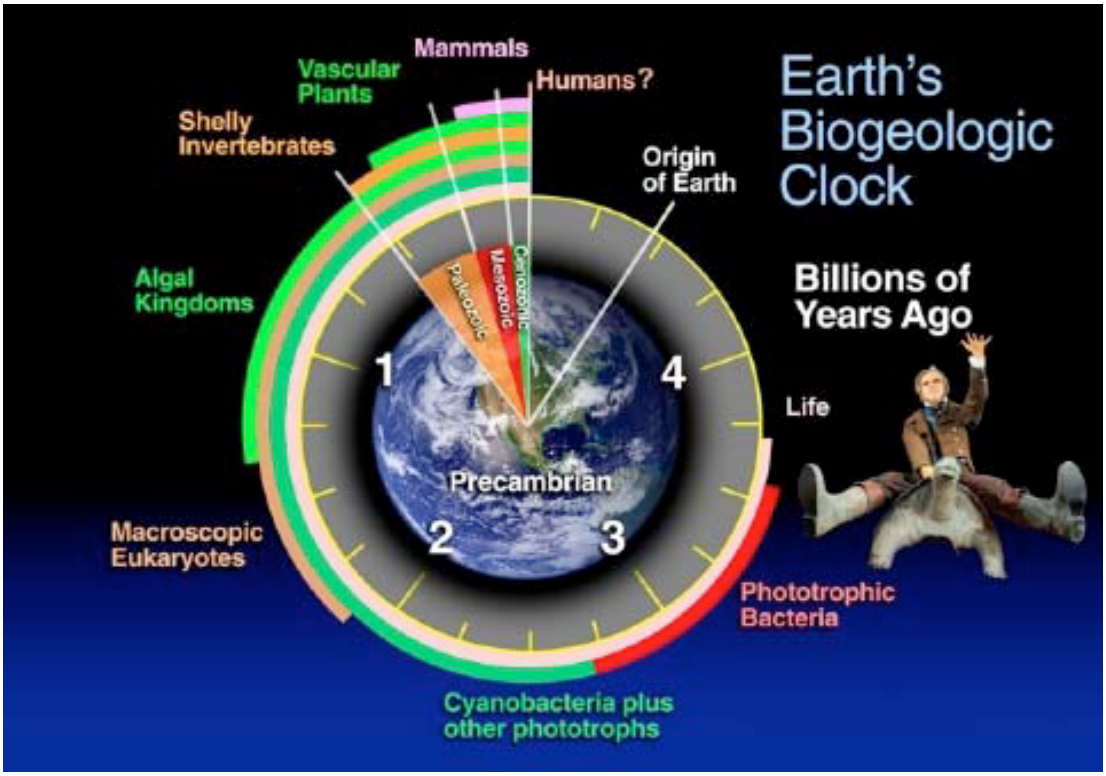
European Geosciences Union

Committee on Education



GIFT - 2011
Evolution and Biodiversity

Geosciences Information for Teachers Workshop

Vienna, Austria, 3-6 April 2011

We gratefully appreciate the permission of David DesMarais and NASA for use of the Biogeologic Clock figure.
We also wish to thank the Museum of Natural History of Vienna for the permission to use the drawing of Charles Darwin riding a Galapagos turtle in the entrance hall of the Museum during the Charles Darwin exhibition which was presented at the Museum in 2010.

European Geosciences Union

GEOPHYSICAL INFORMATION FOR TEACHERS (GIFT) WORKSHOP

Austria Center Vienna
3-6 April, 2011

Dear Teachers,

Welcome to the 9th GIFT workshop!

This year's GIFT Workshop will unite 80 teachers from 19 different countries around the general theme « Evolution and Biodiversity ».

Almost exactly 200 years since the birth of Charles Darwin (1809) and 150 years after publication of « The Origin of Species » (1859), it seemed appropriate to the EGU Committee on Education to schedule a GIFT workshop on this important topic.

In the two and a half days of the workshop we can only address the main aspects of the study of Evolution, such as the geological point of view, the molecular genetics aspects, as well as the possible influence of « external » factors such as an impact by a meteorite or huge volcanic eruptions. Aspects of recent human evolution will also be examined.

"Biodiversity" - the biological richness of an ecosystem - is the product of nearly 3.5 billion years of evolution. On Dec. 20, 2006 the General Assembly of the UN declared 2010 as the International Year of Biodiversity with the objective of limiting the loss of biodiversity. However, in the present Anthropocene, species are being lost at rates far higher than natural extinction rates, to the point that some ecologists believe that we are witnessing the sixth great wave of extinction on our planet. Our speakers will address you on this major, but often ignored by the general public, phenomenon, upon which much of our welfare depends, with the objective of making you (and through you your students!) aware of what is happening and what can be done to limit the consequences.

Even before we get « officially » started, you are in for our special yearly treat: Our traditional visit to the Vienna Museum of Natural History, through the courtesy of Mathias Harzhauser and Herbert Summesberger. Following this visit, we'll have an ice-breaker reception in the beautiful Museum.

Following the success in 2010, we have scheduled two « round table discussions » at the end of each day, one focussed on Evolution, the second on Biodiversity. Please don't be shy in asking questions to our speakers! Showing your interest is the best way to thank them for addressing you in this workshop!

Also, we have organized an Educational Poster Session, "Science in tomorrow's classroom", as part of GIFT, specifically to allow the teachers to show their classroom activities, not only to their fellow teachers, but also to all the participants in the EGU General Assembly. Many of you have submitted abstracts for this session and we thank you very much for the effort and enthusiasm. We invite ALL OF YOU to attend the poster session on Tuesday afternoon, ask questions, meet colleagues and scientists from around the world, in other words make the session as successful as last year!

To encourage communication among teachers, we have included some "teacher-to-teachers" communications in the program, one on a classroom activity (Phylogen), a second on an the Earth Sciences Olympiads for teachers in 2011, and a third about a new web site specifically aimed at making connections among GIFT teachers. Finally, an entire morning is dedicated to hands-on activities led by a science communicator.

Since 2009, we have implemented an activity called GIFT Web Conferences, by which selected talks at GIFT workshops are recorded and made available for download or streaming in the classroom via the internet. We encourage you to use this tool in the classroom and share them with your students, train them to listen to a talk in English language, and discuss the content of the talk. Previous years conferences are accessible through the EGU GIFT Workshop web pages: http://www.egu.eu/webtv/2010/gift/ and http://www.egu.eu/webtv/2009/gift/

As every year, we ask you to seriously consider the GIFT agreement we have asked you to endorse. The GIFT workshop is kindly sponsored not only by the European Geosciences Union, but also by several science organizations. We would like to continue offering teachers the opportunity to attend GIFT and similar workshops, but this depends upon us being able to show our sponsors that teachers have used the new GIFT information and science didactics in their daily teaching, or as inspiration for new ways to teach science to students in their schools.

Therefore, we ask you 1. to fill out the evaluation forms as soon as possible and send them back to us as well as 2. make a presentation of your experiences at GIFT to a group of your teaching colleagues sometime after you return from EGU, and 3. send us reports and photographs about how you have used the GIFT information in your classrooms.
We also encourage you to write reports on the GIFT workshop in publications specifically intended for geosciences teachers.

Information on past and future GIFT workshop is available on the EGU homepage. Look a http://gift.egu.eu where you can find the brochures (pdf) and also the slides of the different presentations given at the GIFT workshops for the last 7 years.
We hope that you enjoy and learn during your time at the 9th GIFT workshop!

Carlo Laj
On behalf of the Committee on Education of EGU

Acknowledgements

The GIFT-2011 workshop has been organized by the Committee on Education of the European Geosciences Union. EGU has supported the major share of the expenses, but the workshop has also benefited of the generous help of:

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Department of Earth Sciences

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Istituto Nazionale di Geofisica e Vulcanologia

Darwin Centre for Biogeosciences

National Science Foundation

Secretaría de Educación, Gobierno del Estado de Yucatan

And we thank all the speakers who have contributed to this educational workshop and their institutions

European Geosciences Union
Committee on Education

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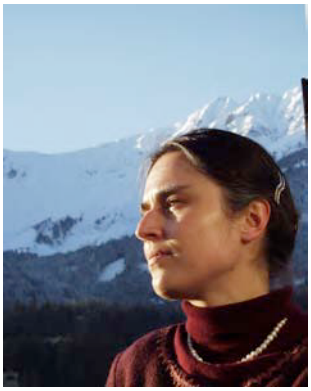

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Jean-Luc Berenguer

Phil Smith

Herbert Summesberger

Program

European Geosciences Union - General Assembly
GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP

Austria Center Vienna, 3-6 April 2011

Room 29

Evolution and biodiversity

Programme

Sunday April 3, 2011

16:30 - 18:30 **GUIDED TOUR OF THE VIENNA MUSEUM OF NATURAL HISTORY** and ice breaker reception
Herbert Summesberger and Mathias Harzhauser
Vienna Museum of Natural History

Monday April 4, 2011

Chairperson: Carlo Laj

08:30 - 08:45 **WELCOME !**
Tujia Pulkkinen or Donald Bruce Dingwell
President and Vice-President of EGU

PRACTICAL INSTRUCTIONS FOR THE WORKSHOP
Carlo Laj
EGU Committee on Education

08:45 – 09:15 **EVOLUTION – THE GEOLOGICAL POINT OF VIEW**
Mathias Harzhauser
Vienna Museum of Natural History
Vienna, Austria

09:15 – 10:00 **THE EVOLUTION OF SEGMENTATION**
Guillaume Ballavoine
Institut Jacques Monod
CNRS-Université Paris Diderot
Paris, France

10:00 – 10:30 **COFFEE BREAK**

Chairperson: Herbert Summesberger

10:30 – 11.15 **THE HUMAN FOSSIL RECORD IN THE POSSESSION OF THE NATURAL HISTORY MUSEUM VIENNA**
Maria Teschler-Nicola
Natural History Museum
Vienna, Austria

11:15 – 12:00 **"BACK TO THE TREES"**
OR HOW TO BUILD PHYLOGENETIC TREES WITH "PHYLOGEN"
Guillaume Dandrey, Paul Pillot and Jean-Luc Berenguer
Science teachers in Valbonne
Sophia Antipolis, France

12:00 – 14:00 **LUNCH** (SANDWICHES)

Chairperson: Jean-Luc Berenguer

14:00 –14:45 **THE DELICATE BALANCE BETWEEN CHICXULUB IMPACT AND/OR DECCAN TRAPS INDUCED MASS-EXTINCTIONS AT THE K-PG BOUNDARY**
Jan Smit
Free University
Amsterdam, The Netherlands

14:45 –15:00 **DISCUSSIONS AND POSTERS (IN ROOM 29)**

15:00 - 15 :30 **COFFEE BREAK**

Chairperson: Francesca Cifelli

15:30 –16:15 **THE EVOLUTION OF INSECTS: A TRIPLE JUMP TO SUCCESS**
Günter Bechly
State Museum of Natural History,
Stuttgart, Germany

16:20 –17:20 **ROUND TABLE**
QUESTIONS ON EVOLUTION TO OUR SPEAKERS
Moderator: *Carlo Laj*

17:20 – 17:30 **INSTRUCTIONS FOR THE POSTER SESSION EOS03**
Angelo Camerlenghi

Tuesday, April 5, 2011

Chairperson: Angelo Camerlenghi

08:30 – 09:15 **YOU SAID…BIODIVERSITY?**
Gilles Boeuf
Museum National de Sciences Naturelles
Paris, France

9:15 – 10:00 **WHY IS THE SEA SO DIVERSE?**
Begoña Vendrell-Simón and Josep-Maria Gili
Department of Marine Biology and Oceanography, ICM-CSIC
Barcelona, Spain

10:00 – 10:30 **COFFEE BREAK**

Chairperson: Annegret Schwarz

10:30 – 11:15 **THE EUROPEAN SPACE AGENCY AND THE INTERNATIONAL ENVIRONMENTAL CONVENTIONS**
Marc Paganini
Directorate of Earth Observation Programmes Science, ESA-ESRIN
Frascati, Italy

11:15 – 12:00 **NATURA 2000 IN SCHOOLS**
Michael Altmoss
Office for Environment, Water Resources management and Trade Control (LUDW)
Mainz, Germany

12:00 - 13:30 **LUNCH** (SANDWICHES)

Chairperson: Eve Arnold

13:30 - 14:15 **GEOBIOLOGY: CUTTING-EDGE RESEARCH THAT IS EXPANDING THE FRONTIERS OF SCIENCE (LIFE AROUND HYDROTHERMAL VENTS)**
Elinor Bartle
Centre for Geobiology, University of Bergen
Bergen, Norway

14.15 - 15.15 **ROUND TABLE**
QUESTIONS ON BIODIVERISTY TO OUR SPEAKERS
Moderator: *Angelo Camerlenghi*

15:15- 15:45 **COFFEE BREAK**

Chairperson: Phil Smith

15:45 – 16:05 **FROM GIFT TO ECO-SCHOOLS: A WEB SITE TO WORK IN INTERNATIONAL PROJECTS**
Laurence Durand
Biology and geology teacher
Lycée Camille Saint-Saens, Rouen, France

16:05 – 16:20 **INTERNATIONAL EARTH SCIENCE OLYMPIAD -** IESO
Roberto Greco
Modena and Reggio Emilia University
Modena, Italy

16:30 – 19:00 **EOS3 POSTER SESSION**

Wednesday April 6, 2011

Chairperson : Stephen Macko

08:30 – 10:00 **UNDERSTANDING EVOLUTION**
HANDS-ON ACTIVITIES
Jennifer Skene
Lawrence Hall of Science, University of California
Berkeley, USA

10:00 – 10:30 **COFFEE BREAK**

Chairperson: Carlo Laj

10:30 – 11:00 **UNDERSTANDING EVOLUTION (CONTINUED)**

11:00 –12.00 **ANTARCTIC PENGUINS AND CLIMATE CHANGE**
Yvon Le Maho
Institut Pluridisciplinaire Hubert Curien
University of Strasbourg and CNRS
Strasbourg, France.

12:00 – 12:30 **Conclusions and writing evaluation**

12:30 **LUNCH and GOODBYE !**

Speakers

Dox. Dr. Mag. Mathias Harzhauser

Head of Department

Naturhistorisches Museum Wien,
Burgring 7, 1010 Wien, Austria

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1983-1991	humanistic Gymnasium in Hollabrunn
1991	enrolment at the University Vienna (Earth Sciences)
1996	master thesis under the leadership *of* Univ. Prof. Dr. F. F. Steininger "*Die Molluskenfauna des Ober- und Nieder-österreichischen Oberoligozäns (Egerium)"*
1997	employment at the Deutschen Forschungsgesellschaft (DFG Projekt "*Palaeogeographic and palaeobiogeographic development of the Eastern Mediterranean to Western Indo-Pacific in the Late Oligocene to Early Miocene")*
1997	temporary employment at the Natural History Museum Vienna (curator for microfossils and Cenozoic molluscs, conception of a new earth-science gallery)
1999	marriage with Elke Kreditsch
2000	PhD thesis: *Paleobiogeography of the Oligocene and Lower Miocene Gastropoda of the Eastern Mediterranean and the Western Indo-Pacific* under the leadership of Univ. Prof. Dr. Werner E. Piller (University Graz) and Univ. Prof. Dr. F. F. Steininger (Senckenberg Museum Frankfurt)
since 2000	regular employment at the Natural History Museum Vienna
2000	Erich Thenius Scholarship
2001	graduation at the Austrian Academy of Administration
2002	Otto Ampferer Award
2003	Science Award of the City of Vienna
since 2003	lecturer at the Universities Graz and Vienna
since 2004	appointment of the Director of the Geological-Paleontological Department of the Natural History Museum Vienna
2005	habilitation (University Graz)

Projects

FWF P-21414-B16 Millennial- to centennial-scale vegetation dynamics and surface water productivity during the Late Miocene in and around Lake Pannon (Leader: M. Harzhauser)

FWF P-18189-N10 Biogeographic Differentiation and Biotic Gradients in the Western Indo-Pacific during the Late Oligocene to Early Miocene (Leader:W.E. Piller)

FWF P-18519-B17 Evolution within Isolated Ecosystems: The Neogene Dinaride Lake System (Leader:O. Mandic)

FWF 19013-B1 Spatial variability in the fossil record of diversity and drilling predation in Eocene to Recent quantitative molluscan assemblages (Leader:M. Zuschin)

FWF P-13745-Bio Evolution Versus Migration: Changes in Austrian Marine Miocene Molluscan Paleocommunities (Leader: M. Zuschin)

FWF P-14366-Bio Stable Isotopes and changing Miocene palaeoenvironments in the East Alpine region (Leader: W.E. Piller)

DFG STE 857/1-1 Palaeogeographic and palaeobiogeographic development of the Eastern Mediterranean to Western Indo-Pacific in the Late Oligocene to Early Miocene (Leader: Fritz F. Steininger)

ÖAW FIR0117-42110 Integrated Facies-Analysis in the Oligo-Miocene of the North Alpine Foreland Basin (Leader: W.E. Piller)

RAG V-79159 Integrated Facies-Analysis in the Oligo-Miocene of the North Alpine Foreland Basin (Leader:M. Harzhauser)

ESF EEDEN Environments and Ecosystem Dynamics of the Eurasian Neogene (Leader: J. Meulenkamp)

ESF NECLIME Klimaentwicklung und terrestrische Ökosysteme im Neogen Eurasiens (Leader: V. Mosbrugger)

Evolution – the geological point of view

Mathias Harzhauser

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Biologists have learned to read the genetic code of organisms and gradually understand the intrinsic factors of evolution. This source of information remains out of reach for earth scientists. Nevertheless, this community may provide important contributions for the understanding of evolution by focusing on the extrinsic factors. It's not only the regularly striking "inner clock", as presented by mutations, that causes the rise and fall of species. Already Darwin recognised the importance of extrinsic processes, such as natural selection. The study of Earth's history, however, documents that even the arms races and competitive interactions between organisms cannot explain the full spectrum of evolutionary developments. These are strongly influenced by unpredictable global and cosmic events. Major perturbations of earth's climate, sea-level changes, asteroid impacts, and the continental drift turned out to be crucial driving forces for the evolution of life. But even this holistic approach is probably too simple. To understand the pace and traits of evolution it is necessary to step back to the very beginning of the biosphere, when life started to modify its own boundary conditions on a young earth which was fundamentally different from our modern world.

Guillaume Balavoine

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Training

2004 Accreditation to supervise research , Université Paris XI Orsay.

1996 Doctorate thesis under Prof. André Adoutte, Cell Biology Laboratory, Université Paris XI Orsay.

1991 Magistère (Master) in Biology-Biochemistry, Ecole Normale Supérieure Ulm

Positions

2009- Group leader in the Jacques Monod Institute, CNRS/Université Paris-Diderot, France.

2002-2009 Group leader in the Centre de Génétique Moléculaire du CNRS, Gif-sur-Yvette , France.

1998-2002 Researcher in the Centre de Génétique Moléculaire du CNRS, Gif-sur-Yvette, France under Prof. André Adoutte.

1996-1998 Post-doctoral researcher in the Institute of Cancer and Developmental Biology (Gurdon Institute) University of Cambridge UK under Michael Akam,

1992-1994 Teaching assistant in Université Paris XI Orsay, France.

The evolution of segmentation

Guillaume Balavoine

Institut Jacques Monod, CNRS/Université Paris Diderot, Paris France.

What do a centipede, an earthworm and a human being have in common? A lot of things indeed. Even though these are animal organisms separated by huge evolutionary distances. They all are active animals. They all have a head region with a brain, a highly organised and concentrated nervous system, a complete digestive apparatus, a circulatory system. One of the most important characteristics pertains to the general architecture of the body: it is segmentation. Segmentation is the property of presenting periodical repetition of an anatomical unit along the anterior-posterior body axis. This is most obvious for the centipede and the earthworm: most of the length of their bodies is made of almost identical segments visible externally as rings. Segmentation extends to external appendages in the centipede (one pair on each segment) and to internal organs, most notably at the level of the nervous system made of a chain of identical ganglia in both groups. In a vertebrate like human beings, segmentation is less obvious on an external point of view but the skeleton is built around a chain of vertebrae. The spinal cord bears pairs of peripheral nerves issuing regularly from in between the vertebrae. Last, in bony as well as cartilagineous fishes to which our own ancestors resembled, muscles are organised in segments in the same register as the vertebral column.

Platynereis dumerilii

Segmentation of the trunk is thus an architecture common among animals. How did this come to be during the evolution of animals? Has it appeared separately several times among non segmented ancestors? Or on the contrary, is it a very ancient

characteristics of the last common ancestor of at least the most complex animals, known as the bilaterians? Has segmentation appeared as an adaptative trait under the control of natural selection? Or is it just an ancient architectural trait that has evolved divergently in each animal group, to the point of disappearing entirely in many lineages? These are very old questions asked repeatedly since the emergence of the theory of evolution in the nineteenth century but these questions have remained without answer to these days.

What has changed today that allows researchers going further on these questions? Simply we have discovered what developmental genes are. We have a good knowledge at least in the most common laboratory animals of the genes that control key aspects of the early embryonic development when the basic characteristics of the body architecture are laid down. This includes genes that are responsible for the determination of the anterior-posterior polarity, the identity of each body section on this axis, the dorsal-ventral differentiation as well as the formation of limbs. Most importantly, the fruit fly, the star of laboratory genetics for more than a century, has allowed the identification of the whole complement of genes that are necessary for making segments. More recently, progresses have been made in vertebrate laboratory animals (first in the chick, then in the mouse and the fish) to identify the genes that are responsible for the segmentation of the skeletal axis. My laboratory in the institute Jacques Monod works on a much more unusual model animal, an annelid worm. Annelids are particularly interesting because they are the closer to what one may describe as "idealized segmentation". Their body is almost entirely made if nearly identical segments, sporting the same appendages and containing the same internal organs.

Does the comparisons of genes responsible for segmentation say about its evolution? The picture is complex. Within a given phylum, such as the arthropods or the vertebrates, the genetic mechanisms for segment formation are remarkably similar. This means that similar genes are involved in defining the boundaries of segments. Distant animals belonging to different phyla make their segments differently, often making use of different genes. However, despite the huge evolutionary distance, there are intriguing similarities that cannot be explained by coincidence. This would mean, although this is still a matter of heated debate between the specialists, that despite the enormous morphological differences between the segments of these phyla, they all derive from an ancestor that would have displayed some kind of segmentation. This scenario in a way goes well with what we know of animal evolution through the fossil evidence. In the so-called "Cambrian Explosion", 540 million years ago, most complex animal groups emerged at the same time including all segmented groups. This remarkable event of body plan diversification happening in a short time span is much more understandable if we assume that the last common ancestor was itself a complex animal that did already display segmentation.

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Curriculum vitae

1971-1976 Studies in Human Biology, European Ethnology and Medicine, University of Vienna

June 1976 Dr. phil.

1972-1976 Research (student) assistant at the Institute of Human Biology, University of Vienna

1976-1982 Research assistant at the Institute of Human Biology, University of Vienna

1982 Curator (Somatological Collection) at the Department of Anthropology, Natural History Museum Vienna

1993 Habilitation (postdoctoral qualification) in Human Biology ("Population biology of early Bronze Age in Eastern Austria ")

1997 Interim head of the Department of Anthropology, Natural History Museum Vienna

1998 Director of the Department of Anthropology, NHM Vienna

2000 Appointed to Adjunct University Professor

Research interests:

Archaeometry, paleopathology and –epidemiology, paleoanthropology, population biology, history of anthropology

Teaching:

- Somatology (for students of the University of Music and Performing Arts Vienna)
- Practical courses in Osteology/prehistoric Anthropology and Palaeopathology (since 1979, running, University of Vienna)
- Excursions to important places of discovery of hominid specimens (since , University of Vienna

- History of Anthropology (since 2005, University of Vienna)

Scientific and public activities/services:

- Organizer of workshops and conferences (e.g., 18th European Meeting of the Palaeopathology Association)
- Organizer of temporary exhibits at the NHM („Mensch und Kultur der Bronzezeit“ [“Humans and culture of the Bronze Age”] (1988-1989); „Gesucht: Neandertaler. 150 Jahre evolutionärer Spurensuche“ [“Neandertals: 150 years of evolutionary inquiry”] (1998-1999); European Union exhibition „Neanderthaler“ (2000-2001, co-operation with Spain, England, Belgium); Co-organizer of numerous exhibitions with emphasis on archaeology/anthropology and history of anthropology in regional and city museums.

Other Activities:

- Member of the editorial board of “Anthropologischer Anzeiger”, Scientific board member of the “Journal of Comparative Biology (HOMO)”, Collaborator of “Anthropologie” (Brno)
- Member of the “Commission for Prehistory of the Austrian Academy of Sciences”
- Member of the board of the German Society for Anthropology, chair of the working group for paleoanthropology and prehistory (1994-1997)
- Member of the board of the friends of the Vienna Natural History Museum (since 1995), Member of the board of the Anthropological society of Vienna (since 1998)
- Honorary member of the Croatian Society for Anthropology

Awards/Prizes:

- Several “Best contributions to Conferences”, Würdigungspreis Wissenschaft d. Landes Niederösterreich 2010.

The human fossil record in the possession of the Natural History Museum Vienna: Historical aspects and significance for questions concerning the evolution and spread of early modern humans in Europe

Maria Teschler-Nicola

Natural History Museum Vienna
Department of Anthropology
Vienna, Austria

The early Upper Palaeolithic human fossils from the Mlade_ (Lautsch) cave (*Fürst Johann's Höhle, Moravia, Czech Republic*) are among the most valuable inventories of the Vienna's Natural History Museum. They are closely associated with the early history of the museum and remain at the centre of scientific discussion in regard to the biological and cultural evolution of anatomically modern humans.

The history of the retrieval and preservation in particular of the Mlade_ finds is marked by circumstances that are both fortunate and tragical: Geologist Ferdinand von Hochstetter, very successful in a variety of positions, and acting for a number of institutions in Austria played a key role not only in establishing the "science of man" in Vienna, but also in the discovery of the Mlade_ remains. In 1881 and 1882, Josef Szombathy, Hochstetters assistant, recovered sensational finds there, among them human cranial, post-cranial, and teeth and jaw fragments of a minimum of six individuals as well as faunal remains and archaeological objects.

It is due to some fortunate circumstances that practically all the Mlade_ finds donated to the Anthropological-Ethnographical Department of the imperial-royal Court Museum of Natural History, all in all 32 specimens, survived two World Wars without suffering any damage;

Regrettably, the bulk of other specimens that were recovered later by Czech scholars and consolidated at the Moravske zemske Muzeum, Brno, were destroyed by fire, which was intentionally torched by the retreating troops and the local Nazi party in 1945.

Josef Szombathy presented and interpreted the complete assemblage of the human specimens in 1925. His work remained for many years the only comprehensive treatment of the Mlade_ cave and its human remains. Up from the 1970s they came into the focus of scientific debate again, thereby contributing, *inter alia*, to a discussion of the models developed to describe the origin of anatomically modern human beings, the multiregional and the Out of Africa model. It was realised by Milford Wolpoff, David Frayer, Fred Smith, Nancy Minugh-Purvis, Jan Jelínek and others that this fossil record of anatomically modern humans was characterised by great variability and distinctive sexual dimorphism and that there was a (probable) evidence of a Neanderthal heritage for the early Upper Paleolithic.

One of the most significant outcomes of recent endeavours was the successful direct radio carbon dating of the Mlade_ assemblage. The dates (obtained by using dentine) range between 32 and 30.5 14C kyr years which put the specimens within the frame of the middle

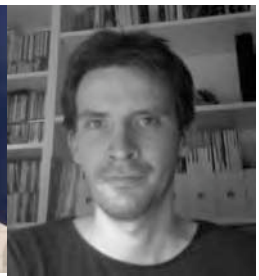
to the late Aurignacian. The results show that both, robust “males” and less robust “females”, fall into the same time period, reinforcing the fact that the variability observed within the assemblage reflects both the original population variability and probably its level of sexual dimorphism.

The skeletal remains are widely accepted as those of early modern humans since the analysis of Szombathy (1925). However, the Mlade_ remains played and still play prominently in the modern human origins debate. Since important specimens of European modern humans, such as Cro Magnon or Vogelherd, have been re-dated and attributed to the Gravettian or are Holocene in age, the Mlade_ remains now represent the key assemblage for the ongoing discussion regarding the fate of the Neandertals and the spread of early modern humans into Europe.

"Back to the trees"

or how to build phylogenetic trees with "Phylogen"





by **Guillaume Dandrey, Paul Pillot and Jean-Luc Berenguer**

Science teachers in Valbonne Sophia Antipolis, France

The ability to draw relevant information about the phylogenetic relationships between species from a phylogenetic tree has become a standard exercise in french schools. On the same line, looking at english textbooks, the analysis of phylogenetic trees has become part of the curicullums too. Besides, today's scientific literature abounds in phylogenetic trees in many areas. The 'tree thinking' is part of Biology basic culture, and leads to consider living things through an historical perspective. It is also a way of structuring biodiversity.

'Phylogen' software was developed and tested for the study of phylogenies. It became an educational tool focused on the construction of phylogenetic trees from observation, the comparison of organisms. This software is widely used in high school programs in France.

Once the notion of evolution is admitted, the aim is to establish the relationships between living organisms and the resulting classifications. '*Phylogen'* software enables to understand how the scientists process the data at their disposal to establish these phylogenetic relationships, Two methods will be proposed in the practical exercise:

- A cladistic method (parsimony) with the analysis of morphological and anatomical data to current and fossil vertebrates, '*Phylogen'* allows to discover the different steps of this approach: homology concept, polarization of the traits (here appears the concept of "descent with modifications").
- A phenetic approach (based on overall similarity) with the computing of Primates molecular data (protein and DNA sequences): molecular homology, sequences alignment, distances matrix, tree construction.

'Phylogen' allows students to understand the today's classifications concept of monophyletic groups, enlightening biodiversity's description by embedding its evolutionary history.

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Professor Event-Stratigraphy, department of Sedimentology, Faculty of Earth and Life Sciences, VU University Amsterdam, (2003-present)

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Recipient of the 1999 Mary Clark Thompson Medal of the National Academy of Sciences, Washington D.C.
Miller Visiting Professor, University of California, Berkeley, 1-30 November 1995.

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The delicate balance between Chicxulub impact and/or Deccan traps induced mass-extinctions at the K-Pg boundary

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The evidence on the mass-extinctions at the Cretaceous-Paleogene boundary (KPgB) 65.9 million years (my) ago overwhelmingly points to environmental changes induced by the Chicxulub impact on the Yucatan peninsula (Schulte, 2010). At least three other impacts of similar size must have taken place in the Phanerozoic, yet after 30 years of intensive search, a general connection between impact and extinction remains largely speculative. Moreover, at the Permian-Triassic boundary the Siberian traps eruptions are the favorite cause of the "Mother of all Mass-extinctions".

What is so special about the Chicxulub impact? Or are the mass-extinctions due to a fortuitous concurrence of Deccan traps volcanism, sealevel changes and multiple impacts? We explore the last, complex, scenario first.

The detailed stratigraphic succession across KPgB must be known in detail, before the role of each of the players in the game can be assessed. The Deccan traps began to extrude about 0.6-0.7 my before KPgB, based on marine Sr and Os isotopes (Ravizza, 2003). The Deccan traps may have led to a slight temperature increase in the deep south Atlantic, but surface waters are unaffected. Throughout the last 4 million years of the Cretaceous, planktic foraminiferal faunas are extremely diverse (>70 species). Only one species disappears and two appear. If ocean surface temperatures in this period had changed as consequence of the Deccan trap extrusions, it should have been noticeable in the diversity of planktic populations. None has been observed before the KPgB.

Changes sea-level changes have been invoked (Gale, 2008) as cause for mass-extinctions at KPgB. Late Cretaceous sequences in the US Gulf coast, Denmark, Holland and Spain, provide conflicting interpretations. In the Late Cretaceous of Holland and Denmark a pronounced shallowing is documented in the last 0.3ma of the Maastrichtian, while in the Zumaya section the temporary disappearance of ammonite shells suggests the opposite: a deepening at 0.25 my followed by shallowing at 40 ky before KPgB. A global sealevel change occurs about 0.1 my after the KPgB, in the sections mentioned above. At the KPgB itself, no unambiguous indications for a sealevel change have been documented anywhere, except in the Gulf where tsunami and gravity flow deposits with Chicxulub ejecta have been mistaken for a transgression or regression of the sea. Thus, no obvious connection exists between any sealevel change and climate changes around KPgB.

The Chicxulub impact ejecta (Ir, shocked qz, spherules) are global and occur exactly at KPgB. Thus far, only one impact ejecta layer, has been identified. However, the occurrence of multiple impacts remains a distinct possibility, as double craters exist, and a shower of impacts, possibly as result of a breakup event (such as Baptistina, Bottke, 2007) in the

asteroid belt, is possible. However, such hypothesis requires extraordinary evidence because of the extremely small probability! Thus far, the evidence for a second impact after KPgB is based on ambiguous evidence in reworked sediments in Beloc, Haiti and Coxquihui, Mexico, but nowhere outside the Gulf of Mexico. Evidence for a Chicxulub impact about 0.3 Ma before another, equally large, impact at KPgB likewise has been interpreted from disturbed sediments in the Gulf, and is therefore highly suspect (Keller, 2009). Widespread evidence from the double KPgB ejecta layer in coal-swamp deposits in the US western interior demonstrates that the KPgB impact and the Chicxulub impact are the same.

This all leaves the Chicxulub impact as the main agent responsible for the mass-extinctions. The question is, what environmental or climate changes were induced by the impact, and on what timescales? Pre-impact signals for change (diversity, stable isotope shifts) are influenced by leaching or bioturbation of the uppermost 10 cm of the Cretaceous. He-isotopes do not support a scenario where the Chicxulub impact occurs within a pedestal of cometary debris, the arrival of which could lead to environmental stress. The environmental effects of the Chicxulub impact must have been almost immediate. Even in complete sections (Kef, Brazos) the first sediments on top of the ejecta layer are highly depleted in calcareous planktic fossils. The dust-cloud darkness scenario would have decimated photosynthetic primary producers within weeks, consistent with the geological record. However, if this would be the only effect, many more of such extinctions should be detected in the geological record, which they are not. However, the dinoflagellate record adds a short-term (<50yrs) global cooling to this scenario, which is consistent with the vaporization of large amount of SOx aerosols from the anhydrite bearing impact target rocks. The 2-23 cm thick boundary clay resting directly on the ejecta provides some clues. Stable isotopes show a crash of primary production (∂13C), but also a global warming (∂18O) over some 2-5 kyrs, which may have prevented an immediate recovery of biota. Vaporized CO2 and H20 and destruction of biomass have probably led to such prolonged greenhouse, and ultimately to the observed mass-extinctions.

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Training and Positions

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The evolution of insects – a triple jump to success

Günter Bechly

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Insects are the most successful and diverse group of organisms on our planet. They have conquered almost all kinds of habitats except for the polar caps and the oceans. In tropical forests the by far biggest portion of the total biomass of animals is not represented by large mammals but by the billions of tiny ants and termites. About 150 million insects fall upon every single human being on Earth. Totally there are likely more than 2 million (maybe even up to 20 million) different species of Recent insects, of which only about one million species are already known to science. Because of their fundamental role in many ecosystems (e.g. as pollinators or vectors), insects are of crucial importance to humans as well. After all, the earliest true mammals, and thus our own ancestors, have been shrew-like nocturnal animals that fed on insects.

A key question suggests itself: Which special circumstances made insects to such a particularly successful group of animals? In the evolution of insects we find three major "jumps" that contributed to this unique success story.

The first evolutionary jump happened in the Silurian or Devonian age about 420 million years ago, and is represented by the transition from a crustacean-like marine ancestor to the first primitive insects living on land. This step could not happen before the evolution of land plants. However, the conquest of land did not initially greatly increase the diversity of early insects, which were still confined to a few primarily wingless species related to springtails, bristletails and silverfish.

The second jump apparently happened with the evolution of insect wings in the Upper Devonian or earliest Carboniferous age about 350 million years ago. Insects are first animals who invented the ability to fly, which gave them many advantages in the "struggle for survival". The evolution of flight therefore caused a first "bloom" of the

insects with a significant increase in diversity. This included giants like the proto-dragonfly *Meganeuropsis* with a wing span of 75 cm that could only exist in those times of very high oxygen content of the atmosphere. Since the Permian and Triassic age, after the great Permian mass extinction event which extinguished 90% of all species at that time, most modern insect orders are already known in the fossil record.

The biggest evolutionary jump finally took place in the early Cretaceous age about 125 million years ago, when the first flowering plants evolved. The mutual co-evolution of flowering plants and insects as their pollinators and pests led to an evolutionary race with an explosive increase in species diversity of both groups. Insects apparently were not much affected by the impact event that brought the end to era of dinosaurs, probably because they could outlive the subsequent months of ecological crisis as eggs and larval stages.

When we look at fossil insect inclusions in Palaeogene (formerly called "Lower Tertiary") amber we find almost exclusively modern groups that suggest that insect evolution was slowing down after the Mesozoic age. There was of course still microevolution on the species level afterwards and major changes of geographic distribution due to changing climate, but no significant further evolution of new body plans and no increase in general diversity.

Today mankind seems to trigger a final "jump" in the evolution of insects. Massive habitat destruction (especially deforestation of the tropical rainforests), pollution, and anthropogenic global warming results in an unprecedented man-made mass extinction event with about 50.000 species (mostly tropical insects) going extinct every year! Due to the complex ecological relationships between many species of animals and plants we simply do not know how long this extinction rate may go on until our most important terrestrial ecosystems collapse.

Gilles Boeuf

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Gilles Boeuf is specialized in environmental physiology and biodiversity. He has worked a long time on salmonid fish smoltification and migration and has studied fish development, growth and adaptation mechanisms through experimental physiology and endocrinology approaches. He has worked a lot on biological bases of aquaculture and on biodiversity, both terrestrial and marine. He is the author of more than 360 publications, book chapters, communications to National and International Conferences. His last book (as co-author) was published in 2010 by Oxford University Press on the biodiversity of the Mediterranean Region. His teaching activity is in several Universities, mainly in the UPMC (both in Paris and Banyuls) and he presents many talks every year in France and in several countries on life in the ocean, biodiversity, adaptation mechanisms and marine resources.

As the President of the National Natural History Museum, he was very implied in 2010 in all the events about biodiversity, from the Meeting of Unesco in January to the Conference of Nagoya at last October. In 2010, he opened the French Conference of Chamonix in May but also presented many talks in France and in the world.

He is :
President of the Scientific Board of Agropolis International at Montpellier, since 2009,
Member of the French Commission of UNESCO, since 2010,
Member of the Scientific Board of IFREMER (since 2002),
Member of the Scientific Board of Natural Patrimony and Biodiversity at the Ministery of Ecology, Sustainable Development, transports and Sea (since 2005),
Member of the « Precaution and Ethic » Committee of INRA and CIRAD, since 2005,
Member of the Scientific Board of the Scientific Centre of the Sea in Monaco (since 2005),
President of the Natural Reserve of la Massane (Oriental Pyreneans), since 2006.

You said… « Biodiversity? »

Gilles Bœuf

University Pierre and Marie Curie, Laboratoire Arago, Banyuls-sur-mer and President of the Muséum national d'Histoire naturelle, Paris

United Nations have declared the year 2010 « *International Year dedicated to Biodiversity* »: why ? Life has diversified since the early beginning, there are 3.9 billion years in the ancestral ocean, largely more than 1 billion species, infinity of forms which have "associated" themselves, in all the ways of the term, to build ecosystems in narrow relationships with the environment. Species which have emerged then disappeared with an endlessness of forms, shapes, sizes, colors, customs, specificities, adaptations, behaviors… Presently we evaluate the number of these species, still living with us, between 10 and 30 million, maybe 1 to 1.5 % of all the species having existed since the beginning on Erath. And today, scientists alarm us: biodiversity is in way of erosion much too high, in fact since a very recent period in the story of the Earth, moment denominated by the Nobel laureate P Crutzen, "*anthropocene*". It is the era of the massive influence of the human on the environment and on Nature. Are we going to the 6th mass extinction crisis?

D Papin then J Watt invented at the end of the XVIIIth Century the reliable vapor machine and an irresistible industrial development has started: for the first time the human replaced horse by "vapor-horse"! Everything then accelerated by the intensive exploitation of fossil energetic resources and destruction of ecosystems: in three-four centuries, humans will be able to entirely exhaust fossil reserves generated during hundreds of millions of years and to provoke urbanization multiplied by ten, associated with ten times more inhabitants. We reject in the environment more and more greenhouse effect gases (methane, carbon dioxide, water vapor…) and sulphur dioxyde and cause by our agricultural practices the fixation of two times more nitrogen. Water resource is very threatened, which wars tomorrow for the access to drinkable water? Water, one the most « ordinary » molecules on this planet, is totally forgotten, it is a crucial mistake, we are made of water!

During hundreds of thousands years, the *Homo* have not so impacted on Nature, no more than a comparative mammal in term of size and alimentary regime, a wild boar for example. But today, in fact since fire domestication then Neolithic period, the impacts will be more and more obvious. *Sapiens* more and more technical, clever, imaginative, inventive, aggressive, begun to change their environment and to degrade Nature, often on an irreversible way for biodiversity. Human population doubled the last 50 years! So after the recommendations of several world Conferences, for 20 years, we have been unable to stop, even to brake biodiversity erosion. And today after the last Conference of Unesco in Paris in January 2010, we have fixed such an aim for 2020: will we be able to succeed between 2010 and 2020, a challenge we totally failed between the conference of Johannesburg in 2002 and today?

Biodiversity is much more than to describe and count living species inhabiting ecosystems, it is the living fraction of Nature, with all the relationships established between living species among themselves and also with their environment. It is all the genetic information included in every diversity unit, individual, species, population, ecosystem. Biodiversity is a scientific priority (to understand its genesis, functions and to stop the erosion), an economical stake (to establish genetic and biological resources and to much

better use and share them), an ethical stake (living species rights) and a social stake (common values and shared advantages). All these terms appeared in the International Convention on Biological Diversity, ratified in Rio in June 1992, today by 191 countries.

Presently, we know, deposited in all the Museums, 1.9 million species and we know it is only a low fraction of the total specific diversity. We described between 16 and 18 000 new species a year, and we need, at such a rhythm of description, between 500 and 1 000 years to end the inventory. We have not time, at the present rate, half of the species will have disappeared for the end of this Century! From the Millennium Ecosystem Assessment, we were informed that the present extinction rate is 1 000 times higher than the background extinction rate calculated on the last 50 million years. Biodiversity is affected by destruction and contamination of natural mediums, over predation and overexploitation, alien invasive species and climatic change. The human being has become the most powerful force of evolution on the planet and must imperatively change its habits if he wants to carry on living in harmony: he is intertwined with hat diversity and cannot do without it.

We have not time to profoundly change our customs and relationships with Nature!

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Bego graduated in both Biology (2003) and Cultural and Social Anthropology (2007) at the University of Barcelona. In 2004, she started a PhD on marine ecology: since then, she has been studying benthic-pelagic coupling on an Antarctic continental shelf ecosystem, particularly how the activity of filter feeders such as sponges affects near-bottom water layers in terms of nutrient cycling and microbial processes. Other research interests include studies about paleoclimate through deep-coral research in the Mediterranean. She has participated in two international Antarctic cruises and two Mediterranean cruises. In 2005 she obtained her Master of Research in Marine Sciences. Parallelly, in 2008 she started her Master in Etnography and Anthropology, and will defend her thesis on phenomena attaining the patrimonialisation of Nature, and both the traditional ecological knowledge and the relationships of fishermen with Nature in February 2011.

Bego participates very actively in outreach activities since 2002; among others, she is member and co-founder of the outreach association *Omnis cellula* and editor of its magazine, she has organised and participated in outreach activities on polar topics (talks in schools and for the general public, development of didactic materials concerning the poles and the contents of several outreach websites, research projects together with schools, Association of Polar Early Career Scientists (APECS) outreach activities for the International Polar Year, working at museums or exhibitions), and written several outreach articles. She has belonged to the APECS Council from 2008 to December 2010, and has been Spain's representative member of the Youth Steering Committee for the International Polar Year.

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Dr. Josep-Maria Gili is a Research Professor at the Marine Sciences Institute (Superior Scientific Research Council) in Barcelona, where he created the Group of Ecology of Marine Benthos. He had been professor at the Ecology Deparment of the University of Barcelona. For 30 years he has been working on different fields of marine ecology, such as integrated studies of coastal ecosystems, the structure and dynamics of benthic communities, zooplancton ecology, trophic ecology of marine invertebrates and biodiversity and taxonomy of cnidarians. He has conducted more than 40 national and international research projects, supervised 15 Doctoral Theses, published about 200 research articles in international research journals and written and edited 14 books, as well as more than 50 outreach publications. He has centered part of his work in forming students and doctors. He currently works in projects attaining the Mediterranean, Antarctic, South Pacific and North Atlantic. Some of his group's research topics are focused on determining the role of benthic communities –especially those dominated by suspension feeders- in biogeochemical cycles, in both coastal and shelf ecosystems, the role of benthos as a boundary system –following the boundary theory of Professor R. Margalef- and determining scientific bases for a better management of the natural marine environment. Particularly, in the Catalan coast, the current studies deal with deep-coral communities and jellyfish.

Besides his scientific activity, he is developing several education and outreach projects which pursue to achieve a better understanding and knowledge of the oceans among the general public, particularly primary and secondary schools. These projects have implied the organisation and development of courses, exhibitions, webpages, lectures, publications, as well as the participation in committees such as that of the new Catalonian Natural Sciences Museum and Barcelona's Town Council Science Committee. He has received the Natural Environment award 2010 from the Institute for Catalan Studies, and is member of the Spanish SCAR Committee since January 2010.

Why is the sea so diverse?

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Although 71% of Earth's surface is Ocean, most of it still remains unexplored. The Ocean is usually seen as a vast and homogeneous amount of water, with small spots of richness such as coral reefs. But the Ocean is not this uniform mass of water: like the terrestrial environment, it is formed by different habitats and subsystems, which should make it at least as diverse as the emerged lands. Diversity, thus, not only refers to the richness of taxa or species, but also to the richness of function and of habitats, of ecosystems. Moreover, if one considers that life originated in a primitive ocean, about 3500 million years ago, one may think that the Ocean has been home to numerous life forms and that it has, itself, undergone lots of changes which have shaped its current properties and inhabitants.

But what makes the ocean so distinct to the terrestrial environment? First, becuse of the properties of water, life forms live suspended in it; second, suspended food items may favour the existence of sessile animals; third, it is a great dispersal means; fourth, it is a stable medium, which enables external reproduction. The Ocean is organised not only as a succession of different habitats in the horizontal axis, but also as a succession of habitats in the vertical one. That is, apart from the diverse environments such as coral reefs, kelp forests, *Posidonia* meadows, deep-sea mounts, hydrothermal vents, marine fronts, cold seeps, seamounts, canyons, deep-coral communities, or whale pitfalls, there is a richness of environments governed by hydrographical features, such as thermoclines, pycnoclines, of the wave-beaten boundary with the coastline: interphase areas generate heterogeneity. Surprisingly, in this amalgama of habitats there is only approximately a 13% of the total biodiversity found in the terrestrial environment, among which about 14 phyla of metazoans belong exclusively to the marine environment; 90% of all marine species are benthic, 80% life above 200 m; 71% species live in coastal tropical areas; 30% live in coral reefs. But, despite these numbers, one must take into account that the number of species known to live in the ocean increases year by year by about a bit less than 2000. The recent report of the programme *Census of Marine Life* has risen the number of known species from 230.000 to 250.000 in only 10 years of research. In fact, scientists currently think that the oceans may shelter between $1\text{-}10 \cdot 10^6$ species.Taking into consideration that 50% of the ocean Taking into consideration that 50% of the Ocean consists of deep environments, this is not surprising, as only less than 0.001% of them have been explored. Evolution in the marine environment is slow, with a slow speciation ratio and great dispersal capacity in a vast gepgraphic area. These features enable low extintion rates. In fact, among different taxonomic groups, marine ones present great mean evolutive longevity compared to non-marine groups.

We will unveil the diversity of life forms and ecosystems in a small part of the global Ocean: the Mediterranean. The Mediterranean Sea is an example of a small ocean with a great variety of habitats, and one which has almost a 18% of the world's total number of marine species just within the 0.83% of the world's ocean surface.

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ESA - European Space Agency

The European Space Agency and the international environmental conventions

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Dramatic environmental problems affecting our planet have recently mobilised governments, scientists, private companies and environmental organisations over the world. As a result, several Multilateral Environmental Agreements (MEAs) have been signed with the objective to reduce environmental degradation.

The United Nations Conference on Environment and Development (UNCED), also known as the « Earth Summit », held in Rio de Janeiro, Brasil, in 1992, resulted in the signature of different multilateral agreements, such as the UN Convention to Combat Desertification (UNCCD), the UN Convention on Biodiversity (UNCBD) and the UN Framework Convention on Climate Change (UNFCCC). The road started in 1992, continued with the World Summit on Sustainable Development in Johannesburg, South Africa in 2002. There, many governments reinforced their commitment to sustainable development at the local, regional, national and international levels, and recognised MEAs as useful for achieving that objective.

Implementing these Conventions requires the collection, analysis and understanding of a huge amount of environmental information, from local to global scales. This information is required for a better understanding of the scientific background of the problems faced, for helping decision-making and for enabling environmental plans to be put in place. It also allows the Convention Secretariats and related bodies to improve their assessment of the performances of the Conventions and apply enforcement procedures if necessary.

Earth Observation from space provides the means to monitor globally the trends on the implementation of these multilateral environmental conventions, over space and time. The presentation will highlight the overarching role of EO satellites in providing critical information on benchmarks and indicators for the implementation of several United Nation treaties related to biodiversity issues - namely the Convention of Biological Diversity, the Convention of to Combat Desertification, the Framework Convention on Climate Change, the World Heritage and the Ramsar Convention on wetlands.

Dr. Michael Altmoos

Member of the scientific staff in nature conservation at the State Office for Environment, Water resources management and Trade control

(LUWG), Mainz, Rhineland-Palatinate, Germany

Michael.Altmoos@luwg.rlp.de

Michael Altmoos, born 1967 in Mannheim (Germany), studied biology in Mainz and Marburg with the focus on conservation biology. He successfully completed his PH.D in geography with the focus on landscape planning in Leipzig.

Working in different scientific projects in conservation biology – mainly at the Helmholtz Centre for Environmental Reseach (UFZ) Leipzig – he elaborated new methods of network sites selection including different specific nature conservation goals.

His field studies concentrated on amphibians, birds, butterflies and locusts. A part of his work were „new wilderness“-concepts for the large opencast brown coal mining sites in Central Germany near Leipzig, which partly became reality.

In the field of practical nature conservation and species protection he developed a target-species-system in the Biosphere Reserve Rhoen (Central Germany). There he coordinated and conducted practical solutions in cooperation with land users (1997-2002).

As a teacher for nature sciences he developed concepts and practical units in nature experiences and in nature conservation education at different levels.

Since 2003 Michael Altmoos works at the State Office for Environment, Water resources management and Trade control (LUWG) in Mainz, Rhineland-Palatinate, Germany) and supports the European network “Natura 2000”

http://www.luwg.rlp.de/

Natura 2000 in schools

Dr. Michael Altmoos

Office for Environment, Water resources management and Trade control (LUWG),
Mainz, Rhineland-Palatinate, Germany

Pupils get involved in biodiversity

Over the last 25 years the EU has built up a vast network of 26.000 protected areas in all the Member States and an area of more than 850.000 km2, which is 18% of the EU's land area. Known as **Natura 2000**, it is the largest network of protected areas in the world, set up to ensure the survival of Europe's most valuable and endangered species and habitats. It is a symbol of the importance that EU citizens realize in biodiversity.

Implementing the goals of Natura 2000 means to come upon many points of contact, cooperation and also conflicts with other strategies, with land users, and citizens. The educational concept at school deals with the development of solutions for these daily problems.

A special role play is a central part in a tuition-concept, that can be adopted in several grades and classes at school, e.g. in the course geography,. With authentic material real conflicts about a Natura 2000-area are handled by the pupils on site. The role play itself is integrated into a relevant knowledge transfer and into outdoor experiences. As a result, the pupils' creation and evaluation competences in the protection of nature are developed. These enable them to become active for a sustainable living environment.

In the workshop the topic Natura 2000 and its model character for school-lessons will briefly be introduced. In a „hands on –phase" there will be test material and structures of the central role play for a case study with the participants. Then the role play will be integrated into the entire process of this educational project. According to the philosophy of Natura 2000 the focus will be put on the possibilities for "Natura 2000-schools" to organize a European exchange of knowledge and project-experience.

Elinor BARTLE
Administrative Leader, Centre for Geobiology
Journalist and Science Communicator

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Personal web page: http://folk.uib.no/gmset/job/science-communication/

Wonder... Mystery... the Unknown...

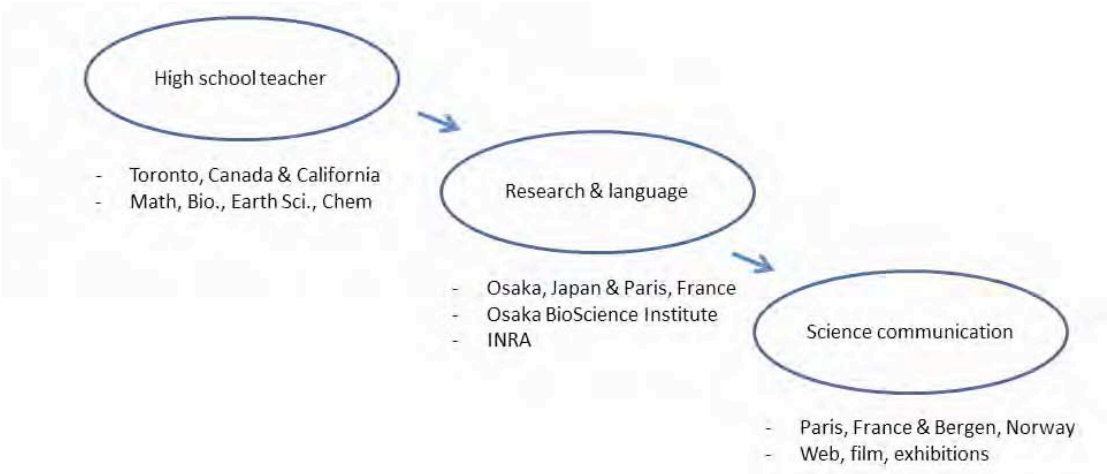
This is what science communication is about.

Whether it was making the words of a math textbook come alive, or sharing some of the number facts behind the natural grace of a marine mammal; whether it was honing rhetorical twists and tightening consistency in manuscript editing or conveying the passion and potential of a research project; I have been involved in science communication for nearly 30 years.

Communicating... Interpreting... Presenting... Sharing... Participating... Involving... Engaging ...

Learning about science is like travelling to a foreign country. But with science, most of us are just armchair travellers. Few will ever visit a research laboratory, suit-up for bio-safety level anything or participate actively in fieldwork. Yet our tax dollars fund these activities. We vote for people who regulate these activities. The results of these activities impact virtually every aspect of our daily lives.

As democratic world citizens, as parents of future world citizens, it is critical that we have at least a minimal understanding of research developments and the research process so that we can understand ourselves, our health, our world, our impact and so that we can optimize our future and the future of our home, the planet Earth.



Science communicators can serve as travel guides.

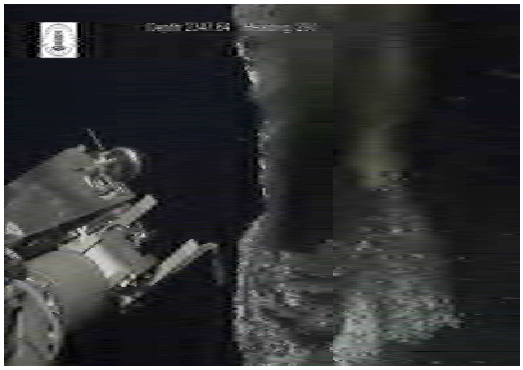
Brief Employment Summary:

1980-1982, 1989-1990, 2004-2005:
High school teacher, Toronto, CANADA (mathematics, biology, chemistry)
1982-1988:
High school teacher, LA, San Diego, California (mathematics, biology, earth science, chemistry); research assistant, Scripps Institute of Oceanography, California, USA
1988-1989:
research assistant, Osaka Bioscience Institute, JAPAN; ESL teacher, scientific article editor
1990-1997:
scientific article editor, translator, INRA, FRANCE; ESL teacher
1998-2011:
science journalist, communication consultant, project manager, University of Bergen, NORWAY

For more information please see: http://folk.uib.no/gmset/job/science-communication/

There are still things to discover:

Did you know the sea-floor leaks?
How would you define the limiting conditions for life?
Is there life elsewhere in the Universe?



Cutting-edge research – insights into scientific activity that is expanding the frontiers of science

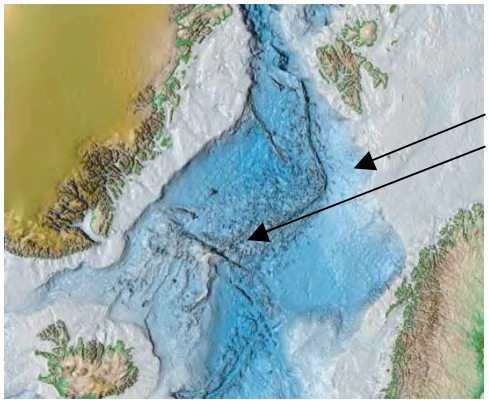
Established in 2007, the Centre for Geobiology (CGB) undertakes integrated and interdisciplinary research into the interaction between the **geosphere**, the **biosphere** and the **roots of life**.

The Dictionary of Earth Sciences. Oxford University Press, tells us that "the **geosphere** refers to the solid parts of the Earth and is used along with atmosphere, hydrosphere, and biosphere to describe the systems of the Earth. In that context, sometimes the term "lithosphere" is used instead of geosphere. However, the lithosphere only refers to the uppermost layers of the solid Earth (oceanic and continental crustal rocks and uppermost mantle)".

The Columbia Encyclopedia, Columbia University, tells us that "our **biosphere** is the global sum of all ecosystems. It can also be called the zone of life on Earth, a closed (apart from solar and cosmic radiation) and self-regulating system."

How did **life originate** on Earth? Was it transported here? Did it arise abiogenetically? Did it emerge under hot or cold conditions? What are the limiting conditions for life? …

Hydrothermal vents are unique and extreme geological features that provide insights into the interaction between Earth's biosphere and geosphere. Many have wondered if conditions at hydrothermal vents are similar to those under which life on Earth began. Thus understanding more about the biological and geological processes ongoing at hydrothermal vents may help us to determine how life began on Earth and may even provide clues that will help us find life on other planets.



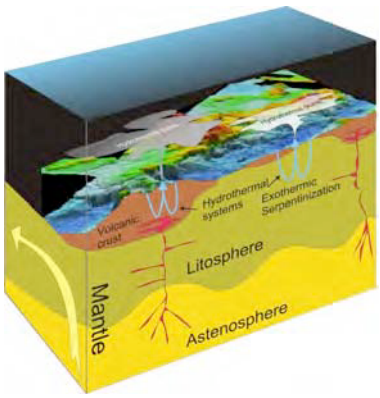
In 2005 and 2008 researchers from CGB discovered the most northerly hydrothermal vents yet identified. They are located along the Arctic Mid-Ocean Ridge system, near Jan Mayen and at the corner of the Mohns and the Knipovich Ridges, respectively.

The hydrothermal activity discovered thus far ranges from low temperature seeping to over 300°C active black smoker venting. It includes an extensive range of extreme environments involving micro-niches with steep chemical and physical gradients as well as symbiosis-based chemosynthetic ecosystems, all of which potentially host a vast range of novel organisms.

In the 1950's scientific explorers discovered one of the most amazing geological features of our planet: **mid-ocean ridges**. Massively long undersea mountain chains, they are the world's biggest geological feature and extend over 60 000km throughout all the oceans of the world. Ridges are actually the sites of tremendous geological activity. Here the earth's crust splits apart and new sea-floor is constantly being formed.

This process happens most rapidly in the Pacific, where the two sides of the ridge can spread apart as much as 15cm a year! It happens more slowly along the mid-Atlantic ridge and in the Arctic it is so slow that scientists describe it as **ultra-slow** as it spreads less than a cm a year.

Dramatic landscape and dynamic geology were not the only surprises mid-ocean ridges had to offer. In 1977 scientific explorers discovered the first hydrothermal vents along a Pacific Ridge near the Galapagos Islands.



Amazingly, it seems that that the sea-floor is not water-tight. Water actually percolates down through the sea-floor everywhere. This process is particularly prevalent at faults where there are deep cracks in the crust. Near mid-ocean ridges where the crust is thinnest, the sinking water is heated by magma reservoirs that lie relatively near the surface at ocean ridges. In the deep sea the pressure is very high. This enormous pressure allows the water to become super-heated so that when it emerges from the sea-floor it can be extremely hot, as much as 400°C, which is much hotter than geysers on land.

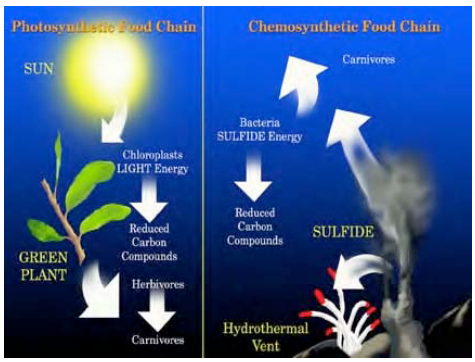
The circulating water dissolves materials from the rocks in the crust and is very mineral-rich. However, once it emerges, it meets the icy cold water of the deep sea and cools rapidly. The cooling water loses its mineral content first as tiny particles that make the water look smoky. The larger particles settle out and build the chimney structures and eventually the mounds around the vent openings.

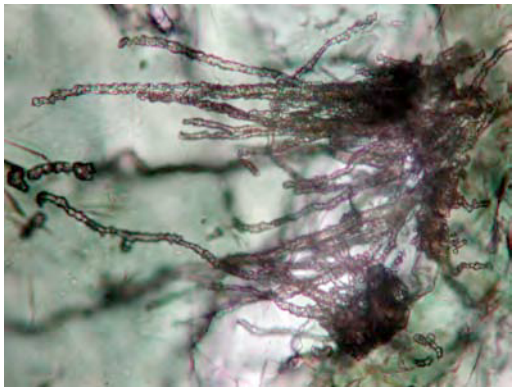
Until CGB's discovery of a black smoker along an ultra-slow Arctic spreading ridge, many geologists did not believe that there was sufficient magmatic activity at ultra-slow ridges to support strong vent activity.

Could the extreme science of ridges and vents be any more exciting?

Absolutely. Here in the deep, in the dark, surviving the crushing pressure, surviving both tremendous heat gradients and toxic chemical mixes, researchers have discovered thriving ecosystems: organisms that have never been seen before and which seem to be unique to the areas around vents. What are they living on? How did they get there?

Extreme biology. The last 30 years have seen the limiting conditions for life constantly redefined. Living organisms have been found living at hotter and hotter temperatures. Organisms have been found thriving without oxygen. In the deep sea and caves organisms have been found thriving in the dark, without light for energy. What does this mean about the origin of life on earth? What does it mean for the chances of finding life on other planets? Deep sea vents are a great place to look for exciting new biological finds. They offer some of the most extreme living conditions on earth.





The kinds of questions being investigated at CGB are even more astounding. Centre leaders include members of a group of frontier geo-chemists who discovered that **rocks ,water and microbes are indelibly linked**. These scientists have learned that organisms have been interacting with chemicals in rocks and causing changes that have fundamentally affected how the Earth has evolved, ever since microbes first appeared over 3 billion years ago. This interaction continues to affect how the earth is evolving today!! These findings have led to the development of a new scientific field: **Geobiology**. And vents are one of the places where it is easiest to learn more about rock-water-microbe interactions.

Laurence Durand

Biology and geology teacher
Lycée Camille Saint Saens,
Rouen, France

"From GIFT to Eco-Schools": A web site for promoting work on international projects

There are two aspects of my involvement in ecology: From a personal point of view, I believe it necessary to think about the future of our children. From a professional point of view, the French high school curriculum changed in 2010. Many aspects of sustainable development, CO_2 carbon cycling and biodiversity have been added to the biology and geography curricula.

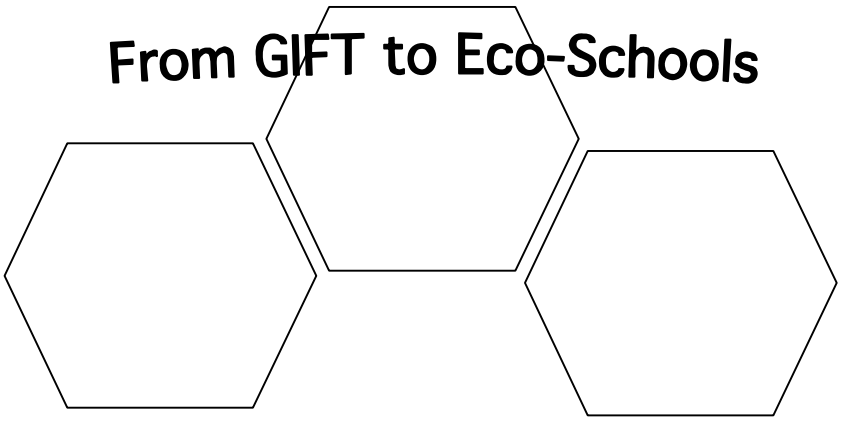
When I talk with my pupils about waste and ecology, they always tell me that they don't feel involved in these issues. They say: "Why should I care about waste, pollution and the inefficient use of energy I generate when industries and governments don't care?"

The question is very interesting because it means that most of the people don't appreciate the global purpose of sustainable development. We live in a consumer society that accepts that throwing away your mobile phone because the battery is out of order is a reasonable alternative to simply buying a new battery, since the difference in price between a new phone and a new battery is small. Everything in our modern society is made to create more "necessities", more consumption and thus more pollution, CO_2 and waste.

I had the great opportunity to come to the GIFT 2010 workshop, where I met a lot of teachers from several countries. We all have sustainable development in our curriculum. So I suggested creating an international web site for schools that want to work on this subject. The purpose of this web site is to have a common place to publish what we study in our schools. It provides an opportunity for teachers to implement projects with several schools in Europe. Teachers and their pupils can write on the web site created in June 2010 that is called "From GIFT to Eco-Schools".

This web site has been created to show the pupils that this subject concerns everyone around the world. By working with pupils from other countries, they will hopefully realize the global issues involved in sustainable development.

On this web site, teachers can work on different subjects: CO_2 Cycles, Biodiversity and sustainable development. I chose those subjects because they are all linked together. The purpose of learning about the CO_2 Cycle and Biodiversity is to understand the matter of sustainable development.



An example of an international project "From GIFT to Eco-Schools":

As a first international project, I work with 2 other schools: The Secondary School of Economics 'Georgi Rakovski' Varna, Bulgaria (Teacher: Nelly Vicheva) and The Secondary School Jaume Balmes, Barcelona, Spain (Teacher: Catalina Sureda).

The project began with a proposition from Catalina Sureda who had already worked on waste management in her school. She contacted me and suggested building a project between our schools.

Then I asked Nelly Vicheva to expand the project to her school.

The project is built in 3 steps:

1st step: Learning how to use the web site

Each pupil is required to introduce himself or herself with a paragraph on their author's page.

Then they must contact other pupils participating in the project using the redactor's forum.

We have added a section called "Traditions sharing", where pupils write articles about Christmas in their country.

2nd step: Finding information about waste management in different areas.

Pupils write an article on the web site about one kind of waste, answering the following questions:

How is the waste managed? What can be done with the waste after it has been processed? Why is it necessary to manage this waste from an ecological and economical point of view?

3rd step: Experimenting and discussing battery management in different regions.

- Listing the batteries used in each house.
- Finding data about the danger of throwing batteries away in landfills or the countryside and the need to recycle.
- Experimenting on plants and/or animals (insects) regarding this hazard.

Pupils perform experiments. Then they write their protocol in an article and report their results. Pupils from other countries can comment and give suggestions about each experiment and about the interpretation in the forum linked to the articles.

Roberto Greco

Natural Science teacher
Earth Science Department,
Modena and Reggio Emilia University,
Italian Ministry of Education
Liceo Classico Muratori,
Modena, Italy

The first International Earth Science Olympiad in Europe!

The International Earth Science Olympiad – IESO - is one of the 10 International Scientific Olympiads. This project was developed by the International Geoscience Education Organization – IGEO.

IESO is an annual competition for secondary school students (students not older than 18 years on July 1st of the year of the Olympiad). The students have to test their skills in all major areas of Earth sciences, including geology, geophysics, meteorology, oceanography, terrestrial astronomy and environmental sciences. The theoretical examination includes problems that are developed to measure the participants' knowledge and understanding in Earth science areas. The practical examination consists of tasks that are designed to assess participants' abilities to carry out scientific investigations in earth science inquiries. The examinations are prepared by specialists in Earth sciences and Earth science education, who also provide solutions and evaluation guidelines. Each delegation is made of 4 students and 2 mentors. Mentors must be specialists in Earth science and Earth science education and capable to serving as members of the International Jury. The official language of IESO is English, however the mentors can translate the written examinations and related materials from English to the participants' native language.

The main aim of IESO is to raise student interest and public awareness of Earth science and even to enhance Earth science learning. With IESO the organizers hope to award talented and gifted students in Earth science and to promote the improvement of teaching Earth science in schools. Last but not least, encouraging friendly relationships among young learners from different countries and promoting international cooperation in exchanging ideas and materials about Earth science and Earth science education. IESO is the only International Olympiad that includes an International Team Field Investigation - ITFI. Past International Team Field Investigations have included developing stratigraphic sequences, evaluating living on Mt. Mayon volcano, and evaluating the fault escarpment of the Chi-Chi earthquake. In 2010 in Indonesia, the International Team Field Investigation will focus on sustainability and the use of underground water.

The IESO is one of the most recent science Olympiads established. The first edition was held in 2007 with the support of countries with a strong emphasis on Earth science in their national curriculum.

2007 1st Republic of Korea, theme: Earth for Life, Universe for future Life

2008 2nd Philippine, theme: Cooptition in Addressing Climate Change (the word "cooptition" refers to a combination of competition and cooperation).

2009 3rd Taiwan, theme: Human Environment

2010 4th Indonesia, theme: The present is the key to the future.

2011 5th Italy, theme: Earth science renaissance, science, environment and art

2012 6th Japan, theme: Our future: Earth and Space

2013 7th India

In 2011 - for the first time - the IESO will be held outside Asia! This would be a great opportunity to involve more European countries in this competition and a great occasion for Earth science education experts to develop a European network!

Jennifer Alicia Skene

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Berkeley, CA 94702-5200, USA

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EDUCATION
University of California, Berkeley Ph.D. Integrative Biology 2009
Brown University Sc.B. Biology 2000
Honors: Magna cum laude with Honors, Goss Prize in Experimental Biology, Brown University. Outstanding Graduate Student Instructor, National Science Foundation GK-12 Fellow, University of California, Berkeley.

EMPLOYMENT
2010 – present Marine Science Specialist, Lawrence Hall of Science, University of California,
Berkeley
2010 Visiting Assistant Professor, Biology Department, Mills College
2010 Lecturer, Department of Integrative Biology, University of California, Berkeley
2009 – 2010 Postdoctoral Employee, University of California Museum of Paleontology, Berkeley

TEACHING EXPERIENCE
2004 – 2006 National Science Foundation GK-12 Fellow, University of California, Berkeley
2002 – 2003, Graduate Student Instructor, University of California, Berkeley. Courses taught:
2006 – 2008 Introductory Biology, Introduction to the Methods of Environmental Science, Ecosystems of California, Population and Community Ecology, Biological Oceanography Laboratory
2006-2009 Workshop Leader, Teaching Conference for Graduate Student Instructors, University of California, Berkeley

SCIENCE PUBLIC EDUCATION AND COMMUNICATION
2010 Program Associate, Education Office, American Institute of Biological Sciences
2009 – 2010 Regional Hub Coordinator, Coalition on the Public Understanding of Science
2008 Content Intern, KQED QUEST, San Francisco's NPR/PBS station
2008 Staff Writer/Graduate Student Researcher, Department of Integrative Biology, University of California, Berkeley

2007 – 2008 Workshop Leader: Expanding Your Horizons in Science and Mathematics Workshop for middle school girls
2006 Science Writing Coursework with Michael Pollan, Berkeley Graduate School of Journalism
2003 – 2007 Writer, Berkeley Science Review
1998 – 1999 Instructor, Providence Science Outreach, Brown University

Understanding Evolution

Presented by Jennifer Skene

Lawrence Hall of Science,
University of California Berkeley, USA

Evolution affects many aspects of our lives and is the central organizing principle that scientists use to understand biodiversity, past and present. Nevertheless, the poor state of understanding and acceptance of this concept is well documented. Polls continue to show strong differences between the public's acceptance and understanding of evolution and that of the scientific community. The latter sees evolutionary theory as extremely well supported and non-controversial, while a sizable segment of the public has little understanding of evolution and rejects it as a valid explanation for the diversity of life (Rutledge & Warden, 2006). These differences are no longer confined to the United States.

As teachers, we have the responsibility and the opportunity to remedy this disconnect. This presentation will look at five key principles for our teaching, offer a series of hands-on activities to engage students in a better understanding of core concepts, and share new on-line resources available for teachers and students through the *Understanding Evolution* (UE) website (www.evolution.berkeley.edu). Participating teachers will receive a list of freely available, online resources to support their teaching, including those listed below, which support the key principles and will be incorporated into the workshop.

Key principles:

1. Connect evolution and the nature of science

The workshop session will begin with a quick "warm-up" activity that examines how science *really* works. We will return to this at the close of the session to emphasize that much of the public's confusion about evolution is actually confusion about science itself—what science is, what it is not, and what is not science.

2. Teach the basics

Activity: Clip Birds

The classic bird beak activity usually involves having students attempt to pick up various objects with a wide variety of "beaks," including scissors, spoons, etc. This traditional approach demonstrates competition in an ecological sense, but does not clearly demonstrate variation within a population, which is central to evolution. In this activity, students learn about variation, reproductive isolation, natural selection, and adaptation.

Activity: What did T. rex Taste Like?

In this web-based module students are introduced to cladistics, which organizes living things by common ancestry and evolutionary relationships. Teachers will be introduced to the module and the importance of "tree-thinking" through a hands-on version.

3. Integrate and reinforce the concepts

Activity: Anolis Lizards

Students “take a trip” to the Greater Antilles to figure out how the *Anolis* lizards on the islands might have evolved. They identify patterns in biological data, such as morphological characters, habitat, and geographical distribution. From the patterns they observe, students develop and test alternative hypotheses about how these lizards colonized the islands and evolved.

4. Make it relevant

Teachers will be introduced to two on-line resources available on the UE site: *Evo in the News* and *Evo Connections*.

5. Recognize student misconceptions

It is essential for teachers to have an understanding of what prior knowledge (correct and incorrect) a student is likely to have regarding particular content. UE’s *Misconceptions* section is based upon this perspective. It outlines incorrect but tenacious and appealing ideas that students (and many members of the lay public) are likely to hold (e.g., that organisms must “try” to adapt).

Yvon Le Maho

Director of Research « Classe exceptionnelle » CNRS

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PhD in 1981: Metabolic adaptations to long-term fasting in antarctic penguins and geese. Medical School & Claude Bernard University, Lyon.
Chairman of the section « Organismic & Evolutionary Biology » of the Academia Europae
Member of the French Academy of Sciences.
Member of the French National Academy of Pharmacy.

MAIN PRESENT CURRENT POSITIONS

After 14 years as Director of the Hubert Curien Institute, Leader of the Group "Functional Ecology"
Member of the French Committee at the UNESCO.
Member of the French Upper Council on biotechnology.
Member of the Program Committee of the French Space Agency (CNES).
Member of the Administrative Board of the Albert 1er Prince of Monaco Fund
Member of the Scientific Committee of CNRS.
Chair of the Scientific Committee on Biodiversity and Natural Heritage, which is an advisory committee of the French Minister of Ecology and Sustainable Development.
Chair of the French Committee on Antarctic and Arctic Research.

FIELD WORK

Overwintering in Antarctica (French Dumont D'Urville Station, DDU) and many summer field sojurns in
Antarctica (DDU and US MacMurdo station), in the Subantarctic (Possession Island in Crozet Archipelago), in
the Arctic (Svalbard) and in French Guyana (Awala-Yalimapo).

SCIENTIFIC PAPERS

About 200 papers, including 12 in the *American Journal of Physiology,* 7 in *Nature,* 2 in the *Proceedings of the Royal Society, London* and 1 in the *Proceedings of the National Academy of Sciences (USA).*

SCIENTIFIC ADVISE FOR MOVIES

« Oceans », cinematographic production.
Film-makers : J. Perrin and J. Cluzaud.
Production : Galatée Films, January 2010, duration 1h40.
« Wing Migration», cinematographic production.
Film-makers : J. Perrin and J. Cluzaud.
Production : Galatée Films, Bac Films, december 2001, duration : 1h30.

« Penguins Under Close Watch», Scientific movie.
Role : Scientific Director and picture.
Film-maker: G. Laurent
Production: CNRS Audiovisual, Meudon, 1992, duration : 20 mn. French, english, spanish and japanese versions.

SCIENTIFIC DIRECTION OF EXHIBITS

« Polar Ice. For the next generations », exposition at the Oceanographic Institute in Monaco. From February 21th to the end of 2008.

« Species to track», exposition on the satellite tracking of wildlife at the Strasbourg scientific Museum. From Mai 22th to June 30th 2004

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Antarctic penguins and climate change

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One of the major objectives in Science is to determine the impact of climate on biodiversity. Since climatic changes are largest in polar ecosystems, the Southern Ocean is of particular interest because of its key role in the world climate regulation and huge marine productivity (ca. 20% of the world's total primary production). However, coincidental to decreases in the secondary production of Antarctic waters, some severe demographic crashes have been observed in several seabird populations living under sub-Antarctic latitudes. Indeed, the effects of climate forcing on primary and secondary production of the short Austral food chains may be integrated at higher levels and thus amplified in top level predators such as seabirds.

Amongst seabirds, penguins are certainly amongst the most emblematic. They moreover breed in large colonies that are easily accessible. In addition to the climate-induced variability in their marine resources, they however have to cope with most severe environmental conditions. Yet, because he assumes the whole task of the incubation, the male emperor penguin has to fast for as long as about 120 days during the severe Antarctic winter, with temperatures which may be as low as -50°C or ambient temperatures which may be quite warmer, such as -20°C, but with winds of up to 150-200 km/h…

Our first goal was then to determine to which extent penguins are able to cope with these severe conditions. We showed for example how emperor penguins, by huddling together, are able to reduce their energy expenditure below the minimum level for an individual. Since they are still maintaining their deep body temperature at a constant 37°C value, which obviously allows them to keep their egg at about 36°C, it means that their mechanism for energy saving differs from hibernation or torpor in mammals and birds, which does involve a drop in body temperature.

The subantarctic king penguin, the closest relative of the emperor penguin, lives in much warmer conditions, since for example in our study site on Possession Island in Crozet Archipelago the ambient temperature rarely goes below 0°C. However, we have shown that the major constraint is the climate-induced variability in the localization and abundance of marine prey. During the summer, the king penguins forage at the Polar Front which is at 300-400 km South of Crozet in "cold"years and at as much as 500-600 km South of Crozet on "warm years". Both mates are alternately incubating and usually the male is taking charge of the three last weeks of the incubation. But, depending on if it is a cold or a warm year, the female may therefore come back before or after hatching since it obviously takes more time to go and forage at a larger distance. Still, we have shown that the father is able to feed the new-hatched chick if the mother has not shown up in time. This means that the father is able to keep food in its stomach in order to feed the newly-hatched chick. In other words, it means that he is able not to digest food when coming ashore to assume the last three weeks of the incubation and to conserve it for 2-3 weeks at his body temperature of 37°C. We have been able to show that this process of conservation, which allows the parent to feed the chick for about a week, involves a small protein of which we have determined the composition and tri-

dimensional structure. We have then been able to produce this molecule by biotechnology and have found that it has an antibacterial and antifungal action.

Another interesting question was to determine how penguins know how to refeed before it is too late when, as a result of bad climatic conditions, their body fuels have been depleted to a critical level. Combining investigations on penguins and laboratory animals, we have been able to show that once a threshold has been reached in the depletion of their body fuels there a mechanism which triggers their abandon of breeding to leave and refeed before it is too late.

The next question was then if these mechanisms are sufficient to allow the birds to cope with climate variability. In particular, a critical period for king penguins is the winter since, due to huge drop in their marine prey availability, the parents have to abandon their chicks to go far south in order to insure their own survival, i.e. at the sea-ice margin, that means a trip of about 1900 km to the South…

To understand how variability in marine resources affects the demography of seabirds over years, a simultaneous investigation of both patterns of variance in breeding success and survival is necessary and requires long-term individual monitoring at the population scale. As for other seabird species, most of our present knowledge on the population dynamics of penguins has been obtained owing to large banding schemes. However, in contrast with other birds, penguin legs cannot be banded due to the anatomical peculiarity of the leg joint. Penguins have thus been individually monitored with bands secured loosely to one of their flippers, close to the articulation. A key advantage is that bands can be identified from a distance, thus avoiding capture stress for the birds.

However, we have recently shown by a study over a decade that flipper-banding has very detrimental effects: it induces a drop of about 40% in their breeding success and of about 16% in their survival. It accordingly introduces a bias when using flipper banded penguins as indicators of the impact of climate change on the marine resources. This results from the drag effect of flipper bands.

To avoid this bias, using a unique set-up, with RadioFrequencyIDentification (RFID) antennas buried on the usual passage ways of unbanded penguins equipped with subcutaneous transponders, we have shown that a slight 0.3°C increase in sea-surface temperature in their overwintering zone at the sea-ice margin is sufficient to induce a 9% drop in their survival. Since, under the present climate scenarios an increase of 0.4°C per 20 years is predicted for the sea temperature in this area, it therefore means that there is a risk of extinction of the penguin colony within about 150 years.

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