Dr **Stuart Noble**, University of Auckland, New Zealand:
"Applications of genomic walking PCR to molecular studies of sponges".

Dr **Shirley Sorokin**, AIMS, Townsville, Australia:
"Microbial contamination and cell nutrition in sponge cell culture".

Dr **Daisuke Uemura**, Shizuoka University, Japan:
"Bioactive metabolites from the black sponge*Halichondria okadai* ".

Dr **Yoko Watanabe** , Ochanomizu University, Japan:
"Embryonic development of *Sycon calcaravis*".

Dr **Philippe Willenz**, Institut Royal des Sciences Naturelles, Brussels, Belgium:
"Ultrastructure of parenchymella larvae and their armoured follicle in the coralline sponge *Calcifibrospongia actinostromarioides* Hartman".

## A preliminary analysis of the phylogenetic relationships of some Axinellid sponges

Belinda Alvarez

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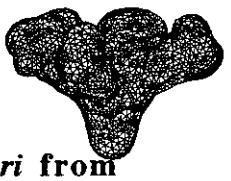
Fifteen species of the genera *Axinella, Auletta, Ptilocaulis,* and *Pseudaxinella* from the Central West Atlantic region were selected to establish possible phylogenetic relationships. Twenty-four morphological characters (52 apomorphic states) were scored for each species. Data were analysed using the phylogenetic program PAUP 3.0. The characters were treated as unordered and weighted equally.*Ectyoplasia ferox* and *Acanthella vaceleti* were selected as outgroups for the polarization of the characters. Analyses were performed using heuristic and "Branch-and-Bound" options and produced 27 trees of length 87 steps and Consistency Index 0.575. The ingroup of the strict consensus tree consists of four groups of species. The most plesiomorphic group is the clade containing *Pseudaxinella grayi* and *P.amphilecta* . The sistergroup of this clade consists of two polytomies and one fully resolved clade. One of the polytomies contains *Pseudaxinella explicata* and *P.* n.spec., and the other contains 5 species of *Axinella* and two of *Ptilocaulis*. The fully resolved clade contains two species of *Phakellia* , two species of *Auletta* and one of the outgroups (*Acanthella vaceleti* ). Characters like growing strategy, type of projections, degree of condensation of the axial skeleton, presence of strongyles, and curvature of spicules were the most phylogenetically informative for this group of species. Although the resultant cladogram does not show fully resolved relationships among the species, it does indicate that some of the present generic groupings are likely to be monophyletic and some paraphyletic (i.e. *Acanthella* ). Further cladistic analyses are required in order to more rigourously test the present classification of the family Axinellidae, and outgroup relationships need investigation, especially *Acanthella*.



**Dormancy of the gemmules of *Eunapius fragilis* and *Ephydatia muelleri* from New England**

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The gemmules of relatively few sponges have been examined with respect to their type of dormancy (i.e. quiescence vs diapause). Furthermore, for any particular species, some of which are widely distributed and occupy diverse habitats, only a few gemmule samples from a small number of populations (sometimes only one) have been studied. Dormancy of gemmules from Connecticut and Massachusetts populations of *Eunapius fragilis* (Leidy) and a Connecticut population of *Ephydatia muelleri* (Lieberkühn) was examined. As has been shown previously, the gemmules of *Eunapius fragilis* undergo a relatively deep diapause, and up to 4 months of chilling at 4-5°C may be required to break diapause in essentially all of the gemmules. However, different samples of gemmules collected at the same site during the last half of October of the same or different years exhibited considerable variation in the depth of diapause. At one extreme, some gemmules were capable of hatching at 20°C after only 3 weeks of chilling and nearly all of them were no longer in the diapause state after 9 weeks at low temperature. At the other extreme, no gemmules were capable of hatching at 20°C following 12 weeks at 4-5°C. The gemmules of *Ephydatia muelleri* from Connecticut also undergo a deep diapause. Although a few (4%) of the gemmules were capable of hatching at 20°C after 4 weeks at 3-4°C, more than 12 weeks of chilling was required to break diapause in essentially all of the gemmules. Following maintenance at 3-4°C for 8-9 months, gemmules of *Eunapius* and *Ephydatia* hatched at this low temperature provided they were kept under uncrowded conditions. In the case of *Eunapius*, 100% of the gemmules hatched at low temperature. Low temperature brings about / accelerates the breaking of diapause and evidently slows but does not completely inhibit emergence from the quiescent state.

## Individual variation in the chemical composition of *Ircinia variabilis*

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Identification of specimens in the genera *Ircinia* and *Sarcotragus* are especially difficult to achieve by the classical skeletal criteria used in taxonomy. Chemotaxonomic studies would provide reliable input to taxonomic problems.

Linear sesquiterpenes characterized by a furan ring at one end and by a conjugated tetronic acid at the other have frequently been encountered in sponges of the genus *Ircinia* . Specific metabolites were described such as variabilin and palinurin from *Ircinia variabilis* and fasciculatin from *I. fascicularis*. Fasculatin, however, was found to coexist with palinurin and variabilin in *I.variabilis* and variabilin and fasciculatin were encountered in other species of *Ircinia* and related genera.

From specimens collected near Djerba (Tunisia) and separately analysed we found that one lot (A) contains only variabilin, another one (B) contains only palinurin. Other lots contain a mixture of palinurin and variabilin.

Morphological analysis of specimens of lot A and B shows no structural differences and the same symbiotic cyanobacteria and they were identified as *I. variabilis* . These results set the problem of identification in *Ircinia* sp. or the possibility of variation in the chemical content of species collected in the same area and on the same day.

**The significance of including chelae-bearing sponges within the Haplosclerida**

Eduardo Hajdu*, Wallie H. de Weerdt & Rob W.M. van Soest

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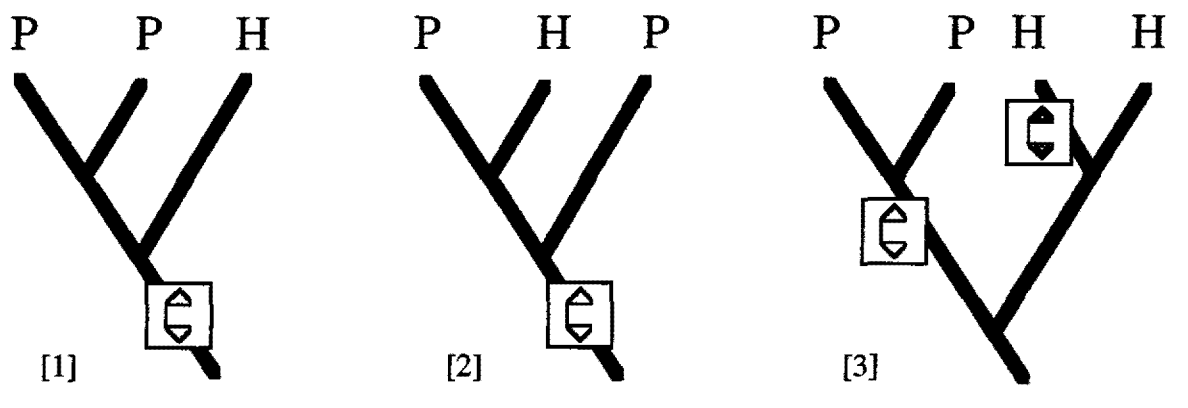
Recent efforts of revision of the phylogenetic relationships within the Haplosclerida have yielded, among others, a hypothesis of the relationships of the families within the order (cf. Van Soest; de Weerdt). Implicitly, haplosclerids were considered to belong within the Poecilosclerida on account of the shared derived presence of a supposedly homologous complement of microscleres (sigmata, toxa). Characters within the haplosclerids were polarized against five poecilosclerid lineages and the Axinellida - with Desmacididae as the nearest outgroup. A broad concept of Desmacididae is most probably artificial given the polyphyly of the family, which has been defended in the recent literature. In this context, *Isodictya* is picked out as the genus which shares indisputable homologies with the Haplosclerida - an isodictyal reticulation of small cigar-shaped oxea very much like the one in *Niphates* . *Coelocarteria* is another genus of dubious poecilosclerid affinities, which has recently been considered to belong to cornulids (cf. Bergquist & Fromont, 1988). The characters shared by the Cornulidae, viz. the fistulose habit, the diactinal megascleres and the palmate chelae are all postulated to be primitive; and the assumption that they form a natural group is presently challenged. The skeleton of *Coelocarteria* is hypothesized to be homologous to that of *Oceanapia* , an observation strengthened by the finding of abundant typical haplosclerid toxa in the specimens of *Coelocarteria*. The complement of palmate isochelae of *Isodictya* and *Coelocarteria* may be interpreted in one of three ways: [1] it might be a synapomorphy for both the Haplosclerida and Poecilosclerida s.s., [2] it might be synapomorphous for the Poecilosclerida s.l. (i.e.including the Haplosclerida, a hypothesis put forward in the recent literature) or [3] it might be homoplasious (synapomorphic for the Poecilosclerida and independently acquired by the Haplosclerida), a very improbable alternative given the complexity of the character.




P = Poecilosclerida, H = Haplosclerida

## A remarkable oscular structure in an *Oceanapia* (Haplosclerida)

John N.A. Hooper[1] & Martin Riddle[2]

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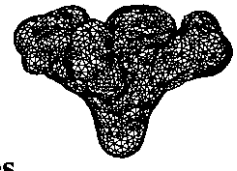
A new species of *Oceanapia* belonging to the '*biminia*' species group (Porifera, Demospongiae, Haplosclerida, Oceanapiidae), recently described from the shallow, soft sediments surrounding the limestone islands of Ko Samui, southwest Gulf of Thailand, was found to have a peculiar, translucent, membraneous, capitate structure on the apex of the primary (open) fistule, bearing many small oscules at the ends of tentacle-like, dendritic, exhalant canals. This oscular structure is fragil, collapsing and disintegrating upon collection and preservation, and it is possible that careful in situ documentation of the sponge fauna will discover such structures to exist in other oceanapiid species.



**Databases as tools for dereplication in sponge natural product studies**

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The search for new drugs is increasingly focused on natural products chemistry in hopes of finding new pharmacophores and mechanisms of action from animal, plant, and microbial sources. The addition of a drug screening program to a natural products group offers an immense potential for reward, but also requires an investment in information management to deal with the vast amounts of screening results from crude extracts, fractions and compounds. The database system currently used by our research program at the University of California, Santa Cruz is composed of several modules: a chemical structure database; a bioactivity database; a field database; and a photographic print catalog.

The chemical structure database (ChemBase®) is used to search substructures, organism source and molecular formula data. Utilization of this database often leads to the quick identification of known compounds present in a sponge extract and thus minimizes unnecessary time spent on known "nuisance"compounds. The bioactivity component is a relational database (Paradox®) that tracks activity in bioassay-guided isolations and is linked to a phylogenetic structure. The bioactivity database stores all field collection records and when used in conjunction with the photographic print catalog, makes it an invaluable tool for recollection and dereplication at the field collection level. A laptop computer will be available for demonstrations and trial searches.

**Antigenic properties of sponge collagen and their potential use in taxonomy**

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In recent research on sponge evolution and taxonomy, intensive efforts have been dedicated to the potential use of characters that could be alternative or complementary to the morphological ones. Among biochemical approaches, the use of isoenzymes characterization or ribosomal RNA sequencing have given valuable results. However, in these methods, the use of freshly collected material preserved in liquid nitrogen or dry ice is mandatory, frustrating studies of geographically distant or large collections preserved in a traditional way.

The analysis of antigenic properties of collagen was successfully applied to systematics of primates, even in studies of fossil specimens. We have tested thus the possibility of its use in sponge taxonomy, since collagen is well preserved in materials fixed by classical methods or even in dried material.

Collagen was obtained and purified from sponge specimens by a series of extractions with buffers containing urea, beta-mercaptoethanol and EDTA. Hens were immunized by three injections of collagen, eggs were collected from 30 days following the first injection, and antibodies (IgY) were obtained from the egg yolk.

The affinity of IgY for collagen of different sponges was estimated by the ELISA test:we used either the quantification of IgY reaction with the increasing quantities of heterologous collagen fixed on the solid phase, or the quantification of competition of the heterologous collagen in the liquid phase with the reactivity between the IgY and the homologous antigen fixed on the solid phase. Both reactions gave similar results. This method could recognize heterologous from homologous collagens, and clear differences were observed among reactions elicited with collagens of different sponges, roughly compatible in most cases with the differences expected following the classical sponge taxonomy. We conclude that antigenic properties of collagen might be used in sponge taxonomy. An extensive study of different sponges will be necessary to recognize its sensitivity, and the possibility of use at different taxonomic levels.

**Spicule microfeatures of *Crambe* (Demospongiae, Poecilosclerida) as a clue for its relationships with "living"fossils**

Manuel Maldonado & Maria-Jesús Uriz

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The phylogenetic relationships of many sponge genera remain enigmaticbecause no clear homology is found between their characteristic spicules and those of other Demospongiae. As a result their family assignment is successively changed with time and authors, without clearly defined or convincing arguments. This is, among others, the case of *Crambe* Vosmaer and *Discorhabdella* Dendy. The recent finding of two new species belonging to both genera in a particular area in the Mediterranean, the Alboran Sea, urged us to re-examine all the extant species of both genera. The study under high magnification (SEM) allowed us to make evident many morphological similarities in spicule complement and skeletal arrangement between *Crambe* and *Discorhabdella* as well as detecting gradual modifications in the spicule features across both species sets. Sphaeroclone desmas and pseudoastrose acanthostyles, traditionally assumed to be singular spicules characterizing both genera respectively, were noted to be probably homologous spicules, but subjected to a divergent process of morphological change. The whole of the skeletal characteristics suggests a common ancestor for both genera, showing *Discorhabdella* as the closest living relative of *Crambe* .

## Is the flagellar velum a constituent character of Porifera?

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The occurrence of two-winged shaped appendages (vanes or velum) on the flagella of sponges is frequently observed. They are fibrillar, fragile processes, about 1 µm wide, which occur on the outside of the flagellar membrane. Standing always perpendicular to the flagellar long axis, these vanes normally appear just above the choanomere body and continue along the first two-thirds of the flagellum, where they end at the upper margin of the microvilli collar. Flagellar vanes have been documented ultramicroscopically from representatives of all major taxa of the Porifera. Within the Pinacophora (Reitner & Mehl = Cellularia Reiswig & Mackie) they have been found in the Calcarea *Sycon ciliatum* and *Grantia compressa*, as well as the Demospongiae *Halisarca* n. sp. and in all Spongillidae. Within the Hexactinellida vanes are found in *Aphrocallistes vastus*, *Dactylocalyx pumiceus* and *Schaudinnia rosea,* but not in *Farrea occa* or *Neoaulocystis grayi* in spite of equally well-fixed samples. Their absence in some species might be the result of secondary reduction. Whenever they occur, flagellar vanes are a constant feature within the entire choanosome of the sponges. The velum is always oriented in the plane of the central microtubule pair, perpendicular to the sinus-curved beating of the flagellum. It is thus closely connected with the function of water-pumping. Since this feature has not been reported from any protozoan flagellate, we consider it as an autapomorphic character establishing the monophyly of the Porifera.

## Monophyly and Systematics of the Porifera

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The monophyly of the Porifera is hitherto controversial (e.g. Bergquist 1985: Syst.Ass.Spec.Vol.28, 14). According to our phylogenetic systematic analysis (methodical approach after Hennig), their status as a monophylum within the Metazoa is well established. The character complex of choanomeres with flagellar vanes - recently documented also for the Hexactinellida- organized in flagellate chambers can be considered as a constituent autapomorphy of the Porifera (compare Mehl, Reiswig & Imsiecke in this volume). Planktic larvae may have evolved independently of those of other sessile metazoans, such as the Cnidaria. The taxon Hexactinellida is considered a sister group of the Calcarea-Demospongiae-Homoscleromorpha taxon, for which the name Pinacophora is suggested. The constituent character of the Pinacophora is the possession of unicellular layers of specialized peripheral and canal cells, the pinacocytes. Furthermore, the potential ability of secretion of secondary calcareous basal skeletons may be an autapomorphic character of the Pinacophora. The Hexactinellida are established by a large number of derived features. Most outstanding differences from other poriferans are the unusual hexactinellid larvae with multiflagellated cells (new findings by Vacelet et al. on *Oopsacas minuta*) as well as the predominantly syncytial tissue organization of adult hexactinellid sponges. According to our phylogenetic hypothesis the mineralized spicules do not belong to the poriferan basic pattern but have evolved independently within the Hexactinellida- Calcarea, and Demospongiae-Homoscleromorpha taxon, respectively. This might be an explanation, why spicules appear not to be present (or not consistently present) within some problematic fossil groups of poriferan affinity.

## Application of a key-making software to the Brazilian Poecilosclerida

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DELTA system is a general system for coding taxonomic descriptions (Dallwitz, 1984). In this study I apply it to the Brazilian Poecilosclerida and we discuss the insights derived from its application to sponge taxonomy. Data input is made by means of 2 files, a "character list"file, which lists all the possible characters/states for the group under study; and an "item descriptions" file, which contains the taxa descriptions coded according to the character list. CONFOR software uses these 2 files to generate 4 types of output files: a classical identification key, an interactive (on-line) identification key, uniformed taxonomic descriptions in natural language, and transformed data files directly usable by different softwares (PAUP, TAXIR, DCR, etc.). In our example with the Brazilian Poecilosclerida, a character list was created, containing 21 characters: external form, consistency, size, external colour alive, external colour in spirit, internal colour, surface texture , dermal membrane, ectosomal skeleton, choanosomal skeleton, number of megasclere categories, monactinal megascleres, diactinal megascleres, number of microsclere categories, "monaxon"microscleres, isochelae, anisochelae,toxa, sigmata, incorporation of debris, and special surface structures. Number of states per character varied from 2 to 15. In the "item"descriptions file were included the 45 species of poecilosclerid sponges known from the Brazilian coasts, coded according to literature descriptions. Application of KEY option allowed the quick construction of an identification key of any of the species included. Application of TONAT option allowed the standardisation of the descriptions in natural language. DELTA software therefore facilitates the organisation and manipulation of taxonomic data. It has a constructive influence on the acquisition of properly comparative data and on character/states definitions. This is important in groups such as the Porifera, in which these aspects of taxonomic practice are still problematical.

## Application of genomic walking PCR to molecular biological studies of sponges

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Genomic walking PCR is a technique which allows one to acquire new sequence information either upstream or downstream of a known sequence (unlike conventional PCR which amplifies the DNA between two known sequences). We are applying this technique to sponge DNA with the aim of isolating genes coding for enzymes involved in the biosynthesis of bioactive sponge metabolites.

Sponge genomic DNA is cut with a particular restriction enzyme, followed by ligation of a small adaptor molecule of known sequence to the cut ends. This adaptor provides a binding site for one PCR primer while the other PCR primer is a known sponge sequence. Amplification using these primers results in the production of a fragment corresponding to the sequence from the sponge primer out to the restriction site which was cut in the initial digestion. The fragment produced can be sequenced and a new walking primer designed from the end of the sequence.

We are amplifying DNA fragments using degenerate PCR primers targeted to genes involved in the biosynthesis of the amino acids tryptophan and tyrosine since a number of interesting sponge metabolites are simple derivates of these compounds. These DNA fragments are being cloned and sequenced to enable identification of the correct gene products. Since biosynthetic genes from a particular pathway are commonly clustered in the genome it should be possible to walk out from these genes and search for genes responsible for the total biosynthesis of novel metabolites.

We are interested in the genes which, when expressed, convert tryptophan into the bioactive compounds aplysinopsin and its 6-bromo derivates in *Fascaplysinopsis reticulata* and *Smenospongia aurea* (Dictyoceratida) and which convert tyrosine into bromotyrosine derivates in *Ianthella* and *Pseudoceratina* (Verongida).

The ultimate aim of this project is to be able to clone and overexpress the genes as a means of producing large amounts of the appropriate bioactive sponge metabolites *in vitro*.

## Microbial contamination and cell nutrition in sponge cell culture

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Microbial contamination and cell nutrition are problematic areas in sponge cell culture. Effects of an antibiotic mixture, containing gentamicin sulphate, kanamyein monosulphate, penicillin G, streptomycin sulphate, and sulphmethazine, on microbial contamination and sponge cell viability were investigated in primary cell structures of the demosponge *Halichondria melanodocia* and the calcareous sponge *Clathrina* sp. The antibiotics were cytotoxic to *Clathrina* cells after eight days incubation, but had no effect on an algal contaminant. Sponge cell viability in *H. melanodocia* was not effected by the antibiotic mixture, although there was an apparent decrease in the ability of cells to attach to the flask. Microbial contamination in *H. melanodocia* culture, was reduced after 24 hours to 100 Colony Forming Units per ml of medium (CFU), compared to 32.000 CFU's in untreated controls, and kept to a minimal level for 28 days. In contaminated flasks of *H. melanodocia* a ring of inhibition around cell aggregations in the surrounding bacterial lawn, indicates possible production of antibiotics by the sponge cells. An increase in cell number after 45 days, of *H. melanodocia* inoculated in nutrient medium 199 and senescence of cells in a medium of artificial sea water, implies the ability of sponge cells to use dissolved nutrient.

# Bioactive Metabolites from the Black Sponge, Halichondria okadai

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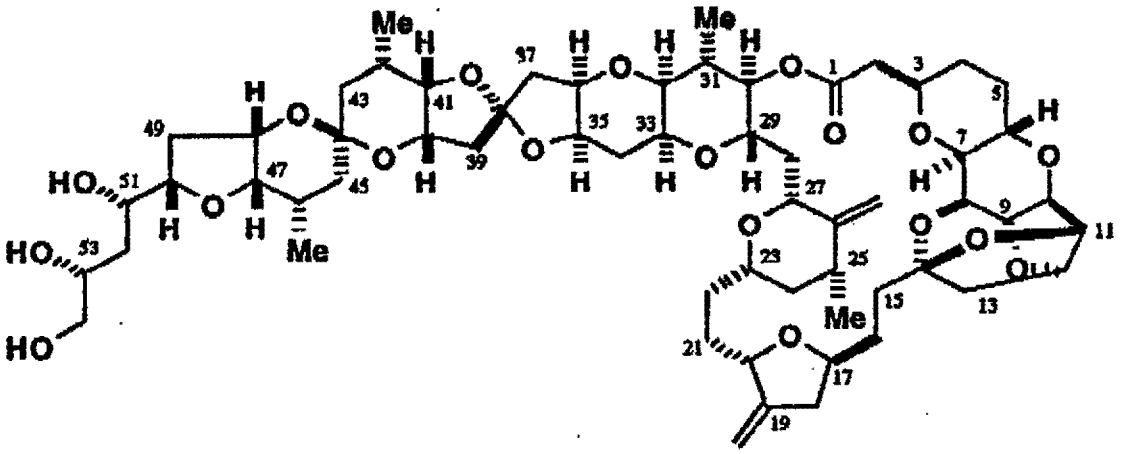
From the black marine sponge *Halichondria okadai* Kadota distributed on the rocky Pacific shores of Japan we isolated a series of halichondrins[1]. For example halichondrin B (1) which exhibits a remarkable antitumor activity and is a candidate of anticancer drugs. Although halichondrin B was completely synthesized by Kishi's group[2], we could supply the amount of gram-scale towards a clinical test. Since it is impossible to obtain halichondrin B from the black sponge, our search for the true natural producers of halichondrins was started because marine micro-organisms such as bacteria or blue-green algae were suspected. Bacteria were isolated from dead animals and cultured in a marine agar medium. Monitoring antifungal activities of this cultured medium made it possible to isolatie such like lipopeptides but not true halichondrins, which is the objective.




1 D. Uemura, Bioactive polyethers, in "Bioorganic Marine Chemistry, Vol. 4", P. J. Scheuer (Ed.), Springer-Verlag, Heidelberg, pp1-31 (1992).

2 T. D. Aicher, K. R. Buszek, F. G. Fang, C. J. Forsyth, S. H. Jung, Y. Kishi, M. C. Matelich, P. M. Scola, D. M. Spero, and S. K. Yoon, J. Am. Chem. Soc., **114**, 3162 (1992).

## Embryonic Development of *Sycon calcaravis*

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In many species of calcareous sponges, the inversion of the blastula is known during embryonic development. We studied the development of *Sycon calcaravis* with light and scanning electron microscope.
Materials were obtained from the cages for Abalone culture at Banda Marine Laboratory of Tokyo University of Fisheries in Tateyama located the Tokyo Bay.
The sexual elements of *S. calcaravis* were found during May and September in the years 1989 to 1992. The oocytes lay in the mesohyl just beneath the choanoderm where the eggs were fertilized and developed into stomoblastula. During cleavage, two types of cells emerged: small flagellated cells and large granular cells. The former are tightly arranged, each of the cells possessed a flagellum extended into the blastula cavity. The latter did not arrange but aggregated at the pole of blastula directly beneath the choanoderm. An opening appeared among the granular cell mass, where the blastula turned inside out through it. At initial stage of inversion, the maternal choanocytes, adjacent to the embryo, lost their collars and flagella, and adhered to the granular cells of the blastula. In this species, placental membrane was not formed around the embryo. During the inversion, the embryo was gradually pushed out from the mesohyl, and when the granular cells came together into the blastula it projected into the choanocyte chamber.
The amphiblastula was connected with the modified choanocytes, before escaping from the mother sponge. These transformed choanocytes were observed to regain the collars and flagella and recover the choanoderm after swimming out of the amphiblastula.
It was suggested that the maternal choanocytes took part actively in the inversion of the embryo. The inversion was completed in cooperation with the maternal choanocytes and granular cells of the embryo.

**Ultrastructure of parenchymella larvae and their armoured follicle in the coralline sponge *Calcifibrospongia actinostromarioides* Hartman (Calcifibrospongiidae)**

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Samples of a large specimen of *Calcifibrospongia actinostromarioides* from the Bahamas were observed in transmission and scanning electron microscopy. Premature typical parenchymella larvae were found encapsulated within armoured follicles close to the surface of the sponge. The follicles have a structure resembling peculiarly to gemmules and consist of spherules reinforced with strongyles typical to the species, embedded within spongin. The internal layer of this capsule is made of flattened flagellated cells. Several uniformly ciliated larvae are gathered in each follicle.

## 8. FRESHWATER SPONGE BIOLOGY

Dr **Roberto Pronzato**, Università di Genova, Italy:
"Life history of *Ephydatia fluviatilis* : a model for adaptive strategies in discontinuous habitats".

Dr **Roberto Pronzato**,Università di Genova, Italy:
"Quiescence and dispersal: a different strategy in gemmule production by *Ephydatia fluviatilis* ".

Dr **Renata Manconi**, Università di Sassari, Italy:
"Distribution of spongillids on Mediterranean Islands".

Dr **Georg Imsiecke**, Universität Mainz, Germany:
"Ingestion and digestion of *Chlamydomonas reinhardti* (Dangeard)(Protozoa, Phytoflagellata) by the freshwater sponge *Spongilla lacustris* (Porifera, Spongillidae)".

Prof. **Gisèle Van de Vyver**, Université Libre de Bruxelles, Belgium:
"Some aspects of the ecology of Belgian freshwater sponges".

Dr **E.Richelle-Maurer**, Université Libre de Bruxelles, Belgium.
"Some aspects of heavy metal tolerance in freshwater sponges".

Dr **G.C. Coutinho**, Université Libre de Bruxelles, Belgium:
"Looking for homeobox genes in the freshwater sponge *Ephydatia fluviatilis* ."

Dr **Henry M. Reiswig**, Redpath Museum, Montreal, Canada:
"Taxonomy, distribution and ecology of *Corvospongilla novaeterrae* " (Porifera, Spongillidae), a problematic freshwater sponge from eastern Canada.

**Life history of *Ephydatia fluviatilis*: a model for adaptive strategies in discontinuous habitats**

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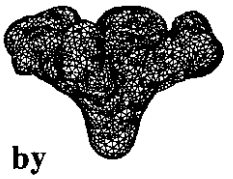
Dormant structures become more complex as the colonization of freshwater habitats increases. Reduction bodies evolved into gemmules that have a thermoproof pneumatic layer. The gemmules then spread by means of spiny spicules which adhere to animal vectors.
Dispersal in discontinuous freshwater habitats is linked to the plasticity of species. *Ephydatia fluviatilis*, which is a truly cosmopolitan species, expresses quiescence as hibernation or aestivation according to the climate. This asynchrony determines a reproductive isolation of populations and seems to confirm the existence of two morphological subspecies, which overlap in parts of the latitudinal range where the inversion of life cycles occurs.
Reproductive strategies of *E. fluviatilis* are contemporary r and the K models. The population structure and dynamics fit the r model if gemmules have a prevalent function as asexual propagules. On the other hand the strategy seems of the K type when gemmules are prevalently dormant bodies. The r strategy is favoured in habitats subjected to frequent catastrophic events such as sudden floods or during dry up and ice up. The K strategy is more evident in stable habitats where sponges show a limited turn over.
Homogeneity and genetic divergence depend on the frequency of gene flow among populations of these sessile clonal organisms. The gemmule represents the key structure in their biology and evolution.



**Quiescence and dispersal: a different strategy in gemmule production by *Ephydatia fluviatilis***

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The study of two populations of *Ephydatia fluviatilis* shows different life strategies related to the presence or absence of environmental stress. Gemmulation is a common phenomenon in both populations but the number of gemmules and the timing of their production are different. In Sicily the whole population is transformed in carpets of gemmules and the quiescence is related to a long period of dry up. In Liguria the population is active all the year round and only the bigger (older) specimens produce a few basal gemmules; gemmulation in this case is not a seasonal process.
*E. fluviatilis* is able to adapt its life cycle to different climates, consequently it is the most common spongillid species. Seasonal quiescence represents a successful strategy to survive environmental stress related to the notable plasticity of this species. *E. fluviatilis* hibernates during an ice up and aestivates during a dry up.
In absence of stress the gemmulation is not strictly necessary as a quiescent phase but this species gemmulates anyway, and this seems related to the dispersive role of gemmules. In stable habitats the gemmulation is activated by an endogenous factor because gemmules are the only structures capable of species dispersal in freshwater sponges.

## Distribution of spongillids on Mediterranean islands

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The freshwater sponge fauna of several Mediterranean islands have been studied from samples collected between 1984 and 1992. Samples were obtained from a total of 365 sites distributed in Majorca (44 sites), Corsica (79), Sardinia (89), Sicily (61), Crete (58) and Cyprus (34). In all, four species have been found: *Spongilla lacustris*, *Ephydatia fluviatilis*, *E. muelleri*, and a new species that will be described in a forthcoming paper.

*E. muelleri* was found only on Sardinia, while *E. lacustris* and the new species were collected on Corsica and Sardinia. *E. fluviatilis* was found on all islands except Cyprus where no freshwater sponges were found, confirming the extreme plasticity of this species.

On the islands the number of species is less than in continental European fresh water habitats from where about ten species of spongillids have been recorded. This notable difference could be related to climatic conditions on the Mediterranean islands which are all characterized by a warm-arid climate and lotic ephemeral habitats subjected to summer dry-up as a result of rainfall conditions very similar to North Africa.

In spite of its climate, Sardinia shows a high number of species (4) and density (sponges in more than 50% of sampled sites) compared to the other islands. This peculiarity may be related to the high number of free-roaming ungulates which may have acted as dispersal agents.

**Ingestion and digestion of *Chlamydomonas reinhardtii* Dangeard (Protozoa, Phytoflagellata) by the freshwater sponge *Spongilla lacustris* (Porifera, Spongillidae)**

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The route followed by food particles in *Spongilla lacustris* (Porifera, Spongillidae) was clarified by light and electron microscopic examination of sponges fed with *Chlamydomonas reinhardtii* (Protozoa, Phytoflagellata). The algal cells are phagocytized by prosendopinacocytes, amoebocytes and lophocytes. Changes in algal structure during digestion were observed and the egestion of algal remnants was documented in life for the first time. In light micrographs digestion of the algal cells is manifest first in shrinkage of the cells, then in disintegration to form several spherical green fragments 2-3 µ in diameter and finally, after 12-18 h, in a reddish brown discoloration of the fragments. Signs of the digestive process in electron micrographs include disappearance of the cell-wall layers, of the flagella, and the pyrenoid and its starch sheath as well as a progressive increase in the density of a cytoplasm and kyroplasm.

**Some aspects of the ecology of Belgian freshwater sponges**

G. van de Vyver, E. Richelle-Maurer & Y. Degoudenne

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A survey of the occurrence and ecology of freshwater sponges was conducted in canals, ponds and rivers in Belgium. For each biotope, physicochemical parameters were measured on site; water and sediment samples were collected for quantification of their metal content. In addition to the four most common Belgian freshwater sponge species a fifth one, *Trochospongilla horrida*, was collected from two canals. This is the first record of this species and its ecology from Belgium. Sponges were often encountered in interspecific mixtures: *T. horrida* with *Spongilla lacustris* or *Ephydatia muelleri*, *E. fluviatilis* and *E. muelleri* with *S. lacustris* or *Eunapius fragilis*. Observations made with light and scanning electron microscopy have shown that for all species mentioned, spicule morphological variations and sometimes malformations lead to difficulties in the recognition. As a matter of fact, interspecific mixtures and ecomorphological variations have often led to erroneous taxonomic identifications and even to description of new species. This again questions the very principles of sponge identification based on spination of megasclerea. Principal component and correspondence analyses were performed to define more precisely the preferential biotope for each species. It is not without reason that growth tests carried out in some water bodies have shown that the species that grew best were also those which were naturally present in those environments.

## Some aspects of heavy metal tolerance in freshwater sponges

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The present work is the first extensive field study, dealing with the tolerance of freshwater sponges to heavy metals and with their metallic content. The four species common in Belgium viz, *Ephydatia fluviatilis*, *E. muelleri*, *Eunapius fragilis* and *S. lacustris* were put in culture under laboratory conditions and after 15 days were transfered to natural sites with various metallic contents. Their growth then was evaluated and compared during 3 weeks for each biotope. Species best adapted were selected and allowed to develop in the field for 6 to 10 weeks. Heavy metal concentrations in sponges and sediments were determined by X-ray fluorescence (XRF), that of the water by inductive coupled plasma spectrometry (ICP). In addition, indigenous sponges from different water bodies were also collected and analysed.
Results are the following: 1) the capacity of freshwater sponges to accumulate different kinds of heavy metals (Cu, Pb, Zn.) shows a concentration $10^3$ to $10^6$ times higher than the concentration in the surrounding water; 2) freshwater sponges tolerate high metal concentrations. It is worth noting that, in the field, freshwater sponges can grow and thrive at a metal concentration which is higher than the lethal threshold determined for Cu, Pb and Zn. We used a new toxicity test developed in our laboratory and based on the capacity of dissociated sponge cells to aggregate and reconstitute functional sponges. Our field and laboratory experiments suggest the existence of detoxification mechanisms in sponges and offer the possibility to use sponges for monitoring heavy metal pollutions.

**Looking for homeobox genes in the freshwater sponge *Ephydatia fluviatilis***

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In all the cases analysed so far, from hydra to vertebrates, it appears that homeobox genes are responsible for determining cell differentiation and developmental patterns. The homeobox is a highly conserved DNA segment encoding a homeodomain of 60 amino acids which are part of a protein working as a transcriptional regulator. The impressive conservation of the homeodomain primary structure, of the chromosome gene organization and of the gene expression suggests a commonality of mechanism across the animal kingdom.

The present work investigates the existence of homeobox genes in a very primitive species, the freshwater sponge *Ephydatia fluviatilis* which processes a few different cell-types but is still devoid of structured organs or even true tissues.

This communication reports the isolation and charaterisation of a 110 bp DNA fragment from *E. fluviatilis*. This fragment was amplified by the polymerase chain reaction (PCR), using degenerated primers corresponding to the conserved residues 16-22 and 47-53 of the *Antennapedia* homeobox. The deduced polypeptide shows 88% of similarity with the homeodomains of the ceh-9 protein from the nematode *Caenorhabditis elegans*. Similarities between 85% and 70% were also found with more than 40 homeodomains from 13 quite different organisms. The well conserved residues between amino 16 and 21, and the leucine 41 are also present. The Garnier program allows to predict for the putative peptide the existence of an alpha-helix turn alpha-helix secondary-structure which is characteristic of homeodomains. These preliminary results strongly indicate that homeobox genes are also existing in sponges which are the lowest metazoans.

# Taxonomy, distribution and ecology of *Corvospongilla novaeterrae* (Porifera, Spongillidae), a problematic freshwater sponge from eastern Canada

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*Corvospongilla novaeterrae* (Potts, 1886) (Demospongiae, Spongillidae) is a rare freshwater sponge known only from a few acidic lakes on the coast of eastern Canada. It is generally considered to be a sexual hybrid of *Corvomeyenia everetti* and an unknown species. This assumption is apparently based on an erroneous interpretation of *C. novaeterrae*'s highly variable gemmoscleres, and foreign spicules (predominantly *Eunapius mackayi*) in Potts' type specimens. Traxler (1898) first asserted that the sponge was a hybrid form, based on an examination of material largely mixed with foreign spicules. In a revision of the Spongillidae, Penney and Racek (1968) supported the hybrid theory and suggested *C. everetti* to be one of the parent species. We have examined a new specimen from Nova Scotia which has no foreign spicules and fits Potts' description. We propose two possible explanations concerning its identity: (1) it is an unusual ecomorphic form of *Corvomeyenia everetti* resulting from atmospheric inputs of sea salts; (2) it is a valid *Corvospongilla* species, closely related to *C. seckti* and *C. boehmii*. *Corvospongilla novaeterrae*'s morphologically variable gemmoscleres are quite similar to those of *seckti* and *boehmii*, and appear to be evolutionary transients between birotulates and amphioxea (as in *Radiospongilla* and *Pectispongilla*). Other characters linking *novaeterrae* with *Corvospongilla* species include (1) large gemmules (diameter > 1000 μm) with simple, multiple foramina and weakly-developed pneumatic layer, (2) size and shape of birotulate microscleres, and (3) predominantly rod-shaped, tangentially-arranged gemmoscleres.

## 9. SPONGE ECOLOGY

Dr **Christopher N. Battershill,** New Zealand Oceanographic Institute,Wellington, New Zealand:
"Sex in the sea and how to avoid it".

Dr **Micha Ilan**, Tel Aviv University, Israel:
"Sponge reproductive strategies".

Dr **Jane Fromont**, James Cook University, Townsville, Australia:
"The reproductive biology of tropical species of Haplosclerida and Petrosida on the Great Barrier Reef".

Dr **Dagmar Barthel**, Institut für Meereskunde, Kiel, Germany:
"The sponge association of the deep Norwegian-Greenland sea: sponge/substrate relationships".

Msc **Ursula Witte**, Institut für Meereskunde, Kiel, Germany:
"Biology and ecology of the deep sea sponge *Thenea abyssorum* "

Dr **Ole S. Tendal**, Zoologisk Museum, Copenhagen, Denmark:
"Mass occurrences of sponges along the Northeast Atlantic shelf and slope: distribution, characteristics and possible causes".

Msc **Yasmine Göbel**, Institut für Meereskunde, Kiel, Germany:
"Size spectra of particles taken up by several marine demosponge species".

Dr **Floyd Sandford**, Coe College, Cedar Rapids, U.S.A.:
"Preliminary studies of the Florida hermit crab sponge".

Dr **Janie L. Wulff**, Williams College, Mystic, U.S.A.:
"Sponge-feeding by Caribbean Angelfishes, Trunkfishes, and Filefishes".

Dr **Klaus Rützler**, National Museum of Natural History, Washington, U.S.A.:
"Sponges growing on trees".

Dr **Clifford Jones**, University College of North Wales, United Kingdom:
"Process-formation by aquarium-kept sponges and its relevance to sponge ecology and taxonomy".

Dr **Sven Zea**, Universidad Nacional, INVEMAR, Santa Marta, Colombia:
"Patterns of coral and sponge abundance in degraded vs.still healthy coral reefs at Santa Marta, Colombian Caribbean".

*MSc. **Mario J. De Kluijver**, University of Amsterdam, The Netherlands:
"Sponge populations in SW Netherlands during major coastal engineering projects of the 1980's".

Dr **Jean Vacelet**, Station Marine d'Endoume, Marseille, France:

"Bacterial attack of spongin skeleton during the 1986-1990 Mediterranean sponge disease".

**Sex in the sea and how to avoid it**

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*In situ* studies on the dynamics of communities characterised by sponges from Antarctica to the tropics, in addition to detailed examinations of the reproductive biology of sponges from a wide range of taxa have shown that sponges possess an extremely varied reproductive repertoire including sexual and asexual modes. A variety of reproductive strategies is often demonstrated within a single species. Despite the variability in reproductive mechanisms, sex does not appear to play an important role in terms of successful settlement of progeny. Asexual reproductive behaviour in sponges can be structurally elaborate and highly tuned to ambient microenvironmental conditions. This mode of reproduction appears to predominate in all the communities examined. The morphology and behaviour of asexually generated propagules from sponges in rocky reef communities located from over 60° in latitude, from Antarctica and temperate New Zealand to coral reefs of tropical Australia, exhibit close similarities. Propagules were found to be well suited to prevailing physical conditions and were able to achieve a high degree of selectivity in settlement site. Sexually produced propagules were clearly disadvantaged on the same reef habitats.

Asexually produced buds, fragments and gemmules have a distinct advantage in size at the time of their release from parent sponges. They are basically adult in terms of cell composition, sensitive to chemical stimuli, and can respond quickly to benevolent conditions thus allowing rapid settlement in locations which are likely to support continued growth. Long distance dispersal of asexually generated propagules appears to be limited. These findings provide new ecological evidence which permits re-interpretation of some biogeographical concepts.

## Sponge reproductive strategies

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Examination of sponges from the Red Sea revealed their reproductive patterns. The reproductive season usually lasted several months, with a lack of winter reproduction in most of the species. Spermatic cysts, derived from choanocytes were detected in twelve of the twenty studied species. Oocytes were detected in fifteen of the species, with various mechanisms of oocyte development. Three types of larvae were developed in fifteen species. Fifteen species brood embryos to the larval stage and five are oviparous.
Four main combinations of reproductive strategies exist: hemaphroditic viviparity; gonochoric viviparity; hermaphroditic oviparity; and gonochoric oviparity. However, all studied sponges exhibited only two of these strategies: hermaphroditic viviparity or gonochoric oviparity. These strategies are in contrast to the situation found in freshwater sponges. In addition, sponges and the other major coral reef inhabitants, stony and soft corals, differ from each other in their reproductive strategies. Generally, viviparity is considered to elevate larval survival and prevent non-fertilized gametes going to waste. Oviparity is accompanied by numerous sexual products. A viviparous hermaphrodite both increases its larval survival, and has more offspring than a viviparous female. Gonochorism is suggested to evolve in viviparous species which commonly reproduce asexually (like freshwater sponges and soft corals), thus preventing selfing. Oviparous gonochronic species either have demersal sticky oocytes that mix and disperse poorly (sponges, soft corals and some scleractinians), or spawn over a long period, with a moderate amount of sexual products (sponges and soft corals), and may lack self incompatability mechanisms. Most scleractinians are oviparous hermaphrodites characterized by numerous sexual products, a short spawning period, and well mixed buoyant oocytes. While some oviparous hermaphroditic scleractinians exhibit selfing, sponges and soft corals lack oviparous hermaphroditism.

**The reproductive biology of tropical species of Haplosclerida and Petrosida on the Great Barrier Reef**

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The reproductive biology of three species of the Haplosclerida, *Haliclona amboinensis*, (Lévi, 1961), *H. cymiformis* (Esper, 1794) and *Niphates nitida* , and three species of the Petrosida, *Xestospongia bergquistia* Fromont, 1991, *X. testudinaria* (Lamarck, 1815) and *X. exigua* (Kirkpatrick, 1900), was examined in tropical waters of the Great Barrier Reef, Australia. Species of the Haplosclerida were viviparous (brood eggs and release larvae) and two of the species, *Haliclona amboinensis* and *Niphates nitida* , contained female reproductive products in brood chambers. The branching sponge, *Haliclona cymiformis*, incubated eggs, embryos, and larvae along the central axis of branches. Species of the Petrosida were oviparous (broadcast eggs), and oocytes were evenly distributed throughout the mesohyl. All species were contemporaneously gonochoric, but in some species, successive hermaphroditism could not be ruled out. Fecundity of all species was high. The results of the studies are discussed in relation to two hypotheses on the reproductive trait of ovipary versus vivipary in the Demospongiae. The first hypothesis suggests that ovipary/vivipary in sponges can be used as a taxonomic character (Lévi, 1953; Bergquist, 1978, 1980), and is phylogenetically determined. The second hypothesis suggests that ovipary and vivipary are life history characteristics (Reiswig, 1973; Hoppe, 1988; Van Soest, 1991). The results of the studies support both hypotheses.

## The sponge association of the deep Norwegian-Greenland Sea: sponge/substrate relationships

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During the 'Meteor' Expedition 13 in July and August 1990 to the Norwegian Sea, 10 stations with a depth of 2000 m or more were sampled with Agassiz-trawl, hyperbenthos sledge and/or a large box core. Sponges were found at all stations. A total of 19 different species occurred, many of which were new for the area. Of the 19 species observed 8 can by frequency of occurrence and abundance be defined to represent the typical sponge association of the Norwegian deep sea. Literature review shows more wide-spread occurrence of this sponge association in the deep Norwegian-Greenland sea. The analysis of substrate utilization of these characteristic 8 species shows that all of them are able tot colonize soft bottom, even some that previously have been considered to be hard substrate species. Flexible strategies for alternative substrate utilization and, in some species, the adoption of an infaunal life style are judged to be major reasons for the success of these species in the Norwegian deep sea sponge associations. The infaunal life style of the species *Thenea abyssorum*, *Radiella sol* and *Tentorium semisuberites* ,and demographic structures are documented for the first time.

**Biology and ecology of the deep-sea sponge *Thenea abyssorum***

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During two cruises with the RV 'Meteor' in 1991 and 1992 sponges sampled with an Agassiz-trawl and box core at different stations in the GIN seas were studied. Here data dealing with some aspects of the biology of *Thenea abyssorum*, one of the most common species in the deep sea, are presented.

1. The soft-bottom sponge *T. abyssorum* lives buried up to two-thirds of its height in the sediment and therefore has to be regarded as an infaunal organism. Size-frequency-diagrams were set up and biomass (AFDW) was determined. AFDW is approximately 20% of its dry weight and this percentage is constant throughout the size classes.

2. *T. abyssorum* does reproduce both sexually and asexually in the Norwegian as well as in the Greenland Sea. Mean bud number per individual increases with increasing animal size. But as large animals (i.e > 17 mm) are rare, animals of middle size (10-17 mm) are most important for the production of buds. Buds are always burried in the sediment and it is not known size how and when they reach the sediment surface. No small sponges of budsize could be found when sieving the sediment surface with a 300 µm sieve. Histological studies revealed that gamete production takes place in sponges of all sizes. Comparison of production of reproductive elements at different sampling sites indicate a seasonal reproduction cycle in contrast to the year-round reproduction described for many other deep-sea organisms.

3. Energy metabolism: heat production and ATP-content were determined. ATP turnover-time (2.17 s) and -rate (0.46/s) are in the range determined e.g. for foraminifera. C: ATP ratios are low but an order of magnitude higher in adult sponges than in buds. *T. abyssorum* could be shown to take up DOC (C14-AA) but uptake rates are low, indicating that either DOC is only an additional source of food or activity is highly variable. Particle uptake was determined in flume experiments.

# Mass occurrences of sponges along the Northeast Atlantic shelf and slope: distribution, characteristics and possible causes

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Bottoms with dense populations of sponges are known from off W. Africa, along Western Europe to Northern Norway, north to Spitzbergen and the Polar Sea, and west to the Faroes, Iceland and South Greenland.

Faroese fishermen use the local name "ostebunde" ("cheesebottoms") for them and have known the phenomenon for a long time. During the recent BIOFAR programme (1988-90) we have mapped the distribution of these aggregations around the Faroes. We have found them mostly to be situated close to the shelfbreak, in or near areas where the bottom slope matches the characteristic slope for propagation of internal tidal wave energy. In such regions the bottom currents are elevated and resuspension and transport of particles are enhanced.

Close to 50 species of sponges have been recorded from the Faroese "cheesebottoms". About 20 species have body sizes of more than 5 cm maximum dimension, and the dominating choristid species of *Geodia* and *Stryphnus* reach diameters of 80 cm and a body weight of more than 20 kg. Other fauna is rich, especially in suspensionfeeders.

Another type of sponge aggregation is found south of Iceland deeper on the slope and comprises mainly the hexactinellid *Pheronema carpenteri.*

At the death of the sponges large amounts of siliceous spicules are released. They can either form a local spicule mat on the bottom, or they are transported to other localities, and become a more or less conspicuous part of the sediment there.

**Size spectra of particles taken up by several marine demosponge species**

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Feeding experiments were conducted with a number of sponge species both in the laboratory and, in some cases, in the field. The sponges were fed with suspensions of standardized fluorescent microspheres ranging from 0.15 to 20 µm in diameter. Faeces were collected and inspected for presence/absence of particles of various sizes. The results show that even the smallest particles are taken up by all species investigated. The upper size limit of particles taken up is in the range of a few µm only and varies from species to species. These differences can in part be explained by differences the structure of the water conducting system of the sponges. The results show that for their nutrition, the sponge species investigated have to rely mainly on pico- and nanoplankton and other very small particles and/or dissolved substances.

**Preliminary studies of the Florida hermit crab sponge**

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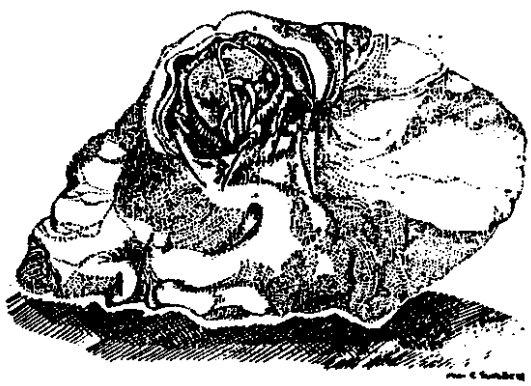
The Florida hermit crab sponge apparently has a limited geographic distribution and debated taxonomy. Disagreement remains as to whether the sponge is *Xestospongia*, *Spongosorites*, or *Suberites*. The sponge shows many similarities to the *Suberites domuncula* - hermit crab association.

It may be limited to the northeastern Gulf of Mexico near Dog Island. Published reports from North Carolina, the Caribbean and elsewhere may involve other species and/or Florida sponges may represent a relict population.

Daily surveys were conducted on Dog Island's beaches from January 7-30, 1992. All sponges washed up near high tide mark or stranded on sand bars were examined. Most sponges were found on the east end of the island in shallow water and low energy wave conditions. 358 sponges were examined. Sponges containing healthy hermit crabs were released. Empty sponges or sponges containing dead or drying crabs were collected. 161 (45%) were empty and 197 (55%) were occupied. 4 (2%) contained the snail *Cantharus cancellarius*; the remainder were occupied by hermit crabs of one of the three species - *Pagurus impressus*, *Pagarus pollicaris*, and *Paguristes hummi*. The occupant in 174 (88%) of the sponges was the red flat-clawed hermit crab, *P. impressus* (see figure).

228 empty and occupied sponges were collected, ranging from 15.58 to 0.42 gm. No significant difference (t-test = .06, df = 122) was found between the mean mass of empty sponges (2.11 + 1.98 gm) vs. crab-occupied sponges (2.09 ± 1.84 gm). In 22 the gastropod on and around which the sponge was growing was identified from exposed portions of the shell. The gastropod species in association with all these sponges was *Cantharus cancellarius*. In most the exposed shell was covered with gemmules. Other sponges showed areas of darkly discolored sponge tissue containing gemmules. Further studies on crab behaviour and aspects of the sponge-hermit crab association are underway.

Figure: Florida hermit crab sponge with red flat-clawed hermit crab, *Pagurus impressus*



## Sponge-Feeding by Caribbean Angelfishes, Trunkfishes, and Filefishes

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Sponges are conspicuous and abundant on most Caribbean coral reefs, but appear to be well defended from predators. When Randall and Hartman (1968) examined gut contents of 212 species of Caribbean reef fishes, they found significant sponge remains (>6% of contents) in only 11 species of angelfishes, trunkfishes, filefishes, a spadefish, and a sharpnose puffer. From 1978 to 1990, every time I saw a fish of one of these species in a shallow reef area of approximately 30 m x 40 m where I was working on other experiments, I followed it and recorded what it ate. French and Gray Angelfishes (*Pomacanthus paru* (Bloch) and *P. arcuatus* (Linneaus) were far more common than the other species, and observations of them yielded 70 feeding sequences, comprising a total of 2285 bites, 75% of which were on sponges. These angelfishes fed on 64 sponge species, representing a wide variety of colors, growth forms, sizes, and most orders of Demospongiae. All sponges within $16m^2$ in the center of the observation area were measured so that relative abundance, in terms of numbers of individuals, total surface area, and total volume of each sponge species could be compared to the preferences of the feeding fish. The 8 most abundant sponge species were included among the 9 species that received the most bites, but fish took bites from all but 6 of the 42 species in the censused area. *Iotrochota birotulata* Higgin was the most abundant sponge, in terms of numbers of individuals, and also received the most bites. By volume, however, *Aplysina (=Verongia) fulva* (Pallas) was most abundant, and it ranked only 4th by numbers of bites taken. Fish moved from species to species as they fed, as predicted by Randall and Hartman's observations of diverse sponges in the guts of individual fish.

**Sponges Growing on Trees**

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The role of Porifera in a mangrove swamp is examined at Twin Cays on the barrier reef of Belize (Central America). The study site is representative of island-mangrove swamps which are among the most common coastal ecosystems in the tropics. These West-Indian mangroves, in contrast to comparable Indo-Pacific swamps, support a diverse and abundant sponge fauna. Because solid substrates are rare in the mangal, sponges and other sessile organisms grow primarily on the stilt roots of red mangroves, *Rhizophora mangle*.
General ecological characteristics of the study area include a small tidal range and, contrary to mainland mangroves, near-oceanic salinity of ambient water. More than 70 species of sponges are found at Twin Cays, ca. 20 of these may be undescribed and are still under study. Surveys and experiments with settling plates show that horizontal distribution is primarily determined by substrate availability and water flow; vertical zonation also by tidal signature, light and sediment exposure, and space competition. Where favorable conditions are combined,the sponge biomass to substrate ratio reaches record values. A few species are uniquely adapted to withstand adverse conditions, such as burial in mud and temperature-salinity extremes.
Sponge larvae are poor swimmers and stay mobile for only a few days. Laboratory experiments show that they switch from positive to negative phototaxis only hours after their release. In situ they stay and settle near parent populations and along the path of strong currents.
Most environmental conditions suitable for sponge growth found in Caribbean mangroves exist also in tidal forest in the Indo-Pacific but the large tidal fluctuations in that region preclude sponge growth by daily exposure of stable substrates to air.

**Process-formation by aquarium-kept sponges and its relevance to sponge ecology and taxonomy**

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Observations on marine sponges maintained in an aquarium under conditions of near starvation have revealed that some species produce long, thin processes which are capable of adhering to the side of the tank. The processes grow in length, presumably utilizing materials derived from the main body of the sponge, which concomitantly shrinks. Hence a behavioural response involving the whole sponge is involved. The processes contain a skeletal framework, canals, choanocyte chambers and cellular tracts, within which spicules are transported to the developing tips of the processes. Along the sides of the processes, but not at their free end, a wide subdermal vestibule is clearly visible in optical section. The living tissue eventually separated proximally from the parent sponge, leaving a naked spicule lattice still connecting the process to the parent sponge. Sponges producing processes included *Haliclona fistulosa*, *Haliclona rosea*, *Haliclona elegans*, *Haliclona ravus*, *Ampilectus fucorum* and *Halichondria panicea*.
Processes have been seen on free-living, littoral specimens of *Haliclona fistulosa*, *H. ravus* and *Halichondria panicea*, which implies that their production in the laboratory is a natural response. The observations suggest that in some species at least the primary response to starvation is a change of form involving reorganization of the tissues to enable parts of the sponge to disperse and possibly reach a more favourable habitat. Caution should be exercised when specifying processes as a diagnostic character.

**Patterns of coral and sponge abundance in degraded vs. still healthy coral reefs at Santa Marta, Colombian Caribbean**

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To study the effect of recent increments in continental runoff on the dynamics of space occupation in Caribbean coral communities, baseline stations were established in three degraded to still-healthy coral reefs located at progressively greater distances from runoff sources, from the city of Santa Marta to the northeast in the Colombian Caribbean Sea. Associated to the extent of the runoff, and related to the state of reef health, downward fluxes of sediments measured in traps were higher on the reef near the sources and progressively lower on the other two reefs. The initial quantification of cover and abundance of sessile organisms was carried out in 1990-91 in similar geomorpholological zones of the three reefs (17-21 m in depth) using point-count chain transects. The results showed that species richness, cover and abundance of sponges was greater near Santa Marta and lower to the northeast, while the opposite pattern occurred for scleractinian corals. On the other hand, comparisons of data taken at the reef near Santa Marta in 1988 with those in 1990 indicated a significant increase in per-species cover and abundance of sponges, while per-species cover and mean number coral of colonies/transect remained similar. In concordance, initial censuses of sponge recruitment carried out in 1991 on plates anchored to the substratum revealed a significantly greater number of attached sponges on the reef near Santa Marta than on the other two reefs. These results may indicate that the patterns of space occupation by major groups of sessile animals are changing as a direct or indirect effect of increased continental runoff. Permanent photoquadrats were also established at each baseline station to further study the dynamics of space occupation.

# Bacterial attack of spongin skeleton during the 1986-1990 Mediterranean sponge disease

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Since 1986, a disease has affected the Mediterranean populations of dictyoceratid sponges, including commercial species. A program for a study of the disease and its economical incidence on the sponge fishing industry has been developed by the FAO.
Observations were conducted during this program on dead or dying specimens of genera *Spongia*, *Hippospongia*, *Cacospongia*, *Sarcotragus* and *Ircinia* collected on the affected sponge grounds. In agreement with previous observations (Gaino & Pronzato, 1989), bacterial digestion of the spongin fibres have been observed in exposed dead parts of the skeleton in dying sponges. However, similar bacteria have been observed boring into spongin fibres in two other circumstances: (i) skeletons of the otherwise healthy living parts of sponges attacked by the disease. (ii) naked skeletons of healthy *Spongia officinalis* experimentally killed and exposed in sea water for several weeks. These results suggest that bacteria that normally degrade dead spongin skeletons may become virulent and digest the spongin fibres in the living tissue of attacked sponges. Isolation of this presumed pathogen and re-infestation experiments were not performed and accordingly it is unknown if these bacteria are involved in the disease as the primary or secondary agent. Digestion of the skeleton implies that the bacteria secrete a collagenase active on spongin, which is resistant to commercially available enzymes.
The disease virulence appears to be related to relatively high sea water temperatures, as sponges have been less affected in the northern zones of the Mediterranean and below 40 m deep. It is also suggested that prolonged, heavy exploitation of commercial sponges on the Mediterranean fishing grounds may have increased the virulence and dispersion of the pathogen.

## 10. HEXACTINELLIDS

Msc **Sally P. Leys**, University of Victoria, British Columbia, Canada:
"Cytoplasmic streaming in the Hexactinellid sponge *Rhabdocalyptus dawsoni* ".

Dr **Dorthe Mehl,** Freie Universität Berlin, Germany:
"New aspects on the living lychniscid sponge *Neoaulocystis grayi* (Bowerbank,1869) and the Lychniscosa (Hexactinellida)".

Dr **Nicole Boury-Esnault**, Station Marine d'Endoume, Marseille, France:
"Structure of the Hexactinellid *Oopsacas minuta* Topsent, 1927".

Dr **Jean Vacelet**, Station Marine d'Endoume, Marseille, France:
"On the development of a hexactinellid sponge, *Oopsacas minuta* Topsent".

**Cytoplasmic streaming in the Hexactinellid sponge *Rhabdocalyptus dawsoni***

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Dissociated sponge cells from *Rhabdocalyptus dawsoni* commonly form spherical aggregates in culture. However, when offered a substrate on glass coverslips or plastic petri dishes coated with an acellular extract from the same species, the cells adhere and spread as a flattened sheet which can cover a 5 $cm^2$ area in 48 h. Spreading cultures show bidirectional cytoplasmic streaming which is inhibited by colcemide ($\geq$ 1 $\mu gml^{-1}$) but is not affected by cytochalasin B (CB) ($\leq$ 50 $\mu M$), suggesting microtubule-based motility is responsible for the streaming. Cell structures exposed to low concentrations of CB (0.1 $\mu gml^{-1}$) show drastic changes in shape by withdrawing from the substrate and undergoing spherulation. Colcemide, in contrast, does not affect aggregate 2.15 $\mu ms^{-1}$ (range 0.9-3.05 $\mu ms^{-1}$). Bidirectional streaming is also apparent in regenerating fragments of *Rhabdocalyptus dawsoni* viewedby light microscopy. Here the cytoplasm flows along spicule shafts to the new dermal membrane and back presumably delivering materials required for tissue morphogenesis. Similarly the cytoplasm will flow along cleaned spicules introduced into adhered, spreading aggregates. While microtubule-based organelle transport has been documented for several freshwater sponges, this is the first report of cytoplasmic streaming in hexactinellids and may have relevance to the syncytial nature of these sponges.

# New aspects on the living lychniscid sponge *Neoaulocystis grayi* (Bowerbank,1869) and the Lychniscosa (Hexactinellida)

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*Neoaulocvstis grayi* is one of only 3 extant species known to represent the large Mesozoic hexactinellid group, the Lychniscosa, important especially during Late Jurassic and Late Cretaceous. Soft body features of *Neoaulocystis* -hitherto unknown - correspond only in part with those of other hexactinellids described. The soft tissues consist almost exclusively of the "membrana reticularis" (Schulze), thin sheets of choano-syncytia stretched on the spicular framework. The choanomeres are interconnected by stolons within the primary reticulum (Rl), which is attached to nodal bodies and choanoblasts by cytoplasmic bridges, but plugs are only occasionally observed. Archaeocytes seem to be rare, and they never occur in aggregates. Within the chambers the secondary reticulum (R2) is extremely fragile and contains no cellular element- such as nuclei. The mesolamella occurs surprisingly massively surrounding young(?) spicules but apparently it is texturally different from that of other Hexactinellida and contains hardly any collagen fibres. The significance of lychniscs is of special interest, since they have been so far interpreted as a mechanical reinforcement of hexactinosan skeletal nodes. However, neither fossil nor recent lychniscosan hexactinellids occur in (paleo-) environments of high water turbulence. According to EM studies of sectioned material, the lychnisc nodes are filled with the "nodal reticulum" of Rl and the mesolamella containing common nuclei and apparently some archaeocytes and vesicular cells. The skeletal architecture of the lychniscosans is probably determined by soft body characters rather than any mechanical condition.

## Structure of the Hexactinellid *Oopsacas minuta* Topsent, 1927

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A dense population of the hexactinellid sponge *Oopsacas minuta* was discovered in a littoral cave near Marseilles. The species was previously known by only two minute specimens from the Gibraltar Straits (924 m). The basidictyonal plate, that Topsent supposed to have been lost in his incomplete type-specimen, is present in all our specimens. The general organisation of the *Oopsacas* tissue corresponds to ultrastructural observations in other hexactinellids. Choanochambers are lined by anucleate collar bodies that bud from subjacent choanoblasts. Choanoblasts form groups of 2 to 6 cells, connected by special "plug" junctions and also with the collar bodies during budding. Both collar bodies and choanoblasts are wrapped in a very thin and digitated trabecular tissue with which they may also be linked by similar junctions. However in our present opinion, the true syncytial organisation of the hexactinellids needs better characterisation. The special junctions can be understood either as intrasyncytial occlusions or intercellular limits. The dense proteic structure of these junctions is similar to desmosomes, and suggests more a mechanical function than a free cytoplasmic communication in a syncytium. The extreme thinness and digitation of the trabecular tissue may require such mechanical reinforcements, that have not been developed in other sponges with thick pinacoderm and choanoderm. Symbiotic thread-like bacteria are abundant in the mesohyl and, surprisingly, inside the collars of collar bodies, at the base of the flagellum. This position may increase exchanges between bacteria and the flowing water, and could represent an adaptation of the sponge-bacteria association to limited food resources in both the cave and deep-sea environment.

## On the development of a hexactinellid sponge, *Oopsacas minuta* Topsent

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In a Mediterranean cave with a stable water temperature (13-14.5 °C), an easily accessible population of the hexactinellid sponge, *Oopsacas minuta* sexually reproduces all year round. Spermatogonies derive from the archaeocyte congeries described in other hexactinellids. Oocytes contain numerous yolk and lipid granules. The tissue organization in embryos and larvae appears to be mostly cellular. The parenchymella-like larvae have a conical pole containing large granular cells and a rounded one with numerous lipid globules. In advanced stages, embryos have large choanochambers which are composed of anucleate collar bodies. Stauractine spicules of the larval skeleton are secreted inside spiculocytes which have the same general features as in Demospongiae. An axial filament with a highly ordered structure is present. The flagellated cell layer covers the larval surface with the exception of its conical part and of the end of the rounded pole. It is composed of large mononucleate cells that are multiflagellated rather than uniflagellated as found in other sponges and in other diploblasts. These flagellated cells are covered by an epithelium which is pierced by their flagella, a very unusual structure in invertebrate larvae and epithelia. During free life, the small larvae (150 µm long) swim counter-clockwise with the rounded, reserve-rich pole forward. Young individuals of about 280 µm in diameter have been observed on the cave walls.

## Horizontal distribution of recent Hexactinellida

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Most Hexactinellida are known from the bathyal zone. Based on the degree of endemism and the distribution areas of species and genera of Hexactinellida five latitudinal bathyal zones are distinguished. The Arctic fauna encloses elements of different origin: endemics and N-Atlantic, N-Pacific and Antarctic. The Antarctic is characterized by: endemics and N-Pacific faunal elements. The Hexactinellida of the Antarctic must have circumantarctic distributions. The Boreal zone consists of N-Atlantic and N-Pacific regions isolated from each other. In the N-Atlantic monotypic genera prevail over polytypic genera, while in the N-Pacific the situation is reversed. The Notalian zone is notably less diverse than the Boreal: the degree of endemism is highest near the shores of New Zealand and South Africa. Bipolarity in Hexactinellida is known at the genus level in *Anoxycalyx* (Arctic- Antarctic) and in several genera of Rossellidae (Boreal-Notalian). The fauna of Hexactinellida in low latitudes shows endemism up to the family level. The fauna of the Indo West-Pacific has the highest share of endemics, especially the region near the Indonesian Archipelago.

A rather low number of species of Hexactinellida inhabit the abyssal. Only four endemics of supraspecific level are registered here: *Hyalonema (Oonema)*, *H. (Phialonema)*, *H. (Skianema)*, *H. (Tallonema)* and *Holascella*. Noteworthy is that all these sponges inhabit the central part of the E-Pacific. All other abyssal supraspecific taxa are cosmopolitan which is more usual for the bathyal. Only a few Hexactinellida are known from the hadal.

It is worth noting that despite their mainly low latitude origin many taxa easily penetrate far into higher laitudes and vice versa. Penetration of Hexactinellida in the abyssal and hadal must have taken place several times presumably in the low latitudes. In the whole, the pattern of zoogeography of bathyal and moreover abyssal is notably simpler than that of the shelf. Borders between zones are less distinct.

## 11. MOLECULAR SYSTEMATICS

Dr **Allen Rodrigo**, University of Auckland, New Zealand:
"Are sponges animals? An investigation into the vagaries of molecular phylogenetic inference".

Dr **Nicole Boury-Esnault**, Station Marine d'Endoume, Marseille, France:
"An analysis of 28S ribosomal RNA sequences suggests early radiations within the Phylum Porifera".

Dr **Michelle Kelly-Borges**, Harbor Branch Oceanographic Institution, Fort Pierce,U.S.A.:
"Molecular systematics of the Lithistida".

Dr.**Antonio M. Solé-Cava**, UFRJ, Rio de Janeiro, Brazil:
"Genetics of marine sponges".

Dr **Russell G. Kerr**, Florida Atlantic University, Boca Raton, U.S.A.:
"Is *Xestospongia muta* a multi-species group ?"

**Are sponges animals? An investigation into the vagaries of molecular phylogenetic inference**

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DNA from *Dysidea* sp. (Demospongiae, Dictyoceratida) was extracted, and a 1.4 kb fragment of the 18S rDNA gene was amplified using the Polymere Chain Reaction (PCR). Two sets of partial DNA sequences, *Dy* 78 (*c.* 0.45 kb) and *Dy* 79 (*c.* 0.40 kb), were obtained using the ABI Automated Sequencer. *Dy* 78 and *Dy* 79 were aligned with coelenterata, human, yeast, strawberry, and slime mould sequences obtained from the GenBank database and a polygenetic analysis was performed on the dataset. The analysis did not conclusively support the claim that sponges are part of the Metazoa: for example, bootstrap analysis of a reduced dataset containing coelenterate, sponge, plant and yeast sequences failed to provide adequate support for the (coelenterate, sponge) clade. We considered the following as possible explanations for the obvious anomaly:

1. *PCR recombinant contamination* of Dy *78* and Dy *79*. To test this we used a modified version of the analysis described in Maynard Smith (1991; *J. Mol. Evol.* **34**: 126-129). Our results indicate that there is no reason to believe that synthetic recombination had occurred.

2. *Transition saturation.* Since the taxa being analysed diverged millions of years before present, it is possible that parallel changes at a number of sites may mask true relationships. In nucleotide sequences, some changes (e.g., transitional changes) are more likely than other (e.g., transversional changes). We weighted transitions and transversions differently to reflect the likelihoods of the respective changes. Although support for the (coelenterate, sponge) clade increased with weighting, the clade was still not significantly supported. Further analysis revealed that, although there were clearly more parallelisms with transitional changes, transversions were also subject to a high level of homoplasy.

3. *Absence of phylogenetic signal.* Tests carried out revealed that phylogenetic signal in the dataset was often obscured. This depended on the inclusions or exclusions of certain taxa. This suggests that either a) the sequences of some taxa are incorrect or b) some taxa have evolved at very different rates from others.

**An analysis of 28S ribosomal RNA sequences suggests early radiations within the Phylum Porifera**

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Sequences from the 5' end terminal part of the 28S ribosomal RNA were obtained and compared for two classes Demospongiae and Calcarea. Phylogenetic analyses undertaken using different methods showed deep radiations and at least three major groups.

In agreement with morphological interpretations, there is a confirmation of the division between the two classes Calcarea and Demospongia; however, rRNA sequences suggest a separation earlier than usually thought. Within Demospongiae our data suggest an early divergence between Haplosclerida and Petrosida on one side and Poecilosclerida, Axinellida, Agelasida and Halichondrida on the other side. Each of these two groups seems to form well separated monophyletic units. These data are clearly in contradiction with the classical taxonomy of demosponges, in particular because the coherence of the sub-class Ceractinomorpha is well accepted. If the respective places of Axinellida and Halichondrida have always been a matter of discussion, the presence of Haplosclerida and Poecilosclerida within the same subclass is of general agreement, and recent cladistic analyses place Haplosclerida as sister group to Poecilosclerida.

The preliminary results suggest that the separation of Haplosclerida-Petrosiida group is a very early radiation. This could be correlated with the fossil record ,the middle Cambrian primitive *Hazelia*, which has a reticulated skeleton of oxeas similar to Haplosclerida-Petrosiida (Finks, 1970).

**Molecular Systematics of the Lithistida**

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Although the Lithistida have traditionally been combined within one order, these sponges are currently regarded as being composed of several assemblages of species, linked by the common possession of a dense interlocking desma skeleton. The diversity of living Lithistida is relatively poor in comparison to that of the fossil fauna. Recent species are found on plateaus or continental shelves down to 600m depth. With the exception of the genera *Discodermia*, *Theonella* and *Corallistes*, most other genera have only been rarely recorded, and described from single or fragmented specimens.

No stable classification of the Lithistda exists to date. Professor Claude Lévi's studies of lithistid faunas of the Norfolk Rise and southern New Caledonia provide the most recent hypothesis of relationships in the group. In 1991, he proposed to adopt the classification of Reid, who in 1963, suggested removing the traditional barriers between the Choristida and the Lithistida, thus creating the two new orders Streptosclerophorida and Euasterophorida.

The Streptosclerophorida are divided into five suborders with desmas, and one without (Streptosclerina). The 'lithistid' suborders include Tetracladina (*Discodermia*, *Theonella*, *Kaliapsis*, *Neosiphonia*), Dicranocladina (*Corallistes*), Megamorina (*Pleroma*, *Anaderma*), and Rhizomorina (*Leiodermatium*, *Scleritoderma*, *Microscleroderma*, *Gastrophanella*, *Aciculites*). Although there are numerous living species of rhizomorinids, the homogeneity of the group is highly debatable. Suborder Helomorina (*Costifer*) is *incertae sedis* within the Streptosclerophorida.

It is crucial to understand the relationships of genera within and between the various assemblages of lithistids, and their affinities with other demosponge genera. Recent research has indicated that lithistids are a promising source of a multitude of bioactive metabolites or novel chemical structures, and, as such, are a group of high priority to natural products investigations. Moreover, with the high fossilization potential of the Lithistida, a substantial body of paleontological evidence is available for use in prediction of a phylogeny for the group. Preliminary questions of relationship within the `Lithistida' are being addressed through nucleic acid sequence aquisition and comparison, and morphological data, in phylogenetic analyses.

## Genetics of marine sponges

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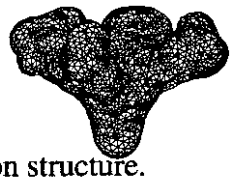
Until recently geneticists and sponge biologists did not seem to talk to each other. In the ten last years, however, some papers appeared that showed how both fields could benefit from cooperative work. This review intends to use those papers as a starting point to raise questions and, possibly, indicate futute lines of research in sponge genetics. These lines include:

Gene variation - Sponges and coelenterates are the genetically most variable animals known. The reasons for that are still not clear. Perhaps sponges are so variable because of their high and temporally stable population size. Alternatively, since sponge cells are in a much more direct contact with sea water than those of other invertabrates, natural selection in varying environments may be favouring species with high levels of gene variation at enzyme coding loci. Studies on levels of gene variation at non coding DNA regions will probably be useful to discriminate between the two hypotheses.

Biochemical systematics - This is the field where most of the genetic studies on sponges have been concentrated. Several sibling species of marine sponges (genera *Suberites, Tethya, Clathrina, Axinella, Oscarella* and *Corticium*) have been detected through enzyme electrophoresis. Such data indicate that the actual number of extant sponge species is likely to be much higher than is usually recognised. Sponges also seem to have extremely low levels of genetic similarity between supposedly congeneric species, compared to other invertebrates. This either means that sponges have some unusually high mutation level and divergence rates or that they are morphologically very conservative. In any case, if this is confirmed in further genetic work, it will have important consequences for taxonomy, and will forcibly affect our understanding of sponge evolution as a whole.

Population genetics - Many sponge species are capable of asexual reproduction. Some studies on histocompatibility have indicated that the extent of clonal formation in some coral reef sponges can be very high. It remains to be tested how common asexual reproduction is in



sponges, and what is the relative importance of the phenomenon for their population structure. Another important, but neglected field in sponge genetics has been that of gene flow: sponge larvae have been studied for years, but we still do not know how effective they are for dispersal. It is imperative that some work be done on the genetic structure of sponge populations, both at the micro- and macro-geographic scales. This will help in estimating the limits and size of their evolutionary units, so that we can address the fundamental problems of speciation and cosmopolitanism in sponge species.

## Is *Xestospongia muta* a multispecies group?

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A multidisciplinary approach is underway to address questions of uniformity (homogeneity) within the West Indian-Caribbean sponge species *Xestospongia muta*. Preliminary analysis of the sterols of a number of individuals of *X. muta* in Puerto Rico indicates the presence of three distinct chemotypes. This has prompted us to investigate whether a similar pattern exists in Florida Caribbean populations of the sponge.

Various chemical and biological approaches are being considered to investigate this problem. Since one lipid component, the sterols, displays three different patterns, other lipid components will be characterized. In addition, morphometric analysis of body characters, including histological features and spicule dimensions, will enable us to detect differences in addition to chemotype, if they exist. Preliminary work underway is reported here today.

## 12. PHYLOGENY AND EVOLUTION

Prof. Dr **Michele Sarà**, Università di Genova, Italy:
"Evolutionary hypotheses and phylogenetic reconstructions in the family Tethyidae (Porifera, Demospongiae)".

Dr **Maurizio Pansini**, Università di Genova, Italy:
"The variability and taxonomic status of different*Petrosia* -like sponges in the Mediterranean Sea".

Ms **Elise V. Robinson**, Harbor Branch Oceanographic Institution, Fort Pierce,U.S.A.:
"The Lithistid genus *Discodermia* (Tetracladina: Theonellidae) from the Atlantic".

MSc **Eduardo Hajdu**, CNPq-Brazil/University of Amsterdam, The Netherlands:
"Poecilosclerid phylogeny revisited: Evidence for the polyphyly of Desmacidids".

Dr **Michelle Kelly-Borges**, Harbor Branch Oceanographic Institution, Fort Pierce,U.S.A.:
"The genus *Ianthella* (Verongida: Ianthellidae) in the South West Pacific".

MSc **Marta Domingo**, CEAB, Blanes (Girona), Spain:
"SPONG-IA: a rule-based expert system for the identification of north-atlanto-mediterranean sponges".

**Evolutionary hypotheses and phylogenetic reconstructions in the family Tethyidae (Porifera, Demospongiae)**

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The family Tethyidae is generally included in the order Hadromerida, but suggestions of a close relationship with the tetractinellid order of Astrophorida have been recently advanced. The present attribution of fifteen genera to the Tethyidae shows that this family is more heterogeneous than hitherto considered. On the basis of new taxonomic knowledge, two different evolutionary scenarios may be hypothesized.

One assumes that the ancestor of Tethyidae was a stalked bathyal organism with radiate structure, globose shape and scarcely developed cortex, traits that exist in some deep water genera of the family and in the genus *Stylocordyla* of the Stylocordylidae. By adaptation to more shallow waters, a genus as *Tethya* maintaining radiate structure and globose shape but acquiring a well developed cortex arose. A further specialization to this environment led to genera in which radiate structure and globose shape, together with the cortex, became reduced or was lost.

The other evolutionary scenario stresses that *Tethya* shares with *Stelletta*, a tetractinellid Stellettidae, some important morphological traits, such as a well-developed cortex with a complex cortical aquiferous system and a full complement of asters. *Tethya*, a large genus with wide geographical and ecological range, is then considered as the taxon closest to the ancestor of Tethyidae. The other genera are considered as derived taxa following two different trends, both implying reduction of the cortex. One, following an adaptation to a deep water habitat, maintained radiate structure and globose shape and acquired a stalk. The other, with increasing adaptation to shallow water habitats, tended to reduction of the radiate structure and loss of the globose shape. These different evolutionary hypotheses have been checked with information derived from cladistic analysis.

**The variability and taxonomic status of different *Petrosia*-like sponges in the Mediterranean Sea**

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Some very common Mediterranean sponge species which were supposed to be well known and identifiable are now becoming much more questionable. This is in part a consequence of recent studies stressing the variability of some characters - such as spicule shape and size - traditionally used in sponge taxonomy. This is the case of *Petrosia ficiformis* (Poiret), whose specific distinction from Esper's *P.clavata* has been recently debated. Since a remarkable variability actually exists among Mediterranean sponges referable to *Petrosia*, an extensive comparison has been performed on a large number of specimens - coming from different localities - taking into account:

- the external morphology, which is strictly bound to the environmental conditions;
- the consistency that seems to be a character quite variable in time;
- the silica content;
- the differences in spicule shape and size among different specimens in the same period and in a single specimen during an annual cycle;
- the characteristics of the skeleton;
- the histology of freshly collected specimens;
- the results of electrophoretic analyses among morphologically or ecologically different sponge populations.

The results of these investigations suggest that the ranging into three different species of the Mediterranean sponge specimens that were often unawarely attributed to *Petrosia ficiformis* is most consistent with the pattern of characters observed.

**The Lithistid genus *Discodermia* (Tetracladina:Theonellidae) from the Atlantic**

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The genus *Discodermia* is distinguished within the family Theonellidae by the presence of simple discotriaenes, in addition to a desma skeleton, combined with a microsclere complement of microxeas and microrhabds. The modified plate-like clads of the triaenes line the surface of the sponge, while the short rhabd projects inwards through the cortex. In addition to the desma skeleton, oxea are scattered through the choanosome or arranged in radiating tracts.
Species of *Discodermia* are extremely difficult to differentiate due to the extreme plasticity of the desma and discotriaene morphology. Furthermore, we have found that the full spectrum of rigidity of the desma skeleton, from densely interlocked to solitary spicules, can be present in a single species. Species of *Discodermia* form tubes, fingers or knobs, but these morphologies are usually not species specific.
*Discodermia* is represented in the western and eastern Atlantic by at least two valid species, *D. dissoluta* and *D. polydiscus;* yet at least 5 species remain undescribed. It is a priority to review and define the specific diagnostic characters of *Discodermia* and to construct a descriptive framework through which new species can be recognised. *Discodermia* is of great interest to drug discovery programs, as strongly bioactive metabolites are known and more can be predicted to occur. To differentiate species of *Discodermia*, we are searching for diagnostic morphological, biochemical and molecular characters to attempt to define species boundaries, and to facilitate rapid field and laboratory identification of key sponge samples for extraction of compounds and screening programs.

**Poecilosclerid phylogeny revisited. Evidence for the polyphyly of desmacidids**

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The possible synapomorphic status of several morphological characters to which little or no importance has been attached in the past when diagnosing higher taxa within the order Poecilosclerida is discussed. Our argument focuses on establishing the polyphyletic nature of desmacidids through the introduction of a new interpretation of the relationships of some of the genera formerly assigned to this family. It may well be true that such an assemblage has been useful in keeping other poecilosclerid families more clearly diagnosed. Nevertheless, our ideas regarding the affinities of anchorate chelae, sigmancistras and placochelae are indicative of the polyphyly of this "family". A proper revision of the genera assigned to it is expected to bring new light onto the phylogeny of the Poecilosclerida. Anchorate chelae have been generally interpreted as polyphyletic. Consequently, little importance has been given to the fact that *Desmacidon* and *Myxilla* share an almost identical complement of anchorate chelae, as well as other skeletal features. *Desmacidon* is hypothesized to be a sister group of *Myxilla* , distinguished from it in the replacement of the choanosomal monactines by ectosomal diactines, and their anchorate chelae are hypothesized as homologous. Several genera bearing anchorate chelae which are currently assigned to other families are also thought to be closely related, with the exception of those of the Cladorhizidae which were very likely developed independently. If *Desmacidon* is related to *Myxilla* , and anchorate chelae are understood as their shared derived trait, the reassessment of the affinities of genera formerly assigned to Desmacididae, but bearing other kinds of chelae becomes urgent. The family name Esperiopsidae has frequently been used for a comparable assemblage of genera, but the recent association of *Esperiopsis* to *Mycale* (cf. Bergquist & Fromont, 1988) with which we concur, makes this family name unavailable for former desmacidids. Genera bearing placochelae are most often assigned to desmacidids. *Eucheliplumа* has placochelae, but also sigmancistras - a character very prominent in cladorhizids which has recently been postulated to be a primitive stage in the development of diancistras and related microscleres. This picture is indicative of the close relationships of *Eucheliplumа* , *Guitarra* and allied genera to cladorhizids, and reinforce our argument about the polyphyly of desmacidids.

## The genus *Ianthella* (Verongida: Ianthellidae) in the South West Pacific

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Sponges in the genus *Ianthella* Gray (Verongida: Ianthellidae) are easily recognised as they occur as single or multilamellate fans that can attain a large size. Colouration within *Ianthella* reflects the different oxidation states of the pigments within the sponge; a single species can display the full range of typically verongid colours such as yellow, burnt orange, green, blue and violet. Fibre construction of *Ianthella* consists of a laminar bark containing spongocytes concentrically arranged around a typical verongid granular pith. The fibres radiate from a constricted base of attachment. The skeleton arrangement is typically a rectangular reticulation of fascicles linked by single or multiple secondary fibres, but in some species fasciculation is absent, the fibres forming a simple net-like reticulation of anastomosing fibres. Extensions of the fibres at right angles to this basic two-dimensional reticulum, are present in several species. These range in complexity from single to multiple dendritic projections, to elaborate reticulated ridges.

Biogeographically, *Ianthella* is a typical "Northeastern Australian-PNG-New Caledonia group, i.e. one that is not known from outside the Indo-Pacific, but which has several species in Australia and only a single species extending out into the Indian Ocean. Other such genera are *Lendenfeldia*, *Thorectandra* and *Thorecta*.

Diagnostic characters of *Ianthella* are reviewed and subjected to phylogenetic analysis in order to evaluate the uniformity of the genus.

## 13. ABSTRACTS OF NON-PARTICIPANTS

Dr **Pedro M. Alcolado**, Instituto de Oceanologia, Cuba:
"Global trends in coral reef sponge communities of Cuba".

Dr **Raisa P. Anakina**, Laboratory of Comparative and Ecological Pathology, St. Petersburg:
"Spermiums of the Barents Sea sponge *Leucosolenia complicata* (Mont.) (Calcarea, Calcaronea) - Cells of unique structure".

Dr **S. Efremova**, Biological Institute, St. Petersburg University, Russia:
"The sponges of Lake Baikal: their biology and genesis".

Dr **A.V. Ereskovsky**, Biological Institute, St.Petersburg University, Russia:
"Sponges of the White and Barents Sea: a faunistic review".

Drs **Stephen Kershaw & Ronald R.West**, Paleobiology Research Unit, Middlesex, United Kingdom & Geology Dept., Kansas State University, U.S.A.:
"Taxonomic value of the calcareous skeleton in Paleozoic chaetetid and stromatoporoid-grade Demosponges".

MSc **Anne B. Klitgaard**, Zoologisk Museum Copenhagen:
"The fauna associated with sponges from the Faroe Islands area".

Prof. Dr. **V.M. Koltun**, Zoological Institute, St Petersburg, Russia:
"The taxonomic structure of calcareous sponges and their classification".

Drs **P.D. Kruse, N.P. James & A. Yu. Zuravlev**, Northern Territory Geological Survey, Darwin, Dept. of Geological Sciences, Kingston, Canada & Paleontological Institute, Moscow:
"Earth's earliest metazoan reefs".

Drs **Beatriz Mothes, Rob W.M. van Soest & Gervasio S. Carvalho**, Museu de Ciencias Naturais,Porto Alegre, Brasil; Institute of Taxonomic Zoology, University of Amsterdam & PUCRS, Brasil: "Biogeography of Brazilian Marine Sponges (Porifera, Demospongiae)"

Dr **Milan Velikonja**, University of Ljubljana, Slovenia:
"Freshwater sponges and the underground habitats".

Dr **Jaya Sree Vennan**, National Institute of Oceanography, India:
"Bioactivity and ecology of the sponges from the Indian coasts".

## Global Trends in Coral Reef Sponge Communities of Cuba

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Information from a great amount of reef stations in Cuba permitted to establish the global trends of ecological indices and the identity of dominant and common species along Cuban reef depth gradients. Species richness and species heterogeneity tend to increase with depth as a result of diminishing of both, hydrodynamic stress and light intensity. Such an ascending trend can be locally disrupted by sedimentation, low substrate quality (sand) and by the unpredictability of environment (storm turbulence) at a specific depth along the depth gradient (critical depth). Geometric complexity of the bottom, which increases with depth, is a redundant factor correlated with the above mentioned ones. A very slight diminution in the global trend of these indices is observed from 20 m to deeper zones. Equitability (J') index varies widely at shallower zones. This variation decreases toward greater depths and values increase as well. A local drop of J' is observed along the depth gradients at the "critical depth" with a further recovery towards the deep reef. Sponge community density varies widely at lower depths and tends to attain values within an aproximate narrow predicted range of 7-11 individuals $m^{-2}$ at depths of 35 m. Sponge cover increases its variation range with depth, with a maximun record of 29 % at 20 m. Predominant species are more predictable in stressed environments than in benign ones.

# Spermiums of the Barents Sea Sponge *Leucosolenia complicata* (Mont.) (Calcarea, Calcaronea) - Cells of Unique Structure

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Spermatogenesis and the structure of mature spermiums have been studied in the sponge *Leucosolenia complicata* by light microscopy with the usage of cytochemical methods. The mature spermium of *L.complicata* looks like a spherical cell with a diameter of 4.8 μm. Its nucleus (4.6 μm in diameter) which is formed by a densely compacted mass of chromatin takes up the main volume of the spermium. It is surrounded by a thin layer of cytoplasm. Flagellum and acrosome are absent.

An absolutely unique characteristic of *Leucosolenia* spermium organization is the existence of a protein capsule which is synthesized around the spermium nucleus during spermiogenesis. This phenomenon does not have any analogy among other Metazoa and it needs further research.

Spherical cells which are similar in their dimensions and absolutely identical in structure with spermiums of *Leucosolenia complicata* were described as cells of C-form in the calcareous sponge *L. nuttingi* (Reiswig & Brown, 1977). Obviously these cells are spermiums of *L. nuttingi*. . "Dolly-cells" are also cell-satellites described for *Sycon raphanus* (Duboscq, Tuzet, 1935, 1937; Sara, 1955, 1974). It is difficult to agree that cells, the main volume of which is a compact nucleus and some quantity of cytoplasm without insertions, can have any meaning for the nutrition of the oocyte. Bidder (1920) who described "dolly-cells" for the first time was right when he considered them as spermiums of *Sycon*..Apparently such organization of spermiums is characteristic for representatives of the Calcaronea group.

## The sponges of the Lake Baikal: their biology and genesis

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P.D. Rezvoj (1936) created the family Lubomirskiidae of freshwater Baikalian sponges on the basis of two principle characters:
1. the absence of gemmulation in their life cycle and
2. the peculiar forms of the asexual reproduction by means of sorites.
It appeared that the "sorites" of the Baikalian sponges were none other than the eggs (Goureeva, 1968). Sexual reproduction has a high similarity to that of the Spongillidae. Sperm cell ultrastructure is identical in the representatives of the two families. The oocyte growth occurs by means of phagocytosis of the trophocytes, specialized cells which are transformed into pseudovitellin cytoplasm inclusions, in the oocytes and in gemmule thesocytes alike. As in the Spongillidae, the larvae of Lubomirskiidae sponges are characterized by precocious differentiation of the choanocytes long before metamorphosis. Histological organization and development of the Baikalian sponges do not show primitive characters when compared with Spongillidae. They are not relicts.
Lubomirskiidae are perennial forms without obvious seasonal changes in their anatomy and histology but with continuous production of oocytes in females. In contrast to Spongillidae they have neither ecological nor physiological preconditions for gemmule formation. As is known, gemmule formation and sexual reproduction in Spongillidae are alternative processes. One can suppose that competition may have existed between the oocytes and gemmule thesocytes for the source of pseudovitellin inclusions - the amoeboid trophocytes. Comparative study of these two families suggest that the Baikalian sponges descended from the Spongillidae as a result of the loss by the latter of their ability for gemmule formation in the peculiar constant conditions of the deep lake - precursor of Lake Baikal in tertiary times.

## Sponges of the White and Barents Sea: a faunistic review

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1. There are 128 species of sponges in the Barents Sea. They belong to Hexactinellida, Demospongiae and Calcarea. Of the last two classes there are 49 species in the White Sea . They are included in the fauna of the Barents Sea. New or endemic species of these seas were not found.
2. Boreal-arctic sponges are dominating in number of species and biomass in all regions of both seas.
3. Maximal diversity for Barents Sea sponges is found in depths from 200 to 300 m, and from 5 to 35 m for White Sea sponges. Water temperature exerts considerable influence only upon the biogeographical sponge composition in different regions of these seas.
4. Almost all euryhaline species of the shore regions of the Barents Sea belong to the White Sea sponge fauna. All sponges found in the White Sea are euryhaline.
5. The nature of the substrate depending on bottom morphology and hydrodynamical features is one of the fundamental factors determining sponge distribution in both seas. The most preferable types of bottom for sponges are stony, stone-silty and mixed bottoms. The substrate type has an influence on sponge body shape.
6. The quantitative distribution of sponges in both seas is closely associated with peculiarities of hydrodynamic conditions, bottom relief, nature of the substrate and organic matter content near the bottom. In the Barents Sea sponge biomass is maximal (77.01 $g/m^2$) in conditions of high water dynamism and mixed substrate in the south-west region, and minimal (0.18 $g/m^2$) on loose bottom sediments in the desalinated south-east region. In the White Sea sponges attain the largest development on stony substrate at shallow depth of Kandalaksha Bay (about 100 $g/m^2$) and the north-east part of Throat (48 $g/m^2$). The least biomass is found on loose substrate in hydrodynamically steady parts of the sea basin (1 g/m2).
7. The Barents Sea recent sponge fauna was formed about 5,000 - 6,000 years ago, although its oldest elements have its origin in Pliocene-Pleistocene times. Ways and directions of settling by sponges of the shelf in this sea depended on the major direction of the North Atlantic current. The formation of the White Sea sponge fauna was closely associated with that of the Barents Sea.

## Taxonomic value of the calcareous skeleton in Paleozoic chaetetid and stromatoporoid-grade demosponges

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Recent work on the classification of modern calcified sponges has clearly shown that the calcareous skeleton has less taxonomic significance than has previously been assumed. Spicule-based taxonomy reveals phylogenetic convergence in the calcareous skeleton. Classification of Palaeozoic chaetetids and stromatoporoids has traditionally been based on the calcareous skeleton, due to the paucity of spicules. However, there is convergence in the calcareous structure of these forms (Wood 1990) and thus the present classification is questionable. Cuif & Gautret (1991) demonstrated that the microstructure in extant calcareous sponge genera is distinct, thereby implying the taxonomic value of the calcareous microstructure itself. They also presented evidence that the microstructure of several Permian and Mesozoic sponges has a phylogenetic relationship with modern forms. More recently Gautret, Vacelet & Cuif (1991) demonstrated that the similarity between the microstructure of *Merlia,* and Jurassic and Carboniferous chaetetids, was such that a phylogenetic relationship was likely. Palaeozoic chaetetid-grade microstructure is normally better preserved than in Palaeozoic stromatoporoids, thus comparisons between extant and fossil chaetetid-grade sponges is possible.

Preservation of Palaeozoic stromatoporoids presents a different problem. Spicules are rarely observed and the calcareous skeleton is nearly always altered, thus the microstructure is either obliterated or changed such that its taxonomic value is worthless. Therefore, phylogenies based on the calcareous skeleton must use the arrangements of the elements of the skeleton and ignore the microstructure. Convergence in the calcareous skeleton, however, increases the risk of erroneous phylogenies. An indication of the value of the calcareous skeleton is its use in recognizing low-level taxonomic units. Traditionally, stromatoporoid species are based on the arrangements of the calcareous elements. Some extant sponges lack spicules, but are identifiable to the generic level (e.g. *Vaceletia).* Identification of species in other extant forms (e.g. *Merlia )* requires spicules,

because the microstructure of the calcareous skeleton is identical in two species of this genus (Gautret, Vacelet & Cuif 1991). As there is a variety of arrangements of calcareous elements in Palaeozoic stromatoporoids comprising the skeletons, these in most cases show consistent differences so that they can be used as taxonomic discriminators. However, in view of the information from *Merlia,* separation of species may not be correct, but genera are probably valid, given current knowledge of Palaeozoic stromatoporoids.

## The fauna associated with sponges from the Faroe Islands area

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Sponges are known to constitute a host for a wide range of invertebrate groups, that live in epi- or endobiotic relation with them. Several investigators have reported relationships of this kind from the tropical and warm-temperated regions in the North Atlantic Ocean. However only very few publications concerning the fauna associated with sponges exist from the North Atlantic Boreal Region.

During the BIOFAR project ("Marine Benthic Fauna of the Faroe Islands") 11 different sponge species belonging to the genera *Geodia*, *Stryphnus*, *Phakellia* and *Thenea* have been examined for epi- and infauna. The BIOFAR sampling programme has shown, that all 11 species are common around the Faroe Islands and, that species of *Geodia* and *Stryphnus* in certain areas are so numerous that, as far as biomass is concerned, they completely dominate the bottom fauna.

A total of 250 invertebrate species, most of which are epibionts, have been found associated with the 11 demosponges. Only very few infauna species have been found. The number of sedentary and errant species present on the sponges are about the same. These results represent a major difference to similar investigations in the warmer regions of the North Atlantic Ocean, where endofauna is commonly found, and where errant species are numerically dominating.

The majority of the invertebrate species found seems to be facultatively associated with the sponges, using these as a substrate. A number of the species, however, show more special relations with the sponges.

## The taxonomic structure of calcareous sponges and their classification

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As with so many other questions the taxonomic assessment of sponges on the basis of their internal structure is inadequately established and lacunal, characterized by incompleteness in general. That pertains particularly to the lower hierarchical levels. The most distinct differentiation of calcareous sponges is connected with the various ways of complexity of their canal-systems: two of them seem to be the result of incomplete asexual reproduction (by longitudinal division or budding) and formation of cormi with their subsequent individualization, and one as a consequence of changes occuring within a simple ascon. Accordingly, three different structural plans of the main skeleton are formed: irregular, radial and pararadial. Stages of complexity and development of canal-system, i.e. such body plan types as ascon, leucon or sycon are differentiated less distinctly from each other. Lower taxa are usually characterized by vague boundaries and extremely broad and diverse polymorphism, which is determined by a very low level of integrity in sponges. Therefore a study of internal structure of species is one of the major goals for the study of group systematics. Otherwise it may be doomed to an infinite and, to a certain degree, meaningless description of forms as separate species.The natural history of calcareous sponges at the present stage of their evolution looks like a process of initiation and parallel development of different ways of complexity of the canal-systems. But this is only a premise of the phylogeny proper, the formation of which is not yet completed and may continue in the course of the evolution, if a final and more significant separation of asconoid, leuconoid and syconoid sponges occurs and parallelism of their origin probably being levelled. The existing classification of calcareous sponges, which has a long history, is extremely hypertrophied. In general it adequately reflects trends of their morphological differentiation, but not the actual taxonomic structure of the group. The results of a long-standing study of the rich sponge collection o the Zoological Institute (St. Petersburg) confirm the validity of Burton's taxonomic strategy and permits us to recognize only 11 valid genera out of quite a number of established genera, with the exclusion of pharetronid sponges. Differences in the structural plans of the main skeleton may only serve as a criterion for the recognition of three families. The first family includes such genera as *Clathrina*, *Leucetta* and probably *Eilhardia* and *Lamontia*, the second includes *Leucosolenia*, *Scypha*, *Amphoriscus* and *Lelapia*, and the third one *Ascandra*, *Leucettusa* and *Baeria* (=*Leucopsilla*). In orde to reflect the dynamic nature of the lower taxa within the classification we obviously cannot neglect using intermediate categories between genera and species.

## Biogeography of Brazilian Marine Sponges (Porifera, Demospongiae)

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The first taxonomic studies on the Porifera of the Brazilian coast concentrated mainly on the fauna of the northeastern region, from the State of Ceará to the State of Bahia, including the Archipelago of Fernando do Noronha and the Atol das Rocas. Later investigations extended the study areas, but prior to our studies there are few records of marine sponges for the southernmost coasts of Brazil, as well as the region north of the mouth of the Amazone river.

The objective of this paper is to detect the areas of endemism of Brazilian sponges, and comparing these with adjoining areas: Colombia, Curaçao and Barbados to the north, and the area from the mouth of the La Plata riiver to Mar del Plata to the south. The method we used is Parsimony Analysis of Endemicity (PAE, Rosen, 1988). The computer analysis was performed with the program PAUP 2.4 (Swofford, 1985). Data consist of 275 species distributed over 15 different localities.

In the first analysis using Brazilian species only a single cladogram was found (286 steps, consistency index 0.77), indicating two larger areas of endemism: a southern area comprising the States of Santa Catarina and Rio Grande do Sul, and a north-south area connecting the southeastern, northeastern and northern areas. A second analysis including the adjoining areas to the north and the south yielded six equally parsimonious cladograms (426 steps, consistency index 0.64), indicating the existence of the following areas of endemism: (1) southernmost Brazil and adjacent areas to the south down to Mar del Plata, (2) from the State of Rio de Janeiro to the State of Santa Catarina,(3) a northeastern-northern areas up to the mouth of the Amazon river, and (4) a northernmost area including the Southern Caribbean. The results indicate that along the Brazilian coastline the main distribution patterns are Patagonian and Caribbean. The first reaches Rio Grande do Sul as its most northerly extension. The latter extends to the south of Brazil (State of Santa Catarina). It is hypothesized that the species recorded from this area are shallow-water (maximum 15 m), inshore sponges. These habitats present high temperatures and a favourable environment for a fauna with Caribbean affinity.

**Freshwater sponges and the underground habitats**

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The distribution of freshwater sponges in hypogean waters was studied in the Postojna-Planina Cave System (PPCS) which is situated in the southern part of the Republic of Slovenia. Three cosmopolitan species of spongillid sponges *Eunapius fragilis* (Leidy, 1851), *Ephydatia muelleri* (Lieberkühn, 1855) and *E. fluviatilis* (Linneaus, 1758) inhabit the beginning of the PPCS, but only the last one inhabits the deeper parts of the cave system. *E. fluviatilis* inhabits also some other caves in the surroundings of the PPCS. All three above mentioned species can reproduce by gemmules at the beginning of the PPCS. In the deeper parts of the PPCS they reproduce sexually only. Specimens from deeper parts of the cave system differ from epigean specimens by their shape (the young ones only), colour, and consistency. Young specimens are mound-like, whitish (or white) in colour, and their consistency is very loose.

**Bioactivity and ecology of the sponges from the Indian Coasts**

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Sixty species of sponges collected from the Indian coasts exhibiting activities like antifertility, diuretic, hypotensive, hypoglycemic, CSN stimulant, spasmogenic and antiviral activity are reported. The distribution and ecological significance of the biological activities are discussed. The sponge *Cliona celata*, from Anjuna (Goa coast), which was associated with a sea cucumber, *Holothuria leucospilota* showed diuretic and hypotensive activities. The sponge *Ircinia ramosa*, which is also associated with a sea cucumber, *Holothuria scabra*, showed likewise hypotensive activities. *Biemna fortis* (Topsent) which has no association with sea cucumbers showed spasmolytic activity.

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