

Training course



Biodiversity, phylogeny and ecology of Porifera



Report

From July 17th to July 30th 2005

Station Marine d'Endoume



The Biodiversity, phylogeny and ecology of Porifera Training Course took place between July 17th and July 30th, 2005, at the Station Marine d'Endoume (SME) in Marseille, France. It was organised by the Unit "Diversity, evolution and MARine functional ecology" (DIMAR) with the financial support of the CNRS, the European Network of Excellence MARBEF, the IRD and the PACA Region, in addition to the collaboration with different services of the Centre d'Océanologie de Marseille (COM).

Sponges are among the most common hard-substrate organisms from the coastal zone to the deep sea communities. Beyond their fundamental role in ecosystem functioning, sponges have an important economic role. They produce secondary metabolites which have important potential applications in the pharmacological industry. Sponges may also be powerful indicators of the environmental health.

These applications require precise identification of the sponges. Their taxonomy, however, is generally considered to be very difficult. These difficulties arise from the characteristics of the sponges themselves, but also in certain deficiencies and contradictions in their taxonomic frame. Currently, a complete review of sponge phylogeny is being done using cladistic methods and a molecular approach. An ongoing review of the morphological criteria in light of these new results suggests a complete revision of our understanding of this group.

All the fields in which knowledge of biology, ecology and chemistry of the sponges is necessary have been covered during this training course. The participants were completely immersed in the subject by alternating lectures, tutorials, laboratory work and field work during two weeks, led by specialists from all countries invited to the Marine Station. Beyond the theoretical lectures, the aim of the course was to share practical experience of field and laboratory work by organising diving sessions and practical working groups in the laboratory.

About forty persons of eighteen nationalities (all the continents were represented!) participated in this course, motivated by the possibility to acquire information and savoir-faire from specialists happy to transfer and exchange their knowledge. The fact that marine biodiversity is one of the objectives of several European Networks of Excellence (MARBEF, Marine Genomics) underlines the importance of understanding the organisms structuring the underwater landscape. This field of study suffers from important erosion due to the disappearance of taxonomy experts. This training course met a continuing demand from young scientists (researchers and technicians) of different disciplines, such as molecular phylogeny, embryology, ecology or chemistry. It was the first training course of this type organised in Europe by a team that has more than fifty years of experience in the field. The scientific Unit DIMAR, with its coastal location facilitating diving activities and its exceptional archives covering all the aspects of the course, was the only French entity able to organise such an event.

Indeed, the Station Marine d'Endoume combines logistic means, and an important documentation in addition to specimen collections and unique photographic archives. The participants benefited from the SME premises, from the diving facilities and service, and from the histology and cytology service which offered the possibility to learn different laboratory techniques. An important collection of documents including rare historic documents of the Marine Station library provided most of the pertinent articles on sponges. Furthermore, participants were able to use a bibliographic database built up by the DIMAR Unit containing more than 10 000 references. An important sample collection gathered over 50 years, facilitated the demonstration to participants of specimens from all the main families including correspondent skeleton preparations and histological slides. In addition, the trainees had access to photographic archives which include photographs *in situ* of Mediterranean sponges and specimens from other regions as well as scanning and transmission electron microscopy photographs.

What appears to have been also important during this training course is the informal exchanges between participants during meals or breaks, leading to projects and eventual collaborations. After this course the participants felt the need to organise future training courses and workshops on the subjects. This underlines the importance of exchanging knowledge and experience between people working on a same subject from different disciplines or with different approaches.

1. The different courses



Lectures and tutorials were in English and took place in the conference room of the Station Marine d'Endoume which was equipped with internet access and a video projector. Part of the documents to consult were available in the conference room, the others were consultable at the library of the COM situated in the adjoining building.



Practical work took place essentially in the laboratory room of the same building of the SME specially equipped for the training course. The observation with the SEM was proposed in the next building of the Station Marine.



The dives were lead by the diving service present at the Station Marine d'Endoume. Dives took place in different sites around Marseille (see map) with the means of the COM.



Lunch was served as a buffet in the dining room of the Marine Station d'Endoume. Volunteers Cécilia Zanatta and Dacha Tokina kindly assured the organisation of the meals. Some of the students and lecturers were put up at the Station Marine d'Endoume the majority had a hotel room nearby.

The training course was able to be organised so thanks to the location and the logistics available at the Station Marine d'Endoume.

An excursion at La Ciotat was organised for Saturday, some participants dived in a cave while others discovered the nearby "Calanques".

2. Scientific content of the training course

Theoretical approach / Lectures	Tutorials and practical work
Introduction to Porifera	
Presentation of the course Bauplan organization of sponges The skeleton Physiology and Ecology Symbiosis Nutrition	Observations, of aquiferous system, different types of spicules and skeleton. Observation of the different cell types on photographs taken in TEM or SEM. Observations of TEM photographs of bacteria, cyanobacteria, zooxanthelles. Example of bacteriosponges. Observations of species with many symbionts. Study of the special case of carnivorous sponges : Observations in aquarium of the capture of the prey and digestion during one week. Different phases of incorporation and digestion demonstrated on photographs in TEM and SEM
Reproduction and comparative embryology	
Gametogenesis, embryogenesis, types of larvae, metamorphosis Asexual reproduction and regeneration Embryology and taxonomy	Field observations and identification of reproducing species. Observations on histological slides and photographs in TEM and SEM of gametogenesis (oogenesis, spermatogenesis), embryogenesis, larvae and metamorphosis in the three species and in different other types of reproduction occurring in sponges.
Classification : basis of taxonomy	
Introduction Demospongiae Hexactinellida Calcispongiae The special case of Homoscleromorpha	Preparation of spicules, skeletons, histology, cytology. Preparation and observation under optical and electronic microscope (SEM). Practice of identification and of identification keys. Case study: problems for the chemist faced to the modifications of the classification of Porifera. What is a synonym, what is the use of the taxonomic nomenclature, why scientific names appear unstable
Place of Porifera within the tree of life	
Monophyly or paraphyly of Porifera Molecular phylogeny of Calcisponges Molecular phylogeny of Demospongiae Importance of the « sponge » model for Evo-Devo	Molecular phylogeny Use of sponge sequences present in databases. Reliability of those data. Importance of the taxonomic knowledge. Sequence alignment. Molecular phylogeny and polarization of morphological characters. Critical studies of different recent papers on sponge phylogeny
Dynamics and genetics of populations	
The notion of species in sponges. Population genetics in sponges. Comparison of the points of view of the geneticist and the taxonomist. Are there true cosmopolitan sponge species? Comparison of equilibrium and non-equilibrium approaches to sponge population genetics. Allozymes, microsatellites and DNA sequences in sponge population genetics.	Critical reading of several papers on sponge genetics recently published Analysis of frequency and sequence data for the analyses of species and population differentiation
Ecology and distribution	
Bathymetric repartition The place of sponges in the various ecosystems Bioindicators of the health state of the milieu Bioremediators Methods for inventory: photo, sample, conditioning. Fixed quadrats for long term observations	Observations in situ, studies of communities. Field trips Case study: l'anse des Cuivres (close to the laboratory) and other diving sites. Study of the diversity of sponges in two communities: photophile rocks and semi-dark caves Observation, photography and collection in the field. Identification by the participants. Production of a species list. The 3PPs cave: which has the exceptional presence in the Mediterranean of one species of hexactinellid and of a carnivorous species of sponge. Database
Use of sponges by man	
Commercial sponges Bioactive molecules Example of pharmacological activities	Bioactive molecules and chemotaxonomy Case studies: <i>Crambe crambe</i> . Practical on the test of sponge extracts for antibacterial activity, cytotoxicity, etc. Use of chemical data in chemotaxonomy Practical use of the chemical database Marinelit.
Fossil sponges and hypercalcified sponges (JV)	
Paleocology of Porifera: Place in the ecosystem of the paleozoic	Observation of specimens Various fossil groups, MEB photographs of skeleton



3. Lectures

The lectures in bold are available on the webpage put up by MarBEF (<http://www.marbef.org/training/porifera/>)

Alexander Ereskovsky

1. **Collection / fixation**
2. **Reproduction Modes of Porifera**
3. **Types of Development of Porifera**

Antonio Solé-Cava

1. Collecting preserving for genetics
2. Population analysis methods
3. Sponge population genetics
4. Refs

Cécile Debitus

1. **Secondary metabolites and chemical ecology**
2. **Secondary metabolites of sponges, pharmacological applications**
3. marine drugs literature

Jean Vacelet

1. JV_Microsymbiotes
2. JV_PlaceOfPoriferaInEcosystems
3. JV_Carnivores
4. JV_Hexactinellida
5. JV_Fossiles

Michaël MANUEL

1. **MM&CB_An introduction to the methodology of phylogenetic reconstruction**
2. **MM_Classification and phylogeny of calcareous sponges**
3. MM_Photocopies
4. **MM_Sponge Evo-Devo**

Nicole Boury-Esnault

1. **General Introduction**
2. **Classification of Demospongiae**
3. **Phylogeny of Porifera**

Thierry Perez

1. **Bath Sponges**
2. **Bioindicators**

4. What did the students think of the training course?

Twenty four questionnaires out of twenty six (students) were turned back concerning the quality of the course. The numerous comments suggest that the course offered theoretical knowledge and techniques that were useful for all the students. Also, the two weeks schedule of the course that proposed lectures, tutorials, practical work in the lab and the field seems to have been efficient for the acquisition of knowledge and furthered exchanges between scientists.



Results (percentages are given on the 24 questionnaires turned back):

1. The majority of the students considered that the organisation was good (87,5%), only 12,5% considered it was satisfactory.
2. 100% considered that the lectures were of good quality. Some comments added that they were excellent (see further down).
3. 92% appreciated the practical lab work that was considered as very useful. Some sparse comments (8%) noted some difficulties in the organisation of the practical work but also noted the fact that everything can not be done.
4. The majority 82% considered that the program completely covered the field of the course, 18% considered that the program covered partially the field of the course (a lecturer was not able to come).
5. Every one expressed the fact that the schedule furthered exchanges between the different scientists (lecturers and students).
6. The benefits of the course were (by order):
 - a. Meeting specialists
 - b. Practical knowledge
 - c. An overview of the current research
 - d. Deepening your knowledge in the field
 - e. Theoretical knowledge
 - f. Learning basic concepts
 - g. Availability of information
7. The most interesting interactions with participants or lecturers took place during (in order):
 - a. Informal sessions (75%)
 - b. Working groups (50%)
 - c. Meal time (42%)
 - d. Diving sessions and seminars
8. The majority (87,5%) believe that the exchanges developed during this training course will lead to scientific collaboration, the others consider that they will develop other exchanges with specialists. Also, 67% believe that the exchanges lead them to new perspectives on their research.
9. 100% consider that this training course should be continued in one form or an other (training course, workshop etc.)

Students' comments on the course (from the questionnaires)

It was very useful for me as a beginner and I hope some other training courses or schools could be organised soon. Thank you very much. Very good practical view of sponges with specialists. Very good exchanges, thank you. The lectures were the most useful for me.



Training course like this every few years is good. Colloquia on more specific subjects can be very useful. Workshops more specific (sometimes). Location very nice and everything available. The English was not as bad as some people thought. Working groups were very useful for me. Really nice atmosphere. I met a specialist in 3d-photogrammetry which is going to be very useful.

Convivialité et compétence des intervenants, des atouts majeurs pour une école thématique. Merci et à bientôt
The biodiversity of the participants and the participation to the discussions were very interesting

There were some problems with organisation of practical sessions. Might have helped if these were more structured? Or with clearer aims. It was not always clear which groups were doing an activity resulting in too many people and lack of microscopes and tutor help at times. The programme was very useful to me as a novice in the area. Good overview of wide range of topics.

The format was really good. I liked having the second week to talk about methods for my own work with specialists and hearing about others works for ideas this should be encouraged. I enjoyed talking and learning on my own and in small groups with the experts and other students.

La variété des enseignements avec alternance de cours, groupes de travail, travail de terrain, interventions diverses avec présentation de travaux personnels constitue un ensemble extrêmement enrichissant, formateur et facilite les échanges entre disciplines. Un peu plus d'écologie aurait été apprécié. Les groupes de travail ont été utiles surtout pour les chimistes afin de mieux comprendre le travail complexe des taxonomistes

The organisation of this course was particularly good for those with a background in sponge taxonomy/DNA applications. We all have a lack of experience in working groups. Every one made the most of exchanges with scientists and informal discussions

In my opinion, this course should take place in a more or less regular basis, preferably in the same forms or possibly as a shorter workshop. It is very important for young scientists performing research on sponges to be able to have contact with so many aspects of biology especially as in most countries people working on sponges are so few, and research on sponges is often not encouraged. I can imagine how hard it should be to organise such a course, but I strongly believe it's worth it!

This course should be continued by a training course with emphasis on practicals both in the field (dive trips) and laboratory work. It was a very well organised workshop. The lecturers were approachable throughout the course and encouraged interactions. With their vast knowledge the lecturers made the lecture material easy to comprehend without being too technical. Excellent opportunity for one to one discussions. Question and answer sessions at the end of each lecture allowed participants to clarify things which were not clear

I think that "summer school training course" will be an ideal platform to educate students or scientist in general.

I think the current format works well. The training course with a mixture of lectures and practical sessions were the most valuable from my point of view. A large focus on taxonomy with some repetitions. I would have liked some basic practical experience with identification of general cell biology. The practical demonstrations and experience were very valuable. Larval ecology was an area I was looking forward to. The interactions with other researchers was very important and valuable

I think that the setup of this course was excellent. There was a very good mix of lectures and practical sessions. I also want to say that this course was excellent. It was amazing to be able to work with so many experts in the field of sponges. Very inspirational and everyone was very helpful and friendly. I definitely gained a lot from this course, both from lectures and from new contacts. Thanks to everyone for organising such a wonderful time. I enjoyed every minute. Thank you.

The course was very well organised with the first week giving a solid basis which you built practical knowledge onto in the second week. Also general organisation on getting to the station and hotel was great too. The lunches were great too! The lectures were all very well prepared. It was nice that we get the pdf versions of the



presentations at the end also. All lectures were of a very high quality, but with such experts present it could only be expected. Lots of new information. I thought it was useful breaking up in the different groups. You could focus on the areas that interested you the most. It was however difficult to choose sometimes as everything was so interesting! Only thing is that Mme Uriz didn't come unfortunately but otherwise I was very happy with the programme of the course. Through discussions with others on the course, both organisation and other students, I was able to gain new ideas and discuss my current work, as well as contribute with my knowledge. There was plenty of opportunity to exchange information during practical sessions, lectures and meal times. Did not participate in the diving, however the diver briefing was useful for the discussion on Mediterranean spp

Combination of lectures with practical work like this course is very important. That is when people can learn actually the most. Thank you very much! It was a wonderful and useful experience!

All the lectures were very good! Lectures by Antonio Solé-Cava and Michaël Manuel were excellent. Maybe we needed a little more time for practical work. Thank you very much.

La forme de ce cours était très bien! Deux semaines c'était bien, une semaine aurait été trop court. Workshop sur un sujet particulier est aussi une bonne idée pour le futur. Les organisateurs ont fait un très bon travail! Bravo! Pour moi, les cours sur tout ce qui touche à la génétique étaient un challenge car je n'ai pas assez de bases. Etant nouvelle dans ce domaine, je sais maintenant qui contacter si j'ai une question. Plusieurs intervenants ont très gentiment offert leur aide dans le futur

The course should be continued: training course like this time but more special in some fields. Interactions with lecturers were the most interesting during coffee break and BBQ!

Sharing what are our current research, keeping in contact (for collaboration) or projects, sharing knowledge.

A small meeting with the people from the course in Brazil would be nice.

I found the course really well organised. It was really interesting to learn about a subject in a ludic way but also to have an overview of the subject through concrete examples. Working groups permit to interact with people in an easier way and to go deeper in the field. It matched quite well the programme offered. Morning specially seemed to be organized in a way that time was allowed to each of us to discuss with each other.

Very well organized course, also for the ideal location of the Station adjacent to the sea. Perhaps some background reading could be suggested before the course (in particular for not molecular biologists). Working groups were useful because we could spend a lot of time to clarify any doubt. I think that in two weeks every effort has been made to cover all the issues in the field of course.

If you wish to have more information and have a look at some photos of the training course, please visit the Porifera webpage (<http://www.marbef.org/training/porifera/>) on the MarBEF website.