



**World Congress of Malacology
Antwerp, Belgium
15-20 July 2007**

ABSTRACTS

edited by

Kurt Jordaens, Natalie Van Houtte, Jackie Van Goethem & Thierry Backeljau



WORLD CONGRESS OF MALACOLOGY

ANTWERP, BELGIUM
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The web-team of the Royal Belgian Institute of Natural Sciences

and so many others who helped in various ways...

THE SCIENCE

Contributed paper sessions:

The World Congress of Malacology is an opportunity for malacologists from throughout the world to get together to discuss the animals on which they work. Accordingly, contributed papers and posters on all aspects of malacology are welcome.

There are several major symposia:

SEXUAL SELECTION IN MOLLUSCS

Traits that evolve through selection during the process of mating are said to be sexually selected. Famously, Darwin claimed that sexual selection could not occur in molluscs, because of their hermaphroditism and imperfect senses, but in this he was clearly wrong. In fact, sexual selection is particularly strong in molluscs owing to the prevalence of sperm competition. Some sexually selected molluscan traits that have been documented by recent studies include extreme variations in reproductive anatomies, complex mating systems, variable mating strategies, mate choices, sexual signaling, bizarre courtship behaviours, and post-copulatory manipulations. Because such traits are closely linked to reproductive success, they tend to evolve rapidly, with sometimes unexpected results such as the love-dart. Also, given that the specific reproductive interests of the two sexes are usually different, and may even be in conflict, male and female traits do not necessarily evolve symmetrically. Some recent evidence points to the occurrence of antagonistic co-evolution between male and female traits within hermaphroditic molluscs. In this symposium we aim at an overview of research on sexual selection in molluscs, with the purpose of stimulating and guiding further research on this topic.

Contact: Dr. Ronald Chase, Dept. Biology, McGill University, 1205 Ave. Docteur Penfield, Montreal, Quebec, H3A 1B1, Canada; Email: ronald.chase@mcgill.ca; Dr. Joris Koene, Dept. Animal Ecology, Free University of Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands; Email: joris.koene@falw.vu.nl

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Species-level taxonomy is making a come-back. The global discovery, description and naming of new mollusc species continues at a steady pace. Undersampled regions or habitats, understudied families, as well as old faunas being revisited with new characters, all contribute new species to the global inventory, as they have in the past. However, the global context of molluscan exploration is changing with, e.g., the Convention on Biological Diversity, the Barcoding of Life or the Global Biodiversity Information Facility directly or indirectly affecting the way we collect, analyze and archive specimens and information related to them. How are new explorations changing our perception of the magnitude of regional or global faunas? Where are the frontiers? How is the molecular revolution impacting day-to-day on alpha taxonomy? What are the bottlenecks to describing and naming new mollusc species? What problems and solutions do we share with other taxonomists, and what makes malacologists different? What is / what should be the place of malacological journals in this endeavour? These will be the core questions dealt with by this symposium.

Contact: Dr. Philippe Bouchet, Muséum National d'Histoire Naturelle, 55, rue Buffon, F-75005 Paris, France; Email: pbouchet@mnhn.fr; Dr. Somsak Panha, Dept. Biology, Chulalongkorn University, 254 Phayathai Road, Patumwan, Bangkok, 10330 Thailand; Email: somsak_panha@yahoo.com

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

The majority of molluscan biodiversity is composed of animals in a size range of <5 mm, yet these micromolluscs are often considered difficult to work with. This symposium brings together various workers on micromolluscs to foster information exchange and to stimulate further investigations. Presentations should be composed of equal parts of detailed methods, including failed attempts and currently unresolved problems, and results. Presentations discussing methods only are also encouraged. All aspects of working with micromolluscs (including: collecting, sorting, preservation, curation, tools, morphology, histology, imaging, life history, fossil, recent, marine, freshwater, terrestrial) may be addressed as long as the maximum diameter of the animals is \leq 5 mm. An open discussion on the various issues will conclude the symposium. Possibilities about symposium proceedings in the form of a special journal issue are considered.

Contact: Dr. Daniel L. Geiger, Santa Barbara Museum of Natural History, Invertebrate Zoology, 2559 Puesta del Sol Road, Santa Barbara, CA 93105, USA; Email: geiger@vetigastropoda.com

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Evolutionary biology is not only a biological subdiscipline but provides us with the foundation stone for biology in general. However, to date two of the least understood phenomena in evolutionary biology are the diversity of biological organisms, or biodiversity, which is far from being discovered, and its causation (i.e. the evolutionary processes leading to it). Surprisingly, decades after the “Modern Synthesis” as most comprehensive scientific achievement in this field and centuries after the commencement of research in biological systematics, we are still unable to satisfyingly answer apparently simple questions such as (i) how many species inhabit the earth today, (2) how did this diversity originate, and (3) how is this diversity distributed. While many contributions in malacology center around morphology, anatomy, and in particular phylogenetic relationships within and among its constituent taxa, rarely molluscs have been utilized explicitly as models for the study of general aspects in evolutionary biology. However, we feel that also this particular group with its many features and facets is highly suitable for providing some fundamental insights into the mechanisms of the genesis of biodiversity, its pattern in historical biogeography and the underlying processes of speciation and radiation. Thus, it is the aim of this symposium to bring together experts and their expertise based on molluscs to provide some of those fundamental studies and data that are of relevance for evolutionary biology with aspects as outlined above, in order to facilitate the influence of malacology within evolutionary biology.

Contact: Dr. Matthias Glaubrecht, Museum of Natural History, Humboldt University Berlin, Invalidenstrasse 43, D-10115 Berlin, Germany; Email: matthias.glaubrecht@museum.hu-berlin; Dr. Thomas von Rintelen, same address; Email: thomas.rintelen@rz.hu-berlin.de

MOLLUSCS IN ECOTOXICOLOGICAL RESEARCH

Ecotoxicology integrates studies related to ecological and toxicological effects of chemical pollutants and/or natural stressors on individuals, populations, communities and ecosystems with those dealing with the fate (transport, transformation and breakdown) of such pollutants in the environment. Molluscs are increasingly used as model organisms in ecotoxicology. The symposium will cover all fields of ecotoxicology in its broadest sense (descriptive studies of pollutant distribution and effects in individuals, development and evaluation of biomarkers, measurement techniques, biomonitoring, exposure and risk assessment, environmental protection and management etc.). Attention will be given to all different levels of biological organisation: cells, tissues, individuals, populations, communities and ecosystems.

Contact: Dr. Kurt Jordaens, Evolutionary Biology Group, Dept. Biology, University of Antwerp, Groenenborgerlaan 171, B-2020, Antwerp, Belgium; Email: kurt.jordaens@ua.ac.be; Dr. Rita Triebkorn, Steinbeis-Transferzentrum für Ökotoxikologie und Ökophysiologie, Blumenstrasse 13, D-72108 Rottenburg, Germany; Email: stz.oekotox@gmx.de

MOLLUSCS AND PEST CONTROL

The worldwide demand for strategies to control molluscs as pests in horticulture, agriculture and aquaculture necessitates an integrated approach amalgamating knowledge from the ecology and biology of molluscs, chemistry, biochemistry, physics, and also from economy. The symposium “Molluscs and pest control” shall, therefore, cover a wide field of research activities including those related to refinements of existing methods to control molluscs, studies on new regulation methods and strategies, work on techniques to detect effects and side-effects of molluscicide agents, and studies on distinct responses of molluscs to (potential) molluscicides at different biological levels (e.g. behaviour, physiological, cellular or molecular reactions) by which distinct modes of action can be elucidated. Also contributions on fundamental research in biology of molluscs aimed at finding new, and possibly more specific instruments for pest control are welcome.

Contact: Dr. Rita Triebkorn, Steinbeis-Transferzentrum für Ökotoxikologie und Ökophysiologie, Blumenstrasse 13, D-72108 Rottenburg, Germany; Email: stz.oekotox@gmx.de; Dr. Bill Bailey, Faculty of Life Sciences, 3.614 Stopford Building, The University of Manchester, Oxford Road, Manchester M13 9PT, UK; Email: member@m336wy.freeserve.co.uk

MOLLUSCAN MODELS: ADVANCING OUR UNDERSTANDING OF THE EYE

Several invertebrate systems have been developed to study the eye and eye disease (*Drosophila*, *Planaria*, *Platynereis*, and most recently, the cubozoan jellyfish *Tripedalia*), but a molluscan model is conspicuously absent. This is surprising as mollusc systems offer many advantages and opportunities to study basic visual processes that may be altered in the disease state, physiology of vision, development of the visual system, and evolution. As an example, recent work shows that cytoskeletal organization is regulated by the state of light and dark adaptation in cephalopods. We also know that some disease states in the retina affect the cytoskeleton. Studies on cephalopod photoreceptors could lead to a better understanding of the role of the cytoskeleton in photoreceptors and provide clues that link its organization to retinal disease. To take advantage and increase the use of molluscan eye models, there is a need to increase interactions between eye researchers and malacologists, who study the organism as a whole. Malacologists provide a detailed knowledge of the organism's ecology/habitat/niche that, when combined with expertise on the development

and physiology of the eye, have the potential to re-direct research to more fruitful questions and model systems. At present, these two groups of researchers are largely unaware of the other's body of work as they do not attend the same meetings or publish in the same journals. This symposium will open a dialog between these fields, to invigorate and advance eye research into new frontiers by using molluscan eyes as a model system to study eye development and disease.

Contact: Dr. Jeanne Serb, Dept. Ecology, Evolution, and Organismal Biology, 245 Bessey, Iowa State University, Ames, IA 50011, USA; Email: serb@iastate.edu; Dr. Laura Robles, California State University, Dominguez Hills, 1000 E. Victoria Street, Carson, CA 90747, USA; Email: lrobles@csudh.edu

ZOOGEOGRAPHY OF THE NON-MARINE MOLLUSKS OF THE EASTERN MEDITERRANEAN

This symposium aims to provide an overview of the distributions of land and freshwater mollusks throughout the eastern Mediterranean countries. We hope to achieve a better understanding of the past events, paleogeography and speciation, from the present patterns and vice versa. The area of coverage includes Greece, Turkey, the lower Balkan countries, Georgia, Armenia, Iran, the Middle Eastern countries and Egypt. Contributions from adjacent countries not listed will be considered.

Contact: Dr. Aydin Örstan, Section of Mollusks, Carnegie Museum of Natural History, Pittsburgh, PA, USA; Email: zoogeography@earthlink.net

BIODIVERSITY AT CROSSROADS: FRESHWATER BIVALVES FROM MASS EXTINCTION TO GLOBAL INVASION

Freshwater habitats represent just a tiny fraction of the Biosphere, yet their role is central in the global ecosystem. They contribute disproportionately to global biodiversity, with about a third of fish species and possibly near a fourth of molluscs. Today this richness is under serious threat from a variety of human-induced factors, among which radical habitat destruction, rampant pollution and expanding invasive species (bivalves included) are paramount. Bivalves have experienced several evolutionary radiations in freshwaters, often becoming keystone ecological elements. The purpose of this symposium is to bring together what we know (and don't) about any and all freshwater bivalves: their diversity, adaptations, evolution, ecology, and management. We would like to cover all major areas of research, as well as all biogeographic regions and taxonomic groups involved. Synthetic, general approaches are thus just as welcome as in-depth, local reports from anywhere. The goal is to provide a coherent, strong case for action in research and conservation of these unique faunas worldwide.

Contact: Dr. Cristian R. Altaba, Laboratory of Human Systematics, Ed. Ramon Llull, University of the Balearic Islands, 07071 Palma de Mallorca, Balearic Islands, Spain; Email: cristianr.altaba@uib.es

NEOGASTROPOD ORIGINS, PHYLOGENY, EVOLUTIONARY PATHWAYS AND MECHANISMS

Neogastropods constitute a diverse and extremely successful radiation of predatory marine gastropods that appeared abruptly in the fossil record during the Albian (100 mya) with nearly all families represented in essentially modern form by the end of the Cretaceous. While neogastropods are united by and easily recognized on the basis of distinctive shell, radular, and anatomical features, these characters have failed to demonstrate an unambiguous affinity to other gastropods, or to resolve into nested subsets that clearly define evolutionary patterns within the group. Relationships among the many lineages within the Neogastropoda have also been difficult to discern because of high rates of homoplasy and high incidence of derived, autapomorphic features in both morphological and molecular data sets. This symposium will address questions of neogastropod origins, monophyly, age, patterns of diversification and cladogenesis and their evolutionary pathways and mechanisms from a variety of perspectives, including paleontology, morphology, anatomy, DNA sequence evolution, reproduction and developmental biology. Detailed studies of taxonomic subsets within Neogastropoda are also welcome. The proceedings of this symposium will be published as a supplement to *The Nautilus*. Contributors are encouraged to contact either of the organizers with a tentative title for their presentation. Oral presentations as well as posters are welcome.

Contact: Dr. M.G. Harasewych, Dept. Invertebrate Zoology, MRC-163, National Museum of Natural History – Smithsonian Institution, P.O.Box 37012, Washington D.C., 20013-7012, USA; Email: Harasewych@si.edu; Dr. Ellen E. Strong, same address; Email: stronge@si.edu

HEART AND CIRCULATION IN MOLLUSCS

This Congress provides an opportunity to examine the roles, in the evolution of the anatomy of heart and circulation of present day molluscs, of behavior and physiological function at several levels: subcellular, tissue, organ, organ systems and interaction with the environment. Local and central control systems may be taken into account. The initiative in organising the symposium is being taken by physiologists convinced that the life of the molluscan animal must be described through relating anatomy and behavior to analysis of physiological functions.

Contact: Dr. Robert B. Hill, Dept. Biological Sciences, Biological Science Center, University of Rhode Island, 100 Flagg Road, Kingston, RI 02881, USA; Email: bob@uri.edu

QUATERNARY MALACOLOGY

The aim is to include contributions from both the marine and non-marine realms and to cover a broad geographical area encompassing the North Atlantic and the whole of the Palaearctic region. We welcome contributions from the Plio-Pleistocene to the Holocene. Likely themes could involve historical biogeography, environmental archaeology, palaeoecology and stratigraphy. The symposium is organised by EQMal (European Quaternary Malacologists) and Naturalis (National Museum of Natural History) in Leiden (The Netherlands).

Contact: Dr. Tom Meijer, Nationaal Natuurhistorisch Museum – Naturalis, Darwinweg 2, NL-2333 CR Leiden, The Netherlands ; Email: meijert@naturalis.nl

CONFERENCE VENUE

The venue for the conference is the University of Antwerp – Campus Groenenborger.

The congress registration desk is situated in the Y-building; this is also the place where lunch will be served.

All lecture halls are situated in the T- and U-buildings. Posters are displayed in the hall of the T-building. A preview room for the oral talks is situated in U 026. Free computer facilities (internet) are available in the S-building (second floor).

A welcome function ('Icebreaker') will be held on Sunday afternoon, July 15th from 17:30 – 19:30 pm at the 'Marmeren Zaal', 'Verlatzaal' and 'Winter Garden' of the Zoo of Antwerp and is situated on the Koningin Astridplein, in the 'corner' near Antwerpen-Centraal (railway station).

The congress diner will be held in 'Grand Café Horta' (Hopland 2, close to the 'Rubenshuis', 'Wapper' and 'Stadsschouwburg').

More information can be found in the 'Travel and accommodation information' that was sent to you by email.

SCHEDULE AT A GLANCE (some evening sessions make last 20 min. longer)

MONDAY 16 JULY					
	T 103	T 105	T 129	T 148	
09:00-09:30	Welcoming and announcements in T103				
09:40-11:00	Neogastropods	Diversity	Eye	Terrestrial ecology	
11:30-12:50	Neogastropods	Diversity	Eye	Terrestrial ecology	
12:50-14:00	Lunch + AMS/AMB closed meeting in U 024				
14:00-15:40	Neogastropods	Pest control	Eye	Mol. Phyl. Evol.	
16:10-17:50	Neogastropods	Pest control	Eye	Mol. Phyl. Evol.	
TUESDAY 17 JULY					
	T 103	T 105	T 129	T 148	
09:00-10:00	Neogastropods	Evolution	EQMal	Ecotoxicology	
10:00-10:40	Inventory	Evolution	EQMal	Ecotoxicology	
11:10-12:50	Inventory	Evolution	EQMal	Ecotoxicology	
12:50-14:00	Lunch + AMS systematics meeting in U 024				
14:00-15:00	Inventory	Evolution	EQMal	Ecotoxicology	
15:00-16:10	Inventory	Evolution	Heart	Ecotoxicology	
16:10-17:50	Inventory	Evolution	Heart	Ecotoxicology	
16:10-18:00	Curator's meeting in U 024				
16:30-17:30	EQMal formal meeting in U -003				
18:00-20:00	Poster session in main hall T building				
THURSDAY 19 JULY					
	T 103	T 105	T 129	T 145	U 024
09:00-10:40	Inventory	Evolution	Sexual selection	Zoogeography E Mediterranean	Bivalve taxonomy
11:10-12 :50	Inventory	Evolution	Sexual selection	Zoogeography E Mediterranean	Mol.Phyl. bivalves
12:50-14 :00	Lunch + AMS conservation committee meeting in U 024				
14:00-15:40	Micro-molluscs	Evolution	Marine ecology	Freshwater Molluscs	
16:10-17:50	Micro-molluscs	Evolution	Marine ecology	-	
19:00-21:00	AMS auction at TPC – building R				
FRIDAY 20 JULY					
	T 103	T 105	T 129	T 149	U 024
09:00-10:40	Micro-molluscs	Evolution	Sexual selection	Freshwater bivalves	
11:10-12:50	Micro-molluscs	General tax.&phyl.	Sexual selection	Freshwater bivalves	
12:50-14:00	Lunch + AMS students meeting in U 024				
14:00-15:40	Micro-molluscs	Opisth. syst.&phyl.	Deep sea	Freshwater bivalves	
16:10-17:10	Unitas Malacologica general meeting in T 103				
17:10-18:10	AMS general meeting in T 103				
20:00-???	Congress diner at 'Grand Café Horta'				
SATURDAY 21 JULY					
09:30-17:00	IUCN SSC Specialist Group meeting in U 024				

CONFERENCE PROGRAM

MONDAY 16 JULY

Lecture hall T 103

09:00 – 09:30 Welcoming and announcements: Thierry Backeljau

**NEOGASTROPOD ORIGINS, PHYLOGENY,
EVOLUTIONARY PATHWAYS AND MECHANISMS**

Chair: Jerry Harasewych

09:40 – 10:00 Origin and early radiation of the Neogastropoda: Evidence from nuclear and mitochondrial genes

Harasewych, M.G.

10:00 – 10:20 What is supporting the Neogastropoda monophyly? New evidences for the paraphyly

Kantor, Yuri I.; Fedosov, Alexander

10:20 – 10:40 Proboscis morphology in Caenogastropoda: Does the neogastropod proboscis have a homologue?

Golding, Rosemary E.

10:40 – 11:00 Kidney anatomy of neogastropods: New insights into relationships, affinities and evolutionary dynamics

Strong, Ellen E.

11:00 – 11:30 Tea/Coffee

**NEOGASTROPOD ORIGINS, PHYLOGENY,
EVOLUTIONARY PATHWAYS AND MECHANISMS**

Chair: Jerry Harasewych

11:30 – 11:50 Evaluation of Neogastropoda of the Cretaceous, their taxonomy and relation based on the morphology of their protoconch

Bandel, Klaus

11:50 – 12:10 The road to an endemic Southeast Pacific fauna: Neogene neogastropods from Chile and Peru

Nielsen, Sven N.; DeVries, Thomas J.

12:10 – 12:30 To live or not to live in mud: The Neogastropod side of the story

Fortunato, Helena

- 12:30 – 12:50 A molecular phylogeny of the Buccinidae—a southern and a northern connection
Hayashi, Seiji
- 12:50 – 14:00 Lunch + AMS Publications and AMB meeting (closed meeting) in Lecture hall U 024

**NEOGASTROPOD ORIGINS, PHYLOGENY,
EVOLUTIONARY PATHWAYS AND MECHANISMS**

Chair: Ellen Strong

- 14:00 – 14:20 Early ontogeny in buccinid gastropods: inferences from morphology
Vendetti, Jann E.
- 14:20 – 14:40 Morpho-phylogenetic analysis of the subfamily Colinae (Buccinidae, Neogastropoda)
Kosyan, Alisa R.
- 14:40 – 15:00 Adaptive significance of secondarily reduced features of the soft anatomy of *Vitularia salebrosa* (Neogastropoda: Muricidae): Experimental, geochemical, and anatomical evidence
Herbert, Gregory S.; Simone, Luiz R.; Fortunato, Helena; Sliko, Jennifer; Dietl, Gregory P.
- 15:00 – 15:20 The coralliophilines radiation: repeated dives into the deep?
Oliverio, Marco; Richter, Alexandra; Barco, Andrea; Modica, Maria Vittoria
- 15:20 – 15:40 Accounts on the phylogeny of the Muricidae (Caenogastropoda) based on comparative morphology of some representatives
Simone, Luiz Ricardo L.
- 15:40 – 16:10 Tea/Coffee

**NEOGASTROPOD ORIGINS, PHYLOGENY,
EVOLUTIONARY PATHWAYS AND MECHANISMS**

Chair: Ellen Strong

- 16:10 – 16:30 Using molecular approaches to investigate the function of the hypobranchial gland of the marine snail, *Dicathais orbita*
Laffy, Patrick W.; Benkendorff, Kirsten; Westley, Chantel; Abbott, Catherine A.
- 16:30 – 16:50 The genesis of Tyrian purple precursors in the gonoduct and egg masses of *Dicathais orbita* (Neogastropoda: Muricidae)
Westley, Chantel; Benkendorff, Kirsten

- 16:50 – 17:10 The enigmatic neogastropod *Tritonoharpa*: New data on cancellariid evolution
Modica, Maria Vittoria; Kosyan, Alisa; Oliverio, Marco
- 17:10 – 17:30 Sexual dimorphism in the shells of the South-Western Atlantic gastropod *Olivella plata* (Ihering, 1908) (Mollusca: Olividae)
Pastorino, Guido
- 17:30 – 17:50 Reproductive studies on volutes of the South West Atlantic (Neogastropoda: Volutidae)
Penchaszadeh, Pablo E.; Arrighetti, Florencia; Bigatti, Gregorio; Cledón, Maximiliano; Giménez, Juliana Carlos Sanchez, Antelo

MONDAY 16 JULY

Lecture hall T 105

OPEN SESSION: LAND SNAIL DIVERSITY

Chair: Beata Pokryszko

- 09:40 – 10:00 Land snail faunas in Polish forests: history, geography and ecology
Cameron, Robert A.D.; Pokryszko, Beata M.; Horsak, Michal
- 10:00 – 10:20 Regional and local scale effects on the richness and composition of land snail assemblages in Hungary
Sólymos, Péter; Jónás, Ágota
- 10:20 – 10:40 Snails from America's heartland: diversity and abundance of terrestrial gastropods in Southern Illinois, USA
Coppolino, Marla L.
- 10:40 – 11:00 Land-snail diversity in a threatened limestone formation in Odukpani, Cross River State, Nigeria
Oke, Chris O.
- 11:00 – 11:30 Tea/Coffee

OPEN SESSION: LAND SNAIL DIVERSITY

Chair: Robert Cameron

- 11:30 – 11:50 Contribution to the revision of the biodiversity of Tunisian terrestrial Malacofauna
Abbes, Intidhar; Nouira, Saïd
- 11:50 – 12:10 Rhytididae in Madagascar: reality or wishful thinking?
Herbert, D.G.; Moussalli, A.; Griffiths, O.
- 12:10 – 12:30 Systematic and distributional studies of Colombian continental mollusks – The land snail genera *Isomeria* Beck and *Labyrinthus* Beck (Gastropoda: Camaenidae)
Borrero, Francisco J.; Kattan, Gustavo; Giraldo, Manuel
- 12:30 – 12:50 Biogeography and systematic concepts of Helicinidae in the Lesser Antilles (Gastropoda: Neritopsina)
Richling, Ira
- 12:50 – 14:00 Lunch + AMS Publications and AMB meeting (closed meeting) in Lecture hall U 024

MOLLUSCS AND PEST CONTROL

Chair: Rita Triebkorn

- 14:00 – 14:40 Controlling slugs and snails – will hope triumph over experience?
Port, Gordon
- 14:40 – 15:00 Pest snails in Australia: current management strategies and challenges for the future
Lush, Angela L.; Baker, G.H.
- 15:00 – 15:20 Impacts of three seasonal soil management regimes on slug abundance and slug damage to oilseed rape
El Titi, Adel
- 15:20 – 15:40 Mortality to the giant African snail *Achatina fulica* Bowdich, 1822 and non-target snails using select molluscicides
Ciomperlik, Matthew A.; Robinson, David G.; Gibbs, Ian H.; Fields, Angela; Stevens, Timothy; Taylor, Bret M.
- 15:40 – 16:10 Tea/Coffee

MOLLUSCS AND PEST CONTROL

Chair: Bill Bailey

- 16:10 – 16:30 Effect of a novel molluscicide on the snail *Oncomelania hupensis*
Xu, Xingjian; Yuan, Yi; Wei, Fenghua; Tu, Zuwu; Cao, Mumin; He, Hui; Fan, Hongping; Li, Guiling; Zhao, Yunbing; Liu, Min; Dussart, G.
- 16:30 – 16:50 The use of microencapsulated BioBullets in the control of invasive bivalves
Aldridge, David C.
- 16:50 – 17:10 Application of a 16S rDNA barcode to diagnose pest *Arion* species in the U.S.A.
Barr, Norman; Cook, Amanda; Elder, Peggy; Molongoski, John; Prasher, Douglas; Robinson, David
- 17:10 – 17:30 Local adaptations, races or even species?
Engelke, Sabine
- 17:30 – 17:50 Molecular diversity among populations of the terrestrial slugs *Arion lusitanicus* and *Arion rufus* (Mollusca, Pulmonata, Arionidae) in Poland
Soroka, Marianna, Kałuski, Tomasz, Kozłowski, Jan, Wiktor, Andrzej

MONDAY 16 JULY

Lecture hall T 129

MOLLUSCAN MODELS: ADVANCING OUR UNDERSTANDING OF THE EYE

Chair: Laura Robles

09:40 – 10:20 Developing molluscan models to study the disease, ecology, and evolution of the eye
Serb, Jeanne M.

10:20 – 11:00 Photoreception and the evolution of photoreceptors (with special reference to Mollusca)
Salvini-Plawen, Luitfried

11:00 – 11:30 Tea/Coffee

MOLLUSCAN MODELS: ADVANCING OUR UNDERSTANDING OF THE EYE

Chair: Laura Robles

11:30 – 12:10 Evolution of mollusc lens crystallins
Piatigorsky, Joram

12:10 – 12:50 Eye structure and vision among gastropods
Zieger, Marina

12:50 – 14:00 Lunch + AMS Publications and AMB meeting (closed meeting) in Lecture hall U 024

MOLLUSCAN MODELS: ADVANCING OUR UNDERSTANDING OF THE EYE

Chair: Jeanne Serb

14:00 – 14:20 The genus *Buccinanops* (d' Orbigny, 1841): No eyes or blind eyes?
Averbuj, Andres; Penchaszadeh, Pablo E.

14:20 – 14:40 Chitons as potential models for investigating recent and parallel evolution of eyes
Eernisse, Douglas J.

14:40 – 15:20 Using the Octopus retina to understand the cell biology of the eye: Surprises and clues!
Robles, Laura J.; Kelly, Shannon

15:20 – 15:40 Analysis of the 3' untranslated regions of α -tubulin and S-crystallin mRNA and identification of CPEB in dark- and light-adapted octopus retinas
Kelly, Shannon; Robles, Laura

15:40 – 16:10 Tea/Coffee

MOLLUSCAN MODELS: ADVANCING OUR UNDERSTANDING OF THE EYE

Chair: Jeanne Serb

16:10 – 16:50 The evolution of eyes in the Bivalvia: new insights
Morton, Brian

16:50 – 17:10 Scallops visually respond to simulated particles in flow
Speiser, Daniel I; Johnsen, Sönke

17:10 – 17:50 Receptor physiology in bivalve eyes and the role of primary inhibition
Wilkens, Lon A.

MONDAY 16 JULY

Lecture hall T 148

OPEN SESSION: TERRESTRIAL ECOLOGY IN SPACE AND TIME

Chair: Heike Reise

- 09:40 – 10:00 Pupilloidea (Pupillidae, Vertiginidae, Valloniidae, Gastrocoptinae) of the Altay – a travel in space and time
Pokryszko, Beata M.; Horsák, Michal
- 10:00 – 10:20 New data on Paleozoic continental gastropods from Poland: Sedimentary and evolutionary context
Stworzewicz, Ewa; Pokryszko, Beata M.; Szulc, Joachim
- 10:20 – 10:40 Synanthropic terrestrial mollusc faunas of Colorado and Utah
Hutchinson, John M.C.; Reise, Heike
- 10:40 – 11:00 Life cycles of the Polish clausiliids – knowns and unknowns
Maltz, Tomasz K.; Sulikowska-Drozd, Anna
- 11:00 – 11:30 Tea/Coffee + AMS Publications and AMB closed meeting in Lecture hall ‘Jan Cox’ (next to Lecture hall T129)

OPEN SESSION: TERRESTRIAL ECOLOGY IN SPACE AND TIME

Chair: John Hutchinson

- 11:30 – 11:50 Harmonic radar evidence for wind dispersal and homing capability in the tree snail genus *Achatinella* (Pulmonata: Achatinellidae)
Hall, Kevin T.; Hadfield, Michael G.
- 11:50 – 12:10 Active camouflage in a snail
Allgaier, Christoph
- 12:10 – 12:30 When a snail dies in the forest, how long will the shell persist?
Pearce, Timothy A.
- 12:30 – 12:50
- 12:50 – 14:00 Lunch + AMS Publications and AMB meeting (closed meeting) in Lecture hall U 024

OPEN SESSION: MOLECULAR PHYLOGENETICS AND EVOLUTION

Chair: Somsak Panha

- 14:00 – 14:20 Phylogenetic relationships of the southeast Asian land operculate snails of the genus *Cyclophorus* (Prosobranchia: Cyclophoridae) using DNA sequence data
Tongkerd, Piyoros, Sutcharit, Chirasak, Douzery, Emmanuel, Jaeger, Jean-Jacques; Panha, Somsak
- 14:20 – 14:40 On the identity of two New World ampullariids, *Pomacea lineata* and *Pomacea figulina*
Thiengo, S.C.; Hayes, K.; Mattos, A.; Fernandez, M.A.; Cowie, R.H.
- 14:40 – 15:00 Populations of baikalian endemic mollusks *Baicalia carinata* (Mollusca: Caenogastropoda) and evolution relation with close related species.
Peretolchina, Tatiana E.; Sherbakov, Dmitry Yu; Sitnikova, Tatiana Ya
- 15:00 – 15:20 New evidence for old names: On the systematics of Neotropical freshwater gastropods (Caenogastropoda: Cerithioidea: Pachychilidae, Thiaridae)
Gomez, Maria; von Rintelen, Thomas; Glaubrecht, Matthias; Strong, Ellen E.; Köhler, Frank
- 15:20 – 15:40 Genetic differentiation in *Maakia herderiana* (Mollusca, Gastropoda)
Fazalova, Varvara; Sherbakov, Dmitry
- 15:40 – 16:10 Tea/Coffee

OPEN SESSION: MOLECULAR PHYLOGENETICS AND EVOLUTION

Chair: Piyoros Tongkerd

- 16:10 – 16:30 Molecular systematics of North American *Ferrissia* (Pulmonata: Ancyliidae)
Walther, Andrea
- 16:30 – 16:50 Achatinellid land snails of the Pacific islands: phylogenetics, phylogeography and evolution
Parker, Meaghan E.
- 16:50 – 17:10 Tahitian tree snail mitochondrial clades survived recent mass-extirpation
Lee, Taehwan; Burch, John B.; Jung, Younghun; Coote, Trevor; Pearce-Kelly, Paul; Ó Foighil, Diarmaid
- 17:10 – 17:30 The widespread slug *Limax maximus* Linnaeus, 1758 (Gastropoda: Pulmonata): species boundaries and redescription
Hyman, Isabel T.; Klee, Barbara; Schnepapat, Ulrich; Haszprunar, Gerhard
- 17:30 – 17:50 Hidden genetic diversity in cephalopods: cryptic speciation or deep mitochondrial coalescent events?
Anderson, Frank E.

17:50 – 18:10 Population genetic structure of a sympatric squid-*Vibrio* mutualism in the Mediterranean Sea
Zamborsky, Daniel J.; Nishiguchi, Michele K.

TUESDAY 17 JULY

Lecture hall T 103

NEOGASTROPOD ORIGINS, PHYLOGENY, EVOLUTIONARY PATHWAYS AND MECHANISMS

Chair: Yuri Kantor

- 09:00 – 09:20 Comparative anatomy of selected Philippine Cone snails (Neogastropoda)
Baoanan, Zenaida Gutay, Cruz, Lourdes J.; Pagulayan, Roberto C.; Lagunzad,
Daniel A.
- 09:20 – 09:40 New insights on the phylogeny of the Conoidea (Neogastropoda) using
molecular data
Puillandre, Nicolas; Samadi, Sarah; Boisselier, Marie-Catherine; Bouchet,
Philippe
- 09:40 – 10:00 A combinatorial phylogenetic analysis of Conoidea
Meyer, Christopher P.; Duda, Thomas F.; Rawlings, Timothy; Kohn, Alan J.;
Todd, Jonathan A.; Olivera, Baldomero M., Watkins, Maren; Ownby, John-
Paul; Thomas, Richard

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Philippe Bouchet

- 10:00 – 10:40 Inventorying the molluscan fauna of the world: how far to go?
Bouchet, Philippe
- 10:40 – 11:10 Tea/Coffee

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Philippe Bouchet

- 11:10 – 11:30 Cryptic diversity of gastropods in oxygen-poor intertidal habitats;
systematics, ecology and evolution of the Phenacolepadidae
Kano, Yasunori
- 11:30 – 11:50 Biogeography and systematic concepts of Helicinidae in the Lesser Antilles
(Gastropoda: Neritopsina)
Richling, Ira
- 11:50 – 12:10 Devil in the detail: Scissurellid systematics in the making (Gastropoda:
Vetigastropoda)
Geiger, Daniel L.

- 12:10 – 12:30 Palaeoheterdonta MMVII: A cosmopolitan assessment of freshwater mussel diversity
Graf, Daniel L.; Cummings, Kevin S.
- 12:30 – 12:50 Evolving with friendly bacteria: global diversity of lucinid bivalves reviewed
Glover, Emily A.; Taylor, John D.
- 12:50 – 14:00 Lunch + AMS Systematics Committee meeting (open to anyone interested) in Lecture hall U 024

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Daniel Geiger

- 14:00 – 14:20 Global opisthobranch biodiversity: Are they evolving faster than we can find them?
Gosliner, Terrence
- 14:20 – 14:40 What shall we do with the old descriptions?
Jensen, Kathe R.
- 14:40 – 15:00 Inventorying the molluscan fauna of the world - The role and impact of malacological serials
Bieler, Rüdiger
- 15:00 – 15:20 Marine cryptic diversity: the allopatric component
Meyer, Christopher P.
- 15:20 – 15:40 Molecular versus morphological taxonomy: a case study of character evaluation in marine Gastropoda
Gittenberger, Adriaan
- 15:40 – 16:10 Tea/Coffee

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Rüdiger Bieler

- 16:10 – 16:30 Approaches and problems in species delimitation of tropical freshwater snails: examples from Southeast Asian pachychilids
von Rintelen, Thomas; Köhler, Frank; Glaubrecht, Matthias
- 16:30 – 16:50 Cutting the Gordian knot of a taxonomic impediment: A plea for MOTU-numbers (Molecular Operational Taxonomic Units)
Klee, B.; Hyman, I.; Wiktor, A.; Haszprunar, G.

- 16:50 – 17:10 *Amphidromus* revisited: A fresh look at the conchologist's favourite land snail genus
Panha, Somsak; Sutcharit, Chirasak; Tongkerd, Piyoros; Prasankok, Pongpun; Yasin, Zulfigar; Tan, Aileen; Ng, Peter; Clements, Reuben; Moolenbeek, Robert; Maassen, Wim; Naggs, Fred; Asami, Takahiro
- 17:10 – 17:30 Diversity of terrestrial snails in Papua New Guinea: Have we only scratched the surface?
Slapcinsky, John
- 17:30 – 17:50 Malacology in the arid areas of the Middle East – unexplored or empty?
Neubert, Eike

Main hall of T building

- 18:00 – 20:00 POSTER SESSION
(with juice, wine, Belgian beers and cheeses)

TUESDAY 17 JULY

Lecture hall T 105

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Matthias Glaubrecht

- 09:00 – 09:20 Molluscs as models in evolutionary biology: from local speciation to global radiation - Introduction to the symposium
Glaubrecht, Matthias; von Rintelen, Thomas
- 09:20 – 10:00 Global patterns of diversity and speciation in tropical marine mollusks
Williams, Suzanne; Reid, David
- 10:00 – 10:20 Historical biogeography and phylogenetics of the Pacific Succineidae
Cowie, Robert H.; Holland, Brenden S.
- 10:20 – 10:40 Evolution and biogeography of ancient freshwater pulmonate gastropods: the limpet family Acroloxidae (Hygrophila)
Albrecht, Christian; Shirokaya, Alena A.; Prozorova, Larisa, A.; Ellis, Bonnie K.; Wilke, Thomas
- 10:40 – 11:10 Tea/Coffee

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Thomas von Rintelen

- 11:10 – 11:30 Replaying the tape: replicated biogeographic patterns in Cape Verde *Conus*
Cunha, Regina L.; Tenorio, Manuel J.; Rüber, Lukas; Afonso, Carlos;
Castilho, Rita; Zardoya, Rafael
- 11:30 – 11:50 Marine and brackish water phylogeography of southeastern Australian Mollusca
Colgan, D.J.; da Costa, P.; Reutelshöfer, T.; Golding, R.E.
- 11:50 – 12:10 Mudwhelks in mangroves: the evolutionary history of the Potamididae
Reid, David G.; Williams, Suzanne; Lozouet, Pierre; Glaubrecht, Matthias
- 12:10 – 12:30 Diversity, speciation and historical biogeography of Bulliidae
Malaquias, Manuel António E.; Reid, David G.
- 12:30 – 12:50 Ancient vicariance and recent dispersal of springsnails (Hydrobiidae: *Pyrgulopsis*) in the Death Valley System, California-Nevada
Hershler, Robert; Liu, Hsiu-Ping

12:50 – 14:00 Lunch + AMS Systematics Committee meeting (open to anyone interested) in
Lecture hall U 024

**MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL
SPECIATION TO GLOBAL RADIATION**

Chair: Christian Albrecht

14:00 – 14:20 Phylogeography and evolution of the Caribbean land snail family Urocoptidae
(Gastropoda, Pulmonata): radiation in isolation
Uit de Weerd, Dennis

14:20 – 14:40 Molecular phylogeny and biogeography of the polytypic genus *Pyrenaearia*
Elejalde, M. Arantzazu; Madeira, María José; Prieto, Carlos E.; Backeljau,
Thierry; Gómez-Moliner, Benjamín J.

14:40 – 15:00 Comparative analysis of land snail radiations on Crete
Sauer, Jan; Hausdorf, Bernhard

15:00 – 15:20 Evolutionary patterns of the terrestrial mollusc genus *Everettia* and
Meghimatium in the Northern Borneo
Liew, Thor-Seng; Schilthuizen, Menno

15:20 – 15:40 *Achatina fulica*: its molecular phylogeny and genetic variation in global
populations
Fontanilla, I.K.C.; Hudelot, C.; Naggs, F.; Wade, C.M.

15:40 – 16:10 Tea/Coffee

**MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL
SPECIATION TO GLOBAL RADIATION**

Chair: Dennis Uit de Weerd

16:10 – 16:30 Fast trails versus hard shells: using defensive traits in aquatic gastropods as a
model system for exploring questions in evolutionary ecology
Rundle, Simon D.

16:30 – 16:50 Witnessing a 'wave of advance'
Gittenberger, Edmund

16:50 – 17:10 Climbing the gene trees: a first molecular step towards elucidating the
extreme morphological variation within *Abida secale*
Kokshoorn, Bas; Gittenberger, E.

17:10 – 17:30 Examination for shell surface adaptations to water management in a rock-
dwelling land snail
Giokas, Sinos

17:30 – 17:50 Waddington's widget in the field: Do different stress response strategies result in variations of pulmonate shell variability?
Köhler, Heinz-R.; Lazzara, Raimondo; Dittbrenner, Nils; Krais, Stefanie; Capowiez, Yvan; Mazzia, Christophe; Tribskorn, Rita

Main hall of T building

18:00 – 20:00 POSTER SESSION
(with juice, wine, Belgian beers and cheeses)

TUESDAY 17 JULY

Lecture hall T 129

QUATERNARY MALACOLOGY: NEW DEVELOPMENTS IN PALAEOECOLOGY AND BIOSTRATIGRAPHY

Chair: Richard Preece

- 09:00 – 09:40 Amino acids in calcite: a tiny time-capsule for the Quaternary
Penkman, K.E.H.; Maddy, D.; Keen, D.H.; Preece, R.C.; Collins, M.J.
- 09:40 – 10:00 The Holsteinian: MIS 7, 9 or 11?
Meijer, Tom
- 10:00 – 10:20 Occurrence of *Retinella* (*Lyrodiscus*) in Quaternary west-european sequences:
taxonomical status and palaeoclimatic implication
Limondin-Lozouet, Nicole
- 10:20 – 10:00 Millennial-timescale environmental changes recorded by molluscan fauna at
Nussloch (Germany) during the last glaciation and perspectives in
quantitative palaeoclimatic reconstructions in quaternary malacology
Moine, Olivier; Rousseau, Denis-Didier; Antoine, Pierre
- 10:40 – 11:10 Tea/Coffee

QUATERNARY MALACOLOGY: NEW DEVELOPMENTS IN PALAEOECOLOGY AND BIOSTRATIGRAPHY

Chair: Nicole Limondin

- 11:10 – 11:30 Analysis of shell growth, structure and chemical composition of ocean
quahog (*Arctica islandica*)
Dunca, Elena; Mutvei, Harry; Göransson, Peter; Mörth, Carl-Magnus;
Whitehouse, Martin J; Elfman, Mikael
- 11:30 – 11:50 Environmental insights into the Crag Sea: investigation of growth rates of
Pliocene *Arctica islandica* from the Coralline Crag (UK)
Harper, E.M.; Finlayson, A.; Richardson, C.A.
- 11:50 – 12:10 Changes in Quaternary mollusc assemblages in Eastern Hungary in Late
Quaternary
Nyilas, István
- 12:10 – 12:30 Late Glacial-Early Holocene environmental change at Favignana island
(Sicily - Italy): evidence from malacological records in prehistoric deposit
Colonese, A.C.; Lo Vetro, D.; Martini, F.

- 12:30 – 12:50 Application of marine mollusk remains from shell middens for paleoenvironmental reconstructions
Antipushina, Zhanna
- 12:50 – 14:00 Lunch + AMS Systematics Committee meeting (open to anyone interested) in Lecture hall U 024

**QUATERNARY MALACOLOGY: NEW DEVELOPMENTS IN
PALAEOECOLOGY AND BIOSTRATIGRAPHY**

Chair: Frank Wesselingh

- 14:00 – 14:20 Molluscan evidence of woodland disturbance in the Irish Holocene
Speller, George R.; Preece, Richard C.
- 14:20 – 14:40 Reconstruction of the pleniglacial environment based of molluscan assemblages of the Titel Old Brickyard Section (Vojvodina, Serbia)
Gaudenyi, Tivada; Jovanovic, Mladjen; Markovic, Slobodan B.
- 14:40 – 15:00 Holocene molluscan successions from the Lake Baikal region, Siberia
Preece, Richard C.; White, Dustin; Shchetnikov, Alexander A.
- 15:00 – 17:50 Symposium: HEART AND CIRCULATION IN MOLLSUCS (see next page)

Lecture hall U -003 (Bioruimte)

- 16:30 – 17:30 Formal meeting of EQMal

Main hall of T building

- 18:00 – 20:00 POSTER SESSION IN MAIN HALL
(with juice, wine, Belgian beers and cheese)

TUESDAY 17 JULY

Lecture hall T 129

HEART AND CIRCULATION IN MOLLUSCS

Chair: Robert Hill

- 15:00 – 15:20 Countercurrent and continuity in gastropods
Voltzow, Janice
- 15:20 – 15:40 Scaling of metabolism of the pelagic squid *Dosidicus gigas*
Trueblood, Lloyd; Seibel, Brad
- 15:40 – 16:10 Tea/Coffee

HEART AND CIRCULATION IN MOLLUSCS

Chair: Robert Hill

- 16:10 – 16:30 Heterometric autoregulation in the bivalve heart
Collis, Leon; Sun, Ying; Hill, Robert B.
- 16:30 – 16:50 Molluscan models for cardiac physiology
Hill, Robert B.; Kuwasawa, Kiyooki; Sun, Ying
- 16:50 – 17:10 Control of a mollusc heart by 5-hydroxytryptamine and acetylcholine receptor subtypes
Devlin, C. Leah; Folger, Peter; Heinz, Justin; Nieves, Joyce; Sverzhin, Maksim
- 17:10 – 17:30 The effects of salinity changes on the heart rate of two species of bivalvia in long-term experiment
Bakmet, I.N.; Komendantov, A.J.; Smurov, A.O.
- 17:30 – 17:50 General discussion

Main hall of T building

- 18:00 – 20:00 POSTER SESSION IN MAIN HALL
(with juice, wine, Belgian beers and cheeses)

TUESDAY 17 JULY

Lecture hall T 148

MOLLUSCS IN ECOTOXICOLOGICAL RESEARCH

Chair: Rita Triebskorn

- 09:00 – 09:40 Gastropod species as model organisms in ecotoxicology ? Introducing the molecular view
Dallinger, Reinhard
- 09:40 – 10:00 Effect of metal accumulation and metallothionein induction on the condition of the periwinkle *Littorina littorea* along the entire Scheldt estuary
Van den Broeck, Heidi; De Wolf, Hans; Backeljau, Thierry; Blust, Ronny
- 10:00 – 10:20 Metal speciation and metallothionein induction after cadmium exposure in the terrestrial snail *Helix aspersa* (Gastropoda, Pulmonata)
Hispard, Florian; Schuler, Dietmar; de Vaufleury, Annette; Dallinger, Reinhard
- 10:20 – 11:10 Tea/Coffee

MOLLUSCS IN ECOTOXICOLOGICAL RESEARCH

Chair: Kurt Jordaens

- 11:10 – 11:30 Biomarkers as tools to assess the risk of environmental stress for terrestrial and aquatic gastropods
Triebskorn, Rita; Dittbrenner, Nils; Kraus, Stefanie; Lazzara, Raimondo; Sawasdee, Banthita; Schmidt, Lena; Köhler, Heinz-R.
- 11:30 – 11:50 Cytogenetic damage in aquatic mollusks as a biomarker of environmental pollution
Baršienė, Janina; Rybakovas, Aleksandras; Andreikėnaitė, Laura
- 11:50 – 12:10 Behavioural and reproductive biomarkers of organophosphate pesticide (Delvap) in the giant land snail *Archachatina marginata* (Swainson)
Fadina, Opeyemi A; Otitoloju, Adebayo A; Egonmwan, Rosemary I.
- 12:10 – 12:30 Comparative assessment of reproductive toxicity of contaminated freshwater sediments by *in vivo* biotests with *Potamopyrgus antipodarum* and *in vitro* assays
Mazurova, E.; Blaha, L.; Hilscherova, K.; Giesy, J. P.; Triebskorn, R.
- 12:30 – 12:50 *Potamopyrgus antipodarum* as a test organism for the assessment of endocrine active chemicals
Schmitt, Claudia; Bervoets, Lieven; De Deckere, Eric; Meire, Patrick
- 12:50 – 14:00 Lunch + AMS Systematics Committee meeting (open to anyone interested) in Lecture hall U 024

MOLLUSCS IN ECOTOXICOLOGICAL RESEARCH

Chair: Reinhard Dallinger

- 14:00 – 14:20 Estrogenic active compounds in bivalve molluscs: physiological role in reproductive development and potential for endocrine disruption?
Knigge, Thomas; Monsinjon, Tiphaine; Denier, Xavier; Labadie, Pierre; Peck, Mika R.; Trigwell, Jackie; Dussart, Georges; Puinean, Alin-Mirel; Rotchell, Jeanette; Hill, Elizabeth M.; Minier, Christophe
- 14:20 – 14:40 Cell and tissue-level biomarkers in slugs (*Arion ater*) are reliable tools for health assessment in soil ecosystems
Marigómez, Ionan; Castilla, Ane M.; Zaldibar, Beñat; Angulo, Eduardo; Soto, Manu
- 14:40 – 15:00 Does lead poison snails?
Beeby, Alan
- 15:00 – 15:20 Effects of Cd⁺ on the calcium metabolism and shell mineralization of bivalve *Anodonta cygnea*
Lopes-Lima, Manuel; Hinzmann, Mariana; Faubel, David; Machado, Jorge
- 15:20 – 16:10 Tea/Coffee
- 16:10 - 16:30 Assessing effects of heavy-metal pollution on short term growth and periodical growth patterns of *Protothaca thaca* (Mollusca: Veneridae) using calcein as a growth marker
Riascos, José M.; Saavedra, Rodrigo J.; Heilmayer, Olaf; Laudien, Jürgen; Guzman, Nury
- 16:30 – 16:50 Combined effects of tidal conditions and environmental contamination on the activities of antioxidant enzymes in *Mytilus edulis*
Letendre, Julie; Vince, Erwann; Budzinski, Hélène; Leboulenger, François; Durand, Fabrice
- 16:50 – 17:50 General discussion

Curator's meeting - Lecture hall U 024

- 16:10 – 18:00 Contact Julia Sigwart

Main hall of T building

- 18:00 – 20:00 POSTER SESSION IN MAIN HALL
(with juice, wine, Belgian beers and cheeses)

WEDNESDAY 18 JULY

WCM conference trips

All excursions will be leaded by a WCM-representative.

All trips start at the car parking in front of the congress site at Campus Groenenborger of the University of Antwerp. There will be three groups of buses waiting for you – one for the Brugge trip, one for the Bouillon trip and one for the Verdronken Land van Saeftinghe + biking trip.

The three groups of buses will depart at different times; please make sure that you are in time for your trip! The WCM-representative for the trip will be waiting for you at the bus and their will be signs guiding you to the correct bus.

Please check the WCM conference trip information that was sent to you be email for more details.

Bus departures:

Brugge: 9:00 am at congres campus (WCM representative: Wim De Belder)

Saeftinghe: 9:30 am at congress campus (WCM representative: Lobke Dillen)

Castle of Bouillon / Monastery of Orval: 7:15 at Roosevelt Plaats (centre of Antwerp) or 7:30 am at the congress campus (WCM representatives: Hilde Vrijders, Vanya Prévot, Thierry Backeljau)

Biking tour: 9:30 am at the congress campus (WCM representative: Kurt Jordaens)

Lecture hall U -003 (Bioruimte)

EQMal: Workshop on Quaternary Mollusca.
Start: 10:00 am

People working on fossil (mostly non-marine) Mollusca from European Quaternary deposits often meet taxonomic problems that can hardly be solved by the use of existing literature that is mostly concerned with extant species. Along with its meetings EQMal often organizes workshops at which molluscan paleontologists can discuss these problems under the microscope. Anyone who wants to contribute and discuss matters of taxonomy, identification, stratigraphy, etc. is invited to attend the workshop. Those who intend to contribute to the workshop are asked to submit the topics and taxa they should like to discuss. Contact Tom Meijer (meijert@naturalis.nl.)

THURSDAY 19 JULY

Lecture hall T 103

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Gary Rosenberg

- 09:00 – 09:20 Terrestrial malacofauna of Central Asia: results of more than 150 years of exploration
Muratov, Igor V.; Sysoev Alexander, V.
- 09:20 – 09:40 Inventories for the Dark Continent: compiling African checklists
Seddon, Mary; Rowson, Ben; Tattersfield, Peter; Lange, Charles; Ngereza, Christine
- 09:40 – 10:00 Exploring biodiversity in caves and limestone: an open window on Polynesia's lost paradise
Gargominy, Olivier; Fontaine, Benoît
- 10:00 – 10:20 Updating the gastropod fauna of the Northeastern Pacific
McLean, James H.
- 10:20 – 10:40 Bivalvia: Inventories and taxonomy in the Indian Ocean
Oliver, Graham P.
- 10:40 – 11:10 Tea/Coffee

INVENTORYING THE MOLLUSCAN FAUNA OF THE WORLD: FRONTIERS AND PERSPECTIVES

Chair: Graham Oliver

- 11:10 – 11:30 Is anything left to be discovered in the malacofauna of Western Europe?
Gofas, Serge
- 11:30 – 11:50 Malacological studies in a mega-diverse and poor country as Brazil
Simone, Luiz Ricardo L.
- 11:50 – 12:10 The need for an inventory of the world's molluscan fauna: a conservation perspective
Seddon, Mary; Cuttelod, Annabelle; Darwall, Will; Stuart, Simon
- 12:10 – 12:30 Towards a global taxonomic authority list for the Mollusca
Rosenberg, Gary
- 12:30 – 12:50 Expanding museum collections by indirect field work
Callomon, Paul

12:50 – 14:00 Lunch + AMS Conservation Committee meeting (open to anyone interested) in Lecture hall U 024 + General discussion Symposium Inventorying the molluscan fauna of the world: frontiers and perspectives in Lecture hall U 025

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

Chair: Daniel Geiger

14:00 – 14:20 Collecting micromolluscs – the key to a good survey
Gofas, Serge

14:20 – 14:40 New techniques yield new insights on the basic biology of living
Microgastropods
Hickman, Carole S.

14:40 – 15:00 Small fossil gastropods: their meaning for phylogeny and diversity
Nützel, Alexander

15:00 – 15:20 Microgastropod population changes from the Late Cretaceous to recent in the
Gulf Coastal Plain of the USA
Garvie, Christopher, L.

15:20 – 15:40 Micromolluscs in Japan: recent findings and future subjects
Sasaki, Takenori

15:40 – 16:10 Tea/Coffee

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

Chair: Bernhard Ruthensteiner

16:10 – 16:30 Diversity of microgastropod fauna in Northwestern Pacific: A case study of
Heterostrophans in Japan
Hasegawa, Kazunori

16:30 – 16:50 “Niku-nuki”, a useful method for preparation of shell-bearing molluscan
specimens
Fukuda, Hiroshi; Haga, Takuma; Tatara, Yuki

16:50 – 17:10 A phylogeny of the minute thyasirids (Bivalvia: Thyasiridae) based on
morphological investigations
Barry, Peter; McCormack, Grace

17:10 – 17:30 Digital imaging of micro bivalves
Turner, James A.; Oliver, Graham P.

17:30 – 17:50 The nervous system of Solenogastres – a confocal view
Todt, Christiane; Wanninger, Andreas

Theologisch Pastoraal Centrum (TPC) – Building R

19:00 – 21:00 Auction of the American Malacological Society at the Theologisch Pastoraal Centrum (TPC). Contact: Paula Mikkelsen

THURSDAY 19 JULY

Lecture hall T 105

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Carole Hickman

- 09:00 – 09:40 What molluscs can tell us about the genesis of biodiversity in ancient Lake Ohrid
Wilke, Thomas; Albrecht, Christian
- 09:40 – 10:00 A DNA-based phylogeny resolves divergent and convergent evolution of limpets (Lottiidae)
Eernisse, Douglas J.; Hewson, William E.; Kelly, Ryan P.
- 10:00 – 10:20 Reproduction, ecology and evolution of the Indo-Pacific limpet *Scutellastra flexuosa* (Quoy & Gaimard, 1834)
Lindberg, David R.
- 10:20 – 10:40 Evolution and biogeography of Southeast Asian viviparids (Gastropoda: Caenogastropoda)
Franke, Helena; Riedel, Frank; Glaubrecht, Matthias; Köhler, Frank; von Rintelen, Thomas
- 10:40 – 11:10 Tea/Coffee

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Thomas Wilke

- 11:10 – 11:30 Molluscan radiations and extinctions in Miocene Amazonian long-lived lake Pebas
Wesselingh, Frank P.
- 11:30 – 11:50 *Melanooides* from Lake Turkana: a documentation of speciation and case study for “punctuated equilibrium”?
Scholz, Henning; Glaubrecht, Matthias
- 11:50 – 12:10 The Turkana mollusks reconsidered: punctuational evolutionary events or biological invasions?
Van Bocxlaer, Bert; Van Damme, Dirk; Feibel, Craig S.
- 12:10 – 12:30 Punctuated equilibrium alive? How living Azorian *Drouetia* Gude, 1911 (Gastropoda: Pulmonata: Zonitidae) can tell a fossil story
Martins, António M. de Frias

- 12:30 – 12:50 The evolutionary adaptation of mollusks to deep-sea vents: insights from their fossil history
Kiel, Steffen
- 12:50 – 14:00 Lunch + AMS Conservation Committee meeting (open to anyone interested) in Lecture hall U 024

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Julia Sigwart

- 14:00 – 14:20 Molluscan mito-genomics: chances and pitfalls in phylogenetics
Steiner, Gerhard; Dreyer, Hermann
- 14:20 – 14:40 Land snails versus mammals: chromosomal neighbourhood of genes drives the „phylogenetic impact“ of DNA sequences
Armbruster, Georg F.J.
- 14:40 – 15:00 Does the size of molecular matrices really matter? Using molecular loci in ‘Archaeogastropod’ phylogenies
Aktipis, Stephanie W.; Giribet, Gonzalo
- 15:00 – 15:20 Hemocyanin: a 'respiratory' chance for molluscan phylogenetics
Lieb, Bernhard; Streit, Klaus
- 15:20 – 15:40 Crystallographic textures of shell layers in Patellogastropoda: a new tool unraveling their phylogeny
Frýda, Jiří; Sasaki, Takenori
- 15:40 – 16:10 Tea/Coffee

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Gerhard Steiner

- 16:10 – 16:30 Radiation and diversity of primitive living chitons – unravelling the base of the polyplacophoran family tree
Sigwart, Julia D.
- 16:30 – 16:50 A molecular phylogeny of apple snails (Gastropoda: Caenogastropoda: Ampullariidae) with emphasis on the African species
Jørgensen, Aslak; Kristensen, Thomas K.; Madsen, Henry
- 16:50 – 17:10 Molecular systematics and evolutionary patterns of diversification in New World Ampullariidae
Hayes, Kenneth A.

- 17:10 – 17:30 Germany's next top model? Towards a morphological phylogeny and evolution of acochlidian opisthobranch gastropods
Schrödl, Michael; Neusser, Timea
- 17:30 – 17:50 Phylogeny and systematics of the genus *Zonites* (Gastropoda, Pulmonata). The new era of systematics in the pulmonate molluscs
Mylonas, Moisis; Kornilios, Panagiotis; Poulakakis, Nikos; Vardinoyannis, Katerina

Theologisch Pastoraal Centrum (TPC) – Building R

- 19:00 – 21:00 Auction of the American Malacological Society at the Theologisch pastoraal Centrum (TPC building R). Contact: Paula Mikkelsen

THURSDAY 19 JULY

Lecture hall T 129

SEXUAL SELECTION IN MOLLUSCS

Chair: Ronald Chase

- 09:00 – 09:20 Shell shape and mating behaviour in hermaphroditic gastropods (Mollusca, Pulmonata)
Jordaens, Kurt; Dillen, Lobke; Backeljau, Thierry
- 09:20 – 09:40 Sexual dimorphisms in *Fasciolaria tulipa* (Buccinoidea, Fasciolaridae) using geometric morphometrics
Galindo, Lee A.; López, Héctor
- 09:40 – 10:00 Sexual selection maintains whole-body chiral dimorphism in snails
Schilthuizen, Menno; Craze, Paul G.; Cabanban, Annadel S.; Davison, Angus; Stone, Jon; Gittenberger, Edmund; Scott, Bronwen J.
- 10:00 – 10:20 Effects of parasitic mites on behavior and life-history traits of their host, the l and snail *Arianta arbustorum*
Schüpbach, Hans Ulrich; Baur, Bruno
- 10:20 – 10:40 Motivation to resist sex in a simultaneous hermaphrodite
Hoffer, Jeroen N.A.; Koene, Joris M.
- 10:40 – 11:10 Tea/Coffee

SEXUAL SELECTION IN MOLLUSCS

Chair: Joris Koene

- 11: 10 – 11:50 Sexual conflict and conflict resolution in hermaphroditic gastropods
Michiels, Nico K.
- 11:50 – 12:10 Sexual selection and its consequences in the Opisthobranchia
Anthes, Nils
- 12:10 – 12:30 Polyandrous mothers maximize hatchling size in the opisthobranch *Chelidonura sandrana*
Sprenger, Dennis; Anthes, Nils ; Michiels, Nico
- 12:30 – 12:50 Sexual selection and sex allocation in *Aplysia*: Hermaphrodites with nonreciprocal mating
Yusa, Yoichi
- 12:50 – 14:00 Lunch + AMS Conservation Committee meeting (open to anyone interested) in Lecture hall U 024

OPEN SESSION: MARINE ECOLOGY

Chair: Mark Davies

- 14:00 – 14:20 Inventoring the marine molluscan fauna of Guanahacabibes Peninsula Biosphere Reserve, Cuba
Caballer, Manuel; Ortea, Jesús; Espinosa, José; Fernández-Garcés, Raúl; Moro, Leopoldo
- 14:20 – 14:40 *Smaragdia viridis* (Gastropoda: Neritidae): A selective seagrass feeder
Rueda, José L.; Salas, Carmen; Gofas, Serge
- 14:40 – 15:00 Hard clams and harmful algae: Effects of brown tide on lipid stores in *Mercenaria mercenaria* larvae
Przeslawski, Rachel; Padilla, Dianna
- 15:20 – 15:40 The effect of diet on reproduction and energy storage in adult mussels *Mytilus galloprovincialis*
Fearman, Jo-Anne; Moltschaniwskyj, Natalie; Bolch, Chris
- 15:40 – 16:10 Tea/Coffee Reproductive strategies of cultivated and wild oysters, *Crassostrea gigas*, in relation to environmental variations in a high-turbidity intertidal mudflat (Bourgneuf, France)
Dutertre, Mickaël; Beninger, Peter G; Barillé, Laurent

OPEN SESSION: MARINE ECOLOGY

Chair: José Rueda

- 16:10 – 16:30 The evolution of co-operative behaviour: a virtual ‘experiment’ using high-shore snails as a model system
Davies, Mark S.; Stafford, Richard; Williams, Gray A.
- 16:30 – 16:50 Ecophenotypic variation in the mangrove oyster, *Isognomon alatus* (Pterioidea: Bivalvia) associated with a tide microhabitat gradient
Wilk, John
- 16:50 – 17:10 Evolutionary ecological aspects of the geographic variation in the intertidal gastropod, *Monetaria annulus* (family Cypraeidae)
Irie, Takahiro
- 17:10 – 17:30 Ecology and population dynamics of *Tridacna maxima* in Lakshadweep Archipelago, India
Apte, Deepak; Idrees, Babu

Theologisch Pastoraal Centrum (TPC) – Building R

- 19:00 – 21:00 Auction of the American Malacological Society at the Theologisch Pastoraal Centrum (TPC building R). Contact: Paula Mikkelsen

THURSDAY 19 JULY

Lecture hall T 148

ZOOGEOGRAPHY OF THE NON-MARINE MOLLUSKS OF THE EASTERN MEDITERRANEAN

Chair: Aydın Örstan

- 09:00 – 09:20 Morphological and shell quality natural population diversity of the edible snail (*Helix aspersa* M.), in southern Hellas
Malandrakis, E. E.; Gogas, A.; Hatzioannou, M.; Panagiotaki, P.; Lazaridou-Dimitriadou, M.; Neofitou, C.; Exadactylos, A.
- 09:20 – 09:40 Remote islands of the Aegean. The island of Psara as a case study
Vardinoyannis, Katerina; Georgantis, Panagiotis; Mylonas, Moisis
- 09:40 – 10:00 The Clasuiliidae fauna (Gastropoda: Pulmonata: Stylommatophora) of the Lakes Region (Göller Bölgesi) in Türkiye
Gümüş, Burçin Aşkım; Yıldırım, M. Zeki
- 10:00 – 10:20 *Graecoanatolica* (Radoman, 1973) (Rissooidea: Hydrobiidae) species of Turkey
Yıldırım, M. Zeki; Koca, Seval; Kebapçı, Ümit
- 10:20 – 10:40 A new land snail zoogeography of Turkey derived from the distribution ranges of endemic species
Örstan, Aydın
- 10:40 – 11:10 Tea/Coffee

ZOOGEOGRAPHY OF THE NON-MARINE MOLLUSKS OF THE EASTERN MEDITERRANEAN

Chair: Aydın Örstan

- 11:10 – 11:30 Mapping the biodiversity of land snails in Turkey: A preliminary study of hotspot analysis
Kebapçı, Ümit; Yıldırım, M. Zeki
- 11:30 – 11:50 Can response to water flow explain the distributions of extant and extinct aquatic *Melanopsis* spp. in the Jordan valley?
Dussart, G.; Heller, J.; Dussart, A.
- 11:50 – 12:50 General discussion
- 12:50 – 14:00 Lunch + AMS Conservation Committee meeting (open to anyone interested) in Lecture hall U 024

OPEN SESSION: FRESHWATER MOLLUSCS

Chair: Bert Van Bocxlaer

- 14:00 – 14:20 Freshwater Hydrobiidae of Morocco (Mollusca: Gastropoda):
Inventory and preliminary red list at regional level
Ghamizi, Mohamed
- 14:20 – 14:40 Freshwater snail diversity of Grande Island, Angra dos Reis, Rio de Janeiro,
southeastern Brazil
Santos, Sonia B.; Myiahira, Igor C.; Lacerda, Luiz Eduardo M.
- 14:40 – 15:00 A brief insight into the species-area relationships of spring fen mollusc
communities
Cernohorsky, Nicole; Horsák, Michal
- 15:00 – 15:20 Predicting the effects of a habitat restoration project on population viability of
one threatened and one endangered lotic gastropod
Arrington, Tristan; Richards, David
- 15:20 – 15:40 The impact of urbanisation on freshwater gastropods of L. Jipe, Kenya
Lange, Charles N.; Kristensen, Thomas K.
- 15:40 – 16:10 Tea/Coffee

Theologisch Pastoraal Centrum (TPC) – Building R

- 19:00 – 21:00 Auction of the American Malacological Society at the Theologisch Pastoraal
Centrum (TPC building R). Contact: Paula Mikkelsen

THURSDAY 19 JULY

Lecture hall U 024

OPEN SESSION: BIVALVE TAXONOMY

Chair: John Taylor

- 09:00 – 09:20 How many unionoid taxa live in the western Palearctic?
Araujo, Rafael; Toledo, Carlos; Nagel, Karlo; Reis, Joaquim; Machordom, Annie
- 09:20 – 09:40 Coral boring bivalve mollusks of Southeastern Thailand
Valentich-Scott, Paul
- 09:40 – 10:00 Spermatozoan morphologies of some species of marine bivalves: aspects of taxonomic and ecological relevance
Orlandi Introini, Gisele; Recco-Pimentel Shirlei Maria
- 10:00 – 10:20 The European bivalve *Nucula nucleus* (LINNAEUS) and its alleged fossil record – an example for what we really know about the fossil history of our recent fauna
Janssen, Ronald
- 10:20 – 10:40 A remarkable new genus of sessile, predatory septibranch bivalves
Leal, José H.
- 10:40 – 11:10 Tea/Coffee

OPEN SESSION: MOLECULAR PHYLOGENY OF BIVALVES

Chair: Emily Glover

- 11:10 – 11:30 Are morphological and molecular perspectives of anomalodesmatan phylogeny reconcilable?
Sartori, André F.; Harper, Elizabeth M.
- 11:30 – 11:50 A molecular phylogeny of heterodont bivalves (Bivalvia: Heterodonta): new analyses of 18S rRNA and 28S rRNA genes
Taylor, John D.; Williams, Suzanne T.; Glover, Emily A.; Dyal, Patricia
- 11:50 – 12:10 Identification of several members of Hox and paraHox genes in heteroconch bivalves
Samadi, Leyli; Steiner, Gerhard
- 12:10 – 12:30 Advances in veneroidean systematics - A status report
Bieler, Rüdiger; Mikkelsen, Paula M.; Kappner, Isabella; Rawlings, Timothy A.; Sartori, André F.; Pintrakoon, Cheewarat; Healy, John M.

- 12:30 – 12:50 Phylogenetics of the Pectinidae: Sexual reproductive modes and the evolution of adult dispersal behaviour
Puslednik, Louise; Serb, Jeanne
- 12:50 – 13:10 Molecular taxonomy of sunken-wood associated Bathymodiolinae: implications for phylogeny at sub-family level
Lorion, Julien; Samadi, Sarah; Boisselier, Marie-Catherine
- 13:10 – 14:00 Lunch + AMS Conservation Committee meeting (open to anyone interested) in Lecture hall U 024

Program continued in other lecture halls

Theologisch Pastoraal Centrum (TPC) – Building R

- 19:00 – 21:00 Auction of the American Malacological Society at the Theologisch Pastoraal Centrum (TPC building R). Contact: Paula Mikkelsen

FRIDAY 20 JULY

Lecture hall T 103

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

Chair: Martin Haase

- 09:00 – 09:40 Soft part 3D visualization by computer reconstruction of serial sections
Ruthensteiner, Bernhard
- 09:40 – 10:00 Opisthobranchs go limnic: comparative 3D microanatomy of the marine interstitial acochlidian *Pseudunela* and the freshwater *Strubellia* from Vanuatu
Neusser, Timea P.; Schrödl, Michael
- 10:00 – 10:20 Sex in the beach: reproduction of the aphyllid, interstitial *Pontohedyle milaschewitchii* (Acochlidia, Opisthobranchia)
Jörger, Katharina M.; Heß, Martin; Schrödl, Michael
- 10:20 – 10:40 Skeneimorph gastropods in Neomphalida and Vetigastropoda
Kunze, Thomas; Beck, Friedericke; Brückner, Martin; Heß, Martin; Ruthensteiner, Bernhard; Haszprunar, Gerhard
- 10:40 – 11:10 Tea/Coffee

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

Chair: James Turner

- 11:10 – 11:30 The evolution of small body size in Vetigastropoda
Geiger, Daniel L.; Thacker, Christine E.
- 11:30 – 11:50 Diversity of sub-antarctic and antarctic Scissurellidae and Anatomidae (Gastropoda: Vetigastropoda): Consequences for the region's biogeography
Zelaya, Diego G.; Geiger, Daniel L
- 11:50 – 12:10 Analysing speciation patterns – lessons from rissooidean and hydrocenid gastropods calling for the integration of methodologies
Haase, Martin
- 12:10 – 12:30 *Vertigo geyeri* in a lowland Irish fen - asking the right questions and getting the answers
Moorkens, E.A.
- 12:30 – 12:50 Micro-molluscs of the Western Ghats: Distribution and threats
Aravind, Neelavar Ananthram; Patil, Rajashekhar K.; Madhyastha, Neelavar Ananthram

12:50 – 14:00 Lunch + AMS Students Meeting (open to anyone interested) in Lecture hall U 024

MICROMOLLUSCS: METHODOLOGICAL CHALLENGES, EXCITING RESULTS

Chair: Evelyn Moorkens

14:00 – 14:20 Contrasting distribution patterns of microsnailes and macrogastropods of forest in Tenerife, Canary Islands

Kappes, Heike; Ibáñez, Miguel; Alonso, Maria R.

14:20 – 14:40 Sampling micromolluscs on tropical limestone karsts: high sampling efficiencies and novel biogeographical patterns

Clements, Reuben

14:40 – 15:00 Mapping subterranean microsnailes: sampling methods and hydrogeological implications

Prié, Vincent

15:00 – 15:40 General discussion

15:40 – 16:10 Tea/Coffee

Lecture hall T 103

16:10 – 17:10 Unitas General Meeting. Chair: Thierry Backeljau

17:10 – 18:10 American Malacological Society General Meeting. Chair: Paula Mikkelsen

20:00 – ????? Congress Dinner at ‘Grand Café Horta’

FRIDAY 20 JULY

Lecture hall T 105

MOLLUSCS AS MODELS IN EVOLUTIONARY BIOLOGY: FROM LOCAL SPECIATION TO GLOBAL RADIATION

Chair: Matthias Glaubrecht

- 09:00 – 09:20 An integrative approach identifies developmental sequence heterochronies in freshwater basommatophoran snails
Smirthwaite, Jennifer J.; Rundle, Simon D.; Bininda-Emonds, Olaf R.P.; Spicer, John I.
- 09:20 – 09:40 Developmental constraint and stabilizing selection against left-right reversal in snails
Asami, Takahiro; Utsuno, Hiroki; Gittenberger, Edmund
- 09:40 – 10:00 Genetic basis of adaptive evolution of left-right reversal under developmental constraint
Utsuno, Hiroki; Asami, Takahiro
- 10:00 – 10:20 Non-reciprocal hybridization against asymmetric introgression of mtDNA in Snails
Wiwegweaw, Amporn; Asami, Takahiro
- 10:20 – 10:40 Simultaneous ambivalent reproductive strategy in the sessile gastropod *Vermetus rugulosus* Monterosato, 1878 (Gastropoda: Prosobranchia)
Scuderi, Danilo; Cantone, Grazia
- 10:40 – 11:10 Tea/Coffee

OPEN SESSION: GENERAL TAXONOMY AND PHYLOGENY

Chair: Luitfried Salvini-Plawen

- 11:10 – 11:30 What's happening with (species names in) the PhyloCode?
Dayrat, Benoît
- 11:30 – 11:50 When is a species a species? Utilizing the fossil record to investigate the morphological disparity and taxonomic affinity of extant shell shapes within the bivalve genus *Cucullaea*
Buick, Devin P.
- 11:50 – 12:10 Sessile snails, mobile genes: Mitochondrial gene dynamics within the worm-snail family Vermetidae
Rawlings, Timothy A.; Collins, Timothy M.; Bieler, Rüdiger

- 12:10 – 12:30 Comparative anatomy of soft-body characters of Caudofoveata with emphasis on the nervous system
Redl, Emanuel; Salvini-Plawen, Luitfried
- 12:30 – 12:50 *Rissoa panhormensis* (Gastropoda: Rissoidae) morphotypes analysis vs species identity
Criscione, Francesco; Scuderi, Danilo; Patti, Francesco Paolo
- 12:50 – 14:00 Lunch + AMS Students Meeting (open to anyone interested) in Lecture hall U 024

OPEN SESSION: OPISTHOBRANCH SYSTEMATICS AND PHYLOGENY

Chair: Terrence Gosliner

- 14:00 – 14:20 Phylogeny of Aeolidacea (Gastropoda: Nudibranchia)
Alejandrino, Alvin
- 14:20 – 14:40 Molecular phylogeny as a lens for examining morphology and biogeography: Examples from the chromodorid nudibranchs
Johnson, Rebecca Fay
- 14:40 – 15:00 Updating the knowledge about the family Bornellidae (Mollusca, Nudibranchia, Dendronotina): Systematics and preliminary phylogeny based on morphological characters
Pola, Marta; Gosliner, Terrence M.
- 15:00 – 15:20 Two new species of *Phyllodesmium* (Ehrenberg 1831) and a discussion of their placement within the phylogeny
Moore, Elizabeth; Gosliner, Terrence
- 15:20 – 15:40 Biogeographic relationships among benthic opisthobranchs in the Atlantic
Calado, Gonçalo; Coelho, Rita
- 15:40 – 16:10 Tea/Coffee

Lecture hall T 103

- 16:10 – 17:10 Unitas General Meeting. Chair: Thierry Backeljau
- 17:10 – 18:10 American Malacological Society General Meeting. Chair: Paula Mikkelsen
- 20:00 – ????? Congress Dinner at ‘Grand Café Horta’

FRIDAY 20 JULY

Lecture hall T 129

SEXUAL SELECTION IN MOLLUSCS

Chair: Janet Leonard

- 09:00 – 09:20 A bioassay to identify the active molecule in the dart gland mucus
Chase, Ronald; Darbyson, Emily; Nagle, Gregg
- 09:20 – 09:40 Mating behaviour and spermathecal morphology in populations of the simultaneously hermaphroditic land snail *Helix aspersa*
Garefalaki, M.E.; Koemtzopoulos, E.; Kalyva S.; Staikou, A.
- 09:40 – 10:00 Sperm transfer and sperm digestion in the land snail *Succinea putris*
(Gastropoda, Pulmonata, Succineidae)
Dillen, Lobke; Jordaens, Kurt; Backeljau, Thierry
- 10:00 – 10:20 Sperm storage organ evolution in the carrefour of stylommatophoran gastropods
Beese, Kathleen; Armbruster, Georg F. J.; Beier, Konstantin; Baur, Bruno
- 10:20 – 10:40 Sperm precedence and lifetime fecundity of *Deroceras panormitanum*
Reise, Heike; Sauer, Josefine; Matthieu, Christiane; Matton, Sabrina; Hutchinson, John M.C.
- 10:40 – 11:10 Tea/Coffee

SEXUAL SELECTION IN MOLLUSCS

Chair: Nico Michiels

- 11: 10 – 11:30 Evidence for sexual selection in *Ariolimax* species Stylommatophora: Arionidae
Leonard, Janet L.; Pearse, John S.; Turner, M.Q.; Diep, P.J.; Breugelmans, Karin; Backeljau, Thierry
- 11:30 – 11:50 Sex and systematics in the Streptaxidae (Pulmonata: Stylommatophora)
Rowson, Ben
- 11:50 – 12:10 Extreme length development of the penis in the terrestrial slug genus *Limax*: a case of sexual selection? (Gastropoda: Limacidae)
Falkner, Gerhard Klee, Barbara
- 12:10 – 12:30 Evolution of spermatophore ornamentation in the land snail genus *Thapsia* (Stylommatophora, Helicarionoidea): a role for sexual selection?
de Winter, Anton. J.

- 12:30 – 12:50 Threshold dimorphism in ejaculate characteristics associated with alternative reproductive behaviours in the squid *Loligo bleekeri*
Yoko, Iwata; Yasunori, Sakurai
- 12:50 – 13:10 Male-male and male-female agonistic behavior of *Abdopus aculeatus*
Huffard, Christine L.; Caldwell, Roy L.; Boneka, Farnis
- 13:10 – 14:00 Lunch + AMS Students Meeting (open to anyone interested) in Lecture hall U 024

OPEN SESSION: DEEP SEA MOLLUSCS

Chair: Julien Lorion

- 14:00 – 14:20 Importance of Cretaceous methane-seep associations in Japan for deciphering the evolution of chemosynthesis-based communities
Kaim, Andrzej; Jenkins, Robert G.; Hikida, Yoshinori; Tanabe, Kazushige
- 14:20 – 14:40 The molluscan fauna of a deep-water coral community at Rockall Bank (NE Atlantic)
Lavaleye, Marc; Duineveld, Gerard; Schulting, Sanne
- 14:40 – 15:00 Oyster beds in the deep sea
Gofas, Serge; Freiwald, André; López Correa, Matthias; Remia, Alessandro; Salas, Carmen; Taviani, Marco; Wisshak, Max; Zibrowius, Helmut
- 15:00 – 15:20 What happens when it gets dark? Biology of deep-sea nudibranch gastropod species and nocturnal behaviour
Valdés, Ángel
- 15:20 – 15:40 Deep-sea squid behavior: posing in the dark
Bush, Stephanie L.
- 15:40 – 16:10 Tea/Coffee

Lecture hall T 103

- 16:10 – 17:10 Unitas General Meeting. Chair: Thierry Backeljau
- 17:10 – 18:10 American Malacological Society General Meeting. Chair: Paula Mikkelsen
- 20:00 – ????? Congress Dinner at ‘Grand Café Horta’

FRIDAY 20 JULY

Lecture hall T 148

BIODIVERSITY AT CROSSROADS: FRESHWATER BIVALVES FROM MASS EXTINCTION TO GLOBAL INVASION

Chair: Cristian Altaba

- 09:00 – 09:20 Freshwater bivalve biodiversity: new insights into ecology, biogeography and conservation
Altaba, Cristian R.
- 09:20 – 10:00 A time to kill and a time to heal: Eradication of the Zebra mussel and restoration of native mussels to improve water quality in the USA
Neves, Richard J.
- 10:00 – 10:20 Biodiversity and conservation of freshwater molluscs in the Plateau Lakes of Yunnan Province, SW China
Aldridge, David C.
- 10:20 – 10:40 Identification and genetic characterization of new populations of the endangered winged mapleleaf, *Quadrula fragosa*
Hemmingsen, Amanda H.; Serb, Jeanne M.
- 10:40 – 11:10 Tea/Coffee

BIODIVERSITY AT CROSSROADS: FRESHWATER BIVALVES FROM MASS EXTINCTION TO GLOBAL INVASION

Chair: Ian Killeen

- 11:10 – 11:30 The relationship between age and shell length in freshwater pearl mussels (*Margaritifera margaritifera*) from Sweden
Dunca, Elena; Söderberg, Håkan; Mutvei, Harry; Norgrann, Oskar
- 11:30 – 11:50 Phylogeographical differentiation of Iberian populations of freshwater pearl mussel (*Margaritifera margaritifera*) based on microsatellites data
Toledo, Carlos; Machordom, Annie; Araujo, Rafael
- 11:50 – 12:10 Taxonomy and phylogenetic relationships of Nicaraguan freshwater mussels (Bivalvia: Unionidae)
Roe, Kevin J.; Robinson, Stephen; Lopez de la Fuente, Adolfo
- 12:10 – 12:30 A morphologic, ecologic and molecular analysis of the freshwater mussels (Bivalvia: Unionidae) from Portugal (western Iberian Peninsula)
Reis, Joaquim; Machordom, Annie; Araujo, Rafael
- 12:30 – 12:50 Complementarity within a functional group of filter-feeding freshwater mussels influences stream foodwebs
Vaughn, Caryn C.; Spooner, Daniel E.; Galbraith, Heather S.

12:50 – 14:00 Lunch + AMS Students Meeting (open to anyone interested) in Lecture hall U 024

**BIODIVERSITY AT CROSSROADS: FRESHWATER BIVALVES FROM MASS
EXTINCTION TO GLOBAL INVASION**

Chair: Richard Neves

14:00 – 14:20 The value of analyzing *Pisidium* faunas
Killeen, Ian

14:20 – 14:40 *Sphaerium corneum*, *Sphaerium nucleus* (Bivalvia: Sphaeriidae) and
difficulties with determination and taxonomy of Sphaeriidae
Kořínková, Tereza; Juříčková, Lucie; Petrušek, Adam

14:40 – 15:40 General discussion

15:40 – 16:10 Tea/Coffee

Lecture hall T 103

16:10 – 17:10 Unitas General Meeting. Chair: Thierry Backeljau

17:10 – 18:10 American Malacological Society General Meeting. Chair: Paula Mikkelsen

20:00 – ????? Congress Dinner at ‘Grand Café Horta’

SATURDAY 21 JULY

Lecture hall U 024

IUCN SSC Specialist Group meeting on a Global Freshwater Initiative 21st July 2007
Convened by the IUCN SSC Mollusc Specialist Group - Contact: Mary Seddon

Global Molluscan Assessment Workshop

This is open to all interested in assessing the conservation status of Molluscs using the IUCN Categories and Criteria and using the IUCN Species Information Service Data Entry Module. No registration fee will be charged.

- 09:30 – 09:45 Welcome to IUCN Mollusc Specialist Workshop;
an overview of the Global Mollusc Assessment proposal.
Mary Seddon & Annabelle Cuttelod (IUCN Mediterranean Office)
- 09:45 – 11:00 An introduction to using the IUCN Categories and Criteria (version 3.1) for Mollusca.
Mary Seddon (based on IUCM training programme)
- 11:00 – 11:15 Coffee/Tea
- 11:15 – 12:00 Questions and Answers session about using SIS DEM module & IUCN Categories and Criteria.
- 12:00 – 13:00 Open discussion forum about a establishing a Global Assessment programme for Mollusca.
- 13:00 – 14:00 Lunch
- 14:00 – 14:15 The African project: lessons learned and overview of results.
- 14:15 – 14:30 North American Assessment project progress.
- 14:30 – 17:00 Potential breakout groups:
Breakout group 1: North African Interim Assessments: closed session for current participants.
Breakout group 2: Mediterranean Assessment; open session for those interested in contributing data and species assessments for a Mediterranean Assessment.
Breakout group 3: Freshwater Assessments: open session working through examples of how to make a Red List assessment.
Breakout group 4: Rest of African Assessment; open session for those interested.

POSTERS

In alphabetical order of the first author. Symposium specific posters and related 'open session' posters will be displayed per symposium.

Land snails microcosm preserved: Good news from Mayotte, Comoro Islands
Abdou, Ahmed; Bouchet, Philippe; Muratov, Igor (POSTER 88)

Allometric growth of *Mytella charruana* (Bivalvia: Mytilidae) based on information-theory approach
Abrahão, Johnnye R.; MacCord, Fábio S.; Yokoyama, Leonardo Q.; Amaral, A. Cecília Z. (POSTER 56)

Are there still rivers suitable for threatened unionid bivalves in Poland (Central Europe)?
Abraszewska, Anna (POSTER 42)

The subfamilies Margaritinae and Calliostomatinae from South Shetlands Island to Bellinghausen Sea: species diversity and unknown identities
Aldea, Cristian; Zelaya, Diego G.; Troncoso, Jesús S. (POSTER 106)

Biodiversity and conservation of freshwater molluscs in the Plateau Lakes of Yunnan Province, SW China
Aldridge, David C. (POSTER 188)

Fossil vesicomid bivalves from the North Pacific region
Amano, Kazutaka; Kiel, Steffen (POSTER 154)

Ultrastructural study of the spermatogenesis of a protandric neogastropod, *Coralliophila meyendorffii* (Muricidae, Coralliophilinae)
Amor, Maria Jose; Richter, Alexandra; Montserrat, Ramón; Dufort, Mercedes (POSTER 101)

Effects of temperature on metabolism and growth in *Protothaca thaca* (Mollusca: Veneridae)
Avalos, Cecilia; Vargas, Cristina; Riascos, José M.; Heilmayer, Olaf (POSTER 52)

Ongoing renovations in the Department of Malacology at the Museum of Comparative Zoology (Harvard University)
Baldinger, Adam J. (POSTER 189)

3D microanatomy of *Omalogyra atomus* (Gastropoda, Omalogyridae)
Bäumler, Natalie; Zernecke, Rebekka; Haszprunar, Gerhard; Ruthensteiner, Bernhard (POSTER 20)

Testing the glacial refugia hypothesis in spring snails (*Bythinella* spp.)
Benke, Mandy; Brändle, Martin; Albrecht, Christian; Wilke, Thomas (POSTER 127)

Spatio-temporal and biomass dynamics of *Corbicula fluminea*, an invasive mussel in the Hungarian Danube section

Bódis, Erika; Hornung, Erzsébet; Nosek, János; Oertel, Nándor (POSTER 43)

Anatomy of the genital system of *Eubbranchus vittatus* (Alder & Hancock, 1842)

(Gastropoda, Nudibranchia, Eubbranchidae)

Botana, Alba G.; Urgan, Victoriano; Señarís, Marcos P.; Díaz-Agras, Guillermo; Corral, Eva; Moreira, Juan (POSTER 183)

Atlas and red list of the terrestrial and freshwater molluscs of Castilla La Mancha (Spain): Distribution and conservation

Bragado, M. Dolores; Aparicio, M. Teresa; Araujo, Rafael (POSTER 107)

Keyhole limpets of the genus *Fissurella* (Archaeogastropoda: Vetigastropoda) in Chilean coasts

Bretos, Marta; Huaquín, Laura; Osorio, Cecilia; Bahamondes-Rojas, Ingrid (POSTER 108)

Molecular phylogeny of the terrestrial slug genus *Arion* (Gastropoda, Pulmonata, Arionidae)

Breugelmans, Karin; Jordaens, Kurt; Van Houtte, Natalie; Pinceel, Jan; Backeljau, Thierry (POSTER 7)

Distribution of terrestrial land snails in Nepal

Budha, Prem B.; Backeljau, Thierry; Naggs, Fred (POSTER 89)

Using the PAM-technology as a tool to investigate the symbiosis between „solarpowered“ Nudibranchia (Gastropoda, Opisthobranchia) and Zooxanthellae (Dinophyceae)

Burghardt, Ingo (POSTER 128)

Discrimination of end-Cretaceous anodontine Unionoidea from North Dakota:

How many taxa make sense?

Burton-Kelly, Matthew; Hartman, Joseph H. (POSTER 153)

Molecular and morphological taxonomy of gastropods from south-east Pacific seamounts

Castelin, Magalie; Samadi, Sarah; Boisselier, Marie-Catherine; Lozouet, Pierre (POSTER 109)

Gastropods of Davraz Mountain

Ceylan, Salih; Kebapçı, Ümit; Yıldırım, M. Zeki; Gümüş, Burçin Aşkın (POSTER 19)

The Santa Barbara Museum of Natural History (California, USA):

Upgrade of research and collection facilities for the 21st Century

Chaney, Henry W.; Carpenter, Shannon; Geiger, Daniel L.; Hochberg, F. G.; Sadeghian, Patricia; Valentich-Scott, Paul (POSTER 190)

Unravelling a taxonomic tangle and a morphological mystery: A molecular phylogeny of the Rapaninae (Neogastropoda: Muricidae)

Claremont, Martine; Reid, David G.; Williams, Suzanne T. (POSTER 129)

Reproductive traits of *Crepidula aculeata* (Gastropoda: Calyptraeidae) from Argentina

Cledón, Maximiliano; Ocampo, Emiliano; Farias, Nahuel; Penchaszadeh, Pablo (POSTER 57)

Correlates of endemism and biogeography of terrestrial molluscs on tropical limestone karsts
Clements, Reuben; Sodhi, Navjot S.; Ng, Peter K.L.; Lu, X. X.; Ambu, Stephen,
Schilthuizen, Menno; Bradshaw, Corey J.A. (POSTER 96)

Molecular phylogenetics of the land snail genus *Anguispira* (Pulmonata: Discidae)
Clutts, Stephanie A.; Anderson, Frank E. (POSTER 164)

Phylogeography and evolutionary origins of Florida's native Apple snail, *Pomacea paludosa*
Collins, Timothy M.; Rawlings, Timothy A.; Choquette, Duane M. (POSTER 173)

Patchy distribution of the (TTAGGG)_n telomeric repeat motif in Mollusca
Colomba, Mariastella; Libertini, Angelo; Gregorini, Armando; Vitturi, Roberto (POSTER
150)

Chromosome numbers and chromosomal evolution in the land snail genus *Arion*
(Gastropoda, Pulmonata)
Colomba, Mariastella; Backeljau, Thierry; Gregorini, Armando; Jordaens, Kurt (POSTER
174)

Mollusca of the subfamily Emarginulinae (Gastropoda, Prosobranchia, Fissurellidae) from the
french campaign Seamount II
Corral, Eva; Urgorri, Victoriano; Botana, Alba G.; Señarís, Marcos P.; Díaz-Agras,
Guillermo; Candás, María (POSTER 58)

A conservational approach over Azorean terrestrial molluscs
Cunha, Regina; Rodrigues, Pedro; Martins, António M. de Frias (POSTER 90)

Freshwater molluscs threat assessments in Africa
Cuttelod, Annabelle; Seddon, Mary; Darwall, Will; Smith, Kevin (POSTER 110)

Genetic and morphological variability in fluviatile species of *Tylomelania*
(Caenogastropoda: Pachychilidae) from Southwest Sulawesi, Indonesia
Dames, Claudia; Glaubrecht, Matthias; von Rintelen, Thomas (POSTER 130)

Spanish lower cretaceous freshwater molluscs
Delvene, Graciela; Araujo, Rafael; Bermúdez-Rochas, David D. (POSTER 131)

Natural history of *Doto koenneckeri* Lemche, 1976 (Gastropoda, Nudibranchia,
Dendronotacea) in the Ría of Ferrol (NW Iberian Peninsula)
Díaz-Agras, Guillermo; Urgorri, Victoriano; Corral, Eva; Botana, Alba G.; Señarís, Marcos
P. & Candás, María (POSTER 59)

Effects of isolation and body size on the mating behaviour of the hermaphroditic land snail
Succinea putris (Gastropoda, Pulmonata, Succineidae)
Dillen, Lobke; Jordaens, Kurt; Backeljau, Thierry (POSTER 6)

Invasive freshwater species *Sinanodonta woodiana* (Lea, 1834) (Bivalvia: Unionidae):
a colonizer of the channels of Międzyodrze area (Western Pomerania Region, N-W Poland)
Domagała, Józef, Łabęcka, Anna Maria, Migdalska, Blandyna, Pilecka-Rapacz, Małgorzata
(POSTER 78)

Anatomy, distribution, and ecology of the slug *Arion alpinus* Pollonera, 1887 (Gastropoda: Arionidae)

Dvořák, Libor; Backeljau, Thierry; Reischütz, Peter L.; Horsák, Michal; Breugelmans, Karin; Jordaens, Kurt (POSTER 9)

Phylogenetic relationships and evolution of *Iberus* species based on mtDNA sequences
Elejalde, M. Arantzazu; Madeira, María José; Muñoz, Benito; Arrébola, Jose Ramón; Gómez-Moliner, Benjamín J. (POSTER 132)

Inherited flesh colour in edible snails
Elmslie, Leslie J. (POSTER 85)

Seasonal foraging activity during spring and neap tide in *Patella ferruginea*
Espinosa, Free; Rivera-Ingraham, Georgina; García-Gómez, Jose Carlos (POSTER 52)

First case of the radular-less representatives of the subfamily Crassispirinae (Turridae) with critical reassessment of the taxonomic status of the subfamily Zemaciinae (Turridae)
Fedosov, Alexander (POSTER 99)

Molecular Morphology of 18S rDNA of Bivalvia
Feistel, Sussane; Haszprunar, Gerhard (POSTER 176)

Phylogeny and morphological variability in land snails: the Sicilian *Marmorana* (Pulmonata, Helicidae)
Fiorentino, Viviana; Salomone, Nicola; Manganelli, Guisepe; Giusti, Folco (POSTER 133)

Land snail conservation in the Gabonese rainforest: Single large or single small?
Fontaine, Benoît; Gargominy, Olivier (POSTER 111)

A challenge to the relationships of “*Omphalotropis*” (Caenogastropoda: Assimineidae)
Fukuda, Hiroshi; Ponder, Winston F. (POSTER 154)

Interference competition in the suspension feeding *Dendropoma maxima*: optimal foraging or an unresolved prisoner’s dilemma?

Gagern, Antonius; Michiels, Nico K.; Anthes, Nils (POSTER 60)

What do we know about sexual dimorphism in gastropods?
Galindo, Lee A.; López, Héctor (POSTER 1)

Documenting the past: The Tomlin Archive
Gallichan, Jennifer (POSTER 191)

New species of proneomenidae (Mollusca: Solenogastres) from Western Antarctica
García-Álvarez, Oscar; Zamarro, María; Gil-Mansilla, Esther; Ugorri, Victoriano (POSTER 75)

Using an electron microscopy shell morphometry in identifying the Weichselian *Pupilla muscorum* and *Pupilla triplicata* species from the loess series of Vojvodina (Serbia)
Gaudenyi, Tivadar; Jovanovic, Mladjen (POSTER 29)

Extreme variability in the radula of Anatomidae (Gastropoda: Vetigastropoda)
Geiger, Daniel L.; Sasaki, Takenori (POSTER 21)

Giustia n.gen. (Gastropoda: Hydrobiidae) a new genus of the groundwater micromollusks of Morocco
Ghamizi, Mohamed; Bodon, Marco (POSTER 22)

New genus of Acanthomeniidae (Mollusca: Solenogastres) from the Abyssal Angola Basin
Gil-Mansilla, Esther; Zamarro, María; García-Álvarez, Oscar; Ugorri, Victoriano (POSTER 74)

Marine bivalves shell shape stabilization and reproduction
Gil, Guacira Maria; Thomé, José Willibaldo; Gomes, Suzete Rodrigues; Troncoso, Jesús Souza (POSTER 187)

Sperm morphology in three marine gastropods from South Western Atlantic Ocean (Caenogastropoda): Systematic importance
Jiménez, J.; Arrighetti, F.; Teso, S.; Zabala, S.; Hermida, G.; Penchaszadeh, P. (POSTER 100)

An improved method for the identification of areas of endemism using species co-occurrences
Giokas, Sinos; Sfenthourakis, Spyros (POSTER 13)

Micro-CT—3D analysis of molluscan anatomy
Golding, Rosemary E.; Jones, Allan S. (POSTER 23)

The Gondwanan origin of Veronicellidae (Gastropoda, Soleolifera): evidences from a cladistic morphological analysis
Gomes, Suzete R.; Mendes, Inga L.V.; Thomé, José W. (POSTER 155)

Molecular phylogeny of the Helicodontidae and Trissexodontidae genera and their taxonomic position within Helicoidea
Gómez-Moliner, Benjamín J.; Elejalde, M. Arantzazu; Madeira, María José; Martínez-Ortí, Alberto; Arrébola, José Ramón; Muñoz, Benito; Puente, Ana Isabel (POSTER 135)

Genetic diversity of an exploited population of banded Murex, *Hexaplex (Trunculariopsis) trunculus*: Implications for stock enhancement and conservation
González-Tizón, Ana; Fernández-Moreno, Mercedes; Vasconcelos, Paulo; Gaspar, Miguel B.; Moreno-Escalante, Óscar; Martínez-Lage, Andrés (POSTER 136)

Evolution of the molluscan assemblage on a seagrass meadow (*Zostera marina*) affected by trawling activity
González, Alexandre R.; Maestre, Manuel J.; Ruiz, Aurora; Gordillo, Ismael; Sánchez, Emilio; García-Gómez, José C. (POSTER 61)

Taxonomic and systematic study of the Families Helicinidae and Ceresidae (Mollusca: Gastropoda: Neritopsina) and the Genus *Drymaeus* (Gastropoda: Pulmonata: Bulimulidae) in three zones of the Reserve Amazonic in Peru
Guevara Muñoz, Samira (POSTER 165)

Pupilloidean snails of Göller Bölgesi (Lakes Region) Turkey
Gülboy, Hatice; Kebapçı, Ümit; Yıldırım, M. Zeki (POSTER 14)

Land snails from a hidden beauty: Afrodisiyas (Karacasu: Aydın) in Türkiye
Gümüş, Burçin Aşkın; Yıldırım, M. Zeki (POSTER 15)

Dynamic gastropods: morphological and genetic differentiation of the land snail *Arianta arbustorum* in an Alpine massif
Haase, Martin; Misof, Bernhard (POSTER 137)

Molecular phylogeny and morphological evolution of pholadoidean boring bivalves
(Bivalvia: Myoida)
Haga, Takuma; Kase, Tomoki (POSTER 177)

The *Cerion* land snails of Long Island, Bahamas: New insights into the relationships and origins of a dynamic fauna
Harasewych, Jerry; Goodfriend, G.A.; Gould, S. J. (POSTER 166)

Interpreting the last molluscan Unionoidea from the Cretaceous of North Dakota
Hartman, Joseph H.; Burton-Kelly, Matthew; Sweet, Arthur R. (POSTER 44)

Caught in the act: Insights into the sex life of *Lanistes ovum* (Gastropoda: Ampullariidae)
Heiler, Katharina C. M.; Schultheiß, Roland; Geertz, Thies; Albrecht, Christian (POSTER 2)

Tag-team approach: Mitochondrial DNA and morphological assessment of Vietnamese freshwater gastropods (Caenogastropoda: Pachychilidae)
Holford, Mande; Do, Van Tu; Ho, Thanh Hai; Köhler, Frank (POSTER 112)

Notes on the distribution of the genus *Pagodulina* (Gastropoda, Orculidae) in the Eastern Mediterranean region: first record on the island of Rhodes (Greece)
Hölling, Michael (POSTER 16)

British Marine Bivalves - A web-based taxonomic tool for bivalves from the intertidal to 5000m
Holmes, Anna M.; Oliver, P. Graham; Killeen, Ian J.; Turner, James (POSTER 178)

Can freshwater mussel density be predicted by complex hydraulic parameters?
Hornbach, Daniel J.; Hove, Mark C.; MacGregor, Kelly R. (POSTER 45)

Taxonomy of the genus *Trochulus* (Gastropoda: Hygromiidae) in the Czech Republic
Hrabakova, Magda; Jurickova, Lucie; Petrussek, Adam (POSTER 113)

Assessment of *Dosidicus gigas* sperm longevity using fluorescence microscopy
Huffard, Christine; Buck, Kurt; Robison, Bruce (POSTER 3)

Examining changes in morphological disparity along a latitudinal gradient in the Neogastropoda
Johnson, Nicholas A. (POSTER 101)

Development of an initial conservation assessment for North American freshwater gastropods
Johnson, Paul D.; Bogan, Arthur E.; Strong Ellen E.; Brown, Kenneth M.; Corderio, Jay E.
(POSTER 114)

Associations between shell strength, shell morphology and heavy metals in the land snail *Cepaea nemoralis* (Gastropoda, Helicidae)
Jordaens, Kurt, Vandecasteele, Bart; Backeljau, Thierry (POSTER 32)

Molluscs in human impacted habitats - summary of present records in the Czech Republic
Jurickova, Lucie (POSTER 83)

The laboratory tests on some chemicals in reducing slug grazing
Kaluski, Tomasz; Kozłowski, Jan; Jaskulska, Monika (POSTER 10)

Morphological and molecular characterization of the Roman snail *Helix pomatia* with data on the phylogeny of the genus *Helix* (Pulmonata, Helicidae)
Ketmaier, Valerio; Fiorentino, Viviana; Tiedemann, Ralph; Manganelli, Giuseppe; Giusti, Folco (POSTER 167)

Distribution and ecology of Thyasiridae (Mollusca: Bivalvia) in coastal waters of Hordaland, Norway
Keuning, Rozemarijn; Schander, Christoffer; Kongsrud, Jon; Willassen, Endre (POSTER 62)

Species boundaries in *Limax* (Gastropoda: Stylommatophora): extreme colour variations in and between species
Klee, Barbara; Heim, René; Hyman, Isabel T.; Haszprunar, Gerhard (POSTER 168)

The fate of received sperm in the genital tract of *Lymnaea stagnalis*
Koene, Joris M., Montagne-Wajer, Kora; ter Maat, Andries (POSTER 4)

Karyotypes of land operculate snails genus *Pterocyclus* and *Rhiostoma* (Prosobranchia: Cyclophoridae) from Thailand and Malaysia
Kongim, Bangon; Tongkerd, Piyoros; Sutcharit, Chirasak; Yasin, Zulfigar; Tan, Aileen; Panha, Somsak (POSTER 117)

Early ontogeny and micro-ornamentation of *Nicaniella* and *Pressastarte* (Bivalvia: Astartinae) from the Jurassic of the Southern Baltic
Koppka, Jens; Malchus, Nikolaus (POSTER 152)

The anatomy and relationships of *Troschelia* (Buccinidae, Neogastropoda): evidence of polyphyly for the Buccinidae?
Kosyan, Alisa; Modica, Maria Vittoria; Oliverio, Marco (POSTER 100)

Vesicomomyidae (Bivalves): trends of morphological adaptations
Krylova, Elena; Sahling, Heiko (POSTER 138)

The microanatomy of *Bathyxyllophila excelsa* Marshall, 1988, and *Ventsia tricarinata* Warén & Bouchet, 1993, two skeneimorph vetigastropods from Pacific deep sea habitats (Vetigastropoda)
Kunze, Thomas; Heß, Martin; Haszprunar, Gerhard (POSTER 24)

B-type esterases in the snail *Xeropicta derbentina* as potential biomarkers of pesticide exposure: in vitro inhibition and reactivation
Laguerre, Christel; Sanchez-Hernandez, Juan C.; Köhler, Heinz-R.; Capowiez, Yvan; Rault, Magali; Mazzia, Christophe (POSTER 33)

Xeropicta derbentina as a sentinel species for evaluating ecotoxicological effects of pesticide treatments?
Laguerre, Christel; Lazzara, Raimondo; Köhler, Heinz-R.; Triebkorn, Rita; Sanchez-Hernandez, Juan C.; Capowiez, Yvan; Rault, Magali; Mazzia, Christophe (POSTER 34)

The freshwater thiarid *Tarebia granifera* as tramp: Molecular systematics and reproductive biology of a tropical invader
Lamers, Rebecca; Stein, André; von Rintelen, Thomas; Glaubrecht, Matthias (POSTER 118)

Spatial differences and temporal variations of antioxidant defences in an intertidal population of the blue mussel *Mytilus edulis*
Letendre, Julie; Olivier, Stéphanie; Poret, Agnès; Leboulenger, François; Durand, Fabrice (POSTER 53)

Phylogenetic and structural aspects of chiton hemocyanins
Lieb, Bernhard; Streit, Klaus; Möller, Vanessa; Eernisse, Douglas J. (POSTER 139)

Ultrastructural and cytochemical study of the oesophagus of *Bulla striata* (Opisthobranchia)
Lobo-da-Cunha, Alexandre; Calado, Gonçalo (POSTER 163)

Preliminary data on molecular diversity of the “*Napaeus pruninus* complex” in São Miguel Island
Lourenço, Paula; Backeljau, Thierry; Martins, António M. de Frias (POSTER 169)

A review of the genus *Satondella* Bandel, 1998 (Gastropoda, Scissurellidae)
Luque, Ángel A.; Geiger, Daniel L.; Rolán, Emilio (POSTER 25)

Effects of a thermal effluent on the rocky intertidal molluscan assemblages
Maestre, Manuel J.; González, Alexandre R.; Espinosa, Free; Ruiz, Aurora; Gordillo, Ismael; García-Gómez, Jose C. (POSTER 54)

Growth of *Donax vittatus* in the north-west coast of Portugal.
Biological data for the management of a new fishery
Maia, Francisco; Pimenta, Joana; Gonçalves, Catarina (POSTER 63)

Diversity and distribution of *Haminoea* (Gastropoda: Cephalaspidea) in the Atlantic and eastern Pacific oceans
Malaquias, Manuel António E.; Reid, David G. (POSTER 119)

Cell and tissue biology of the mussel (*Mytilus galloprovincialis*) digestive gland: a novel view of its form and function

Marigómez, Ionan (POSTER 162)

Cytogenetics of bivalves: a review with some comments on phylogeny

Martínez-Lage, Andrés; Francisco, Marta; Vierna, Joaquín; Da Rocha, Bibiana; Seoane, David; González-Tizón, Ana (POSTER 140)

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ABSTRACTS

Contribution to the revision of the biodiversity of Tunisian terrestrial Malacofauna

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Historical studies and our recent prospections in Tunisia led to the record of twenty-seven species of terrestrial Gastropoda three of which are reported for the first time: *Ponentina subvirescens* (Bellamy, 1839), *Limax flavus* (Linnaeus, 1758) and *Obscurella septemspirale* (Razoumowsky, 1789). Except for two prosobranch species (*Pomatias sulcata* and *Obscurella septemspirale*), all species belong to 14 families and 21 genera from the Pulmonate sub-class. Moreover, a comprehensive study, based on recent field work, and conchological and anatomical survey, has been undertaken in order to discuss the taxonomy of the recorded species, and to set up an updated check list of the Tunisian terrestrial malacofauna.

Furthermore, the geographical distribution study of the different recorded species in some heterogeneous biotopes shows a significant variation in the general distribution area in response of the different abiotic factors. This allows defining some ecological affinities of the species and showing their abilities to cope with the climatic variability.

Land snails microcosm preserved: Good news from Mayotte, Comoro Islands

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Concomitant with habitat loss, numerous species extinctions have taken, and are taking, place in the land snail faunas of many tropical oceanic islands. Located in the northern part of the Mozambique Channel, Mayotte, the easternmost island of the Comoros Islands, is also the oldest (7-8 My old) and has an overall area of 375 km² (~ 40x15 km). Ninety native species of land snails and slugs were historically recorded from Mayotte, of which 41 (46%) are endemic to that single island. Human pressure on the environment is now considerable: population density is estimated to be around 700 per sq. km, and fragmented primary forests occupy roughly only 5% of the land. Forest pockets occupy the steeper slopes and are separated by low rolling hills with secondary agroforests, cultivated lands, fallows and bad lands. As no recent land snail survey has taken place on Mayotte since the 1880s, it was to be feared that its rich and unique fauna had followed the fate of many tropical island land snail faunas. Unexpectedly, a survey carried out in 2001 and 2002 found out that, despite considerable habitat changes, this faunule has survived well. At least 96 species were censused, including 56% single-island endemics and ca. 20 new species; species not seen for more than 100 years were found alive. The extraordinary radiations of Streptaxidae (35 species, 21 endemic), Charopidae (11 species, 9 endemic), Subulinidae (6 species, 3 endemic), and Cyclophoridae (7 species, 5 endemic) were newly documented. Mayotte deviates from other tropical islands in that even anthropicized habitats contain endemic species and secondary forests remain largely dominated by native and/or endemic species.

Allometric growth of *Mytella charruana* (Bivalvia: Mytilidae) based on information-theory approach

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The allometric growth of the mussel *Mytella charruana* (Orbigny) was investigated and compared in two different intertidal mussel beds on soft bottom at Camaroeiro and Cidade beaches, southeastern Brazil (23° 37' S; 45° 27' W). The relation among shell length (SL), height (SH), and width (SW), and the allometric growth of the one body part in relation to other (reference dimension) was studied. Three candidate models were fitted to the log-transformed data (natural logarithms) of each dataset, with least squares: the linear (L), quadratic (Q) and cubic (C). The L model was fitted with simple linear regression, while polynomial regression was used for the Q and C models. In the case, the 'best' model was selected by minimizing the small-sample, bias corrected form of the Akaike Information Criterion (AIC). To quantify the plausibility of each model, given the data and set of three models, 'the Akaike weight' w_i of each model was estimated for each case. A total of 1264 individuals with shell lengths ranging from 3.9 to 69.0 mm were measured at Camaroeiro beach, while at Cidade beach, a total of 1614 individuals were measured, with the shell lengths ranging from 1.3 to 66.6 mm. In the Camaroeiro beach, L was the best model to the relationship between SW and SL. For the relationship SH and SL, L was the best model with Q also having some support. For SH and SW, L was the best model, but the rest of models were supported by the data. In the Cidade beach, C model was the best model for all relationships with essentially no support for any model. Multi-model inference based on Akaike weights is recommended for making robust parameter estimations, and may reveal more information than the classical approach.
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Are there still rivers suitable for threatened unionid bivalves in Poland (Central Europe)?

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Among six native unionids reported from Poland there are three rare species, *Unio crassus* Philipsson, *Anodonta cygnea* (Linnaeus) and *Pseudanodonta complanata* (Rossmässler), included in the Red List of Threatened Animals in Poland and IUCN Red List as being endangered. As for the knowledge of their distribution in Poland is still fragmentary, detailed studies of diverse aquatic habitats in various parts of the country are required. My investigations were carried out in two river catchments. The 342 km long lowland Pilica River in Central Poland is under anthropogenic pressure.

The 1995-1998 studies included 103 localities on the river, tributaries, oxbows, and the dam reservoir on the river. I collected altogether 5700 unionid individuals and recorded presence of all native species, including those from the Red List. In terms of unionid distribution the mid-section of Pilica was the most favourable (varied microhabitats, low degree of pollution) in terms of density, biomass and condition of the bivalves. It was the only section where all the six species were present. Below the dam species composition was reduced to two un abundantly occurring *U. pictorum* and *A. anatina*. Additionally, at the backwater zone of the Sulejowski reservoir a colony of *A. cygnea* was studied (the density reached 30 indiv./m²).

In 2006 I sampled 45 sites in the 186 km long Drawa river – clean, natural in character and with a rapid current – in the Pomeranian lake district. All the native unionid species were found there (total 1416 specimens). *U. crassus* was common and abundant (the density up to 16 indiv./m²) but their shells were dwarfish (the mean length± SD=43,3± 8,5 mm) if compared to the Pilica population (62,9 ± 11,6mm). Most rare unionid species in Poland, *P. complanata*, was also recorded in the Drawa River. The results show that in Polish rivers still exist favourable habitats for the native unionid fauna, however more detailed studies of the subject are needed in the nearest future.

Does the size of molecular matrices really matter? Using molecular loci in ‘Archaeogastropod’ phylogenies

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This analysis investigates the monophyly and phylogenetic placement of the globally distributed gastropod clades Patellogastropoda, Vetigastropoda, Neritimorpha and the so-called ‘Hot-Vent Taxa’ using novel molecular data. At one point, these groups and Cocculiniformia were placed within the Archaeogastropoda (Thiele 1925), but systematists now increasingly question their status as a single clade. Furthermore, researchers have had difficulty obtaining a robust phylogenetic hypothesis for this clade, especially in analyses based solely on molecular data. In an attempt to understand how the inclusion of additional molecular loci affects the phylogenetic relationships among these ‘archaeogastropod’ clades, we have attempted to sequence various ‘novel’ genes for use in gastropod phylogenetics. Currently, we have had success sequencing three under-utilized nuclear coding loci from different gastropod species: myosin heavy chain type II, RNA polymerase II (subunit 1), and elongation factor-1 α . We will present the preliminary results obtained from a phylogenetic analysis of gastropod relationships combining these ‘novel’ genes with ‘more traditional’ molecular loci such as 18S rRNA, 28S rRNA, 16S rRNA, cytochrome *c* oxidase subunit I and histone H3. This analysis incorporates molecular data from up to eight different genes for 23 gastropod taxa representing Patellogastropoda, Vetigastropoda, Neritimorpha and the ‘Hot-Vent Taxa.’ The analysis also includes representatives from the Caenogastropoda and molluscan classes Bivalvia, Polyplacophora, and Scaphopoda. Results of this preliminary research will elucidate the utility of adding under-utilized nuclear protein-coding loci in obtaining more robust phylogenetic hypotheses of gastropod relationships.

Evolution and biogeography of ancient freshwater pulmonate gastropods: the limpet family Acroloxidae (Hygrophila)

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Freshwater limpets of the well distinguished family Acroloxidae (Pulmonata: Hygrophila) are characterized by enigmatic distribution patterns. They are restricted to the Holarctic region with very few commonly recognized species as well as a major radiation in ancient Lake Baikal and a less species-rich assemblage of endemics in Lake Ohrid. In the Nearctic, there is only a single rare relict species, *A. coloradensis*, which has been regarded as closely related to the widespread European *A. lacustris*.

We studied Acroloxidae throughout their distribution range covering Europe, Far East Russia, North America and the ancient lakes Baikal and Ohrid. Phylogenetic and biogeographic relationships and timing of diversification events for the acroloxids were investigated based on DNA data from two mitochondrial (COI, LSU rDNA) and one nuclear gene (SSU rDNA).

In contrast to the commonly held view, *A. lacustris* is not the sister species of *A. coloradensis*, instead the latter is closely related to a Far East Russian species. The endemics of both ancient lakes each form monophyletic groups. The Lake Ohrid species are related to two other European species and the Baikal species flock is the sister group of the Far East and North American species.

Using an average COI molecular clock rate for Protostomia of $2.23 \pm 0.22\%$ K2P distance/My, we estimated the age of the split of the Ohrid species at 0.97 ± 0.43 My. This temporal window coincides with Pleistocene speciation events in other macrozoobenthic groups of Lake Ohrid. In Lake Baikal, the onset of the intralacustrine radiation started 2.55 ± 0.43 Mya. The most recent common ancestor of the North American *A. coloradensis* and the Far East *A. likharevi* diverged 2.41 ± 0.48 Mya. The Baikal radiation probably started in the aftermath of dramatic Late Pliocene climatic changes in the region, while the separation of Far East and North American acroloxids is most likely linked to earlier breakups of Beringia, mainly disintegration of united Siberian-Alaskan river system.

The subfamilies Margaritinae and Calliostomatinae from South Shetlands Island to Bellingshausen Sea: species diversity and unknown identities

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During the Spanish Antarctic Expeditions BENTART (2003 and 2006) numerous species from the subtidal to deep-water mollusks were sampled. This research was focused on West Antarctica, from South Shetlands Islands to Bellingshausen Sea. Among these samples, trochids were particularly abundant, both in number of species and specimens. The abundance of material coming from the BENTART expeditions represented a great opportunity to obtain new information of some of these taxa, as well as further precisions on the distributional range of the species. Despite the great diversification exhibit by Trochidae in the Southern Ocean, there are many species with doubtful taxonomic status and unknown identities, mainly from Bellingshausen Sea, an area poorly sampled. In this study we focus on the subfamilies Margaritinae and Calliostomatinae. The Margaritinae were represented by five species: *Antimargarita dulcis* (Smith, 1907), *A. smithiana* (Hedley, 1916), *Margarella antarctica* (Lamy, 1905), *M. refulgens* (Smith, 1907) and *Tropidomarga biangulata* Powell, 1951. First records for *Antimargarita dulcis*, *A. smithiana* and *Margarella refulgens* are presented. The diagnostic characters for each of these species are revised and is discussed its affinities with others trochids species. The Calliostomatinae were represented by one, most probably new species of *Falsimargarita*, from South Shetlands Islands. This species has a shell very close to the Margaritinae *Antimargarita dulcis*, and the gross anatomy of this species is studied. In this sense, the genera *Falsimargarita* Powell, 1951 and *Antimargarita* Powell, 1951, differ in their radula, but

share morphological features of the shell, being able to observe a pattern common of external iridescence and predominant spiral cords on a more delicate axial sculpture. Furthermore, we perform a comparison of the shell morphology of the new *Falsimargarita* species with the others species of this genus presently known in the Antarctic waters.

Biodiversity and conservation of freshwater molluscs in the Plateau Lakes of Yunnan Province, SW China

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The Plateau Lakes of Yunnan fall within an international biodiversity hotspot. The molluscan fauna of this region is very poorly known, with numerous synonyms within the sparse Chinese literature. Comparison of recent shell beaches with living material shows that increased pollution of the lakes over the past 30 years, in addition to the introduction of non-native taxa, have resulted in dramatic declines in molluscan biodiversity. The high molluscan endemism in the region suggests that many species have become extinct. To date we have discovered at least ten new species of gastropods and bivalves, including unionids and *Corbicula* spp. A key driver of these extinctions is likely to be the loss of aquatic macrophytes. However, we have shown that the invasive water hyacinth provides an important refuge habitat for the remaining invertebrates, and therefore small patches should be retained until indigenous plants can re-establish. We are also using the indigenous Chinese giant mussel, *Anodonta woodiana*, as a tool for the biomanipulation of the lakes. Pilot tests have proved encouraging, and we are currently propagating the mussel for scaled-up restocking programmes. In the longer term we plan to propagate some of the threatened unionid mussels.

The use of microencapsulated BioBullets in the control of invasive bivalves

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The widespread invasion of bivalve molluscs such as the zebra mussel, *Dreissena polymorpha*, golden mussel, *Limnoperna fortunei*, and false mussels, *Mytilopsis* spp., has made them some of the world's most economically and ecologically important pests. Despite the development of numerous control methods, chlorination remains the only widespread and licensed technique throughout the world. Mussels are able to sense chlorine and other toxins in their surrounding environment and respond by closing their valves, thus enabling them to avoid toxic effects for up to three weeks. Furthermore, prolonged dosing of chlorine in raw water produces ecotoxic trihalomethanes (THMs) by reaction with organic material in the water. We have developed a novel, environmentally safe and effective method for controlling the biofouling mussels; the BioBullet. Our method uses the encapsulation of an active ingredient (such as KCl) in microscopic particles of edible material. The mussels' natural filtering ability then removes and concentrates the particles from the water, without stimulating the valve-closing response. By using the mussels' filtering behaviour to concentrate BioBullets the absolute quantity of active ingredient added to the water can be reduced substantially. Our approach allows us to engineer the particles to break-up and dissolve completely within a few hours, thus eliminating the risk of polluting the wider ecosystem. We have demonstrated that the effectiveness of a toxin in the control of biofouling filter-feeders can be enhanced greatly by using our technique. Furthermore, successful industrial trials indicate that the BioBullet provides a viable and more appealing control option than those currently in use.

Phylogeny of Aeolidacea (Gastropoda: Nudibranchia)

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Aeolidacea is one of four diverse clades of nudibranch gastropods. However, for more than 200 years since its description, only a handful of phylogenetic studies have been conducted, which focused on genera and species level relationships. The majority of these studies used morphology data, while one recent study used molecular information. Morphology characters and mitochondrial fragments 16s and Cytochrome Oxidase I (COI) genes were used in this study to determine the monophyly of Aeolidacea. A morphology data matrix was constructed from 60 species using 75 characters. The mitochondrial genes of thirty-six species were sequenced and combined with sequences available online. Morphology and molecular phylogenetic relationships were acquired using PAUP* for maximum parsimony. Maximum likelihood and Mr. Bayes analyses were also applied for the molecular data. Support for nodes on parsimony and likelihood trees were calculated using Bootstrap analysis in PAUP*. All molecular phylogenetic trees do not support the monophyly of Aeolidacea because several Dendronotacea genera (*Hancockia*, *Doto*, *Dendronotus*, *Scyllaea*, and *Tethys*) form a clade sister to Fionoidea. *Embletonia gracilis* and *Pseudovermis* sp. were consistently basal to all the other Aeolidacea as well as other Dendronotacea species (*Marionia* sp.). *Fiona pinnata* and *Calma glaucooides* consistently fell within the Eubranthidae/Tergipedidae clade, suggesting a need for reclassification of their respective families. This study provides a base for further analysis on lower and higher-level taxonomy, helping to resolve issues relating to the monophyly of genera as well as Cladobranchia, Nudibranchia, and Opisthobranchia.

Active camouflage in a snail

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The shells of some pulmonate species in a diverse array of families carry extraneous layers, mostly consisting of dust or soil. In most cases, the manner in which such layers are positioned onto the shell remains unknown. *Napaesus barquini* (Pulmonata, Enidae) from the Canary island of La Gomera, exhibits an impressive extraneous layer which is arranged in the form of prominent lichen protuberances on the shell. Some of these protuberances may even extend beyond the tip of the shell. The way that these lichens are positioned onto the shell and the manner in which they adhere were investigated. The snail grazes lichen material from the substrate and applies it to the surface of its shell in a standardized pattern of movements. The snail uses its mouth to place the moist material onto the shell and to form it into protuberances that adhere as they dry out. To do this, *Napaesus barquini* extends its body far beyond the shell margin so that it can reach the entire outer surface of the shell and cover it with protuberances, presumably as camouflage.

Freshwater bivalve biodiversity: new insights into ecology, biogeography and conservation

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Renewed interest in freshwater bivalves provides a changing view of this major component of global biodiversity. Research on their ecology and systematics points at how little we actually know about them, as well as how fast this diversity is disappearing. In this presentation, a review of my current research along an arch from Africa across the Holarctic and into the Neotropics is intended to highlight unknown areas, and to set a framework for other contributions to this symposium. The Margaritiferidae constitute an old but highly cohesive group, yet its real diversity remains poorly known. For example, the north-west African *Margaritifera maroccana* is a critically endangered species, being a paedomorphic sister taxon of the European *M. auricularia*. Revision of well-known faunas likewise reveals an unexpected diversity among sphaeriids, both in terms of cryptic species and differentiation of peripheral isolates; this is the case of boreoalpine sphaeriids in a snow-melt seep in Sierra Nevada (southern Spain). Differentiation among drainages in northwestern Iberia, a glacial refuge for *M. margaritifera*, shows that Quaternary cladogenesis in relation to fish hosts may be grossly underestimated. The Palearctic and Ethiopian genus *Unio* is also a paradigm of seriously unrecognized diversity. The east-Pyrenean endemic *Unio aleroni* turns out to be an ancient relic. Endemism in southwestern Iberia follows the pattern of many aquatic animals, with species having their sister taxa further north: *U. delphinus* vs. the *U. pictorum/caffer/mancus* swarm, *U. gibbus* vs. *U. crassus*, *Psilunio* (not *Potomida*!), and *Anodonta castroana* vs. *A. anatina*. Vicariance at a much larger scale is suggested by the close relationship of *Microcondylaea* from Croatia with *Gonidea* from northwestern North America, and even closer with an endemic radiation in the Usumacinta river at the Mexico-Guatemala border. The latter shows an explosive diversification of shell shape and sculpture, reminiscent of other instances among Recent and fossil unionoids. It is hypothesized that shell traits in large freshwater bivalves are largely antipredatory devices, their geographic and stratigraphic distribution tracking that of molluscivorous fishes. Most of all this diversity is now threatened by the very same ecological processes that fostered colonization and diversification in freshwaters. From this perspective, the invasive traits of some freshwater bivalves such as *Dreissena* and *Corbicula* can be better understood, and appropriate (albeit courageous) eradication plans can be devised through hydrological management.

Fossil vesicomyid bivalves from the North Pacific region

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A review of the fossil record of vesicomyid bivalves from the North Pacific region (Hokkaido, Japan; Alaska and Washington, USA) allows the clarification of the status of several species based on new data and observations, and four new species are recognized. Detailed examination of the hinge of *Hubertschenckia ezoensis* shows that *Hubertschenckia* is a valid monotypic genus closely related to *Archivesica* and *Calypstogena*. Specimens of ‘*Calypstogena chinookensis*’ from its late Eocene type locality at Bear River in Washington have a hinge structure that clearly places this species in *Adulomya*; silicified ‘*C. chinookensis*’ specimens described earlier from the late Oligocene have a very different hinge structure and are assigned to a new species. The hinge dentition of all three Cretaceous vesicomyids proposed so far is unknown and their validity is doubtful. With *Hubertschenckia ezoensis*, *Adulomya chinookensis*, and *Archivesica* cf. *tchudi*, three genera of large vesicomyids appear more-or-less simultaneously at methane seeps in the middle to late Eocene. The

presumed discrepancy between molecular age estimates and first fossil occurrences of vesicomids emphasized earlier disappears in the light of our evaluation. Of Oligocene age are the new *Archivesica* from Alaska, which is shorter and more oval than other known *Archivesica* species, and a possible *Pliocardia?* sp. from cold seeps in Washington. From the early Miocene of Washington *Isorropodon* is described and represents the first certain record of this genus from outside the Atlantic realm. The new middle Miocene *Adulomya* is so far only known from a whale-fall community in Hokkaido and may have been endemic to this type of habitat. The timing of the occurrences of these taxa show no correlation to the evolution of whales in this area, shedding further doubt on the 'whale stepping-stone' hypothesis for the origin of vesicomids.

Ultrastructural study of the spermatogenesis of a protandric neogastropod, *Coralliophila meyendorffii* (Muricidae, Coralliophilinae)

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The spermatogenesis of a protandric neogastropod, *Coralliophila meyendorffii* (Muricidae, Coralliophilinae) has been studied with electron microscopy and light microscopy. As in other neogastropod species, males of *Coralliophila meyendorffii* develop in the testis two types of spermatozoa, fertile eusperm and sterile apyrene parasperm, both of which are ejaculated in the seminal fluid. Mature parasperm are similar to that of other muricid species. They are worm shaped, motile, lack nucleus, present multiple axonemes arranged peripherally under the plasma membrane and contain degenerated mitochondria, glycogen granules and larger cytoplasmic electron dense granules with polysaccharides. A nutritive role of the parasperm for the eusperm while they are stored in the female oviduct is suggested. The ultrastructure of the mature eusperm and the processes during maturation conform with those observed in other caenogastropod. Primary spermatocytes are characterized by the presence of rod shaped and large mitochondria in a scarce cytoplasm and a nucleus with a granulose chromatin showing the initial synaptoneme complexes and one or two nucleolus. Early spermatid have a nucleus with a still a granulose chromatin forming small amounts on the periphery. The nucleolus are often detected in this phase. The cytoplasm, with mitochondria and the Golgi body, is scarce, and the axoneme starts developing. The next phases are characterized by the progressive chromatin condensation, the mitochondria fusion and the beginning of their twisting around the axoneme at the level of the middle piece. In the part of the tail near the middle piece, the axoneme is surrounded by numerous glycogen granules decreasing progressively in number toward the tip of the tail. In the head region, the Golgi body is highly active and secretes granules to form the acrosome which ascends towards the top of the nucleus. The rests of cytoplasm are excreted as a vesicle.

Hidden genetic diversity in cephalopods: cryptic speciation or deep mitochondrial coalescent events?

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Some cephalopod species show evidence of substantial genetic variation and are probably species complexes, while others appear to be panmictic over large geographic areas. Recent investigations of *Alloteuthis* (Loliginidae) have revealed unexpected patterns of genetic variation. *Alloteuthis* comprises three nominal species of small squid (*A. media*, *A. subulata* and *A. africana*) found in the eastern Atlantic and Mediterranean. Two mitochondrial loci (COI and 16S) were sequenced from multiple individuals from each species, collected from several localities by a network of collaborators. Two of the nominal species (*A. media* and *A. subulata*) have substantially overlapping geographic ranges and cannot be separated based on mitochondrial data, suggesting that these two “species” are actually one (referable to *A. media*), with weak genetic differentiation between Atlantic and Mediterranean populations. The mitochondrial data also revealed three specimens from Italian waters that could represent a cryptic *Alloteuthis* species. All putative *Alloteuthis* species (including the alleged cryptic species) pass two common “DNA taxonomy” tests for species diagnosis using COI data: reciprocal monophyly and the “10X rule”.

However, the aberrant Italian specimens could simply represent an unusually deep mitochondrial coalescent event *within* a single species, rather than reproductive isolation *among* species. To distinguish between these possibilities, a nuclear locus (rhodopsin) was sampled. The *Alloteuthis* rhodopsin phylogeny was broadly congruent with (but not identical to) the mitochondrial phylogeny, suggesting that the cryptic species is a distinct evolutionary entity. Gene tree parsimony analysis and results from coalescent simulations were consistent with the hypothesis that the aberrant specimens represent a cryptic species. This study highlights the importance of 1) sampling multiple individuals, locations and loci for species-level molecular phylogenetic studies, and 2) accounting for the stochastic nature of the coalescent process when assessing incongruence among gene trees for closely related taxa.

Sexual selection and its consequences in the Opisthobranchia

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Charles Darwin validly argued that, in hermaphrodites such as opisthobranchs, sexual selection could not affect traits such as external colouration. Today, however, we are aware that sexual selection often operates much more subtly and targets a multitude of traits associated with the male or female reproductive function of a hermaphrodite. Recent empirical studies provide intriguing insights into the levels at which sexual selection may act in various opisthobranch groups. These include, for example, male and female genital morphology, the behaviour associated with mating, the mode of insemination, male and female mate choice, or the trade-offs between male and female resource investments. Here I examine current evidence for the effects of sexual selection on the evolution of opisthobranch characters and identify fields of research that require increased attention in the years to come. Some specific aspects of opisthobranch reproduction, such as the often independently performed male and female function, render this group particularly suitable to study some general predictions of sexual selection theory.

Application of marine mollusk remains from shell middens for paleoenvironmental reconstructions

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Mollusc remains from two shell middens on Adak Island, Aleutians were analysed to reconstruct the paleoenvironmental conditions in this area.

Radiocarbon analysis showed that the first shell midden was formed 6500-6100 years ago. This deposit is situated near Clam lagoon. Analysis of invertebrates' taxonomic structure showed that seabed relief in Clam lagoon changed significantly during the existence of the ancient settlement. It is manifested in decrease of share of epifaunal molluscs' remains (foolish mussel *Mytilus trossulus* and chitons) from layer 4 to layer 2 of shell midden. Also it is manifested in increase of share of Nuttall's cockle's remains (*Clinocardium nuttallii*) and other species, which live in sand ground, in the same layers. It is likely that the intertidal zone of Clam lagoon had more rocky structure at the end of 6th millennium BC. Then the portion of rock seabed decreased, and the sandy ground began to dominate. The second shell midden, situated near Sweeper Cove, was formed 1800-750 years ago. The remains of epifaunal molluscs dominating in deposit are the evidence of rocky structure of the intertidal zone of Sweeper Cove during the 8th-19th centuries AD. Analysis of the invertebrates' taxonomic structure allows to mark out three periods in the development of this shell midden. Conceivably warmer conditions were from the middle of the 11th till the 15th centuries and from the middle of the 16th till the 19th centuries, because thermophilous species, non typical for this region, (*Nucella heyseana*) were found in the layers. It is likely that higher production of intertidal community from the 15th till the middle of the 16th centuries is result of relatively cold environmental conditions in this time. The colder period corresponds to "Little Ice Age".

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Ecology and population dynamics of *Tridacna maxima* in Lakshadweep Archipelago, India

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The ecology and population dynamics of *Tridacna maxima* were studied in Lakshadweep Archipelago, India. A comparison of *T. maxima* population was carried out in 10 lagoons covering 24 islands. Various aspects related to ecology and population of *T. maxima* such as microhabitat, associate, substrate preference, reef canopy distribution, mortality (predation, diseases, bleaching etc), recruitment were studied in 10 lagoons.

Agatti Island has the highest population of *T. maxima*. *Porites lutea* and *Porites solida* are most important species which offer suitable substrate for *T. maxima* in all islands. Role of herbivore in maintenance of micro-habitat of *T. maxima* was studied in Kavaratti Island. Convict Surgeonfish (*Acanthurus triostegus*) is the most important browser within the lagoon which is responsible in maintenance of *P. lutea* and *P. solida* coral tops.

The trends clearly indicate high mortality in *T. maxima* on all islands while recruitment is very low. Suheli and Bangaram group of islands have shown good recruitment. Bleaching of *T. maxima* has been noticed on few occasions. However, habitat degradation due to human induced alteration in lagoon ecology is the main cause for mortality in *T. maxima* in many islands. In few lagoons like Kalpeni, Bangaram and Bitra, large size *T. maxima* has been observed (480-500 mm). The size exceeds all the known size records for the species.

How many unionoid taxa live in the western Palearctic?

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The taxonomy of the western Palearctic naiads is very far from being clarified. Although the 6 genera recognized (*Anodonta*, *Margaritifera*, *Microcondylaea*, *Potomida*, *Pseudanodonta* and *Unio*) are still valid, the number of species in each genus is under debate. We have used a molecular approach in order to avoid the variability and convergence in shell features, which is the reason for the plethora of names in Palearctic unionoid taxonomy. We have undertaken molecular analyses of 16SRNA and cytochrome *c* oxidase subunit I of more than 300 naiads from a large part of their range: Belgium, France, Germany, Greece, Italy, Ireland, Morocco, Poland, Portugal, Russia, Slovakia, Spain, Switzerland and Turkey. Some of the samples come from the *terrae typicae* of the nominal species or subspecies from Haas (1969). Both our results and the sequences from GenBank confirm the monophyly of 5 genera (except *Anodonta*). *Pseudanodonta* and *Microcondylaea* are monotypic. The genus *Unio* showed at least 13 taxa in Europe. Within the genus *Anodonta*, *A. cygnea* is a valid species, while the widespread *A. anatina* is probably a complex of several species. We have found two different species of *Potomida*, one in western Europe and the other in Turkey. Future results from Moroccan populations may still change this picture. Finally, *M. margaritifera* is a widely distributed species in all Europe and *M. auricularia* has a sister species in the North of Africa.

Micro-molluscs of the Western Ghats: Distribution and threats

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The Western Ghats is one of the 34 hotspots of biological diversity and harbours high level of endemism in variety of taxa. Being a hotspot, most of the work has been done on higher taxa such as mammals, birds etc and lesser taxa such as land snails are totally ignored. Given the rapid land transformation occurring due to anthropogenic pressure in the Western Ghats a need has risen to study the impact of such land use change on poorly known fauna such as land snails. The first attempt was made here to assess the distribution patterns, land use and habitat disturbances on land snails of the Western Ghats. We have assessed a) geographical distribution patterns of micro gastropods along the Western Ghats based on published literature and also from the field studies and b) impact of land use change and habitat disturbance on micro gastropods in the wet forests of the central Western Ghats. The results suggest that a) around 40% of the total 270 species of land snails recorded were micro gastropods, b) southern Western Ghats harbors high species richness for both micro as well as macro molluscs compared to central and northern Western Ghats, c) macro molluscs occur in very high densities compared to macro species, d) land use changes and habitat disturbances tend to prefer macro gastropods over micro. The present study clearly shows the land transformation and a disturbance has a severe impact on land snail diversity. There are no efforts in India to include

lesser known taxa such as land snails in conservation program. This is mainly due to lack of our knowledge on ecology of this cryptic group. So there is urgent need to assess the distribution and landscape ecology to conserve these lesser known but a very significant group of invertebrates before they silently disappear due to anthropogenic activities such as habitat alteration and degradation, pollution and climatic change.

Land snails versus mammals: chromosomal neighbourhood of genes drives the „phylogenetic impact“ of DNA sequences

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DNA sequences evolve through mutation, recombination, selection and/or stochastic fixation in gene pools and phylogenetic lineages. The A, T, G, and C digits of DNA sequences are source-codes in molecular phylogenetics. I report on a particular process of nucleotide evolution: the loss of A and T signals because of the influence of homologous gene “neighbours” along chromosomal positions. The process is based on gene conversion, and is called GC3 drive. GC3 triggers the conversion of A and T nucleotides towards G and C at the third codon position of protein-coding genes without alteration of the amino acid sequence. Here, histone genes of land snails and mammals are used as model systems for GC3 processes.

There is evidence that land snails’ histone genes do not undergo GC3 drive, presumably because of fixed chromosomal arrangement of the loci. Hence, phylogenetically relevant A and T nucleotides might still appear at the third codon position of land snails’ histone genes. A multiple sequence alignment of the H3/H4 gene cluster of land snails is investigated for the appearance of A, T, G, and C nucleotides at the third codon position. Mammals, however, have loose arrangements of homologous and paralogous histone gene copies along chromosomes, and they show high GC3 drive because of gene conversion of neighbouring loci. As a consequence, one should consider less A and T signals in phylogenetic lineages of mammalian histone genes.

In conclusion, gene arrangement and gene conversion have impact in the search of appropriate markers in molecular phylogenetics. I suppose single-copy loci as better targets for studying molecular phylogeny, e.g. the large subunit gene of the RNA polymerase II or the phosphoglucomutase-1 gene for “deep branch” phylogeny. Single-copy genes are attractive phylogenetic tools because the pitfalls of chromosomal neighbourhood and GC3 drive are negligible.

Predicting the effects of a habitat restoration project on population viability of one threatened and one endangered lotic gastropod

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Rare, threatened, and endangered taxa are often considered ‘umbrella taxa’. Their persistence in an ecosystem is considered to reflect a ‘natural state’. River impoundments can often eliminate habitat for aquatic threatened and endangered taxa and reduce population viability. The threatened Bliss Rapids snail, *Taylorconcha serpenticola*, and the endangered Banbury Lanx, an undescribed *Lanx* sp., survive as meta- and fragmented populations in the mid-Snake River drainage, Idaho, USA including the Banbury Springs complex. Much of the lotic habitat in this spring complex has been inundated by the manmade Morgan Lake: neither species occurs in the lake. Habitat restoration projects in the Banbury Springs complex area have been implemented to reduce anthropomorphic impacts on the native taxa and ecosystem, including the removal of Morgan Lake. Management goals include: 1) reestablishment of lotic habitat for *Lanx* sp. and *T. serpenticola*, 2) increased dispersal

between springs, 3) and reduction of the impacts of an invasive snail, *Potamopyrgus antipodarum*. Success of these projects will be evaluated by increased population viability of both native species. We conducted spatially explicit metapopulation viability analyses to predict changes in *Lanx* sp. and *T. serpenticola* viability if Morgan Lake was removed. We modeled this by modifying several parameters: 1) connectivity, 2) dispersal, 3) habitat availability, and 4) *P. antipodarum* abundance. Preliminary results show that removal of Morgan Lake could increase survivability of *Lanx* sp. populations considerably and to some extent, *T. serpenticola* metapopulations. Continued monitoring of these populations after Morgan Lake is removed is required to evaluate the effectiveness of this restoration project.

Developmental constraint and stabilizing selection against left-right reversal in snails

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Diverse animals exhibit left-right asymmetry in visceral anatomy. However, mirror-image animals that develop in left-right reverse have not generally evolved. Similarly in snails, sinistral taxa are limited, and populations seldom contain chiral variants. The frequency-dependent selection hypothesis explains the rarity of chiral variation in snails by selection against the chiral minority resulting from mating difficulties with the majority due to genital mismatch. This hypothesis also explains how mirror-image snails could have evolved, because in this mode of selection, a population could be fixed for the reversal once the variant exceeds 50%. However, the hypothesis cannot explain the general absence of mirror-image species in animals other than snails or externally fertilizing snails, because neither would experience interchiral mating difficulties. On the other hand, the developmental constraint hypothesis proposes that left-right reversal leads to aberrant morphogenesis and thus reduces fitness. However, little solid evidence has supported it. Here we demonstrate direct experimental evidence of developmental constraint against mirror-image morphogenesis and of viability reduction by left-right reversal. Taking advantage of hermaphroditism and the maternal effect of snail handedness gene, we produced sinistral and dextral snails that share the same parental genome but develop in reverse polarity in a freshwater pulmonate *Lymnaea stagnalis*. We discovered that sinistrals suffer high mortalities before hatch, and that sinistrals do not form the shells in the exact mirror-image of dextrals. These results demonstrate the presence of developmental constraint and stabilizing selection against left-right reversal, which could explain the general absence of left-right reversed species across diverse animal groups including snails. We used sinistrals and dextrals that shared nuclear genes from the same parents but differed in the maternal determinant of left-right polarity. Thus, the developmental constraint detected here could have resulted from either pleiotropy (side-effects) of the chiral determinant or from left-right reversal of developmental configuration.

Effects of temperature on metabolism and growth in *Protothaca thaca* (Mollusca: Veneridae)

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Protothaca thaca (Molina, 1782) is an important species for small-scale benthic fisheries, inhabiting shallow (5-15 m) sandy bottoms of the upwelling ecosystem of Chile and Peru. Temperatures in these ecosystem change dramatically during El Niño events. *P. thaca* exhibits good tolerance to high temperatures. To understand the metabolic processes behind this adaptation we studied the effects of temperature on: standard metabolism, growth and body condition index of *P. thaca* from Northern Chile Antofagasta (23° 42' 17" S; 70° 25' 33" W; mean annual sea surface temperature 17.4 °C), Chile. Oxygen consumption of animals acclimated to 12°, 16° and 20° C was measured using an intermittent flow-through system. Animals were stained by immersion in the flouochrome Calcein (100 mg·l⁻¹, 3h) to estimate daily growth rates. Our results show that standard metabolism, growth and body condition index are significantly lower at 12° C compared to 16° and 20°C. No differences are observed between the higher temperatures. Our results are well in line with previous studies showing a wide temperature tolerance window of *P. thaca*. The relative thermal independence of routine metabolism is suggested to conserve energy, which allows the species to be more tolerant to high temperatures.

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The genus *Buccinanops* (d' Orbigny, 1841): No eyes or blind eyes?

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The genus *Buccinanops* groups seven species, all endemic to the South Western Atlantic. *Buccinanops cochlidium* ranges from Rio de Janeiro, Brazil (23° S) to Comodoro Rivadavia in Patagonia, Argentina (45° S). They occur constantly during the whole year and are easily collected by SCUBA diving around Península Valdés. In San José Gulf (42°25' S; 64°31' W) they commonly live in shallow waters between 4 y 15 meters depth, buried in sandy bottoms. Animals are medium in size reaching up to 120 mm length, and are typically blind. The genus name means *no eyes*, due to the lack of visible eyes.

In this work we recognize for the first time the presence of eyes in this genus. Observations evidenced the presence of eye spots in the embryos of *Buccinanops cochlidium*, during intracapsular development as well as in the young hatchlings. The tentacles were histologically studied in late "veliger" stage embryos, juveniles and adults. Eyes were found only in embryonary tentacles which presented sensory cells, corneal cells and a lens. No evidence of an eye was found in continuous serial cuts of an adult tentacle. The possible location and functionality, if any, of the eyes in the adults remain unknown.

Tentative hypothesis on embryonary eye evolution, at the beginning of this work, were:

- 1) The embryonic eye is reabsorbed and disappears.
 - 2) The eye is conserved but is covered by the overgrowth of tentacle tissue (inner migration)
 - 3) The eye is modified so that it is no longer functional and then migrates into the tentacle.
- Ontogenic development evolution of the eye's ultrastructure, functionality and location is currently being studied.

The effects of salinity changes on the heart rate of two species of bivalvia in long-term experiment

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The responses of marine invertebrates to salinity changes have been studied extensively over the last 30 years. However, there have been few attempts to investigate the reactions of sublittoral animals. The major objective of our study was to determine whether there were significant differences in the physiological responses of *Hiatella arctica* L. (Linnaeus, 1767) and *Modiolus modiolus* L. (Linnaeus, 1758) to changes in salinity. *Modiolus modiolus* and *Hiatella arctica* are syntopic species. Nevertheless, *Hiatella arctica* is more euryhaline and can survive from a depth of 0.5 m, whereas *Modiolus modiolus* resides at depths starting from 5-6 m. Another morphological distinction is that the valves of the arctic saxicave are porous and unable to isolate the mollusk tissues from surrounding water. Four experimental salinities – 15, 20 30 and 35 ‰ – and a control salinity of 25 ‰ were employed. Changes in the heart rate were measured in long-term experiments during acclimation and deacclimation of the animals. The results suggest that environmental conditions determine the features of the adaptive physiology of marine mussels. The animals exhibited a significant decrease in the heart rate at all experimental salinities except for 35 ‰, at which an increase in the cardiac activity was observed. Return of the mollusks into the original salinity conditions (deacclimation) induced different responses of the heart rate – from drop to raising. The results prove that the cardiac activity of the animals is quite sensitive to changes in salinity.

Ongoing renovations in the Department of Malacology at the Museum of Comparative Zoology (Harvard University)

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Extensive renovations that facilitate collections storage and collections-based research continue at the Museum of Comparative Zoology (MCZ). Major collection room renovations have taken place in many Departments in the MCZ, including the Department of Malacology. In 2006, renovations began in the pulmonate room, one of five collections rooms in the Department. Funded by MCZ and Harvard University funds, the renovations included the installation of new storage efficient collections cabinetry providing much needed collections storage expansion space, easier specimen retrievability and security for the specimens. The specimens previously arranged taxonomic within geographical subsets, were reorganized in the new cabinets alphabetical by family, genus, species, etc. A list of all pulmonate taxa, including potential types, was generated. Renovations of a second room are set to begin in early fall, 2007.

Evaluation of Neogastropoda of the Cretaceous, their taxonomy and relation based on the morphology of their protoconch

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Traditionally many families of the Neogastropoda have been recognized among the fossil Late Cretaceous species based on the morphology of their adult shell. The excellent preservation of shells from the Campanian and Maastrichtian Ripley Formation of Mississippi and Tennessee allowed to examine the protoconch of many of these taxa. In those species with shell of a planktotrophic veliger a comparison with larvae of different families of modern Latrogastropoda provides no evidence for a close relation between fossil and recent species. Obviously the closeness in morphology in adult shell shape is due to convergence. The study also revealed that many of the taxa of the Ripley Formation have no living counterparts but represent groups that have become extinct since, mostly connected to the K/T event. The Pyrifusidae are united by the character of their protoconch and may represent stem group Neogastropoda. They can be split into several subfamilies according to the shape of their teleoconch. Their larval shells resembles in general shape and ornament some found among modern species of Muricidae, Buccinidae or Conidae with little ornament and a median projection of the final apertural outer lip, but they differ from the modern species by an indistinct apertural margin and gradational transition of larval shell into the teleoconch. Some of the fossil taxa that have been assumed to represent Neogastropoda are actually related to groups of the Neomesogastropoda. The protoconch of Sarganidae and Moreidae is for example lowly coiled with rounded whorls and its apertural margin not lobed, in contrast to the elongate conical protoconch of most modern Neogastropoda as well as that of the Pyrifusidae. Similar shapes are found among modern Ficidae, Capulidae or Eratiodae of the Neomesogastropoda. Cretaceous Paladmetidae have a larval shells that connect in shape and ornament of rectangles to that of the Tonnoidea, but also to the problematic fossil Colombellinidae. The early appearance of the Naticidae, Cypraeidae and Calyptraeidae during the Late Cretaceous provides evidence of the origin of the Latrogastropoda and both their branches Neogastropoda and Neomesogastropoda before Aptian/Albian time about 100 Million years ago. But their representatives are conspicuously absent from all well known Early Cretaceous faunal assemblages. Stem group Latrogastropoda have been suggested in the Maturifusidae of the Jurassic to Cretaceous and the Purpurinidae of the Jurassic to Triassic, but their protoconch is not close to that of the Ripley gastropods. The Pyrifusidae of the Late Cretaceous may have given rise to some of the modern groups of the Neogastropoda such as Volutidae still during the Late Cretaceous, while many of the taxa of the Neogastropoda appear within the Paleogene and their fossil species are usually recognized by the characters of their protoconch.

Comparative anatomy of selected Philippine Cone snails (Neogastropoda)

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Comus (cone snails) is an unusually species-rich genus of predatory and venomous tropical marine gastropods. Comparative analysis on the anatomy of selected Philippine cone snails with different feeding types was done to elucidate the usefulness of anatomical characters in inferring phylogenetic relationships within this genus. Standard dissection supplemented with serial histological sections was used to obtain anatomical data sets from six species of *Comus* (*C. imperialis*, *C. ebraeus*, *C. miles*, *C. textile*, *C. magus*, and *C. striatus*) and two outgroups (*Lophiotoma acuta* and *L. abbreviata*). Characters were taken from the adult shell, operculum, osphradium, ctenidium, male reproductive system, venom apparatus including the salivary gland, and radula. A consensus tree of selected *Comus* species was produced based on 2 most parsimonious trees generated by PAUP* 4.0 (Swofford 1998) from initial data consisting of 40 morphological characters with 95 character states. Preliminary analysis indicates that *C. ebraeus* has more characters shared with the outgroup. The tree has a branching pattern that supports the grouping of *Comus* into different feeding types with 97% bootstrap support based on 1000 replicates.

Application of a 16S rDNA barcode to diagnose pest *Arion* species in the U.S.A.

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The utility of a DNA barcode using the ribosomal 16S gene is examined for *Arion* species by characterizing genetic variation within and between taxa. Comparison of variation within *Arion* DNA sequences indicates that 16S is as variable as the commonly used barcode region of *cytochrome oxidase I*. Analytical sensitivity (measured by PCR success), however, was greater for the 16S marker. Based on 16S variation, a reference database comprising over 270 DNA sequences and over 20 species was generated and used to analyze query sequences from slugs collected within the United States or intercepted at U.S. ports of entry. As expected, the total number of “positive” taxonomic identifications varied when different barcode interpretive rules were applied and the success of the barcode (i.e. proportion of identifications) was greater when queried slugs were from North America. The relevance of this barcode tool to pest quarantine programs and aspects of its implementation are discussed.

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) affects shell mineralization of the freshwater bivalve *Anodonta cygnea* L.

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In freshwater bivalves the outer mantle epithelium (OME) is the organ responsible for the control of shell mineralization. The OME a) secretes the organic molecules where the precipitation of calcium carbonate takes place, b) maintains the calcium concentrations above saturation in the extrapaleal compartment that is in contact with the shell, and c) regulates the pH of the extrapaleal compartment that, by influencing the carbonate concentration, may thermodynamically force the reaction $\text{CaCO}_3 \rightleftharpoons \text{Ca}^{2+} + \text{CO}_3^{2-}$ in one direction or the other.

In short circuit conditions, the OME transports protons at very high rates to the extrapaleal compartment. This transport is due to the operation of a V-ATPase, bafilomycin sensitive and is equivalent to the Isc generated by the OME. To evaluate the effect of TCDD on shell mineralization we have studied its effect on the short circuit current (Isc) *in vitro* and *in vivo*. Using voltage clamp technique the epithelium was mounted in Ussing type chamber and short circuited.

The 6 days exposure of the animals to TCDD (30 nM) resulted in a significantly increase ($p < 0,05$) of the Isc when compared with control animals. The effect of TCDD on shell mineralization will be discussed. The Isc may be a useful tool to study the effect of pollutants on shell mineralization.

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A phylogeny of the minute thyasirids (Bivalvia: Thyasiridae) based on morphological investigations

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The family Thyasiridae Dall, 1900, comprises twelve genera with approximately 90 species. A large proportion of these species do not grow larger than 3 mm. A morphology-based phylogenetic analysis focusing on the group currently included in the subfamily Axinopsidinae Bernard, 1983, was undertaken to test the validity of this classification at subfamily level. This analysis utilized characters coded from the external shell morphology and the internal anatomy. The external shell was prepared for scanning electron microscopy by dissolving soft parts in 2 % sodium hypochlorite and mounting the shell on stubs using a combination of adhesives. Investigating the internal anatomy, traditional paraffin wax-based histological techniques proved unsuccessful. An alternative resin-based technique proved more suitable for dealing with minute specimens. The full technique of using resin-based histology will be outlined, including advantages and disadvantages. Using this methodology a total of 75 diagnostic characters, 35 based on the external shell, 40 based on the internal anatomy were scored for each specimen. Thirty one characters were deemed phylogenetically informative and included in the analysis. In total 27 thyasirid species including four putative new species were coded for phylogenetic analysis. The results of this phylogenetic analysis suggest the subfamily Axinopsidinae, as it currently stands, is polyphyletic. A fundamental split in the family Thyasiridae would appear to have come about through reduction and simplification of anatomy among certain genera. A revised classification of the subfamily is proposed, restricted to those genera which display neotenous characteristics only. Support for this hypothesis is evident from both conchological and anatomical characteristics which will be discussed in conjunction with the practical techniques that uncovered them.

Cytogenetic damage in aquatic mollusks as a biomarker of environmental pollution

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The cytogenetic techniques used in this study proved to be a reliable tool for the evaluation of genetic alterations induced by heavy metals, PAHs, crude oil, flame retardants and other dangerous environmental agents. Cytogenetic damage – aneuploidy, polyploidy, meiotic injuries, chromosomal aberrations, micronuclei and other nuclear abnormalities were employed as a biomarkers of environmental pollution and were evaluated in freshwater and marine mollusk species. In freshwater mollusks, cytogenetic damage was assessed in different species (from *Anodonta*, *Unio*, *Dreissena*, *Viviparus*, *Melanopsis*, *Theodoxus*, and other genera) inhabiting highly contaminated sites in rise and orange-tree fields, in mountain and geothermal springs in eastern Spain, in environs of nuclear power plants (Lithuania, Switzerland, Spain), in different water bodies of Lithuania, Switzerland, and Poland. The highest level of cytogenetic disturbances was found in mollusks from the vicinities of Cofrentes NPP, from geothermal spring and canals in orange-tree fields (eastern Spain), Murten Lake (Switzerland, in nearby two NPPs are located), in rivers below biggest cities. The frequency of aneugenic and clastogenic effects in mollusks from heavily contaminated sites was 3-10 times higher than in mollusks from the reference sites.

In marine mollusks, micronuclei and other nuclear abnormalities were applied to assess mutagenicity in different zones of the Baltic, North Sea and Atlantic Ocean. Relevance of mollusks to monitor environmental mutagenicity was proved in long-term monitoring of cytogenetic damage in mussels and fish after the oil spill in the Baltic Sea. Caged and native bivalves were used in studies of genotoxic effects appeared around different offshore oil platforms in the North and Barents Sea. A clear relationship between concentrations of crude oil, different alkylphenols, flame retardants and levels of cytogenetic damage was found in experimental exposures of mussels (IRIS, Norway).

3D microanatomy of *Omalogyra atomus* (Gastropoda, Omalogyridae)

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The Omalogyridae includes many minute species – shell diameter usually less than one millimetre – some of which have worldwide distribution. Despite of its small size, soft part anatomy of the very common European member *Omalogyra atomus* (Philippi, 1841) has been investigated already in 1948 by Vera Fretter. Although considered as a basal member of Heterobranchia, the exact systematic affinities of the Omalogyridae are unclear. A reinvestigation of *O. atomus* shall shed light on the hypothesis of a possible progenetic origin of the Omalogyridae out of Architectonicidae. Furthermore, direct comparison of the previous and the present results will enable evaluating the advantages of the modern methods applied - “semithin” serial sectioning and computer-aided 3D reconstruction.

The present data confirm most of the results obtained already by FRETTER 1948. In particular the highly glandular nature of the foot and of the mantle cavity, the complete lack of a gill being functionally replaced by prominent ciliary tracts, the relative simplicity of the gut and the high complexity of the hermaphroditic reproductive system adapted for internal fertilization are the most outstanding features of the snail’s anatomy.

Future comparative data on related species and genera will show, whether these characteristics can be ascribed to the extreme smallness of the animals or can be considered as an adaptation to the highly demanding habitat (tide pools) of *O. atomus*. Alternatively, at least some of the characters may be caused by the heterobranch affinities of Omalogyridae. We hope to clear up the systematic position

of Omalogyridae either as an separate clade of early heterobranchs or as a progenetic part of a superclade Architectonicoidea.

Does lead poison snails?

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Lead rarely occurs at levels that significantly impair the growth and reproduction of molluscs and invertebrate studies suggest it is the least toxic of the common metallic pollutants. It is readily accumulated by groups with a high calcium demand, but nearly all invertebrates respond to other toxic metals at much lower concentrations than those of Pb.

Lead may follow pathways of Ca uptake and loss and can substitute for it in some enzymes requiring Ca for their activation. However, Pb is excluded from some Ca-rich tissues in gastropods, suggesting some protective or other mechanism. Additionally, some snail populations may have a Ca metabolism adapted to a high Pb environment. If these are responses to some impairment of function they have resulted from a selective pressure at concentrations beneath those commonly used to define a toxic response. Simple toxicological studies – much of the existing literature – may not fully represent the significance of Pb. Determining the significance of environmental Pb may require a different perspective, with greater attention to its sub-lethal and biochemical effects.

Perhaps lead is relatively benign at most environmental concentrations, when it represents a small fraction of a snail's Ca uptake. If Ca is abundant, low Pb concentrations may have little effect. However, we can detect effects when available Ca is low and demand is high: juveniles across several populations of *Cantareus* favour soft tissue rather than shell growth on a high Pb diet. Those from Ca-rich habitats appear to have different growth strategies to snails from Ca-poor habitats, which may result in different susceptibilities to a Pb burden. Rather like the close associations between Cd and Zn, or Hg and Cu, we may only understand the environmental significance of Pb by reference to an essential metal analogue such as Ca.

Sperm storage organ evolution in the carrefour of stylommatophoran gastropods

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An important factor of postcopulatory sexual selection in internally fertilizing species is the presence of specialized female sperm storage organs. In our study, we morphologically examined the presence and complexity of spermathecae in the carrefour region of 47 stylommatophoran gastropod species. Partial 28S rDNA sequences were used to construct a molecular phylogeny, and maximum likelihood and Bayesian methods were applied to investigate the history of sperm storage organ diversification. The phylogenetic analyses revealed several independent gains and losses of sperm, indicating rapid evolutionary changes. The presence of a complex spermatheca was associated with the occurrence of love darts or any kind of auxiliary copulatory organs, the presence of a long flagellum and cross-

fertilization as the predominant mating system. This result is consistent with the theory that postcopulatory selection is a strong force in shaping reproductive morphology. However, our results also suggest associations of spermatheca presence and complexity with several life-history traits including body size, reproductive strategy (semelparity vs. iteroparity), reproductive mode (oviparity vs. ovoviviparity), and with habitat type, indicating that these factors potentially also influence the evolution of female reproductive morphology and should be taken into account in future studies of reproductive trait divergence.

Testing the glacial refugia hypothesis in spring snails (*Bythinella* spp.)

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The Pleistocene period in general and the last glacial maximum in particular heavily affected the distribution of European biota. The general perception is that with the regression of the ice shield, central and northern Europe were (re-)colonized from three major Mediterranean refugia: the Iberian Peninsula, northern Italy, and the Balkans. However, studies in fishes and crustaceans indicated that several freshwater taxa, the dispersal routes of which are restricted to pathways offered by hydrographic systems, survived the Pleistocene in refugia in northern and central parts of Europe. Here, we investigate the European spring snail genus *Bythinella* (Caenogastropoda) relative to glacial refugia and postglacial (re-)colonization routes. These microgastropods are restricted to low temperate springs being classified as very cold stenotherm and exhibiting low dispersal capacities. Phylogeographical relationships were assessed utilizing the mitochondrial COI gene for circum-alpine *Bythinella* spp. (250 specimens of 82 populations). Phylogeographical analyses indicated major differences in the population structure of population north vs. south of the Alps. Whereas northern population showed extremely low within- and between population diversities, population from areas south, west and east of the Alps were much more diverse. Network and gene flow analyses indicated three distinct recolonization routes: one from the Pyrenees (*B. compressa*, *B. dunkeri*, *B. badensis*), one from northern Italy and Croatia (*B. bavarica*), and one from areas east of the Alps (*B. austriaca*).

Inventorying the molluscan fauna of the world - The role and impact of malacological serials

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Since the first molluscan journals appeared in the 1770s, the field of malacology has generated an ever-increasing diversity of serials. These range from scientific journals that publish original research articles intended as part of the permanent scientific record to newsletters of societal or local interest. Counting major name changes, our field has spawned more than 500 such serial titles of which about 170 are currently active. It would seem that malacological serials thus publish the majority of molluscan-related discoveries and species descriptions, but this is not (and never has been) the case. As in most other fields of biology, today's malacological publications are impacted by developments and discussions concerning publication costs, peer review, electronic and open access, and last but not least, comparative "impact factors" and citation indices.

Assisted by a database of worldwide malacological journals and newsletters (assembled by Bieler & Alan R. Kabat and maintained at the Field Museum of Natural History: <http://emuweb.fieldmuseum.org/iz/journals.php>), this presentation reviews the development and proliferation of such serials and discusses the actual and potential roles they play in species-level discovery and documentation.

Advances in veneroidean systematics - A status report

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The largest extant family of Bivalvia, the marine Veneridae with about 800 recognized Recent species, comprises one of the least understood and most poorly defined molluscan taxa, despite including some of the most economically important and abundant bivalves, e.g., quahog, Pismo clams, and Manila clams. A first comprehensive phylogenetic analysis used 114 taxa to test monophyly of Veneroidea, Veneridae, and 17 nominal venerid subfamilies, based on morphological (conchological, anatomical) data and molecular sequences from mitochondrial (16S, COI) and nuclear (28S, histone 3) genes. Veneridae and Veneroidea were monophyletic in these analyses, but only six subfamily groups (Dosiniinae, Gemminae, Samarangiinae, Sunettinae, Tapetinae, and combined Venerinae + Chioninae) found significant support, and few morphological synapomorphies were identified. Former families Petricolidae and Turtoniidae were also reduced to subfamilies within Veneridae and recognized as members with derived or neotenous morphologies, respectively. A further morphological and molecular study of the Venerinae/Chioninae clade provided increased resolution within (and distinction between) these previously synonymized subfamilies. Various feature-rich character complexes (such as sperm ultrastructure, adult byssal apparatus, and siphonal morphology) are discussed in the context of the new phylogenetic hypotheses.

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Spatio-temporal and biomass dynamics of *Corbicula fluminea*, an invasive mussel in the Hungarian Danube section

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Filter-feeding mussels have a significant role in the material cycle of freshwaters. The importance of the small-sized, but abundant mussels, especially in large rivers, is poorly known. These species of Hungarian mussel fauna belong to three families: Corbiculidae, Dreissenidae and Sphaeriidae. Sixteen small-sized mussel species were found in the Hungarian Danube section, which presents 72,7% of the nationwide fauna. Out of the collected species three (*Corbicula fluminea*, *Corbicula fluminalis*, *Dreissena polymorpha polymorpha*) are of invasive nature, so 18,75% of the small-sized mussel fauna is non-indigenous spreading rapidly.

C. fluminea is a very successful immigrant in new areas due to its special life history strategy and human impacts. The genus *Corbicula* was first detected in the Vén-Duna at Baja (South Hungary) in 1999. Nowadays *C. fluminea* spreads throughout the River Danube, it has appeared in the active alluvial floodplain of the Szigetköz area (North-West Hungary), too.

Besides the investigation of occurrence pattern of *C. fluminea*, we studied its density, biomass dynamics and the body length-body mass relationships in the Danube bend above Budapest. Samples were taken four times in 2005 at 3 different sampling sites in the littoral zone. *C. fluminea* represented 42,42% of the total number of small-sized mussels. The density of *C. fluminea* ranged from 10 ind./ m² to 736 ind./ m². The biomass of *C. fluminea* fluctuated between 2,85 - 166,90 g/m². The minimum and maximum size parameters are follows: body height (0,88 - 14,52 mm), body length (0,95 - 16,24 mm) and body mass (0,11 - 1,93 g). The maximum values of size parameters are very low compared to published data: *C. fluminea* can reach 40-50 mm in body length. Length-frequency analysis of the data clearly indicate that *C. fluminea* has two well defined reproduction peaks in June and November.

Systematic and distributional studies of Colombian continental mollusks – The land snail genera *Isomeria* Beck and *Labyrinthus* Beck (Gastropoda: Camaenidae)

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Systematic, distributional and ecological information on *Isomeria* and *Labyrinthus* from Colombia, South America is examined using published and newly collected data. Traditionally, discrimination between the two genera and between species-groups within each genus has been based on conchological characteristics. Anatomical data (mostly morphology of radulae and genitalia) are available for just a few species, and no molecular data is available. Further, the ecology of all species is virtually unknown. Eighteen of the 31 nominal species of *Labyrinthus* are present in Colombia (58%). For *Isomeria*, of the 28-30 nominal species, 14 are present in Colombia (>46%). Moreover, 3 additional and distinct forms of *Isomeria* were found as part of this study, and are being described as new species. *Labyrinthus* has been considered as distributed in low to moderate elevations, and

Isomeria as distributed in moderate to high elevations. This interpretation may simply reflect lack of information rather than ecological or evolutionary patterns. Newly available and still fragmentary anatomical and distributional data does not fully support the current assignment of all species into each of the two genera. In addition, the conchology-based relationships of species-groups within each genus need to be re-examined.

Anatomy of the genital system of *Eubbranchus vittatus* (Alder & Hancock, 1842) (Gastropoda, Nudibranchia, Eubbranchidae)

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During the last ten years some samplings have been carried out in Galicia (Ría de Ferrol), Portugal (Setúbal) and Ireland (Galway) in order to collect nudibranchs by scuba diving, what has provided us with an important collection of species of the genus *Eubbranchus*. All the species collected of this genus live in association with different species of hydroid colonies. However, three species: *Eubbranchus vittatus*, *Eubbranchus cingulatus* and *Eubbranchus doriae* live on the hydrozoa *Kirchenpaueria pinnata*, although they never share the same branch.

The results of the anatomical study and the reconstruction of the genital system of *Eubbranchus vittatus*, which has been carried out by means of serial cuts, are presented in this communication. The genital system is described herein and a detailed sketch of its reconstruction is also presented in the photographs of cuts of the different parts with an optical microscope.

The reproductive system presents a hermaphroditic duct that opens laterally in the ampulla, which is reniform with a short spermoviduct. The deferent duct presents a clear prostate, which is curved and short. The penial gland is large, dilated and with a short duct that opens into the deferent duct near the tip of the penis. This is short, conic and presents two small corneous hook-shaped structures. The oviduct goes through the albumen and mucous glands and opens independently from the vagina. The piriform seminal receptacle, with a variable size, opens on the lateroinferior part in the upper dilated end of the vagina.

The reproductive system of *E. vittatus* has several similarities to *E. cingulatus*, *E. farrani* and *E. doriae*. The hermaphroditic duct opens laterally in the ampulla as it does in *E. farrani* and *E. cingulatus*, but the prostate of *E. vittatus* is smaller and the penial gland larger. The penis is smaller than that of *E. cingulatus*.

Inventorying the molluscan fauna of the world: how far to go?

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There is a race to document the biodiversity of the world to conserve, manage and salvage it. This urgency is even more acute for molluscs where at least 580 species, or 2.5% of the land and freshwater fauna, are already extinct; this represents more than half of the total recorded global extinctions. New species of molluscs continue to be described at a high and increasing pace, with an annual increment of ca. 600 species (400 marine, 150 land and 50 freshwater), and there is no sign of leveling of the cumulation curves. The attention of malacologists is very unevenly distributed, with the species-rich taxa (Turridae s.l., Triphoridae, Eulimidae, hydrobioids, Galeommatoidae) and the species-rich environments/regions (most of the tropics, the deep sea) receiving disproportionately

little attention. Molluscs are barely on the radar screen of global conservation funding, and there is still little conservation-driven prioritizing for exploring the molluscan fauna of the world. The consequence of the poor image of, and support to, alpha-taxonomy is that the "taxonomic impediment" is likely with us to last.

Despite that biodiversity informatics and environmental awareness have triggered an explosion of global assessments of all sorts; we still lack a reliable measure of the magnitude of molluscan diversity. Molluscan taxonomy is hampered by the burden of vast numbers of poorly described nominal species that have not been revised for decades. Recent published estimates of described valid species range from 45,000 to 130,000; my own figure is 55,000 marine, 6,000 freshwater, and 20,000 land species. With tropical faunas grossly undersampled and micromolluscs vastly undescribed, it is reasonable to speculate that the actual number of recent molluscs is 150-200,000 species. Molecular approaches, until recently limited to a few model organisms, are starting to disclose additional biodiversity that could significantly alter the magnitude of the final count.

Atlas and red list of the terrestrial and freshwater molluscs of Castilla La Mancha (Spain): Distribution and conservation

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The Autonomous Community of Castilla La Mancha, located in the southern half of the Iberian Peninsula, has a surface area of 79.463 km². Its climate is characterized by cold winters with hot summers and irregular rainfall with significant thermal oscillations and notable aridity.

The whole territory was divided into 10x10 km UTM squares covering all possible habitats within each square. Sample points were georeferenced using GPS. Field work was carried out from September 2003 to May 2007. At the moment, 2465 localities have been surveyed.

A guide has been compiled to provide a detailed account of slugs, snails and mussels species found in Castilla La Mancha. Samples from mollusc collections (Museo Nacional de Ciencias Naturales of Madrid), previously collected for other studies and cited in the literature have been also included in the study.

Each species has been registered in a reference card including its photograph, taxonomy, habitat, conservation status and a map with its distribution area.

A total of 182 species (55 freshwater and 126 terrestrial) has been determined. *Unio tumidiformis* Castro, 1899 is recorded for the first time in Spain. Twenty-nine species (13 terrestrial and 16 freshwater) were found for the first time in Castilla La Mancha, i. e. *Acroloxus lacustris* (Linnaeus, 1758), *Arion (Mesarion) hispanicus* Simroth, 1886, *Vallonia excentrica* (O.F. Müller, 1774) and the freshwater invasive species *Corbicula fluminea* (O.F. Müller, 1774).

Threatened species and environmentally interesting locations are specially studied to specify protection areas and conservation actions to reduce possible species extinction risk. Of the 182 species studied, 28 are included in the "Libro Rojo de los Invertebrados de España" (18 freshwater i. e. *Sphaerium corneum* (Linnaeus, 1758) and 10 terrestrial i. e. *Iberus marmoratus guiraoanus* (Rossmässler, 1854)) and 9 (5 freshwater and 4 terrestrial) are included in the "Catálogo Regional de Especies Amenazadas de Castilla-La Mancha".

Keyhole limpets of the genus *Fissurella* (Archaeogastropoda: Vetigastropoda) in Chilean coasts

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The keyhole limpets of the genus *Fissurella* are locally known as “lapas” or chapas” in Chilean coasts. They are the most relevant among the world species of the genus because they show the largest sizes, measuring up to 14 cm in shell length.

Riveros described 26 species for the genus in Chile, only 13 of which were validated by McLean afterwards. At present, validation of species is being evaluated by using techniques of identification of mitochondrial DNA.

Basic studies on the biology of Chilean *Fissurella* have been initiated by Bretos three decades ago. Data obtained through field studies on tagged individuals of *F. crassa* led to determine the growth rate in the natural habitat, formation of growth rings, and maximum length in Northern Chile. Growth rate and spawning periods were analyzed in *F. maxima* and *F. cumingi*, as well as the Trematoda parasites living in their gonads. The same biological aspects were searched in *F. pulchra*, *F. picta*, and *F. nigra*. The minimum size of extraction of 6,5 cm in shell length was proposed on the basis of these studies, and adopted as legal by the government authorities some years later.

The diversity of species of keyhole limpets in the Chilean littoral and their sizes made them commercially important. They constitute a multispecific artisanal fishery, composed mainly by 7 to 9 species, with a mean landed volume in official statistics of about 2.800 metric tons per year. The industrial processed products increased their exportation value to international markets.

Overexploitation has diminished the keyhole limpet populations, both at the intertidal and subtidal zones. Research has been focused on gametes, spawning under controlled conditions, development, and larval hatching and settlement. The main purpose of these technological and applied aspects is getting seeds in hatcheries, to use them to reinforce natural populations.

Molecular phylogeny of the terrestrial slug genus *Arion* (Gastropoda, Pulmonata, Arionidae)

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We present a molecular phylogeny of most of the currently known *Arion* species on the basis of mitochondrial (16S rDNA and COI) and nuclear (ITS1) gene fragments. Different phylogenetic reconstruction methods yielded congruent results and the combination of nuclear and mitochondrial genes provided, without conflict, resolution for both deep and shallow relationships. Based on these results, we suggest the following infrageneric organization of the genus *Arion*. The genus comprises three phylogenetic groups, viz. *Carinarion*, *Kobeltia*, and *Arion* s.s. + *Mesarion*. *Carinarion* has always been regarded as a well defined taxon. The former subgenus *Microarion* is now included in *Kobeltia*, as was already suggested previously. The subgenera *Arion* s.s. and *Mesarion* are lumped

into one taxon, since they form a well defined monophyletic group, and since the characteristics that were previously used to discriminate between the two subgenera do not appear to be synapomorphic for either former subgenus. The phylogenetic position of *A. franciscoloi* remains unresolved. In addition, a number of specific taxonomic issues are approached on the basis of the resulting phylogeny.

Distribution of terrestrial land snails in Nepal

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Nepal is part of the Himalayan Global Biodiversity Hotspot. It has a south to north altitudinal range greater than that for any other country and an east to west transition from high to low rainfall. It has a unique Himalayan fauna and is the meeting point of Central Asian Palaearctic, Indian and Malaysian biotic regions. These attributes combined with a forested terrain with many limestone deposits promise a rich and diverse land snail fauna. But the existing knowledge on distribution pattern of poorly investigated Nepalese terrestrial land snails is inadequate. The preliminary survey reported more than hundred species of land snails. Many species are still in the identification process. This paper is the first attempt to show the distribution of already known Nepalese land snails.

When is a species a species? Utilizing the fossil record to investigate the morphological disparity and taxonomic affinity of extant shell shapes within the bivalve genus *Cucullaea*

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Cucullaea is currently approaching extinction, with decreasing morphological range, geographic distribution and species richness throughout the latter half of its 200 million-year-old evolutionary history. Survivors of this once prolific bivalve genus are found today living throughout the Indo-Pacific, yet because the morphologies represented throughout the region grade into one another, without any separate, distinct species serving as an independent reference, the number of extant species comprising the group has fluctuated from one to four depending on taxonomic opinion. Against this backdrop, well-preserved, extinct species within the globally-distributed fossil record of *Cucullaea* provide a deep-time perspective on the taxonomic affinity of the extant forms by serving as reference points for studying inter- and intraspecific variation in shape. Utilizing these extinct morphologies, the current study aims to address: 1) whether a quantitative analysis of shell shape recognizes distinct, present-day morphological groups; 2) how the amount of intraspecific morphological variation in extinct species compares to the extant species; and 3) how lessons learned about morphological and geographic transitions in *Cucullaea*'s geologic past may be applied to understanding the persistence of the present-day forms. To accomplish these goals, traditional, landmark and outline analyses were conducted using digitized specimens housed within museum collections throughout the United States. This combined approach of utilizing multiple morphometric techniques provides a robust assessment of shape by capturing different sources of morphological disparity, examining shell characteristics considered to be taxonomic (e.g., the hinge plate) and/or ecophenotypic (e.g., overall outline shape) in nature. Morphometric results identify a diverse set of shapes among overlapping, regional groups of extant individuals in morphospace.

High levels of intraspecific variation are also recognized in fossil taxa, suggesting that the broad array of shell shapes observed today is not unique and likely represents a single species.

**Using the PAM-technology as a tool to investigate the symbiosis between „solarpowered“
Nudibranchia (Gastropoda, Opisthobranchia) and Zooxanthellae (Dinophyceae)**

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A symbiosis with unicellular dinoflagellates of the genus *Symbiodinium* is known from different marine invertebrates, including taxa within the Nudibranchia, especially the Aeolidioidea. The source of these zooxanthellae in aeolids is mainly octocorals, on which the nudibranchs feed. *Symbiodinium* is housed inside the cells of the nudibranchs digestive gland. This is affirmed for several species by histological means. But the presence of zooxanthellae alone does not prove a mutualistic symbiosis. By using the non-invasive PAM-Technology (“Pulse Amplitude Modulated Fluorometry”) it is possible to distinguish between photosynthetically active and inactive zooxanthellae inside the nudibranchs. The PAM detects *in vivo* photosynthetic activity of zooxanthellae by measuring the fluorescence emitted by photosystem II (PSII) of chlorophyll a, the oxygen evolving site. About 1% of the light absorbed by a photosynthetic symbiont will appear as chlorophyll a (chl a) fluorescence, detected as emitted red light from PS II with maximum emission at 685 nm. By means of PAM-data it is possible to estimate the efficiency of the symbiosis between a certain nudibranch species and its zooxanthellae. Seven nudibranch species were investigated under starvation conditions (just relying on the photosynthetic products of their symbiotic partner) and the maximum quantum yield of fluorescence for PSII ($\Phi_{IIe-max}$) was plotted versus time in diagrams. Compared with histological results, interspecific differences in the efficiency of symbiosis could be demonstrated. Generally the branching grade of the digestive gland seems to be positively correlated with the efficiency of the symbiosis. A strongly branched digestive gland offers the zooxanthellae a larger surface area that is exposed to the sunlight and is typical for nudibranch species with a highly evolved and efficient mutualistic symbiosis.

**Discrimination of end-Cretaceous anodontine Unionoidea from North Dakota:
How many taxa make sense?**

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The Das Goods Locality (L6516) is a remarkable site for the occurrence of anodontine (Unionoidea) mussels. Stratigraphically just 63 cm between the Cretaceous-Paleogene boundary, it is the youngest Cretaceous mussel locality. Even without shell material, this is the best-known record of *in situ* anodontine bivalves from the Cretaceous of North America. There is little context for interpreting other Late Cretaceous anodontine taxa. The earliest taxa described as anodontine were reported by White in 1877 and 1878, respectively: *Anodonta propatoris* (Campanian Judith River Formation, Montana) and *A. parallela* (Maastrichtian Laramie Formation, Colorado). Russell later (1935, 1932, respectively) described poorly preserved Canadian taxa: *A. johnseni* (Campanian Milk River Formation, Alberta), and *A. argillensis* and *A. macconnelli* (Maastrichtian Whitemud Formation, Saskatchewan). L6516 bivalves are unsculptured and elliptical to ovate in marginal outline. External growth lines are variously preserved. Because no landmark features are clearly available, identifying characteristics are limited to the anodontine nature of the specimens and the shape of the marginal outlines. Elliptical Fourier analysis (EFA) was performed on 33 specimens exhibiting a complete or

near-complete outline. A conservative model was used to complete the outlines of the latter group. For comparative purposes, outlines were included in the EFA of illustrated holotypes of the taxa mentioned above and *Margaritina nebrascensis* Meek, 1871, which also exhibits anodontine character. Preliminary study using principle component analysis (PCA) suggests that unidentified Das Goods mussels can be grouped according to existing fossil “*Anodonta*” species by shell outline morphology; however, this species group is likely artificial. L6516 bivalves form at least two groups after PCA. Shape distribution is potentially sexually dimorphic, amplified by compression of inflated valves. Das Goods bivalves share both a lack of dentition and environmental preference with modern anodontine forms, but there is little evidence linking these two groups phylogenetically under the modern genus *Anodonta*.

Deep-sea squid behavior: posing in the dark

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Shallow-water cephalopods exhibit a wide behavioral range during communication and crypsis via body postures, skin texture, movement and chromatic modifications. However, because 90% of down-welling light is scattered or absorbed within the upper 150 – 200 m, deep-sea species were assumed to be limited with regard to these behaviors. Using Remotely Operated Vehicles (ROVs), *in situ* behavior of the deep-sea squid, *Octopoteuthis deletron* (n = 71), was described and catalogued. This species inhabits open water between 300 – 1900 m and is not known to vertically migrate to shallower depths. Observations demonstrated that *O. deletron* has a large and flexible behavioral repertoire including postures, locomotor components, chromatic variability, ink release, and bioluminescence comparable to shallow-dwelling cephalopods. Individual *O. deletron* achieve a surprising variety of behaviors to attract mates, avoid predation, and acquire food despite inhabiting dark ocean depths.

Inventoring the marine molluscan fauna of Guanahacabibes Peninsula Biosphere Reserve, Cuba

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Before year 2005 just 53 species were recorded in the marine molluscan fauna of Guanahacabibes Peninsula Biosphere Reserve, Cuba. Now the catalogue includes nearly 700 species, all of them collected in 9 localities, from 40 m depth to the shore, as a result of 9 expeditions from year 2002 to 2006 in collaboration with the Office of Integral Development of Guanahacabibes that provided all the infrastructure.

Of them, 74% are Gastropoda, 21 % are Bivalvia, 3 % are Polyplacophora, 1 % are Scaphopoda and 1 % are Cephalopoda. At the moment, 1 Family, 2 Genera and 27 species have been described as new for Science, additionally, 37 have been recorded as new for the Cuban marine molluscan fauna.

The species listed suppose the 46.7 % of the total (1501) cited in the year 1995 by Espinosa, Fernández-Garcés and Rolán for the whole island of Cuba. That species richness emphasizes the importance of Guanahacabibes as larvae emitter center to the Mexico Gulf and Atlantic North America because much of the species have planktotrophic larvae.

Biogeographic relationships among benthic opisthobranchs in the Atlantic

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With the help of many recent publications on the opisthobranch fauna of several regions of the Atlantic Ocean (including the Caribbean and the Mediterranean Seas) it is now possible to work out an almost complete puzzle of the distributions of these species in the area. In this work we build a presence-absence (1/0) data matrix based on virtually all published references and on-line databases on benthic opisthobranch species with explicit references to the Atlantic region. A cluster analysis was performed as an exploratory technique where three main Atlantic clusters were recovered: (1) North Atlantic, including British Isles, Greenland, Scandinavian Peninsula and Atlantic North America; (2) Mediterranean and Macaronesia (Azores, Madera and Canary islands), including the Atlantic coast of the Iberian Peninsula and (3) Central west and SW Atlantic, including Gulf of Mexico, Caribbean Sea, Brazil and Patagonia. This last cluster is also grouped together with East Pacific species that acted together as an outgroup. A parsimonial analysis of endemism (PAE) was also applied to the same dataset and the same basic grouping was obtained, although Eastern Pacific species appeared linked to group (1). These results reinforce the ideas of specific areas of endemism and speciation, although some conclusions should be taken with care due to the lack of information in some important areas such as the West African coast.

Expanding museum collections by indirect field work

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Natural history museums house specimens collected by their own scientists together with those acquired in donated or purchased collections.

Direct collecting yields dense and comprehensive assemblages of specimens with very good data, and thus greatly enhances the museum's holdings in those families for that area. Similar gap-filling can also be achieved by the selective acquisition of private collections. Some enthusiasts devote a lifetime of effort to field collecting within defined areas, and keep meticulous records. Such collections often represent repeated sampling over time, and accurately dated material has a particular value. The tracking of such collections should be part of any collection's growth plans, and in order to acquire them similar levels of planning and expense to those involved in field work can be justified.

The decision to acquire a collection depends on the presence or absence of an electronic catalog, the strength of the institution's existing holdings for the geographical area and families involved and the likelihood of overlapping field work in the foreseeable future. The condition of the specimens is also important, particularly if they are preserved in a wet medium. The availability of funding outside granted research budgets nevertheless remains the prime consideration in most cases.

Opportunities to acquire important collections can appear suddenly, allowing limited time for detailed planning. The plan can thus be a mirror image of that for an expedition, with the material arriving first and curation starting after an assessment of the contents. The strategic commitment is the same, however, with curation taking place over multiple years.

In some countries increasing regulation is restricting the field collecting of material for study, especially for scientists from outside. Habitat destruction and climate change are among other factors that will act to increase the scientific value of well-preserved private collections.

Land snail faunas in Polish forests: history, geography and ecology

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A preliminary analysis of 136 standard samples of land snails from Polish and Ukrainian forests shows that they can be split into 8 regional faunas on the basis of a DCA analysis. Mean levels of alpha diversity differ only slightly between regions, with montane and limestone faunas being marginally richer than those in the N. European Plain. In these faunas, ecological differences (beta diversity) between forest sites are generally of less significance than geographical distances (gamma diversity). Faunas in the lowlands are all very similar, and relate most closely to those of the Sudetes (SW Poland), even far to the east. Ukrainian faunas are the most distinct, and are the only ones south of the Carpathian watershed. Turnover of species north of the watershed is more gradual. Small species (max shell dimension < 5 mm) are generally less geographically restricted than larger ones. These results are discussed in relation to earlier work on the N. European fauna, taking account of the effect of human disturbance, and to work on faunas from regions less affected by Pleistocene climate changes.

Molecular and morphological taxonomy of gastropods from south-east Pacific seamounts

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Previous studies have suggested that the high diversity associated with the Norfolk seamounts (Southwest Pacific) could reflect endemism resulting from limited dispersal due to hydrological phenomena. However in the case of the seamount benthic fauna, the extent of biodiversity is not well established and taxonomy remains poorly known. Majority of studies draw up list of morpho-species without concluding about the names. Moreover most studies concern very restricted area what does not enable to conclude about endemism. Thus the knowledge about diversity of the deep sea fauna is limited by taxonomy. The generalized use of molecular alpha-taxonomy data using the mitochondrial gene (COI) has proposed for the barcode of life project consortium should accelerate the acquisition of new taxonomic data.

To evaluate whether the seamounts constitute patches of isolated habitat and to measure the potential role of larval dispersal on population structure, we explore the pattern of genetic diversity within two genera of gastropods which differ in their larval development. These were *Sassia*, which has a planctotrophic protoconch, suggesting high larvae dispersal abilities, and *Nassaria*, whose

protoconch has non-planctotrophic characteristics suggesting an almost direct larvae development and thus limited dispersal abilities.

Our study rests on intensively sampling carried out by IRD in the *EEZ* of New Caledonia to study the fauna of the seamount situated on the Norfolk ridge and on the Lord Howe Rise. In this study area, *Sassia* genus is composed by only one species, whose geographic distribution is large, and where the haplotypes are closely related, disclosing a high potential of dispersal capacity. On the contrary, the genus *Nassaria* sampled in *EEZ* of New Caledonia is composed by several potential species with various levels of genetic structure, going to large distribution geographic up to potential endemism which is localized on continental slope rather than seamount.

A brief insight into the species-area relationships of spring fen mollusc communities

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The relationship between the number of mollusc species and area was studied at 25 spring fen sites in the Western Carpathian Mts. A set of three nested quadrates was sampled at each site (differing in their mineral richness) as well as a 12 litre sample in the area of 16 m² to obtain information about the site's species pool. Principal differences in the numbers of species (and individuals) when considering all molluscs or only live molluscs were found. Differences were also found among sites of different mineral richness. In the mineral poor fen sites the smallest plot, sized (25 cm)², captured a significantly smaller part of the site's species richness than in the mineral-rich, and tufa forming fen sites, likely due to lower abundances and higher heterogeneity of mineral poor fens. Due to this the species-area curve was steep for mineral-poor sites (especially from the (25 cm)² plot to the (50 cm)² plot) and became shallower towards the mineral-richer fens. However in all the sites, regardless of the mineral type, the largest, (75 cm)², plot captured over 80 % of the site's richness (only 2-3 species short of the total for the whole site). This demonstrates that the (75 cm)² sampling plot reflects the site's species richness very well.

Gastropods of Davraz Mountain

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Davraz Mountain (2200m), one of the most spectacular heights in Southwest Turkey, became an important ski center due to suitability of the topography and precipitation. Study has been carried on at heights enabling climbing above 1300 m on north and northeast (between 2003 and 2005); and on south and southeast (in 2007) directions with 13 stations established.

Conclusively, the following 14 land snails (7 endemics) are found to be distributed on the mountain: *Pyramidula rupestris*, *Sphyradium doliolum*, *Jaminia loewii loewii*, *Chondrula lycanica*, *Zonites megistus*, *Vitrea ernesti*, *Oxychilus cyprius*, *Gallandia annularis*, *Deroceras berytensis*, *Sprattia beycola medoroides*, *Metafruticicola oerstani*, *Xeropicta derbentina*, *Cernuella virgata*, and *Helix dickhauti*.

In the light of vegetation and geographical features, malacofauna of the mountain was discussed and compared with those of the neighboring areas.

**The Santa Barbara Museum of Natural History (California, USA):
Upgrade of research and collection facilities for the 21st Century**

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The Santa Barbara Museum of Natural History is a private institution established in 1916, with public exhibits focused on regional subjects. However, both research and collections are much more extensive in their coverage, with responsibilities divided among five departments. Aggressively developed during the past 25 years are ranked invertebrate collections in mollusks, bryozoans, cnidarians and dicyemid parasites. Mollusk holdings currently exceed 300,000 dry and wet lots, with over 2200 primary and secondary types. Since 1991, high priority has been given to housing collections in an archival quality environment, including custom Delta Design cabinetry and acid free containers and labels.

Approximately 50,000 lots have been catalogued in the *Specify* collection database (www.specifysoftware.org). Updated daily and with some images available, these records are geo-referenced and accessible on line at www.sbcollections.org.

Significant mollusk collections have been compiled through staff expeditionary work, transfers from other institutions and the accessions of large diverse private collections, including those of S. Stillman Berry, Walter J. Eyerdam and Donald Shasky (each in excess of 30,000 lots); as well as many smaller taxonomic or geographically specialized holdings. Well represented are cephalopods that are worldwide in scope, eastern Pacific bivalves, trans-Pacific gastropods, and chitons. Holdings from the oceanic islands of the tropical eastern Pacific are particularly noteworthy.

The research facilities have been significantly upgraded during the past five years by funds received through private bequests and those awarded by a NSF MRI grant. These include a molecular lab (DNA extraction through PCR), histology with regular paraffin microtome, an ultramicrotome, and a variable pressure scanning electron microscope (*Zeiss EVO40XVP*). An all-digital imaging workflow is implemented with several digital SLRs and *Automontage* image processing.

Current malacological research projects include taxonomic studies on cephalopods (Hochberg), Scissurellidae (Geiger), and a monographic review of the Panamic Bivalvia (Valentich-Scott).

A bioassay to identify the active molecule in the dart gland mucus

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Earlier work showed that the "love" dart of *Cantareus aspersus*, when shot successfully during courtship, increases paternity for the shooter relative to that of competing sperm donors. Other work demonstrated that this effect is mediated by an unknown substance that is in the mucus clinging to the dart when it is shot and that is injected into the recipient when hit by the dart. Further studies of the mechanisms underlying the dart's function would be aided by isolating and identifying this bioactive substance (or substances). Also, identification of the dart's molecular agent would facilitate phylogenetic investigations, thus helping to unravel the evolution of the dart.

Because the molecule of interest is likely to be a peptide, we began by subjecting mucus from the dart gland (digitiform gland) to high performance liquid chromatography (HPLC). Two samples

representing time ranges from the HPLC output were reconstituted in a saline vehicle and loaded into hypodermic syringes. In controlled mating trials, sibling virgin snails were mated with each other. One snail in each pair was injected with coded sample #1 and the partner was injected with coded sample #2. One week after the mating, allosperm in the spermathecal tubules were labelled by DNA staining. The relative efficacy of the two samples was then measured by counting individual allosperm using fluorescent microscopy.

From a series of binary tests as described above, we have identified a small region of the HPLC profile that produces a statistically significant effect in our bioassay. Interestingly, the results suggest that the bioactive substance increases allosperm survival by making it easier for the spermatozoa to become embedded in the epithelial walls of the storage tubules. Further testing should allow us to identify the bioactive substance.

Mortality to the giant African snail *Achatina fulica* Bowdich, 1822 and non-target snails using select molluscicides

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Laboratory bioassays and caged field trials were conducted to compare concomitant molluscicide effects on three development stages of the giant African snail (GAS) (*Achatina fulica*) and three non-target snail species in Barbados. Nine commercially available molluscicides, diatomaceous earth, and a kaolin clay product (Surround WP) were evaluated in this study. High levels of mortality to neonate GAS were seen in all the molluscicide treatments except for Surround, diatomaceous earth, and Sluggo pellets. In field trials, Deadline, Durham granules, Metarex, and Orcal pellets caused the highest rates of mortality to juvenile GAS. For adult GAS several molluscicides including Blitzem, Deadline, Durham Granules, Mesurol 75W, Metarex, Orcal pellets, and Slugfest caused greater than 95 per cent mortality in laboratory bioassays. Field trials showed that Durham granules and Slugfest yielded the highest mortality rates. Sluggo pellets, touted as an environmentally safe molluscicide, did not cause significant mortality to juvenile and adult GAS in our field trials.

The majority of the molluscicides tested in our trials were equally or more lethal to *Pleurodonte isabella* (Férussac, 1821), *Bulimulus guadalupensis* (Bruguère, 1789), and *Zachrysia provisoria* (Pfeiffer, 1858) than GAS. Our results suggest that the potential impact on non-target snails during control or eradication programs may be significant, causing substantial mortality regardless of what brand, active ingredient, or formulation is used.

**Unravelling a taxonomic tangle and a morphological mystery:
A molecular phylogeny of the Rapaninae (Neogastropoda: Muricidae)**

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The Rapaninae are a large subfamily of taxonomically perplexing, carnivorous marine snails. This perplexity arises, in part, from the prevalence of convergence within the rapanines and consequent morphological similarity. Bayesian and parsimony analyses of one mitochondrial and one nuclear gene in 15 species within the rapanines and an additional 20 species from across the Muricidae disprove previous phylogenetic hypotheses based on morphological characters. At least five monophyletic subfamilies are supported with the Muricidae: Rapaninae, Ocenebrinae, Ergalataxinae, Muricinae and Muricopsinae. The only representative of the Trophoninae included in this study, *Trophon plicatus*, falls within the Ergalataxinae, questioning the validity of the Trophoninae as a subfamily. In contrast to morphological phylogenies, the Ergalataxinae are not contained within the Rapaninae in any trees, nor is there any evidence to support the hypothesized sister relationship between Rapaninae and Ocenebrinae. Relationships within the Rapaninae and Ergalataxinae are also highly divergent from those hypothesized from morphological evidence, and two of the genera (*Thais* and *Morula*) are polyphyletic.

Reproductive traits of *Crepidula aculeata* (Gastropoda: Calyptraeidae) from Argentina

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C. aculeata reproductive traits for Argentina are presented here. Males present a conspicuous penis when shell length (SL) is between 4.9 and 15.1 mm. Sexchange can start at 8 mm in SL. Then penis undergoes resorption as well as testis. Simultaneously female reproductive system develops. The smallest brooding female found was 16.4 mm in SL. The reproductive season occurs in spring-summer but depends on the latitude. In Mar del Plata (38°02'22S, 57°31'38W) it extends from September to April, while in San Antonio Oeste (40°43'38S, 64°55'57W) from end of October until April. No latitudinal differences were found between broods of both latitudes. Broods contained 9 to 21 triangular egg capsules, which is more than in Venezuela. Egg capsules are 2.84 to 5.36 mm in width. Egg diameter was 230 + 20 µm, which is the half of the diameter reported for Venezuelan *C. aculeata*. There were 217 to 664 embryos starting development synchronously, more than the double than in the Venezuelan population. Between 6 and 21 reach juvenile size feeding from each other, similar to Venezuelan population. The hatchlings were 850 to 1050 µm in SL, which is a similar size to the reported in Venezuela. The number and diameter of eggs supports that the Argentinean population is in fact a different species than the Caribbean *C. aculeata*. Results are compared with other species of *Crepidula* with direct development show no coincidence.

Sampling micromolluscs on tropical limestone karsts: high sampling efficiencies and novel biogeographical patterns

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Micromolluscs comprise a large proportion of terrestrial malacofaunas on limestone karsts. As such, sampling protocols for karst molluscs must consider their patchy distributions, high species densities and minute sizes. As part of a biogeographical study on karst molluscs, sixteen karsts on both sides of the Titiwangsa Mountain range cutting across Peninsular Malaysia were sampled to: 1) determine correlates of mollusc endemism from a set of biogeographical factors (i.e., karst area, isolation, surrounding soil type and geological age); and 2) investigate mollusc species composition trends across the region. On each karst, systematic sampling methods were employed in lieu of random sampling to achieve spatial interspersions and reduce bias resulting from possible segregation. Shells were extracted from soil samples using a combination of floatation and sieving techniques. Sampling saturation on each karst was assessed using completeness ratios and species accumulation curves. Generalized linear mixed-effect models (GLMM) were used to determine correlates of endemism, while non-metric multi-dimensional scaling (NMDS) was used to investigate species compositional variation. Sampling yielded a total of 198 terrestrial mollusc species, of which about 75% were less than 5 mm. Based on high completeness ratios and asymptotic species accumulation curves, sampling on each karst was considered efficient. GLMMs revealed an important contribution of karst area and surrounding soil type on mollusc endemic richness, while NMDS showed that karst malacofaunas on either side of the mountain range were distinct from each other. These results have important conservation implications: planners should take karst area and surrounding soil type into account, together with the effects of vicariant barriers such as mountains, when designing karst reserves in order to maximize the protection of invertebrate diversity.

Correlates of endemism and biogeography of terrestrial molluscs on tropical limestone karsts

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The main objectives of our study were to identify variables (area, isolation, surrounding soil type and geological age) hypothesised to correlate with endemic richness of terrestrial molluscs (a majority of which are micromolluscs) on tropical limestone karsts, and to investigate molluscan species compositional trends across karsts in two biogeographical regions - Peninsular Malaysia and Sabah, Malaysian Borneo. Generalized linear mixed-effect models (GLMM) were used to determine correlates of endemism from the set of biogeographical factors (i.e., karst area, isolation, surrounding

soil type and geological age) for Peninsular Malaysia. Non-metric multi-dimensional scaling (NMDS) was used to investigate how species compositions varied across karsts for both regions. Sampling from 16 karsts in Peninsular Malaysia yielded a total of 198 terrestrial mollusc species from 49 genera, while 173 species from 64 genera were sampled from 27 karsts in Sabah. The GLMM revealed an important contribution of karst area and surrounding soil type on molluscan endemic richness. The most parsimonious model had 63.6% of the AICc weight and explained over 18% of the deviance in the total number of endemic species per karst. NMDS showed that karsts separated by vicariant barriers in different parts of Peninsular Malaysia and Sabah had distinct malacofaunas. To maximise the protection of endemic molluscs, karst conservation planning should therefore take karst area and surrounding soil type into account, together with the effects of vicariant barriers such as mountains and rivers. The results from this study can be used to improve decision-making processes involving karst reserve location, which have generally been lacking in firm scientific basis.

Molecular phylogenetics of the land snail genus *Anguispira* (Pulmonata: Discidae)

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Anguispira is a group of common land snails found primarily in eastern North America. There are currently thirteen recognized species within *Anguispira*. Some *Anguispira* species have broad distributions covering several states, while others have highly restricted ranges. Two *Anguispira* species are known from the western U.S. One of these (*A. kochi*) has a disjunct distribution, with western populations in Idaho and Montana separated from eastern populations by nearly 2500 kilometers. The other, *A. nimapuna*, is known only from a single county in Idaho. In addition, four species of *Anguispira* are currently listed as imperiled or vulnerable and *A. picta* is listed as a federally threatened species.

A phylogenetic study of *Anguispira* could allow many intriguing questions to be addressed, including (1) Is *A. kochi* monophyletic? (2) How is *A. nimapuna* related to the other *Anguispira* species? (3) Is hybridization occurring between *Anguispira* species, as proposed by Hubricht? (4) Are some species with highly restricted geographic ranges simply unique shell morphs of other, more broadly distributed species? To investigate *Anguispira* phylogeny, regions of the mitochondrial cytochrome oxidase subunit I (COI), 16s ribosomal RNA, and cytochrome b genes have been sequenced from eighty individuals representing eleven putative *Anguispira* species, with two *Discus* species and one *Helicodiscus* species used as outgroups. Preliminary analyses suggest that (1) *A. nimapuna* is sister to all other *Anguispira* species (2) Several broadly distributed species (e.g., *A. alternata*) appear to be polyphyletic, and (3) although most species appear to be monophyletic, relationships among species remain poorly resolved. Morphometric data and (if possible) sequence data from a nuclear locus will be combined with the mitochondrial data to delimit species and clarify relationships within this group.

Marine and brackish water phylogeography of southeastern Australian Mollusca

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Each of the few phylogeographic studies of southeastern Australian marine and brackish water environments has revealed further complexity. The complexity is likely due to the interaction of

multiple factors including (i) the repeated challenges posed to fauna by environmental change in the Quaternary; (ii) intra-specific reproductive characteristics and responses to selection; and (iii) sporadic long-distance dispersal. Several studies of marine species have suggested that Quaternary land-bridges between Tasmania and the mainland have had a prominent role in structuring genetic diversity, but with paradoxical inferences about timing and a relatively minor effect on morphological species distributions. No study has identified known major biogeographic boundaries with phylogeographic discontinuities.

Studies of the two nominal species of the estuarine/lagoonal hydrobiid snail *Tatea* have revealed novel diversity patterns implying high levels of population connectivity. In mitochondrial 12S rRNA, the same common haplotype is found in both *T. kesteveni* and *T. huonensis* along more than 5000 kilometres of coastline. Variant haplotypes differ from the common form at few bases and have restricted (although occasionally disjunct) distributions. In the nuclear gene ITS-1 also, the most frequent haplotype is widely-distributed in both species. Two of the possible explanations of this pattern of diversity are rapid expansions from Pleistocene refugia or a selective sweep through both *T. huonensis* and *T. rufilabris*.

We will report on genetic investigations of other estuarine species (including the pulmonate Amphiboloidea *Phallomedusa* and *Salinator*, and the mussel *Xenostrobus securis*) to determine whether the *Tatea* pattern is general in molluscs from this environment. We will describe the non-genetic methods for testing population connectivity that we are undertaking in the Amphiboloidea. We will also report on genetic studies searching for correlations between phylogeographic and biogeographic boundaries in marine species such as the mussels *X. pulex* and *Brachidontes rostratus* and the snails *Siphonaria* spp., *Austrocochlea* spp. and *Bembicium* spp.

Phylogeography and evolutionary origins of Florida's native Apple snail, *Pomacea paludosa*

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The native Florida apple snail, *Pomacea paludosa*, is an important component of food webs within the wetland marshes and rivers of Florida and has been designated a key indicator of the health of freshwater ecosystems. Changes to Florida's wetlands including habitat loss, habitat fragmentation, eutrophication of waterways, manipulation of the seasonal hydrologic regime of flooding and dry downs, and the introduction of at least four exotic *Pomacea* species, however, have raised concern over the long term survival of *Pomacea paludosa* within the State. Understanding the geographic pattern of relationships among apple snail populations can provide critical information needed for developing restoration models of Florida's wetland ecosystems and for charging park managers with the task of restocking waterways devoid of native apple snails. Here we present an analysis of the population genetic structure of Florida's native apple snail based on a 2.5 kilobase contiguous region of mitochondrial (mt) DNA from more than 136 individuals from 35 different locations across the Florida peninsula. Using both phylogenetic and nested cladistic approaches, we have found well-supported geographically structured populations, with branch lengths and topologies indicative of recent range expansion over a large portion of the current range of this species. We have also used mtDNA sequences to evaluate competing scenarios concerning the origins and biogeography of *P. paludosa*. Our results suggest that *P. paludosa* is more closely related to extant species within the Caribbean Islands than to species found in Central America.

Heterometric autoregulation in the bivalve heart

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Straub (early 1900's) was first to identify heterometric autoregulation in the molluscan heart. This was prior to the establishment of the Frank-Starling Law of the heart (1910-1930). It is now evident that the relationship of force and stretch of the cardiac myofibrils is dependent on the mobilization of calcium and to the sensitivity of the contractile apparatus to calcium. Despite the relative abundance of mammalian studies, there is relatively little information on the effect of stretch and rapid shortening on tension in the invertebrate heart. Using digital control, we applied rapid length perturbations to cardiac ventricular trabeculae of the bivalve, *Spisula solidissima* (Heterodonta, Mactridae). Trabeculae lacked a pronounced descending limb of the force-length relationship supporting the notion that molluscan cardiac muscle is able to tolerate large fluctuations in length. We consequently identified and characterized length-dependent activation and deactivation of force during contractile activity in the bivalve heart. The magnitude of deactivation was dependent on the size of the shortening event and the point at which shortening was applied during the cycle of contraction. Our pharmacological data suggests that a reduction in calcium at the contractile element and/or sequestration of calcium may occur during shortening of the muscle. Electron microscopy revealed ultrastructure that resembled mammalian smooth muscle, and possible mechanisms of deactivation may be similar to those observed in this muscle type. Deactivation may minimize the magnitude of work done during active shortening of bivalve cardiac muscle, particularly against the low afterload exhibited in the bivalve peripheral circulatory system. Changes in intracellular calcium during sudden length perturbations may explain the effect of stretch on action potential duration in the bivalve heart, as shown by previous investigators.

Patchy distribution of the (TTAGGG)_n telomeric repeat motif in Mollusca

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Telomeric sequences are thought to be constant in large taxonomic groups. Vertebrates display a hexamer repeat motif, (TTAGGG)_n, which is conserved in all species so far examined from mammals to fish. On the contrary, invertebrates – being a polyphyletic group - exhibit a certain degree of heterogeneity. In fact, although the vertebrate-type (TTAGGG)_n is common, at least two other slightly different motifs as (TTAGG)_n and (TTAGGC)_n have been reported. With reference to the species of molluscs analysed by our group, only in two of them, *Oxynoe olivacea* (Opisthobranchia, Sacoglossa) and *Crepidula unguiformis* (Prosobranchia, Caenogastropoda) telomeres do not hybridize to (TTAGGG)_n and, at present, their sequences remain unidentified. This findings provides evidence supporting a patchy distribution of telomeric repeats within Mollusca.

Chromosome numbers and chromosomal evolution in the land snail genus *Arion* (Gastropoda, Pulmonata)

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The European terrestrial slug genus *Arion* Férussac, 1819 comprises about 30-50 currently recognized species. We determined chromosome numbers in seven *Arion* species, viz. *A. lusitanicus* (N=24), *A. subfuscus* (N=25), *A. rufus* (N=26), *A. vulgaris* (N=26), *A. distinctus* (N=28) and *A. circumscriptus* (N=29). We also determined the chromosome number in three species of two related taxa, viz. *Geomalacus anguiformis* and *G. maculosus* (both N=31) and *Letourneuxia* sp. (N=31). This study confirms the previously reported chromosome numbers for *Arion*. It further supports the current view that the Portuguese *Arion lusitanicus* is different from the non-Iberian '*A. lusitanicus*' that should be referred to as *A. vulgaris*. Finally, the study suggests a close relationship between *Geomalacus* and *Letourneuxia*. Haploid chromosome numbers N=27 and N=30 were not found. Chromosome numbers were plotted onto a molecular phylogeny of the genus and the evolution of chromosome numbers within the genus *Arion* will be discussed.

Late Glacial-Early Holocene environmental change at Favignana island (Sicily - Italy): evidence from malacological records in prehistoric deposit

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The continental shelf is a complex environment where waves, tides, currents, input from the continent and sea, and humans interplay through time and space. To understand the variability in this past environment (i.e., Late Quaternary) multidisciplinary approaches are required, in addition to which archaeological archives in coastal zones may be of prime importance. This paper reports the ecological and geochemical analyses of marine and continental molluscan shell remains from prehistoric layers of Grotta d'Oriente, a coastal cave located on the Favignana island (37°55' N; 12°20' E - Sicily) and frequented by humans during the Late Glacial-Early Holocene. Anthropogenic Late Glacial deposits are characterized by the abundant presence and high frequency of paralic species (i.e., *Pirenella conica* (Blainville, 1826)) as well as by the presence of freshwater species (i.e., *Lymnaea (Galba) truncatula* (Müller, 1774)), probably brought into the cave by humans with aquatic plants. In contrast Early Holocene deposits are instead characterized by the absence of paralic species and the abundance of marine intertidal species (i.e., *Osilinus turbinatus* (von Born, 1778)), exploited by human communities. Freshwater species are even absent in these layers. Ecological and statistical analysis shows evidence of a progressive transition from paralic to marine environment between Late Glacial and Early Holocene and the human response to this abrupt change. According to other records, this environmental transition results from both sea level rise and lower freshwater budget during the formation of Favignana island and its separation from the island of Sicily at this time. Oxygen isotopic composition of *Eobania vermicolata* (Müller, 1774, Gastropoda, Pulmonata) indicates, in accordance with other records from the Mediterranean region, a dry to wet climate transition between Late Glacial and Early Holocene. Results highlight the importance of multidisciplinary approaches in fossil shell analysis with regards to ascertaining past environmental changes and the human communities response.

Snails from America's heartland: diversity and abundance of terrestrial gastropods in Southern Illinois, USA

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Land snails have been recognized as a group of conservation concern in the state of Illinois (USA). Nine out of thirteen threatened or endangered terrestrial gastropod species listed in the Illinois Comprehensive Wildlife Conservation Plan are known to have extant populations in southern Illinois. I am conducting surveys of land snails at 30 sites in a six-county area of southwestern Illinois, bordering the Mississippi River. These sites represent the areas of highest gastropod diversity in Illinois and are currently believed to support approximately 115 species. This region also includes the greatest diversity of vegetation in the state, and comprises several areas with high-calcium, high-pH soils. Although previous collectors have contributed to records of snail occurrences in this region, none have provided quantitative data or accompanying soil studies. I am employing a quantitative method (timed searches in replicated square-meter quadrats), as well as more qualitative methods (e.g., leaf litter sampling) to maximize diversity recovery. Data on ecological variables including rock type, soil chemistry and various microhabitat variables are also being collected. To date, representatives of more than 50 species have been found at the 30 sites surveyed thus far. Preliminary analyses for 11 of the sites show significant differences among them in terms of abundance (one-way ANOVA, $F=6.35$, d.f.=10, 121, $P<0.0001$) and diversity (one-way ANOVA, $F=9.66$, d.f.=10, 121, $P<0.0001$). Sites showing the highest levels of both parameters were in areas of limestone; lowest levels occurred in areas of sandstone.

Mollusca of the subfamily Emarginulinae (Gastropoda, Prosobranchia, Fissurellidae) from the french campaign Seamont II

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The Fissurellidae Prosobranchia Gastropoda belonging to the subfamily Emarginulinae that are presented in this communication, come from the oceanographic French campaign SEAMOUNT II and have been loaned for their study by the National Museum of Natural History of Paris (Serge Gofas). The SEAMOUNT II campaign was carried out by the Laboratoire de Biologie des Invertébrés Marins et Malacologie of the MNHN of Paris and by the IFREMER, between the 4th of January and the 14th of February 1993 on board the vessel Le Suroit. Samples were taken in Gran Canaria and in the banks Meteor, Hyeres, Irving, Plato, Atlantis, Tiro and Antialtair. The family Fissurellidae has been traditionally divided in three subfamilies: Emarginulinae, Diodorinae and Fissurellinae, but McLEAN (1984a, 1984b) recognizes only two: Emarginulinae and Fissurellinae, including genera of the subfamily Diodorinae as members of the subfamily Emarginulinae. In this communication the subfamily is studied following McLean. The Gastropoda of the subfamily Emarginulinae that were collected in this campaign are a total of 1151 specimens that belong to 12 different species of the genera *Cranopsis*, *Puncturella*, *Profundisepta*, *Diodora* and *Cornisepta*. Samples were collected in four stations of Atlantis Bank (340-1340 m depth), three stations of Gran Meteor Bank (470-920 m depth), seven stations of Hyères

Bank (480-1250 m depth), six stations of Irving Bank (670-1150 m depth) and five stations of Plato Bank (580-920 m depth).

The shell morphology at SEM as well as the description of the identifying features of 12 species are presented in this communication: *Cranopsis asturiana* (9 specimens), *Cranopsis larva* (27 specimens), *Cranopsis* sp 1. (306 specimens), *Cranopsis* sp 2. (4 specimens), *Puncturella* sp. (14 specimens), *Profundisepta profundi* (272 specimens), *Profundisepta alicei* (10 specimens), *Profundisepta* sp. (9 specimens), *Diodora edwardsi* (11 specimens), *Cornisepta crossei* (173 specimens), *Cornisepta microphyma* (243 specimens) and *Cornisepta* sp. (27 specimens).

Historical biogeography and phylogenetics of the Pacific Succineidae

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Succineidae are distributed worldwide but have diversified into numerous single island or archipelago endemics in the Pacific, where approximately 100 species are currently considered valid. Fundamental to this diversification is over-ocean passive dispersal, since few of these Pacific islands were ever connected to continental land masses, and in many cases were not connected to other islands within their respective archipelagos. Vicariance also played a role within archipelagos as islands broke up or coalesced as a result of ongoing geological processes and fluctuating sea levels. Here we address Pacific succineid phylogenetics and biogeography using a molecular approach. Our data indicate an overall pattern of extensive passive dispersal. For a number of assemblages a lack of monophyly implies multiple colonizations, viz. 1) the Hawaiian islands - two distinct lineages; 2) Tahiti - 2 lineages, one of which originated on the island of Hawaii; 3) Samoa - 2 lineages, one of which originated on the Hawaiian island of Kauai; 4) Galapagos Islands - 2 lineages, the main lineage related to New World species, the other originating in New Zealand; 6) Japan - three lineages, one related to Ogasawaran and Chinese groups, another to species from New Guinea and Vanuatu. In addition, a single species occurs in the Samoan, Marquesas, Cook and Austral Islands, and is most closely related to an Australian species; and a lineage on Saipan shares haplotypes with a Costa Rican species.

Within the Hawaiian Islands most species are single island endemics (39/42, 93%), but *Succinea caduca* occurs on all main islands, even those that have never shared an above water connection, suggesting enhanced passive dispersal. Haplotype analyses suggest historically enhanced gene flow among Maui Nui and Oahu, further suggesting that past island connections have been important in the evolution of this species.

***Rissoa panhormensis* (Gastropoda: Rissoidae) morphotypes analysis vs species identity**

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In a landmark paper on the subgenera *Apicularia* and *Goniostoma* of the genus *Rissoa* (Prosobranchia, Rissoidae), Verduin (1985) described the new species *Rissoa panhormensis*, basing his observations on few empty shells probably dredged from Palermo (Sicily, Mediterranean). One holotype and six paratypes are now housed in the Institut Royal des Sciences Naturelles de Belgique. Recently, during a sampling campaign carried out by the authors in the Gulf of Catania (Ionian Sea), living specimens belonging to this taxon have been found together with several specimens of the

congener *R. guerinii* Recluz, 1843. The analysis of shells of both species, based on morphometric methods, has showed a clear distinction, confirming Verduin's idea of morphological separation. On the other hand, the examination of soft body parts colour patterns have revealed a full identity between the two species and molecular comparison by means of 16S mitochondrial DNA have showed a complete overlap between DNA sequences of *R. panhormensis* and *R. guerinii*. Furthermore, radular compared morphology, carried out by SEM, have shown a high degree of similarity. For these reasons, *R. panhormensis* Verduin, 1985 can be considered as a peculiar morphotype of *R. guerinii* Recluz, 1843, thus becoming a junior synonym of this latter species.

A conservational approach over Azorean terrestrial molluscs

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In Europe, 9% of the known molluscan species are threatened by extinction, mainly Mediterranean and Atlantic islands endemics, as a consequence of anthropogenic disturbance over their habitats, through urbanization, deforestation, soil erosion and contamination. Terrestrial molluscs are an important component of native habitats in the archipelago of Azores; of their 111 described species, 44% are endemic. Native habitats, vast in Azores in a recent past, are now small and sparse, due to the increase of traffic roads, pasture, commercial harvest and urbanization. In addition, owing to the archipelago's geologically young age natural disturbance is high due to tectonic and volcanic activity in most of its nine islands, and, owing to its geographic location colonization and recolonization events are rare due to isolation. As a consequence, habitat fragmentation is taking place and may threaten populations to extinction. Species with small and/or fragmented populations will exhibit the highest degree of vulnerability and conservation priorities should be focused on them. In the course of projects ATLANTIS and BIONATURA (INTERREG IIIB), a Visual Basic software – Atlantis Tierra 2.0 – was developed for data storage of all species on the surveyed geographical area. It includes several tools, namely, for taxonomic and conservation management analysis, and allows the calculation of species richness, their rarity or complementarity, in cells of 500x500 m. The aim of this study is to demonstrate that Atlantis Tierra 2.0 may represent a powerful tool for molluscan conservation, through its main outputs: regional and local biodiversity check-lists, hot spot analysis, list of Threatened species and Priority sites for conservation. The information provided may also contribute for Natura 2000, Municipal, Special, Regional and Coastal Zone Master Plans or to help political allocation of financial resources into conservation. Presentation of this work at WCM was made possible by Project BIONATURA (INTERREG IIIB).

Replaying the tape: replicated biogeographic patterns in Cape Verde *Conus*

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Isolated oceanic islands are excellent natural laboratories to test the relative role of historical contingency in evolutionary diversification. Here, we reconstruct phylogenetic relationships among species of the marine venomous gastropod genus *Conus* from the Cape Verde archipelago. This small island chain located in the Central Atlantic hosts 10% of the worldwide species diversity of *Conus*. According to the reconstructed phylogeny, endemics of *Conus* in the Cape Verde archipelago were originated from at least two independent colonization events. The first colonization in the Miocene led to the diversification of “small” shelled *Conus* whereas in the Pliocene the ancestor of “large” shelled *Conus* arrived to the islands. The “large” shelled *Conus* remarkably replicated the biogeographic diversification patterns of “small” shelled *Conus* but 12 million years later. Similar selective forces (e.g. both taxa have nonplanktonic lecithotrophic larvae with limited dispersal capacity that impose diversification in allopatry) together with repeated instances of low sea level stands during glacial maxima (at 16 and 3.8 million years ago, respectively), which allowed connection between islands, have overcome the potential effect of historical contingency, and explain the observed similar evolutionary outcomes.

Freshwater molluscs threat assessments in Africa

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With contributions from other members of IUCN Mollusc Specialist Group especially the regional coordinators: Dirk van Damme, Thomas Kristiansen, Charles Lange.

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The Pan Africa Biodiversity Assessment is a four-year project (2005-2009) involving assessments and mapping for approximately 6,000 freshwater species from six taxonomic groups: molluscs, fishes, odonates, aquatic plants, wetland birds, and crabs.

A regional approach is being used:

Eastern Africa: the pilot study for the project was completed in 2005. The overview showed that 23% of all molluscs were threatened with extinction, but a further 28% were Data Deficient.

Southern Africa: the South African Institute for Aquatic Biodiversity (SAIAB) is leading this assessment, and the endemic species will be added to the Global Red List in October 2007.

Western Africa: Wetlands International is coordinating the assessment, and the Mollusc reports are currently being prepared by Thomas Kristiansen.

Northern Africa Freshwater Biodiversity Assessment: is led by the IUCN Centre for Mediterranean Cooperation. The first assessments were undertaken by Dirk van Damme in May 2007.

Further species assessments will be needed to cover those areas such as the Congo Basin and NE Africa which are outside the regional assessments.

The final year of the Pan Africa Biodiversity Assessment will be spent aggregating the separate regional datasets in order to do a final regional assessment for the African continent.

The species data is being gathered using standardised software based on Microsoft Access, so that entry conforms to the documentation standards required by the IUCN Red List. A demonstration and training session will be held on Saturday 21st July where copies of the software will be available.

The poster will present an overview of the results for East Africa, South Africa and West Africa, showing areas of high species richness and areas with high numbers of threatened species. We will comment on the main threats to Molluscs and overall patterns emerging from the programme.

Gastropod species as model organisms in ecotoxicology ? Introducing the molecular view

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During their evolutionary history, gastropods have been successful in colonizing different environments with some of the most adverse habitats on the earth. One of the preconditions for this adaptational capacity of gastropods has been their huge physiological plasticity, along with their high ability to cope with stressful conditions of different origin. In particular, this remarkable potential for adaptation is based, among other features, on an energy metabolism with a variety of anaerobic pathways. This enables some gastropod species to survive in habitats with limited energy resources, and to outlast periods of adverse environmental conditions by reducing their activity and energy demand to a minimum. In addition, a range of stress compensation and detoxification mechanisms ensures the organism's survival even under the influence of stressful physical and chemical environmental factors, including adverse human impact. All these remarkable features make gastropods potential candidates for fundamental and applied research in ecotoxicology. In the present talk, I would like to substantiate this hypothesis by focusing on the exceptional ability of some pulmonate species to cope with metal stress, and perhaps with more than this.

Some terrestrial pulmonates (e.g. *Helix pomatia*, *Cornu aspersum*, *Arianta arbustorum*) possess mechanisms of metal detoxification, which are much more specific compared to those found in most other animal species. The primary reason for this is the fact that these pulmonates rely on metal binding Metallothioneins (MT) consisting of metal- and function-specific isoforms. In the Roman snail (*Helix pomatia*), for example, one MT isoform is devoted to Cu homeostasis, while a second isoform deals with detoxification of Cd. The adaptation of the two peptides to their metal-related tasks represents an unique example of structural and functional diversification of different isoforms within a protein family. Because of its metal-specific features, the Cd-MT isoform of *Helix pomatia* and some other related pulmonate snails has successfully been used as a biomarker of exposure in metal-contaminated terrestrial environments.

Another unique feature of the MT system of terrestrial pulmonates is the complexity of their MT genes. The Cd-MT gene of *Helix pomatia*, for example, is by far the largest and most complex MT gene known throughout all organismic kingdoms. Its nucleotide structure suggests that at the molecular level, adaptation of terrestrial pulmonates to metal stress is achieved by a broad potential of response patterns to a diversity of extrinsic and intrinsic stress stimuli, rather than strict metal specificity. This is confirmed by the fact that the Cd-MT isoform gene of *Helix pomatia* contains, apart from Metal-Responsive Elements (MREs) and nuclear activators and silencers, a manifold array of binding sites for various stress-related transcription factors. These include, among others, transcription factors involved in heat shock response, xenobiotic metabolism, and immune defense. The multiplicity and diversity of these transcription factor binding sites probably allows, apart from metal responsiveness, fine-tuning of transcriptional activation of the Cd-MT gene in dependence of many other environmental stressors. In fact, the induction rate of the Cd-MT gene of *Helix pomatia* due to metal exposure is much higher at the transcriptional level than at the protein level, a feature which has also been observed for other stress-related proteins. The high complexity of the Cd-MT gene of *Helix pomatia* and its sensitivity to transcriptional induction and regulation suggests that it could be used as a complex biomarker for stress response, which includes, apart from metals, many other environmental stressors. We are currently testing this hypothesis by transfection of reporter gene constructs from *Helix pomatia* into embryonic cells of the freshwater pulmonate *Biomphalaria glabrata*.

Genetic and morphological variability in fluviatile species of *Tylomelania* (Caenogastropoda: Pachychilidae) from Southwest Sulawesi, Indonesia

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The species of the endemic viviparous pachychilid gastropod *Tylomelania* Sarasin & Sarasin, 1897 form a prominent element of Sulawesi's limnic biota. *Tylomelania* is widely distributed in rivers and has radiated extensively in the ancient lakes of the island. In contrast to the c. 35 lacustrine species only eight fluviatile taxa have been described to date. Extensive recent sampling has revealed a much higher diversity of fluviatile species than previously anticipated, though.

Southwest Sulawesi harbours several endemic and distinct *Tylomelania* species. Most populations can easily be assigned to a species by their shell morphology. Most of these species are local endemics, just three are more widely distributed. Generally only one species occurs at each locality, the only exception being the Balocci Valley in the western part of the peninsula. The three species occurring syntopic there differ strongly in substrate preference and radula morphology, which is otherwise rather uniform in fluviatile taxa.

Molecular data are in strong conflict with these morphology-based patterns. The sympatric and syntopic species of the Balocci valley have identical mtDNA haplotypes, for example, while haplotypes are very diverse in the most widespread and morphologically rather uniform species *T. perfecta* "smooth". Within this taxon haplotypes group with different clades not just between individuals from geographically separated populations but frequently even within a single population. Several alternative hypotheses may be invoked to explain this discrepancy between the observed morphological and molecular patterns. The identical haplotypes of the morphologically distinct species in the Balocci valley might be explained by incomplete lineage sorting due to rapid speciation, while the highly divergent haplotypes of *T. perfecta* "smooth" might indicate cryptic species. The latter assumption is rendered rather unlikely by the repeated occurrence of extremely distinct haplotypes within single populations lacking any apparent geographic structuring, though. Nuclear data are needed to resolve this conflict.

**The evolution of co-operative behaviour:
a virtual 'experiment' using high-shore snails as a model system**

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Aggregation is a co-operative behaviour with demonstrated individual level selective advantages in many animals. However, the evolution of co-operative behaviour through individual-based selection mechanisms is unresolved. An individual gains no benefit from evolving an aggregation trait, unless the trait is shared. We show that aggregation can occur as an emergent property of individually beneficial traits, providing a fully individual-based mechanism to explain the evolution of co-operative behaviours.

High-shore snails (*Echinolittorina trochoides* and *E. radiata*) were used as model animals. They move upshore with the incoming tide to feed while awash. As the tide retreats, they move downshore, forming complex aggregation patterns both in crevices and on smooth rock. We simulated downshore movement patterns virtually, using three behavioural rules: an aggregation rule, where if two or more

snails interact they may, co-operatively, stop moving; a crevice occupation rule, where if a snail encounters a crevice it may stop moving inside the crevice; and a conspecific mucus trail following rule. Each behavioural rule relied only on chance encounters.

The simulation accurately predicted patterns found in nature. In both simulation and reality, 'super trails' formed, where mucus trails of several individuals converged as snails moved downshore. Consequently, encounters between individuals increased, and large aggregations formed where trails intersected with each other and with crevices.

On removal of the aggregation rule, dense aggregations of snails persisted in positions where 'super trails' intersected with crevices. Aggregation, then, arises as a by-product, or emergent property, of two individually advantageous behaviours: crevice occupation, which reduces thermal stress; and trail following which reduces the cost of locomotion. The individual level benefit of aggregation can then be selected for, stabilizing this emergent behaviour, and allowing aggregation to occur outside crevices. Emergent properties of individually advantageous traits, therefore, provide an initial mechanism to drive the evolution of co-operative behaviours.

What's happening with (species names in) the PhyloCode?

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On May 21st, 2007, the Committee for Phylogenetic Nomenclature, which consists of 12 elected members from the International Society for Phylogenetic Nomenclature, adopted an article providing rules for naming species in the context of phylogenetic nomenclature. This vote, which took place after more than ten years of debates on how to deal with species names in phylogenetic nomenclature, constitutes a major step in the development of the PhyloCode. The new article on species names shall be added to the version of the PhyloCode posted on the web some time this summer. I will present the main components of this article. I will use some practical examples, including from my monographic revision of discodoridid sea slugs, to illustrate it and discuss some of its potential advantages.

Punctuated equilibrium alive? How living Azorian *Drouetia* Gude, 1911 (Gastropoda: Pulmonata: Zonitidae) can tell a fossil story

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The theory of punctuated equilibria, arrived at and demonstrated through careful interpretation of rich fossil data, sustains that evolution proceeds by bursts: short periods of diversification are followed by long periods of stasis. Whereas the two time frames (rapid diversification and long stasis) can be perceived directly from observation of the fossil record, the theory assumes various tenets observable only in living systems: a) the biological species concept (interbreeding and reproductive isolation), b) that reproductive isolation is generally linked to morphological change, and c) the existence of allopatric (peripatric) speciation. Confirmation for the aforementioned assumptions can only come from extant taxa and from them the fine resolution of short time change can be detected as well. To see it in living taxa, one should flatten the time axis and spread it two-dimensionally. That is: select a perfectly contained clade whose members can be assigned to discrete time frames. The model predicts that the members of the clade living in older areas will exhibit less intraspecific diversity and be genetically less related interspecifically (stasis), whereas those living in younger areas will be intraspecifically more diverse although genetically closer interspecifically (diversification).

The Azores archipelago provides the geological history and the biological settings needed to capture punctuated equilibrium alive. Morphological and anatomical analyses show that older islands have species of the endemic *Drouetia* with various degrees of relatedness whereas younger islands include cases of allotopic diversification and of interspecific closeness. Volcanic activity can be interpreted as the “serious environmental perturbation” associated with the diversification episodes.

Spanish lower cretaceous freshwater molluscs

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Two associations of molluscs from the Lower Cretaceous have been recognized at Cameros Basin (North of Spain), famous location due to the presence of dinosaur tracks. Samples were collected from *Valdehiero* and *Valdemadera* sites, which belong to the lithological Urbión Group, upper Hauterivian-lower Barremian in age. The palaeoecosystem is interpreted as a meandering fluvial floodplain with temporary small shallow carbonate lakes. *Valdehiero* site has a rich freshwater bivalve association dominated by the naiad *Margaritifera idubedae*, with representatives of both juvenile and adult specimens registered in marls. *Valdemadera* outcrop has a very similar association dominated by *Margaritifera idubedae* registered in marls with levels where gastropods and bivalves are accumulated in a high number. Among gastropods, Planorbidae and Bythinidae families have been identified. Among bivalves, there are juveniles of *Margaritifera idubedae* which shows a heart-shaped characteristic umbonal ornamentation, some specimens of *Unio*, and some juvenile representatives of the Sphaeriidae family. Although until now we have not found a direct relation between naiads and fish (that is, the presence of glochidia), we have found in both sites of Urbión Group ichthyological remains corresponding mainly to ganoid scales of fishes belonging to the order Semionotiformes (Actinopterygii, Neopterygii). All taphonomic features of both fossil groups (molluscs and fishes) suggest this association as a palaeocommunity. Assuming both, that *Margaritifera* used the same dispersion method in the past than today, and that most of the extant fishes used like host were inexistent or not abundant in the Early Cretaceous, it is plausible that Semionotiformes were a valid host for the naiads at this time. This fishes were very abundant in Mesozoic and very extended paleogeographically in both, marine and freshwaters ecosystems.

Control of a mollusc heart by 5-hydroxytryptamine and acetylcholine receptor subtypes

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We conducted a neuropharmacological study on the respective receptor subtypes involved in cardioexcitation by 5-hydroxytryptamine (5HT) or cardioinhibition by acetylcholine (ACh), using as our model the heart of bivalve, *Mercenaria mercenaria*. Treatment of the heart with 5HT increased cardiac contractions, heart rate and basal tone. 5HT₁ receptor agonist, buspirone mimicked the action of 5HT. Pindolol, a 5HT₁ antagonist, decreased buspirone-induced contractions yet increased heart rate. 5HT₂ receptor agonist, α -methylserotonin maleate (α -MSM) also had an excitatory effect on both heart rate and contractile force. 5HT₂ antagonist, metergoline increased force yet decreased heart rate of α -MSM-induced rhythmicity. These combined data suggest the presence of both 5HT₁ and 5HT₂-like receptors in the bivalve heart. 5HT-induced rhythmicity was blocked completely by treatment with neurotransmitter, ACh. Like ACh, the muscarinic agonists, arecoline, carbachol and methacholine inhibited the action of 5HT. Curiously, other muscarinic agonists such as oxotremorine or pilocarpine had no efficacy in blocking 5HT-induced rhythmicity.

Evolution of spermatophore ornamentation in the land snail genus *Thapsia* (Stylommatophora, Helicarionoidea): a role for sexual selection?

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Land snails of the genus *Thapsia*, like many other helicarionoid snails and slugs, are simultaneous hermaphrodites, which can mate with different partners within a period of a few days, thereby reciprocally exchanging a large, rigid, chitinous spermatophore. These spermatophores consist of a voluminous sperm-filled ampulla, followed by a long, convoluted tail. The tail portion is a narrow, hollow tube with an opening at the posterior end, and is ornamented by a variety of thorns, branched spines and other spiny outgrowths. Details of the elaborate tail ornamentation appear to be species specific, or at least population-specific. Spermatophores constitute a serious investment in terms of quantity of sperm as well as nutritional (protein) resources needed to produce the chitinous material from which the spermatophore is moulded. A sperm-filled spermatophore weighs approximately four to six times as much as a freshly laid egg. It seems therefore unlikely that a spermatophore is a "cheap" commodity and that the ornamentation is selectively neutral. However, it proved difficult to ascribe a function to the various thorns and spines in efficient fertilization of the partner. Comparing spermatophore morphologies of different closely-related species in combination with the orientation of freshly exchanged spermatophores in the distal female genital tract suggests that the evolution of the ornamentation might be better explained as the result of a kind of sperm competition (i.e. post-copulatory sexual selection) arising from conflicting interests between the sexes of the snail: female control over fertilization of her eggs and male maximizing the fertilization success of his sperm.

Natural history of *Doto koenneckeri* Lemche, 1976 (Gastropoda, Nudibranchia, Dendronotacea) in the Ría of Ferrol (NW Iberian Peninsula)

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Doto koenneckeri is a Dendronotacea nudibranch of the family Dotoidae that has some very clear distinctive features: a characteristically cone-shaped apical tubercle, larger than the rest of the ceratal tubercles, that takes up 1/3 or even 1/2 of the total length of the cerata; some comma-shaped carmine red marks on the inner side of the ceratal tubercles and depigmented areas on the base of the cerata. This species lives exclusively on the plumularid hydroid *Aglaophenia pluma dichotoma*, from which it feeds itself and on which it spawns. The spawn has the shape of a long band, is folded up and has a white or yellowish-white color.

Since the study about the nudibranchs of the Ría of Ferrol started in 1977, a special attention has been paid to the nudibranchs of the family Dotoidae, by collecting specimens of different species at any time of the year and in different localities of the ría, using always autonomous diving equipments for their collection and observation, what provided us with a wide information and a large collection of specimens of different sizes and ages. Besides, during the years 1996 and 1997 a specific study was carried out about the biology of some nudibranch species that live associated to the hydroid colonies throughout a complete annual cycle. A follow-up of the two most common species of the Ría of Ferrol was carried out during thirteen monthly samplings: *Doto koenneckeri* and *Doto*

pinnatifida, associated respectively to the hydrozoa *Aglaophenia pluma dichotoma* and *Nemertesia antennina*.

In this communication, the results of the carried-out temporary study as well as the information collected over the years are presented by setting out the main identifying features of the adult specimens of *Doto koenneckeri*, the chromatic and anatomical variation and evolution of its young stages, its trophic and reproductive biology, spatial arrangement in the colony and population cycle.

Effects of isolation and body size on the mating behaviour of the hermaphroditic land snail *Succinea putris* (Gastropoda, Pulmonata, Succineidae)

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We examined the combined effect of isolation and body size on (1) the likelihood of mating, (2) the activity role, (3) the pre-copulatory behaviour, (4) copulation duration, (5) the reciprocity of sperm transfer and the number of (reciprocally) transmitted sperm in the hermaphroditic land snail *Succinea putris*. In addition, we assessed the effects of isolation on the size of the prostate and albumen gland. We show for the first time that both body size and sexual motivation influence mating behaviour in a hermaphroditic species with reciprocal internal sperm transfer: isolated individuals showed an increased eagerness to mate, were more likely to adopt the active role and mounted shells of partners more than nonisolated individuals. Moreover, isolated individuals transferred more sperm than nonisolated individuals. Smaller individuals also showed a preference for the active role. Copulation duration and the reciprocity of sperm transfer were unaffected by isolation or body size. Isolation resulted in an increase of the size of the prostate gland; the effect of isolation on the size of the albumen gland was less pronounced. We suggest that the motivation to mate after a period of isolation reflects a motivation to donate sperm, rather than to receive sperm and that this motivation is regulated by the size of the prostate gland.

Sperm transfer and sperm digestion in the land snail *Succinea putris* (Gastropoda, Pulmonata, Succineidae)

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Sperm competition may be as important in hermaphrodites as in species with separated sexes. Consequently, sperm donor strategies that manipulate the sperm receiver's reproductive physiology may also have evolved in hermaphrodites. Manipulation of the partner during copulation may result in an increase of copulation duration. We studied the relation between sperm transfer and copulation duration in the hermaphroditic land snail *Succinea putris*. Sperm transfer is completed within the first five hours of the copulation, although the mean copulation time is eight hours. Therefore, the prolonged copulation duration could be interpreted as 'contact mate guarding'. No sperm is digested during copulation but took place within the first 72 hours after the end of copulation. We found that remaining in copula after sperm transfer also prevents sperm digestion and therefore may promote allosperm storage. Finally, sperm transfer was mostly sequential with one individual donating all its sperm before its partner started to reciprocate and is not related to the activity role.

**Invasive freshwater species *Sinanodonta woodiana* (Lea, 1834) (Bivalvia: Unionidae):
a colonizer of the channels of Międzyodrze area (Western Pomerania Region, N-W Poland)**

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Sinanodonta woodiana (Lea, 1834) is an alien species in the fauna of Poland. It comes from the catchment area of the rivers Amur and Yangtze. In Poland it was found in the early 1980s in the system of heated lakes near Konin (Kujawy Lake District, Poland). It appeared there together with the silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1884) and big-headed carp *Aristichthys nobilis* (Richardson, 1845) introduced from Hungary. In 2003 it was found in the release channel of cooling water from the Dolna Odra power plant. In the years 2004-05 an inventory of the Międzyodrze channels was made in order to determine the current range of occurrence of *S. woodiana* in the Western Pomerania Region. The mussels were found at five localities below the release of the cooling water. In total 20 empty shells joined by ligamentum and 16 live individuals were collected. Histological analysis of the mussel gonads has shown the presence of ovulated oocytes in females and developed spermatozoa in males. In the outer demibranch marsupia of females the presence of glochidia was detected, which pointed to the readiness of the mussels for reproduction. The channels of Międzyodrze are partly frozen in winter, which indicated the adaptation abilities of this species to waters typical of temperate zone.

The relationship between age and shell length in freshwater pearl mussels (*Margaritifera margaritifera*) from Sweden

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The freshwater pearl mussel, *Margaritifera margaritifera*, is well known not only for its pearls but also for reliable environmental archives within its shells. Unfortunately, this species is threatened by extinction as many of populations through the Europe do not regenerate. Consequently, in most of the European countries the freshwater pearl mussel is protected and there are general efforts to improve the environmental conditions necessary for the regeneration of existing populations. Tools, such as monitoring the population dynamics, improvement of the water quality (as example, liming) and changes of the bottom sediment as well as studies on shell growth and structure are employed in order to create sustainable conservation strategies.

The present paper presents general aspects of shell growth in freshwater pearl mussels from Swedish populations. Unique shell material collected between 1984 and 2006 gave us opportunity to study the shell growth of juvenile bivalves and to use it in order to estimate the eroded umbonal parts of old shells. We have established the correlation between age and shell length in bivalves from 19 river systems from South, Central and North Sweden. Consequently, a more precise age estimation of the mussels by measuring the shell length is possible, which provide a better tool for monitoring of the mussel populations. We did not find any North-South trend in the age distribution and shell length.

However, a growth trend related to the water quality has been observed. In rivers with good nutrient supply and with neutral and stable pH the shells grow larger than expected while in rivers with low buffer capacity (for example rivers that have granite bedrocks) grow smaller. There are good indications that pH of the water together with the food availability and the amount of dissolved oxygen in the water are the strongest factors that affect the shell length in relation to the age of the mussel. Even though, the sclerochronologies based on variations in annual growth of mussel shells exhibit a high degree of running similarity with local variations in summer temperature (especially in localities with pristine conditions). Yet, changes in water quality, as example due to liming, affect the annual growth rate of the shells. The immediate effect of liming is seen as strong growth disturbance line in all collected shells. We demonstrate that *M. margaritifera* mussels, especially the juvenile stages, are very sensitive to sudden changes of their environment. This project was financed by the World Wildlife Fund (WWF) and County Board of Västernorrland.

Analysis of shell growth, structure and chemical composition of ocean quahog (*Arctica islandica*)

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Recent studies of ocean quahog (*Arctica islandica*) demonstrate that the shell growth and structure, as well as its chemical composition reflect changes in the environment. Sclerochronologies (growth increment chronologies) together with isotope analyses allow reconstruction of palaeotemperatures. Consequently, the bivalve shells are considered as reliable proxies for climate reconstructions and there is an increasing trend to use bivalves as environmental bio-monitors. However, shells from shallow water environments along the costal regions are more exposed to salinity fluctuations and to pollutants from human activities than shells from deeper regions. This affects the reliability of temperature reconstructions yet the chemistry of these shells reveals the history of water pollution. In our work we compare the shell structure of ocean quahog collected recently from Kiel Bay, along the Swedish West Coast to Iceland, Spitsbergen and the White Sea with sub-fossil shells from museum collections dated from the Tertiary to Holocene.

Shells from Kiel Bay, Öresund and Kattegat, as well as shells from the White Sea, are considerable thinner and smaller, with many growth disturbance lines, compared to shells from Skagerrak and the North Sea. Shells from Iceland, Spitsbergen and from the Tertiary are particularly large sized, and considerably thicker. They have also a highly organized crossed lamellar microstructure with a very thin outermost granular homogenous sub-layer. In contrast, shells from the Swedish West Coast and the White Sea have a very poorly organized microstructure, mostly homogenous, and only the outer aragonitic layer shows sporadically crossed acicular microstructure. These observations indicate that the microstructure, size and thickness of *Arctica* shells are induced by stress factors, such as salinity changes and water pollution.

Analyses carried out with SIMS, ICP-OES, nuclear microprobe and neutron activation analysis show that higher contents of S, N, Cu, Zn, As, Cd and P in shell portions formed during the last century are related to human activities such as mining and industrial development.

In order to use shells as archives for climate change models it is necessary to evaluate the full range of environmental data recorded in the shells by employing different analytical techniques including chemical analyses that combine high multi-elemental capacity with high sensitivity and high spatial resolution, as well as growth rate and structural analyses.

Can response to water flow explain the distributions of extant and extinct aquatic *Melanopsis* spp. in the Jordan valley?

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Relationships between shell morphology and river flow might explain the ecological distributions of *Melanoides* and *Thiara* in Guadeloupe (Pointier & Dussart, 1999). Grossowicz, Silvan and Heller *et al.* observed in 2003 that *Melanopsis* species hybridised in a narrow ecotone between gently running stream outlets (*M. buccinoidea*) and wave-affected lake shore (*M. costata*) in the Jordan valley. They also suggested that the distribution of elongate, small mouthed forms of *costata* correlated with rivers and lakes with weak currents and rich aquatic vegetation, as on the banks of the River Jordan and the sub-recent lake Hula.

The aim of the work presented here was therefore to investigate whether relationships seen in Guadeloupe might also apply to Jordan valley *Melanopsis* species. Thirty shells of extant populations of each of *M. buccinoidea*, *M. costata costata*, *M. costata jordanica* and *M. saulcyi* were tested for their response to water flow in the laboratory.

Each taxon showed a similar response pattern between flows of 1.18m/s and 1.48 m/s. For each taxon, the pattern changed as flow rate increased, probably as shell sculpture caused a change from laminar to turbulent flow. For all four taxa, smaller shells showed a lower response to flow than larger shells. The response was not linear; *M. buccinoid* showed a smooth, sinuous response whereas *M. costata costata* and *M. costata jordanic* showed intricate changes in response for shells with a cross sectional profile between 35-45 mm² and between 58-62 mm². Small specimens of *M. saulcyi* responded strongly to changes in flow rate.

These results might contribute to an understanding of the Pleistocene biogeography of *M. buccinoidea*, *M. costata*, *M. obediensis*, *M. multiformis*, *M. corrugata* and *M. turriiformis* in the Jordan valley as revealed by sediment cores. It might also help to explain the evolutionary ecology of extant *Melanopsis* in this region.

Reproductive strategies of cultivated and wild oysters, *Crassostrea gigas*, in relation to environmental variations in a high-turbidity intertidal mudflat (Bourgneuf, France)

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Gametogenesis and reproductive effort were investigated in Pacific oysters, *Crassostrea gigas*, in relation to the seasonal variations of their habitat using quantitative histological methods and continuously-recording environmental monitors. Cultivated and wild oysters were installed in February 2005 in two farming sites mainly characterized by different annual mean suspended particulate matter (SPM) concentrations, ranging from 34 mg.l⁻¹ to 154 mg.l⁻¹, and sampled monthly between February 2005 and February 2006. Environmental monitors recorded water temperature, SPM and chlorophyll *a* concentrations, salinity, oxygen content and immersion time throughout the study. The acinal structure of the gonad persisted throughout the year. Spermatocytes and oocytes were respectively observed in males and in females from March when water temperature (<10°C) began to increase. Reproductive effort (proportion of gamete area on the histological sections)

increased from March to summer (June and July), and was slightly greater in cultivated oysters, probably related to their trophic conditioning before installation. When water temperature exceeded, even briefly, 19°C, partial spawnings were observed between April and June in oysters from the high turbid site vs a massive spawning in June for oysters from the low turbid site. A major decrease of the gonosomatic ratio in August corresponded to a massive gamete atresia and resorption both within the acini and the evacuating ducts. In December, gametogenesis was observed in 5-10% of the individuals sampled, and in all cases these were males. Critical stages of the reproductive cycle of oysters were mainly regulated by the water temperature, while the intensity of the reproductive effort depended on the food supply. We suggest that environment-dependant reproduction strategy be integrated in a deterministic growth model for this species.

Anatomy, distribution, and ecology of the slug *Arion alpinus* Pollonera, 1887 (Gastropoda: Arionidae)

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Arion (Kobeltia) alpinus Pollonera, 1887 is a small Central European slug whose northernmost distribution limit crosses the southern part of the Czech Republic. The species can be easily confused with young specimens of *A. (Mesarion) fuscus* (Müller, 1774) or light coloured specimens of *A. (Kobeltia) distinctus* Mabille, 1868. However, *A. alpinus* can be distinguished from both these species by the following features: (1) the upper side of the body is yellowish, yellow-brownish or greenish with darker lateral stripes that do not expand under the pneumostome, (2) the yellow to light orange foot sole, (3) the pale yellowish body mucus, (4) the anatomy of the genitalia, and (5) specific mitochondrial 16S rDNA sequences. There is also a diagnostic papilla at the inner part of the outlet of the epiphallus that distinguishes *A. alpinus* from *A. distinctus*.

A. alpinus seems to be a typical forest species preferring hilly and mountainous regions. It is predominantly a ground-dwelling species since it was mostly found on the ground under leaves, stones, and pieces of wood or bark of fallen trunks and often on mushrooms.

A DNA-based phylogeny resolves divergent and convergent evolution of limpets (Lottiidae)

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A preliminary phylogenetic analysis of the limpet genus *Lottia* (Patellogastropoda: Lottiidae), based on over 400 new and 50 existing partial mitochondrial 16S rDNA sequences, has revealed striking convergence and divergence in shell shape and feeding ecology. Altogether, 30 western North American species of *Lottia* and related genera have been newly sequenced, most represented by multiple populations and multiple specimens per population. All 30 were resolved as reciprocally monophyletic. Deeper branching patterns within *Lottia* are less well resolved by 16S alone, with only some species groups supported, but resolution is still sufficient to infer interesting patterns of limpet ecology and morphology. Among the new or previously reported (e.g., D. R. Lindberg, B. Simison, E. Begovic) patterns that this analysis corroborates are: 1) dramatic shifts in feeding ecology: limpets living on surf grasses (“*Lottia*” *paleacea*) or eel grasses (“*L.*” *depicta*) are in a clade apart from *Lottia*, and this clade also includes a coralline alga specialist, “*L.*” *rosacea*; 2) striking parallelisms: “*L.*” *rosacea* is phylogenetically distant from another morphologically similar coralline alga specialist, *Lottia triangularis*; another example is a new species that is highly convergent to the *L.* “*ochracea*” rock ecomorph; 3) profound ecomorphological variation: *Lottia* “*ochracea*” is merely a rock ecomorph of a species, *L. instabilis*, known for its habit of living on kelp stipes; 4) cryptic species: three other new species are likely allopatric species pairs of *L. digitalis*, *L. pelta*, or *L. strigatella*, respectively, and each pair of species has a similar broad range of ecophenotypic variation; 5) new phylogenetic resolution: as rooted with outgroups, *Acmaea mitra*, *A. funiculata*, and *Lepeta caeca*, the most basal Lottiidae lineage is the type species of *Tectura*, *T. virginea*, whereas a common northern Atlantic species usually referred to this genus, “*Tectura*” *testudinalis*, is phylogenetically remote – it is instead clearly nested within *Lottia*.

Chitons as potential models for investigating recent and parallel evolution of eyes

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Chitons lack a brain or even a head but have hundreds of sensory organs called esthetes (or aesthetes) in the upper layer of their shell plates, and these can be traced to Paleozoic chitons over 400 million years old. The nervous innervation of esthetes is complex and can be visualized with epoxy casts as compared across chitons in a recent collaborative study. Esthetes often have a photosensory role and 1920s naturalists demonstrated that a chiton would immediately stop crawling and clamp tightly when a shadow was cast from over 10m away. Two phylogenetically distant lineages of chitons (Chitonidae: Acanthopleurinae and the distantly related genus *Schizochiton*) have evolved even more elaborate ocelli, organized in radiating rows on their shell plates. A preliminary molecular analysis has confirmed that ocelli must have evolved in parallel. Ocelli are qualitatively different from a simple esthete, being much larger with a well-developed lens, cornea, etc. There are a few ultrastructural and electrophysiological studies and some behavioral experiments have been done to cover up the ocelli to observe how behavior changes, but ocelli are still woefully under-studied. For example, the lineage with the largest ocelli in chitons (*Schizochiton*) was last studied in the 1890s. The lack of ancient fossils of Acanthopleurinae or *Schizochiton* and their derived taxonomic position implies that chiton ocelli only recently evolved. In contrast, the primary model systems for examining eye anatomy and evolution (e.g., mammals, flies, cephalopods) already had ancestors with eyes 500+

MYBP, so the early origins and elaborations of eyes is obscured by their ancient history. The fact that chitons have hundreds of eyes, their relatively recent dual origins, and the extent of variation in ocelli morphology across at least Acanthopleurinae, are all reasons that chiton ocelli could be useful models for investigating the origin and elaboration of eyes in animals.

Molecular phylogeny and biogeography of the polytypic genus *Pyrenaearia*

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The land snail genus *Pyrenaearia* is an endemism of the northern mountains of the Iberian Peninsula. As many as 12-16 species are currently recognised within this genus, which are exclusively differentiated on the basis of shell morphology. Many of them are living above 1.000 m of altitude, while others show a wide altitudinal range and still a few others are restricted to small valleys. We have examined the nucleotide sequences of mtDNA (16S and COI) and the ITS-I region of the nuclear DNA in order to reconstruct the evolutionary history of the genus. Phylogenetic relationships have been inferred using maximum parsimony, neighbour joining, maximum likelihood and Bayesian methods. These analyses suggested eight main phylogroups: One restricted to the Cantabrian mountains, one restricted to the hills in the pre-litoral mountain system of Catalonia, a third group is located in the Moncayo mountains (Iberian System) and the other five phylogroups occur in the Pyrenees and pre-Pyrenees. A nested clade analysis based on mtDNA sequences has been performed to infer phylogeographic patterns. The speciation process and the biogeography of *Pyrenaearia* are discussed in relation to the Pleistocene glaciation events.

This work has been financed by the Basque Country University (Projects: 1/UPV 0076.125-EA-7876/2000; 1/UPV 00076.310-E-15256/2003 and GIU06/09).

Phylogenetic relationships and evolution of *Iberus* species based on mtDNA sequences

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DNA sequences of two mitochondrial genes (COI and 16S rRNA) from 59 specimens of *Iberus* were used to test the validity of the medium-sized morphospecies of the genus and to study the genetic divergences within and between main phylogenetic groups. All the morphospecies of medium size were included in the study: *I. angustatus*, *I. cobosi*, *I. guiraoanus*, *I. loxanus*, *I. marmoratus*, *I. ortizi*,

and *I. rositai*. Besides, their phylogenetic relationships with the larger forms of the genus (*I. alonensis*, *I. campesinus*, *I. carthaginiensis*, *I. gualtieranus*, and related species) were also evaluated. Both gene fragments showed phylogenetic concordance. COI showed faster evolving sequences than 16S and was fully protein-coding with no insertions or deletions. 16S rRNA was more informative than COI in the resolution of the basal nodes. Both individual and combined analyses of the two genes showed five Molecularly defined Operational Taxonomic Units (MOTUs). They were genetically unique lineages with allopatric distribution and considered to have fully-species status. Further subdivisions were also considered. Shell morphology was suitable for delimiting species, but several incongruences between morphology and mtDNA phylogeny were observed. Spatial patterns of sequence divergence, life habits and shell morphology provided important information to conclude that keeled-flat shells have originated several times independently within *Iberus* and they represent a case of similar shell adaptation to karstic arid environment. This work has been financed by the Basque Country University (Project GIU06/09), by the Regional Ministry of the Environment, Junta of Andalusia ("Program for conservation and sustainable snail exploitation in Andalusia) and by the Ministerio de Educación y Ciencia (Project REN2001-0049 / GLO).

Inherited flesh colour in edible snails

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Consumers of edible snails often have preferences for or against a particular flesh colour. In Europe, the white fleshed Burgundy Snail, *Helix pomatia* is highly esteemed, while other closely related species and strains with a grey or brown flesh colour are less appreciated by the market. Bulgaria exports *Helix* snails, collected from the wild in spring. The *H. pomatia* are typically rather grey in flesh colour, whereas the *Helix lucorum* are typically unappealing shades of dark brown. A small supply of adult snails was received from north-west Bulgaria with shells typical of *H. lucorum* but white to pale grey flesh colour. It was suggested that a strain developed from these would be very suitable for snail farming, with the "farmability" of *H. lucorum* but the preferred flesh colour of *H. pomatia*. The adults of the initial supply were allowed to mate freely in field pens and produced offspring (F1) with flesh colours ranging from white to mid brown. In 2006 a selection of sub-adult white-fleshed F1 was transferred to a new pen and a selection of brown-fleshed ones to a different pen. Examining the resulting F2 juveniles in spring 2007, it was easy to distinguish brown from white-fleshed individuals. White-fleshed F1 parents had produced a great majority of white-fleshed F2 juveniles, but with a minority of brown-fleshed ones. Vice-versa, brown-fleshed F1 parents produced a majority of brown-fleshed juveniles, with a minority of white-fleshed ones. Separately, a small number of snails with a much whiter shell colour were noted among the F2 juveniles. Most of these were white-fleshed from white-fleshed F1, but with smaller numbers of all other combinations.

Impacts of three seasonal soil management regimes on slug abundance and slug damage to oilseed rape

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Soil conservation management is increasingly enjoying a worldwide appreciation in arable farming. Erosion control, cost reductions for farm machinery & labour, improvement of soil physical properties, conservation of water and enhancement of soil beneficial organisms are some of the wide-

ranging stimuli driving farmers to adopt minimum tillage practices. Despite various considerable gains for soil, its ecosystem and farm revenues there is a number of constraints reported to be associated with the minimum tillage regimes. Besides elevated infestation incidences for weeds and some plant diseases slugs are considered as a third significant pest problem threatening different arable crops. This is in particular true for oilseed rape. Following the principles of Integrated Pest Management (IPM) the deliberate exploiting of husbandry techniques is listed as preferred option in slug control strategies. Aiming at these objectives a multi-annual study was setup at Berolzheim/ Germany to explore potential impacts of different soil management regimes on slug abundance and slug damage to Oilseed rape. These investigations were performed between 2001 and 2005 comparing effects of three distinct soil management systems on the Field Grey Slug (*Doreceras reticulatum*). These included shallow ploughing (SP), tine cultivation (SG) and direct drilling (no-till system) (DS), each for its own, in combination with seedbed consolidation (roller treatment) and / or molluscicides. Numbers of slugs trapped by refuge traps (Slug mats), seedlings density (plant counts) and foliar damage were the used parameters. All trails were performed on alternating fields at annually changing locations within a commercial farm. The geostatic layout matches a three factorial Strip-block-design, in which each tillage strip (Strip size: 20-30 x 120-180 m) comprised two roller (\pm Roller) and two molluscicides sub-treatments (\pm SI-pellets). All sub-treatments were set-up crosswise to the six soil management strips. Slug pellets (metaldhyde) were applied at the officially recommended rates 2-4 days after sowing.

The results show extreme annual variations in slug activity with no significant correlation to OSR-seedling density. The highest slug activity density over the study period was recorded in the DS plots, followed by the SG and SP- treatments. There was a highly significant “year” effect on crop density, strongly masking both tillage and slug effects. In the average of the study years the highest crop density was observed in the SP treatment, followed by SG and DS treatments. The corresponding seedling numbers varied between 9 - 41,0 pl./m². However, this effect was not consistent and showed extreme variations. SG- tillage treatment proved in contrast the least fluctuations and highest consistency in crop stands. Main effects of seedbed consolidation and those of slug pellets treatments were significant over the experimental years, when compared with no-rolling and no-slug pellets sub-treatments. Between rolling and slug pellets treatments there was remarkable interactions. Slug pellet treatment tended to elevate the number of OSR-seedlings/ m² independent of the soil management regime. Rolling the seedbed after crop drilling contributed to higher seedling density in both DS and SG but not in the SP- treatment.

Local adaptations, races or even species?

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The distribution of the large *Arion* slugs in northern Europe has changed dramatically during the last 100 years, partly due to human interventions. The red slug, *Arion ater rufus*, was introduced into Denmark in 1913 by two amateur entomologists whereas the brown slug *Arion lusitanicus* has expanded its range over the last 50 years, probably because of passive transport among countries. Today, *A. lusitanicus* is the widest distributed of the three large *Arion* slugs and was discovered in Denmark in 1991. The black slug, *Arion ater ater*, is native to Scandinavia and northern Germany. The newly introduced taxa of the large arions may be selfing or have a mixed breeding system, as hypothesized by some workers which could explain the ease by which these taxa have spread in Scandinavia.

This provided me with the opportunity to investigate aspects of invasion biology, with special emphasis on breeding systems (viz. self-fertilization versus outcrossing). Therefore, I studied the population genetic structure of several Danish and German populations of the three taxa using allozyme electrophoresis and the sequencing of mtDNA genes. I also compared the morphology of the proximal genitalia of the three taxa.

The allozyme data showed no sign of obligate selfing in *A. ater rufus* and *A. lusitanicus* and low selfing levels in *A. ater ater*. Morphological, allozyme and mtDNA results suggested that multiple invasions and population admixture have occurred in Denmark. Further, mtDNA and allozyme data could not discriminate among the three large *Arion* taxa. The morphological data did not allow to discriminate between *A. ater rufus* and *A. ater ater*. A Spanish investigation showed that the non-Iberian European *A. lusitanicus* is closely related to *A. ater ater* and *A. ater rufus*. The Portuguese topotype of *A. lusitanicus* is more distantly related to *A. ater ater* and *A. ater rufus*. This and my results support the belief that non-Iberian *A. lusitanicus* are closely related to the other taxa in the *A. ater rufus* complex than it is to Iberian *A. lusitanicus*.

Seasonal foraging activity during spring and neap tide in *Patella ferruginea*

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The protected limpet *Patella ferruginea* (Gmelin 1971) has important populations in North Africa. One crucial point is Ceuta, a Spanish settlement on the northern most tip of this continent. Many studies have been conducted on this coasts, but very little is known about the foraging activity of its individuals, specially during spring and neap tides.

During spring of 2006, a total number of 15 individuals of this limpet were marked in order to obtain data related to the foraging activity of the species and taking into account that individuals of all sizes were selected. These individuals were marked using epoxy Eporai 1127© on both the shell and the rock adjacent to the individual's home scar in order to detect possible movement activity. Before drying, a number was stamped on the shell mark so as to identify each individual.

Monitoring was done during continuous periods of 24 hours, two times per season, once during neap tide and another during spring tide. During this 24 hours, each 30 minutes data about physical parameters was taken as well as the position of each of the marked individuals, using three pre-determined points. The real distance from each point to the nearest shell side was determined using a thin string. This data is afterwards recreated in the laboratory using milimetric paper with the result being a precise record of their movement. These maps are then scanned and compared as to sizes, individuals, seasons and tide conditions.

Evidence of limpets changing home-scars and also of permanent changes in position within the same home-scar were found. It also can be seen that smaller individuals have clearly less activity than the bigger ones. Ethological implications are discussed.

Behavioural and reproductive biomarkers of organophosphate pesticide (Delvap) in the giant land snail *Archachatina marginata* (Swainson)

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The lethal and sublethal effects of an organophosphate insecticide Delvap on a non-target organism, *Archachatina marginata* (Swainson) were investigated to identify easy to recognize biological responses in exposed snails that can serve as early warning signals of pollution. On the basis of 168h mortality data, the derived LC₅₀ for Delvap was 11.24 mg / kg. The avoidance reaction experiment however revealed that concentrations of Delvap that is as low as 1.5 mg / kg caused about 50% of exposed snails to avoid the test media. For sublethal test, exposure of the snails to fractions (1/10th, 1/100th, 1/1000th) of the 168h LC₅₀ values over a 28 days observation period resulted in the thinning

of egg-shell from an average of 8.1 μm in eggs laid by control snails to about 7.1 μm in those laid by exposed snails. About 50% to 60% of eggs laid by snails exposed to sublethal concentrations of Delvap were also cracked before the attainment of full development. The implication of the use of the insecticide on snail populations in the wild especially as it relates to reproductive failures due to egg-shell thinning and cracking were discussed. Additionally, the inclusion of the biological responses such as avoidance (for example artificial aestivation), egg-shell thinning and cracked eggs of snails as biomarkers of organophosphate insecticide contamination in the wild populations was recommended.

Extreme length development of the penis in the terrestrial slug genus *Limax*: a case of sexual selection? (Gastropoda: Limacidae)

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The luxuriant development of the male copulatory organs in some representatives of the European slug-genus *Limax* (penis up to eight times the body length) and the pertaining exceptional behaviour are among the most rousing natural wonders. The phenomenon has already been aptly described in late Humanism (F. Redi), but these observations have long been taken as unreliable misinterpretations. It was only in the 20th century that a spectacular copulation behaviour in *Limax* was described that corroborated the observations from the 17th century (B. Peyer, E. Kuhn, U. Gerhardt). All modern investigators (U. Gerhardt, L. Forcart, A. Wiktor, A. J. de Winter) took the presence of an extreme long penis as a crucial character indicating close phylogenetic relationship of these forms, or even supporting the idea of specific identity. Our combined morphological, behavioural and molecular genetical research revealed that the extreme penis length is not a character that indicates common ancestry. It must have evolved independently at least seven times in different branches of the phylogenetic tree. Of special interest is the group of *Limax corsicus*, distributed over the adjoining Italian continent and the islands of the Tyrrhenian Sea. In this group we have side by side closely related forms with very different penis lengths. The comparison of the bionomics of these forms shows that there exists in all probability an environmental selective pressure in the direction to develop a shorter penis, but the inverse evolution seems to take place only if the environmental factors allow it. Forms with an extra long penis are more demanding and especially vulnerable against environmental disturbances. The strong selective forces that lead to extreme length development must therefore be of endogenous nature. If we declare the adaptive value of the long penis as induced by sexual selection, this is not yet an explanation, but must be taken as a programme for further research.

Genetic differentiation in *Maakia herderiana* (Mollusca, Gastropoda)

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Explaining the origin and development of species' diversity is one of the greatest challenges for biologists. Fast rate of the speciation, morphological variability, and also a low dispersal rate allow considering the molluscs of the lake Baikal (Russia) as suitable for investigation of microevolutionary processes involved in speciation. *Maakia* (*Eubaicalia*) *herderiana* is one of the species dominating the stone littoral of the lake. This species exhibit variation in their shell sculpture: from a ribbed to a smooth type (both: across the depth of the lake and along the shore). Ribbed and smooth shell morphs do not differ neither if the anatomy of the reproductive system is considered nor when the food composition is examined.

We have used mitochondrial COI DNA and nuclear ITS sequences to infer the pattern of genetic diversity in *M. herderiana* inhabiting the southern shore of the lake Baikal. We have analyzed thirty samples from two localities (five hundred meters distant from each other). In one of them ribbed and smooth shell morphs were sympatric. In the other only the ribbed shell morph was represented. The observed proportions of nucleotide substitutions among *M. herderiana* DNA ITS sequences were 0.0 – 1.3% (average 0.18%) and among mtDNA COI sequences were 0.0 – 0.16% (average 0.075%). We did not reveal any significant correlation between the shell sculpture and the genetic differentiation. At the current, initial stage of this study it is still not clear what in particular causes the shell sculpture variation of the *M. herderiana*: whether it is an effect of the phenotypic plasticity under environmental conditions or the process is driven by the natural selection. The study was partially supported by RFBR 05-04-97258.

The effect of diet on reproduction and energy storage in adult mussels *Mytilus galloprovincialis*

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Food quality and quantity is known to influence reproduction in many bivalve species. In a hatchery context, reproduction begins with broodstock conditioning, where adults are held and conditioned for spawning by supplemental feeding with cultured microalgae. This process is vital for the reliable production of juvenile bivalves for aquaculture, including mussels, yet the influence of different microalgal diets on conditioning and energy storage has not been investigated. In this study, adult mussels were conditioned for six weeks with four different feeding regimes: 1) raw seawater; and, raw seawater plus equivalent dry weights of 2) *Chaetoceros calcitrans*, 3) *Pavlova lutheri*, and 4) a 1:1 combination of the two species. The conditioning diet had a significant effect on the quantity of glycogen stored and the reproductive status at the end of six weeks. Mussels fed with raw seawater showed reduced glycogen stores, and a low percentage of mussels that spawned. Those supplemented with *P. lutheri* maintained mature eggs and produced an intermediate percentage of animals that spawned. However, they showed reduced glycogen stores, and produced a low number of D-veliger larvae from the eggs. Mussels supplemented with *C. calcitrans* increased glycogen stores, maintained mature eggs and produced an intermediate number of animals that spawned. They also produced a high number of D-veliger larvae, similar to the combined supplement. The combined *C. calcitrans* and *P. lutheri* supplement showed no change in glycogen stores after 6 weeks, but this likely reflected more rapid glycogen accumulation followed by mobilization into gonad tissue, resulting in a high percentage of animals that spawned, and a high production of D-veliger larvae from eggs. Egg diameter, a measure of egg quality, and fecundity showed no significant difference amongst diets. The scientific and applied implications of these results are discussed in relation to previous research.

First case of the radular-less representatives of the subfamily Crassispirinae (Turridae) with critical reassessment of the taxonomic status of the subfamily Zemaciinae (Turridae)

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Superfamily Conoidea is well known for the unique, ‘toxoglossan’ mode of feeding with usage of the separate marginal radular teeth on the proboscis tip for stubbing and envenomation of the prey. In some groups of Conoidea (Terebridae and subfamily Raphitomininae of Conidae) the tendency to reduction and complete loss of radular, venom apparatus and other foregut structures has been demonstrated.

On the contrary in the family Turridae the loss of radula and venom apparatus is a unique event, which was described, until now, only in one species, *Zemacies excelsa* Sysoev & Bouchet, 2001. Loss of the radula in this species was combined with appearance of the unique foregut structure, the 'pyriform gland'. Basing on the presence of this unusual character in *Z. excelsa* the new nominotypical subfamily Zemaciinae was erected. Conchologically Zemaciinae are very close to Cochlespirinae (Turridae).

Investigations of foregut anatomy of two still unnamed species of *Horaiclavus* (Turridae, Crassispirinae) for the first time in the subfamily demonstrated the absence in of the radula, venom gland and proboscis, as well as the presence of peculiar foregut structure, generally resembling 'pyriform gland' of *Zemacies excelsa*. Other species of *Horaiclavus* possess radula of typical 'crassispirine' type. Anatomy of the foregut of new species is superficially extremely similar to that of *Z. excelsa*, although conchological characters clearly preclude placing them in the same subfamily. Thus previously considered unique foregut arrangement of Zemaciinae appeared at least one more time independently in the subfamily Crassispirinae and probably does not have high taxonomic value. This requires reconsideration of the taxonomic status of subfamily Zemaciinae, which should be considered as a junior synonym of Cochlespirinae. The possible mechanism of functioning of the 'pyriform gland' is suggested and discussed.

Molecular Morphology of 18S rDNA of Bivalvia

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The phylogeny of bivalves (Mollusca) consisting of about 20.000 species is still uncertain. Conventional morphology and sequence analyses did not provide conclusive results beyond the four subtaxa Protobranchia, Pteriomorpha, Heterodonta and Schizodonta. This study is concentrated on the folding patterns of slowly evolving 18S rDNA molecules in expectation of finding "deep phylogenetic" information, i.e. pre-Cambrian or Cambrian structural signatures. For this analysis, sequences of pteriomorph 18S rDNA with lengths of about 1800 base pairs each, available from European Ribosomal RNA Database and GenBank, have been studied. With publicly available software, 3D molecular structures were created from the primary sequences and subsequently mapped into 2D patterns. The 2D/3D structures are known to be more conservative than the primary structure (the linear base sequence). Their morphological characters were detected, quantified and homologized for the generation of a property matrix. A phylogram has been constructed by means of a parsimony method. The method is described in detail and preliminary results are discussed.

Phylogeny and morphological variability in land snails: the Sicilian *Marmorana* (Pulmonata, Helicidae)

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Land snails have long been recognised as suitable organisms for studying phenotypic differentiation and phylogeny in relation to geographical distribution. Morphological data (shell and anatomical biometry on different geographical scales) and partial sequences (COI, 16S) were used to test whether morphological patterns matched phylogeny in a diversified group of Sicilian rock-dwelling land snails of the genus *Marmorana*. The two sets of data were also used to check the taxonomic and

phylogenetic status of the Sicilian populations. The inferred phylogenetic relationships did not match morphological (shell and genitalia) patterns. This result may significantly modify the current taxonomy. Mitochondrial-based reconstructions defined several supported clades that were correlated with geographic distribution and populations were found to have parapatric distribution. The progressive decline in mtDNA sequence similarity observed over a distance of 250 km is consistent with a model of isolation by distance, a pattern already recognised in other groups of land snails. For one clade of *Marmorana*, colonisation along Mediterranean trade routes seems likely.

Land snail conservation in the Gabonese rainforest: Single large or single small?

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In order to assess whether a protected area considered representative of regional large fauna is the best option to preserve invertebrate fauna, we sampled molluscs inside and outside Lopé National Park in Gabon. In the northern part of Lopé National Park, 116 stations were prospected and 71 species collected. Outside the park, 37 stations yielded 96 species, including 71 in Lastoursville, a small limestone area where molluscs are significantly more abundant than in other collecting sites. Overlap between sampling areas was limited, with 20.0% of the species found only in Lopé National Park, and 40.8% of the species found only outside. This suggests that Lopé National Park does not protect the whole molluscan diversity of central Gabon. Given the high levels of allopatric diversity of tropical land snails, conservation strategies cannot be the same for them and for large range vertebrates. Protecting small areas with a high abundance and diversity of molluscs would be less expensive and as efficient for molluscan conservation as protecting large tracts of rainforest. Despite a limited general knowledge on central African molluscs, robust estimates of sites specific diversity can be produced. Limestone areas harbor a remarkable biodiversity: sites such as Lastoursville would be ideal candidates for small protected areas dedicated to the conservation of land snails, and would complement the role of large protected areas.

***Achatina fulica*: its molecular phylogeny and genetic variation in global populations**

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The giant African land snail, *Achatina* (= *Lissachatina*) *fulica* (Bowdich, 1822), is a tropical crop pest species with a widespread distribution across East Africa, the Indian subcontinent, Southeast Asia, the Pacific and the Caribbean. The phylogenetic position of *A. fulica* within the Family Achatinidae and Superfamily Achatinoidea was investigated using segments of the nuclear large subunit (LSU) ribosomal (r) RNA, actin and histone 3 genes and the mitochondrial 16S rRNA and cytochrome oxidase I genes. Results support the monophyly of the Family Achatinidae as well as the taxonomic designation of *A. fulica* as *Lissachatina fulica*, thus distinguishing it from the Western and Central *Achatina* species as proposed by Bequert (1950) and Mead (1995). The extent of genetic diversity in global *A. fulica* populations was also determined using an SSCP molecular marker developed from the 16S rRNA gene. Results reveal only one haplotype emerged from East Africa and spread globally.

To live or not to live in mud: The Neogastropod side of the story

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Although muddy substrates are often viewed as flat and featureless environments, the abundance of nutrient rich material provide an optimal habitat for many infaunal and epifaunal organisms. In the Gulf of Panama (eastern Pacific coast) the dominant habitat type is fine, silty mud, often with terrigenous component. Few sandy patches (carbonate sand, incrusting algae, some coral rubble) are found mostly surrounding islands.

A series of field surveys in two consecutive years (dry and wet season) were conducted to compare the community structure of muddy, sandy, and 'maerl' type habitats. For this study, 50 samples were analyzed in relation to the gastropod fauna.

Mud communities were less structured, inhabited predominately by thin shelled taxa, whereas sandy / 'maerl' type communities were often multilayered.

Concerning patterns of diversity and abundance, mud communities were less diverse even though they had higher abundances. Preliminary results show that collectively, gastropod densities were higher in muddy habitats (averaging 30 specimens per sample). This could relate to the higher abundances of both bivalve prey and detritus found here and used as food sources. Over 100 taxa were recorded, most of them relatively rare. Only 10 taxa could be considered abundant (≥ 25 specimens per habitat). Turrids and nassarids were most abundant / diverse in muddy habitats, whereas buccinids and columbellids predominated in sandy areas.

Feeding guild analysis indicated few differences among habitats. Mud communities showed a higher trophic diversity. Predatory carnivores and detritivorous taxa (turrids, conids, oliv, nassarids) were predominant in muddy habitats, whereas herbivores and some browsing carnivores (columbellids, buccinids) were more abundant in sandy / 'maerl' type areas. Predation levels, as shown by numbers of drilled shells, was much higher in muddy habitats than in sandy patches.

Evolution and biogeography of Southeast Asian viviparids (Gastropoda: Caenogastropoda)

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The freshwater gastropod group Viviparidae is widely distributed in continental and insular Southeast Asia and Australia, occurring on both sides of Wallace's line and thus making it potentially interesting for biogeographic hypothesis testing. With at least 23 described and morphologically distinct genera, the region is the hotspot of viviparid diversity. Minor species radiations have been reported from ancient lakes in Myanmar and Sulawesi. The taxonomy of the Asian taxa both at the generic and species level is still largely based on shell morphology and rather confuse, though, making it difficult to gain deeper insights into their evolution and biogeography at present.

In this study we have used a molecular phylogeny based on mtDNA sequences (cytochrome oxidase I) of a wide range of viviparid species from the Southeast Asian mainland, the Malayan Archipelago and Australia (i) to test the monophyly of previously established genera, (ii) to investigate biogeographical relationships in the region, and (iii) to gain insights into the nature of the alleged ancient lake radiations.

The molecular phylogeny indicates that the current shell morphology-based viviparid taxonomy does not reflect the phylogenetic relationships of species, particularly among the large group of smooth-shelled taxa from the Asian mainland and the large Sunda Isles. The data also support a distinct and

basal origin of species from Sulawesi, and a derivation of Australian taxa from the Southeast Asian mainland. Low genetic differences among the species or populations render the assumption of an intralacustrine radiation in ancient lake Inlé in Myanmar unlikely, while for Lake Poso on Sulawesi the data at least suggest the occurrence of cryptic lacustrine species.

Crystallographic textures of shell layers in Patellogastropoda: a new tool unraveling their phylogeny

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Limpet shells belonging to the Patellogastropoda have the most diversified microstructural pattern among all living gastropods and data on their mineralogy and microstructure have been frequently used for their classification. In contrast to microstructure (characterizing a shape of biocrystals) there are almost no data on crystallographic textures of patellogastropod shells (characterizing an arrangement of crystal axes of individual biocrystals). Shell layers having the same microstructure can have different crystallographic textures and *vice versa*. Thus, analyses of crystallographic texture and microstructure of patellogastropod shells provide non-redundant characters. To fill a gap in our knowledge on the crystallographic textures of patellogastropod shells, we have applied several diffraction techniques providing complementary information about the crystallographic texture and mineralogy of their shells. We analyzed individual shell layers of 14 patellogastropod species belonging to Lottiidae (*Niveotectura*, *Patelloida*, *Lottia*, and *Nipponacmea*), Patellidae (*Scutellastra*), Nacellidae (*Cellana*), Lepetidae (*Limalepeta*), and Acmaeidae (*Pectinodonta*). Our analysis has revealed a large variety of textural patterns of the patellogastropod shells. The crystallographic texture pattern in corresponding shell layers of closely related taxa is identical but different in distantly related taxa. This fact confirms that the crystallographic texture is under biological control as shell microstructure and it is not driven only by abiological forces (like a mineral epitaxy). The crystallographic texture pattern represents characters useful for a phylogenetic reconstruction of the higher levels of the classification of the Patellogastropoda. In addition, our analysis suggests that textural analysis together with mineralogical and microstructural data can help resolve problems of homology of individual shell layers in the patellogastropod shells.

“Niku-nuki”, a useful method for preparation of shell-bearing molluscan specimens

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Often only one or a few individuals of rare species are collected. How do we treat them as intact voucher specimens? The shell of the whole individual in formalin or alcohol will corrode or fade. In order to dissect the soft parts, you must crack or dissolve the shell.

“Niku-nuki”, a traditional method used by Japanese malacologists overcomes this dilemma. It is applicable to minute molluscs. The outline is:

1. Prepare boiling hot freshwater, a small beaker, forceps (with fine tips), a small syringe, a petri dish, and a stereomicroscope.
2. When the live animal in the beaker crawls on the bottom, pour boiling hot water over the animal, which is killed immediately. Some seconds later take the specimen out of the hot water, hold it with two fingers of one hand and hold the forceps with another hand.
3. Under the microscope, grab the foot with the forceps and pull carefully to just separate the columellar muscle from the shell.
4. Pull the foot again in a petri dish filled with cold water as under 3. With coiled gastropods, unscrew the specimen by approximately 1/4 whorls. If it is difficult to move the soft parts, inject water into the aperture gently with the syringe. Repeat it several times, then you will get an empty shell and the complete soft parts.

With this method, we can obtain intact shells and soft parts for multiple purposes such as conchological observation and gross anatomy. DNA can also be extracted from those soft parts because DNA is stable under high temperature. The boiled animal can be dehydrated in alcohol. We can prevent the negative effect of DNase (by heat) and magnesium (by washing in freshwater), both of which decompose DNA.

A challenge to the relationships of “*Omphalotropis*” (Caenogastropoda: Assimineidae)

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Most islands of the Indo-Pacific region have terrestrial assimineids. More than 100 species were described as “*Omphalotropis*” or allied genera in the 19th Century, but data on their anatomy is sparse.

We have anatomically examined these snails from Mauritius (including the type species of *Omphalotropis*, *O. hieroglyphica*), Reunion Id, SW Australia, Lord Howe and Norfolk Ids, Papua New Guinea, New Caledonia, Palau and Guam and will be extending this survey.

The kidney in some species has an anterior lobe which extends forward in the roof of the pallial cavity. While this is unknown in other rissooideans, it is similar to Cyclophoroidea and some terrestrial Littorinoidea. The anterior kidney lobe is variable in size and shape, but is similar in species from the same island group. This, and other characters, suggest that species from each geographical region radiated independently. Species from SW Australia and Lord Howe and Norfolk Ids lack the anterior kidney and represent the plesiomorphic condition.

Using other characters, at least two major groups can be recognized: Group 1 from the Indian Ocean (Mauritius, Reunion Id, SW Australia), Lord Howe Id and Norfolk Id; Group 2 from New Caledonia and northwards in the Pacific. The groups are defined by the following characters:

Group 1. Snout simple, ctenidium present, several small seminal receptacles and anterior oesophagus lacks external gland.

Group 2. Snout with a fold (“buccal cape”), ctenidium absent, seminal receptacle large, anterior oesophagus with large gland on the right.

While the above characters appear to indicate phylogenetic relationships at a supra-generic level, the shell and opercular morphology, the main characters used in determining generic status in the past, are extremely diverse and convergent.

Interference competition in the suspension feeding *Dendropoma maxima*: optimal foraging or an unresolved prisoner's dilemma?

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The sessile, passive suspension feeding wormsnailed *Dendropoma maxima* (Vermetidae) excretes a mucous web to capture planktonic prey. In dense groups, the feeding webs of neighbouring snails frequently overlap and stick together. This may create direct food competition between neighbours, because the earlier retracting snail may get more than its fair share of the prey. We studied whether web overlap triggers a phenotypic response in feeding behaviour. On day 1, focal snails were placed in either of two treatments, solitary or with a direct neighbour. We then recorded feeding behaviour twice, first on day 2 under the initial treatment, and second on day 4 after swapping focals to the opposite treatment. We therefore obtained paired measurements for each focal under both treatment conditions. We found that focals retracted their feeding web significantly earlier when close to a neighbour than when solitary. Our experiments confirm phenotypic response through early web retraction in *D. maxima*. A preliminary model shows that earlier web retraction may occur for two rather different reasons. First, earlier web retraction in groups may represent optimal foraging if prey accumulates more rapidly in overlapping webs. Alternatively, early web retraction may be energetically inefficient, but result from direct interference competition between neighbours. Predictions derived from these models will help disentangling both hypotheses in future experimental studies.

Sexual dimorphisms in *Fasciolaria tulipa* (Buccinoidea, Fascioliidae) using geometric morphometrics

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We studied sexual dimorphism evidences in adult of *Fasciolaria tulipa*, provided by different morphometrics two-dimensional methods. Fifteen landmarks were analyzed employing measurements distances arranged in a truss and TPS (relative warps and two blocks partial least squares). The application of these methods for researching sexual dimorphism in gastropods is still relatively new, thus, an aspect of this research is that it demonstrates potential application in this discipline. All tools considered revealed the existence of some trades of sexual dimorphism. Size of females is larger than males. Allometric coefficients are different between sexes. The application of geometric morphometric offered more details in the shoulder, body whorl, shell aperture and shape. Fasciolar and siphonal area presented more conspicuous inclination respect to spiralization axes in males. Females are more robust, have bigger body whorl and thin and smaller anterior siphon. According to computation, females are more similar within them than males' configuration. Covariance is studied among sexes. Despite differences are significant, high overlapping on morphospace did not allow a reliable discrimination of sexes by using any variable alone.

What do we know about sexual dimorphism in gastropods?

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Traditionally it has been said that sexual dimorphism is absent or inconspicuous in gastropods shell. The results of the sexual dimorphism studies in gastropods found in literature from 1900 are presented. Sexual differences have been found at least in 42 species distributed in 18 families of gastropods. Mostly, these researches have a traditional perspective, and use distance measurements to describe form. Other approximations to the problem have work on variability in growing rate, allometry, colour, weight, apex angle and radula. Less frequent are the studies that referred to the shape “sensu stricta” (= form - size). Few are the records of characters clearly different, and they seem to be autopomorphic, principally related with parental care. In general, females were bigger than males, like said to other invertebrates, supporting the fecundity selection hypothesis. The results suggest that sexual dimorphism in gastropods is not only related with sexual pressures but with other selective pressures that act over sex like ontogeny, heterochrony, spatial distribution, diet and depredation. Despite it has been proposed that sexual dimorphism in gastropods should there be a pattern that characterize clades over than a particular specie taxon, there was not found any comparative research into a monophyletic group, but reports are done over single species and sampling area. The problem has been encouraged using two-dimensional techniques when shell is a complex spiral form. None 3D report was obtained. We suggest that the theme should be approach using more sharpen morphometrics techniques, development mathematical modelling, considering phylogenetics effects, etc.

Documenting the past: The Tomlin Archive

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John Read le Brockton Tomlin (1864-1954) was one of the most highly respected conchologists of his time. He was a founder member of the Malacological Society of London, and editor of the Conchological Society of Great Britain and Ireland for thirty years. In both societies he also held the post of president for a number of years. In addition, he was an associate member of the British Museum of Natural History, London. Tomlin acquired the already large collection of James Cosmo Melvill in 1919, and continued to expand upon it until its bequest to the National Museum Wales, Cardiff in 1955, when it was estimated to total over one million specimens. As a true collector Tomlin had also amassed a unique library of molluscan books and reprints, and his personal archive. The archive is mainly composed of the correspondence between Tomlin and his many shell associates around the world accumulated during his lifetime. As a collection it also contains some earlier material not directly related to Tomlin. It is estimated to contain well over a thousand documents, and we are cataloguing and digitally imaging these. The content of the archive mostly concerns the everyday business of maintaining a large collection. However, the cataloguing process has unearthed many interesting finds. It has brought to light fascinating aspects of the lives of the people who contributed to the archive: - recounting collecting expeditions and voyages, personal illness and hardship, war, dinner invitations, even Christmas cards! It is an archive not only of scientific history, capturing a bygone era of collecting, but also an archive of personal and social history.

New species of proneomenidae (Mollusca: Solenogastres) from Western Antarctica

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The first anatomical data of two new species of proneomenidae from the Spanish campaign BENTART'06 are presented for the study of the benthonic communities of western Antarctica (Bellingshausen Sea and Antarctic Peninsula).

The family Proneomenidae (Solenogastres: Cavibelonia) is characterized by: thick cuticle with several layers of hollow acicular sclerites; polistic-poliserial radula and epithelial ventrolateral foregut glands (type C according to Salvini-Plawen, 1978) or exoepithelial glands with intraepithelial glandular cells (according to Handl & Todt, 2005). The family is composed of two genera: *Pronemenia* and *Dorymenia*, which differ in the absence/presence of copulative stylets.

Pronemenia sp. (a specimen from Bellingshausen Sea-603 m deep). It presents a foregut with glandular cells in a dorsal groove; radula with 22-25 teeth per transverse row with a wide base and a sharp and curved end; unpair opening of the spawning duct with a short and narrow duct; two kinds of erythrocytes; paleal cavity without diverticula or respiratory folds; with abdominal spicules; a dorsoterminal sense organ. It differs from *P. gerlachei* (Bellingshausen Sea-550 m deep) in its radula structure.

Dorymenia sp. (two specimens from Livingston Islands-Southern Shetland Islands). It presents a foregut with glandular cells and circular musculature; radula with 80-100 teeth per transverse row with a wide base and a sharp and curved end; intestine with front caecum; two kinds of erythrocytes; paleal cavity with diverticula, without respiratory folds and with two front bags (dorsal and ventral); unpair ventral opening of the spawning duct into the the ventral bag of the paleal cavity; with abdominal spicules; two dorsoterminal sense organs. It differs from the species of the genus from the same geographic area and with a similar radular structure (*D. hoffmani*, *D. usarpi*, *D. hesperidesi*, and *D. menchuescribanae*), in the arrangement of its paleal cavity.

Mating behaviour and spermathecal morphology in populations of the simultaneously hermaphroditic land snail *Helix aspersa*

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The edible snail *Helix aspersa* belongs to the simultaneous hermaphroditic species, which are obligatory outcrossers. In this species multiple mating before egg laying is common leading to increased sperm competition intensity. In this study we report results on mating behaviour (mating propensity, copulation frequency, and copulation duration) and spermathecal morphology of snails from several populations coming from the mainland of Greece and from the island of Crete which differ in humidity regime of their habitat.

Mating propensity was assessed for each population by the percentage of snails mating at least once during the reproductive period and for each snail by the duration of the latency period between its activation and first mating. Our results indicated that mating propensity was stronger in snail populations coming from drier habitats. Copulation frequency was also found higher in the same

populations. Copulation duration differed among populations studied but a specific pattern related to habitat characteristics was not evident.

Spermathecal morphology did not differ significantly among populations coming from the mainland of Greece. The number of the spermathecal tubules ranged in mainland populations from 3 to 21. In populations from Crete the number of the spermathecal tubules ranged from 1 to 11 and differed significantly from the corresponding number of the mainland populations.

Exploring biodiversity in caves and limestone: an open window on Polynesia's lost paradise

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Considering the few early malacologists and the rapid destruction of natural habitats on small oceanic islands, the molluscan fauna of most Pacific islands is poorly known. But what remains to be discovered? An inventory was carried out by the French Polynesia government and Muséum national d'Histoire naturelle (Paris) in Austral Islands, Society Islands and Makatea (Tuamotu Islands) during the years 2002-2004. While there are still some tiny patches of natural forest in areas such as mountain summits or deep gulleys, the main source for new species was deposits under limestone cliffs or in caves. Although these deposits have not been dated yet, it seems reasonable to think that they are recent - no more than few dozens or hundreds years old, as they are the top layers with present shells. In this context, and for the family Endodontidae only, Rurutu (32.3 sq. km.) has revealed a total of 21 species while only 7 were known from the 1934 Mangareva Expedition. All these new species are subfossils and were not found alive despite specific research, i.e. were extinct at the time of discovering. On Makatea (24 sq. km.), a first estimate has led to more than 20 endodontid species of which only 5 were previously known.

Conversely, collecting on the exclusively volcanic Society Islands has yielded no Endodontidae, either subfossils or alive, except on the summit of Tahiti's Mont Aorai (2000 m). Endemic radiations such as *Nesodiscus* are now thought to be extinct. Deposits containing molluscs are much rarer than in limestone areas. So, whether limestone was a factor influencing radiation or simply represents an artefact of the past diversity may remain an unsolved question.

Microgastropod population changes from the Late Cretaceous to recent in the Gulf Coastal Plain of the USA

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A large collection of over 150,000 mollusk specimens from the Cretaceous through Recent of the Gulf Coast is analysed to determine changes in the microgastropod populations. Four major assemblage groups are recognized, an early Cretaceous assemblage dominated by *Turritella*, *Nerinea* and *Nerita*, a changeover from a Trochoidea to a Philinoidea dominated assemblage in the late Cretaceous, and its increasing dominance until the end of the Oligocene, and a more evenly distributed late Neogene assemblage. In addition it is found that microgastropod populations show much more sensitivity to environmental changes than do populations of larger gastropods.

Reconstruction of the pleniglacial environment based of molluscan assemblages of the Titel Old Brickyard Section (Vojvodina, Serbia)

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If the carbonate content is sufficient Molluscs are one of the most abundant fossils in loess-paleosol sequences. The quantitative malacological investigations could help in reconstructing the environment dynamics of past. The Titel Old Brickyard exposure is located in the southeastern part of the Carpathian Basin, on the Titel Loess Plateau northwest from the confluence of Danube and Tisza rivers, south from the former periglacial regions of Central Europe. The main task was the reconstruct the local environmental conditions of the 16 m thick Pleniglacial loess series. Here we show the the environmental conditions of Titel Old Brickyard section during the Pleniglacial the conditions were arid, steppe-like where the cold demanding species were absent. The Early Pleniglacial (MIS 4) characterized with the forming of sandy loess layer with poor xerotherm steppe demanding *Striata-Pupilla* fauna which has been preserved only at a parts near the contact of the other strata and a 20 thick layer. The Upper Pleniglacial (MIS 3) during which the humic horizon was formed and the molluscan record of *Pupilla-Striata* faunal assemblage represents stable sedimentation record and the arid, steppe-like environment. During the Upper Pleniglacial (MIS 2) the conditions for preservation were excellent, the stable loess sedimentation and its fauna shows the continuous arid, steppe-like environment with the dominant *Pupilla* fauna. The Last glacial maximum was manifested with decreasing number of the land snails and the temperate conditions preferring *Granaria frumentum* minimum, no cold demanding species were found. In the youngest part of the MIS 2 the open woodland species (*Clausilia dubia*) has been detected in low numbers but the environment keeps its steppe-like character. As a lowland plain relief the snail assemblages is quite monotonous with low number of species and connected to the arid, temperate steppe like environment.

Using an electron microscopy shell morphometry in identifying the Weichselian *Pupilla muscorum* and *Pupilla triplicata* species from the loess series of Vojvodina (Serbia)

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Molluscs' remains represent one of the most abundant Quaternary fossils. Their correct interpretations clearly depend on the accuracy with which the species of the fossil molluscan assemblage can be identified. Quantitative palaeontological investigations of Quaternary loess molluscs face to the problem of identifying of species of *Pupilla muscorum* and *P. triplicata* from the Weichselian loess series at the Vojvodina Province (Serbia). If the shell is preserved only fragmentary the identification can be quite difficult because of the shell size and microsculpture similarities. The *P. muscorum* and *P. triplicata* have different ecological requirements (*P. muscorum* is a typical loess steppes [periglacial and non-periglacial] species with a big environmental tolerance, while a *P. triplicata* is a species related to more milder climate of xerophilous, steppe like environment), thus why the species level identifying is welcome. The main task in this study was to try to separate/identify the shell fragments on species level according the shell apex morphometry. The complete shells in total number of 80, previously clearly identified individuals have been studied. The selection of 40 specimens of each species (*P. triplicata* and *P. muscorum*) has been analysed. The shells were scanned on electron microscopy and the maximum cross arbitrary distance of the apex has been measured. The morphometrical results shows the apex value for *P. triplicata* population is between 317 μ and 565 μ , while the apex size for *P. muscorum* starts from 472 μ . According the morphometrical measurements the apex values of shells from 317 μ to 472 μ referred as *P. triplicata*, apex values from 472 μ to 565 μ are classified as *Pupilla spp.* and the values bigger

than 565 μ belongs to *P. muscorum*. The results could be applied for the Weichselian *Pupilla* shells from the loess series of the analysed region.

Extreme variability in the radula of Anatomidae (Gastropoda: Vetigastropoda)

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Anatomidae is a family of small to moderate sized marine snails (1-11 mm) occurring world-wide from the shelf onwards to abyssal depth. Relatively few radulae have been investigated of only a handful of species. We have expanded the sampling significantly and have uncovered very different radular types to a degree usually associated with family-level differentiation. The variability observed to date by far exceeds that seen in Scissurellidae, for which more species have been examined. The shells of those species do not show any co-variation to the highly modified radulae.

We have considered a number of possible factors that could explain those novel radula morphologies:

- Depth: the novel radula types are from species occurring between several hundreds to a few thousand meters, but other species from equal or even greater depth show the more typical anatomid radula.

- Hydrothermal influence: a couple of species, *Anatoma janetae* Geiger, 2006 and an undescribed species were collected in areas of hydrothermal influence, while a third, undescribed species with a highly modified radula did not occur in such a habitat.

- Ocean basin: All species with modified radulae are from the Indian and Pacific Oceans, though sampling of species in the Atlantic is not as dense, and many other species in the Indian or Pacific Ocean have a typical anatomid radula.

- Sexual dimorphism: Some molluscs exhibit sexual dimorphic radulae. In the anatomid species examined thus far, in species for which multiple specimens have been examined, they show the same radula, including one undescribed species with highly modified radula. The probability of examining one gender only of one species and only the other gender in a second species are exceedingly low. The best explanation is that local adaptations affect the radular development. Limited gut content analysis did not indicate any notable feature.

Devil in the detail: Scissurellid systematics in the making (Gastropoda: Vetigastropoda)

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Scissurellids is a group of small marine snails of world-wide distribution. Work leading to a monograph is under way. The advantages and disadvantages of various sources of material (museums, private collectors, dealers, personal collecting) are evaluated. The majority of the literature can be compiled within about five years; Sherborn missed some taxa. Working on a family perceived as difficult offers many opportunities for significant discoveries (new morphologies, placement and monophyly of group, geographic and diversity patterns). The tropical-polar diversity gradient is confirmed both at the genus as well as at the species level.

Common species are over-named, mainly due to underestimated intraspecific variation including scanning electron microscopy (SEM) of single specimens per species. Ontogenetic variability and poorly preserved rare species contribute to the overnaming. Similarly, mistaken diagnostic characters

can lead to erroneous beta taxonomy. Supposedly widely distributed species can be shown to represent discrete species. Approximately 89 species remain to be named, most from the Indo-Malayan Archipelago and New Zealand. Half of all lots and specimens are from the Indo-Pacific, while sampling effort declines exponentially to 1000 m; thereafter the decline is much steeper. The top nine of fifty collections assessed contain approximately 83% of all specimens and lots. Recognition and verification of discrete species requires SEM, but in most cases identification of established species can be done with a stereomicroscope. Advances in SEM technology (variable pressure, environmental) allow type specimens to be imaged without coating. Automontage z-stack integration does not work well for 1 mm white shells; compound microscopes do not adequately resolve some necessary fine structure. Some type specimens have crumbled to dust due to inappropriate storage conditions. A significant problem is the uncertain location and/or existence of types. Restrictive loan requirements of some countries (Brazil) make de facto impossible to include material from that area.

The evolution of small body size in Vetigastropoda

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Vetigastropoda includes a variety of lineages ranging in size from 0.6 to 300 mm, and inhabiting depths of 0 to 6000 m. We use molecular phylogenetics, doubling the taxon sampling of our previous 40-taxon study of Vetigastropoda (Geiger & Thacker, 2005), to investigate the evolution of size and ecology in the group. We assembled a matrix of more than 2600 base pairs, of which approximately 1000 positions were parsimony informative, composed of Histone 3, COI, and 18S rRNA. The expanded data matrix includes several new and interesting lineages such as two skeneids, one seguenziid, *Gorgolepsis*, *Temnocinclis*, *Incisura*, *Sinezona* and *Sukashitrochus*. We emphasize the need of voucher specimens of small species, which usually harbor taxonomic uncertainty, and illustrate how to process minute species to gain the maximum information from single specimens (DNA, shell, radula). We apply continuous character state reconstruction to address size change and vertical colonization of the ocean in Vetigastropoda; both variables exhibit changes over more than three orders of magnitude. Three dimensional reconstruction with Amira 4.1 of the gonad of a scissurellid is used to explain and predict the smallest size in Vetigastropoda, which agrees with the smallest known Vetigastropoda.

Freshwater Hydrobiidae of Morocco (Mollusca: Gastropoda): Inventory and preliminary red list at regional level

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Forty five species belonging to fourteen hydrobiid genera are recorded from the continental freshwater hydrosystems of Morocco. Six genera with twenty three species are strictly stygobiont and collected from wells and hyporheic water of the streams. All are micro molluscs of the Hydrobiidae family, including forms that are not yet formally described. The restricted area of their habitat, in the groundwater systems with less possibilities of the dispersion, provides radiation in forms and high endemism.

The IUCN Red List Categories and Criteria (version 3.1) were used for classifying the Moroccan freshwater species of the family Hydrobiidae. This preliminary assessment is applied at national level to obtain a taxon's risk of extinction within Morocco and proposed to be agreed with relevant Red List Authority. Habitats of species analysed are threatened, due mainly to habitat degradation, eutrophication and water exploitation and need protection, preservation and valorisation planning. Discussion is intended to include information about Hydrobiid snails of the North African region to be for IUCN red list assessment at regional level.

***Giustia* n.gen. (Gastropoda: Hydrobiidae) a new genus of the groundwater micromollusks of Morocco**

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The new genus *Giustia* is described for a new hydrobiid species. Morphological and anatomical characters analysis confirms clearly differences from unknown freshwater valvatoïd hydrobiid genera. Ten species were formally recognized belonging to this new genus, all are micromollusks, and stygobiont, and endemic and inhabiting restricted localities of specific groundwater systems of Morocco. The ten species showing conchological and anatomical (especially genital tracts) characters radiation closely related to their limited area of distribution and patterns of their isolation. Each groundwater hydrographical system is defined by a particular group of species, isolated by natural barriers like the old peri-rifain rift in the northern part of Morocco or by the mountains of the atlas between the central part and the southern regions. Some species live in specific hyporheic water of the stream and to be endemic to a special valley.

New genus of Acanthomeniidae (Mollusca: Solenogastres) from the Abyssal Angola Basin

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During the DIVA 1 expedition, carried out in the year 2000 on the Abyssal Angola Basin, two specimens belonging to a new genus of the family Acanthomeniidae (Solenogastres: Cavibelonia) were collected. This new taxon is characterized by: presenting a thin cuticle without epidermal papillae and with scale-shaped hollow acicular sclerites arranged on an only layer; a joint atriobuccal cavity; having tubular foregut glandular ventral organs with a glandular mass that comes out at the end of each duct (type A according to Salvini-Plawen, 1978 or Acanthomenia, Handl & Todt, 2005); unpair genital orifice; lacking copulative stylets and respiratory folds; and a dorsoterminal sense organ.

The presence of hollow acicular sclerites on the cuticle place the new genus within the order Cavibelonia Salvini-Plawen, 1978 and includes it in the family Acanthomeniidae Salvini-Plawen, 1978 as it has a thin cuticle, hollow acicular sclerites and scale-shaped sclerites on its whole surface as well as ventrolateral glandular organs in the shape of type A and type Acanthomenia. In spite of the fact that the new taxon lacks a radula, it is classified within this family because of the combination of the cuticle sclerites (hollow acicular and scale-shaped) and the type of foregut

glandular ventral organs that have been described so far only in Acanthomeniidae. The lack of radula enables a clear differentiation of this new genus from the other two described in the family: *Acanthomenia* Thiele, 1913 and *Amboherpia* Handl & Salvini-Plawen, 2002, which present a monoserial radula.

Marine bivalves shell shape stabilization and reproduction

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Marine bivalves are important as food and economic resources throughout the entire Brazilian seaboard. Usually, they are collected without any previous studies about their biological cycle. When available, resources needed for the execution of these studies are too great, and the result applies to only one species, besides that they are not easily comprehended by those who effectively explore the resource. The complex techniques used on the biological investigations limit the generated knowledge for the specialists and do not contribute for a better resource management. The articulation between shell morphological analysis and the reproductive process are presented in this work. The study was developed with five marine bivalve species of the genus *Donax* (Linné, 1758) collected on southern and northeastern beaches of Brazil and southern and northwestern beaches of Spain. The results demonstrate that, for each species, there is a length in which the shell shape stabilization occurs, allowing the proposition of a Shape Stabilization Indicator (Indicador de Estabilização da Forma – IEF). It was verified that the shell shape stabilization length is directly associated to the beginning of the sexual maturing process, also allowing the proposition of IEF as an indicator of the beginning of the bivalves' reproductive process. For this genus, the simple determination of ratio between three linear shell measurements is enough to obtain an average length indicator of the beginning of sexual maturing. This methodology does not require sophisticated equipments, long collection periods or complex laboratory analysis. Besides, the sacrifice of dozens of animals is not necessary in order to infer the beginning of the analyzed species' reproductive process. The utilization of IEF for other bivalve species will allow an easy determination of minimum capture length, which, if respected, will contribute to the maintenance of the populations' natural equilibrium, allowing the animals to reproduce before collection.

Sperm morphology in three marine gastropods from South Western Atlantic Ocean (Caenogastropoda): Systematic importance

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The testis from Caenogastropods typically produces two types of spermatozoa, eusperm and parasperm. The structures of both morphological forms of sperm contribute to understand the reproductive biology and also have been useful to elucidate taxonomic and phylogenetic relationships

within gastropods. The following account describes the structure and ultrastructure and the possible systematic importance of euspermatozoa and paraspermatozoa in three species, two from the Volutidae family *Adelomelon beckii* and *Adelomelon ancilla*, and the third one *Olivancillaria deshayesiana* from the Olividae family. Specimens of *A. beckii* and *O. deshayesiana* were collected by bottom trawling of Mar del Plata (38°20'S 57°37'W) in 35 to 40 m and 8 to 12 m water depth respectively. *A. ancilla* were collected in Puerto Madryn, (42° 42' S 65° 06' W), by scuba diving, between 5 and 10 m water depth. For ultrastructural studies small pieces of the testis were fixed in 2% glutaraldehyde, were embedded in Spurr's epoxy resin and ultra-thin sections were cut and stained with uranyl acetate and lead citrate. For light microscopy small pieces of testis were fixed in Bouin's solution for using several techniques as hematoxylin–eosin, and Tricmic of Masson and "Periodic Acid Schiff". In these species, the testis is limited externally by a connective tissue, in contact with the hepatopancreas. Inside of the tubule in the periphery area is possible to see different stages of the spermatogenesis, mature sperm are in the middle of this tubules, as also in the spermatid ducts. The euspermatozoa is characterized by: the presence of an acrosomal vesicle with apical bleb and accessory membrane; the nucleus is long and tubular with the axoneme penetrating the nucleus; midpiece with mitochondrial elements coiled helically around the axoneme, glycogen piece and short en piece. In *A. beckii* and *A. ancilla* was possible to see the paraspermatozoa, vermiform, exhibiting multiple peripheral axonemes and with scattered mitochondria and small dense vesicles.

Examination for shell surface adaptations to water management in a rock-dwelling land snail

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Land snails display a great diversity of shell structures subject to adaptive explanations. Ribs, which are transverse protrusions on the shell surface, are an example. For the rock-dwelling snail *Albinaria* variation of shell sculpture is attributed to water management adaptations. However, detailed experimental tests of these hypotheses are lacking.

I examined trait conservatism and the capacity of various *Albinaria* species, differing in rib pattern, to adhere and retain water on their shells, and the relation between ribbing and activation time after aestivation. Phylogenetic signal in all traits was random. Differences in shell sculpture affect shell weight and water adhesion but not water retention and activation time. Climatic variables have no influence on rib patterns. Therefore, shell sculpture is not sufficient alone to explain the ability of *Albinaria* to withstand adverse conditions. Thus, additional morphological, behavioural and physiological adaptations must be considered as promising candidate traits for further studies of divergence.

An improved method for the identification of areas of endemism using species co-occurrences

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The prerequisite for extensive geographic co-occurrence of all the species within an area of endemism (AoE) is the core of an ongoing debate, and thus alternative approaches favor the identification of biotic elements, which are groups of taxa whose ranges are significantly more similar to each other than to the ranges of other taxa. In this work, we develop a simple method that combines the notions of biotic elements and of areas of endemism. It overcomes the constraints of a previously suggested null model based method that cannot deal with disjunctions and is strictly-grid dependent. First, we use a null model approach to determine which pairs of species have a significant degree of co-occurrence, in order to determine biotic elements. Subsequently, we use only those

species in a parsimony analysis of endemism to delineate candidate AoE, and use multivariate analysis to define groups of biotic elements on the basis of species interactions (co-occurrence, exclusion, neutral). To examine the utility of our method we analyze the well-known data set of *Sciobius* in southern Africa, as well as data on invertebrate taxa endemic to the island of Crete (Greece). Our results are very similar to those of previous analyses, and produce meaningful delineation of areas of endemism and biotic elements in both data sets. Furthermore, our method is flexible regarding null models and significance levels, and eliminates data noise.

**Molecular versus morphological taxonomy:
a case study of character evaluation in marine Gastropoda**

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Molecular analyses are still becoming increasingly important in taxonomical, ecological, biogeographical and evolutionary studies. However, regardless of the various applications of genomics and the rapid progress in for example computer methodologies, one will always need old-fashioned alpha taxonomy to get a better view of the world around us. Especially cases in which morphological and molecular analyses do not give congruent results, prove to be valuable in studying evolutionary principles, behavioral ecology and/or ecosystem complexity. In these studies the seemingly misleading data in either the molecular or the morphological dataset is often used to illustrate interspecific relationships, co-evolution, parallel or convergent evolution, bottleneck events, etc. In marine gastropods large-scale research projects combining genetic and alpha-taxonomical studies have recently been performed in the families Cypraeidae, Epitoniidae and Coralliophylidae. By analyzing both molecular and morphological data, convincing evidence was found for the frequent occurrence of convergent evolution in conchological characters, and cryptic, adaptive radiation of snail species that cannot unequivocally be distinguished on the basis of shell or anatomical characters alone. Furthermore, these studies played an important role in molecular and morphological character evaluation for taxonomical studies of Mollusca more in general. For example, some genetic markers proved to be less valuable than others because of saturation in some but not all lineages of a clade. Such findings could be correlated with alpha-taxonomy or ecological characters of the taxa concerned. Molecular and ecological support was found for the hypothesis that characters of the teleoconch are less valuable for phylogeny reconstructions than those of the radulae, jaws, opercula and egg-capsules in epitoniid snails.

Witnessing a 'wave of advance'

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Shells of the terrestrial molluscan family Clausiliidae are characterized by the presence of a clausilium with a door-like blade by which the aperture can be closed when the snail is inside. Usually there is a relatively narrow bypass-canal next to the blade but in several (groups of) species the clausilium may close the aperture completely. Apparently, the latter character state is the derived condition, which evolved several times in parallel. In one case, among species of Alopiinae, there are reasons to suppose that the genetic factor causing obsolescence of the bypass-canal has been transmitted across incomplete species boundaries. When the character state 'obsolete bypass-canal' is used for phylogeny reconstruction in that case, the results are in conflict with the outcome of both a molecular analysis and biogeographical patterns, whereas extreme convergent evolution in other conchological characters has to be accepted.

Predatory beetles may be seen as the driving force causing a 'wave of advance' here. They may use the bypass-canal to reach the snail's body and eat it, so that its closure is advantageous for these snails.

In an attempt to falsify the hypothesis that transspecific introgression is the phenomenon underlying the observed facts, it is investigated whether (1) there are such predators in the area, (2) the genetic basis causing either an open or a closed canal could be relatively simple, (3) the distributional pattern is in accordance with such a process, and (4) the actual molecular phylogeny reconstruction is in conflict with a classification using a closed bypass-canal as an autapomorphy.

Molluscs as models in evolutionary biology: from local speciation to global radiation - Introduction to the symposium

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Evolutionary biology is not only a biological subdiscipline but provides the foundation stone for biology in general. However, to date two of the least understood phenomena in evolutionary biology are the diversity of biological organisms, or biodiversity, which is far from being discovered, and its causation (i.e. the evolutionary processes leading to it). Surprisingly, decades after the “Modern Synthesis” as the most comprehensive scientific achievement in this field and centuries after the commencement of research in biological systematics, we are still unable to satisfyingly answer apparently simple questions such as, for example, (i) how many species inhabit the earth today, (ii) how did this diversity originate, and (iii) how is this diversity distributed. While many contributions in malacology center around morphology, anatomy, and recently in particular phylogenetic relationships within and among its constituent taxa, rarely molluscs have been utilized explicitly as models for the study of general aspects in evolutionary biology. However, we feel that also this particular group with its many features and facets is highly suitable for providing some fundamental insights into the mechanisms of the genesis of biodiversity, historical biogeography and the underlying processes of speciation and radiation. Thus, it is the aim of this symposium to bring together experts and their expertise based on molluscs to provide some of those fundamental studies and data that are of relevance for evolutionary biology with aspects as outlined above, in order to facilitate the influence of malacology within evolutionary biology.

Evolving with friendly bacteria: global diversity of lucinid bivalves reviewed

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Since the discovery of chemosymbiosis in the 1980's attention has focused on several previously neglected bivalve families such as Solemyidae, Vesicomidae, Thyasiridae and Lucinidae, in particular examining coevolutionary relationships between bacteria and bivalve. Interest in chemosymbiosis has also catalysed systematic studies, with 67 new species and 27 genera of Lucinidae described in the last twenty years, a level of activity unrivalled since the mid 19C. For the same period and, by contrast, descriptions of Veneridae have continued at a low background level. Of the bivalve families with chemosymbiotic bacteria, Lucinidae is by far the most diverse (near 400 species), with a near global distribution and occupying a wide range of habitats, from the intertidal zone to depths around 2500 metres. The richest lucinid faunas, from Indo-West Pacific, have only recently been recorded, resulting from intensive sampling of coral-reef systems of the Philippines and New Caledonia. In the latter case 53% of the species were new. Continued sampling of tropical offshore shelf, slope and bathyal habitats is also yielding unsuspected diverse lucinid faunas, many

awaiting description. The bulk of the new lucinid species are larger than 20 mm (mean 26 mm, largest 150 mm), with numerous small species less well studied. Shell characters remain the mainstay of species-level systematics in lucinids but increased attention to detail, improved microscopy, larger samples and regional comparisons have refined species discrimination. Groups of closely similar, “cryptic” species have been recognised from previously widespread “species” exemplified by the *Anodontia*, *Lamellolucina* and *Austriella* groups; others are suspected but uninvestigated in any detail. Some forms previously regarded as ontogenetic stages of larger species are now recognized as separate taxa. So far molecular analysis has largely served to corroborate and add confidence to taxonomic decisions made on morphological characters and importantly, to establish relationships between species groups.

Is anything left to be discovered in the malacofauna of Western Europe?

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With a history of nearly 250 years of taxonomic publications, the seas surrounding Europe are still a source for new findings of molluscs. For the past ten years (1997-2006 inclusive), the records in the CLEMAM (Check List of European Marine Mollusca) and in the EU-funded ERMS2 (European Register of Marine Species) databases show an average of thirty species (range: 16-54) described as new every year. Reports of species previously undetected in the geographic scope account for an average of eight more new entries each year in the European catalogues, and species rescued from synonymy and newly recognized as valid contribute two more. Conversely, an average of four species entries were removed each year from the catalogues, either placed in synonymy or because records were dismissed.

This brings a net increase of 360 species over the past ten years. There is no sign that the trend is slowing down, considering the average of 27 (range 11-40) new descriptions per year in the decade 1987-1996, and 29 (range 10-71) in the decade 1977-1986.

Most of new findings are Gastropods, followed by Bivalves and Solenogastres. The latter account for as much as 10% of additions, in a group that is hardly 3% of the total fauna.

From the geographical viewpoint, Macaronesian archipelagos and the surrounding seamounts are clearly the cutting edge of European malacology, accounting for about half of the additions. The next largest source is the deep (bathyal and abyssal) Atlantic, with 25%. The Eastern Mediterranean, with its share of new findings of Indo-Pacific immigrants, contributes about 16% of novelties, less than the Central and Western Mediterranean (20%). The negligible contribution (about 2%) of the Western European mainland reflects stability, whereas the near-zero contribution of the Moroccan Atlantic coastline would rather be an artefact due to the lack of malacological activity.

Collecting micromolluscs – the key to a good survey

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The informal size class called “micromolluscs” includes all those species which escape visual collecting in the field due to their small size, and require bulk collection of samples. They usually account for the largest number of individuals and species; therefore no faunal survey should ignore them.

Sampling techniques appropriate for hard bottoms include brushing surfaces of various substrates into a fine meshed net or into a bucket, and the air-lift pump. Care must be taken to include as many

different microhabitats as possible, and specific operations are needed for some species. It is essential to sieve the product in sea water on a column of sieves of 10, 5, 2, 1 and 0.5 mm. The 0.5 mm mesh is small enough to avoid missing any of the smallest species, but large enough to limit clogging with sediment.

Sampling of micromolluscs on soft bottoms is more difficult where the size of sediment grains is in the same range as that of target species. Sediments must be sieved as above, then the fractions can be either left to stand in seawater for the micromolluscs to crawl up (misses endofaunal species), or winnowed to separate the lighter particles (does not work in light coral rubble). In mud or silt, sieving will remove the animals from the sediment but a large amount of clean water is needed.

The sorting must be done on one fraction at a time because homogeneous grain size considerably improves visibility of specimens. Sorting living animals in seawater implies picking specimens one by one but allows careful anaesthesia and fixation, or making notes and drawings of the animals. Dry residues are processed faster but yield only the shelled species. Sorting is always the most tedious phase of gathering a collection, being more time-consuming than collecting and curating combined.

Oyster beds in the deep sea

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Oyster beds are almost invariably perceived as associated with coastal, or neritic, marine environment. Here we report on live and fossil occurrences of large oysters from bathyal (> 300 m) hard bottoms in the eastern Atlantic Ocean and the Mediterranean Sea.

Deep-sea oysters were first documented in the deep Mediterranean Sea by French (e.g., CYANALBORAN, CYLICE) and Italian (e.g., CS73, B74, ET95, CS96, LM99, CORAL, CORTI) oceanographic missions as early as the 1970s but received little if any attention. The on-going European projects ESF Euromargins 'Moundforce' and EU 'Hermes' programs fostered new research (Italian cruises: COBAS, GECO, MARCOS; German cruise: M70/1). Radiocarbon dating (AMS-¹⁴C) yield mid-Holocene ages although rare living specimens do occur in the Western Mediterranean (M. Taviani and co-workers).

The most prominent live occurrences known to date are located in the eastern Atlantic Ocean, associated with deep corals (French Thalassa cruises in the 1970s) or thriving in clusters underneath hardground overhangs. A population in Faial Channel, Azores, was recently investigated with submersible "Lula" in 460-495m depth. Live specimens up to 22 cm were collected for microstructure analyses and stable isotope investigations, in order to evaluate their potential value as geochemical (palaeo)environmental archive (M. Wisshak and co-workers).

The species under scrutiny is definitely pycnodontine, rather than ostreine, judging from the muscle attachment which is closer to the dorsal margin. It is most probably undescribed, distinct from the only other known extant pycnodontine, *Neopycnodonte cochlear* (Poli, 1795) by its large size and prominent beaks. Recent populations currently attributed to *Neopycnodonte cochlear* are currently being re-evaluated using molecular markers with the collaboration of Dr. Gonzalo Giribet of MCZ, Harvard. This dataset should allow to determine whether those deep-sea oysters are extreme

morphological variants of the shallow species, or a different species with a bathyal distribution (S. Gofas and co-workers).

**Proboscis morphology in Caenogastropoda:
Does the neogastropod proboscis have a homologue?**

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The Neogastropoda are united by several synapomorphies of the alimentary system, but the proboscis found in all neogastropod taxa is also present in a number of other caenogastropod families. The Tonnoidea, Ficoidea, Cypraeoidea, Calyptraeidea, Naticoidea and Ptenoglossa (and their close allies) all consist of proboscate taxa in which the anterior head and alimentary system is modified in association with a carnivorous diet. Neogastropod phylogeny is underpinned, to a large extent, by comparative morphological studies of the proboscis, and it is likely that the group is derived from another proboscate lineage within Caenogastropoda. This study aims to provide comparative morphological descriptions of the proboscis and the organs contained within it, for diverse caenogastropod taxa, and to assess the utility of this system in identifying the putative sister-group to Neogastropoda. Proboscis morphology varies with regard to structures including; proboscis retractor muscles (number, origin, point of insertion); proboscis wall (muscle layers); attachment of the buccal mass to the proboscis wall; passage of the anterior aorta (connection to buccal mass, connection to proboscis wall); passage of the buccal muscles (relative to the nerve ring, proboscis retractor muscles, anterior aorta); presence of a rhynchodeum external to the proboscis; mode of retraction of the proboscis. Current schemes of proboscis classification refer only to the manner in which the proboscis retracts, divided into acrembolic, pleurembolic, intraembolic and polyembolic forms. These categories do not necessarily reflect the underlying morphology of the proboscis, are frequently misapplied, and are of little use in inferring phylogenetic relationships. However, detailed analysis of the individual structural components of the caenogastropod proboscis may provide valuable insight into phylogenetic relationships.

Micro-CT—3D analysis of molluscan anatomy

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X-ray microcomputed tomography (micro-CT) is a fine-resolution 3D imaging technique which has been developed for the materials science industry. In a biological context, micro-CT is particularly suited to imaging dense materials such as bone and teeth. However, we have applied high atomic weight stains (osmium tetroxide and phosphomolybdic acid) which allow for the visualisation of soft-tissue anatomy. This is a rapid, non-destructive alternative to the painstaking process of 3D reconstruction from histological sections. Soft-tissue micro-CT has not previously been applied to molluscan specimens, although some species are well suited to this method of examination due to their small size, external shell and complex, asymmetrical anatomy. The Skyscan 1172 microCT has a maximum voxel resolution of 3.5 µm at a maximum specimen size of approximately 3.5 x 7 x 7 mm. Many micromolluscan specimens are within this size range, and soft-tissue micro-CT is a promising new technology for studying the anatomy of these groups. We have generated images of several micromolluscan species and of juvenile specimens of larger species, including assimineids and chitons. Preliminary analyses of the data sets have generated complex, 3D models and serial

image stacks which can be ‘virtually resectioned’ at any desired orientation and plane. We have also experimented with the imaging of single organs dissected from larger specimens. These include the buccal mass, circumoesophageal nerve ring and salivary glands of littorinids and muricids. Challenges to the utilisation of the technique include interpretation of monochromatic images and utilisation of large datasets.

The Gondwanan origin of Veronicellidae (Gastropoda, Soleolifera): evidences from a cladistic morphological analysis

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A cladistic analysis was made, based on 52 morphological characters, obtained from 41 species, classified within 20 genera, of Veronicellidae Gray, 1840. The objectives were to define the synapomorphies for this family, discuss their relationship with the examined outgroups (species of Rathouisiidae and Onchidiidae), establish relatedness hypotheses between the genera, as well as discussing the validity of these taxa. The matrix was built using Winclada 1.00.08 and the cladistic analysis was made using TNT 1.0. One most parsimonious tree was found, with 68 steps, Consistency Index (CI) 85% and Retention Index (RI) 96%. This tree strongly supported the monophyly of Veronicellidae and Rathouisioidae. Two larger clades were formed within of Veronicellidae. One gathered the African and tropical Asia genera. The other grouped the neotropical genera. The Australian region was mainly characterized by exotic species, presenting few native species (found in some islands from Sundaland). Not all relationships among these clades were resolved, although many were established. Some genera (mainly from South America) need to be revised (*Filicaulis*, *Sarasinula*, *Angustipes*, *Colosius*, *Heterovaginina*, *Montivaginulus*, *Novovaginula*, *Potamojanuarius* and *Vaginulus*) as no synapomorphies were found to support them. The proposed phylogeny and the observed distribution patterns allow inferring that current veronicellids share a Gondwanan ancestor.

Molecular phylogeny of the Helicodontidae and Trissexodontidae genera and their taxonomic position within Helicoidea

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The evolutionary interrelationships of the Helicoidea remain largely unresolved, indicating that lower level helicoidean taxa still require phylogenetic investigation. This is the case of the genera included in the Helicodontidae and Trissexodontidae [following CLECOM system (Bank 2003)]. Many

authors disagree about the classification of the taxa included inside these subfamilies mostly because its taxonomy is based on shell morphology and the anatomy of the reproductive system, both aspects subjected to very different interpretations resulting in conflicting taxonomic systems. In this work we present the first comprehensive molecular phylogeny of the group based on DNA sequencing of two mitochondrial (16S rDNA, COI) and one nuclear (ITS-I) loci. The work has been carried out on 42 specimens of the following genera: *Helicodonta*, *Atenia*, *Trissexodon*, *Caracollina*, *Oestophora*, *Hatumia*, *Mastigophallus*, *Oestophorella*, *Gasullia*, *Suboestophora*, *Gasulliella* and *Gittenbergeria*. The new sequences have been compared with those previously published by other authors for several Helicoidean taxa (Steinke *et al.*, 2004; Manganelli *et al.*, 2005), including *Lindholmiola*. Phylogenetic relationships were inferred using maximum parsimony, neighbour joining, maximum likelihood and Bayesian methods. The reconstructed phylogenies showed high values of support for more recent branches and confirmed the monophyletic status of all the genera of the two subfamilies here considered.

This work has been financed by the Basque Country University (Projects: 1/UPV 0076.125-E-15911/2004 and GIU06/09), by the Regional Ministry of the Environment, Junta of Andalusia ("Program for conservation and sustainable snail exploitation in Andalusia) and by the Ministerio de Educación y Ciencia (Project CGL2005-01966).

New evidence for old names: On the systematics of Neotropical freshwater gastropods (Caenogastropoda: Cerithioidea: Pachychilidae, Thiaridae)

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Understanding of the phylogenetic relationships of Central and South American freshwater cerithioidean gastropods is incomplete. Hence, current classifications mainly reflect taxonomic concepts of the late 19th century and are in urgent need of revision. We here present new molecular and morphological data that provide novel insights into the relationships of several Neotropical cerithioidean species. The results demonstrate the inadequacy of earlier classifications and will form the basis for a revised systematization. Accordingly, the once so-called 'melanians' can be affiliated with either one of two distinct lineages: the Pachychilidae and the Thiaridae. Each family comprises at least two Neotropical genera which possess distinctive characteristics of the operculum, radula and stomach that can be used as diagnostic criteria to revise the placement of already established genera. However, the precise limits and taxonomic status of several supraspecific taxa such as *Hemisinus*, *Aylacostoma*, and *Cubaedomus* within the Thiaridae and *Pachychilus* and *Doryssa* within the Pachychilidae remain to be clarified.

Pachychilid taxa were variously allocated to other cerithioidean families such as Thiaridae or Pleuroceridae. However, *Pachychilus* occurring from Mexico to northern South America and *Doryssa* replacing the former in Guyana and Brazil, together with a number of African, Malagasy and Asian taxa form a distinct monophyletic group separate from other cerithioidean freshwater lineages. In contrast, two other Neotropical freshwater gastropods, *Hemisinus* and *Aylacostoma*, possess morphological features typical for the Thiaridae (e.g. radula, mantle papillae). In particular, the viviparous *Hemisinus* exhibits characteristics consistent with a basal position within the family, including a glandular oviduct with a spermatophore bursa in the lateral lamina, a midgut with a crescentic ridge that does not enter the caecum, and numerous statoconia. Implications of these results for the evolution and biogeography of Neotropical freshwater Cerithioidea will be discussed.

Genetic diversity of an exploited population of banded Murex, *Hexaplex (Trunculariopsis) trunculus*: Implications for stock enhancement and conservation

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The banded murex, *Hexaplex (Trunculariopsis) trunculus*, is distributed throughout the Mediterranean Sea, whereas in the Atlantic Ocean occurs from the Portuguese coast southward to Morocco and to Madeira and Canary Archipelagos. In Portugal, *T. trunculus* is subjected to an artisanal fishery in the Ria Formosa lagoon (southern Portugal), traditionally undertaken by hand harvesting during low tide and with an illegal fishing gear locally known as “wallet-line”. Additionally, the agglomerations of females during collective spawning are subjected to hand harvesting during low tide and scuba divers operating illegally inside the lagoon have also been collecting substantial quantities of this species.

Probably due to over-fishing, detrimental collecting practices and disregard to the minimum landing size, the abundance of *T. trunculus* in the Ria Formosa decreased noticeably over the last years, possibly indicating over-exploitation. Altogether, the growing demand for gastropods in the seafood market, the reduced catches and high commercial value of the banded murex, have raised expectations about the potential of *T. trunculus* for molluscan aquaculture, both for commercial production and for stock enhancement in the Ria Formosa.

Analyses of genetic diversity are required to establish adequate and successful stock enhancement programmes. In this context, molecular analyses of nuclear (5S rRNA) and mitochondrial (12S rRNA, 16S rRNA and Cytochrome Oxidase subunit I) genes were performed to investigate the genetic diversity of *T. trunculus* from the Ria Formosa and compare it with two adjacent populations of this species (Ria de Alvor - southern Portugal and Río Piedras - southern Spain), which could eventually constitute source-populations for stock enhancement in the Ria Formosa. A low genetic variability was detected among populations, with a higher similarity between Portuguese populations comparatively to the Spanish population. These slight inter-population differences allow for the potential use of any of these source-populations for stock enhancement initiatives.

Evolution of the molluscan assemblage on a seagrass meadow (*Zostera marina*) affected by trawling activity

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A study to identify the composition of the molluscan assemblages associated to a *Zostera marina* meadow in the coastal waters of Malaga (South Spain) was started in the summer of 2004. In 2005 the meadow was severely affected by illegal trawling activities, losing most of the vegetable cover. The degradation process continued in 2006 with no signs of recovery.

The annual sampling was carried out in summer and was located on each of the 4 cardinal meadow edges (North, South, East, West). The taxonomic identification was carried out to the species level.

Also, biomass of the seagrass (leaves and rhizomes) was quantified for each sample. The principal aim of the study was the evaluation of the molluscan assemblage evolution along several years. The results show the replacement of the well structured molluscan assemblage (with more than 80% of adults and a distribution between gastropods and bivalves near to 50% each) for an assemblage strongly dominated by bivalvian recruits (the total abundance of individuals in the last year was 87% for recruits and 90% for bivalves). The dominant species in the assemblage were the same during the study (genus *Tellina*, *Mysella*, *Spisula* and other *Veneridae*)

Global opisthobranch biodiversity: Are they evolving faster than we can find them?

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Portions of the world's opisthobranch fauna are relatively well known, particularly the shallow waters of the European and Mediterranean and the Atlantic and Pacific coasts of North America. Nevertheless, examination of the chronology of the study of these faunas reveals that much of these faunas has only recently been documented and is not yet complete. Deeper-water faunas from these areas are far less well known than shallow-water taxa.

Other temperate areas such as southern Africa, New Zealand, Australia and Japan are far less well known and many new taxa continue to be discovered. It is likely that a minimum of 15-25 % of these faunas remains undescribed. This view is evidenced by the number of new taxa appearing on websites and by very recent publications describing species from these other temperate regions. Tropical regions, with much higher diversity of taxa, remain less well-studied. Approximately, 300 species have been documented from the Caribbean, of which approximately 20% are undescribed. It is also evident that many other Caribbean species have not yet been discovered.

The tropical Indo-Pacific is home to at least 5-10 times the diversity of species found in Caribbean. Most localities surveyed have 16-52% of their resident species as undescribed taxa. Recent studies in the Philippines over the last 15 years have shown that at least 40% of the species found there are undescribed. The Philippines have more than 700 species of opisthobranchs documented from the archipelago and species accumulation curves indicate that our knowledge of this biota is by no means complete. Within the Indo-Pacific, most species inhabiting deeper waters, below scuba diving depths are new taxa with possibly 90% of the species remaining undescribed. While considerable progress has been made in recent decades to describe the world's opisthobranch fauna, our knowledge, at present, is far from complete.

Palaeoheterodonta MMVII: A cosmopolitan assessment of freshwater mussel diversity

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Numerous issues complicate estimating the current state of our knowledge of the diversity of palaeoheterodonts (Bivalva: Trigonioida + Unionoida): historical and contemporary super-nomination due to typological species concepts, lumped "Biological" species concepts, outmoded higher classification, incomplete knowledge of soft-anatomical variation, and limited taxon sampling for molecular phylogenetic studies, to name a few. These shortcomings are unfortunate given freshwater mussels' globally imperiled status and the potential utility of the group to lend insight to a wide range of evolutionary processes. Based upon cladistic analysis of nuclear (28S) and mitochondrial DNA (COI) as well as 59 morphological characters, we recovered seven palaeoheterodont families: (Trigoniidae, ((Unionidae, Margaritiferidae), (Hyriidae, (Etheriidae,

(Mycetopodidae, Iridinidae))))). A consensus arrangement of several provincial, species-level treatments yields fewer than 850 recognized, valid species worldwide, with all but 5-6 belonging to the Unionoidea. We regard this as an under-estimate. While there are, no doubt, more species to be described, thorough taxonomic revisions are hindered by the ca. 4900 available species-group level nomina. We will discuss patterns of regional and taxonomic diversity and highlight the value of the MUSSEL Project Database for synthetic and revisionary studies of the Palaeoheterodonta.

Taxonomic and systematic study of the Families Helicinidae and Ceresidae (Mollusca: Gastropoda: Neritopsina) and the Genus *Drymaeus* (Gastropoda: Pulmonata: Bulimulidae) in three zones of the Reserve Amazonic in Peru

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This work is based on a systematic and taxonomic description of different species of terrestrial and fluvial molluscs. It was developed in three natural zones in the Amazon region of Peru. The collection took place between February and April 2001. The studied areas are located as following: (1) In the Alto Mayo Forest-BAM 06°13'04"S 76°54'55" W, in the San Martín department in Northwest Peru; (2) Tingo María National Park-PNTM 09°19'45"S 76°01'39" W, Huánuco department in Northeast Peru; (3) Manu National Park PNM 13°09'43"S 71°35'39" W, Madre de Dios department in Southeast Peru. The recent gastropod fauna located in the referred study sites is described and documented, corresponding to 5.000 individuals of different families. The identified individuals were catalogued in a database covering 787 samples. Each sample was numbered and identified following the guidelines of the Zoological Museum of Hamburg (ZMH) Germany. The systematic and taxonomic list of the species was classified into 25 superfamilies, 40 families, 63 genera and 136 species. According to these results the superfamilies Helicinoidea and the Orthalicoidea have been investigated in detail and subsequently split in 3 families. 11 species of the family Helicinidae and 3 species of the family Ceresidae were assigned to the first superfamily, 9 species of the genus *Drymaeus* belonging to the family Bulimulidae (=Orthalicoidea) were assigned to the second superfamily. These three families are documented by a total of 400 specimens. Within the family Helicinidae Lamarck, 1799, the following new species (sp.nov) were tentatively classified: *Helicina bandeli* sp.nov; *Helicina peruensis* sp.nov; and *Alcaldia kasteli* sp.nov. The genus *Archacharax* and species *blandianus*, *glaeserius* and *cousini*, belonging to the family Ceresidae Thompson, 1980, have been redescribed. Field data and bibliography were also collected for each species. Morphology and distribution are discussed and commented. Photographs show different shell forms of each species separated for each location.

Pupilloidean snails of Göller Bölgesi (Lakes Region) Turkey

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The members of the superfamily Pupilloidea have been determined to occur in Göller Bölgesi (Lakes Region) are summarized in the study.

Totally 7 families and 17 species were found. These are: Lauriidae (*Lauria cylindracea*); Orculidae (*Orculella bulgarica*, *O. ignorata*, *Sphyradium doliolum*, *Pagodulina pisidica*, *P. subdola*); Pyramidulidae (*Pyramidula rupestris*); Valloniidae (*Vallonia costata*, *V. enniensis*, *V. pulchella*);

Pupillidae (*Pupilla triplicata*); Vertiginidae (*Vertigo (Vertigo) antivertigo*, *Truncatellina cylindrica*, *T. rothi*), Chondrinidae (*Granopupa granum*, *Rupestrella rhodia*, *Chondrina clienta*). Most species prefer limestone habitats like rocky outcrops and cliffs. Also, while some of the species are xerophiles (like *Pyramidula rupestris*, *Pupilla triplicate*, *Truncatellina cylindrica*, *Granopupa granum*, *Rupestrella rhodia*), mainly determined species have hygrophilous character of varying degrees (*Orculella ignorata*, *Sphyradium doliolum*, *Pagodulina pisidica*, *P. subdola*, *Vallonia costata*, *V. enniensis*, *Vertigo (Vertigo) antivertigo*).

The Clausiliidae fauna (Gastropoda: Pulmonata: Stylommatophora) of the Lakes Region (Göller Bölgesi) in Türkiye

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The Clausiliidae is one of the largest family of Gastropoda. This family occurs in the western Palaearctic region, in South America and in Southeast Africa. In Europe they reach their maximum diversity in the Balkans and the Caucasus (one-fifth of the European land snail species). Geographical speciation is common in this family. The members of this family are abundant in the south and the southwest of Anatolia and in the Aegean (Ege) Region of Türkiye. Although a number of malacological studies in Türkiye have been done since 1800, there has been an impressive accumulation of new data on the Clausiliidae of Türkiye by both foreign (Dr. H. Nordsieck, Dr. H. Schütt, Dr. E. Neubert, Dr. F., Welter-Schultes, Dr. P. Subai, Dr. R. Bank, Dr. H. P. M. G. Menkhorst, Dr. B. Hausdorf, Dr. L. Németh, Dr. M. Szekeres, Dr. E. Gittenberger) and Turkish (Dr. M. Z. Yıldırım, Dr. B. A. Gümüş and Dr. A. Örstan) malacologists. As being the keen malacologists of Türkiye, our aim in this study is to determine the Clausiliidae fauna of the Lakes Region. The specimens (3 species, 11 subspecies) collected from Isparta, Burdur, Denizli, Afyon and their vicinities through the years 2002-2006 were determined. The Lakes Region is under the mixed circumstances of the Mediterranean and the land climate. The speciation in this family is discussed from the point of the region's geographical structure and the conditions of the climate. The sympatric distribution of "*Sprattia beycola medoroides* Nordsieck, 2004 and *Sprattia blissi blissi* (O. Boettger, 1899)" in Dedegöl Mountain (Yenişarbademli: Isparta) is discussed. The new localities for *S. beycola medoroides* (Akyokuş, Gelendost: Isparta) and *Sprattia aksoylari* Yıldırım, 1997 (Kapıkaya Cave, Sütçüler: Isparta) are reported. We would like to thank for Nuray Kayıkçı, Ayşe Yıldırım and Ezgi Oya Gümüş for their helps in collecting the snails.

Land snails from a hidden beauty: Afrodisyas (Karacasu: Aydın) in Türkiye

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Afrodisyas is an antique settlement which is in the southeast of Aydın. This city was set up for Aphrodisias, the goddess of love and beauty and the symbol of the life and fruitfulness. The archaeological findings prove that the first settlements belong to the Chalcolithic Age (B. C. 5500-3000). The settlements belong to the Early Bronze Age follow then. The temple of the goddess was built at the first century B. C. The theatre was built during the Helen period of the city. The theatre

was also used as arena by the Romans. The city was famous with the statues. The statues signed by sculptures of Afrodisyas were found out in Italy, Greece and the other countries around Mediterranean. Also the marble blocks were exported. The marbles were obtained from the mine which still exists and is 2 kilometers east of Babadağ. The city was conquered by Turks at the 12th century A. D.

The land snails were collected from the antique city and its surroundings with the permission of the local authority in April-2007.

9 species were reported. The distribution of “*Caracollina lenticula* (Michaud, 1831)” as a synanthropic beach species in this antique settlement is discussed. Also the anatomical dissection of the *Helix sp.* is given.

We would like to thank for Ayşe Yıldırım for her helps in collecting the snails.

Analysing speciation patterns – lessons from rissoidean and hydrocenid gastropods calling for the integration of methodologies

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Many small species of gastropod, especially those occurring in fresh water, have a low potential for dispersal and consequently restricted ranges. Yet, their diversity may be very high suggesting high rates of speciation. Small species tend to be poor in morphological characters resulting in a high degree of homoplasy. Often, species cannot be discriminated based on morphological data alone, because the taxonomic value of a morphological difference is difficult to interpret. Phylogenetic analyses based on morphological data are practically impossible. Genetic methods, especially sequence analyses, have brought enormous progress. However, there are a number of examples also of genetically cryptic species. Presenting cases from rissoidean and hydrocenid gastropods I will show that only the synthesis of morphological and genetic methods can really enhance taxonomic and phylogenetic analyses. In addition, the integrative approach is setting the stage for evolutionary analyses such as that of speciation patterns.

Dynamic gastropods: morphological and genetic differentiation of the land snail *Arianta arbustorum* in an Alpine massif

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Based on a sequence fragment of mtDNA and a very variable microsatellite locus we analyzed the genetic differentiation of more than 400 individuals of the land snail *Arianta arbustorum* collected in 62 localities of the Alpine massif Gesäuse, where four morphotypes, characterized by geometric morphometrics, occur in close vicinity. We aimed at understanding actual and historical evolutionary processes among the morphotypes. With 135 haplotypes diverging up to 12.5% and 18 microsatellite alleles, genetic diversity was extremely high. The most common haplotype was found in all four morphotypes across the entire study area. Morph-specific haplotypes or alleles could not be identified. Phylogenetic analyses indicated that *A. arbustorum* has colonized the Gesäuse several times in consecutive waves and that introgression of neutral or near neutral markers across morphotypes and selection on shell shape, whose differentiation is apparently ancient, have played an important role. Gene flow was more likely between locally close, different morphotypes than among

distant populations of the same morphotype again indicating that cohesion of morphotypes was mainly due to selection. The actual distribution of morphotypes and haplotypes as well as the high genetic diversity also suggested that the area provided refugia during the Pleistocene glaciations.

Molecular phylogeny and morphological evolution of pholadoidean boring bivalves (*Bivalvia*: *Myoida*)

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The superfamily Pholadoidea consists of Pholadidae (piddocks) and Teredinidae (shipworms) with over 150 modern species living in the deep sea to freshwater rivers. They have unique morphologies adapted to mechanical boring into various substrata such as sand, mud, rocks and woods. A well-accepted hypothesis on the evolutionary pathway in Pholadoidea is that the sand- and mud-borers were preceded by the wood- and rock-borers.

To test this hypothesis, we reconstructed a phylogeny of Pholadoidea based on sequence data from four genes (complete 18S rRNA, partial Histone 3, 16S rRNA, and CO1) for 81 species from 26 genera as an ingroup. Phylogenetic trees were constructed using MP and Bayesian method with a maximum 3,171 bp dataset, and then 60 morphological characters were parsimoniously mapped and reconstructed on the cladogram to search synapomorphies.

Our result shows that Pholadidae, Xylophaginae, Jouannetiinae and Teredinidae are major clades supported by strong statistical values, and that the wood- and rock-borers with anterior-boring mechanism are ancestral while the sand- and mud-borers with ventral-boring mechanism are derivative within the Pholadoidea, which clearly contradicts the previous hypothesis. Our molecular study reveals interesting patterns of morphological evolution in the phylogeny of Pholadidae: the more generalized soft-bottom infaunal mode of life (associated with simplified morphologies and posterior elongation of valves observed in Pholadidae) among bivalves was derived from more specialized rock- and wood-boring mode of life. The wood-boring Xylophaginae and Teredinidae, which harbor associated bacteria for xylotrophy, are phylogenetically distant to each other, suggesting that the associated bacteria was acquired independently in those groups. The Pholadoidea would have gained high species diversity by exploiting various kinds of substrata through mechanical boring rather than chemical boring.

Harmonic radar evidence for wind dispersal and homing capability in the tree snail genus *Achatinella* (Pulmonata: Achatinellidae)

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Conservation efforts for the endangered *Achatinella* tree snails, which are endemic to the island of Oahu, Hawaii, will likely soon include translocations among the remaining wild and captive-bred populations. Natural dispersal rates are being determined as part of optimizing this approach and will be incorporated into models of population connectivity and gene flow. The first of three methods used for observing dispersal was harmonic radar tracking, which yielded some surprising results in addition to the intended short-term dispersal rates. Solely utilizing capture-mark-recapture (CMR)

techniques would have greatly inflated dispersal rates, as these cryptic snails appear to exhibit several types of site fidelity and homing capability. Meteorological data loggers were also deployed when tracking began to look for an association between snail movement and weather fluctuations; the resultant data strongly indicate passive wind dispersal for more distant snail movements. These tracking and weather data will soon be integrated with a large CMR dataset and genetic assignment tests to obtain reliable dispersal rate estimates. The results of these studies emphasize the importance of employing multiple methods to study dispersal.

**Origin and early radiation of the Neogastropoda:
Evidence from nuclear and mitochondrial genes**

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The Neogastropoda are an extremely diverse and successful group of predators that first appeared abruptly in the fossil record of the Cretaceous. Neogastropods now comprise a significant component of every benthic marine community (intertidal to hadal, tropical to polar) and several lineages have invaded freshwater habitats. Because of the rapid proliferation of lineages, each with tendencies to modify organ systems in parallel fashions, relatively few morphological characters originating during the initial radiation have been identified, each uniting small subsets of higher taxa, while leaving relationships among the remaining families unresolved. The absence of congruent patterns of character distributions in the major organ systems have frustrated initial attempts at phylogenetic inference using morphological characters. More recently, studies using DNA sequences of several mitochondrial genes have shown these genes to be powerful and appropriate tools capable of resolving relationships among families, genera and species of Neogastropoda. Representatives of fifteen families of neogastropods, as well as of the various hypothesized sister taxa have been sequenced for mitochondrial and nuclear genes. Phylogenies based on these genes, individually and in combination are used to provide insight into the origins and early divergences within the Neogastropoda.

**The *Cerion* land snails of Long Island, Bahamas:
New insights into the relationships and origins of a dynamic fauna**

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Land snails of the family Cerionidae are endemic to islands of the tropical western Atlantic, ranging from the barrier islands and keys of southern Florida, throughout the Bahamas, Greater Antilles, Cayman Islands, western Virgin Islands, and the Dutch Antilles. These snails live within a few hundred meters of the shore and form dense but patchy colonies. Variation in shell morphology among colonies can be enormous, not only throughout the geographic range of *Cerion*, but even among neighboring populations separated by less than 100 meters. This lavish yet geographically circumscribed morphological diversity has led to the description of roughly 600 nominal species, despite the fact that most will interbreed. There is only a single documented case of two species of *Cerion* living in sympatry. The greatest diversity of *Cerion* occurs on Cuba and in the islands of the Bahamas. However, most the present range of the genus, including southern Florida and many of the

Bahamian Islands were submerged as recently as the Eemian interglacial era (125,000 years before present). Thus, much of the present fauna is the product of subsequent recolonizations. The *Cerion* fauna of Long Island, situated along the southeastern margin of the Great Bahamas Bank, is the most morphologically diverse within the Bahamian Archipelago. A significant portion of this morphological diversity is concentrated along a section of the central east coast of the island, where the entire, non-overlapping ranges of three endemic species, flanked by a broader ranging species (4 transition zones on the order of 20-100 m) are contained within a 12 km region of coastline. We have analyzed the morphological and genetic variability of the Recent fauna of Long Island and compared it with representative samples from throughout much of the range of this genus. Phylogenetic hypotheses based on mitochondrial and nuclear genes sequences from multiple individuals from each population were used to evaluate morphology-based hypotheses, and to assess the genetic distinctiveness of neighboring populations. In addition, we sampled Holocene representatives of *Cerion* throughout this 12 km region of coastline by excavating pits and sampling from sand quarry walls and erosion cuts. These *Cerion* shells were individually dated by amino acid racemization analysis, using the D-alloisoleucine/L-isoleucine (A/I) ratio calibrated against a series of radiocarbon-dated shells. We were able to reconstruct complete temporal sequences from about 4000 yr BP to the present from some of our excavation sites. Very substantial changes in shell morphology are documented in the temporal sequences constructed for most of the sites excavated. At every site, shells older than ca. 3000 yr are substantially different from living forms. More recent changes are also evident at most sites, with living individuals significantly larger than all but the most recent (<200 yrs) fossil shells. Phylogeographic patterns are assessed and evaluated in the context of several possible scenarios for the multiple origins of the observed patterns of spatial and temporal variation in *Cerion* distribution on Long Island.

Environmental insights into the Crag Sea: investigation of growth rates of Pliocene *Arctica islandica* from the Coralline Crag (UK)

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Annually resolved growth lines in recent shells of the long-lived bivalve *Arctica islandica* have been shown to have great potential for the study of the effects of environmental change on annual growth rates and the study of stable oxygen isotopes have shells have allowed for the reconstruction of water temperatures. The occurrence of fossil *A. islandica* in the Pliocene shallow marine Coralline Crag of eastern England, offers an opportunity for the study of seasonal growth rates and the reconstruction of seawater temperatures during the ‘mid Pliocene warm period’ of the late Holocene. Examination of the microstructure and mineralogy of the Crag *A. islandica*, using scanning electron microscopy and cathodoluminescence, showed them to be well preserved with no evidence of diagenesis. Measurement of the growth increments showed rapid growth rates in all individuals, higher than those recorded for modern individuals. The largest clams attained an age >160 years and this longevity is similar to those of live-caught clams from the North Sea and Atlantic Ocean. Analysis of ¹⁸O/¹⁶O ratios in shell material showed clear seasonality of growth line deposition during the lowest seawater temperatures. Reconstruction of the seawater temperatures from the oxygen isotopes at the time of shell deposition suggest an annual temperature range of between 3.6 and 12.8°C.

Interpreting the last molluscan Unionoidea from the Cretaceous of North Dakota

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Arguably, the best-sampled and constrained Cretaceous-Paleogene (K/P) continental mollusk-bearing strata anywhere are in the Williston Basin of Montana and North Dakota. Even so, few unionoid mussels are known within a few meters below or tens of meters above the K/P boundary. The Hartman base-level change hypothesis is that sedimentological conditions changed decidedly prior to the K/P boundary and persisted into the Paleocene. A corollary to this hypothesis is the loss of highly sculptured continental taxa just prior to the K/P impact event, thus contradicting the likely survival of unionoids according to the Robertson et al. sheltering hypothesis. A low-diversity assemblage (Locality L6516, Section M8608) dominated by anodontine unionoids and a Viviparidae species is documented in a 7-cm-thick layer, 90.5 cm above the base of the Ludlow Member (Fort Union Formation) and 63 cm below the K/P boundary (identified on the basis of a well-preserved and diverse suite of angiosperm pollen). Extant anodontines are thin-shelled and most often found in shallow, quiet-water environments. L6516 mussels are preserved as external molds in pale yellowish-brown (10 YR 6/2) silty, very fine-grained sandstone, rich in plant debris. Most are found with their valves closed or in butterfly-open position, indicating that subsequent transport was limited to nonturbulent conditions. This locality raises specific questions: 1) Is this type of preservation more common than previously suspected? Can anodontine or other mussels be located by a systematic search of specific likely lithologies? and 2) Does the presence of an anodontine morphology in this stratigraphic interval indicate a shift in depositional regime as expected by the base-level change hypothesis? The five described Late Cretaceous “*Anodonta*” taxa currently shed no light on the problem; they are without sedimentological context, and three are based on poor material. This record of interesting end-Cretaceous taxa raises far more questions than it answers.

Diversity of microgastropod fauna in Northwestern Pacific: A case study of Heterostrophans in Japan

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In spite of remarkably high diversity among medium to large molluscs in northwestern Pacific waters, which have been relatively well surveyed, only a little is known about the micromolluscan fauna of this region. Researchers undertaking ecological or faunal studies often encounter undescribed species even in the intertidal zone, and this can hinder the progress of their respective studies. For instance, a preliminary field study showed that among 14 species of gastropod occurring on the red algae *Gracilaria verrucosa* in the upper intertidal zone on the Miura Peninsula in Honshu, Japan, five species (including the most dominant one) were regarded as being undescribed. ‘Micro’-species (less than 5 mm in adult body length) occur intermittently throughout the Mollusca, but are especially concentrated in several specific groups, such as the Scissurellidae, Rissooidea and Heterostropha in the Gastropoda. The Heterostropha are the most basal and possible paraphyletic members of the diverse clade Heterobranchia, and comprise rather unfamiliar families that had previously been assigned to ‘Prosobranchia’ or are recently discovered. Most of these families have not attracted much attention from taxonomists, with a few exceptions such as the Pyramidellidae and Architectonicidae, and many species in the northwestern Pacific remain unstudied. In this presentation, species of several heterostrophan families such as the Rissoellidae, Cimidae, Omalogyridae and Hyalogyrinidae from Japanese waters are introduced, with special emphasis on

their habitats and diverse anatomical features, in order to demonstrate the unrevealed diversity of micromolluscs in this area.

A molecular phylogeny of the Buccinidae—a southern and a northern connection

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The Buccinidae comprises one of the most prolific families among the Neogastropoda, with fossil records back into the Cretaceous. There has been marked adaptive radiation of the family, with a distribution ranging from equatorial to polar regions and from fresh water systems to deep ocean vent communities. However, the phylogeny of the family remains ambiguous. There is no consensus as to its taxonomic boundaries, or to the relationships among its genera and subgenera. To address these problems and mainly to identify major phylogenetic groups within the Buccinidae, sequences of the entire mitochondrial 12S and 16S rRNA genes for 45 caenogastropods (including 34 buccinoids) were collected for molecular phylogenetic analysis. This used the conserved (unambiguously aligned) regions of both genes using a Bayesian approach.

The resultant 95% majority-rule consensus Bayesian inference tree revealed monophyly of the Buccinoidea with high statistical significance, yet the initial radiation of the superfamily could not be resolved fully. In contrast, monophyly of the Buccinidae in the traditional sense—except for Babylonia—was not supported; however, this could reflect the inadequate level of resolution of the current dataset. Of polytomously branched clades under the Buccinoidea, most noteworthy is a subordinarily structured clade that accommodates both boreal and Austral genera. This suggests some ancient vicariant or dispersal process across the equator in an early stage of buccinid evolution. For future research, supported clades, as well as unresolved radiation in the present results, need further evaluation with denser taxonomic sampling and additional gene sequences.

Molecular systematics and evolutionary patterns of diversification in New World Ampullariidae

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Apple snails (Ampullariidae) are freshwater, operculate snails globally distributed in humid tropical and subtropical habitats. Nine genera are recognized: *Afropomus* (1 species), *Saulea* (2) and *Lanistes* (~20) are African; *Pila* (~30) is African and Asian; *Asolene* (7), *Felipponea* (3), *Marisa* (2) and *Pomella* (3) are South American; *Pomacea* (~50) ranges from Argentina to the southeastern USA. Ampullariid taxonomy and evolutionary relationships remain poorly understood, especially regarding *Pomacea*, which has implications for research on many aspects of ampullariid evolutionary biology. Here I provide a preliminary phylogenetic basis for addressing questions of Neotropical ampullariid diversification. Samples were collected from ~190 populations in South and Central America, concentrating in Brazil, the center of ampullariid diversity. Phylogenetic analyses of mitochondrial and nuclear loci from 44 species (>1000 snails) in 7 genera indicate that New World Ampullariidae are a robustly supported monophyletic group with respect to Old World ampullariids. Within this group most species of *Asolene*, both *Marisa* species, and *Felipponea neritiformis* form a basal, weakly supported polyphyletic clade, sister to a weakly supported group of species currently placed in *Pomacea* and *Asolene*. Most *Pomacea* spp. cluster into four distinct groups, with 11 and 7 in the “canaliculata group” and “bridgesii group”, respectively. Six species ranging from the Amazon Basin through Venezuela constitute the “glauca group” and 5 from South and Central America are in the “sordida group”. Overall, these results confirm what conchology has always hinted at: New World

ampullariid genera as currently defined are not monophyletic clades easily delimited from one another. Preliminary assessments of anatomical characters, particularly penial sheath morphology, support the species-groupings recovered using molecular data. Also, phylogenetic relationships suggest that oviposition may have played a key role in the extraordinary diversification and distribution of *Pomacea* spp.

Caught in the act: Insights into the sex life of *Lanistes ovum* (Gastopoda: Ampullariidae)

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The freshwater gastropod family Ampullariidae is distributed worldwide in the tropics and subtropics. Due to the fact that some species of the ampullariid genus *Pomacea* PERRY, 1810 have become serious agricultural pest species in different parts of the world, these taxa are common scientific study objects. Especially copulation and reproductive behaviour of *Pomacea canaliculata* (LAMARCK, 1819) are studied intensively. In contrast, very little is known about the behaviour and life cycle of the African ampullariid genus *Lanistes* MONTFORT, 1810, which is clearly distinguishable from all other ampullariid genera by a sinistral shell. In Lake Malawi (African Rift Valley), five species of the genus *Lanistes* are currently recognized. We collected individuals of *Lanistes ovum* PETERS, 1845 within and in the surroundings of Lake Malawi and brought them to Germany alive. To our knowledge this is the first time that individuals of *L. ovum* were kept and bred successfully in the laboratory. Here we report on their reproduction and give details on courtship and copulation behaviour which differs considerably from the copulation behaviour of the dextral *P. canaliculata*. Differences in reproduction include, for instance, copulation position due to the sinistral shell and duration of the copulation. Furthermore, we describe size and number of the spawns as well as size and number of the eggs and hatchlings. These findings are briefly compared to the reproductive behaviour of the invasive *P. canaliculata*. We then discuss the implications of the respective reproductive behaviour in the context of ampullariid invasiveness.

Identification and genetic characterization of new populations of the endangered winged mapleleaf, *Quadrula fragosa*

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The North American freshwater mussel fauna of the family Unionidae are one of most endangered groups of organisms in the world. Reasons for this decline are not well understood, but are presumably due to habitat degradation. For example, the winged mapleleaf, *Quadrula fragosa*, was historically found in the Tennessee, Cumberland, Ohio, and Mississippi River basins in east-central United States. However, by 1991 the range of this species appeared to be reduced to a single population in the St. Croix River of the central United States, resulting in federal protection of *Q. fragosa* and the development of conservation management plans for species recovery. Recently, individuals that are morphologically similar to *Q. fragosa* have been found in Arkansas, Missouri, and Oklahoma. If these southern populations are true *Q. fragosa*, they will need to be included in conservation management plans. We conducted a phylogenetic analysis of mitochondrial ND1 gene sequences to genetically identify these “*fragosa*” morphotypes. Our results indicate that these southern populations indeed belong to *Q. fragosa*. We now are characterizing the genetic structure of all known *Q. fragosa* populations with newly developed microsatellite markers. These data will

examine genetic variation within and among populations of *Q. fragosa*, and identify gene flow. We will present our preliminary population dynamics results and discuss how this new information will aid in the conservation of this endangered species.

Adaptive significance of secondarily reduced features of the soft anatomy of *Vitularia salebroza* (Neogastropoda: Muricidae): Experimental, geochemical, and anatomical evidence

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The feeding ecology of the muricid neogastropod *Vitularia salebroza* from the tropical eastern Pacific is examined in the field and lab to shed light on the adaptive significance of its unusual soft anatomy, which includes a highly simplified buccal mass, radula, and gut. *Vitularia* predators feed on sessile or cemented molluscs leaving traces suggestive of a parasitic association. These include a foot scar on the prey's shell surface and a feeding tunnel. The tunnels themselves are formed by the prey as it deposits new sheets of shell material over the intruding proboscis, but predators are able to maintain distal and proximal openings through movement of the proboscis. Evidence is presented that *Vitularia* parasitizes blood vessels or digestive glands of its prey.

Feeding experiments in laboratory aquaria confirm that *Vitularia* is capable of long-term, non-lethal associations with prey. Attacks on individual vermetids lasted up to 69 days before prey were killed and on oysters up to 104 days (oyster prey still alive when experiment terminated). Stable isotope sclerochronology of growth lines on feeding tunnels of two field-collected oysters indicates that natural interaction times with oysters may exceed 4 months without death of the host. Conceivably, predators may feed on as few as 2 to 3 prey per year and never use their radula. The specialized ecology of *Vitularia*, which is unusual within the Muricidae, suggests that the simplified alimentary system of *Vitularia* is a highly derived condition rather than plesiomorphic.

Rhytididae in Madagascar: reality or wishful thinking?

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The land snail family Rhytididae comprises a group of small to very large carnivorous snails widely distributed in the southern hemisphere. Representative taxa are recorded from southern Africa, Indonesia, Australia, New Zealand and islands in the south-western Pacific – a distribution pattern strongly suggesting a Gondwanan origin. In 1990, Emberton postulated that the Rhytididae also occurred in Madagascar, in the form *Helix covani* Smith, 1879, a taxon which had long been

considered a member of the acavid genus *Ampelita*. He considered that the small embryonic shell of *H. covani* was not consistent with a position in the Acavidae. Instead, he referred it to the Rhytididae on account of 'its rounded, regularly expanding whorls, coarse sculpture and unreflected apertural lip', provisionally placing it in the genus '*Rhytida*'. Emberton's proposal has been accepted by subsequent authors keen to see another Gondwanan fragment added to the geographic range of the Rhytididae. Nevertheless, Emberton based his transfer of *Helix covani* from *Ampelita* to '*Rhytida*' solely on shell characters, pointing out the need for anatomical observations to confirm this. In relation to on-going phylogenetic studies of the Rhytididae of southern Africa (Herbert & Moussalli), the occurrence of a putative rhytidid species in Madagascar is of considerable significance. We therefore set out to obtain living material of *Helix covani* for anatomical study and molecular analysis, so as to acquire more reliable phylogenetic information regarding the relationships of this enigmatic taxon and test the hypothesis that the family Rhytididae is present in Madagascar. The species is evidently rare and restricted to montane rainforest remnants in eastern Madagascar, but we were successful in obtaining living material and here report on the results of our observations. Whilst the shell of *Helix covani* is very similar to that of some rhytidids, the anatomical and molecular data clearly show that it is not a member of the Rhytididae and that in all probability its prior referral to the Acavidae was correct.

Ancient vicariance and recent dispersal of springsnails (Hydrobiidae: *Pyrgulopsis*) in the Death Valley System, California-Nevada

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The Death Valley system (southeastern California and southwestern Nevada) contains a highly endemic aquatic biota that has long been the subject of compelling biogeographic speculation, yet remains little studied phylogenetically. Springsnails (Hydrobiidae: *Pyrgulopsis*) are one of the most diverse elements of this fauna, and are thought to have evolved in association with late Tertiary rearrangements of landscape and drainage. We assembled a molecular phylogeny for this fauna to investigate its evolutionary development in relation to regional geological history. Sequences for two mitochondrial genes were obtained from 80 populations representing 13 of the 14 Death Valley system springsnail species, and 31 extra-limital congeners. Combined analyses of the 1188 base pair dataset consistently depicted the Death Valley system fauna as a polyphyletic assemblage of eight or nine lineages. Based on a molecular clock, the six lineages endemic to the Death Valley system were estimated to be minimally Pliocene in age, which is concordant with inception of regional topographic closure during this time period. The single endemic lineage having a well resolved sister relationship was closest to a species from the upper Gila River basin, which also suggests an old divergence event. Three other lineages shared a pattern of shallow structuring (divergence events < 0.7 Ma) across multiple drainage basins, some of which have long been isolated. This suggests that, contrary to previous thought, regional springsnail biogeography has been shaped in part by geologically recent (Pleistocene) dispersal, and in some places occurred by means other than spread through continuous reaches of aquatic habitat.

New techniques yield new insights on the basic biology of living Microgastropods

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The microgastropod grade of evolution is rich in ecological and taxonomic diversity and full of unusual and unexpected biological phenomena. Little is known of the basic biology of most microgastropod taxa, including entire clades that are known only from shells. The challenge of closing the knowledge gap at the level of the living animal should have special appeal to those who are attracted to field research and recognition of novel phenomena. Advantages of microgastropods in comparative research include uniformity of size (attention to scaling is not required), life history properties conducive to rapid turnover and high evolutionary potential, and the availability of exemplar taxa across the phylogenetic diversity of Gastropoda. Microgastropod species that feed on microbial films may attain extraordinary population sizes for quantitative investigations, particularly those involving phenotypic and genetic variation and polymorphism. Microgastropod groups adapted to novel substrates in the deep sea and for life in extreme environments are attractive models for research in exobiology and paleobiological investigation of patterns of biosphere recovery following global crises and mass extinctions.

Chances of success in pursuit of the living microgastropod can be increased both by looking in unsuspected places and by using new sampling and concentrating techniques. Examples of new methods include: (1) the use of light traps and emergence traps and (2) investigation of novel animal-substrate interactions. Examples of new discoveries using these approaches include: (1) swimming, aggregation, and mass spawning of scissurellid gastropods at light traps, (2) diel vertical migration of microgastropods living on marine algae and seagrasses, (3) epipsammic browsing by species in three distinct microgastropod clades, and (4) mucous thread “kiting” and upside-down locomotion in surface tension.

Molluscan models for cardiac physiology

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Advances in cardiac physiology have proceeded in parallel in Mollusca and Vertebrata. The Law of the Heart was formulated for the human heart by Starling in 1897, and for the heart of *Aplysia fasciata* by Straub in 1904. The literature of cardiac mechanics is vast by now, but one may point out that it was advanced by studies on *Busycon canaliculatum* by Smith in 1985. Spike and plateau electrograms from molluscan hearts have been studied at least since the work of Rijlant in 1931. The relationship between force and the time course of the molluscan cardiac action potential has repeatedly been directed towards interpretation of modulation of cardiac function by bioactive substances. In several cases, it appears that the molluscan cardiac action potential has a calcium spike and a plateau phase consisting of sodium current under calcium control. This may be simulated as a computer model. Since 1967 *Aplysia* and *Dolabella* have been used for studies of neural control of cardiac muscle. The action of neurally released acetylcholine, from inhibitory cardiac innervation, was first shown to be mediated by induction of unitary IJPs in molluscan tissue. The bivalve *Mercenaria mercenaria* is an appropriate subject for the study of cardiac innervation.

Immunohistochemistry reveals neural processes that respond to anti-serotonin antibody. A serotoninergic antagonist, methysergide, reduces the amplitude of EJPs in the AV valve. IJPs are blocked by cholinergic antagonists, such as Mytolon and d-tubocurarine. IJPs in the AV valve of *Mercenaria mercenaria* invert to depolarizing potentials in low chloride medium. Serotoninergic control of the heart of the chiton, *Acanthopleura japonica*, indicates that serotoninergic excitatory control appeared early in molluscan evolution. Serotoninergic fluorescence histochemistry identifies fibers in the chiton heart and pericardium. Serotonin excitation of pericardial beating may be compared to serotoninergic excitation of the whole chiton heart. The ventricle of *Busycon canaliculatum* has been used as a test organ for identification of the characteristics of neuropeptides which determine relative levels of excitation of ventricular inotropism. This work is complemented by work with T. Fort and a number of collaborators, using the whelk radular protractor muscle as itself a model of molluscan cardiac muscle. Excitatory interaction of serotonin and acetylcholine provides a model for interaction between biopeptides. The radular protractor muscle, mounted in a double sucrose gap, has served for modeling, implementation and application of a new digital voltage clamp. This work, with the collaboration of Leon Collis and Jiang Wu has made a new Universal Clamp practicable. This digital voltage clamp has in turn been applied to ventricular trabeculae of *Spisula solidissima*.

Metal speciation and metallothionein induction after cadmium exposure in the terrestrial snail *Helix aspersa* (Gastropoda, Pulmonata)

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The effect of Cd²⁺ exposure on metallothionein induction and on the speciation of metals (Cd, Cu, Zn) were studied in the terrestrial pulmonates *Helix aspersa* (syn. *Cantareus aspersus*), to better understand their possible contribution to the trophic transfer of trace elements, and the potential bioavailability of the Cd they stored for consumers and predators. The soluble and non-soluble pools of the accumulated metals and their tissue distribution in uncontaminated and contaminated edible snails were investigated after a two-week exposure to Cd²⁺. In the soluble cytosolic pool of the hepatopancreas of *H. aspersa*, three metal-specific putative metallothionein (MT) isoforms were separated following a fractionation protocol with DEAE cellulose, size exclusion chromatography, ultrafiltration, and reversed phase (RP) HPLC. Interestingly, one of the above isoforms seems to bind both Cd and Cu which may in addition mobilize, after induction by Cd²⁺, some of the intracellular Cu, and thus perhaps increase the bioavailability of the Cu pool in the cytosolic fraction. The cDNA and its translated amino acid sequence of a Cd²⁺ binding MT isoform from the snail hepatopancreas was also characterized and attributed to one of the putative MT isoforms obtained upon RP-HPLC. The amino acid sequence of this Cd-MT isoform of *H. aspersa* was found to differ from similar sequences described in other terrestrial pulmonates, such as *Helix pomatia* or *Arianta arbustorum*, by only a few amino acids (6 and 10, respectively). That the identified Cd-MT from *H. aspersa* is inducible by Cd²⁺ was also shown, chromatographical evidence laid aside, by a specific PCR protocol on a cDNA basis, which included a non-inducible, house-keeping gene as a control.

Motivation to resist sex in a simultaneous hermaphrodite

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Sexual encounters are usually accompanied by conflicts of interest between mating partners. Theoretical modeling indicates that these conflicts may be more severe in hermaphrodites than in gonochorists. Using the simultaneous hermaphrodite *Lymnaea stagnalis* (Gastropoda, Pulmonata) we investigated behavioral aspects of sexual conflict.

It has been shown that the motivation of individuals to mate in the male role (conditional reciprocal insemination does not occur) is dependent on the amount of fluid present in the prostate gland. When an animal has not donated sperm for more than a week, the male sex drive is at a maximum. It is usually assumed that sperm recipients are passive during sexual encounters. However, female-acting copulants receive a sizeable amount of hormones together with the sperm, which interferes with their ability to optimally allocate resources to male and female functions and growth. Receiving an ejaculate may thus not be in the interest of an individual.

We focused on female resistance against insemination in behavioral experiments. Specifically, we examined the behavior of animals that 1) were isolated or grouped, 2) were satiated or starved, 3) had laid eggs or not and 4) were virgin or recently inseminated. These animals were all paired with individuals with maximal male-drive. By monitoring the behavior of the focal (treatment) animal, we attempt to dissect the motivation or resistance to accept an ejaculate.

Tag-team approach: Mitochondrial DNA and morphological assessment of Vietnamese freshwater gastropods (Caenogastropoda: Pachychilidae)

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The DNA Barcoding Initiative (DBI) has led to a lively debate on the utility of DNA sequences to assess the world's biota and identify species by the sequence of certain reference genes. Mitochondrial sequences, already instrumental for the inference of phylogenetic relationships of organisms, are increasingly being used by barcoders for the recognition and delineation of species. Generally it is not disputed that sequences contain taxonomically relevant information, but claims that barcode data should exclusively or preferential be used in taxonomic work are not widely accepted. In the present study we compared the degrees of morphological and mitochondrial differentiation of Vietnamese freshwater gastropods (Caenogastropoda: Pachychilidae), in order to determine whether analyses of reference sequences alone provide accurate species level identifications. For this purpose, fragments of two mitochondrial genes (COI, 16S) were analysed independently by reconstructing Maximum Likelihood phylograms. If species indeed can be recognized and delineated only by means of their mitochondrial sequences, then conspecific individuals should cluster together in well- individualized clades. Our observations were only partly consistent with this precondition: The trees produced a clear separation between several different sequence clusters, indicating the representation of individual species. However, various specimens clustered together in a loose group, making it impossible to unambiguously differentiate species. In addition, we found no correlation between genetic and morphological differentiation. By contrast, we observed high degrees of morphological differentiation in genetically rather homogeneous groups and vice versa. We conclude that mitochondrial genes are useful to explore the diversity of a given group, but reliable taxonomic decision should always be based on thorough analysis of both genetic

and morphological characters. Our study illustrates that sequence data collected for the DBI has to be coupled with existing taxonomic routines and morphological data to contribute to an accurate inventory of earth's biodiversity.

Notes on the distribution of the genus *Pagodulina* (Gastropoda, Orculidae) in the Eastern Mediterranean region: first record on the island of Rhodes (Greece)

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The finding of a tiny terrestrial snail from the Genus *Pagodulina* on the island of Rhodes is reported for the first time. The non-marine snail fauna of the island has been investigated several times in the past, but the only Orculids found so far were *Orcula dolium* and *Schileykula scyphus*. The distribution of the Genus *Pagodulina* in the region is discussed.

British Marine Bivalves - A web-based taxonomic tool for bivalves from the intertidal to 5000m

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Tebble's *British Bivalve Seashells* (1967) currently remains the primary taxonomic tool for the identification of bivalves around the British Isles. Here coverage is restricted to shelf depths and both the nomenclature and species list are in need of revision. Around the British Isles oil-exploration has extended into continental margin and bathyal waters requiring ecological impact assessments to be made. At these depths there is no single taxonomic tool available, filling this gap is the main requirement of our major sponsor the Dept. of Trade & Industry.

This project, for the first time, will create a web-based taxonomic tool for all species of bivalves found from the intertidal to the abyss. The geographic coverage will encompass between 48°N and 63°N and west as far as 20°W (Rockall). The project will include growth series (as available) and many variations in shell form. A variety of keys will be made with the aim of facilitating multiple comparisons. The imagery will all be taken using computer enhanced digital photography and Scanning Electron Microscopy. Nomenclature will primarily follow CLEMAM, with any taxonomic changes supported by published research.

Can freshwater mussel density be predicted by complex hydraulic parameters?

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Freshwater mussels are among the most endangered animals in North America. Changes in water quality, land use, and modification of rivers have been implicated in their decline. The St. Croix River is home to a dense and diverse assemblage of mussels and serves as an important refuge for these organisms. Despite their importance in rivers little is known about factors that control their distribution and abundance. Simple habitat factors, such as water velocity, depth and substrate type, are not strong predictors of abundance or diversity. The use of more complex hydraulic parameters shows promise. We randomly selected 40 locations in a 5 km stretch of the St. Croix River between

Interstate Park and Franconia, MN, USA. At each location we sampled 3 1-m² quadrats quantifying mussels, and collected sediment samples from 1 quadrat. Depth and velocity were measured with an acoustic Doppler current profiler under different discharge levels allowing us to measure the range of hydraulic stresses experienced by the river bottom. Complex hydraulic parameters (Froude number, boundary Reynolds number, shear velocity, etc.) were calculated. Analyses of covariance using the hydraulic parameters as a covariate and location (Franconia or Interstate) showed that there was a significant interaction between location and the hydraulic parameters Froude number, shear velocity and shear stress. The Froude number, shear velocity and shear stress are all higher at Interstate which harbors a greater density of mussels than Franconia. Mussel density was significantly correlated with these parameters (except Reynolds number), with large numbers of mussels corresponding to high Froude number, shear stress, turbulent flow, and thin laminar flow layers. These hydraulic parameters suggest that Franconia is a more depositional riverbed environment, which may account for the overall lower mussel density there. These data suggest that reach-scale hydraulic measurements may be helpful in determining habitat suitability for mussels.

Taxonomy of the genus *Trochulus* (Gastropoda: Hygromiidae) in the Czech Republic

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Genus *Trochulus* (formerly *Trichia*) was always considered to be taxonomically problematic. The previous research revealed substantial cryptic diversity in the surroundings of the Alps, however, little was known about situation in other Central European regions. Our study focuses on the question whether the observed morphological and ecological differences of populations in the Czech Republic can be explained by the presence of cryptic species, or by intraspecific variation.

We analysed 35 populations of two species of the genus – *Trochulus plebeius* and *T. hispidus* from Central Europe. Karyotype analysis revealed that all studied populations have identical number of chromosomes (n = 23) of similar morphology. Sequence analysis of 16S rDNA and COI showed two main divergent groups of *T. hispidus* populations. The molecular difference between these two groups is similar to the difference between the species *T. hispidus* and *T. plebeius*. Revealed lineages differ in geographic distribution (north-western versus eastern). The pattern given by analysis of shell morphology of studied populations does not correspond with lineages created by molecular analysis. To clarify the status of the two clades, we are conducting breeding experiments to test for the potential reproductive isolation.

Male-male and male-female agonistic behavior of *Abdopus aculeatus*

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Male-male and male-female agonistic behavior by *Abdopus aculeatus* was studied in situ in Sulawesi, Indonesia and a summary of interactions is provided. Smaller octopuses consistently fled from larger octopuses. Most male-male aggression occurred in defense of a female. ‘Grappling’ was most common between males that did not occupy a den within arm’s reach of a female and between males

closely matched in size. Male-female interactions involved fewer and less-physical acts than male-male interactions. Aggression did not appear to correlate with mate-rejection, reproductive strategy, or size, and thus did not appear to be an aspect of direct mate choice by females (although possibly by males). Although aggression was most common between males, males and females had similar degrees of arm injury, indicating that many injuries sustained at these sites might not result from aggression.

Assessment of *Dosidicus gigas* sperm longevity using fluorescence microscopy

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Cephalopod sperm demonstrate among the most prolonged longevity of any animals. During mating, many male squids deposit sperm in packets ('spermatangia') externally to the female's buccal area where it is then stored for an unknown time before fertilization at spawning. An understanding of sperm longevity is integral to our understanding of reproductive activity in cephalopods. So that we may measure sperm longevity of species that must be examined at sea, we employed an alternative to traditional motility assays, thereby avoiding the complications of shipboard vibration and the occasional need to conduct analyses well after samples have been taken. Spermatangia of *Dosidicus gigas* were stored in 1 ML filtered seawater at 12°C for seven days, and sperm suspensions fixed in 3% formaldehyde every six hours. Samples were then refrigerated and protected from light until examined at a later date using fluorescent microscopy. Taking advantage of the autofluorescence of fixed squid sperm, we counterstained sperm suspensions with the cell-impermeable dye Propidium Iodide, which only enters dead cells. Ratios of live to dead sperm at time of fixing were calculated to create a mortality curve for this species.

Synanthropic terrestrial mollusc faunas of Colorado and Utah

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Our aim was to establish semi-quantitatively which are the important synanthropic species in big conurbations such as Denver and Salt Lake City positioned either side of the Rocky Mountains, but both with a similar continental climate, and both only 150 years old. The synanthropic sites surveyed were mostly garden centres, flower beds and bushes around town centres, public gardens, parks and cemeteries. We sampled 31 sites in Colorado, from Fort Collins to Colorado Springs, and 28 sites in Utah, from Provo to Logan. At most cultivated sites the generous and regular watering, usually automated, sustained a mollusc fauna, sometimes to the extent that gardeners felt the need to apply molluscicides. Wood-chip mulch was extensively used to conserve moisture, and was particularly favourable for *Vallonia* and other species, especially underneath spreading perennials. However, some sparsely watered allotments seemed devoid of molluscs and most uncultivated rough ground also dried out too much. European and Holarctic species predominated. The introduced *Deroceras reticulatum*, *Oxychilus draparnaudi* and *Arion fasciatus* were particularly widespread, extending also into some less disturbed sites along rivers and in the mountains. Several other introduced pest species (e.g. *Deroceras panormitanum*) were more widespread than published records suggest, and by dissecting material (where necessary after rearing to adulthood) we recognised species that are mostly not distinguished in the North American literature. The garden centres were especially rich in molluscs, and extensively supplied with material from out of state, thus providing a ready means for the spread of exotics despite the difficulty of unassisted dispersal in the dry climate. This would explain the similarity in faunas within and between states. More introduced species were established

in Utah (e.g. *Oxychilus alliarius*, *Arion intermedius*), but *Oxychilus cellarius* appeared only in Colorado (two sites); similarly within Colorado *A. circumscriptus* was restricted to localities around Boulder.

The widespread slug *Limax maximus* Linnaeus, 1758 (Gastropoda: Pulmonata): species boundaries and redescription

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Limax maximus is a terrestrial slug belonging to the family Limacidae (Mollusca, Gastropoda, Pulmonata). It is the type species of *Limax* and is also one of the most widespread and externally variable species in the genus. In addition, *L. maximus* has been introduced throughout the world. Before any biological control can be considered, *L. maximus* needs to be well understood in its natural environment.

Limax maximus can be distinguished from most other *Limax* species by the presence of a uniformly pale sole and spots on the mantle as well as the body. Considerable colour variation exists, however: The background colour can range from pale cream to dark grey, and patterns vary considerably from few spots to thick longitudinal stripes. Some forms are almost completely black, with spots just visible at the edge of the mantle. The objectives of the present study were to sample specimens of *L. maximus* from throughout the geographical range and across the full spectrum of colour morphs in order to use anatomical and molecular data to determine the limits of the species.

Our molecular dataset was based on 1334 nucleotides of the mitochondrial gene cytochrome *c* oxidase subunit I (COI) for more than 30 specimens of *Limax maximus* from throughout Europe and from Australia, New Zealand, North America and Hawaii. Additional *Limax* and other limacid species were also included. Analysis using Bayesian Inference indicated that all *L. maximus* specimens belong to a single species, with overall variation of 1.4%. Slugs of similar external appearance did not group together.

Dissections reveal little variation within *Limax maximus* in any organ system. Slight differences in the length of the blind penis tip did not correspond with any grouping on the molecular tree. However, *L. maximus* can clearly be distinguished from other *Limax* species based on anatomy. The most important characters include the length and coiling of the penis and the position of attachment of the vas deferens and penis retractor muscle.

Evolutionary ecological aspects of the geographic variation in the intertidal gastropod, *Monetaria annulus* (family Cypraeidae)

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As with the other cypraeid species, *Monetaria annulus* is particularly suitable for investigating molluscan body size variation because of their determinate growth. In Okinawa Island (Japan), *M. annulus* is found in the lower intertidal zone on fringing reefs, and exhibits a remarkable geographic variation in body size at maturity; soft body size in adult individuals is smaller in shallower habitats located at the landward margin of reef flats, partially covered by coralline rubbles and sand (referred to as “inshore habitats”) than in slightly deeper habitats on the outer edge of reef flats, characterized by exposed rocky substrates (“offshore habitats”). Through a common-garden experiment in which minute juveniles collected from the two types of populations are reared in the same environmental condition in the laboratory, I recently demonstrated that phenotypic plasticity, instead of genetic

differentiation, is responsible for the among-population body-size variation. To explain the proximate mechanisms of the variation, furthermore, I considered and examined two mutually non-exclusive hypotheses: (1) body size of the individuals newly recruited into adult populations is smaller in inshore habitats than in offshore habitats; (2) size-dependent adult mortality enhances the size variation, i.e., larger adults are selected out in inshore habitats, and vice versa. A quadrat-based monthly field research from February 2005 to February 2006 supported the first hypothesis, but the second hypothesis was rejected by the mark-recapture sampling in inshore habitats. Consequently, I concluded that the among-population size variation in Okinawa Island is primarily caused by the phenotypic plasticity in size at maturity. I also propose a hypothesis that provides an adaptive explanation on the observed pattern; smaller size at maturity may be a by-product of earlier maturation and longer reproductive period, which is expected to be adaptive in inshore habitats where a shorter lifetime is imposed.

The European bivalve *Nucula nucleus* (LINNAEUS) and its alleged fossil record – an example for what we really know about the fossil history of our recent fauna

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The protobranch bivalve *Nucula nucleus* (LINNAEUS 1758) is a well known element of the marine mollusc fauna of the European seas, widespread in the Eastern Atlantic from the North Sea to Western Africa and in the Mediterranean Sea.

According to the paleontological literature the species formed already a regularly occurring constituent of many fossil deposits as early as since the beginning of the Miocene (ca. 24 my). So we can find records of it for the Early, Middle and Late Miocene as well as the Pliocene of the Mediterranean province, further for the Early and Middle Miocene of the Paratethys basin and finally for the Early Miocene until the Pliocene of the North Sea Basin. This fossil distribution seems to show that the species represents an old European endemic faunal element with a broad adaptation to subtropical to temperate resp. cool climates.

However, a critical survey of the fossil populations from various fossil localities and stratigraphical stages from all European Miocene basins demonstrates that the picture is not as simple as supposed. In fact it can be shown that the Miocene records apply to a number of different species, none of them being closely related to *N. nucleus*. The first fossil occurrence which can be attributed with certainty to that Recent species dates from the Pliocene (ca. 5 my). The example of *N. nucleus* demonstrates how much basic taxonomical work still is needed to answer the question of the phylogenetical roots of certain elements of our Recent European mollusc fauna.

What shall we do with the old descriptions?

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Collecting tiny, cryptically colored specimens from remote, difficult to access places is definitely a major constraint on describing new species of Sacoglossa (Gastropoda, Opisthobranchia). However, the detective work of finding old, inadequate descriptions of species, which have not been collected since their original description, may also be a time consuming task. Many of these species have been described from only a single preserved specimen and type material has not been deposited. In some cases the original description does not include an illustration of a complete specimen, live or preserved. The description itself often consists of only a few lines that can fit almost any species in the genus or even family, or, conversely, does not seem to fit any species collected subsequently.

A recent review of the biogeography of the Sacoglossa yielded 36 species that had been described before 1900 plus 13 species described between 1901 and 1950 and never collected since the original description. If names were only used by taxonomists, the easy thing would be to ignore these species names until something turned up that would once and for all establish their identity with the selection of neotypes. However, species names are also used for conservation and environmental monitoring. If taxonomists decide to leave out these uncertain species names, are we then manipulating the data? Are we also trying to manipulate the conservationists and decision makers? If the names are included in species lists, may a certain place then become a species diversity hotspot? A center of endemism? When it may just be the victim of a long deceased, incompetent taxonomist. These questions will be discussed using sacoglossan examples.

Examining changes in morphological disparity along a latitudinal gradient in the Neogastropoda

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The morphological disparity (examination of the distribution of morphology) of Neogastropod radulae was investigated across regional assemblages in the western North Atlantic. This is a preliminary analysis with radulae scored for over 60 species. Regional species assemblages were compiled from published collection lists for the Bay of Fundy (16/24 species), Long Island (14/19 species), Delaware (13/18 species), North Carolina (30/110 species), and northern Florida (43/139 species). (Numbers in parentheses are the number of species occurring in that locality included in the analysis out of the total number of species recorded at that locality). The radula of each included species was scored for 47 characters. These include a mix of binary, meristic, multi-state, and quantitative characters. The entire resulting dataset was ordinated using principle coordinate analysis, and then grouped by locality. The differences in volume, centroid, and nearest-neighbor distance between localities were quantified, and the analysis was performed using morphological rarefaction to control for differences introduced purely because of differences in species number. Average nearest-neighbor distance between species in the morphospace is uncorrelated with latitude, while volume decreases significantly with increasing latitude. There is also a marked shift in the morphospace centroid caused primarily by the loss of the Marginellidae from northern species lists. Instances of apparent “displacement” of one family by another in the morphospace will also be discussed.

Development of an initial conservation assessment for North American freshwater gastropods

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In 1993 the American Fisheries Society (AFS) published a general conservation assessment of freshwater mussels of North America authored by J.D. Williams et al. This mussel assessment was followed by similar assessments for crayfishes and southeastern fishes. The AFS has granted

permission to begin a conservation assessment for North American freshwater gastropods and an initial committee has been formed. The final evaluation will be based on our current understanding of freshwater gastropod taxonomy. Breaking with earlier assessments, we seek to replace categorical rankings (i.e. Endangered, Threatened, Species of Concern, etc.), with more definitive G-rankings that are actively monitored by NatureServe, state Natural Heritage Programs and UNITAS. A draft evaluation focusing on 655 species in all 50 states and 11 Canadian Provinces was completed in early 2004. This initial assessment determined 60 species of freshwater snails are likely extinct, at least 310 additional species rank as G1 or G2, with another 75 species listed as G3. Thus, 445 currently valid aquatic gastropod taxa are extinct, endangered, threatened, or of special concern – the highest level of imperilment for any group of animals in North America. The initial draft checklist will be presented and comments from symposium participants solicited.

Molecular phylogeny as a lens for examining morphology and biogeography: Examples from the chromodorid nudibranchs

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Chromodorid nudibranchs are a diverse, beautifully colored family of shell-less opisthobranchs found worldwide, mainly in the tropics. The last comprehensive study of the entire group is 23 years old and was based solely on morphology. Except for a few cases, many morphological characters used to diagnose genera are continuous or can be found throughout the group. This lack of understanding of characters has led to both the expansion of genus diagnoses and the creation of new generic names for unusual morphology. These problems combined with the regional nature of many previous studies have added to the difficulty of determining monophyletic groups and polarizing morphological characters for phylogenetic analyses. Previous molecular work on chromodorids has been limited to fewer than 10% of the more than 300 described species. Of these sequenced species the majority are from the Atlantic and eastern and southern Australia. The Indo-Pacific tropics are home to the greatest diversity of chromodorid nudibranchs, and yet the bulk of this fauna has never been included in any molecular studies of the group. In this study, thanks to targeted collecting trips, dedicated collectors and DNA extracted from museum collections, I was able to include specimens from the Indo-Pacific, eastern Pacific and Caribbean. I sequenced fragments of the mitochondrial genes, cytochrome oxidase I (658bp) and 16s (~330bp), for over 225 individuals, representing 120 species and 15 of the 17 genera currently classified in the family Chromodoridiade. By including three species of from the Actinocyclusidae and other dorid nudibranchs in my data set, I was able to test the monophyly of the chromodorids, the proposed sister group relationship of the actinocyclusids to the chromodorids as well as further investigating the relationships among chromodorids. This phylogenetic hypothesis is a framework for further examining morphological characters, discovering synapomorphies, delineating monophyletic groups, and exploring biogeographic questions.

**Associations between shell strength, shell morphology and heavy metals in the land snail
Cepaea nemoralis (Gastropoda, Helicidae)**

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In snails there is an intimate relation between shell size, thickness, strength and calcium content which may be influenced by environmental factors such as predation and heavy metal pollution. The snail *Cepaea nemoralis* shows variability for shell colour and banding pattern, and frequencies of colour morphs are highly variable in natural populations. We used *C. nemoralis* to investigate (i) the relations between shell morphology, shell Ca and heavy metal content (Cd, Cr, Zn), and shell strength, (ii) differences in shell morphology and shell strength among localities and yellow and pink shells and (iii) whether snails from polluted sites show increased levels of heavy metals in their shell. Larger shells were heavier, thicker, needed a higher force to be crushed but did not have a higher Ca concentration. Cd and Zn concentrations were higher in shells from polluted plots compared to shells from unpolluted plots but Ca levels in the shell were comparable among plots. Zn concentration was negatively correlated with shell traits. Although there was substantial variation in shell strength, thickness and dry weight among localities, none of the shell traits differed between individuals from polluted and reference plots nor between colour morphs. Our results suggest that the effect of heavy metal pollution on shell strength and morphology is limited in the investigated populations.

Shell shape and mating behaviour in hermaphroditic gastropods (Mollusca, Pulmonata)

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Previous work suggests that low-spired hermaphroditic snails mate face-to-face and have reciprocal sperm exchange, whereas high-spired snails mate by shell mounting and have unilateral sperm exchange. This observation has stimulated others to speculate on the evolution of enigmatic mating behaviours and whole-body enantiomorphy. We reviewed the literature on mating behaviour in pulmonate snails and show that i) several pulmonate species show considerable intraspecific variation in mating behaviour, ii) mating position does not predict reciprocity of penis intromission and sperm exchange, iii) dart-shooting may be correlated with reciprocity of sperm exchange but other factors must explain the gain or loss of darts, iv) it seems unlikely that the degree of reciprocity is the most important factor in explaining the relation of whole-body enantiomorphy and shell shape, and v) the reciprocal intromission of penises does not necessarily involve the reciprocal transfer of sperm. Therefore, current ideas on the evolutionary relationship between shell shape and reciprocity with whole-body enantiomorphy and sexual selection (including dart-use) in hermaphroditic snails should be refined.

A molecular phylogeny of apple snails (Gastropoda: Caenogastropoda: Ampullariidae) with emphasis on the African species

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Ampullariids are widespread in Africa, Asia and South and Central America. Between 7 and 10 genera are currently recognized depending on the authority. A basal phylogenetic relationship of the African genera *Afropomus* and *Saulea* has been inferred based on anatomical evidence. Until recently the Viviparidae was believed to be the sister-group of Ampullariidae but recent molecular data infer a sister-group relationship with Campanilidae. We have used members of both families as outgroups in the present investigation on ampullariid phylogeny. We have used data from five molecular loci *i.e.* the nuclear genes 18S rRNA, 28S rRNA and H3 and the mitochondrial genes 16S rRNA and COI. Our preliminary data most often infer a basal position of *Afropomus*. The position of *Saulea* is more ambiguous being inferred both as the second most basal taxon but also as a member of a clade including the South American *Marisa* and *Pomacea*. The African genus *Lanistes* is inferred to be paraphyletic by the conserved 18S and 28S, but form a clade when H3 and 16S are analysed. COI also infer paraphyly, but this gene show evidence of beginning substitutional saturation. The African and Asian genus *Pila* is most often inferred to be monophyletic (except for 28S). A sister-group relationship is most often inferred between *Lanistes* and *Pila*. The species radiation of *Lanistes* in Lake Malawi did only show 0.64% and 1.22% sequence variation in COI and 16S, respectively, between *Lanistes ellipticus*, *L. nyassanus* and *L. solidus*. This suggests that the morphological divergence has happened much faster than the molecular divergence.

Sex in the beach: reproduction of the aphyllid, interstitial *Pontohedyle milaschewitchii* (Acochlidia, Opisthobranchia)

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Within the opisthobranchs external sperm transfer via spermatophores is very unusual and knowledge on the structure of opisthobranch spermatophores and the insemination following the placement of the spermatophores on the body wall is scarce. The mainly minute and interstitial Acochlidia are known for an extraordinary reproductive life, such as for the occurrence of gonochorism, the remodelling up to complete reduction of the male copulatory organs, and for the development of different modes of sperm transfer: by copulation, by hypodermic injection and via spermatophores. Spermatophores in Acochlidia are known from the gonochoristic Microhedylidae, the hermaphroditic Asperspinidae and are also suggested for at least one likewise aphyllid species of the hermaphroditic Hedylopsidae.

The ultrastructure of spermatophores and spermatozoa of the microhedylid *Pontohedyle milaschewitchii* (Kowalevsky, 1901) were studied using transition electron microscopy (TEM). Spermatozoan morphology was reconstructed 3-dimensionally from ultrathin serial sections using AMIRA software. The movement of the spermatozoa during the discharge of the spermatophore could be observed directly under the fluorescence microscope using DAPI-staining of the nuclei. Spermatophores of *P. milaschewitchii* were placed indifferently on head-foot complex and visceral hump of the counterparts (including other males and immature specimens). The discharge of the spermatophore lasted various hours. The spermatozoa were observed moving actively and

independently, some successfully intruding into the body tissue, others moving along the body surface. Similar to the situation in *Microhedyle remanei* (Marcus, 1953) mature sperm of *P. milaschewitchii* shows a midpiece surrounded by one single glycogen helix. The extremely elongated and keeled sperm nuclei are discussed to be an adaptation to the mode of hypodermal insemination, easing the sperm to intrude into the epidermis and move through the body tissue in a corkscrew-like manner.

Molluscs in human impacted habitats - summary of present records in the Czech Republic

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The composition of molluscan assemblages of several human impacted habitats in the Czech Republic is presented: castle ruins, after the Second World War ruined villages, old quarries, big cities, motorway verges and fields. Malacocoenoses of nearly 500 localities were compared using published and unpublished mostly author's data. Individual habitats represent various succession stages. Higher proportion of invasive species occurs in the molluscan assemblages of fields (almost 70% localities) and big cities (25 % localities), in other type of habitats it is under 10%. The number of localities with synanthropic species was surprisingly lowest in motorway verges and old quarries, and highest in field and cities again. All ruined villages, and nearly all castle ruins host anthropophobic species, and approximately 50 % of these localities host strong anthropophobic molluscs. The number of localities inhabited by these species decrease from quarries, cities, and motorways to fields. The most slugs occur in fields, and no slugs live in the motorway verges. The habitats of early succession stages (motorway verges, fields) host more invasive, catholic, and synanthropic species. By contrast, the habitats of the later succession stages (ruined villages, and castle ruins especially) represent refuges for anthropophobic species in the surrounding human impacted landscape. In a region of long human impact history, like Central Europe, long-term coexistence of humans with nature led to development of specific molluscan assemblages adapted to different habitat types.

Importance of Cretaceous methane-seep associations in Japan for deciphering the evolution of chemosynthesis-based communities

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Since long time Japan remains in active margin zone and starting from Cretaceous sources well-preserved material from the chemosynthesis-based associations represented by numerous gastropods, bivalves, decapods, and vestimentiferan tube worms. Studied material suggests that some modern distribution of animals in the chemosynthesis based communities might be strictly connected to their place of entering such community and its further local evolution. The Cretaceous methane seeps in Japan reveal some striking similarities to their recent counterparts. Acmaeid limpets *Serradonta*, which is apparently, still endemic for Japan also in Cretaceous lived on vestimentiferan tubes. Another acmaeid *Bathyaemaea* is also found in the Cretaceous seeps. This is the only known

occurrence of this gastropod in the fossil record while nowadays its occurrences are spread southward along the western Pacific active zone. The Cretaceous seeps are densely settled also by ataphrid gastropods which might be related to turbinids. This species was apparently an early member of Japanese type of chemosynthesis-based communities as nowadays similar gastropod is known exclusively from a single spot at hot vent field in Okinawa Through. Least but not last, the Cretaceous methane seep deposits contain high diversity of provannids and/or provannid-like gastropods. Silicified Cenomanian provannids from the Kanajirisawa locality (Tappu area of Hokkaido) preserved details of their protoconchs proving undoubtedly their pre-Cenomanian origin. These decollate protoconchs of Cenomanian provannids are strikingly similar to their recent counterparts widely distributed in most of the chemosynthesis-based communities. Lack of other animals so common in the recent chemosynthesis-based communities accounts on their post-Cretaceous origin.

The laboratory tests on some chemicals in reducing slug grazing

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Arion lusitanicus Mabille, 1868 (*Gastropoda: Pulmonata: Arionidae*), is one of the most important pest in the south Poland where cause serious damage to vegetables, ornamentals and crops. Control of this slug, as others, augment a lot of problems. In the Poland there are only six molluscicides registered with only two active substances: methiocarb and metaldehyde. Efficiency of these plant protection products is usually disappointed, moreover these molluscicides can be harmful for beneficial organisms. That's why new substances and new methods for control slug populations has to be studied. In the 2007 in the Institute of Plant Protection laboratory tests on effectiveness of some chemicals in reducing slug grazing and damage to plants were carried out. The tests were made on Chinese cabbage leaves and oilseed rape seedlings with 13 active substances in two concentrations. The active substances from different chemical groups were tested: monoterpenes (α -pinen, α -terpineol, limonene, carvone), triterpenes glycosides (saponin from roots of *Saponaria officinalis*), tannins (tannin), alkaloids (9-amino-1,2,3,4-tetrahydroacridine, benzylnicotine), dimethyl dithiocarbamates (thiram), molluscicides (methiocarb, metaldehyde) and amino acids (acetylcysteine). The acetyl cysteine was tested separately and in solutions with methiocarb, metaldehyde and thiram. In presented experiments the vitality of slugs and percentage of damage to leaves of cabbage and oilseed rape seedlings were noted. The best results in reducing slug grazing were showed by methiocarb in both tested concentrations (0.1 and 0.5%). The good results against slugs were also obtained with carvone, α - pinen and mixtures: methiocarb and metaldehyde with acetylcysteine. The obtained results showed that consecutive tests with tested active substances in different concentrations should be made. The future experiments should concern on other natural substances which can impact on slugs activity and feeding.

Cryptic diversity of gastropods in oxygen-poor intertidal habitats; systematics, ecology and evolution of the Phenacolepadidae

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Over the last three decades, increasing attention has been paid to reveal the taxonomic and evolutionary diversity of gastropods in deep-sea hydrothermal vents and cold seeps as well as in sunken-wood and whalebone communities. Yet, few scientists acknowledge the presence of a gastropod assemblage associated with similar, dysoxic and sulphide-rich environments in more easily

accessible tidal flats. This assemblage can be found on the under-surface of deeply embedded stones and decaying wood, sometimes with filamentous bacterial mat. Species exclusive to the assemblage belong to Phenacolepadidae, Irvadiidae, Elachisinidae, Vitrinellidae and Cornirostridae. Their close relatives often inhabit vents, seeps and/or sunken wood, suggesting ties between these shallow- and deep-water biotopes.

Phenacolepadidae is a group of limpets and snails adapted to various dysoxic environments in shallow and deep seas including vents, seeps and sunken wood. They bear a huge gill, and their blood is crimson as they have red-blood cells or erythrocytes to increase capacity to transport oxygen. Taxonomic diversity of the family is much higher than previously expected. Dozens of undescribed species have been found from such intertidal habitats as the underside of deep-embedded stones and driftwood and the inside of shrimp burrows. Mitochondrial (COI, 12S & 16S) and nuclear (28S) gene phylogenies reveal two robust clades in Phenacolepadidae: one with shallow-water and sunken-wood species and the other with vent and seep taxa. Each shallow-water, sunken-wood and vent group is polyphyletic or paraphyletic, indicating repeated habitat shifts since the late Cretaceous or early Cenozoic. These recent habitat shifts are well explained by their high dispersal capability. Evidences from laboratory culture, geographic distribution, population genetics, protoconch and opercular morphology suggest extended larval period in the open ocean for all phenacolepadids. Re-evolution of shell coiling and functional operculum is plausible for the methane-seep snail *Bathynnerita*, a descendant of the vent limpet *Shinkailepas*.

What is supporting the Neogastropoda monophyly? New evidences for the paraphyly

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Neogastropoda are generally considered monophyletic, although this usually is contradicted in molecular analyses. The latter requires serious reconsideration of the syn- ant autapomorphies defining the group. One of the uncontroversial monophyletic groupings within the Neogastropods is the superfamily Buccinoidea. This very taxonomically rich clade lacks 2 out of three characters, which are considered as key autapomorphies, namely accessory salivary glands and the rectal gland. The only other autapomorphy of the Neogastropoda uniting Buccinoidea with the rest of the group is the so-called valve of Leiblein.

The study of the morphology of the valve of Leiblein of different Neogastropods (2 species of Raphitominae, Conidae, one of Muricidae, one of Nassariidae, one of Buccinidae, one of Cancellariidae, one of Volutomitridae) revealed its strong morphological heterogeneity. E.g. in Muricidae, Volutomitridae and Cancellariidae the dorsal folds (and corresponding groove) of the anterior oesophagus can be traced within the valve, while in Buccinacea the lumen of the valve is uninterrupted. In Cancellariidae the cone of cilia is absent, while the valve itself is very long, spiral forming nearly three volutions.

Published and original data on the embryonic development of the valve in Buccinidae and Muricidae demonstrated that it originates from different sections of the anterior foregut.

The preliminary data indicate that the homology of the valve of Leiblein within Neogastropoda is at best questionable. This is casting doubts in the monophyly of the Neogastropoda in general, which probably include at least two stems.

Contrasting distribution patterns of microsnails and macrogastropods of forest in Tenerife, Canary Islands

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The snail fauna of the Canary Islands is characterized by a high number of highly endemic species that may even be restricted to a small area within a single island. Thus, it may be expected that the islands show a distance-related faunal gradient. We studied the gastropod fauna from the forests of Tenerife, Canary Islands. Sampling was performed in a total of 27 sites in the “Monteverde” (laurel forest) zone up to the lower “Pinar” (pine forest) zone of the regions Anaga, Orotava valley (W and SE), Teno, and Güimar. At each site, we took eight parallels covering a total of 0.5m². The analyses revealed some major faunal divergence between two larger areas (comprising two and three regions each), but also some additional differences between single regions. Many differences between the single regions were significant only if the microsnails (< 5mm shell size) were included. The exclusion of the microsnails enhanced the expected picture of a distance-related faunal gradient at least for the monteverde of the northern slope. We conclude that microsnails that have higher population densities than macrogastropods also have a higher dispersal probability than the latter group. As a result, microsnails seem to be indicators of recent environmental conditions, whereas the occurrence of many of the macrogastropods may be related to historical refuges.

Mapping the biodiversity of land snails in Turkey: A preliminary study of hotspot analysis

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Although incomplete, malacofauna of Turkey has been studied since 1700s and the current data can be used for generalizations on the fauna. According to the literature and our studies, 20 families and 593 species of land snails and slugs represented with significant subspecific divergence (totally 707 taxa) in some families (like Clausiliidae) occur in Turkey. In the present study, in which the taxa were taken as units, current data on the distributions of land snails in Turkey were evaluated from the aspects of endemism, chorotype, species richness and biodiversity. Also, the factors affecting the richness and vulnerability were also discussed.

Analysis of the 3' untranslated regions of α -tubulin and S-crystallin mRNA and identification of CPEB in dark- and light-adapted octopus retinas

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We have previously reported the differential expression and translation of S-crystallin and α -tubulin mRNAs and protein in dark- and light-adapted octopus retinas. Real-time PCR analysis of light-

adapted retinal mRNA showed 1.4- and 2-fold inductions of α -tubulin and S-crystallin, respectively, when compared to dark-adapted retinas. Percent volume analysis of dark-adapted retinal protein showed that α -tubulin and S-crystallin were 2-fold more abundant when compared to light-adapted retinas. Coinciding with the observed differential expression are the following morphological changes of dark- and light-adapted rhabdomeres: the number of rhabdomeric microvilli increase in the dark, resulting in the growth of rhabdomeres; whereas, there is a decrease in the number of rhabdomeric microvilli in the light, resulting in the diminution of the rhabdomeres. We believe that mRNA for these cytoskeletal proteins may be stored and translated when needed in either the dark or light. If masking and unmasking of these mRNAs does occur, then regulatory elements or sequences should be present in the 3'UTR regions. CPEB is a 62 kDa trans-acting RNA binding protein, which binds to the variable CPE consensus sequence, U₄₋₅A₁₋₃U, in 3' UTR regions of mRNA, and is indicated in temporal regulation of translational activation and repression. Using western blot analysis and immunocytochemistry, we have identified the presence of CPEB in dark- and light-adapted octopus retinas. Using 3'RACE analysis of the 3' UTR regions of α -tubulin and S-crystallin mRNAs, we have detected the following CPE-like sequences in the 3' UTR of isolated 326-bp S-crystallin A and B variants: UUUAACA, UUUUUAA, and UUUUA. The detection of CPEB and the identification of the putative CPE-like sequences in the S-crystallin 3' UTR suggest that CPEB may be involved in the activation of masked S-crystallin mRNA, but not in the regulation of α -tubulin mRNA, resulting in increased S-crystallin protein synthesis in dark-adapted octopus retinas.

Morphological and molecular characterization of the Roman snail *Helix pomatia* with data on the phylogeny of the genus *Helix* (Pulmonata, Helicidae)

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Diagnostic uncertainties have favoured fraudulent traffic of different edible snails which are sold under the name of the costly Roman snail: *Helix pomatia*. The application of molecular markers combined with diagnostic morphological characters is thus decisive for reliable identification of the species in natural and non-natural conditions as well as in prepared food products. Given the commercial value of the Roman snail and the lack of knowledge about its phylogeography, we endeavoured to cover most of the species range with our sampling (i.e. Sweden, Denmark, Germany, United Kingdom, France and Italy). The study is based on analysis of sequence variation at two mitochondrial (CO1 and 16S rRNA) and two nuclear (ITS-1 and ITS-2) genes plus detailed study of genital structure. To place the study in a wider phylogenetic context we also included four congeneric species from European sites (*H. campana*, *H. cincta*, *H. ligata* and *H. lucorum*), plus four other helicids (*Cornu aspersum*, *C. mazzullii*, *Eobania vermiculata* and *Helicigona lapicida*) as outgroups. Molecular data supports the monophyly of the genus *Helix* and robustly clustered all Roman snail populations included in the study. We found seven haplotypes in *H. pomatia*, five of them unique to single populations and only two shared among different populations (France-NW Italy and Sweden-Denmark, respectively). The relatively little divergence detected among haplotypes (from 1 to 6 substitutions) suggests recent northward expansion (historical and at least partly human-mediated) of the species. The anatomical analyses are in full agreement with the above scenario. All of the Roman snail populations showed substantial uniformity of the genital characters examined.

Distribution and ecology of Thyasiridae (Mollusca: Bivalvia) in coastal waters of Hordaland, Norway

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As pollution of marine environments is getting more of an issue and the oil industry, among others, has become more interested in monitoring marine environments, the search for species able to respond to environmental changes related to oil spills or other forms of pollution, is more focussed. Several marine species have been recognized as environmental indicators, and bivalves seem to be important. Their filter-feeding behaviour renders them sensitive to environmental change and responses to pollution may both be positive and negative.

The Thyasiridae is a group of burrowing bivalves occurring in both shallow and deep waters. Sixteen species are currently recognized from the North-east Atlantic, of which 12 have been reported from the British shelf. A similar number of species is expected to be found in Norwegian coastal waters. Several species live in symbiosis with sulphide oxidizing bacteria. With their extensive burrowing behaviour they contribute to oxidizing the sediments, and in their deep burrows they mine the reducing sediments for sulphides. This behaviour is interesting since it means that the species can re-oxidize reducing and polluted sediments, making the sediments more attractive to sulphide-intolerant benthos.

It has previously been difficult to study the Thyasiridae due to lack of sufficient literature, therefore, not much is known about the genus in Norwegian coastal waters. By revising extensive museum material and re-sampling several stations we want to (1) provide an overview of the populations of the different species along the coast of Hordaland, accompanied by geographic and bathymetric information, and (2) collect data from sediment analyses in order to investigate the potential of the Thyasiridae as environmental indicators. The material will be documented using SEM images.

Thyasira succisa, not previously described from coastal waters in Norway, has been identified from samples taken in 2003, deposited at the Natural History Museum in Bergen.

The evolutionary adaptation of mollusks to deep-sea vents: insights from their fossil history

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Deep-sea hydrothermal vents and methane seeps are inhabited by numerous molluscan clades. It has been proposed that mollusks used sunken whales and wood (coined whale- and wood-falls) as 'stepping stones' during their adaptation to these extreme environments. This 'stepping stone hypothesis' is here explored using fossil evidence. Numerous whale- and wood-fall communities have been found in Late Eocene to Early (35-20 Ma) Miocene deep-water strata in Washington State, USA, including the oldest whale-fall community known to date. The Eo-Oligocene (35-23 Ma) whale-fall communities lack typical vent- and seep-type taxa but are very similar in their taxonomic composition to contemporary wood-falls. The lack of typical vent/seep taxa at the early whales shows that the early whales were not used as stepping stones by these taxa, contrary to the prediction of the 'stepping stone hypothesis'. It was apparently not before the middle Miocene (16 Ma) that decaying whale carcasses were sulfide-rich enough to support vent- or seep-like communities.

The value of analyzing *Pisidium* faunas

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Species of the genus *Pisidium* (Sphaeriidae) are the most diverse and numerically abundant group of bivalves in European lowland river systems. However, there have been relatively few studies that have examined the fauna in detail within a large river catchment. Samples of *Pisidium* were collected from 158 sites on the River Thames, England and 18 of its tributaries. Quantitative sampling of *Pisidium* is problematic and thus the aim was to collect between 200 and 500 individuals at each site which were then analyzed quantitatively. All individuals were identified and the numbers of each species converted to a percentage of the whole sample. Twelve species of *Pisidium* (75% of the British fauna) were recorded from the Thames catchment. The results showed many differences in species composition and relative abundance both between rivers and within individual rivers from upstream to downstream. There was some evidence of a correlation between species distribution/abundance and environmental factors (habitat and water quality). Species relationships were also examined using Bray-Curtis similarity. Sampling of selected sites in successive years demonstrated that the sampling method used for the study gave results on the species' composition and relative abundance that were both representative of the site, and repeatable. A further aspect of the study was on *Pisidium tenuilineatum* Stelfox, 1918, a species which is believed to rare across its European range and is Red Data listed in several countries, including Britain. Prior to this study, *P. tenuilineatum* was known only from a few sites in the River Thames and some of its tributaries. During the present study it was recorded in 15 of the 19 rivers, and at 96 of the 158 individual sample sites. Thus, the Thames catchment has a high conservation value and the data gathered should allow a more informed conservation and management policy to be developed.

Cutting the Gordian knot of a taxonomic impediment A plea for MOTU-numbers (Molecular Operational Taxonomic Units)

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Current activities in molecular taxonomy and various barcoding initiatives are defining a large number of organismic units. However the “taxonomic impediment”, i.e. the lack of taxonomic specialists, hinders the validation of (known or new) names of these taxonomic units and thus the application of these units, which often but not always reflect species boundaries, for other biological questions.

Based on previous experience with OTU-number-systems such as the L-numbers in ichthyology (catfish family Loricariidae) or the pupae-numbers for chironomid midges (Diptera) in entomology we propose the establishment of MOTU-numbers based on COI-sequences at the genus to family level. Each MOTU-number is at least correlated with (1) the GenBank-Codes of the sequenced specimens, (2) named and geo-referenced location and legitimization of the source of specimens, and (3) location (e.g. inventory numbers of collections), type and availability of (strongly encouraged) vouchers. Noteworthy “taxonomic indexing” or “species banks” can also be established on MOTUs, a web-based information system on the given MOTU-numbers is necessary in any case. Despite the doubtless advantages of the MOTU-number-system, the establishment of code-based and therefore stabilized names based on any species concept, which then can be correlated with a (or several) MOTU-number(s), remains a significant and highly valuable step in the inference of taxa.

This theoretical proposal is illustrated by the species-rich genus *Limax* (Stylommatophora) as a case study. While the full taxonomic establishment under the current rules of nomenclature will need

decades, the application of a MOTU-number-system enables right now the clear identification of evolutionary units and thus the correlation of all types of biological data to these units. The pros and cons of this proposal are outlined and discussed in the lecture.

Species boundaries in *Limax* (Gastropoda: Stylommatophora): extreme colour variations in and between species

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Biodiversity research needs taxonomic expertise in a broad variety of organisms. Most scientists working in the creation of species inventories are not specialists in every investigated group, so reliable species identification is one of the major problems. Working on the terrestrial slug genus *Limax*, we recognized that specimens from many species, even common ones, are often misidentified in checklists or collections. Juvenile animals are even more difficult to assign to a species. In the current study we compare three species, all of which show extreme variation in their external appearance. Two of these species, *Limax maximus* and *Limax cinereoniger*, are very widely distributed in Central Europe. The third (undescribed) species, *Limax* sp., is endemic to the south-western Central Alps. In all three species, body colour ranges from black to pale yellow or cream, with patterning ranging from absent to variable black stripes or spots. It is usual to find more than one colour variant in a population and extraordinary exceptions in colouration also exist. Our preliminary molecular phylogeny of *Limax* has shown that these three species can clearly be distinguished using the mitochondrial gene cytochrome oxidase subunit I. These results agree with conventional characters such as penis morphology and copulation behaviour. We have been able to use these results to reassess the external appearance characters, and have found that in combination, colour and pattern may be used for identification of adults. The most important characters include the colour and pattern of the sole and the pattern on the mantle.

Estrogenic active compounds in bivalve molluscs: physiological role in reproductive development and potential for endocrine disruption?

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Mussels are considered suitable organisms for the assessment of pollution in aquatic ecosystems. This is particularly due their high bioaccumulation capacity for contaminants, including estrogenic active chemicals. Aquatic environments receive significant levels of (xeno)estrogens that could potentially interfere with the natural hormonal systems of molluscs and affect the reproductive development of these organisms. However, relevant endpoints of endocrine disruption are still

lacking. Accordingly, one of the objectives of the Franco-British Interreg European programme, which studies endocrine disruptors and their effects on the aquatic fauna, was to improve the understanding of estrogenic contamination of bivalve molluscs.

Two sentinel species, *Mytilus edulis* and *Dreissena polymorpha*, were studied in order to monitor bioavailable xenoestrogens in marine, estuarine and freshwater ecosystems. To provide a better understanding of mussel reproductive biology, the gametogenic cycle was first surveyed by histological sections of the gonad and then correlated with oestrogen levels. The population followed the known gametogenic cycle and clearly showed a vitellogenic period in early spring which corresponded to a marked increase of the gonadosomatic index. However, the association of oestrogen levels with the gametogenic condition remained ambiguous. Using an *in-vitro* assay for estrogenic activity, it was shown that mussels sampled from sites with high concentrations of (xeno)estrogens were heavily contaminated with (esterified) steroidal estrogens compared with samples from reference sites. Experimental exposure confirmed that waterborne estrogens were rapidly taken up and esterified by both species into lipophilic metabolites. Vitellogenin gene-expression was investigated as a possible biomarker for oestrogen contamination in *M. edulis*. Laboratory studies revealed that vitellogenin gene expression was not induced by oestrogen exposure. These studies suggest that either expression of the vitellogenin gene is not oestrogen-dependent or that the sequestration of steroids *via* esterification may inhibit the induction of the gene. Thus, the implication of estrogens in mussel reproductive physiology remains to be unravelled before they may be used as indicators of endocrine disruption.

The fate of received sperm in the genital tract of *Lymnaea stagnalis*

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In animal species that mate promiscuously, store sperm and fertilise internally, the sperm from two or more donors usually compete for access to eggs. For simultaneous hermaphrodites it remains unclear how general sperm competition and the resulting sexual conflicts are. For the great pond snail *Lymnaea stagnalis* it has previously been shown that stored sperm can be used for over three months. In this species, and Basommatophora in general, this storage allegedly occurs in the “carrefour” region (i.e. fertilisation pouch, junction where hermaphroditic duct divides in a male and female tract). This assumption seems entirely based on extrapolations from Stylommatophora, which have a well-defined allosperm storage organ attached to their fertilisation pouch. We have therefore investigated the fate of donated sperm by looking at sperm digestion, sperm storage and sperm utilisation. We find that within three hours after copulation most sperm has been transported into the bursa copulatrix, where it is digested in the subsequent hours. By fluorescently labelling sperm in histological sections made at different times after copulation, we find that allosperm is not stored in the carrefour, but probably in the hermaphroditic duct or the seminal vesicles, where ripe autosperm are also stored. Finally, using microsatellites, we show that sperm of different partners do compete within one recipient, and that in double matings this leads to a roughly equal share of paternity. The implications of these findings for understanding the mechanisms underlying sperm competition and mixed mating (the production of both selfed and outcrossed offspring within one egg mass) will be discussed.

Waddington's widget in the field: Do different stress response strategies result in variations of pulmonate shell variability?

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In a stable environment, stabilizing selection favours an average intensity of a phenotypic trait whilst extremes are cut off from this trait's variability curve. Consequently, stabilizing selection reduces phenotypic variability which, however, is the prerequisite for all evolutionary processes. This is a well-known dilemma in microevolutionary theory. A way to circumvent this dilemma is to accept hidden variability which can occur in populations and species but is not subject to selection in its hidden form, and is phenotypically expressed at certain occasions only. Besides inherited but unexpressed characters (e.g. the potential variability of male characters in a mostly parthenogenetic population), an epigenetic phenomenon which has been called Waddington's widget may contribute to often disguised but occasionally apparent phenotypic variability: the observation that variability increases in populations undergoing stress. In recent years, it was discovered that stress proteins can act as molecular capacitors of phenotypic variability and thus likely contribute to the Waddington's widget phenomenon. We investigated natural populations of different species of mediterranean pulmonate snails (which showed different variability in their shell morphology) for their stress protein (hsp70, hsp90) responses to environmental heat stress. In our dataset, a stress response strategy which involved rather low levels of stress proteins correlated with a high morphological variability in the colouration of the shell. This is the first evidence that a molecular process which is thought to contribute to Waddington's widget may condition morphological variability in natural field populations.

Climbing the gene trees: a first molecular step towards elucidating the extreme morphological variation within *Abida secale*

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The genus *Abida* Turton, 1831 (Pulmonata: Chondrinidae) consists of 10 currently known species. All are obligate limestone dwellers, i.e. occurring exclusively in calcareous habitats. With the exception of two species, viz. *A. polyodon* (Draparnaud, 1801) and *A. secale* (Draparnaud, 1801), their distributional ranges are restricted to the Cantabrian mountains in NW Spain and the Pyrenees. *Abida secale* occurs throughout Europe, from England in the west, Belgium and southern Germany in the north and Slovakia and former Yugoslavia in the east. The southern part of its distribution includes N. Italy, France and NE. Spain. The morphological differentiation is small over the largest part of its range. An exception to this uniformity is found in the extreme southwestern part of the species' range. In SE. France and NE. Spain the species shows an extreme morphological differentiation. This has led to the description of three subspecies in the French part of the Pyrenees, one in Andorra and an astonishing eleven in the province of Catalunya, Spain.

DNA studies using both nuclear (ITS-1) and mitochondrial (COI sub. 1) DNA suggest a recent hybridization event between *A. attenuata* (Fagot, 1886) and *A. secale*. The *A. attenuata* mitochondrial and nuclear haplotypes show an introgression pattern into *A. secale*, that is consistent with the geographical distributions of the taxa. The remaining ‘*secale*’ haplotypes suggest temporary isolation with clade distributions associated with river valleys in northern Spain. The genetic patterns are geographically coherent but conspicuously inconsistent with shell morphology.

Karyotypes of land operculate snails genus *Pterocyclus* and *Rhiostoma* (Prosobranchia: Cyclophoridae) from Thailand and Malaysia

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The snorkel snails of the two related genera *Pterocyclus* and *Rhiostoma* collected from Thailand and Malaysia were karyotyped. These genera showed distinct intrageneric similarities in both haploid and diploid chromosome number ($n = 14$, $2n = 28$) but the ranges of fundamental chromosome number (FN) exhibit variation of 48, 52 and 56. Karyotypes of the two *Pterocyclus* species from south Thailand and Malaysia show $8M + 4SM + 2T$ in *Pterocyclus asiphon* and $7M + 5SM + 2T$ in *Pterocyclus* sp. The six species of *Rhiostoma* examined herein show the karyotypes variation with chromosome morphology differentiation. The karyotype varied from $7M + 4SM + 3T$ in *R. hainesi* from eastern Thailand. Two species from the south i.e. *R. chupingense* exhibits $6M + 5SM + 3T$ and $2M + 9SM + 3T$ in *R. jalorensis*. The two island species *R. asiphon* from Angtong Island has $3M + 8SM + 1T + 2A$ and $5M + 5SM + 2T + 2A$ in *R. samuiense* from Samui Island. Karyotypes among populations of *R. housei* showed variation between the central ($9M + 2SM + 3T$) and southern regions ($9M + 2SM + 2T + 1A$) of Thailand. This is the first report on chromosome study of the peculiar land operculate snails of the Thai-Malay Peninsula. The systematic surveys of these snail genera is now being critically studied.

Early ontogeny and micro-ornamentation of *Nicaniella* and *Pressastarte* (Bivalvia: Astartinae) from the Jurassic of the Southern Baltic

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This paper documents for the first time early ontogenetic shells and micro-ornaments of *Nicaniella* and *Pressastarte*, two cosmopolitan genera of Jurassic Astartidae. Results are still preliminary and taxonomy in a flux. Nevertheless, *Nicaniella* species can be shown to have clearly distinguishable prodissoconch 1 and 2 stages, the latter with well developed growth rings; in contrast, *Pressastarte* lacks a clearly defined P1 stage and the P2 has no obvious growth lines. Micro-ornaments of the two genera consist of a superficial reticulation and pits of slightly larger size than the net elements. Reticulation begins as irregular and widely spaced grooves of micrometre size

on the first postlarval growth step; they are fully developed from the 3rd or 4th step onward. Pits become more numerous and occur in radial rows. Reticulation and pits have been previously described from the periostracum in some recent astartids. Our results now suggest that this ornament is a property of the underlying shell rather than of the periostracum itself. The pits do apparently not reflect the sites of periostracal spikes, but short thread-like radial ridges sometimes occur very close to them. Low energy forms like *N. (Trautscholdia) phillis* possess a finer reticulation than high energy forms such as *N. (Nicanella) morini*. A similar pattern is observed for species of *P. (Pressastarte)* (fine) and *P. (Pinguistarte)* (coarse).

Early juvenile right valves of *N. (Trautscholdia)* and *P. (Pressastarte)* provide evidence that cardinal teeth 3a and 3b are indeed connected (so far only assumed). Hinge teeth are stronger and earlier developed in *Nicanella* than in *Pressastarte*, and the angle between 3a and 3b is significantly larger (97° vs. 78°). 5b is only present in juvenile *Nicanella*. In summary, larval dimensions, micro-ornament and angles between cardinal teeth provide significant information on larval strategy and taxonomy, and micro-ornaments appear to be facies dependent.

***Sphaerium corneum*, *Sphaerium nucleus* (Bivalvia: Sphaeriidae) and difficulties with determination and taxonomy of Sphaeriidae**

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The diversity and taxonomical relationships in the family Sphaeriidae are still not completely understood. There are several groups of hardly distinguishable sibling taxa, the rank of which is a subject to discuss.

We focused on anatomy, shell morphology, ecology, karyotypes and sequences of selected genes to compare populations of *Sphaerium corneum* and *S. nucleus* from the Czech Republic and Central Europe. The taxa proved to be good and distinct species, whether the biological or ecological species concept was adopted. However, none of the traditional anatomical and morphological characters alone is absolutely reliable for determination. *S. corneum* and *S. nucleus* have very similar karyotypes and differ from the most species of the family in the ploidy - they are probably diploid, whereas allopolyploidy is otherwise very common in the genus *Sphaerium* and *Pisidium*. No evidence for the occurrence and distinctness of the obscure “*S. ovale*” has been found so far. The analogy with other species complexes (e.g. *Pisidium casertanum/globulare*) and possible taxonomical and faunistic consequences are also discussed.

The anatomy and relationships of *Troschelia* (Buccinidae, Neogastropoda): evidence of polyphyly for the Buccinidae?

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Phylogenetic relationships among the 200+ genera and subgenera included in the gastropod family Buccinidae remain quite ambiguous. The northeastern Atlantic monotypic genus *Troschelia* Mörch, 1876, has been classified by a number of authors (e.g., G.O. Sars, J. Thiele, A. Graham) in the family

Fascioliariidae due to the peculiar radula of the single species, *Troschelia berniciensis* (King, 1846). Conversely, Bouchet & Warén classified it in the Buccinidae, interpreting the lateral teeth with multiple uniform cusps on the lateral teeth in some Buccinidae.

To elucidate phylogenetic relationships of *Troschelia* with the families Buccinidae and Fascioliariidae, morphological and anatomical features were studied, and partial sequences from the mitochondrial 16S rRNA gene were analyzed for *Troschelia berniciensis* and a number of buccinid and fascioliariid taxa. *Troschelia berniciensis* is anatomically very similar to other boreal representatives of buccinids. The anatomy of the studied fascioliariids, representing five different genera of three subfamilies, is in general very similar to that of Buccinidae, with a few unique features of the digestive system, which are not known among buccinids. In the phylogenetic hypothesis derived from the molecular data, including 16 buccinid and 4 fascioliariid taxa, *Troschelia* is in the same clade with the tropical buccinids *Pareuthria* and *Phos*. The fascioliariid taxa form a separate clade, yet making Buccinidae polyphyletic. Pisaniinae lie as a sister group to buccinid-fascioliariid clade, again suggesting a polyphyletic origin of the buccinids.

Morpho-phylogenetic analysis of the subfamily Colinae (Buccinidae, Neogastropoda)

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Subfamily Colinae Gray, 1857 (Buccinidae, Neogastropoda) is the most abundant and diverse buccinid group in the North-Western Pacific and Far-Eastern Seas of Russia. It includes several conchologically similar genera or subgenera with unclear status and composition. Basing on 37 morphological and anatomical characters of 35 species attributed to *Colus* Röding, 1799, *Plicifusus* Dall, 1902, *Latisipho* Dall, 1916, *Aulacofusus* Dall, 1918, *Retifusus* Dall, 1916, *Retimohnia* McLean, 1995 and *Pararetifusus* Kosuge, 1967 phylogenetic analysis was conducted.

Obtained majority rule consensus tree well resolves genera *Plicifusus*, *Retifusus*, *Pararetifusus* и *Aulacofusus*. Genus *Retimohnia* appears to be junior synonym of the genus *Retifusus*. Analysed species of heterogeneous genus *Colus* form paraphyletic group. Presented results demonstrate the importance and opportunity of using anatomical characters for taxonomy of extremely diverse and variable family Buccinidae.

Vesicomiyidae (Bivalves): trends of morphological adaptations

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The term Vesicomiyidae is used here in a wide definition considering not only "large clams", but also "small vesicomiyids", what is supported by preliminary results of recent molecular analysis. All studies conducted so far indicate that the large vesicomiyids possess obligate chemosymbiosis with sulfur-oxidizing bacteria. In gills of "small vesicomiyids" bacteria also were detected, but obligate chemosymbiosis is not yet proved. The family comprises 94 described and about 15 yet unnamed living species distributed from 77° N to 70°S at depths from 100 to 9050 m in reducing sulphide-rich habitats. The family is highly morphologically disparate. Species range in length from 2.0 to 270 mm; shell shape varies from rounded to strongly elongate. There are differences in number of ctenidial demibranchs, relative size of demibranchs, internal structure of ctenidia, structure of siphons

and alimentary system. The analysis of morphological diversity suggests the following general trends within the family: increasing of body size, elongation of shell, reduction of the outer demibranch and simplification of alimentary system. Increasing of body size in vesicomysids is correlated with elongation of shell. Extremely elongated shell has evolved independently within the family at least in two different groups – species with single demibranch and ones with two demibranchs.

Skeneimorph gastropods in Neomphalida and Vetigastropoda

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Until recently the classification of the members of the Skeneidae (type species *Skenea serpuloides* Clark 1851) has been solely based on shell characters, radula details and external morphology. Accordingly, this vetigastropod group is suspected to represent a polyphyletic, “skeneimorph” assemblage. Recent methodological progress including serial semithin sectioning combined with computer-aided (software AMIRA) 3D-reconstruction enables the detailed anatomical investigation of such small (max. 3 mm), helicoid gastropods. Indeed, already preliminary anatomical data shed some light on the skeneimorph question:

True Skeneidae (exemplified by *Skenea serpuloides*) doubtless belong to the Vetigastropoda and probably rests within the Trochoidea/Turbinoidea. Apomorphies of *Skenea* and related genera include a penis formed by the right propodium.

Cyclostremiscus ornatus, *Bathyxylophila excelsa* and *Ventsia tricarinata* also have papillate cephalic and epipodial tentacles, a single monopectinate ctenidium with skeletal rods and bursicles, a papillary left and a right excretory organ, and statocysts with several statoconia. All these characters suggest a position of these species inside the Vetigastropoda. However, the distinct appearance of epipodial tentacles and the lack of a combined epipodial sense organ argues against an inclusion into the Trochoidea/Turbinoidea and Skeneidae, where combined epipodial tentacles are always present. At present, these species cannot be classified in any known vetigastropod subclade.

Leptogyra, *Xyleptogyra* and *Leptogyropsis* species are characterized as follows: Smooth cephalic and epipodial tentacles, a single, left excretory organ, a monotocardian heart bypassed by the rectum, and statocysts with one statolith. These anatomical data clearly contradict inclusion in the Vetigastropoda, but strongly suggest a systematic position in the likewise rhipidoglossate Neomphalida.

It is likely that microanatomical studies on the more than 40 remaining “skeneimorph” genera will greatly influence our understanding of the evolution of Vetigastropoda and related gastropod clades.

The microanatomy of *Bathyxylophila excelsa* Marshall, 1988, and *Ventsia tricarinata* Warén & Bouchet, 1993, two skeneimorph vetigastropods from Pacific deep sea habitats (Vetigastropoda)

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The family Skeneidae (Vetigastropoda, Trochoidea/Turbinoidea?) is currently regarded as a polyphyletic lumping pot for small (max. 3 mm), rhipidoglossate gastropods (“skeneimorphs”) showing signs of internal fertilisation. Recent methodological progress including serial semithin sectioning combined with computer-aided (software AMIRA) 3D-reconstruction enables the detailed anatomical investigation of such small, helicoid gastropods. Here we describe the microanatomy of the small (max. 1.5 mm) *Bathyxylophila excelsa* Marshall, 1988, found on sunken wood (800 m

depth) near Chatham Rise, New Zealand, and the hot-vent inhabitant *Ventsia tricarinata* Warén & Bouchet, 1993, (max. 2.5 mm) from the Lau Basin, Fiji (1800 m depth).

Ventsia tricarinata has papillate cephalic and epipodial tentacles, a single left monopectinate ctenidium with skeletal roots and bursicles, a monotocard heart penetrated by the rectum, a left papillate and a right excretory organ, a rhipidoglossate radula with one pair of radula cartilages, two intestinal loops, a papillate oesophagus a hypoathroid nervous system, two statocysts with several statoconia, a single left osphradium, a subradular organ and one pair of ESO-tentacles. The sexes are separated, the female genital systems consists of an ovary with big yolky eggs covered by a vitellin layer, a simple urinogenital duct, and a separated receptaculum seminis.

Bathyxylophila excelsa differs as follows: The heart does not encircling the rectum, the oesophagus lacks papillae. Due to insufficient fixation, many histological details could not be cleared up.

All anatomical data strongly suggest a position of both species inside the Vetigastropoda. However, the combination of characters exclude both species from all currently defined subclades of the Vetigastropoda. Until more data on possibly related forms are collected they remain as “incertae sedis”.

Using molecular approaches to investigate the function of the hypobranchial gland of the marine snail, *Dicathais orbita*

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The marine snail *Dicathais orbita* produces potent anti-cancer and antibacterial compounds as the chemical precursors of the dye Tyrian purple within its hypobranchial gland (HBG). Furthermore, choline esters have also been found in the HBG which may find clinical use due to their neuromuscular blocking action. The identification of key enzymes expressed within the hypobranchial gland may allow us to develop biosynthetic methods using recombinant techniques for producing these pharmaceutically active compounds. It is known that there are three enzymes involved in the formation of these compounds but the genes responsible have yet to be identified in *D. orbita* or any marine mollusc. A more detailed investigation into HBG gene expression may also indicate the biological processes and overall function of this organ in *D. orbita*.

Suppressive subtractive hybridization was performed to create a cDNA library from *D. orbita* HBG RNA, containing genes that are differentially expressed in the HBG that are not expressed in *D. orbita* mantle tissue. cDNA was then cloned and sequenced and a computer pipeline, created specifically for processing this data, was used to identify coding gene sequences and their possible functions. 400 unique sequences were obtained from the HBG of *D. orbita*. Of these sequences, 70 had their functions putatively identified with roles in electron transport, protein biosynthesis and modification, acetylcholine metabolism and cell structure formation, as well as a partial arylsulfatase sequence which may be involved in Tyrian purple production. These results indicate the HBG is a biosynthetic organ. A gene involved in acetylcholine metabolism was also identified, suggesting a cellular process for managing choline ester production exists within the HBG. Several sequences were identified as using a ciliate protozoan coding system, and recent identification of protozoans inhabiting the HBG suggests that suppressive subtraction has identified protozoan sequences, as well as unique HBG transcripts.

B-type esterases in the snail *Xeropicta derbentina* as potential biomarkers of pesticide exposure: in vitro inhibition and reactivation

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Inhibition of the B-type esterase (cholinesterase [ChE] and carboxylesterase [CbE]) activities is one of the most used biomarker for assessing exposure to organophosphorus (OP) and carbamate (CB) pesticides. The aims of this work are 1) to characterize ChE and CbE activities in the snail *Xeropicta derbentina*, 2) to evaluate the effects of the OPs chlorpyrifos-oxon and dichlorvos and the CB carbofuran on the B-type esterase responses and 3) to test whether chemical reactivation of inhibited ChE with pyridine-2-aldoxime-methochloride (2-PAM) can be a complementary methodology of pesticide exposure for field monitoring purposes.

In vitro experiments were performed on postmitochondrial supernatants. CbE basal specific activities were 32.88, 229.71 and 221.28 mU/mg of protein for α -naphthyl acetate, p-nitrophenyl valerate and p-nitrophenyl acetate, respectively. The mean ChE activity was 25 mU/mg of protein.

Acetylcholinesterase activity is the major type of soluble ChE form (80 % of total ChE activity) in *X. derbentina*.

CbE activity was dose-dependently inhibited by the OPs but not by carbofuran. ChE activity was dose-dependently inhibited by the three pesticides but it was more sensible to carbofuran ($IC_{50} = 9.7 \cdot 10^{-8}$ M) than dichlorvos ($IC_{50} = 2.98 \cdot 10^{-7}$ M) or chlorpyrifos-oxon ($IC_{50} = 2.27 \cdot 10^{-7}$ M). The OP-inhibited ChE activity was reactivated in the presence of 5×10^{-4} M 2-PAM after 30-min incubation. The reactivation kinetics for chlorpyrifos- and dichlorvos-inhibited ChE followed an exponential rise to recover a maximum of 75% and 65%, respectively.

These preliminary results pointed out three important features: (i) the different CbE sensibility of *X. derbentina* to OPs and CB compounds could explain the different ChE sensibility to these chemicals, (ii) CbE activity was resistant to inhibition by carbofuran and (iii) the chemical reactivation of phosphorylated ChE activity of *X. derbentina* enormously extends the practical possibilities of this organism as bioindicator of pesticide contamination.

***Xeropicta derbentina* as a sentinel species for evaluating ecotoxicological effects of pesticide treatments?**

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Xeropicta derbentina is among the most frequently encountered land snails in Mediterranean countries. Due to their good adaptation to warm countries and their summer activity, these snails

could potentially represent a sentinel species to evaluate environmental pollution during summer when pesticide application rates increase in orchards.

Preliminary works permitted to characterize *in vitro* cholinesterase (ChE) activity of this snail and its sensibility to pesticides. In order to validate this biomarker, we performed a simulated field study (microcosm) to test the effects of organophosphate (OP/chlorpyrifos/Pyrinex) and carbamate (CB/carbaryl/Sevin) pesticides as well as a field bioassay performed in a peach orchard before Pyrinex application.

Microcosm consisted of Potter tower used to spray Petri dishes (8 snails/box) and nominal concentrations (0, 0.01, 0.1, 1 and 10 ppm) of pesticides were delivered. ChE activity was measured at 1, 2, 4 and 7 days after pesticide exposure. In the field experiment, snails were released in the orchard before the Pyrinex treatment and were sampled at 2, 4 and 7 after OP application.

Cholinesterase activity was significantly decreased in the snails exposed in the microcosms to concentrations close to Predicted Environmental Concentration of both pesticides. The carbamate caused a higher snail ChE decrease compared to chlorpyrifos, and esterase decrease took place more quickly (1 day after CB treatment). The highest doses of carbaryl decreased ChE activity permanently while chlorpyrifos caused a maximum decrease during the second day after exposure but ChE activity recovered after 4 days. In the field bioassay, chlorpyrifos caused a slight ChE decrease after 2 days of spraying.

These results demonstrate that ChE decrease of *X. derbentina* is a suitable early and sensitive biomarker of neurotoxic pesticides and, in addition, *X. derbentina* represents an excellent sentinel organism to assess pesticide impact on non-target invertebrates in agroecosystems of Mediterranean climate regions.

The freshwater thiarid *Tarebia granifera* as tramp: Molecular systematics and reproductive biology of a tropical invader

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Recently studies on bioinvasions have revealed that various characteristics and strategies of the neo-zoon taxa are essential to understand invasiveness. Within an evolutionary ecology framework the phylogenetic relatedness of an invader (e.g., to existing native communities) and reproductive strategies provides clues to understand bioinvasions, and can even be used as predictive tool. Among limnic gastropods some Thiaridae were found to act as tropical invaders in recent years, as e.g. species of the viviparous *Tarebia* Adams & Adams, 1854. The *Tarebia granifera* complex comprises several taxa from Southeast Asia which were described as morphospecies based on slightly distinct conchological features in combination with different geographical occurrences. A comparative approach of representative populations from the entire range using phenotypical variability (including anatomy) and molecular genetics (mtDNA fragment of the 16S gene) allows to distinguish four taxa within this species complex for which, however, monophyly could not be established. One of these species, *T. granifera* (Lamarck, 1822) is originally distributed in Southeast Asia from Thailand to the Pacific islands Fiji and Vanuatu. It started decades ago to invade the Caribbean from southern USA to northern South America, and are recently reported also from South Africa. We found various differences in the reproductive strategies not only among autochthonous populations from the Oriental region, but also among the invasive ones. Typically, compared to autochthonous populations the allochthonous populations exhibit a higher percentage of eggs than shelled juveniles carried in the brood pouch; however, at the same time the absolute number of eggs and juveniles is remarkably lower in the invaders. We contrast these reproductive biology features of the invasive populations with strategies found in populations in particular on the Indonesian island of Sulawesi, serving here as a natural laboratory, in order to evaluate their contribution and effect in bioinvasions.

The impact of urbanisation on freshwater gastropods of L. Jipe, Kenya

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The Lake Jipe of southeastern Kenya, is an important freshwater biodiversity conservation centre in Eastern Africa. It is a hot-spot and centre of endemism for several species of flora and fauna. Despite the lake biodiversity conservation significance, it is currently experiencing increasing anthropogenic disturbances mainly associated with creation of small urban centers mainly to serve the local fishery activities. Despite the ensuing urbanisation associated with numerous anthropogenic disturbances no detailed freshwater gastropods studies have ever been executed at the lake. Only one incidental collection was conducted at the lake nearly over two decades ago. Studies elsewhere suggests the potential for major impact on gastropods diversity following anthropogenic influences with likely crucial conservation and medical implications. The present study was thus implemented to investigate the impact of the urbanisation along L. Jipe on freshwater gastropods diversity patterns. Snail sampling was carried out at sites around the small urban centers and protected sites within a nearby national park for comparison using a standard scoop. Fieldwork for the study is just completed and data processing is ongoing to be completed in a months time then the final report compiled by end of April, 2007. A complete synthesis of the project findings including the recommendations will be presented in form of a poster during the forthcoming world congress on malacology, Antwerpen, Belgium. The study I being implemented with financial support from International Foundation for Science(IFS).

The molluscan fauna of a deep-water coral community at Rockall Bank (NE Atlantic)

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Deep-water coral reef communities occur patchy along the European continental margin, commonly between depths of 200-1000 m. One of the workpackages within the HERMES project (Hotspot Ecosystem Research on the Margins of European Seas, 2005-2009) funded by the EU is designated for research on deepsea coral reefs. One of the goals within this project is to measure the importance of the benthos within a coral community in respect to biodiversity, density and biomass, and the role of the different species within this ecosystem.

The living benthos including Mollusca from 6 boxcores taken at and near a coral mound at the SE slope of the Rockall Bank (500-800m) was identified, counted and weighed. Besides, the trophic structure of the community was mapped by analysis of the stable isotope($\delta^{15}\text{N}$) signatures of the most common animals. Additionally, the dead shell material from quantitative boxcore samples was also sorted, identified and counted, to get a time-integrated idea of the biodiversity and density of molluscs.

Densities and biomass of molluscs are much higher (>20x) within the coral area than in nearby area's without corals, while biodiversity is 5 times higher. Biodiversity of the dead material (shell gravel) within the coral area was about 2 times higher than that of the living material. The isotopic signature of the molluscs was at about the same level as corals, tunicates and crinoids, suggesting that they all live on the same material by filter-feeding. In conclusion molluscs are important within the corals because of a high biodiversity, but especially so because of their high relative density and biomass.

A remarkable new genus of sessile, predatory septibranch bivalves

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A new genus of sessile septibranch bivalves is presented. The new taxon encompasses at least three species: an unnamed one from the slope off the Florida Keys, another from 950961 m off Vanuatu, and “*Corculum*” *inexpectatum* Crozier, 1996, collected at 805 m off the Three Kings Islands, New Zealand. Unusual symmetry and form constitute peculiar morphological features of the new taxon. There is strong antero-posterior compression and lateral expansion associated with rotation of the largest dimension (height), which forms about 30° with the antero-posterior axis. The hinge includes a single (possibly secondary) cardinal tooth and interlocking socket on each valve and sunken ligament. The two unnamed species are known from live-collected specimens found adhering to boulders of possible volcanic origin by means of a robust byssal system. Features of gross anatomy such as absence of ctenidia, size and arrangement of siphons and siphonal tentacles, extensive fusion of mantle edges, and presence of septum with ostial apertures allocate the species within the septibranch bivalves. Presence of ostracods in the digestive tracts is evidence of predation. Phylogenetic relationships are yet to be determined for the new taxon; however, a siphonal area with 1315 tentacles, large and possibly eversible incurrent siphonal cowl, presence of three paired groups of ostial apertures in septum, and hermaphroditic reproductive system suggest inclusion in the Poromyidae. Shell shape and outline in the new taxon crudely evoke those of the cardiid genus *Corculum*. In fact, despite differences in proportions and shell sculpture between “*Corculum*” *inexpectatum* (soft parts unknown) and the two unnamed species, general shell morphology and hinge dentition suggest that the three species are closely related. Notwithstanding lack of understanding of the precise means of prey capture, it is clear that the new taxon represents a rare instance of predation on motile invertebrates by sessile mollusks.

Tahitian tree snail mitochondrial clades survived recent mass-extirpation

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Oceanic islands frequently support endemic faunal radiations that are highly vulnerable to introduced predators. This vulnerability is epitomized by the rapid extinction in the wild of all but five of 61 described Society Islands partulid tree snails, following the deliberate introduction of an alien biological control agent: the carnivorous snail *Euglandina rosea*. Tahiti's tree snail populations have been almost completely extirpated and three of the island's eight endemic *Partula* species are officially extinct, a fourth persisting only in captivity. We report a novel molecular phylogenetic estimate of Tahitian *Partula* mitochondrial lineage survival calibrated with a 1970 reference museum collection that pre-dates the predator's 1974 introduction to the island. Although severe winnowing of lineage diversity has occurred, none of the five primary Tahitian *Partula* clades present in the museum samples is extinct. Targeted conservation measures, especially of montane refuge populations, may yet preserve a representative sub-sample of Tahiti's endemic tree snail genetic diversity in the wild.

Evidence for sexual selection in *Ariolimax* species (Stylommatophora: Arionidae)

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Systematics in banana slugs (*Ariolimax* spp) has been based on genital morphology, with subgenera distinguished by the presence (*Meadarion*) or absence (*Ariolimax*) of an “epiphallus” and species distinguished by the size and shape of the penis and vaginal musculature. This rapid evolutionary divergence of genitalia has been accompanied by an even more striking radiation in sexual behavior. Each of the species studied has a unique pattern of courtship and copulation. Copulation may be either brief (mean = 25 min) and unilateral in bouts (*A. californicus*, *A. brachyphallus*) or simultaneously reciprocal [*A. dolichophallus* (mean = 198 min), *A. stramineus* (mean = 62 min)]. In *A. buttoni* copulation can last more than 24 h. Courtship ranges from 2 h of conspicuous biting and head-swinging in *Meadarion* species to a brief (20 min) mutual exploration (*A. stramineus*). Both *A. californicus* and *A. brachyphallus* show bouts of copulations but in *A. brachyphallus* there is mutual penial stroking between copulations in the bout. Apophallation can occur in *A. californicus* and *A. dolichophallus*. Individuals that have suffered apophallation may mate as females and (in one case) even as a male, subsequently. Phally polymorphism is present in at least some populations in *A. buttoni*. In a population with aphally, individuals reared in isolation produced more hatchlings than grouped individuals whereas in a population without aphally, hatchling production correlated with the number of sexual partners available. The long duration of sexual interactions, apparent high energetic costs and evidence for reciprocity suggest that sexual selection has been involved in the evolution of these species. Each species also has a unique suite of life history characteristics, including egg size, hatchling color and growth rate, suggesting that natural selection has also created differences between species. Mean egg size varies from 0.20 g to 0.45 g with sister taxa representing the extremes.

Combined effects of tidal conditions and environmental contamination on the activities of antioxidant enzymes in *Mytilus edulis*

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The coastal zone is characterized by a high variability of abiotic parameters linked to the tidal cycle and by the presence of diverse chemical compounds in the water. These particular conditions represent a multiple stress that resident organisms have to deal with. Interactive effects of physiological and toxicological stresses were investigated in the blue mussel (*M. edulis*) by studying the activities of 5 antioxidant enzymes (Cu/Zn superoxide dismutase, Cu/Zn SOD; catalase, CAT; glutathione peroxidase, GPx, glutathione reductase, GRd, glutathione-S-transferase, GST) in gills and digestive gland of mussels sampled at high shore (HS) and low shore (LS) in a reference site (Yport, France) and a contaminated site (Le Havre harbour, France) during the tidal cycle. Antioxidant activities in gills presented higher levels in HS mussels than in LS mussels in the clean site, whereas at the polluted site an inverse trend was observed for Cu/Zn SOD and both HS and LS

mussels showed elevated levels for GPx and CAT activities at any sampling time. In digestive gland, LS mussels exhibited equal or higher levels of antioxidant activities than HS mussels for the reference site; in the polluted site a reversion of the patterns for GPx and GRd activities and greater levels of SOD activity for both location were observed.

These results suggest that patterns of activities of antioxidant enzymes are affected by environmental contamination as well as ecophysiological stresses imposed by tidal conditions and the combination of the 2 parameters can induce a specific response of these activities.

Spatial differences and temporal variations of antioxidant defences in an intertidal population of the blue mussel *Mytilus edulis*

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During the tidal cycle, blue mussels undergo an alternation of tissular normoxia - strong hypoxia - hyperoxia due to the decrease in oxygen availability in emersion and the sudden re-oxygenation when recovery occurs. To deal with the oxidative and energetic stresses implied by this context, this specie may have evolved acclimation capacities of its antioxidant defences. Activity levels of antioxidant enzymes (Cu/Zn superoxyde dismutase, Cu/Zn SOD; catalase, CAT; glutathione peroxydase, GPx, glutathione reductase, GRd, glutathione-S-transferase, GST) were measured in gills and digestive gland of mussels sampled at high shore (HS, air exposure > 6h/12h) and low shore (LS, air exposure < 2h/12h) of the intertidal zone of Yport (Normandie, France) over the entire tidal cycle. Whatever the phase of the cycle, activity levels observed in both tissues were higher in individuals from high shore in a +40 to 100% manner than in LS mussels. In gills, CAT (HS: +30%, LS: +56%), GRd (HS: +44%, LS: +53%) and GST (LS: +44%) activities present a transient increase after 2h of emersion, in the same way as the GRd activity in digestive gland (HS: +49%, LS: +70%). These results suggest that a global pro-oxidant condition is imposed by the high ranges of the shore and consequently the resident organisms exhibit an acclimation of antioxidant capacities according to this context.

Phylogenetic and structural aspects of chiton hemocyanins

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The phylogeny of chitons is mainly based on morphological characters and one molecular analysis. According to the most current evidence from both of these approaches, Polyplacophora can be subdivided into two major groups: Lepidopleurida and Chitonida. Our molecular study, based on a hemocyanin sequence data set, also confirms this fundamental division. As supported by morphology but in contrast to the sole molecular analysis by A. Okuzo and co-authors, our maximum likelihood analysis supported *Callochiton* is supported as a basal ingroup taxon of the monophyletic Chitonida, rather than as basal within Lepidopleurida, as in the molecular study. Within the relatively sparsely represented remaining members of Chitonida that have been sampled to date, we also found strong bootstrap support for the monophyly of one of the two suborders, Chitonina but not for the other, Acanthochitonina. However, our results are at least compatible with the possible monophyly of Acanthochitonina, and we found strong support for the monophyly of three of its families: Mopaliidae, Acanthochitoninae and the Lepidochitonidae, even if we were not able to resolve the relationships among these when only partial hemocyanin sequences were analyzed. We are therefore increasing our taxon sampling continuously and moving toward combining these gene sequences with other molecular and morphological evidence. Beside these phylogenetic results, we discovered

another highly interesting structural sequence characteristic. Hemocyanin sequences from Chitonida appear to have a derived deletion of 5 amino acids, whereas Lepidopleurida appear to be “normal” or plesiomorphic in more closely resembling gastropod hemocyanins. We predict that this might cause a structural rearrangement of the complete hemocyanin molecule, and we further postulate that hemocyanins of members of Lepidopleurida might also be able to form didecameric hemocyanins which have never been observed within chitons yet. Further analyses are in progress to test this prediction.

Hemocyanin: a 'respiratory' chance for molluscan phylogenetics

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Hemocyanins are ancient respiratory proteins exclusively found in molluscs and are a synapomorphy of this phylum. Most probably, they had already evolved within the last common ancestor of all molluscs before the latest Precambrian (544+ MYBP). We obtained hemocyanin sequence data from >70 species of gastropods, cephalopods, protobranch bivalves, and chitons in order to trace the phylogenetic relationships across and also within these groups at different taxonomic levels. At higher taxonomic levels these data suggest a close relationship among protobranch bivalves and most phylogenetic inferences also support the monophyletic origin of the four groups analysed. However, very little was resolved for the relationships among these classes. In contrast, our analyses with collaborators at lower phylogenetic levels show that hemocyanin is a good character to trace the phylogeny within orders, families, or genera. We were able to use hemocyanin for (i) the phylogeographic analyses of the Haliotidae and (ii) a preliminary analysis of Turbinidae phylogeny; (iii) a broadened analyses on the cephalopod genus *Spirula*; (iv) substantial progress in resolving the high-level phylogeny of Polyplacophora; and (v) a combined analysis of a hemocyanin intron with three other gene regions for inferring the phylogeny of a selected chiton genus, *Lepidozona*. Significant results, limitations, and opportunities to trace molluscan phylogeny will be highlighted and discussed.

Evolutionary patterns of the terrestrial mollusc genus *Everettia* and *Meghimatium* in the Northern Borneo

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Sabah (Northern Borneo) had experienced the period of the Borneo's most active (and recent) tectonic evolution. Expansion of land from Middle Eocene (ca. 40 mya) to Middle Pliocene (ca. 4 mya) and climate fluctuation in Pleistocene (2.5 mya to 10 kya). The interplay of the past geology and climate is an agent for generating extra-ordinary diversity and genetic distinctiveness among population of a species. However, to date, it is not clear to what extent these past processes are reflected on contemporary distribution land snail in Borneo. The Mitochondrial DNA sequences from 16S rRNA and COI genes, and nuclear ribosomal DNA sequences from ITS-1 were used to investigate phylogeographic patterns of the land snail *Everettia* (Gastropoda: Ariophatidae) and slug *Meghimatium* (Gastropoda: Philomycidae) in the Northern Borneo. Furthermore, the genetic data were also used for revision of taxonomy for both groups. Maximum parsimony and maximum likelihood on these genetic datasets produced trees in general agreement for both genus in plogeographical pattern and their taxonomy (based on the morphology) were also well-supported by

genetic data. The resulting diversity and phylogeography for both groups of terrestrial mollusc can be linked to major geological vicariance event in the Miocene and Pliocene. Also, the phylogenetic tree showed that a number of endemic species on Mount Kinabalu are remnants during the Pleistocene climate fluctuation.

Occurrence of *Retinella (Lyrodiscus)* in Quaternary west-european sequences: taxonomical status and palaeoclimatic implication

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Recent studies undertaken at several sites in the Somme and the Seine valleys (Northern France) together with revision of ancient collections have provided new data on occurrences of the genus *Retinella (Lyrodiscus)* within Pleistocene interglacial deposits.

This new material has led to a revision of first the taxonomic status and second the palaeoenvironmental and climatic significance of the genus in a Quaternary perspective. Taxonomic reassessment of the species shows that *Retinella (Lyrodiscus) skertchlyi* Kerney 1976 is a junior synonym of *Retinella (Lyrodiscus) elephantium* (Bourguignat, 1869) and that at least two extinct species of *R. (Lyrodiscus)* are known in Western Europe during the Quaternary. Occurrences of *Retinella (Lyrodiscus)* within interglacial deposits are discussed using records of different temperate periods at different European locations, mainly British, German and Deutsch sites. Until now the genus does not appear after the Holsteinian. Within MIS 11 north-west European tufa deposits the species belongs to a peculiar assemblage representative of humid forest biotopes developed under fully temperate conditions. However *R. (Lyrodiscus)* might also appear in silt sequences, associated with species representative of more open environments which induce a different palaeoenvironmental significance. Variations of shell morphology, morphostratigraphical context and malacological assemblages are discussed at a west-european scale.

Reproduction, ecology and evolution of the Indo-Pacific limpet *Scutellastra flexuosa* (Quoy & Gaimard, 1834)

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The patellogastropod *Scutellastra flexuosa* was studied at Temae islet reef on Moorea, Society Islands, French Polynesia between 1998 and 2001 to compare and contrast the respective roles of deep phyletic history with recent adaptations in shaping its current ecological and life history characteristics. Most of the characters examined are consistent with related specialist species and are therefore determined by ancestry. These characteristics include habitat restriction, algal gardening, local distribution, home site fidelity, adult/juvenile differentiation and protandric hermaphroditism. The only character that appears autapomorphic and a possible adaptation to its proximal setting is its small body size. Large body size is often associated with species that maintain and defend territories. However, the variance in size in clades with and without territorial species presents a more complex picture. The putative size reduction of *S. flexuosa* has not affected many of the specialized traits shared within its lineage and it remains a classic territorial taxon albeit in miniature. The phyletic pattern that emerges here is one of a clade dominated by specialist species that gave rise to generalist species that in turn gave rise to another group of specialists with identical traits albeit in different habitats.

Ultrastructural and cytochemical study of the oesophagus of *Bulla striata* (Opisthobranchia)

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Specimens of *Bulla striata* (Cephalaspidea) were collected in Ria de Alvor an estuary in the South coast of Portugal. In order to extend the current knowledge about the digestive tube in opisthobranchs, their oesophaguses were fixed with a mixture of glutaraldehyde and paraformaldehyde, post-fixed with OsO₄, dehydrated in ethanol and embedded in Epon. Semithin sections (2µm) were used for light microscopy studies and ultrathin sections for observations by transmission electron microscopy (TEM). In the most anterior region, including the dorsal oesophageal pouch, the columnar epithelium is ciliated and most cells present apical protrusions with a homogeneous content devoided of organelles. These protrusions are released into the lumen, an activity that seems to be particularly intense in the epithelium of the oesophageal pouch. Posteriorly to the oesophageal pouch, the epithelium is covered with microvilli embedded in a thick coat of granulo-fibrillar material, but apocrine secretion was not observed. In all the epithelium, the cytoplasm above the nucleus contains electron-dense lysosomes and residual bodies, in general, showing a reduced arylsulphatase activity. These cells can accumulate high amounts of glycogen in the cytoplasm above and below the nucleus, but lipid droplets are scarce. Subepithelial gland cells are very abundant in the wall of the oesophagus, except in the oesophageal pouch. The gland cells have a long neck that crosses the epithelium reaching the lumen, but the main cell body is embedded in the connective tissue below the epithelium. Large electron-lucent secretory vesicles containing a web of filaments and many Golgi stacks fill most of their cytoplasm, but mitochondria and lysosomes are also present. These cells can be stained by PAS reaction in semithin sections and their secretory vesicles contain acid mucopolysaccharides that were detected by colloidal iron particles in TEM. The outer layer of the oesophageal wall is formed by muscle cells.

Effects of Cd²⁺ on the calcium metabolism and shell mineralization of bivalve *Anodonta cygnea*

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The survival of freshwater mussels is easily affected by cadmium pollution due to the fact that it accumulates in bivalves displacing the calcium ion in its transport and regulation mechanisms. A first study with freshwater bivalves *Anodonta cygnea* under enriched Ca²⁺ (2 mM) water during different periods (three, four and eighteen days), showed a calcium content with a significant (P<0.05) increase in the ventricle fluid of the animals proportional to time exposure. In a second study 4 bivalve groups were exposed during four days to Ca²⁺ enriched water as a control situation, to the others an additional treatment was administered: one experimental group was exposed to a low concentration (10⁻⁶ M) of Cd²⁺ and to the other two groups animals were injected with vitamin D or with SEA0400 a promoter and an inhibitor of the calcium transport respectively. Fluid samples from

different compartments were analyzed on Ca^{2+} and Cd^{2+} composition as well as other ions relevant to the osmoregulation. Concerning the second study experimental groups it was shown high significant ($P < 0.001$) calcium contents in the ventricle fluids under Cd^{2+} and vitamin D, also in pericardium fluid under Cd^{2+} , vitamin D and SEA0400. By these results it's possible to speculate a specific transport mechanism from the intestine to the ventricle fluid, which may be induced with vitamin D. A general internal acidosis by Cd^{2+} , releasing calcium from the calcareous concretions and a specific inhibition of the calcium resorption, by the SEA0400, from the pericardium towards the ventricle are also considered possible. The cadmium contents in all experimental fluids and tissues are significantly ($P < 0.05$) augmented under influence of the Cd^{2+} exposition. Scanning electronic microscopy (SEM) imaging of the border regions of the shell presented clear ultrastructural changes under Cd^{2+} incubation suggesting a direct influence of this ion on the shell biomineralization mechanisms.

Molecular taxonomy of sunken-wood associated Bathymodiolinae: implications for phylogeny at sub-family level

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Bathymodiolinae sub-family currently includes mussels from hydrothermal vents and cold seeps but other modioliiform mussels inhabiting organic substrates such as sunken wood or whale bones were traditionally attributed to Modiolinae sub-family. Distel (2000) showed that these mussels associated to organic substrata cluster in a monophyletic group with vent and seeps species and should thus be considered as belonging to the Bathymodiolinae sub-family. However, specific diversity associated to organic substrata has been poorly explored. From an extensive sampling of south-west Pacific area and using a molecular taxonomy approach based both on nuclear and mitochondrial data we identified 20 MOTU (Molecular Operational Taxonomy Units). These 20 entities were broadly congruent with shell morphology and most of them are probably new for science. The evolutionary origin of vent and seep mussels remains under discussion and phylogenetic analyses have not yet resolve the question. Thus, including this unexpected specific diversity of Bathymodiolinae mussels associated to organic substrata (mostly sunken woods) in the phylogenetic analyses should permit to resolve the history of deep-sea floor colonization by modioliiform mussels. A preliminary phylogenetic study using 4 genes from a subset of these 20 species suggests that the ancestors of vent and seep species was probably associated to sunken woods.

Preliminary data on molecular diversity of the “*Napaeus pruninus* complex” in São Miguel Island

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The first endemic mollusk described from the Azores was *Bulimus pruninus* Gould, 1846, a napaeid of the equally endemic subgenus *Macaronapaeus* Hesse, 1933. Arthur Morelet, in his “Histoire Naturelle des Açores” (1860) illustrated profusely the variability of that species and described four additional species: *B. vulgaris*, *B. hartungi*, *B. delibutus* and *B. forbesianus*. Of particular interest was an intermediate form between *B. pruninus* and *B. vulgaris*, which Morelet interpreted as the result of “an adulterine affair between these two molluscs”. Preliminary work on the anatomy and

spermatophore morphology of *Napaesus pruninus* in S. Miguel has pointed out to possible relationships of some populations with species of neighboring islands, viz.: those of the central-south with *N. tremulans* (Mousson, 1858) from Santa Maria; those of the western portion, namely from Sete Cidades complex, with *N. alabastrinus* (Morelet, 1860) from Terceira, one of Morelet's varieties later elevated to specific status; and the remaining eastern portion apparently showing intermediate morphology.

The present work intends to contribute to the clarification of the taxonomic meaning of the morphological variability of *N. pruninus* in S. Miguel and of the so-called hybrids, using partial sequence data from the 16S rRNA mtDNA gene.

A review of the genus *Satondella* Bandel, 1998 (Gastropoda, Scissurellidae)

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The genus *Satondella* Bandel, 1998 is currently known from three species: *Satondella minuta* Bandel, 1998, from Indonesia (type species); *S. tabulata* (Watson, 1886), from the Caribbean Sea, and *S. senni* Geiger, 2003, from Easter Island. We found four new species among material in various museum collections.

The range of *Satondella minuta* is extended to Fiji, Solomon Islands, New Caledonia and S. Queensland (Australia). *Satondella tabulata*, described from Culebra Island (Puerto Rico), is here recorded from Bermuda, Florida, Bahamas, the Gulf of Mexico and throughout the whole Caribbean. *Sinezona brasiliensis* Mattar, 1987, described from Amapá (North Brazil) and recorded south to São Paulo, is probably a junior synonym of *S. tabulata*. The radula of *Satondella tabulata* is described, the first for the genus.

Satondella n. sp. 1, from New Caledonia, the Loyalty and Solomon Islands, differs from *S. minuta* by having a protoconch with weak spiral sculpture and more numerous axial ribs. *Satondella* n. sp. 2 from Christmas Islands, New Caledonia, Loyalty Islands and Vanuatu differs from *S. tabulata* by a sunken smooth protoconch, instead of a flat one with microhexagonal sculpture, less axial ribs on teleoconch 2 and more numerous spiral cords. *Satondella* n. sp. 3, from New Caledonia differs from all other species by the strong axial protoconch sculpture. *Satondella* 4, from Loyalty Islands and New Caledonia, has a much higher number of axial ribs on teleoconch 1 and 2 than any of the precedent species, and it is the only species with elevated protoconch.

Material from all *Satondella* species is quite scarce; empty shells come from medium depths (50-700 m, shells from greater depths probably fallen from shallower waters), and only some specimens of two species has been caught alive between 15 and 56 m (*Satondella tabulata*) and 140–182 m (*Satondella* n. sp. 2).

Pest snails in Australia: current management strategies and challenges for the future

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Several terrestrial snail species cause significant economic losses across a wide range of agricultural industries in Australia. Losses can occur through a decrease in production, downgrading and/or cleaning of produce, management, monitoring and inspection costs, and in some cases loss of export markets. This paper reports on the strategies currently used to manage these problems, with a particular focus on the broad-acre cropping and citrus industries.

Theba pisana, *Ceriuella virgata*, *Cochlicella acuta*, and *Prieticella barbara* are all pests of grain crops in south-eastern Australia. A substantial research program has been undertaken over ~ 20 years to provide management options to farmers. These options include chemical and cultural controls such as burning, cabling, rolling and grain sieving, and more recently, a biological control agent, *Sarcophaga penicillata*, has been introduced into Australia against *C. acuta*.

In the citrus industry, *Cantareus aspersus* and *Microxeromagna armillata* are responsible for the majority of the economic losses. *M. armillata* has been found contaminating export fruit, which has threatened market access of Australian fruit. Research has focused on understanding the basic biology and ecology of *M. armillata* in addition to evaluating both chemical and cultural control methods.

All of the aforementioned snails are introduced to Australia and, while the impacts of these species on agricultural production are well documented, the influence of these species on the native flora and fauna is not known. Understanding their impact and developing management strategies for these pests in national parks and bushland is a substantial challenge for the future. Possible incursions of other pest snails such as *Achatina fulica* and the aquatic *Pomacea canaliculata* are also of significant concern and are discussed in this context.

Effects of a thermal effluent on the rocky intertidal molluscan assemblages

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Thermal stress has been considered to be among the most important factors of organisms distribution in the rocky intertidal zone. However, there are few studies that have been conducted in order to evaluate the influence of thermal effluents on rocky intertidal communities.

Spatial-temporal distribution of rocky intertidal species affected by a thermal effluent was monitored during one year. This study was carried out in Algeciras Bay (South of Spain). An increase on water temperature of 10 °C was found at the stations continuously exposed to the effluent. For molluscs, a decrease on Shannon diversity index and species richness in the affected area was detected. The most common species in the control area such as *Patella caerulea*, *Cymbula safiana* and *Patella rustica*, were absent or scarce in the affected zone. However, the false limpet, *Siphonaria pectinata*, was the most abundant mollusc, and its vertical distribution range was higher in the influenced area. On the other hand, macrophyte communities also presented a lower species diversity and richness in the stations closest to the thermal effluent. The seaweed *Titanoderma pustulatum* var. *confine*, almost absent in the control area, was the dominant species in the thermal zone. The mollusc *S. pectinata* was displaced by this algae in the area with the highest coverage.

In summary, most of the common rocky intertidal molluscan species, in spite of being adapted to abrupt punctual change of temperature during low tide, presented a relatively low thermal tolerance during prolonged exposure to artificially elevated water temperatures.

**Growth of *Donax vittatus* in the north-west coast of Portugal.
Biological data for the management of a new fishery**

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The marine mollusc fishery in the north-west coast of Portugal (NWCP) has been directed to the white surf clam (*Spisula solida*). However, the high fishing effort in the area caused the collapse of this resource in the 1990s. Thus, there is an urgent need to find alternative or complementary species for that fishery. Preliminary studies carried by INIAP/IPIMAR showed that the banded wedge shell (*Donax vittatus*) could be an important target species for the fishery in this region. The aim of this work is to study the growth of this species in order to provide basic information for this fishery management. The shell growth was investigated from samples collected monthly at NWCP from November 2003 to October 2004. The analysis of the marginal shell growth showed that the annual growth ring was formed once a year, in the winter. The age and the shell growth of *D. vittatus* were assessed using both surface growth rings and internal shell microgrowth patterns (by the acetate peel method). The estimated von Bertalanffy growth curves, expressed for length and weight, are the following:

<u>rings on the shell surface:</u>	$L_t = 43,1 [1 - e^{-0,38(t+0,20)}]$	$W_t = 7,4 [1 - e^{-0,38(t+0,20)}]^{3,04}$
<u>acetate peel method:</u>	$L_t = 40,5 [1 - e^{-0,38(t+0,50)}]$	$W_t = 6,1 [1 - e^{-0,38(t+0,50)}]^{3,04}$

**Morphological and shell quality natural population diversity of the edible snail
(*Helix aspersa* M.), in southern Hellas**

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No relevant information on stock definition has been produced recently concerning edible snails, which are both commercially and ecologically important species in the eastern Mediterranean region. The present study addresses on nine (9) quantitative and qualitative traits [on the axial view - SH: shell height, SD: shell maximum diameter; on the apertural view - AL: aperture length from the point of adhesion of aperture to body whorl, AW: maximum aperture width, WW: wet weight; and number of bands, band colour, shell's base colour, overall colour pattern], diversity of six (6) natural populations of the edible snail, *Helix aspersa*, collected in Peloponnesus (Megalopoli, Corinth, Argolida, Zacharo) and the island of Crete (Chania, Ierapetra), southern Hellas.

Multivariate statistical analysis of quantitative traits is a powerful technique used to investigate geographical variation of populations. It has provided useful results for assessing stock structure of several species, because it can yield information complementary to that derived from biochemical, physiological and life history studies. Principal component analysis (PCA) was used to test for the contribution of these traits in the configuration of variance. Forward stepwise discriminant analysis (DA) based on the generalized Mahalanobis distance was used to determine the similarity between populations and the ability of these traits to identify the specimens correctly. A dendrogram of phenotypic relationships was constructed based on Mahalanobis distances using UPGMA cluster analysis.

Diversity, speciation and historical biogeography of Bullidae

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Phylogenetic relationships and historical biogeography of the worldwide gastropod family Bullidae, a monophyletic assemblage of mainly tropical species inhabiting shallow seagrass and sandy-mud areas, are inferred by Bayesian analysis of individual and combined genes (mitochondrial cytochrome oxidase I and 16S rRNA, and nuclear 28S rRNA). The geographical mode and time of speciation are hypothesized from the phylogeny, fossil evidence and geographical distributions of extant species. The geographical pattern of speciation was assessed by plotting percentage of range overlap between sister clades against age of nodes; divergence times (age of nodes) and rates of evolution were calculated by penalized likelihood with fossil ages; and a lineage-through-time plot was used to assess diversification rate. The family Bullidae had its origin in the tropical Tethys Sea and during the Miocene was widespread across the Tethyan realm. Major tectonic events like the closure of Tethys Sea and the uplift of the Isthmus of Panama, coupled with cold-water currents around South Africa and expanses of open ocean (East Pacific and Mid-Atlantic Barriers) shaped the phylogenetic structure of Bullidae, resulting in a monophyletic assemblage in the tropical Indo-West Pacific and another in the Atlantic plus Eastern Pacific. Within the latter clade there are sister relationships across the Isthmus of Panama, and on both sides of the Atlantic Ocean. Allopatry is the only mode of speciation in Bullidae, and both vicariance and dispersal played important roles in the formation of species. Despite the orthodox view that Plio-Pleistocene sea-level oscillations have promoted speciation in shallow-marine organisms, the origin of extant species of Bullidae dates from the Miocene. Patterns of diversity conform roughly to the general trend observed in tropical organisms, with a maximum of six species in the Indo-West Pacific region as a whole (and up to three sympatric in its central part) and two species each in the East Pacific, Western Atlantic and Eastern Atlantic regions. The southern Australasian species *Bulla quoyii* is hypothesized to be a Tethyan relict that is sister to the Atlantic plus eastern Pacific clade. This provides the first molecular support for the idea that southern Australia is a refuge of Tethyan fauna.

Diversity and distribution of *Haminoea* (Gastropoda: Cephalaspidea) in the Atlantic and eastern Pacific oceans

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This is a new project, recently begun with the aim of combining data on shells, anatomy, fossil record and molecular sequences of all available species of *Haminoea* in a systematic, phylogenetic and biogeographic analysis. The main objectives are to review and clarify the systematics of the group, and to produce a species-level phylogeny as a basis for hypotheses of origin, speciation and historical biogeography. The genus *Haminoea* occurs worldwide in tropical and temperate habitats, inhabiting

coastal lagoons, estuaries, coral reefs and rocky shores with algae. As in the majority of cephalaspidean gastropods, systematic work has been based mostly on shells, which in Haminoea are all exceedingly similar between species: small (average length 10 mm), bubble-shaped, brownish, fragile, translucent and smooth. This led to a confused taxonomy and an unknown number of valid species. Forty-six species names are available in the entire Atlantic and eastern Pacific (eastern Atlantic: 20; western Atlantic: 15; eastern Pacific: 11), but modern accounts of molluscan diversity for these regions typically recognize no more than 13 valid native species. An example of the taxonomic problems surrounding the genus is the widespread use of the name *H. elegans* to refer to specimens from the tropical Caribbean. The assignment of this name to one of the Caribbean species is a common practice among authors, although this name was introduced by Gray in 1825 to designate specimens from the southern British Isles and is likely a synonym of *H. navicula* da Costa, 1778, a species restricted to the eastern Atlantic and Mediterranean Sea. Several authors have shown that characters of the radula, gizzard plates and male genital system are useful to differentiate species; shell shape and microsculpture can also be helpful to distinguish between groups of species, but for example the complex female reproductive glands have hardly been investigated. Here, we present a preliminary account of the genus across three biogeographical regions: the eastern and western Atlantic and eastern Pacific, and will discuss distributions, diversity and the value of systematic characters.

Life cycles of the Polish clausiliids – knowns and unknowns

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Out of 177 terrestrial gastropods recorded from Poland, life cycles are completely known in 13 (7%) cases; only some life cycle parameters are known in 32 (18%) cases, most often based on field observations. Out of the 24 clausiliid species, literature data, often fragmentary, pertain to 13 species (54%): *Ruthenica filograna*, *Macrogastera plicatula*, *M. ventricosa*, *Clausilia bidentata*, *C. dubia* and *Laciniaria plicata* (fragmentary data from laboratory observations), *Balea perversa*, *Cochlodina laminata*, *Charpentieria ornata*, *Alinda biplicata*, *Vestia gulo* and *Bulgarica cana* (life cycles partly known based on field and laboratory observations) and *Vestia elata* (complete data from field observations). Reproductive biology is not known in detail in any representative of the family occurring in Poland. Out of 13 endangered (Red List) and five legally protected clausiliids, four have been studied partly or fragmentarily: *Vestia elata*, *Balea perversa*, *Vestia gulo* and *Charpentieria ornata*.

Cell and tissue-level biomarkers in slugs (*Arion ater*) are reliable tools for health assessment in soil ecosystems

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Slugs are useful sentinels (“Slug-watch”) in soil health assessment. At present, diverse (exposure and biological effect) biomarkers measured at molecular, cellular and tissue levels provide useful information to diagnose environmental distress due to chemical pollution. Laboratory experiments have demonstrated that slugs respond to chemical insult in a measurable manner (biomarkers) after exposure to model metals and organic chemical compounds but also after exposure to complex

mixtures of pollutants. Moreover, as the development of biomarkers is based on the mechanistic understanding of the biological responses to pollutants, biomarkers provide early warning signals that precede changes in feeding activity and growth (which are endpoints of ecological relevance) and, on the other hand, also may provide indication of chronic pollution after long-term exposure. A battery of biomarkers (MT induction, intralysosomal metal accumulation, enlargement/shrinkage of digestive cell lysosomes, lysosomal membrane stability; induction of AOX activity, accumulation of lipofuscins, and (quantitative) histopathological alterations in the digestive gland) is currently available. This battery was applied separately to male, female and immature slugs exposed to diverse pollutants (metals –Cd, Cu, Zn, Pb, Hg-, organic chemicals –Kerosene-, and mixtures of metals and metals+organic chemical compounds). It was observed that sensitivity and responsiveness to pollution insult changes throughout slug life cycle (females are more susceptible than males and immature juveniles). Likewise, slugs subjected to chronic pollution (i.e., inhabiting ancient miles) and their descendents were less responsive to chemical insult but, interestingly, they were also less affected by additional pollutant exposures. These are crucial issues in order to determine critical values of biomarkers (baselines, toxicity thresholds –NOEC-) suitable for soil health assessment. Overall, although biomarkers, pollutant tissue burdens and parameters indicative of general stress are rarely correlated between them, biomarkers are valuable tools to link exposure to pollutants to ecologically relevant effects in soils.

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Cell and tissue biology of the mussel (*Mytilus galloprovincialis*) digestive gland: a novel view of its form and function

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A novel view of form and function of the mussel, *Mytilus galloprovincialis*, digestive gland is proposed based on recent data concerning its cell and tissue biology. The digestive gland is comprised of complex alveoli that include a central chamber from which finger-like tubular projections are projected. Each digestive alveolus is connected by a single opening into a secondary duct in a non-terminal position, and is packed by a layer of fibrous connective tissue. In small juvenile mussels, dozens of tubules arise from one single chamber whereas in mature individuals each alveolus is comprised by 6-10 tubules connected to one flattened chamber. The form of the alveolus may change throughout digestion, due to environmental stress (finger-like tubules reduced in length), and with intertidal position (tubules are shorter and thicker in subtidal than in intertidal mussels). Two differentiated mature cell types (digestive and basophilic cells) comprise its epithelium. Since both cell types may undergo division by separate (autologous cell division of mature cells) they must be considered two distinct cell types. Cell proliferation is neither eventual nor continuous but governed by environmental factors. It follows a circatidal pattern modulated by tide (food) and light in both intertidal and subtidal mussels and presents marked seasonal variability (whereas the epithelium is entirely renovated every month in summer only vestigial cell proliferation occurs in winter). As a result, it seems unconceivable that breakdown and reconstituting phases take place every digestion cycle, as proposed in conventional models of feeding and digestion in bivalves. Accordingly, digestion phases have been reinterpreted based on enzyme and lectin histochemistry, 3D-reconstruction and image analysis, and a new model (digestions waves) is presented to explain cyclic intracellular digestion processes and trafficking of food and debris in digestive diverticula., which includes close collaboration between digestive and basophilic cells to produce lysosomal hydrolases.

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Cytogenetics of bivalves: a review with some comments on phylogeny

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Bivalvia, the second largest class of molluscs, are scarcely investigated at chromosome level. Studies have determined chromosome number for eight Protobranchia species, 111 Pteriomorphia, 28 Palaeoheterodonta, 62 Heterodonta and one Anomalodesmata. Analysis of chromosome morphology and karyotype is even more limited, these numbers being 8, 91, 11, 41 and 1, respectively. For chromosome number, Protobranchia species display diploid modal values of 22, 24 and 38 chromosomes. Subclass Pteriomorphia shows high variability, as chromosome number ranges from $2n = 12$ (for some species of the genus *Anomia*), $2n = 20$ (most frequent number in oyster species), $2n = 28$ (for mussels) and $2n = 38$ (for pectinids). Species included in the Palaeoheterodonta subclass show, mainly, $2n = 38$, except in the case of *Mutela rostrata*, which displays 20 chromosomes. Subclass Heterodonta exhibits a tendency to $2n = 38$ (most Heterodonta present this chromosome number); however, the only species showing polyploid chromosome numbers belong to this subclass are included in genera *Lasaea* and *Corbicula*. Finally, chromosome number for subclass Anomalodesmata species was only determined for *Laternula elliptica*, which shows a diploid number of 40 chromosomes.

The aim of this work was to review the cytogenetic status of bivalve species to follow the karyotyping of this group of animals and to comment on their phylogeny based on chromosome data.

Revision of the taxonomy of the Ibero-Balearic populations of *Tudorella* (Caenogastropoda, Pomatiidae) by molecular and morphological analyses

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We have realized molecular and morpho-anatomical studies of two Spanish populations from Alicante and Granada provinces, both fossil and recent forms traditionally assigned in the Iberian Peninsula to *Tudorella sulcata sulcata*. They have been compared with other populations from Marseille (France) (Type locality), Sardinia and Sicily (Italy), Malta, NW Algeria and S Portugal, as well as with *T. ferruginea* from Balearic Islands and *T. mauretana* from NE Morocco. DNA sequences of two mitochondrial genes, COI and 16S rRNA were used to know the phylogenetic relationships, using *Leonia mamillaris* as outgroup. The individual and combined analyses of these genes show three main genetically unique lineages which were considered as different species: *T. ferruginea*, *T. mauretana* and *T. sulcata*. The study of the shell size and shape, including microsculpture of protoconch and teleoconch, together with anatomical studies of the reproductive system allow us to characterize the morphology of the main phylogroups obtained. There is a great congruence between morphology and phylogeny. Besides, the validity of the subspecies *T. sulcata melitense* and *T. s. sulcata* is also evaluated on the basis of their genetic divergences and morphology.

We conclude that both Spanish populations from Alicante and Granada provinces, should be reassigned to *T. mauretana*, that inhabits also in North Africa between Oran (Algeria) and NE Morocco. After this study, we consider that *Tudorella* populations from SE France, Sardinia, Sicily, Algeria and Portugal correspond to *T. sulcata sulcata*. Malta specimens are considered a valid

subspecies: *T. s. melitense*. *T. ferruginea* is restricted to the Balearic Islands. We discuss about the possibility that populations of *T. sulcata sulcata* from Portugal and Marseille could be the result of historical introductions.

Accompanying fauna of *Bulgarica cana* (Held)

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In 2001-2006 68 forest localities in Poland were sampled for terrestrial malacocoenoses; 45 of them included *Bulgarica cana*. The distribution of the species includes essentially the entire Poland, but in many areas it is rare. Since life cycle of *B. cana* is at present being studied, we took the opportunity to analyse its accompanying fauna. Samples were taken with standard methods; all the samples met the completeness criteria. The studied malacocoenoses came from Białowieża Forest (9 sites), Romincka Forest (4), Pieniny Mts (9), Bieszczady Mts (7) and the Bieszczady foothills (16). The total number of species accompanying *B. cana* was 82, the number of species per malacocoenosis ranging from 18 to 43. In the southern part of the country (mountain areas) malacocoenoses with *B. cana* included a total of 77 species, the number of species per malacocoenosis being 21-43 (mean 31.1); the respective values for the northern (lowland) sites were 49 and 18-37 (25.9). Thirty three species were recorded only for mountain malacocoenoses (the absence of four of them in lowland malacocoenoses could be accidental), six - only in lowland malacocoenoses (where the absence of three could be accidental). Forty two species (including *B. cana*) were common to both types of malacocoenoses, the overall Nei similarity was 0.70. The heterogeneity of the malacocoenoses as expressed by Whittaker's indices was $I = 2.8$, $I_{\max} = 1.9$ and was higher for the mountain sites ($I = 2.5$, $I_{\max} = 1.8$) compared to the lowlands ($I = 1.9$, $I_{\max} = 1.3$). The following species were found to accompany *B. cana* in 90% or more sites in both regions: *Carychium tridentatum*, *Columella edentula*, *Vertigo pusilla*, *Punctum pygmaeum* and *Aegopinella pura*; in the lowlands also *Cochlicopa lubrica*, *Discus ruderatus*, *D. rotundatus*, *Vitrea crystallina*, *Nesovitrea hammonis*, *Euconulus fulvus*, *Cochlodina laminata*, *Macrogastra ventricosa*, *Macrogastra plicatula*, *Laciniaria plicata*, *Bradybaena fruticum* and *Perforatella bidentata*, and in the mountains *Acanthinula aculeata*, *Vitrea diaphana*, *Aegopinella epipedostoma*, *Macrogastra tumida*, *Vestia gulo*, *Perforatella vicina*, *Chilostoma faunstinum* and *Isognomostoma isognomostoma*.

Habitat –related shell variation of two Baikal endemic gastropods

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It was revealed the similar trend of morphological shell variations of two species, *Maackia herderiana* and *Teratobaikalia ciliata* from an endemic family Baicaliidae (Caenogastropods) related to their habitat on stone-rocky sediments along the south-western littoral of Baikal. The shell of both species living in a wave-affected depth zone (up to 5-8 m) is small in size and has a transverse ribbed sculpture that supply periostracal hair in *T. ciliata*. At the depth of 18-30 m, beyond the reach of waves, the shell of both species is larger and actually lacks sculpture, and moreover, in some microhabitats their body is free of a black pigmented layer. Thus both species separate to two ecotypes shell of which is adapted to environments. The depth from 8 to 15 m is probably a hybrid zone where individuals as sculptured as smooth and as intermediate forms were found together. There are differences of width of this zone in depending of bottom slope in distinct regions. Ecotype

distribution of two Baikal gastropod species is similar to the ecotypes of a sea snail *Littorina saxatilis* (see review Rolan-Alvarez, 2007) and apparently is an evidence of initial stages in sympatric speciation. It is planning to investigation of the molecular variability of the ecotypes. The ecotypes of Baikal gastropods described by molecular genetic means will be studied further. This study was carried out within the State Program N 7.9.1.3 and supported by SB RAS project N 11.14 (“Biodiversity...”), RFBR project N 05-04-97258

Comparative assessment of reproductive toxicity of contaminated freshwater sediments by *in vivo* biotests with *Potamopyrgus antipodarum* and *in vitro* assays

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Reproductive toxicity of sediments contaminated with waste coal was examined in chronic laboratory tests with the prosobranch snail *Potamopyrgus antipodarum*. The exposure was conducted with control sediment, contaminated sediment and two mixtures of these sediments. Furthermore, the effects of three doses of organic extracts prepared from the contaminated sediment (added to the control sediment) were also studied. The fecundity of parthenogenetic females was examined after two, five and eight weeks of exposure. During the exposure, an accelerated embryo development followed by a decreasing production of new embryos was observed. This trend became obvious in the experiments with native contaminated sediment as well as with control sediment treated with the organic extract from the contaminated sample. Chemical contaminants of sediment (16 PAHs, PCBs and OCPs, heavy metals) as well as organic carbon content were characterized in addition. *In vitro* studies with H4IIE.luc and MVLN cell lines as well as estrogen-responsive recombinant yeast assays showed the potency of the sediment organic fraction to elicit dioxin-like and endocrine disruptive potentials. This integrative assessment demonstrates complex evaluation of ecological risks associated with complicated heterogeneous environmental samples such as contaminated sediments. The study was supported by the ECODIS project of EU 6FWP and by the DBU fellowship to E.M.

Updating the gastropod fauna of the Northeastern Pacific

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The northeastern Pacific marine mollusks were once considered well known, but we of the western U.S. now lag behind because a database approach to the entire fauna is years away, to be done by the next generation. Bivalves were monographed in 1990 by Coan, Scott, and Bernard, but no new species were included. A full revision of the shell bearing gastropods is underway, taking into account the large number of new species, and following recent advances in phylogeny and classification. Numerous new species result from deep sea sampling by the University of Oregon and Scripps Institution of Oceanography, and fishery monitoring expeditions along the Aleutian Islands from the Baxter collection and Roger Clark. With the exception of David Lindberg’s collaboration with patelliform limpets, I remain the only person committed to revision on a faunistic scale, so I am without collaborators to hasten the process. This is in contrast to the fauna of the northwestern Pacific for which there have been major checklists and well illustrated manuals produced by collaborating

teams in Japan and Russia within the last eight years. Time is too short to begin with a checklist or with separate publication of the new species, so it is necessary to include them in my books. There are to be two separate but overlapping taxonomic manual/revisions, the first to treat the species from British Columbia south to central Baja California, the second to treat the north Pacific species from British Columbia and Alaska, west to Kamchatka, the Kurile Islands, and Hokkaido, considering that the north Pacific represents a continuous faunal region connected by the Bering Sea and the Aleutian Islands. The northwestern Pacific species can now be integrated with the northeastern Pacific species, thanks to the publication in 2006 of Kantor & Sysoev's *Illustrated Catalog* of Russian gastropods. With the help of a part-time imaging assistant over the last five years, the working illustrations of about 400 half-page plates (for placement next to the text) for the southern book have been completed; work on the illustrations for the northern book is well underway. Publication of the first volume that treats 1400 species should be possible in two years.

The Holsteinian: MIS 7, 9 or 11?

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The Holsteinian is a Middle Pleistocene interglacial that has been introduced on the basis of marine mollusc bearing deposits in Northern Germany. In Europe, the interglacial shows (except for marine taxa) a remarkable molluscan record. Although individual species also occur in other interglacials, the fluvial assemblages include *Theodoxus danubialis*, *Viviparus diluvianus*, *Valvata naticina*, *Parafossarulus crassitesta*, *Pisidium clessini*, etc. Notably, many of these taxa are also present in the preceding Fourth Cromerian Interglacial. The terrestrial 'Lyrodiscus assemblage' is considered to be of Holsteinian age (is, however, absent in the Holsteinian type area) and includes *Lyrodiscus elephantium*, *Zonitoides sepultus*, *Aegopinella bourdieri*, *Aegopis acieformis*, *Ruthenica filograna*, *Laminifera pauli*, etc. All mentioned taxa (fluvial and terrestrial) occur far beyond their modern area or are extinct.

The age of the Holsteinian was controversial and attributed to MIS (Marine Isotope Stage) 7, 9 or 11 respectively. Now, most authors consider the Holsteinian to represent MIS 11. However, the problems in dating the Holsteinian stratotype show that this conclusion is premature and probably incorrect.

Recently, Amino Acid Racemization dating of marine molluscs showed that the Holsteinian stratotype dates from MIS 9. The Fourth Cromerian Interglacial at its type site appears to date from MIS 11, and this was similarly shown for the Dutch 'Holsteinian' site of Neede. Therefore, at least the characteristic fluvial assemblages with *Viviparus diluvianus* are NOT Holsteinian but date from the preceding interglacial (but still MIS 11). These conclusions are corroborated by new insights in the lithostratigraphy of the areas in question as well as absolute dating of the Holsteinian parastratotype. These results have no bearing for the 'Lyrodiscus Assemblage' although many other data point to MIS 11, implying an age of Fourth Cromerian Interglacial as well. Similarly, any site attributed on sound data to MIS 11, is not Holsteinian but Fourth Cromerian Interglacial.

Marine cryptic diversity: the allopatric component

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Molecular data are revolutionizing our ability to characterize global biodiversity. One of the most outstanding marine patterns emerging from molecular systematics and phylogeography is that most sister taxa do not share geographic ranges, and that overlap often requires millions of years. As such, allopatric speciation is supported as the dominant mode driving marine diversification.

Comprehensive phylogeographic surveys for many marine molluscan clades support this pattern. Moreover, many broadly distributed species turn out to be species complexes of allopatrically distributed lineages. Allopatric diversification can occur on basinal, sub-basinal, peripheral or archipelagic scales, and is most strongly related to dispersal ability. A survey of available phylogeographic studies for over 100 described marine species reveals that these taxa actually represent nearly 300 distinct lineages; an average allopatric cryptic multiplier of ~x3. The results are strongly bimodal, however, based on larval type. Those with feeding larvae, and presumably greater dispersal ability, have an average x2.8 multiplier; whereas those without feeding larvae average x14. Given that much of molluscan diversity is small, and that dispersal ability tends to scale with size, the prevalence of allopatrically distributed species complexes in micromollusks may contribute substantially to global marine species estimates.

A combinatorial phylogenetic analysis of Conoidea

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In joint collaboration, we assembled a supermatrix of all available mtDNA sequence data for Conoidea species to better assess overall relationships within the group. The dataset includes members of twelve currently recognized families/subfamilies within the superfamily, with especially broad coverage across the genus *Conus*. Based on examination of sequence similarity, we culled a larger dataset consisting of over 1500 OTUs to 334 exemplar taxa that best represent independent species or ESUs. We performed a series of phylogenetic analyses using this data set: (A) separate analyses for each of three genes, 16S, 12S and COI; (B) analyses including only taxa for which all genes are present, with and without areas of ambiguous alignments; and (C) analyses including all taxa regardless of sequence coverage, with and without areas of ambiguous alignments. We compared the results from each of these analyses to determine if subtrees are concordant and if certain species and/or sequences bias topological stability and support. We use the subsequent phylogeny to examine Conoidea systematics, as well as evolutionary dynamics within the genus *Conus*.

Sexual conflict and conflict resolution in hermaphroditic gastropods

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Sexual selection results from competition within and between sexes over reproductive success. Although Darwin coined the term, and assumed that it would be limited to species with separate sexes (gonochorists), consequences of sexual selection have now been shown for many hermaphroditic taxa. A majority of these studies have focused on pulmonate gastropods and opisthobranch sea slugs. This talk gives an overview of some of the most spectacular examples of excessive and complicated traits that have evolved in the context of sexual conflict and conflict resolution found thus far in these groups. The sheer diversity and nature of these traits is overwhelming. This is particularly obvious when compared to prosobranchs, where such diversity seems to be absent. I shall offer some explanations, which are sometimes non-intuitive and based on theoretical models. No explanation seems to be sufficient to explain all the known systems, suggesting high evolutionary dynamics. At the end, I shall speculate on whether hermaphroditic groups like these should be considered derived or ancestral, and whether they may lead into evolutionary dead-ends.

Bivalves of the Florida Keys – The monograph

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Molluscan diversity in the Florida Keys, a relatively well-known and oft-sampled area (10,000 km²) by professional and amateur collectors and now Florida Keys National Marine Sanctuary, has surpassed all previously published estimates and checklists. A combination of region-wide qualitative sampling, thorough and rapid collecting techniques, "data mining" of museum collections and literature, and a large-scale transect project have nearly tripled the number of known marine mollusks to about 1,700 species, and provided insight into their distribution and ecology. Dated records were used to investigate species occurrences over the past 100+ years and indicate recent introductions and losses in this region. After more than 12 years of intensive study, a first phase focusing on bivalves is being completed, resulting in faunal analyses and critical catalogues including photographic documentation of the nearly 400 species. Although the molluscan community is relatively uniform throughout the Keys, results indicate (1) nearly half of the species can be characterized as rare, (2) no losses were recorded, and gains can be attributed to introduced exotic species, increased freshwater input (from The Everglades), and new sampling technologies, (3) a distinct northeast-to-southwest gradient in community structure was evident only in the shallow-water bayside of the island chain (absent on the oceanside at all depths), and (4) the overall community showed greatest similarity with those of the Gulf of Mexico and Cuba. The considerable clade richness (representing half of the world's bivalve families) prompted a comparative survey of bivalve morphology, the focus of a forthcoming book-length monograph. Text and images combine to present the full range of species- to family-level characteristics exemplified by the Florida Keys fauna. Illustrations include 1,500 color images of shells, underwater habitats, bivalves in situ, original anatomical and hinge drawings, scanning electron micrographs, and unique "transparent clam" anatomical drawings. [Supported in part by NSF PEET DEB-9978119].

First steps in the ecological and phylogenetic study – land snail *Monacha cartusiana* (O. F. Müller, 1774) in the area of Central Europe

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The main aim of the study is to explain factors important for distribution of the presumably non-indigenous land snail *Monacha cartusiana* (O. F. Müller, 1774), currently spreading from its original range in the Mediterranean to Western and Central Europe. The number of recorded populations of this species in the Czech Republic has significantly increased especially in the last 15 years, which makes this species a good model for evaluation of factors facilitating the invasibility of terrestrial molluscs. The proposed project has two parts – firstly, ecology of Czech populations with different life histories (well-established overwintering populations vs. short-term invasions) will be compared with data from the Mediterranean, and survival ability of individuals from Southern Europe under Central European climatic conditions will be tested. Secondly, phylogenetic and phylogeographic analysis of *M. cartusiana* populations in comparison with other related species will assess the intraspecific diversity and test the hypotheses about origin of newly established populations. We would like to establish a partnership with malacozoologists all over the Europe to obtain new experiences, new contacts and materials for the phylogenetic and phylogeographic study. For further information about this project please contact Alena Mikovcova from Charles University in Prague.

**The enigmatic neogastropod *Tritonoharpa*:
New data on cancellariid evolution**

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Uncovering the origin of the neogastropods and the relationships among neogastropod families may benefit significantly from information on key taxa. The strong tendency to parallel evolution of anatomical systems and conchological features in neogastropods, requires the use of molecular data along with morphological ones to delineate phylogenetic hypotheses.

Tritonoharpa Dall, 1908 includes 19 nominal species, and has been long considered as close relative of *Colubraria* Schumacher, 1817, basing on strong shell similarity and the assumed common lack of a radula. It was included in Cancellariidae by Beu & Maxwell (1987: *NZ Geol. Surv. Pal. Bull.* 54), and distinguished from *Plesiotriton* Fisher, 1884, by the lack of columellar plaits and of a radula in *Tritonoharpa*.

Tritonoharpa is indeed similar to *Colubraria* in the morphology of head-foot, pallial complex, reproductive and excretory systems, the extremely long and coiled proboscis, and the very large and long stomach. It differs however in the rest of foregut anatomy, which reveals cancellariid affinity, and in its radula, with a typical nematoglossan structure. The molecular data confirm Beu & Maxwell's suggestion that *Tritonoharpa* is a cancellariid, close to *Plesiotriton*. It is also suggested that cancellariids be the sister-group to the rest of neogastropods.

Tritonoharpa has a rather large and well developed glandular structure, which may recall either the gland of Leiblein of other neogastropods or the unpaired acinous accessory salivary gland of Marginellidae. If this was confirmed as a true homologue to the gland of Leiblein, the possession of the gland should be considered a synapomorphy of the whole Neogastropoda, and the presence of no more than a glandular stripe of tissue in other cancellariids could be a secondary reduction. If it was

demonstrated to be a different structure, then a new light could be shed on the evolution of the foregut in Neogastropoda, especially as more anatomical data on other cancellariids will be available.

Millennial-timescale environmental changes recorded by molluscan fauna at Nussloch (Germany) during the last glaciation and perspectives in quantitative palaeoclimatic reconstructions in quaternary malacology

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The millennial-timescale climatic variability of the last glaciation has already been shown through the study of ice- and marine-cores in the North Atlantic area. Its influence on European environments was mainly studied in Mediterranean domain through long pollen records and speleothems, which lack in continental domain. The terrestrial molluscs, sampled every 10 cm in the loess section of Nussloch (Germany), thus provides a high-resolution record of millennial-scale environmental changes between -70000 and -20000 years that has been correlated with the GRIP ice-core (Greenland). Increases in mollusc abundance and juvenile proportions are linked with warmer phases, i.e. Dansgaard-Oeschger interstadials.

These cyclical climatic oscillations also triggered humidity and vegetation changes recorded by malacological populations and sedimentological features. The pattern proposed for the Upper Pleniglacial (-35 to -20 kyr) is also valid for the Lower Pleniglacial (-75 to -50 kyr) with some differences, but partly differs for the Middle Pleniglacial due to a lower sedimentation rate and warmer climatic conditions. Moreover, according to the composition of the malacofauna, each interstadial has a particular environmental signature in terms of temperature, humidity and vegetation.

In Western Europe, Upper Weichselian malacofauna from England, northern France and Benelux are similar, poor and homogeneous through the whole Upper Pleniglacial indicating a persistence of homogeneous and poorly vegetated environments. In the Rhine Valley, the malacofauna are richer and partly different from site to site. However, this relative richness varies synchronously with sedimentological features through the Upper Weichselian. In four sites from this area, the development of tundra soils is associated with cold and moister conditions reflected by poorer malacofauna, which tend to resemble those observed in North- Western Europe. This suggests the occurrence of cyclical shifts to the East of the environmental conditions prevailing in North-Western Europe in response to millennial timescale changes of the climate dynamics.

The Zebra mussel as a bioindicator for endocrine disruption? A study on the annual gametogenic cycle and oestrogen levels in *Dreissena polymorpha*

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Bivalve molluscs can be potentially exposed to high concentrations of waterborne estrogens in the vicinity of sewage treatment plants. The zebra mussel is an abundant freshwater mollusc and, as a sessile organism with a high filtration rate, it may be particularly useful to locate sources of xenoestrogens. However, the effects of compounds with estrogenic activity on bivalve reproduction are unclear. It is assumed that bivalves synthesise endogenous steroidal hormones and that they may possess oestrogen receptors as well as vitellogenin-like proteins. This gives reason to hypothesise that mussels are sensitive to endocrine disruption by steroid hormones, but the relation to vitellogenesis and gonad development is not fully understood. As a background for evaluating possible effects of estrogenic endocrine disrupting chemicals, we have investigated the gametogenic cycle of *Dreissena polymorpha* (Pallas, 1771). Animals from an unpolluted reference site were monitored monthly over more than one year. Histological samples of the gonads were analysed qualitatively to determine the different developmental stages of the gonad. Quantitative histological analysis was conducted to estimate the vitellogenic phase of oocyte development. Moreover, the gonad index was determined and steroid levels were assessed.

The basic pattern of the reproductive cycle of *D. polymorpha* could be confirmed. After a resting phase in late summer gametogenesis commenced in autumn with gametes developing throughout winter until release in spring and summer. A rapid increase of the gonad index in February and March clearly marked vitellogenesis. However, on the individual level, the picture was less clear. The simultaneous occurrence of different development stages within the same animal confounded the classification. These problems were resolved by the use of stereology. Nonetheless, it remained difficult to correlate the highly variable levels of free oestrogen with oocyte development. In summary, possible effects of xenoestrogen on gonad development of bivalve molluscs should be elucidated for precisely determined gametogenic conditions.

Two new species of *Phyllodesmium* (Ehrenberg 1831) and a discussion of their placement within the phylogeny

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The facelinid genus *Phyllodesmium* (Ehrenberg, 1831) consists of approximately 27 morphologically diverse species that prey upon soft-bodied corals. At least 11 species have yet to be described, making it an interesting genus for testing phylogenetic hypotheses. One of the most interesting adaptations found in this genus is the widespread participation in a symbiotic relationship with photosynthetic dinoflagellates in the genus *Symbiodinium*. Many species in *Phyllodesmium* are able to retain zooxanthellae, which they obtain from their alcyonarian food source. A large degree of anatomical adaptations that enhance the ability to retain zooxanthellae make this group an ideal place to study the progression of symbiosis as it evolved in these animals. Histological studies have shown a positive relationship between the extent of digestive gland branching and the zooxanthellae retention abilities of these nudibranchs. Based on this observation, it is thought that animals with

minimal or no branching are more primitive species, whereas animals with vastly branched digestive tissue are highly evolved for maintaining algal symbionts. In this study, two new species of *Phyllodesmium* from the Philippine Islands and Japan are described. Both species have no digestive gland branching, and do not harbor symbiotic zooxanthellae. A preliminary examination of the *Phyllodesmium* phylogeny suggests that these species are basal, further indicating that symbiosis is a derived trait in this group.

***Vertigo geyeri* in a lowland Irish fen - asking the right questions and getting the answers**

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Vertigo geyeri has protected status under Annex II of the European Union Habitats and Species Directive. Member states with populations of this species must maintain Special Areas of Conservation in favourable conservation status. This has presented a challenge to national authorities charged with its protection.

This paper outlines ten years of studies in a lowland fen in the Republic of Ireland. A number of methodologies and results are outlined; each designed in order to answer specific questions. Repeated surveys ranged from general fen survey (200 hectares) to annual surveys of 57 separate quadrats (1m²) to monthly assessments of 2,000 quadrats (5cm²), including methodologies of destructive sampling and non-destructive sampling.

The fen used in this ten year study was impacted by dewatering of the aquifer driving its hydrogeology, so baseline and post-impact results are presented from the various methodologies used.

General walk-over surveys with non-destructive sampling were found to be useful in locating important patches of habitat for more intensive study. Annual surveys at the medium (1m²) scale provided useful data regarding the mobility of *V. geyeri*, and the benefits and shortcomings of utilizing wetness indices based on a wide range of molluscan species. In general, wetness indices were poor at measuring small scale changes, but good at highlighting gross changes. Intensive non-destructive survey contributed to a larger hydrogeological model that was able to define the micro-habitat requirements of this tiny species. Monthly destructive sampling on a wider scale was able to provide useful measurement of change and has been used in examining the effects of temporary mitigation measures at the site.

The combined work over the last ten years has been used in the design of a monitoring survey methodology for all areas protected for *V. geyeri* under European law in the Republic of Ireland.

Reproductive cycle of the giant clam *Panopea generosa* at Magdalena Bay, South Baja California, Mexico

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In the Mexican western coast a high percentage of the demand for fishing resources is concentrated in the bivalve mollusks. The giant clam *Panopea generosa* is considered a potentially exploitable

resource with high commercial value; this species is distributed from the north of the Pacific of Canada, the United States of America to South Baja California, Mexico. Due to the lack of biological information and to the increasing demand mainly for exportation, it has being established as the study object of this research the characterization of the reproductive cycle by means of the histological analysis of the gonad and comparing the phases of gonadic maturity with the organism's sizes to establish the reproduction size. The clams were collected from September, 2005 to September of 2006 in Magdalena Bay at South Baja California. In order to select a subsample for histological study, the analysis of frequency of sizes and weight of the whole organisms was made by means of kernel density estimators with the bandwidth from the Silverman multimodality test; the frequency estimators obtained with a significant number of modes per month permitted the characterization of Gaussian components by Bhattacharya method. Consecutively the visceral mass was extracted and fixed to carry out the histological technique. With the histological analysis five phases of development were observed: undifferentiated, developing, ripe, partially spawned and spent; the undifferentiated phase occurred in September and October; the phase of development were present in November and December; the ripe phase was observed in January, February and March; by April and May, the phase of partially spawned was observed and from June, July and August occurred the spent phase. This stage sequence is in agreement with the climatic seasons: autumn, winter, spring and summer indicating the growth, reproduction and recruitment periods respectively.

Temporal variation of bivalve assemblages in sandy subtidal sediments of the Ensenada de Baiona (Galicia, NW Spain)

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The Galician rías are complex estuarine systems with high primary productivity and great economic and social importance because of the presence of fisheries and diverse shellfish resources. In addition, the rías have a large variety of sediments inhabited by a diverse benthic fauna. In some rías, a number of human activities, such as the culture of bivalves on rafts, the construction of harbour facilities and the disposal of sewage, have already induced large alterations in composition of benthic assemblages through organic enrichment and changes in sedimentary composition. These disturbances may also affect the variability of individual populations of benthic organisms. Therefore, in order to identify the impact of anthropogenic disturbances in the marine benthos it is necessary to study the distribution and natural spatio-temporal variations of the benthic infauna. Despite the existing wealth of information on the benthic fauna of many Galician rías, little is known of the spatio-temporal variation of the subtidal soft-sediment fauna from the Ensenada de Baiona. This inlet is located in the mouth of the Ría de Vigo and its sediments are mostly sandy. Bivalves are a key component to the structure of marine benthic assemblages, the diet of a number of demersal fishes of economic interest and may serve as indicators of the conditions of the marine bottoms. In the Ensenada de Baiona, bivalves are one of the dominant taxa in shallow subtidal soft sediments. This study describes the temporal dynamics of the bivalve assemblages on sandy sediments during a 1-year period from three sampling stations in the Ensenada de Baiona. Sampling was done monthly by means of a Van Veen grab from February'96 to February'97. Sampling stations were at depths of between 4 and 7 m and had a similar sediment with low content in silt/clay and organic matter.

The evolution of eyes in the Bivalvia: new insights

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Two types of eyes have been identified in the Bivalvia. These are, first, paired cephalic eyes occurring internally at the anterior end of the ctenidia and seen only in representatives of the Arcoidea, Limopsoidea, Mytiloidea, Anomioidea, Ostreoidea and Limoidea. The eyes, comprising a pit of photo-sensory cells and a simple lens are thought to represent the earliest method of photoreception. The second type of photoreceptor comprises ectopic pallial eyes located on the outer mantle fold of marine, shallow-water, representatives of the Arcoidea, Limopsoidea, Pterioidea and Anomioidea, the middle fold in the Pectinoidea and Limoidea and inner fold in the Cardioidea, Tridacnoidea and Laternulidae (Anomalodesmata). They do not occur in either freshwater or deep-sea taxa.

The pallial eyes on the outer mantle fold range from simple photo-sensory cells (Pterioidea) to pits of photo-sensory and pigmented cells (Arcoidea: *Barbatia*), as in cephalic eyes, to caps of ommatidium-like combinations of photo-sensory and pigmented cells, the latter probably derived from the former by eversion. Those of the middle fold comprise in *Ctenoides* (Limoidea) a simple photo-sensory cup and lens, open to the sea that by incorporation into its internal structure of an inner fold tentacle creates a more complex eye with a double, ciliary-based, retina (Pectinoidea). Those of the inner fold comprise a photo-sensory cup, backed by a tapetum (*Cerastoderma*) that by incorporation into its structure of a sensory accessory organ results in the formation of a more complex eye with a double, ciliary-based, retina (*Laternula*). The hyaline eyes of species of *Tridacna*, like those of *Cerastoderma*, are too large to be simple photoreceptors and probably also focus light upon symbiotic, mantle-contained, zooxanthellae. The double retina pallial eyes of the Laternulidae and Pectinidae are thus examples of convergent evolution.

A revised picture of the independent evolution of ectopic pallial eyes in some phylogenies and representatives of the Bivalvia is provided.

Terrestrial malacofauna of Central Asia: results of more than 150 years of exploration

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Majority of terrestrial mollusks of Central Asia is known from Pamiro-Alai and Tien-Shan mountain systems. It is a well-defined zoogeographical region, inhabited by 192 species, of which 80% are endemics. It is bordered by Gobi desert on the east; isolated by Zaysan depression from Altai mountains (with 36 species) on north-east; bordered by Kirgiz Steppe, Kyzyl Kum and Kara Kum deserts from north to west; by Kopetdagh (with 28 species) and Hindu-Kush (with 35 species) on west and south-west; by Himalaya mountains and Takla Makan desert on the south.

Unusually low relative number of genera (4.97 species per genus on average) is very characteristic of terrestrial malacofauna of this region. More than half of all endemic species belong to only four genera: *Pseudonapaeus* – 33 species (21.4%), *Turanena* – 11 species (7.1%), *Friticicola* – 21 species (13.6%) and *Leucozonella* – 16 species (10.4%). Composition of the fauna also shows its predominantly Mediterranean origin: 67% of endemics belong to Enidae (55 species), Hygromiidae (39 species), Limacidae (5 species) and Parmacellidae (4 species). The other two important directions of colonisation are illustrated by 26 species of Bradybaenidae (16.9%) from East and by 4 species of *Macrochlamys* (Ariophantidae – 2.6%) from tropical South Asia.

Of more than 60 ranges of this mountain system, the best studied areas are Zailiiskiy Ala-Tau range (with 81 species), Ferghana range (with 79 species) and Kirgiz range (with 77 species).

Nineteen, thirteen and sixteen new species were described from Pamiro-Alai and Tien-Shan for the last 3 decades of the 20th century respectively. Thus, despite more than 150 years of exploration

resulted in 154 described endemic species, there is no evidence that terrestrial malacofauna of this comparatively well-known region is close to be studied exhaustively. However, main discoveries are probably waiting malacologists in Hindu-Kush, Pamirs, Himalaya and on the slopes of Tibetan Plateau.

Phylogeny and systematics of the genus *Zonites* (Gastropoda, Pulmonata). The new era of systematics in the pulmonate mollusks

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Molecular phylogenetic studies that are related to paleogeographic events offer us a good basis to re-approach systematics in many plants and animal taxa.

In the present study we focused on the genus *Zonites*, which is distributed in the northeastern Mediterranean region. The genus includes 26 extant species; most of them with an allopatric distribution in the Aegean islands.

Forty three *Zonites* individuals, belonging to 15 different species, from 20 localities of Greece and Turkey have been analyzed with the use of molecular markers, specifically of 16S RNA.

The produced phylogenetic tree mostly coincides with the paleogeography of the area, but there are few clades suggesting that a revision of the present taxonomy is needed. We analyzed these problematic cases and re-evaluated the taxonomic characters and the taxonomy of the genus. We also discuss our results in relation with other known cases of contemporary systematics in terrestrial snails of the area.

Simultaneous polyphenism and cryptic species in an intertidal limpet from New Zealand

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The small intertidal limpets known under the name *Notoacmea helmsi* occupy a wide variety of habitats in New Zealand and exhibit a variety of shell forms. Phylogenetic analyses of DNA sequences from two genes, mitochondrial COI and nuclear ITS1, reveal that this taxon comprises at least five morphologically cryptic species, with at least one of these species, *N. scapha*, consisting of individuals with two obviously different shell types. One of these forms is an ecophenotypic response to living on eelgrass (*Zostera*) fronds. Unlike its extinct relative, *Lottia alveus*, *N. scapha* is not restricted to this substrate, but individuals living elsewhere are larger and have a different shell shape. Although there is significant overlap in shell form among the different cryptic species, there is some habitat differentiation, with two species predominantly found on exposed shores and three confined to mudflats. One species exhibits distinctive light-avoiding behaviour, the first known case in which behaviour can be used to separate cryptic species in molluscs.

Malacology in the arid areas of the Middle East — unexplored or empty?

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The arid areas of the Middle East are among those regions of the world that are least known in terms of the presence or absence of terrestrial molluscs. On the one hand this lack of information is due to the environmental conditions being unsuitable for terrestrial molluscs, but on the other hand it is the result of the poor scientific exploration.

Information compiled from the available literature concerning species richness, taxonomical structure, endemism and biogeographical background of the area is presented. Numbers illustrating the present state of knowledge are given supplemented by estimates on the numbers of species that can be expected. Results show that the arid areas of the Middle East represent an undersampled region, where a considerable increase of species numbers can be expected. The lack of records mainly dates from the era of the ‘Golden Age of Malacology’ between 1800–1890, when interest was focused on more easily accessible areas, while the Middle East was more or less ignored. Thus, an enormous gap in knowledge persists until today.

Unfortunately, recent efforts in inventorying the malacofauna of the world, such as checklists and databases, continue to disregard this malacofauna. An inventory reflecting the true composition of the malacofauna is impeded by the following factors: the enormous backlog in cataloguing historical material present in major museums, the information widely scattered in literature, the unsatisfactory state of present taxonomical concepts, the disregard of species-level taxonomy, and others.

Additionally, the traditional approach towards biology in the countries concerned is more focused on applied questions such as parasitology and similar subjects. The importance of inventories or of surveys on biological diversity as tools for conservation strategies is not fully accepted until today.

Opisthobranchs go limnic: comparative 3D microanatomy of the marine interstitial acochlidian *Pseudunela* and the freshwater *Strubellia* from Vanuatu

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Uniquely among the otherwise marine opisthobranchs, several acochlidian species are known to inhabit true freshwater systems. Our histological re-examination of the Caribbean mountain spring swamp dweller *Tantulum elegans* Rankin, 1979 revealed severe discrepancies to its original description, but its systematic position remained unresolved. The present study tries to explore the secrets of an array of limnic acochlidian species that are distributed over several tropical Indo-Pacific islands. The internal anatomy of a limnic *Strubellia* species from Espiritu Santo, Vanuatu is 3-dimensionally reconstructed from serial histological slides using AMIRA software. For an in-depth structural comparison with a marine species, the poorly known mesopsammic *Pseudunela cornuta* (Challis, 1970) is redescribed from Vanuatu specimens in greatest possible detail. The potential origin of Indo-Pacific limnic species from a *Pseudunela*-like marine ancestor is discussed and evolutionary pathways towards successfully colonizing limnic habitats are highlighted.

3-dimensional microanatomy and sperm ultrastructure of the arctic interstitial acochlidian gastropod *Asperspina murmanica* (Kudinskaya & Minichev, 1978)

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This study aims to re-examine in detail the microanatomy of the Arctic opisthobranch *Asperspina murmanica* (Kudinskaya & Minichev, 1978), the only acochlidian that was described to maintain a well-developed mantle cavity and, thus, was thought to be basal within Acochlidia. Several specimens were recollected at the type locality in the Barents Sea, Russia. Histological semi-thin serial sections were prepared and a computer-based three-dimensional reconstruction of all major organ systems was made using AMIRA software. For the first time the sperm ultrastructure of a member of the Asperspinidae was examined by transmission electron microscopy.

Our results show significant differences to the original description: the nervous system shows large aggregations of precerebral accessory ganglia, paired rhinophoral and gastrooesophageal ganglia, while the presence of a genital ganglion can be excluded; there is a fused stomach/digestive gland cavity, instead of a well-defined muscular stomach; the circulatory system includes a small heart, and the reproductive system is well-developed comprising a sac-like ampulla and three female glands. But the most unexpected discrepancy to the original description refers to the complete absence of any mantle cavity. The gonopore, anus and nephropore open dextrolaterally and separately to the exterior. Little reason remains for suspecting a basal systematic position.

A time to kill and a time to heal: Eradication of the Zebra mussel and restoration of native mussels to improve water quality in the USA

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In 2006, a zebra mussel population in a 5 ha quarry in eastern Virginia was eradicated using potash (KCI) at a target concentration of 100 mg/L. In situ bioassays throughout the quarry confirmed the complete mortality of caged mussels after 30 days of exposure to the KCI. Other aquatic animals (fishes, turtles, aquatic insects) were seemingly unaffected by the treatment, and potassium levels are expected to remain toxic for years to prevent reinfestation. Propagation of native freshwater mussels continues to expand, with new facilities and techniques to enhance grow-out of juveniles. We are approaching the 10 million mark for the number of propagated juveniles of endangered mussel species released into natal rivers. With the recent ASTM document in 2005 providing standard methods for conducting laboratory toxicity tests with early life stages of mussels, juvenile mussels are being cultured and tested against current water quality criteria in U.S. waters for such contaminants as ammonia, copper, chlorine, and other compounds. For example, bioassay results using juvenile mussels confirm that they are less tolerant to ammonia, copper and zinc than most other aquatic invertebrates and fishes. However, they are relatively tolerant of chlorine, lead and cadmium. Currently, the U.S. EPA is being petitioned to consider lowering the ammonia standard to be protective of mussel populations in U.S. rivers.

The allocation of energy for reproductive success in *Cornu aspersum* before and after hibernation

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120 newly hatched snails of the species *Cornu aspersum* were reared on three diets of increasing energy value: 2200kcal/kg = E- diet, 2300kcal/kg = E diet, 2400kcal/kg = E+ diet. When snails became adult, the BH subsample was allowed to mate and lay eggs once maturity was achieved. The AH subsample was submitted to a six-month period of hibernation before entering the breeding activity. The purpose was to analyze the effects of the energy content on the snail reproduction before and after hibernation. In the BH subsample, 60 snails laid 48 clutches in one month, distributed among diets E-/E/E+ in the ratio: 20/14/14. In the AH subsample, 60 snails laid 86 clutches in one month in the ratio: 25/32/29. By analyzing the distribution of egg and hatchling weight as well as egg and hatchling number in each subsample with the method of resolution into gaussian components a difference between diets appeared only for the egg weight. However, the difference in the energy value of the three diets is too low to have an impact on reproductive success. The diet data were pooled for further analyzes. Before hibernation snails adopt a high number/ low weight strategy for egg laying. The hatchlings show a higher degree of cannibalism on eggs which explains the low hatching rate and the high hatchling weight (36mg). By achieving the sexual maturity, the snails get an endogen signal for preparing hibernation. The snails lay only one clutch, producing heavy hatchlings with a high probability to survive hibernation. After hibernation the snails adopt a low number/ high weight strategy for egg laying. This leads to a high hatching rate and a low hatchling weight (30mg). By producing more than one clutch, the snails enhance their reproductive success. Further studies should focus on the hatchling survival for each strategy.

The road to an endemic Southeast Pacific fauna: Neogene neogastropods from Chile and Peru

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The Neogene record of Neogastropoda in southern Peru and Chile shows the evolution from a warm-temperate to tropical fauna with many cosmopolitan genera to a highly endemic fauna of temperate to cool water temperatures. Several endemic Southeast Pacific neogastropod genera apparently have their origins in the Neogene, although their ancestors invariably are still unknown. *Acanthina* appears in the latest Oligocene, several muricids and volutes are known since the early Miocene (*Trophon*, *Concholepas*, *Adelomelon*, *Miomelon*, *Pachycymbiola*), the late Miocene (*Chorus*, *Xanthochorus*) or the early Pliocene (e.g., *Crassilabrum*) of both countries. However, the oldest records of the volutes (*Adelomelon*, *Miomelon*, *Pachycymbiola*) and *Trophon* are from the Eocene and Oligocene of Argentina, respectively. Some other taxa still living in the Southwest Pacific were also established during the early Miocene (*Aeneator*, *Mitrella*, *Hima*, *Oliva*, *Mitra*, *Ptychosyrinx*). *Olivancillaria* is known from latest Oligocene to Pliocene, but is now restricted to the Atlantic coast of South America. Endemism was always relatively high. Several endemic genera are known from the early Miocene (*Carhuaspina*, *Tactilispina*, undescribed muricids, *Testallium*, *Palaeomelon*) and Pliocene

(*Hermespina*, *Muregina*, undescribed buccinids). A strong connection with the Southwest Pacific during the early Miocene of Chile (30% of genera; e.g. *Bedeva*, *Xymene*, *Xymenella*, *Penion*, *Lamprodomina*, *Awheaturris*, *Maoridaphne*, *Zeacuminia*, *Marshallena*) disappeared later during the Miocene. Other genera apparently retreated north when water temperatures decreased during the Miocene and Pliocene (*Muregina*, *Macron*, *Borsonella*, *Nihonia*). Factors controlling the patterns of immigration, origination and extinction that created the current Peru-Chile endemic fauna are discussed as well as regional differences between the two countries.

Effect on burying deep of *Mesodesma mactroides* by artificial siphon nipping and different nutritional conditions

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Siphon nipping is supposed to increase vulnerability to lethal predation but it is not widely proven. This work aims to prove the effect of siphon nipping and low food availability on *Mesodesma mactroides* burying deep. Siphon nipping was simulated by cut of terminal 10% of siphons. Low food availability was achieved by maintenance of individuals in a closed water recirculation system while natural food availability was obtained in an open water circulation system with direct input of unfiltered sea water pumped directly from the sea. Light and temperature conditions were natural for both systems. Individual burying deep was measured after 24 hours.

To test the effect of nipping, natural fed clams were compared. Cut individuals were buried 50% less than uncut (ANOVA $p=0.004$). The same effect was observed in sub-fed clams (ANOVA $p=0.0001$). To test feeding effect, uncut clams were compared. Sub-fed individuals were buried 30% deeper than the natural fed (ANOVA $p=0.046$). No significant effect was observed when cut clams were compared.

Present results prove that siphon nipping affect burying deep of *M. mactroides* in a higher proportion than expected by actual anatomical effect, turning them more vulnerable to lethal predation.

Environmental variables play an important role in determination of burying deep as shown by phytoplankton availability. The effect of temperature and light remain to be tested. If result does not change significantly from present ones, these clams would be more vulnerable in spring-summer season. This could be related to physiological advantages for filter or reproduction when clams are near the sand surface.

Small fossil gastropods: their meaning for phylogeny and diversity

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The study of fossil gastropods with small adult size and of protoconchs has revolutionized our view of gastropod evolution. Protoconch characters increase the total number of shell characters considerably and therefore they improve phylogenetic analyses and taxonomy. There are spectacular examples of teleoconch convergence that were resolved by protoconch studies. Except of a few early pioneer studies, minute gastropod shells including protoconchs have mainly been studied since the

last 25 years i.e., since SEMs have been used in paleontology. Improved sampling techniques and sampling effort produced a great amount of new data. Generally, well-preserved small fossil gastropods with protoconchs are rare. Many or even most newly described gastropod taxa are small. This suggests that the fossil global gastropod species richness consists to a large part of species with a small adult size. Most of the published data of minute fossil gastropods come from poorly lithified clay-stones which commonly represent soft-bottom communities or were transported by mud-flows. Calcareous rocks are another important source of small gastropods. Here, shells are normally replaced by Calcite or they are silicified. Calcite replacements may weather out or can be cracked out mechanically. Silicified material can be obtained by dissolution of limestones with acids. Shells with original aragonitic composition become increasingly rare with increasing geological age. They are quite common in the Cenozoic, rare in the Mesozoic, exceedingly rare in the Late Paleozoic, and unknown from the Middle and Early Paleozoic. In terms of Paleocology, the consideration of microgastropods usually increases species richness in samples distinctly. Even rank abundance and therefore faunal structure change if species with small adult size are considered. Especially high-spired caenogastropods and heterobranchs which are too small to be found in the field by surface collections are commonly very abundant at least from the Late Paleozoic onward, as will be shown with several examples. This indicates that the radiation of both groups initiated earlier than previously suggested. Ideally, such fossil data should be published with information about the sampling technique, mesh size, analyzed rock volume and numerical data on the taxa. However, such data are rarely available in the literature. Moreover, well-preserved microgastropod material is largely unknown from the Early Paleozoic. Such material is urgently needed because the major evolutionary steps were taken during that period.

Changes in Quaternary mollusc assemblages in Eastern Hungary in Late Quaternary

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Hungary played an important role in the Late Quaternary development of the European Mollusc fauna, as it is located in the central part of Europe and it was not covered with ice even in the coldest periods of Pleistocene. As a periglacial territory, it has preserved the majority of its earlier fauna and was also a refuge area for arctic-alpine (*Columella columella*) and boreo-alpine species (*Vertigo geyeri*, *Vertigo substriata*).

One of the most outstanding faunas of Late Quaternary with a species number over 50, was studied in one study site in Hortobágy National Park. Hortobágy is a perfectly flat area where some tens of centimeters difference can greatly influence the moisture content, vegetation and microclimate of the base, as well as the mollusc fauna forming on it. The quaternary mollusc assemblages in Hortobágy seem to have a double character, i.e. besides land species represented in bigger numbers (e.g. *Succinea oblonga*, *Oxyloma elegans*, *Cochlicopa lubrica*, *Columella edentula*, *Columella columella*, *Vertigo substriata*, *Vertigo geyeri*, *Pupilla muscorum*, *Vallonia pulchella*, *Vitrea crystallina*, *Trichia hispida*) aquatic species can also be found in one third of the total individual number (e.g. *Valvata pulchella*, *Bythinia leachi*, *Anisus leucostomus*, *Anisus spirorbis*, *Gyraulus laevis*, *Pisidium obtusale*, *Pisidium casertanum*).

The other study site was a typical loess area in the Hajdúság (eastern Hungary), where over 20.000 individuals of the two profiles were analysed. The diversity of this region is low, its fauna was made up of only land species, the most typical of which are: *Succinea oblonga*, *Columella edentula*, *Columella columella*, *Vertigo parcedentata*, *Pupilla muscorum*, *Vallonia tenuilabris*.

The mollusc assemblages of the two study sites have been compared. Radiocarbon method was used to identify their age. For better comparison fine stratigraphic method was used, samples were taken by 10 centimeters. In addition to the abundance and dominance data we analysed the population structure of the same species at the two sampling sites (e.g. *Succinea oblonga*, *Columella edentula*, *Vertigo parcedentata*). The analysis of some aquatic species in the profile at Hortobágy has also been

done. The correlation between mollusc species and environmental factors was revealed using Canonic Correspondence Analysis.

Habitat selection of limpet (*Patella* ssp.) species in the tidal zone at the Adriatic Sea

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Limpets (*Patellidae*) are important grazing molluscs in the tidal zone at the Adriatic Sea. Our studies were carried out in 18 sample areas along the east coast of the Adriatic Sea between 2004-2007. The aim of our investigations was to reveal the abundance and dominance conditions of the limpet species occurring along this coast, as well as metrically characterize the populations. The following species have been found: *Patella coerulea*, *P. caerulea* f. *subplana*, *P. rustica*, *P. ulyssiponensis*.

Multivariable statistical methods have been used to find correlation between the *Patella* species and environmental factors.

18 sample sites were chosen in a way to cover various habitat types, including two islands (Krk, Murter). The conditions of occurrence of the *Patella* fauna of the islands have been compared to those of on the coastline of the Balkan Peninsula. Both natural limestone and anthropogenic concrete bases were examined in the course of sampling.

Quadrat method was used to measure the abundance of limpets. Environmentally limiting factors were examined, including physical (e.g. the quality of base surface, tidal exposure time, water level and temperature, depth of occurrence, slope), chemical (e.g. pH, salinity, conductivity, base rock, the chemical composition of the water) and biological factors (e.g. potential food supply, other sea animals).

Patella coerulea was found in each sampling site in the biggest numbers. Significantly bigger individuals lived on concrete than natural limestone base. Concrete is smoother, adhesion to its more even surface is favourable for the animal, whereas the uneven surface of limestone provides less favourable conditions. At times of low tide, tight attachment tends to be essential for survival. The size of *Patella* species seems to decrease in more extreme habitats. On the basis of present nomenclature, *P. coerulea* f. *subplana* occurred in the infralittoral zone. *Patella rustica* mainly occurs on vertical surface exposed to rolling sea in the supralittoral fringe, while *Patella ulyssiponensis* is typical in the infralittoral fringe. Food at the examined sites was abundant, so distributional differences are primarily due to environmental factors. *Patella* species and their habitats were ordinated using Canonic Correspondence Analysis (CCA) and further correlation with environmental factors was assessed.

Species delineation and genetic variation in the genus *Hiatella* (Bivalvia, Heterodonta)

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Hiatella is a common bivalve genus in the European rocky subtidal. It is not clear, however, how many species are represented due to the high plasticity in shell form and the resulting problems in species delineation. They live at depths down to 60 m, either in rock crevices as bioeroders, nestling in kelp holdfasts, or within sponges. Shell morphology is often influenced by the shape of the crevices and eroded during boring. We here present the preliminary results of a molecular investigation of *Hiatella* from the Mediterranean, testing taxonomical and ecological concepts. We collected *Hiatella* specimens in different habitats of the Mediterranean, including the North Adriatic Sea (Croatia), the Ligurian Sea (Italy), and the south coasts of Spain and Portugal. We used a

fragment of about 2200 bp of the mitochondrial genome including parts of the COI, parts of the 16S rRNA and parts of the COIII genes as genetic markers. A haplotype analysis of 87 samples shows conspecificity of bioeroders, nestlers and sponge-dwelling specimens in three haplotype groups, with a maximum genetic divergence of 1.8%. All three groups contain Croatian and Italian specimens, whereas Spanish and Portuguese samples occur only in one group. These preliminary results suggest gene flow between Croatian and Iberian populations on one hand and Croatian and Italian populations on the other hand. The extent of gene flow between Italian and Iberian populations is, due to the limited sample size, not sufficiently demonstrated. Additional sequences from Spain and Portugal and Italy may help elucidate the gene flow within this morphologically and genetically variable species.

Land-snail diversity in a threatened limestone formation in Odukpani, Cross River State, Nigeria

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The land snail fauna of a threatened limestone formation in Odukpani is studied using a combination of direct search (for 1hour) and litter-sieving techniques. A total of 423 specimens comprising 52 species/morphospecies belonging to nine molluscan families were collected from seven sample plots. Each plot yielded between 19 and 98 specimens (mean 70.5 ± 31.72). The diversity per plot ranged from 7 to 34 (mean $19.14, \pm 9.74$). Extrapolation suggests that the true diversity lies around 72 species. Nine snail families were represented, of which the most prominent was the carnivorous Streptaxidae. The streptaxids dominated the molluscan fauna in diversity of species and number of individuals. Twenty-one (40%) species and 158 (37%) individuals of streptaxid land snails was recorded from the study area. Our study reveals high land snail species richness in Odukpani limestone cave in spite of low abundances and small sample size. Some of the species found were new records for the region and probably new to science. The conservation of the limestone cave is advocated so as to protect its unique biodiversity.

Bivalvia: Inventories and taxonomy in the Indian Ocean

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Currently there is no inventory of marine bivalves specific to the Indian Ocean. The OBIS Indo-Pacific Mollusk Database includes the Indian Ocean but is a tool primarily for the systematic malacologist. Smaller regional inventories would be more valuable for conservation management, impact surveys, ecology and teaching. The taxonomy behind such inventories should be as accurate and contemporary as possible and should allow comparable identifications within and between regions. There are many regional species lists from the 19th and early 20th centuries but their taxonomies are not comparable and the identifications require verification. Many are supported by museum collections and if consulted can give these older lists enhanced value. A much greater involvement at the local level is needed to progress this work. Without revision, amalgamation of previous lists into an ocean inventory would be unwise. There is superfluity of bivalve names for some taxa but recent taxonomic revisions indicate that there is also under-estimation of species-richness. This arises from uncritical synonymisation as well as a multitude of undescribed smaller or cryptic taxa. The largest discrepancy exists with the Galeommatoidea.

Although the Indo-Pacific has been regarded as a single biogeographic unit there is increasing evidence that this is not the case and that within the Indian Ocean there are distinct regional faunas; Red Sea, Northern Arabian Sea, Gulf of Aden, Mascarenes, Bay of Bengal. Much debate remains over the interpretation of geographical variation versus speciation but this will only be solved by systematics research.

Current data suggests that species-richness does not reach that discovered in the Indo-west Pacific but no similar surveys have been undertaken. Very little data is available for outer shelf and continental margin zones but collections made by the RS “Meteor” in the Red Sea and Gulf of Aden indicate a diverse and largely undescribed fauna.

The coralliophilines radiation: repeated dives into the deep?

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Coralliophila and related genera (e.g. *Babelomurex*, *Latiaxis*, *Leptoconchus* and *Quoyula*) form a highly diverse group of neogastropods of ca. 250 described species. They are distributed worldwide in warm temperate and tropical oceans, and are traditionally grouped in at least 7-10 "genera" based on their shell morphology. Coralliophilinae are known in the fossil record since at least the Middle Eocene (ca 40 MYbp). All species with known ecology are symbionts (ecto or endobiotically) of anthozoans (including sea-anemones, gorgonians and reef-building corals species), on which they feed.

An extensive phylogenetic study based on two mitochondrial sequences (12S and 16S) and 58 anatomical characters is performed to uncover relationships of the Coralliophilinae within the family Muricidae, and of a large representation of species within the subfamily. A close phylogenetic relationships with the Rapaninae s.l. within Muricidae is confirmed. Yet, coralliophiline digestive anatomy is strongly modified in relation to their feeding habit, and other anatomical traits are unique within Neogastropoda having evolved broodcare and protandry.

Two main lineages are highlighted in our analyses. At least two of the main “genera” of traditional taxonomy, namely *Coralliophila* and *Babelomurex*, are evidently polyphyletic. Relationships among the species emerging from both datasets (molecular and anatomical, analysed separately and combined) are surprisingly in contrast with most of the traditional taxonomic arrangements. Coralliophiline diversity is presently higher in deep waters (>100 m depth: 65-85% of the species) than in shallow waters. Along with the phylogenetic patterns depicted here, this seems to indicate that coralliophiline radiation probably started in shallow waters, but has been more successful in deeper environments. There is evidence that from a shallow water stem group, several colonization of deep waters resulted in as many radiations in those habitat.

It will be interesting to analyse in parallel the vertical patterns of diversity in coralliophilines (and other coral feeding gastropods) and in their anthozoans “hosts”. The lack of information on host association for most deep water species has been so far a serious problem for these analyses, which could be partly resolved by applying a sort of ecological DNA-barcoding of the gut contents.

Spermatozoan morphologies of some species of marine bivalves: aspects of taxonomic and ecological relevance

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Several studies of comparative sperm morphology have been published within the Bivalvia, and collectively these help to confirm the usefulness of sperm features for taxonomic and phylogenetic analysis at and above the species level. It has been suggested that besides the mode of fertilization, the sperm morphology could also be correlated with egg size and larval development. Hence, the occurrence of different types of sperm morphology according to distinct reproductive patterns has showed the relevance of studies that focus the comprehension of the relationships associated with evolution, ecology and morphological sperm diversity.

Using scanning and transmission electron microscopy, the spermatozoan morphologies of marine bivalve species from Brazil and Panama - *Brachidontes darwinianus*, *B. solisianus*, *Mytella charruana*, *Mytella guyanensis* (Mytilidae) *Isognomon bicolor*, *I. alatus* (Isognomonidae), *Anomalocardia brasiliana* and *Tivela mactroides* (Veneridae) - were described and compared with those of others bivalves.

The compilation of the sperm ultra structure studies of the marine bivalves provides a plethora of information. These studies are enough to outline a comparative study with taxonomic relevance. In addition, the results of the present work showed evidences that there is a strong correlation between sperm morphology and environmental conditions. Some special features of the sperm cells such as hydrodynamic shape, presence of glycogen clusters or even length of the tail could represent an adaptation to turbulent waters and could be responsible for reproductive advantages. Hence, the results of the present analysis are of taxonomic relevance and could contribute to the robustness of bivalve systematic. Besides, the study of the sperm morphology allows the comprehension of some ecological aspects that could contribute to the successful dominance of some species.

Certainly, cell characteristics reflect an adaptation to marine environment, albeit unfortunately, just some authors have discussed sporadically the correlation between marine dynamism and sperm features.

A new land snail zoogeography of Turkey derived from the distribution ranges of endemic species

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Approximately 210 taxa of stylommatophoran land snails whose ranges do not come within 50 km of a land border are considered to be endemic to Turkey. The Clausiliidae top the list with 67 endemic taxa, followed by the Enidae with 40, the Hygromiidae with 38 and the Zonitidae with 28 taxa. There are 11 genera endemic to Turkey.

The distribution ranges of the endemic taxa were mapped on a 1° latitude x 1° longitude grid.

Various indexes for endemism taken from the literature were used to analyze the distribution patterns of the endemics.

The ranges of the endemic species cluster around three centers of endemism: (1) in the northwest bordering the Sea of Marmara and the Black Sea; (2) in the northeast along the Black Sea; (3) in the southwest along the Mediterranean. No family is restricted to any one center of endemism and all three centers contain representatives of all of the four largest families.

The three centers of endemism fall on mountainous areas. Each is in a different climate zone, but they all are in areas that receive the highest amount of precipitation in Turkey. The distribution

patterns of several genera across different climate zones mostly invalidate the previous attempts at zoogeographic division of Turkey using a single group (e.g. Zonitidae).

**Histopathology and bioaccumulation of heavy metals (Cu & Pb) in the giant land snail
Archachatina marginata (Swainson)**

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Histopathological effects of heavy metals (Cu and Pb) and their bioaccumulation were assessed in the edible giant land snail *Archachatina marginata* (Swainson). On the basis of 168h LC₅₀, CuSO₄.5H₂O was found to be significantly more toxic than Pb(NO₃)₂. The exposure of the snails to sublethal concentrations of Cu and Pb, resulted in a prevalence of hepatocellular foci of cellular alterations (FCA) in the digestive glands. Hepatocytes of snails exposed to sublethal concentrations of Cu were observed to be clogged together with peripheral thickening while exposure to Pb caused inflammation of the digestive tubules. Basophilic adenoma and ovotesticular fibrillar inclusions were also observed in the ovotestes of exposed snails. Exposure of *A. marginata ovum* to sublethal concentrations of Cu resulted in a five-fold and three-fold accumulation of the metal in the digestive gland and foot of exposed snails compared to the control. The exposure to Pb, however, showed that the snail had high capacity to accumulate the metal ions in both the digestive gland and foot: compared to the control, the concentration of Pb in the digestive gland was found to be up to 375 folds and over 1000 folds was observed in the foot. The tissue alterations observed in this study reinforce the use of histopathology in combination with monitoring of metal levels in body tissues of edible animal as powerful tools for early monitoring anthropogenic contamination of terrestrial environments and prevent potential public health tragedies.

**First record of a species belonging to the genus *Dendropoma* (Mollusca, Caenogastropoda,
Vermetidae) from the rocky subtidal zone of Peninsula Mejillones, northern Chile**

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Marine gastropods belonging to the family Vermetidae are sessile. Their distribution is restricted to tropical and subtropical latitudes (i.e. Mexico, California and West Africa) as well as to locations in the Mediterranean Sea. Habitats comprise rocky intertidal and subtidal zones with warm and oxygenated waters. Several clusters of *Dendropoma* sp. (Vermetidae) were recorded for the first time inhabiting the rocky subtidal zone of Peninsula Mejillones, northern Chile in July 2006. Samples were collected by SCUBA divers from the rocky "Anemones Wall" (23°28'17.30"S, 70°37'13.80"W) at 17m depth. This discovery extends the geographical range of the genus *Dendropoma* into the Southeastern Pacific. Thus the present species is the first vermetid gastropod able to thrive under cold upwelling conditions. As the taxonomy of vermetids is complicated due to lacking precise morphological patterns no species assignment was attempted and a genetic study is necessary for feasible species identification. Due to the lack of local fossil records, we hypothesize that the species invaded the Peninsula Mejillones area and discuss three hypotheses: dispersal via (i) larval stages, (ii) due to anthropogenic activities (ship fouling, ballast water), or (iii) rafting. We concluded that the invasion by rafting is the most possible explanation. Funding for field trips was provided by "Programa Bicentenario de Ciencia y Tecnología" PBCT and the INCO – EU project

Micro-scale assessment of land snails on coarse woody debris in central European beech forests

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Coarse woody debris (CWD) plays essential role in shaping species richness and composition of natural forests of temperate Europe. We investigated the effects of CWD properties on land snail assemblages in six beech forests in Hungary and Romania. We applied 2×8 minutes search sampling in sample pairs (close to CWD and 2 m apart from it), we measured CWD diameter and decaying stage, the depth and moisture of the leaf litter. We used generalized linear mixed models, generalized additive models and regression trees to analyze our data. Our results revealed that decaying stage of CWD has profound direct effect, while leaf litter properties around CWD and diameter of CWD are of much less concern. Richness was higher near CWD than distant to it. We were unable to detect any systematic changes in species composition due to decaying stage. Most of the species tended to prefer micro-sites close to CWD or under bark. Further, abundant species tended to aggregate, and micro scale richness was limited and independent of local richness of the site. Richness was positively correlated with CWD diameter in earlier decaying stages. These indicate that micro-scale limitation of the number of co-occurring species is driven by dispersal limitation and not by competition for limited resources.

***Amphidromus* revisited: A fresh look at the conchologist’s favourite land snail genus**

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The attractive colour variation found in *Amphidromus* shells has long placed them among the most highly sought after land snails by shell collectors and attracted the attention of many nineteenth

century conchologists. In the past twenty five years of land snail surveys in Thailand many *Amphidromus* specimens have been collected and a good deal of information on their distribution and life history has been accumulated. In addition to its striking appearance and interest to shell collectors *Amphidromus* proves to be an informative and fascinating subject for studies in systematics and evolutionary biology. We have harnessed the tools of allozyme analysis and constructed phylogenies based on mtDNA as well as comparative morphology to gain an understanding of population dynamics, species limits, relationships and distribution. The example of *Amphidromus* in exhibiting stable whole-body enantiomorphy is unique and the subject of a recent study. Our studies are timely in trying to gain an insight into the evolutionary history of the group because the natural habitat islands occupied by *Amphidromus* have been greatly depleted by human exploitation much having been lost during the period of our surveys, and populations are increasingly isolated in fragments of their previous range.

Achatinellid land snails of the Pacific islands: phylogenetics, phylogeography and evolution

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The Pacific island orthurethran land snail family Achatinellidae includes five subfamilies: the endemic Hawaiian subfamilies Achatinellinae and Auriculellinae, and three Pacific-wide subfamilies, Pacificellinae, Tornatellinae and Tornatellidinae. The Achatinellinae, which include the conspicuous and endangered Oahu tree snails (genus *Achatinella*), exhibit great variability in shell color and banding pattern and have as a result attracted much scientific interest. The other four subfamilies include smaller, less colorful snails and have consequently attracted less attention. This study addresses the phylogenetic relationships among species in the four non-achatinelline subfamilies. Partial mitochondrial DNA cytochrome *c* oxidase subunit I (COI) gene sequences have been obtained from 250 individuals from 26 sites on four of the main Hawaiian Islands and from four sites in the Ogasawara Islands of Japan. Using a pupilloid outgroup (also Orthurethra), these preliminary results indicate that: 1) COI is appropriate for resolving species, genera and subfamily relationships (although some of the deeper nodes are not well supported); 2) the four non-achatinelline subfamilies are supported as monophyletic groups 3) one species appears to have colonized Ogasawara from Hawaii, either naturally or through human introduction; and 4) many sites in Hawaii harbor more than one species. These data on the four non-achatinelline subfamilies complement published research on the phylogenetic relationships in the subfamily Achatinellinae, and with more comprehensive data to be collected in the future will permit a broad understanding of the evolutionary relationships and biogeography of the entire family.

Sexual dimorphism in the shells of the South-Western Atlantic gastropod *Olivella plata* (Ihering, 1908) (Mollusca: Olividae)

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Most known cases of sexual dimorphism in molluscs are based on size differences. A remarkable case of structural sexual dimorphism recorded during a revision of the genus *Olivella* from Argentine waters is presented. Over 200 specimens of *Olivella plata* (Ihering, 1908) were collected at Villarino (42°24'S-64°15'W) in Golfo San José and Punta Pardelas (42°37'S-64°15'W) in Golfo Nuevo, both localities from Chubut province, northern Patagonia. Each live specimen collected was sexed based on the presence of penis and the pedal gland. Female shells are easily recognised as they show an anterior wide vertical groove, adjacent to the parietal callus and the pillar structure. The groove is not

on the same plane as the aperture, i.e., it runs approximately at right angles to the apertural plane. Therefore, it is clearly visible in lateral view and not quite so in apertural or adapertural views. The groove curves adaxially at the tip of the also curved pillar. Male shells are distinguished because there is no groove but a continuation of the parietal callus which, apparently “infills” the groove described for the female shells.

The existence of such a structure, only present on the females of *O. plata*, may have helped the animal glue the capsules to the apertural side of the shell, or else may have been at least related to the process of laying capsules.

When a snail dies in the forest, how long will the shell persist?

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After snails die, their shells sometimes persist in the environment. Although some shells survive as fossils for hundreds of millions of years, most shells decompose more quickly, probably in months or years.

We know little about the rate at which shells decompose, and what we know is mostly anecdotal. Nevertheless, many studies knowingly or unknowingly make assumptions about the rate of shell decomposition. Endangered species biologists need to know how long ago a species was living at a site having an empty shell. Using empty shells to estimate diversity of living populations requires assuming that death assemblages accurately reflect living populations across species and localities. However, in most cases, we do not know whether fragile and robust species, at different localities, decompose at the same rate.

In order to determine how long empty shells persist in the forest, and to test for differences in decomposition rate among species and among sites, I put shells in mesh litter bags at one site in Delaware and at two sites in northern Michigan, and monitored shell weight annually for 6 years. Results indicate that mean annual mass decrease of unbroken shells was 5-8%, with no significant difference among localities, but some differences among species. Mean annual mass decrease of all shells, crushed plus unbroken, was 8-13%, showing differences among sites and larger species tended to decrease mass more slowly. Surprisingly, loss of periostracum did not increase rate of mass loss.

Molecular systematics and proposed taxonomy in *Ariolimax* (Stylommatophora: Arionidae)

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Molecular data suggest revision of the giant banana slugs of west coast of North America. The genus *Ariolimax* Mörch, 1860 is currently broken into five taxa in two subgenera based on penis morphology, *Ariolimax*, *sensu stricto* and *Meadarion* Pilsbry, 1948. *A. (A.) columbianus columbianus* (Gould in Binney, 1851) ranges from central California to southeast Alaska while *A. (A.) c. stramineus* Hemphill, 1891 is found on the coast of south-central California. *A. (M.) dolichophallus* Mead, 1943, *A. (M.) californicus californicus* Cooper, 1872, and *A. (M.) c. brachyphallus* Mead 1943 were known from different parts of the San Francisco Peninsula. Sequence data from 3 mitochondrial and 2 nuclear genes revealed 5 distinct clades in an unresolved polytomy. There are two clades within *A. (A.) c. columbianus*, which we propose should each have separate species ranks: *A. columbianus* ranging from northwest California to southeast Alaska and *A. buttoni* (Pilsbry &

Vanatta, 1896) in north-central California. *A. stramineus* forms a separate clade and should be a distinct species, and there is fourth distinct clade that is an undescribed species on Mount Palomar, San Diego County, California. The fifth clade (*Meadarion*) is comprised of 4 subclades, three already named as species or subspecies. We propose that each be considered a species distinguished by morphology and sexual behavior. *A. californicus* and *A. dolichophallus* are found mainly in San Mateo and Santa Cruz counties, respectively, while *A. brachyphallus* has a disjunct distribution and is found on the northern tip of the San Francisco Peninsula, the Monterey Peninsula, and Cambria in San Luis Obispo County. A fourth clade represents an undescribed species found on Fremont Peak, San Benito County. More in-depth analyses will be needed to resolve the relationship among these clades, and whether the subgenus *Ariolimax* is paraphyletic with respect to *Meadarion*.

Reproductive studies on volutes of the South West Atlantic (Neogastropoda: Volutidae)

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Reproductive patterns and season of five volutid neogastropods have been studied: *Adelomelon brasiliana* (Lamarck, 1811), *Zidona dufresnei* (Donovan, 1823) and *Adelomelon beckii* (Broderip, 1836) from the subfamily Zidoninae in Mar del Plata; *Odontocymbiola magellanica* (Gmelin, 1791) and *Adelomelon ancilla* (Lightfoot, 1786) from north Patagonia (subfamilies Odontocymbiolinae and Zidoninae respectively).

Volutids spawn large egg capsules containing few eggs. The embryos develop and grow for a period of up to three months; eggs ranged between 90 to 300 µm in diameter, feed extravitelline food contained in the intracapsular fluid; no nurse eggs occur and they hatch as crawling juveniles exceeding 1 cm in shell length.

The reproductive season of *Adelomelon brasiliana* extended from September to April. This is the only volutid known to lay free egg capsules.

Gonad development in *Zidona dufresnei* reveals a reproductive season from October to March. Size at which 50% of the population was mature was 15.7 cm in females and 15.0 cm in males.

Preliminary studies of *Adelomelon beckii* showed the spawning season from August to January. Egg capsules are attached to hard substrate, is semi-spherical, with a diameter of 50 mm and 35 mm high and the number of embryos varies from 7 to 9.

Odontocymbiola magellanica spawn white, spherical, calcareous egg capsules attached to hard flat surfaces. Major oviposition events occurred from July to December, characterized by females' aggregation. Male individuals reach maturity at 80 mm and females mature at 90 mm (7 and 8 years of age respectively).

Oviposition in *Adelomelon ancilla* occur mainly from June to December. Minimum shell length of a females laying egg capsules was 114 mm.

In the patagonic species oviposition was coincident with increasing of photoperiod from winter to summer solstices and not apparently by increasing of water temperature as observed in the species from Mar del Plata.

Amino acids in calcite: a tiny time-capsule for the Quaternary

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Whilst amino acid racemization (AAR) in mollusc shells was once applied widely as a dating technique for the Quaternary, recently other geochronological tools have become more routinely used, at the expense of AAR. However, successful results have been achieved using AAR of proteins in ratite eggshell, proposed to act as a closed-system with respect to the entrapped protein. At those sites not lucky enough to have an abundance of large flightless birds, a commonly occurring biomineral with similar closed-system properties would extend the potential of AAR to provide a simple dating tool. In an attempt to isolate a closed system in gastropod shells, we: (i) use multiple amino acid DL ratios, (ii) cross-check the *Free* amino acids (released from degraded proteins) against the *Total* amino acid compositions in the biomineral, (iii) bleach to remove contaminants and the degradable organic matrix. This approach both ensures the analysis of only the original amino acids, and allows the identification of bacterial contamination and post-depositional recrystallization. Despite these innovations, beyond MIS 9 the level of resolution in gastropod shells becomes limited. However, this work has been recently eclipsed by results obtained from the analysis of the tiny *Bithynia* opercula, common fossils in Quaternary freshwater deposits. The shells are aragonite, but the humble operculum which closes the gastropod aperture is calcite. Preliminary results with opercula are spectacular and as a consequence, the extent of protein degradation in opercula can be used to resolve not only stages but sub-stages within the Quaternary. The analyses of over 600 single opercula from 100 northern European sites are reported, with this coherent calcite intra-crystalline system allowing the development of an AAR chronology to at least 2.5 Ma.

Populations of baikalian endemic mollusks *Baicalia carinata* (Mollusca: Caenogastropoda) and evolution relation with close related species.

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Baicalia carinata (Dybowski, 1875) belongs to endemic family Baicaliidae of Lake Baikal. High intra-specific shell polymorphism is peculiar to this family and makes species identification based on morphological traits a very difficult task.

Here we use molecular phylogeny of mitochondrial cytochrome oxidase 1 (mtCO1) gene (588 bp) and nuclear internal transcribed spacer (ITS1) (360 bp) nucleotide sequences in order to study evolution relation with close related species and population genetic structure of *B. carinata* in Lake Baikal. In total, 130 sequences of mtCO1 and 105 sequences of ITS1 were obtained.

The phylogeny based on mtCO1 sequences shows that *B. carinata* forms two clades named North-West and East population but close related species aren't separated from *B. carinata*. In contrast, on ITS1 tree *B. carinata* doesn't form geographically defined clades but *B. rugosa*, *B. dybowskiana* and other close related species are situated separately from *B. carinata*.

In spite of the fact that nuclear genome evolves on the whole slower than the mitochondrial one, there are some exceptions. That is, observed level of polymorphism for nuclear DNA in some cases may be higher than in mitochondria. This fact may be explained by "sweeping effect", which may occur when an advantageous mutation appears in mitochondrial genome. In this case the advantageous haplotype may "weep" other haplotypes. As a result, the level of genetic polymorphism in mtDNA

will be decreased whereas polymorphism in nuclear DNA will be kept. The necessary condition of "sweeping" in mtDNA is absence of recombination. This hypothesis explains different locations of *B. rugosa* and *B. dybowskiana* on mtCO1 and nuclear ITS1 phylogenetic and spanning trees.

Pronounced karyological divergence of the North American congeners *Sphaerium rhomboideum* and *S. occidentale* (Bivalvia, Veneroida, Sphaeriidae)

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Polyploid taxa pose significant challenges to systematists because they may be the products of qualitatively distinct generative mechanisms (allo-/auto- polyploidization) that have important implications for our ability to accurately infer genealogies. Although polyploidy is thought to be uncommon in animals, recent chromosomal studies have revealed the presence of exceptionally variable mitotic chromosome numbers, from 30 to 247, in the exclusively freshwater bivalve family Sphaeriidae. These extraordinary karyological complements strongly suggest that pronounced polyploidization is prevalent in this family and single-copy nuclear gene allelic trees of some North American polyploid taxa have indicated an early genome duplication, predating the divergence of three *Sphaerium* subgenera (*Amesoda*, *Herringtonium*, and *Musculium*). However, the evolutionary origins of sphaeriid genome amplification remain obscure, as does the actual levels of ploidy they exhibit.

Advancing our knowledge of sphaeriid genome amplification processes will hinge on the identification of robust sister relationships among taxa differing in chromosome complements, especially those involving diploid and polyploid species. In the present study, we karyotyped two North American taxa, *Sphaerium occidentale* and *S. rhomboideum*, that displayed a robust and exclusive sister relationship for a nuclear ribosomal marker (ITS-1) but, interestingly, were not sister taxa for a mitochondrial ribosomal marker (16S). A chromosome count of ~209 has been recorded for *S. occidentale* and our karyotype of this species is the first such for a polyploid sphaeriid.

Although a large fraction of chromosomes was too small to arrange with confidence, the largest and medium-sized chromosomes of *S. occidentale* clustered into four subgroups on the basis of shared size and morphology. *S. rhomboideum*'s chromosomal complement has not been previously studied and we found it to be diploid (2n=44), the first such record for a New World sphaeriniid and one that represents a novel focal point for investigating the evolution of polyploidy in these taxa.

Evolution of mollusc lens crystallins

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The abundant lens crystallin proteins are diverse, multifunctional proteins that are often expressed outside of the eye. Crystallin recruitment involved selective high lens expression with or without gene duplication. S-crystallins, the major crystallins of cephalopods (squid, octopus), descended from glutathione S-transferase (GST) and evolved by an initial gene duplication, elevated lens expression, subsequent gene duplications, site-specific mutations and insertion of an additional exon. The single squid GST gene is expressed principally in the digestive gland. The lens-preferred (if not specific)

GST/S-crystallins are enzymatically inactive, except for one without an insert peptide. Ω -crystallin, a minor cephalopod crystallin, descended from aldehyde dehydrogenase (ALDH) and lacks enzyme activity. Scallop lenses lack S-crystallins and accumulate inactive Ω -crystallin (Sc Ω -crystallin; ALDH1A9). Cytoplasmic Sc Ω -crystallin aligns best with mitochondrial ALDH2 but lacks a mitochondrial N-terminal signal sequence. Sc Ω -crystallin does not bind NAD(P) possibly due to I to V modifications at positions 278 and 282. Sc Ω -crystallin comprises 4 ~50 kilodalton subunits, yet, unlike ALDH2, chromatographs as a ~100 kilodalton protein. The Sc Ω -crystallin promoter, like other crystallin promoters, contains transcription factor binding sites for Maf, CRE, Retinoic acid receptor and Pax. Crystallin promoters utilize Pax6 for all species tested except jellyfish, which use PaxB containing a Pax2/5/8 paired domain. The Sc Ω -crystallin promoter has two putative Pax binding sites that can interact with Pax6. Site 2, however, has a 3' C consistent with preferential binding by Pax2. Possibly then the Sc Ω -crystallin gene is activated by Pax6 and/or Pax2 (both are present in scallops). Thus, mollusc crystallins evolved from GST and ALDH by convergent events employing gene duplication, profound changes in promoter activity, and multiple alterations in protein structure.

Adverse effects of the Zebra mussel (*Dreissena polymorpha*) on the Swollen river mussel (*Unio tumidus*) in a riverine habitat

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The study was carried out in a mid-forest part of the Wielki Kanał Brdy (River Brda Great Canal) downstream of the village of Rytel in the Tucholskie Forest (NW Poland). The canal section sampled is 20 - 30 m wide and 0.5-1.5 m deep; the bottom is sandy-gravelly. The most common molluscs in the samples included *Viviparus viviparus*, *Dreissena polymorpha*, and unionids, represented primarily by *Unio tumidus*.

All the *U. tumidus* individuals collected were covered by clumps of zebra mussel, the density of the latter varying from 2 to 44 individuals per unionid (mean of 15,2). In most cases, the total weight of the zebra mussel exceeded that of the swollen river mussel and ranged from 0,9 to 30,9 g (mean of 10, 1 g). The zebra mussel to the infested mussel weight ratio was 0,2 – 6,8 (mean of 2,4 g). The zebra mussel shells measured. 5,0 – 23,6 mm; most of the *D. polymorpha* individuals being adults. The observations showed the zebra mussel to negatively affect the swollen river mussel. The adverse effects were manifested as a small size of the infested *U. tumidus* (mean shell length of 39, 1 mm), thinning and perforation of their shells, and increased mortality. A 15.1-20.0 g zebra mussel load per unionid was found to constitute a critical level marking the beginning of *U. tumidus* die-off. Dead individuals accounted for 35.2 % of the population studied, their proportion being much higher than that in river and lakes free of *D. polymorpha*.

Molecular characteristics of the part of Na,K-ATPase alpha subunit isolated from *Helix pomatia* L.

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The Na,K-ATPase, or a sodium pump, belongs to the very important family of enzymes mediating the ATP-dependent transport of Na⁺ and K⁺ ions against their electrochemical gradients across the plasma membrane. All animal cells have a sodium pump, which is crucial to various physiological processes, including osmoregulation, cell volume regulation, transport of certain amino acids and sugars, and maintenance of membrane excitability. Na,K-ATPase is composed of two noncovalently linked subunits: Na,K- α (catalytic subunit) and Na,K- β (subunit required for the translation,

transport, stabilization and function of Na,K- α at the plasma membrane). The sodium pump exists in plasma membrane as a heterotetramer: $\alpha_2\beta_2$.

Na,K- α has a highly conserved amino acid sequence. Its sequence similarity between birds, fish and mammals is close to 90%. Although the Na,K-ATPase is a well-studied enzyme, it has not been examined extensively in invertebrates, especially in molluscs. There are only a few fragments of gastropod Na,K-ATPase sequences in the GenBank. Here we report the nucleotide and deduced amino acid sequence of a large part of Na,K- α for *Helix pomatia* (the edible Roman snail). It is the longest sequence of a mollusc α -subunit characterized thus far.

The method often referred to as RACE (rapid amplification of cDNA ends) was used to generate a full-length cDNA of *H. pomatia* Na,K- α . This method has been developed to amplify DNA sequences from a messenger RNA (mRNA) template between a defined internal site and unknown sequences of either the 3' or the 5' end of mRNA. As a result of RACE, we obtained a 1580-bp sequence of *H. pomatia* Na,K- α . This fragment comprises two conserved (for α -subunit) domains: 1) the N domain (amino acid sequence: GDASE), containing the ATP-binding site; and 2) the P domain (DKTGT) containing the phosphorylation site. Sequencing of lacking fragments of *H. pomatia* Na,K- α is in progress.

Pupilloidea (Pupillidae, Vertiginidae, Valloniidae, Gastrocoptinae) of the Altay – a travel in space and time

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Based on material collected during two expeditions (2005 and 2006) the following pupilloid species were recorded from the Altay: *Vallonia pulchella* (O. F. Müller), *V. kamtschatica* Likharev, *V. costata* (O. F. Müller), *V. ladacensis* (Nevill), *V. tenuilabris* (A. Braun), *Gastrocopta theeli* (Westerlund), *Vertigo substriata* (Jeffreys), *V. microsphaera* Shileyko, *V. pygmaea* (Draparnaud), *V. ronneyensis* (Westerlund), *V. genesii* (Gredler), *V. pseudosubstriata* Ložek, *V. parcedentata* (A. Braun), *V. alpestris* Alder, *Vertigo* n. sp., *Columella edentula* (Draparnaud), *C. columella* (Martens), *C. intermedia* Skileyko et Almukhambetova, *Truncatellina cylindrica* (Férussac), *Gibbulinopsis* n. sp., *Pupilla muscorum* (Linnaeus), *P. alpicola* (Charpentier), *P. alabiella* Shileyko, *Pupilla* n. sp. 1, *Pupilla* n. sp. 2, *Pupilla* n. sp. 3. Of these 26 species 12 are extant in Europe (c. 5000 km away) or in rather remote localities in Europe and Asia, eight only in Asia, while three are known from the Pleistocene of Europe (two of these are extant also in other places in Asia, one in the mountains of Asia and in an isolated site in Norway); another three are at present known only from the Altay. The fairly numerous localities of species otherwise known from the Pleistocene of Europe (*Vallonia tenuilabris*, *Vertigo pseudosubstriata*, *Vertigo parcedentata*) provided crucial information for palaeoecological interpretation of European fossil sites. The rich material of *Vertigo microsphaera* and *Columella intermedia*, previously known as single specimens, made it possible to provide more precise descriptions and specify variability ranges of the species.

Updating the knowledge about the family Bornellidae (Mollusca, Nudibranchia, Dendronotina): Systematics and preliminary phylogeny based on morphological characters

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The dendronotid family Bornellidae includes two genera: the genus *Bornella* (Gray, 1850) and the monospecific genus *Pseudobornella* Baba, 1932. Some of the members of the genus *Bornella* are known for having a unique swimming behaviour, but little is known about its systematics or the position of this group in the phylogeny of Dendronotina.

To date 16 species have been described within the genus *Bornella* but nine of these are currently regarded as synonyms of the type species *B. stellifer* (Adams & Reeve, 1848). Another species, *B. excepta* Bergh, 1884 is considered as valid species but is known only from its original description. Three new species of *Bornella* are described in this paper. Most species of the family are distributed throughout the Indo-Pacific, except two species, *B. calcarata* Morch, 1863 and *B. sarape* Bertsch, 1980 that are known from the Western Atlantic and eastern Pacific, respectively. The species *Pseudobornella orientalis* is known from Japan and also recorded from Philippines and China. The review of the morphological variability within Dendronotina provides the basis for a preliminary phylogenetic analysis of the group. Phylogenetic relationships of nudibranchs in the family Bornellidae are presented based on a cladistic analysis of 59 morphological characters from ten species of the family, four species of *Dendronotus* and eight more species of different families within Dendronotina. Members of the family Tritoniidae are used as outgroup. This analysis indicates that Bornellidae is monophyletic. The genus *Dendronotus* represents the sister group of Bornellidae.

Controlling slugs and snails – will hope triumph over experience?

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Over the last 50 years the most widely used control method for terrestrial slugs and snails has been the use of molluscicide baits. Whilst these baits often produce results they are far less effective than pesticides used against other pest groups. A major difficulty with baits is ensuring that the pest makes contact with the bait and this is affected by behavioural and environmental factors. Ways of maximising the efficacy of molluscicide baits will be discussed.

New chemical products and other means of controlling slugs and snails are frequently described. The opportunities for exploiting these new approaches and some of the constraints preventing their commercialisation will be reviewed.

A range of biological and ecologically based controls are available for slugs and snails, but are not always used, often because commercial factors influence pest control decisions. Approaches for integrating a range of control methods for improved management of mollusc pests will be described.

Holocene molluscan successions from the Lake Baikal region, Siberia

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This paper reviews the Holocene molluscan successions from two well-dated sites in the Baikal region of south-central Siberia, the most detailed yet reported from the entire eastern Palaearctic. Floodplain sediments of the upper Lena River near Basovo, west of the northern tip of Lake Baikal, yielded over 72 500 shells from at least 28 species of terrestrial and 23 species of freshwater mollusc, an abundance and diversity far higher than previously reported from the region. The molluscan assemblages are dominated by land snails, especially *Vallonia*, represented by five species including *V. tenuilabris* and two poorly known taxa *V. kamtschatica* and *V. cf. chinensis*. Other noteworthy species recovered include *Gastrocopta theeli*, *Carychium pessimum*, *Vertigo extima* (southernmost record), *V. microsphaera* (fourth record) and the first Asian records of three other taxa (*V. geyeri*, *V. genesii* and *V. parcedentata*). The molluscan assemblages show clear successional trends during the early to mid Holocene, reflecting episodes of dryness/wetness on the floodplain. Drier conditions at c. 6350 ¹⁴C yr BP coincide with major changes in the archaeological record seen at other sites in the region but it remains unclear whether the two are linked. A prominent charcoal-rich horizon dated to c. 2800 ¹⁴C yr BP marks a burning event in the catchment, which resulted in a twofold increase in sediment accumulation rate. The faunal analyses have been integrated with a detailed pedological study of the sedimentary profile and a chronology provided by means of twelve AMS radiocarbon dates. The second site near Burdukovo lies east of Lake Baikal and it too has provided a clear Holocene succession but somewhat less dynamic than that at Basovo. This study provides the first detailed palaeoecological information relating to Holocene molluscan assemblages from the Baikal region and lays the foundation for future work in the eastern Palaearctic.

Preliminary study of DNA sequence variation in the terrestrial snail *Rumina decollata*

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Rumina decollata (Gastropoda: Subulinidae) is a predaceous land snail that is native to countries bordering the Mediterranean Sea and that has been widely introduced in many other areas. The species presents a high degree of shell and colour polymorphism. Being a hermaphroditic species, *R. decollata* is described as a complex of homozygous allozyme strains generated by a breeding system of facultative self-fertilization. The North African form of *R. decollata* may be a separate species, viz. *R. sahariana*, which seems to be supported by the genital anatomy.

In order to (re-)interpret the taxonomy, population genetic structure and colonisation history of this species, both in its native range and in areas where it was (recently) introduced by man, we started a combined morphological and molecular genetic analysis on both micro- and macrogeographic scales.

In this contribution, we present our first, preliminary data of a DNA sequence variation survey of six gene fragments (2 nuclear genes: ITS1 and ITS2; 4 mitochondrial genes: CO1, CytB, 12S and 16S), showing that there are two highly divergent groups, the European strains (= *R. decollata*) and the North African/East European strains (*R. saharica*), which support the specific status of *R. saharica*. *R. decollata* itself appears to be further substructured in two strongly supported clades, which may occur sympatrically.

This work was made with the support of the FNRS (Fonds National de la Recherche Scientifique, Belgique) that conceded a FRIA (Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture) PhD grant to V. Prévot.

Mapping subterranean microsnails: sampling methods and hydrogeological implications

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Subterranean snails are mostly stygobite, i. e. groundwater dwelling species. They have minute and fragile shells and are generally scarce in their environment. France hosts 75 species, some of them protected by law, but very few is known about their micro-distribution, their abundance and their population sizes.

The challenge for collecting stygobite snails rests on two drawbacks (1) the restricted access to the subterranean habitat and (2) the difficulty to find the animals in their subterranean biotope.

In order to assess a micro-distribution pattern in a restricted karstic area from southern France, a heavy sampling effort was performed to collect material from all the hydrogeological entities.

Different methods were used to reach subterranean waters: cave diving, drifting nets in springs and caves, pump sampling of hyporheic zone. Sediment samples were dried out and poured into water in order to allow empty shells to surface. Morphometrical analysis was performed on shells pictures using appropriate computer software.

The micro-distribution was first mapped using available hydrogeological data, based on the hypothesis that species are uniformly distributed in all the aquifer they have been found in. Then, based on snails micro distribution, some of the hydrogeological entities could be redrawn.

Morphological differences between sites could be observed in a single species. This could be due to isolation between hydrogeological entities leading to genetic divergences or to a morphological adaptation linked to water quality. In both cases, stygobite snails could then be considered either as biological markers of subterranean waters or as bio-indicators of water quality.

Hard clams and harmful algae:

Effects of brown tide on lipid stores in *Mercenaria mercenaria* larvae

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Marine invertebrates have complex life histories that often include a swimming planktivorous larval stage. These pelagic larvae are vulnerable to numerous abiotic and biotic stressors, which can affect survivorship and growth. In addition, sublethal effects imposed by these factors may leave a lasting legacy after metamorphosis. We investigated the effects of the harmful brown tide alga *Aureococcus anophagefferens* on the larvae of the commercially-important hard clam, *Mercenaria mercenaria*. *M. mercenaria* was the dominant bivalve in Great South Bay, Long Island until the mid-1970s, but very few larvae are presently found in these waters. Brown tide has been hypothesized to pose a barrier to recovery of the hard clam populations by negatively affecting clam larvae. Previous studies have revealed that brown tide has no effect on the survivorship of clam larvae but can affect larval growth under some circumstances. Most recently, we have shown that brown tide negatively affects lipid

accumulation during the larval phase, with larvae fed only brown tide containing less lipids than larvae fed an equal biovolume of a known good food, the alga *Isochrysis*. Lipids are important in bivalves for post-metamorphic juvenile growth and survivorship, and a diet of brown tide thus may have lasting legacies for hard clam larvae.

New insights on the phylogeny of the Conoidea (Neogastropoda) using molecular data

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The superfamily Conoidea is one of the most speciose groups of marine molluscs, with almost 700 genera and 10000 living species. Previous classifications were based on morphological and anatomical characters, but clades and phylogenetic relationships were not well assessed. Informations provided by one mitochondrial (COI) and three nuclear (28S, 18S and H3) genes were used to infer the phylogeny of this group. Data were obtained from more than 100 specimens, belonging to 57 genera, collected during recent cruises in West-Pacific (Philippines, Vanuatu, Norfolk ridge and Chesterfield and Salomon Islands). Some older specimens collected in West Africa were also included in the study. Analyses were performed on each gene independently as well as for a data matrix where all genes were concatenated, using several methods (ML, Parcimony, Bayesian). Some families and subfamilies among Conoidea correspond to well-supported clades uniformly found with all genes and all methods, but others appear to be polyphyletic. Several bathyal and abyssal genera are also found polyphyletic. Our results also pointed out some new phylogenetic relationships at the family, subfamily and genera level.

Phylogenetics of the Pectinidae: Sexual reproductive modes and the evolution of adult dispersal behaviour

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The Pectinidae is a large, cosmopolitan group of marine bivalves and includes approximately 300 species. This diversity offers a rich system to examine major evolutionary questions on the origin and evolution of complex traits and behaviours. Within the pectinids, at least three modes of sexual reproduction are displayed: gonochorism, hermaphroditism and protandry. Other aspects of life history also vary within the Pectinidae, including dispersal capabilities of the adult organism. Hence, pectinid species can be divided into six different categories based on their dispersal life history, such as byssal attachers, cementers, nestlings, recliners, excavators or gliders. It has been hypothesized that sexual reproductive mode may be influenced by an organism's mode of dispersal, whereby organisms that are highly mobile may be more likely to be gonochoristic. To test this hypothesis, we undertook a comparative study to examine the evolutionary correlation of reproductive mode and adult dispersal in the Pectinidae using a molecular phylogenetic framework.

A molecular phylogeny was produced for approximately 60 pectinid species using DNA sequence from three genes: two mitochondrial (12S and 16S) and one nuclear (H3). We used both maximum parsimony and Bayesian analyses to construct molecular phylogenetic hypotheses of the family. Categories of sexual reproduction and dispersal life history for each species were mapped separately onto the molecular phylogeny. We tested for correlated evolutionary change between sexual reproductive mode and dispersal life history using the phylogenetic comparative method. The molecular phylogeny supports previously identified tribes within the Pectinidae. Gliding dispersal behaviour has evolved independently three times with the Pectinidae.

The limited number of taxa sampled suggest there is a trend between gliding behaviour and gonochorism. The inclusion of more taxa in the analysis is needed to further investigate the relationship between dispersal behaviour and sexual reproductive modes.

Effect of piperaceae extracts on Schistosomiasis vector *Biomphalaria glabrata* (Say, 1818)

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Schistosomiasis is a disease that occurs in 54 countries, mainly in South America, Caribbean Region, Africa and east Mediterranean. Currently five to six million Brazilian people are infected and thirty thousand are under infection risk. This disease is associated to the lack of basic sanitation and polluted water used in agriculture, housework and leisure. One of the most efficient methods for its control is the application of molluscicides which eliminates or reduces the population of the intermediate host snail. Studies on extracts with molluscicides effects obtained from plants have been stimulated by issues such as environmental preservation, high cost and recurrent resistance of the snail to synthetic molluscicides. The aim of this study is to determine the molluscicide action of the crude extracts obtained from Piperaceae species on adult and embryonic stages of the snail *Biomphalaria glabrata*. Twenty different extracts prepared from eighteen Piperaceae species were obtained from stems, leaves and roots. The extracts were screened on snails in two different concentrations (500 ppm and 100 ppm) and those causing 100% mortality at 100 ppm concentration were selected to obtain LC₉₀ (lethal concentration of 90% mortality). *Piper aduncum*, *P. crassinervium*, *P. cuyabanum*, *P. diospyrifolium* and *P. hostmannianum* presented toxic effect with 100% mortality on adult snail at concentrations from 60 to 10 ppm. Active extracts ranging from 60 to 10 ppm were also submitted to different embryogenic stages of *B. glabrata* and those obtained from *P. cuyabanum* and *P. hostmannianum* showed 100% of ovicidal action at 20 ppm. Thus, further dereplication procedures of bioactive extracts should be carried out looking at determination of molluscicide compounds.

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Fresh water mollusks of the Azores: a reappraisal

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The first studies of the malacofauna of the Azores clearly stated the absence of fresh-water molluscs. Arthur Morelet, deemed by Wollaston “an exceptionally lucky naturalist”, in his six month expedition to the archipelago in 1857 registered 69 species of land snails, but remarked the complete absence of fresh-water molluscs. Milne-Edwards, upon coming ashore in 1885 during his “Talisman” expedition and failing to find there any fresh-water molluscs, interpreted the fact as evidence that the Azores were certainly the peaks of a long gone continent, for fresh-water snails, better adapted to low altitudes, had disappeared with it. However, the first fresh-water species, *Physa teneriffae* Mousson [= *Physella acuta* (Draparnaud)], had been recorded in 1881 by the Azorean malacologist F. Arruda Furtado and soon after (1887) Jules de Guerne described *Pisidium dabney* [= *Pisidium casertanum* (Poli)] from Faial and *Hydrobia evanescens* from S. Miguel, the latter probably based on embryonic shells of unknown origin; a year later Simroth recorded a *Pisidium fossarinum* Clessin [= *Pisidium casertanum*] from S. Miguel. E. Fisher-Piette, in 1946, added *Ancylus striatus* Q. & G. but its presence in the Azores was never confirmed. Wim Backhuys, in his revision of the land and fresh-

water malacofauna of the Azores, in 1975, dismissed ?*H. evanescens* and *A. striatus* from the Azorean list, but added *Helisoma trivolvis* (Say), *Lymnaea truncatula* (Müller) and *Lymnaea peregra* (Müller). Related to an outbreak of fasciolosis, a survey of the fresh-water molluscs was conducted in S. Miguel and Terceira, in 1991, by one of the authors (AMFM). The present contribution extends the distribution of *Lymnaea truncatula* to Santa Maria, *Pisidium casertanum* to Santa Maria and Flores, and for the first time records *Ferrissia clessiniana* (Jickeli) from S. Miguel, Santa Maria, and Graciosa.

Microalgae as feed for nursery phase cultivation in blue mussels (*Mytilus edulis*)

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Microalgae as live feed play an important role to feed shellfish to fulfill nutritional requirements. The aim of this research is to improve production of blue mussel (*Mytilus edulis*) by improving a process design and technology for either microalgae or shellfish in terms of growth, filtration, clearance rate and carbon metabolism. Different types of microalgae will be produced and then labeled with ¹³C to feed blue mussels at nursery phase. Then, Nuclear Magnetic Resonance was used to assess the enrichment of feeding in terms of quality and metabolism. In such a way, the digestibility of different microalgae can be analyzed. As a consequence, growth, filtration and clearance rate of each types of microalgae can be revealed and knowing that adding the right composition of microalgae results in development of nursery phase cultivation to improve the production.

Sessile snails, mobile genes: Mitochondrial gene dynamics within the worm-snail family Vermetidae

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The Phylum Mollusca is challenging our traditional view of highly conserved mitochondrial (mt) gene orders within animal phyla. Representatives of three classes of molluscs share remarkably few mt gene boundaries, with gene order varying extensively even within the Gastropoda. Here we present further evidence of an unusually labile gastropod mitochondrial genome based on four complete and three partial (> 7kb) mitochondrial genomes from members of one gastropod family, the Vermetidae. Vermetids represent a clade of sessile, uncoiled, suspension-feeding gastropods that radiated from a basal caenogastropod stock in the early Cenozoic. Demonstration of major gene order changes within such a young taxonomic group is exciting for a number of reasons. First, vermetid mt genomes are helping to understand more fully the mechanics of gene order changes, since the telltale vestiges of gene duplications and translocations, typically erased or overwritten with time, are still present within some of these genomes. Second, vermetid mt genomes are providing the opportunity to study putative mechanisms accounting for gene order homoplasy and tRNA gene remodeling at a

fine taxonomic level. We have now identified cases of tRNA identity change between isoaccepting leucines from L_{CUN} to L_{UUR} as well as from L_{UUR} to L_{CUN}, and have one genome with three leucine tRNAs. Finally, gene order changes can provide compelling phylogenetic markers that can supplement or contradict primary sequence data, and provide resolution for deeper nodes that are often weakly supported in sequence-based phylogenies. We have found several mitochondrial gene order changes that are phylogenetically informative within the Vermetidae. These markers are helping us to improve our phylogenetic hypothesis for the enigmatic Vermetidae and to investigate the conditions under which sequence-based phylogenies lack resolution or prove misleading.

Comparative anatomy of soft-body characters of Caudofoveata with emphasis on the nervous system

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Among specialists there is still some discussion on the definition of genera and families in the Caudofoveata. Since the current taxonomy and systematics of this group are almost exclusively based on the morphology of hard parts, i.e. the radula and the sclerites, these structures are very well investigated. Data on soft-body anatomy, in contrast, is often not very detailed or completely lacking, especially in recent publications. Hence the discrepancies mentioned above obviously cannot be solved by the investigation of hard parts alone, more knowledge on the soft-body anatomy of these animals is desirable. Promising character complexes in this respect are for example the various muscle systems (e.g. the pedal-shield and ctenidial retractors or the radula musculature) and the nervous system which is the main focus in this study. The anatomy of the nervous system and its variation has been studied using serial sections of several species from four genera (*Scutopus ventrolineatus* Salvini-Plawen, 1968; *Psilodens elongatus* (Salvini-Plawen, 1972); *Prochaetoderma raduliferum* (Kowalevsky, 1901); *P. californicum* Schwabl, 1963; *Falcidens crossotus* Salvini-Plawen, 1968; *F. guttuosus* (Kowalevsky, 1901)) representing all families (Limifossoridae, Prochaetodermatidae, Chaetodermatidae). The usefulness of some characters, such as the number of precerebral ganglia, is doubtful due to a potential high variability. Other characters, such as the anatomy and histology of the cerebral ganglia, show variations, which seem to be of systematic significance. We present a selection of our results and discuss the systematic value of the nervous system in Caudofoveata at different hierarchic levels and the consequences for caudofoveate systematics.

Preliminary data on a new species of *Kruppomenia* (Simrothiellidae, Cavibelonia, Solenogastres) from Norwegian waters

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Despite the fact that the Scandinavian waters are probably the best investigated region in the world in relation to the two groups of aplacophoran molluscs (Caudofoveata and Solenogastres), new research still yield samples containing species hitherto unknown to science. Here the first data on a new species of *Kruppomenia* Nierstrasz, 1903 from Norwegian waters is presented. So far, there are seven

described species of this genus, one of them, *K. borealis* Odhner, 1921, is previously known from Norway. The new species differs from *K. borealis* in several characters including the position of the dorsoterminal sense organ, the anatomy of the pericardioducts and spawning ducts, the configuration of the copulatory stylets and the morphology of the scaly sclerites alongside the pedal fold. Furthermore, neither the anatomical, nor the bathymetrical and geographical data of the new species is consistent with the data of any of the other six species. The continuous new findings of undescribed species of aplacophoran molluscs from all parts of the world indicate that the biodiversity of these groups is vastly underestimated.

Mudwhelks in mangroves: the evolutionary history of the Potamididae

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Mudwhelks of the family Potamididae are among the most characteristic of the gastropods associated with mangrove environments. In the Recent fauna they are represented by seven genera and a total of about 30 species, of which 70% are restricted to the Indo-West Pacific province. In their distribution and diversity gradient the Potamididae closely parallel the mangroves themselves, and they may serve as a model for the diversification of the biota of the mangrove ecosystem. Based on sampling of 65% of the extant morphospecies and all genera, we present a molecular phylogeny of the Potamididae. The group has an extensive fossil record throughout the Tertiary and the earliest fossils of modern genera occur in the Eocene of the Tethys Sea. This, together with the phylogeny, suggests a rapid radiation in the mangrove habitat following the appearance of mangrove trees. Closure of the Tethyan Seaway in the early Miocene, and regional extinction of formerly widespread genera, resulted in the modern restriction of most potamidid genera to either the Indo-West Pacific (IWP), or to the Atlantic plus Eastern Pacific (AEP). However, molecular evidence has revealed one clade with representatives in both the IWP and AEP. The genus *Potamides* has been considered to have had a continuous fossil record in the Tethyan province since the Oligocene, with a single relict (*P. conicus*) surviving in the Mediterranean and western Indian Ocean. Molecular evidence is inconsistent with this view.

Data on the ecology and phylogeny of Atlantic Ovulidae (Mollusca: Gastropoda)

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During a fieldwork period from April till June 2005, 105 samples (~200 specimens) belonging to four species of Ovulidae were collected along the leeward coast of Curaçao, The Netherlands Antilles. Identification of most ovulid species is relatively difficult because clear taxonomical shell characters are often lacking and the mantle can have many different patterns and a plethora of colour variations. Most of this variation is probably related to the symbiotic or predatory relationship between the snails and their soft coral hosts, resulting in camouflage of the snail on its host species or functioning as a defence against predators, i.e. as a 'warning' for noxious properties.

To obtain a better insight in the life histories and phylogenetic relationships within this gastropod family, ecological data (e.g. depth, host, position on host) were recorded and phylogeny

reconstructions based on two different markers were performed. It was found that *Cyphoma gibbosum* is the most common ovulid species in Curaçao. *Cymbovula acicularis*, *Simnia uniplicata* and *Cyphoma signatum* were significantly less common. We found that *C. gibbosum* is a generalist predator, occurring with 21 of the 49 Octocorallia species recorded, which are classified in 9 genera. Both *C. acicularis* and *S. uniplicata* showed a preference for only two host genera, viz. *Pseudopterogorgia* and *Gorgonia*. The molecular analyses showed a paraphyly for the genus *Simnia* sensu auct. When our molecular data are analysed in combination with sequences of Indo-Pacific Ovulidae, obtained from GenBank, it turns out that there is a well-supported dichotomy between the Indo-Pacific and the Atlantic ovulid species.

A morphologic, ecologic and molecular analysis of the freshwater mussels (Bivalvia: Unionidae) from Portugal (western Iberian Peninsula)

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European Unionid diversity is in need for revision since Haas' work in the twentieth century. The use of new techniques such as molecular analyses and the integration of various information sources is essential to clarify many controversial issues. Here we use such an approach to the western limit of Unionid distribution in Europe.

A comprehensive sampling of 21 river basins in Portugal was done between 2001 and 2006. Unionids were found in 138 sites from 51 rivers or streams. Morphologic characters were analyzed and compared to previous descriptions as well as with other European regions. Geographic and ecological traits in morphology were noted. Phylogenetic analysis based on the mitochondrial genes 16S and COI were performed using representative populations of each putative species. We identified five good species: *Anodonta anatina*, *A. cygnea*, *Potomida littoralis*, *U. cf. pictorum* and the endemic *Unio tumidiformis*. The morphology of the hinge area, umbo sculpture and glochidia were the most useful characters to distinguish between species. Shell shape was found to be useful but not reliable. Morphometric measures showed to be very useful to distinguish between live specimens of the two *Unio* species. Several ecological morphotypes within *P. littoralis* and *U. cf. pictorum* were found, but had no genetic expression. Two genetic lineages of *A. anatina* were found, one occurring in the Guadiana and Sado basins and another in the northern basins. The phylogenetic and evolutionary relationships of the taxa between themselves and with others outside the study area are discussed. Based on the relationships of Iberian and central European *Anodonta anatina* and *Unio* spp. we think that at least two colonization events of the Iberian Peninsula must have taken place. We hypothesize that *A. cygnea* might be a recent introduction because it showed no differentiation regarding central European populations and was found to be very localized.

***Unio tumidiformis* Castro 1885: A highly endangered endemic species (Bivalvia: Unionidae) from the south-western Iberian Peninsula**

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The family Unionidae is highly threatened worldwide, constituting the most endangered animal group in the United States. In Europe several endangered species were recognized (*Margaritifera*

margaritifera, *M. auricularia*, *Unio crassus*, *U. mancus*), but a poor understanding of the systematics and taxonomy of the group jeopardizes the efficiency of conservation efforts.

Following the recognition of the endemic character of the Portuguese *Unio crassus* sensu Haas, based on molecular phylogenetic analyses, we redescribed this species that was first designated as *Unio tumidiformis* Castro, 1885. We revised the collections in the zoologic museums of Lisbon, Coimbra and Porto (Portugal), Madrid (Spain) and Paris (France) and made extensive samplings throughout the Iberian Peninsula. We analysed its distribution, morphology, anatomy and life cycle. *U. tumidiformis* is restricted to the southern Atlantic basins of the Iberian Peninsula with an emphasis on the Guadiana basin. This small species, rarely over 5cm in length, is very uncommon with many populations represented by only a few individuals. It shares some morphologic characters with central and northern european *U. crassus*, its genetic sister group, clearly distinct from all other european *Unio*. It lives in small streams burried in fine sediment near the banks. Females with glochidia can be found between March and July. Glochidia are 200µm in length and released as a loose conglutinate. Five fish species of the genus *Squalius* were determined to be good hosts for the species. Metamorphosis takes place in 10 days at a average temperature of 22°C. Neither Habitat nor fish hosts explain its restricted distribution, which must have origin in its long evolutionary history as evidenced by molecular phylogentic analyses.

U. tumidiformis will retain the legal conservation status of *U. crassus* in the E.U. Habitats Directive, but its very restricted distribution, rarity and the sensitivity of its habitat to more and more frequent and extreme drought events should draw special attention to it.

Sperm precedence and lifetime fecundity of *Deroceras panormitanum*

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We are using the terrestrial slug *Deroceras panormitanum* as a model species to investigate whether sexual conflict has driven the radiation of this speciose genus. In this context it is of relevance to learn to what extent later matings reduce the paternity of earlier partners. *D. panormitanum* is a simultaneous hermaphrodite, and mating involves mutual, external exchange of single packages of ejaculate from penis to penis. It will mate repeatedly, even a few days after an earlier mating. We used laboratory stocks of three colour morphs with a simple Mendelian inheritance pattern to investigate paternity. Virgin slugs were mated twice to different virgin partners separated by an interval of 5-7 days. We also compared lifetime fecundity of the double-mated slugs and their single-mated partners. Slugs significantly more often produced no offspring if single mated rather than double mated, suggesting that matings often fail (possibly because of unsuccessful sperm transfer, defective sperm, or genetic incompatibility). Even excluding these non-fertile individuals, the lifetime fecundity of single-mated slugs was significantly lower, suggesting that slugs might become sperm depleted. Surprisingly, there was no indication that later mating reduced paternity of the first partner. 44% of double mated slugs with offspring produced offspring of mixed paternity, often even within single clutches. Mixed paternity was always strongly biased towards one father, but there was no consistent sperm precedence according to mating order or colour morph. There were several cases of self-fertilisation, but nearly all involved very few offspring. Slugs laid a succession of clutches over several weeks, with clutch size and hatching proportion tending to decrease. Maximum fecundity was 354 hatchlings. Fertile eggs were laid up to 82 days after sperm receipt. Ongoing experiments test whether the increased fecundity of double-mated slugs depends on whether the second mating is with the same partner or another.

Assessing effects of heavy-metal pollution on short term growth and periodical growth patterns of *Protothaca thaca* (Mollusca: Veneridae) using calcein as a growth marker

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Mollusc shells have been successfully used as environmental and paleo-environmental recorders. The cockle *Protothaca thaca* inhabits the shallow sublittoral of Chilean sandy bottoms and may be used for palaeoceanographic reconstructions because of its high temperature tolerance in changing environments and its presence in archaeological deposits. Prior to the analyses of this species as a potential recorder, shell growth and growth rate variations under different environmental conditions need to be investigated. The objective of this study was to assess the effect of heavy-metal pollution on growth rates and periodicity of shell growth of this species. Tagging-recapture growth experiments at several locations (polluted and unpolluted) of San Jorge Bay (Antofagasta, Chile) were carried out. Animals were marked with the fluorochrome Calcein (100 mg l⁻¹, 3h). Parameters of the von Bertalanffy growth model (K and L_∞) and the index of overall growth performance (P) were estimated to compare polluted and unpolluted sub-populations. Preliminary results indicate that growth parameters and growth performance of *P. thaca* are lower under polluted environmental conditions (K=0.127; L_∞=70.3; P=4.6) than under unpolluted conditions (K=0.3408; L_∞=71.9; P=5.1). Calcein markings were used to validate increment periodicities under the two growing conditions and thus, describe the growth modalities of *P. thaca* to provide the base for a sclerochronological analysis of this cockle.

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**Biogeography and systematic concepts of Helicinidae in the Lesser Antilles
(Gastropoda: Neritopsina)**

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Although fairly known, the geological history of the Caribbean region still remains subject of controversial discussions. The same applies to an even higher degree to our understanding of distribution patterns of flora and fauna in this area where vicariance and dispersal hypotheses were repeatedly contrasted. Therefore, exact systematics and data on the distribution of different groups of organisms are urgently needed. With their low mobility land snails provide an excellent example for such studies. A preliminary revision of the helicinid fauna of the Lesser Antilles will exemplarily highlight possible misinterpretations of biogeographic issues based on wrong systematic concepts. Applying previous classifications by WAGNER and BAKER, the helicinid snail fauna of the Lesser Antilles shows up to be more closely related to the fauna of the Greater Antilles with a comparably similar assemblage of the present genera, although greatly depleted in the diversity. Besides others most of the Lesser Antillean species were assigned to *Alcacia* and subgenera and only few to *Helicina*.

The present study that is based on different anatomical characters reveals that - except for two species - the genus *Alcudia* is completely absent from these islands, contrasting the situation on Cuba, Jamaica, Hispaniola and Puerto Rico. The helicimid assemblage is clearly dominated by the highly diversified genus *Helicina*. Contrary to conclusions reached by the application of previous classifications, these results hereby render the fauna of the Lesser Antilles remarkably distinct from the Greater Antilles where the genus *Helicina* is only represented by very few species. Puerto Rico shares elements with the other Greater Antilles as well as with the Lesser Antilles and northern South America, although to a minor degree. Whereas Cuba, Hispaniola and Jamaica each harbours only endemic species of Helicinidae, some of the species of the Lesser Antilles show a wider distribution on several islands.

Poorly explored jewels of the tropics - diversity in non-pulmonate land snails of the family Helicinidae (Neritopsina)

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The Helicinidae represent a family of small to medium-sized land snails of exclusively subtropical and tropical distribution being absent on the African continent. The highest diversity is reached on the Greater Antilles in the tropics of the New World, and on the Indopacific islands in the Australasian and Pacific region.

The most recent compilation of the representatives worldwide dates back to WAGNER in 1907-1911 and it includes 377 species and 161 subspecies. Subsequently about 270 new taxa were added in scattered publications. Despite a comparatively high share in abundance of the total land snail fauna in many areas even local revisions of the family were often neglected because of the limited number of recognised differentiating characters, questionable systematic concepts, intergrading shell morphologies and convergence combined with usually very limited material, especially for anatomical studies. Examples are given. Except for the detailed revisions for most of the Cuban genera, the few contributions on local helicimid faunas originate from the first third of the last century (e. g. works of PILSBRY - different areas; BAKER - Mexico, Venezuela, Jamaica; NEAL - Hawaii; BARTSCH - Philippines).

New systematic approaches together with recent exploration of undersampled regions and a more intensive search for microsnailes have already revealed a significant number of new species. Estimates of a possible total number of species are provided on the basis of results of these revisions and work in progress from Costa Rica, New Caledonia and the Lesser Antilles. Moreover, poorly studied areas are highlighted and modern challenges discussed.

Diversity, distribution patterns, and biogeographic affinities of the Helicinidae on New Caledonia (Gastropoda: Neritopsina)

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Comprehensive collections assembled between 1978-1989 by scientists and collaborators of the Muséum National d' Histoire Naturelle de Paris allowed the first revision the representatives of the operculate land snail family Helicinidae in the biodiversity hot spot area of New Caledonia and the adjacent Loyalty Islands. In combination with historical material, the study is mainly based on shell morphology and anatomy.

In a rather conservative approach 17 species were recognised as valid, among them three new species. All species are endemics with a more or less restricted distribution. The three Loyalty Island species are local endemics while the smaller northern and southern adjacent islands of New Caledonia (Îles Belep, Île des Pins etc.) share their one or two species with the main island. The highest diversity (eight species) is found in the southern third of Grande Terre.

On account of similarities in the female reproductive system all New Caledonian helicinids were included into the single genus *Sturanya* WAGNER 1905. Despite the similarities, two subgroups were recognised on Grande Terre that are readily distinguished by the surface sculpture of the early postembryonic whorls. The significance of this characters is evidenced by the resulting consistent pattern of distribution revealing a northern and a southern radiation with the latter being more diverse and reaching further north because of a few small-sized species with a wider distribution.

The younger Loyalty Islands were clearly colonised from different sources, with one species originating from the southern radiation on Grande Terre, while the other two species show affinities to Vanuatu and to several north-eastern archipelagos including Vanuatu, Fiji, Tonga, and Samoa respectively.

A comparative anatomical and ultrastructural study of the gland of Leiblein of two muricid species with different diets

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Preliminary results on the ultrastructure of the gland of Leiblein of two neogastropod species of different feeding habits, *Bolinus brandaris* and *Coralliophila meyendorffii* (Muricidae), are reported. Under laboratory conditions, individuals of *B. brandaris* predate on living bivalves (*Chamalea* sp.), while individuals of *C. meyendorffii*, which pertains to a highly modified and late muricid radiation integrated exclusively by symbionts of anthozoans, suck on the tissue of actinarians and scleractinian corals. Among both species, the gland of Leiblein shows drastic differences in the anatomical organization and in its connection to the mid-oesophagus. In *B. brandaris*, the gland, pale yellow in starved, and brown and soft in fed individuals, appears as a solid organ formed by tightly adpressed acini with high prismatic cells that is connected to the oesophagus through a duct with glandular folds. By contrast, the gland of Leiblein of *C. meyendorffii*, which in fed individuals acquire the same colour of the anthozoan host, consists in a large sac directly connected to the mid-oesophagus and with a wide central cavity crossed by two bilateral symmetrical rows of folds hanging free from the wall. Such organization has been described in the few coralliophilines studied to date. At the ultrastructural level, at least two common main cell types, also present in *Nucella lapillus*, are recognized in the glands of both species. One of the cell types is ciliated and has principally an absorption function, as suggested by the dense microvilli at the apical plasma membrane. The second type, with a smooth apical surface and a dense cytoplasm with Golgi complex and rich in endoplasmatic reticulum, lysosomes and mitochondria, maybe is involved in pinocytosis and in the synthesis of secretion granules. The ultrastructural similarities among the gland cells of both species supports strongly the homology of the organ at least within Muricidae.

**Using the Octopus retina to understand the cell biology of the eye:
Surprises and clues!**

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Recent progress toward understanding the cell and molecular biology of degenerate eye diseases has implicated the cytoskeleton found within retinal cells. Invertebrate retinas, particular those of cephalopods, are excellent model systems in which to study the cytoskeleton, factors that control its organization and mechanisms which disrupt the cytoskeleton leading to retinal degeneration. In the retina of *Octopus bimaculoides*, microvilli that compose the light sensitive rhabdoms increase in cross-sectional area in the dark and shrink in the light. Concomitantly, proteins involved in phototransduction translocate within the rhabdom compartment. Using standard cell and molecular techniques we have implicated signaling pathways involving the Rho GTPases in cytoskeletal organization and have further determined that expression of mRNAs for retinal proteins is regulated at the translational level by “masking and unmasking” processes first demonstrated in oocytes. Our results show that in the dark, Rho GTPase is activated and binds to the rhabdom membrane and may initiate signaling pathways leading to growth of rhabdomere microvilli. In the light, Rho is present in the soluble fraction, is inactivated and likely bound to a Rho GDI. Receptors involved in the activation of Rho in the dark are undetermined and may involve rhodopsin or other membrane proteins. Western blot analysis identified the trans-acting cytoplasmic polyadenylation binding protein (CPEB) in retinal extracts. CPEB functions in the masking and unmasking of maternal mRNAs during early development by binding to the cytoplasmic polyadenylation element (CPE) located within the 3' UTR of mRNAs. 3'RACE analysis of S-crystallin mRNA in octopus retinal extracts revealed CPE-like sequences located within the 3' UTRs of two 326-bp S-crystallin variants. Our results can be applied to vertebrate retinas to unravel control of photoreceptor cytoskeletons and expression of retinal-specific mRNAs.

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Soil mollusc response to different fertilized strategies for grass production in Galiza (NW Spain)

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There is already much research about the effects of the use of different sources of organic and mineral fertilizers on the physical-chemical properties of the soil, but less is known about their effects on the edaphic fauna. The main aim of this essay is to compare the effects caused by different fertilization strategies on soil mollusc community, based on the application of: i) dairy sludge, ii) cattle slurry, iii) poultry dung and iv) chemical fertilizers (N,P,K addition). The four types of fertilization are compared among themselves and with non- fertilized plots of grassland. The research

work consisted on the installation, in October 2001, an experiment in casual blocks where a pasture of rye-grass and white clover was sown. The experimental units are composed of 20 plots with 3m x 1.3 m area (four replicates by each treatment, at random).

During 2004 and 2005 year, molluscs were sample during the spring and autumn of each one. The most important parameters in terms of soil were done too. Species Richness and Abundance, Margalef, Shannon diversity indices and Smith and Wilson evenness index were also used to analysing possible differences on mollusc community. The results shown that Dairy-sludge treatment promoted the most species richness and highest diversity (H'). From un-transformed land surrounding sward (control), five species were sample: *Deroceras reticulatum*, *Arion ater*, *Arion intermedius*, *Cepaea nemoralis*, and *Portugala inchoata*.

From dairy-sludge amended, four species were found: *D. reticulatum*, *A. ater*, *A. intermedius* and *Ponentina subvirescens*.

From the remainder treatments (mineral, poultry dung and cattle slurry) only three species were found: *D. reticulatum*, *A. ater* and *A. intermedius*.

Dairy-sludge amendment was related with a more Nitrogen addition to soil, and with the lower C/N ratio.

Taxonomy and phylogenetic relationships of Nicaraguan freshwater mussels (*Bivalvia*: *Unionidae*)

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Lake Nicaragua is one of the largest lakes in the Western Hemisphere and was formed due to tectonic and volcanic activity < 3million years ago. The lake is home to a number of species of freshwater mussels, found nowhere else in the world, that were described in the middle part of the 19th century. These descriptions were based on shell characters, and do not allow for clear identification of species and that make the taxonomic placement of these mussels relative to other unionids difficult to assess. Following a literature review and examination of existing museum holdings, a collecting trip to Lake Nicaragua (Cocibolca) and the surrounding area was undertaken in 2006. The purpose of this trip was to collect materials for a re-description of these taxa, and if possible to make observations on the natural history of these organisms. Newly collected material will be identified by comparison to type material and taxonomic descriptions. The revised descriptions of Nicaraguan mussels will be prepared in a monographic format and include descriptions of soft anatomy, conchology, and glochidia, observations on natural history and reproductive period. In addition, tissue samples were taken for molecular phylogenetic analyses to develop hypotheses for relationships between these taxa and the phylogenetic affinities to North American unionids. Examination of museum specimens has identified seven nominal unionid species in three genera. Preliminary analysis of DNA sequence data indicates that Nicaraguan unionids mussels are relatively derived members of two North American unionid clades: the Amblemini and the Lampsilini, but indicate little genetic differentiation between putative Nicaraguan species within these clades. These results have implications for the evolution of reproductive traits with the Unionidae and highlight the need for more extensive taxonomic sampling in future systematic studies of this diverse group.

Three new species of minute heterobranchs (Gastropoda: Heterobranchia: Omalogyridae and Rissoellidae) from Namibia

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Namibian molluscan fauna is poorly known, with only about 140 species of marine molluscs recorded up to now. The superfamilies Rissoelloidea and Omalogyroidea, currently included in Heterobranchia, contain only the nominotypical families (Rissoellidae and Omalogyridae, respectively), and comprise minute marine gastropods which are still scarcely known all over the world. About 26 species of omalogyrids and 20 rissoellids have been described from the Atlantic, but there are no records of species of these two families from Namibia.

Samples collected near Swakopmund (central Namibia) by washing algae from intertidal rocky pools result in several living specimens of two Omalogyridae and one Rissoellidae new species, which are here described.

Retrotortina n. sp. differs from the only other known Atlantic species of the genus (*Retrotortina fuscata* Chaster, 1896, from the Mediterranean and NE. Atlantic) in having larger shell (up to 0.9 mm), less prominent abapical part, somewhat concave columellar edge and proportionally smaller aperture. Radula, operculum and head-foot characters of this new species are described.

Ammonicera n. sp. (up to 0.67 mm) differs from the 17 known Atlantic species of this genus by its teleoconch lacking axial sculpture, with only a faint spiral cord at both upper part and basis.

Rissoella n. sp. (up to 1.7 mm in length) differs from other congeneric species by shell and head-foot characters; the radula and operculum are also described.

Towards a global taxonomic authority list for the Mollusca

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Much of systematist's work is rummaging through the "graveyard" of synonymized and forgotten names to determine whether a candidate new taxon is indeed undescribed. Therefore an authoritative list of known taxa is essential to inventorying the world's molluscan fauna. The authority list should minimally include all the names by which each taxon is known and would enable linking data from disparate sources, such as online databases of museum collections.

Despite the recognized potential for global taxonomic authority lists to accelerate discovery and description of biodiversity, and the numerous programs and agencies calling for development of such lists, progress on molluscan databases has slowed. There are several successful regional projects: CLEMAM and CLECOM for Europe, Malacolog for the Western Atlantic, SOMBASE for the Southern Ocean, the Indo-Pacific marine database, but they are not yet interlinked.

There are several impediments to going global. It is easier to get funding for regional projects than global ones, and to attract funding one must have discrete, visible products that provide services needed by the target audience. Each project thus has slightly different goals and practices. Various standards exist for required elements in taxonomic databases, and complying with all simultaneously is burdensome. Furthermore, scientists resist authority lists as impinging on taxonomic freedom.

To progress toward a global list, we must recognize that it is necessary to have a federation of regional projects that feed into a central mechanism that supports multiple classifications. Editorial

structures are needed that allow maintenance by taxonomic experts while allowing community input, perhaps in Wiki format. The recently announced Encyclopedia of Life, which aims to create webpages for all known species, might help in developing such infrastructure.

Sex and systematics in the Streptaxidae (Pulmonata: Stylommatophora)

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Recently, sexual selection (often via sexual conflict) has been implicated in the diversification of organisms. The Streptaxidae are a little-studied, widely distributed and highly diverse family of carnivorous tropical land-snails. New data from an ongoing systematic study suggests sexual selection may have been a major force in the diversification of certain clades. A synapomorphy of the family is possession of a simple penis studded with sharp conchiolinous hooks. In different major African lineages this has been modified as follows: (A) taxa having serially repeating hooks, lacking spermatophores, and having a muscular vagina; (B) taxa having serially repeating hooks and penial stimulators containing novel, conchiolinous dart-like structures, lacking spermatophores, and having a muscular vagina; (C) taxa having differentiated, specialised hooks and configurations of penial pilasters, possibly functioning as stimulators, and possessing calc sacs, stylophores or spermatophores, but lacking a vagina. Type (A) and (B) taxa are moderately speciose, usually occurring in allopatry, while type (C) taxa are extremely speciose, often occurring in sympatry. These divisions are largely congruent with phylogenetic reconstructions based on non-genital morphology, mitochondrial (16S) and nuclear (actin exon) DNA. The latter also suggests that the majority of type (C) taxa are the product of a single, recent radiation. I interpret the genital differences between the three types as evidence of differences in the type and strength of sexual selection, and interpret the differences in diversity as evidence of the resulting response. Under this scenario, the genital features unique to type (C) taxa are seen as adaptations to rampant sexual conflict, and may also be key innovations that have promoted the recent diversification. The evidence for an alternative explanation, that of adaptive radiation relating to carnivory, is considered strong only for type (A) taxa. Improved phylogenetic reconstructions will allow a more robust test of these predictions in a comparative framework.

Streptaxomorph shells: an evaluation and possible explanation

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A “streptaxomorph” shell form, in which the coiling axis deviates substantially to the right during growth, is common among the Streptaxidae (Pulmonata: Stylommatophora). It does not occur in any plausible outgroup. This raises two questions: i) why does streptaxomorphy occur at all? and ii) has it arisen many times, or been repeatedly lost after being inherited by all streptaxids? This poster presents methods for describing the phenomenon in morphometric terms, offers explanations for its occurrence, and suggests a possible scenario for its evolution. Preliminary data indicate that the vast majority of streptaxid species are in fact axially deviated, either to the right (i.e., streptaxomorphy) or to the left (as in columnar or barrel-shaped species). Streptaxomorph shells are less frequent, but occupy a greater region of morphospace than left-deviated ones, including a region exploited by few other land snails (the “Cain gap” where height is approximately equal to diameter). However, alternative and more appropriate measurements indicate that this is misleading, with streptaxomorph

taxa avoiding the Cain gap by attaining a “streamlined” narrow shell profile. In life this may confer greater freedom of movement in the apertures of prey snails, and hence selective advantage. Size and shape of the main raptorial and feeding organ, the buccal mass, is also positively correlated with the degree of streptaxomorphy, despite this organ showing remarkably weak allometry and considerable conservatism across streptaxids in general. I suggest that selection for a narrow shell and a large buccal mass marks out streptaxomorphy as an ecological adaptation to dealing with large prey. As such it is likely to have arisen repeatedly and homoplasy is to be expected in systematic studies. Further analyses of this and other shell morphologies may identify other adaptive minima (like the Cain gap) that correspond to unexploited regions of streptaxid morphospace.

***Smaragdia viridis* (Gastropoda: Neritidae): A selective seagrass feeder**

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The emerald neritid *Smaragdia viridis* (L., 1758) is the only marine neritid native to European coasts (mainly Mediterranean). Little is known on its ecology and biology, with some information indicating that it is highly associated with *Zostera marina* and *Cymodocea nodosa* beds and forms therein stable populations. The link with these seagrasses has not been thoroughly investigated yet, so that it was interesting to study the possible trophic dependence of this neritid on both seagrass species. Laboratory experiments with live individuals have been performed using (1) shoots of *Z. marina*, (2) shoots of *C. nodosa* and (3) leaves with similar area of both seagrasses. Information on the feeding and absorption of food (seagrasses) by this gastropod was obtained in these experiments and from field data.

Smaragdia viridis ingests epidermal tissues of *Z. marina* and *C. nodosa*, leaving characteristic radular marks and egesting faeces composed by recognizable remains of seagrass cells (~ 99 %). A preference for *Z. marina* has been found when both seagrasses are available. The neritid feeds preferentially on young areas of *Z. marina* and *C. nodosa* such as those located close to the divergence point of leaves, displaying a higher ingestion rate in *C. nodosa* than in *Z. marina*. Nevertheless, the absorption of cells is higher in *Z. marina* than in *C. nodosa*, probably due to thicker cell walls in the latter. Very few mollusc species worldwide are known to feed on fresh tissues of seagrasses, and these actually represent a very low percentage of the species associated with the seagrass beds. *Smaragdia viridis* represents one of these and probably the first known species within this trophic category for the European malacofauna.

This study has been funded by a research grant of The Malacological Society of London given to the first author.

***Jujubinus striatus* (L, 1758) (Gastropoda: Trochidae) from a deep *Zostera marina* bed in southern Spain (Alboran Sea): notes on its ecology and biology**

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Jujubinus striatus is an efficient periphyton grazer of vegetated bottoms such as those of the eelgrass *Zostera marina* or the green algae *Caulerpa prolifera*, in which they may become the top dominant species of the epifauna. Information on the biology and ecology of this trochid is scarce and still insufficient to answer the reasons of its high dominance in these types of habitats. In order to understand this high dominance, the reproduction of this species has been studied seasonally in a deep eelgrass bed (12 - 14 m) in southern Spain. The temporal and diel variation of its population in

relation with environmental variables and the phenology of *Z. marina* have been also analyzed for obtaining information on its ecology and biology.

J. striatus is the top dominant epifaunal species on the *Z. marina* beds from the Alboran Sea (60 - 80%) and its density is highly correlated with the leaf biomass of this seagrass. This trochid performs vertical movements along the shoots of *Z. marina* within a diel cycle, with higher density of individuals on shoots at night time. In an annual cycle, *J. striatus* displays maximum densities (40 - 80 individuals. m⁻²) during spring and summer due to a peak of recruitment in spring months (up to 5 juveniles . m⁻²). Nevertheless, ultrajuveniles of this gastropod (shell height < 1mm) are present in the eelgrass bed during a longer period (from February to October) coincident with the presence of individuals in active (gonad full of gametes) or spawning stages. The sexual maturity of the studied population is reached at 2-3 mm (shell height) and each individual can spawn more than once a year. The presence of spermatophores in the pallial cavity of one male may indicate some kind of internal fecundation.

Fast trails versus hard shells: using defensive traits in aquatic gastropods as a model system for exploring questions in evolutionary ecology

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Aquatic gastropods possess defensive traits that allow us to explore important questions in evolutionary ecology. Here I present data that illustrate patterns in defensive trait expression and plasticity at the level of species and populations. Interspecific comparisons of morphological (shell) and behavioral (avoidance) traits demonstrated trait compensation (i.e. a negative correlation) between these different forms of defense: in freshwater species this related to differences in shell strength between species, whereas for marine taxa, shell shape was of more importance. A cross-species comparison of plasticity in defensive morphological traits (i.e. shell size and shape) in marine gastropods suggested considerable variation between species in the type and degree of plastic response exhibited and no clear relationship with phylogeny. Finally, a study focusing on avoidance behavior in a freshwater gastropod (*Lymnaea stagnalis*) suggested that both selection and plasticity may play a role in shaping responses in local populations. Together, these findings suggest that gastropod defensive traits can provide valuable insights into evolutionary ecology. I conclude by suggesting that this utility of gastropods may be extended within a framework that allows us to take a more integrated approach to the study of evolution, including the role of developmental plasticity.

Soft part 3D visualization by computer reconstruction of serial sections

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Recent increases in performance of computer hard- and software at the PC level enabled a variety of 3D graphical applications, like surface visualizations of biological specimens. This indirectly recalled an old morphological method back to life, the investigation of soft part anatomy by light microscopical serial section analysis.

After a brief historical review of sectioning reconstruction, approved histological and computer graphical methods resulting in 3D surface models (“surface rendering”) of small molluscan specimens are demonstrated. Ribboned serial sections of resin embedded specimens provide to be most practical for 3D processing. Ribboning is achieved by applying contact cement only to the cutting surface of the block, which is a modification of an old protocol. Details on the material, like embedding media (epoxy resins) and knives (Ralph glass or special diamond knife) used and general

handling for the entire procedure are given and critically evaluated. 3D processing is carried out with amira® software. The number of section images utilized for one specimen ranges from 120 to 400. Resolution should be adjusted to result in a file size for an image stack of approximately 400 MB. For completion and corrections of “materials” selected by hand drawing, “interpolate” turned out to be a most functional tool. The major steps in graphical processing from section image capturing until 3D visualization are illustrated.

Examples of 3D visualization of micromolluscs are followed by a discussion on the application possibilities of the method as a whole. At last, ways for directly embedding and displaying 3D specimens in standard desktop publishing and presentation software are demonstrated.

Genital system anatomy and development of *Ovatella myosotis* (Gastropoda, Ellobiidae) by 3D computer visualization

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The hermaphroditic genital system of the Euthyneura is highly complex and thus useful for systematic and phylogenetic analyses. Because primitive taxa with general plesiomorphic conditions in morphology and development are particularly informative, a member of the “archaeopulmonate” family Ellobiidae, *Ovatella myosotis* is investigated. Adult anatomy as well as organogenesis of the genital system is analyzed in detail by means of serial sectioning and 3D computer reconstruction and visualization. In the adult a spermoviduct leads from the middle portion, which has four nidamental glandular portions, to a common genital aperture. From here two separate structures, the vas deferens and a groove on the body surface, run anteriorly. The latter is termed egg groove because it carries the egg ribbon anteriorly, a function that is recognized here for the first time in the Ellobiidae. The evolution of this structure is discussed. In development, the organ system arises from four separate anlagen: (1) the ovotestis anlage, (2) the pallial anlage giving rise to hermaphrodite duct, fertilization pouch-spermatheca complex, nidamental glandular complex and spermoviduct, (3) the bursa copulatrix anlage, and (4) the anlage of the copulatory organ, vas deferens and egg groove. This development mode very much resembles that of the siphonariid pulmonate *Williamia radiata*, supporting its interpretation as a plesiomorphy in Pulmonata. Similarities in development of primitive pulmonates and evolution in gastropods lead to the assumption that ontogenesis of this organ system reflects evolution to some degree.

Cytogenetic damage in gill cells of blue mussels from different areas of the Baltic Sea

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The frequency of micronuclei (MN) and other nuclear abnormalities (nuclear buds (NB), bi-nucleated (BN) and fragmented-apoptotic (FA) cells) were studied in bivalve molluscs (*Mytilus* spp.) as biomarkers of environmental pollution impact in different areas of the Baltic Sea. Mussels were collected from three sites of the Lithuanian coast, four sites of the Gulf of Gdansk (Poland) and one reference site – Kvädöfjärden (Sweden) in April-June 2001-2003 and October - November 2001 and 2002. MN frequency in gill cells of mussels from the Lithuanian coast ranged from 1.2 (Palanga, June 2001) to 3.85 MN/1000 cells (Būtingė, September 2002). After the oil spill in the Būtingė oil terminal (November 2001), the Palanga and Būtingė sites were impacted by oil. In June 2002 and 2003, MN incidences were significantly increased ($p=0.0030$) in resident mussels. MN frequencies in molluscs from different stations of the Gulf of Gdansk were not significantly different. The highest

values of micronuclei's in Baltic mussels were detected in those collected from the Gulf of Gdansk (6.7 MN/1000 cells), the lowest frequency of MN (0.37 MN/1000 cells) was found in mussels from the reference site (Kvädöfjärden). In general, the frequency of micronuclei in gills of molluscs, which were sampled in Lithuanian coastal areas are lower than in those, sampled in the Gulf of Gdansk. The highest frequencies of nuclear abnormalities were observed in blue mussels from the Gulf of Gdansk, (5.3 NB/1000 cells, 9.0 BN/1000 cells and 5.0 FA/1000 cells) (Sobieszewo, September 2002), the lowest frequencies observed in mussels from the reference site (Kvädöfjärden). There was detected site- and season-specific variation of MN incidences in mussels. Significantly higher frequencies of micronuclei were detected in the gill cells of mussels which were sampled in autumn. Temperature-dependent frequencies of MN and other nuclear abnormalities were shown in mussels from the Gdansk Bay.

Taxonomical composition and morphological diversity of the genus *Policordia* (Bivalvia)

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The genus *Policordia* (Bivalvia) comprises specialized carnivorous bivalves distributed all over the World Ocean mainly in the bathyal and abyssal zones. Material studied contains 28 samples from 310 to 9050 m from Atlantic, Pacific and Indian Oceans obtained during a number of research cruises of P.P. Shirshov Institute of Oceanology RAS. Altogether the collection includes 21 species, out of them 12 are tentatively new.

Details of alimentary system, siphons, structure of ctenidia showed that morphological diversity in this genus is higher than anticipated before. A cladistic analysis using shell and anatomy characters supported two well-defined groups, one is subgenus *Angustebranchia* with 4 species and the other is yet undescribed taxon comprising 4 species. Subgenus *Policordia* in current understanding seems not to be monophyletic species group. The subgeneric level in *Policordia* requires revision.

Databases on scaphopod molluscs

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The widespread information on scaphopod molluscs was compiled and put into MS-Access 2000 databases. The two main databases consist of all references on scaphopods (recent as well as fossil, approx. 3800 entries) and of all scaphopod taxa (about 860 recent and 1280 fossil named species), as far they are included into the Volumes of the Zoological Record, published in the scientific literature or retrievable from the internet.

If available, the original diagnosis of the recent taxa was transcribed and included. Data on synonymy, illustrations, distribution, biology, radula etc. are added as well. By means of built-in or self createable queries selections and reports from the data can be performed, to reveal e.g. all green colored scaphopods, Dentalium species with more than 12 ribs, or the members of the genus Fissidentalium in an area. In this way a quick preselection of species could be made without consulting a lot of sometimes not easily available papers first.

The databases are updated regularly and are published in the internet at bimonthly intervals.

Photoreception and the evolution of photoreceptors (with special reference to Mollusca)

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Due to the general expression of the transcription factor gene Pax-6 in eyes of Triploblastica, as well as due to the overall presence of the opsin as photopigment, the polyphyletic evolution of photoreceptors (rather than of photoception) has recently been put into question. It is proposed that the developmental pathway of photoreceptor evolution reflects two different, subsequent processes: (a) the (monophyletic?) differentiation of the photoreception as such, mediated by a certain transcription factor gene (such as Pax-6 or sine oculis), and (b) the genetic induction by that regulative factor (normative unit) to differentiate the stimulated (polyphyletic) morphogeneses of photoreceptors proper by multiple convergent co-option with variable network-modifications. The structural significance of the epidermal photosensitive receptors with ciliary versus rhabdomeric surface enlargements is reconsidered: the differentiation of both receptor types in identical cells during development (of veliger larvae) evidences them as interchangeable structures (mere morphs), apparently dependent on functional requirement. Consequently, on the one side, the structural type of the receptive organelle has no direct bearing upon the homology identification of the photoreceptors. On the other side, there is no need anymore to propose separate (ciliary and rhabdomeric) precursor cells in metazoans.

Photoreceptive organs in Mollusca show a rich morphological diversity. All photoreceptors, ocelli and eyes (including the larval organs), however, appear to represent ingroup differentiations. Their polyphyletic lines are surveyed and the fine structure of eyes of three additional Bivalvia species, among them of the pteriomorph Lima, is reported.

Identification of several members of Hox and paraHox genes in heteroconch bivalves

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Homeobox genes encode transcription factors characterized by the homeodomain, a 60-amino acid DNA binding motif. Hox and ParaHox genes are particular subgroups of homeobox genes, which are found in special gene clusters and function in the patterning of body axis. Up to know Hox and ParaHox genes have been studied in several molluscs but the number of the genes identified in the clusters ranges severely in different classes. We carried out a polymerase chain reaction survey using degenerate primers to amplify Hox and paraHox genes in the heteroconch bivalves *Abra nitida*, *Thyasira sp.*, *Hiatella sp.*, and *Astarte elliptica*. Our results show that at least one anterior, five central, and one posterior Hox genes exist in these species. Two to four *antennapedia* orthologs are present in each species. Gene duplication of *labial*, *deformed*, *Lox2* or *Lox4* Hox cognates is apparent in some species. These results suggest that some of the anterior or posterior orthologs may have been lost in some species, while the medial cognates are either lost and/or duplicated. Mollusc-specific signature peptides were recognized in the central part of the homeodomain (20-46 amino acid position) of *labial*, *deformed*, *Lox4*, and posterior genes. We were not able to amplify paralog 3 group (*zerknult*) gene in any of the species. The entire paraHox cluster genes -including *Cdx*, *Xlox*, and *Gbx*- occur in all species studied here. At least one member of the cluster undergoes duplication in each species. *Hiatella sp.*, e.g., has a duplicated paraHox cluster. These results suggest that the number of genes in both Hox and paraHox clusters differs from species to species in the Heteroconchia, and that loss/duplication events probably occurred independently in different clades.

Freshwater snail diversity of Grande Island, Angra dos Reis, Rio de Janeiro, southeastern Brazil

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The main goal of this study was to elaborate a taxonomic list and distribution map of the freshwater snail biodiversity of Grande Island in order to support future studies on taxonomy, ecology as well as monitoring biodiversity. Grande Island has protected remnants of tropical forests at highlands and disturbed habitats at lowlands, being included in the Brazilian Atlantic Rainforest hotspot. The invertebrate fauna, including freshwater snails is still poorly known. Within 192 km² we have 32 catchments including small rivers, waterfalls, wetlands with shallow seasonal waterbodies, mangroves and two coastal lagoons. Intensive surveys were made since 2000, each catchment were visited at least two times with five to eight collecting points in each explored waterbody. Three people searched for snails for 15 minutes in the stream substrate, with a long handled metallic scoop and by eye for 15 minutes in other possible habitats, as under garbage, stones, decayed leaves and sticks. A total of nine species were found. Prosobranchia: *Melanooides tuberculatus* (Müller, 1774), exotic, introduced perhaps after 2004, only at Vila do Abraão, the most populous village and principal port of entry into Grande Island; *Heleobia australis* (d'Orbigny, 1835); *Heleobia* sp., only into the two lagoons. Basommatophora: *Biomphalaria tenagophila* (d'Orbigny, 1835), one of the natural vectors of *Schistosoma mansoni* Sambon, 1907, only at Vila do Abraão, recently transplanted, perhaps after 2004 from continental adjacent areas; *Antillorbis nordestensis* (Lucena, 1954), *Ferrissia* sp., *Burnupia* sp.; *Gundlachia ticaga* (Marcus & Marcus, 1962). Bivalvia: *Pisidium punctiferum* (Guppy, 1867). Vila do Abraão shows seven of the listed species, probably because accessibility. The very recent introduction of *M. tuberculatus* and *B. tenagophila*, probably by means of aquarium releases, offers a remarkable opportunity to monitor invasion behavior of introduced species, and to better understand invasive process, especially of *M. tuberculatus*, in an insular stream in southeastern Brazil.

Diversity and altitudinal patterns of land snails in two mountains of Atlantic Rain Forest at Grande Island, Angra dos Reis, Rio de Janeiro, southeastern Brazil

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Considering that species richness and density varies along elevational gradients, this study is the first effort to describe altitudinal patterns of land snail diversity on the mountains of Atlantic Rain Forest, one of the hotspots of biodiversity, at southeastern Brazil. Two mountains at Grande Island were studied: one on the oceanic side (Jararaca Trail), other on the continental side (Pico do Papagaio Trail). On each mountain, five areas with 100m elevation levels from 100m to 500m were chosen and samples collected from December 2004 to February 2005. At each altitudinal level, terrestrial molluscs were time searched for 3.5 hours and ten 25 x 75cm quadrats of litter were collected; environmental data were also obtained. Simple correlation was performed with biological data to generate the matrix used to cluster analysis. Biological groups identified as similar were used to the discriminant analysis to point the environmental factor responsible for the clustering. A total of 994 specimens, 14 families and 38 species were collected (50% micromolluscs). The richness was similar on both sides, but species composition and density were different perhaps due to environmental

heterogeneity. The values of the diversity indexes were very close, on both sides, slightly higher at the oceanic side. Accumulation curves showed that samples were not enough. Jackknife richness estimator indicated 29 to 41 species to the oceanic side and 34 to 51 species to the continental. The cluster analysis identify three similar biological groups: one at 100m, other at 200m, another joining the 300, 400 and 500m altitudinal level. The most important factors explaining snail distribution, on the two sides were humidity, atmospheric and soil temperature and litter depth; on the continental slope brightness and canopy closure also influenced the distribution of the snails. With this work, the land snail richness of Grande Island reaches 62 species.

Are morphological and molecular perspectives of anomalodesmatan phylogeny reconcilable?

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In recent years, the use of molecular techniques in studies of bivalve phylogeny has revolutionized our understanding of the relationships among several taxa. Based on molecular evidence, the ecologically diverse Anomalodesmata has been reclassified as an order of basal heterodonts instead of as a subclass of its own. Traditional views of internal anomalodesmatan relationships have also been challenged, with several families and superfamilies widely accepted as monophyletic on morphological grounds being rendered strongly as non-monophyletic in molecular surveys. Such incongruence between these two sources of data might indicate that convergent evolution of morphological traits has been so common in the group as to mask phylogenetic signal. Alternatively, at least part of the conflicting results may be due to misinterpretation of homologies and insufficient knowledge of the morphological variation within each nominal family. If the latter is the case, increasing the number of taxa and morphological characters sampled in previous cladistic analyses should resolve the issue and clarify what derived character states are shared by the clades supported by molecular studies. To test this hypothesis, a cladistic investigation based on morphological data is in progress, comprising previously unsampled anomalodesmatan genera and characters, as well as a reinterpretation of traits used in previous studies. A preliminary analysis of this dataset is presented.

Micromolluscs in Japan: recent findings and future subjects

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Studies of micromolluscs are essential in the malacology of the 21st century. Our understanding on molluscs has been chiefly based on large-sized species, but there are many little-known taxa composed only of small-sized species. Obviously high-quality research focusing on micromolluscs must be accelerated in various fields, especially in species-level taxonomy, comparative anatomy, and molecular phylogeny. In taxonomic studies, species diversity is extremely high in Gastropoda and Bivalvia, and undescribed small species also exist in other classes. In Japan, more than 8000 species of molluscs have been recorded since 18th century, but there are still numerous (more than 1000?) unidentifiable or undescribed species. For anatomical and molecular studies, obtaining fresh material is particularly important. Live micromolluscs can be collected almost everywhere by standard methods like sediment screening and rock washing, but some specific groups had been known only as empty shells. New findings since the late 1990s suggest that we have to pay attention to all possible environments, including undersides of half-buried boulders, deep crevices in rocks, submarine caves, sunken drift wood, chemosynthesis-based biological communities, underground freshwater, etc. Developmental and life-history studies are also necessary to establish identification

keys for micromollusc samples: The distinction of immature stages of larger species and adults of smaller species is critical in most groups except for those showing the sign of maturity in the shell (determinate growth).

Anatomy of *Eulepetopsis vitrea* McLean, 1990 (Patellogastropoda: Neolepetopsidae)

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Neolepetopsidae is one of families newly discovered from hydrothermal vents in the late 20th century. It was originally classified as an independent suborder (Lepetopsina) in Patellogastropoda, but such treatment was questioned by subsequent authors. To obtain more detailed evidence for phylogenetic estimation, we investigated the anatomy of *Eulepetopsis vitrea*, using gross dissection, serial sectioning and scanning electron microscopy. As a result, the animal of *E. vitrea* was revealed to possess the following features: short-type pallial margin tentacles, mouth surrounded by oral lappet, pedal wall lacking pallial ridges, ctenidium and osphradia entirely missing, unique configuration of alimentary tract, reduced salivary glands, small angle of oesophageal torsion, paired openings into digestive glands, acmaeoidan-type buccal musculature, dorsal protractor muscle of odontophore thin and widely covering buccal mass, two pairs of odontophoral cartilages, ventrally positioned thin approximator muscle, rectum bypassing ventricle, statocysts attached to outer lateral side of pleural ganglia, deeply ramified testis but massive ovary. The combination of above characters suggests the possible relationships with deep-sea Acmaeoidea (e.g. *Bathyacmaea*, *Pectinodonta* or some lepetids). In contrast, the closeness to Patelloidea (Patellidae and Nacellidae) is clearly rejected by the fact that there is no uniquely shared character among three families. Further anatomical investigations are necessary for unstudied subtidal and deep-sea groups (e.g. *Acmaea*, *Serradonta*, many lepetids) to understand the phylogeny of whole patellogastropods.

Comparative analysis of land snail radiations on Crete

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To investigate the causes for the land snail radiations on Crete we studied the systematics and phylogeny of the radiation of the genus *Xerocrassa* on Crete using morphological characters, mitochondrial (cox1, 16S rDNA) and nuclear (ITS2) DNA sequences and AFLP markers. Twelve *Xerocrassa* species occur on Crete, six of which have not been described so far. Distribution maps of these species were based on almost 3000 records. With these data and corresponding data on other Cretan land snail radiations, especially of the genera *Mastus* and *Albinaria*, we tested the hypothesis that these radiations were the result of a fragmentation of Crete into several paleoislands during the late Miocene and Pliocene. Contrary to the predictions of this hypothesis, Monte Carlo simulations showed that the distribution areas of the Cretan endemics are not significantly clustered and the phylogenies of the radiations do not reflect a common pattern. These results indicate that the land snail radiations on Crete were not caused by a common sequence of vicariance events. Probably, stochastic events like chance colonization of isolated habitats were more important. Although most sister clades of Cretan *Xerocrassa* species are allopatric and show strong range size asymmetry as predicted by the peripatric speciation model, a test for peripatric speciation based on a Monte Carlo simulation of range size asymmetry was non-significant. This indicates that different speciation modes might have been involved in the radiation of Cretan *Xerocrassa* species. Hardly any habitat differences between Cretan *Xerocrassa* species can be identified. Thus, the radiation is apparently

mainly non-adaptive as has been shown earlier for the Cretan Albinaria and Mastus radiations. However, size differences are larger between sympatric species than between allopatric species. Thus, sympatric occurrence seems to be coupled with the evolution of niche differences.

Molluscan fauna of shallow hydrothermal vents on the Knipowitch ridge

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Deep-sea hydrothermal vents are usually associated with a highly specialized fauna and since their discovery in 1977, more than 400 species of animals have been described. Specialized vent fauna includes various animal phyla, but the most conspicuous and well known are annelids, mollusks and crustaceans.

We have investigated the fauna collected around newly discovered hydrothermal vents on the Knipowitch ridge north of Jan Mayen. The venting fields are located at 71°N and the venting takes place within two main areas separated by 5 km. The shallowest vent area is at 500-550 m water depth and is located at the base of a normal fault. This vent field stretches approximately 1 km along the strike of the fault, and it is composed of 10-20 major vent sites each with multiple chimney constructions discharging up to 260°C hot fluids. A large area of diffuse, low-temperature venting occurs in the area surrounding the high-temperature field. Here, partly microbial mediated iron-oxide-hydroxide deposits are abundant.

The molluscan fauna found in the vent area is, with one exception, an assortment of bathyal species known in the area. This, yet undescribed, species is a gastropod related to *Alvania incognita* Warén, 1996 and *A. angularis* Warén, 1996 (Rissoidae), two species originally described from pieces of sunken wood north and south of Iceland. It is by far the most numerous mollusc species at the vents and was found on smokers, in the bacterial mats, and on the ferric deposits. In most samples, shells with the calcium carbonate dissolved or replaced by iron oxides were common. Of the altogether 19 species of mollusks (Solenogastres, gastropods and bivalves), eleven had not previously been recorded from the vicinity of Jan Mayen.

Sexual selection maintains whole-body chiral dimorphism in snails

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While the vast majority of higher animals are fixed for one chiral morph or another, the cause for this directionality is known in only a few cases. In snails, rare individuals of the opposite coil are unable to mate with individuals of normal coil, so directionality is maintained by frequency-dependent selection. The treesnail subgenus *Amphidromus* presents an unexplained exception, because dextral (D) and sinistral (S) individuals occur sympatrically in roughly equal proportions (so-called “antisymmetry”) in most species. Here we show that in *Amphidromus* there is sexual selection for dimorphism, rather than selection for monomorphism. We found that matings between D and S individuals occur more frequently than expected by chance. Anatomical investigations showed that the chirality of the spermatophore and the female reproductive tract probably allow a greater fecundity in such inter-chiral matings. Computer simulation confirms that under these circumstances, sustained dimorphism is the expected outcome.

***Potamopyrgus antipodarum* as a test organism for the assessment of endocrine active chemicals**

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Within the last years, the research on endocrine disruption in invertebrates increased and nowadays there are several examples reported in the literature. Especially, prosobranch snails have been recommended as promising candidates for test organisms regarding the assessment of endocrine active chemicals. The reproduction of *Potamopyrgus antipodarum* seems to be a very sensitive endpoint for xeno-estrogens (bisphenol A, octylphenol and ethinylestradiol) and xeno-androgens (triphenyltin, tributyltin and methyltestosterone). Due to many practical advantages for ecotoxicological testing, by means of easy culturing and test performance, *P. antipodarum* appears to be an appropriate species to be introduced into the OECD guideline program for standardisation.

The presentation will introduce biotests with *P. antipodarum* for water- and sediment exposure in the laboratory and point out the advantages of *P. antipodarum* compared to other prosobranch snails which are used in ecotoxicological tests. Furthermore, results of laboratory experiments and biological effect monitoring surveys in the field will be discussed.

***Melanoïdes* from Lake Turkana: a documentation of speciation and case study for “punctuated equilibrium”?**

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The Plio-Pleistocene molluscs of the Turkana Basin were considered as ideal documentation of speciation and the theory of “punctuated equilibrium” in the past. The hypothesis of “punctuated equilibrium” is debatable in general and was in particular disputed for Williamson's Turkana molluscs. For example, the question of simultaneous emergence of new genotypes, the problems of phenotypic variability of freshwater molluscs in general and the implications of time averaging of Williamson's findings were repeatedly addressed. After being hotly debated in the 1980th, no further studies were carried out, neither based on Williamson's collections nor on new material collected in situ. Here, we report on an re-evaluation of the *Melanoïdes* collection of Williamson in order to test

alternative explanations. We found that the shell morphology of these thiarid gastropods actually change throughout the Koobi Fora Formation. However, based on stratigraphic analyses taking the revised geological data into account, this change appears to be more gradual and not as abruptly as predicted in Williamson's original model. Where abrupt changes of shell morphology do occur, they are associated with significant changes in the sedimentary facies or hiatuses in the sedimentary succession. Therefore, we suggest that these molluscs are no palaeontological documentation of speciation and, thus, for the theory of "punctuated equilibrium". Alternatively, ecophenotypic variation and migration of faunas due to changes in the drainage pattern through time could have caused the changes in shell morphology observed by Williamson. This is documented in particular by dwarfism of *Melanooides* associated with an increase in morphological variability possibly due to environmental stress caused by shrinking of the palaeo-lake Turkana. Eventually, these morphotypes disappeared and were replaced later by more typical morphotypes of *Melanooides* from the Omo River. Thus, ecophenotypic variation followed by extinction and new immigration of these gastropods mimic lacustrine speciation processes.

Germany's next top model? Towards a morphological phylogeny and evolution of acochlidian opisthobranch gastropods

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Reconstructing evolutionary history requires knowledge on the relationship of units involved. Phylogenetics, however, faces serious problems. Historic diversity has been lost by extinction, samples and characters available for analysis are even more limited and selected, homology assumptions are probabilistic, and primary data are often deficient, among others. Obtaining robust and plausible phylogenetic hypotheses for at least some nodes is exception rather than rule, especially in more ancient groups and those with "rampant parallel evolution" like opisthobranchs. Conclusions on evolution, beyond population genetics and recent radiation level, are seldom more than speculation.

Acochlidians are enigmatic shell-less opisthobranchs which have been widely ignored. Not a surprise, since most species are tiny and worm-like, inhabiting interstitial spaces of coastal marine sands. Others are macroscopic, but live hidden under stones in a few rivers on tropical islands. Why should anybody seriously consider acochlidians as a suitable model group for phylogenetics, or for studying evolutionary pathways and processes?

Our results indicate the Acochlida is 1) monophyletic, 2) quite ancient, 3) comprises 27 valid plus several undescribed species worldwide, and 4) is extraordinarily diverse with regard to morphology and (especially reproductive) biology. We would not know of other animal groups combining an (early?) Mesozoic age with manageable numbers of recent species expressing an evenly fascinating evolutionary history. Minimizing branch lengths and selection, we attempt for considering "all" species and "all" structural characters discernable. High quantity and quality data is obtained by applying histological and ultrastructural techniques. By computer-based 3D reconstructions, entire specimens are analyzed. Organs are compared in unseen detail and homology assumptions are improved. Such optimized morphological information is used for cladistic analyses. Can we obtain a robust topology and reveal an ancient evolution, at least for a likewise ideal model group such as the Acochlida?

(Yes, some funding for supplementary molecular analyses would help!)

Challenging the biogeographical scenario of diversification of the Ampullariidae (Caenogastropoda) using molecular methods

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Members of the gastropod family Ampullariidae Guilding, 1828 have a considerable impact on human life: *Pomacea* spp., for example, are known as invasive pest species, affecting paddy fields in Asia. *Marisa cornuarietis* (Linnaeus, 1758), on the other hand, serves in Africa as intermediate host for the blood fluke *Schistosoma bovis* Sonsino, 1876. However, the intergeneric relationships of this circumtropically distributed family and, therewith, hypotheses on its origin and diversification patterns have barely been addressed in recent literature.

In the present study, we provide preliminary data that challenge, in part, the current conception of ampullariid diversification based on anatomical and morphological data. We used DNA sequence data of two mitochondrial fragments (ribosomal LSU and NADH dehydrogenase subunit 1) and included specimens from North and South America as well as from Africa in our analyses. The dataset included the proposed most basal ampullariid genus *Afropomus* Pilsbry & Bequaert, 1927 as well as the widely distributed African genus *Lanistes* Montfort, 1810 – both have so far not been subject to molecular phylogenetic analyses. We compared the results of various phylogenetic reconstructions (including Bayesian inference, Maximum Parsimony and Neighbour Joining) and found two consistent patterns that are in conflict with the anatomically and morphologically based hypotheses: first, our analyses indicate a sister taxon relationship between *Lanistes* and *Pila* Röding, 1798, the other in Africa widely distributed genus. Therewith, the most recent common ancestor (MRCA) of *Pila* is probably not – as so far suggested – also the MRCA of all non-African ampullariid snails. Second, the basal position of *Afropomus* within the ampullariids could not be confirmed beyond any doubt. We discuss the biogeographical implications of these findings with respect to the current hypotheses and suggest a new scenario for the diversification of this gastropod family.

Effects of parasitic mites on behavior and life-history traits of their host, the land snail *Arianta arbustorum*

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Parasites can influence the population dynamics of their hosts by affecting life-history strategies and behavior. The hematophagous mite *Riccardoella limacum* lives in the lung cavity of terrestrial gastropods. We investigated parasite-induced changes in the behavior and life-history traits of the simultaneously hermaphroditic land snail *Arianta arbustorum*, a common host of *R. limacum*. Naturally infected *A. arbustorum* collected in the wild showed a decreased activity compared to uninfected snails. The reproductive output, expressed as the number of eggs deposited in a reproductive season, was reduced in mite-infected hosts. However, the hatching success of the eggs laid by parasitized snails was slightly higher than that of uninfected individuals. We also examined winter survival in 361 adults of *A. arbustorum* collected from 4 natural populations. Prevalence of mite infection ranged 44.8–70.1% in three populations (snails in the fourth population were not infected). Winter survival was reduced in infected snails in 2 of 3 populations. The reduced reproductive output and winter survival indicate that parasite pressure imposed by *R. limacum* might be an important factor in the life-history evolution of *A. arbustorum* populations. Further, the reduced

activity might alter the sex-specific resource allocation towards the female function by reducing the mating frequency of infected *A. arbustorum*.

Simultaneous ambivalent reproductive strategy in the sessile gastropod *Vermetus rugulosus* Monterosato, 1878 (Gastropoda: Prosobranchia)

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Vermetids, worm-like sessile molluscs distributed within a restricted tropical and sub-tropical latitudinal range, have not been hitherto considered capable of high diffusion: among the very few papers on the reproductive biology of vermetids, only few species are reported to have planctotrophic larvae, while direct intracapsular development seems to be the most common strategy adopted by the majority of the species. These data seem to be in contrast with those of the biogeographical distribution of the species.

Vermetus rugulosus Monterosato, 1878 is a very small, but well defined Mediterranean species, whose intracapsular mode of reproduction has already been described in detail. Along with reproductive pattern studies conducted by the author on some species of Vermetidae, seasonal samplings of living *V. rugulosus* were carried out along the E-Sicily coast: some specimens were dissected and the capsulae extracted and observed for morphometric analysis; others were stored in aquaria for observations on spawnings. Summer samples have confirmed the intracapsular mode of development of this species, while winter samples have revealed to have an ambivalent production of veligers and crawling juveniles, hatching simultaneously from the same capsule. Considerations on the real distribution capability of this species are here presented too, in the light of such new reproductive observations.

Inventories for the Dark Continent: compiling African checklists

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We estimate that the land snail fauna of Africa contains over 3400 taxa based on the regional species inventories. Most of the species descriptions come from the periods of colonial expansion between 1860 and 1960. These are in scattered monographs and papers containing brief descriptions and drawings with types are widely dispersed in European and American Museums.

Since 1993 we have surveyed sites in Kenya, Tanzania and Uganda. Consequently we know that the country lists published by Verdcourt are incomplete. We have found morpho-species that represent either local variants of species known from other mountain ranges or undescribed species; these are the subject of ongoing research.

At present most new species are micro-molluscs (under 5 mm) rather than the larger shelled taxa. Many of the recently described species are from the Streptaxidae, a family that dominates the East African fauna (c. 40% of species). These species have distinctive shell forms as well as distinctive anatomical characters (see Rowson, this volume). We believe that the Family Punctidae, Subulinidae, Vertiginidae and Urocyclidae also hold new taxa. Some of these families would benefit from a major revision across the region as anatomical data is required to define species limits, however alcohol

preserved material is rare for these groups. In addition there are new distributional records for the families and genera, especially close to regional boundaries in the south and west of Tanzania. One major impediment to the completion of species level inventories is the number of morpho-taxa only 1 or 2 specimens are known despite intensive efforts to find more. Where shell morphology is distinct it is possible to confidently attribute the status, but where the shells are broken or immature the nature of the taxa remains uncertain.

We describe our progress at national and regional levels establishing species catalogues.

The need for an inventory of the world's molluscan fauna: a conservation perspective

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Since 1999 the IUCN Red List has become a tool used by different organisations to assess changes in the status of biodiversity. The quantitative methodology for evaluating threats has allowed a more rigorous analysis of the changing trends through time. The IUCN Red List was still dominated by the assessment of threatened species rather than a more balanced assessment of all species. Consequently over the last five years the IUCN Red List Partnership has developed Global Species Assessments to comprehensively assess the status of different taxonomic groups. The first major assessment was Birds followed by the Global Amphibian Assessment. This data was used to promote the concept of a Red List Index for measuring changes in overall threats to species. This index is one of various proposed methodologies for measuring of biodiversity change currently being tested for the Convention on Biodiversity (CBD) and the Millenium Development Goals. However, in order to make these assessments more meaningful in conservation terms, there needs to be a broader suite of species contributing to the overall analysis.

One of the first requirements for a Global Species Assessment is an agreed species list, that is accessible, taxonomically robust, accepted by the wider scientific community and in electronic format. With a list, then it becomes easier to consider a Global Assessment, especially from fund-raising perspective. For the Mollusca, there is no global species list, instead there are regional lists as well as numerous national lists. We discuss the future challenges for conservation planning and some regional projects examining threats to freshwater molluscan faunas. We also look at the ways in which future species assessments can contribute to the overall picture at a local, national and global level.

A new species of nudibranch (Gastropoda, Nudibranchia, Dorididae) of the Ría of Ferrol (NW Iberian Peninsula, Spain)

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In the researches that have been carried out about the Nudibranchia Mollusca of Galicia (Spain) during the last 30 years, 18 specimens of a rare Doridacea have been collected and their study has shown that this is actually a new species for the science. The size of the specimens ranges between 20 and 71 mm long. They were collected in two stations of the Ría de Ferrol on an infralittoral bottom between 17 and 20 m depth.

The specimen has an orangey-yellow color with a very dense and thin black dotting that may be only observed by means of a stereoscope microscope. Its back is covered with spherical tubercles with a rough surface, slightly pointed and with a small basal stalk; the tubercles have different sizes: large, medium and small. Laminar rhinophores and 6 to 8 tripinnated branchiae, being both structures encircled by a rather high sheath around its base. It has two oral lobes, although it presents no tentacles. Labial cuticle lacking rodlets. Mantle with a hard consistency, a very thick spicule framework may be observed ventrally. The intertegumental spicules are dense on the mantle, foot, rhinophores and branchiae, being also of two different kinds: irregular fusiform of different sizes and very small spherules that may be only found on the mantle and rhinophores.

The radula lacks any central tooth, it is composed of 38 rows with 72 simple hook-shaped teeth per row and with 3-4 marginal teeth on each side with bristles on the cusp. The genital system presents a short penis without spines or hooks, a short deferent duct and a fusiform prostate; its ampulla is long and narrow. It has a large and spherical bursa copulatrix and an oval seminal receptacle.

According to VALDES (2002), the new species is placed within the genus *Doris*, being therefore a new species *Doris* sp.

Molecular diversity and phylogenetic relationships of the family Viviparidae (Gastropoda, Mollusca) with special emphasis on the *Bellamya* radiations in the Rift Valley Lakes of Africa

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Two genera of the gastropod family Viviparidae are currently recognized on the African continent, i.e. the widespread *Bellamya* with 18 species, and the monotypic *Neothauma*, which is endemic to Lake Tanganyika. The genus *Bellamya* has radiated in the Rift Valley Lakes and intralacustrine speciation accounts for most of the species (67%). Lake Victoria is the relatively youngest of the Rift Lakes, however comprising the highest number of endemic species. To investigate the phylogenetic relationship of *Bellamya* we studied 10 taxa (N=43) of the family Viviparidae from the Great Rift Valley Lakes and one out-group, *Viviparus contectus* from Denmark. Sequence variation was assessed for partial sequences of the nuclear histone H3, the mitochondrial cytochrome c oxidase subunit I (COI) and 16S ribosomal DNA. Maximum parsimony, maximum likelihood and Bayesian inference analyses were conducted. The COI diversity within the lakes was low; Lake Victoria/Albert/Kyoga (0-2.2%) and Lake Malawi (0-1.9%). This suggests that either differentiation in *Bellamya* is not accompanied by strong sequence divergences or the number of *Bellamya* species is

an overestimate. The *Bellamya* species radiation in Lake Victoria is not monophyletic. The endemic *Bellamya rubicunda* from Lake Albert and *B. sp.* from Lake Kyoga are inferred to be part of the clade. Lake Victoria is connected to Lake Albert through the Victoria Nile and Lake Kyoga. *Bellamya capillata* from Lake Kariba is placed as a sister-group to the Lake Victoria/Albert/Kyoga clade, indicating that it might be the ancestral riverine form, or one of several, which has radiated in the lakes into the species present today. The position of *Neothauma* has not yet been completely resolved; it might not be basally placed, but instead be sister-group to either the *Bellamya* species of Lake Malawi or to the Lake Victoria/Albert/Kyoga clade.

Developing molluscan models to study the disease, ecology, and evolution of the eye

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Several invertebrate systems have been developed to study the eye and eye disease including *Drosophila*, *Planaria*, *Platynereis*, and most recently, the cubozoan jellyfish *Tripedalia*; however, molluscs, the second largest metazoan phylum, have so far been underrepresented in eye research. This fact is surprising as mollusc systems offer many advantages and opportunities to study basic visual processes that may be altered in the disease state, physiology of vision, development of the visual system, behavior, and evolution. Malacologists have labored for over a century as morphologists, systematists, physiologists, and ecologists, in order to understand the structural and functional diversity in molluscs at all levels of biological organization. Yet, malacologists have had little opportunity to interact with researchers whose interests are restricted to the biology and development of eyes as model systems as they do not publish in the same journals and do not go to the same meetings. In an effort to highlight the advantages of molluscan eyes as a model system and encourage greater collaboration among researchers, I will provide an overview of molluscan eye research from these two perspectives: eye researchers whose interests involve the development, physiology and disease of the eye and malacologists who study molluscs as the complete organism in their natural environment. I will discuss the developmental and genetic information about molluscan eyes, and the need to place this work in ecological and evolutionary perspectives. Finally, I will discuss how synergy between these two groups will advance eye research, broaden research of both fields, and aid in developing new molluscan models for eye research.

Diversification of the genus *Theodoxus* (Neritidae) in the Black Sea Basin

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As a relic of the Paratethys, today's Black Sea region is considered a hotspot of brackish water gastropod endemism. One of the gastropod groups that shows a remarkable degree of diversification is the genus *Theodoxus* Montfort, 1810 (Neritidae). The group is mainly distributed in Europe, Northern Africa and the Near East. Due to high physiological (colour) plasticity, the status of some described species remains dubious. Specimens of *Theodoxus* from different tributaries of the Black Sea, mainly from large river deltas, were genetically (mitochondrial LSU rDNA and COI genes) and morphometrically (PCA and NPMANOVA) analyzed. Both tree- and network based phylogenetic analyses revealed three distinct Black Sea clades that correspond to *T. velox*, *T. euxinus* and *T. cf.*

danasteri. *Theodoxus velox* is distinct from the so-called “*T. fluviatilis* complex”, which comprises four well-supported clades. Using an average COI molecular clock rate for Protostomia of $2.23 \pm 0.22\%$ K2P distance/My, we estimate the age of the split of *T. velox* from its sister clade at 1.37 ± 0.29 My. At this time during the early Pleistocene a relatively small and isolated brackish water body - the Gurian Sea - existed in the Euxinian depression. Freshening, cooling and decrease of water level during that time could have had a vicariance effect on the common ancestor of *T. velox* and the *T. fluviatilis* complex. According to our data, *T. cf. danasteri*, previously referred to as “Danubian *T. fluviatilis* group” forms a sister clade to the group containing W European *T. fluviatilis* and *T. euxinus*. The significant differences among *T. velox*, *T. euxinus* and *T. cf. danasteri* could be confirmed utilizing morphometrical analysis of shell geometry. The evolution of Black Sea Basin *Theodoxus* lineages in time and space is discussed in a Pan-European context.

Exceptional preservation of molluscs in the buckhorn asphalt quarry

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The Late Carboniferous (Desmoinesian, approx. 306 m years) sediments of the Buckhorn Asphalt Quarry (Oklahoma, USA) contain the best preserved Palaeozoic mollusc fauna world wide. Molluscs are commonly preserved in original aragonite including shell microstructures, though aragonite is normally dissolved or recrystallised shortly after deposition. Even larval shells and colour patterns are preserved. The good preservation of fossils was caused by Ordovician oil which intruded into the sediments simultaneously to or shortly after deposition, sealing pore space and preventing recrystallisation *via* circulating pore waters. The oil then transformed into asphalt losing its volatiles.

The fauna of the Buckhorn Asphalt is dominated by mollusc species, especially by cephalopods and small gastropods. For the purpose of inferring the depositional environment and Palaeoecology, thin sections were prepared from samples of all main lithologies. Asphaltic rocks were dissolved in a Soxhlet apparatus using methylene chloride as solvent (asphalt content is up to 20%). The dissolved samples were sieved (2 mm, 500 μ m, 125 μ m) and picked. Fossils, especially small gastropods were documented with SEM- and light microscope pictures. Bioerosion in the Buckhorn fossils is common and could be proved using SEM-photographs of fossils and casts, as well as with thin sections. At least 50 gastropod species, two coiled and three orthocone nautiloids have been documented, however brachiopods and bivalves are rare. The rich marine fauna is furthermore represented by ostracods, foraminifers, echinoderms, and bryozoans. Vertebrate remains like fish teeth are rare. First results suggest that most fossils lived in shallow water as is indicated by a diverse assemblage of bioeroders within the mollusc shells as well as by the presence of large land plant remains. The fossil material is mixed with siliciclastic sediment which is conglomeratic sometimes, and was transported over a relatively steep slope or in channels.

Shape variability of *Mactra isabelleana* (Heterodonta: Bivalvia) from two different habitats off Buenos Aires province coast

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The frequent species *Mactra isabelleana* (d’Orbigny, 1846) can be found in several locations along the coast of the province of Buenos Aires, including the Rio de la Plata estuary. The different environmental processes present at these locations can produce morphological variation in the specimens. In order to prove this hypothesis we analyze, using geometric - morphometric methods, the shell shape variation of *Mactra isabelleana*. In addition, we also compare this species with the cogenetic *M. marplatensis* to verify the generic variability. All specimens were collected by a trawling net in two locations that represent the estuary and the open sea. They were San Clemente (36°20’50’’ S, 56° 43’ 40’’ W) and Mar del Plata (38°01’45’’S, 57°30’05’’W) respectively. Sixteen *ad hoc* landmarks were digitalized from shell pictures. Principal Component and Canonical Variation analysis were carried out with IMP software, in order to investigate the shape variability between specimens and samples from different habitats. Samples from Mar del Plata were the most variable and those from San Clemente were the most homogeneous, perhaps because all of them belonged in the same population. Principal Component analysis allowed us to unquestionably separate the two species. However, Canonical variation analysis was necessary to reveal the shape variation in *M. isabelleana*. According to Bartlett’s test, we found significative differences between specimens from San Clemente and Mar del Plata. This analysis also allowed us to verify the distance between the two species. Finally, to prove the cause of this variability, tests will be carried out of the different environmental factors like salinity, sediments and tide and wave dynamic, among others.

Radiation and diversity of primitive living chitons – unravelling the base of the polyplacophoran family tree

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Chitons are often referred to as “living fossils” in part because they are proposed as one of the earliest-diverging groups of living molluscs but also because the gross morphology of the polyplacophoran shell has been conserved for hundreds of millions of years. As such, the analysis of evolution and radiation within polyplacophorans is of considerable interest not only for resolving the shape pan-molluscan phylogeny but also as model organisms for the study of character evolution. This study presents a new rigorous cladistic analysis of the morphological characters used in taxonomic descriptions for chitons in the suborder Lepidopleurina (the most basal living group of chitons). Shell-based characters alone entirely fail to recover any recognised subdivisions within the group, which may raise serious questions about the application of fossil data (from isolated shell valves). New analysis including characters from girdle armature and gill arrangements recovers some genera within the group (*Hanleya*, *Ferreiraella*) but also points to new and previously unrecognised affinities within the main genus *Leptochiton*. Additional characters from molecular data and soft anatomy are clearly needed to resolve questions of chiton relationships. However, the datasets currently available already provide interesting insights into the analytical power of traditional morphology, as well as some knowledge about the early evolution and radiation of this group.

Mollusc collections in the National Museum of Ireland: Céad míle fáilte!

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Collections-based Biology in Dublin (CoBiD) is a joint venture between the National Museum of Ireland (Natural History Division, NMINH) and University College Dublin, dedicated to improving the accessibility and the research applications of the Museum's scientific collections. CoBiD's activities currently focus on the documentation of the molluscan collections. The collections of the NMINH date from 1792 and are global in scope (with an emphasis on other former British colonial territories); the holdings are of a similar size to scientific museums in other European capitals. However, the NMINH suffers from critical understaffing and employs a total of five (5) staff. Work on the molluscan collections has been the main activity of CoBiD's volunteers since November 2006. The collection includes significant material from 19th century collectors (e.g. Jeffreys, Monterosato, and the Norwegian Asbjornsen) and exploring expeditions (e.g. *Challenger*, Southern Cross). To date, this project has resulted in the cataloguing and re-housing of over 8,000 museum specimen 'lots', including more than 156,000 individual molluscs. Of this collection, approximately one-third of material was never previously accessioned or documented by the museum. In May 2007 we completed documentation of the bivalve shell collection. The bivalves cover 81 families, including more than 1,400 lots from Ireland and Britain and a further 2,370 lots from other localities around the world. Full catalogue details are available electronically by request. We also expect great things from the gastropods, which are due to be completed in early 2008. The NMINH represents an excellent general collection, which has never been tapped for malacological research.

Accounts on the phylogeny of the Muricidae (Caenogastropoda) based on comparative morphology of some representatives

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As part of a wider study on the phylogenetic understanding of the Caenogastropoda higher taxa, samples of the more diverse branches of each taxon has been studied in their detailed morphology and anatomy. The comparative analysis of these samples, as representatives, has brought accounts on the phylogeny and taxonomy of the Caenogastropoda as a whole and its main branches. The project is now in the phase of refining the most diverse families. The main goal is to define each family phylogenetically, including their internal branches and their relationship with the other closer families. The present project is respect to the Muricidae, which is one of the more diverse of the caenogastropods. Samples of the all subfamilies and allies (as Thaididae, Coralliophilidae) were studied in their detailed anatomy. Although the study is still being developed, the analysis of the differences and similarities of the anatomy of the samples so far studied has revealing an interesting arrangement, sometimes unlike the present knowledge and systematics. The provisional results and the main implications of them in the phylogenetic and taxonomical knowledge will be presented, looking for suggestions, criticisms and additional material for fulfilling any strategic branch.

Malacological studies in a mega-diverse and poor country as Brazil

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The Malacofauna from Brazil, both marine and continental, are the best studied from South America. However, informal estimative is that it is no more than a third known. The problems are still more urgent because of quick environmental degradation and the weak resources for zoological studies in a country that more than 20% are deprived people. Certainly several species have been lost before they at least have been known.

Two examples of research in Brazilian territory are shown. One of them is dredges provided by shell dealers in Canopus Bank, NE Brazilian coast, relatively close and shallow, in which several new species were obtained. The other is an analysis based on a catalogue recently published, that inventoried the entire known malacofauna of the Brazilian ecosystems. This is an important source of data, showing the main known groups and the bio-communities weaker studied.

Species diversification in ancient lakes: patterns of morphological and ecological differentiation in *Tylomelania* (Cerithioidea: Pachychilidae) from Lake Poso, Sulawesi, Indonesia

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Ancient lakes and their endemic faunas are model systems for the study of evolutionary patterns and add to our understanding of speciation processes. Species level taxonomy often remains poorly studied in ancient lake radiations, though, presenting a major obstacle for evolutionary hypothesis testing. We here present for the first time morphological and ecological data for a species flock of the viviparous freshwater gastropod *Tylomelania* (Cerithioidea, Pachychilidae) in Lake Poso, Sulawesi, Indonesia.

Only four species of *Tylomelania* have been described from Lake Poso so far, plus three species from the outflowing river that show lacustrine features as well. Recent sampling campaigns in the lake have revealed a high diversity of hitherto undescribed forms, however. At least 24 morphospecies can currently be distinguished based on their characteristic shell and radula morphology. A unique feature of Lake Poso *Tylomelania* is the conspicuous body colouration in some species. Many species show clear substrate preferences, with several taxa occurring on just one substrate such as e.g. rocks, wood or mud. In addition, some taxa were found to exhibit a marked depth preference as well.

The diversity of radula forms in Lake Poso *Tylomelania* is striking and even exceeds that found in the other ancient lake system on Sulawesi, the Malili lakes. Common to both lake systems, however, is the correlation between radula morphs and substrates documented here for the first time for Lake Poso. Some radula types are species specific and several similar radula forms are characteristic for certain substrates such as e.g. very short and dense radulae for soft substrates and enlarged pointed radulae on rocks. Some highly derived radula forms seem to have evolved in parallel in both ancient lake systems on Sulawesi.

Ecological character displacement among endemic Baikal gastropods

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Parabaikalia oviformis (Caenogastropoda: Rissooidea: Baicaliidae) represents a widely distributed endemic species living on sandy substrates within the cold water zones of the Lake Baikal littoral. It must be assumed that the deep basins of Lake Baikal represent a barrier in respect of direct gene flow between populations living on opposite sides of the lake. In some parts of the lake *P. oviformis* coexists with the closely related species *P. florii*. In order to evaluate the influence of competition on the morphology of these two species, shell variability and female reproductive systems have been investigated in 220 specimens of *P. oviformis* and in 83 specimens of *P. florii*. The comparative analysis of individuals from the southwestern littoral revealed that the morphologies of the reproductive systems of the two species are very similar. There are, however, significant differences in size (shell and soft parts), that of *P. florii* being 1.5-2 times larger compared to *P. oviformis*. These size differences appear to reflect the main reproductive isolation between the two species. Competition for food resources is limited by a different depth distribution, most individuals of *P. oviformis* dwelling in shallower water than *P. florii*. On the other hand, individuals of *P. oviformis* living along the eastern littoral of central Baikal, where *P. florii* does not compete, are much larger compared to the southwestern population and here reach the size of *P. florii*. We therefore assume the existence of an ecological character displacement between these species, according to the phenomenon that closely related species develop size differences where they occur jointly while these differences do not occur between populations which are spatially clearly separated. This study was carried out within the State Program N 7.9.1.3 and supported by SB RAS project N 11.14 ("Biodiversity..."), RFBR project N 05-04-97258 and by the Deutsche Forschungsgemeinschaft.

Diversity of terrestrial snails in Papua New Guinea: Have we only scratched the surface?

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Tropical forests harbor the richest terrestrial faunas on the planet. Until recently, however, land snails were thought by some to be more diverse in temperate habitats. It is now becoming apparent that tropical snails are relatively poorly sampled and far more diverse than previously reported. Recent surveys (2002-2005) of terrestrial snails in Papua New Guinea have uncovered a rich land snail fauna with many narrow range endemics that may reflect the country's complex geological history and numerous isolated mountains and islands. In fact, over 75% of the approximately 100 species from the three largest islands in the Louisiade Archipelago are endemic to single islands and nearly half of these taxa are undescribed. Similarly, species from mountains, many created by the accretion of offshore island terranes onto mainland New Guinea also display high levels of endemism. The fauna of higher elevations is especially poorly known and in many places entirely endemic and undescribed. Small to moderately sized species of Charopidae, Rhytididae, and Helicarionidae are especially poorly sampled. Each of these families contains large radiations with many new species. For example, only 14 species of the endemic charopid genus *Paryphantopsis* were known before these surveys, which uncovered an additional 15 species, all of which appear to be endemic to single mountain chains or islands. Slug species are also poorly sampled especially the rathousiid slug genus

Atopos. Although very poorly surveyed there are nearly as many species now known from New Guinea and surrounding islands as from all of North America north of Mexico, an area 43 times larger. Estimates suggest that continued surveys could double the known fauna of New Guinea.

Endemic molluscs (Gastropoda, Bivalvia) in hypogean habitats in Slovenia

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Slovenia is situated in Central Europe and covers an area of 20,273 km² (that's half the size of Switzerland). Four major European geographic regions meet in Slovenia: the Alps, the Dinaric area, the Pannonian plain and the Mediterranean. There is 26,000 kilometres of rivers and streams, some 7,500 springs of drinking water. Forests cover half the territory. Most of Slovenia has a continental climate with cold winters and warm summers. The average rainfall is 1000 mm for the coast, up to 3500 mm for the Alps. Approximately 8 % of the Slovenia's territory is specially protected. Molluscs are a relatively well studied group as their investigation goes back to the previous century. This applies particularly to land and freshwater snails. Molluscs are a group that is extremely interesting because of Slovenia's geographic location and the diversity of ecosystems. They are affected by central European, Alpine, Dinaric, Pannonian, and Mediterranean regions. Roughly 30 species and subspecies of stygobionts (genera: *Belgrandiella*, *Boleana*, *Erythropomatiana*, *Hadziella*, *Hauffenia*, *Horatia*, *Iglica*, *Kerkia*, *Mervicia*, *Neohoratia*, *Bythiospeum* (*Paladilhiopsis*), *Sadleriana*, *Lanzaiopsis*, *Bythinella*, *Acroloxus*, *Congerina*) and 9 species and subspecies of trogllobionts (genera: *Zospeum*, *Spelaodiscus*) are recognized as endemic in Slovenia. Until now, molluscs have been protected completely only in their subterranean habitats as a constituent part of hypogean animal world. Hypogean waters are endangered, along with molluscs inhabiting them, by increasing pollution. In the future, more attention will have to be paid to areas inhabited by endemic species. These are the mountain and karst areas.

An integrative approach identifies developmental sequence heterochronies in freshwater basommatophoran snails

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Adopting an integrative approach to the study of sequence heterochrony, we compared the timing of developmental events encompassing a mixture of developmental stages (e.g. trochophore, veliger, hippo) and functional traits (e.g. eye spots, heart beat, crawling) in the embryos of twelve species of basommatophoran snails, within an explicit phylogenetic framework. There was clear evidence for altered timing of developmental events between species and PARSIMOV analysis formally demonstrated functional heterochronies associated both with basal branches within the phylogeny and with terminal speciation events. On average, 0.50 and 0.58 events were inferred to have changed their position in the developmental sequence on internal and terminal branches, respectively; these values are comparable with frequencies of sequence heterochrony reported in mammals. Directional heterochronies such as the early occurrence of body flexing in relation to the ontogeny of the eye spots, heart beat and free swimming events occurred convergently and/or at different levels (i.e.

familial, generic and species) within the phylogeny. Such a functional approach to the study of developmental sequences has highlighted the possibility that heterochrony may have played a prominent role in the evolution of this group of invertebrates. Current studies are expanding phylogenetic coverage to include the influence of habitat shifts (i.e. freshwater to marine) and convergence (in “limpet” forms) on developmental sequences.

Regional and local scale effects on the richness and composition of land snail assemblages in Hungary

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Richness and composition of local assemblages is influenced by both local and regional scale effects, but relative influences of these factors are little known. Here we used published occurrence data of 103 land snail species from 210 sites in Hungary. Sites were classified according to vegetation structure (forested, unforested), moisture (dry, moist), and geographical regions (Great Plain, Transdanubian hills and mountains, and Northern Mountains). We used general linear models, univariate and multivariate regression tree analyses. The best fit linear model for the determinants of local species richness contained the interaction of region and moisture. Richness was lowest in the Great Plain, intermediate in dry habitats of Transdanubia and the Northern Mountains, highest in moist Transdanubian sites, and significantly the highest in moist habitats of the Northern Mountains. Regression tree analysis revealed similar results, region was most important, richness being lowest in the Great Plain. The split within localities of Transdanubia and the Northern Mountains was best explained by moisture, with lower richness in dry sites. Third split within moist sites was according to region, again: richness was higher in the Northern Mountains (especially in forests) than in Transdanubia. According to multivariate regression tree, species composition was determined primarily by vegetation, secondarily by region. Moisture was important in Transdanubia and the Northern Mountains in forested and unforested habitats as well. Our results indicate that species richness reflects primarily geographical (regional scale) constraints on the dispersal of species and secondarily responses to a moisture gradient. Species composition is determined primarily by local factors, i.e. vegetation, through species-sorting and secondarily by regional constraints. This research was supported by the Hungarian R&D program No. 3B023-04 and Hungarian Scientific Research Fund (OTKA T 043508).

Geographical variation in the richness and composition of forest snail faunas in central and southeast Europe

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Recent efforts have made towards an understanding of diversity and composition of land snail faunas on a wide array of locations and geographical scales. In Europe, northwestern and Mediterranean areas are relative well explored, but areas south to the Northern Carpathian mountain chain and areas

of the Balcan peninsula (excluding Greece and Turkey) are almost unexplored. Here we present data from 24 sites (10 countries) that - although suffering from variable sampling intensity - might fill in this gap. According to the generalized linear models, two polynomial terms of latitude and longitude explained 40% of the total variation of species richness, while effect of altitude and clustering of the sampling sites based on faunal similarities was not significant. This indicates a gradual decrease of species richness in beech forests towards south and west, which can be due to warmer climate. Richness was highest in the Carpathian region with Clausiliids comprising 40% of the regional species pool. Species composition - opposed to richness - changed abruptly between the identified main zoogeographical cluster of the sites (Albanicum, Illyicum, Moesicum, western and eastern part of the Carpathicum, following traditional terms). Species turnover was almost complete in 500 km distance (80-100% Jaccard distance). Although this turnover rate may be overestimated by 10-15% because of the exclusion of widespread microsnails (<4 mm shell dimension) due to higher comparability. Vicariance was not a significant mechanism in shaping land snail faunas in the studied sites, although it was apparent in some genera (eg. *Bulgarica*, *Chilostoma*). This research was partly funded by the Hungarian R&D programme No. 3B023-04 and VEGA grants No. 2/5152/05 and 1/3283/06.

Molecular diversity among populations of the terrestrial slugs *Arion lusitanicus* and *Arion rufus* (Mollusca, Pulmonata, Arionidae) in Poland

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The *Arion lusitanicus* and *Arion rufus* slugs inhabit ecologically degraded areas and both are serious vegetation pests. In recent years, their new localities have been found in various parts of Poland. Here we the study morphology of 90 specimens of 9 populations of slugs. The morphology of the genital system allowed us to identify 60 *A. lusitanicus* specimens in 6 populations and 30 *A. rufus* individuals in another 3 localities. In order to describe their genetic diversity at levels of an individual, population, and the species, we compared the sequences within the mitochondrial cytochrome oxidase subunit I (*cox1*) gene. The morphological analysis revealed that each of the studied populations comprised a single species, which was also confirmed by the molecular assay. For each species, we obtained a 674-bp sequence of the *cox1* gene and identified four haplotypes. The genetic diversity of *A. lusitanicus* individuals ranged between 0.3% and 2.1%, whereas that of *A. rufus* was twice lower, 0.4-1.0%. The difference between the two species within the *cox1* gene was at a level of 12%. Three *A. lusitanicus* and two *A. rufus* populations were found to be monomorphic. A strong inter-population variability was found within each of the studied species, which suggests that the Polish populations of *A. lusitanicus* may have developed from repeated, separate introductions arriving from various parts of Europe.

First identification of mitochondrial M genome in males of *Anodonta anatina* and *Unio pictorum* (Mollusca, Bivalvia, Unionidae)

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Mitochondrial DNA (mtDNA), contrary to nuclear DNA, is inherited only maternally. This standard maternal inheritance (SMI) occurs in a majority of eukaryotic organisms. However, in marine and freshwater bivalves, another pattern of mtDNA inheritance takes place, which is named *doubly uniparental inheritance* (DUI). In this case, we observe two types of mitochondrial DNA: the F-type, which is inherited from the mother, and the M-type, inherited from the father. A male has both those types: the mitochondrial M-type genome, which is located in male gonads and is transmitted to male progeny and the F-type of mtDNA in its somatic cells. Females usually have maternally inherited F-type mtDNA in all their cells. The fact that DUI was found in phylogenetically remote bivalves families (Mytilidae, Veneridae, Unionidae) suggests that the phenomenon is widespread. Among unionids DUI was found in 18 species. The taxonomic restriction of the phenomenon is difficult to explain and not thoroughly studied. Many authors use somatic tissues as a source of DNA, thus obtaining only F haplotype. In these studies DNA was isolated from the gonads of male unionid specimens: *Anodonta anatina* and *Unio pictorum*. In both species the M-type mitochondrial DNA was identified through sequence analyses of the mitochondrial cytochrome oxidase subunit I (*cox1*) gene. Using the observed divergency method within the M-type of mtDNA, the level of inter-species genetic divergence ranged from 0 to 0.2%. The parameter was higher, up to 18%, between *A. anatina* and *U. pictorum* specimens. The sequence divergence between the M- and F-types within the *cox1* gene region reached 29-32% for both species and, although very high, was still characteristic for the bivalves in which DUI had been found. In homology and phylogenetic trees M and F types form separate clades.

3D-anatomy of the rhipidoglossate heterobranchs *Hyalogyrina depressa* Hasegawa, 1997 and *Xenoskenea pellucida* Monterosato, 1874 (Gastropoda, Ectobranchia)

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The discovery of marine representatives of the Valvatoidea (Ectobranchia) by Ponder in 1990 established this clade as basal Heterobranchia, formerly known only from freshwater habitats. We investigated the anatomy of two marine microgastropods originally classified as Skeneidae by shell and radula characters and later transferred to the Valvatoidea as family Hyalogyrinidae: *Hyalogyrina depressa* from deep waters off Japan and *Xenoskenea pellucida* from Mediterranean shallow water. We applied computer aided 3D-reconstructions (software: AMIRA™) based on semithin section series.

Both species have a tapered snout with a pair of tentacles, an anteriorly bifurcate foot, and a metapodium with a large mass of calcium cells. The mantle cavity contains an osphradium, a bipectinate, ciliated gill without bursicles or skeletal rods, and a left, pallial kidney. The rectum bypasses the monotocardian heart and shows several loops in the pallial roof. A complex, hermaphroditic genital system suggests internal fertilisation. The rhipidoglossate radula apparatus lacks cartilages, the salivary glands are long and tubular, the stomach shows a gastric shield. The nervous system is epiathroid and streptoneurous, each statocyst contains a single statolith. The eyeless *Hyalogyrina depressa* has a ciliated pallial tentacle at the right side. *Xenoskenea pellucida* has a small copulatory organ behind the right cephalic tentacle, a metapodial tentacle, and simple lens eyes. These anatomical data and the hyperstrophic larval shells all reflect basal heterobranch conditions. The metapodial calcium cells and the looped pallial rectum are interpreted as synapomorphies for the

Hyalogyrinidae. Their rhipidoglossate radula and the lack of cartilages suggest that the Heterobranchia as a whole emerged from the rhipidoglossate rather than from the taenioglossate level of gastropod evolution. Accordingly, a change of function in the supporting apparatus (replacement of cartilages by a muscular mass) predates the change of the radular type itself at the beginning of heterobranch evolution.

Molluscan evidence of woodland disturbance in the Irish Holocene

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Radiocarbon dated molluscan sequences from three extensive Irish Holocene tufa deposits have provided information relating to human impact on the environment. Work at Newlands Cross, situated in the outskirts of Dublin in the east of Ireland, builds on an earlier study, which demonstrated that this thin deposit of tufa (only about 1 m thick) covered much of the early to mid Holocene, providing the most detailed succession of land snails known from Ireland. The new work includes the analyses of five further profiles, with a much-improved sampling resolution (down to 1 cm). These have amplified aspects of faunal history and enabled further light to be shed on a Mesolithic disturbance horizon previously identified at the site. The new records suggest that the area affected by the disturbance was extremely limited (perhaps less than 50 m²) and of relatively brief duration (a few hundred years). Two sites (Graffy and Cartronmacmanus) located only 3 km apart in Co Mayo in western Ireland provided less complete records for the very early Holocene but furnished excellent sequences from about 8200 yrs BP to 2000 yrs BP. The faunal successions were less dynamic than those at Newlands Cross but they too yielded evidence of woodland disturbance, this time dating from the late Bronze Age and early-middle Iron Age. The registration of at least five such events differed significantly from the characteristic faunal signatures associated with comparable impacts in southern Britain. This results from the relative scarcity in Ireland of species such as *Vallonia costata*, although the impacts are clearly indicated by declines in shade-demanding species, such as *Discus rotundatus*.

Scallops visually respond to simulated particles in flow

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Scallops' eyes are abundant in number and positioned along the mantle at the edges of the valves. The optical properties of these eyes have been well-studied and they are known to form relatively high-resolution images. However, the function of scallop vision remains open to debate. We tested whether scallops, which are filter feeders, use their eyes to detect suspended particles. Specimens of the Common Bay Scallop *Argopecten irradians* were placed in an operating flow tank and shown simulated images of moving particles. Their mantle gapes were then observed at 24 second intervals over ten minute trials. We found that 25 scallops were open in 52% ± 6% of observations when particles were shown, while 24 scallops viewing a blank screen were open in 29% ± 5% of observations. The difference between these treatments was found to be significant (P<0.01; two-tailed t-test). Because mantle gape correlates positively with feeding rate, our data suggest that scallops may use visual information to influence feeding behavior.

Polyandrous mothers maximize hatchling size in the opisthobranch *Chelidonura sandrana*

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Offspring size can have pervasive effects throughout the life history of many marine invertebrates. In external fertilizers, variation in egg size is largely determined by environmental conditions, since a mother has no direct control over fertilization. In internally fertilizing species maternal resource allocation might additionally vary in response to the number and quality of male mating partners. Although positive effects of mating multiply with several different males (polyandry) have been confirmed for a variety of taxa, such investigations are entirely lacking for internally fertilizing marine invertebrates. With many being simultaneous hermaphrodites, there is some evidence that the male function gains an almost linear fitness increase with the number of different partners inseminated, while the effects of multiple mating on the female function remain unresolved. We tested the effects of ejaculate amount (repeated matings with the same ‘male’) and ejaculate diversity (repeated matings with different ‘males’) on maternal provisioning in the hermaphroditic sea slug *Chelidonura sandrana*. We found that polyandric focal ‘females’ produced significantly larger egg capsules and larger veligers, while repeatedly mated focals suffered from reduced mid-term fecundity. Our findings are consistent with two alternative hypotheses on the effects of polyandry, where females either benefit from the genetic diversity of their offspring (‘genetic diversity’/ ‘bet-hedging’) or are manipulated by their male partners.

In a subsequent study we determined the relationship between mating rate and female provisioning. We found that i) focal ‘female’ fecundity decreased with elevated mating rate, but that ii) maternal investment in egg capsule volume was maximized at an intermediate mating rate that corresponds to the natural mating rate observed in the field. Our results show that mating strategies are an important addition to understanding variation in offspring size in internally fertilizing marine invertebrates. Moreover, they suggest that polyandry indeed increases female fitness in simultaneous hermaphrodites.

The neoplastic disease in *Macoma balthica* (L.) – an impact on condition of the Baltic clam population from the Gulf of Gdańsk (Baltic Sea)

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Neoplasia is a kind of cancer found in over 20 bivalve species around the world. Although etiology of this disease still remains uncovered, many authors suggest a cause-and-effect relationship with environmental conditions. Characteristic patterns of disease are aneuploidy, the presence of microchromosomes or unpaired chromosomes, hypertrophy of nucleus and high frequency of mitotic divisions. In the late stages of neoplasia animals exhibit weakness, emaciation and show degenerative changes in atypical cells and organs that increases mortality rate. The presence of neoplasia is a significant environmental and aquacultural problem due to the fact that the occurrence of the disease is linked organisms metabolic activity and condition. Neoplastic changes in the population of *Macoma balthica* (L.) from the Gulf of Gdańsk (Baltic Sea) have been observed since 1996 with an average prevalence of 27.8%. This high prevalence of tumor makes the Baltic clam especially interesting as a test organism for studying the disease etiology mechanisms and the environmental importance of the cancer. The aim of study was to determine neoplasia occurrence in years 2005-2006 and evaluation of tumor influence on the Baltic clam population from the Gulf of Gdańsk. During whole sampling period the prevalence of the tumor ranged from 0-60 % and was dependent on the investigated station as well as the season. The spatial differentiation of neoplasia prevalence

can be used as a marker of the sediment pollution. Moreover, the disease affect negative on organisms physiological activity (respiration, reproduction) and total condition. The occurrence of epizootics like neoplasia can be of a particular importance for the exploitation of aquacultures and wild populations of bivalves.

Molluscan mito-genomics: chances and pitfalls in phylogenetics

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The use of complete mitochondrial (mt) genomes – their sequences and gene orders – has raised high hopes of resolving important questions in molluscan phylogenetics. Yet, published data and analyses reveal only a limited power of resolution and several obvious nonsense-clades. Why is that so? In contrast to arthropods or vertebrates, mt-gene order is highly variable within molluscs, and changes in gene order often involve changes in strands the genes are encoded on. A change from the light to the heavy strand, or *vice versa*, also changes the nucleotide substitution skews of A and T, and C and G. This inhomogeneity leads to wrong model parameters in phylogenetic analyses and, therefore, to unreliable or erroneous trees. We present ten unpublished mt-genomes in a phylogenetic analysis with published data. A gene-by-gene comparison of strand skews reveals some pitfalls in the bivalve data set and possible sources of errors. In addition, we report near-plesiomorphic gene orders from an aplacophoran and a protobranch bivalve. This implies that extensive gene rearrangements have occurred independently in all major conchiferan lineages. Consequently, gene order data may be informative for lower level phylogenies but are unlikely to resolve the relationships among the class-level taxa.

Kidney anatomy of neogastropods: New insights into relationships, affinities and evolutionary dynamics

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The landmark study of Rémy Perrier published in 1889 described the organization, histology and circulation patterns of the kidney in a broad diversity of “prosobranch” gastropods. Perrier’s study established the structural differences between the “kidney proper” and the nephridial gland, and demonstrated that cypraeids, naticids and neogastropods possess kidneys with two lobes of excretory lamellae with distinct structure and function. Since that time, few detailed comparative studies have examined organization and circulation patterns of neogastropod kidneys. The only character routinely described and/or cited in the context of neogastropod phylogeny is the degree of interdigitation of the lobes. Thus, the extent to which this organ system can provide characters pertinent for assessing relationships and affinities of neogastropods is unknown.

A comparative survey of neogastropod kidney anatomy, histology and blood supply has revealed several new characters of renal organization and circulation and refined the distribution of characters already documented among neogastropods and potential outgroup taxa. In addition to degree of interdigitation, characters found to vary relate to extension of the kidney roof into the mantle cavity, distribution of primary and secondary tubules, development of secondary tubules, blood supply patterns of the dorsal branch of the afferent renal vessel, and penetration of the afferent renal vessel by the gland of Leiblein terminal ampulla. These characters vary at a number of taxonomic levels suggesting a potential utility in lower and higher order systematics. The distribution of these characters will be reviewed in a broad comparative context, including an assessment of putative

homologues among other caenogastropods, and their potential relevance in evaluating the relationships and affinities of neogastropods will be discussed. Although not character rich, this organ system provides a unique perspective on possible sister group relationships and evolutionary dynamics of neogastropods, including the rare invasion of freshwater habitats within the group.

The Sphaeriidae (Mollusca: Bivalvia) of Victor Sterki

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The Sphaeriidae is a family of Bivalvia comprising about 150-200 species. These species are well represented in the Palearctic and Nearctic regions. A leading student of the Nearctic sphaeriid fauna was Victor Sterki (1846-1933). During his lifetime, Sterki corresponded with many malacologists and exchanged material with them. At the time of his death, his sphaeriid collection contained an estimated 12,000 lots. The Carnegie Museum of Natural History acquired this collection. Between 1894 and 1927, Sterki described 158 new sphaeriid taxa. He rarely noted whether specimens were type material on the labels. His extensive trading with others has dispersed much type material to other collections. Over the years, many of these collections have found their way into other museums. Often, it is not realized that these collections contain sphaeriid types. These unrecognized types, along with Sterki having published his descriptions in several serials, makes it difficult and time consuming for museum personnel to determine the type status of their Sterki material. At the Carnegie Museum, a quick check of 8 species of *Pisidium* from Sterki's collection found 48 type lots. Based on this, it is estimated that the Carnegie's collection contains more than 900 Sterki types. We are currently developing a database, listing all taxa of Sphaeriidae described by Sterki along with the type localities (often more than one for each taxon) and original publication references. This database will eventually be available on the Carnegie Museum website. Using this database, personnel at other museums will be able to determine whether their collections contain type specimens of sphaeriids described by Sterki.

New data on Paleozoic continental gastropods from Poland: Sedimentary and evolutionary context

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The advent of the first terrestrial snails and their differentiation at the earliest stages of evolution have long been of great interest to malacologists. The extreme scarcity of fossil record does not provide facilities for a re-construction of the history of terrestrial malacofauna. Poland is among the few countries, next to the United States, Canada, England, France, Germany, Austria, the Czech Republic and – probably – Russia, with fossil record of land snails from the late Carboniferous and early Permian. Based on the literature studies, the total number of terrestrial Palaeozoic snails world-wide does not exceed 20 taxa. The Polish contribution to such studies was a description of a new species, *Dendropupa zarecznyi* Panow, 1936. cursory mentions of another two species are contained in the

fundamental paper by Solem and Yochelson (1979) on North American Palaeozoic snails; the authors, however, did not attempt identification of these forms.

Recently, a rich malacofauna has been found again in the swamp facies of Lower Permian molasse deposits of postvariscan, rift valley, situated NE from Cracow, which comprise volcanic rocks, fanglomerates, playa mudflat deposits and freshwater carbonates mostly referred to as Karniowice Travertine. In fact these carbonate rocks encompass, beside the travertines, also other calcareous deposits such as limnic varved limestones, fluvial carbonates, and calcareous deposits of swamp facies (palustrine carbonates), with numerous, calcified remains of vascular plants. These plants allowed to determine their habitat as topogenous fen. The rich assemblage of hygrophilic plants under generally semi-arid climate conditions of the Lower Permian was possible only due to the presence of a vast system of karstic springs which fed an extensive oasis.

Contrary to the Early Permian malacofauna from the so called "Karniowice tufa" which has been mentioned in the world literature, there are no published data on snail remains found in Upper Carboniferous sphero-siderite concretions in spoil-heaps of the mine in Sosnowiec (Upper Silesia Coal Basin). A preliminary assessment indicates that they represent at least two snail species. Earlier findings from the site including representatives of freshwater and terrestrial fauna: crustaceans, bivalves, insects and remains of terrestrial plant of the genera Calamites, Sigillaria and Lepidostrobus were published some years ago.

Life history and population dynamics of *Vestia gulo* (E.A. Bielz, 1859) (Pulmonata: Clausiliidae)

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Life cycle of forest dwelling clausiliid *Vestia gulo* was studied in the field and in laboratory. Field data were collected in the Polish Carpathians in four localities that represent different habitat conditions within the whole altitudinal range of the species. Seasonal changes in the age structure of population and whorl increment in marked individuals has been investigated.

Vestia gulo is oviparous but able to egg retention. In natural populations, from May till July, a high proportion of adult snails contain eggs (8 – 21) in the reproductive tract. Egg laying starts in June and reaches maximum in July. In laboratory, *V. gulo* lays eggs in 1-3 batches per year, mainly in April and May, during five seasons at least. Clutch size ranges from 6 to 19 eggs. Hatching is asynchronous. Egg cannibalism within clutch occurs on regular basis. Shell growth is completed after 10-12 months while egg laying starts not earlier than 24 months from hatching. Directly after formation of closing apparatus the reproductive system is immature. *V. gulo* is able to reproduce uniparentally however hatching success in individuals kept in isolation is low.

In the populations inhabiting mountain foothills (425 m above sea level) young snails reach about 6,5 whorls in the first growing season while not more than 5 whorls in the population from the upper mountain zone (1150 m a.s.l.). In the second season young snails inhabiting foothills reach ultimate size and those from the higher altitudes reach 8 whorls and overwinter for second time before completing growth. Consequently, the time required to accomplish growth increases with altitude from 10 months to over 2 years, even if the adult size decreases from 10,7 to 9,4 whorls along the same gradient.

Toxic effects of water samples of Tietê River in adults and embryos of *Biomphalaria glabrata* (Say, 1818)

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The potential impact of secondary effluent discharge on Tietê River was evaluated by analyzing acute toxicity in *Biomphalaria glabrata*. Acute toxicity assays were conducted in adult specimens and embryo at blastulae, gastrulae, trocophore and veliger stages of freshwater snails *B. glabrata*. Four sites were chosen for sampling: in the river, 200 meters before the treatment station; the influent and effluent of the municipal wastewater system; and in the river, 200 meters after the treatment station discharge. The work was initiated in 2005 september and at least three additional sampling will be performed. At september 2005, the station affluent was toxic for the snail *B. glabrata* with the following LC50 values: 37.76% for adult snails and 13.99%, 20.09%, 23.15% and 23.80% for embryos at blastulae, gastrulae, trocophore and veliger stages respectively. Only the raw sample of the station effluent was toxic for embryos, but not for adult snails. Acute toxicity was remarkably reduced at august 2006, as shown by the lower LC50 values found. – 44.19%, 41.91%, 58.58% and 60.76% for embryos at blastulae, gastrulae, trocophore and veliger stages respectively and 100% for adult snails. The station effluent was not toxic for adult and embryos. Sampling at february 2007 was toxic only for adult snails, with a LC50 value of 32,53%. The station effluent was not toxic for adult and embryos. In all samplings, after discharged into the river, treated effluents were not toxic for *B. glabrata* adult snails and embryos. In these study, the potential impact of effluent discharges to the biota of Tietê River was showed. Biological treatment was quite efficient in reducing toxicity to *B. glabrata* as shown by the low toxicity of the effluent plant samplings. With the dillution effect of the river, acute toxicity to *B. glabrata* was eliminated. These results show the importance of the biological treatment of effluents in reducing acute toxicity.

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Revision of *Paludinellassiminea* (Caenogastropoda: Assimineidae) – preliminary report

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The genus *Paludinellassiminea* (type species: *Omphalotropis japonicus*) is distributed in Japan and South Korea. They live under rocks and debris on the supratidal zones or the edge of costal forests. They are likely to be threatened in Japan, because their habitats have rapidly been decreasing partly through construction of concrete banks over excessive ranges of coasts and rivers.

Paludinellassiminea has been thought to be closely related to *Omphalotropis* (*sensu lato* – it may need to be divided into several genera), based on the similarities of shell, operculum, head-foot and penis. However, *Paludinellassiminea* differs from *Omphalotropis* in having the outer marginal teeth with no secondly cusps in the radula. The internal anatomy of *Paludinellassiminea* is little known, and its relationships to other genera remain unclear.

The purpose of this study is to revise the systematics *Paludinellassiminea* by thorough anatomy. We have obtained the following primary results:

- 1) The kidney extends forward into the pallial cavity, as in some *Omphalotropis* spp., the kidney consists of two slender lobes. The gill filaments are present.

2) The pallial oviduct has some small seminal receptacles, similarly to *Omphalotropis*.

3) The snout is simple and has no buccal cape.

The simple cusps of the outer marginal radular teeth, the presence of the gill, and the absence of the buccal cape support that *Paludinellassiminea* may be one of the most primitive groups within the genus *Omphalotropis s.l.*

There are seven available species names in the genus and three or four of them have been regarded as valid. On the other hand, several populations classified as *P. japonica* or *P. stricta* were distinct from each other in morphologies of the penis, vas deferens and pallial oviduct, indicating the presence of undescribed species and necessity of reconsideration of invalidated taxon names. Clearly the systematics of *Paludinellassiminea* will largely change through our thorough revision.

Coralliophilinae associated with deep-water coral banks in the Mediterranean Sea

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The Mediterranean Sea hosts a variety of deep-water corals settling on both soft and hard substrates. Some skeletonised cnidarians (mostly the scleractinians *Lophelia pertusa*, *Madrepora oculata*, *Desmophyllum dianthus*, *Javania cailleti*, *Caryophyllia* spp., *Dendrophyllia* spp., the gorgoniacean *Corallium rubrum* and few others) may at places form considerable banks, at depths in excess of 300 m, that are receiving increasing attention by the scientific community as biodiversity hotspots (e.g., ESF Euromargins Moundforce and EU Hermes programmes).

In spite of the wide interest on the ecosystem functioning of such coral banks, the key interactions between the cnidarians and their potential predators (which include gastropods belonging to several families) have not been adequately explored. Documentation of gastropod predation over Mediterranean deep-water corals is almost inexistent. The reason stays on (1) the relative paucity of deep-water living corals in this basin; (2) the objective rarity of most coral-related gastropod taxa, (3) the difficulty to image or sample these deep-water environments. Italian and German oceanographic missions in the Strait of Sicily, aboard the research vessels *Urania* (cruise MARCOS, 2007) and *Meteor* (cruise M70/01, 2006) respectively, sampled three deep-water Coralliophilinae on the coral banks: '*Coralliophila richardi*' (P. Fisher), *Hirtomurex ruderatus* (Sturany), and *Babelomurex sentix* (Bayer). *C. richardi* has been collected from the Malta coral banks at about 600 m. This amphiatlantic species is known from various sites in the eastern Atlantic Ocean and has been already reported alive in the Tyrrhenian Sea. The consistent co-occurrence of living *Madrepora* in the samples suggests at least a preferential association with this scleractinian. *H. ruderatus* may represent a deep-water morphotype of the variable *Hirtomurex squamosus* (Bivona). A single living specimen was found overhanging on bedrock at c. 600 m water depth off the island of Linosa, Strait of Sicily (cruise M70/01: P.I. A. Freiwald). The ROV images document a variety of co-occurring cnidarians in this site including *Lophelia*, *Madrepora*, *Desmophyllum*, *Corallium*, but also anthypatharians and gorgonians. Two living specimens of *B. sentix* have been trawled south of Malta in April 2007 from coral banks dominated by adult *Lophelia*, *Madrepora* and *Desmophyllum* and small colonies of *Corallium*.

In all cases, living coralliophilines were not found still attached to their cnidarian hosts. The fortunate catch of living specimens makes their study feasible not only to assess more precisely their taxonomy, but also to sort out their host by ecological DNA-barcoding of their gut content.

The biogeography of these very rare coralliophilines merits attention. The three species have established populations in the Atlantic Ocean and, potentially, their planktotrophic larvae may be

passively dispersed into the Mediterranean by currents. *C. richardi* is known alive from other Western Mediterranean sites and its status of permanent resident in the basin cannot be excluded.

A molecular phylogeny of heterodont bivalves (Bivalvia: Heterodonta): new analyses of 18S rRNA and 28S rRNA genes

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A new molecular phylogeny is presented for the highly diverse, bivalve subclass Heterodonta. The study, the most comprehensive for heterodonts to date, used new sequences of 18S rRNA and 28S rRNA genes for 100 species from 49 family groups with species of Palaeoheterodonta as outgroups. Results confirm previous analyses that an Carditidae/ Astartidae/ Crassatellidae clade is basal and sister group to all other heterodonts including Anomalodesmata. Thyasiroidea occupy a near basal position between the Crassatelloidea and Anomalodesmata. Lucinidae form a well-supported monophyletic group distinct from Thyasiridae and Ungulinidae. The Solenoidea and Hiatelloidea link as sister groups distant from the Tellinoidea and Myoidea respectively where they had been previously associated. The position of the Gastrochaenidae is unstable but does not group with myoideans. Species of four families of Galeommatoidea form a clade that also includes Sportellidae of the Cyamioidea. The Cardioidea and Tellinoidea form highly supported, long-branched, individual clades but group as sister taxa. A major clade including Veneroidea, Mactroidea, Myoidea and other families is given the unranked name Neoheterodontei. There is no support for a separate order Myoidea. Dreissenidae group within the clade including Myidae, Corbulidae, Pholadidae and Teredinidae. The Corbiculoidea is confirmed as polyphyletic with the Sphaeridae and Corbiculidae forming separate clades within the Neoheterodontei. Hemidonacidae are unrelated to the Cardiidae but nest within the Neoheterodontei. The Gaimardiidae group near to the Ungulinidae and not with Cyamioidea. Ungulinidae form a well-supported clade within the Neoheterodontei. Monophyly of Glossoidea, Arcticoidea and Veneroidea is unconfirmed. The fossil record of heterodonts indicates that the basal clades of Crassatelloidea, Anomalodesmata and Lucinoidea diverged early in the Lower Palaeozoic. Other groups such as the Hiatelloidea, Solenoidea, Gastrochaenidae probably originated in the late Palaeozoic, while Cardioidea and Tellinoidea appeared in the Triassic and major groups of Neoheterodontei radiated in the Late Mesozoic.

Morphology, ecology and species: diversification patterns in an ancient lake species flock of *Tylomelania* (Cerithioidea: Pachychilidae) from Lake Mahalona, Sulawesi, Indonesia

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Ancient lakes are ideal model systems for the study of speciation and diversification processes in general. The five lakes of the ancient Malili system on the Indonesian island Sulawesi harbour 25 species of the viviparous gastropod *Tylomelania* (Caenogastropoda: Cerithioidea: Pachychilidae), which show a remarkable degree of inter- and intraspecific morphological differentiation. We here focus on the seven sympatric species of *Tylomelania* in comparatively small Lake Mahalona, which is situated between two major lakes.

Lake Mahalona species were initially delimited using shell and radula characters. All seven taxa have characteristic shells, embryonic shells and radulae. In addition, all species show a clear substrate preference, even though some taxa may occur on several substrates, such as rock and wood, or gravel and mud. The correlation between radula form (i.e. trophic morphology) and substrate is less clear. Species occurring almost exclusively on one substrate and showing no significant variation in their

radula were found as well as species with a rather distinct radula irrespective of substrate. Two species are highly variable both in shell and trophic morphology, even within populations on one substrate. These findings are consistent both with the assumption of intraspecific polymorphism or possible incipient speciation. Molecular phylogenies based on mtDNA data and nuclear AFLPs were used to test these hypotheses and the validity of morphological species delineations in general. While the mtDNA data fail to support even a single morphospecies, the results from the AFLPs are generally in concordance with the morphological findings and provide evidence for fine-scaled differentiation and possible speciation in one case. The discordance between the two molecular data sets also suggests that introgressive hybridization might be a common factor in this system. Simple models of diversification do not seem sufficient to explain the observed diversity in this ancient lake species flock.

On the identity of two New World ampullariids, *Pomacea lineata* and *Pomacea figulina*

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Ampullariids are freshwater snails distributed throughout the tropical regions. They are represented in the New World by five genera: *Asolene* (7 spp.), *Felipponea* (3), *Marisa* (2), *Pomella* (3) and *Pomacea* (~ 50). The taxonomy and evolutionary relationships within *Pomacea* are still confused in spite of its abundance, wide distribution and importance from biological, parasitological and economic points of view. This study is part of a collaborative project aimed at a taxonomic revision of New World ampullariids based on morphological and molecular studies. *Pomacea figulina* was illustrated by Spix as a full species but when Spix's illustration was published by Wagner (1827) the latter treated it as a small variety of *P. lineata*. It has since been considered a synonym of *P. lineata* by many authors. However, examination of the types of both species at the Zoologische Staatssammlung München revealed that the shells are quite different. In addition, data from morphological and molecular studies on specimens of both species collected in Brazil confirmed their distinction. *Pomacea lineata* has a more elongate shell with a wide umbilicus and the penial sheath has a prominent outer basal gland and concave tip, while *P. figulina* is more globose, the shell is almost imperforate and the penial sheath has two inner glands and a rounded tip. Supporting the morphological distinctiveness, phylogenetic analyses of mitochondrial and nuclear sequences places the two species into reciprocally monophyletic groups. The distribution of the two species overlaps and we have collected specimens from six states from the northeast, southeast and Midwest regions of Brazil.

The nervous system of Solenogastres – a confocal view

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Even though the nervous system has been considered to provide important characters for mollusk systematics and phylogeny for many decades, the plesiomorphic type of the molluscan nervous system is still under debate. The Solenogastres (or Neomeniomorpha) are, together with the

Caudofoveata (or Chaetodermomorpha) and Polyplacophora, generally regarded as the most basal stemlines among the Mollusca, even if there is no consensus upon the relative position of the three clades to each other and to the more derived conchiferan clades.

Here, the morphology of the nervous system of the solenogaster *Wirenia argentea* is presented based on histological and immunocytochemical analyses using fluorescent markers against the neurotransmitters serotonin and FMRF-amide, as well as acetylated α - tubulin, in combination with confocal laser scanning microscopy. The results for *W. argentea* are compared to preliminary results on other solenogaster species. The nervous system of solenogasters in general displays a distinct tetra-neury with fused cerebral ganglia, large pedal ganglia, and longitudinal nerve cords connected by numerous fairly regularly spaced connectives and commissures. There is no indication of metamery, though. FMRF-amidergic immunoreactivity is present in most compartments of the nervous system, while serotonergic immunoreactivity appears to be restricted to the main nerve cords. Labeling with acetylated α - tubulin depicts the entire nervous system and diverse ciliary structures, including the specialized cilia of sensory cells.

Biodiversity of aplacophoran mollusks in the coastal area near Bergen, Norway

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The Northern Scandinavian West coast is unique in that it comprises extremely diverse climate regimes from temperate to arctic waters. In addition, in the fjord region deep-water species are found in relatively shallow waters. Mollusks are an important integrative element of the benthic fauna communities in Scandinavian coastal areas but research has largely been focused on the Bivalvia, Gastropoda, and Cephalopoda. Much less is known about the worm-shaped aplacophoran classes Solenogastres (Neomeniomorpha) and Caudofoveata (Chaetodermomorpha). These taxa are considered to have a crucial position at the base of the phylogenetic tree of the Mollusca, but our knowledge of the biology, geographical distribution, and biodiversity of these often small and inconspicuous animals is still very limited. Worldwide, the total number of species described is about 240 for Solenogastres and 140 for Caudofoveata. From coastal waters of the Northern Atlantic Ocean in the Bergen area (Western Norway) twelve species of Solenogastres and five species of Caudofoveata were previously reported. Our intense collecting efforts of the last years showed that the biodiversity of aplacophoran mollusks was considerably underestimated, especially concerning the Solenogastres. In this poster we present an overview of the new and old findings and show the great morphological variety and beauty of Western Norwegian aplacophoran mollusks.

Phylogeographical differentiation of Iberian populations of freshwater pearl mussel (*Margaritifera margaritifera*) based on microsatellites data

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Margaritifera margaritifera is a species of freshwater mussel critically endangered across its range, making the development of conservation and management strategies a priority for this species. The genetic structure and variability of Iberian populations were analysed based on 13 previously published polymorphic microsatellites for 14 populations from different basins located in north-western Iberian Peninsula (previously studied using mtDNA). Preliminary analyses revealed generally low levels of polymorphism with a heterozygote deficit at each locus. Despite this fact we

were able to detect weak genetic differentiation among populations. Three distinct areas were distinguished based on the presence of private alleles and allele frequencies: Cantabric, Miño basin and Duero-Tagus drainages. Within the latter group, results for the Alberche river population (Tagus basin) support the hypothesis that it was recently ‘captured’ from the Duero drainage basin by the Tagus basin. These genetic data, together with ecological and phylogeographical data, provide information critical to the development of appropriate conservation programs for this species.

***Margaritifera marocana* Pallary, 1918, a distinct species of *Margaritifera* still survives in Morocco**

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Among the Unionoida, the family Margaritiferidae is a relict group for which the number of genera and species is under discussion. Two species of the genus *Margaritifera* live in the West Palearctic: *Margaritifera margaritifera* and *M. auricularia*, both of which are endangered across their respective distributions. *M. auricularia* only lives in the Ebro basin in Spain, the Loire and Garonne basins in France and in Morocco. Populations from the latter area are regarded as a distinct subspecies (*M. auricularia marocana*) based on conchology.

We have had the opportunity to analyse samples from Morocco, and compare their sequences with the other studied species of the same family. Partial sequences of the mitochondrial genes cytochrome oxidase subunit I (CoI) and 16S rRNA (16S) support the recognition of the Moroccan population as a different lineage. The divergence found between the Iberian and Moroccan populations of *M. auricularia* (9.4% for CoI and 6.3% for 16S) is of the same order as that between *M. falcata* and *M. laevis* (7.9% for CoI and 4.1% for 16S) or between *M. margaritifera* and *M. laevis* (9.9% for CoI and 4.7% for 16S).

Though further morphological and ecological studies must be undertaken, our molecular data clearly support the recognition of the specimens from Morocco as representing a distinct species. Until further work disentangles the taxonomic organization of Moroccan populations we propose the name *Margaritifera marocana* Pallary, 1918.

In addition, a similar comparative study is also required to establish the degree of relatedness between the two surviving populations of *M. auricularia* from Spain and France in order to complete our knowledge about these relict populations of a very endangered species.

Phylogenetic relationships of the southeast Asian land operculate snails of the genus *Cyclophorus* (Prosobranchia: Cyclophoridae) using DNA sequence data

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A molecular phylogeny is presented for part of the Southeast Asian land operculate snails of the genus *Cyclophorus* Montfort, 1810 (Prosobranchia: Cyclophoridae) based on DNA sequences data from the mitochondrial cytochrome oxidase 1 locus. It has at least 10 parapatrically distributed colour

forms in Thailand and nearby areas. While the status of these forms is uncertain, they behave as genetically isolated species where they are in contact. Molecular data are consistent with speciation *in situ* with isolation mainly due to isolated limestone habitats. Due to the paucity of available samples, phylogenetic status of *C. aurantiacus* and *C. turgidus* remain to be examined in the future.

Biomarkers as tools to assess the risk of environmental stress for terrestrial and aquatic gastropods

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Not only their species richness with more than 100000 recent species, but also their importance as environmental performance indicators emphasizes the importance of gastropod diversity to be protected from adverse effects posed by environmental stressors including chemicals. The possible risk of environmental pollution for organisms can be assessed using different tools in retrospective and prospective risk assessment. The guideline ISO 15952, e.g., uses survival and reproduction of juvenile land snails as an indicator for soil pollution. We investigated cellular and biochemical responses in terrestrial (*Deroceras reticulatum*, *Arion lusitanicus*, *Cerņuella virgata*, *Cerņuella aginnica*, *Xeropicta derbentina*, *Theba pisana*, *Pomatias elegans*) and aquatic gastropods (*Marisa cornuarietis*) as biomarkers of effect providing information on the health of the exposed snails. The stress protein hsp70 was shown to be a useful tool not only to trace effects of chemicals themselves but also their interaction with confounding factors as, e.g., elevated temperature. Histological investigations of the hepatopancreas were, in addition, suitable instruments to determine and differentiate metabolic pathways involved in the stress response.

Scaling of metabolism of the pelagic squid *Dosidicus gigas*

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The influence of body mass on metabolic rate has been a theme in biology since its first publication in 1883 by Max Rubner. Mass-specific rate of metabolism (B) typically declines with increasing body mass (M) according to $B = b_0 M^b$, where b_0 is a normalization constant independent of mass and b is a scaling coefficient that, according to recent theory, reflects universal geometries of oxygen and nutrient transport systems. The value of this scaling coefficient varies in the literature, but is commonly accepted as -0.25 . Anaerobic metabolism has been shown to scale with body mass well, but with greater variation and typically expresses a positive coefficient. Most studies examining this phenomenon have focused on vertebrates, less is known about the scaling of invertebrate metabolism. This study examines a pelagic squid occupying a large size range (0.1 g – 20 kg), which has been shown to have high metabolic rates. The Ommastrephid, *Dosidicus gigas* was examined for oxygen consumption ($MO_2 = b_0 M^b$ ($\mu\text{M O}_2 \text{ g}^{-1} \text{ h}^{-1}$)), citrate synthase activity ($CS = b_0 M_b$ (units g^{-1})) and octopine dehydrogenase activity ($ODH = b_0 M_b$ (units g^{-1})). The scaling coefficient of aerobic processes was notably shallower than -0.25 . The result of this shallow coefficient is that large squid have a higher metabolic rate than any reported organism of comparable size. Anaerobic metabolism processes (ODH activity) showed a strong negative correlation to body mass as well. This unusual

scaling relationship may be the result of squid's unique body geometry, mode of swimming,, or circulatory system.

Digital imaging of micro bivalves

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The Department of Biodiversity & Systematic Biology (BioSyB) at the National Museum of Wales has, over recent years, embarked upon a number of projects aimed at producing taxonomic tools to aid researchers in the identification of bivalves. Digital imaging has been key to many of these projects. Over three thousand images have been captured in under four years, with many of these being images of bivalve specimens of 5mm in size or less.

Advancements in digital camera technology, microscope optics and image capture software has allowed researchers to capture more detailed and higher quality images than ever before.

Digital imaging using light microscopy at high magnifications does, however, have its limitations. Features that may be diagnostic for species identification can often be difficult to illustrate using this technique alone, and other methods, such as Scanning Electron Microscopy (SEM) and traditional line illustration, may be better suited to the task. However, the best results are often achieved by using a combination of these methods.

Drawing from the experiences gained whilst undertaking digital imaging projects, the presentation will cover current working practices in place at the National Museum of Wales, providing details on the equipment and techniques in use. Specimen preparation, lighting methods, digital image post-processing and image file management will be discussed. These topics will detail the methods used for capturing aspects of bivalve morphology of both the shell and the anatomy in order to produce publication quality images for taxonomic research.

Phylogeography and evolution of the Caribbean land snail family Urocoptidae (Gastropoda, Pulmonata): radiation in isolation

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The land snail family Urocoptidae has an extraordinary diversity in the Caribbean area, both in terms of number of species and in terms of ecological differentiation. On the Greater Antilles, which harbour the majority of species, there are conchologically distinct ground-dwelling, rock-dwelling and arboreal forms. Similar shell forms are often found on different islands, a pattern that can be explained by assuming multiple colonisation events and/or parallelism/convergence. So far biologists have not been able to assess the role of these processes, for want of a phylogeny based on an independent set of characters.

In this study such a dataset was assembled, consisting of nuclear (28S) and mitochondrial (COI) DNA sequences of representatives of most genera within the Urocoptidae. Phylogenetic analyses of these data overturn the current morphology-based classification within the family, and instead support several clades confined to (palaeo)islands. These clades unite morphologically dissimilar forms, indicating independent radiations. Similar ecological specialisations evolved independently on different islands. With a few exceptions, dispersal between islands has been rare. Besides shedding light on the phylogeography and evolution of the Urocoptidae, this study has implications for taxonomy and conservation.

Interstitial Mollusca of the amphioxus sand of the Galician Coasts (NW Iberian Peninsula)

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The results of the researches carried out about the malacological components of the interstitial fauna of three infralittoral banks of amphioxus sands of the Galician coasts are presented herein. Solenogastres: *Biserramenia psammobionta* Salvini-Plawen, 1967, *Meioherpia* sp.; Prosobranchia: *Caecum glabrum* (Montagu, 1803); Opisthobranchia: *Philinoglossa helgolandica* Hertling, 1932, *Hedylopsis spiculifera* (Kowalevsky, 1901), *Asperpina loricata* (Swedmark, 1968), *Unela glandulifera* (Kowalevsky, 1901), *Pseudovermis artabrensis* Urgorri, Cobo & Besteiro, 1991, *Embletonia pulchra* Alder & Hancock, 1851 and two tiny species of Doridacea found in these sands. All the studied material comes from three infralittoral banks of amphioxus sands, of which two are placed on the Ría of Ferrol and one on the Ría of Arousa (Galicia, NW Iberian Peninsula), located between 11 and 25 m depth. The specimens were sorted out by dipping a portion of sediment into a solution of Cl₂Mg at 5% (50% seawater and fresh water) for 5 minutes. The sediment was then put into water, shaken and quickly decanted onto a tower of three sieves with a netting of 500, 250 y 100 µm respectively.

The external anatomy, the radular system at SEM and the geographic arrangement are described in each species. Besides, the taxonomical position of the specimens of the two Doridacea species according to their particular anatomical features is needed. Finally, it is discussed if these are either young specimens of known species or new species, as well as if they are young specimens or if, on the contrary, they are adults of interstitial species, taking into account that no Doridacea have been ever described so far in this environment.

Biogeographical analysis of a molluscan hotspot in the Alboran Sea

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The Alboran Sea represents a crossroad between Atlantic and Mediterranean waters, where upwellings and mixing of waters take place and define different sectors with genuine characteristics. The hydrology is strongly influenced by the geomorphology of the Strait of Gibraltar, resulting in a conspicuous gyre of superficial waters of Atlantic origin. All these factors favour the coexistence of species from both basins. A survey covering different types of bottoms has been carried out on a short stretch of coastline (10 km) between Punta de Calaburras (36°30'4"N - 04°38'W) and Cabo Pino (36°28'N - 04°44'W) (Malaga, southern Spain). Objectives were to assess the composition of the molluscan fauna in this area, to evaluate the need for its protection and to study the biogeographical affinities of the species.

A total of 329 species of molluscs were found. Their shared presence in the following six sectors has been considered: (1) northern Europe, (2) western Europe (between the Channel and Portugal), (3) Ibero-Moroccan Gulf, (4) Canary Islands, (5) tropical West Africa (south of Cap Blanc, Mauritania) and (6) Mediterranean Sea. Most of the species have a wide Atlantic-Mediterranean distribution (219 spp.; 67.8 %), whereas 65 spp. (~ 20 %) are Mediterranean and only 9 spp. (2.8 %) are shared with the Atlantic coasts of Europe and not with the Mediterranean. The tropical West African fauna is

represented by 23 spp. (7.1 %) and there are 8 endemic species (2.4 %) from southern Spain or the Ibero-Moroccan area.

The diversity of the molluscan fauna, possibly the highest in European waters for a single locality, is favoured by variety of habitats but also by drawing from different biogeographic origins. The presence of upwellings may also explain the rather large share of West African species, which is surprising considering the rather cool temperatures of surface waters.

Valve ultrastructure of suborder Ichnochitonina (Polyplacophora) from the South West Atlantic

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The ultrastructure of the intermediate valves of *Plaxiphora aurata* (Spalowsky, 1795) (Mopaliidae), *Chaetopleura isabellei* (d'Orbigny, 1841) (Ischnochitonidae, Chaetopleurinae), *Callochiton puniceus* (Gould, 1846) (Ischnochitonidae, Callochitoninae) and *Tonicia lebruni* (Rochebrune, 1887) (Ischnochitonidae, Lepidochitoninae), collected along the Argentine coast, was studied based upon different sections, *i.e.*, transversal, sagittal, exsagittal, diagonal and parallel to the surface. Four main layers were found: tegmentum, articulamentum, p. hypostracum and myostracum, according to terminology described by Hass (1972).

The tegmentum is the outermost layer. It covers the dorsal surface of the valves and eventually folds at boundaries. This layer is made up of micro crystals without evident order, although in the upper portion it seems to form spherulitic sectors. The p. hypostracum shows a greater development in the jugal area, occupying most of its thickness. It has a crossed lamellar arrangement with its long horizontal axis normally to the sagittal axis of the chiton, although this orientation becomes somewhat disorganised when thin prismatic layers pass through the p. hypostracum. Muscles are inserted in the myostracum, which is made up of crystals arranged prismatically with their longer axis almost normal to the ventral surface of the valve. The articulamentum, which is imbedded into the soft tissues of the chiton, is made of micro crystals that diverge from the centre towards the dorsal and ventral sides, becoming almost parallel to each other. Differences among the species studied are discussed. In addition, these features are compared with those observed by Bøggild (1930) and Haas (1972) for other chiton species.

Genetic basis of adaptive evolution of left-right reversal under developmental constraint

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The animal rule of directional asymmetry in developmental polarity indicates the presence of selection against left-right reversal. If developmental constraint stabilizes the left-right polarity in snails, how sinistral snails have repeatedly evolved? Our study answers this question. Sinistral variants of *Lymnaea stagnalis* hatch poorly, and hatchlings do not grow in the exact mirror-image of dextrals, even if they share nuclear genome from the same parents. This example of developmental constraint against sinistrality may result from distortion due to pleiotropy (side-effects) of the left-right determinant or to left-right reversed morphogenesis. To determine the cause, we crossed a racemic mutant with the wild dextral type in a simultaneous hermaphrodite *Bradybaena similaris*. The racemic mutant produces both dextral (RD) and sinistral (RS) offspring that share cytoplasmic factors from the same mother. The wild type produces only dextrals (WD). We found that only RS exhibit significantly reduced hatching success and flattened shell shape compared to RD and WD, despite sharing nuclear genes from the same parents. Because RD does not exhibit those effects of

developmental constraint, pleiotropy of any maternal factor cannot be responsible for the differences of RS in viability and morphology. Parents-offspring regression analyses showed that the narrow-sense heritability of hatching success is close to 0.9 in each of the dextral and sinistral that the racemic mutant produces, while no genetic correlation exists between dextral and sinistral hatching successes. Artificial selection of the best hatching sinistrals has improved the sinistral to be equivalent to the dextral in one generation, confirming the extremely high heritability. These results show that sinistral variants could overcome developmental constraint, where sinistrality is advantageous as suggested in the examples of reproductive character displacement and specialized predation of dextral snails by snakes. This study provides new insights into the genetic basis of adaptive evolution of mirror-image species in snails.

**What happens when it gets dark?
Biology of deep-sea nudibranch gastropod species and nocturnal behavior**

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Several lineages of nudibranch gastropods have colonized the deep sea independently, including hydrothermal vents and cold seeps. Many of these organisms have pale colorations or lack color altogether, particularly those found at depths greater than 500 meters. This is a strong indication of the significance of color for shallow water animals and its possible biological role in camouflage and mimicry. However, many of these shallow water species with bright external colorations are nocturnal, which seems to contradict the general agreement on the biological role of color. Recent exploration of tropical eastern Pacific waters has revealed unusual properties of some species under particular light conditions, which opens the door for further research and speculation. In this talk, we discuss the different instances of colonization of the deep sea and the implications for understanding the biology, evolutionary history and classification of nudibranch mollusks as well as the properties of some species under specific light conditions.

Coral boring bivalve mollusks of Southeastern Thailand

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Anatomical and shell morphologies of twenty-one species of intertidal and subtidal coral boring bivalves from southeast Thailand are compared. The coral boring fauna of the study region represents the highest diversity yet recorded in the Indo-Pacific Ocean. Siphonal characters are presented for the first time for many of the treated taxa, which has yielded many new useful characters to discriminate cryptic species. The SE Thailand boring bivalves are represented in five families; Mytilidae, Petricolidae, Trapezidae, Pholadidae, and Gastrochaenidae. A new species *Botula* (Mytilidae) will be discussed.

New inventory and conservation methods of the threatened freshwater bivalve *Unio crassus*

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Finnish Museum of Natural History acting together with the WWF-Finland joined in 1996 the inventory of *Unio crassus* into the Margaritifera working group. The main object is to inventory and study the distribution, ecology, morphology and protection of these species. *Unio crassus* is protected by law in Finland and it belongs to the Annex II and IV of the EU Habitats directive and is strict protected in the European Union.

Sub-aqua work is very prominent in the research of this group. We have inventoried one meter wide underwater research transect by SCUBA divers more than 2500 km. This inventory project is one of the largest and most accurate in Europe. It gave lot of new information about the methods how to inventory natural and seminatural environments of *U. crassus*. The importance of the right water flow and the natural continuity of different river habitats, macro- meso- and microhabitats, have been turned out as a very important reason for a successful conservation of *U. crassus*.

Two of the largest calculated *U. crassus* populations in Europe exists in Finland in the river Mustionjoki and in the river Vantaa. In both of these there are more than one million specimens. The former river belongs to the Natura 2000 network being set up under the EU Habitats Directive. The river Vantaa flows through the capital of Finland, Helsinki and it is not yet in the Natura 2000. There are only four rivers of the 20 known inhabited by *U. crassus* which are inside Natura network in Finland. The mussels working group has checked *U. crassus* populations also in some rivers in Estonia and Latvia.

The Turkana mollusks reconsidered: punctuational evolutionary events or biological invasions?

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A controversial concept in current evolutionary thought is Eldredge & Gould's punctuated equilibrium model, which proposes long periods of morphological stasis interspersed with rapid bursts of dramatic evolutionary change. The validity of the punctuated equilibrium model remains contested, with various high-profile studies often cited in support of its veracity. One of the most iconic pieces of research in support of punctuated equilibrium is the work of Williamson on the Cenozoic molluscs of the Turkana Basin. This study claimed to have found firm evidence for three episodes of rapid evolutionary change separated by long periods of stasis in a 35 ka high resolution sequence. Most of the discussions following this report centered on the topics of (eco)phenotypy vs genotypy and the possible presence of preservational and temporal artefacts. The debate remains largely unsettled, leaving Williamson's reports as one of the empirical foundations of the paradigm of punctuated equilibrium. Here we conclusively show Williamson's original interpretations to be highly flawed. The supposed rapid bursts of punctuated evolutionary change are in fact artefacts resulting from the invasion of extrabasinal faunal elements in the Turkana palaeolakes during Plio-Pleistocene East African wet phases. The new results emphasize the importance of taking into account geological, climatological, hydrogeographical and ecological parameters when considering faunal successions in an evolutionary context. The punctuated equilibrium model loses herewith empirical palaeontological support.

On the invasion of *Biomphalaria* (Gastropoda: Planorbidae) in Africa and the evolution of the human bloodfluke *Schistosoma mansoni*: the palaeontological evidence

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Modern genetic research indicated *Biomphalaria* (PRESTON, 1910) to have invaded Africa from South America during the Late Cenozoic and molecular clock calculations suggest this invasion to have taken place between 4.5 and 2.3 Ma, or even later, 1.1-1.8 Ma. Molecular biologists claim this to be in correspondence with fossil evidence of *Biomphalaria* in Africa, which is incorrect. The paleontological record of Africa corroborates the genetically based invasion hypothesis, but suggests the timescale provided by molecular clock data to be unfounded. Fossil-bearing beds all over the African continent document *Biomphalaria* to be absent, until it makes an explosive, sudden appearance around 250-200 ka. This geologically very recent appearance of *Biomphalaria* in Africa, coinciding with the onset of an Interglacial, and the latest evidence on the origin of *Schistosoma mansoni*, has far reaching ramifications for research concerning zoogeography as well as parasite-intermediate host evolution and human parasitology, for the presence of *Schistosoma mansoni*, a digenetic trematode and parasite of humans, is determined by the occurrence of its intermediate host, freshwater snails of the genus *Biomphalaria*. This study indicates the resolution of molecular inferred age determinations to be often too poor to make accurate claims on the divergence of taxa. The sudden appearance of *Biomphalaria* in African molluscan assemblages during Late Pleistocene times provides a useful biostratigraphic marker.

Effect of metal accumulation and metallothionein induction on the condition of the periwinkle *Littorina littorea* along the entire Scheldt estuary

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The Scheldt estuary (the Netherlands) consists of two tributaries of which the western part is heavily polluted while the eastern is relatively clean. The western Scheldt estuary has been ranked among the most heavily polluted estuaries in the world with reference to metal concentrations in water and sediment (i.e. particularly Cd). Furthermore, it has a salinity gradient that opposes the downstream decreasing metal gradient. Hence, the cadmium bioavailability will be much higher in the upstream parts of the western Scheldt estuary (i.e. low salinity, high Cd loads) and decreases in a downstream fashion towards higher salinity and lower ambient cadmium levels. As an important biomarker for metal pollution, metallothionein (MT) plays an important and unique role in the homeostasis of essential metals (i.e. Zn and Cu) and the energy demanding detoxification of toxic metals (i.e. Cd) in invertebrates.

In this study metals (i.e. Ag, As, Ca, Cd, Co, Cu, Mn, Pb, Zn), MT levels and condition indices (i.e. lipid content and dry weight:wet weight ratio) were measured in the periwinkle *Littorina littorea* to determine differences within and between both tributaries. While metal and MT levels followed the ambient upstream increasing pollution gradient in the western Scheldt estuary, they were opposed by the condition indices gradients. A canonical discriminant analysis using all parameters indicated that differences between both tributaries were mainly caused by Cd. Finally, a canonical correlation analysis was performed which showed that periwinkles with a high metal load (i.e. Cd, Cu and Zn)

also had high MT levels but were in a relatively poor condition (i.e. lipid content and dry weight:wet weight ratio).

Genetic variation in the periwinkle *Littorina littorea* along the Western and Eastern Scheldt estuary

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The Scheldt estuary (the Netherlands) consists of two tributaries of which the western part is heavily polluted primarily by metals (i.e. particularly Cd) while the eastern part is relatively clean. Furthermore, the Western Scheldt estuary has a salinity gradient that opposes the downstream decreasing metal gradients. A previous isoelectric focussing study on esterase (EST) loci revealed an estuary based phenotypic structuring, grouping the most polluted, least saline like sites together. Against this background we assessed the genetic variation in *Littorina littorea* along the Scheldt estuary using polyacrylamide gel electrophoresis of six allozyme loci [i.e. esterase (EST), superoxide dismutase 1 and 2 (SOD1 & SOD2), phosphoglucose dehydrogenase (PGD) and glutathione reductase 1 and 2 (GR1 & GR2)]. With the exception of EST, all other loci are well known antioxidants which play a role in stress mediating responses to poor environmental conditions, including metal pollution. All loci, except for SOD2 were polymorphic and were used in our analysis. Heterozygosity for SOD1 and PGD was extremely low in the Eastern Scheldt, despite heterozygotic individuals were regularly detected in the Western Scheldt. Moreover heterozygosity for GR2 increased upstream along the Western Scheldt, thus following the ambient pollution gradient. Finally, periwinkles were collected along the Dutch, Belgian and French coastline. An integrated analysis will be performed to investigate the genetic variation in the Scheldt estuary in relation to these neighbouring locations.

Remote islands of the Aegean. The island of Psara as a case study

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The Aegean Sea is covered by more than 7,000 islands of various sizes. These islands are scattered all over the area; some are within “walking” distance from the nearby land, while some others are located nearly in the middle of the archipelago. The study of an island or a group of islands can be a surprise even for an experienced (in the area) researcher.

As a remote island of the Aegean we chose the island group of Psara, which is located in the north part of the Aegean, northwest of Chios isl. and southeast of Skyros isl. We surveyed the two largest islands, namely Psara and Antipsara. They consist mainly of volcanic rocks, and the vegetation is mainly phrygana.

In this presentation we will present the first data on the malacofauna of the group and we will compare its fauna with the islands of Skyros and Chios, as well as with other remote islands of the Aegean, such as Agios Efstratios (in the north) and Astypalaia (in the south).

Complementarity within a functional group of filter-feeding freshwater mussels influences stream foodwebs

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This study examined the influence of biodiversity on ecosystem function within a trait-based functional group, freshwater mussels, and asked if biodiversity effects varied with environmental context and species composition. We conducted a manipulative field experiment examining the effects of freshwater mussel assemblages varying from one to four species on periphyton biomass and invertebrate grazer abundance on mussel shells across two sets of seasonal environmental conditions, moderate flow and water temperature (fall) and severely reduced flow combined with high water temperature (summer), in a small river in the southcentral U.S. Biodiversity effects varied with species composition, environmental context, and across trophic levels. Algal biomass was influenced most strongly by trait-independent complementarity. This effect was evident in both seasons, but was strongest in summer, and is likely due to differences between species in N:P excretion rates in summer when nutrients are limiting. Invertebrate grazer densities were also influenced most strongly by trait-independent complementarity, but biodiversity effects were more complex than for algal biomass. Grazer densities were likely influenced by a combination of varying algal abundance and shell morphology between mussel species. In this study, biodiversity effects extended across trophic levels, but in general were non-additive and not predictable across trophic levels. This study shows that the strength of biodiversity effects, and underlying mechanisms, can vary with environmental context.

Molluscs of the infra- and circalittoral of the Azores: The story of a field-trip of an undergraduate Malacology class

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The Mollusca are very diversified in their external appearance and ways of life; octopuses and clams, limpets and snails, however, share a common structural plan. Such high diversity and tight phylogenetic relationship makes them privileged models for the study of evolution. Concurrently, knowledge of the local fauna is needed to understand patterns resulting from evolution and the processes leading to it; these themes are discussed in Malacology, an undergraduate level discipline offered at the University of the Azores. The Azorean circalittoral is underrepresented in studies dealing with the marine fauna of the archipelago, the stress having been put historically on the near-shore and deep-sea faunas. During the school year 2006/2007 and on the wake of the 3rd International Workshop of Malacology and Marine Biology conducted at Vila Franca do Campo (2006), part of the course's field-work dealt with aspects of the circalittoral malacofauna. Taking advantage of acquired expertise and stored facilities during the workshop, collecting with dredge and grab off Vila Franca do Campo was done at depths 30 to 50 meters; the material was kept alive in the laboratory until sorted and the animals photographed. Seventy-four species were recorded. Many empty shells were dredged, some of species from neighbouring hard-bottoms, most apparently from mixed substrate, thus making it difficult to assess the real biology of the explored area. The sandy bottom was

dominated by polychaete worm *Ditrupa arietina*, as well by turrids, usually predators on polychaetes; abundance of bored bivalve shells indicated the active presence of naticids. The bivalve *Ervilia castanea* dominated shallower depths, being gradually replaced by *Tellinella donacina* and *Timoclea ovata*; at greater depths, *Tellina balaustina* became relatively abundant. Presentation of this work at the WCM by one of the participating undergraduate students (Ana Velosa) was made possible through a grant from SOGEO/ grupo EDA – Empresa de Electricidade dos Açores, Lda.

Early ontogeny in buccinid gastropods: inferences from morphology

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Gastropods in the Family Buccinidae are abundant, diverse neogastropods with interspecific variation in their larval strategies, or developmental modes. These developmental differences are expressed during early ontogeny and are reflected in the morphology of larval shells and protoconchs. According to “shell apex theory”, typical non-planktonic buccinid species (so called “direct-developers”) should exhibit a bulbous protoconch and paucispiral larval shell, with little ornamentation. In contrast, species with planktonic larvae are expected to show morphological signs of their free-swimming life, in the form of a high-conical shell apex, and a multispiral larval shell with a sinusigeral ridge. These characteristics plus protoconch size and shape dimensions comprise the suite of criteria used to distinguish planktonic versus non-planktonic developers in extant and fossil buccinid taxa. To date, however, there has been no direct study of the suitability of this method to buccinid gastropods. This study reports on tests of developmental mode criteria using (1) larval shells of *Kelletia kelletii*, a buccinid gastropod with planktonic larvae and (2) protoconchs of species within the genus *Bruclarkia*, an extinct buccinid gastropod endemic to the Eastern Pacific during the Eocene, Oligocene, and Miocene. Methods described include larval rearing, fossil collection, protoconch molding and casting, and scanning electron microscope (SEM) imaging with ImageJ analysis. Larval shell and protoconch characters are evaluated and the suitability of inferences of developmental mode from morphology is discussed. The application of this method and its value are couched in phylogenetic and paleontological context.

Mating behaviour across the contact zone in pairs of sibling slug species

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Deroceras is the most speciose genus of terrestrial slugs. Although varying little externally, they show a spectacular interspecific diversity of penis morphs and mating behaviours. We hypothesise that the evolution of these traits has been driven by sexual conflict between the mating partners over the donation and utilisation of sperm, resulting in rapid divergence of geographically isolated forms, and thus in incompatibility on secondary contact. We studied the mating behaviour of three sibling *Deroceras* species (*D. fatrense*, *D. praecox* and *D. rodnae*) in their zones of contact. Our aim was to test if differences in mating behaviour are accentuated within the very narrow zone in which apparent morphological hybrids were found; that would suggest reproductive character displacement to avoid hybridisation after secondary contact. Alternatively, introgression may have resulted in more similar

behaviour near the zone of contact. Mating behaviour of this group is very complex, including a sudden penis eversion and mutual sperm exchange from penis to penis, which demands perfect synchronisation between the partners. Earlier studies had revealed differences in mating behaviour between allopatric populations causing prezygotic reproductive isolation. Our new experiments involved slugs collected at two contact zones and from several kilometres away on either side of each zone. They were first isolated and then pairs were put together under observation in the laboratory. From 610 couples, 206 started courtship behaviour, that is each everted its sarcobelum, a penial organ with which they stroke one another. The three species showed differences in sarcobelum shape and way of stroking. Nevertheless, these differences did not lead many couples to break off mating, and 199 proceeded to copulation, i.e. everted their penes. However, video analysis revealed that many did not succeed in mutual sperm exchange, mainly caused by imperfect synchronisation or by misalignment of penes due to shape differences.

Snails as bio-indicators - Imposex of the netted whelk *Nassarius reticulatus* in Brittany along a transect from a point source

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Imposex, the development of additional male sex organs in female prosobranch snails, is caused by endocrine disruptors with androgenic potential, such as tributyltin (TBT), a biocide and a component of antifouling paints. In a field survey, imposex intensities in *Nassarius reticulatus*, collected from 2004 to 2007 at 7 different sites in the coastal area of Roscoff, were investigated. In all years, the VDSI showed a decrease along a transect with distance from the harbour. In addition to VDSI values, the penis length of males and females was measured. The median female penis length decreased with increasing distance from the harbour. This correlation was significant in all sampling years. Neither the VDSI nor the female penis length showed significant differences in all sampling years for a given site. A comparison of pooled VDSI data in *N. reticulatus* with the amount of TBT-Sn in water and snail tissue resulted in a highly positive relation. Harbours can be contaminated with TBT for several years, therefore our observations indicate still high TBT concentrations in the sediments. This conclusion is supported by the results of a temporal trend monitoring of imposex intensities in *N. reticulatus* at four sites in and around Roscoff over a period of 17 years (1989 to 2006). While there is only little evidence for a recovery from imposex intensities at two sites in or directly influenced by a harbour, VDSI values dropped at two reference sites.

Countercurrent and continuity in gastropods

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Complementary to the vascular circulatory system of molluscs is the flow of water through the mantle cavity. Water flowing through the gills provides the oxygen collected by the countercurrent flow of hemolymph in the circulatory system. Thus the two systems oppose each other in direction of flow and diffusion of gases. Water moving through the mantle cavity obeys the principle of continuity. Water flows most slowly at the largest cross-sectional area of the system, the spaces between the lamellae of the gills, facilitating diffusion across the epithelium of the gill. In addition, the water carries chemical signals and nutrients that can be detected by the osphradium in gastropods

and collected on the gill in suspension-feeding species. In the vascular system a muscular, chambered heart pumps water through arteries, interstitial spaces, and veins. In contrast, cilia on the surface of the gill pump water through the mantle cavity. Flow rate appears to depend upon the diameters of the incurrent and excurrent openings of the mantle cavity, which are controlled by the muscle and connective tissue fibers in the mantle tissue.

**Pleistocene refugia in Patagonia:
Evidence from the freshwater snail genus *Chilina* (Gastropoda: Chiliniidae)**

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The evolution of the Patagonian ice fields since the Last Glacial Maximum (LGM) is of great interest regarding the peopling of the southern cone of South America. It is generally believed that the homogenous ice sheet made it impossible for humans migrating by boats going further south and therefore humans migrating through the ice free Pampas were the first reaching the Land of Fire. There is, however, anecdotic evidence that ice free areas along the western edge of Patagonia existed that may have permitted an earlier human colonisation.

Here, we use phylogeographical patterns of the freshwater gastropod genus *Chilina* GRAY, 1828 for testing the Pleistocene refuge hypothesis in western Patagonia. *Chilina* is a basommatophoran genus that is restricted to the southern South America with several described species. The species of this taxon live in lotic habitats and the occurrence is thus dependant on ice free environments. Therefore, extant *Chilina* populations in Patagonia must either have colonised this area after the LGM or have survived in ice free freshwater areas within Patagonia.

Given this background, we are studying the phylogeography of *Chilina* spp. from the south-western parts of South America (Argentina, Chile) using mitochondrial genes (COI, LSU rDNA). Preliminary phylogenetic analyses show that the individuals studied form three main clades. The first clade contains most of the individuals collected on the South American mainland. The second clade consists of individuals collected on offshore islands (Chiloé Island and Wellington Island) and a third clade is formed by snails from a single mainland locality. We also found relatively high within and between population diversities that may indicate the existence of ice free freshwater habitats during the LGM. Multiple immigration events, however, can not be fully excluded as explanation for the patterns seen in our data. Therefore, we are currently extending our dataset both with additional populations and additional markers in order to obtain a more precise phylogeographical picture of this taxon.

***Pupilla pratensis* (Clessin, 1871) a distinct species in the form group of *Pupilla muscorum* (Linnaeus, 1758) (Gastropoda, Pulmonata, Pupillidae)**

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Pupilla muscorum (Linnaeus, 1758) is the most widespread species in the genus *Pupilla*. The species is highly variable and rich in forms. The taxonomic identity of one of these forms, var. *pratensis* (Clessin, 1871), commonly considered an ecophenotype of wet habitats, has been investigated using morphological, ecological and molecular data. The forms differ in a row of morphological characters, *pratensis* being larger, more thin-shelled, and having a toothless aperture. They separate well also using molecular data (COI and CytB) and hence, we conclude that the two forms represent distinct species. *Pupilla pratensis* shows some resemblance to the high alpine taxon *Pupilla alpiola* (Charpentier, 1837), but differs distinctly in some morphological characters. *P. pratensis* is pronounced hygrophile, occurring in calcareous fens. It was described from Germany and also occurs in Poland and the Czech Republic. It is distributed almost throughout all of Scandinavia. A wide, but scattered distribution, mainly in calcareous areas in central, north (and possibly western) Europe is to be expected.

The underused combined approach (morphology, ecology and DNA-barcoding) proves to be a powerful tool in distinguishing among closely related species within the genus *Pupilla*. We suggest that combined results from several methods should be used before assigning taxonomic identity and when sorting out complexes in other taxonomic groups as well.

Approaches and problems in species delimitation of tropical freshwater snails: examples from Southeast Asian pachychilids

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The destruction of freshwater biota and the loss of habitats is particularly dramatic in Southeast Asia. The region has rich endemic assemblages of limnic molluscs, especially prosobranch gastropods, and their inventorization is a prerequisite for the conservation of freshwater diversity. We here employ data from the endemic and speciose Southeast Asian genera of the cerithioidean Pachychilidae to illuminate issues arising from using classical morphological and recent molecular methods such as DNA barcoding in the process of species delimitation and diversity assessment.

We used traditional morphological characters such as the shell or radula in the initial delimitation of pachychilid species. This procedure proved straightforward in sympatric situations, which were then employed as a benchmark against which species status could be estimated in allopatric situations. This approach revealed a considerably higher number of putative species than previously described, mostly endemics with a restricted occurrence. The taxa delineated by this method did show a poor match to genetic units derived from a molecular phylogeny based on mtDNA, though. The high level of congruence among different morphological characters and geography indicates that this rather is a problem inherent to properties of the mtDNA markers than reflecting errors in prior species delimitation or cryptic species.

The widespread mismatch between species hypotheses derived from morphological and molecular data even among sympatric taxa suggests that a mere ‘barcoding shortcut’ is not applicable in diversity assessment in these freshwater gastropods, which are probably representative for many tropical limnic caenogastropods. While sequencing may fail in facilitating easy species recognition, estimates of genetic diversity remain nevertheless valuable. In allopatric situations, which constitute the majority of cases, species delimitation remains ambiguous, since our molecular data indicate that even a high genetic distinctiveness may not be correlated with reproductive isolation. Species diversity estimates will have to take account of that intrinsic uncertainty.

Does ecological specialization lead to speciation? – a case study on *Tylomelania sarasinorum* from the Malili lake system (Sulawesi, Indonesia)

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Ancient lakes and their endemic faunas are model systems to study evolutionary patterns and add to our understanding of speciation processes. In this context the Malili lake system in the central highlands of the Indonesian island Sulawesi is no exception. It harbours an endemic species flock of 29 species of the viviparous freshwater snail *Tylomelania* (Cerithioidea, Pachychilidae), which is endemic to Sulawesi. The focus of this study is on *Tylomelania sarasinorum* (Kruimel, 1913), a hard-substrate dweller in Lake Towuti, the largest and southernmost of the five connected Malili lakes. In contrast to other species from the system, a conspicuous radula polymorphism with five distinguishable forms is found in *T. sarasinorum*, while the shell is generally rather uniform. Several of the 36 populations sampled showed a correlation between a radula form and a specific substrate (wood and rocks), albeit sporadic. Just in a few populations from the north coast of Loeha Island, located in the middle of the lake, were the radula forms not only strongly correlated with the different substrates, but also with distinct shell morphologies (shell shape and aperture colour). Moreover, preliminary molecular data from amplified fragment length polymorphism (AFLP) analyses reveal a genetic separation of both morphs on Loeha Island. We suggest that this indicates an example of incipient speciation, where ecological factors, i.e. substrate specific specialization of the radula, play an essential role.

Preliminary rDNA sequence data on arionid phylogeny

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The phylogenetic relationships within the terrestrial slug 'family' Arionidae are still highly controversial. Recent studies, based on nuclear ribosomal ITS1 and mtDNA sequence data, provided many new insights, particularly with respect to species relationships in the genus *Arion*, but at the same time appeared inconclusive with respect to relationships between genera and 'subfamilies'. The present contribution explores to what extent arionid relationships can be resolved by DNA sequence data of the complete 18S rDNA gene and stretches of the rDNA cluster including the 3' end of the 5.8S gene, the complete ITS2 region, and the 5' end of the large ribosomal subunit (28S). To this end we aim to assess (a) deep phylogeny within the 'Arionidae' at 'subfamilial' and generic levels, (b) 'subgeneric' relationships within the Arioninae, (c) the position of *Arion franciscoi*, and (d) the status of the Carinarion-complex.

Preliminary results suggest that: (a) *A. franciscoi* occupies a basal position relative to the genera *Arion*, *Geomalacus* and *Ariunculus* (18S data only) or occupies a basal position relative to the genus *Arion* only (5.8S –ITS2 –28S stretch and combined data set), (b) the subfamily Anadeninae is probably not monophyletic, (c) the subfamily Ariolimacinae seems monophyletic but the relationships between *Ariolimacina* sp. remain unresolved, (d) the subgenera *Mesarion* and *Arion* as currently interpreted, cannot be separated, (e) the genus *Geomalacus* is paraphyletic relative to *Letourneuxia*, (f) the subgenera *Kobeltia* and *Microarion* are confirmed as a single taxon, and (g) the Carinarion-complex shows nearly no sequence variation for the rDNA sequences used, reinforcing the idea that the taxa involved may be not distinct at the species level.

Molecular systematics of North American *Ferrissia* (Pulmonata: Ancyliidae)

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Members of the ancyliid gastropod genus *Ferrissia* (Walker, 1903) are characterized by fine radial striae on their shell apices. They have a near-cosmopolitan distribution in freshwater ecosystems but have received relatively little systematic attention in recent decades. In North America, the last major study was that of Paul Basch (1963), who recognized 5 *Ferrissia* species but stated *I have found no way to separate species unequivocally, and believe that they may all represent different directions of clinal variations within one large super-species*. I aim to revisit the systematics of North American *Ferrissia* nominal taxa using molecular phylogenies to resolve taxonomic ambiguities. I obtained samples of the constituent nominal species from throughout their ranges in North America and utilized nuclear and mitochondrial markers to generate representative gene trees. My findings reveal that two primary lineages of *Ferrissia* occur in North America and that they are not sister taxa, but form a paraphyletic clade also containing *Ancylus* and *Rhodacmea* species. One *Ferrissia* lineage appears to be restricted to North America and is comprised exclusively of individuals from two nominal species: the lotic *F. rivularis* and the lentic *F. parallelus*. These species are taxonomically polyphyletic, and the within-clade topology exhibits a pronounced geographic east/west structuring with evidence of limited secondary movement from east to west. The other primary North American lineage comprises *F. fragilis*, a minute pond-specialist capable of aestivating under drought conditions by producing a septum. *F. fragilis* has Old World sister lineages, but it has recently become globally invasive, establishing cryptic alien populations in tropical Asia and throughout Europe. It was first documented in Europe 60 years ago and has since been sequentially recorded across much of the continent as *F. wautieri* or *F. clessiniana*. It may well be establishing cryptic invasive populations in temperate and tropical freshwater pond ecosystems worldwide.

Preliminary studies on the occurrence of the Asiatic clam *Corbicula fluminea* (O.F. Müller, 1774) (Bivalvia: Corbiculidae) in River Odra (Poland)

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Corbicula fluminea (O.F. Müller, 1774) is a south-eastern Asiatic species which has been expanding to other continents since the early 20th century; it is now known from European rivers. The first Polish record of *C. fluminea* dates back to October 2003 when the bivalve was found in a power station cooling water canal in the downstream reaches of River Odra (NW Poland). It is not known how far the species has been dispersing in the river since and what dispersal means and pathways have been used. To elucidate the present range of *C. fluminea* in River Odra, as of spring 2005, regular surveys were performed along the entire course of the Odra (from its origins in the Czech Republic to the discharge to the Pomeranian Bay, Baltic Sea). The surveys were repeated in summer and autumn 2005 and were continued throughout 2006. In 2005, no live *C. fluminea* were found, nor were empty shells present in the samples. In May 2006, however, live specimens were retrieved from samples collected in the middle and upper reaches of the river; in addition, empty shells were found in the river bank deposits, particularly at sites showing traces of former elevated water levels. Subsequently, particularly in October 2006, the bivalve was observed to have clearly expanded its range as the number of live individuals distinctly increased; an elevated amount of empty shells was recorded as well. The bivalves occurred at sandy and sandy-muddy sites. The periostracum of most individuals from sandy bottoms was yellow-olive in colour, brown coloration being typical of shells from muddy sites. The mean shell dimensions of both live individuals and empty shells indicate the

population to consist primarily of young individuals, the oldest specimens being completely absent. This suggests that the population is at its developing stage.

Genetic variability in the Mediterranean interstitial gastropod *Pontohedyle milaschewitchii* (Opisthobranchia, Acochlidomorpha)

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Pontohedyle milaschewitchii Golikov & Starobogatov, 1972 is a widely distributed mesopsammic, dioecious species with internal fertilization and direct development. The dispersal potential is, therefore, low and considerable genetic differentiation among population to be expected. The present study aims to investigate the genetic variability of this species and to test the genetic conductivity between populations of different parts of the Mediterranean. Samples were collected from two separate sites at Croatian (Northern Adriatic Sea) and Ligurian coast (North-west Italy). A fragment about 1900 bp of the mitochondrial genome containing partial cytochrome c oxidase subunit 1, tRNA-Val, and partial 16S rRNA genes is used as genetic marker. The results reveal high genetic variability within *P. milaschewitchii*: all 29 haplotypes are unique. They cluster in six haplotype groups: three are limited to the Italian coast, one is limited to the Croatian coast. Two haplotype groups are present at both locations. This indicates limited gene flow between these geographically widely separated populations. Additional sequences from these locations and further analyses will help to increase our understanding of the genetic conductivity and population structure of *Pontohedyle milaschewitchii*.

Molluscan radiations and extinctions in Miocene Amazonian long-lived lake Pebas

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During the Miocene, spectacular diversifications of endemic mollusc and ostracod faunas occurred in a huge (> 1 million km²) long-lived complex of lakes and wetlands, known as the Pebas system, that occupied most of present-day western Amazonia. The anatomy of the mollusc radiations and extinctions are documented, based on an improved ecological and stratigraphic framework. The Pebas fauna diversified from possibly one ancestral cochliopid gastropod species and two corbulid species about 23 million years ago into a fauna of approximately 75 co-occurring endemic species about 12 million years ago. Evolutionary innovations in cochliopid gastropods and corbulid bivalves are documented and their significance is discussed. It is demonstrated that the mollusc were able to expand into ecological niches where dysoxia, high predation pressure and unconsolidated bottoms dominated. Episodic marine incursions did modify the diversity, but did not interrupt the continuity of the fauna as a whole. The non-endemic components of the Pebas fauna have a Neotropical signature. The Pebas fauna became largely extinct by the onset of the modern Amazon River system, circa 8-10 million years ago. The Pebasian mollusc development provides an excellent example of the documentation of evolution and its context in a long-lived lake.

Extinction and immigration in the wake of climatic deterioration: Marine molluscan diversity in the Pliocene-Quaternary in the southern North Sea Basin

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During the Pliocene and early Quaternary, a strong marine molluscan faunal turnover occurred in the North Sea Basin. In this poster we document the extinction of warm-temperate/subtropical taxa as well as species endemic to the North Sea Basin during the Zanclean-Gelasian and their replacement by Pacific and Arctic immigrant species. During the Zanclean (ca. 4 million years ago) the mollusc fauna was rich in species, several of which persist nowadays in more southerly areas such as the Mediterranean. Also, a considerable number of supposed North Sea endemics occurred. Diversity deteriorated drastically during the Piacenzian and Gelasian (c. 1.8-3.5 million years ago). This is in part explained due to cooler climate regimes and a general shallowing of the North Sea, but mostly caused by the disappearance of oligotrophic habitats as a result of increased glacial cyclicality and associated hinterland erosion. Immigrants expanded to become major faunal elements in the North Sea Basin at the same time. At the end of the Gelasian, an impoverished boreal fauna inhabited the North Sea.

The genesis of Tyrian purple precursors in the gonoduct and egg masses of *Dicathais orbita* (Neogastropoda: Muricidae)

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Muricid molluscs, such as *Dicathais orbita*, are renowned for production of the ancient dye, Tyrian purple. Within the hypobranchial gland is the prochromogen, tyrindoxyl sulphate. By action of arylsulphatase, cytotoxic intermediates are generated, and in the presence of sunlight, Tyrian purple evolves. Tyrian purple genesis also occurs in muricid egg masses; however, the origin of precursors is presently unknown. As the hypobranchial gland lies adjacent to the capsule gland, it is hypothesized that precursors are introduced into the intracapsular fluid as a form of maternal investment. Alternatively, encapsulated embryos may possess the capacity to synthesize precursors de novo. To determine precursor distribution in the female reproductive system, a method was developed for the quantification of dye precursors using liquid chromatography-mass spectrometry (LC-MS). Tyrindoxyl sulphate dominated capsule, albumen and ingesting gland extracts and the intermediates, tyrindoxyl, tyrindoleninone and tyriverdin were detected in capsule gland extracts. This provides preliminary evidence for the involvement of Tyrian purple genesis in muricid reproduction. To investigate the potential incorporation of precursors into egg capsules, novel histochemical techniques for the localization of compounds and enzymes essential for prochromogen and intermediate synthesis were applied to the female pallial gonoduct and encapsulated juveniles. Albumen and capsule glands were found to incorporate tryptophan, bromoperoxidase and arylsulphatase into the intracapsular fluid and lamina of egg capsules, and the vitellus of embryos. In regions where bromoperoxidase and tryptophan were found to coincide, tyrindoxyl sulphate was also histochemically detected, indicating the potential for prochromogen synthesis. LC-MS analysis of egg capsule fractions revealed that tyrindoxyl sulphate concentration was 1000-fold higher in embryo than intracapsular fluid extracts, but declined from embryo to veliger in conjunction with vegetal pole absorption. This and the absence of a true hypobranchial gland in embryos, suggest that precursors arise in the egg masses of *D. orbita* from a maternal source.

Mollusc identifications cards for Central Europe ("miniposters") - a tool for determination, field work and education

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Even for the well-documented molluscan fauna of Central Europe handy and cheap identification tools also for non-specialists are rare. Therefore laminated determination cards of about 20 x 30 cm double-sided were created which are robust for field work. These cards illustrate almost all molluscan species (shells of snail and slugs) of Central Europe in colour photographs. Each identification card covers the inhabitants of a different environment. Up to date the following miniposters are available: "Süßwassermollusken" (= freshwater molluscs, 90 species illustrated), "Landschnecken 1" (= landsnails 1, all important lowland shell-bearing snails, 130 species), "Landschnecken 2" (= landsnails 2, slugs, alpine and montane snails, 120 species), "Weichtiere" (= molluscs, the most important land and freshwater species, overview for beginners), "Nordsee-Strand, Schnecken und Muscheln" (= shells of the North Sea), "Ostseestrand" (= litoral animals of the Baltic Sea).

The inclusion of almost all species allows the comparison of related or similar species and the recognition of family characters. All figures are scaled and in addition, ecological information is provided when useful for determination, e. g. in land snails. The authors hope that the miniposters will also help to promote malacology to young and adult non-specialists by the beauty and great variety of the molluscs shown in high quality images.

Ecophenotypic variation in the mangrove oyster, *Isognomon alatus* (Pterioidea: Bivalvia) associated with a tide microhabitat gradient

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The marine bivalves of the genus *Isognomon* Solander, 1786 exhibit extreme phenotypic plasticity. So much morphological variation exists within these "flat oysters" that species boundaries are difficult to perceive and taxonomic designations cannot be made with confidence. Understanding the environmental sources of this variation and their resulting effects would allow us to quantify and potentially correct for this variability. However, most specimens held in museum collections do not have records of microhabitat conditions at the collection site detailed enough to allow for any sort of ecophenotypic correction. My current research examines the ecophenotypic responses of *Isognomon alatus* (Gmelin, 1791) to a tidal gradient and asks if these morphological changes have the potential to confound taxonomic designations.

Results indicate that abundance of this bivalve is positively correlated with average yearly air exposure while specimen size is negatively correlated with this environmental factor. This leads to a population of many, small individuals at high tidal positions and a few, large individuals inhabiting permanently submerged positions. Shape analysis was carried out using geometric morphometrics on a dataset containing both landmark and outline information. Multivariate regressions of shape show that a small but statistically significant proportion of the variation in shell shape was correlated with both time submerged per year and area available per oyster. Due to the strong covariation between the two microhabitat variables, the separation of the two effects is not yet possible. The combined morphological effect of these factors is approximately one-tenth the magnitude of allometric growth and one-half that seen between *Isognomon alatus* and *I. ephippium* (Linnaeus, 1758), members of the

same sub-genus. While position within the tidal column does produce variation in shell morphology, the magnitude of this effect is small enough that, within this genus, it is unlikely obscure taxonomic designations. This research partially funded by NSF-PEET DEB-9978119.

Judging a mangrove oyster by its cover: Differentiating extremely similar allopatric *Isognomon* species (Pterioidea: Bivalvia) using geometric morphometric analysis of conchological features

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Dry shell specimens of *Isognomon alatus* (Gmelin, 1791) and *I. ephippium* (Linnaeus, 1758) are nearly indistinguishable. These two members of the subgenus *Melina* Philipsson, 1788 share a flat, circular, and highly variable shell type with no distinct conchological characters that differentiate the two taxa. Strikingly similar and allopatrically situated, *I. alatus* in the western Atlantic and *I. ephippium* in the Western Pacific, these species are generally considered sister taxa. The *Isognomon* molecular database I am currently developing suggests that these two species are not as closely related as their morphological similarity may imply. To understand the nature of this conchological similarity I examined the shape and development of these bivalves using geometric morphometrics. A dataset consisting of both traditional and sliding semi-landmarks from 114 left valves were examined using pairwise, regression, and vector analyses carried out in the TPS and IMP software suites. Pairwise tests found significant differences in shape between *Isognomon alatus* and *I. ephippium* at all sizes classes with the most pronounced differences seen in early and late ontogeny. Regression analysis found that significant differences in shape develop relatively early shell development, at shell sizes below those included in the study. These differences then reduce in magnitude as the shells approach mean sampled size but then increase in magnitude as the shells continue growing. It was also found that these two species travel along significantly different ontogenetic vectors during shell development. Together these analyses indicate that while these species begin their development at different points in morphospace, the ontogenetic vectors of these bivalves almost intersect, leading to intermediate size classes that are very conchologically similar despite different developmental processes leading to those morphologies. This research is partially supported by NSF-PEET DEB-9978119.

What molluscs can tell us about the genesis of biodiversity in ancient Lake Ohrid

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With an estimated age of 2-5 million years, the oligotrophic and karstic Balkan Lake Ohrid is the oldest and most outstanding European ancient lake. Together with its sister lake, Lake Prespa, it harbors a remarkable degree of invertebrate biodiversity. In terms of number of endemic species per area, Lake Ohrid is the most species-rich lake in the world. Whereas some workers suggest a high number of relic species occurring in Lake Ohrid, other workers favor intralacustrine speciation as key evolutionary process responsible for the high degree of biodiversity seen today.

Based on a genetic survey of nearly all extant molluscan taxa in Lake Ohrid, we are addressing questions of the genesis of its biodiversity in space and time. Our data indicate:

A) The presence of several ancient lakes species flocks in the Gastropoda

They include radiations in the subfamily Pyrgulinae (Caenogastropoda), and in the genera/subgenera *Ancylus*, *Acroloxus*, and *Carinogyraulus* (Basommatophora). Our molecular studies indicate that

each of these radiations goes back to a single invasion event, that all these radiations started relatively simultaneously, and that they are all younger than the lake itself (i.e., intralacustrine radiation).

B) Micro-habitats and intralacustrine barriers may have supported allopatric speciation. Phylogenetic data indicate a strong horizontal (e.g. feeder springs vs. actual lake) and vertical structuring (e.g. below and above the Chara belt) in Lake Ohrid molluscs that may have contributed to micro-allopatric speciation.

C) Ongoing speciation

Though intralacustrine radiations started in the early Pleistocene, there is evidence for ongoing diversification in Lake Ohrid. We hypothesize that the high degree of biodiversity seen today may not be due to elevated speciation rates but rather due to reduced extinction rates.

D) Source function of Lake Ohrid

Within a European phylogeographical context, we identified taxa, ancestors of which possibly evolved inside the lake and later spread over the Balkans. Examples include the mussel *Dreissena presbensis* and the gastropod *Pyrgula annulata*.

In summary, it can be said that Lake Ohrid served as evolutionary reservoir for relic species from different parts of Europe. However, the vast majority of the endemic faunas seen today is relatively young and the result of allopatric intralacustrine speciation.

Receptor physiology in bivalve eyes and the role of primary inhibition

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Bivalve molluscs are known for shadow responses involving closure and/or retraction of the siphon and valve adduction. In representative genera (*Spisula*, *Mercenaria*, *Lima*) the pallial nerves contain photosensitive fibers that exhibit physiological shadow responses. These photoreceptors are mostly spontaneously active in the dark and inhibited by light. Dimming, i.e., a shadow triggers an excitatory burst of off-response spikes. Equivalent responses characterize the photoreceptors in bivalve eyes. Optic nerve fibers with vigorous light-off responses are known for the siphon tentacle eyes of *Cardium*, and the mantle eyes of scallops, e.g., (*Argo*)*Pecten* and *Lima*. Invariably these off-receptors are ciliary based and constitute a distal retinal layer in scallops, distinct from a proximal microvillar layer. In the ciliary off-receptors, light inhibition is the result of a hyperpolarizing receptor potential. A rebound depolarization generates the spike burst in response to dimming. Hartline (1938) initially attributed light inhibition to inhibitory synapses, as seen in *Limulus* lateral eyes. The absence of synapses in the scallop retina concludes that the absorption of light directly inhibits the off receptors, in contrast to a depolarizing, excitatory light response in all other invertebrate photoreceptors. Although primary inhibition is apparently universal among bivalves, the scallop eye also features proximal (microvillar) receptors depolarized by light with bursts of spikes at light onset. Aside from *Pecten* and *Lima* the only other bivalve eye in which receptor potentials have been investigated are those of the giant clam, *Tridacna*. Here, two types of hyperpolarizing light-inhibited receptors have been described, one of which generates spikes at light offset, the other non-spiking. Vertebrate photoreceptors are the only other receptors where light elicits “inhibitory” hyperpolarizing receptor potentials. However, membrane conductance and ion specificity is unrelated. In bivalves light triggers an increase in K⁺ current whereas in vertebrates light triggers a decrease in the dark Na⁺ current.

Global patterns of diversity and speciation in tropical marine mollusks

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Today, the Indo-West Pacific (IWP) is the largest marine biogeographic province and the richest in terms of species diversity, especially for shallow water marine invertebrates. The origin of this diversity and the timing of its appearance are of particular interest because it has been suggested that the tropics are the source of many evolutionary novelties and that they have provided a species pool, from which temperate regions were populated.

Molecular phylogenies for the genus *Turbo* and for the subfamily Turbininae were used to assess the consequences of temperature regime and tectonic events on the diversification of turban shell species, with particular focus on the IWP. Both Bayesian and parsimony analyses of the subfamily recovered five clades and suggested that temperate habitat is an ancestral character in at least four. Therefore, in contrast to most fossil evidence for molluscs, the tropics are not acting as a source of genetic diversity for temperate and polar regions. Instead it appears likely that the latitudinal gradient in this group is best explained by higher rates of diversification in the tropics.

Phylogenetic analyses of the genus *Turbo* in combination with the fossil evidence suggest that present day IWP is behaving as both a cradle of diversity (with new species originating in situ) and a museum of diversity (with lineages that pre-date its isolation also being maintained). A period of rapid diversification in the IWP was observed to begin approximately 24-25 Ma in both *Turbo* and the tropical periwinkles, *Echinolittorina*, corresponding to the time period when Australia and New Guinea collided with Southeast Asia. These tectonic events resulted in increased shallow water habitat and a mosaic of different habitats able to support a large number of taxa within the small central IWP area, resulting in what is commonly known as the 'centre-of-diversity'.

Non-reciprocal hybridization against asymmetric introgression of mtDNA in Snails

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Population surveys with molecular markers often reveal that introgression is ordinary between related species. It leads to recent concerns of genetic pollution through hybridization with introduced aliens. Non-reciprocal introgression of mtDNA has naively been thought to indicate the direction of hybridization with no biological examination. Here we show that simple interpretation of introgression detected by molecular markers misleads us to a wrong conclusion of non-reciprocal hybridization. The terrestrial pulmonates *Bradybaena pellucida* (*BP*) and *B. similaris* (*BS*) can clearly be distinguished only by penial surface structure. *BP* is endemic to western Japan, while *BS* from overseas has been introduced to most lowlands. Our survey of mtDNA haplotypes in eastern Japan has detected introgression significantly more frequently across collection sites of *BP* than of *BS*, regardless of allopatry or sympatry. This pattern of introgression would normally be interpreted that mtDNA leaks from *BS* to *BP* more often or easily than vice versa, with little doubt of hybrid production by *BS*. On the contrary, we found that *BS* seldom produces hybrids, despite simultaneous reciprocal copulation with *BP*. The latter instead produces hybrids with no breakdown. Then, another ordinary interpretation is that *BS* leaks mtDNA by backcrossing with hybrids. We again, however, found that *BS* copulates with a hybrid but does not reproduce, while the hybrid partner does. These crossing experiments indicate that mtDNA leakage from *BS* to *BP* cannot be easier or frequent than vice versa, against the ordinary interpretations. The frequent detection of introgression from *BS* to *BP* could only be explained by carry-over of alien haplotypes by *BP* that has recently expanded distribution, or by frequent dispersals of *BS* into *BP* populations. Our results exemplify that

introgression patterns detected by molecular markers could mislead us to wrong interpretations of non-reciprocal hybridization without examination of underlying mechanisms.

New molluscan names introduced by César-Marie-Felix Ancey

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César-Marie-Felix Ancey (1860-1906) was a keen land and freshwater snail collector with a wide geographical interest. He lived in Algeria for most of his adult life and mainly focused on snails from the Hawaiian Islands, Central Asia and South America but he also covered Europe, Africa and north America. In his short conchological career he was known to have described some 550 taxa and published over 140 papers. After Ancey's death Edouard Fischer (1908) published a list of his many small publications on mollusca and Paul Geret (1909) published a list of Ancey's introduced molluscan names. Neither of these lists were however complete, perhaps partly because Ancey's articles were often very short and he published in some obscure scientific journals. When Geret sold Ancey's collection after his death it became fragmented and now specimens mainly reside in Cardiff (Melvill-Tomlin collection), Brussels (Dautzenberg collection), Honolulu, Paris, and London (Connolly collection).

Our current project is to expand on the work already undertaken by Fischer and Geret and to provide a definitive list of Ancey's bibliography and his introduced new molluscan names. Tomlin purchased many lots from Ancey's collection in 1919 and 1923 and kept the Geret sales lists in his archive. These lists provided an excellent starting point when investigating the Ancey types located in the National Museum of Wales Melvill-Tomlin collection. We have now researched and imaged all of these specimens and labels. Through our research we have also uncovered many types in other institutions, many of which were previously unidentified. We are compiling all of this information into a museum publication which will provide a strong starting point for researchers hoping to make revisions of any of Ancey's taxa.

Land snails diversity patterns in Uganda

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The Albertine Rift Valley has been identified as one of the major biodiversity hotspots world-wide and as an area with an extraordinary high rate of endemism. We sampled land snails in indigenous forests along the Albertine Rift and the Lake Victoria forest belt in western Uganda. 169 species of snails and slugs were recorded from 60 sites in 13 forests which are part of protected areas. The number of species per forest varies between 33 and 68. Between 4 and 44 species have been recorded per 20m x 20m plot. The majority of the species are small litter dwellers, with 73% having a major shell dimension of less than 5 mm.

There is a hump-shaped relation between species richness and altitude. Richness increased with altitude between 700 and 2000m above sea level, but decreases with altitude above 2000m. The distribution areas of the Ugandan land snails are significantly clustered. Five biotic elements can be distinguished. One is restricted to the areas above 1500m in SW Uganda, another highland element is centred in Mgahinga, the highest site (2570m altitude), one widespread lowland element is found in areas below 2000m, another lowland element in areas below 1500m and one element is restricted to the NE part of the study area (Semliki, Budonga, Mabira).

Moreover, the ranges of Ugandan land snail species are significantly nested. The nestedness of the land snail fauna might have been caused by range restrictions during the Pleistocene cold ages. The geographic centre of the sets of nested subsets is in the mountains in SW Uganda close to the supposed East-Congolian forest refuge. Differential immigration of species restricted to the refuge during the glacials was probably an important mechanism resulting in the observed nestedness of the ranges of the Ugandan land snail species.

Effect of a novel molluscicide on the snail *Oncomelania hupensis*

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In recent years, a cooperative project between the Hubei Institute of Schistosomiasis Control and the Tongji Medical College has developed a novel molluscicide (LDS). In order to further understand the effect of this molluscicide, parallel trials were undertaken with both LDS and Niclosamide against *Oncomelania hupensis*. Application methods included immersion, spraying and powder applications. For immersed snails, mortality was affected by temperature (LDS 0.4mg/l mortality at 20 °C, 25 °C and 30 °C was 96.7%, 100% and 100% respectively). In field trials, immersion in 0.4mg/l for 24, 48h and 72h at temperatures between 15 to 24 °C led to mortality rates of 92%, 100% and 100% for LDS and 60%, 76%, and 96% for Niclosamide.

When a spray method of application was investigated in the laboratory, 0.4g/m² at 25 °C gave a seven-day mortality rate of 100% for LDS and 96% for Niclosamide. Spraying in the field at temperatures of 15-24 °C and concentration of 0.2g/m², 0.4g/m² and 0.8g/m² gave a three-day mortality rate of 81.4%, 97.0% and 100% respectively for LDS, and 54%, 87% and 91% respectively for Niclosamide.

Powder application in the lab of 0.4g/ m² at 25 °C gave seven-day mortality rates of 92% for LDS and 94% for Niclosamide. In the field, powder application at temperatures of 15-24 °C and concentrations of 0.2g/ m², 0.4g/ m² and 0.8g/ m² gave three-day mortality rates of 70%, 90% and 99% respectively for LDS and 58%, 85% and 90% respectively for Niclosamide. LDS seems to be an interesting contender as a control agent for *O.hupensis*. The effects on other target snails which are vectors of fascioliasis and African schistosomiasis are under investigation.

Malacofauna of Akdağ (Keçiborlu, Isparta, Turkey) and its environs

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According to surveys carried on between 1993-2006 of the malacofauna in 13 stations representing Akdağ (1889 m) and its environs (province Isparta), apart from 15 aquatic snails, it has been determined that 40 land snail species (ordo Stylommatophora) are found in the area. Among these species 15 are endemic to Turkey (appr. 38%) and 5 are exclusively endemic to the study area. The 5 narrow endemics, the enid *Borlumastus yildirimi* (monotypic genus) and all clausiliid taxa to exist in the area (endemic genera Phrygica and Sprattia), reflect the biogeographical isolation from the surrounding heights

***Graecoanatolica* (Radoman, 1973) (Rissooidea: Hydrobiidae) species of Turkey**

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Graecoanatolica, single genus to tribus Graecoanatolicini RADOMAN, 1973, is known to be distributed in two disjunct areas: Macedonia, Greece and Turkey. In central western Anatolia ('Lakes region') namely *G. pamphylica*, *G. lacustrisurca*, *G. tenuis*, *G. kocapinarica*, *G. conica*, *G. brevis* have previously been reported. However, due to habitat alterations *G. conica* is now can not be seen, while *G. kocapinarica* is under serious threat.

With this study also a new taxon, *G. wilkei*, is introduced as new to science.

Biodiversity loss in the Lakes Region of Turkey, with Special emphasis on the malacofauna

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The lake system in southwestern Turkey is recognizable with high biological diversity and endemism. The two shallow, tectonic lakes interconnected via a channel, Kovada and Eğirdir, are within province Isparta. Lake Eğirdir, second largest fresh water lake in Turkey, has a great economical value due to uses for fishery, tourism, irrigation and obtaining drinkable water. Lake Kovada, on the other hand, was announced as a national park and mainly has a recreational value. Discharge of fertilizers and other pollutants, alien introductions, and other linked practices have been seen serious threats to aquatic biota, resulting in the decline and extinction of populations. From the lakes and sources connected to the lakes, totally 8 prosobranch (6 endemics), 14 basommatophoran gastropods (1 endemic), and 3 bivalve taxa haven been determined so far. In the present study, present and past status of the biodiversity of the lakes and threats are summarized. Affiliations of the present status with the populations of mollusks, problems and possible conservative strategies to be followed are discussed.

Threshold dimorphism in ejaculate characteristics associated with alternative reproductive behaviours in the squid *Loligo bleekeri*

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Male dimorphism has been thought to correlate with alternative reproductive behaviours. Alternative reproductive behaviours promote asymmetry in sperm competition, and sperm competition theory in a "fair raffle" process (the more sperm put in, the higher the chances of success) predicts that males invest more energy on sperm production and ejaculate more when they have disadvantages in behavioural competition. Coastal squid *Loligo bleekeri* has body-size related alternative mating behaviours and characteristic sperm competition situation. Females have two sperm storage sites in their body, and males have two mating behaviours (mate-guarding and sneaking) associated with each sperm storage site. We show that there is clear dimorphism in internal character (spermatophore length) in males using allometric analysis. Larger individuals made discontinuously longer spermatophores than smaller individuals, although no such discontinuity was observed for external characters. Sperm mass ejaculated from long-type spermatophores had a rope-like shape, and those ejaculated from short-type spermatophores had a drop-like shape. Observations on each sperm mass attached on the different body parts of females showed that the rope-like sperm mass were attached in the sperm storage site of females, where paired males pass spermatophores during mate-guarding copulations. In contrast, the drop-like sperm mass were attached on the sperm storage site of females, where small males pass spermatophores during sneaking copulations. The clear internal-morphological switch could be an adaptation to the characteristic alternative mating behaviours of loliginid squid, in which males employing each mating tactics pass spermatophores on different sperm storage sites of females. The result that small males make relatively shorter spermatophore suggests that male squid may allocate sperm resources dependent on rules other than a standard "fair raffle" principle. Our results indicated that alternative reproductive behaviours promote morphological adjustment in internal character, under different roles of sperm competition game.

Population dynamics, growth and secondary production of *Nassarius vibex* (Say, 1825)

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The growth, production and population dynamics of *Nassarius vibex* (Gastropoda, Nassariidae) were analysed in a population at Camaroeiro sandy beach (23°37'62''S, 45°23'86''W), north coast of São Paulo state, Brazil. The species occurred in a soft bottom bed of *Mytella charruana* (Bivalvia, Mytilidae) (Area A) and in its superior adjacent region (Area B). Four replicates were obtained in each area, using a quadrat with 1m² of area. The shell length of 1465 gastropods was measured with a digital caliper. Significant difference ($T=-7.57$, $p<0.05$) were observed between densities of area A (72.34±7.92 individuals per m²) and area B (15.68±7.68 inds per m²). Over the months (February 2006 to February 2007) an elevation in the density was observed in August and maintained constant until December. Inversely, in area B, a significant reduction in density occurred from September ($H=34.52$, $p<0.05$). A non-linear regression analyses fitted to the Von Bertalanffy growth function was used for growth analysis of *N. vibex* ($K=2.622±0.523$, $L∞=17.674±0.278$, $T_0=0.146±0.05$). The species presented a fast growth in its the early stages of life, with a estimate longevity of 3 years. There were no significant differences in the mean shell length between the months (Annual mean:

16.38±0.65) with minor reductions occurring in August and December due to recruitment peaks. Annual production (P) was 0.32g AFDM m⁻² y⁻¹ and the mean biomass 0.99g AFDM m⁻² with a P:B relation of 0.32.

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Sexual selection and sex allocation in *Aplysia*: Hermaphrodites with nonreciprocal mating

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In this presentation, I will review my own work on sex allocation and sexual selection in *Aplysia* spp. (mainly *A. kurodai*; Gastropoda: Opisthobranchia). Most current theories predict a male-to-female shift in sex allocation with growth and weak sexual selection on the male function in simultaneous hermaphrodites, although empirical data for both predictions are insufficient in hermaphrodites with nonreciprocal mating.

To address these issues, I first studied sex allocation patterns in *A. kurodai*. Laboratory observations showed that both frequency and duration of egg-laying increased with body size. In a controlled experiment, egg mass weight actually increased almost linearly with body weight. On the other hand, both laboratory and field observations showed that frequency and duration of mating as males did not increase with body size, suggesting that sperm usage was independent of size. Therefore, sex allocation in *A. kurodai* shifted from male to female functions with growth.

Next, concerning sexual selection before and during mating, the lack of a relationship between body size and mating activities as males suggests that there was virtually no "female" choice or inter-"male" competition with respect to body size. However, frequency and duration of mating as females increased with body size, suggesting a "male" choice for large, and hence more fecund, partners. This "male" choice is further supported by the presence of size-assortative mating. In addition, the variance in mating frequency as females was similar or larger than that as males. These results imply that the direction of sexual selection before and during mating are weakly reversed in *A. kurodai*, acting more strongly on the female than male function. However, due to multiple mating, sexual selection after mating should act more strongly on the male function.

Population genetic structure of a sympatric squid-*Vibrio* mutualism in the Mediterranean Sea

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Squids from the genus *Sepiola* (Cephalopoda: Sepiolidae) living sympatrically in the Mediterranean Sea form a mutualistic symbiosis with two species of the *Vibrio* genus: *V. fischeri* and *V. logei*. Environmentally transmitted symbionts inhabit the light organs and produce ventrally-directed luminescence used in anti-predatory behavior. The light organ expulses symbiotic bacteria daily, and is subsequently re-colonized by the remaining *Vibrio* bacteria in the light organ. This diurnal event has led to phylogeographical variation within the squid-*Vibrio* system in other regions of the world (Indo-Pacific). Although the symbiosis amongst sympatric *Sepiola* species and both species of *Vibrio* in the Mediterranean has been well documented; the genetic structure of the host squid and *Vibrio* symbiont has not been described. Using nested-clade analysis we have investigated the genetic variation within host and bacterial symbiont populations in the geographical range of the Mediterranean. The results demonstrate a localization of haplotypes in the host squid populations closely related to the physical range of the host. *Vibrio* symbionts show a broader number of haplotypes over a wider geographic area suggesting a strong influence of migratory forces, both biotic and abiotic. Biotic factors such as host movement within the Mediterranean as well as abiotic

influences such as currents may contribute to the diversiform genetic architecture of the symbiont population observed in this study.

Data about two species of Solenogastres of the NW Iberian Peninsula

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The DIVA-ARTABRIA Campaigns have as their main aim the study of the biodiversity of the organisms of the bathial deep-sea benthos in the western coast of Galicia (NW Spain). Numerous specimens of Mollusca Solenogastres were collected during the 2002, 2003 and 2004 campaigns and the first anatomical data of two species are presented herein.

Wirenia sp. (Pholidoskepia). 800 m depth. 2.3 - 3.5 x 0.3-0.6 mm. Thin cuticle (5 µm) without epidermal papillae. Lanceolate scales with a long keel that doesn't reach the base, with a rounded base and a basal and lateral reinforcement (100-137 µm). An only atriobuccal cavity. Pedal groove with a fold. Sacciform sense organ at the first ventral commissure. Distich radula with two medial denticles per tooth. Without vesicles or seminal receptacle. Paired/unpaired genital orifice in a bag placed dorsally to the rostral canal of the paleal cavity. Pair of copulative stylets that come out into the dorsal bag. Paleal cavity with two lateral bags that provide the paleal cavity the shape of a T. Ten respiratory folds. Dorsoterminal sense organ. This species is similar to *Wirenia argentea*, with some differences in the final end of its reproductive system.

Hemimenia sp. (Cavibelonia). 1000 m depth. 7.6 x 1-1.2 mm. Thin cuticle (25-30µm). Developed matrix (50-150µm). Four types of sclerites. Foregut divided in two regions (a very short posterior one) by a strong muscular ring. With seminal receptacles. Without seminal vesicles. The spawning ducts are paired throughout, opening by means of a common short cone. Two pairs of copulatory stylets with gland: the stylets consist of a spine and a gutter-like element arranged ventrally to the spine. A pair of midgut sacs that surround the copulative stylets partially. Two groups of four prepaleal stylets. 9-10 respiratory folds. *Hemimenia* sp. is close to *H. cyclomyata*, from the same geographic area, but it differs in its developed matrix, short posterior foregut, midgut sacs and in its ventral gutter-like elements.

**Diversity of sub-antarctic and antarctic Scissurellidae and Anatomidae
(Gastropoda: Vetigastropoda): Consequences for the region's biogeography**

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The southern tip of South America, the so called Magellan Region, and the adjacent Antarctic areas were linked in the past, as part of the Gondwana supercontinent, and are physically and geographically separated at present. Under this framework, the study of the molluscan fauna can be used to address particularly interesting questions pertaining to evolution and biogeography, among them, those that refer to the effects of the Polar Front as a biogeographic barrier, and the West Wind Drift as a possible disperser.

In the present study we performed a systematic revision of the species of Scissurellidae and Anatomidae occurring in the Sub-Antarctic and Antarctic Southern Ocean and, based on the geographic distribution exhibited by these species, we re-evaluate the faunistic affinities between the Magellan and Antarctic Regions. This study was based on the material collected during several field trips, and the examination of museum collection.

Out of 15 nominal species of scissurellids and anatomids previously reported from Sub-Antarctic and Antarctic waters, twelve proved to be valid species, and the remaining three species were synonyms. The generic allocation of all these species was confirmed through SEM. In addition, three new species were found. The examination of the radula morphology and gross anatomy provided additional characters for generic definitions.

The studied species showed varied distributional patterns, ranging from species with rather restricted geographic distribution to widely distributed species. However, the Polar Front is regarded as a strong biogeographic barrier for scissurellids and anatomids, separating two different realms: a group of Sub-Antarctic species at the north, and a second group of Antarctic species at the south; only one scissurellid species occurred at both areas. As part of this study it was possible to confirm the circumantarctic distributions of three of the species, a pattern most probably facilitated by the West Wind Drift.

Eye structure and vision among gastropods

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Species, living in different light environments, are compared with each other in relation to retinal designs, optics, cellular composition of the retina and visually-guided behaviour. The eyes of some aquatic pulmonates do differ from those of terrestrial pulmonates; the latter, in species such as *Cepaea nemoralis*, *Trichia hispida*, *Arion rufus* and *Deroceras agreste* possess conventional, cup-shaped retinas, but the aquatic species *Lymnaea stagnalis*, *Radix peregra*, *Physa fontinalis*, and *Planorbarius corneus* have retinas that are partitioned into dorsal and ventral depressions. The eyes of *L. stagnalis* and *R. peregra* are well adapted to function in both water and in air, but the eyes in *P. fontinalis*, *Pl. corneus* are less modified from those of their terrestrial ancestors. Terrestrial snails and slugs have relatively poor vision. Good resolving power may be of greater importance in aquatic pulmonates than in the terrestrial species. Theoretical calculations of the eye's performance are supported by behavioural tests. The dominant cellular components of the retinae are pigmented (supportive) cells and microvillar photoreceptors, the latter occurring in two morphologically distinct types that likely represent dim- and bright-light receptors. *V. viviparus* has only one type of

photoreceptor cell, where cilia and microvilli are present together. A rhodopsin-retinochrome system was demonstrated in the eye of *Onchidium*. Retinal neurosecretory (in *A. rufus*) and glial cells (in *L. stagnalis*) are developed. The presence of efferent innervation in the eyes and visuo-vestibular conditioning are shown in *L. stagnalis*. To fully understand the morphology and functional integrity of the gastropod eye, results on reparative eye-morphogenesis in the land snail *Achatina fulica*, which has an additional eye like that of *D. agreste*, are discussed. Attention focuses on visual ecological adaptations, specific visual needs and the evolutionary history of the molluscs.

ERRATA

The abstract of Iwata, Yoko; Sakurai, Yasunori (Threshold dimorphism in ejaculate characteristics associated with alternative reproductive behaviours in the squid *Loligo bleekeri*) is not listed alphabetically. This abstract can be found on page 247.

The abstract of Martins, António M. de Frias (Punctuated equilibrium alive? How living Azorian *Drouetia* Gude, 1911 (Gastropoda: Pulmonata: Zonitidae) can tell a fossil story) is not listed alphabetically. This abstract can be found on page 47.

We apologise for this inconvenience!

ADDENDUM

Feeding mechanism in volutids from north Patagonian shallow waters

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The volutids *Odontocymbiola magellanica* (Subfamily Odontocymbiolinae) and *Adelomelon ancilla* (Subfamily Zidoninae) occur along the South Atlantic coast from 35°S, down to the Magallanes Strait. These neogastropods are sympatric species in north Patagonian gulfs belonging from different subfamilies, have different radula shape and position of salivary and accessory salivary glands, but observations done in natural environment revealed that they have a similar feeding mechanism. In a first step of capture, both species strongly engulfed the prey with their foot, creating a cavity which is closed but not isolated from the environment. After around 10 hours, prey are narcotized by a white liquid produced in the accessory salivary glands and introduced inside this cavity by the proboscides (pH of salivary liquid is around 10). Prey narcotization leads to lower muscle speed reaction, enabling the predator to feed on the prey fresh tissues by means of its radula. This organ is very sharp in both species and tears the tissues of the living prey, so in the stomachs analyzed only a mucous mass was found. Field observations suggest that narcotization is produced due to the constant release of salivary liquid into the cavity generated by the foot, where the prey are immobilized. The analysis of prey obtained by SCUBA diving indicated that *O. magellanica* and *A. ancilla* are top predators in the benthic community, its diet consisting mainly in gastropods and bivalves. *O. magellanica* mainly feeds on gastropods (54%) and bivalves (46%). *Adelomelon ancilla* mainly consumes bivalves (90 % of the cases), follow by gastropods and in some isolated cases the sea urchin *Arbacia dufresnii* (less than 2 % of the items). In sandy bottoms, where aggregation of *O. magellanica* occurred but no other mollusks were found, intraspecific cannibalism was registered in 4.7% of the cases while *A. ancilla* did not present cannibalism.

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