



**ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ, ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ
ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΕΡΕΥΝΑΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ**

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ΕΛΛΗΝΙΚΟ ΚΕΝΤΡΟ ΘΑΛΑΣΣΙΩΝ ΕΡΕΥΝΩΝ**

**Summer School on
"Functioning and Evolution of the
Mediterranean marine ecosystems"**

Final Report

Anavyssos, 10 September 2010

Acknowledgements

The summer school was a unique opportunity for this group of young scientists to experience cutting-edge science and, above all, to come close to all aspects of the challenging ecosystems in the Mediterranean Sea. We really hope that we inspired and built a strong and long-lasting cooperation between all participants and a station of knowledge and scientific expertise.

We would like to thank *The John S. Latsis Public Benefit Foundation* and its Executive Board members, Prof Gavroglou, Mr Afendoulis, and Prof. Koundouri, for giving us the opportunity, through their sponsorship, to make this summer school come true. The foundation's will to initiate and support public benefit activities in the areas of science and environmental protection gave us the chance to broaden our horizons, while simultaneously adding a multi-national dimension to the school. We would like to further extend our thanks to the *John S. Latsis Public Benefit Foundation* personnel, for assisting us in all matters regarding the completion of the summer school, as well as the highly efficient public relation officers, for their support throughout the duration of the course.

We would also like to thank *The Hellenic Centre for Marine Research* for its valuable support, allowing us to work on the line of education; education that will certainly foster and promote more scientific collaborations in the future. Our past experiences in the organisation of similar events were a useful guide in this current project, while we tried to convey the latest developments in Marine sciences based upon our scientific and technological research, and experimental development, especially in the fields of study and protection of the hydrosphere.

Special thanks to all the lecturers, who not only did their best in their presentations, but also prolonged their stay in Athens in order to help the students and interact more with the group as a whole. This summer school would have never been made possible without their contribution.

Above all, we would like to thank all the young scientists for their active participation in the summer school. Their willingness and eagerness to dynamically take part in all learning activities and events has left us confident that the future of Marine Sciences in the region is, indeed, promising and innovative.

Introduction

This is the final report for the John S. Latsis Public Benefit Foundation, regarding the organisation of the Summer School on the topic of "Functioning and Evolution of the Mediterranean marine ecosystems", as organized and conducted by the Hellenic Centre for Marine Research (HCMR) from 1-15 July 2010. The Summer School was exclusively financed by the Foundation, and in the context of its educational initiatives, it aimed at advancing the knowledge and scientific research both in Greece and abroad.

The Hellenic Centre for Marine Research (HCMR) aims to carry out scientific and technological research, experimental progress, dissemination and implementation of collected data and results. Special attention has always been given to the fields of study and protection of the hydrosphere, its organisms, the interface with the atmosphere, the coast and the sea bottom, the physical, chemical, as well as the biological and geological conditions that prevail and regulate the aforementioned systems. In this spirit, the summer school was organized in a manner that would meet the current challenges regarding the functioning and evolution of the Mediterranean Sea.

The Summer School also attempted to establish a code of collaboration among a diverse group of young scientists from different countries. The summer school allowed students to formulate and produce an output of their opinion on today's scientific efforts, with regards to studying the Mediterranean Marine Ecosystems. Additionally, the school provided an opportunity to scrutinize and criticize past and present actions that scientists have taken in order to maintain and enhance the appropriate function and evolution of the Mediterranean marine Ecosystems. Finally, the school revealed the great potential for future collaborations, especially in an area such as the Mediterranean, heavily burdened by political pressures.

It is believed that all challenges arisen during the Summer School were met successfully, while difficulties faced during its conduct were efficiently overcome. What remained at the end was the sense of collaboration towards delivering and using this much needed knowledge, if we are to protect the fragile Mediterranean Ecosystems.

Overall Description of the Summer School

The main objective of the summer school was to advance the scientific knowledge in a group of young people, who would also like to eventually work in the field of Mediterranean marine ecosystems. The organization of this Summer School was based and designed upon what we currently know about the Mediterranean ecosystem and its functions. More specifically, the aims of the summer school were to help students to:

- Understand the mechanisms, functioning and evolution of Mediterranean marine Ecosystems;
- Assess the state of these ecosystems while also taking into account their unique environmental drivers and pressures from natural and anthropogenic sources;
- Describe the functioning of the extreme ecosystems found in the Mediterranean environment.

Adhering to the objectives, two major aspects, aside from attending the lectures, were accomplished:

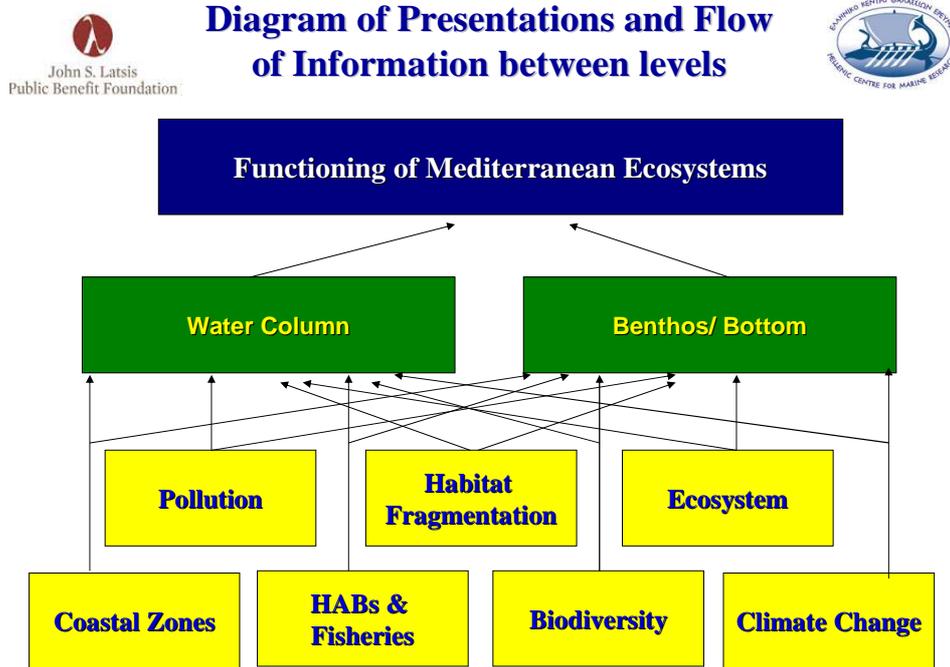
- Oceanographic cruise with R/V AEGAEO. A two-day (4-5 July 2010) oceanographic cruise for all students in the Saronikos Gulf was completed. Participants were divided into two main groups, one to explore the water column (5 July) and one designated to study benthic processes (4 July). In both cases, the students were considered to be part of the scientific cruise staff. HCMR specialised personnel helped the participants to become familiar with the sampling procedures and perform sampling and further analyses in the Saronikos Gulf samples.
- Student Group Presentations at 3 levels: Students were grouped according to their background and competence, and gave a small presentation on a chosen subject, which was related to the various summer school themes. Mid-term preparations for the presentations (Student Working Session) took place on Thursday, 8 July, and Tuesday, 13 July. The themes were part of the Summer School's objectives and members of the Organising Committee acted as Tutors for these specific themes.

Three (3) levels of presentations were completed on the last day of the Summer School (15 July), with increasing difficulty due to the high level of complexity of each theme regarding Mediterranean Ecosystems:

1. **Themes.** Seven Themes were chosen and each group of participants had the opportunity to present their scientific views on: 1) Pollution, 2) Ecosystem, 3)Habitat fragmentation, 4)Coastal zones, 5)HAB's & fisheries, 6)Biodiversity and 7)Climate change Effects
2. **Pelagic and Benthic Marine Ecosystems**
3. **Mediterranean Marine Ecosystems**

At the same time, students were divided into two major groups, studying two different processes: **pelagic** and **benthic**.

Finally, the whole group was requested to present its views on the **Mediterranean Marine Ecosystems**. The way in which these groups interacted is shown below:



This structure of interactive participation, although tough for the participants, provided a system which allowed students to combine, divide and manage their time between the different themes, processes and ecosystems that had to be presented simultaneously, all by the end of the Summer School.

Participants were required to follow and attend their intensive lectures on different themes and sessions, while at the same time they were expected to organize their time and base their presentation on the ability of the HCMR's staff to provide literature searching through the HCMR Library. Access to international electronic libraries was provided to all students through the HCMR's system facilities.

Lectures conducted at the HCMR premises, in Anavyssos, gave students the opportunity to visit the research centre and its facilities, the laboratories, the submersible THETIS, the underwater remotely operated vehicle SUPER ACHILLE ROV, as well as the HCMR Library documentation and Information Centre.

The Summer School Programme was as follows:

Programme

Thursday 1 July	
9:00-9:10	Welcome by <i>John S. Latsis Public Benefit Foundation</i>
9:10-9:30	Introduction to the course – <i>Ev. Papathanassiou</i>
9:30-11:00	The Mediterranean Sea: an alternative ocean - <i>L. Legendre (in collaboration with L. Prieur)</i>
11:00-11:30	Coffee Break
11:30-13:30	The Mediterranean Sea: an alternative ocean - <i>L. Legendre (in collaboration with L. Prieur)</i> (cont.)
13:30-14:30	Lunch Break
14:30-16:00	Observing the ocean from space: basic concepts and oceanographic applications– <i>R. Santoleri</i>
16:00-16:30	Coffee Break
16:30-18:30	Observing the ocean from space: basic concepts and oceanographic application– <i>R. Santoleri</i> (cont.)

Friday 2 July	
9:30-11:00:	Habitat Fragmentation – <i>F. Boero</i>
11:00-11:30	Coffee Break
11:30-13:30	Habitat Fragmentation – <i>F. Boero</i> (cont.)
13:30-14:30	Lunch Break
14:30-17:00	Habitat Typology & Management- <i>P. Panagiotidis</i>
17:00-17:30	Coffee Break
17:30-18:30	European climate change research post Copenhagen - <i>E. Lipiatou</i>

Saturday 3 July	<i>(Amfitriti Room- HCMR)</i>
9:30-11:00:	Coastal Zones - <i>Ch. Anagostou</i>
11:00-11:30	Coffee Break
11:30-13:30	Coastal Zones - <i>Ch. Anagostou</i> (cont.)
13:30-14:30	Lunch Break
14:30-16:30	Effects of Aquaculture activities in Coastal areas - <i>J. Karakassis</i>
16:30-17:00	Coffee Break
17:00-18:30	Introduction to sampling with R/V AEGAE0; Connection with EU Water Framework Directive Objectives - <i>M. Simboura</i>

Sunday 4 July

R/V AEGAE0 (Benthos and benthic Processes)

Monday 5 July

R/V AEGAE0 (Water Column)

Tuesday 6 July	
9:30-11:00	Harmful Algal Blooms (Habs) - <i>K. Pagou</i>
11:00-11:30	Coffee Break
11:30-13:30	Harmful Algal Blooms (Habs) - <i>K. Pagou</i> (cont.)
13:30-14:30	Lunch Break
14:30-16:00	Fishery Resources: Status and Trends – <i>V. Vassilopoulou</i>
16:00-16:30	Coffee Break
16:30-18:30	Fishery Resources: Status and Trends – <i>V. Vassilopoulou</i> (cont.)

Wednesday 7 July	
9:30-11:00	Biodiversity in the water column – <i>I. Siokou</i>
11:00-11:30	Coffee Break
11:30-13:30	Biodiversity in the water column – <i>I. Siokou</i> (cont.)
13:30-14:30	Lunch Break
14:30-17:00	Biodiversity including non-indigenous species- <i>A. Zenetos</i>
17:00-17:30	Coffee Break
17:30-18:30	Biodiversity including non-indigenous species– <i>A. Zenetos</i>

Thursday 8 July	
9:30-11:30	Climate change and marine ecosystems: A holistic approach. - <i>T. Oguz</i>
11:30-12:00	Coffee Break
12:00-13:30	<i>Students Working Session</i>
13:30-14:30	Lunch Break
14:30-17:00	Medusae: trophic role, link to microbial food web and impacts on humans. – <i>A. Malej</i>
17:00-17:30	Coffee Break
17:30-18:30	Medusae: trophic role, link to microbial food web and impacts on humans. – <i>A. Malej</i>

Friday 9 July	
9:30-11:00	Extreme and Deep Environments: The mud volcanism and gas hydrates in the Eastern Mediterranean- <i>V. Lykousis</i>
11:00-11:30	Coffee Break
11:30-13:30	Extreme & Deep Environments in the Mediterranean: Biodiversity and Ecosystem Function. - <i>A. Tselepides</i>
13:30-14:30	Lunch Break
14:30-17:00	Extreme and Deep Environments: Life in the deep - <i>M. Priede</i>
17:00-17:30	Coffee Break

17:30-18:30	Extreme and Deep Environments: Life in the deep - <i>M. Priede</i>
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Saturday 10 July

Excursion to Nafplion and Epidaurus (Ancient Theatre)

Sunday 11 July

Free Day (Acropolis Museum)

Monday 12 July	
9:30-11:00	Inorganic Pollution – <i>E. Kaberi</i>
11:00-11:30	Coffee Break
11:30-13:30	Organic Pollution - <i>M. Tsapakis</i>
13:30-14:30	Lunch Break
14:30-17:00	Marine Pollution and aspects of coastal zone and water resources management. - <i>M. Scoullas</i>
17:00-17:30	Coffee Break
17:30-19:00	The Past Climate of the Mediterranean Sea: physical, biogeochemical and ecosystem perspectives – <i>A. Gogou</i>

Tuesday 13 July	
9:30-11:30	Impacts of climate change on the ecosystems - <i>M. Zavatarelli</i>
11:30-12:00	Coffee Break
12:00-13:30	<i>Students Working Session</i>
13:30-14:30	Lunch Break
14:30-17:00	Impacts of climate change on the ecosystems – <i>C.P. Reid</i>
17:00-17:30	Coffee Break
17:30-18:30	Impacts of climate change on the ecosystems – <i>C.P. Reid</i>

Wednesday 14 July	
9:30-11:00	Stakeholder Analysis in Marine Governance – <i>A. Kontogianni</i>
11:00-11:30	Coffee Break
11:30-13:30	Stakeholder Analysis in Marine Governance – <i>A. Kontogianni (cont.)</i>
13:30-14:30	Lunch Break
14:30-17:00	Socio-economic scenarios for marine ecosystem management.– <i>M. Skourtos</i>
17:00-17:30	Coffee Break
17:30-18:30	Socio-economic scenarios for marine ecosystem management.– <i>M. Skourtos (cont.)</i>

Thursday 15 July	
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9:30-11:00	Student groups presentations (Live presentations)
11:00-11:30	Coffee Break
11:30-13:30	Student groups presentations (Live presentations) (cont.)
13:30-14:30	Lunch Break
14:30-16:00	Student groups presentations (Live presentations) (cont.)
16:00-16:30	Coffee Break
16:30-18:30	Student groups presentations (Live presentations) (cont.)

Lecturers

Lecturers were chosen from a pool of distinguished scientists in the field of Marine Sciences in the Mediterranean area, but came from all over Europe, beyond strict geographical limits. Since the organizing process had begun, the idea was to try and allow sufficient time for interaction between students and Lecturers. The lecturers were free to conduct their lectures as they preferred, given their huge experience in similar events. However, they were asked to demonstrate interactive approaches and choose any method of interaction that they find appropriate regarding their lecture, which proved to be a useful and pleasant exercise.

Lecturers were asked to extend their stay in Athens for a day or two after their lecture, in order to give students the opportunity to actively and freely interact with them. All the invited lecturers responded positively to participating in the summer school, while most of them even prolonged their stay in Athens, in order to help and interact with the students. In total, 25 Lecturers from 7 countries were invited: Greece, Belgium, France, Italy Slovenia, Turkey, and UK Universities. The final list of lecturers is shown below:

	Name	Title-Affiliation	Theme in Summer School
1	Prof Louis Legendre	Director of CNRS, Villefranche-sur-Mer Marine Station, France	Mediterranean and World Ocean: Similarities, Differences and peculiarities
2	Dr Rosalia Santoleri	Researcher, CNR Rome, Italy	Ocean from Space
3	Dr Elizabeth Lipiatou	Head of Climate Unit, DG Research European Commission	European Commission actions on the study of climate changes.
4	Prof Ferdinando Boero	University of Lecce, Italy	Habitat Fragmentation
5	Dr Panagiotis Panagiotidis	Research Director HCMR	Habitat Fragmentation
6	Dr Yannis Karakassis	University of Crete	Coastal Zones
7	Dr Christos Anagnostou	Research Director HCMR	Coastal Zones
8	Dr. Nomiki Symboura	Associated Researcher HCMR	Water Framework Directive, Sampling procedures and results
9	Dr Kaliopi Pagou	Research Director HCMR	Harmful Algal Blooms
10	Dr Vassiliki Vassilopoulou	Senior Researcher HCMR	Fisheries and Productivity
11	Dr Argyro Zenetos	Research Director HCMR	Biodiversity including non-indigenous species.
12	Dr. Ioanna Siokou	Research Director HCMR	Biodiversity in water column.

13	Prof Dr Alenka Malej	Director, Piran Marine Station, Slovenia	Medusae in the Mediterranean Sea
14	Prof Anastasios Tselepidis	University of Piraeus	Extreme and Deep Environments
15	Dr Vassilios Lykoussis	Research Director, HCMR	Extreme and Deep Environments
16	Prof Dr Monty Priede	University of Aberdeen, Oceanlab	Extreme and Deep Environments
17	Dr Eleni Kaberi	Researcher ,HCMR	Radioactive and Inorganic Pollution
18	Dr Manolis Tsapakis	Researcher, HCMR	Organic Pollution
19	Prof Michael Scoullis	University of Athens	Pollution
20	Dr. Alexandra Gogou	Associated Researcher HCMR	Past Climate in the Mediterranean Sea
21	Dr. Marco Zavatarelli	University of Bologna	Impacts of climate change on the ecosystems
22	Prof. Philip Chris Reid	University of Plymouth, Sir Alister Hardy Foundation for Ocean Science	Impacts of climate change on the ecosystems
23	Prof Temel Oguz	METU, Institute of Marine Sciences, Turkey	Impacts of climate change on the ecosystems. A holistic Approach
24	Prof. Areti Kontoyanni	University of Aegean	Stakeholder Analysis in Marine Governance
25	Prof. Michalis Skourtos	University of Aegean	Socioeconomic Scenarios

In addition to their lecture time, each of the lecturers also assumed an advisory role for one theme/group as follows:

Scoullis, Kaberi, Tsapakis	(pollution)
Legendre, Priede, Tselepidis, Lykoussis	(ecosystem)
Boero, Panayotidis, Malej	(habitat fragmentation)
Anagnostou, Panayotidis, Karakassis	(coastal zones)
Pagou, Vassilopoulou, Oguz	(HAB's & fisheries)
Zenetou, Siokou, Malej, Boero	(biodiversity)
Reid, Oguz, Zavatarelli, Gogou, Lipiatou, Santoleri	(climate change)

There were 6 Key Lectures shown below (from 17:30-18:30) open to the general public (by invitation), which were also recorded for future use in the DVD trailer of the summer school.

1. European climate change research post Copenhagen -E. Lipiatou (2nd July)
2. Biodiversity including non-indigenous species –A. Zenetos (7th July)
3. Medusae: trophic role, link to microbial food web and impacts on humans. – A. Malej (8th July)
4. Extreme and Deep Environments: Life in the deep -M. Priede (9th July)
5. Impacts of climate change on the ecosystems –C.P. Reid (13th July)

6. Socio-economic scenarios for marine ecosystem management – M. Skourtos (14th July)

Seven (7) lectures were considered as ‘Open Lectures’ for the HCMR personnel and University Staff. These were:

1. The Mediterranean Sea: an alternative ocean -L. Legendre (in collaboration with L. Prieur) (1st July)
2. Coastal Zones - Ch. Anagnostou (3rd July)
3. Effects of Aquaculture activities in Coastal areas - J. Karakassis (3rd July)
4. Harmful Algal Blooms (Habs) -K. Pagou (6th July)
5. Extreme and Deep Environments: The mud volcanism and gas hydrates in the Eastern Mediterranean- V. Lykoussis (9th July)
6. Extreme & Deep Environments in the Mediterranean: Biodiversity and Ecosystem Function. - A. Tselepides (9th July)
7. Impacts of climate change on the ecosystems -M. Zavatarelli (13th July)

A short CV for all Lecturers can be found in ANNEX I.

Participants

The call for students ended on 23 April 2010. In total, 124 applications were received. From these there were 52 applications by Greek students and 72 applications by students from various countries. The high educational level of all the candidates made decisions very hard and challenging. However, all members of the Organising Committee have seen it as very promising development for the future of our Seas, as fine, talented, young scientists step forward from European and Mediterranean countries, and are able to perform high quality research in the area. The website had also been designed as a Data Base for all students applying to attend the Summer School, and this facilitated the processing of all applications.

In the end, thirty (30) participants were selected based upon their CVs. Successful applicants were officially notified on 1 May 2010. Two of the students (one from Turkey and one from Lebanon) cancelled their participation for personal reasons; therefore 28 students successfully completed the Summer School. Nineteen (19) students were at PhD level, seven (7) held a Masters Degree while two (2) were Bachelor graduates.

The average age of the participants, who came from 12 countries, was 30 years. The full name and country of origin of all students is shown below:

	First Name	Last Name	Country
1	Melissa J.	Acevedo Dudley	Spain
2	Eleonora	Anagnostopoulou-Visilia	Greece
3	Zina	Armi	Tunisia
4	Cecilia	Baggini	Italy
5	Mahdia	Belounis	Algeria
6	Eleni	Bintoudi	Greece
7	Stavroula	Christidoulopoulou	Greece
8	Niki	Diogou	Greece
9	Giulio	Franzitta	Italy
10	Ioanna	Georga	Greece
11	Aikaterini	Giamalaki	Greece
12	Arapov	Jasna	Croatia
13	Stefanos	Kalogirou	Greece
14	Denada	Kasemi	Albania
15	Nikolaos	Katsiaras	Greece
16	Vasiliki	Kousteni	Greece
17	Paraskevi	Louizidou	Greece
18	Orit	Nir	Israel
19	Meltem	Ok	Turkey
20	Maria	Pantazi	Greece
21	Anastasia	Papadopoulou	Greece
22	Branka	Pestoric'	Montenegro
23	Nayrah Abd ElNabi Ali	Shaltout	Egypt
24	Olena	Sibirtsova	Ukraine
25	Kalliopi	Sigala	Greece
26	Antonios	Stamoulis	Greece
27	Maxime	Suroy	France
28	Uxue	Tilves	Spain

The different groups, selected by taking into account previous experience of each participant, were formed as follows:

1. POLLUTION

1. ELEONORA ANAGNOSTOPOULOU-VISILIA
2. NAYRAH SHALTOUT
3. ANTONIOS STAMOULIS

2. ECOSYSTEM

1. STEFANOS KALOGIROU
2. BRANKA PESTORIC
3. UXUE TILVES
4. MAXIME SUROY

3. HABITAT FRAGMENTATION

1. VASILIKI KOUSTENI
2. NIKI DIOGOU
3. ORIT NIR
4. ELENI BINTOUDI

4. COASTAL ZONES

1. MELTEM OK
2. KALLIOPI SIGALA
3. DENADA KASEMI
4. AIKATERINI GIAMALAKI

5. HABs & FISHERIES

1. STAVROULA CHRISTODOULOPOULOU.
2. JASNA ARAPOV
3. IOANNA GEORGA
4. ZINA ARMI

6. BIODIVERSITY

1. OLENA SIBIRTSOVA
2. ANASTASIA PAPADOPOULOU
3. GIULIO FRANZITTA
4. PARASKEVI LOUIZIDOU

7. CLIMATE CHANGE

1. MELISSA J. ACEVEDO DUDLEY
2. CECILIA BAGGINI
3. NIKOLAOS KATSIARAS
4. MARIA PANTAZI
5. MAHDIA BELOUNIS

The **Benthos group** comprised the following students

Eleonora Anagnostopoulou-Visilia, Eleni Bintoudi, Stavroula Christodouloupoulou, Giulio Franzitta, Aikaterini Giamalaki, Stefanos Kalogirou, Nikolaos Katsiaras, Denada Kasemi, Paraskevi Louizidou, Orit Nir, Meltem Ok, Kalliopi Sigala, Antonios Stamoulis

The **Water Column** Group comprised the following students

Melissa J. Acevedo Dudley, Maria Pantazi, Jasna Arapov, Zina Armi, Cecilia Baggini, Mahdia Belounis Niki Diogou, Ioanna Georga, Vasiliki Kousteni, Anastasia Papadopoulou, Branka Pestic, Nayrah Shaltout, Olena Sibirtsova, Uxue Tilves, Maxime Suroy

Organising Committee:

The Summer School Organising Committee comprised mainly HCMR scientific staff, while collaboration with the University of Athens, in the light of improved organisation and better dissemination of information, was achieved.

Evangelos Papathanassiou, Chair, Deputy Director of the I.O, HCMR

Vassilios Lykousis, Research Director, HCMR

Stella Psarra, Senior Researcher, HCMR

Paraskevi Pitta, Senior Researcher, HCMR

Kostas Nittis, Research Director, HCMR

Vassilios Papadopoulos, Researcher, HCMR

Manos Dassenakis, Associate Professor, University of Athens

Secretarial Support:

Paschalia Georgoulakou, HCMR

Martha Papathanassiou, HCMR

Following the participation design, and for best practice reasons, each member of the Organizing Committee was responsible, as a Tutor/Supervisor for one theme/group as shown below. Care was taken to leave the students to decide on their own presentations and follow them through; trying in this way to solve any major problems they may have stumbled upon.

- | | |
|--------------------------|---------------|
| 1. Pollution | DASSENAKIS |
| 2. Ecosystem | PSARRA |
| 3. Habitat Fragmentation | NITTIS |
| 4. Coastal Zones | LYKOUSIS |
| 5. HABs & Fisheries | PAPATHANASIOU |
| 6. Biodiversity | PITTA |
| 7. Climate Change | PAPADOPOULOS |

Scientific Outputs of the Summer School

The Theme of the Summer School is rather broad and it was not believed that it could cover all aspects of the ecosystem functioning and evolution. However, what was planned out from the beginning was to clearly demonstrate to the participants that the individual and specific research they are or will be carrying out, is part of a bigger “picture”, of the ecosystem. By offering new knowledge, and exploring all parts of the food chain and adopting an ecosystem approach, the Summer School has built a strong foundation for future multinational collaborations, scientific interconnection between disciplines and themes, showing eventually the power of integration at a higher level. The presentations given were along these lines.

Based on the Lectures and the Programme, the Summer School started with a general ecosystem approach and oceanography from space. Both Lecturers, **Prof. Louis Legendre** and **Dr. Rosalia Santoleri**, gave the option of considering the alternative ocean as well as the means to measure some parameters in the sea from space. A complementary view of the space oceanography aspects and tools on the ecosystem was also presented.

Louis Legendre presented his views of the Mediterranean Sea as an alternative ocean which is governed by the same physical, chemical and biological processes as those that operate in the world ocean. In many instances, however, these processes lead to different physical, chemical and biological characteristics in the Mediterranean Sea than in the world ocean. In that sense, the Mediterranean Sea is another realisation of the ocean’s environment, i.e. it is an “alternative ocean”, not a miniature ocean. The Mediterranean Sea is not the only alternative realisation of the ocean’s environment on Earth, e.g. the neighbouring Black Sea offers a strikingly different “alternative ocean”. Prof Legendre suggested that studying alternative realisations of systems governed by the same sets of processes, brings enlightening information on the functioning of these different systems; hence, studying comparatively the Mediterranean Sea and the world ocean can improve the knowledge of the functioning of these two ocean systems and of the basic processes they share. He presented, in detail, all aspects regarding the functioning of the ecosystem in the Mediterranean Sea and compared these with the marine ecosystems in several oceans around the globe. He demonstrated that the Mediterranean Sea has different physical, chemical, biogeochemical and biological characteristics from those in the world Ocean and he concluded that these differences do not arise from different laws or principles of the different disciplines, but they can instead be ascribed to specific features of the Mediterranean basin.

Dr. Rosalia Santoleri’s lecture focused on the observation of oceanographic parameters from space and the potential oceanographic applications. She presented the Satellite Observing System, which is today considered an essential component of the Earth Observing System and talked about the satellite sensors (body emission, atmospheric transmittance, type etc.) and geophysical variables. She also gave the view of the different satellite measurements (SST, Ocean colour, Altimeter, chlorophyll etc.), the basic concepts behind these measurements and the calculation processes and gave some specific examples on Satellite Oceanography in the Mediterranean Sea. Dr. Santoleri concluded that the satellite system provides an important source of data to study the ocean, and satellite products are now easily

available to the scientific community thanks to the operational oceanography effort. Finally, she presented the view of the last decade, where satellite oceanography provided an important contribution to understand the dynamics and variability of the Mediterranean Sea ecosystem, at short and long time scales.

On 2 July 2010, the presentations given were mainly on habitat fragmentation, habitat typology and management. The lecture by **Prof. Ferdinando Boero** started by outlining the general view of the ecosystem, with a review of marine and terrestrial ecosystem biodiversity and continued with all compartments of the ecosystem, from autotrophs to photosynthesis, to secondary production and tertiary producers. The lecture continued by paying special attention to different fluxes; fluxes from one generation to the next, fluxes from one species to another one, fluxes from a living to a non-living state, in order to finally arrive at fluxes from a non-living to a living state. Following the habitat fragmentation F. Boero tried to show the importance of habitat integrity. Habitat degradation, destruction, fragmentation, and loss are the most dramatic consequences of anthropogenic pressures on natural systems, while the impact of habitat changes is difficult to assess. The understanding of the status and trends of marine habitats is insufficient, and the effects of anthropogenic activities are more often assumed than actually quantitatively evaluated. He has insisted to present the habitat as a whole and not fragmented, thereby showing the audience that although they will be working in individual aspects, they should consider the habitat as a whole, through a more integrated view. He described, in a few words, the anthropogenic impact and changes that could be observed in the future from climate change, as well as the anthropogenic effects and changes that might occur in organisms ranging from fish to jellyfish, clearly reflected in his question “Marine Ecosystem Functioning: a shift from fish to jellyfish?”

Dr Panayotis Panayotidis described the different habitat types in the Mediterranean Sea, the delimitation of the different systems by energy and flux, the differentiation between benthic and pelagic ecosystems and the concept of biological communities. Following the introduction on the communities and bionomics of benthic systems in the Mediterranean, Dr. Panayotidis referred to typology and its importance for management, especially in benthic communities. He described in detail the different marine habitat types, the management bodies in the Mediterranean that have to convert to EU Directives, and gave a thorough demonstration, using dedicated examples from the Greek waters, on the concept of Marine water body types under the WFD 2000/60/EC. He finished with an overall presentation of the Marine Strategy Framework Directive (MSFD) on the concept of Good Environmental Status for 2020.

The Lecture given by **Dr. Elisabeth Lipiatou** was a Keynote Lecture on European Climate Change Research – Post Copenhagen. She started by presenting data and information on climate changes, their effects on marine systems and especially on the Mediterranean and gave an estimate on climate expectations through IPCC models. She insisted on the importance of adaptation to Climate Change and gave a well documented presentation on the Research Framework Programme of the EU Commission, identifying the major axes of contribution: on the Understanding, monitoring and predicting climate change and its impacts, on providing tools to analyse the effectiveness, costs and benefits of different policy options for mitigation and adaptation and, finally, improving existing climate-friendly technologies and developing the technologies of the future. She highlighted the EU Research strategy

post-Copenhagen for the 2020 horizon and gave very good examples of EU Research in terms of projects and results on climate change issues. She also gave her view on the importance of research in the Polar Regions and on how these may affect the whole planet, especially for the Mediterranean. Dr. Lipiatou mentioned several projects on climate change and their impacts (acidification, water shortage etc) which have already been launched through FP6 and continue to FP7, following the EU strategy on the 2020 Horizon.

On Saturday, 3 July 2010, all lectures were held at the HCMR premises and the entire day was devoted to Coastal zones research and management issues. **Dr. Christos Anagnostou** presented the issues and pressures on Mediterranean coastal zones and focused on the functioning of the coastal zone system, the evolution and the anthropogenic (human) activities and the pressures on the coastal zone system. He presented several examples of the common characteristics of the coastal system and the dynamics of such systems. He defined the coastal zone system and the Mediterranean coastal zone – The boundaries – [the spatial property], the dynamics of energy and matter flow in the coastal zone system and the Energy and matter flow in the Mediterranean coastal zone from energy and matter sources. Finally, he introduced the factors Time and Evolution: -From the past to the present, from the present to the future. In the second part of his presentation, Dr Anagnostou focused on the coastline compartments, meaning the rocky coasts compartment, the positional coastal compartment, as well as the deltaic systems in the Mediterranean. He made an extensive presentation of a case study regarding Matter transfer and biogeochemical cycles in coastal systems of the Mediterranean Sea in the Gulf of Lions (France) and Thermaikos Gulf (Greece), by considering all aspects of the coastal areas. Finally, he presented his views on integration, from the management of isolated problems to the Integrated Coastal Zone Management (ICZM).

Professor Yannis Karakassis focused on Environmental impacts of aquaculture in the Mediterranean Sea. He introduced the reasons of aquaculture activity and expansion in the coastal areas and gave a very thorough answer on the question of whether the oceans will help to feed humanity. Prof Karakassis presented the aquaculture activity as a good example for analyzing human impacts on coastal ecosystems in terms of: releasing a variety of substances into the environment, interfering directly and indirectly with different marine biogeochemical processes, affecting some of the species which are considered to be of priority for conservation especially in the coastal zone, where biodiversity is high and human pressures are increasing and complex. Finally, aquaculture is a rapidly expanding industry with potential for large-scale effects and involves impacts at varying spatial and temporal scales. Prof Karakassis presented the effects that aquaculture may have on marine ecosystems, where the literature mainly shows local effects. However, he showed that conflicts with other users of the coastal zone and mainly with the well-established tourism industry, decreases profitability (market saturation) and is considered to be responsible for environment and biodiversity issues. He presented several EU projects which pertain to the effects of aquaculture on the marine environment, the nutrients that are lost from the water column in aquaculture areas and, additionally, showed how complex the decision on the management of activities in coastal zones can be, by using an example from the Irish Sea. Finally, he focused his presentation on the interaction with wild fish, sea grasses (especially *Posidonia oceanica*). In the second part of his presentation he referred to the Mediterranean initiatives regarding aquaculture interactions and sustainability, focusing on the carrying capacity and

ecological carrying capacity of the area and the management actions from GFCM (General Fishery Commission for the Mediterranean of FAO) as well as EU and National Regulations.

Dr Nomiki Simboura completed the presentations of the day by giving a lecture on the sampling with R/V AEGAEO (which was going to be completed over the next two days) and connected this sampling activity with the EU Water Framework Directive objectives (WFD 2000/60). She presented the innovative character of the WFD and the overall objective, focusing on the fact that all EU member states should achieve good ecological and chemical status for all water bodies by December 2015. She provided definitions for words like 'water body', 'ecoregion', 'typology', 'classification', 'reference conditions' and 'intercalibration', and presented the different ECOLOGICAL QUALITY ELEMENTS & INDICATOR PARAMETERS to access the data. Dr Simboura gave a full analysis of the different indices used under the WFD principals like BENTIX, AMBI, MEDOCC, BOPA, CARLIT, EEI , the Benthic Quality Index (BQI) etc. and their intercalibration data, as it appeared in the Intecalibration Working Group for the Mediterranean countries (MED-GGIG). Finally, she presented web software that may be used to calculate the results for the data used, by applying the different indices for the zoobenthos data. This software was used for the data collected during the previous years in the Saronikos Gulf, and was also used for the practical interpretation of data given to the summer school class.

The next unit was Habs and Fisheries. **Dr. Kaliopi Pagou** presented a very detailed structure of phytoplankton entities and divisions according to the size and functions, and the model of primary production, its differentiation in the open ocean and self & coastal areas, as well as the greater picture regarding primary production: a nutrient poor sea due to narrow continental shelf and few rivers outflow. Following this introduction, Dr. Pagou moved on to Harmful Algal Blooms, focusing on the physical, chemical and biological factors that could create an algal bloom, the direct or indirect effects that could make an algal bloom harmful, the geographical and frequency factors that create the problems, as well as the solutions regarding how and what we can regulate when studying the physical, chemical, and biological parameters. After the actual definition of algal blooms and the critical biomass or increase above background, she focused mainly on toxic or ecological effects of Harmful blooms in terms of species, growth strategies and competition, their ecological/oceanographic significance in terms of nutrient limitation in the ocean, their geographical distribution and the export production and sequestration in coastal ecology, together with the implications for nutrient cycling & trophic cascade. Finally, she gave a very good representation of case studies around the world, including, as a final presentation, the situation in the Mediterranean Sea.

Dr. Vassiliki Vassilopoulou gave a presentation on Mediterranean Fishery resources, their status and trends and divided her talk into two parts, the first of which analyzed the ecosystem and introduced the differences, as well as importance in the Mediterranean Sea, of pelagic, deep pelagic and demersal fisheries. She presented the target species, the fishing gear and the impacts of fishing in the open sea and coastal waters, while she showed the vast changes in the Mediterranean marine biota, since the 1980s, illustrated by the alteration of food webs, mass mortalities, and population explosions, such as jellyfish outbreaks, attributing these to the intense anthropogenic activities, but also to climate change. Referring to fisheries management, Dr. Vassilopoulou explained the need to implement an ecosystem approach to fisheries management and presented the principles of relevance to an ecosystem approach to

fisheries (EAF): Avoiding overfishing, ensuring reversibility and rebuilding, minimizing fisheries impact, considering species interactions, ensuring compatibility (of legislations), applying the precautionary approach, improving human well-being and equity, allocating user rights, promoting sectoral integration, broadening stakeholders participation and maintaining ecosystem integrity. The second part of Dr Vassilopoulou's talk made a special reference to the Mediterranean, as fisheries in this region have certain distinct features like high diversity of the catches, high number of marketable and non-marketable species, absence of large single stocks and a relatively small size of specimens (small growth rates). She mentioned the different means of fisheries in the different zones. The differences of resources in the pelagic, demersal or deep pelagic fisheries and the landings and comparisons with other adjacent areas (like Black Sea for the small pelagics) have also been presented. Finally, she emphasized the need for better statistics and stock assessment, which has also arisen from the execution of different EU, international and national programmes.

The next unit was about biodiversity and has been split into pelagic and benthic biodiversity. Regarding pelagic biodiversity, **Dr Ioanna Siokou-Frangou** referred to the plankton in the Mediterranean Sea and its biodiversity, production and food webs, as well as to Mesozooplankton distribution in the open Mediterranean Sea. She gave a very well documented explanation of the biodiversity and its forms that we could focus on and gave an indication of the structure and function of the marine ecosystem, its compartments and its complex connections from bacteria to zooplankton. In the second part, Dr. Siokou-Frangou focused more on mesozooplankton distribution in the Mediterranean basin and the differences observed through spatial distribution and time. Despite the efforts of the last 30 years, there is still lack of knowledge regarding: Diversity and distribution of viruses, small autotrophs and heterotrophs in all areas of the basin; Biological processes (production, grazing and mortality) of all the players, especially the above; Functioning of the ecosystem and Time series data sets, which can show climate change and anthropogenic activities impact.

Dr. Argyro Zenetos gave a very interesting presentation on biodiversity, including non-indigenous species and summarized that in the Mediterranean Sea there are nearly 1000 alien marine species with most of them being introduced through the Suez Canal, unintentionally or ship-transferred. Most of the species are present in the Eastern Mediterranean; their origin and introduction vector differ greatly among basins; more rapid and extensive geographical spread in the past two decades with one new species every 9-10 days; Climate change is a significant factor. Dr. Zenetos also discussed the challenges of environmental management with regard to biodiversity and alien species, and described the actions taken at International, European, Mediterranean and national level, giving specific suggestions on things to be done at each and all levels. Finally, she mentioned the evolution of alien species distribution in the Mediterranean, the so called "tropicalisation of the Mediterranean and its attributes. Part of Dr. Zenetos' lecture was a Keynote Lecture in the Summer school.

The next session was on medusae, also introducing the holistic approach of assessing climate and anthropogenic effects. **Prof Temel Oguz** gave a holistic view on climatic changes due to anthropogenic global warming (the cause and signatures), their decadal modulations of climate by atmospheric teleconnection patterns and their impacts on marine ecosystems. He gave some explicit examples of higher temperatures in the oceans, the effects of climate change in ecosystems and more

specific examples from the Black Sea. Prof. Oguz talked about Global Warming & Reduction of nutrient availability in the surface mixed layer, the long-term Continuous Plankton Recorder survey data in the Northeast Atlantic, and the specific invasion of the alien ctenophore *Mnemiopsis leidyi* in the Black Sea. Finally, regarding climate changes, he noted that these alter the marine ecosystems synergistically, together with other environmental pressures, such as eutrophication, fishery overexploitation, and alien species invasions. The impact of climate on the marine ecosystems is clear and the anthropogenic warming signal is more clearly detected on a global scale. At regional scale, a more dominant signal is associated with decadal oscillations of natural climatic variability, but the anthropogenic warming and natural decadal oscillations are interlinked with each other through complicated atmospheric nonlinear feedback mechanisms.

Prof Alenka Malej gave a lecture, and a Keynote lecture, on the gelatinous species and especially the medusae. Prof Malej showed how successful the gelatinous species are in the marine environment, inhabiting practically all habitats from coastal to deep waters, from tropical to arctic, having different trophic status (herbivorous, carnivorous, omnivorous, feeding on pico-to mesoplankton) and underlining their ability to become dominant in some areas and /or seasons. She introduced the biology of the different taxa of gelatinous organisms, and presented the biology and ecology of jellyfish, their habitat, distribution, abundance and life cycles, and population dynamics. While she mentioned the impacts on marine ecosystems as being cascading effects (predatory impact), the fate of gelatinous biomass and the large scale marine processes such as carbon cycling, other reasonable anthropogenic causes can be overfishing, climate change, eutrophication and/or invasions as multiple interacting factors. Finally, she presented the model and movement of jellyfish in the Adriatic and posed the same question as Ferdinando Boero, regarding Marine Ecosystem Functioning: a shift from fish to jellyfish?

After the pelagic description and function, the Extreme and deep waters and ecosystem function was described by **Dr. Vassilis Lykousis**, **Prof. Anastasios Tselepidis** and **Prof. Imants (Monty) Priede**, on 9 July 2010. **Dr. Lykousis** described the Mud volcanism and gas hydrates in the E. Mediterranean deep environments. Part of his lecture focused on the Geological processes and deep/extreme environments of the E. Mediterranean, especially connected with Gas hydrates, giving a very well documented example of work on the potential of Gas hydrates in the E. Mediterranean (Anaximander mountains). He illustrated the sampling procedures on the Morphological features of the seabed with limited aerial extension resulted from complicated geo-processes (plate tectonics, convergence/divergence, active faulting, erosion etc) and enhanced presence of energy (carbon) in the near bottom environment (i.e. downslope POM flow, sea bed CH₄ flow). Finally, he presented the different environments in the deep in the Black Sea mounts and Anaximander, stating the potential of this kind of research as well as the ecosystem functioning in these deep morphological features.

Prof Anastasios Tselepidis presented the deep Mediterranean Sea ecosystem and its evolution, diversity, functioning and conservation. In his lecture, he emphasized the late observations on climate change effects in the deep sea, as evidence is accumulating, which suggests that climate change induced modifications in deep-sea biodiversity and ecosystem function occur more often than previously anticipated. It is stated that the Deep Mediterranean Sea changing, it is susceptible to climate forcings and it is generally a fragile/vulnerable ecosystem. After a very thorough

examination of the situation, Prof Tselepidis' view is that the deep Mediterranean is generally acting as a "biological desert", although certain areas display such high benthic activity so as to be characterized as "benthic hot spots". These areas are, in most cases, located at or near the mouth of submarine canyons that transport, through flush flooding, sediment failure and dense shelf water cascading, large amounts of sediment and organic material to the deep sea floor. In addition to this, abyssal trenches act as traps of organic matter of either terrestrial or pelagic origin. Large-scale hydrographic changes (Eastern Mediterranean Transient-EMT) have also been considered to enhance the productivity of the euphotic zone and, indirectly, the structure of the underlying deep benthic communities.

The final session in this unit was completed by **Prof. Monty Priede**. Prof Priede's view of the deep Mediterranean waters showed the differences, the problems and the issues related to the abyssal zone in the oligotrophic marine environment and showed how life in the deep Mediterranean could be affected by different processes. Bioluminescence was one of the processes that Prof Priede focused on, as well as the signaling of organisms through this process for various activities, using a very sensitive technique and a camera for this purpose. In the second part, he focused mainly on the fish in the deep ocean and the simple ways through which we could provide data and information through a Lander Operation that is acoustically retrieved onboard. Finally, Prof Priede mentioned that deep sea populations depend on depth and surface productivity and gave a sequence and transition of species occupying a specific space over time.

In the Pollution unit, **Dr. Eleni Kaberi** described the inorganic pollution in the Mediterranean, giving an overall status of pollution in the marine environment, while also addressing the Sources and Sinks, and the overall processes influencing the cycling of elements in the marine environment. She gave a well documented description of the metal pollution and toxicity and the pollution caused by point sources (single location) like wastewater treatment plants, sewer system overflows, animal feeding operations, industrial facilities and dumping, e.g. waste oil, paints, etc. Similarly, she presented the issues related to non-Point Sources (diffuse sources) like air wash pollutants out of air, fertilizers and animal waste nutrients, bacteria, viruses, hormones, antibiotics, pesticides, sediments and oil, and other chemicals. Dr Kaberi also mentioned radioactive pollution and described the different indicators used in several cases in the Mediterranean Sea. Finally, she gave an indication of tackling this kind of pollution and its effects on the marine environment, especially in the Mediterranean, through different initiatives from the UNEP and EU.

Dr. Manolis Tsapakis' presentation followed, which focused on organic pollution and its effects in the marine environment. Dr. Tsapakis gave an introduction of organic pollution in the marine ecosystems, the ecosystem's response to organic enrichment in the marine environment and the organic chemicals that could/should be of environmental concern, related to the structures and physical/chemical properties, the analytical chemistry, the behavior in the environment and animal tissues and the mass balance and processes that govern the fate of organic chemicals in the Mediterranean Sea. He also referred to the different organic pollutants like the POPs, being all synthetic (man-made) organic chemicals, which enter intentionally or non-intentionally the marine environment. They are persistent in the environment and some of them will almost always be found, if tested, in tissues or environmental samples from different parts of the world. POPs are likely to accumulate, persist and bioconcentrate and could, eventually, achieve toxicologically relevant concentrations

– even though exposure episodes may appear limited. In the end, Dr Tsapakis presented the influence of atmospheric deposition in the Mediterranean and its effects from these processes.

Prof. Michael Scoullou presented, in two parts, the Priorities for Capacity Building linked to H2020, made out of the Barcelona convention and the Marine Pollution, as well as aspects of coastal zone and water resources management. Regarding the H2020, Prof Scoullou identified the Top sources of Mediterranean pollution, like municipal waste, urban waste water and the industrial emissions accounting for up to 80% of pollution in the Mediterranean Sea. H2020 is part of the Barcelona Process that would build on existing institutions and results, filling gaps where it could bring added value. It will operate within the framework of existing and developing policy instruments, and supports the implementation of the commitments. Regarding the Marine Pollution aspects in coastal zones, Prof Scoullou emphasized the need to link science with applications, governance and regulation, as most of the relevant important processes take place around the coastal zone. The Mediterranean Sea is landlocked, with complex political realities and the Mediterranean, the EU, the Euro-Mediterranean Partnership and the UfM should try to find major initiatives to depollute the Mediterranean and all are required to produce thorough scientific input.

The final presentation within this unit was from **Dr. Alexandra Gogou**, on The Past Climate of the Mediterranean Sea and its physical, biogeochemical and ecosystem perspectives. The Mediterranean Sea's atmospheric circulation is dominated, in large-scale terms, by interplay between temperate (westerlies) conditions and subtropical conditions. The summer in the area is dominated by subtropical conditions (especially the SE sector), while winter seasons are dominated by the influence of temperate (westerlies) conditions (especially W and NW). Finally, the external influence of tropical/monsoon conditions by modification of the basin's hydrological budget (Nile's and other runoffs) can be considered. Using sapropel formation, Dr Gogou demonstrated the enhancement of productivity and collapse of the deep ventilation in the eastern Mediterranean, which led to sapropel deposition (several kyrs), due to disruption in the basin's hydrological cycle. Some sapropels showed extinction of all bottom life throughout the eastern Mediterranean from 300m down (others only down from 2000m). They are not singularities, but evolve through different phases according to the astronomical 'pacemaker'. Finally, the merging of knowledge on sapropels and that on anoxic and suboxic zones, showed that it could be very effective not only for understanding their dynamics, but also to predict future scenarios in the present ocean. Dr. Gogou demonstrated the past, cold periods in the Mediterranean, which can also lead to effectively studying the climate change issues of today.

On Tuesday, 13 July, the unit of lectures was on Climate Change and their effects in the marine environment.

Prof. Marco Zavatarelli gave a presentation on Climate change and its effects on Marine ecosystems, by illustrating the Planet Earth Energy budget and the Greenhouse gases that absorb longwave radiation emitted from the Earth's surface. Dr Zavatarelli mentioned the Reciprocal interactions of the different "spheres" (atmosphere, hydrosphere, lithosphere hydrosphere, cryosphere, anthroposphere and biosphere) and showed the Solar energy input change, which increases with time. He talked about the anthropogenic greenhouse gases' input into the atmosphere and the corresponding global temperature increase which allow the ocean's (SST) warming.

He tried to connect the air-sea CO₂ fluxes composed of natural and anthropogenic fluxes and gave the estimates of budgets of CO₂ in different regions around the globe based on the different “pumps” (“solubility pump”, “organic carbon pump”, “CaCO₃ counter pump”). Finally, he addressed the issue of circulation affecting the biology in the Mediterranean Sea and portrayed a primary image of the possibility of a “stagnant” deep Mediterranean Sea in the 21st century.

Prof Chris Philippe Reid presented the Climate Change: Facts, Impacts and Global Security. He mentioned all the facts related to Climate Change issues, like the Hydrological cycle, Precipitation, Evaporation and Salinity, Carbon dioxide (CO₂) the Fossil fuel emissions, the cement manufacture and the Forest destruction. He first analysed the facts to derive to the Impacts, especially on the High temperature, the Sea level rise, the Ocean carbon pumps, as there are indications showing that the efficiency of the ocean carbon pumps are reducing. Facts on the small variation - potential large impact on the atmosphere, the melting ice, the disappearance of mountain glaciers, the methane release, the permafrost hydrates and the trans-arctic migration that may happen, have also been considered and presented by Prof. Reid. As a result of climate change, there are going to be Droughts & Floods, especially through Tropical cyclones, the regime shift and Biodiversity. A further complication may occur due to Ocean acidification, thereby giving rise to coral reef destruction/extinction. Thus, according to this presentation, the vulnerability of corals, plankton and the biological pump to ocean acidification, will all increase. Forest/peat fires will become more regular than they are today. Regarding the Global Security, factors like water scarcity, trade, urbanisation, migration, travel/tourism, will also be affected, while it is considered that more wars will begin. Human health will be affected too, with Epidemics raised, while heat exhaustion and economics will be further affected. However, major economic benefits will be given if we act now, and this is a political decision which must be taken.

The final unit of Lectures was designed to explore socioeconomics and stakeholder analysis, presented by **Prof. Areti Kontoyanni** and Socioeconomic scenarios presented by **Prof. Michael Skourtos**.

Professor Kontoyanni started her presentation with definitions of Stakeholders (primary, secondary Key), Stakeholder analysis, which is needed to identify a project's key stakeholders, the assessment of their interests, and the ways in which these interests affect a project's risk and viability. In terms of Governance, she explained the needs for all Governments to implement their policies and programs in a more cost-effective, responsive and equitable manner, in order to increase overall social benefits. Prof. Kontoyanni provided some good examples of protected area management issues requiring Governance-related solutions. She presented a scoping framework of DPSIR and a case study of eutrophication in the Gera Gulf, on the island of Lesvos, in Greece. Additionally, she presented views on conducting stakeholder analysis and presented a methodology for Scoping Analysis related to Focus Groups. Finally, Prof. Kontoyanni held a very interesting role-playing session, whereby she assigned different roles to the students (major of the town, journalist, NGO, administration, fisherman etc.), and asking them to perform these in a real-life situation, thus asking them to take decisions based on various environmental problems, acting Stakeholders themselves.

Prof. Michael Skourtos presented the ecosystem approach strategy and provided integrated information on management of land, water and living resources that promotes conservation and sustainable use of resources in an equitable way. Baseline, as well as scenarios related to population, economic development, technology and

natural resources for use, together with environmental data and scenarios, were also presented based on the data and information provided in the EU IP Project SESAME. Prof. Skourtos also presented the main aims of socio-economic scenarios in the assessment of environmental impacts, adaptation and vulnerability based on characterizing the demographic, socio-economic and technological driving forces underlying anthropogenic impact on the environment, thereby characterizing the sensitivity, adaptive capacity and vulnerability of social and economic systems in relation to human pressures and, at the same time, being able to apply the best policy options without trying to predict the future development of natural systems.

On the last day, all groups presented their own output, which was based upon the critical judgement of the presentations and the publications that could be downloaded from the electronic libraries. The 7 presentations of the different groups were followed by the presentations of the water column and benthos groups, and the final presentation on the Mediterranean Marine Ecosystem Functioning and Evolution was given by Antonios Stamoulis. All presentations from the students are included herein.

It is important to mention that this Summer School offered a high level of scientific interaction between different groups and individuals, namely between the students themselves, between Lecturers and students, between students and members of the Organising Committee and, finally, between the different groups of students. We truly believed that what started during this Summer School could give rise to a nucleus of Mediterranean, interactive activities, that will foster and promote further collaborative activities in the area. The HCMR intended to pursue this challenge and complete a unique Summer School, more than capable to address the needs of the young scientific community.

ANNEX I

A short CV of all Lecturers can be found below. For Key Lectures, a small introduction on the subject was given prior to the Lecturer's CV.

Short CV of Lectures

Prof. Louis Legendre is currently director of the Laboratoire d'Océanographie de Villefranche (LOV) of France. He was born in Québec, Canada and he is one of the most memorable marine ecologists of his generation as his scientific activities bridge disciplines, latitudes and continents. His major research interests are biological oceanography and marine biogeochemistry; numerical ecology; philosophy of science. He has received important honours: Knight of Malta, Fellow of the Royal Society of Canada, Honorary Doctor of the University of Liège of Belgium, and G. Evelyn Hutchinson Award of the American Society of Limnology and Oceanography. He is a world-renowned scientist and has published many papers and works such as *Excellence in Ecology Books*, *Numerical Ecology (Developments in Environmental Modelling)* and many others.

Dr. Rosalia Santoleri is a physical oceanographer. She has a long experience on marine circulation, satellite oceanography and air-sea interaction studies. She has worked on the combined use of in situ and satellite data to study the dynamics of Mediterranean Sea. She has been involved in researches on the variability of SST field over the Mediterranean basin, on the study of the circulation at large scale and mesoscale and of its interactions with biological processes, and on air-sea interaction phenomena, with special regards to the energy fluxes, to define their role in the climatic evolution of the Mediterranean area. All these studies were carried out by means of passive and active satellite measurements (SST, ocean colour, altimetry, passive microwave) and in situ data. Since 1999 she has been involved in operational oceanography programs, developing and providing Near Real Time SST and ocean colour products for forecasting of Mediterranean circulation and sea state.

Prof. Ferdinando Boero was born in Italy. He is Full professor of Zoology at the University of Lecce. Author of 165 scientific articles and editor of 7 scientific books. He is responsible of research projects financed by various Italian Ministries, the European Community, the National Science Foundation of the US, UNEP and SPARAC of the United Nations, local Italian authorities etc.. Nando is member of the editorial board of several very prestigious scientific journals like *Oebalia*, *Thalassia Salentina*, *Italian Journal of Zoology*, *Cahiers de Biologie Marine*, *Journal of Evolutionary Biology*, *Ecology Letters*, *Marine Ecology Progress Series*. He is President of the Committee *Environnements Littorales* of the *Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée (CIESM)* and General Secretary of the *Società Italiana di Ecologia*. His main research interests are Biodiversity, Marine Biology, Evolutionary Ecology, Developmental Biology, Philosophy of Science.

Dr. Panayotis Panayotidis Born in Thessaloniki (Greece), married, two children. He studied at the Aristotelian University of Thessaloniki where he got his BSc in Natural Sciences and his PhD in Marine Biology at the University of Aix-Marseille II

During his military service assisted the Hellenic Hydrographic Service and has done his first steps in the research field in Greece. From 1983 to today he is a Researcher at the Hellenic Center for Marine Research. His research field include Seagrass and algae taxonomy, biology and ecology, benthic communities structure and function, evaluation of eutrophication and water quality status, according to the European Directives. New methods for rapid environmental assessment.

He participated in numerous research projects in Greece and abroad but his main strength is the synthesis of information towards the implementation of EU Directives. He worked recently on the implementation of the Habitat Directive in Greece and mapping of 67 marine NATURA-2000 sites (1999-2001), the implementation of the Water Framework Directive (2002-2008) in Greece, the masterplan of aquaculture in Greece (2009) and the implementation of the Marine Strategy Framework Directive (2009-2010).

Dr. Christos Anagnostou is currently a Research Director in the Institute of Oceanography at the Hellenic Center for Marine Research, Greece. He began a 30+ year career in geology and oceanography after completing a B.Sc. degree in Natural Science in the University of Thessaloniki, followed by a Ph.D. in Geology from Ruhr University in Germany. While he was promoting research in several fields in marine geology being a researcher in the Hellenic Centre for Marine Research, Christos has worked as faculty and as a guest lecturer at various research institutions, and participated in research projects at many scales. He coordinated and participated in several European ELOISE Research Projects like METRO-MED, EUROCAT-, KEYCOP-Project.

SPICOSA, etc. He has more than 80 research publications and over 70 reports. His main research interests today focus on coastal areas, integrated coastal zones management in addition to his deep sea interests on sedimentation, material fluxes and geological structures. He was for several years the coordinator of the Coastal Zone Activities at inter-sectoral level at the Institute of Oceanography in HCMR.

Dr. Nomiki Simboura, is an Associate Researcher (PhD) in the Institute of Oceanography, Hellenic Centre for Marine Research. Her research objectives include benthic ecology with an expertise in Polychaete taxonomy, ecology of marine ecosystems, effects of anthropogenic impact on benthic ecosystems, impact assessment studies, development and testing of benthic indices for ecological quality status classification, ecological status assessment. She has participated in more than 80 national and international projects undertaking task responsibility, coordinating actions or as project coordinator in 38 of them. She has published 36 papers in international journals with 350 citations, 1 monograph, 6 book chapters, and numerous communications in national and international Symposia and Technical Reports. She has been actively involved in the implementation of EU Water Framework Directive 2000/60 in coastal waters (EU and national level). Her educational work includes theses supervision at undergraduate and postgraduate level, summer school teaching, and lectures or seminars in postgraduate University courses.

Dr. Kalliopi Pagou, is a Researcher Director at HCMR. She has done her BSc. on Biology, Univ. of Thessaloniki (1981), MSc. on Biological Oceanography, Univ. of

Athens (1985), PhD. on Environmental Sciences, Univ. of Aegean, Mytilini (1994). She was a scholar in 1982-1985 of the N.R.C."DEMOKRITOS", with a research scholarship from the Greek Atomic Energy Commission, 1986-1997, research assistant in Inst of Oceanography, National Center for Marine Research and 1997 - 2003 Researcher at N.C.M.R (Inst. Oceanography). From 2003 – 2009 she was Senior Researcher at H.C.M.R. Her *Research activities* include Marine phytoplankton and autotrophic picoplankton ecology, community structure and function in coastal and open sea areas, primary production – biological processes – carbon flow, eutrophication assessment and indicators, marine ecosystems studies disturbed by human activities, study of HABs (Harmful Algal Blooms) and their relation to marine food webs and toxicity experiments in field and with laboratory cultures. *She has more than 30 publications in peer reviewed journals and Book chapters, 90 Communications in congresses with proceedings, 32 Oral communications in workshops, meetings, etc and participated in 42 national and international research projects and 95 technical reports.*

Dr Ioanna Siokou-Frangou is Research Director at H.C.M.R (Institute of Oceanography). Her main research interest is the study of marine zooplankton ecology and biodiversity in the water column. Her research activities concern zooplankton community composition and structure, effects of environmental factors on zooplankton communities, copepods grazing and biogeography, plankton food web structure in coastal and offshore waters. She has been involved in several projects, national (project leader of the Saronikos Ecosystem Monitoring Project), international and EU. She was co-leader for the Mediterranean Sea within the network of excellence EUR-OCEANS and she is task leader for zooplankton within the IP SESAME. She represents HCMR in the consortium EUR-OCEANS. She has about 40 publications in international journals and 55 communications at international and national conferences with proceedings.

Temel Oguz, Professor since 1992 in the METU. He is generally recognized for his work on the Black Sea circulation and ecosystem dynamics, even though his research interests covered a wide spectrum during his career on the two basins, Black Sea and Mediterranean.

Working until mid 1980's, in coastal oceanography; moved then into deeper ocean of the Eastern Mediterranean.

His current research interests include continental shelf dynamics, dynamics of two-layer stratified flows and its application to the Turkish Straits System, Mesoscale dynamics of ocean circulation, large scale and mesoscale circulation in the Mediterranean, Marmara and Black Seas.

He works currently on modelling ecosystem dynamics and biogeochemical cycles and their coupling with circulation and upper layer physics especially related with applications to Black and Mediterranean Seas.

He is one of the first scientists to approach the holistic approach to the ecosystem and has numerous of publications on ecosystem approach, climate change effects on marine ecosystems and anthropogenic pressures.

Dr. Vasilis Lykousis is a Research Director in Institute of Oceanography at HCMR and was responsible of inter-sectoral unit of “Open Seas and deep basins” coordinating all actions on this issue in the Institute of Oceanography from 1998 to 2007. He has a BSc in Earth sciences, University of Athens (1974), a Dipoma. In

Applied. Marine Studies, University College of Swansea-UK (1979), MSc in Holocene sedimentation in the N. Aegean, University of Wales- UK (1980) and a PhD on Prodelta deposits: Seismic stratigraphy and slope stability of slope sediments from University of Patras. His main fields of interest include Deep sea geological processes. Mud volcanoes and gas hydrates Slope-to-basin sedimentation processes and fluxes, mass gravity processes, late Pleistocene sediment sequences and sedimentary facies, Geohazards, SPM dynamics and fluxes, Seismic stratigraphy of Late Quaternary sediment sequences and sea level changes. He has been involved as major partner in 18 EU research projects (1 coordinator), and was the coordinator of 3 large scale offshore facilities projects and 14 applied (engineering) projects. He is evaluator of EU projects (and Marie Curie fellowships) in research and development/Environment directive (DGXII) and has published about 90 peer-review papers in 30 different international journals.

Prof. Anastasios Tselepidis is a Biological Oceanographer and a professor at the department of Maritime Studies of the University of Piraeus. During the last 25 years he has been involved in a variety of research projects, many of which were funded by the EU. His main scientific interests are deep-sea research in general, productivity of marine ecosystems, climate change and its impact on the marine environment, structure and function of oligotrophic ecosystems, pelagic-benthic coupling mechanisms, benthic community structure and microbial diversity. He has published over 60 peer-reviewed papers and is or has been a member of several professional bodies, scientific and consultation committees (ASLO, CIESM, MAST-COM, ECOPS/ESF, CoML etc.). Most of his work has focused on the functioning of the Mediterranean Sea but he has also worked in the Pacific and Atlantic Oceans

Dr. Eleni Kaberi is a Chemical Oceanographer and Associate Researcher in the Institute of Oceanography at HCMR. He has BSc degree in Chemistry and PhD in Marine Chemistry from the University of Athens. Her Research interests include heavy metal analyses in sediments, particulate matter and marine organisms; sedimentation rates (^{210}Pb method, ^{137}Cs); radionuclide tracers of water masses. She has been actively involved in many EU projects for the Mediterranean: MTPIL-MATER; METROMED/ELOISE; INTERREG I; KEYCOP; INTERREG II; INTERPOL, MEDPOL as well as in a number of national pollution projects. She is currently the Project Manager of the SESAME Project and she is an author of more than 40 scientific publications in peer-reviewed journals and international conferences.

Dr. Manolis Tsapakis is an Associate Researcher of the Institute of Oceanography, at HCMR. He holds a PhD in Environmental Organic Chemistry (2003) and a B.Sc. (1993) in Chemistry from the University of Crete, Greece. His main research interests include the fate of POPs in the marine and atmospheric environment, the sources and fate of PAHs in the environment, air - sea interactions, and the interaction of aquaculture with the marine environment. In particular his research areas include:

- a.. Anthropogenic pressure in the marine ecosystems from organic (PCBs, PAHs) and inorganic (nutrients etc) pollutants.
- b.. Air - Sea interactions
- c.. Sources and fate of PAHs in atmospheric Environment
- d.. Interaction between aquaculture and marine environment

e.. Study of effects of inorganic pollution in the primary productivity using modern techniques as in situ bioassays

f.. New technologies and methodology for the detection the environmental changes

He has worked as a team leader in a number of recent and ongoing EU and other international research projects including GLOBAL-SOC, OSOA, BIOFAQs, MERAMED and MEDVEG and his research has been presented in more than 30 scientific publications in leading peer-reviewed journals and books..

Prof. Michael J. Scoullos (1948), Environmental Chemist (MSc, DSc University of Athens) and Oceanographer (PhD University of Liverpool). Professor of Environmental and Marine Chemistry at the University of Athens, Director of the Laboratory of Environmental Chemistry. He has also worked for years on issues of Environmental Policies, Environmental Diplomacy and Environmental Education and Education of Sustainable Development. He represents, as an expert, the European Parliament on the Management Board and the Executive Bureau of the European Environmental Agency (EEA). He has acted as scientific advisor to the EU, UNEP, UNESCO, IFAD, IUCN, several Governments, etc. Apart from his major contribution in the Marine and Water Chemistry of the Mediterranean he is among the pioneer figures who have placed the civil society and in particular environmental NGOs in the cycle of policy formulation. President for many years of many scientific and environmental organizations and bodies such as MIO-ECSDE (Mediterranean Information Office for Environment, Culture and Sustainable Development), the Global Water Partnership-Mediterranean (GWP-Med), the EEB (European Environmental Bureau), Elliniki Etairia (Hellenic Society for the Protection of the Environment and the Cultural Heritage), the Greek National Committees of MAB/UNESCO and of UNEP, etc. He is the author of several books and major reports of environmental issues and of more than 300 articles. He has organised a large number of International Conferences and has received numerous international distinctions among which the Gold Medal of the City of Paris, the Simon Bolivar medal of UNESCO, the Environmental Award of the Academy of Athens, Knight of st. John of Jerusalem, Officer of the “Order of the Cedars” of Lebanon etc.

Dr. Alexandra Gogou is an organic biogeochemist/ chemical oceanographer currently Associate Researcher in the Institute of Oceanography, HCMR. She earned her Ph.D. degree at the Chemistry Department of the University of Crete in Heraklion, Greece. She has had a two-year post-Doctoral appointment with Woods Hole Oceanographic Institution (WHOI), Department of Marine Chemistry & Geochemistry. In 2001-2002 she worked as a postdoctoral E.U. postdoctoral fellow (Marie Curie Fellowship Program) at the “Laboratoire de Biogéochimie et Chimie Marines” in University Paris VI, on assessing the biogeochemical cycling under different conditions (mesotrophic vs. oligotrophic) in the Mediterranean Sea. In September 2005 she was elected as Assistant Professor in the Department of Marine Sciences, University of the Aegean until 2008.

Her research activities focused on deciphering biogeochemical processes and responses to climatic and environmental change that are recorded in the chemical structure, abundance and isotopic composition of organic molecules in the marine environment. Critical to these are the understanding of the origin and biogeochemical fate of organic matter, both natural and anthropogenic.

She has been involved in numerous national and EU-funded projects and has strong links with National and International Universities and Research Institutes. She has

published more than 30 articles in international journals. A central element of her professional perspective is educating and motivating students, with one aim being to nurture and develop strong candidates for research in marine sciences. Her view of education involves an early conformation of students with modern questions in marine biogeochemistry, ecosystem and climate change sciences.

Dr. Marco ZAVATARELLI is currently research staff member at the Physics Department and at the Interdepartmental Center for Environmental Sciences of the Bologna University. He holds a doctorate in Marine Environmental Sciences. Former research positions at Princeton University (USA), the Danish Hydraulic Institute-Ecological Modelling Centre (DK), the International Institute for applied Systems Analysis (A) and the National Research Council (I). His main scientific activity is in the field of numerical modelling of the ocean general circulation and ecosystem dynamics. He has participated to several EU funded Projects mainly concerned with the numerical modelling of the Adriatic Sea general circulation and ecosystem dynamics, but also contributed to biogeochemical data analysis. He is author of about 25 internationally peer-reviewed papers.

Ass. Professor Areti D. Kontogianni teaches environmental economics and integrated coastal zone management at the Department of Marine Sciences, University of Aegean, Greece. She has acted for 7 years as academic responsible of the International Inter-departmental Postgraduate Programme Environmental Policy and Management. She is an Honorary Research Fellow at the Centre for Social and Economic Research on the Global Environment (CSERGE), University of East Anglia. She has been involved in several EU research projects. Her publications and research interests focus on multidisciplinary holistic approaches trying to integrate natural and socio- economic perspectives, specifically on integrated coastal zone management, non-market valuation, social risk perception and participatory approaches.

Introduction on the Subject of the Key Lectures and CV of Lecturers

Introduction to Climate Change and Elizabeth Lipiatou

Climate Change is an issue today which may affect our lives tomorrow...In that respect climate change effects on marine ecosystems but also the synergies around the climate changes are very important to know as they may help us all to realise what we should expect, what we are doing and what we envisage for the near future, based on different scenarios. Therefore Climate Change actions at EU level are important to know especially after the Copenhagen Resolution that we all know that did not fulfilled all expectations.....

I would think that we are privileged today to have with us **Dr. Elisabeth Lipiatou** who is Head of Unit of Climate Change and Environmental Risks Unit at the European Commission. The unit is managing research, projects and initiatives in the area of climate change, environmental impacts on health, natural hazards and extreme events.

Dr. Lipiatou, as you may have guessed from her name, is Greek. She received her Diploma in Chemistry from the University of Athens (1983), her Master in Oceanography and Meteorology from the University Pierre and Marie Curie in Paris (1984), and her Master in Computer Sciences applied in Chemistry and Biology from the University Paris VII (1985). She became a Doctor of Sciences in Chemical Oceanography at University Pierre and Marie Curie, Paris, in 1989.

Elisabeth Lipiatou has ten years of academic experience in various universities and research centers, including the Centro de Investigacion y Dessorollo (CSIC) in Barcelona, the Ecole Normale Superieure in Paris and the University of Minnesota. Her research and published work were mostly in the field of biogeochemistry and chemical oceanography, with a geographical focus on the Mediterranean Sea, the Great Lakes in US and the East Africa Lakes. She was visiting scholar at Rutgers University and member of the international Panel on Water, Environment and Health of UN University.

She has sixteen years of experience in science and policy interface at the European Commission, Directorate General Research. She was a member of the organizing Committee of the Third World Climate Conference. She is the contact person of the European Commission with the Intergovernmental Panel on Climate Change (IPCC). She lives in Brussels; she is married and has two daughters.

Introduction for Marine Biodiversity and Argyro Zenetos

Although marine species richness may only total 4% of global diversity, as we all know life began in the sea.

Our understanding and knowledge of marine diversity in the present is poor compared to our knowledge for terrestrial organisms, and an appreciation for the dramatic changes in marine ecosystems that have occurred in historic times is only just beginning to emerge. Some basic questions especially for the Mediterranean basin, still remain, like:

What then can we say about recent trends in the state of marine biodiversity and what they imply for its future?

How these changes in marine biodiversity have and will affect the provision of essential ecosystem services?

Marine biodiversity is the variety of life in the sea, encompassing variation at levels of complexity from within species to across ecosystems. The term biodiversity is not a simple concept like temperature or volume but rather multidimensional. It can thus be measured in different and complementary ways and have different units.

In addition to this complex term, in the Mediterranean Basin problems, related mainly with species that were not used to live in the basin coming from ecosystems outside the Med, increase this complexity. Dr. Argyro Zentos is one of the key scientists in the Mediterranean region to study marine biodiversity, one of the scientists who has the best available picture on marine biodiversity in the Mediterranean, and I am really happy to introduce her.

Dr. Argyro Zenetos received her B.Sc (Athens University, 1975), in Natural Sciences, M.Sc (St. Andrews, Scotland, 1980) on Computational Paleoecology and Ph.D (Athens, 1986) on Marine Biology. Dr. Zenetos is currently a Research Director at the Institute of Biological Resources HCMR, with a 25 year experience in the taxonomy and biodiversity of benthic macrofauna . She has been studying marine biodiversity with a focus on alien species in the Mediterranean since 1997 and has published widely including one of the CIESM volumes on alien molluscs in the Mediterranean. She is the co-ordinator of the Hellenic network on Aquatic Invasive Species (ELNAIS). As a member of the SEBI2010 expert group on “trends in invasive alien species. She is responsible for marine alien species and has developed a Pan-European database which is updated to Oct 2009 under EEA contracts. She worked as a Consultant to EEA developing a trends indicator at Pan-European level (1994-to date) and to UNEP/MAP MEDPOL, UNEP/MAP RAC/SPA on alien species, status and trends (contracts in 2008, 2009, 2010). She author and co-author of more than 70 peer-reviewed papers and Executive Editor in the HCMR Journal, Mediterranean Marine Science.

Introduction Jellyfish to and Alenka Malej

Jellyfish form an abundant guild of top predators in marine ecosystems along with fish. In some cases they have even predicted to occupy the top predator seat of the ecosystem, in the future. They could vary in size from a few millimetres to a few metres and have a life cycle that is either truly planktonic or that includes a benthic polyp stage. Jellyfish are important planktonic predators of fish larvae and their zooplankton food, so they can affect fisheries.

Recent years' evidence especially in the Western Mediterranean indicates that jellyfish have increased in abundance and blooms (outbreaks of tens to hundreds of medusae per cubic metre) now occur more frequently in many seas. These outbreaks have been attributed variously to alterations in the trophic structure of marine ecosystems owing to overfishing, and to hydroclimatic effects, since sea temperature can influence jellyfish life cycles and reproductive output. The socio-economic effects of jellyfish outbreaks in the Mediterranean are not solely confined to pelagic fisheries, as they are toxic and can be detrimental to coastal aquaculture through damage to caged fish, and to tourism by curtailing bathing activities.

I am please to welcome Professor **Alenka MALEJ**, a Biological Oceanographer that I think knows the biology and ecology of medusae more than anybody else in the Mediterranean region. She is the Head of Marine Biology Station of the National

Institute of Biology and director of the International Ocean Institute Operational Center in Piran, Slovenia.

She has published over 100 refereed papers and has very broad experience in the coordination of national and international research projects. Her main research interests are biological oceanography, plankton ecology and nuisance phenomena (jellyfish swarming, mucilage accumulation, red tides) and eutrophication of coastal waters. In 2000, she was awarded the National Science Award for her scientific contributions. Her experience in education includes lecturing general and marine ecology, coastal zone management, mentoring of undergraduate and graduate students, she also lectured at several international courses (UNDP, UNESCO, and EU-funded summer school in Bulgaria) and is co-chair of the Joint Master Degree offered by Universities of Primorska (Slovenia) and Trieste (Italy). Professor Malej has varied and extensive community service experience serving on numerous national/international committees and panels (Bureau Central CIESM, National Committee for IOC-UNESCO, UNEP/MAP National MED POL coordinator, GEF national coordinator etc.).

Introduction to Deep Waters and Monty Priede

Deep waters are once considered as lifeless domains. However, deep-sea habitats are at present, from a biodiversity viewpoint, exceptional ecosystems that harbour singular trophic webs. Moreover, deep-sea ecosystems are now the ultimate target of industrial fisheries worldwide, following the depletion of fish communities on the continental shelves, in a sort of “(over)fishing down the bathymetric range” effect. Especially in the Mediterranean, the different geomorphological features – such as submarine canyons, seamounts, mud volcanoes or deep trenches – have introduced a distinctive biodiversity pattern in the deep waters that are probably not comparable with other regions in the world. Furthermore Mediterranean is unique as it is one of the few warm deep-sea basins in the world, where temperatures remain largely uniform at around 12.5-14.5°C at all depths, with high salinity (38.4-39.0 PSU) and high oxygen levels (4.5-5.0 ml l⁻¹);

Another important issue is the relative isolation of deep sea communities, even between Eastern and Western Mediterranean. All these features reinforce the potential for unique deep-sea communities in the Mediterranean, and the importance of precautionary action to limit the impact of human activities on these fragile habitats. As someone can imagine working on these communities requires skill, devotion and well planning activities, funding and cooperation.

I am very happy to introduce **Professor Imants (Monty) Priede**, the Director of Oceanlab, in University of Aberdeen, UK who has been working on deep sea ecosystems providing the way to tackle problems related to the deep sea ecosystems and their biodiversity. Professor Priede is responsible for a world-wide programme of marine research specialising in use of unmanned autonomous lander vehicles to carry out experiments and make observations with both stills and video cameras on the deep sea floor. His own research is also concerned with deep sea fishes and how they survive in environments remote from surface food supply. He has worked in the Mediterranean area, close or even at, the deepest point of the Mediterranean and has done very important research on bioluminescence in the deep sea and other aspects of marine biology. He is particularly interested in the problems of how to make long term observations in the deep sea and of course he has been involved as a coordinator

and very important partner in EU research projects related with installing deep laboratories at EU level, like ESONET and EMSO projects.

Introduction to Climate Change Effects and Chris Reid

Climate Change is an issue today which may affect our lives tomorrow. Climate change effects on marine ecosystems but also the synergies around the climate changes are very important to know, as environmental factors are expected to have the greatest direct effects on estuarine and marine systems.

The state of our knowledge of environmental factors that are induced from global climate changes could allow us to make reasonable predictions about some of their effects, but not about others. Just to give you the obvious example, temperature influences organism biology (mortality, reproduction, growth, behaviour), affects dissolved oxygen concentrations in water, and plays a direct role in sea-level rise and in major patterns of coastal and oceanic circulation.

I have the pleasure to welcome **Prof. Phillip C. Reid**, to give the next lecture on Climate effects on marine ecosystems.

Prof. Philip (Chris) Reid retired at the end of 2006 as Director of the Sir Alister Hardy Foundation for Ocean Science that operates the Continuous Plankton Recorder (CPR) survey, after 13 years in this post. From January 2007 he took up positions as a Professor in Oceanography at the University of Plymouth, UK and until the end of 2007 as Executive Director of the Partnership for the Observation of the Oceans. In 2008/09 he completed a major report on 'The Impacts of the Oceans on Climate' that was published in *Advances in Marine Biology* in December 2009. In 2008 he received the Ecological Engagement Award of the British Ecological Society.

In a scientific career spanning more than 40 years he has worked both as a geologist and marine biologist with research interests ranging from palaeoglaciations to plankton biogeography and ecology as well as fish/plankton relationships. Recent research has focussed on large scale and long term trends in the plankton of the North Atlantic based on data from the CPR survey and climate change. This work has involved studies of the relationship of plankton changes to hydro and meteorological variability at a range of different scales with a focus on climate change issues and links to the deep sea palaeo record. Work with colleagues at SAHFOS has shown that observed changes in the plankton are correlated with Northern Hemisphere temperatures and thus climate change. One study has described the introduction of a Pacific planktonic plant into the North Atlantic via the Arctic for the first time in 800,000 years as a consequence of the recent intensified melting of Arctic ice.

Before joining SAHFOS he worked for six years at the UK Department of the Environment (now Defra), led the UK delegation on the North Sea Task Force that produced the 1993 Quality Status Report on the North Sea and subsequently contributed to the Quality Status Report 2000 for the North East Atlantic as Vice Chairman of the Assessment and Monitoring Committee (ASMO) of the OSPAR Commission. He has acted as a scientific advisor to the Belgian national marine research programme and has contributed to a number of UK, European and international scientific committees. He contributed as a co-author to the European Science Foundation Position Paper on: Impacts of Climate Change on the European Marine and Coastal Environment that was published in 2007.

Introduction to Socioeconomic Scenarios and Michael Skourtos

In an ecosystem approach strategy we try to provide integrated information on management of land, water and living resources that promotes conservation and sustainable use of resources in an equitable way. Baseline and scenario data related to population, economic development, technology and natural resources for use, together with environmental data and scenarios, are of course within the first aspects and issues that we would like to have in order to be able to provide valuable assessments.

Why do we need socio-economic scenarios? Why do we need to learn about socio-economic scenarios?

It can be said that the main purposes of socio-economic scenarios in the assessment of environmental impacts, adaptation and vulnerability are:

- to characterise the demographic, socio-economic and technological driving forces underlying anthropogenic impact in the environment
- to characterise the sensitivity, adaptive capacity and vulnerability of social and economic systems in relation to human pressures and
- to be able to apply the best policy options without trying to predict the future development of natural systems (which we can not....)

I have the pleasure to welcome **Prof. Michael S. Skourtos**. Prof Skourtos teaches environmental economics and policy at the Department of Environmental studies, at the University of Aegean, in Greece. He has over twenty years of teaching and research experience and he has published extensively on environmental policy in the fields of: management of water resources, biological and agricultural resources, management of protected areas, conservation of biodiversity, integrated coastal zone management, waste management, economic valuation and assessment of environmental impacts, especially related to climate change, environmental diplomacy and multilateral environmental agreements. He has been the Head of the Department of Environmental Studies, Founding Director of the Inter-departmental Postgraduate Programme Environmental Policy and Management. He has served in numerous national and international policy forums (European Commission, OECD, UNEP/MAP, UNESCO, National Representative at the JRC Governing Board Chairman of the Committee on International Affairs and Environmental Policy – Greek Ministry of External Affairs). He is an Honorary Research Fellow at the Centre for Social and Economic Research on the Global Environment [CSERGE], University of East Anglia and Director of the Laboratory for Applied Environmental Economics.